Watershed Management Plan

Protecting Our Drinking Water Supply

Salt Lake City Public Utilities

Keep It Pure

DON'T POLLUTE THE WATERSHED

Introductions

Mentimeter Word Cloud

Introductions

Agenda

- Introductions – SLCDPU & Stakeholder Committee
- Meeting Agenda, Meeting Courtesies – Cindy Gubler
- Plan’s purpose – Laura Briefer
- Climate Conditions –JW Associates
- Facilitated Discussion – The Langdon Group & Stakeholder Committee

Meeting Courtesies

- Mute your microphone
- Leave your camera on
- Use the comment tool or the raise your hand tool
- Our ground rules:

  - Want everyone to participate
  - There are no right or wrong answers – every opinion counts
  - Be respectful; no one interrupts or talks over another person
  - Keep an open mind, listen carefully, and try to understand other people's view
  - Respond to others how you want to be responded to

What To Expect:

- Ask if there are slide questions during presentation
- Facilitated discussion at the end
- Want your input, ideas and recommendations
- We appreciate your time, knowledge, and views
- We will prepare a meeting report

Plan Need & Historical Context

GOAL

Protect the high-quality source of drinking water supply that originates from our watershed areas.

NEED

Salt Lake City Department of Public Utilities is required by the Safe Drinking Water Act to create and implement a plan that documents how our source waters are protected. The conditions in our watershed areas have changed and they are under pressure on multiple fronts. It's time to update the plan.

VISION

Develop sound policy that can be executed methodically by Salt Lake City Department of Public Utilities through collaborative management with trusted partners.

"The eyes of the future are looking back at us, and they are praying for us to see beyond our time"

– Local author and naturalist Terry Tempest Williams

Plan Need & Historical Context

Keeping Our Drinking Water Pure

Is The Purpose Of The Watershed Management Plan

Keep It Pure

DON'T POLLUTE THE WATERSHED

Climate Change Conditions

JW Associates

Source Water Protection

and

Managing for Resilient Watersheds

in 2022

Protecting Our Drinking Water Supply – 2022 Watershed Management Plan Update

Little Dell Reservoir

Photo: JW Associates – Jessica Wald

Critical concerns for watershed health

- Climate Change
- Wildfire
- Human Influence

Watershed Condition – Vulnerability to Stress

"Watershed condition changes over time due to natural processes and anthropogenic influences. The most pervasive impacts to watershed condition are expected to come from population increases . . . and climate change".

Mountain Dell and Little Dell Reservoirs, Parleys Canyon

Photo: Patrick Nelson

US EPA, Healthy Watersheds Protection: Developing a Watershed Vulnerability Index, EPA.gov.

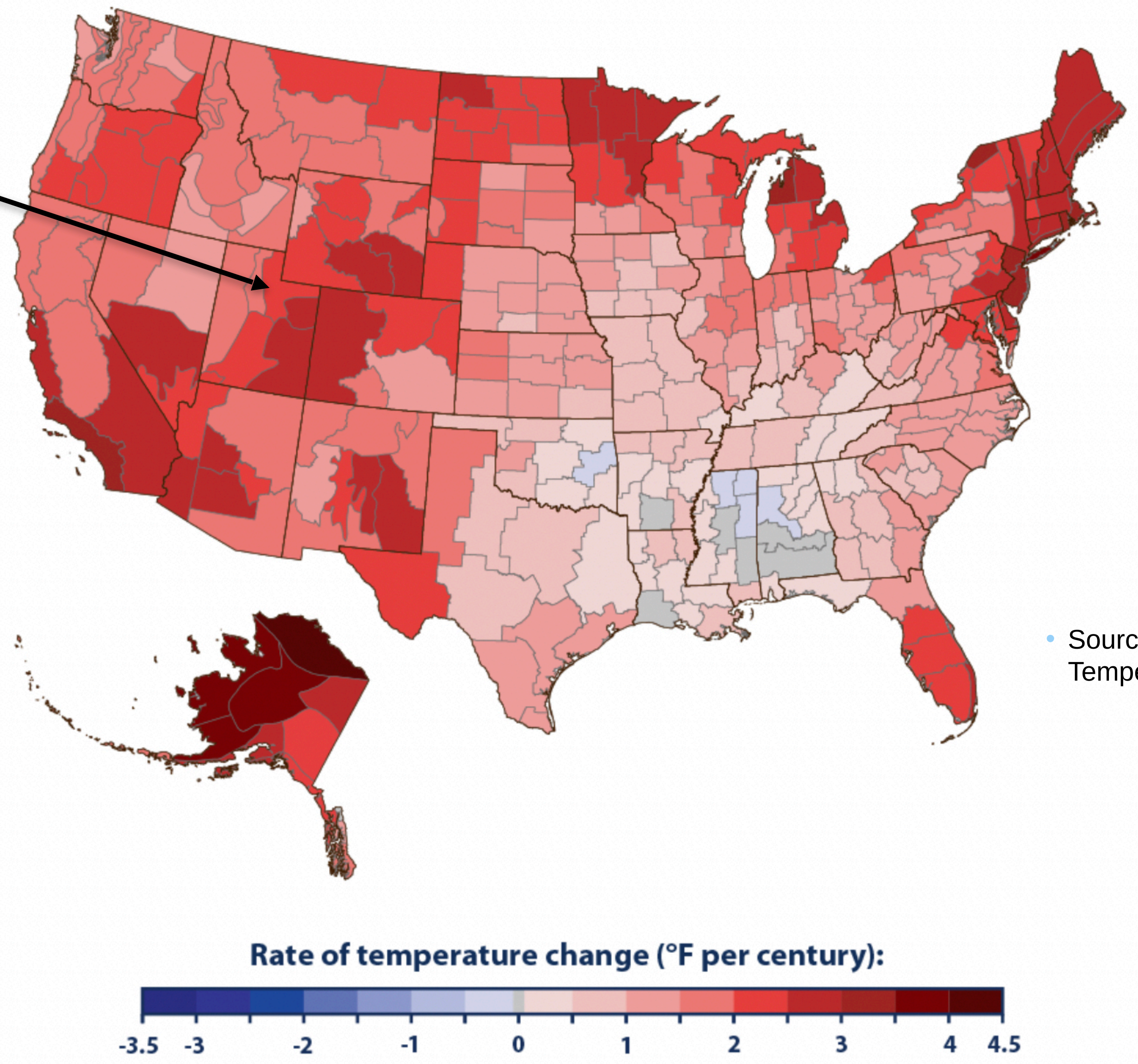
What are we going to talk about/agenda

1. How has our climate changed and what does the future look like
2. Defining important terms - exposure, sensitivity and resilience
3. Characteristics of watershed resilience
4. Climate Change Vulnerability Index analysis
5. Potential management actions

Rising Temperatures - Average Annual Temperature Deviations from long-term averages (1901- 2020)*

Salt Lake City and Wasatch Mountains

Figure 3. Rate of Temperature Change in the United States, 1901–2020



The last decade was the warmest on record throughout the west.

- Source: US EPA, Climate Change Indicators, US Temperature Change, EPA.gov

Temperatures in Northern Utah have risen 1.5 to 2.5 °F from historical averages

Temperatures in high elevations worldwide are warming faster than sea level.

Utah ski resorts are warming faster than global averages.

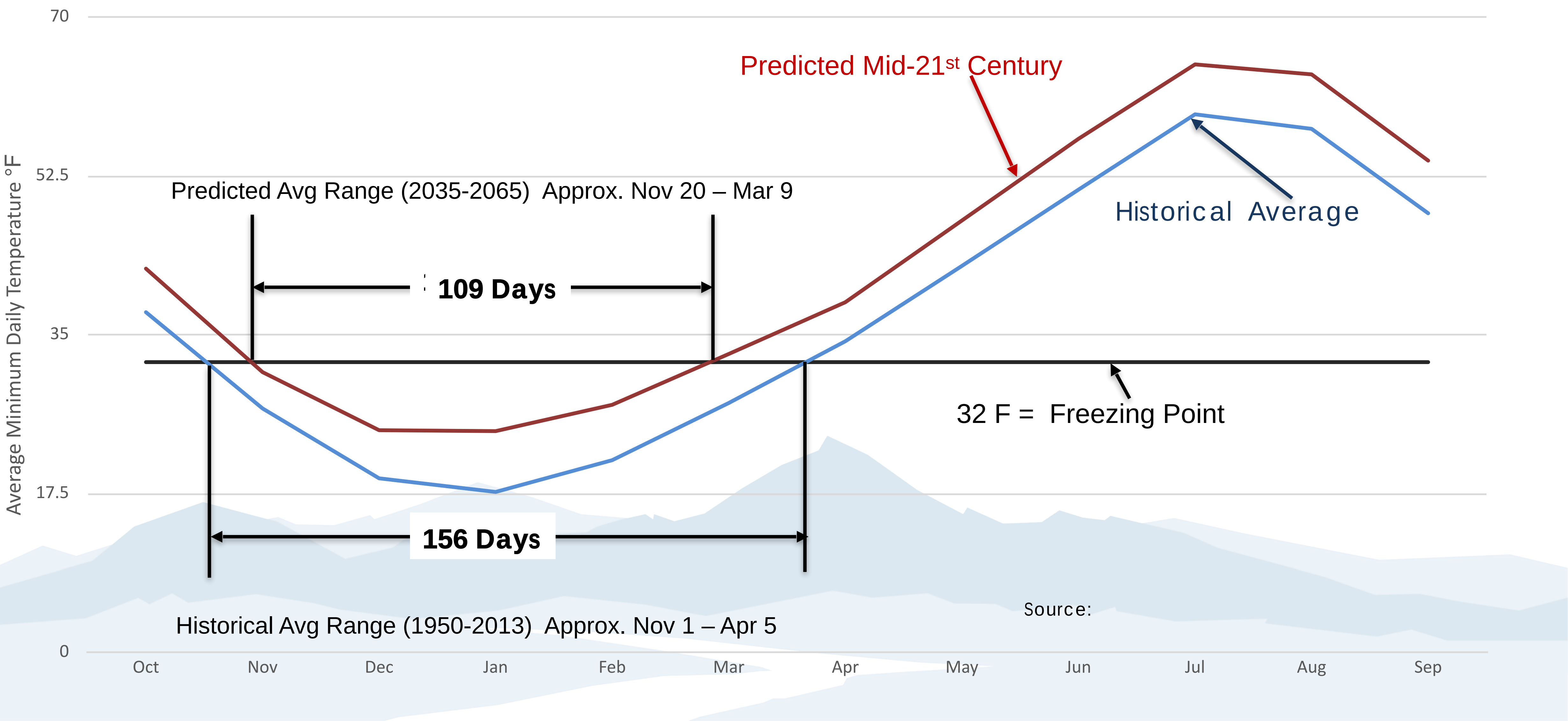
Minimum winter temps (Dec-Mar) are expected to rise 10°F by 2100.

Pace of change in temperature is increasing.

