Water Briefing Notebook

City of Bend

2012

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RESOLUTION NO. 2867

A RESOLUTION SETTING FORTH A MODIFIED PLAN TO RETAIN BEND'S DUAL WATER SOURCE AT REDUCED COST TO RATEPAYERS, DIRECTING A LIMITED RE-EVALUATION OF CERTAIN ASPECTS OF THE SURFACE WATER IMPROVEMENT PROJECT, AND INSTITUTING A PROGRAM TO INCREASE FLOWS IN TUMALO CREEK

Findings:

A. Certain assumptions and values have formed the basis of the City Council's decision related to the Surface Water Project, and the Council finds that it is beneficial to document those values so that citizens fully understand the reason for its judgment and the decisions Council has made. These have been stated in numerous prior council meetings and resolutions but are worth restating (*see* Resolutions 2814, 2817, 2846 and 2853).

B. The City Council is fully aware that the project has generated controversy. This can be normal for large and costly infrastructure projects, but Council desires to be responsive to the community's concerns related to the timing, economics and environmental impacts of the project.

C. The City Council is especially aware of the rate impacts of large infrastructure projects at a time when the Bend economy continues to struggle.

D. The Bridge Creek source has been studied and evaluated many times, including in the 1980 Water System Master Plan, the Bridge Creek Pipelines Evaluation (2009), the Brown and Caldwell Water Supply Alternatives Study (2009), the HDR Surface Water/ Ground Water Cost Comparison (2010), the Value Engineering Study (March 2011), the Optimization Study (2011), and the HDR Technical Report Timing of Hydro Project (August 2011). The City Council has held numerous public work sessions and other public meetings related to the proposed project. In addition, the City's Infrastructure Advisory Committee held a more recent public forum, receiving input from the public and City consultants, and indicated its firm support of the project. The IAC is made up of members of the public that have expertise in engineering, water utilities, geology, environmental law, as well as representatives of the public and business interests. Over-studying a project may not serve the community well in terms of time, expense and resources. Still, Council values the importance of a thorough risk/benefit assessment, and desires to ensure that its approach to the problem remains the most viable in light of current economic and regulatory conditions.

E. The City Council also must be cognizant that it is currently under a regulatory obligation to meet the requirements of the Safe Drinking Water Act, and the requirements of the Long Term 2 Enhanced Surface Treatment Rule ("LT2 rule"), that it has received a two year extension through October of 2014, and that the extension is dependent on meeting a tight project schedule that will be put in jeopardy by much more delay in the project. Nonetheless, the Council believes that pausing design and delaying construction of the treatment aspect of the project is in the best interest of the community for the reasons set forth in this Resolution.

F. This Resolution is intended to again articulate the City Council's values and assumptions related to the Surface Water Project, and to describe a new approach with the goals of reducing cost, improving stream flows in Tumalo Creek and the Deschutes River, and continuing to provide exceedingly high-quality drinking water for the City's residents..

Values and Assumptions:

G. The City of Bend is extremely fortunate and prior councils were farsighted and perceptive in securing and protecting two sources (a dual source) of water, especially a high quality and pristine source such as the Bridge Creek surface water supply. Bend has used water from Bridge Creek for approximately 85 years. It gets half of its water, annually, from Bridge Creek, which flows from the flank of Broken Top through a protected watershed, owned by the USDA Forest Service ("Forest Service"). It would be irresponsible of this Council to forsake half of the City's water supply.

H. A dual source is an especially valuable asset in the modern era—other communities are paying a high price to find a second or multiple source of water due to climate change/drought risks, water quality concerns, regulatory requirements, and water rights uncertainty. Specifically in Oregon, the City has received letters from the Tualatin Valley Water District, the Oak Lodge Water District, and the Eugene Water and Electric Board, all confirming that a second source of water supply brings invaluable flexibility and reliability into the future, and that as water utilities, they have relentlessly been pursuing strategies to develop a second source of water. Those letters are attached to this Resolution.

I. The City has received the attached letter of support from EDCO for a similar reason—the recognition that a high quality surface water source is the envy of communities that do not have it, that it is in the best interest of Bend residents and businesses to keep the surface water source, longtime water rights, and the transmission system to deliver surface water to Bend residents and businesses. EDCO mirrored the Council's view that dual system provides valuable reliability for future needs, that a gravity system is cost effective long term, and that without such a system, the City's infrastructure could be hampered, limiting job growth and economic development.

J. Gravity flow provides a reliable, energy efficient, lower operation and maintenance cost water supply with low carbon footprint into the future. Groundwater, while also a valuable water source and beneficial to the City, requires pumping from 400-700 feet below surface, which is an energy intensive activity and highly likely to be more expensive in the long run (however, electricity costs fluctuate over the years).

K. A dual source provides operational flexibility and gives high confidence in water availability as demand changes with season and population growth into the future.

L. A dual source provides environmental flexibility so that if quantity, quality or regulatory problems with one source occur, the other can still be used. Equally important, in the event that something happens to one source, the second source gives the City potential for lower cost solutions to enable the City to maintain two sources. A recent study by DEQ found that out of 253 wells for drinking water systems within the Deschutes Watershed, 101 of them have had contamination events. The EPA has indicated it is "likely" to further regulate groundwater in a manner that could require costly filtration of that source. A dual source also maximizes potential for renewable energy.

M. The surface water source is secured by water rights, including senior and certificated rights, the value of which cannot be underestimated or lightly put at risk. This is especially true in light of the complexities of Oregon water law, further complicated by the intricacies of the Deschutes Groundwater Mitigation Program and its requirements to provide for offsets to impacts to the Lower Deschutes Scenic Waterway flows caused any newly permitted groundwater withdrawals within the upper basin's defined study area. The Deschutes Groundwater Mitigation Program is itself a temporary and, in some circles, controversial program, without which newly permitted groundwater withdrawals in the upper basin would be impossible. In the event the Mitigation Program's detractors are successful in further limiting it or preventing its reauthorization in the future, a sole reliance upon groundwater would significantly hamper the City's ability to meet water demand.

N. As stewards of Bend's infrastructure and long term water system and community and economic growth, the time frame the City Council has determined is appropriate to consider in making long term water infrastructure decisions is at least 50 years in Bend's future. The City Council recognizes that the existing water infrastructure related to the surface water source is over 80 years old and that any replacement of this infrastructure will utilize materials and design that will last in excess of 100 years.

O. There are three primary threats to the continued use of Bridge Creek:

a. The EPA LT2 was implemented by the federal government to address real problems with surface water in some parts of the country. The deadline is currently October 1, 2014;
b. The risk of wildfire in the watershed which would potentially increase long term turbidity and sedimentation issues to the water source; and
c. Deteriorating pipe infrastructure, including a pipe that was constructed in 1926, the tar lining of which is currently fragmenting and traveling down the pipe (*see* photo exhibits showing lining in bottom of tank). 1926 and 1950s pipes, both of which are subject to tree and root encroachment further increasing risk failure.

P. Environmentally, the project will not alter the upper diversion at the source springs which has operated continuously since the 1950's, and therefore will cause no change to the existing flow regime established to minimize turbidity into Bridge Creek by keeping diverted flows constant. The proposed project will have an environmental benefit in that the City's existing system has lacked flow control so that the City has diverted water at a constant rate of 18.2 cfs, even when actual city use is lower. The new system will have flow controls so that only water needed will be diverted, eliminating downstream return flows and related turbidity events and now passing unused flow beginning at the intake location through 9.5 miles of stream.

Q. The City Council has considered changing the point of diversion to farther downstream on Tumalo Creek, as a cost saving measure in that it would result in a shorter pipe which would create a new intake upstream of Shevlin Park. However, as in the past, the City rejected this idea due to water quality concerns (possibility of water pollution due to upstream development, vehicle traffic and human activity, increased fire probability, turbidity issues further downstream, etc.), legal risks to water rights in changing the point of diversion, environmental concerns in moving the diversion through the rocky/steep canyons further down the river, and uncertainties as to constructing a new diversion on/across Forest Service lands.

R. The City received the attached letter of support from Central Oregon Irrigation District in which they state, "... perfected and certificated water rights in the Deschutes Basin are not held by many entities, and are rarely if ever voluntarily relinquished. COID would only consider relinquishment of its water rights if there was a 100% guarantee of replacement of that supply...and Bend has only the promise of future supply..."

S. The City has received the attached letter of support from Tumalo Irrigation District and through ongoing discussions throughout the project development with Tumalo Irrigation District, and as evidenced by its State approved 2005 update to its Water Management and Conservation Plan (WMCP), that it has identified estimated annual water losses of over 31,000 acre feet, much of it within its delivery system, which it intends to reduce by completing conservation projects.

T. It is the City's understanding that Tumalo Irrigation District has completed the following projects to date:

   a. Completed the Bend Feed Canal that returned 5.82 cfs of senior water, and 11.3 cfs of junior water (State project CW-9);
   b. Completed two phases of the Tumalo Feed Project (State project CW-37), which when fully completed is estimated to return an additional 20 cfs of water for instream purposes (depending on funding). Phase 3 is underway this winter, expected to be completed by start of irrigation season; and
   c. Completed annual instream leases over the past ten years averaging approximately 5.4 cfs of senior water placed instream (Source DRC).

   The district expects to continue this trend of conserving water and increasing the instream flows within Tumalo Creek.

U. The City Council also finds it fortunate to have an existing 1926 agreement with the Forest Service which created the Bend Municipal watershed and laid the basis for subsequent special use permits and memorandums of agreement that continues the protection and management of the watershed today with a recognized priority for the production of municipal drinking water.

V. At the request of this City Council, Bend sought successful inclusion and assisted in creation of the Deschutes Skyline Collaborative Forest Landscape Restoration Project with the potential for up to $10 Million dollars of additional funding for this collaborative with the Deschutes National Forest through the Collaborative Forest Landscape Restoration Act of 2009, and that the Bend Municipal Watershed is included in the study area with the goal of finding additional cost effective methods of reducing the risk of fire that work in conjunction with the surface water project and continuing to assist agencies and organizations who continue to work towards improving water quality (temperature), enhancing riparian and aquatic habitat, and improving stream bank stability in Tumalo and Whychus Creeks.

Based on these findings, the Bend City Council resolves as follows:

<u>Section 1</u>. The Council is committed to continuing with the pipeline and intake facility design/construction on schedule, and obtaining the Special Use Permit from the Forest Service (including the National Environmental Policy Act (NEPA) process), to coincide with the Federal Highway Administration and Deschutes County rebuild of the existing Skyliners Road occurring in 2013. Council reaffirms its commitment to retaining the current diversion point because it minimizes potential contamination, and legal risk of

environmental compliance costs and risk to water rights, as further set forth in the above Findings.

Section 2. Council is equally committed to retaining the Bridge Creek source at the lowest possible cost. The City is currently seeking to delay compliance with the treatment requirement of the LT2 rule, thereby significantly reducing water rate increases. To this end, the City has initiated aggressive efforts on behalf of its constituents, by working with:

- The Oregon Health Department to seek an Alternative Compliance Schedule for treatment under a negotiated administrative order; and
- The EPA and Congressional delegation to seek flexibility in the LT2 treatment rule, including delaying treatment improvements as the EPA reviews the LT2 rule, and rebalancing the costs and benefits of rule compliance as applied to Bend and other similarly situated cities with high quality water sources.

Because of the risk of fire, City staff is directed to work with the Forest Service to mitigate the fire risk to the greatest extent possible, as the City works through the issues related to the staging of the surface water treatment improvements.

Section 3. By Resolution No. 2817, the City Council directed staff to proceed with design and construction of the Membrane Filtration Treatment for the City's Surface Water Reinvestment Project. The engineering design of the treatment facility is currently at about 75%. City staff has recently worked with its design consultant, HDR, to reduce monthly expenditures by slowing down the pace of design, so that the tasks that were scheduled for completion by March, are now scheduled for completion by June, at no corresponding increase in cost.

The City Council continues to find that it is in the best interest of the City to continue to 90% design for the Membrane Treatment Facility in order to avoid significant work stop/start charges. However, prior to proceeding to 100% design, the City desires to "pause" to take the actions set forth in Section 6 below. Council believes that 100% design is likely desirable to show good faith progress with its obligations under the LT2 rule, to have a ready design in the event of a wildfire in the watershed, and to receive the full benefit of the City's investment to date, but it believes further community input on this decision would be valuable.

Council directs staff to delay construction of the Membrane Treatment Facility as it works through the issues identified in Section 2 above. A delay in construction costs is expected to reduce the immediate need for significant rate increases. A recognized risk is that it could increase project construction costs in the future, compared to the costs projected currently.

Section 4. The City Council holds open the possibility of opting for UV or another treatment type as a less costly measure given economic problems in Bend. Council continues to recognize the benefit of membrane treatment as a superior treatment method in the event of turbidity from a wildfire in the watershed.

Section. 5. By Resolution No. 2846, the City Council directed staff to proceed with the construction of the hydroelectric facility as part of the Surface Water Improvement Project. The Hydro portion of the project was to operate on water used by Bend for beneficial use, based on current demand and its water rights—in other words, no additional water would be diverted for hydroelectricity other than what is needed to serve utility customers.

The design of the Hydro project and permitting has been stopped pending further direction from Council. The City Council desires to re-evaluate Hydro at this time, and delay the cost of design, turbine procurement, construction and permitting, in order to reduce the up-front cost of the surface water project.

The City Council understands that the trade-off in doing so is that a hydroelectric facility produces a valuable revenue stream which would provide ratepayer relief as well as the potential for investment in stream flow improvement efforts, offsetting operational and construction costs in relatively few years, and produces clean, green energy. However, the City Council is willing to defer construction to a future date, and further explore private investment.

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.

Section 7. In taking the steps described in Sections 1 through 4, it is Council's intent to reduce project costs so that rate increases in fiscal year 2012-2013 will be reduced from 15% to no more than 5%, with corresponding reduction in rates in the years thereafter. The estimated rate increase for a fiscally constrained surface water project would equate to an additional monthly charge ranging from $.85-$1.70 each year for the average Bend household.

Section 8. The Council directs the formation of a Tumalo Creek restoration subgroup, at first comprised of at least one council member, supported by city staff, to create a collaborative dialogue with the Tumalo Irrigation District board and staff, to establish a mutually agreeable flow restoration target; identify a mutual list of priority projects; determine related funding requirements and potential partners; and seek other mutually beneficial projects, processes or agreements that may be necessary to meet restoration and long term water supply goals of each entity.

Adopted by roll call vote on March 7, 2012.

YES:	Tom Greene Scott Ramsay Mark Capell Jodie Barram Kathie Eckman Mayor Jeff Eager	NO:	Jim Clinton

Jeff Eager, Mayor

ATTEST:

Robyn Christie, City Recorder

Approved as to form:

Mary A. Winters, City Attorney

Tualatin Valley Water District

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November 2, 2010

Mayor Kathie Eckman and Bend City Councilors
City of Bend
710 NW Wall Street
Bend, Oregon 97701

TRANSMITTED VIA EMAIL

Dear Mayor Eckman and Bend City Councilors:

It is my understanding that you are soliciting feedback from other water providers regarding the City of Bend's water supply options and, more specifically, our experience with our water supplies. Obviously the approach that the City of Bend takes is ultimately up to you, however, we are pleased to share our experience in the hope that it will assist you in making an informed decision that considers the various risks associated with water supply and water rights.

As background, the Tualatin Valley Water District (TVWD) serves more than 200,000 people in parts of Washington County. Our service area covers more than 45 square miles and includes portions of Beaverton, Hillsboro, and Tigard. Approximately 70 percent of our water is used by residential customers and the other 30 percent used for business and industrial needs. Our water supply is comprised of water purchased from the Portland Water Bureau (includes water from the Bull Run Watershed and the Columbia South Shore Wellfield) and our ownership in the Joint Water Commission (includes water from Barney Reservoir, Hagg Lake and the Tualatin River). As you can see, we have a number of sources that are used to meet our needs and provide the reliability our customers have come to expect.

For a number of reasons, TVWD has deliberately pursued a water supply strategy that involves the use of multiple sources of water. This approach has served us well in periods of short supply (drought) or when a source might not be available due to mechanical or quality issues. Prior to this approach, residents served by TVWD (and its predecessor) were saddled with water restrictions due to limitations of relying on a single source of supply. The drought of 1992 was a clear example of some of the unfortunate consequences and impact of a sole source strategy. It was during this period that TVWD customers experienced mandatory water restrictions that prevented the watering of established lawns, car washing and other normally allowed uses of water. Enforcement included the imposition of penalties ranging from $100 to $500. Interestingly, that drought only affected one source in the Portland Metro area, Portland's Bull Run System. It was as a result of that drought that the TVWD Board of Commissioners instructed staff to develop a second source of supply for the District.

I hope the information I have provided regarding TVWD's experience is helpful and provides some background on how and why we have approached the issues of water supply, reliability and value of water the way we have. Good luck in your water supply planning process and implementation. Please let me know if I can be of any assistance or provide additional information that you might find useful.

Sincerely,

Gregory E. DiLoreto
Chief Executive Officer

Cc: Eric King, Bend City Manager

To: Tom Hickman, City Engineer/Assistant Public Works Director

From: Dan Bradley, General Manager

Date: October 27, 2010

Subject: Abandonment of Existing Water Supply

I would like to offer my perspective of the discussions occurring at the City of Bend regarding the abandonment of the Bridge Creek surface water supply. I have actually visited the site and am familiar with the supply source.

I can, without hesitation, say that I would never recommend let alone consider abandoning a source of such high quality water as the Bridge Creek source. It is an asset not only of huge value today but of untold value in the future.

The Oak Lodge Water District currently receives its source water from the Clackamas River. The Clackamas River is fully allocated and is no longer available for summer appropriation. As a result, Oak Lodge currently has a contract with MSA/GSI to develop a groundwater source not only for emergency purposes but also as an additional source of supply. Quite the opposite of what is being proposed in Bend.

I know some parts of the Deschutes Mitigation Plan but certainly not enough to comment with much certainty. But from what I know of the Plan I wonder why anyone in the area would even consider abandoning a pristine source that provides so many opportunities especially with the addition of adding hydroelectric generation that will provide a sizeable income for decades.

I mentioned this to some of my Board Members who were essentially shocked at the concept. Some of the comments I received are "What are they thinking?" "Why would they do something like that?" Is there any chance we could get access to the water if they give it away?" Based on these comments I think it is clear the Oak Lodge Water District Board would never consider abandoning a water source.

In conclusion, possessing water rights to any water supply sources in Oregon is an asset that I could not put a price on today and certainly not into the future. I strongly recommend the City of Bend not abandon this wonderful source.

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October 28, 2010

City Manager/City Council
City of Bend
710 NW Wall Street
Bend, OR 97701

RE: Feedback on Upcoming Water Supply Planning Decision

Dear Mr. Eric King and City Council Members:

It is with the unpleasant distinction as the largest water provider in the Pacific Northwest without a second source of supply that we are writing you to encourage maintaining both your surface water source and your ground water source for future water supply for your community. Having a single source of supply may be common in small towns and rural communities in Oregon, but the majority of larger communities rely on diversity to meet the growing needs of their communities (both residential growth and industrial/commercial growth). Some examples of diversified water supply sources in Oregon are: Portland Water, Medford Water Commission, City of Albany, Springfield Utility Board, Clackamas River Water, City of Lake Oswego, City of Wilsonville, City of Beaverton, City of Tigard, Tualatin Valley Water, City of Salem, City of West Linn, Oak Lodge Water District, City of Hillsboro, and City of Milwaukie. It is our Board directed goal for staff to add the Eugene Water & Electric Board (EWEB) to this list.

We recognize and acknowledge the economic factors in your decision. The unquantifiable cost to your community of **not being able** to provide water reliably in the future should cause you great pause while considering the cost differences (short and long term) between a single source of supply and dual source of supply. In addition to providing the flexibility of a second source, your surface water system provides gravity flow of water to most of your city (an extremely valuable asset in itself for public health and public safety). Furthermore, it provides a renewable energy supply to be used locally for electric power. Being the largest publicly owned utility in Oregon we recognize the value of renewable energy sources to our northwest power customers. We believe you will find benefits and additional pride in adding power generation to the services you provide to your community. As a water provider we rely on our electric utility for reliable power (the water utility is our 7th largest customer on the electric side). Having a power source that you control will provide a degree of increased reliability if you choose to utilize this electric resource to supply some of your water infrastructure.

We are envious of your current position as a dual source of supply water system. EWEB serves the second largest city in Oregon (170,000+ people). We have been working relentlessly to bring viable options to our Board to consider adding a second source of supply to our water supply portfolio. Because of the difficulty with obtaining legal access to new supplies we have yet to realize this Board supported objective. I highly encourage you to not underestimate the challenges of acquiring legal access to new water supplies, especially in light of the complexities of our Oregon water right laws, which are further compounded in the Deschutes basin because of the designation of the Deschutes River as a wild and scenic river and the mitigation rules for ground water withdrawals.

The city of Bend is fortunate to have many things that attract visitors, residents and businesses to it: mountains, the endless recreational opportunities, the micro-brews, and a diverse water supply. It is our professional judgment that it would be in your city's best interest to maintain this water supply diversity to meet the needs of your community now and into the future. It will be a decision that future generations will grow to appreciate.

If we can provide you or your staff with any additional information or testimony we would be glad to participate as needed.

Regards,

Tom Buckhouse
Director of the Water Division
EWEB
tom.buckhouse@eweb.org

Brad Taylor
Water Resource and System Planner
EWEB
brad.taylor@eweb.org

cc: Roger Gray, General Manager, EWEB
Tom Hickmann, City Engineer/Assistant Public Works Director, City of Bend

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A MUNICIPAL CORPORATION OF THE STATE OF OREGON

2 November. 2010

Mayor Kathie Eckman
City Council Members
City of Bend – City Hall
710 NW Wall Street
Bend, OR 97701

Re: Project to Replace the City's Surface Water Supply System

Mayor Eckman and City Council Members,

Central Oregon Irrigation District (COID) is providing these comments out of respect for your process of deliberation on this issue and under the objectives stated in our joint Memorandum of Understanding (MOU) signed in 2003.

The MOU was approved and executed by both of our governments recognizing that cooperative and creative efforts are going to be needed in meeting current and future water supplies. A foundational element of Bend's current water supply is the perfected and certificated water right on Bridge Creek. Perfected and certificated surface water rights in the Deschutes Basin are a precious item not held by many entities and are rarely if ever voluntarily relinquished. COID would only consider relinquishment of its water rights if there was a 100% guarantee on replacement of that supply. That situation does not currently exist for the City of Bend as the Deschutes Ground Water Mitigation Program is due for legal sunset in 2014 and the chances of that program to be extended by the state legislature is not known. While many informed voices may advocate for an all groundwater supply, the fact remains that the City of Bend already has a perfected water right in hand and only a promise of additional groundwater rights in the future.

In addition, as with COID's water delivery system, the Bridge Creek water supply is fully provided by gravity and a sustainable and affordable delivery independent of mechanical or electrical failures. While the infrastructure may require repair and maintenance over time the fundamental delivery is provided by gravity at no additional expense.

Thank you for your attention to these comments and trust they are of benefit in your deliberations.

Sincerely yours,

Steven C Johnson

Steven C Johnson
District Secretary - Manager

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December 11, 2010

To: Members of the Bend Infrastructure Advisory Council

Subject: Letter of support for combined surface and groundwater option for the City of Bend.

I regret that I will not be able to attend the IAC meeting on December 13th regarding the Bend water upgrade option. Please accept this memo in my absence.

Securing an adequate water supply to meet Bend's population projections will involve substantial infrastructure decisions that will impact City residents for decades. I strongly support a combined surface and groundwater system, including the proposed upgrade of the Bridge Creek facility that the City Council recently approved.

The existing dual-source system is the most cost-effective option over time given the energy required for an all-groundwater system and inevitable increases in energy costs. The Northwest Power Planning Council, PGE and Pacific Corp, the Bonneville Power Administration and the Oregon Department of Energy all anticipate steady increases in the cost of electricity. These costs will be exacerbated by the fact that Oregon currently faces a bottleneck in transmission capacity. Whether Oregonians choose to meet additional electricity demand through the existing coal based system or through development of renewable energy sources, capacity must be added to the transmission system. This is an expensive undertaking and it will be reflected in increased electricity costs.

Pumping water is a very energy-intensive activity. The gravity-fed surface water system will save Bend residents significant money by reducing electricity costs associated with groundwater pumping.

Another point to consider is that, in an effort to reduce greenhouse gas emissions and increase energy security, the Pacific Northwest region will likely expand policies and incentives for development of renewable energy sources. Designing the upgraded surface water system so that it provides opportunities to develop small-scale hydro-electric facilities will give the City flexibility to benefit from programs supporting renewables. In addition, at some point it is likely that we will see regional, and eventually national, regulations on greenhouse gas emissions. It is possible that the increased greenhouse gasses associated with groundwater pumping will be a liability under those regulations.

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Finally, climate change is a real concern and there is great uncertainty about the impacts it will cause. The best way to safeguard against such uncertainty is to add diversity to our systems. Climate change will likely affect surface water flows, and this further supports the case for reinvestment in the Bridge Creek system, which is groundwater fed and will be less affected. If climate change becomes severe enough to significantly affect surface water and snowpack fed streams and rivers, it will reduce the hydropower capacity on the Columbia system, further driving up electricity costs.

I urge the IAC to consider these points and support the City Council's decision to move forward with a combined surface and groundwater system.

Sincerely,

Cylvia Hayes

Cylvia Hayes
CEO, 3EStrategies

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November 3, 2010

Mr. Eric King, City Manager
City of Bend
710 NW Wall Street
Bend, Oregon 97701

SUBJECT: LETTER OF SUPPORT, CITY OF BEND WATER SUPPLY PROJECT

Dear Mr. King:

It is the understanding of the Tumalo Irrigation District that the City of Bend is currently in the investigative and design stages of renovating its surface water supply from the Bridge Creek/Tumalo Creek watershed. The supply has been in use for over 80 years and we understand that the project includes the replacement of aged, failing pipe and the addition of water treatment to address new EPA rules. We also understand that the City is investigating the addition of renewable energy production through hydroelectric power generation.

As you know, the City and the Tumalo Irrigation District have been long time stewardship partners on Tumalo Creek requiring continuing cooperation to facilitate the proration of the various water rights held by both entities (according to the State water right certificates). We understand the proposed project to enhance control, use and delivery of the City's water through the addition of measurement devices for intake water and elimination of routine operational return flows at the Outback site. This will serve to facilitate better tracking and evaluation of water use and insure the proper allocation of water to the City and Tumalo Irrigation District as called for in the State water rights held by each party. We perceive this as a benefit of the project. We also note that a portion of the City's water rights include assessment payments to the District (for 692 equivalent acres). Preserving and upgrading its surface water right insures the continuing beneficial value of these specific rights.

We understand that the City's historical and proposed supply of surface water is through gravity and based upon the natural "fall" from the diversion point to the Outback site. Additionally, the City may implement hydroelectric power generation if practical. The Tumalo Irrigation District supports the idea of sustainable and energy efficient operations.

The District shares the City's desire to upgrade its systems and is in the process of upgrading its century-old delivery systems as well and appreciates the support of the City in the District's endeavors to further enhance the Tumalo Creek watershed and provide additional conserved water instream through such projects as its Tumalo Feed Canal piping project.

Based upon our current understanding of the project and our continued input and involvement in the City's process, the Tumalo Irrigation District supports the City of Bend's efforts to renovate its surface water supply system, implement and share the data results of complete water diversion measurement and associated telemetry, implement water treatment as required by law, and to investigate the implementation of renewable energy.

Should you have any questions on this letter of support, please call.

Sincerely,

TUMALO IRRIGATION DISTRICT

Elmer G. McDaniels, Manager

February 22, 2012

City of Bend
City Councilors
710 NW Wall St.
Bend, OR 97701

Dear Councilors:

On behalf of our Board of Directors, I would like to express support from Economic Development for Central Oregon (EDCO) for the City of Bend to maintain its dual source water system and preserve its current surface water rights. At its February 9th meeting, the EDCO Board of Directors unanimously approved a motion to write a letter of support for this critical infrastructure asset. A high quality surface water source such as the one Bend possesses is the envy of those communities that do no have it. Any effort or campaign to eliminate it is not in the true best interests of the City of Bend, its residents and businesses.

We understand that there are a number of issues currently being publicly debated – whether to have a hydroelectric component to the surface water source as well as the cost, timing and method of treatment required by federal laws. To be clear, EDCO is not weighing in on these issues with this letter, rather our support is specific to keeping the surface water source, longtime water rights, and the transmission system to deliver surface water to Bend residents and businesses. It is our understanding that the aging transmission line is at risk of failure or is already experiencing problems in sections. Modernization and replacement of such transmission lines are common in the region, and consequently are a very straightforward project for EDCO to support.

As you know, EDCO has been the tri-county region's lead economic development organization for the past 30 years. Water supply is frequently an important element of our business and industry recruitment efforts as well as work we do to help local manufacturers, high technology and other traded-sector companies to grow and prosper. During that time Bend has experienced tremendous growth that was supported by the City's abundant and high quality water supply.

Evaluations conducted throughout the years have confirmed time and again that the City's dual source water system (surface water from Bridge Creek and ground water) is by far the most reliable arrangement for future needs. With gravity delivering the needed pressure to make the system work, it is also the most cost effective alternative, long term. Without such a system, the City's infrastructure could be hampered, limiting future growth and development.

Water rights and mitigation credits in the high desert climate of Central Oregon are very limited, so to consider forfeiting those the City already has would be—in the opinion of our Board—shortsighted. EDCO relies on assets such as a high quality workforce, low cost power and worker's compensation rates, in addition to quality of life and other amenities when it comes to job creation. With the competition fierce for such projects it is critical that the City's water supply not be a concern for potential employers.

Thank you for your considerable efforts on this issue. We know it has been a project that has consumed a very large amount of time and with it some controversy, however it really is a critically important aspect of what a city provides. EDCO encourages the City of Bend to stay the course and protect its surface water supply.

Should you have any questions about our support, please don't hesitate to contact me or any of our Board of Directors.

Best Wishes,
Roger J. Lee
Executive Director

Jeff Staudenmaier, Region Manager, Cascade Natural Gas Corporation

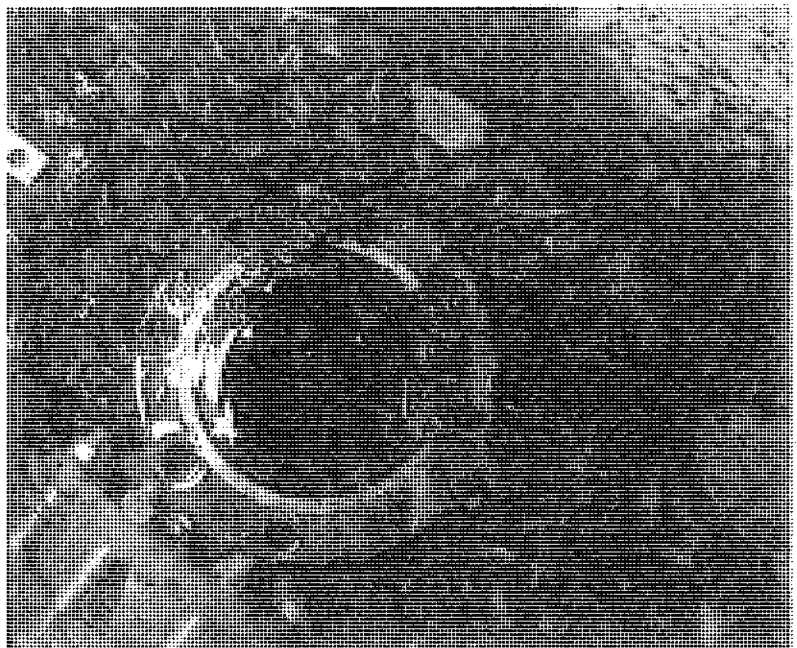


Figure 1. An accumulation of pipe lining material (black material) with sand and gravel in one of the Outback reservoirs

Figure 7. A 30-inch conifer within 4 feet of the 1926 pipeline

Significant damage from trees is expected in several sections of the upper portions of the pipelines. The pipelines are at risk of failure due to trees overturning for much of the upper sections of the 1926 and 1957 pipelines. Reduction in the risk of damage could be accomplished by cutting the trees, if that can be reasonably done. Tree removal on public land will likely require permits from the land manager. This process may be lengthy and will likely require some form of environmental assessment. Where the trees are now holding the road bank in place above Tumalo Creek and where the trees are major landscape elements in the Skyline subdivision, permission for tree removal may be very difficult to obtain.

Easement Intrusions

The pipeline routes run through the Skyline subdivision and then through several large private holdings east of the subdivision. These large lots create some access problems for maintenance of the pipelines. Certainly the owners would have concerns with major ground-disturbing work, but they are likely to be manageable and a major pipe failure in those areas is not an overt life-safety issue. However, within the Skyline subdivision, several major concerns are apparent, including the following:

- **Structures:** Many structures have been placed in the easements, at least four of which are immediately above the 1926 pipeline (see Figure 8 for examples).

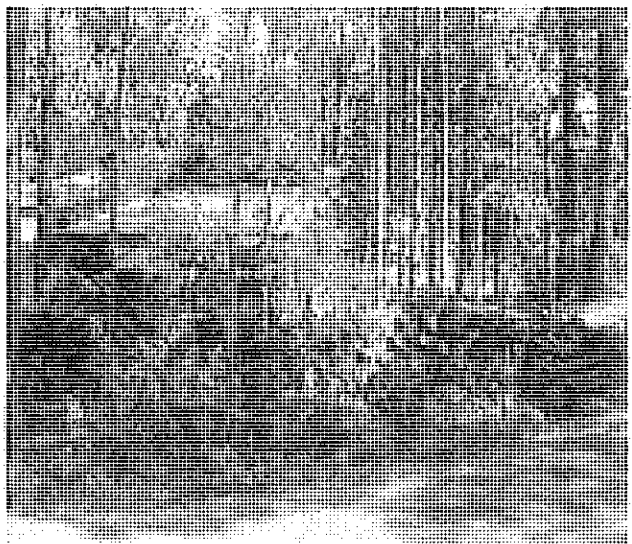
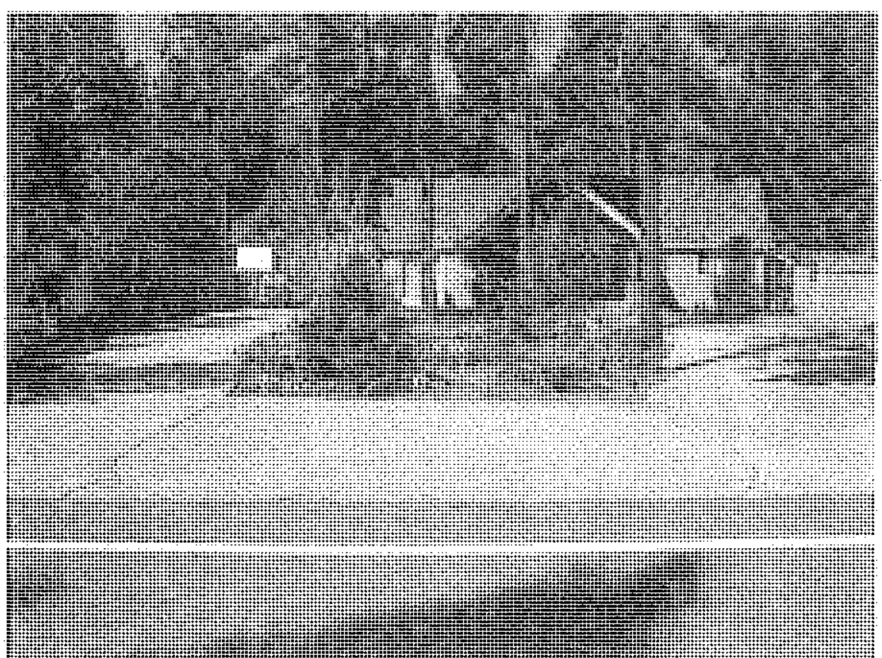



Figure 8. Pipeline route is under right edge of building (left); pipeline route (blue stake) directly under large RV shelter (right)

- **Large trees:** Many large conifers are located near or immediately above the two pipelines. Trees with 24-inch-diameter trunks are not uncommon.
- **Landscaping:** Some of the homes have installed extensive landscaping in the easement and above the 1926 pipeline. See Figure 9 for an example.

Figure 9. Landscaping above pipelines; 1957 pipeline is under concrete in foreground, 1926 pipeline is under trees in planted island



- **Wells:** A number of wells are located in the easement; four were observed. Two were within 1 foot, if not inches, of the 1926 pipeline. One well house was constructed above the pipeline (see Figure 10).

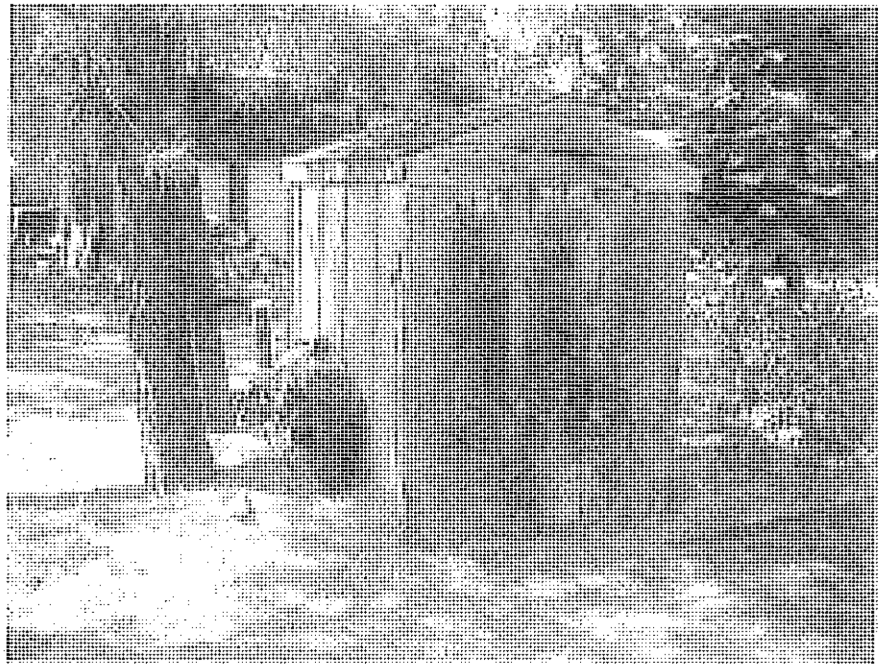


Figure 10. Well house directly above 1926 pipeline; another well can be seen in background that is less than 1 foot from the pipeline

All of this intrusion in the subdivision puts the pipeline at risk from the following:

- localized corrosion due to stray current from power lines to buildings and wells
- accidental damage to the pipeline from further construction
- crushing of the shallow, old pipeline from wheel loads and building foundation pressures.

Failure of the pipeline in this area is both a life/safety issue for those living in the subdivision and a damage liability issue for the City.

Maintenance of this section of the pipeline route will be very difficult at best. The property owners have a lot of land value to lose by the City clearing the easements. They will likely fight any attempt to maintain the easement and argue for at least the 1926 line to be relocated into Skyliners Road. Given the likely poor condition of the pipeline in this area, that will be a hard argument to overcome.

Hydraulic Condition

The two pipelines are not designed to withstand the pressures that would build if a valve near the end of the pipeline was closed. Pressures in such an instance would build to more than 400 psi; the pipe walls would rupture under that much pressure. Therefore, the pipelines were designed to use a small diameter to create friction within the pipelines that will reduce the pressure as the water flows through the pipes. The 1926 and 1957 pipelines have 21 and 28 air valves, respectively, to help relieve the lines of air and prevent vacuum damage. They are shown to also have four interconnections and up to five mainline valves to help control pressures in the lines.

Memorandum

To: Paul Rheualt, Mary Winters

From: Tom Hickmann P.E.

Subject: Condition of the Surface Water Transmission Pipes

Date: August 31, 2009

The purpose of this memorandum is to identify the risks currently facing our two transmission lines. This is intended to identify what staff has discovered over past years through observation and provide an engineering perspective of those observations.

Encroachment - Lines are not under an existing roadway, allowing numerous encroachments of structures on, or near, the pipes.

Shallow Bury - The current lines typically have less than 12-inches of cover, but can vary from above ground to 18-inches below ground. Current standards require a minimum of 36-inches from top of pipe.

Vegetation Growth - There is significant tree growth on top of the pipes and the pipes are root entangled.

Pipe Velocities - 11 feet per second in each pipe, nearly double the design standard for modern pipe materials.

Pipe Bedding - The pipe is laying directly on rock, in some cases sharp rock, putting additional strain on the pipe.

Wall Lining Material Failing - Coal tar lining of the pipe is found across the floor of the first treatment tank where it settles out.

Inadequate Vacuum Release - The line could potentially suffer an extensive catastrophic collapse if a small hole or break in the line developed.

New and Illegal Connections - The City staff have had conversations with individuals who live in the Skyliner subdivision area and were told that some homes in that area may be illegally connected to the existing lines. Requests for new connections to the existing lines have also been made. Under DHS rules, the City can not deliver untreated water.

Historical Attempts to Fix and Maintain the Pipe - Little written and documented information exists on historical issues regarding the pipe maintenance, or correction of identified problems.

1980 Water Master Plan – The City of Bend 1980 Water Master Plan identified that these pipes needed to be replaced.

The Washington Standards also discuss how a system could be equipped with excess supply capacity to help offset equalizing and potentially fire suppression storage requirements. Using wells to offset equalizing storage is likely to increase system operating costs, and also places a higher reliance on groundwater pumping. Relying on wells to offset fire suppression storage could be feasible for Bend, but is not recommended due to the system size and complexity.

