# OREGON COORDINATE REFERENCE SYTEM

For the Everyday Surveyor

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Munson & Associates

# Three advantages of the OCRS for the everyday land surveyor

- Low distortion at low cost
- A "legal" coordinate system
- Easy to use and adaptable

# Low Distortion at Low Cost

- Oregon state plane coordinate system (SPCS) does not minimize distortion, especially at altitude or as you move away from the standard parallels.
- Local Datum Plane Coordinates (LDPC) offer a low distortion solution, but must be tailored to each project.
- OCRS coordinates can provide an easy to use, low distortion method for GNSS field surveys, where grid distance equals ground (or close enough).

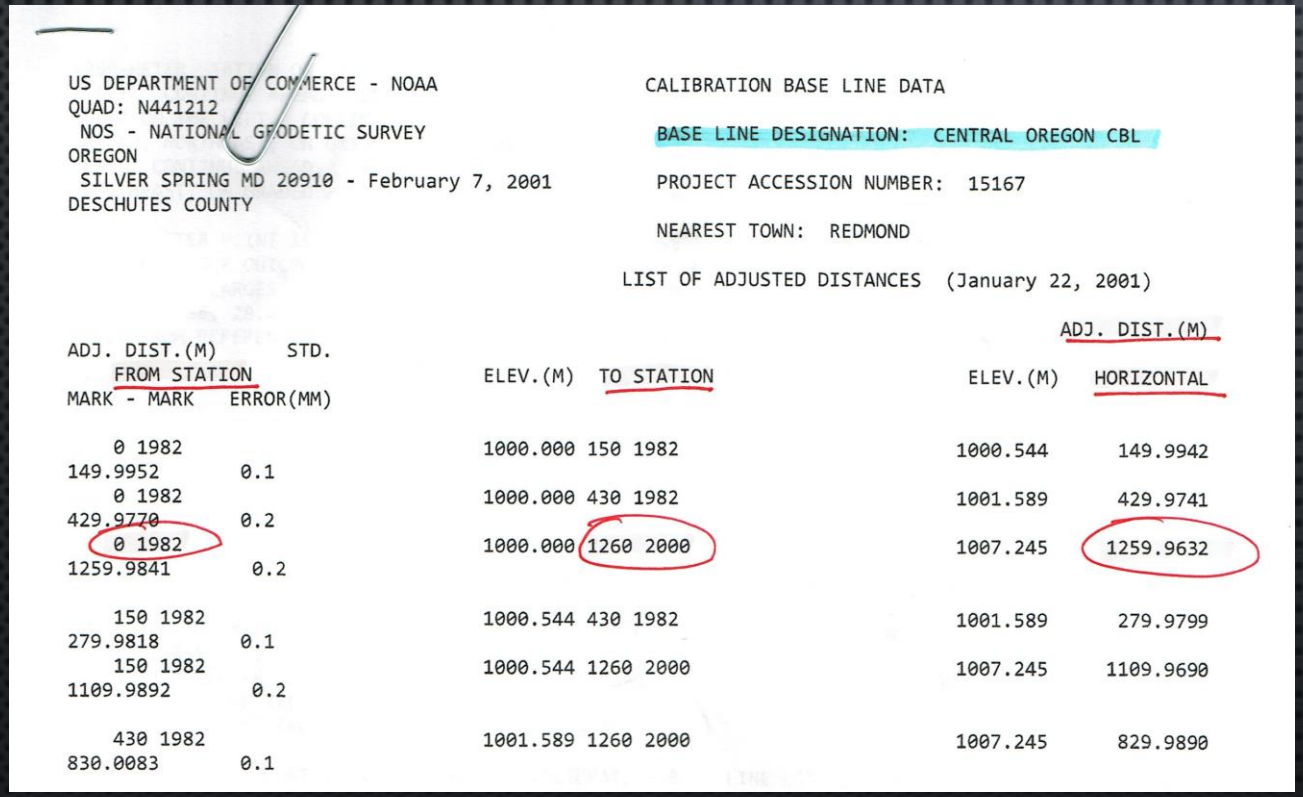
# Does grid equal ground in the OCRs?

- Or at least, close enough? Let's test it out…..

# TEST EQUIPMENT

- TRIMBLE R8 MODEL 2 GNSS SYSTEM
- PUBLISHED HORIZONTAL ACCURACY OF ±10 MM (0.03') + 1 PPM FOR KINEMATIC SURVEYING
- LINKED TO THE OREGON REAL-TIME GNSS NETWORK (ORGN), RECEIVING GPS-ONLY CORRECTORS FOR THIS TEST.

# CENTRAL OREGON CALIBRATION BASELINE



US DEPARTMENT OF COMMERCE - NOAA
QUAD: N441212
NOS - NATIONAL GEODETIC SURVEY
OREGON
SILVER SPRING MD 20910 - February 7, 2001
DESCHUTES COUNTY

