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Oregon and S2S Forecasting

Possible Oregon S2S Applications

Western States Water Council S2S Workshop – San Diego

Keith Mills, P.E., G.E.

State Engineer for Water Resources

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Outline

- Oregon Water Resources Department
- Integrated Water Resources Strategy
- Oregon Hydrology
- Droughts
- Floods
- Most Useful Forecast Information?

OWRD Agency Responsibilities

- In-stream use
- Out-of-stream use
- Reservoir Storage
  - (Permit, approve, inspect, don't own)
- Groundwater
- Drought response
- Dam Safety
- Flood role?

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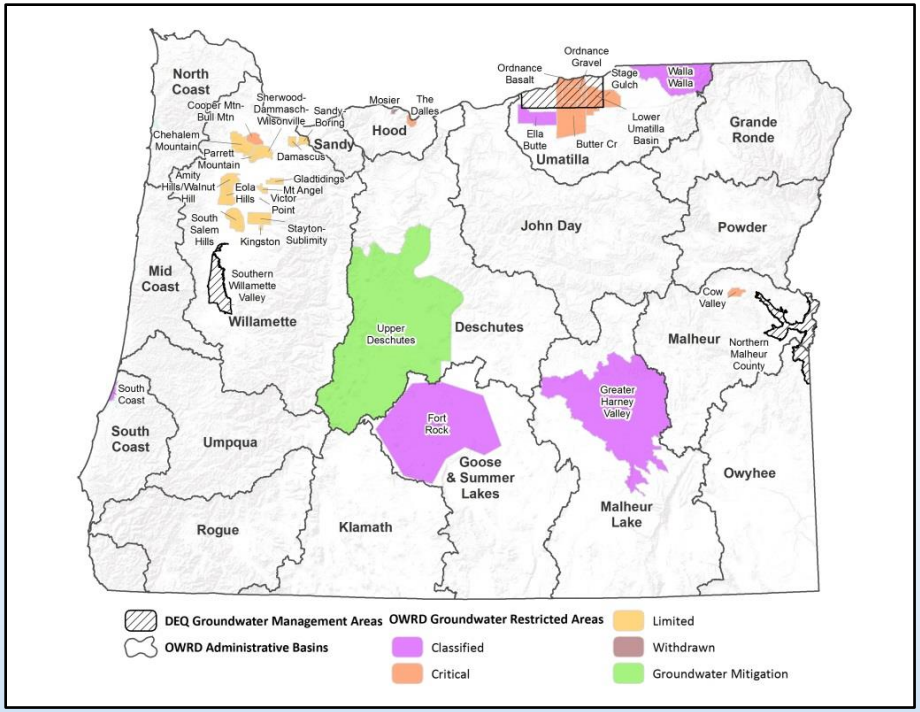
OWRD Agency Responsibilities

Surface Water Science

Groundwater



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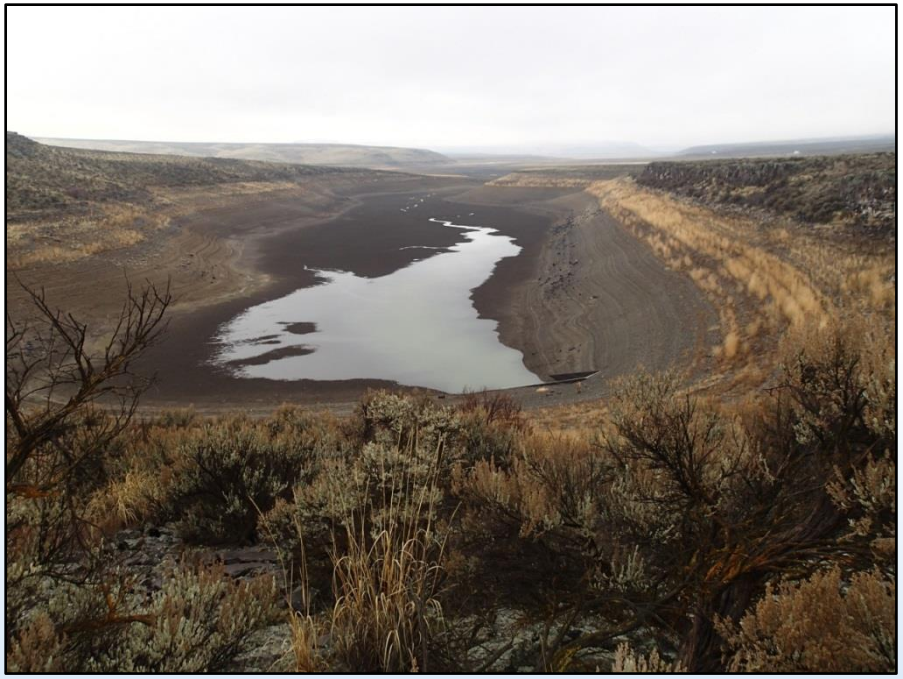
State Engineer Roles

- Principal assistant to agency director for engineering
- Historically State Engineer was a small agency responsible
- Dam safety
  - Statutes and rules (new)
  - Dam hazard rating and condition classification
  - Designs and inspections
  - Enforcement and restrictions
  - Just one other PE
- Safety in emergencies
  - Dams
  - Other hydraulic structures
  - OERS Council



