Committee Background and History

City Council Resolution 2900, superseding Resolution 2867, adopted by roll call vote on February 20, 2013, states the following:

- Section 6. As part of its commitment to being responsive to community questions about the project, the City Council is willing to take an additional third party, independent look at the treatment methods, timing and hydro aspects of the project, with a neutral and knowledgeable third party facilitating the discussion. The City Council does not intend to review the underlying values and assumptions for the Council decisions to retain the dual source and to replace the transmission line.

Formation of the Water Treatment Advisory Committee

Applications for the committee were received until May 17, 2013. Interviews of the applicants were conducted on May 28, 2013 by Mayor Jim Clinton and Councilors Sally Russell and Victor Chudowsky. The committee members were appointed by City Council on June 5, 2013. The committee roster is as follows:

- Ray Auerbach, Retired District Manager, Paradise Irrigation District
- Eric Bercot, Head of Chemical Development, Suterra, LLC
- Mark Buckley, Senior Economist, ECONorthwest
- Tim Casey, President and CEO, Bend Chamber of Commerce
- Reagan Desmond, Attorney, Clyde Snow
- Roger Dressler, Principal, RWD Consulting, LLC
- Robert Eimstad, P.E., Senior Vice President, Carollo Engineers
- Craig Horrell, Utilities Manager, Deschutes Brewery
- Casey Roats, Vice President, Roats Water System
- Cindy Tisher, Paralegal, Dwyer Williams Potter
- Kevin Larkin, ex-officio member, District Ranger, US Forest Service

Purpose of the Water Treatment Advisory Committee

An eleven-member citizen committee, the Water Treatment Advisory Committee (WTAC), has been appointed by Bend City Council to generate information on additional treatment options to comply with the Long Term 2 Enhanced Surface Water Treatment Rule (LT2) for Council review and assessment.

The committee's efforts emphasize value-based decision making; evaluating the issue as a community investment that weighs risks and costs associated with treatment options, supported by sound, independent technical information.

Water Treatment Advisory Committee Paraphrased Charge

- To evaluate and select (possibly rate) treatment options of the surface water, considering LT2 and other water quality aspects, and also to balance the cost with benefit and risk
- Advise the City Council
- Choose a treatment option that treats (regulatory requirements) the full water rights for the long term

- Strive for consensus (able to support the decision outside of the committee)
- If consensus is not reached, will allow for a minority report
- Provide information to the public
- Will not consider hydro

Activities to Date

- 5/28 – Interviews of committee members
- 7/15 through 7/25 facilitator interviews with committee members to establish topics for future meetings and focus of the committee
- 7/26 – Hike, Orientation and Overview of treatment system options and financial considerations
- 8/14 - Detail of Treatment system options and financial considerations
- 8/27 – Wildfire Risk & Water Quality
- 9/10 - Treatment System Options Cost Comparison and draft recommendations document
- 10/1 – Finalize recommendation document.

Information Available at the Water Treatment Advisory Committee Web Page

- Committee Information
- Project Information & Resolutions
- Additional Information
    - Water Quality
    - Wildfire
- Meeting Information

Shared Facts, Assumptions and Opinions

Through the committee members' personal research, informational meetings, phone calls with experts and deliberation with other committee members, a large amount of information was gathered. While the committee members did not agree about everything, there were a number of foundational facts, assumptions and opinions that are widely shared by the committee members. Below is a list of statements that are widely shared by the committee:

Statement	Level of Support
We value the dual source of surface and ground water	10 of 10
We must treat surface water to meet LT2 requirements	10 of 10
Membrane Filtration can handle more variability in source water quality than can UV treatment.	10 of 10
Capital and O&M costs for UV treatment are less than Membrane Filtration	10 of 10
If the risk of fire was zero, I would choose UV	10 of 10