CALIBRATION BASE LINE DATA

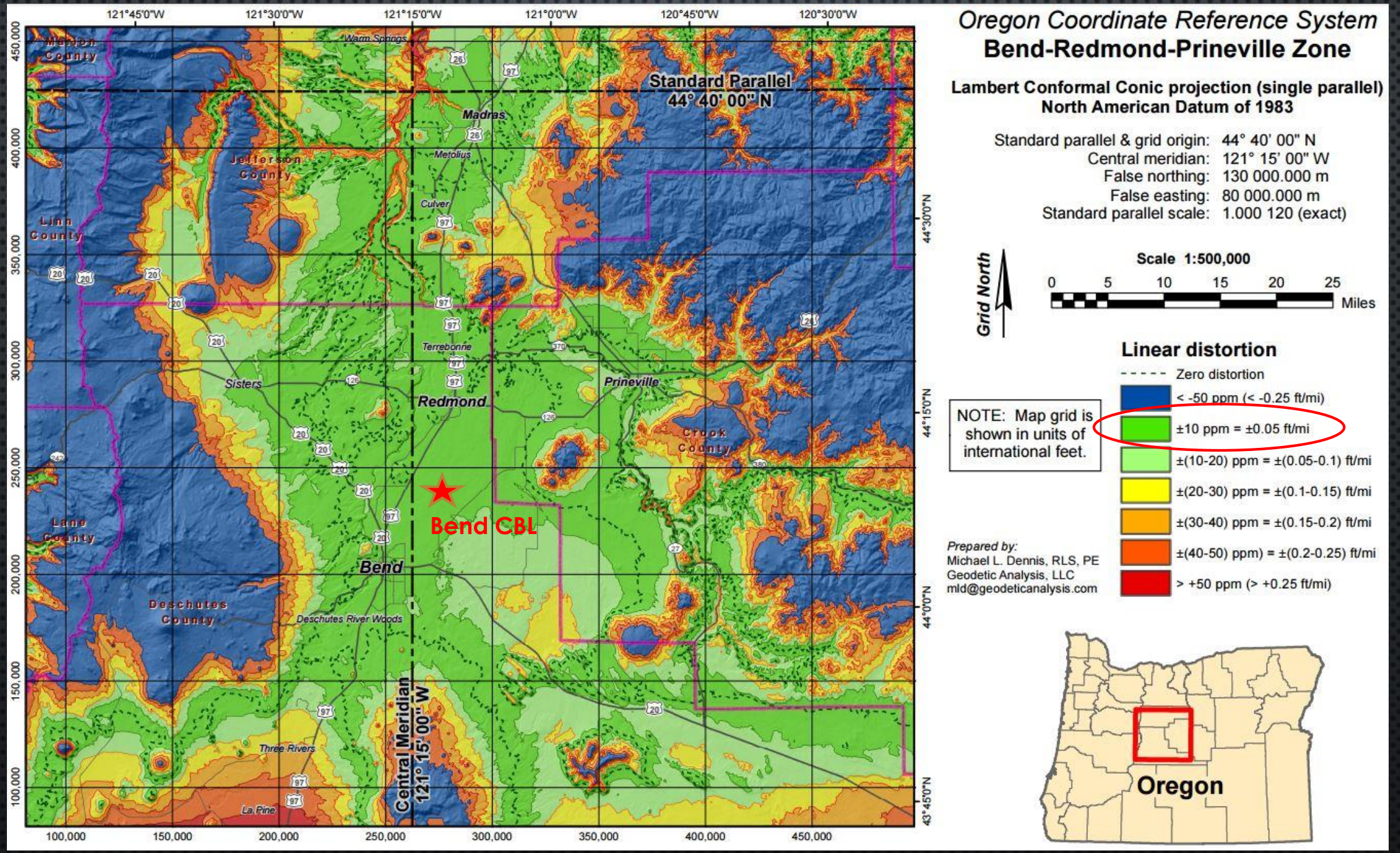
BASE LINE DESIGNATION: CENTRAL OREGON CBL

PROJECT ACCESSION NUMBER: 15167

NEAREST TOWN: REDMOND

LIST OF ADJUSTED DISTANCES (January 22, 2001)

| ADJ. DIST.(M) FROM STATION MARK - MARK | STD. ERROR(MM) | ELEV.(M) | TO STATION | ELEV.(M) | ADJ. DIST.(M) HORIZONTAL |
|---|---|---|---|---|---|
| 0 1982 149.9952 | 0.1 | 1000.000 | 150 1982 | 1000.544 | 149.9942 |
| 0 1982 429.9770 | 0.2 | 1000.000 | 430 1982 | 1001.589 | 429.9741 |
| 0 1982 1259.9841 | 0.2 | 1000.000 | 1260 2000 | 1007.245 | 1259.9632 |
| 150 1982 279.9818 | 0.1 | 1000.544 | 430 1982 | 1001.589 | 279.9799 |
| 150 1982 1109.9892 | 0.2 | 1000.544 | 1260 2000 | 1007.245 | 1109.9690 |
| 430 1982 830.0083 | 0.1 | 1001.589 | 1260 2000 | 1007.245 | 829.9890 |


Oregon Coordinate Reference System
Bend-Redmond-Prineville Zone
Lambert Conformal Conic projection (single parallel)
North American Datum of 1983
Standard parallel & grid origin: 44° 40' 00" N
Central meridian: 121° 15' 00" W
False northing: 130 000.000 m
False easting: 80 000.000 m
Standard parallel scale: 1.000 120 (exact)
Standard Parallel 44° 40' 00" N
Central Meridian 121° 15' 00" W
Grid North
Scale 1:500,000
0 5 10 15 20 25
Miles
Linear distortion
Zero distortion
< -50 ppm (< -0.25 ft/mi)
±10 ppm = ±0.05 ft/mi
±(10-20) ppm = ±(0.05-0.1) ft/mi
±(20-30) ppm = ±(0.1-0.15) ft/mi
±(30-40) ppm = ±(0.15-0.2) ft/mi
±(40-50) ppm) = ±(0.2-0.25) ft/mi
> +50 ppm (> +0.25 ft/mi)
NOTE: Map grid is shown in units of international feet.
Prepared by:
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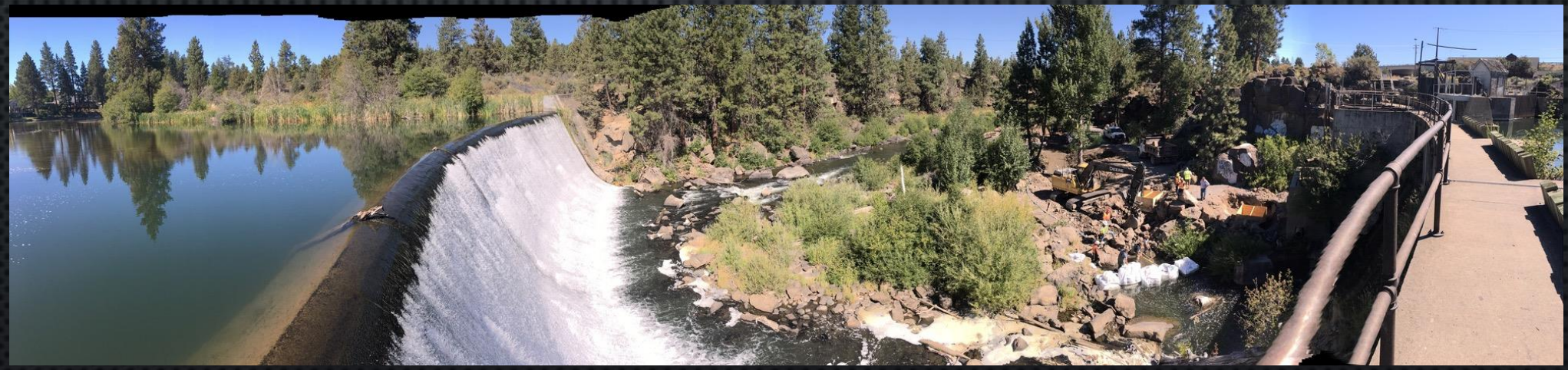
Bend CBL
Oregon
Warm Springs
Madras
Metolius
Culver
Terrebonne
Sisters
Redmond
Prineville
Bend
Deschutes River Woods
Three Rivers
La Pine
Jefferson County
Linn County
Crook County
Deschutes County
Lane County
121°45'0"W
121°30'0"W
121°15'0"W
121°0'0"W
120°45'0"W
120°30'0"W
44°30'0"N
44°15'0"N
44°0'0"N
43°45'0"N
100,000
150,000
200,000
250,000
300,000
350,000
400,000
450,000