Table 3 – Summary of Groundwater Well Capacity, SCADA capability and Back-up Power (April 2011)

Groundwater Production Facility	Zone Supplied	Capacity (MGD)	SCADA Present	Capacity With SCADA	Back-up Power	Capacity With Back-up Power	Redundant Capacity Back-up & SCADA
COPPERSTONE_W	3	1.4	N	0	N	0	0*
OUTBACK_W1	3	1.0	N	0	Y	1.0	0
OUTBACK_W2	3	1.1	N	0	N	1.0	0
OUTBACK_W3	3	1.7	Y	1.7	Y	1.7	1.7
OUTBACK_W4	3	1.7	Y	1.7	Y	1.7	1.7
OUTBACK_W5	3	1.8	Y	1.8	N	1.8	0*
OUTBACK_W6	3	1.8	Y	1.8	Y	1.8	1.8
OUTBACK_W7[1]	3	1.8	Y	1.8	Y	1.8	1.8
OUTBACK_W8	3	*Future*					
WESTWOOD_W	4A	1.0	Y	1.0	N	0	0
BEAR_CREEK_W1	4B	1.5	Y	1.5	N	0	0
BEAR_CREEK_W2	4B	1.6	Y	1.6	N	0	0
ROCK_BLUFF_W1	4B	1.2	Y	1.2	Y	1.2	1.2
ROCK_BLUFF_W2	4B	0.0[2]	N	0	N	0	0
ROCK_BLUFF_W3	4B	1.2	Y	1.2	Y	1.2	0*
PILOT_BUTTE_W1	5	1.2	N	0	N	0	0
PILOT_BUTTE_W2	5	*Decommissioned*					
PILOT_BUTTE_W3	5	1.3	N	0	N	0	0
PILOT_BUTTE_W4[3]	5 (4B emerg)	1.6	Y	1.6	Y	1.6	0*
RIVER_W1	5	2.7	N	0	N	0	0
RIVER_W2	5	3.0	N	0	N	0	0
SHILOH_W1	3D	0.0	N	0	N	0	0
SHILOH_W2	3D	0.0	N	0	N	0	0
SHILOH_W3[4]	3D/4B	2.0	Y	2.0	Y	2.0	0*
HOLE_10_W1	2B	0.8	Y	0.8	Y	0.8	0*
HOLE_10_W2	2B	0.8	Y	0.8	Y	0.8	0.8
Total Groundwater Capacity		**32.3**		**20.5**		**18.5**	**9.0**

Notes * Although these wells have back-up power and are connected to SCADA, they are not redundant

1) Outback 7 online by April 2011
2) Rock Bluff 2 is out of service, not expected to be returned to service
3) Pilot Butte 4 online by April 2011 - Generator confirmed but well is not redundant without Pilot Butte 1 or 3
4) Out of service; online April 2011 with portable generator plug in facilities following upgrade, not redundant

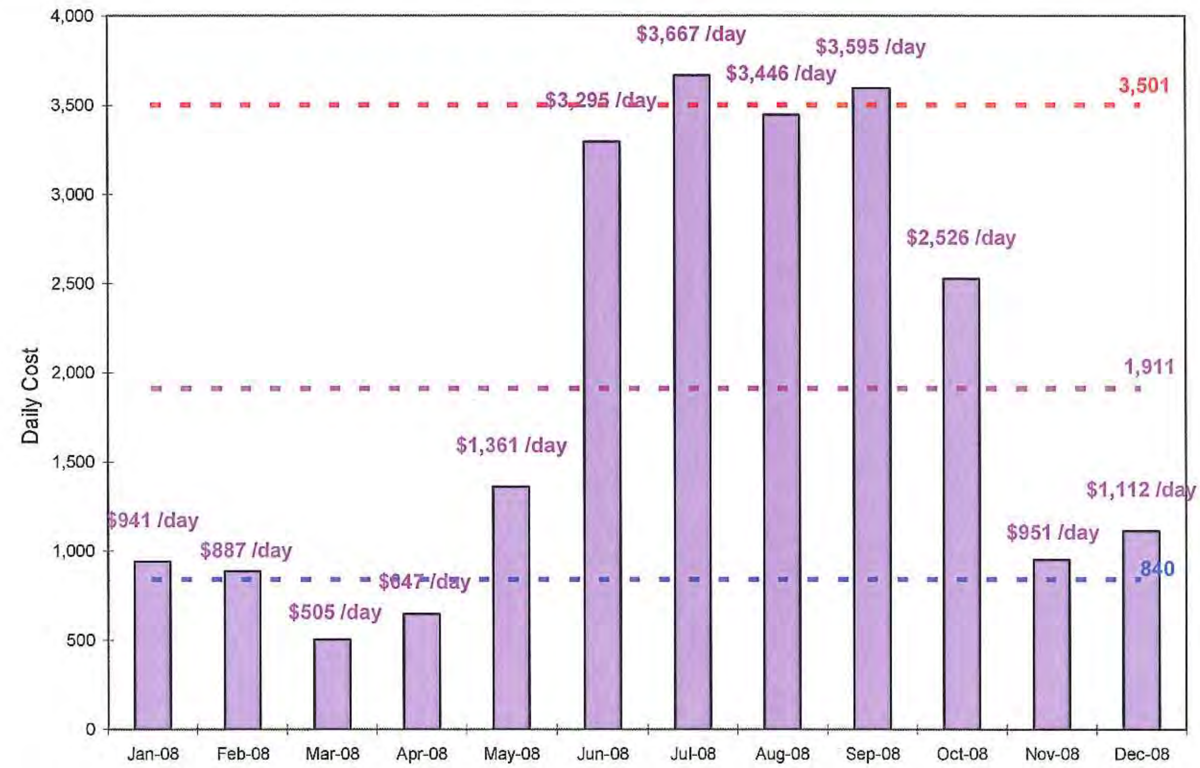


Figure 3.3 – System-wide power costs per day and winter, summer and annual averages – 2008

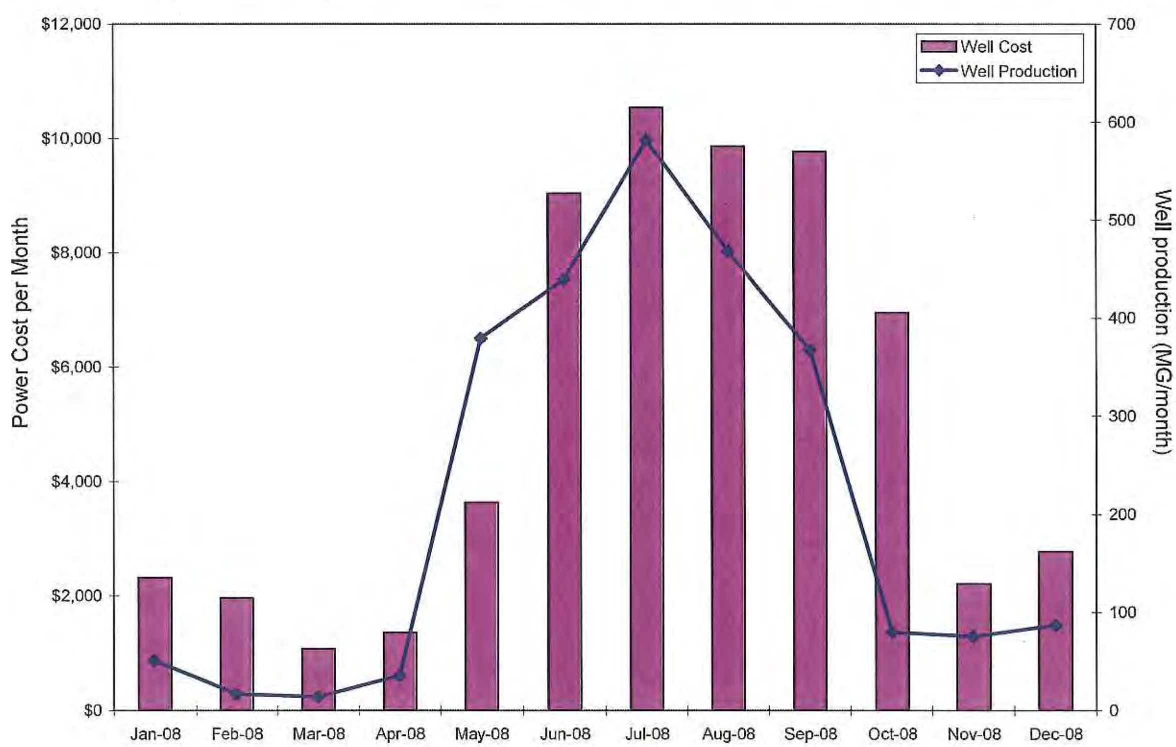
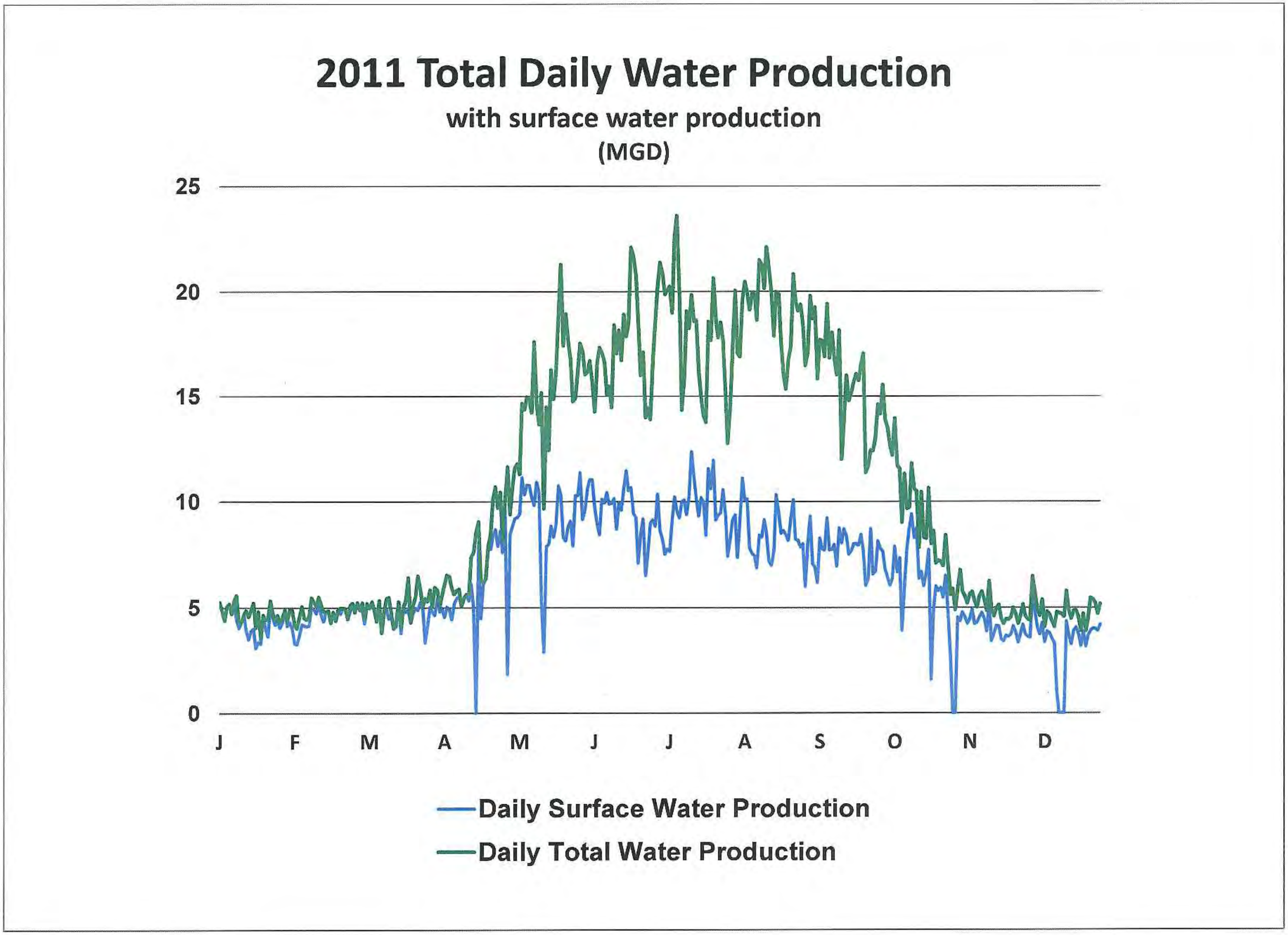
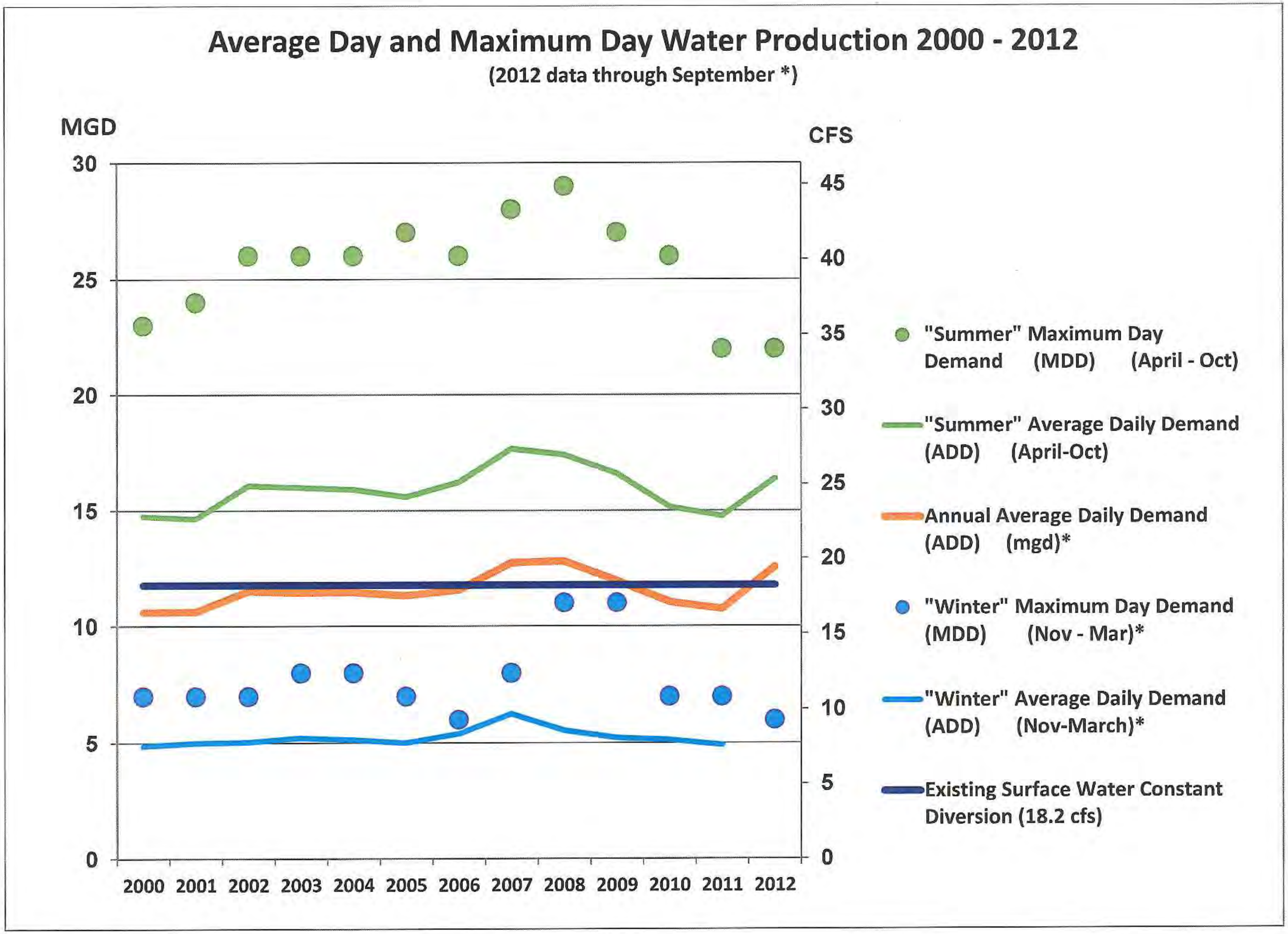
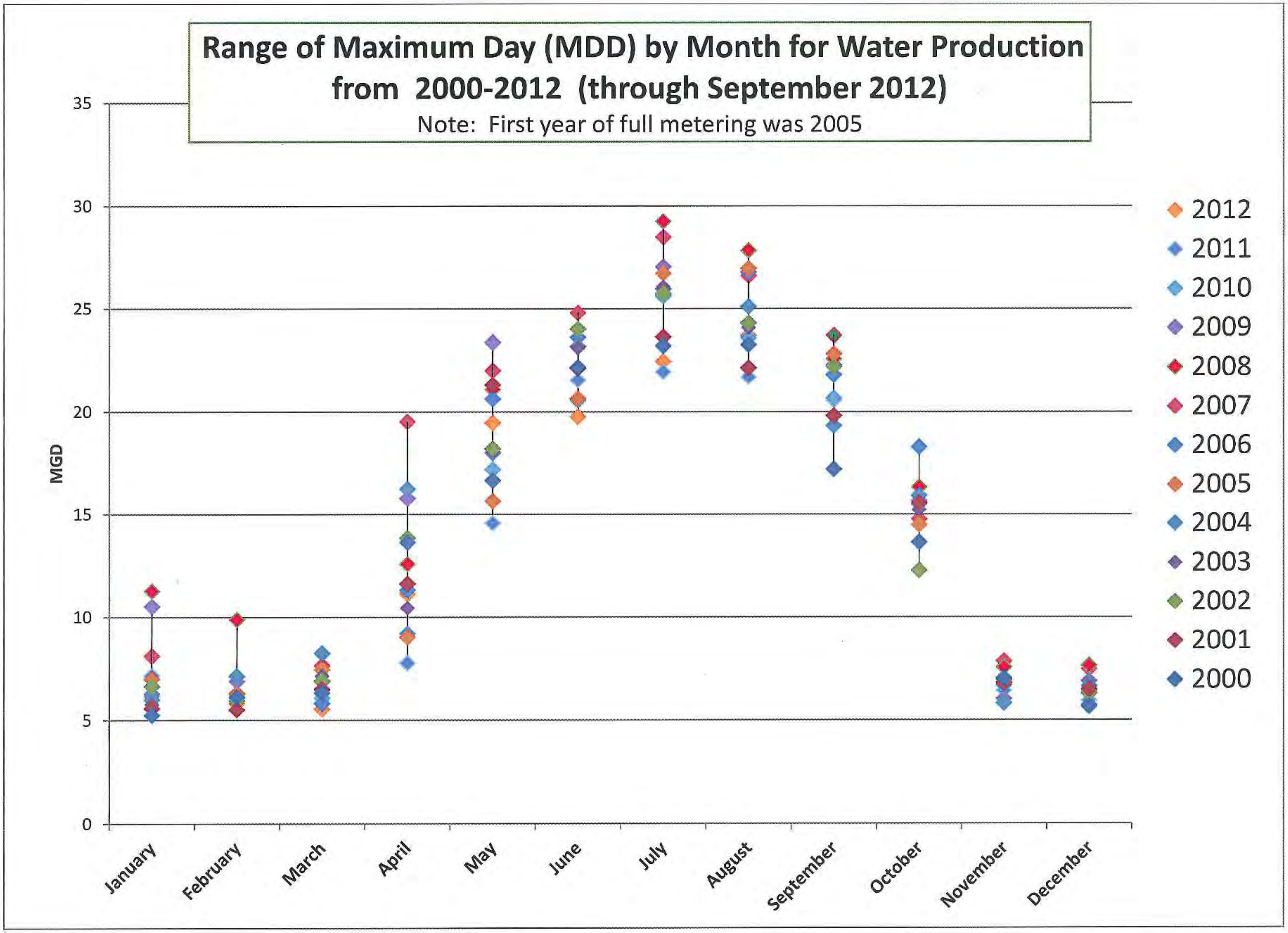


Figure 3.4 – Comparison of well production and associated power costs – 2008


2011 Total Daily Water Production
with surface water production
(MGD)
25
20
15
10
5
0
J
F
M
A
M
J
J
A
S
O
N
D
Daily Surface Water Production
Daily Total Water Production



Average Day and Maximum Day Water Production 2000 - 2012
(2012 data through September *)
MGD
CFS
30
25
20
15
10
5
0
45
40
35
30
25
20
15
10
5
0
2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012
"Summer" Maximum Day Demand (MDD) (April - Oct)
"Summer" Average Daily Demand (ADD) (April-Oct)
Annual Average Daily Demand (ADD) (mgd)*
"Winter" Maximum Day Demand (MDD) (Nov - Mar)*
"Winter" Average Daily Demand (ADD) (Nov-March)*
Existing Surface Water Constant Diversion (18.2 cfs)



Range of Maximum Day (MDD) by Month for Water Production from 2000-2012 (through September 2012)
Note: First year of full metering was 2005
MGD
0
5
10
15
20
25
30
35
January
February
March
April
May
June
July
August
September
October
November
December
2012
2011
2010
2009
2008
2007
2006
2005
2004
2003
2002
2001
2000

CHAPTER 2
ALTERNATIVE OPTIONS SELECTION

Prepared for
City of Bend, Oregon
October 23, 2009

Prepared by

Jack Warburton, Brown and Caldwell

BROWN AND CALDWELL

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CHAPTER 2

ALTERNATIVE OPTIONS SELECTION

2.0 Introduction

In the near future, the Bridge Creek Supply System (BCSS) may not be able to continue to meet the City of Bend's (City) potable water demand reliably. Its aging infrastructure, risk of fires in its watershed, and new regulations will require the system to be upgraded. To address these issues, the City retained the services of a consultant team led by Brown and Caldwell to identify and develop the best alternative that will satisfy these impending demands.

This chapter documents the alternative identification and screening process that led to the selection of a preferred alternative: the construction of a water treatment plant and a hydropower facility at the Outback site and the replacement of the existing intake mains with a penstock. This alternative will be the object of further refinement in the subsequent efforts of this project.

2.1 Background: Existing Conditions

The City depends on surface water from the BCSS and locally developed groundwater to meet its potable water demands. To meet the future projected demands, the City Master Plan contemplates increasing the capacity of the groundwater supply.

The BCSS currently provides half the annual water supply to the City. In general, the BCSS is used to meet all of the City's winter water demand, which currently averages 6 million gallons a day (mgd) and peaks at about 26 mgd. As demand increases in the spring season, wells are used to provide additional flow beyond what is available from the BCSS.

The components of the BCSS are described in the following sections.

2.1.1 BCSS

The existing BCSS includes a diversion works that captures pure spring flows and a canal that diverts the spring into the headwaters of Bridge Creek; an intake works on Bridge Creek; the Intake Mains from the Bridge Creek Intake to Outback; and the Outback Chlorination and Storage Facility. The system conveys water from elevation 4,992 feet at the Bridge Creek Intake to the elevation 3,980 foot elevation at the chlorine contact basin (see Figure 2-1).

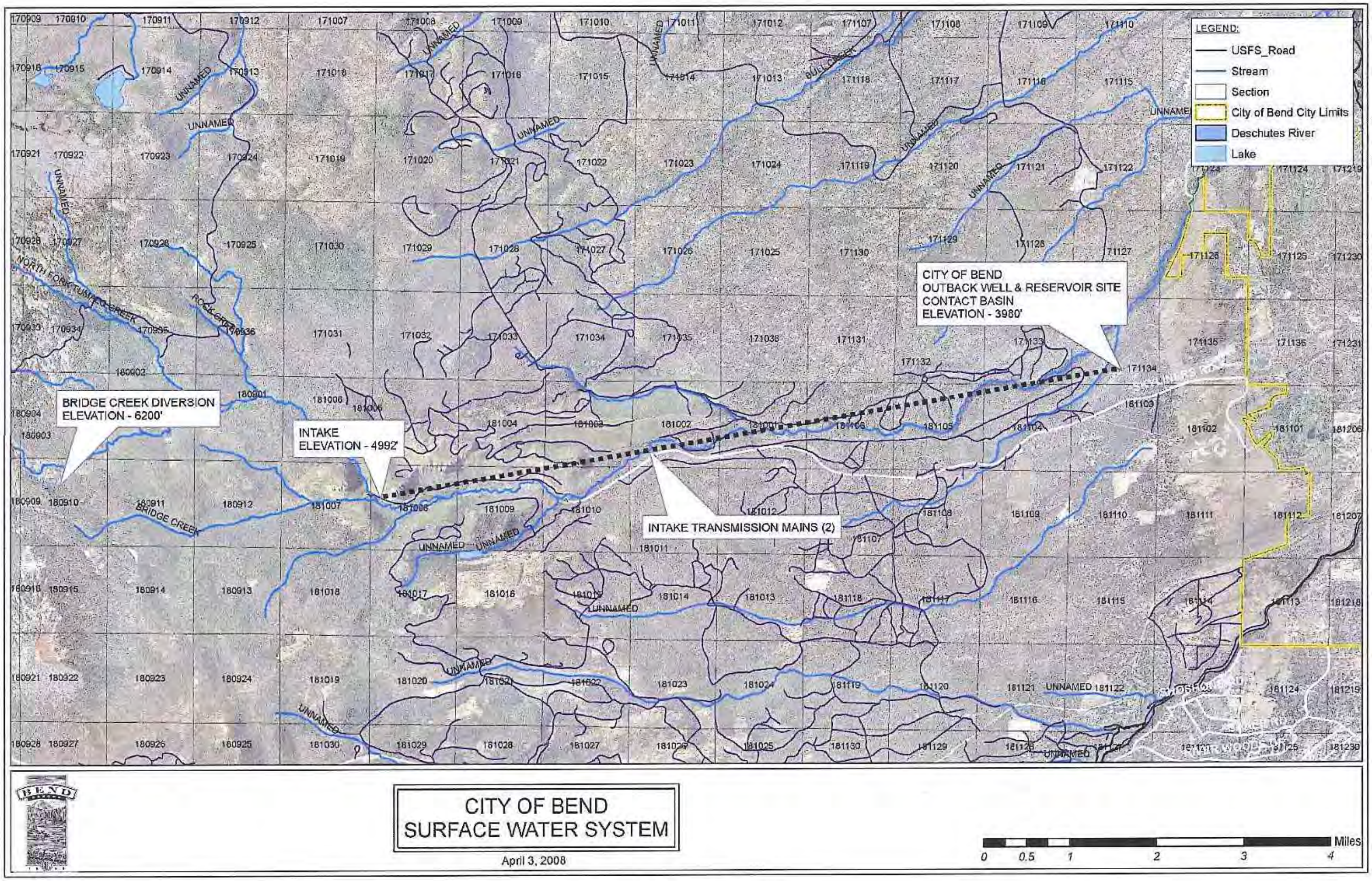


Figure 2-1. BCSS Site Map

Each of the key components is described in additional detail in the following subsections.

2.1.1.1 Bridge Creek Intake

Built in 1926, the Bridge Creek Intake facility includes a dam, overflow, debris screen, and caretaker's building. The intake consists of a small concrete gravity dam with a side channel intake from the pond created by the small dam. Inside the diversion structure is a series of screens that filter out leaves and other debris. Water entering the intake is diverted into two conduits that convey the water to the Outback Storage and Treatment Facility.

A small wood frame structure, originally constructed as the caretaker's residence, sits on top of the intake structure. The building has been updated several times, though much of its original structure, including its metal siding, still remains. The building is now used to house water monitoring equipment and is the focus of limited seasonal tours.

2.1.1.2 Intake Mains

Welded steel pipes, 14 and 16 inches in diameter, run 10 miles to connect the Bridge Creek Intake facility with the Outback site. The pipelines were installed in 1926 and 1956, respectively, and have been repaired several times. Some of their reaches have been replaced with larger sections, up to 20 inches in diameter.

Most of the pipes' alignment lies within heavily forested areas, on U.S. Forest Service (USFS) land. The pipelines also cross several private properties on City easements. In several easements, structures encroach the conduits' alignments. Tree roots and structure loading have contributed to the accelerated deterioration of the pipes and the development of leaks.

The conduits were designed with small diameters to develop high flow velocities that burn the excessive potential energy associated with the drop from the 4,992-foot elevation at Bridge Creek Intake to the 3,980-foot elevation Outback site overflow. The original capacity of the pipelines is not known.

2.1.1.3 Background

The Outback site contains the terminal storage tanks for the BCSS. The conduits discharge into a steel tank, retrofitted as a Chlorine Contact Basin, where the BCSS water is chlorinated. The chlorinated water then overflows to other storage tanks at the site, which feed by gravity into the City's distribution system.

The site also contains groundwater wells that pump to a dedicated storage tank. These groundwater wells, in addition to others in the City, supplement the BCSS whenever the system demands exceed the BCSS capacity or during periods when the BCSS is too turbid to use.

2.1.2 Challenges to the Bridge Creek Supply

The City has identified three primary challenges to the continued use of the BCSS.

- Meeting 2012 U.S. Environmental Protection Agency (USEPA) regulations
- Addressing aging infrastructure
- Mitigating the water quality impacts from a large wildfire in the watershed

The magnitude of these challenges will be explained further in the following paragraphs.

2.1.2.1 Meeting 2012 Regulations

The BCSS is an approved unfiltered water system. Per USEPA, unfiltered public water systems that use surface water or groundwater under the direct influence of surface water serving 50,000 to 99,999 people must have started 24 months of source water monitoring for Cryptosporidium by April 2007. In addition, these systems must report their average of all Cryptosporidium sample results to USEPA or to the state by September 2009 to determine treatment requirements listed in Table 2-1. The required treatment systems must be installed and in operation by September 30, 2012.

Table 2-1. Inactivation Requirements for Unfiltered Systems

Cryptosporidium concentration, oocysts per liter	Required Cryptosporidium inactivation
<0.01	2-log
>0.01	3-log

Under certain circumstances, which may include a system with active capital improvements intended to achieve regulatory compliance, USEPA can extend the compliance deadline by 24 months.

2.1.2.2 Addressing Aging Infrastructure

Essential components of the BCSS are 50 to 80 years old. Inspection by the City of the two 10-mile-long intake mains that convey the surface water to the Outback Storage and Treatment Facility revealed many areas with severe overgrowth of trees in the easements and over the pipelines. Evidence of root intrusions in the pipelines has been found as root debris in the storage reservoirs at the Outback facility. The level of service of other components is uncertain. Designed and constructed to 1926 standards, the reliability of the Bridge Creek Intake Dam may not meet the standards of a lifeline facility, as defined by the American Society of Civil Engineers.

Subsequent chapters will evaluate the condition of Bridge Creek Intake and determine pipe replacement alternatives.

2.1.2.3 Mitigating Fire Danger in Watershed

A large fire in the Bridge Creek watershed would result in a high sediment loading in Bridge Creek. This would cause the water quality of the system to exceed the drinking water standards for one to several years. The water quality impact of fires was already witnessed by the City in past events. The BCSS is essential to meet the City's daily summer demands; its unavailability would create a serious water shortage.

The likelihood of a wildfire is currently increased by the large amount of dead trees in the Bridge Creek watershed. The USFS has estimated that dead trees amount to 40 percent of the tree inventory in the watershed.

2.2 Alternative Description

The alternatives considered to address the challenges facing the continued use of the BCSS are outlined in this section. Figure 2-2 provides a summary of the alternatives that are described in detail below.

Though the actual quantity of available BCSS water varies throughout the year, this evaluation assumes its capacity to be 13.5 mgd.

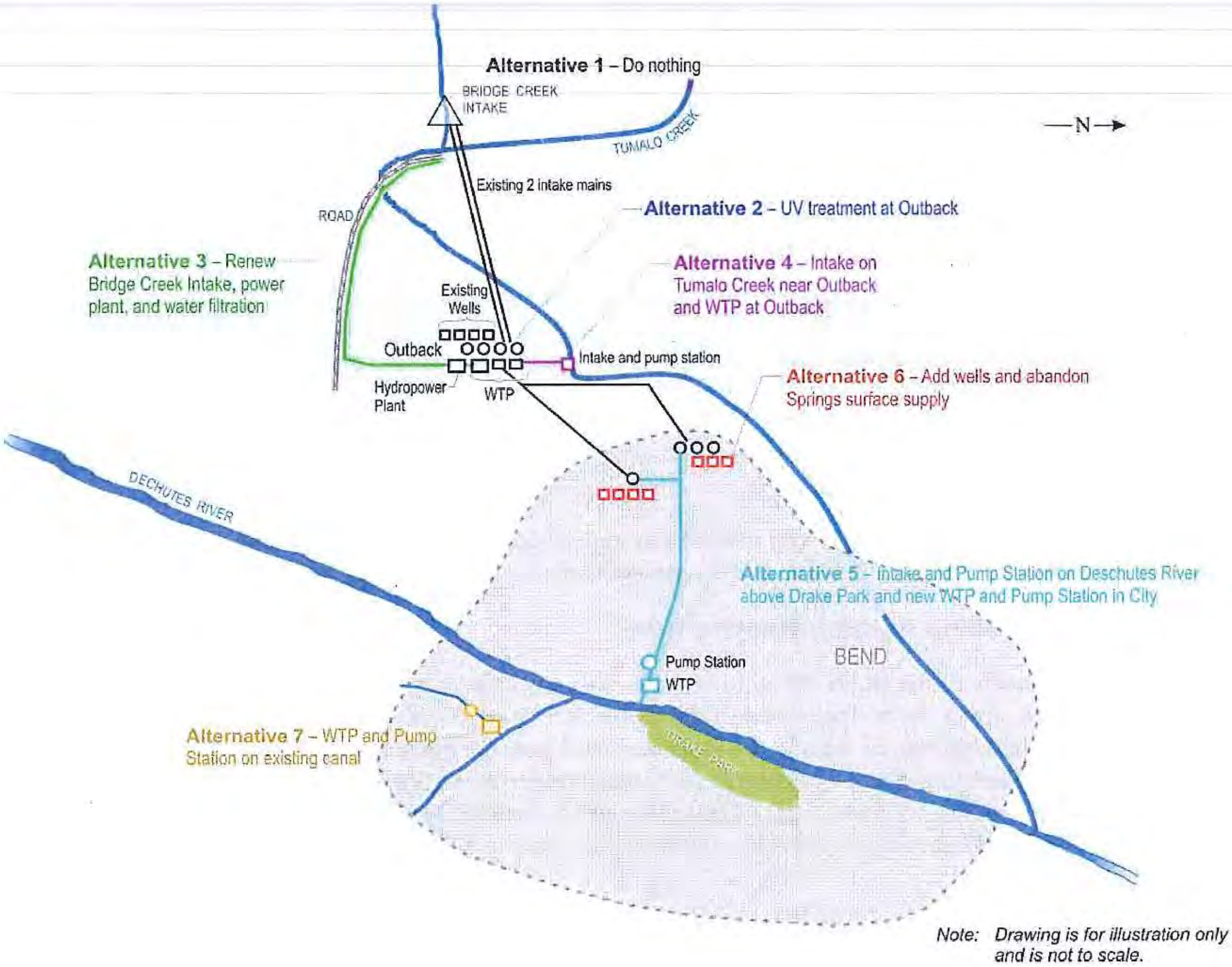


Figure 2-2. Alternative Summary

2.2.1 Alternative 1—Do Nothing

As the title implies, Alternative 1 will leave the existing system of structures and pipelines as is and will not make any major improvements to them. This option will result in abandonment of the BCSS in 2012 when it will no longer be in compliance with USEPA regulations.

2.2.2 Alternative 2—No Upgrades to Springs WSS but Add Ultraviolet (UV) Disinfection

Similar to Alternative 1, Alternative 2 does not make major capital improvements to the existing BCSS. However, this option includes the addition of UV disinfection at the Outback facility. The addition of UV disinfection will keep the Springs Water Supply System (WSS) in compliance with USEPA beyond 2012 when regulations require additional disinfection on unfiltered supplies. It does not reduce the risk of water quality impacts from fire in the Bridge Creek Watershed or failure of the 1926/1956 pipelines.

2.2.3 Alternative 3—Renew Bridge Creek Intake and Filter Water

Alternative 3 will provide major capital upgrades to the BCSS, including the following:

- Seismic and structural upgrade to the Bridge Creek Dam, Intake, and caretaker's structure
- Installation of a new fish/debris screen at the Bridge Creek Intake
- Replacement of the intake mains with a new penstock to the Outback site
- Installation of new hydropower facilities at the Outback site
- Installation of a new water filtration plant at the Outback site that will be designed to treat water in the event of degraded water quality associated with impacts from a local forest fire and will meet the 2012 USEPA requirements

The improvements will tie into the existing system at the Outback site and will continue to use the other infrastructure for the City's distribution system.

2.2.4 Alternative 4—Intake on Tumalo Creek near Outback Site

Alternative 4 will abandon the BCSS and will install an intake and pump station on Tumalo Creek near the Outback site. Alternative 4 will include a new water filtration plant, similar to Alternative 3, but will not include the hydropower facilities. The Tumalo Creek facilities will require a sophisticated, wild-river intake and will be installed in an environmentally sensitive area with protected aquatic species.

2.2.5 Alternative 5—Intake and Pump Station on Deschutes River

Alternative 5 will abandon the BCSS and will include installation of a new intake and pump station on the Deschutes River near Drake Park. Alternative 5 will require a fish screen at the intake on the Deschutes River and will include a new water treatment plant. The treatment plant will be more sophisticated than the filtration plant for Alternatives 3 and 4. Additional treatment processes will be needed to remove organic carbon, taste, and odor. The Deschutes River supply will also require an additional pump station after the treatment plant to pressurize the water for the distribution system. The supply location will make mixing with the local groundwater supply more problematic unless the supply has a direct pipeline to the Outback site.

2.2.6 Alternative 6—Increase Well Capacity and Abandon Bridge Creek Supply System

Alternative 6 will abandon the BCSS and will expand the City's use of local groundwater. The City will need to replace the Springs WSS with additional well capacity. The local wells will be located at the Outback site and throughout Bend and will be in addition to the wells that are already planned to meet the City's future growing water demands.

2.2.7 Alternative 7—New Supply on Existing Canal

Alternative 7 will be similar to Alternative 5 but will take advantage of the existing fish screens at the inlet to a canal from the Deschutes River. This alternative will avoid the direct intake on the Deschutes River. The treatment requirements will be similar to that of Alternative 5, but will need to address the potential water quality degradation associated with flow in the open irrigation canal. In addition, the pumping requirements likely will be more extensive than those required for Alternative 5, since the treatment plant will be located farther from the major storage for the City's distribution system and will likely require a new major river crossing pipeline.

2.3 Alternatives Screening

This section describes the evaluation and screening process for selecting the preferred alternative. The screening was conducted in two phases. Phase 1, conducted during the workshop kick-off meeting, identified the alternatives that merited more detailed development. Phase 2, as documented below, performed the selection of the preferred alternative.

The evaluation and screening process used is built upon identifying the full life-cycle cost or full cost of ownership of an alternative. The full cost of ownership is composed of the capital cost; the operational, maintenance, and refurbishment costs; the environmental and community costs; and the risk inherent to each one of these elements. The alternative that delivers and maintains the required level of service with the lowest cost of ownership as measured by its net present value (NPV) is by definition the preferred alternative.

The initial screening that was conducted as part of the January 7 and 8, 2009 project initiation meeting, was based on a combination of preliminary capital and operational costs developed by Brown and Caldwell for the meeting, a qualitative assessment of the overall project risks, and the specific risks for potential alternatives. The process was used to select the preferred alternative.

2.3.1 Business Case Evaluation (BCE)

We used the BCE process to identify the full cost of ownership. A BCE consists of the following steps:

1. Appoint a BCE expert team
2. Define the problem and set the level of service (LOS)
3. Collect data on the current situation
4. Identify alternatives based on meeting the LOS
5. Screen alternatives and eliminate those that do not meet the required LOS
6. Develop cost information for viable alternatives
7. Compare viable alternatives based on NPV

The BCE differs from a conventional engineering evaluation because it includes the assignment of a multi-disciplinary team with knowledge of all aspects of the life-cycle of the alternatives and clear definition of the problem in LOS terms and the consideration of environmental, community, and risk costs. Additional description of the BCE process is provided in Appendix A.

2.3.2 Initial Screening Workshop

The initial screening workshop was conducted in Bend on January 7 and 8, 2009. The workshop participants are listed in Appendix B. During the workshop, the problem was defined, risk categories were identified, a qualitative score was assigned, potential mitigation measures were identified, and the risks were ranked.

Subsequent to the workshop, the initial alternatives were screened for fatal flaws based on meeting the required LOS. The remaining alternatives were ranked based on the combination of cost and the qualitative risk score. The problem statement, LOS fatal flaw analysis, and risk quantification are presented below.

2.3.2.1 The Problem Statement

Following is the problem statement developed at the workshop.

The City is not able to assure current and future surface water supply quality and quantity and to meet regulatory requirements.

Expressed in LOS terms, potential alternatives must accomplish the following:

- Provide water capacity equivalent to current surface water supply
- Comply with regulatory requirements
- Deliver high level of water quality reliably

The underlying root cause of the problem was identified as follows:

- Compliance with USEPA Surface Water Rules is projected to be imposed by September 30, 2012
- There is a risk of contamination of the surface water source
- There is a risk of a forest fire in the watershed which could degrade the raw water quality
- There is increased risk of structural failure due to the aging infrastructure.
- With continued urbanization of Bend, there is a risk to water quality from increased human activity in the watershed

2.3.2.2 Alternative LOS Fatal Flaw Screening

The results of the fatal flaw analysis of the seven alternatives identified earlier are illustrated in Table 2-2.

Table 2-2. Fatal Flaw Analysis

Alternative number	Alternative description	Meets LOS objectives		
		Capacity of surface supply	Regulatory compliance	Reliable high quality water
1	Do nothing	No	No	No
2	No upgrades to BCSS but add UV disinfection	Yes	Yes	No
3	Renew Bridge Creek intake and filter water	Yes	Yes	Yes
4	Intake on Tumalo Creek near Outback site	Yes	Yes	Yes
5	Intake and pump station on Deschutes River	Yes	Yes	Yes
6	Increase well capacity and abandon BCSS	Yes	Yes	Yes
7	New supply on existing canal	Yes	Yes	Yes

The alternatives remaining after the LOS fatal flaw screening are as follows:

- Alternative 3–Renew Bridge Creek Intake and filter water
- Alternative 4–Intake on Tumalo Creek near Outback site
- Alternative 5–Intake and pump station on Deschutes River and abandon BCSS
- Alternative 6–Increase well capacity and abandon BCSS
- Alternative 7–New supply on existing canal and abandon BCSS

2.3.2.3 Risk Assessment and Quantification Process

Risk is defined as the product of the likelihood and the consequence of a risk occurrence. For the qualitative analysis, a scale of 1 to 5 was utilized to score the probability of the risk event occurring. A similar 1 to 5 scale was used to assign the magnitude of a scope and schedule increase. The specific values utilized in the risk assessment are listed in Table 2-3.

Table 2-3. Qualitative Risk Assessment Basis of Scoring			
Score	Probability, percent	Scope increase, percent	Schedule increase, percent
1	<10	Insignificant	Insignificant
2	11-25	<10	<20
3	26-50	11-20	21-40
4	51-75	21-40	41-80
5	>75	>40	>80

The risk assessment process consists of the following steps:

1. Identify potential areas of risk
2. Develop specific risks and their potential mitigation
3. Organize the information in a risk register
4. Undertake the qualitative analysis and apply 1 to 5 points to the probability, scope and schedule impacts
5. Assign specific risks to the evaluated alternatives

The risk score of a risk category is the aggregate of the risk of scope increase and schedule increase. It is computed per the following formula:

$$\textit{Probability} \times \textit{Scope Increase} + \textit{Probability} \times \textit{Schedule Increase}$$

A higher score corresponds to a higher risk.

2.3.2.4 Potential Risk Area Categories

The following risk categories were identified:

- Regulatory/permitting water rights
- Potable water supply
- Forest service
- Hydropower implementation
- Natural disasters
- Construction and operational costs
- Financial viability
- Stakeholders

Table 2-4 lists the output of the risk assessment process by risk category and overall ranking.

add new wells	5	4	5	Exchange surface w - for additional groundwater rights >1:1?	Water rights, 200 cubic feet per second (cfs) cap uppe basin, hydrogeologic, i permits, science, land procurement
rmit for new water rights	5	3	5	Agreement with stakeholders, section D mitigation	Up-front dollars
rmit FERC	5	3	5	Agreement with stakeholders, section D mitigation, USFS relationships	Endangered Species Act (ESA) Nexus
time, mitigation, public, operational constraints	5	3	5		
ed fire	5	3	5		Question of when and how big—accelerate schedule. Different approaches if W
ion for in-stream water	4	4	5	Temperature Model no impact on reach B?	Cold water take water away from generation
support	3	5	5		Potential no project
n ongoing initiatives with other local agencies	3	4	5	DWA signed	
rmit for existing water rights	4	2	4	Agreement with stakeholders, section D mitigation	Upfront $
on of 15 cfs permit to water right	4	2	3		Reaches B and D. Have to get extension before 'prove' up. Issue of prior grou applications
vater regulations, i.e., requires treatment	2	5	5		Gordon Grant Study EWEB, timing of surface water, most of the resource is gr
raise rates	5	1	3		
ke	2	3	5	County? City has done analysis that requires fixing specific breaks.	Take out Bridge Creek and pipeline, bolted tanks
onomic recovery delayed	4	1	3		Ability to get increased rates
st fluctuations up wells	5	2	1		Negative
failure	5	2	1		Accelerate
on of surface water to groundwater injection torage and recovery recharge	4	2	1	Critical factor in economic analysis	Not on critical path, trigger full groundwater studies
Easements disagreement	2	3	3		
limate	3	3	1		
ty and cost of project financing	2	3	3		Stimulus package
d public response	3	1	3		Gets more negative as economy. Green initiative is a plus.
er Quality Standards	1	5	5		Issues beyond what we know
pportunity for joint road investment	1	5	5		
ntive changes	2	3	2		High probability of improving
hen power can be produced	2	3	2		
es Tier II watershed	3	2	1	Addressed by mitigation	Reach B
o flexibility to adjust 2012 schedule	3	2	1	Maintain current staff relationships, proactive friendly compliance order	Portland strategy to have exemption in Oregon Administrative Rules, stretches
tion material inflation	3	2	1		
Conditional Use	2	2	2	Early communication	USFS
g for new distribution	1	3	4		Connecting new wells in the system
Green tags	1	5	2		Currently low expect to increase
egulatory, total maximum daily load	2	2	1	Addressing D segment, i.e., wet, run water quality model	
g of National Environmental Policy Act ents (creek crossings, new alignment)	3	1	1	Avoid creeks (go under), relocate out of wetland	Impacts can be avoided
st fluctuations down hydro	1	5	1		Positive
rastructure failure ,wells, tanks diversion	2	2	1		
ns staff challenge of new facilities (wells)	3	1	1		Bigger issue if all wells. City has standby power. Can plant operations be 24-h
ty of infrastructure for interconnects to grid	1	2	1		
permits/conditional use (City, county, federal)	1	1	1		City involved in well permitting
from other water agencies, potable and irrigation	1	1	1	Already have agreements with irrigation districts	
change impacts on flows	1	1	1		Climate change a high probability however impact on Springs

Allocation of identified risks to the screened alternatives is presented in Table 2-5. The alternative assigned the highest risk is Alternative 7, followed in descending order by Alternatives 3, 6, 4, and 5. The highest risk categories carried by Alternative 3 are related to the risks of implementing the hydropower element of the project.

Table 2-5. Risk Matrix–Prioritized by Risk Category

Risk number	Risk description	Risk score	Alternative risk allocation				
			3 BCSS	4 Tumalo Creek	5 Deschutes River	6 GW	7 Canal
1	Ability to add new wells	45	0	0	0	45	0
2	Hydropower permit for new water rights	40	40	0	0	0	0
3	Hydropower permit for Federal Energy Regulatory Commission	40	40	0	0	0	0
4	Unknown time, mitigation, public, operational constraints	40	0	40	40	40	40
5	Watershed fire	40	0	0	0	0	0
6	Competition for in-stream water	36	36	36	36	0	36
7	Council support	30	0	30	30	30	30
8	Impact on ongoing initiatives with other local agencies	27	27	27	27	27	27
9	Hydropower permit for existing water rights	24	24	0	0	0	0
10	Conversion of 15 cfs permit to water right	20	20	20	20	20	20
11	Groundwater regulations, i.e., requires treatment	20	0	0	0	20	0
12	Ability to raise rates	20	0	20	20	20	20
13	Earthquake	16	0	0	0	0	16
14	Local economic recovery delayed	16	0	16	16	16	16
15	Power cost fluctuations up wells	15	15	0	0	15	0
16	Pipeline failure	15	0	0	0	0	0
17	Conversion of surface water to groundwater injection aquifer storage and recovery recharge	12	12	12	12	12	12
18	Existing easements disagreement	12	12	12	0	0	12
19	Bidding climate	12	12	12	12	12	12
20	Availability and cost of project financing	12	0	12	12	12	12
21	Ill defined public response	12	12	12	12	12	12
22	USEPA water quality standards	10	0	0	0	10	0
23	Missed opportunity for joint road investment	10	0	10	10	10	10
24	Tax incentive changes	10	10	0	0	0	0
25	Timing when power can be produced	10	10	0	0	0	0
Cumulative risk score			270	259	247	268	275

2.3.2.5 Combining Preliminary Cost Data with Qualitative Risk Scores

The net present value of the alternatives and the risk scores are combined in Table 2-6. Alternative 3 is clearly the alternative with the lowest adjusted NPV that meets the LOS requirements, followed by Alternatives 4, 6, 5, and 7, respectively. As identified in the risk assessment, Alternative 3 carries the unique risks related to obtaining regulatory approval for the hydropower portion of the alternative. In the further evaluation of the preferred alternative in this phase and subsequent phases, the specific risks and mitigation strategies to manage the regulatory risks will be developed.

Table 2-6. Final Alternative Ranking

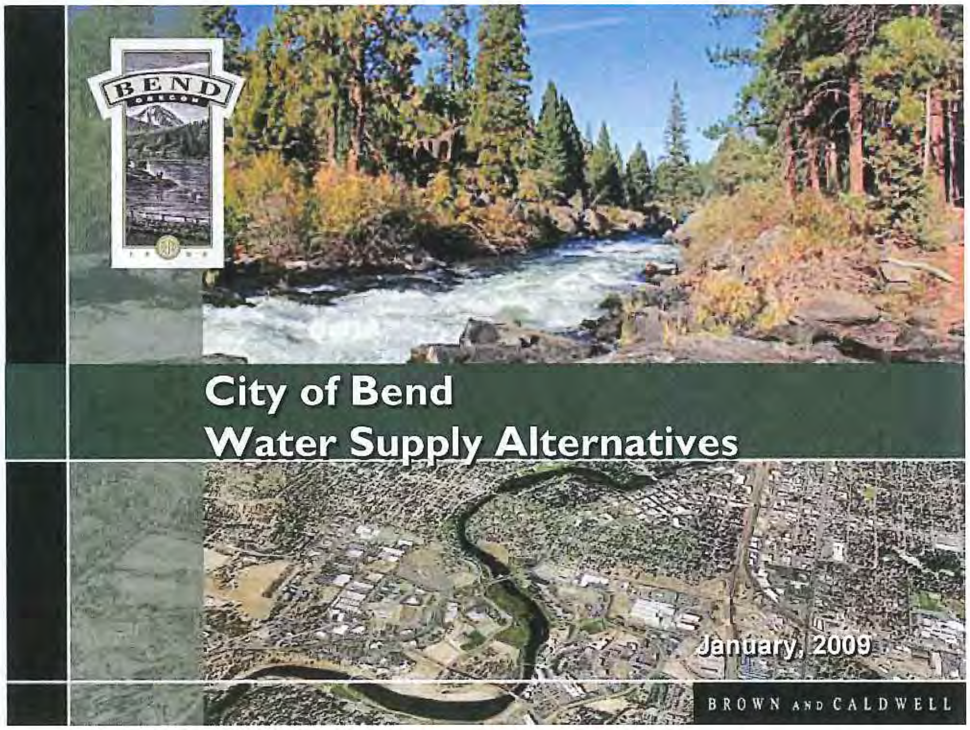
Alternative number	Alternative description	NPV, $ millions	Relativ e NPV	Risk score	Risk cost adjustment factor	Combined NPV/risk relative score	Alternative ranking
3	Renew Bridge Creek intake and filter water	23.00	1	270	1.09	1.09	1
4	Intake on Tumalo Creek near Outback site	(70.40)	(3.06)	259	1.05	(3.21)	2
5	Intake and pump station on Deschutes River	(94.20)	(4.10)	247	1	(4.10)	4
6	Increase well capacity and abandon BCSS	(88.10)	(3.83)	268	1.09	(4.16)	3
7	Intake and pump station on existing canal	(104.60)	(4.55)	275	1.11	(5.06)	5

Notes:

1. The NPV numbers for this analysis were developed from preliminary estimates of cost and revenue generated for this purpose by Brown and Caldwell. They are included in Appendix C.
2. The Relative NPV is the NPV of an alternative divided by the NPV of the lowest cost alternative. As an example for alternative the Relative NPV of Alternative 6 is negative $88.10 million divided by positive $13.00 million or negative 3.83.
3. Risk cost adjustment factor is the normalized risk score relative to the lowest risk alternative. In this case, the specific alternative risk score divided by 247.
4. Combined NPV/risk relative score is the product of the relative NPV multiplied times the risk cost adjustment factor. As an example, for Alternative 6 the value is negative 3.83 X 1.09 = (4.16).

APPENDIX 2-A

Description of the Business Case Evaluation Process



BCE Process for Selecting the Preferred Alternative

- Identifies the Full Cost of Ownership by Considering and Monetizing:
  - Capital
  - O&M
  - R&R
  - Community
  - Environment
  - Risk
- Preferred Alternatives Defined by Lowest Cost of Ownership that meets the Level of Service.

BROWN AND CALDWELL

The Business Case Evaluation Process

1. Form Expert Team
2. Describe Service Level Required of System
3. Document Problem Statement
4. Identify Alternative Solutions
5. Eliminate Fatally Flawed Alternatives
6. Develop Total Cost-of-Ownership for Each Alternative
7. Select Preferred Alternative
8. Document Decision

BROWN AND CALDWELL

Form Expert Team

1. **Form Expert Team**
2. Describe Service Level Required of System
3. Document Problem Statement
4. Identify Alternative Solutions
5. Eliminate Fatally Flawed Alternatives
6. Develop Total Cost-of-Ownership for Each Alternative
7. Select Preferred Alternative
8. Document Decision

- Experience in Operating System
- Experience in Maintaining System
- Experience in Planning System
- Experience in Financing / Budgeting
- Experience in Engineering
- Knowledge on Project Objectives
- Utility-wide Perspective
- 'Subject' Expertise

BROWN AND CALDWELL

Describe Service Level Required of System

Describing the service level requirement identifies what is expected.

