Master Planning for a Wildfire in the Watershed

Heather Burns, Consor

Jeff Fuchs, Consor

Ramsey Krieps, City of Bend

Outline



Source: HoriZen Video - Stunning drone flight to Drake Park and beyond

Outline

1. Project Need
2. Wildfire Considerations
3. Pre-Treatment Conceptual Design
4. Key Tenants



SECTION 1

Project Need

Project Need - Recent Fires

- July 24th 2024: 15 fires
- 2020-2025: 5M-6M acres burned



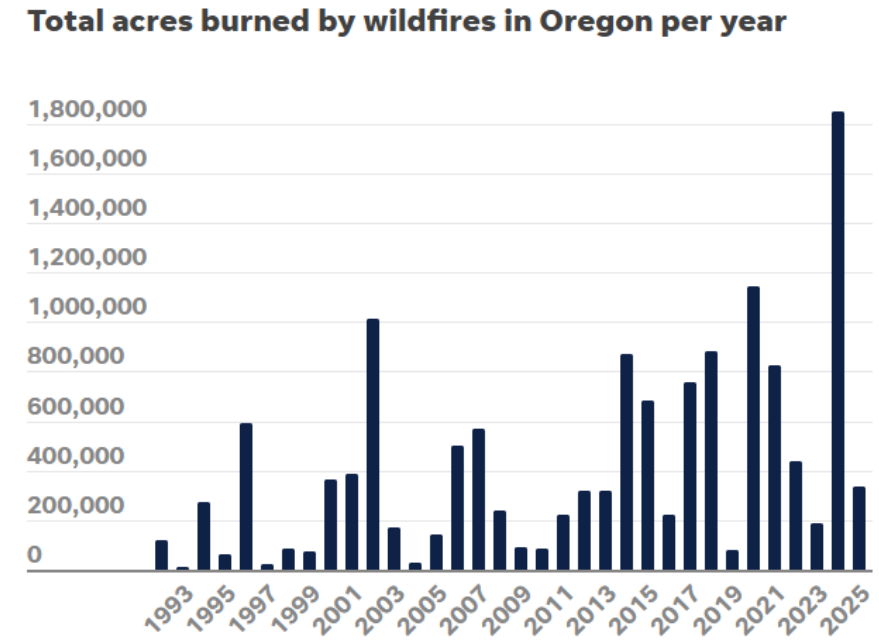
Oregon Legislature approves $218 million in additional wildfire funding in emergency session

The state spent more than $350 million responding to more than 2,000 wildfires in 2024, far exceeding projected costs and leaving some contractors unpaid

BY: **ALEX BAUMHARDT AND JULIA SHUMWAY** - DECEMBER 12, 2024 5:46 PM

Source: KOIN, July 2024, Record fire season costs Central Oregon businesses

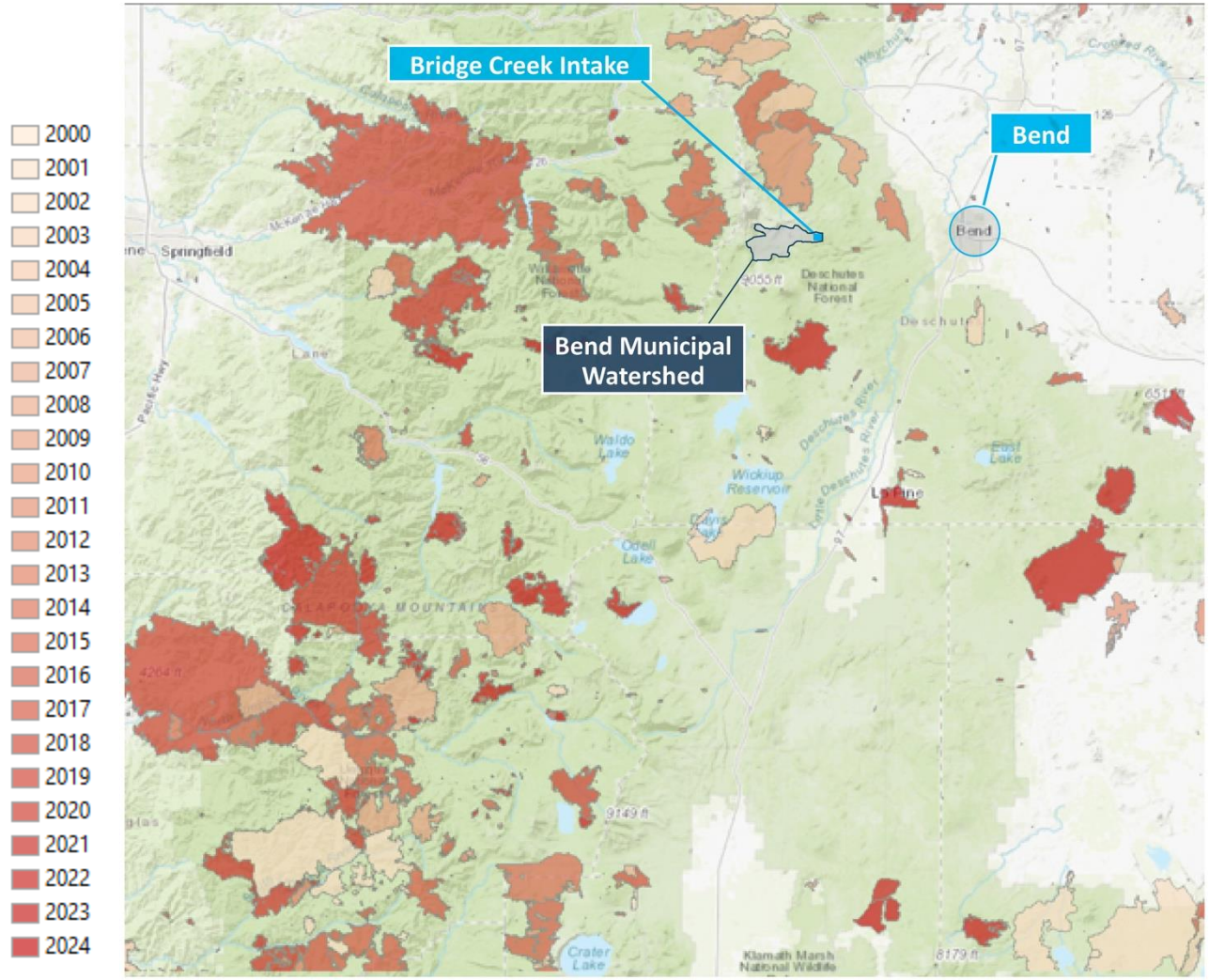
Project Need – Recent Fires



*2024 numbers through Aug 5. Majority of acres burned in grassland
2002: **Biscuit fire** - 500,000 acres in southwest Oregon,
2012: **Holloway, Long Draw, Miller Homestead fires** - 964,051 acres in SE Oregon
2020: **Labor Day Fires** - almost 1 million acres burned around Sept. 7-8 in W. Oregon
2021: **Bootleg Fire** - 413,762 acres near Klamath Falls