# CENTRAL OREGON CALIBRATION BASELINE

# North Unit Canal

- Construction began in 1938 by the Bureau of Reclamation & the Works Progress Administration.
- Stalled by World War II as the WPA workers went to war, construction was taken over by conscientious objectors, and the main canal was finished in 1946.
- By 1949, 50,000 acres of previously dryland farms were being irrigated.



# North Unit Canal

- The main canal is over 65 miles long, stretching from the diversion point on the Deschutes River in Bend to the farms of Jefferson County.
- Water is stored in Wickiup Reservoir.
- The North Unit project is the largest irrigation project on the Deschutes River.

# RIGHT TO AND THROUGH SMITH ROCK….

# BACK TO THE BASELINE TEST

- Two 180-epoch observations on the 0 and 1260 meter marks, separated by a change in satellite constellation.
- Real-time correctors provided by the ORGN (GPS-only).

# WHAT IS THE DESIRED OUTCOME?

- STATUTORY REQUIREMENT: ORS 92.050(2)
  - "…WITHIN ONE-TENTH OF A FOOT OR ONE TEN-THOUSANDTH OF THE DISTANCE…WHICHEVER IS GREATER."
- REASONABLE STANDARD OF CARE

**92.050 Requirements of survey and plat of subdivision and partition.** (1) A person shall not submit a plat of a subdivision or partition for record, until all the requirements of ORS 209.250 and the plat requirements of the subdivision or partition have been met.

(2) The survey for the plat of the subdivision or partition shall be done in a manner to achieve sufficient accuracy that measurements may be taken between monuments within one-tenth of a foot or one ten-thousandth of the distance shown on the subdivision or partition plat, whichever is greater.

# RESULTS

| Projection | Distance (m) | Difference | Error (raw) | Error (minus published equipment error) |
|---|---|---|---|---|
| True Ground (NGS-measured) | 1259.963 | 0 | 0 | 0 |
| ORS 92.050(2) | | ±0.126 m (±0.41 ft) | ±100 ppm (1/10,000) | |
| Ground (GPS-measured) | 1259.977 | +0.014 m (+0.05 ft) | +11 ppm | +3 ppm |
| State Plane South Zone | 1259.836 | -0.127 m (-0.42 ft) | -101 ppm | -93 ppm |
| OCRS Bend-Redmond-Prineville Zone | 1259.984 | +0.021 m (+0.07 ft) | +17 ppm | +9 ppm |
| Central Oregon Coordinate System | 1259.985 | +0.022 m (+0.07 ft) | +17 ppm | +10 ppm |