Malheur dam in drought
110 foot dam with State Engineer Restriction

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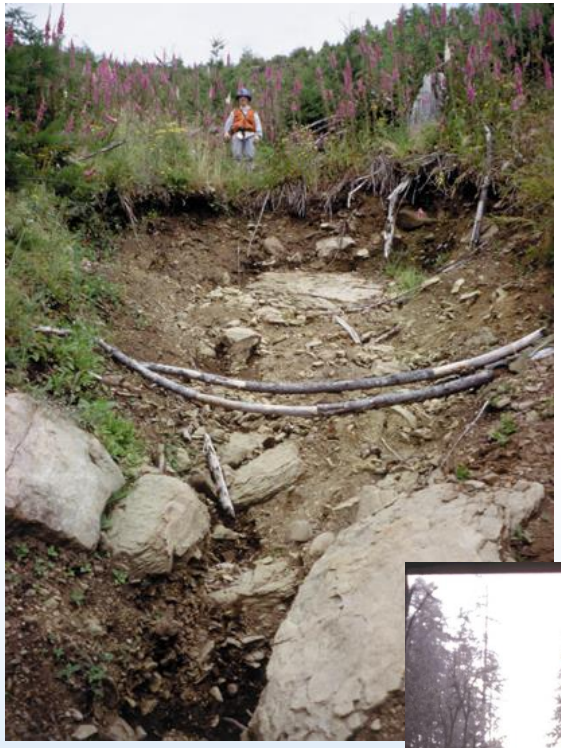
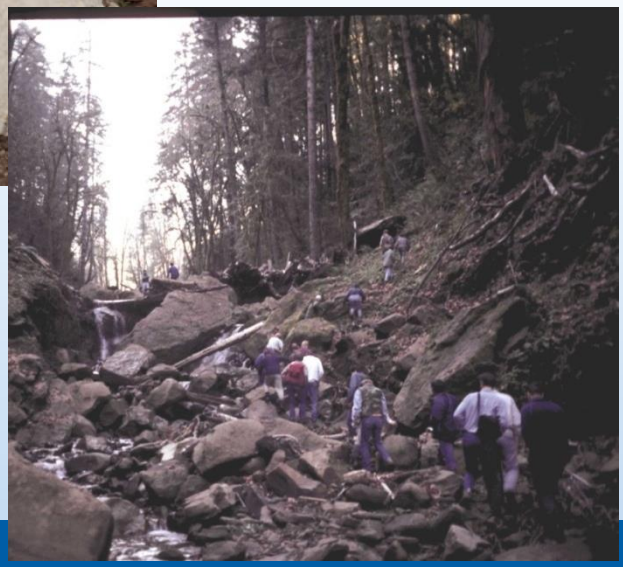
My background for current role

- ODF 27 years
- Landslides, debris flows
- Natural resource engineering and policy
- PE, GE
- **Concerns with droughts and floods similar**





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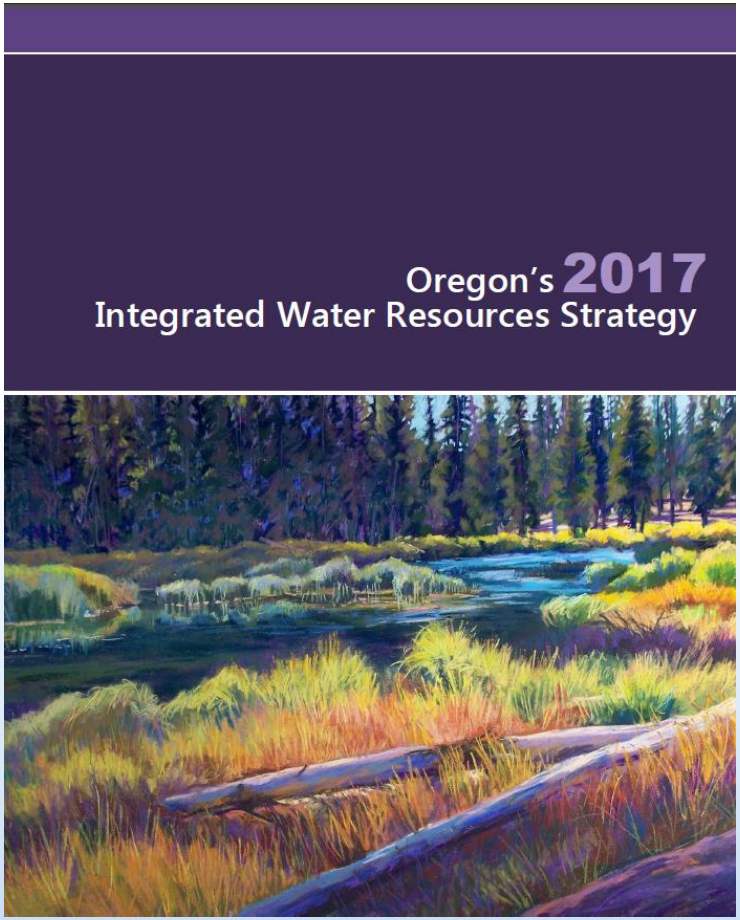
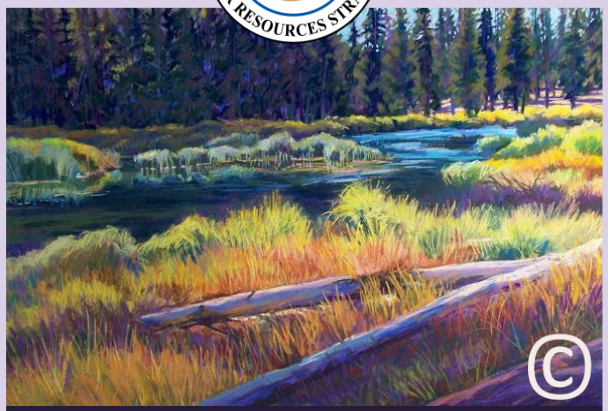
2017 Integrated Water Resources Strategy



With DEQ, ODFW, ODA, DSL, ODA, ODF, others

1. Water Resources Today
2. Instream and Out of Stream Needs
3. Coming Pressures
4. Meeting the needs

Overview of Content



Introduction

- The charge to develop a Strategy
- Our successes since 2012
- Cross-cutting issues
  - Groundwater
  - Climate change & extreme events
  - Funding & investments
  - Collaborative solutions

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IWRS Drought Recommendations

Recommended Action 5.5A Plan and Prepare for Drought Resiliency

1. Assess and assist those communities and ecosystems most vulnerable to drought
2. ***Develop the appropriate set of indicators that signal and forecast differing stages of drought***
3. Document the economic, social, and environmental impacts of drought, including the frequency, distribution, intensity and duration
4. Prepare for, respond to, and mitigate for the impacts of drought
5. Improve the drought toolbox through education and outreach, drought contingency plans, more efficient water distribution systems, and additional voluntary measures to improve streamflow

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IWRS Flood Recommendations

Recommended Action 5.5B Plan and Prepare for Flood Events

1. ***Develop indicators of flood emergency stages, using information about meteorologic, hydrologic, hydraulic, and watershed conditions***
2. Document the economic, social, and environmental impacts of floods
3. ***Evaluate potential for extreme flooding, under atmospheric rivers*** **and climate change scenarios**
4. Establish early flood warning systems in areas where recent drought and wildfire have affected forests and vegetation