Source: Forest Service Research Data Archive, National Wildfire Coordinating Group

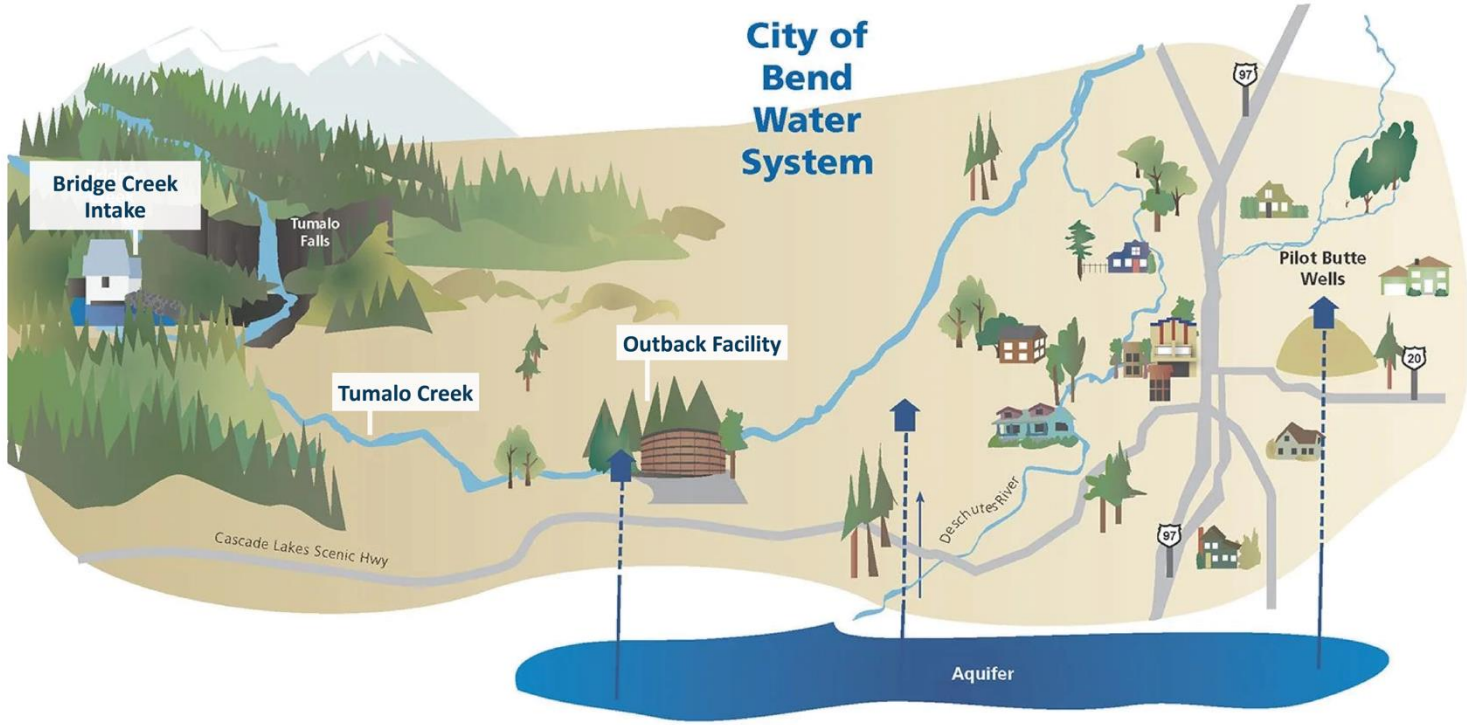
Source: Statesman Journal, July 2024: Oregon wildfires: 17 large fires bring evacuations statewide



Data Source: Oregon State University; Oregon Fire Perimeter History (2000-2024) | Oregon Explorer

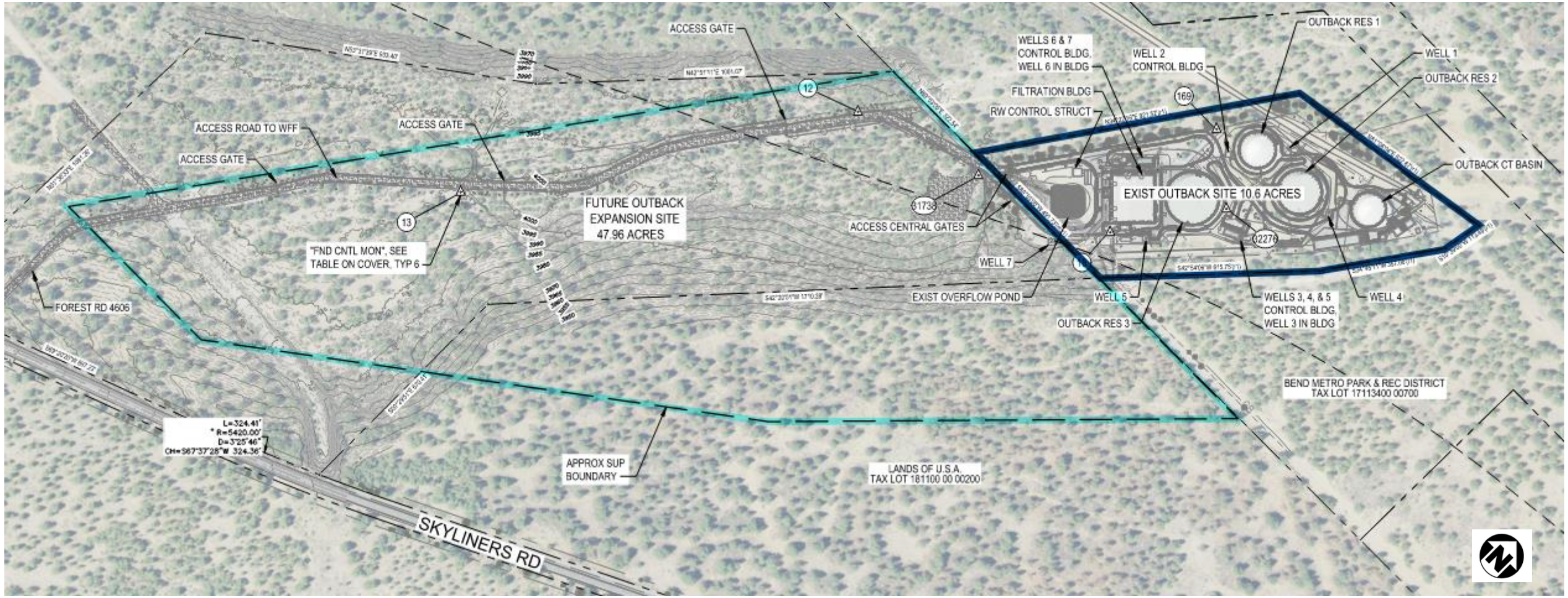
Project Need – Surface Water Supply

- Bend Watershed: Bridge Creek Intake
- 10 miles of 30” diameter pipe - drops 1000’
- Energy is dissipated with Sleeve valves at Outback