Expectations for alternatives can be summarized in categories:

- •Performance (e.g. capacity, efficiency, water quality, etc.)
- •Reliability (e.g. expected O&M activities, redundancy, etc.)
- •Sustainability (eCO_2, fossil fuel)
- •Financial (bonding, rates)

BROWN AND CALDWELL

Document Problem Statement

- Define the problem in terms of level of service
- Understand the root cause for the project
- Document the Problem

BROWN AND CALDWELL

Identify Alternative Solutions

- Form Expert Team
- Describe Service Level Required of System
- Document Problem Statement
- **Identify Alternative Solutions**
- Eliminate Fatally Flawed Alternatives
- Develop Total Cost-of-Ownership for Each Alternative
- Select Preferred Alternative
- Document Decision

Potential solutions include:

- Do nothing new –retain existing system
- Water Treatment
- New Intakes
- Investment of R & R of existing assets
- New water sources
- Water rights transfer
- Maximizing hydro-electric potential

Each alternative should include:

- Description of solution and the system elements
- Potential O&M issues
- Community Impacts
- Environmental Impacts
- Risk

BROWN AND CALDWELL

Eliminate Fatally Flawed Alternatives

- Form Expert Team
- Describe Service Level Required of System
- Document Problem Statement
- Identify Alternative Solutions
- **Eliminate Fatally Flawed Alternatives**
- Develop Total Cost-of-Ownership for Each Alternative
- Select Preferred Alternative
- Document Decision

- Eliminate from consideration any solutions that are fatally flawed.
- Inability to solve problem or meet level of service requirement.
- Document fatal flaws
- Only viable solutions are subject to detailed evaluation.

BROWN AND CALDWELL

Compare Cost-of-Ownership for Each Alternative

- Form Expert Team
- Describe Service Level Required of System
- Document Problem Statement
- Identify Alternative Solutions
- Eliminate Fatally Flawed Alternatives
- **Develop Total Cost-of-Ownership for Each Alternative**
- Select Preferred Alternative
- Document Decision

Cost-of-ownership includes:

- Capital Costs (permits, engineering, construction, mitigation)
- Ongoing base O&M/R&R Costs
- Community Costs
- Environmental Costs
- Risk Costs (Risk is defined by identifying potential failure modes, assigning a probability to each failure mode, and identifying the cost of a failure.)The product of the annual probability of a failure and the cost of a failure is the annual risk cost.
- Adding these costs and reformulating all costs into net present value (NPV) allows for comparing alternatives

BROWN AND CALDWELL

Select Preferred Alternative

- Form Expert Team
- Describe Service Level Required of System
- Document Problem Statement
- Identify Alternative Solutions
- Eliminate Fatally Flawed Alternatives
- Develop Total Cost-of-Ownership for Each Alternative
- **Select Preferred Alternative**
- Document Decision

The preferred alternative is the alternative with the lowest total cost-of-ownership in terms of NPV that meets the Level of Service

BROWN AND CALDWELL

Document Decision

1. Form Expert Team
2. Describe Service Level Required of System
3. Document Problem Statement
4. Identify Alternative Solutions
5. Eliminate Fatally Flawed Alternatives
6. Develop Total Cost-of-Ownership for Each Alternative
7. Select Preferred Alternative
8. **Document Decision**

- The Team
- The Problem Statement
- Alternatives Considered
- Evaluation Outcome
- Preferred Alternative

BROWN AND CALDWELL

Draft Problem Statement

1. Form Expert Team
2. Describe Service Level Required of System
3. Document Problem Statement
4. Identify Alternative Solutions
5. Eliminate Fatally Flawed Alternatives
6. Develop Total Cost-of-Ownership for Each Alternative
7. Select Preferred Alternative
8. Document Decision

Unable to assure current and future surface water supply quality and quantity requirements

Root Cause:

- Comply with EPA Surface Water Rules 2012
- Risk of contamination of source water
- Risk of watershed fire impacts
- Forest Service Window Opp.
- Aging infrastructure (pipeline, intake)
- Increased human activity in watershed

BROWN AND CALDWELL


Level of Service
Form Expert Team
Describe Service Level Required of System
Document Problem Statement
Identify Alternative Solutions
Eliminate Fatally Flawed Alternatives
Develop Total Cost-of-Ownership for Each Alternative
Select Preferred Alternative
Document Decision
• Maintain City Control
• Maintain dual source of supply
• Maximize existing assets
• Minimize energy consumption
• Minimize cost (capitol, O&M)of supply
• Maintain current water aesthetics
• Meet regulatory requirements
• Provide flexibility for future
• Achieve environmentally sound projects
• Maximize potential for renewable energy
• Maintain ability to provide community safety (serve peak during power outage, fire)
BROWN AND CALDWELL

APPENDIX 2-B

List of Workshop Participants

Bend Water Supply Alternatives Kick-Off Meeting List of Attendees, January 7, 2009	
Attendee	**Company**
Tom Hickmann	City of Bend
Heidi Lansdowne	City of Bend
Patrick Griffiths	City of Bend
Michelle Cheek	Black & Veatch
Kevin Crew	Black Rock Consulting
Jim Doane	Brown and Caldwell
Ed Olson	Brown and Caldwell
Phil Roppo	Brown and Caldwell
David Prull	David Evans and Associates
Adam Sussman	GSI Water Solutions
Karen Swirsky	David Evans and Associates
Pat Van Duser	Black & Veatch
Jack Warburton	Brown and Caldwell
Bob Willis	Brown and Caldwell

APPENDIX 2-C

Net Present Worth Value Calculations for Various Alternatives

Alternative	Construction Costs Power	Construction Costs Water Supply	Capital Costs Total	O & M Costs	Revenue	Net Present Surplus or (Net Present Cost)
Alternative 1 – Do Nothing	$0	$0	$0	$0	$0	0
Alternative 2 – No Upgrades to Spring Supply but Add UV	$0	$2,400,000	$3,200,000	$9,100,000	$0	(12,300,000)
Alternative 3 – Renew Bridge Creek Intake & add filtration	$41,400,000	$27,700,000	$56,100,000	$7,900,000	$87,000,000	23,000,000
Alternative 4 – Intake on Tumalo Creek near Outback Site & add filtration	$0	$30,300,000	$40,500,000	$29,900,000	$0	(70,400,000)
Alternative 5 – Intake and Pump Station on Deschutes River & add filtration +	$0	$40,000,000	$53,500,000	$40,700,000	$0	(94,200,000)
Alternative 6 – Add Well Capacity to Replace Bridge Creek Supply	$0	$21,200,000	$28,400,000	$59,700,000	$0	(88,100,000)
Alternative 7 – Intake on Existing Canal & add filtration ++	$0	$44,300,000	$59,200,000	$45,400,000	$0	(104,600,000)

Project Cost	
Costs/Power	$ -
Costs/Water	$ -
	$ -
ant	$ -
d Capital Costs	$ -

Financial Parameters	
Life of Bonds	25
Life of Project	50
Interest	5.50%
Inflation	3.00%
Green Tag, Cost and Value of Power Beyond 2024	5.70%

12	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	0	0	0	0	0	0	0	0	0	0	0
739	0.0781	0.0826	0.0873	0.0922	0.0975	0.1031	0.1089	0.1151	0.1217	0.1286	0.1360
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
-	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
69	0.069	0.071	0.074	0.077	0.078	0.080	0.071	0.081	0.081	0.081	0.081
10	0.011	0.011	0.012	0.012	0.013	0.014	0.015	0.016	0.016	0.017	0.018
20	0.021	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-	-
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-	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
1	**0.97087**	**0.94260**	**0.91514**	**0.88849**	**0.86261**	**0.83748**	**0.81309**	**0.78941**	**0.76642**	**0.74409**	**0.72242**
-	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
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Project Cost	
Costs/Power	$ -
Costs/Water	$ -
	$ -
ant	$ -
d Capital Costs	$ -

Financial Parameters	
Life of Bonds	25
Life of Project	50
Interest	5.50%
Inflation	3.00%
Green Tag, Cost and Value of Power Beyond 2024	5.70%

26	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$
	0	0	0	0	0	0	0	0	0	0	
06	0.1697	0.1794	0.1896	0.2004	0.2119	0.2239	0.2367	0.2502	0.2645	0.2795	0
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$
90	0.095	0.101	0.106	0.112	0.119	0.126	0.133	0.140	0.148	0.157	(
22	0.023	0.024	0.026	0.027	0.029	0.030	0.032	0.034	0.036	0.038	(
-	-	-	-	-	-	-	-	-	-	-	
-	-	-	-	-	-	-	-	-	-	-	
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$
112	0.64186	0.62317	0.60502	0.58739	0.57029	0.55368	0.53755	0.52189	0.50669	0.49193	0.
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$

Project Cost	
Costs/Power	$ -
Costs/Water	$ -
	$ -
ant	$ -
d Capital Costs	$ -

Financial Parameters	
Life of Bonds	25
Life of Project	50
Interest	5.50%
Inflation	3.00%
Green Tag, Cost and Value of Power Beyond 2024	5.70%

39	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$
	0	0	0	0	0	0	0	0	0	0	
301	0.3489	0.3688	0.3898	0.4121	0.4356	0.4604	0.4866	0.5144	0.5437	0.5747	0
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$
85	0.196	0.207	0.219	0.231	0.244	0.258	0.273	0.288	0.305	0.322	(
45	0.047	0.050	0.053	0.056	0.059	0.062	0.066	0.070	0.074	0.078	(
-	-	-	-	-	-	-	-	-	-	-	
-	-	-	-	-	-	-	-	-	-	-	
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$
019	**0.43708**	**0.42435**	**0.41199**	**0.39999**	**0.38834**	**0.37703**	**0.36604**	**0.35538**	**0.34503**	**0.33498**	**0.**
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$

Project Cost	
Costs/Power	$ -
Costs/Water	$ -
	$ -
ant	$ -
d Capital Costs	$ -

Financial Parameters	
Life of Bonds	25
Life of Project	50
Interest	5.50%
Inflation	3.00%
Green Tag, Cost and Value of Power Beyond 2024	5.70%

52	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	0	0	0	0	0	0	0	0	0	0
786	0.7173	0.7582	0.8014	0.8471	0.8954	0.9464	1.0004	1.0574	1.1177	1.1814
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
81	0.402	0.425	0.449	0.475	0.502	0.531	0.561	0.593	0.627	0.662
92	0.097	0.103	0.108	0.115	0.121	0.128	0.135	0.143	0.151	0.160
-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
656	**0.29763**	**0.28896**	**0.28054**	**0.27237**	**0.26444**	**0.25674**	**0.24926**	**0.24200**	**0.23495**	**0.22811**
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -

Cost		
ower	$	-
/ater	$	2,385,000
	$	-
	$	-
l Costs	$	2,385,000

Financial Parameters

Life of Bonds	25
Life of Project	50
Interest	5.50%
Inflation	3.00%
Green Tag, Cost and Value of Power Beyond 2024	5.70%

	2013	2014	2015	2016	2017	2018	2019	2020	2021
0	$ 177,800	$ 177,800	$ 177,800	$ 177,800	$ 177,800	$ 177,800	$ 177,800	$ 177,800	$ 177,8
0	$ 103,000	$ 106,090	$ 109,273	$ 112,551	$ 115,927	$ 119,405	$ 122,987	$ 126,677	$ 130,4
	514104	514104	514104	514104	514104	514104	514104	514104	514104
	0.0781	0.0826	0.0873	0.0922	0.0975	0.1031	0.1089	0.1151	0.1217
2	$ 40,158	$ 42,447	$ 44,866	$ 47,424	$ 50,127	$ 52,984	$ 56,004	$ 59,196	$ 62,5
2	**$ 320,958**	**$ 326,337**	**$ 331,939**	**$ 337,775**	**$ 343,854**	**$ 350,189**	**$ 356,792**	**$ 363,674**	**$ 370,8**
	0.069	0.071	0.074	0.077	0.078	0.080	0.071	0.081	0.081
	0.011	0.011	0.012	0.012	0.013	0.014	0.015	0.016	0.016
	0.021	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	-	-	-	-	-	-	-	-	-
	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	$ -	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
2)	**$ (320,958)**	**$ (326,337)**	**$ (331,939)**	**$ (337,775)**	**$ (343,854)**	**$ (350,189)**	**$ (356,792)**	**$ (363,674)**	**$ (370,8**
1	**0.97087**	**0.94260**	**0.91514**	**0.88849**	**0.86261**	**0.83748**	**0.81309**	**0.78941**	**0.76642**
0	**$ 172,622**	**$ 167,594**	**$ 162,712**	**$ 157,973**	**$ 153,372**	**$ 148,905**	**$ 144,568**	**$ 140,357**	**$ 136,2**
2	**$ 138,988**	**$ 140,010**	**$ 141,059**	**$ 142,135**	**$ 143,240**	**$ 144,373**	**$ 145,536**	**$ 146,730**	**$ 147,9**
	$ -	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
2)	**$ (311,610)**	**$ (307,604)**	**$ (303,771)**	**$ (300,108)**	**$ (296,612)**	**$ (293,278)**	**$ (290,104)**	**$ (287,087)**	**$ (284,2**
0	**$ 350,422**	**$ 518,016**	**$ 680,728**	**$ 838,701**	**$ 992,073**	**$ 1,140,978**	**$ 1,285,546**	**$ 1,425,903**	**$ 1,562,1**
2	**$ 276,980**	**$ 416,991**	**$ 558,050**	**$ 700,185**	**$ 843,425**	**$ 987,798**	**$ 1,133,335**	**$ 1,280,065**	**$ 1,428,0**
	$ -	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
2)	**$ (627,402)**	**$ (935,006)**	**$ (1,238,778)**	**$ (1,538,886)**	**$ (1,835,498)**	**$ (2,128,776)**	**$ (2,418,880)**	**$ (2,705,968)**	**$ (2,990,1**
3									
1									

Cost	
ower	$ -
/ater	$ 2,385,000
	$ -
	$ -
al Costs	$ 2,385,000

Financial Parameters

Life of Bonds	25
Life of Project	50
Interest	5.50%
Inflation	3.00%
Green Tag, Cost and Value of Power Beyond 2024	5.70%

	2025	2026	2027	2028	2029	2030	2031	2032	2033
0	$ 177,800	$ 177,800	$ 177,800	$ 177,800	$ 177,800	$ 177,800	$ 177,800	$ 177,800	$ 177,8
6	$ 146,853	$ 151,259	$ 155,797	$ 160,471	$ 165,285	$ 170,243	$ 175,351	$ 180,611	$ 186,0
	514104	514104	514104	514104	514104	514104	514104	514104	514104
	0.1519	0.1606	0.1697	0.1794	0.1896	0.2004	0.2119	0.2239	0.2367
2	$ 78,103	$ 82,555	$ 87,261	$ 92,235	$ 97,492	$ 103,049	$ 108,923	$ 115,132	$ 121,6
8	$ 402,757	$ 411,614	$ 420,858	$ 430,506	$ 440,577	$ 451,093	$ 462,074	$ 473,543	$ 485,5
	0.085	0.090	0.095	0.101	0.106	0.112	0.119	0.126	0.133
	0.021	0.022	0.023	0.024	0.026	0.027	0.029	0.030	0.032
	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-
	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
8)	$ (402,757)	$ (411,614)	$ (420,858)	$ (430,506)	$ (440,577)	$ (451,093)	$ (462,074)	$ (473,543)	$ (485,5
	0.68095	0.66112	0.64186	0.62317	0.60502	0.58739	0.57029	0.55368	0.53755
5	$ 121,073	$ 117,547	$ 114,123	$ 110,799	$ 107,572	$ 104,439	$ 101,397	$ 98,444	$ 95,5
6	$ 153,185	$ 154,579	$ 156,009	$ 157,478	$ 158,984	$ 160,531	$ 162,117	$ 163,746	$ 165,4
	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
2)	$ (274,258)	$ (272,126)	$ (270,133)	$ (268,277)	$ (266,556)	$ (264,969)	$ (263,514)	$ (262,189)	$ (260,9
4	$ 2,068,697	$ 2,186,244	$ 2,300,368	$ 2,411,167	$ 2,518,739	$ 2,623,178	$ 2,724,575	$ 2,823,018	$ 2,918,5
0	$ 2,032,745	$ 2,187,324	$ 2,343,333	$ 2,500,811	$ 2,659,795	$ 2,820,326	$ 2,982,443	$ 3,146,189	$ 3,311,6
	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
5)	$ (4,101,442)	$ (4,373,568)	$ (4,643,701)	$ (4,911,978)	$ (5,178,534)	$ (5,443,504)	$ (5,707,018)	$ (5,969,207)	$ (6,230,2

Cost	
ower	$ -
/ater	$ 2,385,000
	$ -
	$ -
l Costs	$ 2,385,000

Financial Parameters

Life of Bonds	25
Life of Project	50
Interest	5.50%
Inflation	3.00%
Green Tag, Cost and Value of Power Beyond 2024	5.70%

	2037	2038	2039	2040	2041	2042	2043	2044	2045
0	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
9	$ 209,378	$ 215,659	$ 222,129	$ 228,793	$ 235,657	$ 242,726	$ 250,008	$ 257,508	$ 265,2
	514104	514104	514104	514104	514104	514104	514104	514104	514104
	0.2955	0.3123	0.3301	0.3489	0.3688	0.3898	0.4121	0.4356	0.4604
3	$ 151,904	$ 160,563	$ 169,715	$ 179,389	$ 189,614	$ 200,422	$ 211,846	$ 223,921	$ 236,6
2	**$ 361,282**	**$ 376,222**	**$ 391,844**	**$ 408,181**	**$ 425,270**	**$ 443,148**	**$ 461,854**	**$ 481,429**	**$ 501,9**
	0.166	0.175	0.185	0.196	0.207	0.219	0.231	0.244	0.258
	0.040	0.042	0.045	0.047	0.050	0.053	0.056	0.059	0.062
	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-
	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	$ -	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
2)	**$ (361,282)**	**$ (376,222)**	**$ (391,844)**	**$ (408,181)**	**$ (425,270)**	**$ (443,148)**	**$ (461,854)**	**$ (481,429)**	**$ (501,9**
	0.47761	**0.46369**	**0.45019**	**0.43708**	**0.42435**	**0.41199**	**0.39999**	**0.38834**	**0.37703**
6	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
7	**$ 172,550**	**$ 174,452**	**$ 176,404**	**$ 178,407**	**$ 180,462**	**$ 182,571**	**$ 184,736**	**$ 186,957**	**$ 189,2**
	$ -	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
3)	**$ (172,550)**	**$ (174,452)**	**$ (176,404)**	**$ (178,407)**	**$ (180,462)**	**$ (182,571)**	**$ (184,736)**	**$ (186,957)**	**$ (189,2**
3	**$ 3,188,943**	**$ 3,188,943**	**$ 3,188,943**	**$ 3,188,943**	**$ 3,188,943**	**$ 3,188,943**	**$ 3,188,943**	**$ 3,188,943**	**$ 3,188,9**
5	**$ 3,990,875**	**$ 4,165,328**	**$ 4,341,731**	**$ 4,520,138**	**$ 4,700,600**	**$ 4,883,171**	**$ 5,067,906**	**$ 5,254,863**	**$ 5,444,1**
	$ -	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
8)	**$ (7,179,819)**	**$ (7,354,271)**	**$ (7,530,674)**	**$ (7,709,081)**	**$ (7,889,543)**	**$ (8,072,114)**	**$ (8,256,850)**	**$ (8,443,806)**	**$ (8,633,0**

Cost		
ower	$	-
/ater	$	2,385,000
	$	-
	$	-
al Costs	$	2,385,000

Financial Parameters

Life of Bonds	25
Life of Project	50
Interest	5.50%
Inflation	3.00%
Green Tag, Cost and Value of Power Beyond 2024	5.70%

	2049	2050	2051	2052	2053	2054	2055	2056	2057
	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
8	$ 298,523	$ 307,478	$ 316,703	$ 326,204	$ 335,990	$ 346,070	$ 356,452	$ 367,145	$ 378,1
	514104	514104	514104	514104	514104	514104	514104	514104	514104
	0.5747	0.6074	0.6421	0.6786	0.7173	0.7582	0.8014	0.8471	0.8954
8	$ 295,440	$ 312,280	$ 330,080	$ 348,895	$ 368,782	$ 389,802	$ 412,021	$ 435,506	$ 460,3
6	**$ 593,963**	**$ 619,759**	**$ 646,783**	**$ 675,099**	**$ 704,772**	**$ 735,872**	**$ 768,473**	**$ 802,652**	**$ 838,4**
	0.322	0.341	0.360	0.381	0.402	0.425	0.449	0.475	0.502
	0.078	0.082	0.087	0.092	0.097	0.103	0.108	0.115	0.121
	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-
	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
6)	$ (593,963)	$ (619,759)	$ (646,783)	$ (675,099)	$ (704,772)	$ (735,872)	$ (768,473)	$ (802,652)	$ (838,4
	0.33498	0.32523	0.31575	0.30656	0.29763	0.28896	0.28054	0.27237	0.26444
	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
9	$ 198,967	$ 201,562	$ 204,224	$ 206,956	$ 209,760	$ 212,637	$ 215,590	$ 218,620	$ 221,7
	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
9)	$ (198,967)	$ (201,562)	$ (204,224)	$ (206,956)	$ (209,760)	$ (212,637)	$ (215,590)	$ (218,620)	$ (221,7
3	$ 3,188,943	$ 3,188,943	$ 3,188,943	$ 3,188,943	$ 3,188,943	$ 3,188,943	$ 3,188,943	$ 3,188,943	$ 3,188,9
0	$ 6,225,058	$ 6,426,620	$ 6,630,844	$ 6,837,800	$ 7,047,560	$ 7,260,197	$ 7,475,786	$ 7,694,406	$ 7,916,1
	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
3)	$ (9,414,001)	$ (9,615,563)	$ (9,819,787)	$ (10,026,743)	$ (10,236,503)	$ (10,449,140)	$ (10,664,729)	$ (10,883,349)	$ (11,105,0

Cost	
ower	$ -
/ater	$ 2,385,000
	$ -
	$ -
l Costs	$ 2,385,000

Financial Parameters

Life of Bonds	25
Life of Project	50
Interest	5.50%
Inflation	3.00%
Green Tag, Cost and Value of Power Beyond 2024	5.70%

	2061	2062
	$ -	$ -
5	$ 425,622	$ 438,391
	514104	514104
	1.1177	1.1814
9	$ 574,605	$ 607,358
4	**$ 1,000,227**	**$ 1,045,748**
	0.627	0.662
	0.151	0.160
	-	-
	-	-
	$ -	$ -
	$ -	$ -
	$ -	$ -
	$ -	**$ -**
4)	**$ (1,000,227)**	**$ (1,045,748)**
	0.23495	**0.22811**
	$ -	**$ -**
5	**$ 235,004**	**$ 238,543**
	$ -	**$ -**
5)	**$ (235,004)**	**$ (238,543)**
3	**$ 3,188,943**	**$ 3,188,943**
5	**$ 8,835,809**	**$ 9,074,351**
	$ -	**$ -**
8)	**$ (12,024,752)**	**$ (12,263,294)**

ed in Flows

ont Project Cost	
ital Costs/Power	$ 41,400,000
ital Costs/Water	$ 27,700,000
and BETC Grants	$ 23,020,000
Grant	$ 4,140,000
isted Capital Costs	$ 41,940,000

Financial Parameters	
Life of Bonds	25
Life of Project	50
Interest	5.50%
Inflation	3.00%
Green Tag, Cost and Value of	5.70%

2012	2013	2014	2015	2016	2017	2018	2019	2020	
3,126,600	$ 3,126,600	$ 3,126,600	$ 3,126,600	$ 3,126,600	$ 3,126,600	$ 3,126,600	$ 3,126,600	$ 3,126,600	$
125,000	$ 128,750	$ 132,613	$ 136,591	$ 140,689	$ 144,909	$ 149,257	$ 153,734	$ 158,346	$
200,000	200,000	200,000	200,000	200,000	200,000	200,000	200,000	200,000	
0.0739	0.0781	0.0826	0.0873	0.0922	0.0975	0.1031	0.1089	0.1151	
14,780	$ 15,622	$ 16,513	$ 17,454	$ 18,449	$ 19,501	$ 20,612	$ 21,787	$ 23,029	$
3,266,380	**$ 3,270,972**	**$ 3,275,725**	**$ 3,280,645**	**$ 3,285,738**	**$ 3,291,010**	**$ 3,296,469**	**$ 3,302,121**	**$ 3,307,975**	**$**
0.069	0.069	0.071	0.074	0.077	0.078	0.080	0.071	0.081	
0.022	0.023	0.025	0.026	0.027	0.029	0.031	0.032	0.034	
0.044	0.047	0.049	0.052	0.055	0.058	0.061	0.065	0.069	
5,910,000	11,820,000	11,460,000	11,460,000	11,460,000	11,740,000	12,020,000	12,020,000	12,020,000	
407,790	$ 817,944	$ 818,244	$ 850,332	$ 881,274	$ 918,068	$ 957,994	$ 855,824	$ 972,418	$
130,020	$ 274,862	$ 281,681	$ 297,737	$ 314,708	$ 340,773	$ 368,788	$ 389,809	$ 412,028	$
260,040	$ 549,725	$ 563,362	$ 595,473	$ 629,415	$ 681,547	$ 737,576	$ 779,618	$ 824,057	$
797,850	**$ 1,642,531**	**$ 1,663,286**	**$ 1,743,542**	**$ 1,825,397**	**$ 1,940,388**	**$ 2,064,359**	**$ 2,025,252**	**$ 2,208,503**	**$**
(2,468,530)	**$ (1,628,441)**	**$ (1,612,439)**	**$ (1,537,103)**	**$ (1,460,341)**	**$ (1,350,622)**	**$ (1,232,110)**	**$ (1,276,870)**	**$ (1,099,472)**	**$**
1	**0.97087**	**0.94260**	**0.91514**	**0.88849**	**0.86261**	**0.83748**	**0.81309**	**0.78941**	
3,126,600	**$ 3,035,534**	**$ 2,947,120**	**$ 2,861,282**	**$ 2,777,943**	**$ 2,697,033**	**$ 2,618,478**	**$ 2,542,212**	**$ 2,468,167**	**$**
139,780	**$ 140,167**	**$ 140,565**	**$ 140,973**	**$ 141,392**	**$ 141,821**	**$ 142,262**	**$ 142,715**	**$ 143,179**	**$**
797,850	**$ 1,594,690**	**$ 1,567,807**	**$ 1,595,588**	**$ 1,621,841**	**$ 1,673,796**	**$ 1,728,868**	**$ 1,646,715**	**$ 1,743,413**	**$**
(2,468,530)	**$ (1,581,011)**	**$ (1,519,878)**	**$ (1,406,667)**	**$ (1,297,494)**	**$ (1,165,058)**	**$ (1,031,873)**	**$ (1,038,212)**	**$ (867,933)**	**$**
3,126,600	**$ 6,162,134**	**$ 9,109,254**	**$ 11,970,536**	**$ 14,748,479**	**$ 17,445,512**	**$ 20,063,990**	**$ 22,606,202**	**$ 25,074,368**	**$**
139,780	**$ 279,947**	**$ 420,512**	**$ 561,486**	**$ 702,877**	**$ 844,699**	**$ 986,961**	**$ 1,129,676**	**$ 1,272,855**	**$**
797,850	**$ 2,392,540**	**$ 3,960,347**	**$ 5,555,935**	**$ 7,177,776**	**$ 8,851,572**	**$ 10,580,440**	**$ 12,227,155**	**$ 13,970,568**	**$**
(2,468,530)	**$ (4,049,541)**	**$ (5,569,419)**	**$ (6,976,086)**	**$ (8,273,580)**	**$ (9,438,638)**	**$ (10,470,511)**	**$ (11,508,723)**	**$ (12,376,656)**	**$**
56,077,264									
7,921,128									
87,017,392									
23,019,000									

ed in Flows

ont Project Cost	
ital Costs/Power	$ 41,400,000
ital Costs/Water	$ 27,700,000
and BETC Grants	$ 23,020,000
Grant	$ 4,140,000
isted Capital Costs	$ 41,940,000

Financial Parameters	
Life of Bonds	25
Life of Project	50
Interest	5.50%
Inflation	3.00%
Green Tag, Cost and Value of	5.70%

2023	2024	2025	2026	2027	2028	2029	2030	2031	
3,126,600	$ 3,126,600	$ 3,126,600	$ 3,126,600	$ 3,126,600	$ 3,126,600	$ 3,126,600	$ 3,126,600	$ 3,126,600	$
173,029	$ 178,220	$ 183,567	$ 189,074	$ 194,746	$ 200,588	$ 206,606	$ 212,804	$ 219,188	$
200,000	200,000	200,000	200,000	200,000	200,000	200,000	200,000	200,000	
0.1360	0.1437	0.1519	0.1606	0.1697	0.1794	0.1896	0.2004	0.2119	
27,196	$ 28,746	$ 30,384	$ 32,116	$ 33,947	$ 35,882	$ 37,927	$ 40,089	$ 42,374	$
3,326,825	**$ 3,333,566**	**$ 3,340,551**	**$ 3,347,790**	**$ 3,355,293**	**$ 3,363,070**	**$ 3,371,133**	**$ 3,379,493**	**$ 3,388,162**	**$**
0.081	0.081	0.085	0.090	0.095	0.101	0.106	0.112	0.119	
0.040	0.043	0.045	0.048	0.051	0.053	0.056	0.060	0.063	
-	-	-	-	-	-	-	-	-	
12,020,000	12,020,000	12,020,000	12,020,000	12,020,000	12,020,000	12,020,000	12,020,000	12,020,000	
973,620	$ 968,812	$ 1,024,034	$ 1,082,404	$ 1,144,101	$ 1,209,315	$ 1,278,246	$ 1,351,106	$ 1,428,119	$
486,577	$ 514,312	$ 543,628	$ 574,615	$ 607,368	$ 641,988	$ 678,581	$ 717,261	$ 758,144	$
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$
1,460,197	**$ 1,483,124**	**$ 1,567,662**	**$ 1,657,019**	**$ 1,751,469**	**$ 1,851,303**	**$ 1,956,827**	**$ 2,068,367**	**$ 2,186,263**	**$**
(1,866,627)	**$ (1,850,441)**	**$ (1,772,888)**	**$ (1,690,771)**	**$ (1,603,823)**	**$ (1,511,767)**	**$ (1,414,305)**	**$ (1,311,126)**	**$ (1,201,899)**	**$**
0.72242	**0.70138**	**0.68095**	**0.66112**	**0.64186**	**0.62317**	**0.60502**	**0.58739**	**0.57029**	
2,258,722	**$ 2,192,934**	**$ 2,129,062**	**$ 2,067,051**	**$ 2,006,845**	**$ 1,948,394**	**$ 1,891,644**	**$ 1,836,548**	**$ 1,783,056**	**$**
144,647	**$ 145,162**	**$ 145,690**	**$ 146,233**	**$ 146,789**	**$ 147,360**	**$ 147,946**	**$ 148,548**	**$ 149,165**	**$**
1,054,878	**$ 1,040,234**	**$ 1,067,502**	**$ 1,095,485**	**$ 1,124,202**	**$ 1,153,671**	**$ 1,183,913**	**$ 1,214,947**	**$ 1,246,795**	**$**
(1,348,491)	**$ (1,297,862)**	**$ (1,207,251)**	**$ (1,117,799)**	**$ (1,029,433)**	**$ (942,083)**	**$ (855,678)**	**$ (770,149)**	**$ (685,426)**	**$**
32,055,853	**$ 34,248,787**	**$ 36,377,850**	**$ 38,444,901**	**$ 40,451,746**	**$ 42,400,140**	**$ 44,291,784**	**$ 46,128,332**	**$ 47,911,388**	**$**
1,705,303	**$ 1,850,464**	**$ 1,996,155**	**$ 2,142,387**	**$ 2,289,176**	**$ 2,436,537**	**$ 2,584,483**	**$ 2,733,031**	**$ 2,882,197**	**$**
17,838,183	**$ 18,878,417**	**$ 19,945,919**	**$ 21,041,404**	**$ 22,165,605**	**$ 23,319,276**	**$ 24,503,189**	**$ 25,718,136**	**$ 26,964,932**	**$**
(15,922,972)	**$ (17,220,835)**	**$ (18,428,085)**	**$ (19,545,884)**	**$ (20,575,317)**	**$ (21,517,400)**	**$ (22,373,078)**	**$ (23,143,227)**	**$ (23,828,653)**	**$**

ed in Flows

ont Project Cost		
ital Costs/Power	$	41,400,000
ital Costs/Water	$	27,700,000
and BETC Grants	$	23,020,000
Grant	$	4,140,000
sted Capital Costs	$	41,940,000

Financial Parameters	
Life of Bonds	25
Life of Project	50
Interest	5.50%
Inflation	3.00%
Green Tag, Cost and Value of	5.70%

2034	2035	2036	2037	2038	2039	2040	2041	2042	
3,126,600	$ 3,126,600	$ 3,126,600	$ -	$ -	$ -	$ -	$ -	$ -	$
239,513	$ 246,698	$ 254,099	$ 261,722	$ 269,574	$ 277,661	$ 285,991	$ 294,571	$ 303,408	$
200,000	200,000	200,000	200,000	200,000	200,000	200,000	200,000	200,000	
0.2502	0.2645	0.2795	0.2955	0.3123	0.3301	0.3489	0.3688	0.3898	
50,041	$ 52,893	$ 55,908	$ 59,095	$ 62,463	$ 66,024	$ 69,787	$ 73,765	$ 77,969	$
3,416,154	**$ 3,426,191**	**$ 3,436,607**	**$ 320,817**	**$ 332,037**	**$ 343,685**	**$ 355,778**	**$ 368,335**	**$ 381,377**	**$**
0.140	0.148	0.157	0.166	0.175	0.185	0.196	0.207	0.219	
0.074	0.079	0.083	0.088	0.093	0.098	0.104	0.110	0.116	
-	-	-	-	-	-	-	-	-	
12,020,000	12,020,000	12,020,000	12,020,000	12,020,000	12,020,000	12,020,000	12,020,000	12,020,000	
1,686,512	$ 1,782,643	$ 1,884,254	$ 1,991,656	$ 2,105,180	$ 2,225,176	$ 2,352,011	$ 2,486,075	$ 2,627,782	$
895,317	$ 946,350	$ 1,000,292	$ 1,057,309	$ 1,117,575	$ 1,181,277	$ 1,248,610	$ 1,319,781	$ 1,395,008	$
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$
2,581,829	**$ 2,728,993**	**$ 2,884,546**	**$ 3,048,965**	**$ 3,222,756**	**$ 3,406,453**	**$ 3,600,621**	**$ 3,805,856**	**$ 4,022,790**	**$**
(834,325)	**$ (697,198)**	**$ (552,061)**	**$ 2,728,148**	**$ 2,890,719**	**$ 3,062,768**	**$ 3,244,843**	**$ 3,437,521**	**$ 3,641,413**	**$**
0.52189	**0.50669**	**0.49193**	**0.47761**	**0.46369**	**0.45019**	**0.43708**	**0.42435**	**0.41199**	
1,631,749	**$ 1,584,222**	**$ 1,538,080**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$**
151,116	**$ 151,801**	**$ 152,503**	**$ 153,224**	**$ 153,964**	**$ 154,723**	**$ 155,502**	**$ 156,302**	**$ 157,122**	**$**
1,347,437	**$ 1,382,758**	**$ 1,419,005**	**$ 1,456,203**	**$ 1,494,375**	**$ 1,533,548**	**$ 1,573,748**	**$ 1,615,001**	**$ 1,657,336**	**$**
(435,428)	**$ (353,265)**	**$ (271,578)**	**$ 1,302,979**	**$ 1,340,411**	**$ 1,378,825**	**$ 1,418,245**	**$ 1,458,699**	**$ 1,500,214**	**$**
52,954,961	**$ 54,539,184**	**$ 56,077,264**	**$ 56,077,264**	**$ 56,077,264**	**$ 56,077,264**	**$ 56,077,264**	**$ 56,077,264**	**$ 56,077,264**	**$**
3,333,560	**$ 3,485,361**	**$ 3,637,864**	**$ 3,791,088**	**$ 3,945,051**	**$ 4,099,774**	**$ 4,255,277**	**$ 4,411,579**	**$ 4,568,701**	**$**
30,904,866	**$ 32,287,624**	**$ 33,706,629**	**$ 35,162,832**	**$ 36,657,207**	**$ 38,190,755**	**$ 39,764,502**	**$ 41,379,503**	**$ 43,036,840**	**$**
(25,383,655)	**$ (25,736,920)**	**$ (26,008,498)**	**$ (24,705,519)**	**$ (23,365,108)**	**$ (21,986,283)**	**$ (20,568,038)**	**$ (19,109,339)**	**$ (17,609,125)**	**$**

ed in Flows

ont Project Cost	
ital Costs/Power	$ 41,400,000
ital Costs/Water	$ 27,700,000
and BETC Grants	$ 23,020,000
Grant	$ 4,140,000
isted Capital Costs	$ 41,940,000

Financial Parameters	
Life of Bonds	25
Life of Project	50
Interest	5.50%
Inflation	3.00%
Green Tag, Cost and Value of	5.70%

2045	2046	2047	2048	2049	2050	2051	2052	2053	
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$
331,542	$ 341,488	$ 351,733	$ 362,285	$ 373,153	$ 384,348	$ 395,878	$ 407,755	$ 419,987	$
200,000	200,000	200,000	200,000	200,000	200,000	200,000	200,000	200,000	
0.4604	0.4866	0.5144	0.5437	0.5747	0.6074	0.6421	0.6786	0.7173	
92,077	$ 97,325	$ 102,872	$ 108,736	$ 114,934	$ 121,485	$ 128,410	$ 135,729	$ 143,466	$
423,618	**$ 438,813**	**$ 454,605**	**$ 471,021**	**$ 488,087**	**$ 505,833**	**$ 524,288**	**$ 543,484**	**$ 563,453**	**$**
0.258	0.273	0.288	0.305	0.322	0.341	0.360	0.381	0.402	
0.137	0.145	0.153	0.162	0.171	0.181	0.191	0.202	0.214	
-	-	-	-	-	-	-	-	-	
12,020,000	12,020,000	12,020,000	12,020,000	12,020,000	12,020,000	12,020,000	12,020,000	12,020,000	
3,103,232	$ 3,280,116	$ 3,467,083	$ 3,664,707	$ 3,873,595	$ 4,094,390	$ 4,327,770	$ 4,574,453	$ 4,835,197	$
1,647,410	$ 1,741,312	$ 1,840,567	$ 1,945,480	$ 2,056,372	$ 2,173,585	$ 2,297,480	$ 2,428,436	$ 2,566,857	$
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$
4,750,642	**$ 5,021,429**	**$ 5,307,650**	**$ 5,610,186**	**$ 5,929,967**	**$ 6,267,975**	**$ 6,625,249**	**$ 7,002,889**	**$ 7,402,053**	**$**
4,327,024	**$ 4,582,616**	**$ 4,853,045**	**$ 5,139,165**	**$ 5,441,879**	**$ 5,762,142**	**$ 6,100,961**	**$ 6,459,405**	**$ 6,838,600**	**$**
0.37703	**0.36604**	**0.35538**	**0.34503**	**0.33498**	**0.32523**	**0.31575**	**0.30656**	**0.29763**	
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$
159,715	**$ 160,625**	**$ 161,559**	**$ 162,517**	**$ 163,501**	**$ 164,510**	**$ 165,546**	**$ 166,609**	**$ 167,699**	**$**
1,791,117	**$ 1,838,068**	**$ 1,886,251**	**$ 1,935,696**	**$ 1,986,438**	**$ 2,038,509**	**$ 2,091,946**	**$ 2,146,783**	**$ 2,203,058**	**$**
1,631,401	**$ 1,677,443**	**$ 1,724,692**	**$ 1,773,179**	**$ 1,822,937**	**$ 1,873,999**	**$ 1,926,400**	**$ 1,980,175**	**$ 2,035,359**	**$**
56,077,264	**$ 56,077,264**	**$ 56,077,264**	**$ 56,077,264**	**$ 56,077,264**	**$ 56,077,264**	**$ 56,077,264**	**$ 56,077,264**	**$ 56,077,264**	**$**
5,045,209	**$ 5,205,834**	**$ 5,367,394**	**$ 5,529,911**	**$ 5,693,412**	**$ 5,857,922**	**$ 6,023,468**	**$ 6,190,077**	**$ 6,357,776**	**$**
48,274,102	**$ 50,112,170**	**$ 51,998,421**	**$ 53,934,117**	**$ 55,920,555**	**$ 57,959,064**	**$ 60,051,010**	**$ 62,197,794**	**$ 64,400,852**	**$**
(12,848,371)	**$ (11,170,928)**	**$ (9,446,236)**	**$ (7,673,057)**	**$ (5,850,121)**	**$ (3,976,122)**	**$ (2,049,721)**	**$ (69,547)**	**$ 1,965,812**	**$**

ed in Flows

ont Project Cost	
ital Costs/Power	$ 41,400,000
ital Costs/Water	$ 27,700,000
and BETC Grants	$ 23,020,000
Grant	$ 4,140,000
isted Capital Costs	$ 41,940,000

Financial Parameters	
Life of Bonds	25
Life of Project	50
Interest	5.50%
Inflation	3.00%
Green Tag, Cost and Value of	5.70%

2056	2057	2058	2059	2060	2061	2062
-	$ -	$ -	$ -	$ -	$ -	$ -
458,932	$ 472,699	$ 486,880	$ 501,487	$ 516,531	$ 532,027	$ 547,988
200,000	200,000	200,000	200,000	200,000	200,000	200,000
0.8471	0.8954	0.9464	1.0004	1.0574	1.1177	1.1814
169,424	$ 179,081	$ 189,288	$ 200,078	$ 211,482	$ 223,537	$ 236,278
628,355	**$ 651,780**	**$ 676,169**	**$ 701,565**	**$ 728,014**	**$ 755,564**	**$ 784,267**
0.475	0.502	0.531	0.561	0.593	0.627	0.662
0.252	0.267	0.282	0.298	0.315	0.333	0.352
-	-	-	-	-	-	-
12,020,000	12,020,000	12,020,000	12,020,000	12,020,000	12,020,000	12,020,000
5,710,039	$ 6,035,512	$ 6,379,536	$ 6,743,169	$ 7,127,530	$ 7,533,799	$ 7,963,226
3,031,284	$ 3,204,067	$ 3,386,699	$ 3,579,741	$ 3,783,786	$ 3,999,462	$ 4,227,431
-	$ -	$ -	$ -	$ -	$ -	$ -
8,741,323	**$ 9,239,579**	**$ 9,766,235**	**$ 10,322,910**	**$ 10,911,316**	**$ 11,533,261**	**$ 12,190,657**
8,112,968	**$ 8,587,798**	**$ 9,090,066**	**$ 9,621,345**	**$ 10,183,302**	**$ 10,777,697**	**$ 11,406,390**
0.27237	**0.26444**	**0.25674**	**0.24926**	**0.24200**	**0.23495**	**0.22811**
-	$ -	$ -	$ -	$ -	$ -	$ -
171,146	**$ 172,356**	**$ 173,597**	**$ 174,871**	**$ 176,178**	**$ 177,520**	**$ 178,897**
2,380,890	**$ 2,443,301**	**$ 2,507,349**	**$ 2,573,076**	**$ 2,640,525**	**$ 2,709,743**	**$ 2,780,775**
2,209,744	**$ 2,270,946**	**$ 2,333,752**	**$ 2,398,205**	**$ 2,464,347**	**$ 2,532,223**	**$ 2,601,878**
56,077,264	**$ 56,077,264**	**$ 56,077,264**	**$ 56,077,264**	**$ 56,077,264**	**$ 56,077,264**	**$ 56,077,264**
6,867,709	**$ 7,040,065**	**$ 7,213,662**	**$ 7,388,533**	**$ 7,564,711**	**$ 7,742,232**	**$ 7,921,128**
71,362,622	**$ 73,805,924**	**$ 76,313,273**	**$ 78,886,349**	**$ 81,526,874**	**$ 84,236,617**	**$ 87,017,392**
8,417,650	**$ 10,688,596**	**$ 13,022,348**	**$ 15,420,552**	**$ 17,884,899**	**$ 20,417,122**	**$ 23,019,000**

ɔfront Project Cost		
ɪpital Costs/Power	$	-
ɪpital Costs/Water	$	30,259,178
ΞTC	$	-
ˈO Grant	$	-
ljusted Capital Costs	$	30,259,178

Financial Parameters	
Life of Bonds	25
Life of Project	50
Interest	5.50%
Inflation	3.00%
Green Tag, Cost and Value of Power Beyond 2024	5.70%

2012	2013	2014	2015	2016	2017	2018	2019	2020
2,255,802	$ 2,255,802	$ 2,255,802	$ 2,255,802	$ 2,255,802	$ 2,255,802	$ 2,255,802	$ 2,255,802	$ 2,255,802
125,000	$ 128,750	$ 132,613	$ 136,591	$ 140,689	$ 144,909	$ 149,257	$ 153,734	$ 158,346
3,049,525	3,049,525	3,049,525	3,049,525	3,049,525	3,049,525	3,049,525	3,049,525	3,049,525
0.0739	0.0781	0.0826	0.0873	0.0922	0.0975	0.1031	0.1089	0.1151
225,360	$ 238,205	$ 251,783	$ 266,135	$ 281,304	$ 297,339	$ 314,287	$ 332,201	$ 351,137
2,606,162	**$ 2,622,758**	**$ 2,640,198**	**$ 2,658,528**	**$ 2,677,795**	**$ 2,698,050**	**$ 2,719,346**	**$ 2,741,738**	**$ 2,765,285**
0.069	0.069	0.071	0.074	0.077	0.078	0.080	0.071	0.081
0.010	0.011	0.011	0.012	0.012	0.013	0.014	0.015	0.016
0.020	0.021	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-	-	-	-	-	-	-	-	-
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
(2,606,162)	**$ (2,622,758)**	**$ (2,640,198)**	**$ (2,658,528)**	**$ (2,677,795)**	**$ (2,698,050)**	**$ (2,719,346)**	**$ (2,741,738)**	**$ (2,765,285)**
1	**0.97087**	**0.94260**	**0.91514**	**0.88849**	**0.86261**	**0.83748**	**0.81309**	**0.78941**
2,255,802	**$ 2,190,099**	**$ 2,126,310**	**$ 2,064,378**	**$ 2,004,251**	**$ 1,945,875**	**$ 1,889,199**	**$ 1,834,174**	**$ 1,780,751**
350,360	**$ 356,267**	**$ 362,330**	**$ 368,551**	**$ 374,935**	**$ 381,487**	**$ 388,211**	**$ 395,110**	**$ 402,191**
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
(2,606,162)	**$ (2,546,367)**	**$ (2,488,640)**	**$ (2,432,929)**	**$ (2,379,186)**	**$ (2,327,362)**	**$ (2,277,409)**	**$ (2,229,284)**	**$ (2,182,942)**
2,255,802	**$ 4,445,901**	**$ 6,572,211**	**$ 8,636,590**	**$ 10,640,840**	**$ 12,586,715**	**$ 14,475,914**	**$ 16,310,087**	**$ 18,090,839**
350,360	**$ 706,627**	**$ 1,068,957**	**$ 1,437,508**	**$ 1,812,443**	**$ 2,193,930**	**$ 2,582,141**	**$ 2,977,251**	**$ 3,379,442**
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
(2,606,162)	**$ (5,152,529)**	**$ (7,641,168)**	**$ (10,074,098)**	**$ (12,453,284)**	**$ (14,780,646)**	**$ (17,058,055)**	**$ (19,287,339)**	**$ (21,470,280)**
40,459,034								
29,949,784								
-								
(70,408,818)								

›front Project Cost		
ıpital Costs/Power	$	-
ıpital Costs/Water	$	30,259,178
ЕТС	$	-
ˈO Grant	$	-
ıjusted Capital Costs	$	30,259,178

Financial Parameters

Life of Bonds	25
Life of Project	50
Interest	5.50%
Inflation	3.00%
Green Tag, Cost and Value of Power Beyond 2024	5.70%