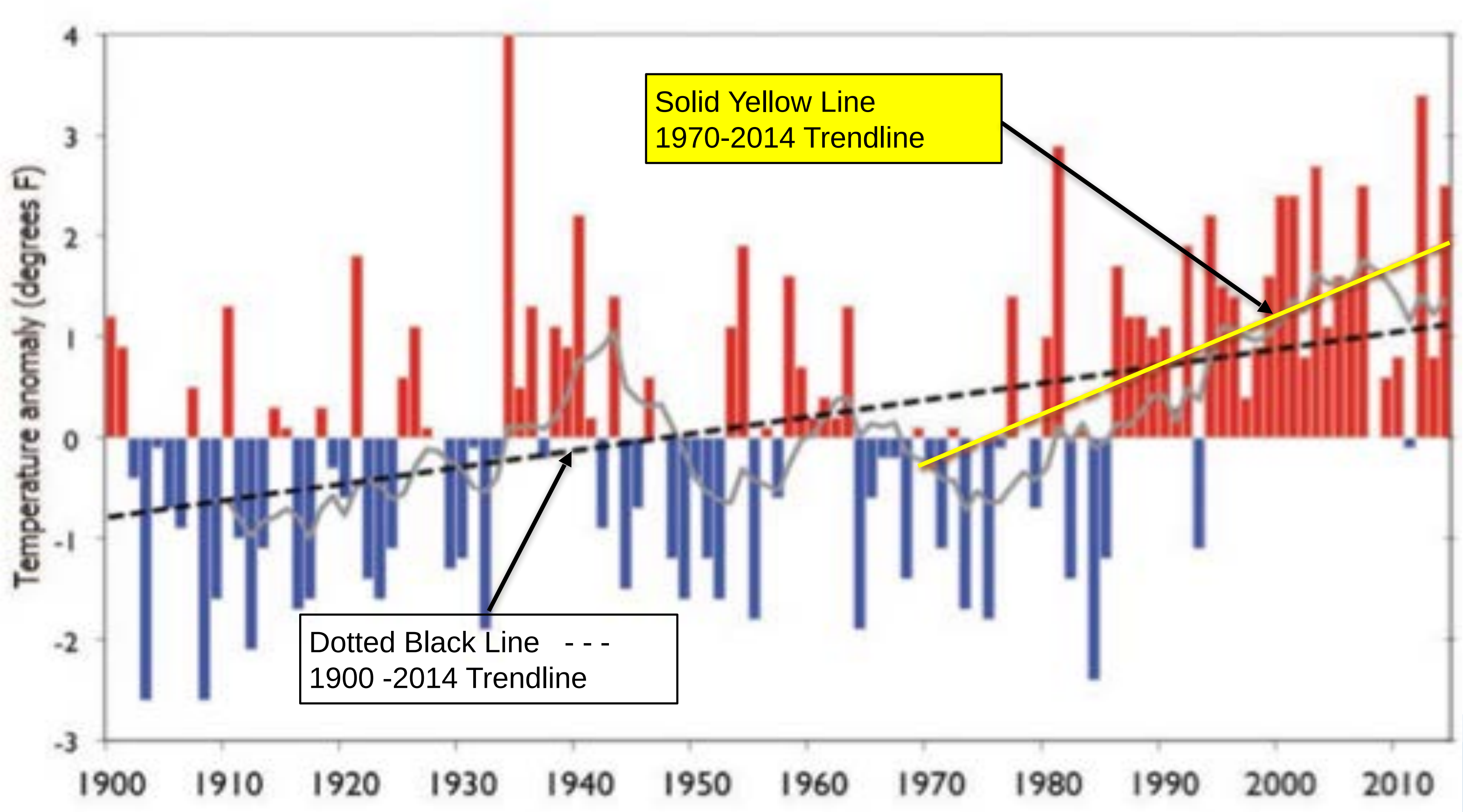
1900-2014 Pace = 0.2 °F per decade • 1970-2014 Pace = 0.5 °F per decade

Sources: Utah Department of Public Safety: Utah Hazard Mitigation: Climate Change https://hazards.utah.gov/wp-content/uploads/Utah-SHMP-Ch12-Climate-Change-1.pdf. Accessed March 4, 2022;
Utah State University, Utah State Today, Climate Change in Utah will Require Ski Resort Adaptations. July 29, 2021.

Average Minimum Daily Temperatures for Salt Lake County
Historical (1950-2013) & Predicted Mid-Century (2035-2065)



Mean Annual Temperature Anomaly from 1900-2014 Mean Annual Average Utah Climate Division 5



Gray line = 10 year running average

Note: Utah Climate Division 5 covers the majority of the Uinta-Wasatch-Cache and Ashley National Forests.
Source: NOAA http://ncdc.noaa.gov/cag/

In the Wasatch and Uinta Mountain Ranges

Between 1950 and 2010, amount of precipitation falling as snow has decreased by 9%.

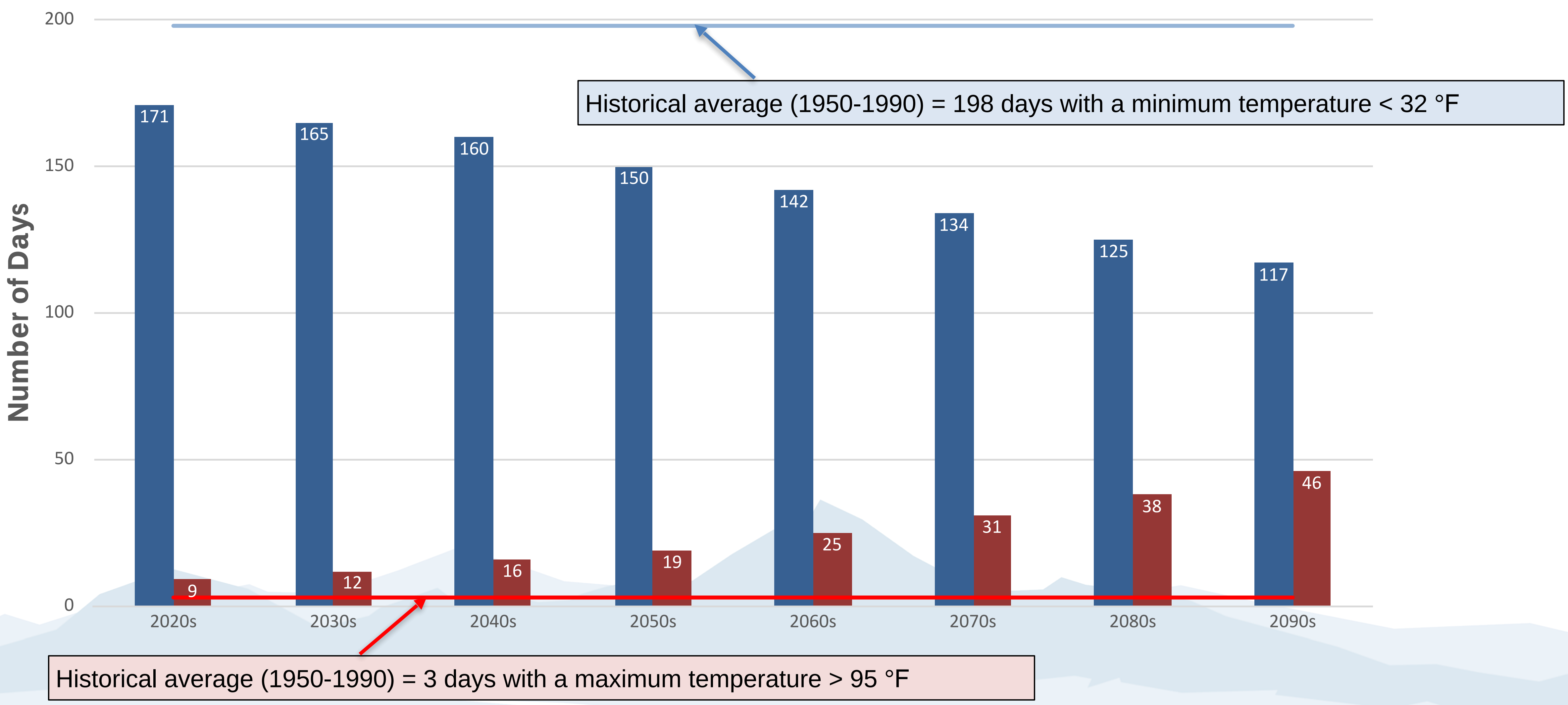
By 2080s , maximum median temps are outside historical range for all seasons.

By mid-century, > 50% of precipitation will fall as rain between December and February.

By 2100 – The increase in median maximum temperature is expected to range from 5-11 °F (low-high emission scenarios).

Sources: USDA FS RMRS-GTR-375, Klos et al 2014 as cited in USDA FS RMRS-GTR-362 2017)

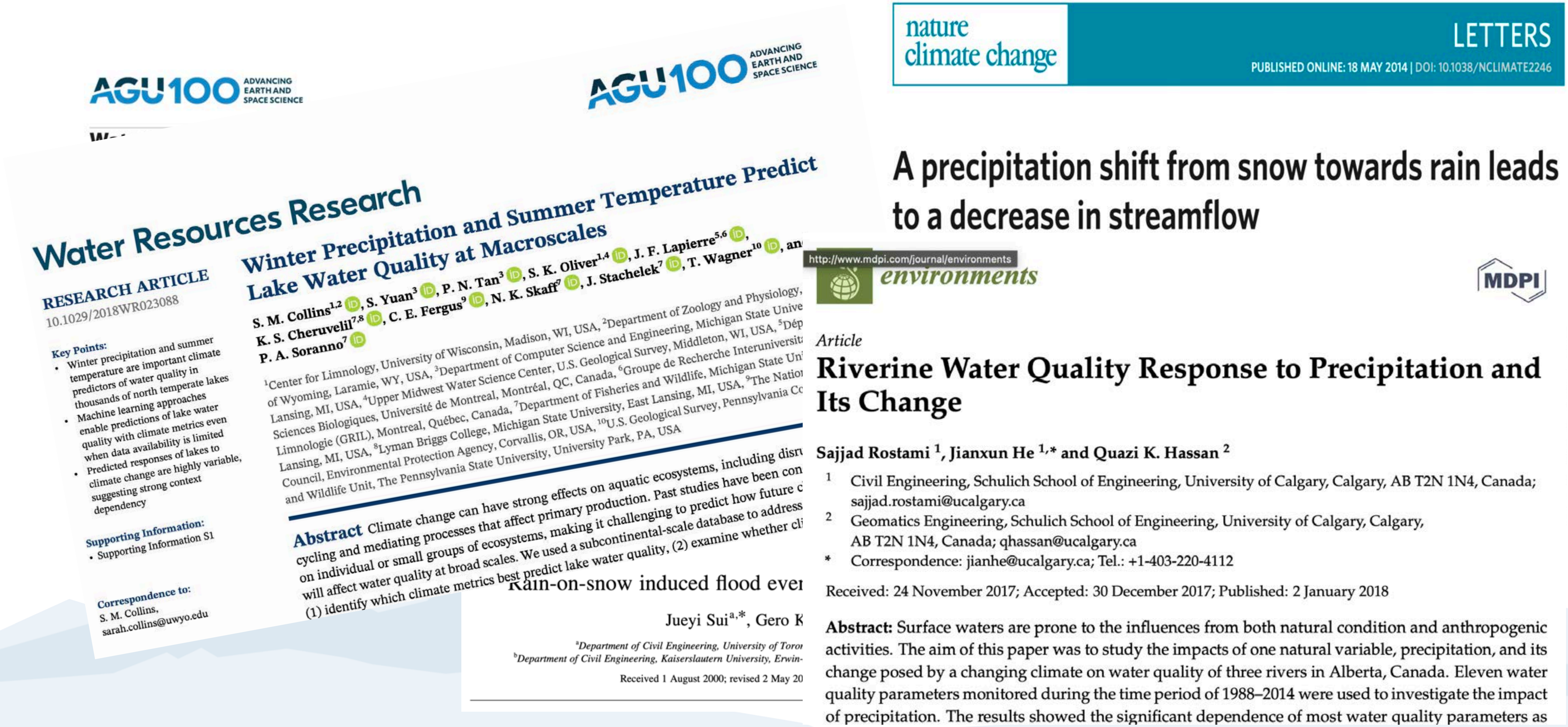
Wasatch Front - More days above 95 °F -- Fewer below 32 °F



Source: USDA Forest Service, Office of Sustainability and Climate, Climate by Forest: A tool for exploring climate change information on National Forest System Lands. February 23, 2022. Website accessed April, 2022.