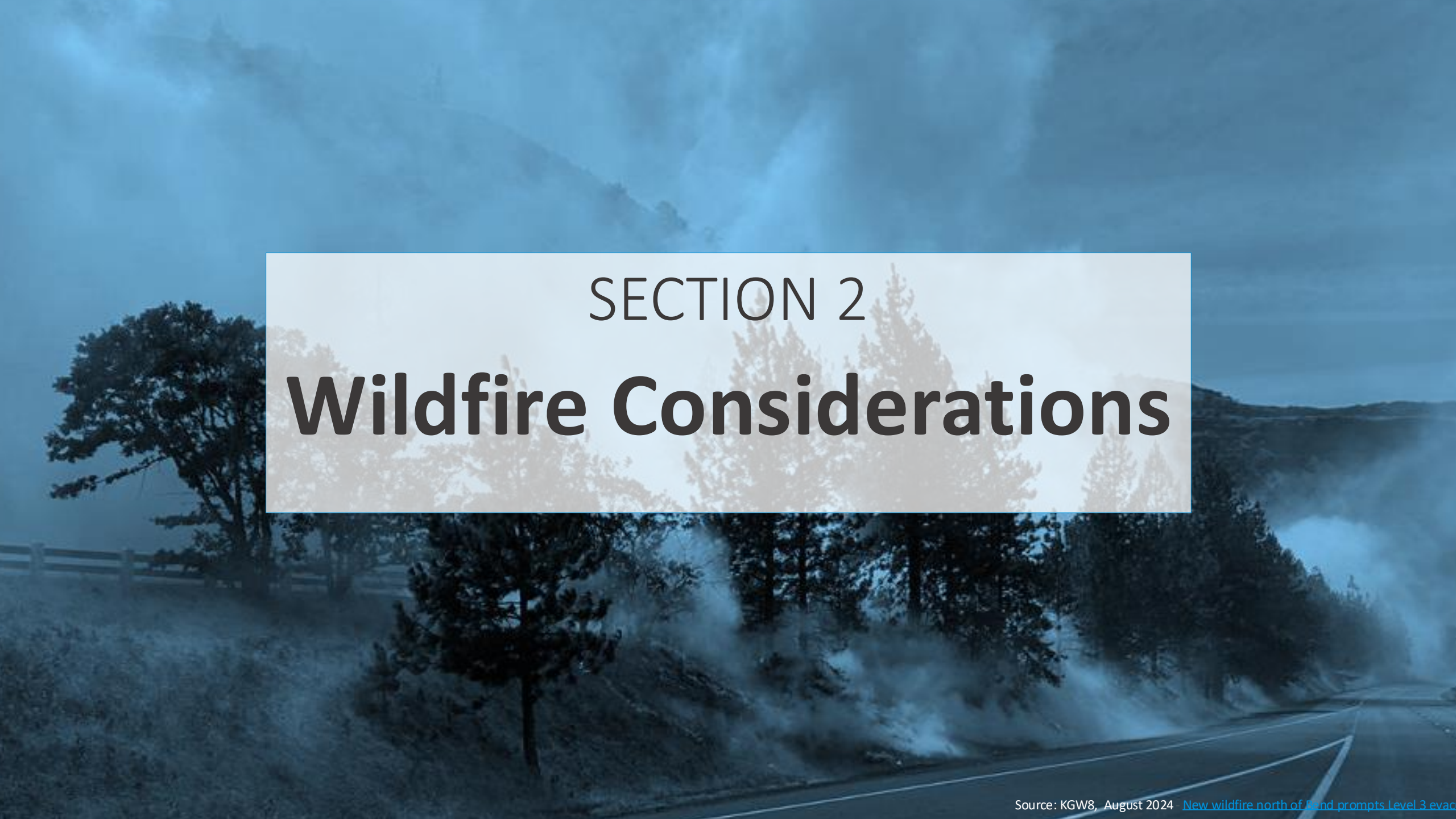
Source: Christine Rains Graphic Design, City of Bend Water System Illustrative Map

Project Need – Site Expansion



SECTION 2

Wildfire Considerations

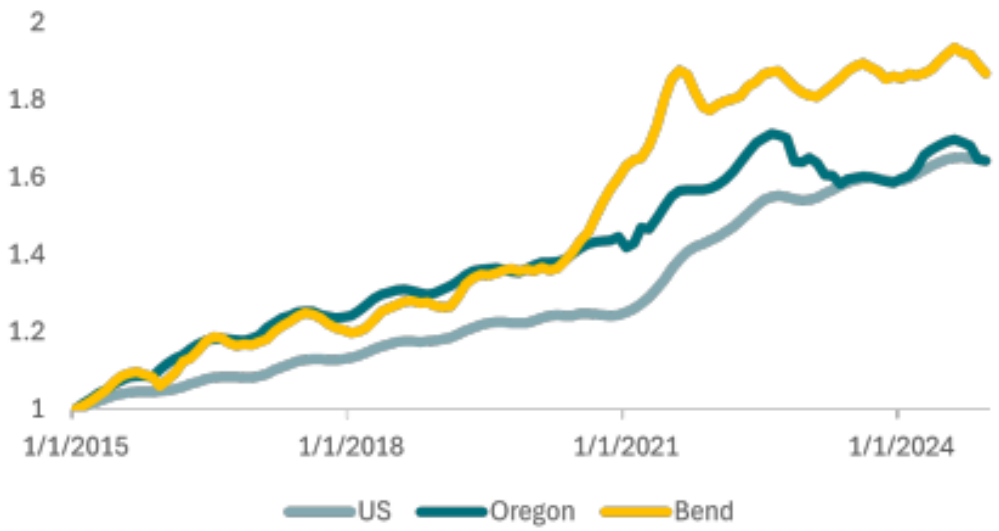


Source: KGW8, August 2024 New wildfire north of Bend prompts Level 3 evac

Wildfire Considerations - Goals

- Goal: Improve WFF resiliency during & after a wildfire
- What does resiliency mean to Bend?
  - Reliable plant operation
    - Select pre-treatment methodology
    - Hydropower
  - US Forest Service dip ponds
  - Overnight staffing space
  - & more