Membrane Filtration will allow SW to be used with high turbidity (historically the surface water has been turned off an average 54 days per year - 2008 to 2012 - due to turbidity above 1.49 NTU).	10 of 10
Membrane Filtration does not require a filter waiver for LT1 like UV does. (eliminates the risk of losing the waiver)	10 of 10
In the event of a fire, Membrane Filtration will probably be operational sooner than UV treatment.	10 of 10
UV treatment will be suspended after a major fire until source water quality improves.	10 of 10
Membrane Filtration could be suspended after a major fire	10 of 10
The extent of potential wildfire impacts to the watershed and water source is uncertain.	10 of 10

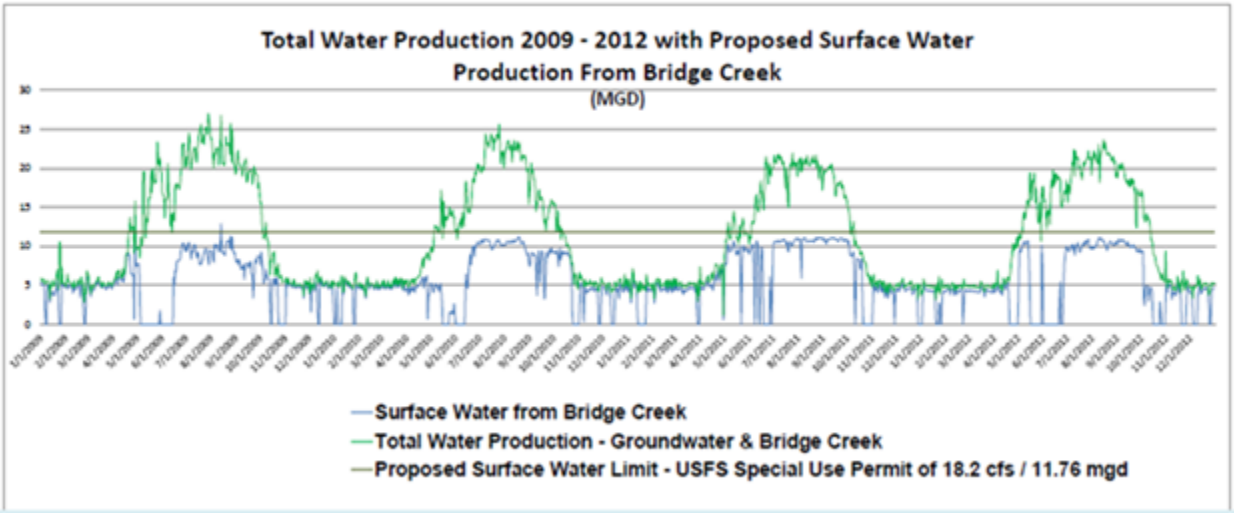
Water Demand and Source

Surface water meets non-irrigation water demand throughout the year. During irrigation season, water demand increases and both groundwater and surface water are required to meet daily demand.

The current treatment of the surface water includes only screening and chlorine disinfection. For operational reasons, the City opts to not use surface water as a supply source when source water turbidities reach 1.49 Nepholometric Turbidity Units (NTU). At those times, the City relies solely on groundwater to meet demand. There have been an average of 54 days (15% of the time) when source water turbidity was at or above 1.49 NTU and surface water was not used (2008 to 2012). Over that time period no turbidity events of consequence have occurred in July, August or September, those periods of peak water demand. The following table shows turbidity events of about a day duration from 2008 through 2012.

	Month											
Year	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
2008	4				17	9					10	14
2009	5	3			26	14				11	1	3
2010	10				7	12				8	3	4
2011	12		2		1	11				2	1	4
2012	7	1		11	16	24					7	11

The chart below depicts water usage and the source of water over the last three years.



Costs

For a large number of the committee members, the cost of the solutions was a major reason for selecting an option. All solution costs will be covered by existing and future reserve funds as well as rate increases when the reserves are depleted.