# Conclusions:
# Does Grid Equal Ground in the OCRS?

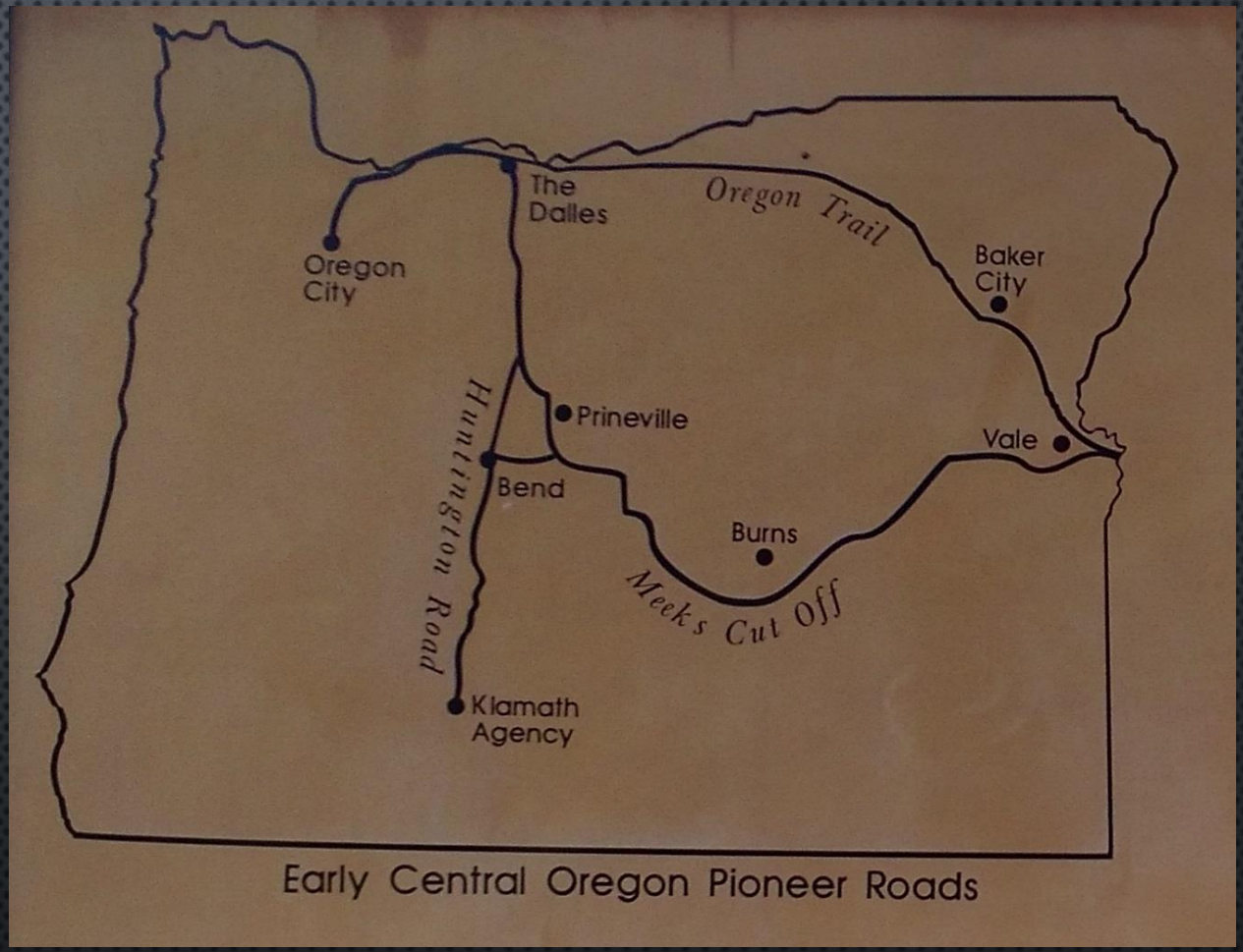
- Yes—In this limited experiment, published distortion of the OCRS is correct.
- With proper use of published OCRS distortion rasters, a surveyor can meet statutory allowed error, local standards of care, and project error budgets.
- The OCRS can allow for (close to) grid equals ground surveying in the majority of the state without the need for separately determined LDPCs. However, in certain high-distortion areas of the state, an LDPC may still be appropriate.
- Existing legacy regional LDPs such as the Central Oregon Coordinate System can still provide high accuracy.

# HUNTINGTON WAGON ROAD

- Old Indian route improved in 1864-1867 by J.W. Perit Huntington, Superintendent for Indian Affairs.

# HUNTINGTON WAGON ROAD

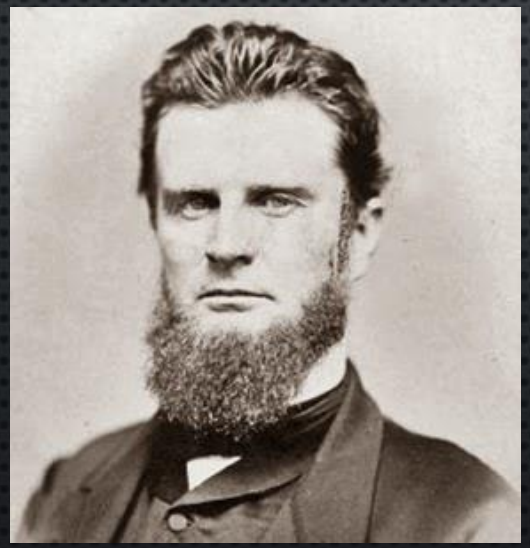
- Road was improved from the Dalles to Klamath Agency in order to furnish supplies as required by an 1864 treaty.
- Was also heavily used by the Army in the Modoc War of 1872-1873.



Early Central Oregon Pioneer Roads

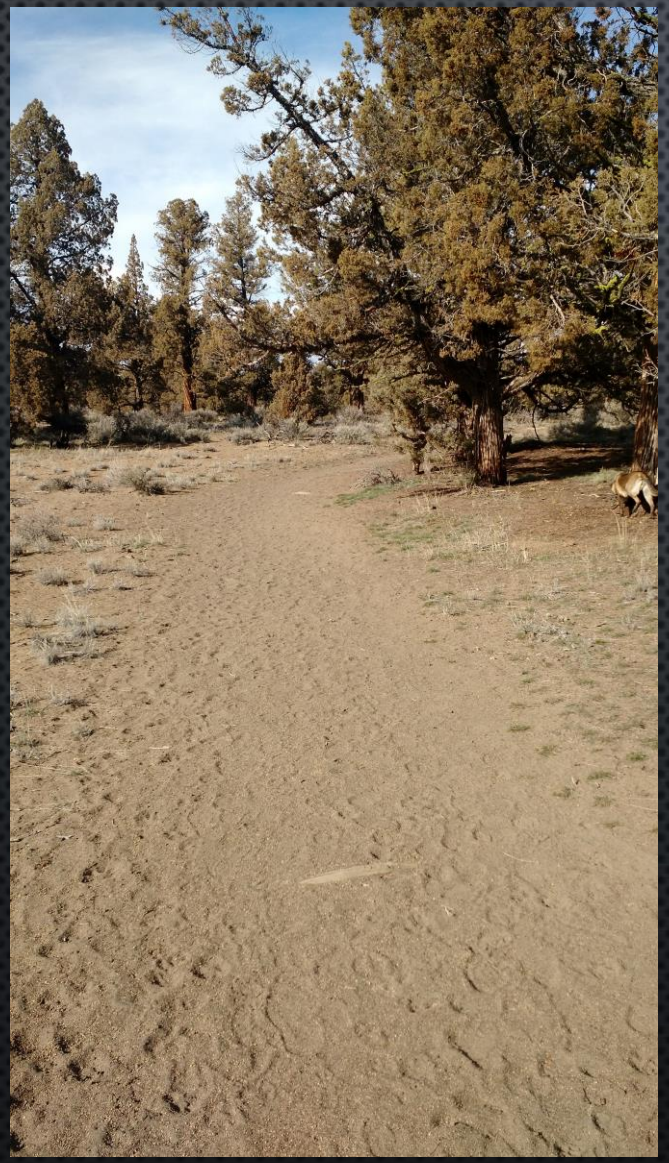
# HUNTINGTON WAGON ROAD

## J.W. PERIT HUNTINGTON



## CHIEF PAULINA

# Huntington Wagon Road



# Tree blaze marking the road

# Old Camp

# "Target Tree"

# LEGAL ASPECTS OF THE OCRS

- THE OCRS IS LEGALLY DEFINED IN ORS 93.312 & OAR 734-005.
- ORS 209.250(3)(D) REQUIRES FILED MAPS OF SURVEY TO IDENTIFY THE BASIS OF BEARINGS FOR THAT SURVEY.



ernment survey, when the identical spot can be determined.