2023	2024	2025	2026	2027	2028	2029	2030	2031
2,255,802	$ 2,255,802	$ 2,255,802	$ 2,255,802	$ 2,255,802	$ 2,255,802	$ 2,255,802	$ 2,255,802	$ 2,255,802
173,029	$ 178,220	$ 183,567	$ 189,074	$ 194,746	$ 200,588	$ 206,606	$ 212,804	$ 219,188
3,049,525	3,049,525	3,049,525	3,049,525	3,049,525	3,049,525	3,049,525	3,049,525	3,049,525
0.1360	0.1437	0.1519	0.1606	0.1697	0.1794	0.1896	0.2004	0.2119
414,669	$ 438,305	$ 463,288	$ 489,696	$ 517,609	$ 547,112	$ 578,298	$ 611,261	$ 646,102
2,843,500	$ 2,872,327	$ 2,902,657	$ 2,934,572	$ 2,968,157	$ 3,003,503	$ 3,040,706	$ 3,079,867	$ 3,121,093
0.081	0.081	0.085	0.090	0.095	0.101	0.106	0.112	0.119
0.018	0.019	0.021	0.022	0.023	0.024	0.026	0.027	0.029
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
(2,843,500)	$ (2,872,327)	$ (2,902,657)	$ (2,934,572)	$ (2,968,157)	$ (3,003,503)	$ (3,040,706)	$ (3,079,867)	$ (3,121,093)
0.72242	0.70138	0.68095	0.66112	0.64186	0.62317	0.60502	0.58739	0.57029
1,629,639	$ 1,582,174	$ 1,536,091	$ 1,491,351	$ 1,447,914	$ 1,405,741	$ 1,364,797	$ 1,325,046	$ 1,286,452
424,566	$ 432,418	$ 440,477	$ 448,747	$ 457,233	$ 465,942	$ 474,880	$ 484,051	$ 493,463
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
(2,054,205)	$ (2,014,593)	$ (1,976,568)	$ (1,940,098)	$ (1,905,147)	$ (1,871,684)	$ (1,839,677)	$ (1,809,097)	$ (1,779,916)
23,127,891	$ 24,710,065	$ 26,246,157	$ 27,737,508	$ 29,185,421	$ 30,591,162	$ 31,955,960	$ 33,281,006	$ 34,567,458
4,630,378	$ 5,062,796	$ 5,503,273	$ 5,952,020	$ 6,409,253	$ 6,875,195	$ 7,350,075	$ 7,834,126	$ 8,327,589
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
(27,758,269)	$ (29,772,862)	$ (31,749,430)	$ (33,689,528)	$ (35,594,674)	$ (37,466,358)	$ (39,306,035)	$ (41,115,132)	$ (42,895,048)

ɔfront Project Cost	
ɪpital Costs/Power	$ -
ɪpital Costs/Water	$ 30,259,178
ĒTC	$ -
̄O Grant	$ -
ljusted Capital Costs	$ 30,259,178

Financial Parameters	
Life of Bonds	25
Life of Project	50
Interest	5.50%
Inflation	3.00%
Green Tag, Cost and Value of Power Beyond 2024	5.70%

2034	2035	2036	2037	2038	2039	2040	2041	2042
2,255,802	$ 2,255,802	$ 2,255,802	$ -	$ -	$ -	$ -	$ -	$ -
239,513	$ 246,698	$ 254,099	$ 261,722	$ 269,574	$ 277,661	$ 285,991	$ 294,571	$ 303,408
3,049,525	3,049,525	3,049,525	3,049,525	3,049,525	3,049,525	3,049,525	3,049,525	3,049,525
0.2502	0.2645	0.2795	0.2955	0.3123	0.3301	0.3489	0.3688	0.3898
763,003	$ 806,494	$ 852,465	$ 901,055	$ 952,415	$ 1,006,703	$ 1,064,085	$ 1,124,738	$ 1,188,848
3,258,318	**$ 3,308,995**	**$ 3,362,366**	**$ 1,162,777**	**$ 1,221,989**	**$ 1,284,364**	**$ 1,350,076**	**$ 1,419,308**	**$ 1,492,256**
0.140	0.148	0.157	0.166	0.175	0.185	0.196	0.207	0.219
0.034	0.036	0.038	0.040	0.042	0.045	0.047	0.050	0.053
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
(3,258,318)	**$ (3,308,995)**	**$ (3,362,366)**	**$ (1,162,777)**	**$ (1,221,989)**	**$ (1,284,364)**	**$ (1,350,076)**	**$ (1,419,308)**	**$ (1,492,256)**
0.52189	**0.50669**	**0.49193**	**0.47761**	**0.46369**	**0.45019**	**0.43708**	**0.42435**	**0.41199**
1,177,286	**$ 1,142,996**	**$ 1,109,705**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
523,206	**$ 533,644**	**$ 544,356**	**$ 555,349**	**$ 566,630**	**$ 578,207**	**$ 590,087**	**$ 602,278**	**$ 614,790**
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
(1,700,492)	**$ (1,676,640)**	**$ (1,654,061)**	**$ (555,349)**	**$ (566,630)**	**$ (578,207)**	**$ (590,087)**	**$ (602,278)**	**$ (614,790)**
38,206,332	**$ 39,349,328**	**$ 40,459,034**	**$ 40,459,034**	**$ 40,459,034**	**$ 40,459,034**	**$ 40,459,034**	**$ 40,459,034**	**$ 40,459,034**
9,866,951	**$ 10,400,595**	**$ 10,944,951**	**$ 11,500,300**	**$ 12,066,930**	**$ 12,645,136**	**$ 13,235,223**	**$ 13,837,502**	**$ 14,452,291**
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
(48,073,283)	**$ (49,749,923)**	**$ (51,403,985)**	**$ (51,959,334)**	**$ (52,525,963)**	**$ (53,104,170)**	**$ (53,694,257)**	**$ (54,296,535)**	**$ (54,911,325)**

›front Project Cost	
ıpital Costs/Power	$ -
ıpital Costs/Water	$ 30,259,178
ΞTC	$ -
ˈO Grant	$ -
ljusted Capital Costs	$ 30,259,178

Financial Parameters	
Life of Bonds	25
Life of Project	50
Interest	5.50%
Inflation	3.00%
Green Tag, Cost and Value of Power Beyond 2024	5.70%

2045	2046	2047	2048	2049	2050	2051	2052	2053
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
331,542	$ 341,488	$ 351,733	$ 362,285	$ 373,153	$ 384,348	$ 395,878	$ 407,755	$ 419,987
3,049,525	3,049,525	3,049,525	3,049,525	3,049,525	3,049,525	3,049,525	3,049,525	3,049,525
0.4604	0.4866	0.5144	0.5437	0.5747	0.6074	0.6421	0.6786	0.7173
1,403,949	$ 1,483,974	$ 1,568,560	$ 1,657,968	$ 1,752,472	$ 1,852,363	$ 1,957,948	$ 2,069,551	$ 2,187,515
1,735,491	**$ 1,825,462**	**$ 1,920,293**	**$ 2,020,253**	**$ 2,125,626**	**$ 2,236,711**	**$ 2,353,826**	**$ 2,477,306**	**$ 2,607,503**
0.258	0.273	0.288	0.305	0.322	0.341	0.360	0.381	0.402
0.062	0.066	0.070	0.074	0.078	0.082	0.087	0.092	0.097
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
-	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
(1,735,491)	**$ (1,825,462)**	**$ (1,920,293)**	**$ (2,020,253)**	**$ (2,125,626)**	**$ (2,236,711)**	**$ (2,353,826)**	**$ (2,477,306)**	**$ (2,607,503)**
0.37703	**0.36604**	**0.35538**	**0.34503**	**0.33498**	**0.32523**	**0.31575**	**0.30656**	**0.29763**
-	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
654,325	**$ 668,201**	**$ 682,440**	**$ 697,053**	**$ 712,048**	**$ 727,437**	**$ 743,229**	**$ 759,435**	**$ 776,066**
-	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
(654,325)	**$ (668,201)**	**$ (682,440)**	**$ (697,053)**	**$ (712,048)**	**$ (727,437)**	**$ (743,229)**	**$ (759,435)**	**$ (776,066)**
40,459,034	**$ 40,459,034**	**$ 40,459,034**	**$ 40,459,034**	**$ 40,459,034**	**$ 40,459,034**	**$ 40,459,034**	**$ 40,459,034**	**$ 40,459,034**
16,375,050	**$ 17,043,251**	**$ 17,725,691**	**$ 18,422,744**	**$ 19,134,792**	**$ 19,862,229**	**$ 20,605,458**	**$ 21,364,893**	**$ 22,140,959**
-	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
(56,834,083)	**$ (57,502,284)**	**$ (58,184,725)**	**$ (58,881,777)**	**$ (59,593,826)**	**$ (60,321,263)**	**$ (61,064,492)**	**$ (61,823,927)**	**$ (62,599,992)**

›front Project Cost	
ıpital Costs/Power	$ -
ıpital Costs/Water	$ 30,259,178
ETC	$ -
O Grant	$ -
ljusted Capital Costs	$ 30,259,178

Financial Parameters	
Life of Bonds	25
Life of Project	50
Interest	5.50%
Inflation	3.00%
Green Tag, Cost and Value of Power Beyond 2024	5.70%

2056	2057	2058	2059	2060	2061	2062
-	$ -	$ -	$ -	$ -	$ -	$ -
458,932	$ 472,699	$ 486,880	$ 501,487	$ 516,531	$ 532,027	$ 547,988
3,049,525	3,049,525	3,049,525	3,049,525	3,049,525	3,049,525	3,049,525
0.8471	0.8954	0.9464	1.0004	1.0574	1.1177	1.1814
2,583,307	$ 2,730,556	$ 2,886,198	$ 3,050,711	$ 3,224,601	$ 3,408,404	$ 3,602,683
3,042,239	**$ 3,203,255**	**$ 3,373,078**	**$ 3,552,198**	**$ 3,741,133**	**$ 3,940,431**	**$ 4,150,671**
0.475	0.502	0.531	0.561	0.593	0.627	0.662
0.115	0.121	0.128	0.135	0.143	0.151	0.160
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	$ -	$ -	$ -	$ -	$ -	$ -
-	$ -	$ -	$ -	$ -	$ -	$ -
-	$ -	$ -	$ -	$ -	$ -	$ -
-	$ -	$ -	$ -	$ -	$ -	$ -
(3,042,239)	**$ (3,203,255)**	**$ (3,373,078)**	**$ (3,552,198)**	**$ (3,741,133)**	**$ (3,940,431)**	**$ (4,150,671)**
0.27237	**0.26444**	**0.25674**	**0.24926**	**0.24200**	**0.23495**	**0.22811**
-	$ -	$ -	$ -	$ -	$ -	$ -
828,620	**$ 847,064**	**$ 865,992**	**$ 885,416**	**$ 905,350**	**$ 925,805**	**$ 946,797**
-	$ -	$ -	$ -	$ -	$ -	$ -
(828,620)	**$ (847,064)**	**$ (865,992)**	**$ (885,416)**	**$ (905,350)**	**$ (925,805)**	**$ (946,797)**
40,459,034	**$ 40,459,034**	**$ 40,459,034**	**$ 40,459,034**	**$ 40,459,034**	**$ 40,459,034**	**$ 40,459,034**
24,573,358	**$ 25,420,423**	**$ 26,286,415**	**$ 27,171,831**	**$ 28,077,181**	**$ 29,002,986**	**$ 29,949,784**
-	$ -	$ -	$ -	$ -	$ -	$ -
(65,032,392)	**$ (65,879,456)**	**$ (66,745,449)**	**$ (67,630,865)**	**$ (68,536,215)**	**$ (69,462,020)**	**$ (70,408,818)**

ɔfront Project Cost	
ɑpital Costs/Power	$ -
ɑpital Costs/Water	$ 40,012,347
ΞTC	$ -
ΤO Grant	$ -
ɉjusted Capital Costs	$ 40,012,347

Financial Parameters

Life of Bonds	25
Life of Project	50
Interest	5.50%
Inflation	3.00%
Green Tag, Cost and Value of	5.70%

2012	2013	2014	2015	2016	2017	2018	2019	2020
2,982,895	$ 2,982,895	$ 2,982,895	$ 2,982,895	$ 2,982,895	$ 2,982,895	$ 2,982,895	$ 2,982,895	$ 2,982,895
125,000	$ 128,750	$ 132,613	$ 136,591	$ 140,689	$ 144,909	$ 149,257	$ 153,734	$ 158,346
4,439,818	4,439,818	4,439,818	4,439,818	4,439,818	4,439,818	4,439,818	4,439,818	4,439,818
0.0739	0.0781	0.0826	0.0873	0.0922	0.0975	0.1031	0.1089	0.1151
328,103	$ 346,804	$ 366,572	$ 387,467	$ 409,552	$ 432,897	$ 457,572	$ 483,654	$ 511,222
3,435,997	**$ 3,458,449**	**$ 3,482,079**	**$ 3,506,952**	**$ 3,533,136**	**$ 3,560,701**	**$ 3,589,723**	**$ 3,620,283**	**$ 3,652,463**
0.069	0.069	0.071	0.074	0.077	0.078	0.080	0.071	0.081
0.010	0.011	0.011	0.012	0.012	0.013	0.014	0.015	0.016
0.020	0.021	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-	-	-	-	-	-	-	-	-
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
-	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
(3,435,997)	**$ (3,458,449)**	**$ (3,482,079)**	**$ (3,506,952)**	**$ (3,533,136)**	**$ (3,560,701)**	**$ (3,589,723)**	**$ (3,620,283)**	**$ (3,652,463)**
1	**0.97087**	**0.94260**	**0.91514**	**0.88849**	**0.86261**	**0.83748**	**0.81309**	**0.78941**
2,982,895	**$ 2,896,014**	**$ 2,811,664**	**$ 2,729,771**	**$ 2,650,263**	**$ 2,573,071**	**$ 2,498,127**	**$ 2,425,366**	**$ 2,354,725**
453,103	**$ 461,703**	**$ 470,529**	**$ 479,587**	**$ 488,882**	**$ 498,421**	**$ 508,209**	**$ 518,255**	**$ 528,563**
-	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
(3,435,997)	**$ (3,357,717)**	**$ (3,282,194)**	**$ (3,209,358)**	**$ (3,139,145)**	**$ (3,071,492)**	**$ (3,006,337)**	**$ (2,943,621)**	**$ (2,883,288)**
2,982,895	**$ 5,878,909**	**$ 8,690,573**	**$ 11,420,344**	**$ 14,070,607**	**$ 16,643,678**	**$ 19,141,806**	**$ 21,567,172**	**$ 23,921,897**
453,103	**$ 914,806**	**$ 1,385,335**	**$ 1,864,922**	**$ 2,353,804**	**$ 2,852,225**	**$ 3,360,435**	**$ 3,878,689**	**$ 4,407,253**
-	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
(3,435,997)	**$ (6,793,715)**	**$ (10,075,908)**	**$ (13,285,267)**	**$ (16,424,412)**	**$ (19,495,904)**	**$ (22,502,240)**	**$ (25,445,861)**	**$ (28,329,149)**
53,499,832								
40,697,640								
-								
(94,197,472)								

ɔfront Project Cost	
ıpital Costs/Power	$ -
ıpital Costs/Water	$ 40,012,347
ETC	$ -
TO Grant	$ -
ljusted Capital Costs	$ 40,012,347

Financial Parameters	
Life of Bonds	25
Life of Project	50
Interest	5.50%
Inflation	3.00%
Green Tag, Cost and Value of	5.70%

2023	2024	2025	2026	2027	2028	2029	2030	2031
2,982,895	$ 2,982,895	$ 2,982,895	$ 2,982,895	$ 2,982,895	$ 2,982,895	$ 2,982,895	$ 2,982,895	$ 2,982,895
173,029	$ 178,220	$ 183,567	$ 189,074	$ 194,746	$ 200,588	$ 206,606	$ 212,804	$ 219,188
4,439,818	4,439,818	4,439,818	4,439,818	4,439,818	4,439,818	4,439,818	4,439,818	4,439,818
0.1360	0.1437	0.1519	0.1606	0.1697	0.1794	0.1896	0.2004	0.2119
603,718	$ 638,130	$ 674,504	$ 712,951	$ 753,589	$ 796,543	$ 841,946	$ 889,937	$ 940,664
3,759,642	**$ 3,799,245**	**$ 3,840,965**	**$ 3,884,919**	**$ 3,931,229**	**$ 3,980,026**	**$ 4,031,447**	**$ 4,085,636**	**$ 4,142,747**
0.081	0.081	0.085	0.090	0.095	0.101	0.106	0.112	0.119
0.018	0.019	0.021	0.022	0.023	0.024	0.026	0.027	0.029
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
(3,759,642)	**$ (3,799,245)**	**$ (3,840,965)**	**$ (3,884,919)**	**$ (3,931,229)**	**$ (3,980,026)**	**$ (4,031,447)**	**$ (4,085,636)**	**$ (4,142,747)**
0.72242	**0.70138**	**0.68095**	**0.66112**	**0.64186**	**0.62317**	**0.60502**	**0.58739**	**0.57029**
2,154,907	**$ 2,092,142**	**$ 2,031,206**	**$ 1,972,045**	**$ 1,914,607**	**$ 1,858,841**	**$ 1,804,700**	**$ 1,752,136**	**$ 1,701,103**
561,139	**$ 572,572**	**$ 584,304**	**$ 596,344**	**$ 608,700**	**$ 621,379**	**$ 634,391**	**$ 647,744**	**$ 661,447**
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
(2,716,046)	**$ (2,664,714)**	**$ (2,615,510)**	**$ (2,568,389)**	**$ (2,523,306)**	**$ (2,480,221)**	**$ (2,439,092)**	**$ (2,399,881)**	**$ (2,362,550)**
30,582,497	**$ 32,674,639**	**$ 34,705,845**	**$ 36,677,890**	**$ 38,592,497**	**$ 40,451,338**	**$ 42,256,038**	**$ 44,008,175**	**$ 45,709,278**
6,057,532	**$ 6,630,104**	**$ 7,214,408**	**$ 7,810,753**	**$ 8,419,453**	**$ 9,040,832**	**$ 9,675,224**	**$ 10,322,968**	**$ 10,984,415**
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
(36,640,029)	**$ (39,304,744)**	**$ (41,920,254)**	**$ (44,488,643)**	**$ (47,011,949)**	**$ (49,492,170)**	**$ (51,931,262)**	**$ (54,331,142)**	**$ (56,693,693)**

ɔfront Project Cost	
ɑpital Costs/Power	$ -
ɑpital Costs/Water	$ 40,012,347
ΞTC	$ -
ΓO Grant	$ -
ɗjusted Capital Costs	$ 40,012,347

Financial Parameters	
Life of Bonds	25
Life of Project	50
Interest	5.50%
Inflation	3.00%
Green Tag, Cost and Value of	5.70%

2034	2035	2036	2037	2038	2039	2040	2041	2042
2,982,895	$ 2,982,895	$ 2,982,895	$ -	$ -	$ -	$ -	$ -	$ -
239,513	$ 246,698	$ 254,099	$ 261,722	$ 269,574	$ 277,661	$ 285,991	$ 294,571	$ 303,408
4,439,818	4,439,818	4,439,818	4,439,818	4,439,818	4,439,818	4,439,818	4,439,818	4,439,818
0.2502	0.2645	0.2795	0.2955	0.3123	0.3301	0.3489	0.3688	0.3898
1,110,860	$ 1,174,179	$ 1,241,107	$ 1,311,850	$ 1,386,626	$ 1,465,663	$ 1,549,206	$ 1,637,511	$ 1,730,849
4,333,268	$ 4,403,772	$ 4,478,101	$ 1,573,573	$ 1,656,200	$ 1,743,325	$ 1,835,197	$ 1,932,082	$ 2,034,257
0.140	0.148	0.157	0.166	0.175	0.185	0.196	0.207	0.219
0.034	0.036	0.038	0.040	0.042	0.045	0.047	0.050	0.053
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
(4,333,268)	$ (4,403,772)	$ (4,478,101)	$ (1,573,573)	$ (1,656,200)	$ (1,743,325)	$ (1,835,197)	$ (1,932,082)	$ (2,034,257)
0.52189	0.50669	0.49193	0.47761	0.46369	0.45019	0.43708	0.42435	0.41199
1,556,750	$ 1,511,408	$ 1,467,386	$ -	$ -	$ -	$ -	$ -	$ -
704,750	$ 719,947	$ 735,543	$ 751,547	$ 767,971	$ 784,826	$ 802,122	$ 819,872	$ 838,087
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
(2,261,500)	$ (2,231,355)	$ (2,202,929)	$ (751,547)	$ (767,971)	$ (784,826)	$ (802,122)	$ (819,872)	$ (838,087)
50,521,037	$ 52,032,445	$ 53,499,832	$ 53,499,832	$ 53,499,832	$ 53,499,832	$ 53,499,832	$ 53,499,832	$ 53,499,832
13,054,615	$ 13,774,561	$ 14,510,104	$ 15,261,651	$ 16,029,622	$ 16,814,448	$ 17,616,570	$ 18,436,442	$ 19,274,529
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
(63,575,652)	$ (65,807,007)	$ (68,009,936)	$ (68,761,483)	$ (69,529,454)	$ (70,314,279)	$ (71,116,402)	$ (71,936,273)	$ (72,774,360)

ɔfront Project Cost

ıpital Costs/Power	$	-
ıpital Costs/Water	$	40,012,347
ETC	$	-
TO Grant	$	-
djusted Capital Costs	$	40,012,347

Financial Parameters

Life of Bonds	25
Life of Project	50
Interest	5.50%
Inflation	3.00%
Green Tag, Cost and Value of	5.70%

2045	2046	2047	2048	2049	2050	2051	2052	2053
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
331,542	$ 341,488	$ 351,733	$ 362,285	$ 373,153	$ 384,348	$ 395,878	$ 407,755	$ 419,987
4,439,818	4,439,818	4,439,818	4,439,818	4,439,818	4,439,818	4,439,818	4,439,818	4,439,818
0.4604	0.4866	0.5144	0.5437	0.5747	0.6074	0.6421	0.6786	0.7173
2,044,016	$ 2,160,524	$ 2,283,674	$ 2,413,844	$ 2,551,433	$ 2,696,864	$ 2,850,586	$ 3,013,069	$ 3,184,814
2,375,557	**$ 2,502,013**	**$ 2,635,407**	**$ 2,776,129**	**$ 2,924,586**	**$ 3,081,212**	**$ 3,246,464**	**$ 3,420,824**	**$ 3,604,801**
0.258	0.273	0.288	0.305	0.322	0.341	0.360	0.381	0.402
0.062	0.066	0.070	0.074	0.078	0.082	0.087	0.092	0.097
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
(2,375,557)	**$ (2,502,013)**	**$ (2,635,407)**	**$ (2,776,129)**	**$ (2,924,586)**	**$ (3,081,212)**	**$ (3,246,464)**	**$ (3,420,824)**	**$ (3,604,801)**
0.37703	**0.36604**	**0.35538**	**0.34503**	**0.33498**	**0.32523**	**0.31575**	**0.30656**	**0.29763**
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
895,647	**$ 915,849**	**$ 936,580**	**$ 957,854**	**$ 979,686**	**$ 1,002,091**	**$ 1,025,083**	**$ 1,048,677**	**$ 1,072,890**
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
(895,647)	**$ (915,849)**	**$ (936,580)**	**$ (957,854)**	**$ (979,686)**	**$ (1,002,091)**	**$ (1,025,083)**	**$ (1,048,677)**	**$ (1,072,890)**
53,499,832	**$ 53,499,832**	**$ 53,499,832**	**$ 53,499,832**	**$ 53,499,832**	**$ 53,499,832**	**$ 53,499,832**	**$ 53,499,832**	**$ 53,499,832**
21,902,918	**$ 22,818,767**	**$ 23,755,347**	**$ 24,713,201**	**$ 25,692,887**	**$ 26,694,978**	**$ 27,720,061**	**$ 28,768,738**	**$ 29,841,628**
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
(75,402,749)	**$ (76,318,598)**	**$ (77,255,178)**	**$ (78,213,033)**	**$ (79,192,719)**	**$ (80,194,810)**	**$ (81,219,893)**	**$ (82,268,569)**	**$ (83,341,459)**

ɔfront Project Cost	
ɪpital Costs/Power	$ -
ɪpital Costs/Water	$ 40,012,347
ΞTC	$ -
ΓO Grant	$ -
ɟjusted Capital Costs	$ 40,012,347

Financial Parameters	
Life of Bonds	25
Life of Project	50
Interest	5.50%
Inflation	3.00%
Green Tag, Cost and Value of	5.70%

2056	2057	2058	2059	2060	2061	2062
-	$ -	$ -	$ -	$ -	$ -	$ -
458,932	$ 472,699	$ 486,880	$ 501,487	$ 516,531	$ 532,027	$ 547,988
4,439,818	4,439,818	4,439,818	4,439,818	4,439,818	4,439,818	4,439,818
0.8471	0.8954	0.9464	1.0004	1.0574	1.1177	1.1814
3,761,049	$ 3,975,429	$ 4,202,029	$ 4,441,544	$ 4,694,712	$ 4,962,311	$ 5,245,163
4,219,981	**$ 4,448,129**	**$ 4,688,909**	**$ 4,943,031**	**$ 5,211,244**	**$ 5,494,338**	**$ 5,793,151**
0.475	0.502	0.531	0.561	0.593	0.627	0.662
0.115	0.121	0.128	0.135	0.143	0.151	0.160
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	$ -	$ -	$ -	$ -	$ -	$ -
-	$ -	$ -	$ -	$ -	$ -	$ -
-	$ -	$ -	$ -	$ -	$ -	$ -
-	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
(4,219,981)	**$ (4,448,129)**	**$ (4,688,909)**	**$ (4,943,031)**	**$ (5,211,244)**	**$ (5,494,338)**	**$ (5,793,151)**
0.27237	**0.26444**	**0.25674**	**0.24926**	**0.24200**	**0.23495**	**0.22811**
-	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
1,149,404	**$ 1,176,257**	**$ 1,203,814**	**$ 1,232,094**	**$ 1,261,115**	**$ 1,290,896**	**$ 1,321,459**
-	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
(1,149,404)	**$ (1,176,257)**	**$ (1,203,814)**	**$ (1,232,094)**	**$ (1,261,115)**	**$ (1,290,896)**	**$ (1,321,459)**
53,499,832	**$ 53,499,832**	**$ 53,499,832**	**$ 53,499,832**	**$ 53,499,832**	**$ 53,499,832**	**$ 53,499,832**
33,212,005	**$ 34,388,262**	**$ 35,592,076**	**$ 36,824,170**	**$ 38,085,285**	**$ 39,376,182**	**$ 40,697,640**
-	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
(86,711,837)	**$ (87,888,094)**	**$ (89,091,908)**	**$ (90,324,002)**	**$ (91,585,117)**	**$ (92,876,013)**	**$ (94,197,472)**

ıt Project Cost		
ıl Costs/Power	$	-
ıl Costs/Water	$	21,225,000
	$	-
ırant	$	-
ted Capital Costs	$	21,225,000

Financial Parameters

Life of Bonds	25
Life of Project	50
Interest	5.50%
Inflation	3.00%
Green Tag, Cost and Value of Power Beyond 2024	5.70%

2012	2013	2014	2015	2016	2017	2018	2019	2020	
1,582,310	$ 1,582,310	$ 1,582,310	$ 1,582,310	$ 1,582,310	$ 1,582,310	$ 1,582,310	$ 1,582,310	$ 1,582,310	$
112,000	$ 115,360	$ 118,821	$ 122,385	$ 126,057	$ 129,839	$ 133,734	$ 137,746	$ 141,878	$
ı980,655	6,980,655	6,980,655	6,980,655	6,980,655	6,980,655	6,980,655	6,980,655	6,980,655	6
ı.0739	0.0781	0.0826	0.0873	0.0922	0.0975	0.1031	0.1089	0.1151	
515,870	$ 545,275	$ 576,356	$ 609,208	$ 643,933	$ 680,637	$ 719,433	$ 760,441	$ 803,786	$
2,210,180	**$ 2,242,945**	**$ 2,277,487**	**$ 2,313,903**	**$ 2,352,300**	**$ 2,392,786**	**$ 2,435,477**	**$ 2,480,497**	**$ 2,527,974**	**$**
0.069	0.069	0.071	0.074	0.077	0.078	0.080	0.071	0.081	
0.010	0.011	0.011	0.012	0.012	0.013	0.014	0.015	0.016	
0.020	0.021	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
-	-	-	-	-	-	-	-	-	
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$
-	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$**
(2,210,180)	**$ (2,242,945)**	**$ (2,277,487)**	**$ (2,313,903)**	**$ (2,352,300)**	**$ (2,392,786)**	**$ (2,435,477)**	**$ (2,480,497)**	**$ (2,527,974)**	**$**
1	**0.97087**	**0.94260**	**0.91514**	**0.88849**	**0.86261**	**0.83748**	**0.81309**	**0.78941**	
1,582,310	**$ 1,536,223**	**$ 1,491,479**	**$ 1,448,038**	**$ 1,405,862**	**$ 1,364,915**	**$ 1,325,160**	**$ 1,286,563**	**$ 1,249,090**	**$**
627,870	**$ 641,393**	**$ 655,271**	**$ 669,512**	**$ 684,126**	**$ 699,123**	**$ 714,514**	**$ 730,308**	**$ 746,516**	**$**
-	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$**
(2,210,180)	**$ (2,177,617)**	**$ (2,146,749)**	**$ (2,117,549)**	**$ (2,089,988)**	**$ (2,064,038)**	**$ (2,039,674)**	**$ (2,016,871)**	**$ (1,995,606)**	**$**
1,582,310	**$ 3,118,533**	**$ 4,610,012**	**$ 6,058,050**	**$ 7,463,912**	**$ 8,828,827**	**$ 10,153,986**	**$ 11,440,549**	**$ 12,689,639**	**$**
627,870	**$ 1,269,264**	**$ 1,924,534**	**$ 2,594,046**	**$ 3,278,172**	**$ 3,977,295**	**$ 4,691,809**	**$ 5,422,118**	**$ 6,168,634**	**$**
-	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$**
(2,210,180)	**$ (4,387,797)**	**$ (6,534,547)**	**$ (8,652,096)**	**$ (10,742,084)**	**$ (12,806,122)**	**$ (14,845,796)**	**$ (16,862,667)**	**$ (18,858,273)**	**$**

28,379,588
59,676,943
-
88,056,531)

ıt Project Cost	
ı Costs/Power	$ -
ı Costs/Water	$ 21,225,000
	$ -
ırant	$ -
ted Capital Costs	$ 21,225,000

Financial Parameters	
Life of Bonds	25
Life of Project	50
Interest	5.50%
Inflation	3.00%
Green Tag, Cost and Value of Power Beyond 2024	5.70%

2023	2024	2025	2026	2027	2028	2029	2030	2031	
1,582,310	$ 1,582,310	$ 1,582,310	$ 1,582,310	$ 1,582,310	$ 1,582,310	$ 1,582,310	$ 1,582,310	$ 1,582,310	$
155,034	$ 159,685	$ 164,476	$ 169,410	$ 174,492	$ 179,727	$ 185,119	$ 190,673	$ 196,393	$
980,655	6,980,655	6,980,655	6,980,655	6,980,655	6,980,655	6,980,655	6,980,655	6,980,655	6
).1360	0.1437	0.1519	0.1606	0.1697	0.1794	0.1896	0.2004	0.2119	
949,217	$ 1,003,322	$ 1,060,512	$ 1,120,961	$ 1,184,856	$ 1,252,392	$ 1,323,779	$ 1,399,234	$ 1,478,991	$
2,686,561	**$ 2,745,318**	**$ 2,807,298**	**$ 2,872,681**	**$ 2,941,658**	**$ 3,014,430**	**$ 3,091,208**	**$ 3,172,217**	**$ 3,257,693**	**$**
0.081	0.081	0.085	0.090	0.095	0.101	0.106	0.112	0.119	
0.018	0.019	0.021	0.022	0.023	0.024	0.026	0.027	0.029	
-	-	-	-	-	-	-	-	-	
-	-	-	-	-	-	-	-	-	
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$
-	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$**
(2,686,561)	**$ (2,745,318)**	**$ (2,807,298)**	**$ (2,872,681)**	**$ (2,941,658)**	**$ (3,014,430)**	**$ (3,091,208)**	**$ (3,172,217)**	**$ (3,257,693)**	**$**
.72242	**0.70138**	**0.68095**	**0.66112**	**0.64186**	**0.62317**	**0.60502**	**0.58739**	**0.57029**	
1,143,094	**$ 1,109,800**	**$ 1,077,476**	**$ 1,046,093**	**$ 1,015,625**	**$ 986,043**	**$ 957,324**	**$ 929,440**	**$ 902,369**	**$**
797,735	**$ 815,710**	**$ 834,157**	**$ 853,087**	**$ 872,514**	**$ 892,450**	**$ 912,908**	**$ 933,903**	**$ 955,448**	**$**
-	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$**
(1,940,829)	**$ (1,925,511)**	**$ (1,911,633)**	**$ (1,899,181)**	**$ (1,888,138)**	**$ (1,878,493)**	**$ (1,870,232)**	**$ (1,863,343)**	**$ (1,857,817)**	**$**
16,222,830	**$ 17,332,630**	**$ 18,410,106**	**$ 19,456,200**	**$ 20,471,824**	**$ 21,457,868**	**$ 22,415,191**	**$ 23,344,632**	**$ 24,247,001**	**$**
8,509,736	**$ 9,325,446**	**$ 10,159,603**	**$ 11,012,690**	**$ 11,885,204**	**$ 12,777,653**	**$ 13,690,561**	**$ 14,624,464**	**$ 15,579,911**	**$**
-	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$**
24,732,566)	**$ (26,658,076)**	**$ (28,569,709)**	**$ (30,468,890)**	**$ (32,357,028)**	**$ (34,235,521)**	**$ (36,105,752)**	**$ (37,969,095)**	**$ (39,826,912)**	**$**

ıt Project Cost

l Costs/Power	**$ -**
l Costs/Water	**$ 21,225,000**
	$ -
irant	**$ -**
ted Capital Costs	**$ 21,225,000**

Financial Parameters

Life of Bonds	**25**
Life of Project	**50**
Interest	**5.50%**
Inflation	**3.00%**
Green Tag, Cost and Value of Power Beyond 2024	**5.70%**

2034	2035	2036	2037	2038	2039	2040	2041	2042	
1,582,310	$ 1,582,310	$ 1,582,310	$ -	$ -	$ -	$ -	$ -	$ -	$
214,604	$ 221,042	$ 227,673	$ 234,503	$ 241,538	$ 248,784	$ 256,248	$ 263,935	$ 271,853	$
980,655	6,980,655	6,980,655	6,980,655	6,980,655	6,980,655	6,980,655	6,980,655	6,980,655	6
.2502	0.2645	0.2795	0.2955	0.3123	0.3301	0.3489	0.3688	0.3898	
1,746,588	$ 1,846,143	$ 1,951,373	$ 2,062,601	$ 2,180,170	$ 2,304,439	$ 2,435,792	$ 2,574,633	$ 2,721,387	$
3,543,501	**$ 3,649,495**	**$ 3,761,356**	**$ 2,297,105**	**$ 2,421,708**	**$ 2,553,224**	**$ 2,692,040**	**$ 2,838,568**	**$ 2,993,240**	**$**
0.140	0.148	0.157	0.166	0.175	0.185	0.196	0.207	0.219	
0.034	0.036	0.038	0.040	0.042	0.045	0.047	0.050	0.053	
-	-	-	-	-	-	-	-	-	
-	-	-	-	-	-	-	-	-	
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$
-	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$**
(3,543,501)	**$ (3,649,495)**	**$ (3,761,356)**	**$ (2,297,105)**	**$ (2,421,708)**	**$ (2,553,224)**	**$ (2,692,040)**	**$ (2,838,568)**	**$ (2,993,240)**	**$**
.52189	**0.50669**	**0.49193**	**0.47761**	**0.46369**	**0.45019**	**0.43708**	**0.42435**	**0.41199**	
825,796	**$ 801,743**	**$ 778,392**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$**
1,023,531	**$ 1,047,425**	**$ 1,071,946**	**$ 1,097,110**	**$ 1,122,933**	**$ 1,149,433**	**$ 1,176,628**	**$ 1,204,536**	**$ 1,233,175**	**$**
-	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$**
(1,849,327)	**$ (1,849,169)**	**$ (1,850,338)**	**$ (1,097,110)**	**$ (1,122,933)**	**$ (1,149,433)**	**$ (1,176,628)**	**$ (1,204,536)**	**$ (1,233,175)**	**$**
26,799,453	**$ 27,601,196**	**$ 28,379,588**	**$ 28,379,588**	**$ 28,379,588**	**$ 28,379,588**	**$ 28,379,588**	**$ 28,379,588**	**$ 28,379,588**	**$**
18,581,247	**$ 19,628,672**	**$ 20,700,618**	**$ 21,797,728**	**$ 22,920,661**	**$ 24,070,095**	**$ 25,246,723**	**$ 26,451,259**	**$ 27,684,434**	**$**
-	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$**
45,380,699)	**$ (47,229,868)**	**$ (49,080,206)**	**$ (50,177,316)**	**$ (51,300,249)**	**$ (52,449,683)**	**$ (53,626,311)**	**$ (54,830,847)**	**$ (56,064,022)**	**$**

ıt Project Cost	
ıl Costs/Power	$ -
ıl Costs/Water	$ 21,225,000
	$ -
;rant	$ -
ted Capital Costs	$ 21,225,000

Financial Parameters

Life of Bonds	25
Life of Project	50
Interest	5.50%
Inflation	3.00%
Green Tag, Cost and Value of Power Beyond 2024	5.70%

2045	2046	2047	2048	2049	2050	2051	2052	2053	
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$
297,062	$ 305,973	$ 315,153	$ 324,607	$ 334,345	$ 344,376	$ 354,707	$ 365,348	$ 376,309	$
980,655	6,980,655	6,980,655	6,980,655	6,980,655	6,980,655	6,980,655	6,980,655	6,980,655	6
.4604	0.4866	0.5144	0.5437	0.5747	0.6074	0.6421	0.6786	0.7173	
3,213,773	$ 3,396,958	$ 3,590,585	$ 3,795,248	$ 4,011,577	$ 4,240,237	$ 4,481,931	$ 4,737,401	$ 5,007,433	$
3,510,835	**$ 3,702,932**	**$ 3,905,737**	**$ 4,119,855**	**$ 4,345,923**	**$ 4,584,613**	**$ 4,836,638**	**$ 5,102,749**	**$ 5,383,741**	**$**
0.258	0.273	0.288	0.305	0.322	0.341	0.360	0.381	0.402	
0.062	0.066	0.070	0.074	0.078	0.082	0.087	0.092	0.097	
-	-	-	-	-	-	-	-	-	
-	-	-	-	-	-	-	-	-	
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$
-	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$**
(3,510,835)	**$ (3,702,932)**	**$ (3,905,737)**	**$ (4,119,855)**	**$ (4,345,923)**	**$ (4,584,613)**	**$ (4,836,638)**	**$ (5,102,749)**	**$ (5,383,741)**	**$**
.37703	**0.36604**	**0.35538**	**0.34503**	**0.33498**	**0.32523**	**0.31575**	**0.30656**	**0.29763**	
-	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$**
1,323,677	**$ 1,355,439**	**$ 1,388,034**	**$ 1,421,484**	**$ 1,455,810**	**$ 1,491,036**	**$ 1,527,186**	**$ 1,564,283**	**$ 1,602,352**	**$**
-	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$**
(1,323,677)	**$ (1,355,439)**	**$ (1,388,034)**	**$ (1,421,484)**	**$ (1,455,810)**	**$ (1,491,036)**	**$ (1,527,186)**	**$ (1,564,283)**	**$ (1,602,352)**	**$**
28,379,588	**$ 28,379,588**	**$ 28,379,588**	**$ 28,379,588**	**$ 28,379,588**	**$ 28,379,588**	**$ 28,379,588**	**$ 28,379,588**	**$ 28,379,588**	**$**
31,563,402	**$ 32,918,842**	**$ 34,306,876**	**$ 35,728,359**	**$ 37,184,169**	**$ 38,675,205**	**$ 40,202,391**	**$ 41,766,674**	**$ 43,369,026**	**$**
-	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$**
59,942,990)	**$ (61,298,429)**	**$ (62,686,464)**	**$ (64,107,947)**	**$ (65,563,757)**	**$ (67,054,793)**	**$ (68,581,979)**	**$ (70,146,262)**	**$ (71,748,614)**	**$**

ıt Project Cost	
ı Costs/Power	$ -
ı Costs/Water	$ 21,225,000
	$ -
;rant	$ -
ted Capital Costs	$ 21,225,000

Financial Parameters

Life of Bonds	25
Life of Project	50
Interest	5.50%
Inflation	3.00%
Green Tag, Cost and Value of Power Beyond 2024	5.70%

2056	2057	2058	2059	2060	2061	2062
-	$ -	$ -	$ -	$ -	$ -	$ -
411,203	$ 423,539	$ 436,245	$ 449,332	$ 462,812	$ 476,697	$ 490,997
980,655	6,980,655	6,980,655	6,980,655	6,980,655	6,980,655	6,980,655
).8471	0.8954	0.9464	1.0004	1.0574	1.1177	1.1814
5,913,438	$ 6,250,504	$ 6,606,783	$ 6,983,370	$ 7,381,422	$ 7,802,163	$ 8,246,886
6,324,641	**$ 6,674,043**	**$ 7,043,028**	**$ 7,432,702**	**$ 7,844,234**	**$ 8,278,859**	**$ 8,737,884**
0.475	0.502	0.531	0.561	0.593	0.627	0.662
0.115	0.121	0.128	0.135	0.143	0.151	0.160
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	$ -	$ -	$ -	$ -	$ -	$ -
-	$ -	$ -	$ -	$ -	$ -	$ -
-	$ -	$ -	$ -	$ -	$ -	$ -
-	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
(6,324,641)	**$ (6,674,043)**	**$ (7,043,028)**	**$ (7,432,702)**	**$ (7,844,234)**	**$ (8,278,859)**	**$ (8,737,884)**
.27237	**0.26444**	**0.25674**	**0.24926**	**0.24200**	**0.23495**	**0.22811**
-	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
1,722,654	**$ 1,764,875**	**$ 1,808,203**	**$ 1,852,666**	**$ 1,898,295**	**$ 1,945,120**	**$ 1,993,173**
-	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
(1,722,654)	**$ (1,764,875)**	**$ (1,808,203)**	**$ (1,852,666)**	**$ (1,898,295)**	**$ (1,945,120)**	**$ (1,993,173)**
28,379,588	**$ 28,379,588**	**$ 28,379,588**	**$ 28,379,588**	**$ 28,379,588**	**$ 28,379,588**	**$ 28,379,588**
48,414,610	**$ 50,179,485**	**$ 51,987,688**	**$ 53,840,354**	**$ 55,738,649**	**$ 57,683,770**	**$ 59,676,943**
-	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
76,794,198)	**$ (78,559,073)**	**$ (80,367,276)**	**$ (82,219,942)**	**$ (84,118,237)**	**$ (86,063,358)**	**$ (88,056,531)**

ont Project Cost		
tal Costs/Power	$	-
tal Costs/Water	$	44,267,169
:	$	-
Grant	$	-
sted Capital Costs	$	44,267,169

Financial Parameters

Financial Parameters	
Life of Bonds	25
Life of Project	50
Interest	5.50%
Inflation	3.00%
Green Tag, Cost and Value of	5.70%

2012	2013	2014	2015	2016	2017	2018	2019	2020	
3,300,089	$ 3,300,089	$ 3,300,089	$ 3,300,089	$ 3,300,089	$ 3,300,089	$ 3,300,089	$ 3,300,089	$ 3,300,089	$
125,000	$ 128,750	$ 132,613	$ 136,591	$ 140,689	$ 144,909	$ 149,257	$ 153,734	$ 158,346	$
,054,548	5,054,548	5,054,548	5,054,548	5,054,548	5,054,548	5,054,548	5,054,548	5,054,548	
0.0739	0.0781	0.0826	0.0873	0.0922	0.0975	0.1031	0.1089	0.1151	
373,531	$ 394,822	$ 417,327	$ 441,115	$ 466,258	$ 492,835	$ 520,927	$ 550,620	$ 582,005	$
3,798,620	**$ 3,823,661**	**$ 3,850,029**	**$ 3,877,795**	**$ 3,907,036**	**$ 3,937,833**	**$ 3,970,272**	**$ 4,004,443**	**$ 4,040,440**	**$**
0.069	0.069	0.071	0.074	0.077	0.078	0.080	0.071	0.081	
0.010	0.011	0.011	0.012	0.012	0.013	0.014	0.015	0.016	
0.020	0.021	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
-	-	-	-	-	-	-	-	-	
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$
-	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$**
(3,798,620)	**$ (3,823,661)**	**$ (3,850,029)**	**$ (3,877,795)**	**$ (3,907,036)**	**$ (3,937,833)**	**$ (3,970,272)**	**$ (4,004,443)**	**$ (4,040,440)**	**$**
1	**0.97087**	**0.94260**	**0.91514**	**0.88849**	**0.86261**	**0.83748**	**0.81309**	**0.78941**	
3,300,089	**$ 3,203,970**	**$ 3,110,650**	**$ 3,020,049**	**$ 2,932,086**	**$ 2,846,686**	**$ 2,763,772**	**$ 2,683,274**	**$ 2,605,121**	**$**
498,531	**$ 508,323**	**$ 518,371**	**$ 528,683**	**$ 539,265**	**$ 550,124**	**$ 561,268**	**$ 572,704**	**$ 584,440**	**$**
-	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$**
(3,798,620)	**$ (3,712,292)**	**$ (3,629,021)**	**$ (3,548,731)**	**$ (3,471,351)**	**$ (3,396,810)**	**$ (3,325,040)**	**$ (3,255,978)**	**$ (3,189,561)**	**$**
3,300,089	**$ 6,504,059**	**$ 9,614,709**	**$ 12,634,758**	**$ 15,566,844**	**$ 18,413,529**	**$ 21,177,302**	**$ 23,860,576**	**$ 26,465,697**	**$**
498,531	**$ 1,006,854**	**$ 1,525,225**	**$ 2,053,907**	**$ 2,593,172**	**$ 3,143,296**	**$ 3,704,564**	**$ 4,277,268**	**$ 4,861,708**	**$**
-	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$**
(3,798,620)	**$ (7,510,912)**	**$ (11,139,934)**	**$ (14,688,665)**	**$ (18,160,016)**	**$ (21,556,825)**	**$ (24,881,866)**	**$ (28,137,844)**	**$ (31,327,405)**	**$**
59,188,882									
45,449,897									
-									
(104,638,780)									

ɔnt Project Cost		
ɫal Costs/Power	$	-
ɫal Costs/Water	$	44,267,169
;	$	-
Grant	$	-
sted Capital Costs	$	44,267,169

Financial Parameters

Life of Bonds	25
Life of Project	50
Interest	5.50%
Inflation	3.00%
Green Tag, Cost and Value of	5.70%