Figure 20. Rent Growth Index



Source: City of Bend State Housing Report, 2025

Wildfire Considerations – Water Quality

- Similar Projects & Studies
  - Typical WQ after Fires
    - Turbidity, color, suspended solids, dissolved organics, algal blooms (T&O)
  - Quantifying these?
    - **Highly dependent on watershed features**
      - Geology, vegetation, hydraulic connectivity
    - **Highly dependent on fire features**
      - Duration, temperature, size
- Flexible pre-treatment

Brookings, OR
No effects
- Leverich, Prugue (2019)

Increased Turb +70 NTU
- Chen, Chang (2025)

Increased DOC 15+ years
Alum doses 65+ mg/L
- Hohner, Rhoades, Wilkerson, et al (2019)

Increase fines
30-70 mg/L TSS max
- Clark, Murphy, Skalak, et al (2024)

Increased TSS for 3 years
- Ryan, Shobe, Rathburn, Dixon (2024)

Wildfire Considerations – Water Quality

- How do we justifiably quantify an unknown event?
  - Examine a range of reasonably assumed criteria

Assumed Conditions

Scenario	NTU	DOCr (mg/L)	PACL Dose (mg/L)	PAC Dose (mg/L)
Wildfire	50	15	20	20
	150	20	45	25
	250	25	55	30
	350	35	60	35
	500	40	65	40

Studies, other projects, plant data

Wildfire Considerations – Typical Use

Figure 4 | Post-storm Raw Water Turbidity



Source: Consor, September 2021, Outback Siting Study

- Emergency planning with improvements for “typical” ops
- Seasonal runoff concerns

Assumed Conditions

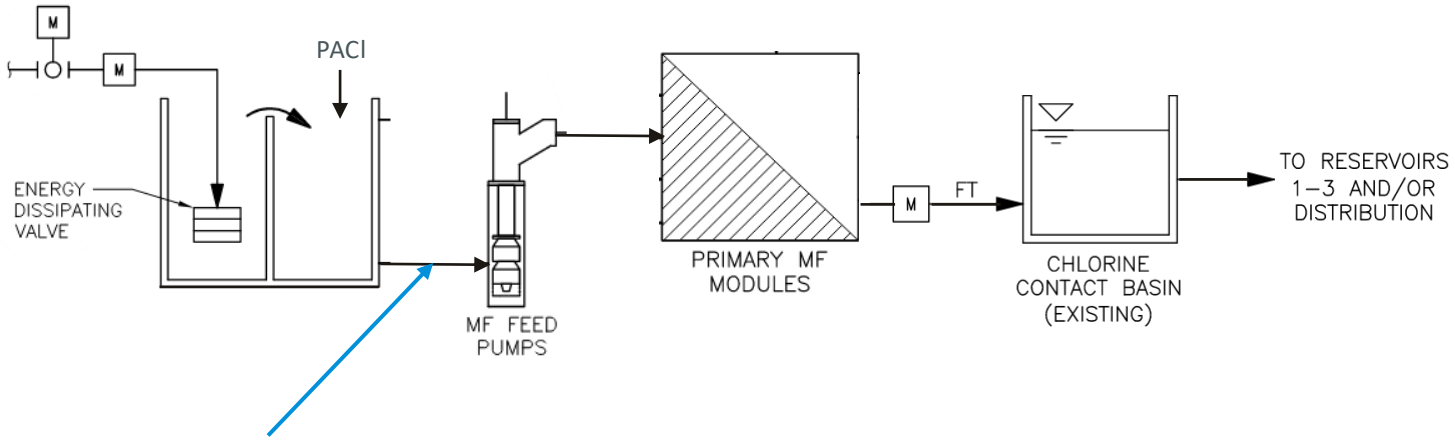
Scenario	NTU	DOCr (mg/L)	PACL Dose (mg/L)	PAC Dose (mg/L)
Typical	.04	.78	.8	0
Rain on Snow	10	5	10	10
Wildfire	50	15	20	20
	150	20	45	25
	250	25	55	30
	350	35	60	35
	500	40	65	40



SECTION 3

Pre-Treatment Conceptual Design

Pre-Treatment Conceptual Design



FUTURE:

- SELECTED PRE-TREATMENT



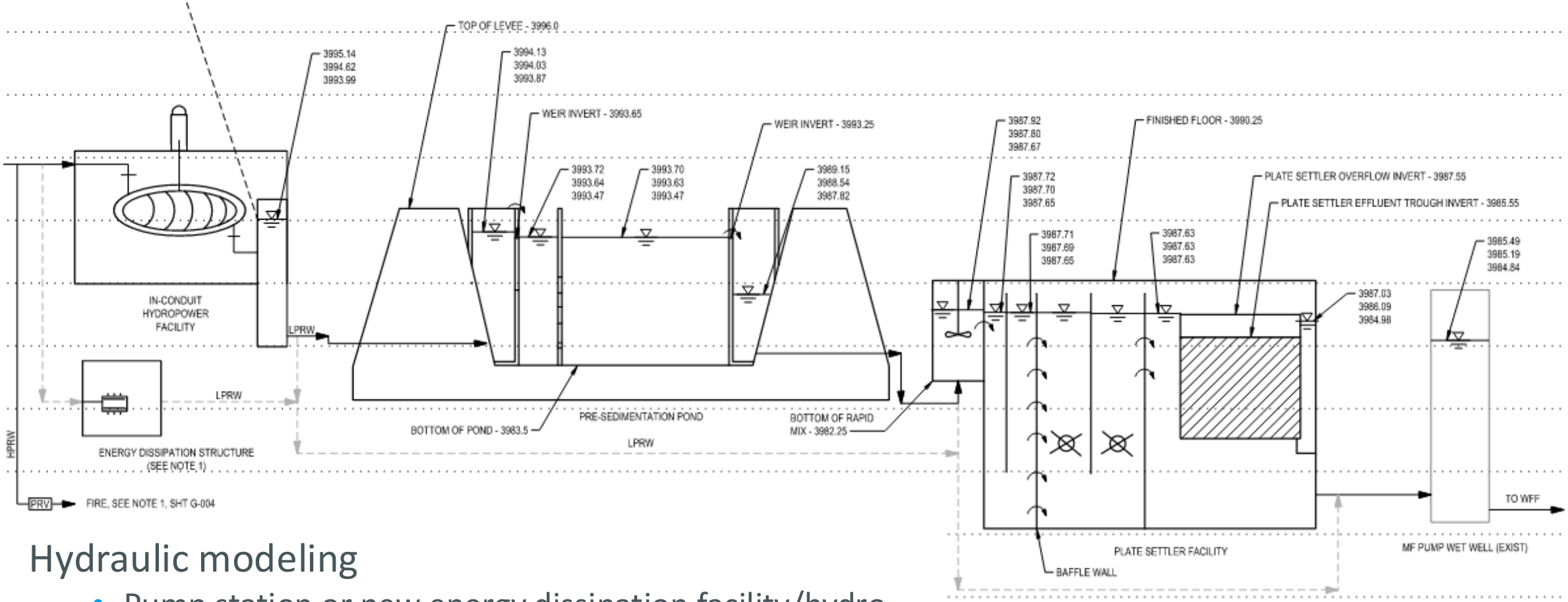
Pre-Treatment Conceptual Design

- 2021 Siting Study
  - Selection of pre-treatment methods
  - Selection criteria
- Pre-Sedimentation + Plate Settlers



Criteria	Weighting Factor
Capital Costs	3
Life Cycle Costs	3
Redundancy/Resiliency	3
TOC Removal Efficiency	3
Turbidity Removal Efficiency	3
Color Removal Efficiency	3
T&O Removal Efficiency	2
DBP Reduction	2
Future Regulatory Compliance	3
Flow Attenuation	2
Complexity of Operations	3
Power Use	3
Process Footprint	1
Proprietary parts/spare parts	3
Ease of Implementation	2
Hydropower Compatibility	3
Total Weighted Scores:	

Pre-Treatment Conceptual Design



Hydraulic modeling

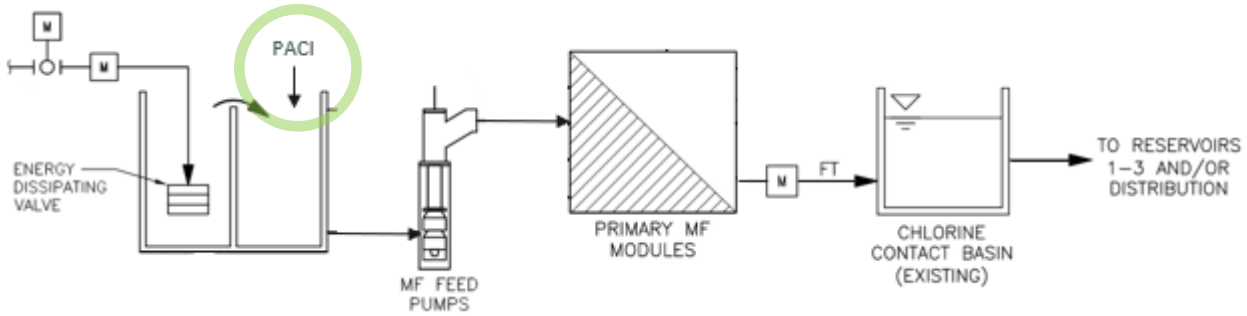
- Pump station or new energy dissipation facility/hydro

Source: Consor, September 2021, Outback Siting Study

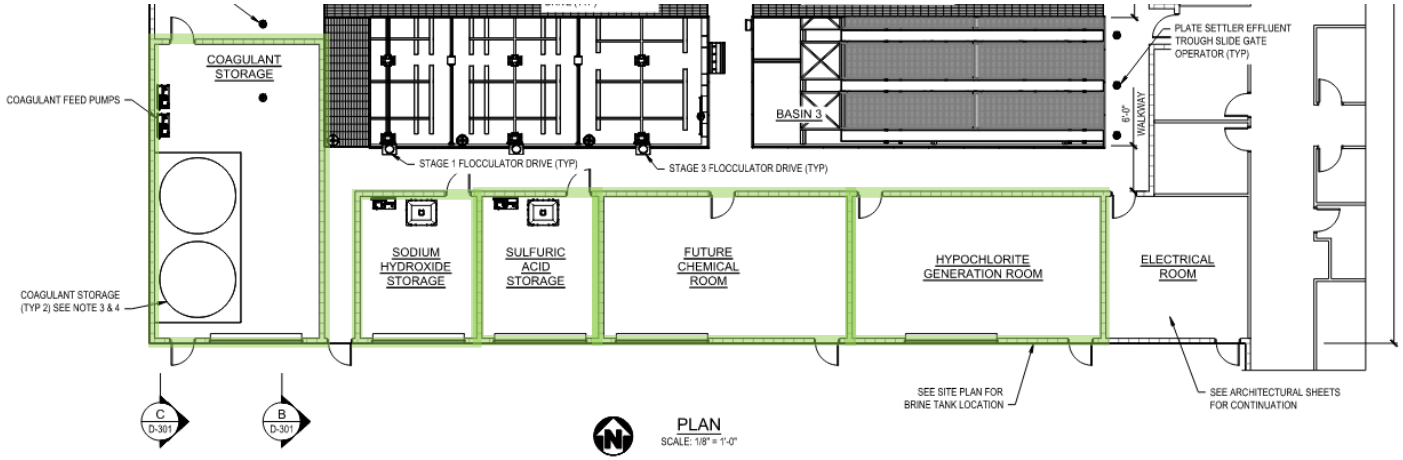
Pre-Treatment Conceptual Design

Chemicals

- Relocated coagulant injection point
- Future chemicals
  - Coagulant (PACl)
  - Oxidant (rain-on-snow)
  - Powdered Activated Carbon
  - Onsite generation
- Footprints for storage, delivery
- Operator comfort level