Capital Costs

Current reserve funds are approximately $14 M.
Each $7 M of additional capital expense will require a 5% increase in the current rates.
The average annual residential water bill is $430 in 2012
One industry estimate suggests a per barrel of beer cost increase of $.065 per 5% increase in rates

Present Worth

The industry standard 20 year net present worth cost was calculated for each of the options described below.

Sunk Costs

$5 million have already been spent on design of the Membrane Filtration treatment facility. The City estimates that approximately $0.5 million in design costs was for project elements that are shared between the two treatment options and approximately $4.5 million has been spent on the Membrane Filtration facility alone.

Wildfire

One reason to choose MF over UV is that MF can operate during normal turbidity events effectively adding up to 11.7 MGD to the water supply. A second and more important reason for some is maintaining surface water as a supply source after a fire in the watershed. Numerous data sources and local expert opinion suggest a wildfire in the watershed has a non-trivial probability of occurrence in the next few decades. Committee members differ in their estimation of the impact of a wildfire to surface water quality, and the subsequent impact to each SWT options' infrastructure/performance.

Options

The committee defined the following options:

1. Membrane Filtration
2. UV Treatment

2a. UV Treatment Plus Additional Wells to Mitigate Watershed Fire Risk

Option 1 - Membrane Filtration

Description: Install Membrane Filtration and include in the design a way to add pretreatment options that will improve post-fire finished water quality. See schematic below.

Option 1A – Membrane Filtration with no provision for pre-filtration and post-filtration treatment to mitigate catastrophic fire impacts on source water quality.

Option 1A Costs	
Capital Investment:	$30.5 M
20 Year Present Worth	$38 M

Benefits

1. Meets LT2 requirements
2. Faster compliance to LT2 deadline
3. No amendment to City planning documents
4. Eliminates need for filtration waiver.
5. Surface water could be used during high turbidity events that currently limit the use of the surface water as a supply source. The manufacturer guarantees performance for influent turbidities up to 3,500 NTU. For operational reasons, the City currently opts not to take surface water when turbidities exceed 1.49 NTU.

Risks/Unknowns:

1. It is uncertain whether Membrane Filtration will produce high quality finished water when the source water is degraded by widespread catastrophic fire in the watershed. Increased concentrations of dissolved organic carbon, nitrites, nitrates, and metals after catastrophic fire may make continued use of surface water problematic.

Option 1B – Membrane Filtration with sedimentation basins and equipment to provide pre-filtration treatment. This pre-filtration treatment would likely be required to help mitigate catastrophic fire impacts on source water quality. Additional treatment costs to address potential post-fire taste and odor issues were not included.