2023	2024	2025	2026	2027	2028	2029	2030	2031	
3,300,089	$ 3,300,089	$ 3,300,089	$ 3,300,089	$ 3,300,089	$ 3,300,089	$ 3,300,089	$ 3,300,089	$ 3,300,089	$
173,029	$ 178,220	$ 183,567	$ 189,074	$ 194,746	$ 200,588	$ 206,606	$ 212,804	$ 219,188	$
;,054,548	5,054,548	5,054,548	5,054,548	5,054,548	5,054,548	5,054,548	5,054,548	5,054,548	
0.1360	0.1437	0.1519	0.1606	0.1697	0.1794	0.1896	0.2004	0.2119	
687,308	$ 726,485	$ 767,895	$ 811,665	$ 857,929	$ 906,831	$ 958,521	$ 1,013,157	$ 1,070,906	$
4,160,426	**$ 4,204,794**	**$ 4,251,550**	**$ 4,300,827**	**$ 4,352,764**	**$ 4,407,509**	**$ 4,465,216**	**$ 4,526,049**	**$ 4,590,184**	**$**
0.081	0.081	0.085	0.090	0.095	0.101	0.106	0.112	0.119	
0.018	0.019	0.021	0.022	0.023	0.024	0.026	0.027	0.029	
-	-	-	-	-	-	-	-	-	
-	-	-	-	-	-	-	-	-	
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$
-	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$**
(4,160,426)	**$ (4,204,794)**	**$ (4,251,550)**	**$ (4,300,827)**	**$ (4,352,764)**	**$ (4,407,509)**	**$ (4,465,216)**	**$ (4,526,049)**	**$ (4,590,184)**	**$**
0.72242	**0.70138**	**0.68095**	**0.66112**	**0.64186**	**0.62317**	**0.60502**	**0.58739**	**0.57029**	
2,384,054	**$ 2,314,616**	**$ 2,247,200**	**$ 2,181,747**	**$ 2,118,201**	**$ 2,056,506**	**$ 1,996,608**	**$ 1,938,454**	**$ 1,881,995**	**$**
621,526	**$ 634,542**	**$ 647,899**	**$ 661,606**	**$ 675,672**	**$ 690,107**	**$ 704,921**	**$ 720,123**	**$ 735,723**	**$**
-	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$**
(3,005,581)	**$ (2,949,158)**	**$ (2,895,099)**	**$ (2,843,353)**	**$ (2,793,874)**	**$ (2,746,614)**	**$ (2,701,529)**	**$ (2,658,577)**	**$ (2,617,718)**	**$**
33,834,570	**$ 36,149,186**	**$ 38,396,386**	**$ 40,578,134**	**$ 42,696,335**	**$ 44,752,841**	**$ 46,749,449**	**$ 48,687,904**	**$ 50,569,898**	**$**
6,688,561	**$ 7,323,103**	**$ 7,971,002**	**$ 8,632,607**	**$ 9,308,280**	**$ 9,998,387**	**$ 10,703,308**	**$ 11,423,431**	**$ 12,159,154**	**$**
-	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$**
(40,523,131)	**$ (43,472,289)**	**$ (46,367,388)**	**$ (49,210,741)**	**$ (52,004,615)**	**$ (54,751,228)**	**$ (57,452,757)**	**$ (60,111,334)**	**$ (62,729,052)**	**$**

ɔnt Project Cost	
ɫal Costs/Power	$ -
ɫal Costs/Water	$ 44,267,169
;	$ -
Grant	$ -
sted Capital Costs	$ 44,267,169

Financial Parameters	
Life of Bonds	25
Life of Project	50
Interest	5.50%
Inflation	3.00%
Green Tag, Cost and Value of	5.70%

2034	2035	2036	2037	2038	2039	2040	2041	2042	
3,300,089	$ 3,300,089	$ 3,300,089	$ -	$ -	$ -	$ -	$ -	$ -	$
239,513	$ 246,698	$ 254,099	$ 261,722	$ 269,574	$ 277,661	$ 285,991	$ 294,571	$ 303,408	$
;,054,548	5,054,548	5,054,548	5,054,548	5,054,548	5,054,548	5,054,548	5,054,548	5,054,548	
0.2502	0.2645	0.2795	0.2955	0.3123	0.3301	0.3489	0.3688	0.3898	
1,264,668	$ 1,336,754	$ 1,412,949	$ 1,493,487	$ 1,578,616	$ 1,668,597	$ 1,763,707	$ 1,864,238	$ 1,970,500	$
4,804,270	**$ 4,883,541**	**$ 4,967,137**	**$ 1,755,209**	**$ 1,848,190**	**$ 1,946,258**	**$ 2,049,698**	**$ 2,158,809**	**$ 2,273,908**	**$**
0.140	0.148	0.157	0.166	0.175	0.185	0.196	0.207	0.219	
0.034	0.036	0.038	0.040	0.042	0.045	0.047	0.050	0.053	
-	-	-	-	-	-	-	-	-	
-	-	-	-	-	-	-	-	-	
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$
-	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$**
(4,804,270)	**$ (4,883,541)**	**$ (4,967,137)**	**$ (1,755,209)**	**$ (1,848,190)**	**$ (1,946,258)**	**$ (2,049,698)**	**$ (2,158,809)**	**$ (2,273,908)**	**$**
0.52189	**0.50669**	**0.49193**	**0.47761**	**0.46369**	**0.45019**	**0.43708**	**0.42435**	**0.41199**	
1,722,292	**$ 1,672,128**	**$ 1,623,425**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$**
785,021	**$ 802,322**	**$ 820,077**	**$ 838,298**	**$ 856,996**	**$ 876,184**	**$ 895,875**	**$ 916,083**	**$ 936,820**	**$**
-	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$**
(2,507,312)	**$ (2,474,450)**	**$ (2,443,502)**	**$ (838,298)**	**$ (856,996)**	**$ (876,184)**	**$ (895,875)**	**$ (916,083)**	**$ (936,820)**	**$**
55,893,329	**$ 57,565,457**	**$ 59,188,882**	**$ 59,188,882**	**$ 59,188,882**	**$ 59,188,882**	**$ 59,188,882**	**$ 59,188,882**	**$ 59,188,882**	**$**
14,464,068	**$ 15,266,390**	**$ 16,086,467**	**$ 16,924,765**	**$ 17,781,761**	**$ 18,657,945**	**$ 19,553,820**	**$ 20,469,903**	**$ 21,406,722**	**$**
-	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$**
(70,357,397)	**$ (72,831,847)**	**$ (75,275,349)**	**$ (76,113,647)**	**$ (76,970,643)**	**$ (77,846,827)**	**$ (78,742,702)**	**$ (79,658,785)**	**$ (80,595,605)**	**$**

ɔnt Project Cost	
ɫal Costs/Power	$ -
ɫal Costs/Water	$ 44,267,169
;	$ -
Grant	$ -
sted Capital Costs	$ 44,267,169

Financial Parameters	
Life of Bonds	25
Life of Project	50
Interest	5.50%
Inflation	3.00%
Green Tag, Cost and Value of	5.70%

2045	2046	2047	2048	2049	2050	2051	2052	2053	
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$
331,542	$ 341,488	$ 351,733	$ 362,285	$ 373,153	$ 384,348	$ 395,878	$ 407,755	$ 419,987	$
;,054,548	5,054,548	5,054,548	5,054,548	5,054,548	5,054,548	5,054,548	5,054,548	5,054,548	
0.4604	0.4866	0.5144	0.5437	0.5747	0.6074	0.6421	0.6786	0.7173	
2,327,027	$ 2,459,667	$ 2,599,868	$ 2,748,061	$ 2,904,700	$ 3,070,268	$ 3,245,273	$ 3,430,254	$ 3,625,778	$
2,658,568	**$ 2,801,155**	**$ 2,951,601**	**$ 3,110,345**	**$ 3,277,853**	**$ 3,454,616**	**$ 3,641,152**	**$ 3,838,009**	**$ 4,045,766**	**$**
0.258	0.273	0.288	0.305	0.322	0.341	0.360	0.381	0.402	
0.062	0.066	0.070	0.074	0.078	0.082	0.087	0.092	0.097	
-	-	-	-	-	-	-	-	-	
-	-	-	-	-	-	-	-	-	
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$
-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$
-	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$**
(2,658,568)	**$ (2,801,155)**	**$ (2,951,601)**	**$ (3,110,345)**	**$ (3,277,853)**	**$ (3,454,616)**	**$ (3,641,152)**	**$ (3,838,009)**	**$ (4,045,766)**	**$**
0.37703	**0.36604**	**0.35538**	**0.34503**	**0.33498**	**0.32523**	**0.31575**	**0.30656**	**0.29763**	
-	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$**
1,002,350	**$ 1,025,349**	**$ 1,048,950**	**$ 1,073,170**	**$ 1,098,025**	**$ 1,123,531**	**$ 1,149,707**	**$ 1,176,568**	**$ 1,204,133**	**$**
-	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$**
(1,002,350)	**$ (1,025,349)**	**$ (1,048,950)**	**$ (1,073,170)**	**$ (1,098,025)**	**$ (1,123,531)**	**$ (1,149,707)**	**$ (1,176,568)**	**$ (1,204,133)**	**$**
59,188,882	**$ 59,188,882**	**$ 59,188,882**	**$ 59,188,882**	**$ 59,188,882**	**$ 59,188,882**	**$ 59,188,882**	**$ 59,188,882**	**$ 59,188,882**	**$**
24,347,112	**$ 25,372,461**	**$ 26,421,411**	**$ 27,494,581**	**$ 28,592,606**	**$ 29,716,137**	**$ 30,865,844**	**$ 32,042,411**	**$ 33,246,544**	**$**
-	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$**
(83,535,994)	**$ (84,561,343)**	**$ (85,610,293)**	**$ (86,683,463)**	**$ (87,781,488)**	**$ (88,905,019)**	**$ (90,054,726)**	**$ (91,231,293)**	**$ (92,435,427)**	**$**

ont Project Cost

tal Costs/Power	$ -
tal Costs/Water	$ 44,267,169
;	$ -
Grant	$ -
sted Capital Costs	$ 44,267,169

Financial Parameters

Life of Bonds	25
Life of Project	50
Interest	5.50%
Inflation	3.00%
Green Tag, Cost and Value of	5.70%

2056	2057	2058	2059	2060	2061	2062
-	$ -	$ -	$ -	$ -	$ -	$ -
458,932	$ 472,699	$ 486,880	$ 501,487	$ 516,531	$ 532,027	$ 547,988
;,054,548	5,054,548	5,054,548	5,054,548	5,054,548	5,054,548	5,054,548
0.8471	0.8954	0.9464	1.0004	1.0574	1.1177	1.1814
4,281,798	$ 4,525,861	$ 4,783,835	$ 5,056,513	$ 5,344,735	$ 5,649,385	$ 5,971,400
4,740,730	**$ 4,998,560**	**$ 5,270,715**	**$ 5,558,000**	**$ 5,861,266**	**$ 6,181,412**	**$ 6,519,388**
0.475	0.502	0.531	0.561	0.593	0.627	0.662
0.115	0.121	0.128	0.135	0.143	0.151	0.160
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	$ -	$ -	$ -	$ -	$ -	$ -
-	$ -	$ -	$ -	$ -	$ -	$ -
-	$ -	$ -	$ -	$ -	$ -	$ -
-	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
(4,740,730)	**$ (4,998,560)**	**$ (5,270,715)**	**$ (5,558,000)**	**$ (5,861,266)**	**$ (6,181,412)**	**$ (6,519,388)**
0.27237	**0.26444**	**0.25674**	**0.24926**	**0.24200**	**0.23495**	**0.22811**
-	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
1,291,241	**$ 1,321,812**	**$ 1,353,185**	**$ 1,385,380**	**$ 1,418,419**	**$ 1,452,325**	**$ 1,487,119**
-	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
(1,291,241)	**$ (1,321,812)**	**$ (1,353,185)**	**$ (1,385,380)**	**$ (1,418,419)**	**$ (1,452,325)**	**$ (1,487,119)**
59,188,882	**$ 59,188,882**	**$ 59,188,882**	**$ 59,188,882**	**$ 59,188,882**	**$ 59,188,882**	**$ 59,188,882**
37,031,657	**$ 38,353,470**	**$ 39,706,655**	**$ 41,092,035**	**$ 42,510,454**	**$ 43,962,779**	**$ 45,449,897**
-	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
(96,220,539)	**$ (97,542,352)**	**$ (98,895,537)**	**$ (100,280,917)**	**$ (101,699,337)**	**$ (103,151,661)**	**$ (104,638,780)**

CHAPTER 9
FINANCIAL ANALYSIS

Prepared for
City of Bend, Oregon
October 23, 2009
Revised November 11, 2009

Prepared by

Deb Galardi, Galardi Consulting, LLC.

BROWN AND CALDWELL

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CHAPTER 9

ALTERNATIVE OPTION SELECTION

9.0 Summary

This chapter summarizes the financial analysis that was conducted in conjunction with the City of Bend (City) Water Supply Alternative project. The scope of the financial analysis was to perform the following tasks:

1. Update the previous financial plan model developed by Galardi Consulting in 2008 to reflect current operating and capital budget data, as well as updated assumptions related to future cost and revenue projections (e.g., customer growth and consumption trends and cost escalation) as provided by City finance staff.
2. Evaluate potential financing options for capital improvements in conjunction with Brown and Caldwell (which provided information related to renewable energy construction incentive programs) and the City's finance staff and financial advisor (who provided information on current bond market conditions and existing bond covenants).
3. Determine rate impacts of different capital project alternatives using the updated financial plan model and the relevant package of construction and financing assumptions.
4. Develop documentation and presentation material, including a memorandum and matrix of construction/financing alternatives and corresponding rate impacts.

Over the course of the study, 22 primary scenarios were developed representing different options related to hydropower, treatment technology, timeline (2012 deadline versus 2014 treatment deadline), and penstock construction. Additional scenarios were developed to analyze the impact of alternative debt assumptions (e.g., subordination of debt) and modified operation and maintenance (O&M) and hydropower revenue assumptions. This chapter presents information on the baseline financial plan assumptions, as well as the specific assumptions and findings related to the four primary Bridge Creek alternatives presented to the City Council in August and September 2009.

9.1 Baseline financial Plan

The financial plan provides annual O&M and capital cost forecasts and projects revenue under existing rates and required annual system-wide revenue increases to meet established financial policies through the City's 5-year capital improvement plan (CIP) period (fiscal year [FY] 2009–10 through FY2013–14). The financial plan model—originally developed for the City in 2008—was updated with the following data:

- FY2009–10 and FY2010–11 adopted budget (O&M line item expenditures, revenues, and transfers)
- FY2009–10 through FY2013–14 CIP
- FY2009–10 through FY2013–14 system development charge (SDC) forecast

The forecast model was also extended through FY2019–20; however, because the City does not have annual projections of capital improvement needs beyond FY2013–14, the rate impact analysis focused on a 5-year window.

9.1.1 Forecast Assumptions

The financial plan relies on a number of assumptions related to future cost and revenue escalation and customer growth and consumption trends. The key assumptions used in the study include the following:

- Rate revenue:
  - FY2010 water consumption adjustment (-15 percent summer; -9 percent annual)
  - Future years' consumption per account: flat
  - FY2010 and FY2011 account growth: 0 percent
  - Post FY2011 annual account growth: 1.5 percent
- Cost escalation (post FY2010 and FY2011 budget):
  - Salaries and wages: 3 to 4 percent per year (based on Financial Consulting Solutions Group [FCSG] report)
  - Benefits: 4.2 percent (per FCSG report)
  - Materials and services: 5 percent
  - Transfers: 5 percent
  - Capital: 0 percent (projects already inflated)
- Interest earnings: 3.0 to 4.5 percent (per FCSG report)
- Other:
  - Contingency: 60 days of O&M
  - Budget spent: 100 percent

9.1.2 CIP

Table 9-1 lists the components of the City's 5-year CIP, excluding the source water project. Total project costs are about $20.4 million and include improvements to wells, reservoirs, transmission, and distribution, as well as equipment and costs for studies and planning. Construction costs for the project alternatives are presented in Section 9-3.

9.1.3 Capital Financing

The City will use a combination of current revenues (primarily rates and SDCs) and long-term financing to fund the CIP and project costs. Long-term financing options considered include conventional revenue bonds (paid by revenues of the water system; no voter approval required), as well as state and federal loan programs.

The CIP is assumed to be funded from the following sources:

- SDCs (based on projected development activity)
- $5.6 million in stimulus funding which assumes 50 percent grant and 50 percent loan (repaid at 3 percent interest and a 20-year term)
- Revenue bonds

Table 9-1. Water System CIP

Project	FY 2009–10, dollars	FY 2010–11, dollars	FY 2011–12, dollars	FY 2012–13, dollars	FY 2013–14, dollars	Total, dollars
CIP: consultants	250,000	200,000	0	0	0	450,000
Water rights acquisition	595,000	250,000	500,000	500,000	500,000	2,345,000
New reservoir, Rock Bluff 2	0	0	1,109,000	725,000	0	1,834,000
Airport well 3 design/drilling	100,000	0	0	0	0	100,000
Automatic meter reading	1,850,000	0	0	0	0	1,850,000
Avion 12-inch	70,000	0	0	0	0	70,000
Water Division Shiloh well	650,000	0	0	0	0	650,000
TBR Road/Murphy 16-inch water	1,253,000	0	0	0	0	1,253,000
Well 4 Pilot Butte control facility	1,610,000	0	0	0	0	1,610,000
WA0808 water modeling	100,000	100,000	100,000	100,000	100,000	500,000
WA09FA optimization	400,000	0	0	0	0	400,000
New projects						
Juniper Ridge reservoir	0	0	150,000	2,704,000	0	2,854,000
Outback 3 reservoir	100,000	0	0	0	0	100,000
Pilot Butte wells (5, 6, 7, 8)	0	0	1,250,000	2,450,000	1,250,000	4,950,000
Tillicum Village projects	515,000	0	0	0	0	515,000
Water management and conservation plan update	50,000	50,000	100,000	0	0	200,000
Water reuse feasibility	0	75,000	0	0	0	75,000
Repair and maintenance						
Communication equipment	0	0	200,000	200,000	200,000	600,000
Total CIP	**7,543,000**	**675,000**	**3,409,000**	**6,679,000**	**2,050,000**	**20,356,000**

In estimating debt service costs for revenue bonds, the following assumptions were used:

- Interest rate: 5.5 percent
- Term: 30 years
- Issuance cost: 1.5 percent (funded with proceeds)
- Required reserve: 8 percent (funded with proceeds)
- Minimum debt service coverage target: 1.5 (with SDCs); 1.0 (without SDCs)
- Timing: just-in-time financing (i.e., separate issues were assumed for each year's funding needs, as opposed to a larger issue earlier in the plan to fund multiple years of construction)
- First year payment: 50 percent for most issues; 2 years' deferral of principal on the largest bond (FY2012)

9.1.4 Operating Costs

Baseline budgeted operating costs are listed in Table 9-2, based on the adopted budget for FY2009–10 and FY2010–11. As listed in Table 9-2, total O&M costs for the 2-year budget period average $11.4 million. Costs do not include projected additional O&M costs and electrical cost savings associated with the project.

Table 9-2. Operating Budget

	FY2009–10, dollars	FY2010–11, dollars
Watershed/surface water	129,600	130,552
Wells	801,586	825,961
Disinfection	218,881	224,773
Water resources	482,860	496,570
Reservoirs	171,611	153,679
Distribution mains	1,752,303	1,837,685
Water services	2,905,773	2,930,902
Pumping	342,509	351,985
Administration and support (e.g., legal)	2,417,225	2,567,647
Billed services (e.g, garage, fuel)	441,900	459,900
Transfers (e.g., finance, information and technology)	1,547,777	1,523,300
Capital expansion	83,425	87,553
Total	**11,295,450**	**11,590,507**

Based on the escalation factors discussed previously, total baseline O&M costs may increase to $13.2 million in FY2013–14.

9.2 Bridge Creek Alternatives

Table 9-3 summarizes the results of the financial analysis associated with the Bridge Creek alternatives presented to the City Council in August and September 2009. Financial plans were developed for each alternative, based on the baseline data and analysis described in Section 9-2. In addition, project-specific assumptions were developed for each scenario related to the following issues:

- Total construction costs and financing
- Annual O&M costs and savings
- Hydroelectric power production revenue (if applicable)
- Annual system-wide water rate increase

Table 9-3. Summary of Bridge Creek Alternatives

Alternative	Total construction costs, dollars in millions	Annual O&M cost[1], dollars	Annual hydro revenue, dollars in millions[1]	Annual rate increase, percent
Membrane and penstock only	58.2	502,000	0.0	10.8
Ultraviolet and penstock only	44.9	190,000	0.0	8.2
Membrane, penstock, and hydroelectric	71.2	502,000	1.3	7.6
UV, penstock, and hydroelectric	57.9	190,000	1.3	4.7

[1] First full year of project operation (FY2013–14)

9.2.1 Capital Costs and Financing

As listed in Table 9-3, construction costs for the Bridge Creek alternatives range from $44.9 million (UV treatment and penstock only) to $71.2 million (membrane treatment, penstock, and hydroelectric). Funding for the treatment costs are assumed to be a combination of SDCs, rates, and revenue bond funding, as described in Section 9-2 for the 5-year CIP projects.

In addition, the hydroelectric project may be eligible for state and federal loan, grant, and tax credit programs targeted specifically for renewable energy projects. The following funding was assumed for the hydroelectric and penstock (pipeline) project costs ($41.4 million):

- City will obtain partner funding up-front to utilize state and federal energy tax credits (worth about $7.8 million discounted) to reduce the amount that needs to be financed to $33.6 million.
- $12.4 million will be in the form of federal government grants (Federal Business Energy Investment Tax Credit).
- $6 million will be in the form of state loans (Oregon Department of Energy) that assume 3 percent interest, no reserves, 20-year term, and subordinated obligations.

More detailed information about the project financing assumptions for the hydroelectric scenarios is provided in Appendix 9-A.

The City's current water system debt service is limited to about $0.3 million annually for the series 2000 revenue bonds. Annual debt service costs are projected to increase significantly under all of the Bridge Creek alternatives—in part to fund a portion of costs associated with the 5-year CIP—ranging from about $4.2 million for the UV scenarios to about $5.1 million for the membrane scenarios.

9.2.2 Operating Costs

Operating costs vary for the alternatives, based on the assumed treatment technology. Annual operating costs for membrane treatment are estimated to be $502,000 in FY2013–14 (the first full year of operation). The annual costs for UV treatment are $190,000. Some reductions in baseline operating costs are projected for the membrane treatment alternatives, due to reduced energy costs (about $55,000) associated with reduced reliance on the wells.

9.2.3 Revenue

Revenue under existing rates is projected to be about $11.4 million in FY2009–10. As debt service costs increase significantly to fund the project, as well as the other CIP costs, revenue requirements from rates are projected to increase to between $14.0 million (for the UV, penstock and hydroelectric scenario) and $18.0 million (for the membrane and penstock only scenario).

The revenue requirements from rates reflect projected revenues from other sources of funds, including hydroelectric revenues, which are available to fund a portion of the debt service and operating costs of the water system. Hydroelectric revenues are assumed to be about $1.3 million in FY2013–14, and help mitigate water rate increases for the hydroelectric alternatives. As listed in Table 9-3, the annual rate increase needed for the Bridge Creek options through FY2013–14 range from 4.7 percent (for the UV, penstock, and hydroelectric scenario), to 10.8 percent (for the membrane and penstock only scenario). Additional rate increases will likely be needed in subsequent years to fund additional capital improvements and normal increases in operating costs.

9.2.4 2014 Scenarios

The City is currently operating under the assumption that the project construction will need to be completed in 2012. However, some other communities are pursuing delayed construction schedules through 2014. Additional scenarios were developed to examine the impact of delaying the treatment plant construction for 2 years. Table 9-4 lists the revised rate increases based on the delayed schedule.

Table 9-4. Summary of Bridge Creek Alternatives: 2014 Treatment Plant Construction

Alternative	Annual rate increase, percent
Membrane and penstock only	8.8
UV and penstock only	7.2
Membrane, penstock, and hydroelectric	5.85
UV, penstock, and hydroelectric	4.1

9.3 Conclusion

The City has a longstanding practice of adjusting water rates annually based on a long-term financial plan to avoid large single-year rate adjustments. The City last adopted a water system financial plan in 2008, and projected the need for an annual rate increase of 8.25 percent through FY2012–13; the City implemented the first two rate increases from that plan in FY2008–09 and FY2009–10. The updated financial plan projects rate increases of 4.7 percent to 10.8 percent for FY2010–11 through FY2013–14, to fund the City's current adopted 5-year, projected baseline O&M costs, as well as projected construction and O&M costs associated with a Bridge Creek water supply and treatment alternative. The hydroelectric options significantly mitigate projected rate increases, due to the additional revenue projected from the sale of hydroelectric power, as well as significant construction cost incentives. All of the Bridge Creek alternatives will greatly increase the City's debt service costs, and therefore will require a long-term commitment from the City to maintain sufficient rates and charges to meet bond covenants.

The rate increases projected herein are based on available information on costs and revenues as of May 2009, and include a number of assumptions related to future financing eligibility and market conditions. Changes in these assumptions may warrant modifications to the rate increases. Furthermore, continued economic challenges will require close monitoring of revenues and expenses, and possible future revisions to rate increases if customer growth and consumption drop below projected levels.

APPENDIX 9-A

Source Project Financing Assumptions

Source Project Financing Assumptions
Scenario
Membrane Treatment with Powerhouse and Penstock

		Total	Discounted Value	FY 2009-10	FY 2010-11	FY 2011-12	FY 2012-13	FY 2013-14
	Construction Costs							
	WTP	$29,750,000		$925,000	$4,550,000	$22,300,000	$1,975,000	
	Powerhouse & Penstock	$41,400,000		$725,000	$14,275,000	$13,750,000	$12,650,000	$0
	Total	**$71,150,000**		**$1,650,000**	**$18,825,000**	**$36,050,000**	**$14,625,000**	**$0**
	Construction Funding Sources							
		Total	**Discounted Value**					
			6%					
	Construction Incentives -- Grants/Partner Financing							
	WTP	$0		$0	$0	$0	$0	$0
	Powerhouse & Penstock							
	Federal Business Energy Inv Tax Credit (ITC)	$12,420,000	$12,420,000	$0	$0	$6,398,559	$6,021,441	$0
0%	Unused	$0	$0	$0	$0	$0	$0	$0
	Federal Renewable Energy Grants	$400,000	$335,848	$0	$117,867	$113,532	$104,449	$0
	Oregon Energy Business Tax Credits (OBETC)	$10,000,000	$7,497,978	$0	$2,631,435	$2,534,657	$2,331,885	$0
0%	Energy Trust of Oregon Open Solicitation Program	$0	$0	$0	$0	$0	$0	$0
	ETO non Open Soliciation Program	$0	$0	$0	$0	$0	$0	$0
0%	USDA Rural Energy for America Program (REAP) Grants	$0	$0	$0	$0	$0	$0	$0
	Subtotal	$22,820,000	$20,253,825	$0	$2,749,302	$9,046,748	$8,457,775	$0
	Net Construction Financing							
	WTP	$29,750,000	$29,750,000	$925,000	$4,550,000	$22,300,000	$1,975,000	$0
	Powerhouse & Penstock	$18,580,000	$21,146,175	$725,000	$11,525,698	$4,703,252	$4,192,225	$0
	Total	**$48,330,000**	**$50,896,175**	**$1,650,000**	**$16,075,698**	**$27,003,252**	**$6,167,225**	**$0**
	Construction Incentives -- Loans							
	WTP							
	Powerhouse & Penstock							
	Clean Renewable Energy Bonds (CREBs)	$0		$0	$0	$0	$0	$0
	Qualified Energy Conservation Bonds (QECBs)	$0		$0	$0	$0	$0	$0
0%	USDA Rural Energy for America Program (REAP) Loan	$0		$0	$0	$0	$0	
	Oregon Small Scale Loan Program	$0		$0	$0	$0	$0	$0
	Subtotal	$0	$0	$0	$0	$0	$0	$0
	O&M							
	WTP			$0	$0	**$0**	**$362,000**	**$502,000**
	Powerhouse & Penstock			$0	$0	$0	$25,500	$53,000
	Reduction in Electricity Costs						-$55,000	-$57,750
	Total	**$0**	**$0**	**$0**	**$0**	**$0**	**$332,500**	**$497,250**

Source Project Financing Assumptions
Scenario
Membrane Treatment with Powerhouse and Penstock

	Total	FY 2009-10	FY 2010-11	FY 2011-12	FY 2012-13	FY 2013-14
O&M and Debt Funding Sources -- Hydro						
mWh produced hydro					4,475	9,260
mWh produced Total					4,475	9,260
Rate -- PP&L					$0.071	$0.074
Rate -- Green Tags					$0.022	$0.023
Rate -- Hydro Production Incentive					$0.022	$0.023
Power Production Payment - PP&L rate schedule					$317,725	$684,314
Green Tags					$98,450	$215,332
Hydro Production Incentive					$98,450	$211,869
Renewable Energy Production Tax Credits					$98,450	$203,720
Total			**$0**	**$0**	**$613,075**	**$1,315,235**

Source Project Financing Assumptions
Scenario
UV Treatment w/Penstock and Powerhouse

	Total		FY 2009-10	FY 2010-11	FY 2011-12	FY 2012-13	FY 2013-14
Construction Costs							
WTP	$16,500,000		$500,000	$2,475,000	$12,375,000	$1,150,000	
Powerhouse & Penstock	$41,400,000		$725,000	$14,275,000	$13,750,000	$12,650,000	$0
Total	**$57,900,000**		**$1,225,000**	**$16,750,000**	**$26,125,000**	**$13,800,000**	**$0**
Construction Funding Sources							
	Total	**Discounted Value**					
		6%					
Construction Incentives -- Grants/Partner Financing							
WTP	$0		$0	$0	$0	$0	$0
Powerhouse & Penstock							
Federal Business Energy Inv Tax Credit (ITC)	$12,420,000	$12,420,000	$0	$0	$6,398,559	$6,021,441	$0
0% Unused	$0	$0	$0	$0	$0	$0	$0
Federal Renewable Energy Grants	$400,000	$335,848	$0	$117,867	$113,532	$104,449	$0
Oregon Energy Business Tax Credits (OBETC)	$10,000,000	$7,497,978	$0	$2,631,435	$2,534,657	$2,331,885	$0
0% Energy Trust of Oregon Open Solicitation Program	$0	$0	$0	$0	$0	$0	$0
ETO non Open Soliciation Program	$0	$0	$0	$0	$0	$0	$0
0% USDA Rural Energy for America Program (REAP) Grants	$0	$0	$0	$0	$0	$0	$0
Subtotal	$22,820,000	$20,253,825	$0	$2,749,302	$9,046,748	$8,457,775	$0
		$20,253,825					
Net Construction Financing							
WTP	$16,500,000	$16,500,000	$500,000	$2,475,000	$12,375,000	$1,150,000	$0
Powerhouse & Penstock	$18,580,000	$21,146,175	$725,000	$11,525,698	$4,703,252	$4,192,225	$0
Total	**$35,080,000**	**$37,646,175**	**$1,225,000**	**$14,000,698**	**$17,078,252**	**$5,342,225**	**$0**
Construction Incentives -- Loans							
WTP							
Powerhouse & Penstock							
Clean Renewable Energy Bonds (CREBs)	$0		$0	$0	$0	$0	$0
Qualified Energy Conservation Bonds (QECBs)	$0		$0	$0	$0	$0	$0
0% USDA Rural Energy for America Program (REAP) Loan	$0		$0	$0	$0	$0	
Oregon Small Scale Loan Program	$0		$0	$0	$0	$0	$0
Subtotal	$0	$0	$0	$0	$0	$0	$0
O&M							
WTP			$0	$0	**$0**	**$95,000**	**$190,000**
Powerhouse & Penstock			$0	$0	$0	$25,500	$53,000
Reduction in Electricity Costs							

Source Project Financing Assumptions
Scenario
UV Treatment w/Penstock and Powerhouse

	Total		FY 2009-10	FY 2010-11	FY 2011-12	FY 2012-13	FY 2013-14
Total	$0	$0	$0	$0	$0	$120,500	$243,000
O&M and Debt Funding Sources -- Hydro							
mWh produced hydro						4,475	9,260
mWh produced Total						4,475	9,260
Rate -- PP&L						$0.071	$0.074
Rate -- Green Tags						$0.022	$0.023
Rate -- Hydro Production Incentive						$0.022	$0.023
Power Production Payment - PP&L rate schedule						$317,725	$684,314
Green Tags						$98,450	$215,332
Hydro Production Incentive						$98,450	$211,869
Renewable Energy Production Tax Credits						$98,450	$203,720
Total				$0	$0	$613,075	$1,315,235

Source Project Financing Assumptions
Scenario
Membrane Treatment with Powerhouse and Penstock (2014)

	Total		FY 2009-10	FY 2010-11	FY 2011-12	FY 2012-13	FY 2013-14	FY 2014-15
Construction Costs								
WTP	$29,750,000				$925,000	$4,550,000	$22,300,000	$1,975,000
Powerhouse & Penstock	$41,400,000		$725,000	$14,275,000	$13,750,000	$12,650,000	$0	
Total	**$71,150,000**		**$725,000**	**$14,275,000**	**$14,675,000**	**$17,200,000**	**$22,300,000**	**$1,975,000**
Construction Funding Sources								
	Total	**Discounted Value**						
		6%						
Construction Incentives -- Grants/Partner Financing								
WTP	$0		$0	$0	$0	$0	$0	$0
Powerhouse & Penstock								
Federal Business Energy Inv Tax Credit (ITC)	$12,420,000	$12,420,000	$0	$0	$6,398,559	$6,021,441	$0	$0
0% Unused	$0	$0	$0	$0	$0	$0	$0	$0
Federal Renewable Energy Grants	$400,000	$335,848	$0	$117,867	$113,532	$104,449	$0	$0
Oregon Energy Business Tax Credits (OBETC)	$10,000,000	$7,497,978	$0	$2,631,435	$2,534,657	$2,331,885	$0	$0
0% Energy Trust of Oregon Open Solicitation Program	$0	$0	$0	$0	$0	$0	$0	$0
ETO non Open Soliciation Program	$0	$0	$0	$0	$0	$0	$0	$0
0% USDA Rural Energy for America Program (REAP) Grants	$0	$0	$0	$0	$0	$0	$0	$0
Subtotal	$22,820,000	$20,253,825	$0	$2,749,302	$9,046,748	$8,457,775	$0	$0
Net Construction Financing								
WTP	$29,750,000	$29,750,000	$0	$0	$925,000	$4,550,000	$22,300,000	$1,975,000
Powerhouse & Penstock	$18,580,000	$21,146,175	$725,000	$11,525,698	$4,703,252	$4,192,225	$0	$0
Total	**$48,330,000**	**$50,896,175**	**$725,000**	**$11,525,698**	**$5,628,252**	**$8,742,225**	**$22,300,000**	**$1,975,000**
Construction Incentives -- Loans								
WTP								
Powerhouse & Penstock								
Clean Renewable Energy Bonds (CREBs)	$0		$0	$0	$0	$0	$0	$0
Qualified Energy Conservation Bonds (QECBs)	$0		$0	$0	$0	$0	$0	$0
0% USDA Rural Energy for America Program (REAP) Loan	$0		$0	$0	$0	$0		
Oregon Small Scale Loan Program	$0		$0	$0	$0	$0	$0	$0
Subtotal	$0	$0	$0	$0	$0	$0	$0	$0
O&M								
WTP			$0	$0	**$0**	$0	**$0**	**$362,000**
Powerhouse & Penstock			$0	$0	$0	$25,500	$53,000	$55,253
Reduction in Electricity Costs						-$55,000	-$57,750	-$60,060
Total	**$0**	**$0**	**$0**	**$0**	**$0**	**-$29,500**	**-$4,750**	**$357,193**
O&M and Debt Funding Sources -- Hydro								
mWh produced hydro						4,475	9,260	9,450
mWh produced Total						4,475	9,260	9,450

Source Project Financing Assumptions
Scenario
Membrane Treatment with Powerhouse and Penstock (2014)

	Total	FY 2009-10	FY 2010-11	FY 2011-12	FY 2012-13	FY 2013-14	FY 2014-15
Rate -- PP&L					$0.071	$0.074	$0.076
Rate – Green Tags					$0.022	$0.023	$0.025
Rate – Hydro Production Incentive					$0.022	$0.023	$0.024
Power Production Payment - PP&L rate schedule					$317,725	$684,314	$718,200
Green Tags					$98,450	$215,332	$232,276
Hydro Production Incentive					$98,450	$211,869	$224,865
Renewable Energy Production Tax Credits					$98,450	$203,720	$207,900
Total			**$0**	**$0**	**$613,075**	**$1,315,235**	**$1,383,241**

Source Project Financing Assumptions
Scenario
UV Treatment with Powerhouse and Penstock (2014)

	Total	Discounted Value	FY 2009-10	FY 2010-11	FY 2011-12	FY 2012-13	FY 2013-14	FY 2014-15
Construction Costs								
WTP	$16,500,000				$500,000	$2,475,000	$12,375,000	$1,150,000
Powerhouse & Penstock	$41,400,000		$725,000	$14,275,000	$13,750,000	$12,650,000	$0	
Total	**$57,900,000**		**$725,000**	**$14,275,000**	**$14,250,000**	**$15,125,000**	**$12,375,000**	**$1,150,000**
Construction Funding Sources								
	Total	**Discounted Value**						
		6%						
Construction Incentives -- Grants/Partner Financing								
WTP	$0		$0	$0	$0	$0	$0	$0
Powerhouse & Penstock								
Federal Business Energy Inv Tax Credit (ITC)	$12,420,000	$12,420,000	$0	$0	$6,398,559	$6,021,441	$0	$0
0% Unused	$0	$0	$0	$0	$0	$0	$0	$0
Federal Renewable Energy Grants	$400,000	$335,848	$0	$117,867	$113,532	$104,449	$0	$0
Oregon Energy Business Tax Credits (OBETC)	$10,000,000	$7,497,978	$0	$2,631,435	$2,534,657	$2,331,885	$0	$0
0% Energy Trust of Oregon Open Solicitation Program	$0	$0	$0	$0	$0	$0	$0	$0
ETO non Open Soliciation Program	$0	$0	$0	$0	$0	$0	$0	$0
0% USDA Rural Energy for America Program (REAP) Grants	$0	$0	$0	$0	$0	$0	$0	$0
Subtotal	$22,820,000	$20,253,825	$0	$2,749,302	$9,046,748	$8,457,775	$0	$0
Net Construction Financing								
WTP	$16,500,000	$16,500,000	$0	$0	$500,000	$2,475,000	$12,375,000	$1,150,000
Powerhouse & Penstock	$18,580,000	$21,146,175	$725,000	$11,525,698	$4,703,252	$4,192,225	$0	$0
Total	**$35,080,000**	**$37,646,175**	**$725,000**	**$11,525,698**	**$5,203,252**	**$6,667,225**	**$12,375,000**	**$1,150,000**
Construction Incentives -- Loans								
WTP								
Powerhouse & Penstock								
Clean Renewable Energy Bonds (CREBs)	$0		$0	$0	$0	$0	$0	$0
Qualified Energy Conservation Bonds (QECBs)	$0		$0	$0	$0	$0	$0	$0
0% USDA Rural Energy for America Program (REAP) Loan	$0		$0	$0	$0	$0		
Oregon Small Scale Loan Program	$0		$0	$0	$0	$0	$0	$0
Subtotal	$0	$0	$0	$0	$0	$0	$0	$0
O&M								
WTP			$0	$0	**$0**	$0	**$0**	**$95,000**
Powerhouse & Penstock			$0	$0	$0	$25,500	$53,000	$55,253
Reduction in Electricity Costs								
Total	**$0**	**$0**	**$0**	**$0**	**$0**	**$25,500**	**$53,000**	**$150,253**
O&M and Debt Funding Sources -- Hydro								
mWh produced hydro						4,475	9,260	9,450
mWh produced Total						4,475	9,260	9,450

Source Project Financing Assumptions
Scenario
UV Treatment with Powerhouse and Penstock (2014)

	Total	FY 2009-10	FY 2010-11	FY 2011-12	FY 2012-13	FY 2013-14	FY 2014-15
Rate -- PP&L					$0.071	$0.074	$0.076
Rate -- Green Tags					$0.022	$0.023	$0.025
Rate -- Hydro Production Incentive					$0.022	$0.023	$0.024
Power Production Payment - PP&L rate schedule					$317,725	$684,314	$718,200
Green Tags					$98,450	$215,332	$232,276
Hydro Production Incentive					$98,450	$211,869	$224,865
Renewable Energy Production Tax Credits					$98,450	$203,720	$207,900
Total			**$0**	**$0**	**$613,075**	**$1,315,235**	**$1,383,241**

CHAPTER 11
WATER RIGHTS CONSIDERATIONS

Prepared for
City of Bend, Oregon
October 23, 2009

Prepared by

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BROWN AND CALDWELL

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CHAPTER 11

WATER RIGHTS CONSIDERATIONS

11.0 Introduction

As part of its Water Supply Alternatives Project, the City of Bend (City) wishes to integrate water rights information into its preliminary alternatives development for future use of its existing surface water and groundwater rights. The City requested that GSI Water Solutions, Inc. (GSI) develop this chapter to provide foundational information about the its water rights, and in particular, the opportunities, impediments, regulatory requirements, and basin-wide context of the City's current water rights.

This chapter describes the water rights held by the City and, more specifically, explores the amount of surface water available to the City under its existing surface water rights. It also describes the City's historic use of surface water and groundwater, and surface water variability. Finally, it considers how the amount of surface water use could vary under different scenarios, based on the likely availability of water under a particular water right due to its relative priority date within the system. We have developed this analysis of the City's water rights, without regard to infrastructure considerations.

11.1 City Groundwater Rights

The City has groundwater rights that authorize the use of up to 68.24 cubic feet per second (cfs). The City holds seven water right certificates that authorize use of up to 31.43 cfs of groundwater. The City holds five permits that authorize use of up to 36.81 cfs of groundwater. The City's most junior permits (G-16177 and G-16178) authorize the use of up to 24.0 cfs in total. Both permits are conditioned to require the City to provide mitigation for the use of groundwater under these permits, under the Oregon Water Resources Department's (OWRD) Deschutes Groundwater Mitigation Program. Mitigation for the maximum use under both rights combined would require 3,223 mitigation credits. Assuming a cost of $2,500 per credit, this would total $8,057,500.

If the City applied for a new groundwater right, a new permit would include a similar mitigation requirement. *It is unlikely that a new permit would be issued at this time, however, because of a limitation built into OWRD's mitigation program rules.* The program rules allow only an additional 200 cfs of new groundwater use authorized under the mitigation program. As of the development of this chapter, the groundwater use requested under applications, now pending with OWRD, and authorized under the final order and permits issued under the mitigation program, exceed the 200 cfs cap. As a result, without changes to OWRD's administrative rules or new legislation, groundwater may not be an option for long-term water supply.

11.2 City Surface Water Rights

Table 11-1 describes the City's surface water rights as of the date this chapter was developed. The City holds five surface water rights from Bridge Creek and Tumalo Creek. As summarized in Table 11-1, the City holds three certificates (31411, 31665 and 85526) for the use of water from Tumalo Creek. The City also has a transfer (B-112) for use of Tumalo Creek. These rights authorize a total combined maximum use of up to 21.113 cfs for municipal purposes. In addition to the rights for water from Tumalo Creek, the City also holds a permit for the use of up to 15.00 cfs from Bridge Creek and Tumalo Creek for municipal purposes. As listed in Table 11-1, the combined maximum rate of diversion for all of the City's Tumalo Creek and Bridge Creek water rights is 36.113 cfs or 23.33 million gallons per day (mgd).

Table 11-1. City Surface Water Rights

Source	Transfer, permit, or certificate number	Priority date	Authorized rate, cfs/mgd	Season of use	Status	Stated annual volume limits, acre-feet
Bridge Creek	Permit S-49823	12/12/1983	15.00/9.69	year-round	Permit	N/A
Tumalo Creek	Certificate 85526	N/A	6.00/3.88	year-round	-	N/A
	Certificate 31411	9/30/1900	4.50/2.91	April 15 to October 15	Certificated	821.7
		8/5/1900	2.00/1.29			
		6/1/1907	0.02/0.01			
	Certificate 31665	9/30/1900	1.314/0.85		Certificated	328.14
		4/28/1905	0.186/0.12			
		6/1/1907	1.103/0.71			
	Transfer B-112	10/29/1913	2.43–5.99/ 1.57–3.87[1]	April 1 to November 1	Inchoate (to be completed by 2019)	1,923.5
	Total authorized rate		36.113 cfs (23.33 mgd)			

[1] *Maximum authorized rate of diversion varies based on the season. Maximum rate of 5.99 cfs is allowed May 15 to September 15. It appears, however, that there may be an error in the transfer order and the maximum rate may be 7.99 cfs.*

Although the City's surface water rights have a total authorized rate of 36.113 cfs, this amount of water is not necessarily available to the City year-round. First, the use of water under Certificates 31411 and 31665 and Transfer B-112 is limited by a season of use. All three of these water rights were irrigation rights originally and as a result, have a season of use consistent with the irrigation season: April 15 to October 15 for the certificates and April 1 to November 1 for Transfer B-112. For ease of analysis herein, the season of use for Transfer B-112 also will be considered to be April 15 to October 15. Tables 11-2 and 11-3 summarize the seasonal limitations on the City's surface water rights.

Table 11-2. City Surface Water Rights During the Irrigation Season (April 15 to October 15)

Source	Transfer, permit, or certificate number	Maximum authorized rate, cfs/mgd	
Bridge Creek	Permit S-49823	15.00/9.69	15.00/9.69
Tumalo Creek	Certificate 85526	6.00/3.88	21.113/13.6
	Certificate 31411	4.50/2.91	
		2.00/1.29	
		0.02/0.01	
	Certificate 31665	1.314/0.85	
		0.186/0.12	
		1.103/0.71	
	Transfer B-112	2.43–5.99/ 1.57–3.87[1]	
Total authorized rate			36.113 cfs/23.33 mgd

[1] *Maximum authorized rate of diversion varies based on the season. Maximum rate of 5.99 cfs is allowed May 15 to September 15. It appears, however, that there may be an error in the transfer order and the maximum rate may be 7.99 cfs.*

Table 11-3. City Surface Water Rights Outside the Irrigation Season (October 16 to April 14)		
Source	Transfer, permit, or certificate	Maximum authorized rate, cfs/mgd
Bridge Creek	Permit S-49823	15.0/9.69
Tumalo Creek	Certificate 85526	6.0/3.88
Total authorized rate		21.0 cfs/13.57 mgd

In addition, the City's use of water is subject to annual volume limits. Certificates 31411 and 31665 and Transfer B-112 contain annual volume limits associated with the originating irrigation rights. (See Table 11-1.) The maximum annual volume authorized by Certificate 31411 is 821.7 acre-feet and the maximum volume authorized by Certificate 3165 is 328.14 acre-feet. The maximum annual volume for Transfer B-112 is 1923.5 acre-feet. Certificate 85526 and Permit S-49823 do not include a stated annual volume limitation, but allow use of the maximum authorized rate year-around.

Finally, the use of these surface water rights, except Certificate 85526, is subject to regulation by the State of Oregon watermaster according to its priority within the system and an established distribution schedule created by the watermaster to distribute the waters of Tumalo Creek between the City and the Tumalo Irrigation District (TID). As described above, several of the water rights held by the City were part of irrigation water rights, which are now held by TID. As a result, the City and TID hold several water rights with the same priority dates. In addition, several instream water rights on Tumalo Creek have the same priority dates, because they were also created from the original irrigation rights. To distribute water equitably among the City's, TID's and the instream water rights with identical priority dates when streamflow is not sufficient to meet the water users' needs, the watermaster uses a distribution schedule (based on streamflow and the proportionate share of water rights) to allocate water among these water uses. As streamflows decrease during the irrigation season, less water is available for use under these water rights, based on their priority dates. Regulation is typically complaint-driven. That is, the watermaster does not generally regulate water rights unless a water right holder requests regulation. However, the watermaster does need to monitor streamflow proactively for distribution associated with the instream water rights.

In the following sections, we explore the volumes of surface water that may be available to the City under its current water rights during the period of April 15 to October 15 (the irrigation season) after considering all of the above-described limitations. The following scenarios were developed to demonstrate the amount of water potentially available to the City during this time period, and to show where opportunities and limitations exist to use surface water differently.

11.3 The City's Historic Use of Surface Water and Groundwater

Historically, the City has used surface water primarily during the late fall, winter, and early spring months. This has been supplemented during the summer months by the use of groundwater. According to information provided by the City, the annual volume of surface water used has been relatively constant over the past 9 years, as shown in Figure 11-1. The City's use of groundwater has increased generally during that time period. The City produced roughly the same volume of surface water and groundwater in 2004 and 2005, but from 2006 through 2008, groundwater was the predominant water source for meeting its municipal water needs.