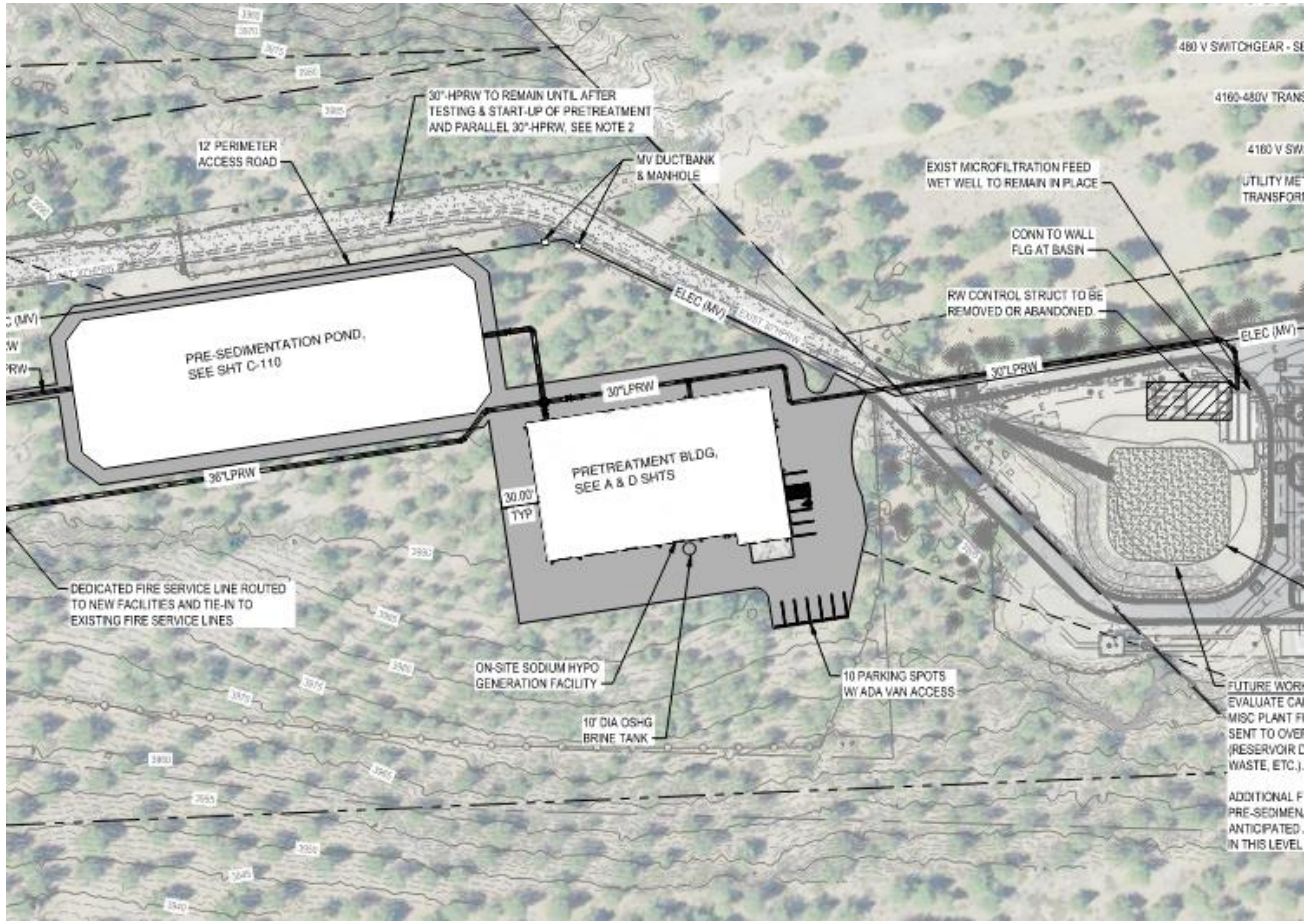
Date	Color	Iron	PH	TDS	TOC	TSS	Turbidity
03/12/25	5	0.017	7.37	50.0	0.78	2.50	0.32
03/27/25	10	0.095	7.09	42.0	0.77	3.76	1.40



Pre-Treatment Conceptual Design

Pre-30% Design

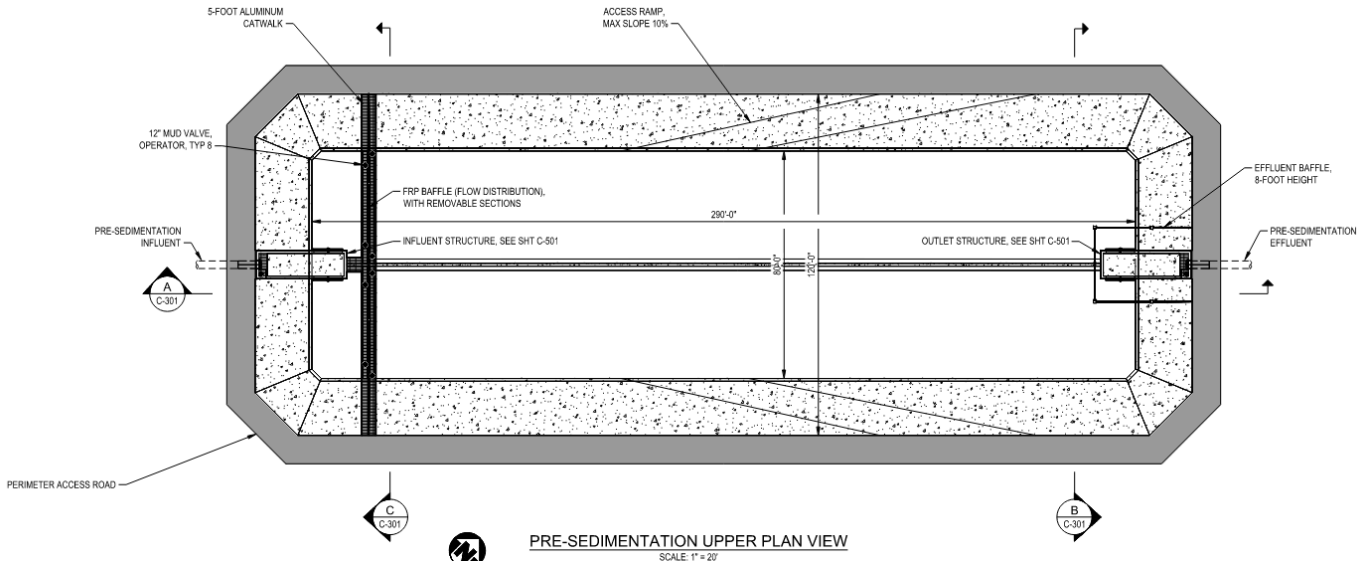
- Define the footprint
- Planning-level



Pre-Treatment Conceptual Design

Pre-Sedimentation Pond

- Settling dominated by:
  - Water Temperature
  - Particle Size
- 3-hour detention time @ 11.8 mgd
- Dual basins
- 6’ or 10’ water depth