Mentimeter or other questions/discussion

Effects of Temperature and Precipitation in Snow-Dominated Hydrology



Potential Climate Related Impacts to Watersheds and Water Supply

Increased insects and disease

→ *Higher wildfire risk, earlier snow melt, more nutrient export*

Increased size and higher intensity wildfires

→ *Increased sediment & nutrient yield, debris flows, stream bank erosion, damage to riparian areas*

Increased populations of invasive species

→ *Increased erosion, altered nutrient cycling, increased fire risk*

Degradation of riparian zones

→ *Reduction in filtering, altered nutrient cycling, increased stream bank erosion*

Potential Climate Related Impacts to Watersheds and Water Supply

Altered timing & quantity of runoff

→ *Changed patterns for water supply, increased erosion*

Increased instream & reservoir water temperatures

→ *Increased algal growth, increase in TDS, reduced water quality*

Increased intensity of rainfall, rain-on-snow events

→ *Increased sediment delivery to streams, larger peak flows & altering timing*

Increased evaporation from reservoirs

→ *Reduction in water supply, potentially higher TDS*

Wasatch Mountains = **HIGH** Vulnerability to Climate Change

- Highly sensitive to increases in drought, heat and flooding
- Snow-dominated hydrologic regime
  - More evaporation, snowpack loss, earlier snowpack melting = earlier runoff and lower streamflow
  - Loss of snowpack is expected to be especially pronounced in Wasatch Range due to elevation and latitude
- Effects likely to be compounded by wildfire and land uses

Management actions can **build resilience** and assist with transitions to help adapt to a changing climate

Source: Rice et al., Assessment of Watershed Vulnerability to Climate Change for the Uinta-Wasatch-Cache and Ashley National Forests, Utah. USDA RMRS GTR-362, 2017

Driving Concept – Watershed Resiliency

RESILIENCY DEFINITIONS

General Definition

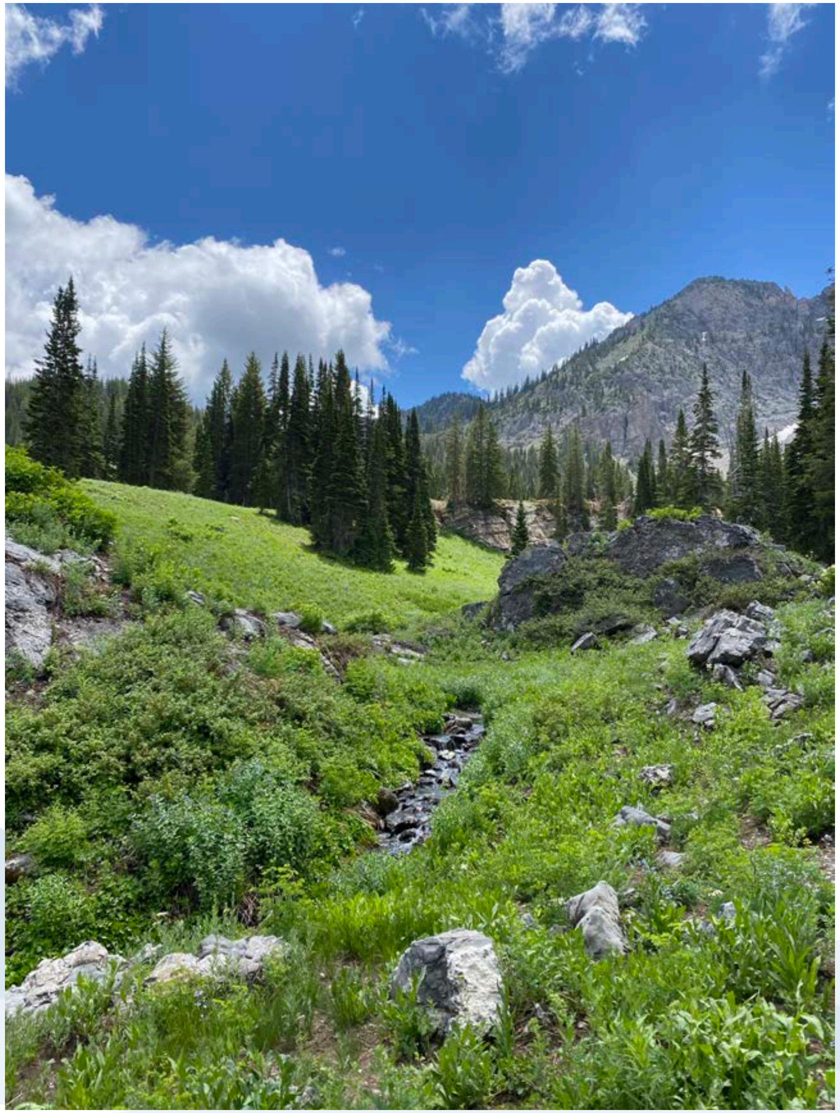
"The capacity of a system to absorb disturbance and reorganize while undergoing change so as to retain essentially the same function, structure, identity, and feedbacks."

Holling, C.S. 1973. Resilience and Stability of Ecological Systems. Annual Review of Ecology and Systematics. Vol. 4: 1-23.

Watershed Resiliency

The ability of a watershed to withstand or recover quickly from a severe event such as fires, floods or extreme weather.

Cornell Cooperative Extension



Resilient Watershed Characteristics – Riparian, Wetlands, Streams

- Healthy riparian areas
- Intact wetlands
- Natural stream flows
- Functional flood plains

Benefits to water supply

- Filter erosion from hillslopes
- Space for sediment deposition
- Reduced peak flows
- Proper nutrient cycling
- Faster post-fire recovery
- Protect stream banks

Resilient Watershed Characteristics – Uplands

- Healthy, diverse upland vegetation
- Openings/meadows
- Good ground cover
- Wildfires in natural disturbance regime

Benefits to water supply

- Ground cover recovers more quickly
- Diversity & patchiness reduces wildfire intensity
- Longer exposure to intense rainfall events
- Diversity & openings buffer both fire & insect outbreaks

Resilient Watershed Characteristics – Roads and Development

- ➢ Minimal impervious or compacted cover
- ➢ Lower road density
- ➢ Well designed stream/road crossings

Benefits to water supply

- Fewer developed areas lowers pollutants
- Less impervious cover more natural runoff & peak flows
- Lower road density, lower peak flows, runoff, sediment yields
- Well designed road crossings lowers risk of sediment increases & road failures

Mentimeter or other questions/discussion

Climate Change Concepts – Exposure, Sensitivity, and Resilience

Areas most at risk from climate change have a **High Vulnerability** to Climate Change

- **High Exposure**

  Areas that will experience the most severe changes in temperature and precipitation. Wasatch has a high exposure

- **High Sensitivity**

  Ecologically sensitive to climate related changes

- **Low Resilience**

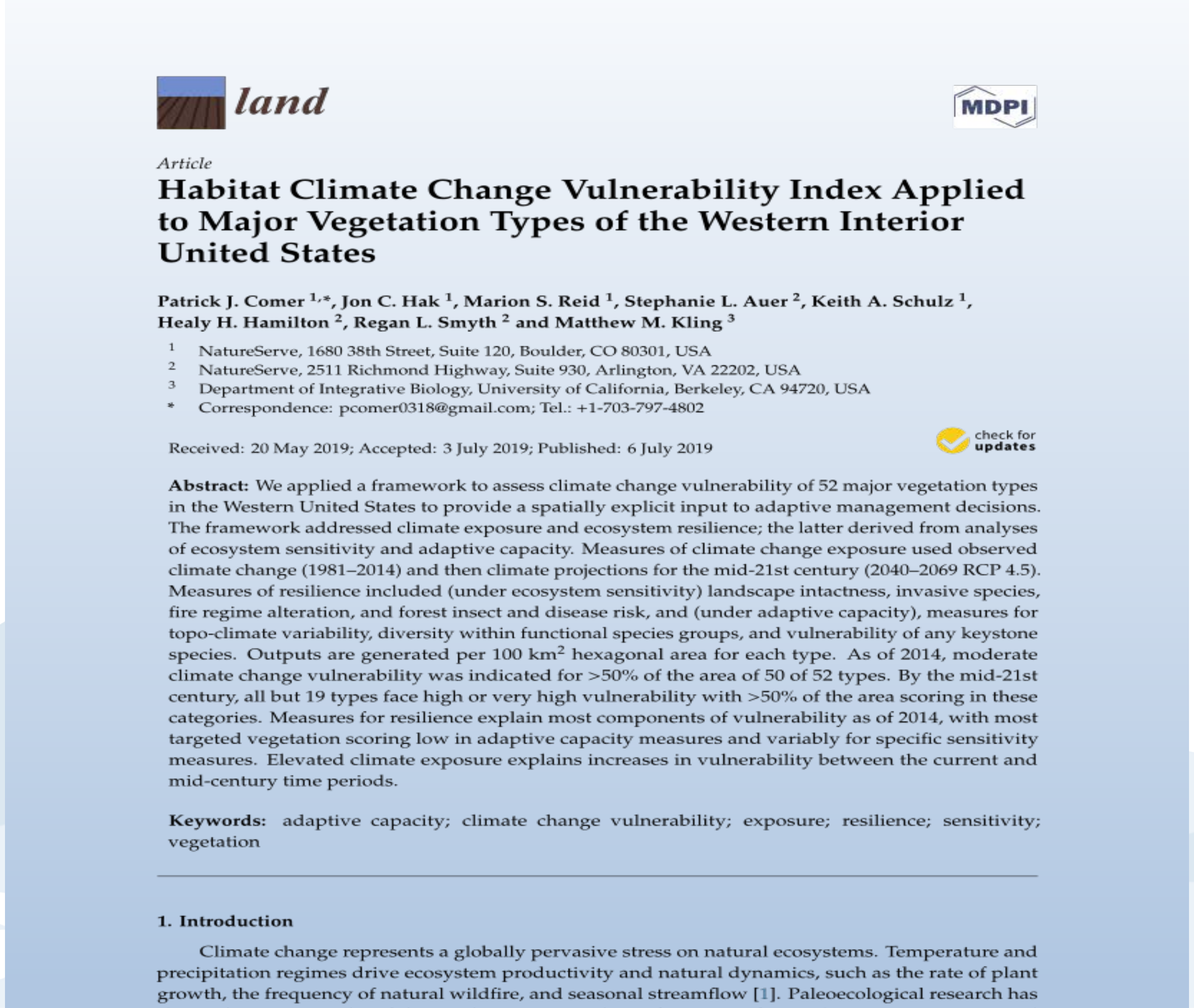
  Limited capacity to absorb changes or adapt to changes