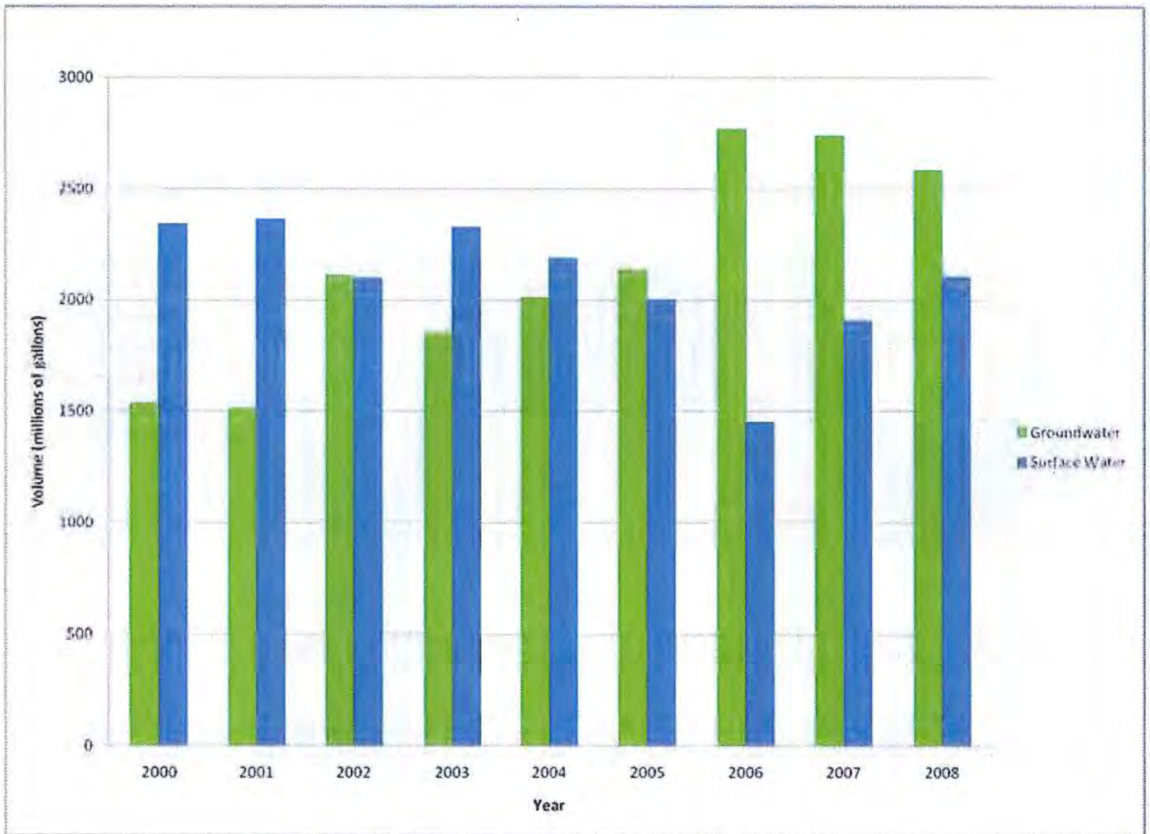


Figure 11-1. City of Bend Yearly Production Volume by Source

As shown in Figure 11-2, the City's seasonal production of surface water has been variable over the last 5 years. The numerous rapid daily declines in surface water use are reported to be associated with high turbidity events which cause cessation of use of this source under current regulatory requirements and treatment regimes. Surface water use would likely stabilize if higher-level treatment were available for this source. However, there is a discernable general trend that, not surprisingly, shows higher surface water production in late summer and early autumn, and lower surface water production during the winter months. From this information, we have developed an average surface water production trend line, which we have used later in this chapter to represent the general pattern of City's surface water production.

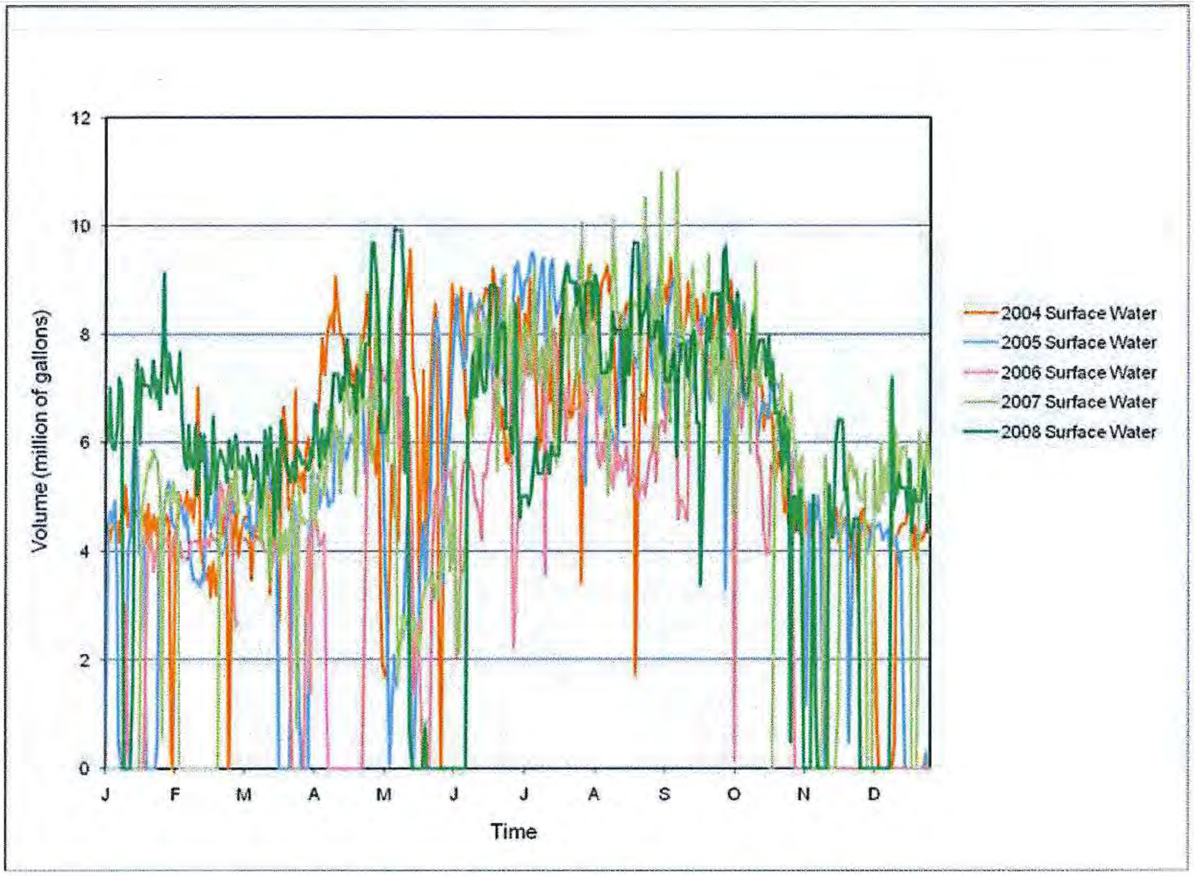


Figure 11-2. Annual Surface Water Production by Year

11.4 Alternative Scenarios

As a starting point, we compared the City's surface water rights with the surface water flows in Tumalo Creek. In particular, we determined whether the mean daily flows in Tumalo Creek ever dropped below the combined maximum rates of diversion authorized by the City's surface water rights. The mean daily flow of Tumalo Creek based on 63 years of mean daily values (1923 to 1987) is shown in blue in Figure 11-3. The combined maximum authorized rate of diversion for the City's water rights is shown in red. The maximum authorized rate increases at the start of the irrigation season (April 15) when use of Certificates 31411 and 31665 and Transfer B-112 can begin. The maximum rate fluctuates during the irrigation season based on the varying maximum authorized rate in Transfer B-112. (As noted in Table 11-1, the maximum authorized rate of diversion under Transfer B-112 varies from 2.43 to 5.99 cfs, based on the season. The maximum rate of 5.99 cfs is allowed from May 15 to September 15.) At the end of the irrigation season (October 15), the maximum authorized rate returns to 21.0 cfs, where it remains until the beginning of the next irrigation season. In addition, we have worked with the watermaster in OWRD's Bend office to obtain information about the combined maximum authorized rate of diversion for the TID's Tumalo Creek water rights. One of TID's water rights (Certificate 74147) has a maximum rate of diversion that varies during the irrigation season; however, for purposes of general reference and in the interest of efficiency, we have used the largest rate authorized, which is authorized between May 15 and September 15. TID's combined maximum authorized rate of 211 cfs is shown in green in Figure 11-3.

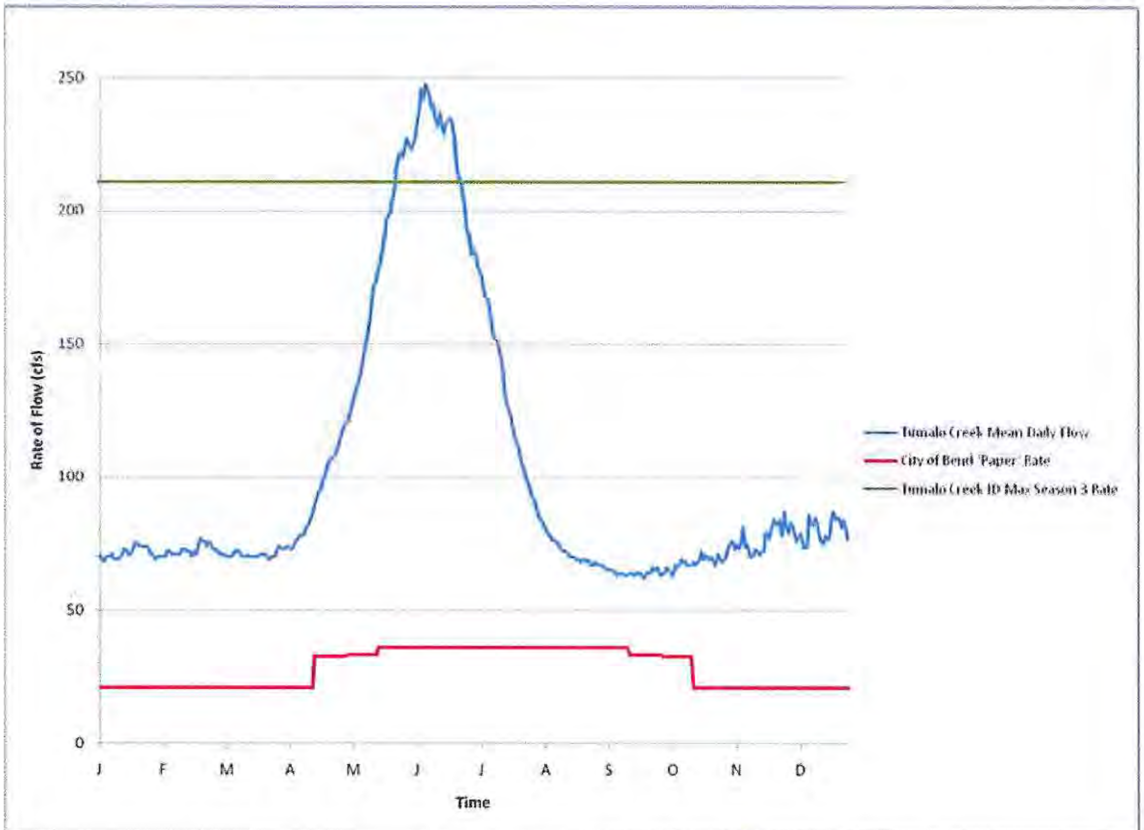


Figure 11-3. Tumalo Creek Flow and City of Bend and TID Water Rights

As shown in Figure 11-3, the mean daily flows always significantly exceed the combined maximum authorized rates for the City's water rights throughout the year. Consequently, surface water flows are not, per se, a limiting factor for the City's use of its surface water rights.

However, the City's use of water under its surface water rights is limited by their seasons of use, volume limitations, and potential regulation by the watermaster according to the distribution schedule for the City and TID. The following discussion provides four scenarios describing various assumptions about how the above variables might come together and implications for the City's use of surface water. Since the maximum authorized rate of the City's surface water rights do not vary outside of the irrigation season, this analysis focuses on the period from April 15 to October 15. The scenarios provided are solely to demonstrate opportunities and limitations and should not be construed as recommendations for surface water use.

11.4.1 Scenario 1

Scenario 1 is included for demonstration purposes only to show how all the above-described limitations work together. This scenario assumes that the City has access to all of its surface water rights and that the watermaster regulates the City according to the above-described City/TID distribution schedule throughout the irrigation season (April 15 through October 15). Since the watermaster typically does not regulate Tumalo Creek until July or August, this is a very conservative assumption. Under this scenario, we have assumed that the City would begin using all of its surface water rights at their maximum authorized rates on April 15 and would continue to use each right at its maximum rate until either it reached its maximum annual volume limitation, it was regulated off, or the irrigation season ended.

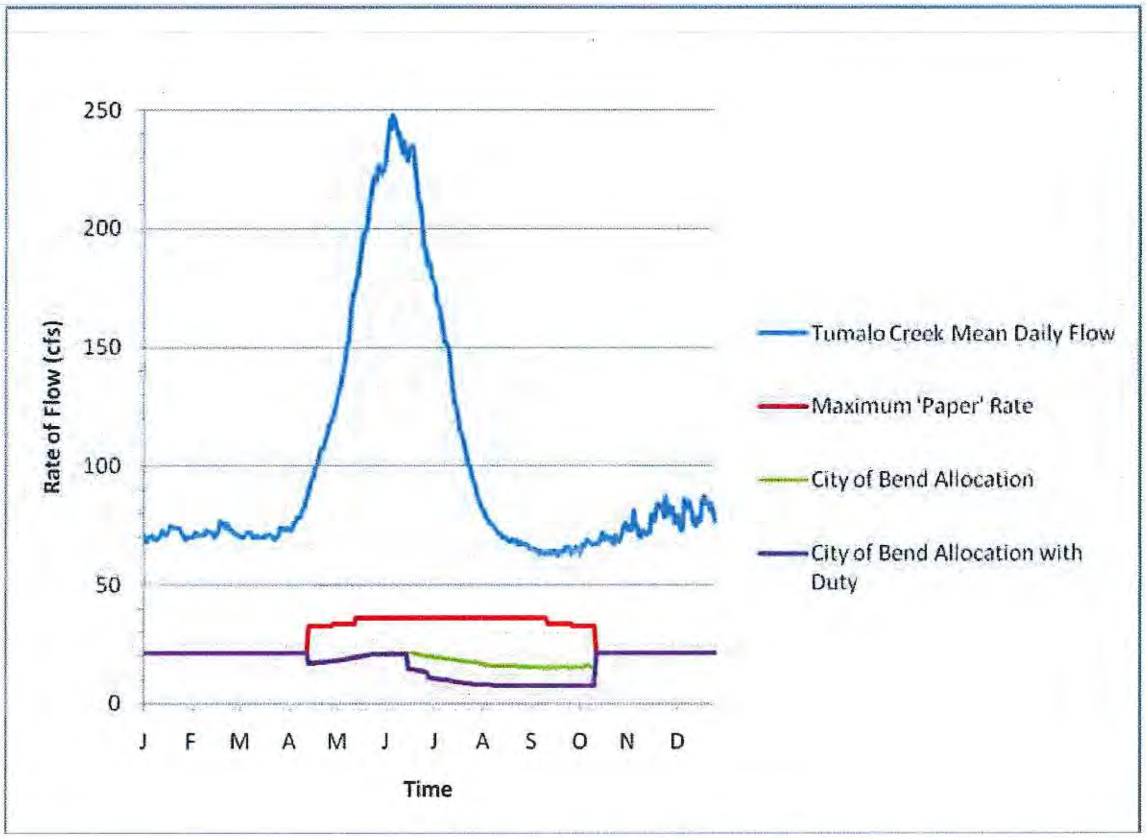


Figure 11-4. Rate Comparison – Scenario 1

The red line in Figure 11-4 shows the combined maximum rates of the City's surface water rights, without regard to the volume limitations contained in some of these rights. The green line shows the watermaster's allocation of water to the City if the flow in Tumalo Creek was that identified by the blue line (the mean daily flow). The use of the City's surface water rights is also limited by the annual volume limitations in Certificates 31411 and 31665 and in Transfer B-112, as described above. These limitations are shown by the purple line. Figure 11-5 describes in more detail how this water would be accounted for under the City's existing water rights and describes the daily volume of water that could be produced under this scenario.

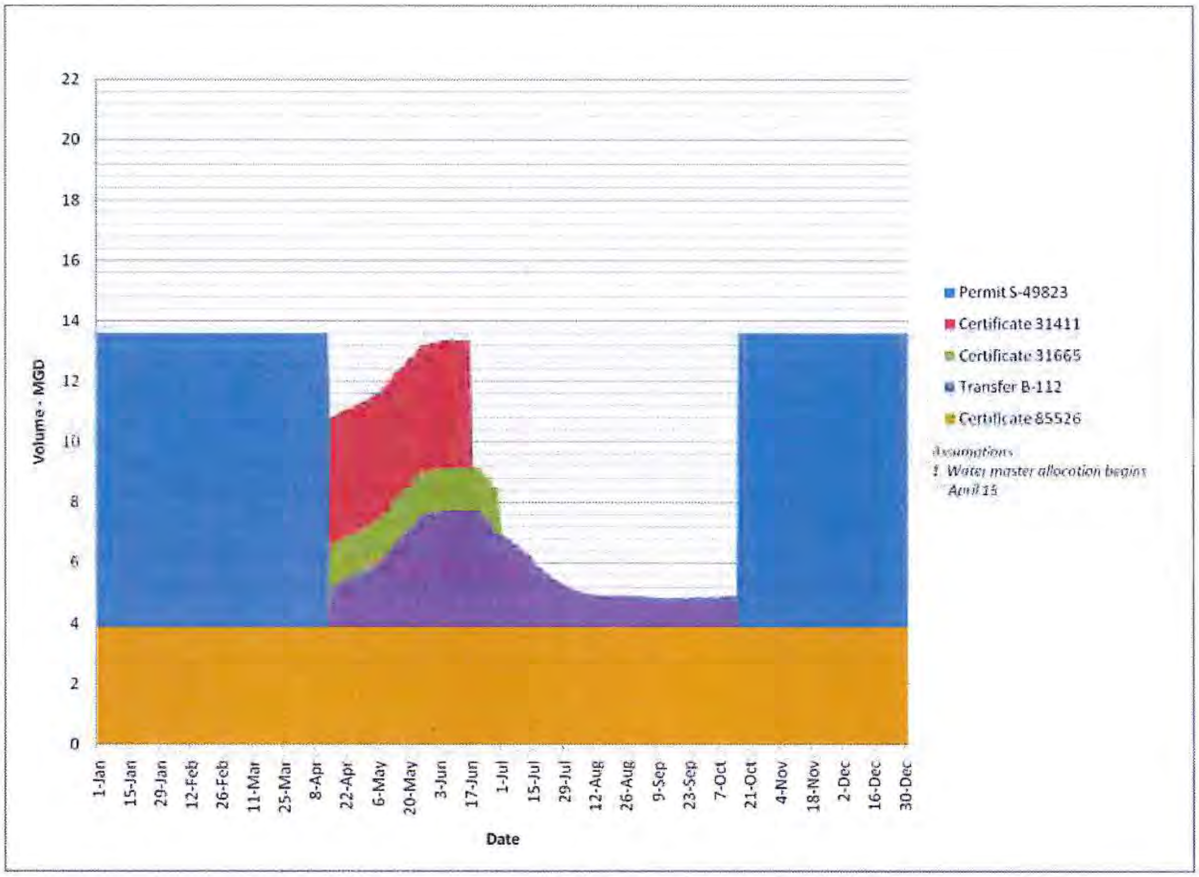


Figure 11-5. Daily Volume Produced During Year – Scenario 1

Under Scenario 1, the City would be able to use the full 6.0 cfs under Certificate 85526 (shown in orange) throughout the year because it is senior to all other water rights on Tumalo Creek. Also, the City could fully utilize Permit S-49823 (in blue) outside of the irrigation season but, under this scenario, once the irrigation season began the permit would be regulated off by the watermaster due to its early priority date and would not contribute to the surface water available to the City during that portion of the year. As described above, the City's other water rights can be used only during the irrigation season. The use of water under Transfer B-112 (shown in purple) would increase and then decrease, according to its maximum authorized rates during the irrigation season and due to regulation by the watermaster according to the distribution schedule. Under this scenario, Certificates 31411 and 31665 would be available at their maximum authorized rates until the City reached its annual volume limitations in mid-June and late-June, respectively. .

While Scenario 1 is not a realistic method for utilizing the City's surface water rights, it is a useful demonstration of the limitations of the individual water rights. The following scenarios present potentially more realistic circumstances for the availability of surface water under the City's water rights.

11.4.2 Scenario 2

In Scenario 2, we have again assumed that the watermaster will begin regulating the City's surface water rights according to the distribution schedule for the entire irrigation season (April 15 through October 15), which is, as previously described, a very conservative assumption. In this case, however, we have staggered the use of the City's surface water rights in an effort to match the City's average surface water production curve, which is shown as an orange line in Figure 11-6. Since the City's use of Certificate 85526 and Permit S-49823 outside of the irrigation season would not be affected by the assumptions used in the following scenarios, we have only represented the use of the City's water rights during the irrigation season.

In this scenario, as in all scenarios, the City could use the full 6.0 cfs under Certificate 85526 throughout the irrigation season due to its seniority. The City would also use water at the full authorized rate under Certificate 31411 at the beginning of the irrigation season until it reached its annual volume limit. When that limit was reached in mid-June, the City would then begin using Transfer B-112 and Certificate 31665 for the remainder of the irrigation season. Initially, water could be used at the maximum authorized rate under Certificate 31665, but as stream flows decreased later in the summer, the rate of diversion would be reduced under the distribution schedule. Under this scenario, the City could not use the full authorized rate under Transfer B-112 due to its junior relative priority, and the allowed rate of diversion would be reduced further as stream flows decreased. As in Scenario 1, Permit S-49823 would contribute little water during the irrigation season due to its junior priority date. Under this scenario, the City would not be able to meet the average surface water production in the later part of the summer (after mid-July), as shown in Figure 11-6. While this scenario is not realistic today, it shows the potential implications of significant modifications to the implementation of the current distribution schedule. It should be noted that Figure 11-6 shows a scenario that has never occurred to date. As a result, it does *not* demonstrate that the City has used surface water in excess of its water rights. It only illustrates what could happen *if* regulation occurred throughout the irrigation season.

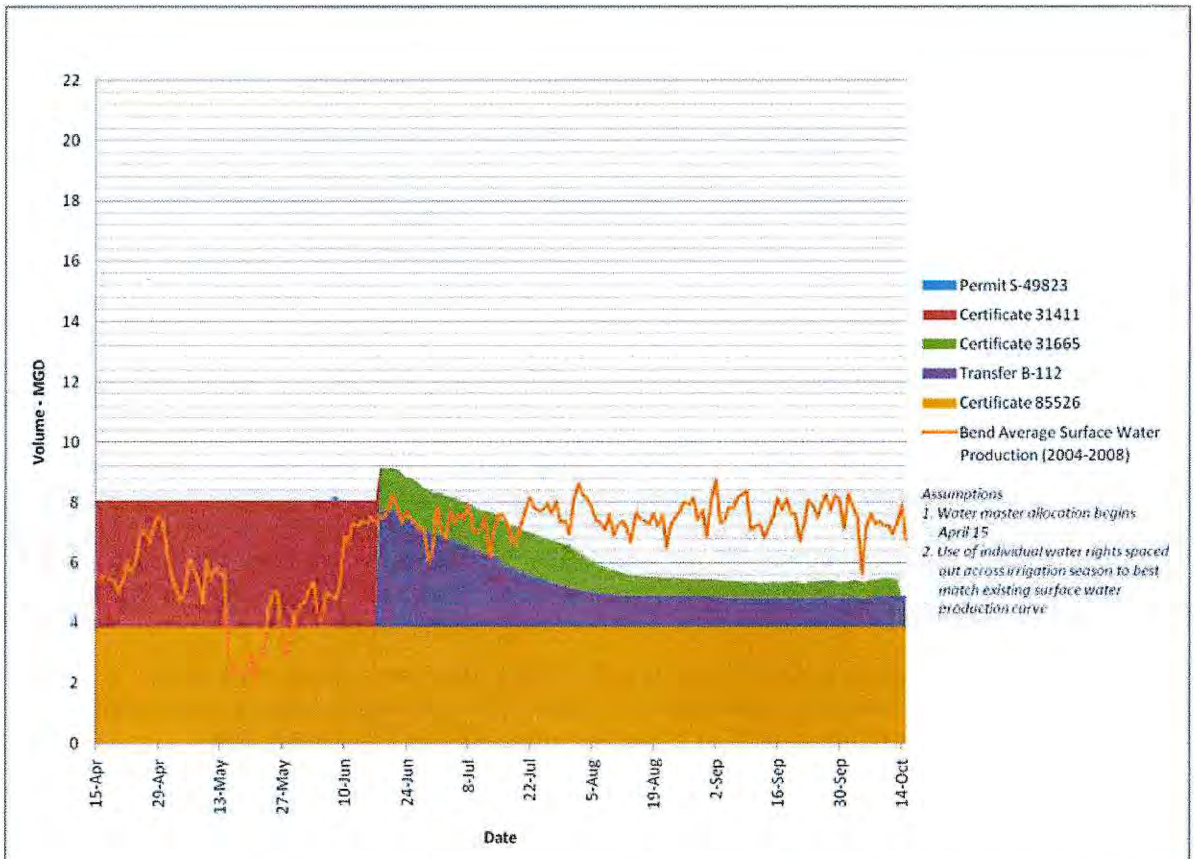


Figure 11-6. Daily Volume Produced During Irrigation Season – Scenario 2

(Not representative of actual use of water by the City of Bend)

11.4.3 Scenario 3

In Scenario 3, we assume that the watermaster will not begin regulating the City's water rights according to the distribution schedule until June 1 and will stop regulating after September 22. Based on historic regulation patterns (streamflow versus TID's need for water), this is a relatively conservative assumption. According to City staff, historically distribution has occurred in late July or early August. Similar to Scenario 2, we have arranged the City's use of its surface water rights during the irrigation season to match somewhat the City's average surface water production curve during the regulated portion of the irrigation season (June 1 to September 22).

As shown in Figure 11-7, assuming later initiation of regulation according to the distribution schedule increases the City's ability to use its Permit S-49823. It also increases the City's opportunity to use more water under its relatively junior water right, Transfer B-112, which has a 1913 priority date, during the unregulated portions of the irrigation season. In this scenario, the City is able to use its certificates to match closely its average surface water production curve during the regulated portions of the irrigation season and to exceed the historic production curve outside of the regulated portion of the irrigation season. The City could use the full authorized rate under Certificate 31665. Water could be used initially at the full rate authorized by Certificate 31411, but decreased streamflows would quickly result in a reduced rate of appropriation under the distribution schedule.

If the City wanted to improve its opportunity to increase use of surface water during the regulated portion of the irrigation season, it will need to obtain access to additional water rights or otherwise adjust its proportional share of Tumalo Creek water rights with TID. For example, the City could provide water from an irrigation district with Deschutes River water rights to TID in exchange for use of Tumalo Creek water. The water rights held by districts within the area authorize the use of water at rates that range from 1 cfs for every 32 acres of irrigation to 1 cfs for every 80 acres irrigation.

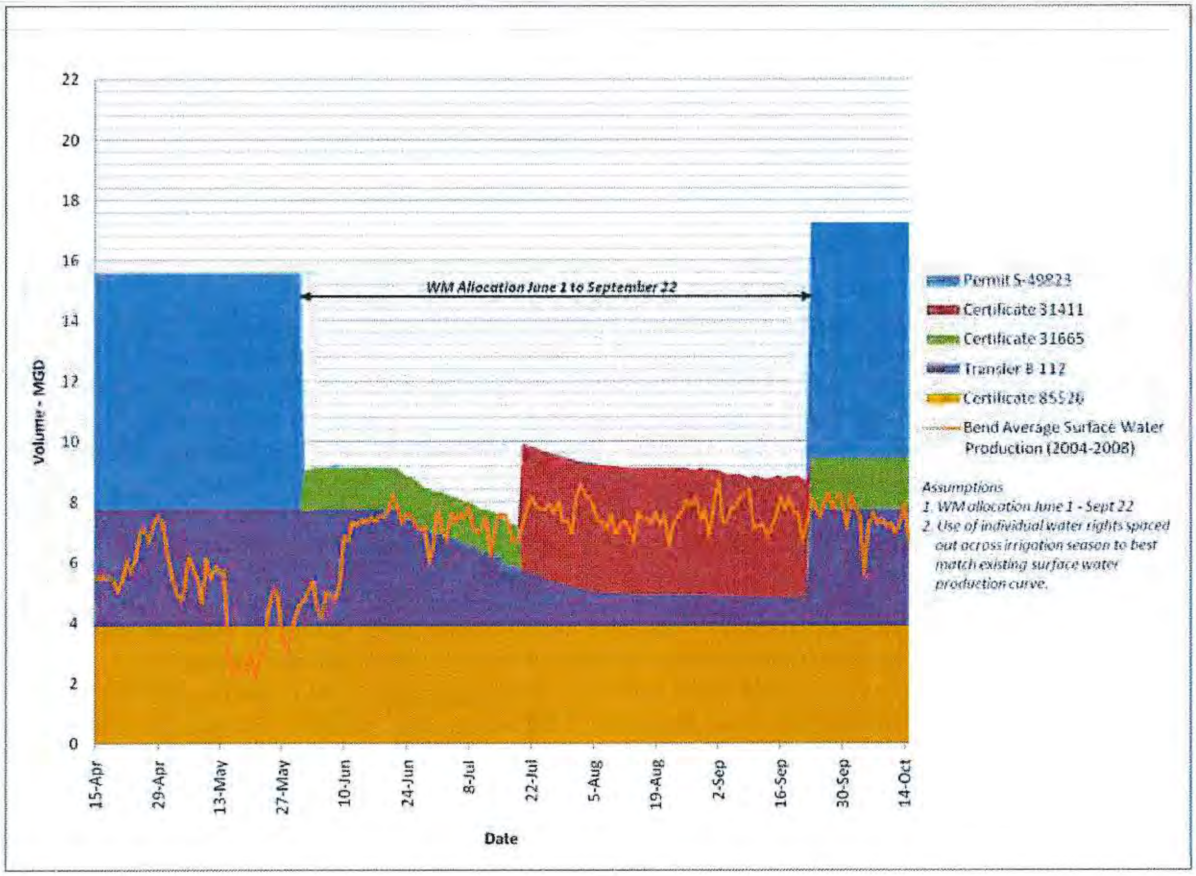


Figure 11-7. Daily Volume Produced During Irrigation Season – Scenario 3

Hypothetical use of the City's surface water rights under Scenario 3.

(Not representative of actual use of water by the City of Bend)

11.4.4 Scenario 4

In Scenario 4, we assume that the watermaster will not begin regulating the City's surface water rights according to the distribution schedule until August 1. Under current conditions, this may be a relatively realistic scenario, since based on the City's records, the watermaster often does not regulate Tumalo Creek until late July or early August. We have retained the other assumptions from Scenario 3.

Similar to Scenario 3, later initiation of regulation provides the opportunity for the City to more fully utilize its junior water rights (Permit S-49823 and Transfer B-112) during the irrigation season before stream flows drop and regulation by the watermaster begins, as shown in Figure 11-8. In addition, since the time period during which Tumalo Creek is currently regulated is short, the City appears to have opportunities to meet current and future demands through the use of surface water, if it chooses to do so. As described for Scenario 3, if the City wanted to improve its opportunity to increase use of surface water during the regulated portion of the year, it could obtain access to additional water rights or otherwise adjust its proportional share of Tumalo Creek water rights.

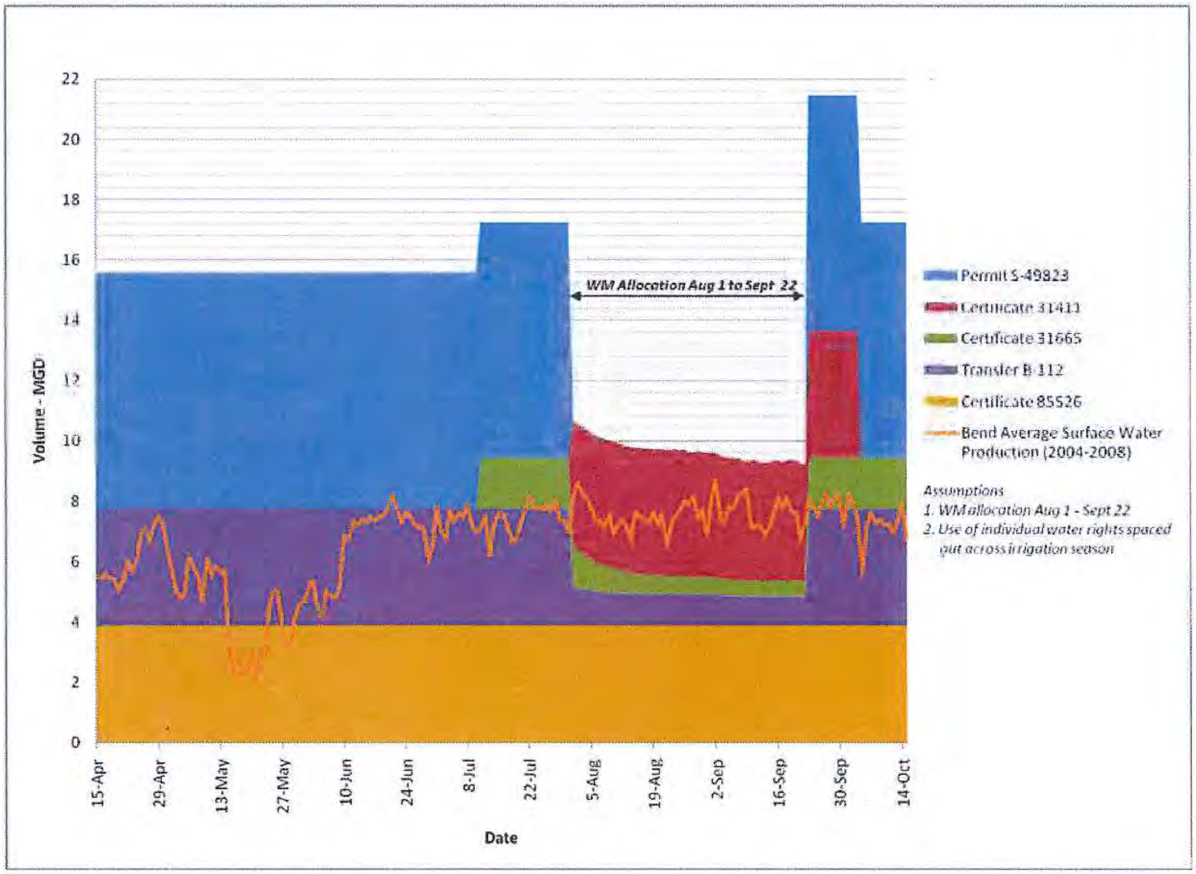


Figure 11-8. Daily Volume Produced During Irrigation Season – Scenario 4

Hypothetical use of the City's surface water rights under Scenario 4.

(Not representative of actual use of water by the City of Bend)

11.5 Summary

The City holds surface water and groundwater rights that it uses to meet municipal water demands. As the City considers how to best utilize these water rights to meet future water needs, in addition to engineering considerations, it will need to consider the limitations on the use of these water rights. Many of the City's surface water rights have season of use and annual water use limitations because they originated from irrigation rights. In addition, many of the surface water rights will be subject to regulation at some time during the irrigation season under the watermaster's distribution schedule. As a result, when considering potential changes to its use of surface water, the City should be mindful of these considerations and the basin-wide context of changing how it uses surface water currently.

To:	Heidi Lansdowne, PE, City of Bend
From:	Bryan Black, PE
Project:	Surface Water Improvement Project
Date:	October 27, 2010
RE:	Surface Water / Groundwater Cost Comparison, FINAL

1 Executive Summary

The City of Bend currently relies on both surface water from Bridge Creek and groundwater from the Deschutes Regional Aquifer to serve its residents, and each source provides about one-half of the City's annual water supply. Surface water flows from higher elevations to customers through a gravity system; whereas groundwater is pumped from 300- to 750-feet below ground.

To continue using the surface water from Bridge Creek, the City must substantially re-invest in the surface water system to comply with new federal treatment requirements, as well as replace old transmission pipelines that are at risk of catastrophic failure. Facing this expense, the City completed a Water Supply Alternatives Study (WSAS) in 2009 that analyzed three alternatives for water delivery to Bend residents. The alternatives included re-investing in the surface water system, replacing the Bridge Creek supply with groundwater, or supplying water from the Deschutes River. After analyzing multiple variables - including water rights, existing water delivery infrastructure, and long term energy, construction, and operational costs, the consultant identified reinvestment in the Bridge Creek water supply as the most economical long-term water supply option.

The Water Supply Alternatives Study (2009) included consideration of hydroelectric power generation, associated grant funding, and revenue associated with selling the power generated. Some of the revenue sources assumed in the 2009 study are either no longer available or are substantially diminished. Therefore, the City Council directed staff to re-evaluate whether re-investment in the surface water system is still the most viable long-term option for providing water to the citizens of Bend.

1.1 Executive Summary – Purpose

The purpose of this memorandum is to determine which, out of the three options before the City (1-Surface water reinvestment with Hydropower, 2-Surface water reinvestment without Hydropower, and 3- Groundwater only), is the most economical choice for the ratepayers in the City of Bend.

To accurately analyze the costs associated with each option, this memorandum evaluates the initial and ongoing costs of each alternative over a 50-year planning horizon to determine which alternative is in the best long-term interest of the City and its ratepayers. A 50-year planning horizon was used since improvements will be designed to last for that duration, similar to the existing surface water system that has been in operation since 1926.

1.2 Executive Summary – Findings

The cost evaluation contained in this memorandum concludes that re-investing in the surface water source remains the least expensive long-term water supply alternative for the City, either with or without hydropower. This finding is mostly due to the lower cost (primarily power cost) of operating the surface water system as opposed to pumping groundwater. **Table ES-1** compares the primary alternatives to 1) keep surface water with hydropower; 2) keep surface water without hydropower; and 3) abandon surface water (use groundwater only). Abandoning surface water is anticipated to cost the City between $372 to $454 million more than surface-water options over the 50-year analysis period (see **Table ES-1, Figure ES-1**).

Table ES-1. Summary of Cumulative Cash Flow Costs of Water Supply Alternatives

Time Frame	Keep Surface Water with hydropower ($M)	Keep Surface Water no hydropower ($M)	Abandon Surface Water (Use Groundwater only) ($M)
2023 (10-year)	$64	$59	$71
2038 (25-year)	$148	$139	$201
2063 (50 year)	$103	$185	$557

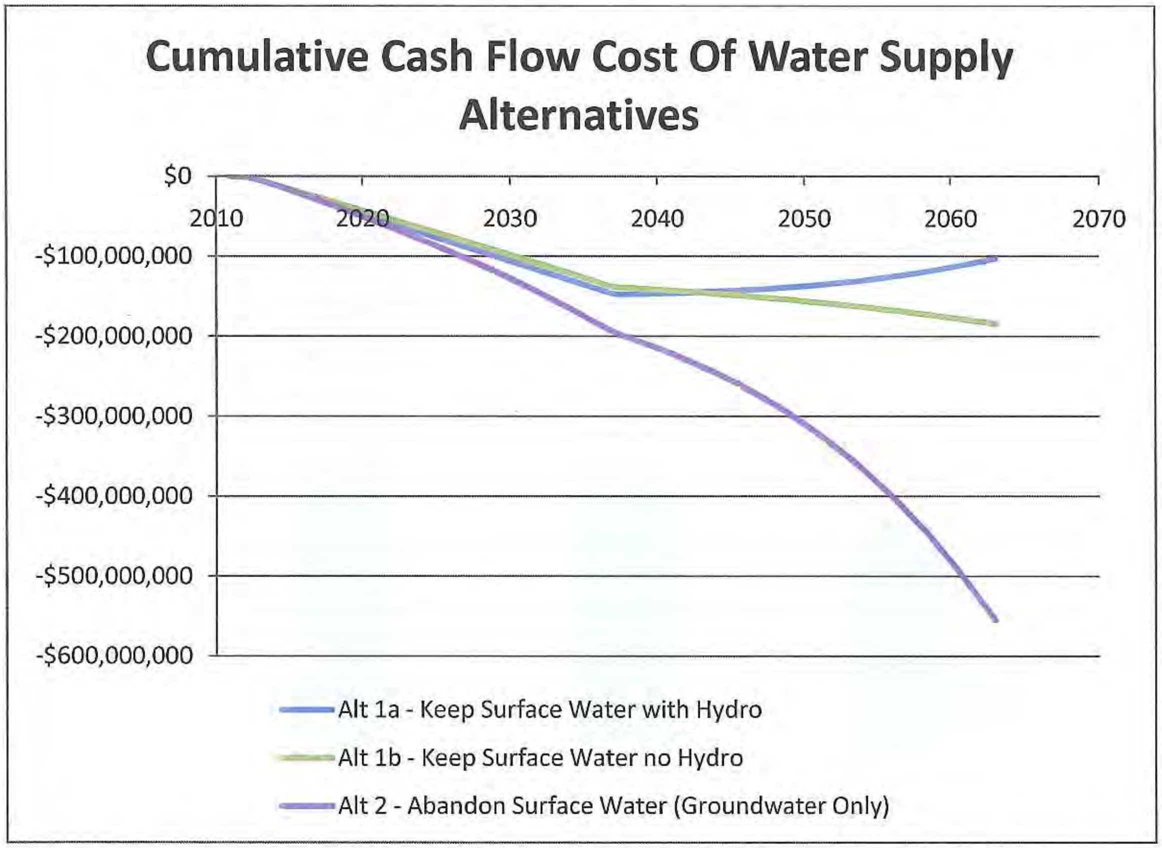


Figure ES-1. Cumulative Cash Flow Cost of Water Supply Alternatives

Figure ES-2 presents the present-worth costs of the water supply alternatives in year 2010 dollars. The alternatives that retain surface water are less expensive than the alternative to abandon surface water. This is primarily due to the power consumption and costs of pumping groundwater to replace surface water. The anticipated O&M cost for the abandon surface water (all groundwater) option is only slightly less than the entire project costs for the surface water alternatives.

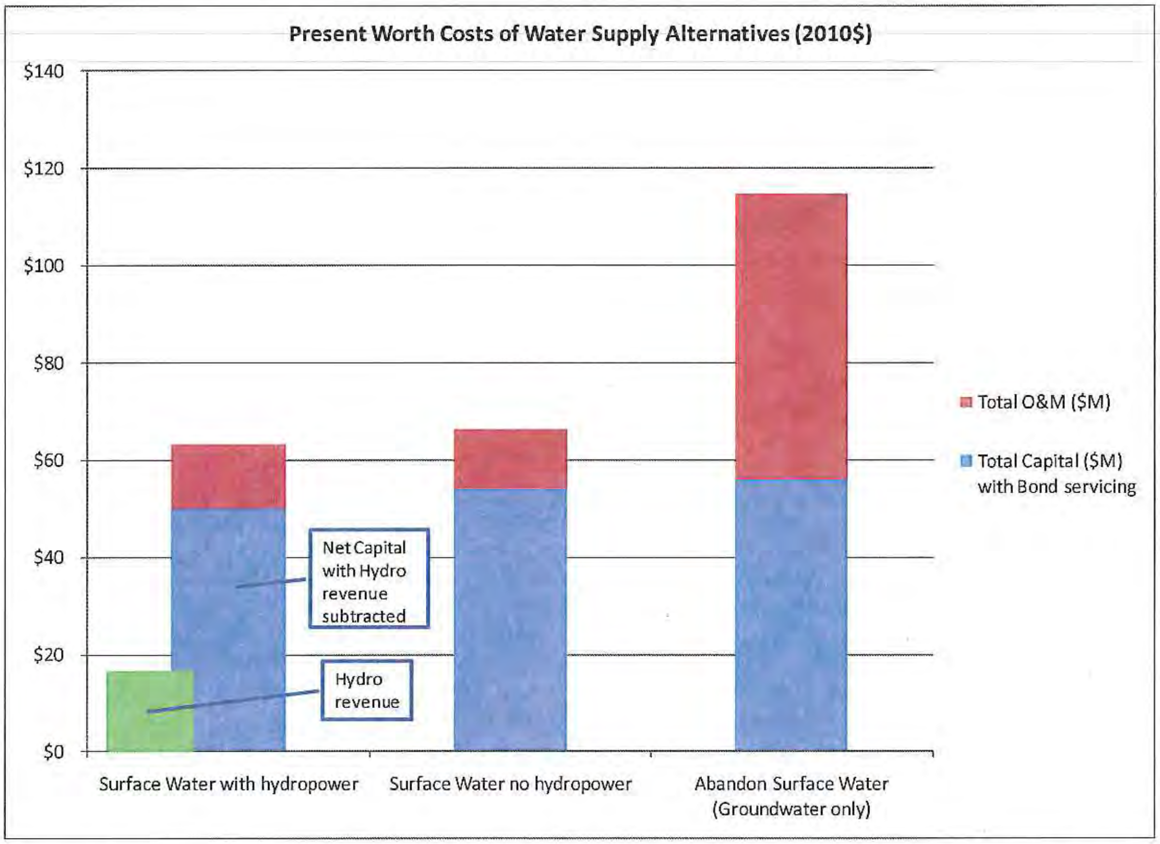


Figure ES-2. Present Worth Costs of Water Supply Alternatives (2010$)

2 Background

The City's drinking water is supplied from both groundwater and surface water sources. Over the last 10 years, each source provided about one-half of the City's annual water supply (**Figure 1**).

Figure 2 illustrates the elevations of the water sources. Surface water flows from higher elevations by gravity without pumping or power consumption. By contrast, groundwater must be pumped up from far below the City.

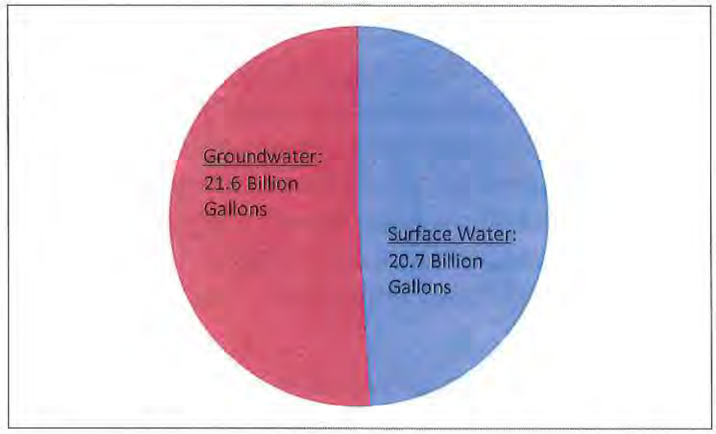


Figure 1. Surface water and groundwater each have provided about one-half of the City's supply over the last 10 years

The power consumption of pumping groundwater from 300- to 750-feet below the City is substantially greater than using surface water that flows by gravity without power consumption from 1,320-feet above the City. This makes surface water the more energy efficient and cost effective source to use.

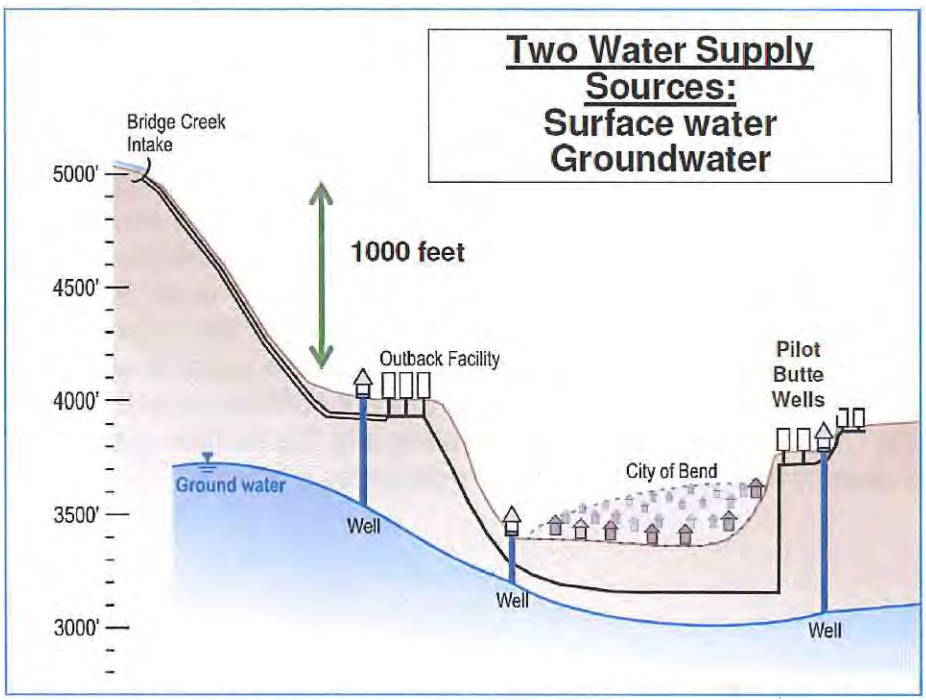


Figure 2. City of Bend's Dual Source Water System: Groundwater pumped from 300- to 750-feet below the City and Surface Water Flowing by Gravity without pumping from 1,320-feet above the City

Although surface water is less expensive to operate than groundwater, surface water supplies of high quality and in sufficient quantity to meet the entire water demand of the City of Bend are generally not available. Therefore, the

City developed a groundwater supply system to supplement surface water during times of peak water demands when the surface water supply is not sufficient.