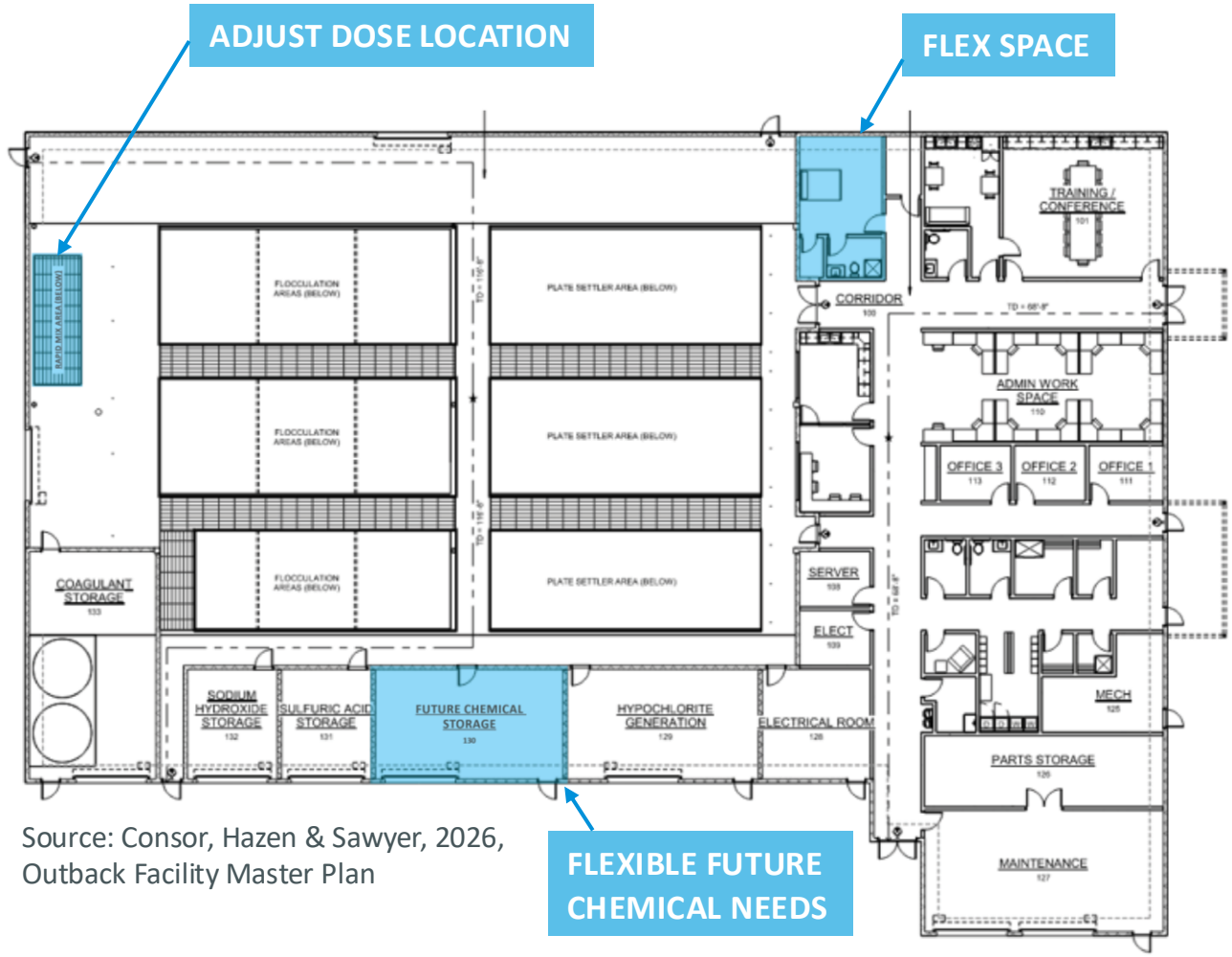
Rate of settling in pure, still water (temp=10°C, sp. gravity of particles=2.65, shape of particles=spherical) (Welch, 1935)

Material	Diameter (mm)	Hydraulic subsiding value (mm/sec)	Time required to settle 1 ft.
Gravel	10.0	1000.0	0.3 sec
Coarse sand	1.0	100.0	3.0 sec
Fine sand	0.1	8.0	38.0 sec
Silt	0.01	0.154	33.0 min
Bacteria	0.001	0.00154	55.0 hr
Clay	0.0001	0.0000154	230.0 days
colloidal particles	0.00001	0.000000154	63 years

Pre-Treatment Conceptual Design

Pre-30% Design

- Improve location of PACl dose
- Plans for current and future chemical use
- Overnight space
- Flexibility