Option 1B Costs	
Capital Investment	$35.6
20-Year Present Worth*	$43.2M

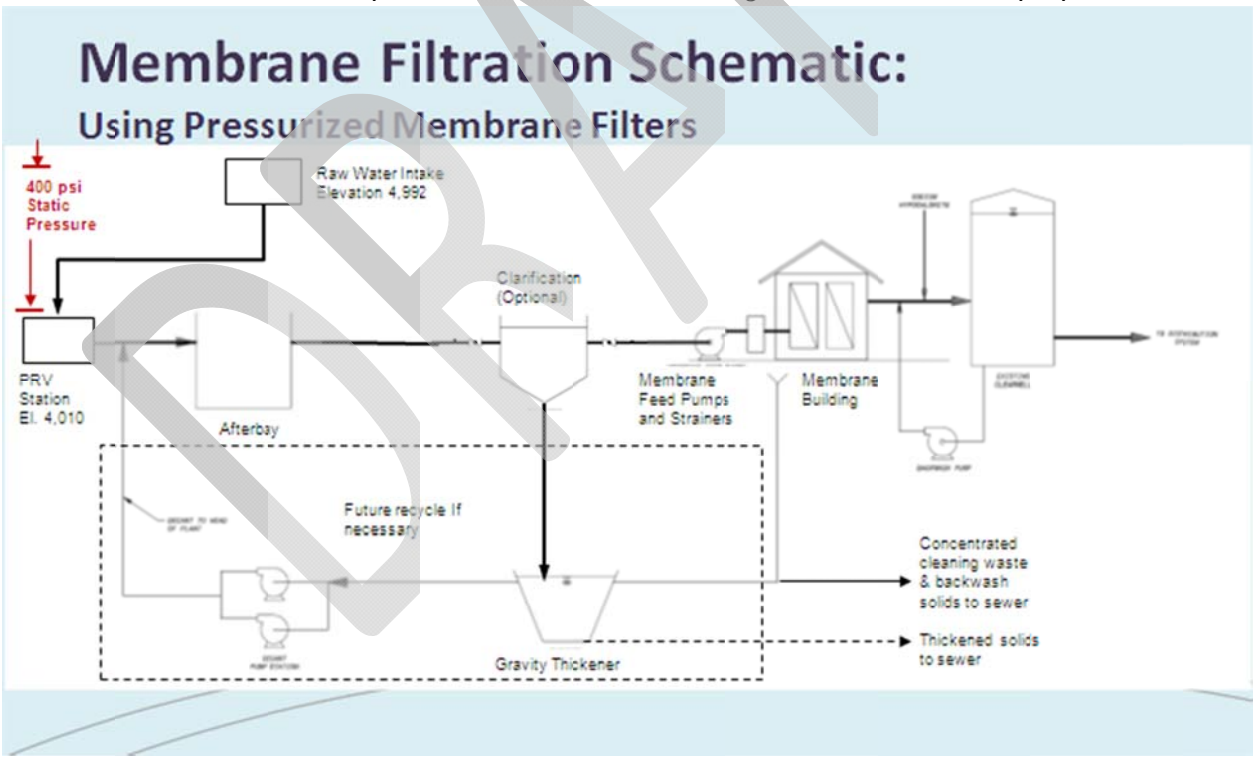
* Present worth costs do not include the O&M costs of operating and pre-filtration or post-filtration treatment facilities. These post-fire operating costs were not provided to the committee.

Benefits:

1. Meets LT2 requirements
2. Faster compliance with LT2 deadline
3. No amendment to City planning documents
4. Eliminates need for filtration waiver.
5. Surface water could be used during high turbidity events that currently limit the use of the surface water as a supply source. The manufacturer guarantees performance for influent turbidities up to 3,500 NTU. For operational reasons, the City currently opts not to take surface water when turbidities exceed 1.49 NTU
6. In the event of a fire, additional pre-filtration and post-filtration processes could be installed to improve water quality and filtration performance on the degraded source water.

Risks/Unknowns:

1. It is uncertain whether Membrane Filtration, along with pre-filtration and post-filtration treatment, will provide high quality finished water when the source water is degraded by widespread catastrophic fire in the watershed. Increased concentrations of dissolved organic carbon, nitrites, nitrates, and metals after catastrophic fire may make continued use of surface water problematic, even with the high level of treatment proposed.



Option 2 – UV Treatment
Description: Install Ultraviolet treatment. See schematic below.