Analysis of Climate Change in Watershed Management

Challenge is identifying & mapping areas of highest concern in a watershed

> Climate Change Vulnerability Index <

- Analysis from Comer et al. 2019
- Two major factors
  - Resilience
  - Ecosystem Sensitivity



land

MDPI

Article

Habitat Climate Change Vulnerability Index Applied to Major Vegetation Types of the Western Interior United States

Patrick J. Comer [1,*], Jon C. Hak [1], Marion S. Reid [1], Stephanie L. Auer [2], Keith A. Schulz [1], Healy H. Hamilton [2], Regan L. Smyth [2] and Matthew M. Kling [3]

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Received: 20 May 2019; Accepted: 3 July 2019; Published: 6 July 2019

Abstract: We applied a framework to assess climate change vulnerability of 52 major vegetation types in the Western United States to provide a spatially explicit input to adaptive management decisions. The framework addressed climate exposure and ecosystem resilience; the latter derived from analyses of ecosystem sensitivity and adaptive capacity. Measures of climate change exposure used observed climate change (1981–2014) and then climate projections for the mid-21st century (2040–2069 RCP 4.5). Measures of resilience included (under ecosystem sensitivity) landscape intactness, invasive species, fire regime alteration, and forest insect and disease risk, and (under adaptive capacity), measures for topo-climate variability, diversity within functional species groups, and vulnerability of any keystone species. Outputs are generated per 100 km^2 hexagonal area for each type. As of 2014, moderate climate change vulnerability was indicated for >50% of the area of 50 of 52 types. By the mid-21st century, all but 19 types face high or very high vulnerability with >50% of the area scoring in these categories. Measures for resilience explain most components of vulnerability as of 2014, with most targeted vegetation scoring low in adaptive capacity measures and variably for specific sensitivity measures. Elevated climate exposure explains increases in vulnerability between the current and mid-century time periods.

Keywords: adaptive capacity; climate change vulnerability; exposure; resilience; sensitivity; vegetation

1. Introduction

Climate change represents a globally pervasive stress on natural ecosystems. Temperature and precipitation regimes drive ecosystem productivity and natural dynamics, such as the rate of plant growth, the frequency of natural wildfire, and seasonal streamflow [1]. Paleoecological research has

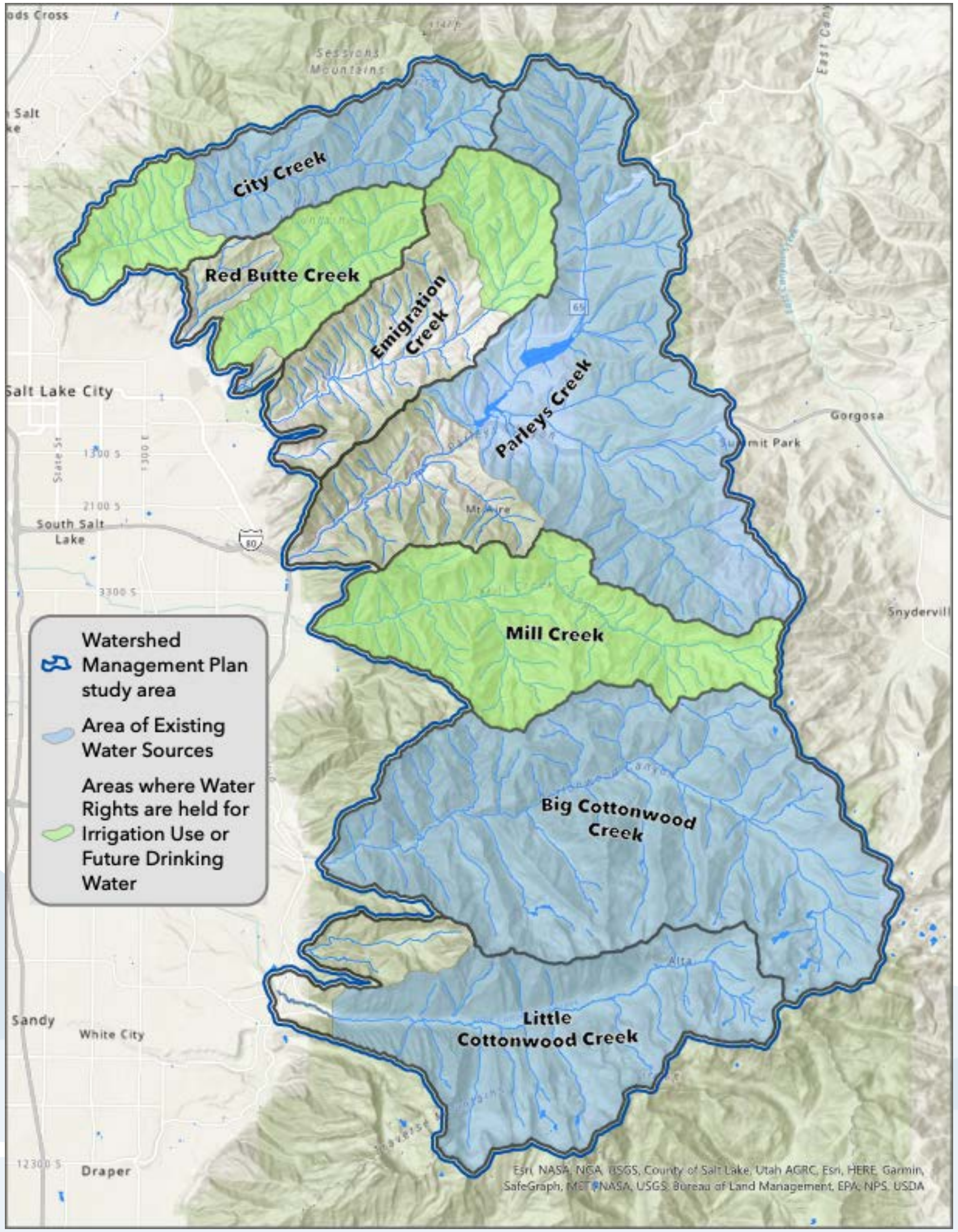
How did we apply this research to analyze the watersheds?

Foundational Concept

Analysis provides a scientific basis for management to prioritize actions & optimize resources.

First - Analyze the Components

1. Start with the watersheds as shown in map
2. Subdivide each watershed into smaller 7th level watersheds
3. Analyze conditions within those smaller watersheds
4. Resilience components include:
    - Vegetation Diversity
    - Topo-Climatic Variability
5. Ecosystem sensitivity components include:
    - Landscape Condition
    - Fire regime departure
    - Forest Insects & Disease



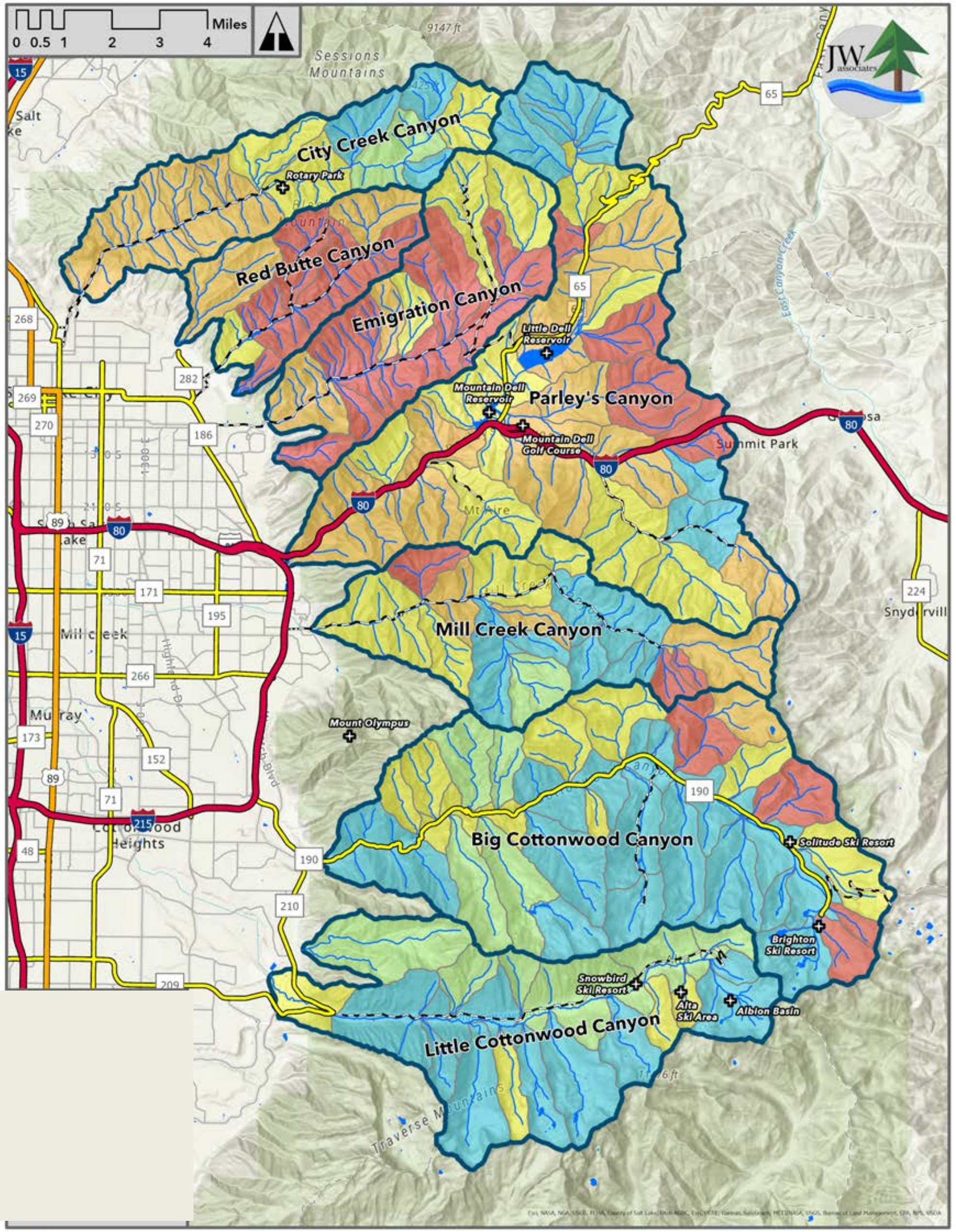
How did we apply this research to analyze the watersheds?

Second – Rank the Individual Components

1. Comparatively rank all the smaller watersheds across the WMP Study Area (map) for each analyzed component
2. Group watersheds of similar magnitude into five roughly equal categories
3. Categories range from Lowest (green and blue) to Highest (orange and red) reflecting potential for increasingly adverse impacts from climate change

Third – Combine all factors into one metric the Climate Change Vulnerability Index

1. In all maps, including the final composite map, areas in orange and red are at most risk from climate change.
2. Provides localized detail for management decisions.



Important Points

1. This is a tool to help prioritize management actions and optimize resources.

2. This is a comparative analysis.

3. Wasatch Mountains has a whole has high vulnerability. This analysis helps us see the differences on a smaller scale.

4. Blue or green watersheds are ranked lower but that does not mean those areas will not see the effects of climate change or are not at risk.