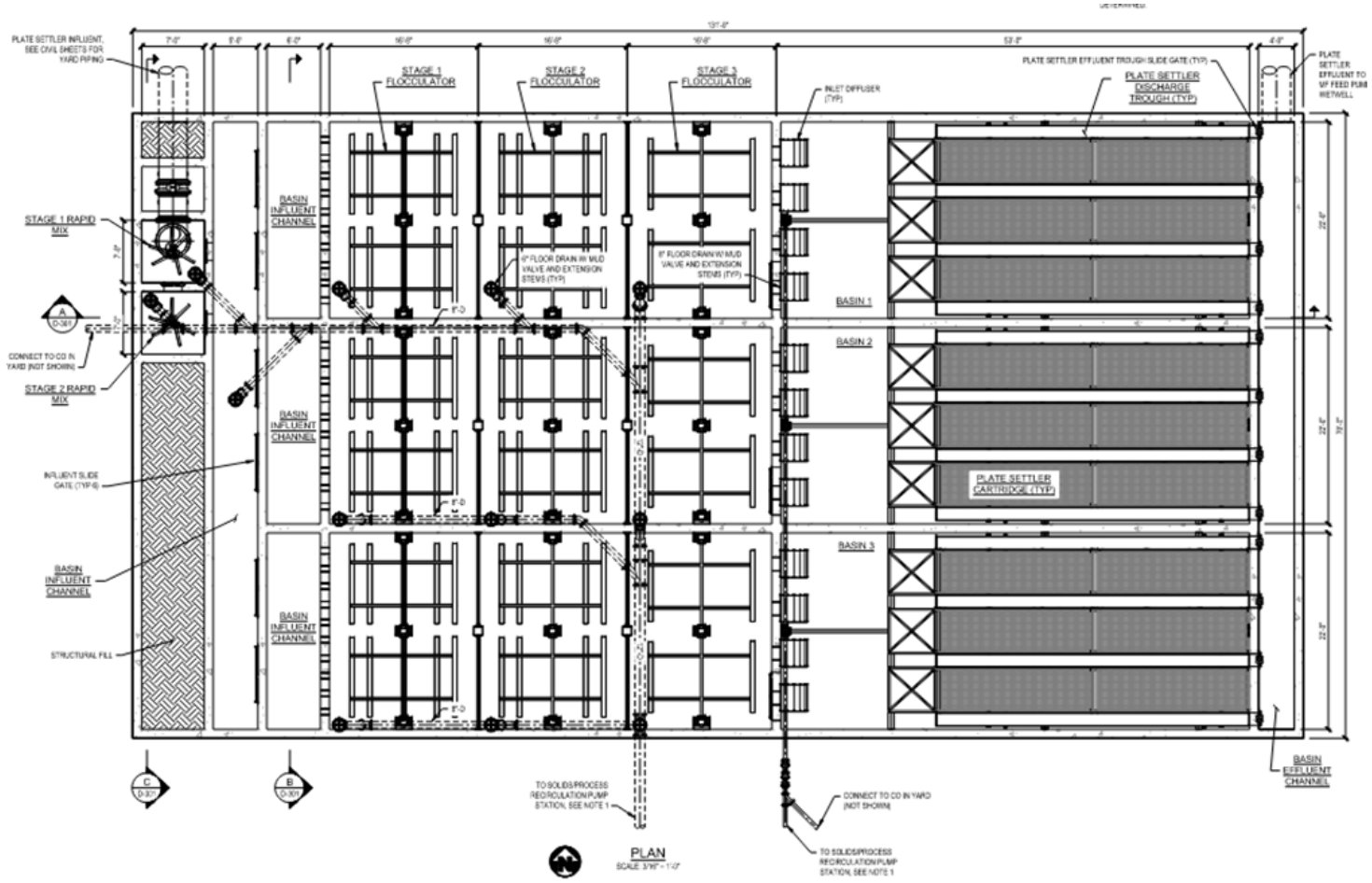


Source: Consor, Hazen & Sawyer, 2026, Outback Facility Master Plan

Pre-Treatment Conceptual Design

Pre-30% Design

- Rapid mix
- 2+1 basin configuration
- 3 stage floc, plate settlers



Pre-Treatment Conceptual Design

- Solids handling: drying beds or sewer

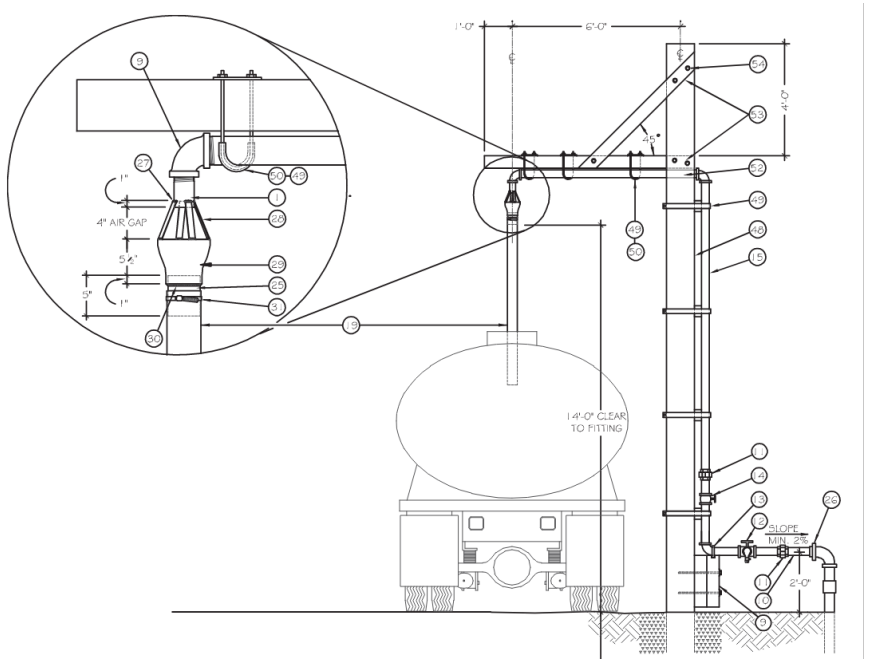
Assumed Conditions

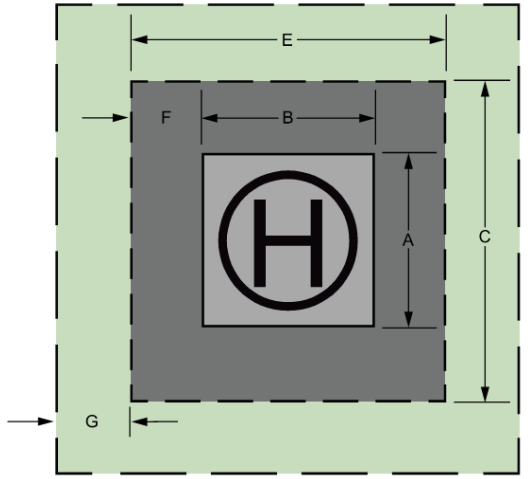
Estimated Flow to Sewer

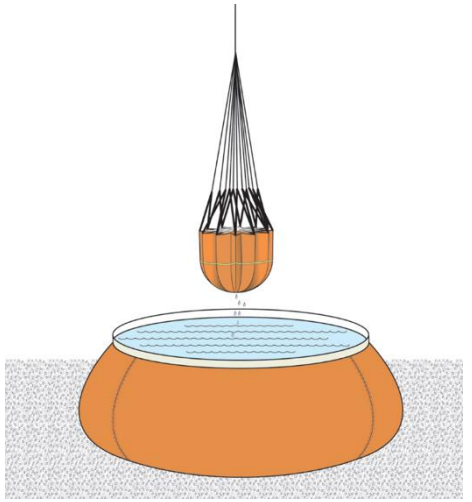
Scenario	NTU	DOCr (mg/L)	PACL Dose (mg/L)	PAC Dose (mg/L)	Plant Flow (mgd)	Dry Solids/Day (lbs)	Sludge Production (gpm)	Spent Filter Backwash (gpd)	Total Flow to Sewer (gpd)
Typical	.04	.78	.8	0	11.8	164	3	45,000	34
Rain on Snow	10	5	10	10	11.8	3,299	54	45,000	85
Wildfire	50	15	20	20	11.8	11,519	187	45,000	218
	150	20	45	25	11.8	28,133	457	45,000	488
	250	25	55	30	11.8	44,226	718	45,000	750
	350	35	60	35	11.8	60,637	985	45,000	1,016
	500	40	65	40	11.8	83,937	1,363	45,000	1,395

Provisions for USFS

- Water fill station
- Helicopter dip tank
  - 16' dia. X 10 deep
  - 110-ft dia. clear area
- Helipad
  - 182-ft x 400-ft clear area









SECTION 4

Key Tenants

Key Tenants

- **Challenge:** Define reasonable criteria for an event that has yet to happen
- “You won’t know until you know”
- “We don’t want to build another pump station”





Thank You

Hazen & Sawyer
Jacobs
City of Bend