(3) When the identical spot cannot be determined, the legal and permanent corner must be reestablished with reference to the current United States Manual of Surveying Instructions. [Amended by 1979 c.653 §13; 1989 c.394 §13; 2007 c.71 §70]

**209.210** [Repealed by 1979 c.653 §18]

**209.220 Oath taken by employees.** Each person employed by the county surveyor or a deputy shall, before commencing the duty assigned, take an oath or affirmation faithfully and impartially to execute the duties of employment. The county surveyor or a deputy shall administer the oath or affirmation of each employee. [Amended by 1979 c.653 §14]

**209.230 Materials and equipment for certain purposes.** The county surveyor shall procure at the expense of the county the materials and requisites for carrying into effect ORS 209.100 to 209.230. The county court shall pay for the same and all expenses incurred therein out of the general fund of the county.

**209.240** [Amended by 1979 c.653 §15; repealed by 1981 c.111 §2]

**209.250 Survey by registered land surveyor; requirements for map, narrative or report of survey; waiver of required filing; effect of noncompliance.** (1) A registered professional land surveyor making a survey of lands within this state wherein the surveyor establishes or reestablishes a boundary monument shall, within 45 days thereafter, submit for filing a permanent map of the survey to the county surveyor for review. When filed, the map is a permanent public record in the office of the county surveyor. In establishing or reestablishing a public land survey corner, the surveyor shall comply with ORS 209.070 (4), 209.130 and 209.200. If the surveyor is unable to complete the survey and submit a permanent map within 45 days, the surveyor shall, within 45 days of establishing or reestablishing a boundary monument, provide written notice to the county surveyor containing the reasons for the delay, an estimate of the amount of time reasonably necessary to complete the survey but not exceeding 180 days, and a temporary map showing the position of monuments established or reestablished.

(2) The permanent map must have a written narrative that may be on the face of the map. If the narrative is a separate document, the map and narrative must be referenced to each other. The map and narrative must be made on a suitable drafting material in the size required by the county surveyor. The lettering on the map and narrative must be of sufficient size and clarity to be reproduced clearly. The narrative must explain the purpose of the survey and how the boundary lines or other lines were established or reestablished and must state which deed records, deed elements, survey records, found survey monuments, plat records, road records or other pertinent data were controlling when establishing or reestablishing the lines. If the narrative is a separate document, the narrative must also contain the following:

(a) Location of survey by one-fourth section, Township and Range.

(b) The date of survey.

(c) The surveyor's seal and original signature.

(d) The surveyor's business name and address.

(3) A permanent map must show the following:

(a) Location of survey by one-fourth section, Township and Range.

(b) The date of survey.

(c) Scale of drawing and North Arrow.

(d) The distance and course of all lines traced or established, giving the basis of bearing and the measured distance and course to a monumented section corner, one-quarter corner, one-sixteenth corner or Donation Land Claim corner in Township and Range, or to a monumented lot or parcel corner or boundary corner of a recorded subdivision, partition or condominium.

(e) Measured bearings, angles and distances that are used as a basis for establishing or reestablishing lines or monuments separately indicated from those of record together with the recording reference. Metric measurements may be used if a conversion to feet is provided.

(f) Monuments set and their relation to older monuments found. A detailed description of monuments found and set must be included and monuments set must be separately indicated from those found.

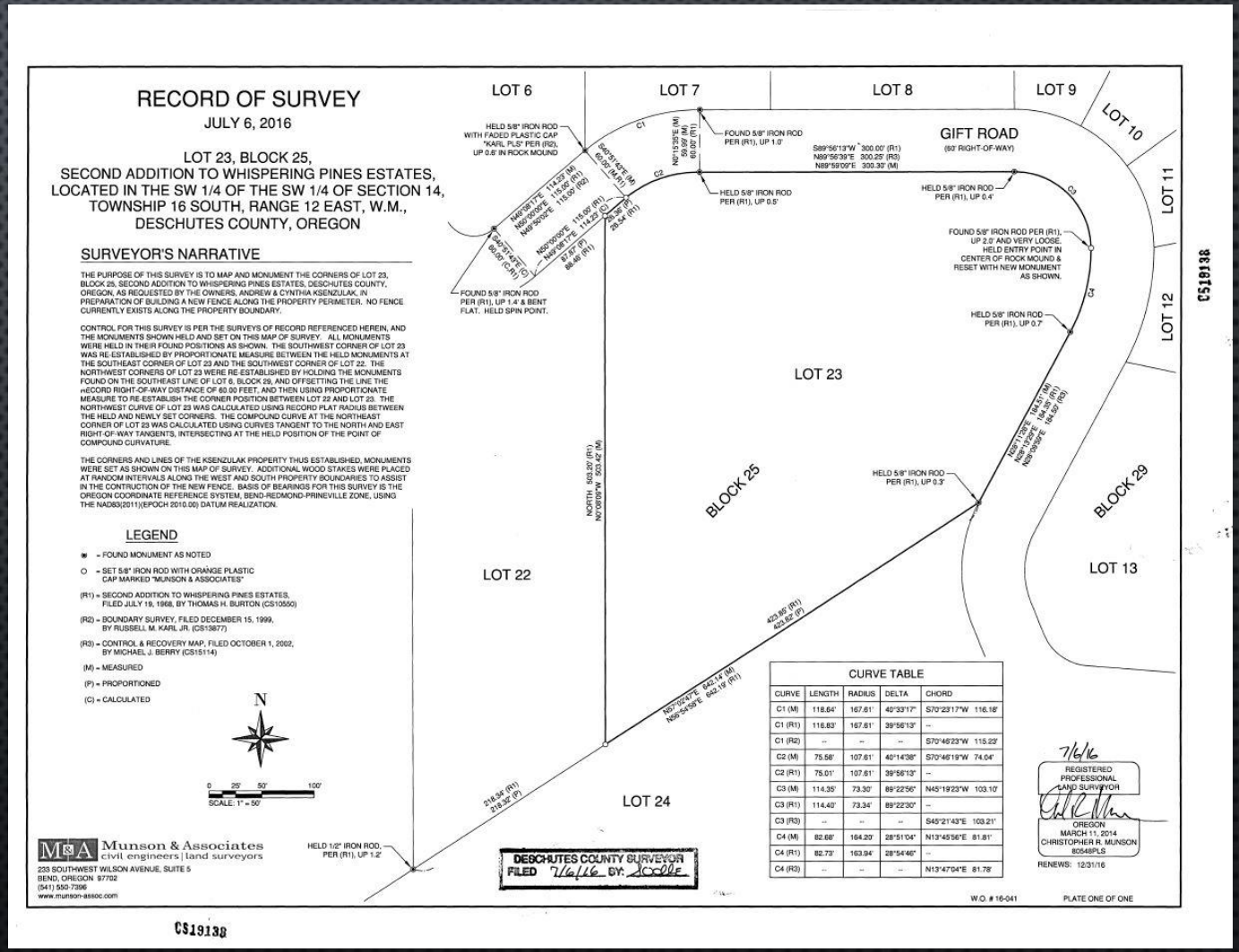
(g) The surveyor's seal and original signature.