Option 2A – Install UV Treatment

Option 2A Costs

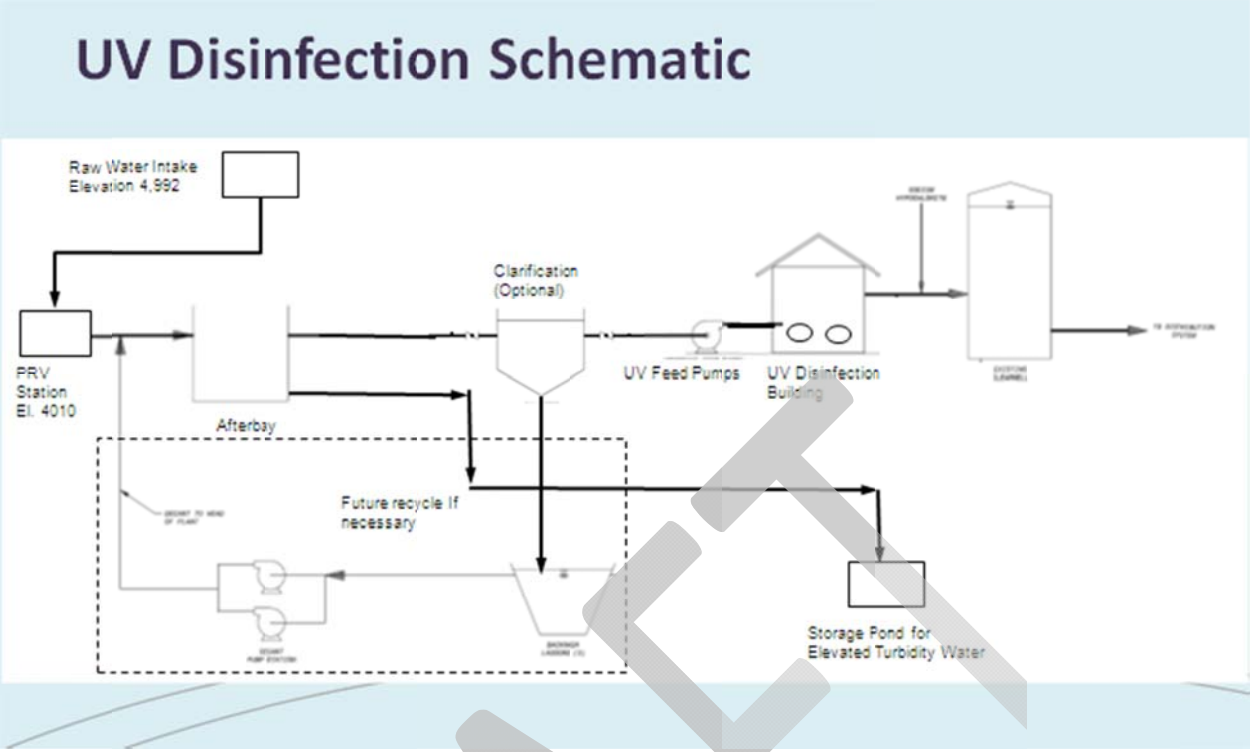
Capital Investment:	$12M
20-Year Present Worth	$14M (verify this)

Benefits:

1. Meets LT2 requirements
2. Lower Cost

Risks / Unknowns:

1. Risk - Requires a filtration waiver
2. The UV treatment could not be operated when turbidities are higher than 5 NTU. Source water turbidities exceeding 5 NTU have occurred 4 days during the 2008-2013 sampling period (less than 1% of time). The City currently opts not to take surface water when turbidities exceed 1.49 NTU. It is uncertain if UV could be used with turbidity levels between 1.49 and 5 NTU.
3. In the event of a fire or other future watershed disturbances that cause source water turbidities above 5 NTU, the City would have to discontinue use of the surface water source until the watershed "heals" and source water quality is restored to pre-fire conditions.
4. Loss of surface water after a catastrophic fire would require greater dependency upon groundwater. Although the City currently relies solely on groundwater for an average of 54 days per year (2008-2012 average), City staff has indicated that improvements would have to be made to the groundwater supply to reliably distribute water throughout the City.
5. Some irrigation curtailment could be required until the watershed recovers or until additional groundwater supplies are constructed.
6. More shutdowns of SW due to seasonal turbidity than MF. (Hence higher GW pumping costs.)
7. Due to redesign, plant would not be functional until well past 2014 LT2 compliance deadline (2 years), potentially exposing City to economic/social (health) risks from having a non-compliant system.
8. The filter waiver for LT1 may be lost due to water quality issues.
9. Operational breakdowns for groundwater would be more problematic when surface water is unavailable.