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Oregon's hydrology

- Winters mild(er) and wet
- Summers very dry
- Many recent droughts
  - More SE, less NW
- Atmospheric rivers to the west
- Convective storms to the east
- Complex orographic effects
- AEP flood and PMF uncertainty
- Last widespread flooding -1996

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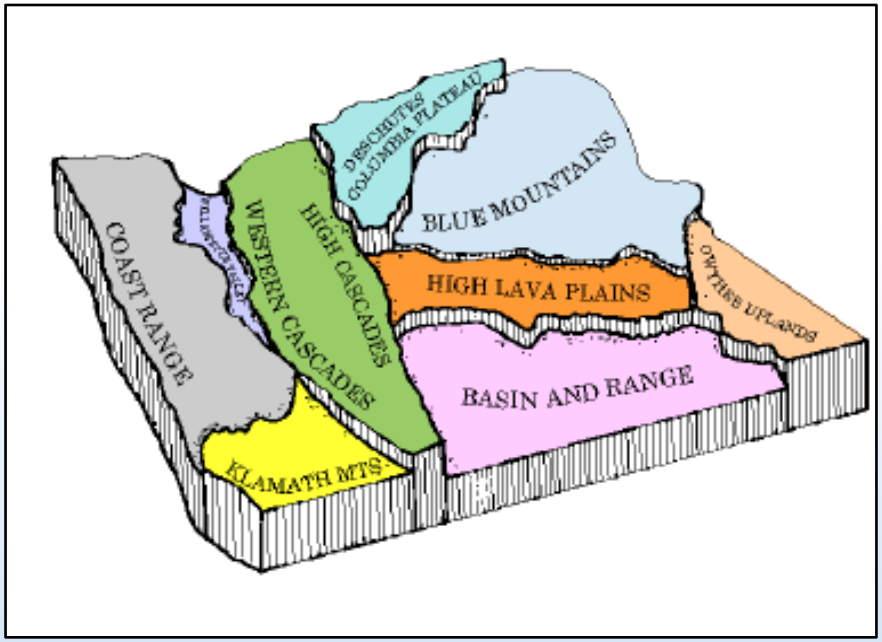
Oregon's Hydrology



- Western Oregon orographic
  - Lower high mountain elevations than CA, WA
  - Small Willamette Valley
- Eastern Oregon rain shadows
  - Pretty high, dry and rugged
- Warm winters serious issue, especially for basins with little storage

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Importance of Snowpack

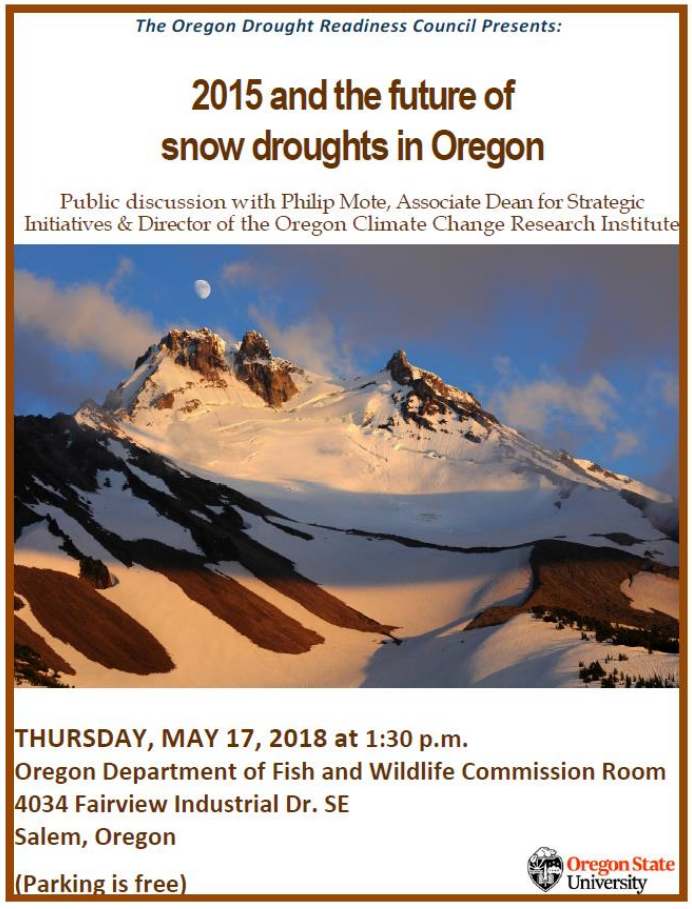
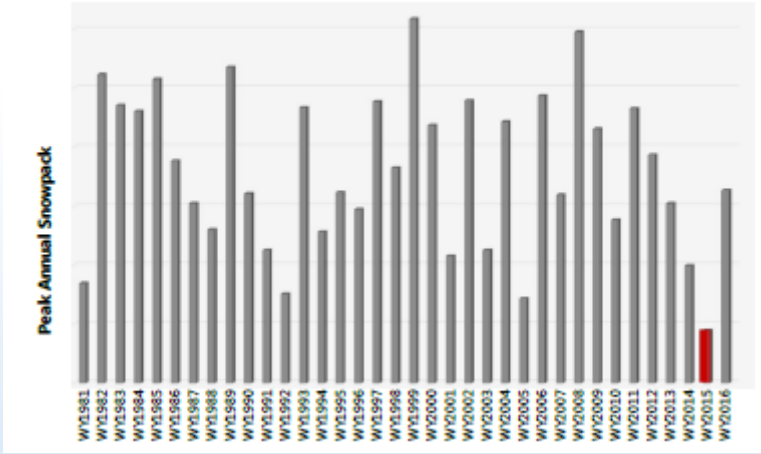