(h) The surveyor's business name and address.

(4)(a) Within 30 days of receiving a permanent map under this section, the county surveyor shall review the map to determine if it complies with subsections (1), (2) and (3) of this section and applicable local ordinances. A map must be indexed by the county surveyor within 30 days following a determination that the map is in compliance with this section. A survey prepared by the county surveyor in an official or private ca-

# BASIS OF BEARINGS

THE CORNERS AND LINES OF THE KSENZULAK PROPERTY THUS ESTABLISHED, MONUMENTS WERE SET AS SHOWN ON THIS MAP OF SURVEY. ADDITIONAL WOOD STAKES WERE PLACED AT RANDOM INTERVALS ALONG THE WEST AND SOUTH PROPERTY BOUNDARIES TO ASSIST IN THE CONTRUCTION OF THE NEW FENCE. BASIS OF BEARINGS FOR THIS SURVEY IS THE OREGON COORDINATE REFERENCE SYSTEM, BEND-REDMOND-PRINEVILLE ZONE, USING THE NAD83(2011)(EPOCH 2010.00) DATUM REALIZATION.



# WHAT IF YOUR BOUNDARY SURVEY ENDS UP IN COURT?

- OCRS and State Plane Coordinates are both "Legal" coordinate systems, but what about Local Datum Planes?
- Try explaining Local Datum Planes, combined scale factors, transformations, etc., to a judge and jury.

BASIS OF BEARINGS, COORDINATES, & PROCEDURE:
THE BASIS OF BEARINGS AND COORDINATES IS A LOCAL DATUM PLANE BASED ON 1983 OREGON STATE PLANE SOUTH ZONE, GRID BEARINGS. WE INITIALLY ESTABLISHED A RANDOM BASE STATION AND COLLECTED A TWO HOUR OBSERVATION OF GPS DATA. THIS WAS SUBMITTED TO THE USGS FOR AN "OPUS" POSITION. THE SOLUTION USED CORS STATIONS AT CORVALLIS, MEDICINE MOUNTAIN AND REDMOND. THE SOLUTION PROVIDED NAD83(CORS96)(EPOCH: 2002) LATITUDE AND LONGITUDE, 1983 OREGON SOUTH ZONE STATE PLANE COORDINATES AND A COMBINED SCALE FACTOR OF 0.99980802. SURVEY IS INTERNATIONAL FEET UNITS, ALL POSITIONS CONVERTED TO THE LOCAL DATUM PLANE. ALL MONUMENTS WERE OBSERVED TWICE AT LEAST 30 MINUTES APART AND THE POSITIONS AVERAGED IN ORDER TO ACHIEVE AN EXPECTED POSITIONAL ACCURACY OF WITHIN 2 CENTIMETERS (0.06 FEET). REAL TIME KINEMATIC GPS AND CONVENTIONAL TERRESTRIAL OBSERVATIONS WERE USED IN LOCATING OUR CONTROL AND INITIAL MONUMENTS. ADDITIONAL MONUMENTS WERE LOCATED BY USING THE OREGON REAL TIME NETWORK TRANSFORMED TO OUR LOCAL DATUM PLANE.