5 Minute Break/Mentimeter

Resilience – Vegetation Diversity

First – Analyze Ecosystem Resilience

Ecosystem Resilience = Vegetation Diversity + Topo-Climatic Variability

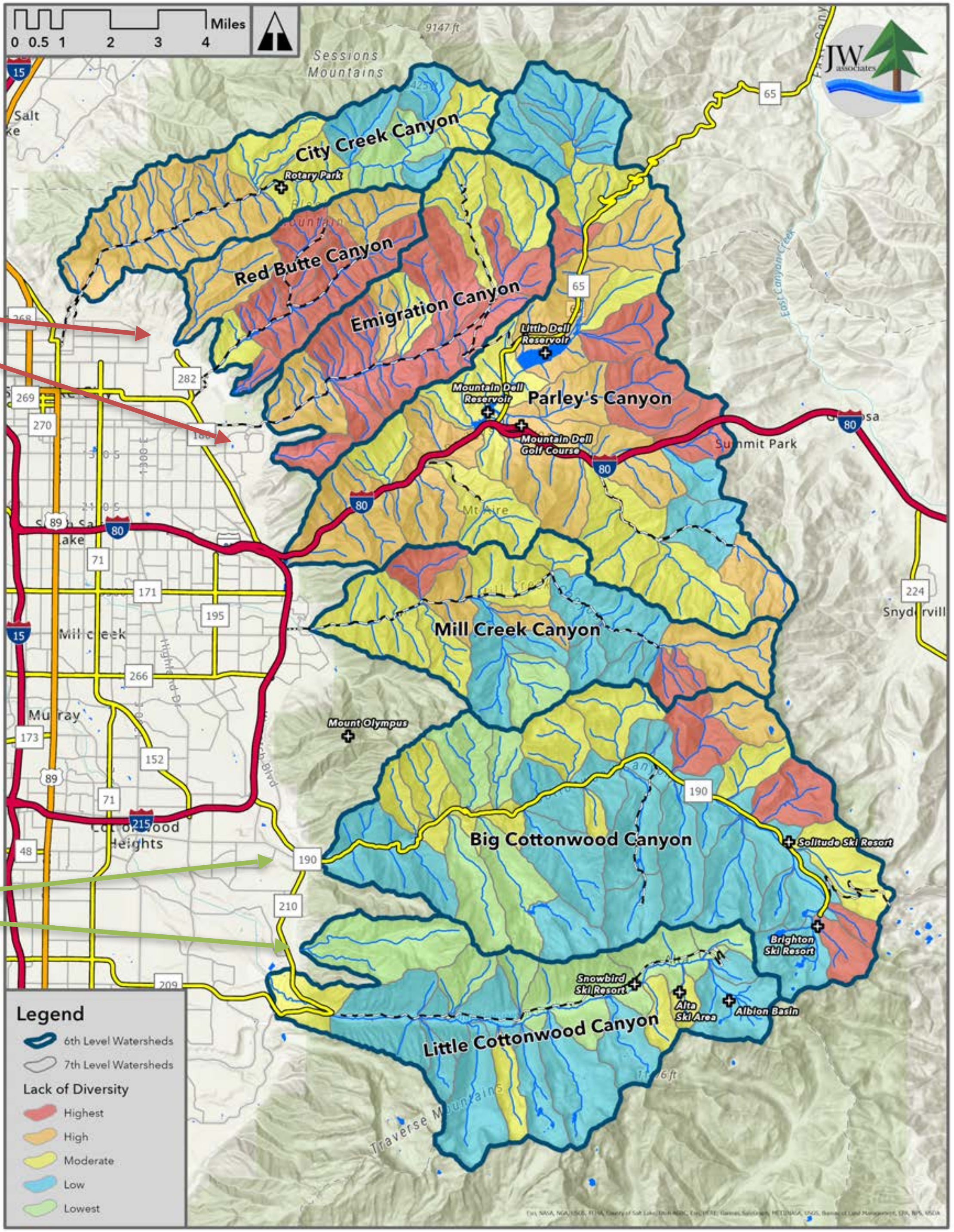
Resilience – Vegetation Diversity

Lower diversity is worse

Simpson's Diversity Index

- Measure of ecological diversity – includes both **number of species** present and relative **abundance** of each species
- As species richness increase, Simpson's Diversity Index increases

Higher diversity is good



Resilience – Topo-Climatic Variability

Influence of topography on microclimate variability

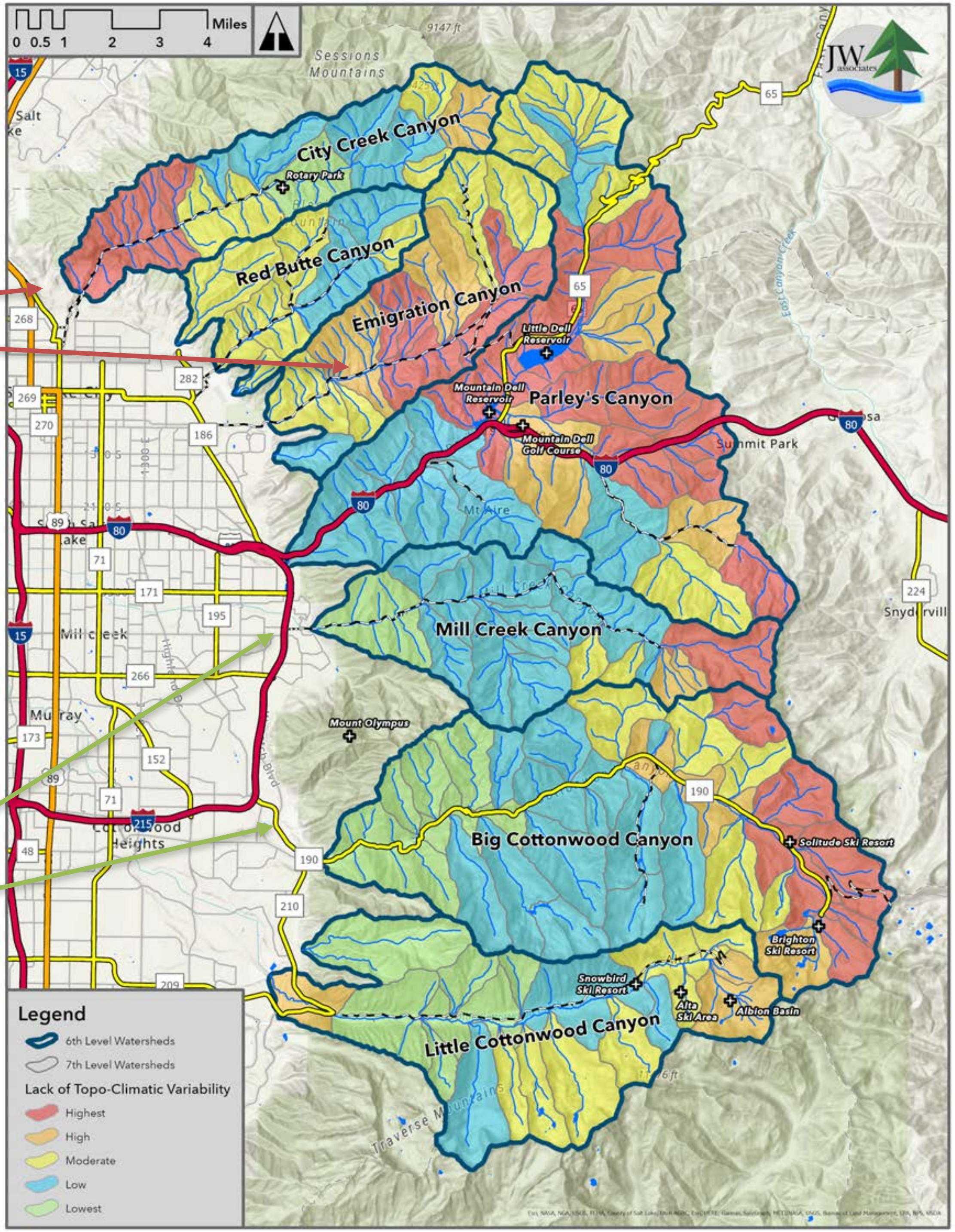
Resilience – Topo-Climatic Variability

Lower micro-climate variability is worse

Terrain Ruggedness Index (TRI)

- Defined by Riley et al. 1999
- Describes the amount of **elevation difference between adjacent cells** of a Digital Elevation Model (DEM)

More micro-climate variability is good

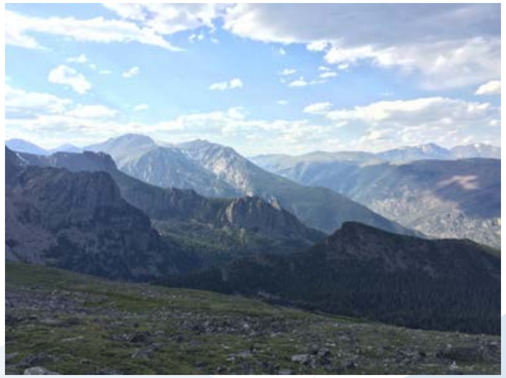


Ecosystem Resilience

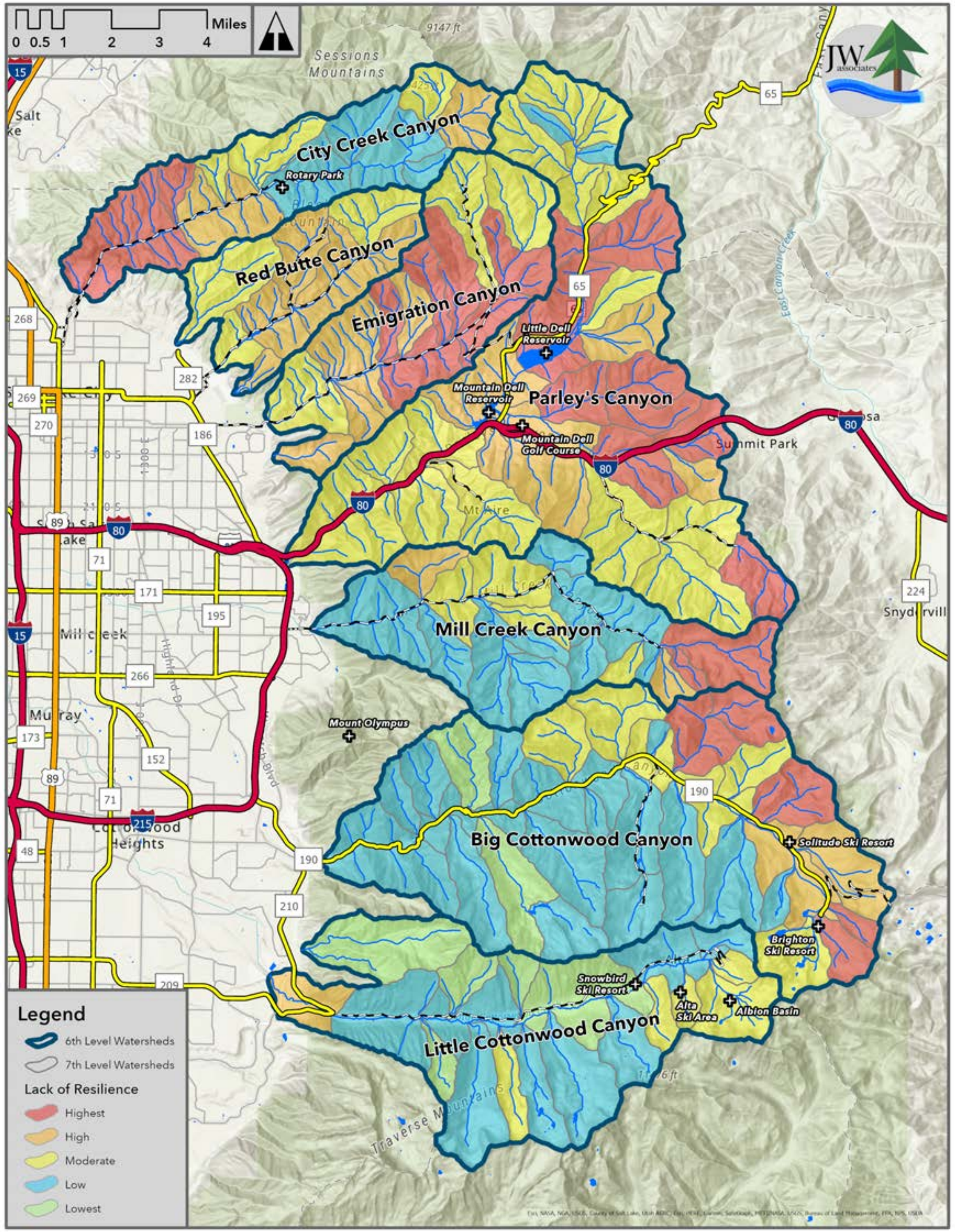
Vegetation Diversity

+

Topo-Climatic Variability



= **Ecosystem Resilience**



Next – Ecosystem Sensitivity

Ecosystem Sensitivity =
Landscape Condition +
Topo-Climatic Variability +
Fire Regime Departure

Ecosystem Sensitivity – Landscape Condition

How far to the nearest road?