Figure 3-6: Oregon's Peak Annual Snowpack
Water Years 1981-2016



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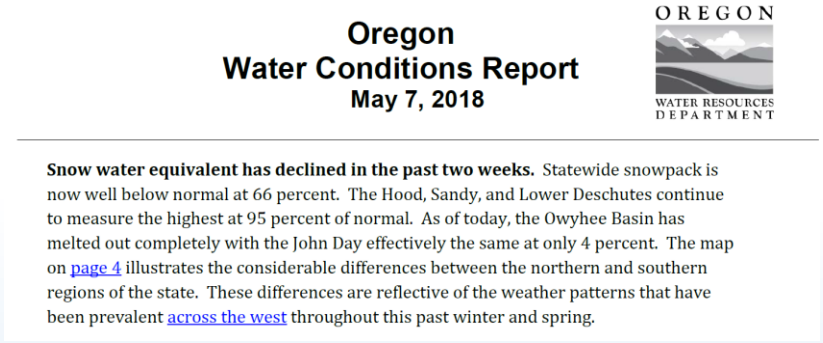
Droughts in Oregon

Antelope Reservoir and dam in late May 2015

Droughts in Oregon



Oregon
Water Conditions Report
May 7, 2018

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Snow water equivalent has declined in the past two weeks. Statewide snowpack is now well below normal at 66 percent. The Hood, Sandy, and Lower Deschutes continue to measure the highest at 95 percent of normal. As of today, the Owyhee Basin has melted out completely with the John Day effectively the same at only 4 percent. The map on page 4 illustrates the considerable differences between the northern and southern regions of the state. These differences are reflective of the weather patterns that have been prevalent across the west throughout this past winter and spring.

Continues for 12 more pages, selected figures follow

Water Supply Availability Committee

- NRCS Snow Survey
- NWS Portland Office
- NW River Forecast Center
- Oregon Climate Service (OSU)
- ODF
- USGS
- State Climatologist
- OWRD

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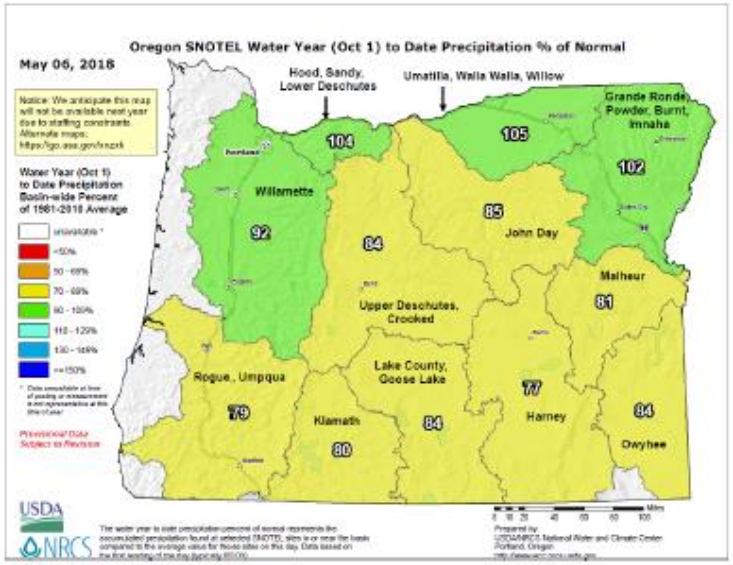
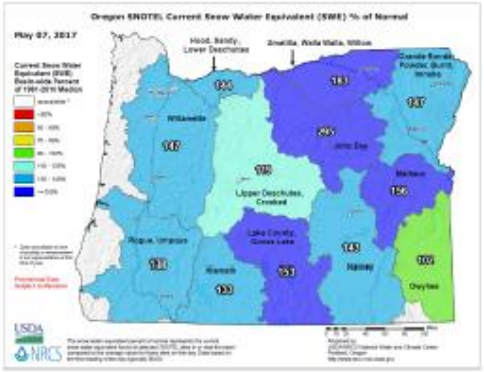
Droughts in Oregon

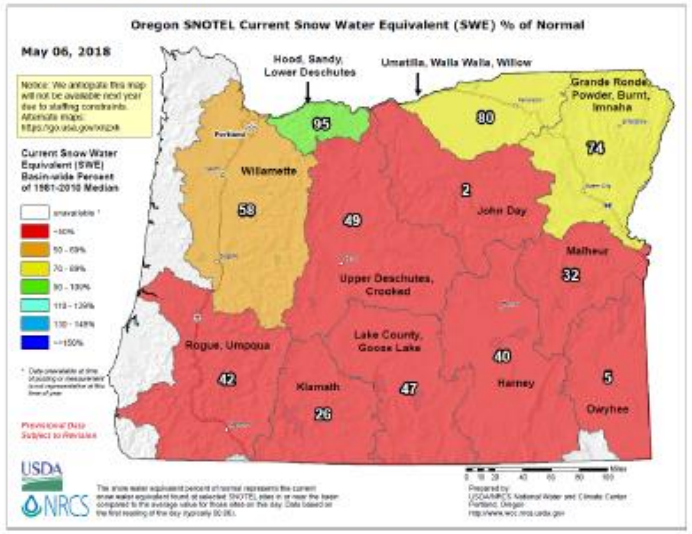
Precipitation (Mountain) - Percent of Normal