Option 2A – Install UV Treatment and Additional Ground Water Capacity

Description: Install UV Treatment and invest in up to 12.5 Million Gallons per Day MGD in wells to provide redundant and reliable water supply in the case of catastrophic watershed fire and subsequent inability to utilize the UV Treatment.

Costs

Capital Investment (UV)	$12M
Capital Investment (Additional Wells)	$16.3M Well development would be staged
20-Year Present Worth	$33.8M

Notes:

1. Capital Investment in wells assumes all well capacity is developed immediately. It is more likely that well capacity would be added over time.
2. 20-year Present Worth conservatively assumes that wells are operated 25% of the time when turbidity events prevent usage of the UV treatment system. Historical turbidity data indicates that turbidity events that would preclude UV Treatment occur less than 2% of the time.
3. Worst case scenario is that there is a catastrophic watershed fire in the first day of UV operation and the fire causes permanent abandonment of the UV facility. In that case, the City would be entirely reliant on groundwater and the 20-Year NPW Cost for this alternative, due to increased pumping costs, would increase to $42.5 million. This compares to M $43 million NPW Cost for Membrane Filtration.
4. The city will require development of more groundwater resources eventually even with secure surface water as demand increases, but not for decades.

Benefits:

1. Meets LT2 requirements
2. Spend less money now and invest in more water supply as needed.
3. Eliminates risk of watershed fire impacting supply. Maintaining sufficient redundancy of drinking water infrastructure and sources affords the City with the best protection against the detrimental effects of wildfires.
4. Provides sufficient capacity during turbidity to meet city needs.
5. Would provide sufficient capacity even if UV Treatment and the surface water source is abandoned after a catastrophic watershed fire.

Risk/ Unknowns:

1. Capital costs for wells are based on City planning costs previously published. The aquifer capacity and groundwater depth in different locations has not been studied by the City. The capital cost estimate for the wells in this alternative presumes that new wells can be located at or near the Outback site where 6 future wells are planned. If wells are located in different locations, additional water distribution improvements will likely be required which could increase post-fire supply costs.
2. The City has expressed concerns about constructing wells that are not used or are used infrequently.
3. Abandonment of UV system following a fire would result in abandonment of approximately $2.5 – 3 million of investment in UV facilities.
4. While there are wells planned for the outback facility there may not be the capacity to meet the demand of additional wells, so wells would have to be located elsewhere as described in the current plan (Table E-3, Optimatics).
5. In order to expand groundwater capacity/reliability for any wells not built at the outback capital and operating expense will be required to re-configure conveyance connectivity (Table E-3, Optimatics).

Other Expressed Thoughts and Concerns

- The committee also agrees that five meetings is not enough to fully understand the facts and variables relevant to this decision. Based upon the conversations and materials presented we offer our opinions such as they are.
- The City should invest in additional infrastructure and or wells to ensure that in the event surface water is unusable (no matter the treatment) there is enough water to meet demand.

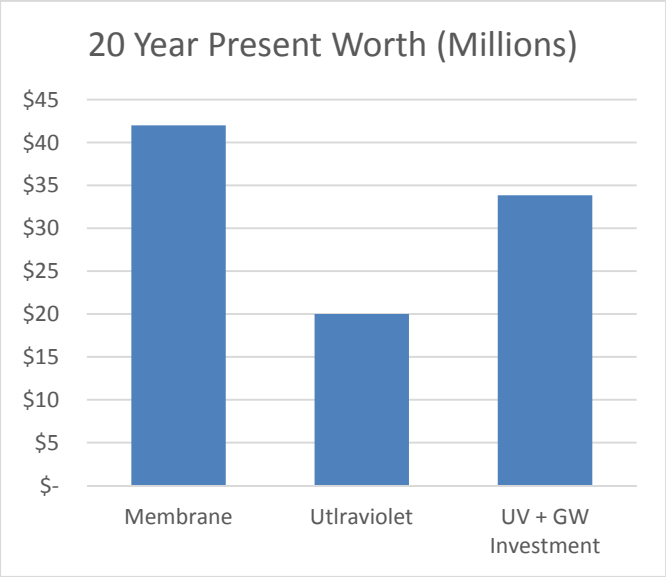
Critical Considerations for the City Council

The committee's deliberations focused on these two major aspects.