The City's dual-source water system has served it well. Surface water is used year-round to meet the base water demands of the City, since surface water is the least expensive water source to operate. Groundwater capacity is more available but has higher operating costs – so it is best used to meet the short-term summer peak needs. By strategically developing and using both water sources as identified in **Table 1**, the City maintains the most cost-effective water system for its customers.

Table 1. General costs of City water supplies and best uses

Source	Operating cost	Best Use Principle
Surface Water	Lower	Year-round continuous operation to meet base demands minimizes energy use and operating costs
Groundwater	Higher	Short term operation to meet summer peak needs minimizes capital investment

Figure 3 illustrates the typical use of both surface water and groundwater to meet the overall water demands in the City. Since surface water has the lowest operating cost, City staff prioritizes the use of surface water and only uses groundwater when sufficient quantities of surface water are not available. In winter months – when there is enough surface water available to meet demand - most of the water used by the City is surface water since this is the most cost and energy efficient source to deliver. In the summer, surface water is used to the maximum extent possible, but available flows are not sufficient to meet the water needs of the City. Therefore, the City supplements the surface water supply with groundwater to meet peak summer demands.

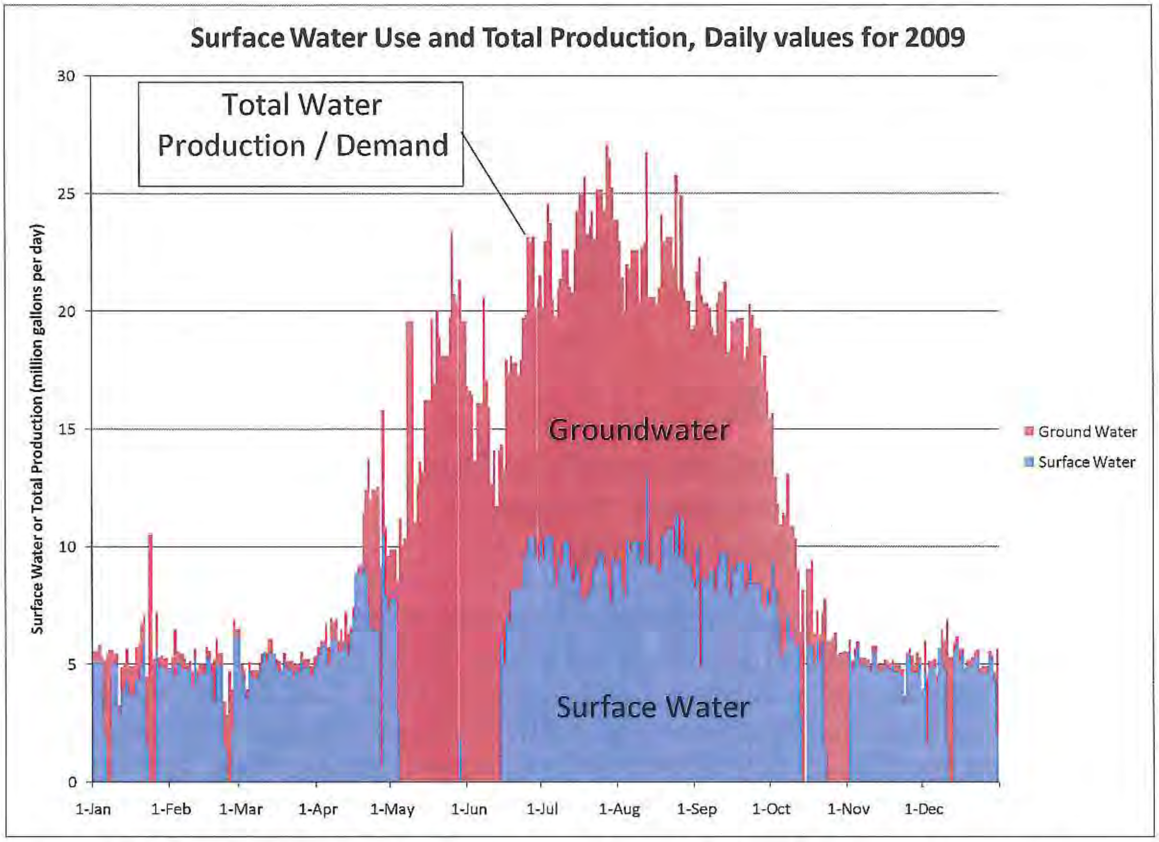


Figure 3. City staff prioritizes the use of surface water throughout the year since it is less expensive to operate and supplements with groundwater when surface water is not sufficient (during summer higher water use and during turbidity events)

Although the City's surface water system has historically been the most economical source of supply to operate, it now requires re-investment due to new treatment requirements and old transmission pipelines that are at risk of failure. A potential alternative to re-investment is to abandon the surface water supply system and replace it with additional groundwater wells. Although additional wells may seem to require less initial capital investment, the long-term costs of operations are greater. Therefore, to accurately analyze the costs associated with each option, this memorandum evaluates the initial and ongoing costs of each alternative over a 50-year planning horizon to determine which alternative is in the best long-term interest of the City and ratepayers.

An evaluation of alternative sources of supply, including re-investment in surface water and development of additional groundwater supply capacity, was completed in 2009 (Water Supply Alternatives Study, WSAS 2009). The WSAS recommended re-investing in the surface water system. The recommendation was based on inclusion of hydropower and associated assumed revenue and funding incentives. The projections for revenue and funding have now decreased, and on August 18, 2010, the City Council requested that the costs and feasibility of developing additional groundwater supply in lieu of re-investment in surface water be re-evaluated.

Abandoning the surface water supply system would require development of additional groundwater supply capacity. This memorandum compares the initial and on-going costs of 1) re-investing in (keeping) the surface water supply system and 2) abandoning the surface water supply and developing additional groundwater to meet demand. To determine which alternative is in the best long-term interest of the City's ratepayers, the analysis was completed over a 50-year planning horizon.

3 Water Demands

Current water demands (2008) for the City of Bend are:

- Average day annual demand: 12.8 mgd
- Maximum day demand: 29.2 mgd

Future water demands were projected for the City of Bend's master planning effort (see Future Demand section of the *Water Model Development Documentation for Water System Optimization* by MSA, Dec 2009). Water Demands are projected to increase by about 60% over the next 10 years and almost triple under build-out conditions in the current Master Plan, as shown in **Figure 4**. A sensitivity analysis was performed to evaluate the impact of water demand projections on the relative cost of alternatives as described in **Section 7**. The sensitivity analysis indicates that no reasonable variation in the water demand forecast would change the cost ranking of the water supply alternatives.

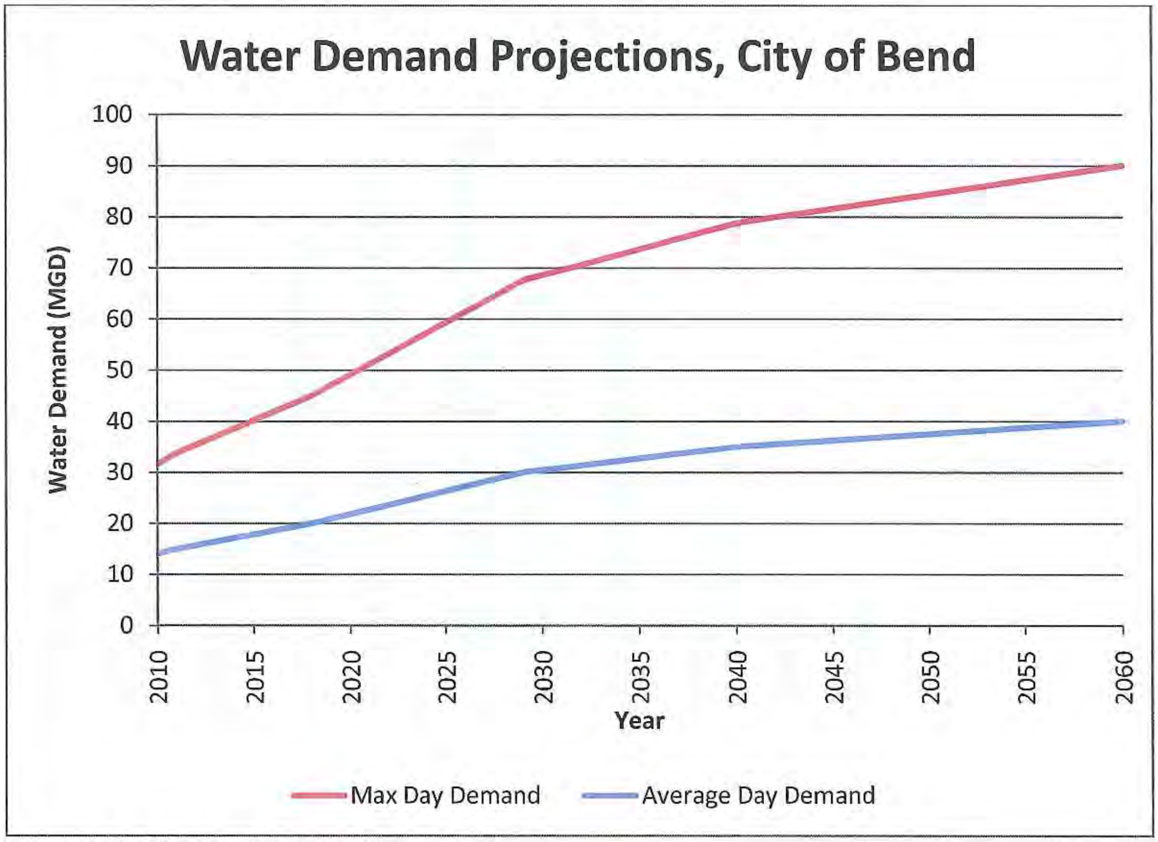


Figure 4. Water Demand Projections

To determine the potential use of surface water in the future, water demands were estimated on a monthly basis through the 50-year planning period. Demands were allocated by month based on the historical patterns of use, shown in **Figure 5**. Projected water demands by month through the 50-year planning period are presented in **Appendix A, Table A-1**.

This analysis did not consider effects of water conservation strategies, such as conservation pricing schemes and outreach programs, on projected demands. Projecting potential changes in use based on such efforts is highly speculative. The City continues to consider conservation pricing and has directed staff to remove the remaining base quantity allowance. At the same time, the City is committed to maintaining affordable water rates to its citizens. The City will continue to implement their Water Management and Conservation Plan and its WaterWise program as budgets allow. However, water conservation alone will not provide adequate supplies for all future water demands.

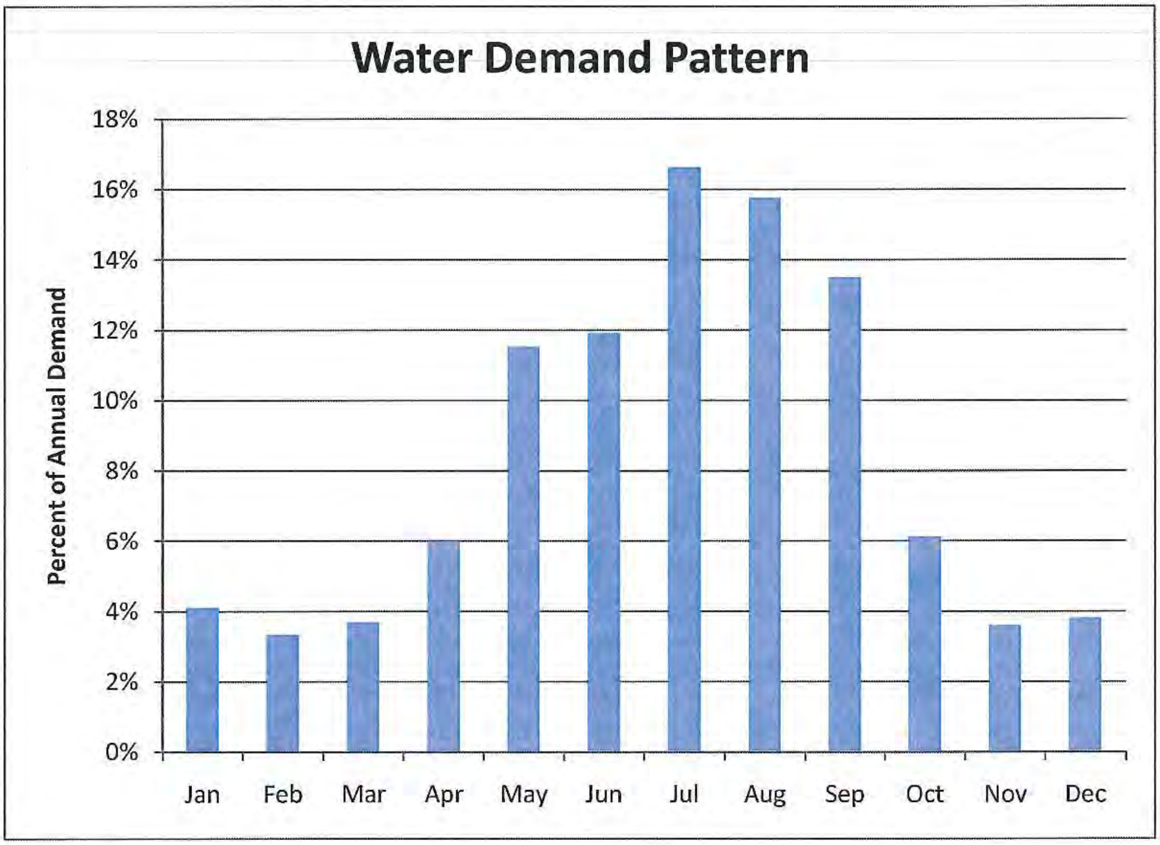


Figure 5. Historical water demand pattern

4 Cost Analysis Assumptions

This section describes some of the assumptions used in the cost analysis.

4.1 Cost Evaluation Period

Deciding whether to re-invest in its surface water supply is an important long-term decision, given that elements of the existing surface water system have lasted over 80-years (since 1926). Although a new surface water project is anticipated to last 80-years or longer, this cost evaluation has been limited to a 50-year time frame. Extending the cost evaluation beyond 50-years will favor the water supply alternative with the lower operating costs.

4.2 Future Cost of Power

A long-term decision on whether to re-invest in the surface water system requires understanding the operational cost differences between a new surface water system and replacing the surface water system with groundwater, so power consumption and costs must be estimated over the evaluation period of 50-years. Data from the Northwest Power and Conservation Council was used to estimate potential power cost increases over the 50-year planning period

In 2010, the NW Power and Conservation Council developed a long-term forecast (through 2030) of Mid-Columbia wholesale power prices as a key input to its 6th Northwest Power Plan (see www.nwcouncil.org).

The Northwest Power and Conservation Council uses the AURORA$^{xmp®}$ Electric Market Model to forecast electricity prices for the Pacific Northwest. The AURORA^{xmp} model projects future wholesale power market prices based on model inputs that determine the underlying supply and demand conditions in the future. Key inputs to the AURORA^{xmp} model include forecasts of future electricity demand, inventories of existing electricity generating plants, forecasts of construction costs for new electricity generating plants, and forecasts of future fuel prices for electricity generating plants. Given the forecast of future electricity demand and the set of drivers of future electricity supply, the model then uses economic logic to project future resource additions and market-clearing wholesale electricity prices. Prices shown reflect spot market transactions for wholesale power supplies delivered at the Mid-Columbia trading hub. The price forecast is expressed nominal dollar values (includes inflation).

The average NW Power and Conservation Council wholesale power cost forecast is presented in **Figure 6**. Wholesale power costs are anticipated to triple over the next 20 years. Power costs are projected to be lowest in May and June, and highest in November and December.

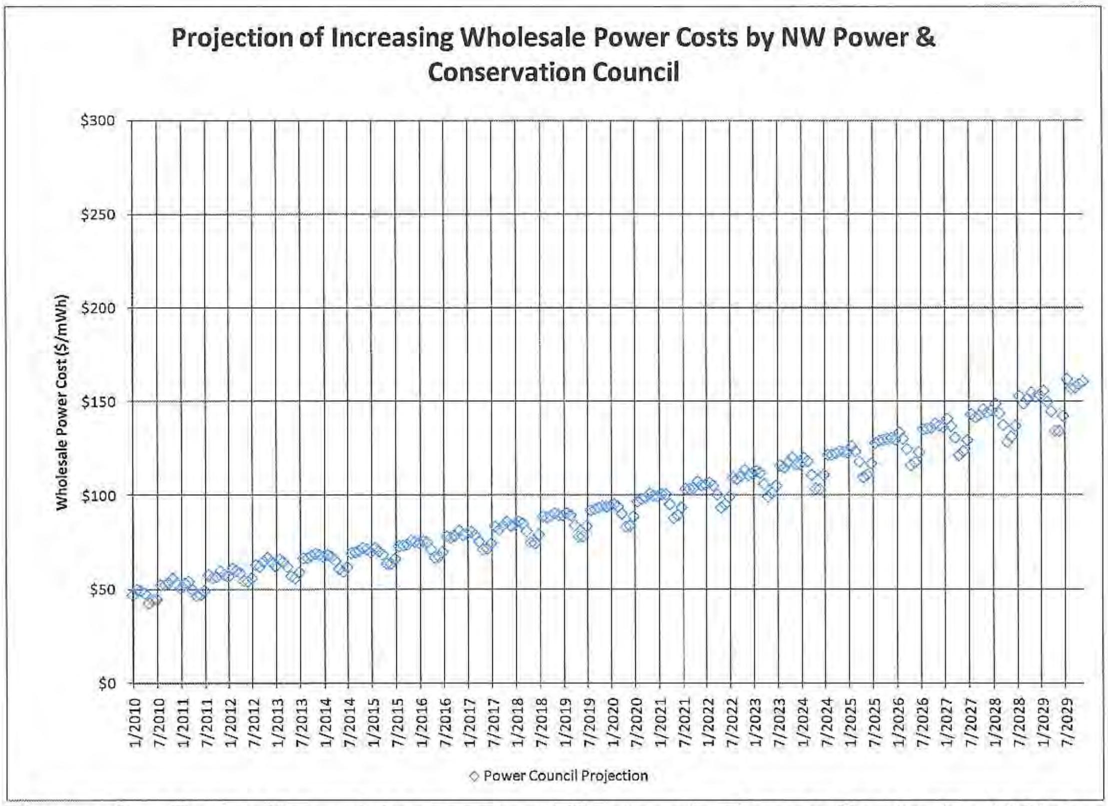


Figure 6. Projection of Increasing Wholesale Power Costs by NW Power and Conservation Council

The NW Power and Conservation Council projections were analyzed to determine the equivalent annual percent increase. The best-fit equivalent annual percent increase was determined by minimizing the squared residuals between Council derived and model predicted costs (least-squares optimization). The best-fit equivalent annual wholesale power percent increase was determined to be 6.22% per year. **Figure 7** compares the Council's projections (data points) against projections using the 6.22% per year increase model (solid line). The 6.22% per year model provides a good approximation of the NW Power Council's forecasted wholesale power cost data.

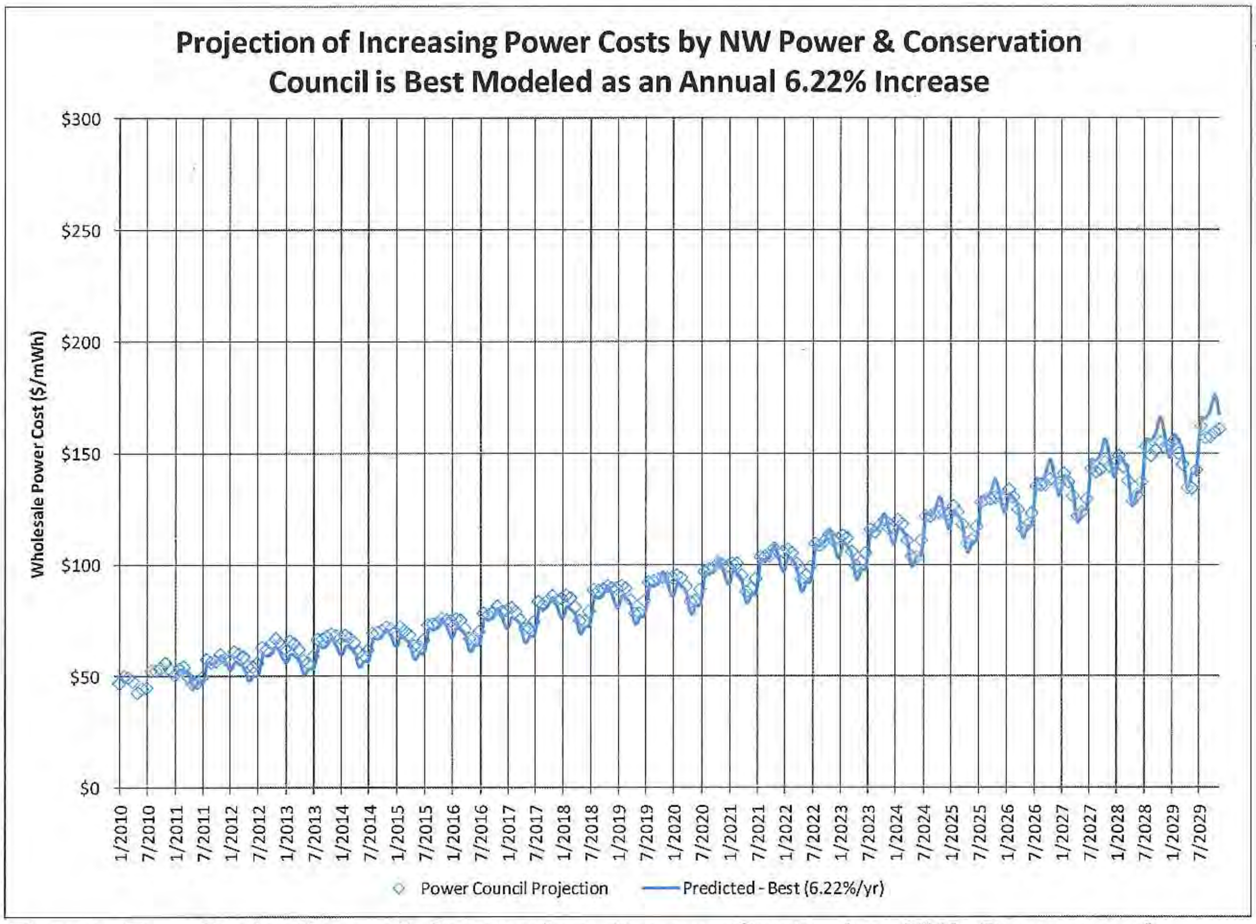


Figure 7. Projection of Increasing Power Costs by NW Power and Conservation Council is Best Modeled as Annual 6.22% Increase

A sensitivity analysis was performed to evaluate the impact of power cost escalation on the relative cost of alternatives as described in **Section 7**. The sensitivity analysis indicates that no reasonable variation in the power cost escalation would change the cost ranking of the water supply alternatives.

4.3 Other Cost Assumptions

The cost analysis was performed using the assumptions listed in **Table 2**.

Table 2. Assumptions used in the Cost Analysis

Cost Analysis Parameter	Value
Discount Rate	6%
Interest rate for tax free bonds	5.5%
Interest rate for taxable bonds	7%
Escalation of O&M Costs (except power), last 10-year average inflation	2.3%
Escalation of Power Purchase Costs (including inflation); Escalation of Power Revenue after schedule expiration in 20 years	6.22%
Loan duration	25 years

5 Water Sources

The City's dual-source water supply system provides flexibility and reliability for the City. The current maximum day water demand (2008) is approximately 29.2 mgd. Existing wells in service can provide about 26.8 mgd. The surface water system, with proposed improvements, could provide 13.6 mgd, bringing the total reliable water supply to about 40.4 mgd. If re-investment in the surface water system is not made, the City will need to invest in additional groundwater wells to replace the 13.6 mgd capacity.

The water sources are briefly described below.

5.1 Surface Water

The City's surface water is obtained from Bridge Creek, a tributary to Tumalo Creek. Water flows from the source to customers' taps by gravity. Historically, surface water has been the least expensive source for the City to use because it does not require pumping.

The City's surface water system now requires re-investment for continued use due to new treatment requirements and the need to replace the old raw water transmission pipelines that are in poor condition. Because of the elevation drop from the source, the City could add hydroelectric turbines to the surface water delivery system to produce power from the water supply flowing to town. Installation of hydropower would require water intake improvements to comply with Oregon fish passage requirements. No intake improvements are anticipated to be required if hydropower is not installed.

5.1.1 Projected future surface water use

The future use of the Bridge Creek surface water supply will be determined by either the City's demand or water availability, whichever is less. Projected water demands by month through the 50-year planning period are presented in **Appendix A, Table A-1**. The City has rights to divert up to 13.6 mgd (21 cfs) of surface water in the winter and up to 23.3 mgd (36 cfs) in the summer.

However, water availability and other senior rights to divert water from Tumalo Creek will likely limit the rate at which the City can divert surface water. Based on an evaluation of creek flows, the expected typical maximum water diversion rate is listed in **Table 3**.

Table 3. Expected typical maximum water diversion rate

Month	Typical Water Right Availability (MGD)	Typical Water Right Availability (cfs)
Jan	13.6	21.0
Feb	13.6	21.0
Mar	13.6	21.0
Apr	11.6	18.0
May	12.9	20.0
Jun	13.6	21.0
Jul	11.6	18.0
Aug	11.0	17.0
Sep	11.0	17.0
Oct	11.0	17.0
Nov	13.6	21.0
Dec	13.6	21.0

Future surface water use is projected by taking the minimum of the projected water demand by the City and the surface water supply available under the water right. The projections assume filtration is installed so that surface water can be used year-round, even during spring snow-melt conditions. **Figure 8** projects total water demand and projected surface water use in year 2015. Use of surface water in the winter would be limited by the water demand in the City. During summer, water demand increases and available water becomes the factor limiting surface water use.

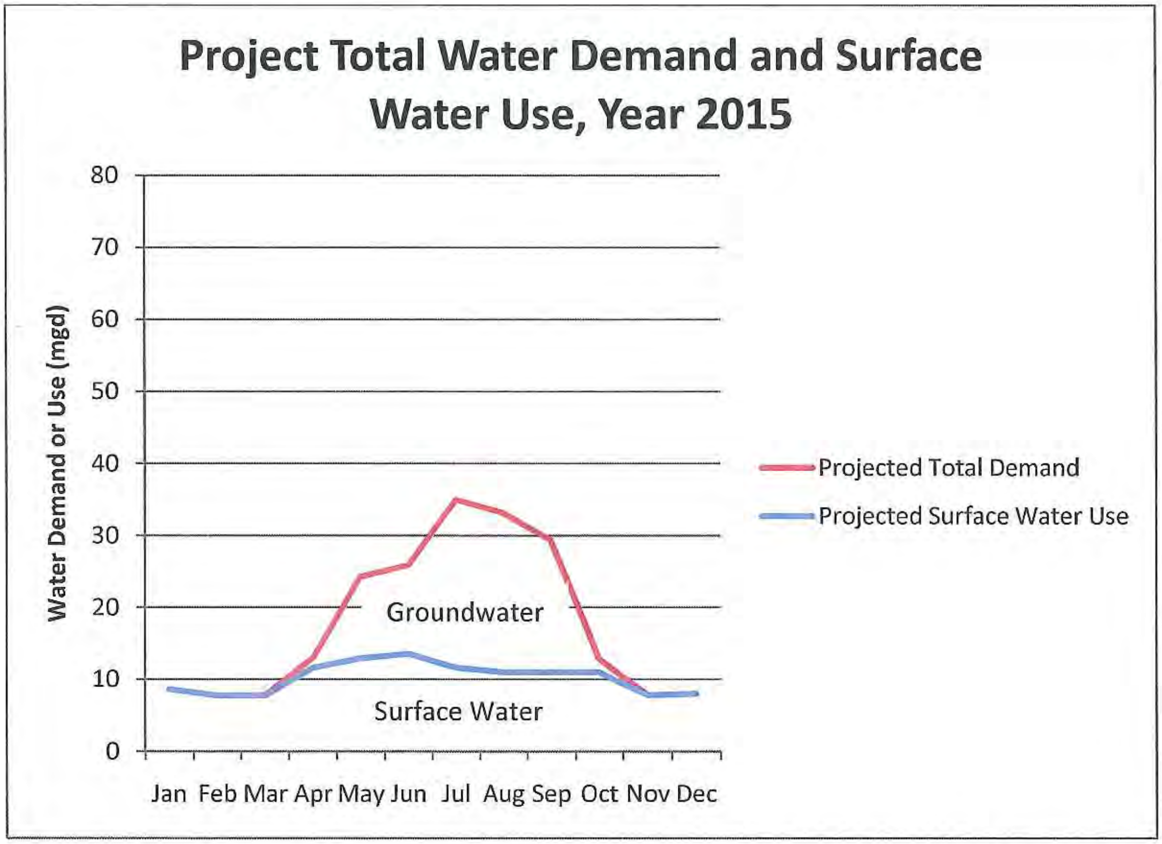


Figure 8. Projected total water demand and surface water use, year 2015.

Figure 9 projects total water demand and surface water use in year 2040. By 2040, winter demands are expected to be greater than the rights / availability of surface water. Therefore, in 2040, surface water use would be limited by rights / availability throughout the year. Surface water use is not currently anticipated to increase beyond the use shown in 2040 due to limited availability and water rights.

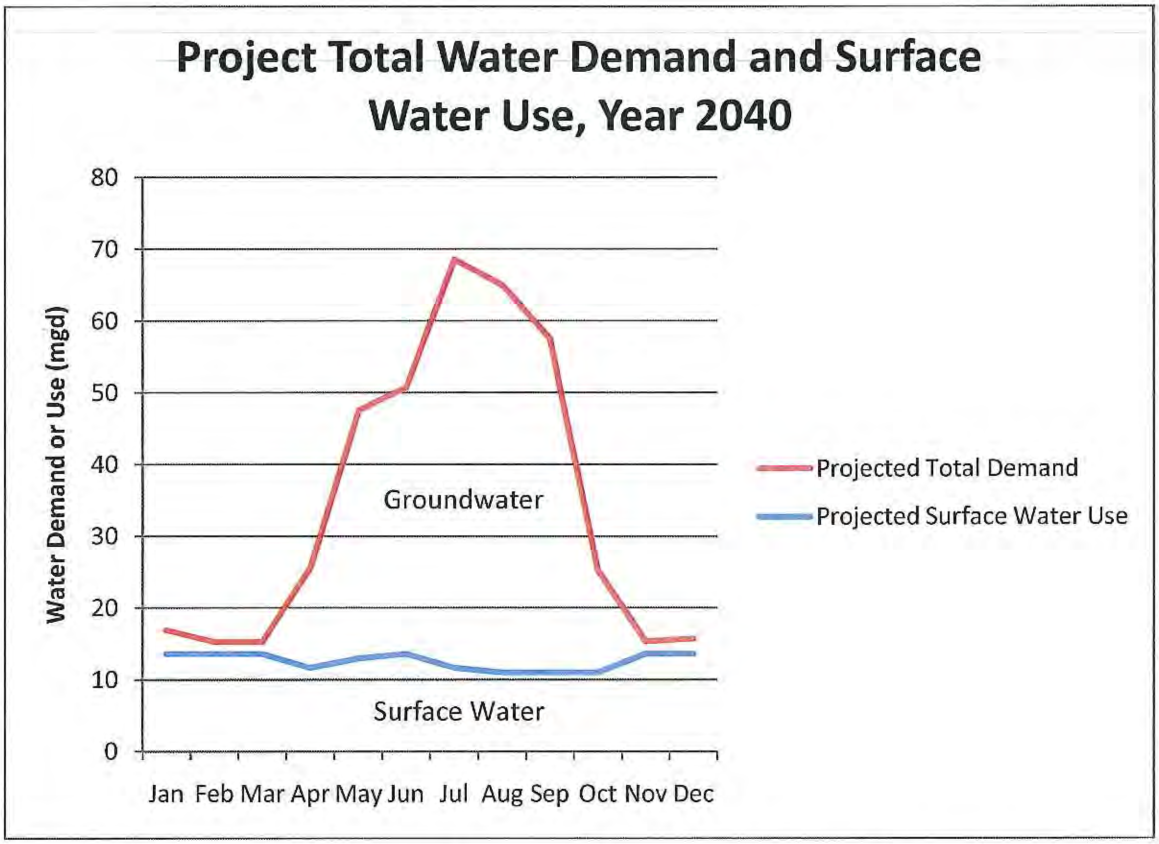


Figure 9. Projected total water demand and surface water use, year 2040

Appendix A, Table A-2 presents the projections of potential surface water use by month over the 50-year planning period.

5.1.2 Capital Costs

Cost estimates for required and optional improvements are listed in **Table 4**. Cost estimates assume a new raw water transmission pipeline (conduit) to the Bridge Creek Intake and a membrane filtration water treatment plant. Optional improvements related to production of hydropower include intake modifications or replacement and a hydroelectric powerhouse.

Table 4. Current capital cost estimates for needed and optional surface water improvements

Required or optional?	Item	Cost $M
Required	Conduit	28.0
	Membrane Filtration WTP	29.75
	Subtotal Required	**57.75**
Optional	Intake	1.87
	Hydropower	13.46
	Total Project	**73.08**

The capacity of the surface water system (with proposed improvements) is assumed to be 13.6 mgd (21 cfs), but the City holds rights to 23.3 mgd (36 cfs) during the summer irrigation season.

5.1.3 O&M Costs

The operation and maintenance (O&M) costs for the re-built surface water system would be higher since filtration is proposed. The expected annual 2010 O&M cost for a membrane filtration plant (including capital refurbishment and filter replacement) is projected to be $502,000 (see **Appendix A, Table A-3**), and for hydropower generation is assumed to be $55,250 (WSAS, 2009). These O&M costs are considered to be conservative given the excellent raw water quality of Bridge Creek. Power costs associated with membrane filtration water treatment are escalated similar to that for groundwater as described in **Section 4.2.**

5.2 Groundwater

Bend currently operates 9 groundwater facilities throughout its service area, consisting of 25 wells that pump Deschutes Aquifer water to the City's system. The total in-service groundwater well capacity is 26.8 mgd (Optimatics, 2010) and the 2008 maximum day water demand was 29.2 mgd. The City must operate its systems to meet peak day demand, and does not currently have excess well capacity. In 2011 the City utilized over 11 mgd of surface water to meet its peak demand. Groundwater is located generally 300- to 750-feet below the ground in Bend and must be pumped up to the various pressure zones throughout the City. The pumping required to supply groundwater makes the groundwater system more costly for the City to operate than the surface water source that does not require pumping.

5.2.1 Capital Costs

To deliver the same amount of water provided by the current dual-source water system, an additional 13.6 mgd in groundwater well capacity would need to be developed. The cost for new wells is estimated at $1.89M per MGD of capacity including contingency, engineering, and administration (MSA 2009, Optimatics 2010). This cost estimate assumes a 16-inch diameter steel casing and a static water depth of 750 ft below ground surface. **Table 5** lists the assumptions associated with estimating the capital costs of additional groundwater wells. A total well capacity of 15.1 mgd is estimated to be needed to achieve the firm capacity of 13.6 mgd (with one well out of service) that would be equivalent to the surface water supply capacity. The new wells would need to be outfitted with standby engine power generators (diesel) to ensure reliability. The total estimated capital cost for installing the groundwater wells is $28.5M, but additional facilities would be needed to transmit the water to new terminal storage reservoirs for water distribution.

The City's water distribution system has been developed to accept and distribute surface water through the Outback Reservoir site. The City has planned to retain surface water and supplement the surface water with wells at the Outback site. If the surface water source is abandoned, then new well fields would need to be installed out in undeveloped areas of the distribution system to supplement the wells already planned for the Outback site. Developing additional groundwater to replace the surface water would require new pipelines in addition to new wells to transmit the water to new terminal storage reservoirs. New terminal storage reservoirs would be required to equalize the flow rate so the water can be distributed to meet the City's variable water demand pattern.

Additional actions and facilities costs associated with integrating the new additional wells to replace surface water are described in the memorandum in **Appendix B.** A summary of facilities and estimated costs are presented in **Table 6**. Groundwater right mitigation costs are unknown and so mitigation costs are included in this analysis. However, these mitigation costs are not considered insignificant. Current mitigation requirements are estimated at $6M.

Table 5. Capital Cost of Additional Wells to Replace Surface Water with Groundwater

Surface Water Supply (MGD)	13.6
Typical Well Capacity (MGD)	1.5
Number of Wells Required	9.0
Extra Well for Firm Capacity (reliability)	1
Total Number of Wells	10.0
Total Well Capacity (MGD)	15.1
Unit Cost of Well Capacity ($M/mgd)	1.89
Total Capital Cost ($M)	28.5
Construction Start Date	2011
Construction End Date	2016
Construction Duration (years)	5
Average Annual Expenditure ($M/yr)	5.7
Well O&M Rate (% of capital cost)	1.00%
Well O&M excluding power ($M/year)	0.204

Table 6. Additional costs required to develop 13.6 mgd additional groundwater supply to replace surface water

Action / Facility	Anticipated Cost, $M
Construction of new well fields (see **Table 5**)	$28.5
Water Master Plan	$0.2
Land Acquisition	$0.25
Well field transmission piping	$22.01
New terminal storage reservoirs	$8.51
Booster pumping capital costs	None anticipated - needs review
Additional storage in the distribution system	None anticipated – needs review
Total	**$59.47**

5.2.2 O&M Costs

Drilling and installation costs for the new wells are included above under Capital Costs. The O&M costs associated with groundwater pumping are related primarily to pumping energy, mechanical repairs, and labor.

5.2.2.1 Pumping energy and costs

The City of Bend tracks power costs for operating its existing wells. Power costs for groundwater wells including power demand charges for 2008 are listed in **Table 7**.

Table 7. City of Bend Observed Annual Power Costs for Wells in 2008

Facilities	2008 Annual Cost Pacific Power
Bear Creek Wells 1 & 2	$80,700
Copperstone Well	$42,800
Hole 10 Wells	$67,100
Outback 6,7,8	$27,700
Outback Wells 1,2	$40,500
Outback Wells 3,4,5	$91,200
Pilot Butte Wells 1,3	$74,900
North River Well	$29,200
South River Well	$74,700
Rock Bluff Well 1,2,3	$50,300
Shilo Wells	$16,300
Westwood Well	$7,600
Total	**$603,000**

Operating costs include energy and demand charges for water facilities in the main system. Does not include costs associated with:

Surface water	Irrigation
Reservoirs	Airport system
Disinfection	

Observed well production was obtained to understand the relationship between well water production and power costs. Observed well production and power costs are presented in **Table 8**.

Table 8. 2008 Well Production and Power Cost

Month	Well production (MG/month)	Power Cost ($/month)
Jan-08	60	22,742
Feb-08	25	19,263
Mar-08	20	10,572
Apr-08	42	13,380
May-08	380	35,614
Jun-08	442	88,614
Jul-08	580	103,291
Aug-08	466	96,626
Sep-08	380	95,779
Oct-08	80	68,168
Nov-08	68	21,687
Dec-08	85	27,265
Total	**2628**	**603,000**

The 2008 power cost of $603,000 was associated with operating the wells to produce 2,628 million gallons in 2008, resulting in an observed power cost for groundwater production of $230/Million Gallons (MG). Theoretical engineering calculations were also performed using the 2008 well production data. The engineering calculations generally agree with the values observed presented in **Table 8,** as described in **Appendix C**.

The observed power cost for groundwater production of $230/MG was applied to the projected future use of surface water, assuming that the City would replace the future use of surface water with groundwater. **Appendix A, Table A-4** provides estimates of the estimated power consumption by using wells / groundwater instead of surface water. **Appendix A, Table A-5** lists the assumed unit power costs ($/kW-hr) and **Table A-6** lists the anticipated costs of pumping groundwater to replace the available surface water.

5.2.2.2 Other O&M costs

Other O&M costs related to operating additional wells include labor, mechanical materials / repairs, and upkeep. These other O&M costs are typically estimated as 2.5% of the capital costs of the facilities. However, for purposes of this study since other wells are already operated by the City, the O&M costs were estimated at only 1% of the capital costs. This results in an estimated annual cost for other O&M of approximately $200,000 per year (2010 dollars) for the 10 new wells needed to replace surface water. A significant component of the other O&M costs is anticipated to be pump motor maintenance and replacement. New motors for these wells are anticipated to cost in the range of $30,000.

6 Cost analysis and results

The cost analysis compared the known and assumed costs for building and operating the water sources, either 1a) refurbished surface water system with membrane filtration and hydropower; 1b) refurbished surface water system with membrane filtration no hydropower; and 2) abandoning the surface water system and replacing with additional groundwater supply.

A summary comparison of initial capital and year one O&M costs and revenue is presented in **Table 9**.

Table 9. Summary of initial capital costs and year one O&M costs / revenue

Year 2010 Costs	Surface Water with Hydropower ($M)	Surface Water no Hydropower ($M)	Abandon Surface Water (New Groundwater Only) ($M)
Capital Cost ($M)	73.08	57.75	59.47
O&M Cost ($/yr)	557,253	502,000	985,478
Hydro revenue ($/yr)	700,000	0	0

The cost analysis was completed over a 50-year planning horizon. The current surface water system has lasted since 1926, over 80 years, so a 50- to 80-year analysis time frame is considered appropriate.

The 50-year analysis, including initial construction costs and on-going operating costs, indicates that the dual-source system (surface water and groundwater) is a significantly less costly water supply alternative for the City of Bend than the all-groundwater alternative (see **Table 10 and Figures 10 and 11**). The all-groundwater alternative is anticipated to cost more than double the dual-source alternative over the 50-year period, and this differential gets even larger if viewed on an 80-year time frame. When compared with the dual-source alternative that includes hydropower, the groundwater-only alternative is more than three times as expensive. If the City decides to abandon surface water, it can expect to pay an additional $372 million to $454 million over the course of the 50-year planning period.

Table 10. Costs of Water Supply Alternatives over 50 Years (cumulative cash flows)

	Surface Water with hydropower	Surface Water no hydropower	Abandon Surface Water (Groundwater only)
Total Capital ($M) with Bond servicing	$151	$119	$122
Total O&M ($M)	$71	$66	$434
Total Revenue ($M)	($119)	$0	$0
Total Cumulative Cash Flow ($M)	$103	$185	$557

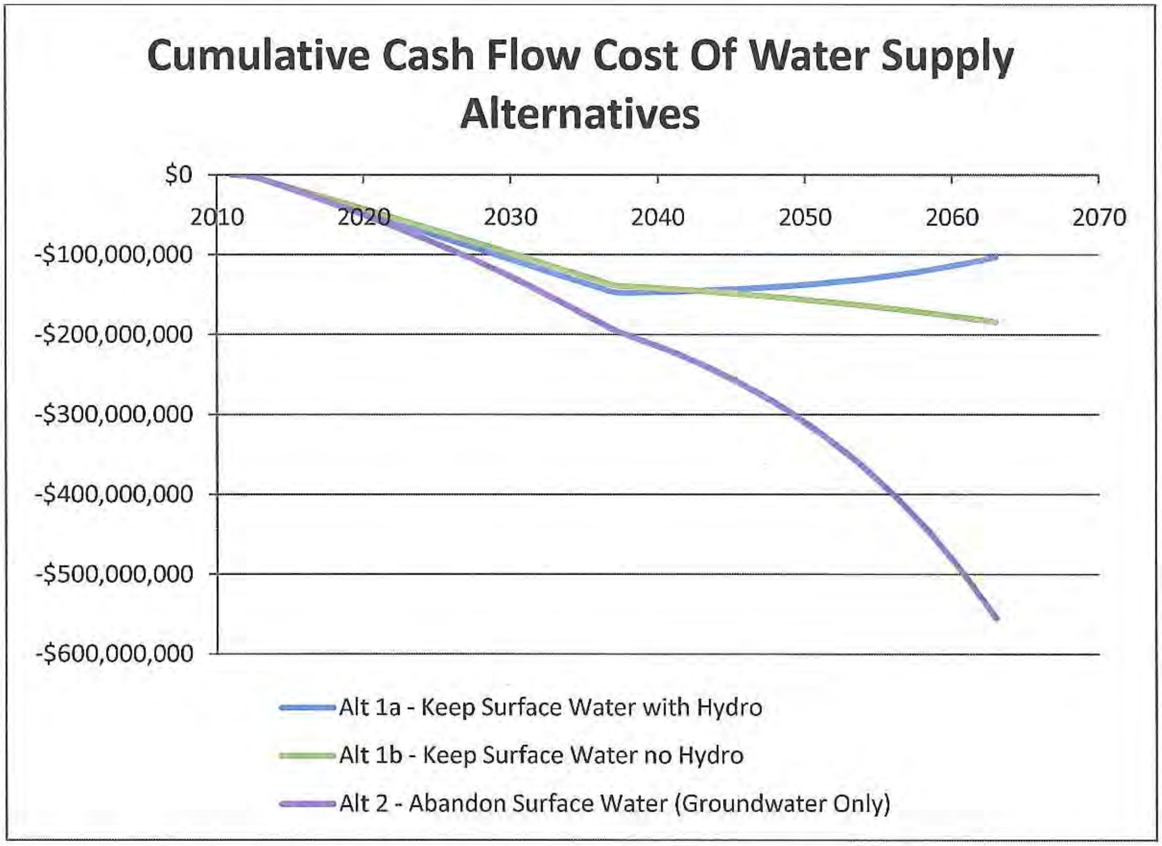


Figure 10. Cumulative Cash Flow Cost of Water Supply Alternatives

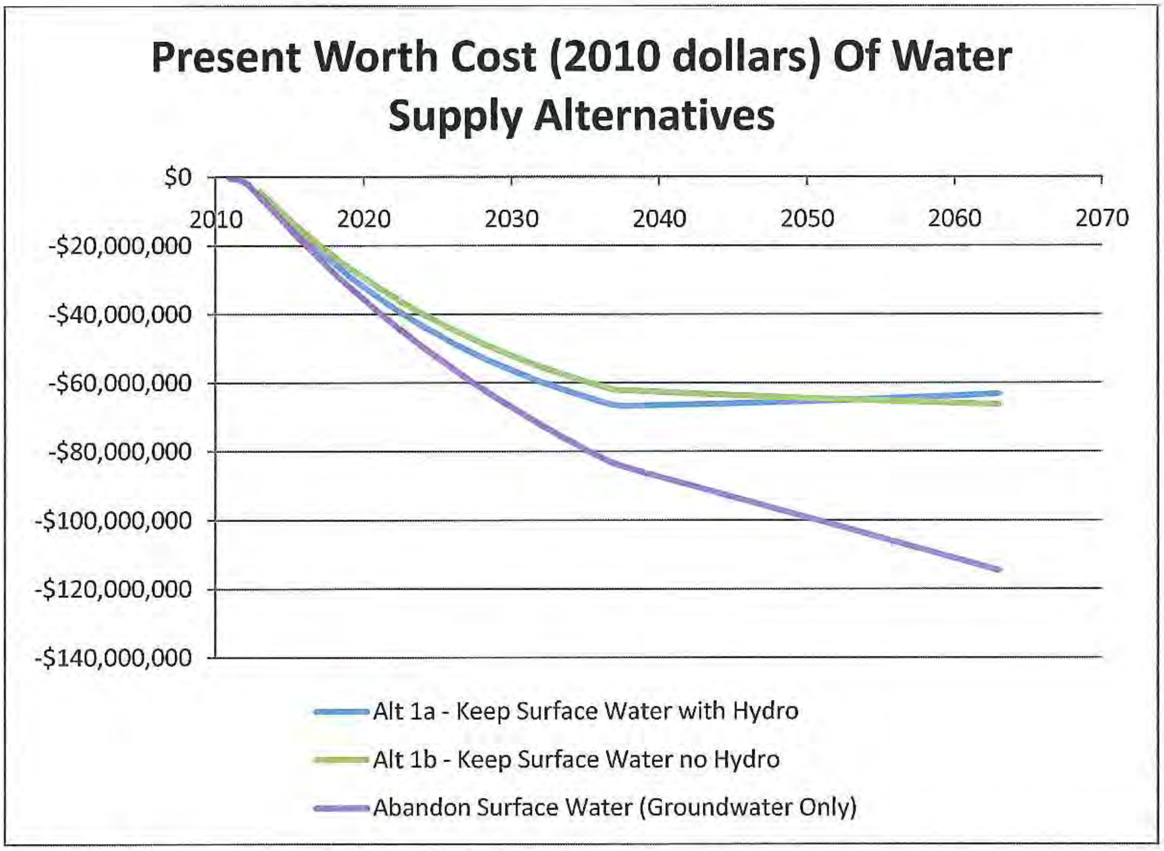


Figure 11. Present Worth Cost (2010 dollars) of Water Supply Alternatives

Abandoning surface water and going all groundwater is an expensive option for the City. The initial costs are comparable to re-building the surface water system, but the operating costs are much greater primarily due to the greater power consumption.