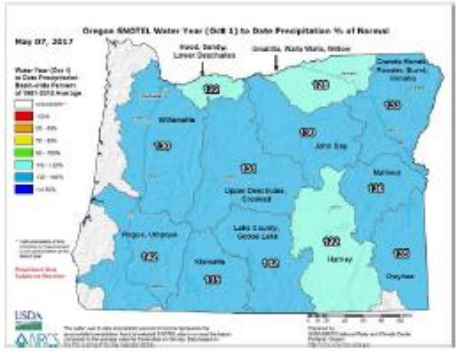
Compared to this time last year -



Snow Water Equivalent – Percent of Normal



Compared to this time last year -



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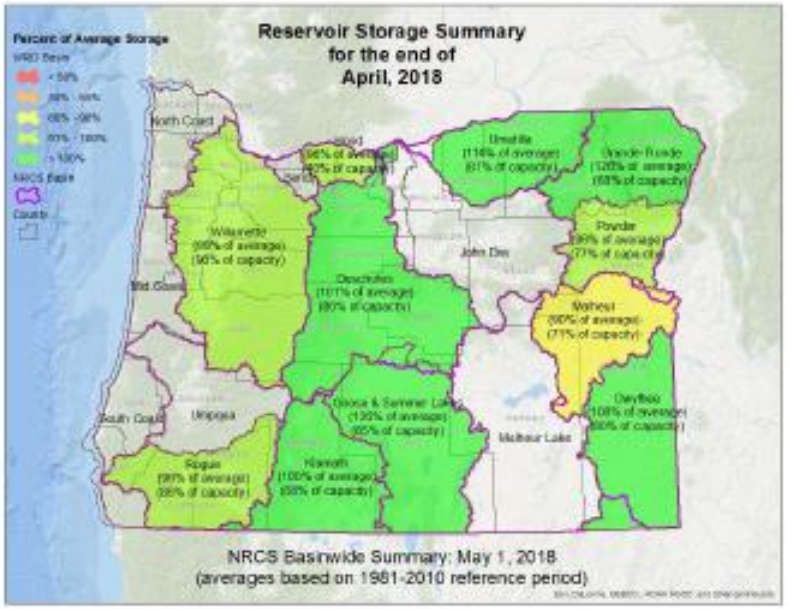
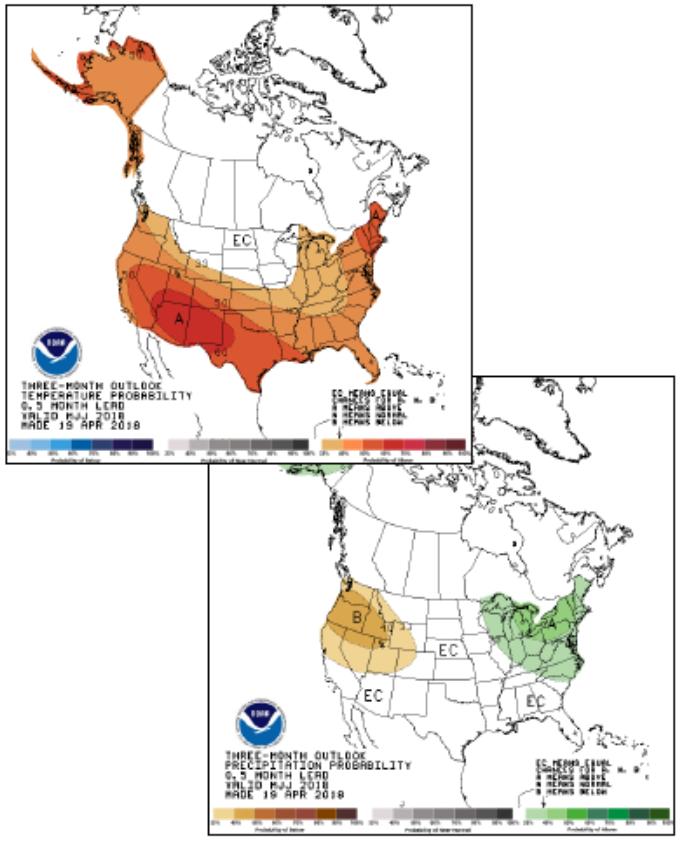
Droughts in Oregon

Statewide Reservoir Conditions - April



Three Month Temperature and Precipitation Outlook

May through July Outlook - Follow link for the latest information.
Website: http://www.cpc.ncep.noaa.gov/products/predictions/long_range/seasonal.php?lead=1



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Droughts in Oregon

USDA United States Department of Agriculture

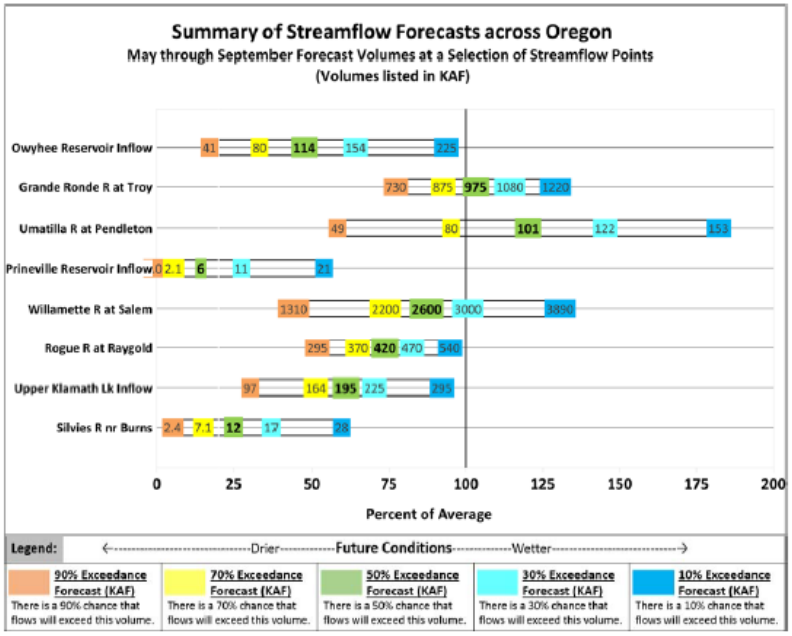
NRCS Natural Resources Conservation Service

Oregon Basin Outlook Report

May 1, 2018

Abundant sunshine, warm temperatures, and a lower than normal snowpack meant that Silvies SNOTEL on Steens Mountain melted out several weeks early this year.

Photo courtesy of Bill Overman (NRCS Snow Surveys)