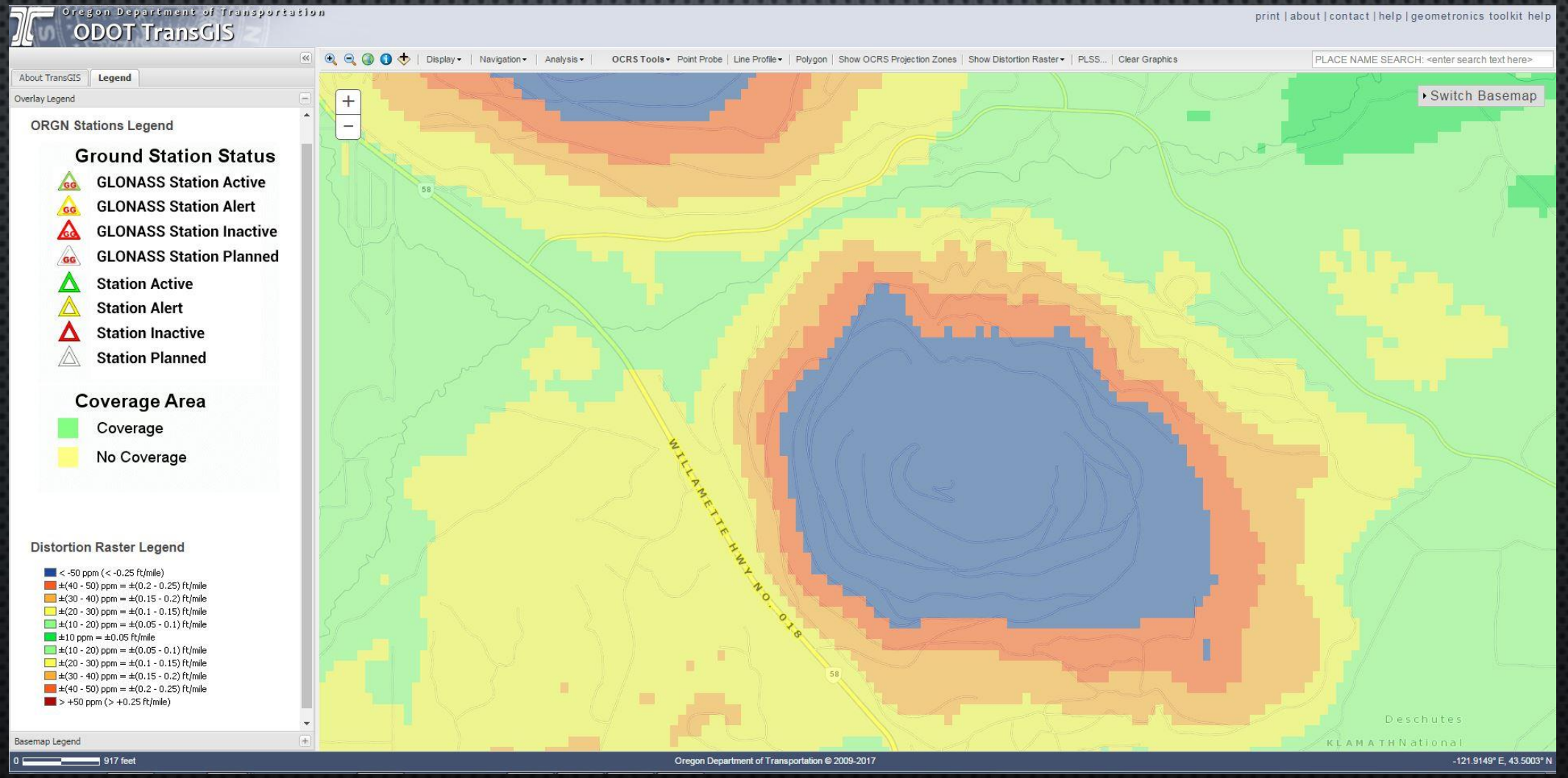
FENCES EXIST ALONG AND ON THE NORTH AND WEST PROPERTY LINES. THE WOOD AND WIRE FENCES ALONG THE EAST PROPERTY LINE VARY BETWEEN 0.9 FEET WEST AND 1.1 FEET EAST OF THE TRUE LINE. THE BASIS OF BEARINGS FOR THIS SURVEY IS THE OREGON COORDINATE REFERENCE SYSTEM BEND-REDMOND-PRINEVILLE ZONE USING THE NAD83(2011)(EPOCH 2010.00) DATUM REALIZATION. MONUMENTS FOUND AND SET DURING THE COURSE OF THIS SURVEY ARE SHOWN ON THIS SUBJOINED PLAT OF SURVEY.

# ODELL BUTTE

- USING OCRS ZONES OUTSIDE THE RECOMMENDED COMMUNITIES.