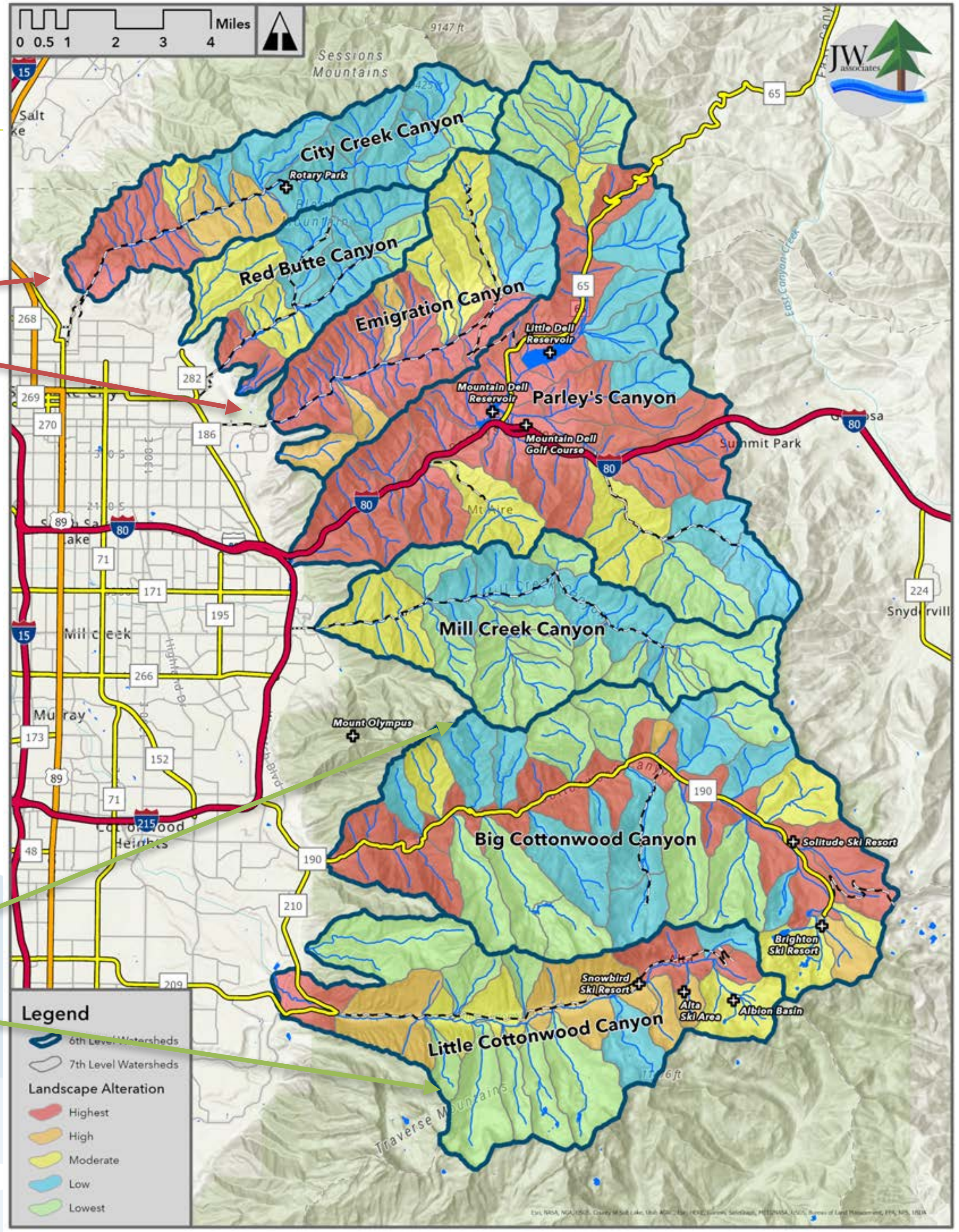
Resilience – Landscape Condition

Areas close to roads have more alteration and are more sensitive

How far to the nearest road?