Probability distribution very useful

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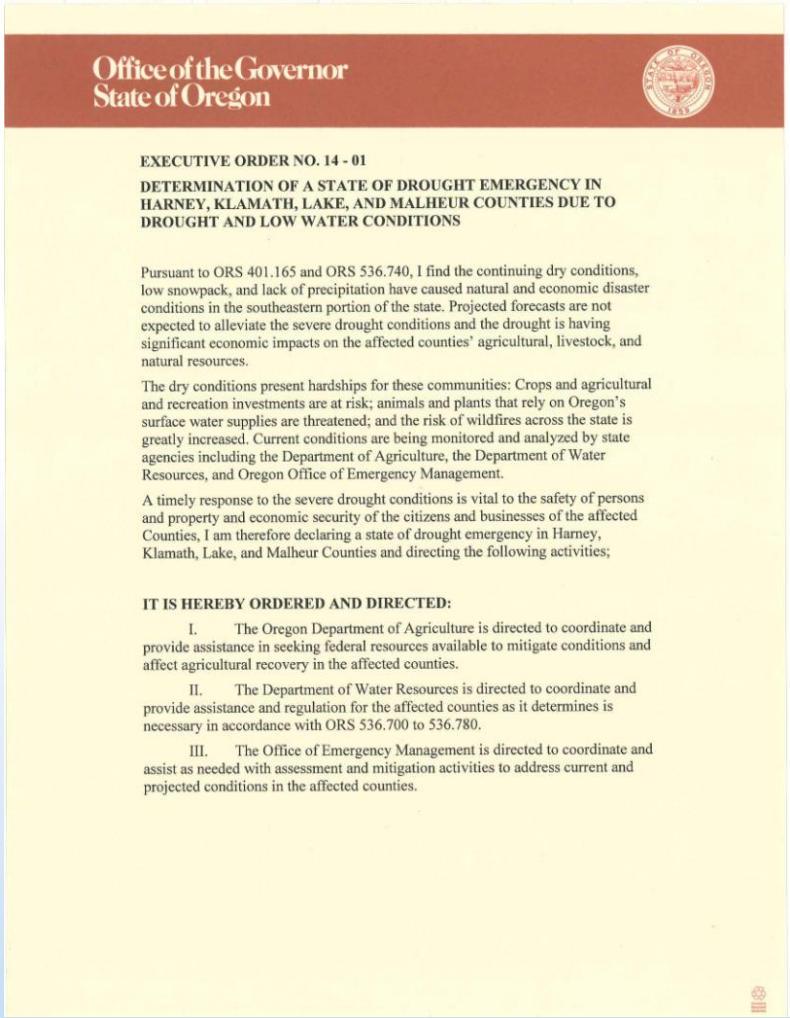
Droughts



Office of the Governor
State of Oregon

EXECUTIVE ORDER NO. 14 - 01

DETERMINATION OF A STATE OF DROUGHT EMERGENCY IN HARNEY, KLAMATH, LAKE, AND MALHEUR COUNTIES DUE TO DROUGHT AND LOW WATER CONDITIONS

Pursuant to ORS 401.165 and ORS 536.740, I find the continuing dry conditions, low snowpack, and lack of precipitation have caused natural and economic disaster conditions in the southeastern portion of the state. Projected forecasts are not expected to alleviate the severe drought conditions and the drought is having significant economic impacts on the affected counties' agricultural, livestock, and natural resources.

The dry conditions present hardships for these communities: Crops and agricultural and recreation investments are at risk; animals and plants that rely on Oregon's surface water supplies are threatened; and the risk of wildfires across the state is greatly increased. Current conditions are being monitored and analyzed by state agencies including the Department of Agriculture, the Department of Water Resources, and Oregon Office of Emergency Management.

A timely response to the severe drought conditions is vital to the safety of persons and property and economic security of the citizens and businesses of the affected Counties, I am therefore declaring a state of drought emergency in Harney, Klamath, Lake, and Malheur Counties and directing the following activities;

IT IS HEREBY ORDERED AND DIRECTED:

I. The Oregon Department of Agriculture is directed to coordinate and provide assistance in seeking federal resources available to mitigate conditions and affect agricultural recovery in the affected counties.

II. The Department of Water Resources is directed to coordinate and provide assistance and regulation for the affected counties as it determines is necessary in accordance with ORS 536.700 to 536.780.

III. The Office of Emergency Management is directed to coordinate and assist as needed with assessment and mitigation activities to address current and projected conditions in the affected counties.

Oregon's Drought Response Tools

- **Preference of water rights use for human or livestock consumption**
- **Temporary supplemental groundwater right**
- **Temporary emergency permits, transfers and in-stream leases**

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Other Drought Efects

- **Wildfire around problem dam on landslide**
- **Flash flood, landslide and debris flow risk**
- **Governors office and Federal support to remove quickly**
  - (1.5 months from burn date for a 55 foot dam on Federal lands)

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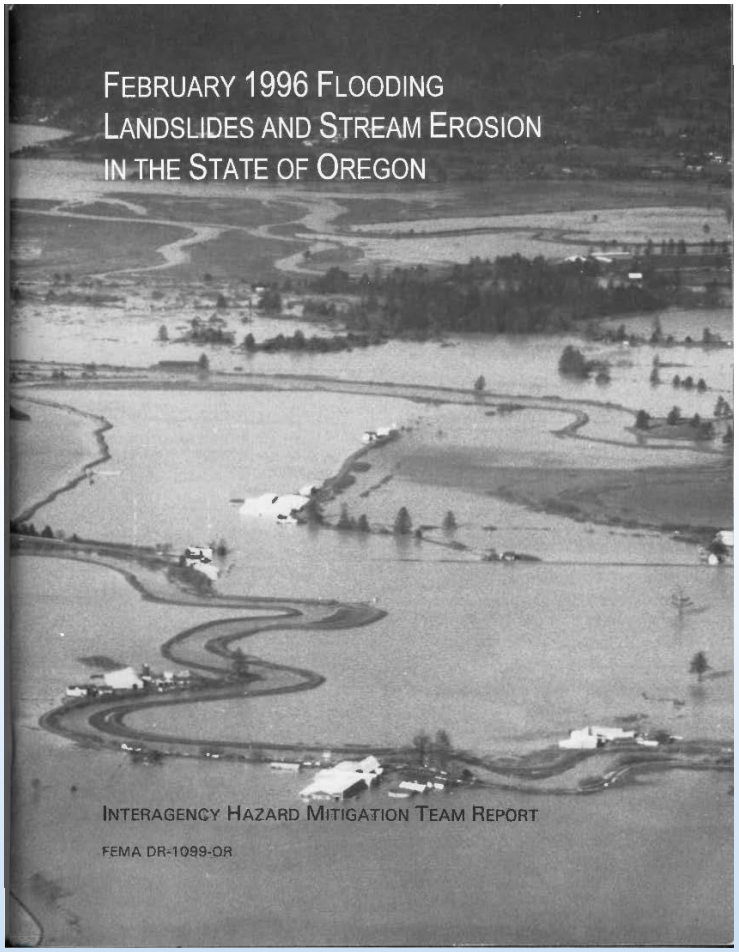
Flooding in Oregon