- Design SWT to maximize surface water asset VS Design SWT to minimize cost and meet LT2
- Design SWT to mitigate risk of wildfire VS Rely on groundwater to mitigate risk of wildfire

	Membrane Filtration		UV Treatment	
	Base	With Pretreatment	UV	UV + Wells
Traits	High Cost, Will operate at turbidities greater than 5 NTU	Reduces Fire Risk	Low Cost, Will operate only at turbidities less than 5 NTU	Eliminates Fire Risk
Capital Cost Treatment	$30.5M	$35.6M	$12.0M	$12.0M
Capital Cost GW Expansion				$16.2M
Total Capital Cost	$30.5M	$35.6M	$12.0M	$28.2 M
20 year Present Worth Cost Comparison	$38.0M	$43.0 M	$14.1M	$33.8M
Common Design Spent	$0.5M	$0.5M	$0.5M	$0.5M
Sunk Design Costs	$4.5M	$4.5M	0	0
Committee Members Selecting	5[1]		5[2]	

[1] All committee members choosing MF supported designing the system so that pre and post treatment could be added in the event of a catastrophic fire.



[2] All committee members choosing UV supported investing in additional groundwater wells to provide a reliable source of water in the event surface water is unusable. In one case if aggressive expansion of groundwater isn't feasible or much more expensive than the table displays, he would choose MF.

Glossary of Terms

1. **Filtration Waiver:** The Bridge Creek Watershed has consistently complied with all applicable state and federal regulations for source water under the Safe Drinking Water Act, including the 1989 Surface Water Treatment Rule filtration-avoidance criteria. http://www.deq.state.or.us/wq/dwp/docs/swasummary/pws00100.pdf

2. **LT1ESWTR (LT1):** The Environmental Protection Agency (EPA) finalized the Long Term 1 Enhanced Surface Water Treatment Rule (LT1ESWTR) on January 14th, 2002. The purposes of the LT1SWTR are to improve control of microbial pathogens, specifically the protozoan *Cryptosporidium*, in drinking water, and address risk trade-offs with disinfection byproducts. The rule will require certain public water systems to meet strengthened filtration requirements. It will also require systems to calculate levels of microbial inactivation to ensure that microbial protection is not jeopardized if systems make changes to comply with requirements of the Stage 1 Disinfectants Disinfection Byproducts. It can be read in full here: http://www.epa.gov/fedrgstr/EPA-WATER/2002/January/Day-14/w409.htm

3. **LT2ESWTR (LT2)**: The purpose of the LT2 rule is to reduce illness linked with the contaminant *Cryptosporidium* and other disease-causing microorganisms in drinking water. The rule will supplement existing regulations by targeting additional *Cryptosporidium* treatment requirements to higher risk systems. This rule also contains provisions to reduce risks from uncovered finished water reservoirs and to ensure that systems maintain microbial protection when they take steps to decrease the formation of disinfection by-products that result from chemical water treatment. It can be read in full here: https://www.federalregister.gov/articles/2006/01/05/06-4/national-primary-drinking-water-regulations-long-term-2-enhanced-surface-water-treatment-rule

4. **MF - Membrane Filtration Technology:** Membranes can provide a physical barrier that effectively removes solids, viruses, bacteria, protozoa including *Giardia* and *Cryptosporidium*, and other unwanted large molecules. Different types of membranes are used for turbidity removal, softening, disinfection, organic removal, and desalination of water and wastewater and can be installed in compact, automated, modular units. Membrane filtration units can also be installed in relatively small facilities that blend into the surrounding area and can be fully automated to significantly reduce the required amount of operator attention.