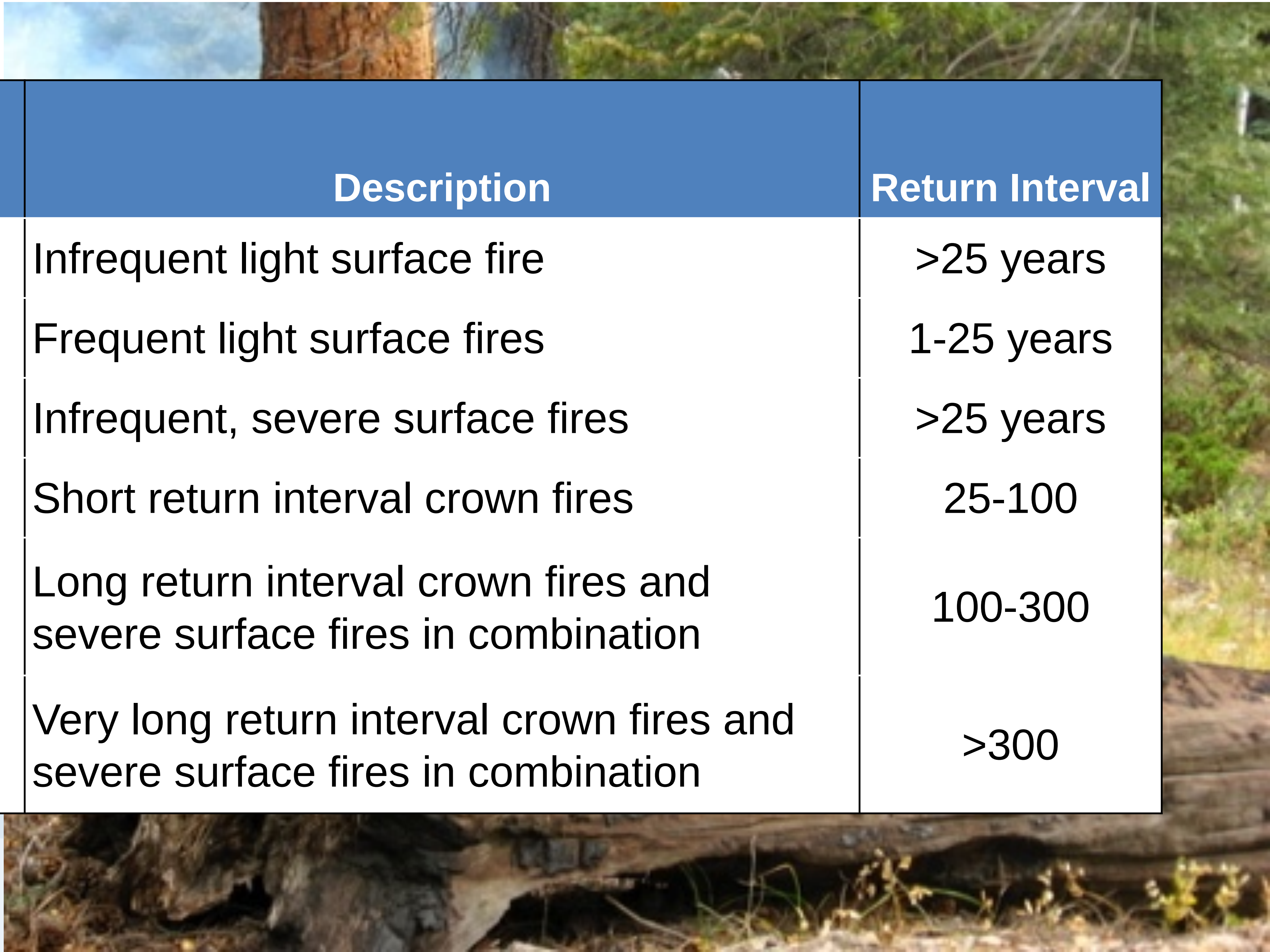
- Defined by Ritters and Wickham, 2003

Areas further from roads have less alteration and are less sensitive



Ecosystem Sensitivity – I Regime Dep

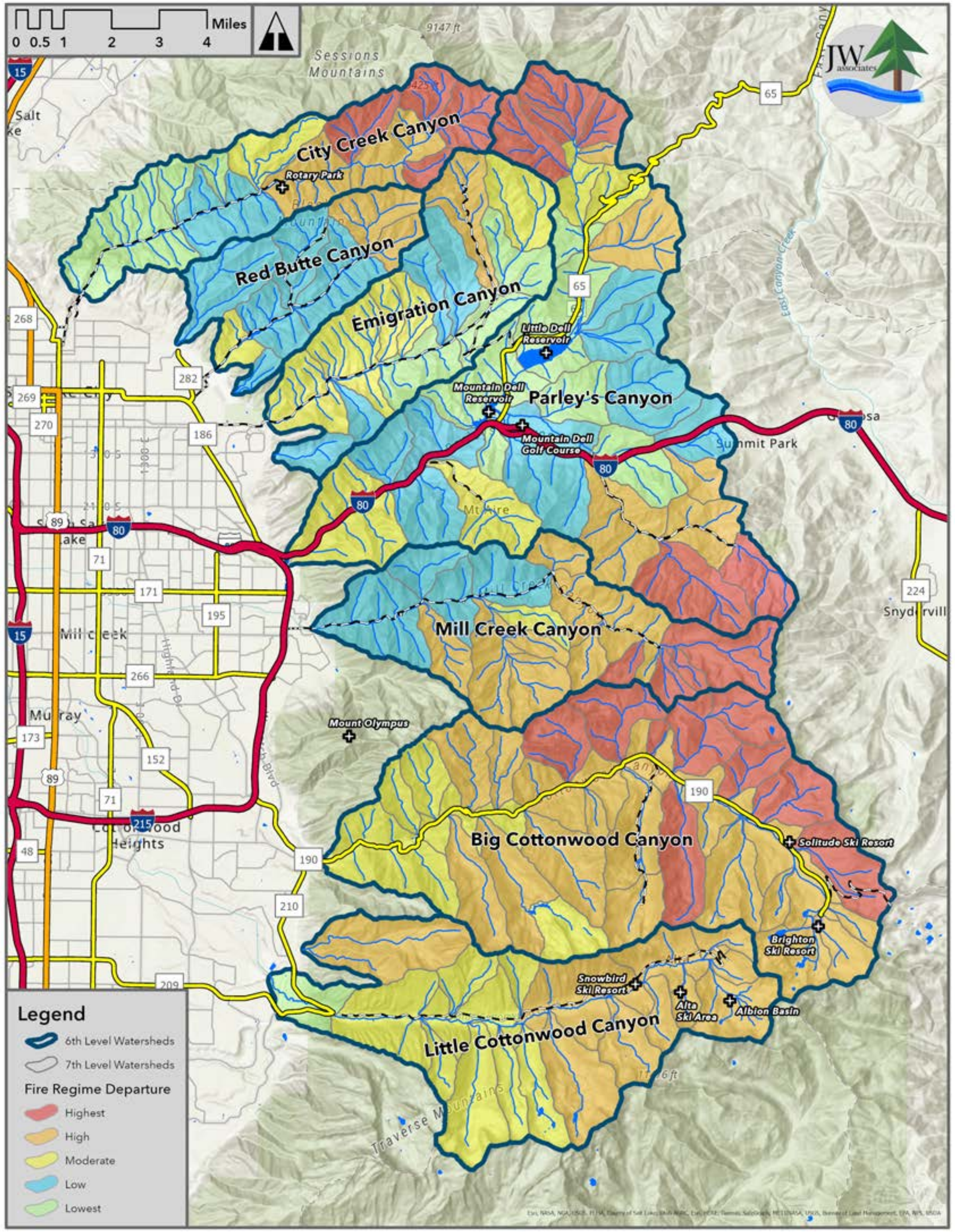
Change fr natural fire regime



Fire Regime	Description	Return Interval
I	Infrequent light surface fire	>25 years
II	Frequent light surface fires	1-25 years
III	Infrequent, severe surface fires	>25 years
IV	Short return interval crown fires	25-100
V	Long return interval crown fires and severe surface fires in combination	100-300
VI	Very long return interval crown fires and severe surface fires in combination	>300

Ecosystem Sensitivity – Fire Regime Departure

- What is a fire regime?
- Recurrence interval and Intensity
- Grasslands
  - Short recurrence interval and low intensity
- Spruce-fir
  - Long recurrence interval and high intensity
- Departure is change from natural fire regime
- Vegetation Condition Class (VCC)



Ecosystem Sensitivity – Forest Insects & Disease Risk

Balsam Woolly Adelgid

Adelges piceae (Ratzeburg)

Photo Credit: Oregon Department of Forestry

State level report County level observation

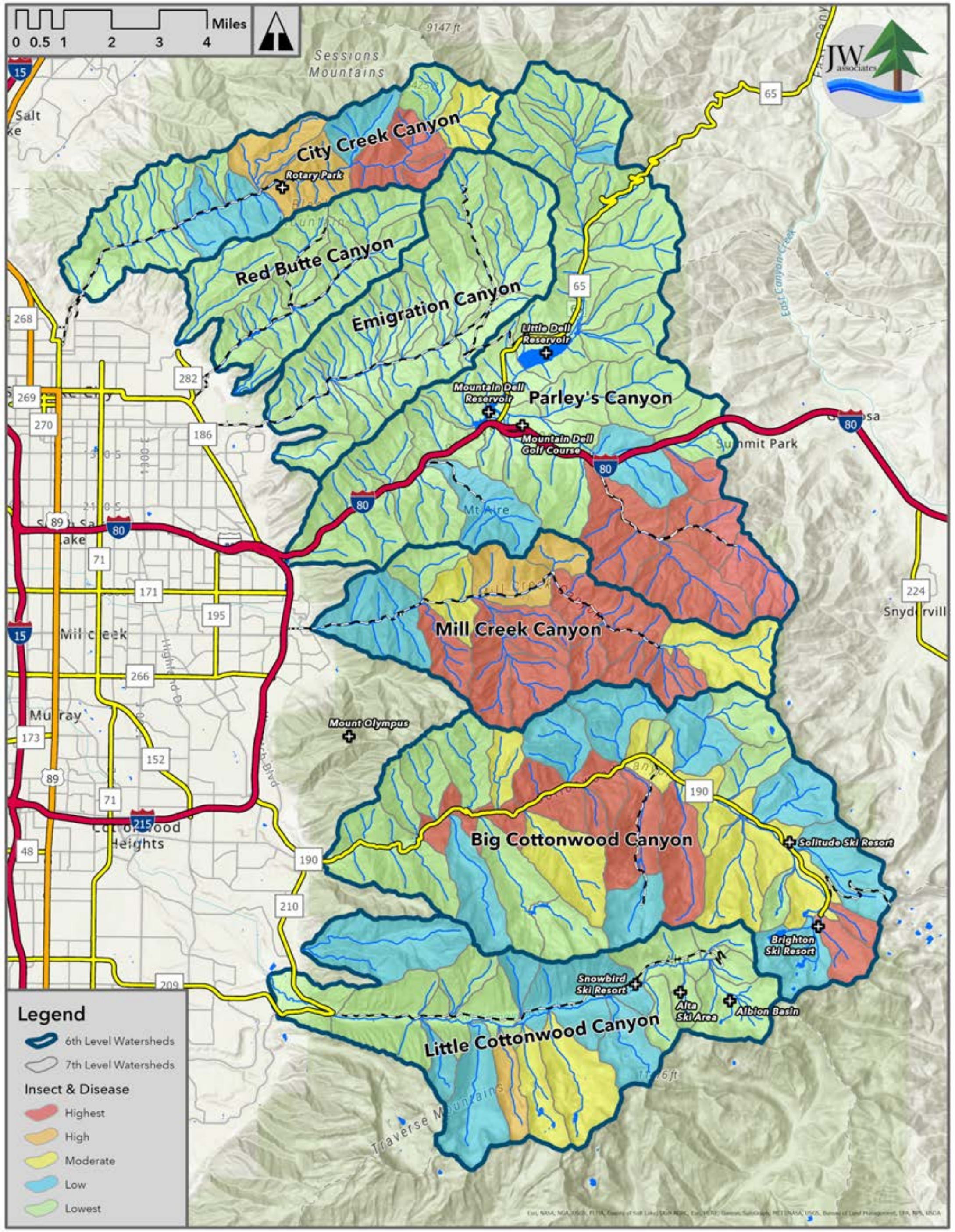
Date created: 13 Feb. 2020

The Alien Forest Pest Explorer maintains spatial and biological information for 89 non-indigenous pests to the United States forests. Some of these pests are widely known, but a great number of them are obscure and relatively unknown. Because of this disparity, information for this site is generated from a variety of sources and depicts a geographic range at the county scale. For some of the regulated forest pests, we collect data from Forest Health Protection (FHP) and its partner's Insect and Disease Survey (IDS) Dataset. For the other pests, information is annually updated using peer-reviewed articles, gray literature, museum specimens and communications with experts. We strive to generate maps that reflect the best of our current knowledge for each species; however, a degree of error is inherent in all maps. The maps are distributed "AS-IS" without warranties of any kind, either expressed or implied, including but not limited to warranties of suitability to a particular purpose or use. The Forest Service and its partners shall not be held responsible for missing or inaccurate data. An accuracy assessment has not been completed for this dataset. Maps and data may be updated without notice.

Please cite this map as follows: USDA Forest Service, Northern Research Station and Forest Health Protection. "Alien Forest Pest Explorer - species map." Database last updated 13 February 2020. <https://www.nrs.fs.fed.us/tools/afpe/maps/> (access date).

Ecosystem Sensitivity - Insect & Disease Risk

- Impacts vary from reduced vigor to high levels of mortality
- “the expectation that, without remediation, at least 25% of standing live basal area greater than one inches in diameter **will die over a 15-year timeframe (2013–2027)** due to insects and diseases” (Krist et al. 2013)



Additional Consideration for Ecosystem Sensitivity – Invasive Plants

- Reduce diversity
- Out-compete natives
- Change disturbance regimes
- Reduce habitat values