- Most general floods in western Oregon occur due to winter storms
- November through February (i.e. now)
- Widespread Oregon flooding occurred in 1861, 1948, 1964 and 1996



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Eastern Oregon

Heppner Flood

- June 14, 1903
- Local thunderstorm
- 247 fatalities
- Worst natural flash flood disaster in US

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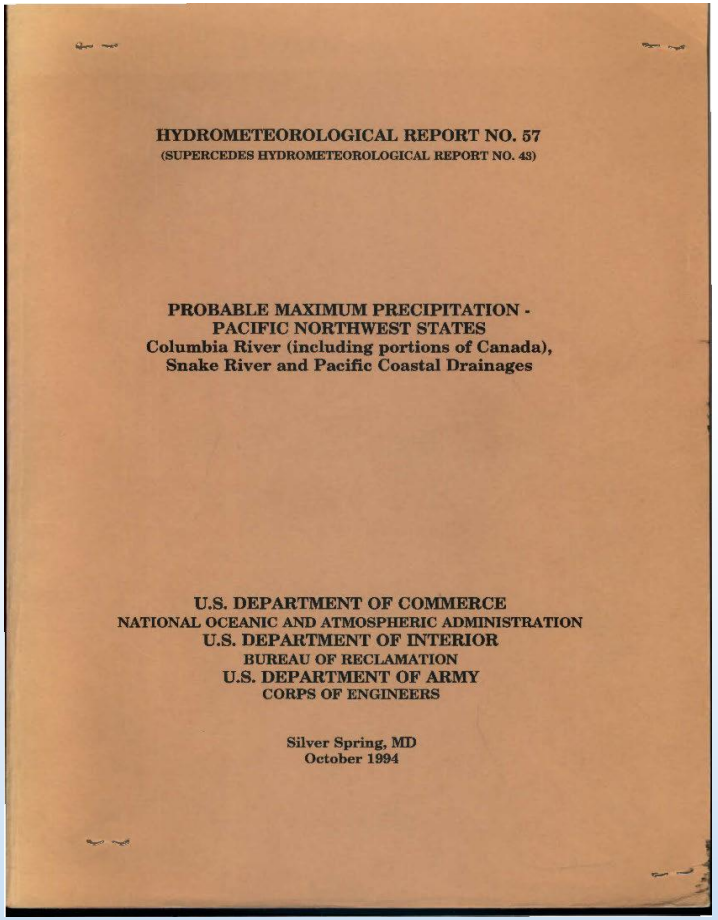
Flood Potential

- Oregon One of 5 States without a NOAA Atlas 14
- PMP procedures based more on tropical storm behavior with Gulf of Mexico source, dated
- Corps of Engineers doing site specific work
- **How much moisture can an atmospheric river deliver?**


HYDROMETEOROLOGICAL REPORT NO. 57
(SUPERCEDES HYDROMETEOROLOGICAL REPORT NO. 43)

PROBABLE MAXIMUM PRECIPITATION -
PACIFIC NORTHWEST STATES
Columbia River (including portions of Canada),
Snake River and Pacific Coastal Drainages

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
U.S. DEPARTMENT OF INTERIOR
BUREAU OF RECLAMATION
U.S. DEPARTMENT OF ARMY
CORPS OF ENGINEERS

Silver Spring, MD
October 1994

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Working on flood annex
Floods of 1996

- February 1996
- Four day atmospheric river
- Very well forecast
- Who is on first?
- City of Portland example
  - Forgot where flashboard were for the seawall
- Many state buildings flooded
  - No state directed flood fight

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Atmospheric Rivers

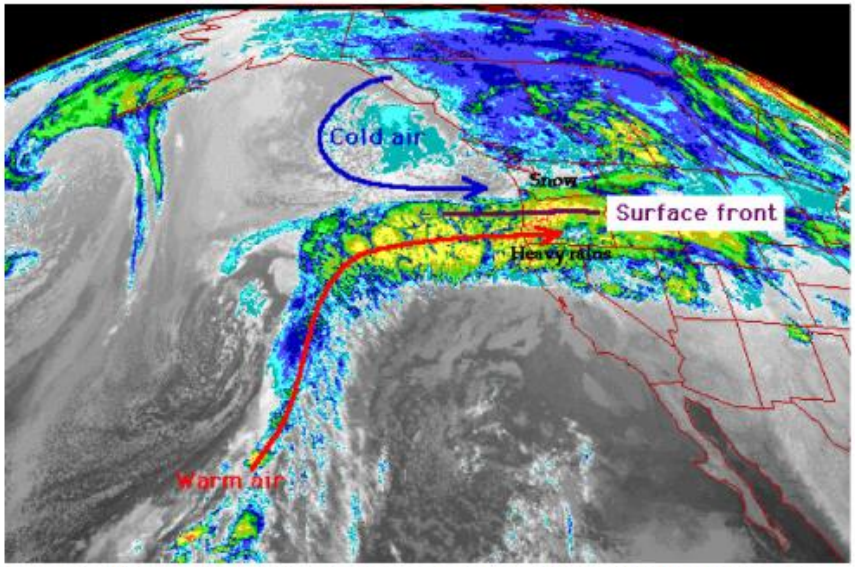

Figure 2. Infrared satellite photograph for November 18, 1996, showing subtropical jet stream bringing moisture from the southwest, and a cold air mass over Washington. (Photograph courtesy of the Oregon Climate Service, Corvallis, Oregon).

- Storm 2 our of 3 in 1996
- Shorter duration
- Less common pattern
- Much more severe than forecast
  - (Several gages around 1.5 inch per hour for 4-5 hours)

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2007 Flood at dam

Water filled to crest, all boats and logs through interior spillway

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Awareness of unusual flood situation

Oregon Emergency Operations Plan being rewritten

Flood Situation Agencies

- NWS and RFC forecasts and Consultation
- OWRD
- USACE
- ODOT
- OEM.

• How much time is needed to get resources ready?