   http://www.kochmembrane.com/PDFs/Membrane-Filtration-Technology---Koch-Membrane-Sys.aspx

   A membrane or, more properly, a semi-permeable membrane, is a thin layer of material capable of separating substances when a driving force is applied across the membrane. Once considered a viable technology only for desalination, membrane processes are increasingly employed for removal of bacteria and other microorganisms, particulate material, and natural organic material, which can impart color, tastes, and odors to the water and react with disinfectants to form disinfection byproducts (DBP). As

advancements are made in membrane production and module design, capital and operating costs continue to decline.
The pressure-driven membrane processes are microfiltration (MF), ultrafiltration (UF), nanofiltration (NF), and reverse osmosis (RO).
http://www.nesc.wvu.edu/pdf/dw/publications/ontap/2009_tb/membrane_DWFSOM43.pdf

5. **MGD – Million gallons per day:** a rate of flow of water equal to 694.44 gallons per minute, 133,680.56 cubic feet per day,1.5472 cubic feet per second, or 3.0689 acre-feet per day.

6. **NTU - Nephelometric Turbidity Units:** The unit used to describe turbidity. Nephelometric refers to the way the instrument, a Turbidimeter, measures how much light is scattered by suspended particles in the water. The greater the scattering, the higher the turbidity. Therefore, low NTU values indicate high water clarity, while high NTU values indicate low water clarity.

7. **O&M – Operations and Maintenance:** The activities related to the performance of routine, preventive, predictive, scheduled, and unscheduled actions aimed at preventing equipment failure or decline with the goal of maintaining efficiency, reliability, and safety.

8. **Optimatics Report:** The purpose of this report is to present the recommendations resulting from the Water Master Plan Update Optimization Study undertaken by Optimatics. The report outlines relevant data, constraints, assumptions and methodology employed in the development of the recommended Final Build-out Solution and Capital Improvement Plan (CIP). This study and report builds on the previous 2007 Water Master Plan Update developed by Murray, Smith & Associates, Inc. (MSA).
http://bend.or.us/Modules/ShowDocument.aspx?documentID=3201

9. **Post-filtration Treatment:** Post-filtration systems are used in water treatment to meet each unique project's final water use and quality requirements. Typical post-filtration treatment methods can include final disinfection, corrosion control additives, taste and odor control. If a high-pressure membrane system is being used (such as NF or RO), it is common to locate these processes downstream of filtration.

10. **PW or PV - Present Worth or Present Value:** Estimated current value of a future amount to be received or paid out, discounted at an appropriate rate, usually at the cost of capital rate (the current market interest rate). Present value provides a common basis for comparing investment alternatives. Also called present worth.

11. **Pretreatment:** The chemical, mechanical, and/or physical conditioning of surface water prior to filtration and/or disinfection. Most typically used to remove turbidity and dissolved organic material or to optimize other water quality parameters prior to filtration and/or disinfection.

12. **SW - Surface Water:** The type of water that has collected on the ground. This water is naturally open to the atmosphere and may come from the ground water (springs), streams, rivers, lakes, wetlands and the oceans. Snowmelt and rainfall can affect the volume and quality of surface water on a seasonal basis.

13. **SWT – Surface Water Treatment:** The use of chemical, mechanical, and/or physical process(es) to remove suspended solids and pathogens to protect public health and improve water quality.

14. **Turbidity:** Turbidity is a measure of water clarity in NTU (how much the material suspended in water decreases the passage of light through the water). Suspended materials include soil particles (clay, silt, and sand), algae, plankton, microbes, and other substances.

15. **UV – Ultraviolet Treatment:** The use of ultraviolet light to disinfect drinking water, which involves generating UV light with the desired germicidal properties and delivering or transmitting that light through the water to pathogens. Guidance manual for UV disinfection can be found at the following link: http://www.epa.gov/ogwdw/disinfection/lt2/pdfs/guide_lt2_uvguidance.pdf