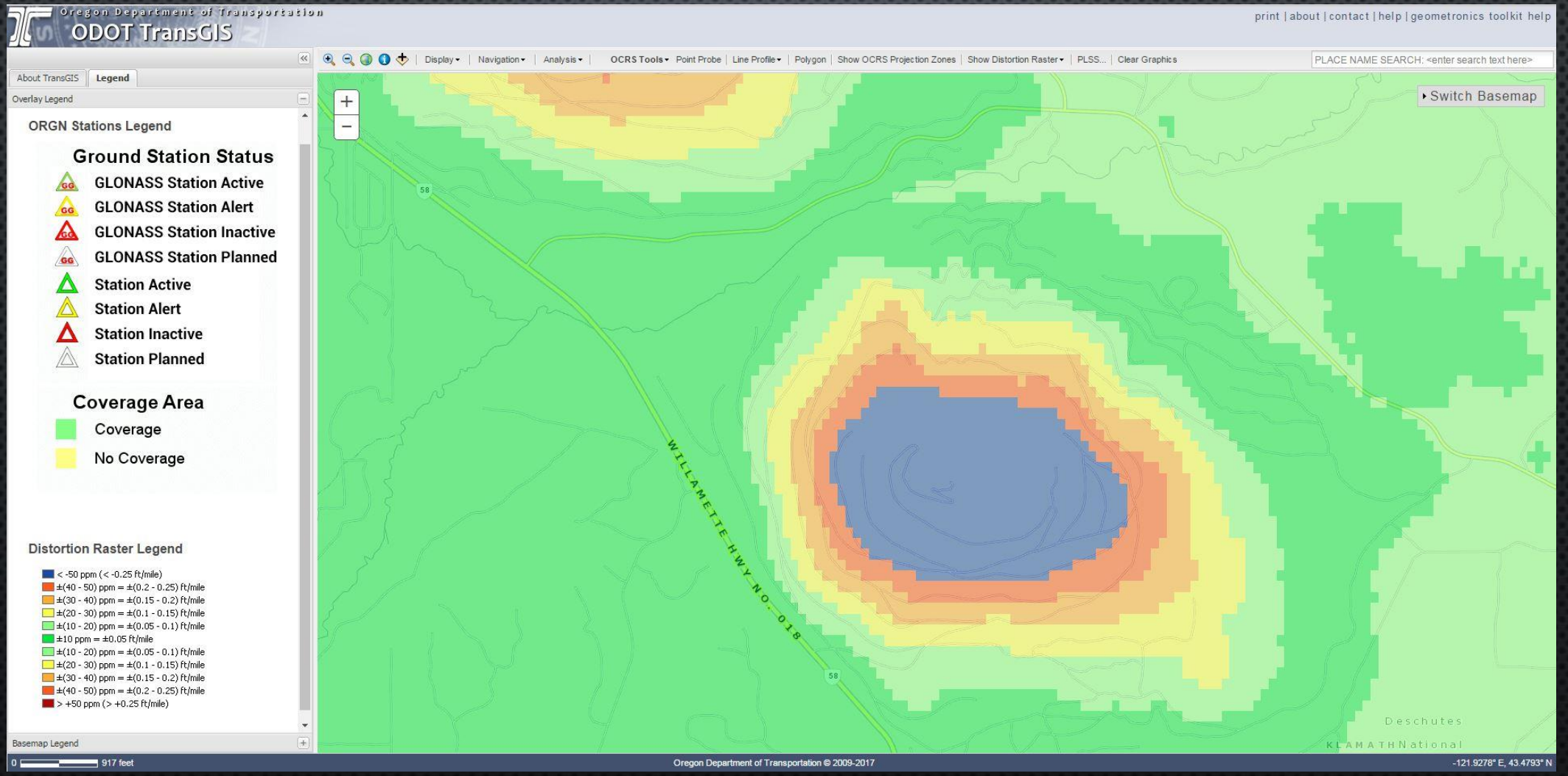

# ODELL BUTTE

- BEND-KLAMATH FALLS ZONE



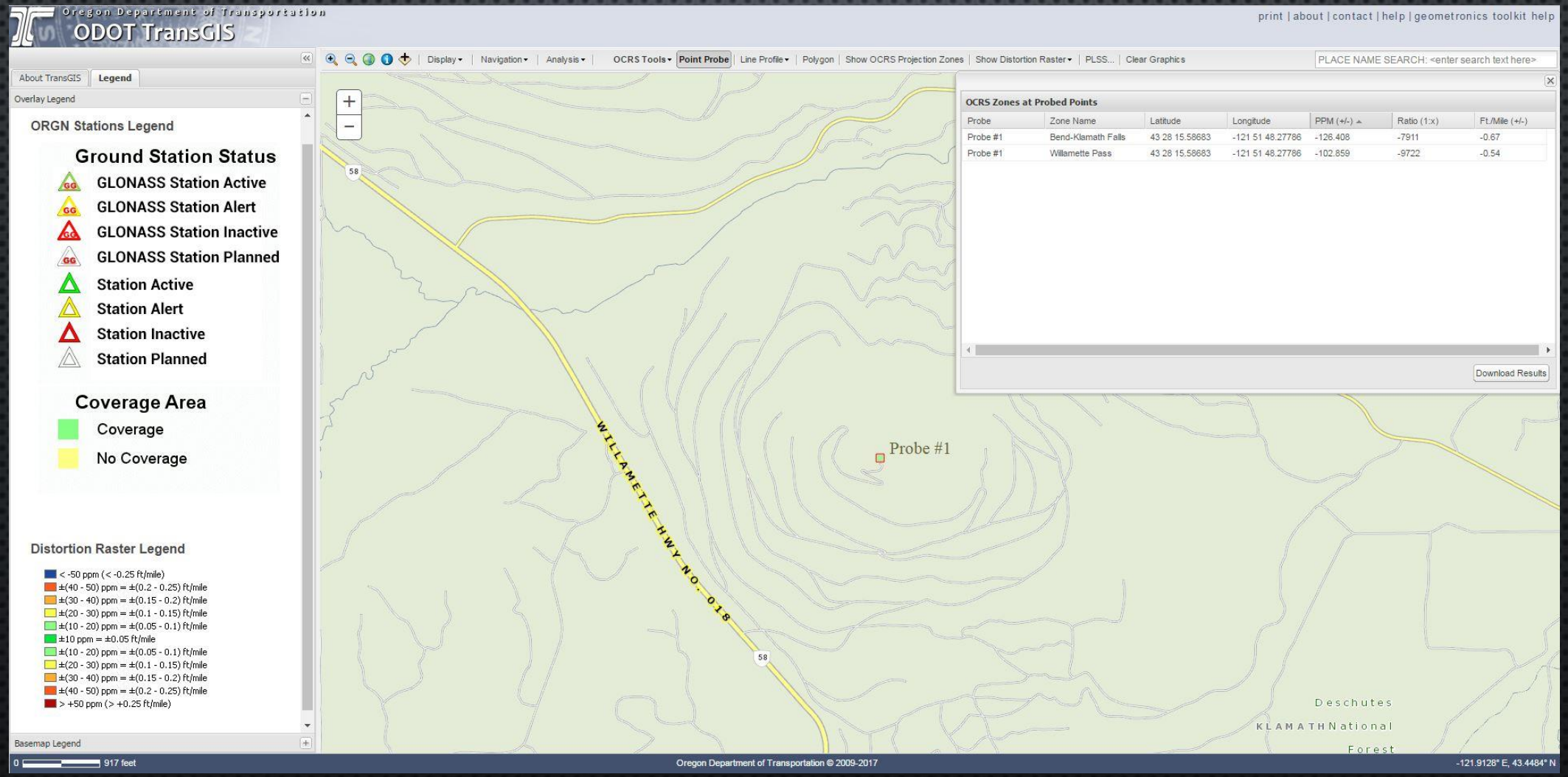
# ODELL BUTTE

- WILLAMETTE PASS ZONE



# ODELL BUTTE

- POINT PROBE TOOL



# Odell Butte

- What do you do if there's no suitable zone?
- Use a local datum plane….
- Or use a "out-of-zone" OCRS zone.
- Odell Butte was surveyed using a the Bend-Redmond-Prineville zone, with a distortion of ± 7 ppm (0.04 ft/mile)

# WHERE DID THE RODMAN GO?