Yellow Star Thistle

Garlic Mustard

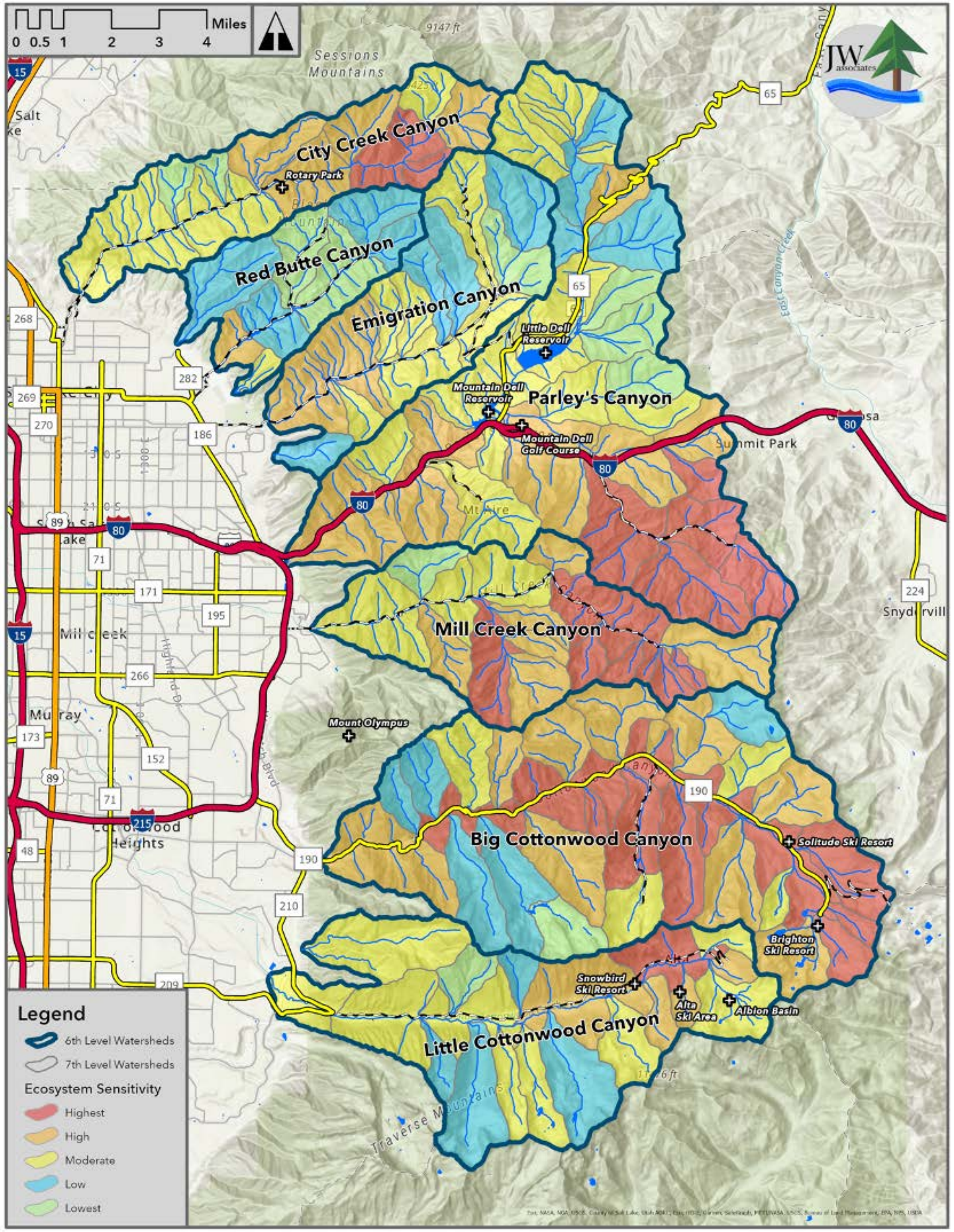
Ecosystem Sensitivity

Landscape Condition

Fire Regime Departure

Forest Insect and Disease Risk

= Ecosystem Sensitivity



Finally - Climate Change Vulnerability Index

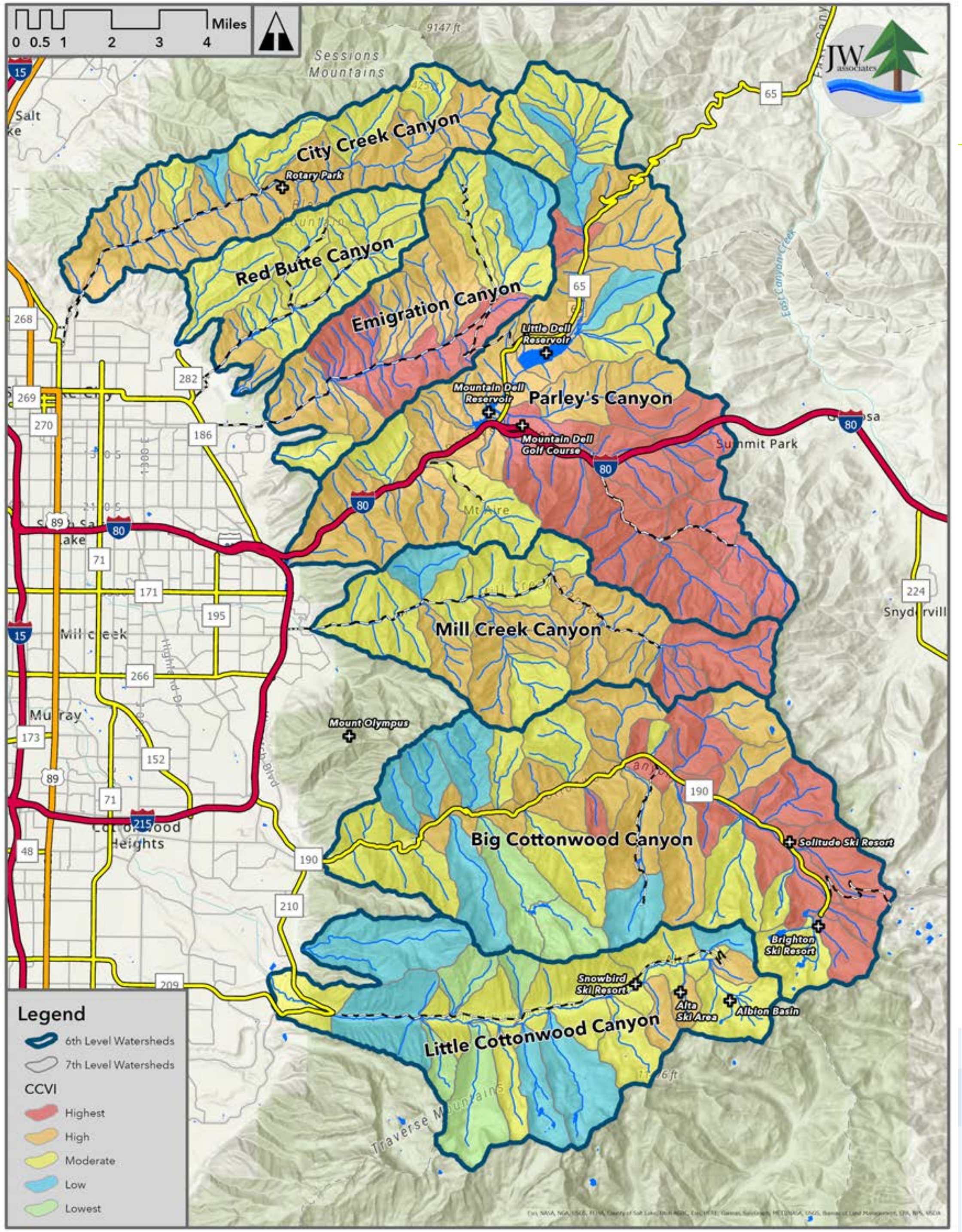
Resilience

+

Ecosystem Sensitivity

=

Combined Rank:
Climate Change Vulnerability Index



Mentimeter or other questions/discussion

Management Strategies

What CAN we do?

- ✓ Increase watershed resilience
- ✓ Reduce watershed sensitivity

Exposure: Keep working to minimize carbon emissions

Drilling Down on Red Watersheds

Ecosystem Sensitivity Calculations

14 code HUC	Small Watershed	Landscape Condition	Fire Regime Departure	Insect & Disease	ES Metric	Ecosystem Sensitivity Rank
16020204030201	Headwaters Parleys Canyon	5.5	1.8	1.4	8.7	3.7
16020204030202	UT to Headwaters Parleys Canyon	4.9	3.6	5.5	12.0	5.5
16020204030203	Upper Parleys Canyon	5.5	1.5	1.8	8.7	3.7
16020204030204	Headwaters Lambs Canyon	2.5	5.1	5.5	12.0	5.5
16020204030205	Upper Lambs Canyon	2.0	4.5	5.4	11.9	5.5
16020204030206	UT to Lambs Canyon	0.6	4.7	5.5	10.9	4.9
16020204030207	Lower Lambs Canyon	3.5	3.6	4.8	11.8	5.4
16020204030208	Middle Parleys Canyon	5.5	1.8	1.4	8.7	3.7
16020204030209	UT to Alexander Creek	2.1	1.6	0.5	4.2	1.1
16020204030210	Upper Alexander Creek	5.5	1.7	0.5	7.7	3.1
16020204030211	Lower Alexander Creek	5.5	0.7	0.5	6.7	2.5
16020204030212	Headwaters Mountain Dell Canyon	0.6	4.7	1.3	6.5	2.4
16020204030213	Box Spring Hollow	0.5	5.2	1.0	6.7	2.5
16020204030214	UT to Box Spring Hollow	0.5	5.3	1.1	6.8	2.6
16020204030215	Upper Mountain Dell Canyon	2.5	2.7	0.5	5.7	2.0
16020204030216	UT1 to Mountain Dell Canyon	1.2	4.4	2.5	8.1	3.3
16020204030217	UT2 to Mountain Dell Canyon	0.9	5.2	0.5	6.6	2.5
16020204030218	UT3 to Mountain Dell Canyon	5.5	2.7	0.5	8.7	3.7
16020204030219	Middle Mountain Dell Canyon	5.5	0.6	0.5	6.6	2.5

Can We Increase Watershed Resilience?

- **Topo-Climatic Variability - No**
- **Vegetation Diversity – Yes, In some places**

How to increase vegetation diversity

- Thin over dense forest
- Enhance aspen
- Create openings
- Remove conifer encroachment in riparian areas
- Increase patchiness
- Increase age class diversity

Can We Reduce Watershed Sensitivity?

- **Landscape Condition - Maybe**
- **Fire Regime Departure – In some places**
- **Forest Insect & Disease Risk – In some places**

Actions to Reduce Watershed Sensitivity

- Reduce road impacts
- Forest restoration
- Reduce forest density
- Enhance aspen
- Enhance function of riparian areas

Management Strategies

Increasing watershed resilience

One of the most effective strategies to increase watershed resilience is to increase vegetation diversity.

Planning & Preparing for Disturbances

- *Analysis of diversity & climate change vulnerabilities*
- *Prioritize watersheds*
- *Identify potential changes*
- *Plan & Implement pre- and post-disturbance actions*
- *Prepare for expected changes*
- *Revise analysis & planning with new information*

Keep In Mind

Keeping Our Drinking Water Pure

Is The Purpose Of The Watershed Management Plan

Keep It Pure

DON'T POLLUTE THE WATERSHED

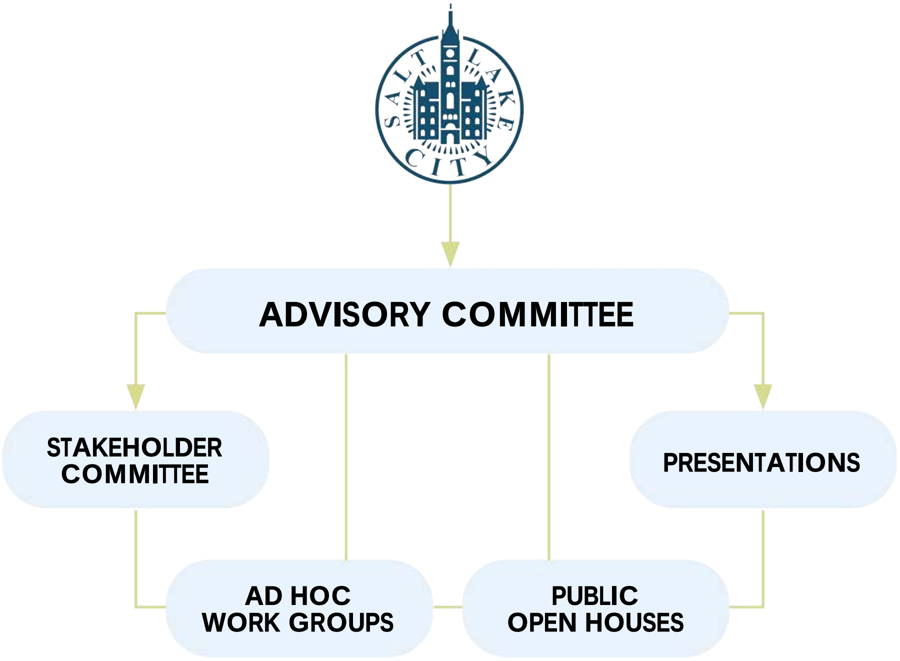
Facilitated Discussion

The Langdon Group

Website

slcwatershedmanagementplan.com

Wrap Up



Advisory Committee Meetings (3 total)

- **Meeting 1 – Process Framework**
  March 14, 3:00 – 4:00 pm

Stakeholder Committee Meetings (8 total)

- **Meeting 1 – Need, Characteristics & Framework**
  March 24, 1:00 – 3:00 pm
- **Meeting 2 – Climate Change**
  April 11, 3:00 – 5:00 pm
- **Meeting 3 – Wildfire**
  April 21, 10:00 – 12:00
- **Meeting 4 – Human Impacts**
  May 6, 10:00 – 12:00
- Meeting 5 – Elements To Be Explored
  TBD
- Meeting 6 – Draft Guidelines/Practices/Tools
  TBD
- Meeting 7 – Draft Plan
  TBD
- Meeting 8 – Updated Draft Plan
  TBD

Public Open Houses (4 total)

- **Meeting 1 – Need, Characteristics, Framework, Areas Of Focus**
  May 25, 5:00 – 7:00 pm

Thank You

Public Utilities

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