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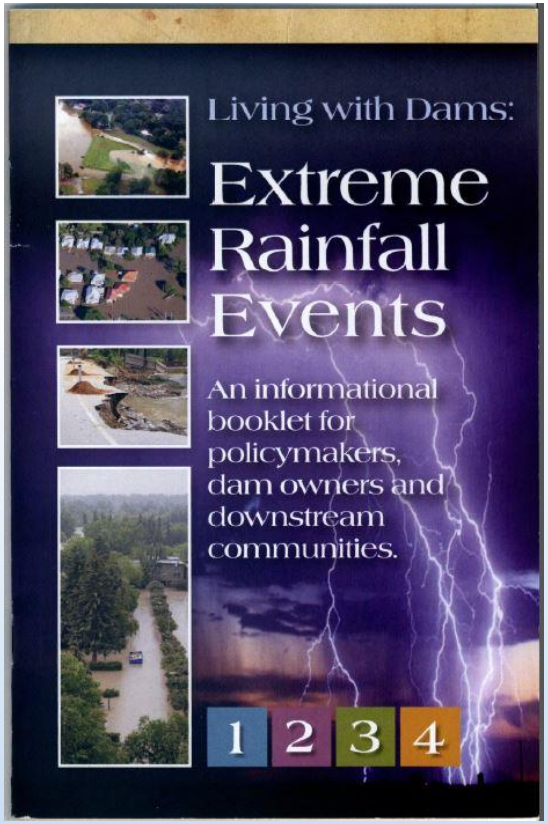
Dams and Reservoirs

Association of State Dam Safety Officials

Five strategies

1. Design review to ensure the the dam be safe when built?
2. Would people be at risk if the dam were to fail
3. Inspections to determine if it remains safe
4. A plan to detect and prevent failure
5. Evacuation and notice if its failing so people have enough time to get to safety?



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Dam safety authorities in Oregon

- **USACE**
- **USBOR**
  - **Owyhee dam**
- **FERC**
- **OWRD**
  - Many past due for rehabilitation

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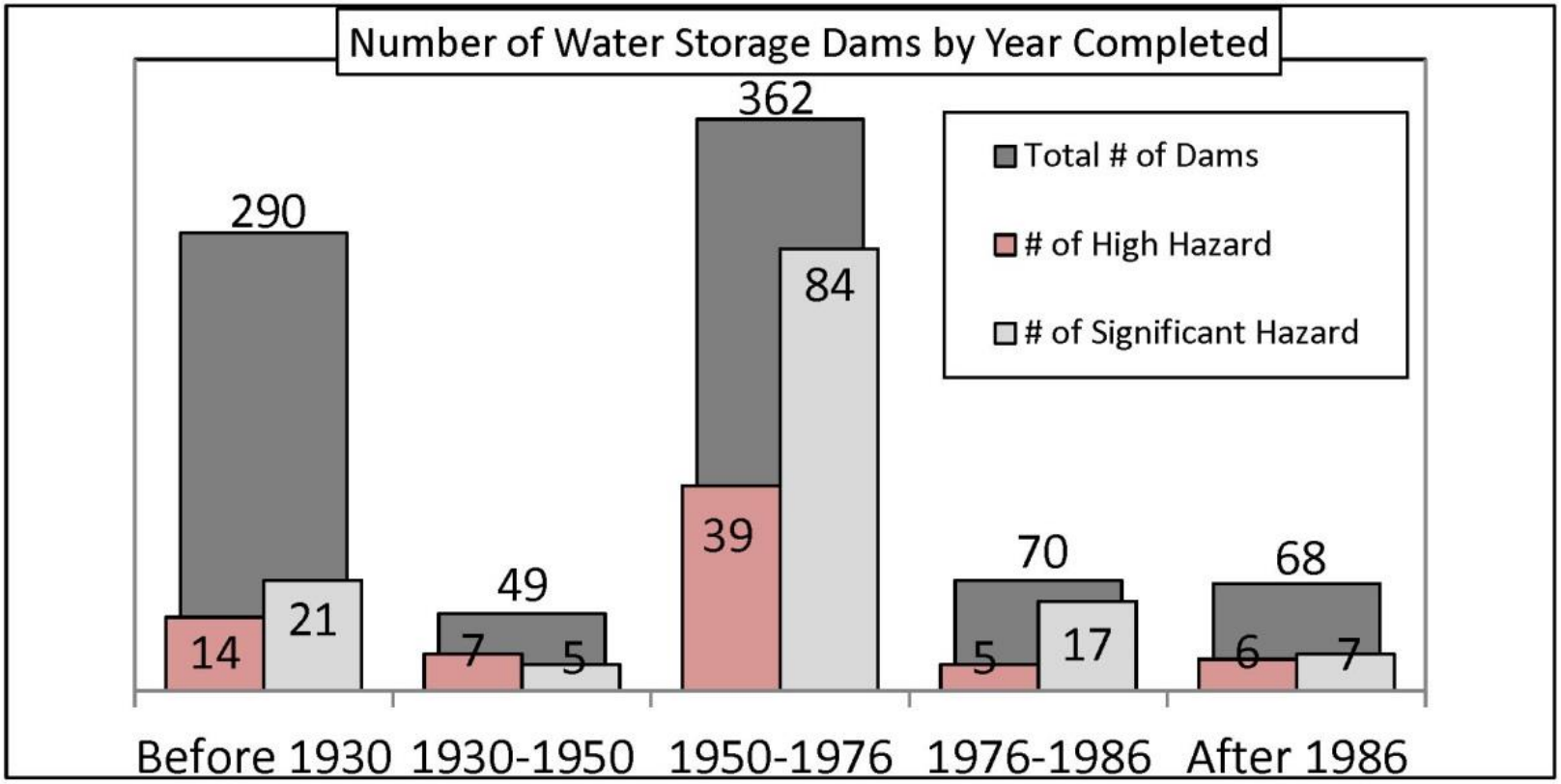
Oregon's Dams Are Older



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We learn from California

Effective communication between engineers, geologist and meteorologists and public safety officials should not be taken for granted

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Flood Control System

Willamette Valley Project

- 13 reservoirs
- Flood control a primary purpose
- Need to follow rule curve to minimize flood risk before filling
- Not enough information to change operations in drought
- PMF analysis underway

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Areas of Greatest Need

- **What is the confidence in and range of potential temperature and precipitation in the S2S forecasts.**
- **Documentation on range of precipitation that can be delivered by a west coast atmospheric river**
- **What mechanisms cause long duration heavy precipitation. What is an extreme range for maximum duration.**
- **Probability of occurrence (is an extreme flood possible now, even if low probability)**

Questions?