7 Sensitivity Analysis

The relative cost of water supply alternatives may be impacted by key assumptions in the cost analysis, including the escalation in power cost and the projection of water demands. This section provides a sensitivity analysis for these cost parameters.

7.1 Escalation in Power Cost

The cost analysis assumes a 6.22% annual increase in the cost of power, including inflation assumed to be 2.3%. This sensitivity analysis evaluated cost projections under conditions where the cost of power escalated at only 1% over inflation, or 3.3%. Under these conditions, the total 50-year cumulative cost of the abandon surface water (all groundwater) option is estimated to be $287M (see **Table 11**). Under the low power escalation scenario, the abandon surface water (all groundwater) option is $102M to $184M more expensive than the surface water options (see **Table 12**).

Table 11. Results of Sensitivity Analysis for Escalation in Power Costs, Costs of Abandon Surface Water (Groundwater Only) Alternative (50-year (cumulative cash flow)

Scenario:	Base Condition	Low Power Escalation (1% greater than inflation)
Assumed power escalation	6.22% / year	3.3% / year
Inflation included in Assumed Power Escalation	2.3% / year	2.3% / year
Total Capital ($M) with Bond servicing	$122M	$122M
Total O&M ($M)	$434M	$165M
Total Cumulative Cash Flow ($M)	$557M	$287M

Table 12. Costs of Water Supply Alternatives Under Low Power Cost Escalation Scenario, (50-year cumulative cash flow)

	Surface Water with hydropower	Surface Water no hydropower	Abandon Surface Water (Groundwater only) – Low Power Escalation Scenario
Total Cumulative Cash Flow ($M)	$103M	$185M	$287M

7.2 Water Demand Projection

The cost projections are impacted slightly by the water demand projections. Maximum day water demands are projected to increase by almost 60 MGD over the next 50 years. Lower demand forecasts would tend to decrease the additional costs associated with the abandon surface water (all groundwater) alternative since less water would need to be pumped from underground. This sensitivity analysis assumed a low demand increase of 13.6 MGD maximum day demand over the next 50 years. If the low demand increase were to occur, the estimated 50-year cumulative cost of the abandon surface water (all groundwater) option is $488M (see **Table 13**). Under a low demand forecast scenario, the abandon surface water (all groundwater) option is $303M to $385 more expensive than the surface water options (see **Table 14**).

Table 13. Results of Sensitivity Analysis for Water Demand Forecast, Costs of <u>Abandon Surface Water (Groundwater Only) Alternative</u> over 50 Years (cumulative cash flows)

Scenario:	Base Condition	Low Demand Assumption for Sensitivity
Assumed max. day demand increase over 50 years	60 MGD	13.6 MGD
Total Capital ($M) with Bond servicing	$122M	$122M
Total O&M ($M)	$434M	$366M
Total Cumulative Cash Flow ($M)	$557M	$488M

Table 14. Costs of Water Supply Alternatives Under Low Power Cost Escalation Scenario, (50-year cumulative cash flow)

	Surface Water with hydropower	Surface Water no hydropower	Abandon Surface Water (Groundwater only) – Low Power Escalation Scenario
Total Cumulative Cash Flow ($M)	$103M	$185M	$488M

Appendix A

D) - Projection, City of Bend

Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Annual (MG)	Average Day (MGD)	Max Day (MGD)
28	31	30	31	30	31	31	30	31	30	31	365		
.34%	3.69%	6.00%	11.53%	11.92%	16.63%	15.76%	13.50%	6.12%	3.59%	3.81%	100.0%		2.25
6.1	6.1	10.2	19.0	20.3	27.4	26.0	23.0	10.1	6.1	6.3	5110	14.0	31.5
6.5	6.5	11.0	20.4	21.7	29.4	27.8	24.6	10.8	6.6	6.7	5475	15.0	33.8
6.8	6.8	11.5	21.3	22.8	30.8	29.2	25.8	11.3	6.9	7.0	5736	15.7	35.4
7.1	7.1	12.0	22.3	23.8	32.2	30.5	27.0	11.8	7.2	7.4	5996	16.4	37.0
7.5	7.5	12.5	23.3	24.9	33.6	31.8	28.2	12.4	7.5	7.7	6257	17.1	38.6
7.8	7.8	13.0	24.2	25.9	35.0	33.1	29.3	12.9	7.8	8.0	6518	17.9	40.2
8.1	8.1	13.6	25.2	26.9	36.4	34.5	30.5	13.4	8.1	8.3	6779	18.6	41.8
8.4	8.4	14.1	26.2	28.0	37.8	35.8	31.7	13.9	8.4	8.6	7039	19.3	43.4
8.7	8.7	14.6	27.1	29.0	39.2	37.1	32.8	14.4	8.7	9.0	7300	20.0	45.0
9.1	9.1	15.3	28.4	30.3	40.9	38.8	34.3	15.1	9.1	9.4	7632	20.9	47.0
9.5	9.5	15.9	29.6	31.6	42.7	40.5	35.8	15.7	9.5	9.8	7964	21.8	49.1
9.9	9.9	16.6	30.8	33.0	44.5	42.2	37.3	16.4	9.9	10.2	8295	22.7	51.1
10.3	10.3	17.3	32.1	34.3	46.3	43.9	38.8	17.0	10.3	10.6	8627	23.6	53.2
10.7	10.7	17.9	33.3	35.6	48.1	45.6	40.3	17.7	10.7	11.0	8959	24.5	55.2
11.1	11.1	18.6	34.5	36.9	49.8	47.2	41.8	18.3	11.1	11.4	9291	25.5	57.3
11.5	11.5	19.3	35.8	38.2	51.6	48.9	43.3	19.0	11.5	11.8	9623	26.4	59.3
11.9	11.9	19.9	37.0	39.5	53.4	50.6	44.8	19.7	11.9	12.2	9955	27.3	61.4
12.3	12.3	20.6	38.2	40.9	55.2	52.3	46.3	20.3	12.3	12.6	10286	28.2	63.4
12.7	12.7	21.2	39.5	42.2	57.0	54.0	47.8	21.0	12.7	13.0	10618	29.1	65.5
13.1	13.1	21.9	40.7	43.5	58.7	55.7	49.3	21.6	13.1	13.4	10950	30.0	67.5
13.3	13.2	22.2	41.3	44.2	59.6	56.5	50.0	21.9	13.3	13.6	11116	30.5	68.5
13.4	13.4	22.6	42.0	44.8	60.5	57.4	50.8	22.3	13.5	13.9	11282	30.9	69.5
13.6	13.6	22.9	42.6	45.5	61.4	58.2	51.5	22.6	13.7	14.1	11448	31.4	70.6
13.8	13.8	23.2	43.2	46.1	62.3	59.1	52.3	22.9	13.9	14.3	11614	31.8	71.6
14.0	14.0	23.6	43.8	46.8	63.2	59.9	53.0	23.3	14.1	14.5	11780	32.3	72.6
14.2	14.2	23.9	44.4	47.5	64.1	60.7	53.7	23.6	14.3	14.7	11945	32.7	73.6
14.4	14.4	24.2	45.0	48.1	65.0	61.6	54.5	23.9	14.5	14.9	12111	33.2	74.7
14.6	14.6	24.6	45.7	48.8	65.9	62.4	55.2	24.2	14.7	15.1	12277	33.6	75.7
14.8	14.8	24.9	46.3	49.4	66.8	63.3	56.0	24.6	14.9	15.3	12443	34.1	76.7
15.0	15.0	25.2	46.9	50.1	67.6	64.1	56.7	24.9	15.1	15.5	12609	34.5	77.7
15.2	15.2	25.6	47.5	50.7	68.5	65.0	57.5	25.2	15.3	15.7	12775	35.0	78.8
15.3	15.[illegible]	25.7	47.8	51.1	69.0	65.4	57.[illegible]	25.4	15.4	15.8	12866	35.3	79.3
15.4	15.[illegible]	25.9	48.2	51.5	69.5	65.9	58.[illegible]	25.6	15.5	15.9	12958	35.5	79.9
15.6	15.6	26.1	48.5	51.8	70.0	66.4	58.7	25.8	15.6	16.0	13049	35.8	80.4

D) - Projectir City of Bend

Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Annual (MG)	Average Day (MGD)	Max Day (MGD)
28	31	30	31	30	31	31	30	31	30	31	365		
.34%	3.69%	6.00%	11.53%	11.92%	16.63%	15.76%	13.50%	6.12%	3.59%	3.81%	100.0%		2.25
15.7	15.7	26.3	48.9	52.2	70.5	66.8	59.1	25.9	15.7	16.1	13140	36.0	81.0
15.8	15.8	26.5	49.2	52.6	71.0	67.3	59.5	26.1	15.9	16.2	13231	36.3	81.6
15.9	15.9	26.7	49.5	52.9	71.5	67.7	59.9	26.3	16.0	16.4	13323	36.5	82.1
16.0	16.0	26.8	49.9	53.3	72.0	68.2	60.4	26.5	16.1	16.5	13414	36.8	82.7
16.1	16.1	27.0	50.2	53.6	72.5	68.7	60.8	26.7	16.2	16.6	13505	37.0	83.3
16.2	16.2	27.2	50.6	54.0	72.9	69.1	61.2	26.8	16.3	16.7	13596	37.3	83.8
16.3	16.3	27.4	50.9	54.4	73.4	69.6	61.6	27.0	16.4	16.8	13688	37.5	84.4
16.4	16.4	27.6	51.2	54.7	73.9	70.1	62.0	27.2	16.5	16.9	13779	37.8	84.9
16.5	16.5	27.8	51.6	55.1	74.4	70.5	62.4	27.4	16.6	17.0	13870	38.0	85.5
16.6	16.6	27.9	51.9	55.5	74.9	71.0	62.8	27.6	16.7	17.1	13961	38.3	86.1
16.8	16.7	28.1	52.3	55.8	75.4	71.5	63.2	27.7	16.8	17.3	14053	38.5	86.6
16.9	16.9	28.3	52.6	56.2	75.9	71.9	63.6	27.9	16.9	17.4	14144	38.8	87.2
17.0	17.0	28.5	52.9	56.5	76.4	72.4	64.1	28.1	17.1	17.5	14235	39.0	87.8
17.1	17.1	28.7	53.3	56.9	76.9	72.9	64.5	28.3	17.2	17.6	14326	39.3	88.3
17.2	17.2	28.8	53.6	57.3	77.3	73.3	64.9	28.5	17.3	17.7	14418	39.5	88.9
17.3	17.3	29.0	54.0	57.6	77.8	73.8	65.3	28.6	17.4	17.8	14509	39.8	89.4
17.4	17.4	29.2	54.3	58.0	78.3	74.2	65.7	28.8	17.5	17.9	14600	40.0	90.0

Surface Water Availability

Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total (MG)	Average (MGD)
28	31	30	31	30	31	31	30	31	30	31	365	
13.57	13.57	11.64	12.93	13.57	11.64	10.99	10.99	10.99	13.57	13.57		
6.1	6.1	10.2	12.9	13.6	11.6	11.0	11.0	10.1	6.1	6.3	3406	9.3
6.5	6.5	11.0	12.9	13.6	11.6	11.0	11.0	10.8	6.6	6.7	3518	9.6
6.8	6.8	11.5	12.9	13.6	11.6	11.0	11.0	11.0	6.9	7.0	3587	9.8
7.1	7.1	11.6	12.9	13.6	11.6	11.0	11.0	11.0	7.2	7.4	3640	10.0
7.5	7.5	11.6	12.9	13.6	11.6	11.0	11.0	11.0	7.5	7.7	3689	10.1
7.8	7.8	11.6	12.9	13.6	11.6	11.0	11.0	11.0	7.8	8.0	3737	10.2
8.1	8.1	11.6	12.9	13.6	11.6	11.0	11.0	11.0	8.1	8.3	3785	10.4
8.4	8.4	11.6	12.9	13.6	11.6	11.0	11.0	11.0	8.4	8.6	3834	10.5
8.7	8.7	11.6	12.9	13.6	11.6	11.0	11.0	11.0	8.7	9.0	3882	10.6
9.1	9.1	11.6	12.9	13.6	11.6	11.0	11.0	11.0	9.1	9.4	3944	10.8
9.5	9.5	11.6	12.9	13.6	11.6	11.0	11.0	11.0	9.5	9.8	4005	11.0
9.9	9.9	11.6	12.9	13.6	11.6	11.0	11.0	11.0	9.9	10.2	4067	11.1
10.3	10.3	11.6	12.9	13.6	11.6	11.0	11.0	11.0	10.3	10.6	4128	11.3
10.7	10.7	11.6	12.9	13.6	11.6	11.0	11.0	11.0	10.7	11.0	4190	11.5
11.1	11.1	11.6	12.9	13.6	11.6	11.0	11.0	11.0	11.1	11.4	4251	11.6
11.5	11.5	11.6	12.9	13.6	11.6	11.0	11.0	11.0	11.5	11.8	4313	11.8
11.9	11.9	11.6	12.9	13.6	11.6	11.0	11.0	11.0	11.9	12.2	4374	12.0
12.3	12.3	11.6	12.9	13.6	11.6	11.0	11.0	11.0	12.3	12.6	4434	12.1
12.7	12.7	11.6	12.9	13.6	11.6	11.0	11.0	11.0	12.7	13.0	4482	12.3
13.1	13.1	11.6	12.9	13.6	11.6	11.0	11.0	11.0	13.1	13.4	4530	12.4
13.3	13.2	11.6	12.9	13.6	11.6	11.0	11.0	11.0	13.3	13.6	4552	12.5
13.4	13.4	11.6	12.9	13.6	11.6	11.0	11.0	11.0	13.5	13.6	4569	12.5
13.6	13.6	11.6	12.9	13.6	11.6	11.0	11.0	11.0	13.6	13.6	4579	12.5
13.6	13.6	11.6	12.9	13.6	11.6	11.0	11.0	11.0	13.6	13.6	4579	12.5
13.6	13.6	11.6	12.9	13.6	11.6	11.0	11.0	11.0	13.6	13.6	4579	12.5
13.6	13.6	11.6	12.9	13.6	11.6	11.0	11.0	11.0	13.6	13.6	4579	12.5
13.6	13.6	11.6	12.9	13.6	11.6	11.0	11.0	11.0	13.6	13.6	4579	12.5
13.6	13.6	11.6	12.9	13.6	11.6	11.0	11.0	11.0	13.6	13.6	4579	12.5
13.6	13.6	11.6	12.9	13.6	11.6	11.0	11.0	11.0	13.6	13.6	4579	12.5
13.6	13.6	11.6	12.9	13.6	11.6	11.0	11.0	11.0	13.6	13.6	4579	12.5
13.6	13.ϵ	11.6	12.9	13.6	11.6	11.0	11.0	11.0	13.6	13.6	4579	12.5
13.6	13.	11.6	12.9	13.6	11.6	11.0	11.0	.1.0	13.6	13.6	4579	12.5

Surface Water Availability

Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total (MG)	Average (MGD)
28	31	30	31	30	31	31	30	31	30	31	365	
13.57	13.57	11.64	12.93	13.57	11.64	10.99	10.99	10.99	13.57	13.57		
13.6	13.6	11.6	12.9	13.6	11.6	11.0	11.0	11.0	13.6	13.6	4579	12.5
13.6	13.6	11.6	12.9	13.6	11.6	11.0	11.0	11.0	13.6	13.6	4579	12.5
13.6	13.6	11.6	12.9	13.6	11.6	11.0	11.0	11.0	13.6	13.6	4579	12.5
13.6	13.6	11.6	12.9	13.6	11.6	11.0	11.0	11.0	13.6	13.6	4579	12.5
13.6	13.6	11.6	12.9	13.6	11.6	11.0	11.0	11.0	13.6	13.6	4579	12.5
13.6	13.6	11.6	12.9	13.6	11.6	11.0	11.0	11.0	13.6	13.6	4579	12.5
13.6	13.6	11.6	12.9	13.6	11.6	11.0	11.0	11.0	13.6	13.6	4579	12.5
13.6	13.6	11.6	12.9	13.6	11.6	11.0	11.0	11.0	13.6	13.6	4579	12.5
13.6	13.6	11.6	12.9	13.6	11.6	11.0	11.0	11.0	13.6	13.6	4579	12.5
13.6	13.6	11.6	12.9	13.6	11.6	11.0	11.0	11.0	13.6	13.6	4579	12.5
13.6	13.6	11.6	12.9	13.6	11.6	11.0	11.0	11.0	13.6	13.6	4579	12.5
13.6	13.6	11.6	12.9	13.6	11.6	11.0	11.0	11.0	13.6	13.6	4579	12.5
13.6	13.6	11.6	12.9	13.6	11.6	11.0	11.0	11.0	13.6	13.6	4579	12.5
13.6	13.6	11.6	12.9	13.6	11.6	11.0	11.0	11.0	13.6	13.6	4579	12.5
13.6	13.6	11.6	12.9	13.6	11.6	11.0	11.0	11.0	13.6	13.6	4579	12.5
13.6	13.6	11.6	12.9	13.6	11.6	11.0	11.0	11.0	13.6	13.6	4579	12.5
13.6	13.6	11.6	12.9	13.6	11.6	11.0	11.0	11.0	13.6	13.6	4579	12.5
13.6	13.6	11.6	12.9	13.6	11.6	11.0	11.0	11.0	13.6	13.6	4579	12.5
13.6	13.6	11.6	12.9	13.6	11.6	11.0	11.0	11.0	13.6	13.6	4579	12.5

Table A-3. Surface Water Projected operation and maintenance costs (2010$) with membrane filtration / hydropower

Item	Estimated annual cost ($/yr)
Labor	257,900
Power	63,800
Chemicals and disposal	79,000
Mechanical components / membrane filter replacement	101,300
Sub-Total Membrane Filtration	**502,000**
Hydropower	55,253
Total	**557,253**
Source: WSAS, 2009	

28	31	30	31	30	31	31	30	31	30	31	365
Feb	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Total**
765,632	847,466	1,376,889	1,798,881	1,827,895	1,618,993	1,529,049	1,479,725	1,403,574	824,544	872,900	15,287,137
820,320	907,999	1,475,238	1,798,881	1,827,895	1,618,993	1,529,049	1,479,725	1,503,830	883,440	935,250	15,789,465
859,383	951,237	1,545,488	1,798,881	1,827,895	1,618,993	1,529,049	1,479,725	1,529,049	925,508	979,786	16,101,879
898,446	994,475	1,566,767	1,798,881	1,827,895	1,618,993	1,529,049	1,479,725	1,529,049	967,577	1,024,322	16,340,104
937,509	1,037,714	1,566,767	1,798,881	1,827,895	1,618,993	1,529,049	1,479,725	1,529,049	1,009,646	1,068,857	16,557,050
976,572	1,080,952	1,566,767	1,798,881	1,827,895	1,618,993	1,529,049	1,479,725	1,529,049	1,051,714	1,113,393	16,773,995
1,015,635	1,124,190	1,566,767	1,798,881	1,827,895	1,618,993	1,529,049	1,479,725	1,529,049	1,093,783	1,157,929	16,990,941
1,054,698	1,167,428	1,566,767	1,798,881	1,827,895	1,618,993	1,529,049	1,479,725	1,529,049	1,135,851	1,202,465	17,207,886
1,093,760	1,210,666	1,566,767	1,798,881	1,827,895	1,618,993	1,529,049	1,479,725	1,529,049	1,177,920	1,247,000	17,424,831
1,143,477	1,265,696	1,566,767	1,798,881	1,827,895	1,618,993	1,529,049	1,479,725	1,529,049	1,231,462	1,303,682	17,700,944
1,193,193	1,320,726	1,566,767	1,798,881	1,827,895	1,618,993	1,529,049	1,479,725	1,529,049	1,285,003	1,360,364	17,977,056
1,242,910	1,375,757	1,566,767	1,798,881	1,827,895	1,618,993	1,529,049	1,479,725	1,529,049	1,338,545	1,417,046	18,253,168
1,292,626	1,430,787	1,566,767	1,798,881	1,827,895	1,618,993	1,529,049	1,479,725	1,529,049	1,392,087	1,473,728	18,529,281
1,342,342	1,485,817	1,566,767	1,798,881	1,827,895	1,618,993	1,529,049	1,479,725	1,529,049	1,445,629	1,530,410	18,805,393
1,392,059	1,540,847	1,566,767	1,798,881	1,827,895	1,618,993	1,529,049	1,479,725	1,529,049	1,499,171	1,587,091	19,081,505
1,441,775	1,595,878	1,566,767	1,798,881	1,827,895	1,618,993	1,529,049	1,479,725	1,529,049	1,552,713	1,643,773	19,357,618
1,491,492	1,650,908	1,566,767	1,798,881	1,827,895	1,618,993	1,529,049	1,479,725	1,529,049	1,606,254	1,700,455	19,633,730
1,541,208	1,705,938	1,566,767	1,798,881	1,827,895	1,618,993	1,529,049	1,479,725	1,529,049	1,659,796	1,757,137	19,903,264
1,590,924	1,760,968	1,566,767	1,798,881	1,827,895	1,618,993	1,529,049	1,479,725	1,529,049	1,713,338	1,813,819	20,118,235
1,640,641	1,815,999	1,566,767	1,798,881	1,827,895	1,618,993	1,529,049	1,479,725	1,529,049	1,766,880	1,870,501	20,333,205
1,665,499	1,843,514	1,566,767	1,798,881	1,827,895	1,618,993	1,529,049	1,479,725	1,529,049	1,793,651	1,888,825	20,430,674
1,690,357	1,871,029	1,566,767	1,798,881	1,827,895	1,618,993	1,529,049	1,479,725	1,529,049	1,820,422	1,888,825	20,509,818
1,706,036	1,888,825	1,566,767	1,798,881	1,827,895	1,618,993	1,529,049	1,479,725	1,529,049	1,827,895	1,888,825	20,550,767

Table A-5. Assumed Unit Power Costs (6.22%/year escalation)

Year	Unit Power Cost ($/kWh)	Year	Unit Power Cost ($/kWh)
2010	0.051	2037	0.261
2011	0.054	2038	0.277
2012	0.058	2039	0.294
2013	0.061	2040	0.312
2014	0.065	2041	0.332
2015	0.069	2042	0.353
2016	0.073	2043	0.374
2017	0.078	2044	0.398
2018	0.083	2045	0.422
2019	0.088	2046	0.449
2020	0.093	2047	0.477
2021	0.099	2048	0.506
2022	0.105	2049	0.538
2023	0.112	2050	0.571
2024	0.119	2051	0.607
2025	0.126	2052	0.645
2026	0.134	2053	0.685
2027	0.143	2054	0.727
2028	0.151	2055	0.772
2029	0.161	2056	0.821
2030	0.171	2057	0.872
2031	0.182	2058	0.926
2032	0.193	2059	0.983
2033	0.205	2060	1.044
2034	0.218	2061	1.109
2035	0.231	2062	1.178
2036	0.245		

28	31	30	31	30	31	31	30	31	30	31	365
eb	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Total ($)**
9,139	43,322	70,387	91,959	93,442	82,763	78,165	75,644	71,751	42,151	44,623	781,478
4,543	49,304	80,105	97,679	99,254	87,911	83,027	80,349	81,657	47,970	50,784	857,363
9,567	54,865	89,139	103,754	105,428	93,379	88,191	85,346	88,191	53,381	56,511	928,710
5,043	60,926	95,987	110,208	111,985	99,187	93,677	90,655	93,677	59,278	62,755	1,001,070
1,009	67,529	101,958	117,063	118,951	105,356	99,503	96,294	99,503	65,703	69,556	1,077,455
7,504	74,719	108,300	124,344	126,350	111,910	105,692	102,283	105,692	72,698	76,961	1,159,468
4,570	82,541	115,036	132,078	134,208	118,870	112,266	108,645	112,266	80,308	85,018	1,247,516
2,255	91,047	122,191	140,293	142,556	126,264	119,249	115,403	119,249	88,584	93,779	1,342,031
0,607	100,292	129,791	149,020	151,423	134,118	126,667	122,581	126,667	97,579	103,302	1,443,477
0,618	111,372	137,864	158,289	160,842	142,460	134,545	130,205	134,545	108,360	114,715	1,557,557
1,523	123,443	146,440	168,134	170,846	151,321	142,914	138,304	142,914	120,104	127,148	1,680,244
3,396	136,585	155,548	178,592	181,473	160,733	151,803	146,907	151,803	132,890	140,684	1,812,168
6,314	150,883	165,223	189,701	192,760	170,731	161,246	156,044	161,246	146,802	155,412	1,954,002
0,361	166,432	175,500	201,500	204,750	181,350	171,275	165,750	171,275	161,931	171,427	2,106,469
5,629	183,332	186,416	214,033	217,486	192,630	181,928	176,060	181,928	178,373	188,834	2,270,344
2,214	201,690	198,011	227,346	231,013	204,612	193,244	187,011	193,244	196,235	207,743	2,446,455
0,222	221,623	210,328	241,487	245,382	217,338	205,264	198,643	205,264	215,628	228,274	2,635,691
9,765	243,255	223,410	256,508	260,645	230,857	218,032	210,998	218,032	236,675	250,555	2,838,064
0,965	266,720	237,306	272,462	276,857	245,216	231,593	224,122	231,593	259,506	274,725	3,047,152
3,951	292,164	252,066	289,410	294,078	260,469	245,998	238,063	245,998	284,261	300,932	3,271,270
4,617	315,038	267,745	307,411	312,369	276,670	261,299	252,870	261,299	306,517	322,781	3,491,399
6,833	339,628	284,399	326,532	331,799	293,879	277,552	268,599	277,552	330,442	342,858	3,722,930
8,941	364,184	302,088	346,842	352,436	312,158	294,816	285,306	294,816	352,436	364,184	3,962,392
9,401	386,837	320,878	368,416	374,358	331,574	313,153	303,052	313,153	374,358	386,837	4,208,853
1,133	410,898	340,837	391,331	397,643	352,198	332,632	321,901	332,632	397,643	410,898	4,470,643
4,218	436,456	362,037	415,672	422,376	374,105	353,321	341,924	353,321	422,376	436,456	4,748,717
8,738	463,603	384,556	441,527	448,648	397,374	375,298	363,191	375,298	448,648	463,603	5,044,087
4,784	492,439	408,475	468,990	476,554	422,091	398,641	385,782	398,641	476,554	492,439	5,357,830
2,449	523,069	433,882	498,161	506,196	448,345	423,437	409,778	423,437	506,196	523,069	5,691,087
1,836	555,604	460,870	529,147	537,681	476,232	449,775	435,266	449,775	537,681	555,604	6,045,072
3,050	590,162	489,536	562,059	571,125	505,853	477,751	462,339	477,751	571,125	590,162	6,421,076
6,206	626,871	519,985	597,020	606,649	537,318	507,467	491,097	507,467	606,649	626,871	6,820,467
1,424	665,862	552,328	634,154	644,382	570,739	539,031	521,643	539,031	644,382	665,862	7,244,700
8,832	707,278	586,683	673,599	684,463	606,239	572,559	554,089	572,559	684,463	707,278	7,695,320
8,568	751,271	623,174	715,496	727,037	643,947	608,172	588,553	608,172	727,037	751,271	8,173,969
0,774	798,000	661,936	760,000	772,258	684,000	646,000	625,161	646,000	772,258	798,000	8,682,390

28	31	30	31	30	31	31	30	31	30	31	365
'eb	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Total ($)**
5,607	847,636	703,108	807,272	820,293	726,545	686,181	664,047	686,181	820,293	847,636	9,222,434
3,227	900,359	746,841	857,485	871,315	771,736	728,862	705,350	728,862	871,315	900,359	9,796,070
3,810	956,361	793,295	910,820	925,511	819,738	774,197	749,223	774,197	925,511	956,361	10,405,385
7,539	1,015,847	842,638	967,473	983,078	870,726	822,352	795,825	822,352	983,078	1,015,847	11,052,600
'4,610	1,079,032	895,050	1,027,650	1,044,225	924,885	873,502	845,325	873,502	1,044,225	1,079,032	11,740,072
5,231	1,146,148	950,722	1,091,570	1,109,176	982,413	927,834	897,904	927,834	1,109,176	1,146,148	12,470,305
9,622	1,217,439	1,009,857	1,159,465	1,178,166	1,043,519	985,546	953,754	985,546	1,178,166	1,217,439	13,245,957
8,019	1,293,163	1,072,670	1,231,584	1,251,448	1,108,426	1,046,847	1,013,077	1,046,847	1,251,448	1,293,163	14,069,856
0,669	1,373,598	1,139,390	1,308,189	1,329,289	1,177,370	1,111,960	1,076,091	1,111,960	1,329,289	1,373,598	14,945,001
7,839	1,459,036	1,210,260	1,389,558	1,411,970	1,250,602	1,181,124	1,143,024	1,181,124	1,411,970	1,459,036	15,874,580
9,809	1,549,788	1,285,538	1,475,989	1,499,795	1,328,390	1,254,590	1,214,120	1,254,590	1,499,795	1,549,788	16,861,979
6,877	1,646,185	1,365,499	1,567,795	1,593,082	1,411,016	1,332,626	1,289,638	1,332,626	1,593,082	1,646,185	17,910,794
'9,360	1,748,578	1,450,433	1,665,312	1,692,172	1,498,781	1,415,515	1,369,853	1,415,515	1,692,172	1,748,578	19,024,846
'7,597	1,857,339	1,540,650	1,768,894	1,797,425	1,592,005	1,503,560	1,455,058	1,503,560	1,797,425	1,857,339	20,208,191
1,943	1,972,866	1,636,478	1,878,920	1,909,225	1,691,028	1,597,082	1,545,563	1,597,082	1,909,225	1,972,866	21,465,140
2,780	2,095,578	1,738,267	1,995,788	2,027,978	1,796,209	1,696,420	1,641,697	1,696,420	2,027,978	2,095,578	22,800,272
0,511	2,225,923	1,846,387	2,119,926	2,154,119	1,907,934	1,801,937	1,743,810	1,801,937	2,154,119	2,225,923	24,218,449

Appendix B

Potential Additional Groundwater Facilities Costs Memorandum

To: Heidi Lansdowne, PE, City of Bend

From: Bryan Black, PE

Project: Surface Water Improvement Project

Date: October 27, 2010

RE: Potential Additional Groundwater Facilities Costs, FINAL

1 Potential Additional Groundwater Facilities

The City of Bend requested that HDR evaluate the costs of replacing its surface water system with groundwater. This memorandum describes the additional facilities and costs that are anticipated to be required to integrate the additional 13.6 mgd of groundwater well capacity into the City's existing water distribution system to replace the surface water system. This memorandum does not include the cost of installing the additional wells that would be required. The complete cost evaluation is provided in a companion memorandum, and includes the cost of additional wells.

The additional actions / facilities that are anticipated to be required in addition to the wells are:

1. Water master planning
2. Land acquisition for additional wells
3. Well water transmission piping from the new wells to storage reservoirs
4. New terminal storage reservoirs for well-produced water
5. Booster pumping for water distribution
6. Additional storage in the distribution system for emergencies storage and fire flows

The City currently has plans to retain the surface water system and install new groundwater wells at the Outback site. If the surface water source is abandoned, new groundwater facilities will need to be located in relatively undeveloped areas of the City. Potential locations for these additional groundwater facilities are illustrated in **Figure 1**.

1.1 Water master planning

The City's water supply and distribution system has been developed to effectively receive and distribute surface water. If the City decides to seriously consider replacing its surface water supply with additional groundwater and wells, it should complete a thorough water master planning effort to determine the additional facilities that would be required. Water master planning efforts of this scale typically require a time period of seven to twelve months and a budget in the range of $200,000.

1.2 Land acquisition for wells

The City has reserved locations for future wells needed for the current dual-source system. Additional land will need to be acquired to site new well fields to replace surface water. Per the companion groundwater cost memorandum, 10 additional wells would be needed to provide the 13.6 mgd firm capacity. For this analysis, it is assumed that wells will be sited in two groups of three each and one group of four in Southwest Bend, as shown in **Figure 1**. It is assumed that each well will occupy one-half acre, so a total of 5 acres would be needed. The cost of land is assumed to be $50,000 per acre so $250,000 would need to be budgeted for land acquisition.

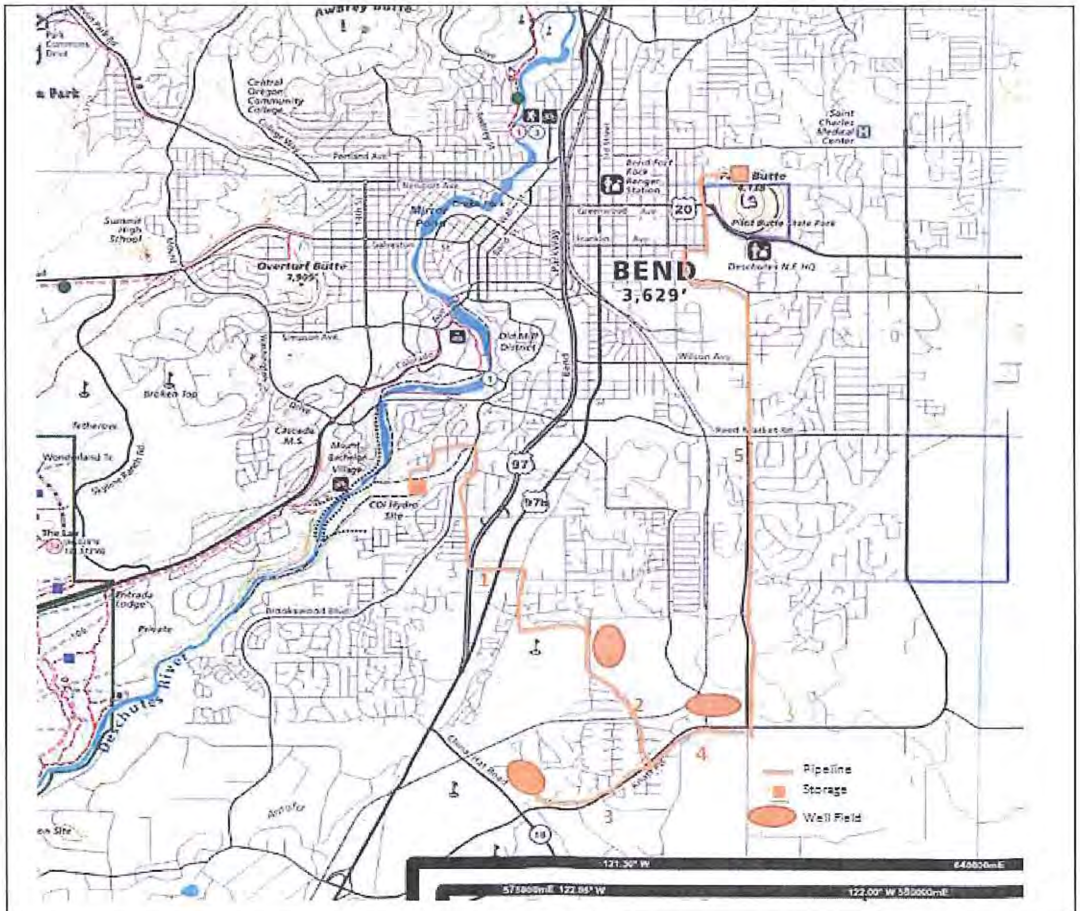


Figure 1. Potential Locations for Additional Groundwater Facilities

1.3 Well transmission piping to water storage reservoirs

The new well fields will require water transmission pipelines from the well fields to finished water storage reservoirs prior to water distribution within the

City. Finished water storage reservoirs could potentially be located on the north side of Pilot Butte State Park and at Rock Bluff. **Figure 1** shows potential transmission mains from the three wells fields to the two new proposed storage reservoirs.

Pipeline lengths, diameters, and estimated costs are presented in **Table 1**. The total estimated costs for the transmission pipelines is $22M including engineering and contingencies.

Table 1. Well Transmission Pipeline Lengths, Diameters, and Estimated Costs

Pipe Segment	Length (Feet)	Capacity (mgd)	Capacity (gpm)	Diameter (inch)	Unit Cost ($/foot)	Total Cost ($)
1	16,051	13.6	9,452	30	430	6,900,000
2	5,016	9	6,255	24	350	1,760,000
3	6,019	4.5	3,128	18	265	1,600,000
4	4,013	9	6,255	24	350	1,400,000
5	24,077	13.6	9,452	30	430	10,350,000
Total	**55,176**					**22,010,000**

Note: Unit cost from Optimatics, 2010

1.4 New terminal storage reservoirs for well-produced water

New terminal storage reservoirs are needed to equalize the flow rate produced from the new wells fields. Water will be produced by the wells at a constant rate of 13.6 mgd (9,452 gpm) but water will be consumed by customers at variable rates on a peak summer day from about 4,700 gpm to about 14,000 gpm (Optimatics 2010 indicates a peak hour demand / maximum day demand factor of 2.4). The new terminal storage reservoirs will allow the constant rate groundwater wells to meet the range of water demands in the City.

Figure 2 illustrates the constant inflow from the well fields, the variable consumption rate by City water customers, and the amount of water needed to be stored during the day to allow the wells to meet the variable customer demands.

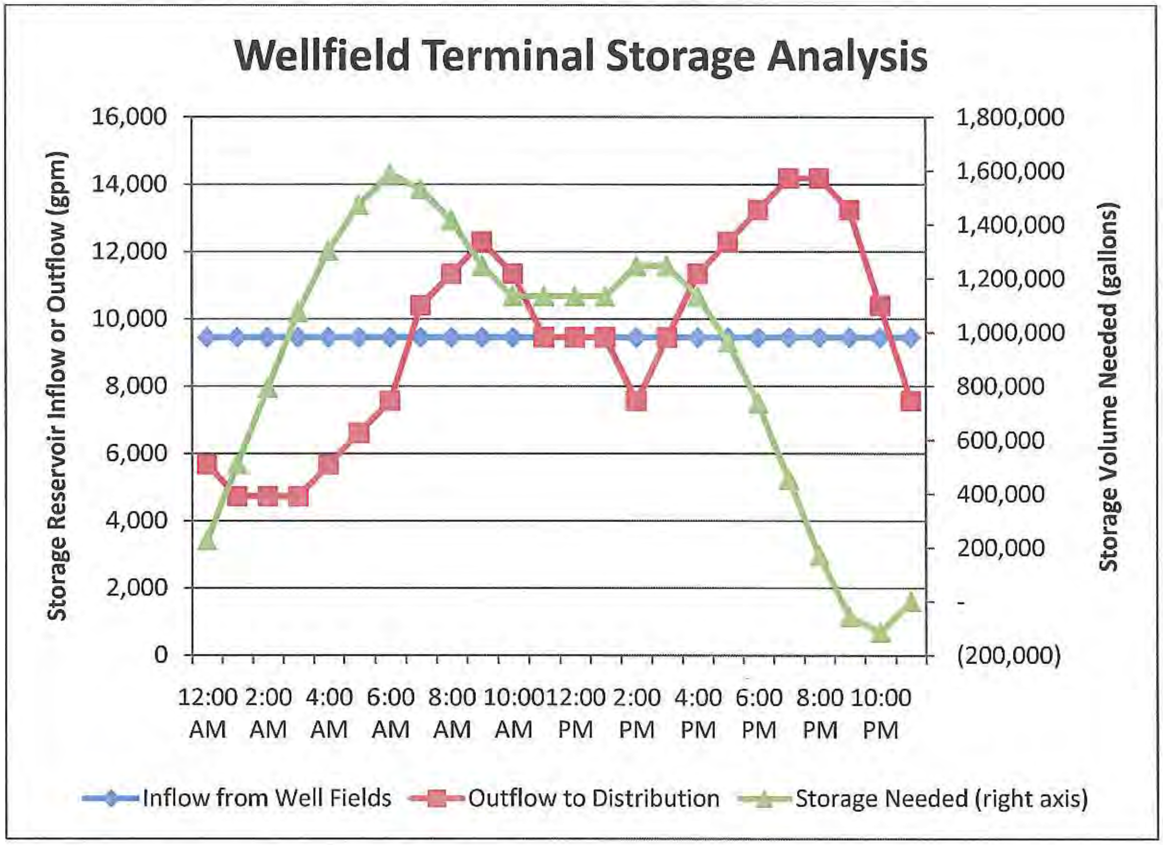


Figure 2. Storage analysis with constant well production, variable consumption, and quantity of water required to be stored

The storage analysis indicates that the terminal water storage reservoirs should be sized in the range of 1.6 million gallons each. **Attachment A, Table 1-1** provides the storage calculations used to generate **Figure 2** and the storage analysis.

The storage reservoir near Pilot Butte would be buried concrete and the reservoir at Rock Bluff would be at-grade steel construction. **Table 2** provides a summary of terminal water storage recommendations along with an estimate of probable costs.

Table 2. Summary of Storage recommendations and estimate of probable costs

Location	Volume (million gallons)	Type	Unit Cost ($M/MG)	Estimated Cost ($M)
Pilot Butte (north)	1.6	Buried Concrete	2.3	5.15
Rock Bluff	1.6	At-grade steel	1.5	3.36
Total	**3.2**			**8.51**

Note: Unit Costs from Optimatics 2010, 40% added for engineering, contingency, administration

1.5 Booster pumping for water distribution

It is currently not known if additional booster pumping capacity would be needed with installation of the anticipated volumes of terminal storage listed in Section 1.3. Further, the additional power costs for booster pumping to higher water pressure zones have not been evaluated. If the City decides to replace its surface water with additional groundwater, then the City should further investigate the costs of power for booster pumping the additional groundwater, which could be substantial, in a water master planning effort.

1.6 Additional storage in the distribution system

It is currently not known if additional distribution storage would be needed with the installation of the anticipated volumes of terminal storage listed in Section 1.3. However, additional distribution system storage may actually be required for emergency water storage or fire flows. This should be further investigated in a new water master plan if the City wants to seriously consider replacing its surface water supply with additional groundwater and wells.

2 Additional groundwater facility summary

This memorandum provided an initial review of additional facilities required to integrate a new 13.6 mgd groundwater supply into the City's water system to replace the surface water supply. Well facilities that are also required are described in a companion memorandum. Estimated costs for additional actions / facilities to support integration of new well field supplies into the City's water system are presented in **Table 3**. The estimated costs for additional actions / facilities is $28.5M.

Table 3. Additional costs required to develop 13.6 mgd additional groundwater supply to replace surface water

Action / Facility	Anticipated Cost
Water Master Plan	$200,000
Land Acquisition	$250,000
Additional Wells (Qty 10, see companion memo, "Surface Water / Groundwater Cost Comparison")	$28,500,000
Well field transmission piping	$22,010,000
New terminal storage reservoirs	$8,510,000
Booster pumping capital costs	None anticipated - needs review
Additional storage in the distribution system	None anticipated – needs review
Total	**$59,470,000**

Attachment 1

Water Storage Equalization Calculations

Table 1-1. Terminal Storage Analysis for Additional Groundwater Wells

Hour	Inflow (gpm)	Outflow (gpm)	Peaking	Stored (gallons)
12:00 AM	9452	5671	0.6	226,848
1:00 AM	9452	4726	0.5	510,408
2:00 AM	9452	4726	0.5	793,968
3:00 AM	9452	4726	0.5	1,077,528
4:00 AM	9452	5671	0.6	1,304,376
5:00 AM	9452	6616	0.7	1,474,512
6:00 AM	9452	7562	0.8	**1,587,936**
7:00 AM	9452	10397	1.1	1,531,224
8:00 AM	9452	11342	1.2	1,417,800
9:00 AM	9452	12288	1.3	1,247,664
10:00 AM	9452	11342	1.2	1,134,240
11:00 AM	9452	9452	1	1,134,240
12:00 PM	9452	9452	1	1,134,240
1:00 PM	9452	9452	1	1,134,240
2:00 PM	9452	7562	0.8	1,247,664
3:00 PM	9452	9452	1	1,247,664
4:00 PM	9452	11342	1.2	1,134,240
5:00 PM	9452	12288	1.3	964,104
6:00 PM	9452	13233	1.4	737,256
7:00 PM	9452	14178	1.5	453,696
8:00 PM	9452	14178	1.5	170,136
9:00 PM	9452	13233	1.4	(56,712)
10:00 PM	9452	10397	1.1	(113,424)
11:00 PM	9452	7562	0.8	-
	226,848	226,848	24.00	

Appendix C

Power Use Calculations for Groundwater

Pumping energy and costs

The groundwater pumping power, energy and costs can calculated as follows:

Power (kW) = 0.0001886 * flow (gpm) * head (feet) / efficiency %

Where: Efficiency = 80%

Head = Hydraulic Grade Line Outback (4,011 ft) – Static groundwater elevation (2,880 ft)

= 1,131 feet

Flow = monthly flow assumed to be pumped from groundwater (gpm)

Energy (kWh) = Power (kW) * time (hours)

Where: Time = days per month * 24 hours / day

Cost ($/month) = Energy *(kWh/month) * unit power cost ($/kWh)

Where: Unit power cost ($/kWh) = 0.05112 in 2010 and escalates at 6.22% annually

The power cost calculation method described above was compared to observed power costs by the City of Bend. Observed power costs in 2008 are listed in **Table C-1**.

Table C-1. City of Bend Observed Annual Power Costs for Wells in 2008

Facilities	2008 Annual Cost Pacific Power
Bear Creek Wells 1 & 2	$80,700
Copperstone Well	$42,800
Hole 10 Wells	$67,100
Outback 6,7,8	$27,700
Outback Wells 1,2	$40,500
Outback Wells 3,4,5	$91,200
Pilot Butte Wells 1,3	$74,900
North River Well	$29,200
South River Well	$74,700
Rock Bluff Well 1,2,3	$50,300
Shilo Wells	$16,300
Westwood Well	$7,600
Total	**$603,000**

Operating costs include energy and demand charges
for water facilities in the main system. Does not include costs associated with:

Surface water	Irrigation
Reservoirs	Airport system
Disinfection	

The 2008 power cost of $603,000 was associated with operating the wells to produce 2,628 million gallons in 2008, resulting in a power cost per million gallons of $230/MG.

Observed well production was obtained to understand the relationship with pumping energy to evaluate the predictive capability of the power cost calculation method. Observed well production and predicted power, energy, and associated costs are presented in **Table C-2**.

Table C-2. Predicted power costs using the calculation method described

	Observed	Predicted		
Month	Well production (MG/month)	Power (kW)	Energy (kWh)	Cost ($)
Jan-08	60	365	266,847	$ 13,641
Feb-08	25	152	111,186	$ 5,684
Mar-08	20	122	88,949	$ 4,547
Apr-08	42	255	186,793	$ 9,549
May-08	380	2309	1,690,028	$ 86,394
Jun-08	442	2685	1,965,770	$ 100,490
Jul-08	580	3524	2,579,517	$ 131,865
Aug-08	466	2831	2,072,508	$ 105,947
Sep-08	380	2309	1,690,028	$ 86,394
Oct-08	80	486	355,795	$ 18,188
Nov-08	68	413	302,426	$ 15,460
Dec-08	85	516	378,033	$ 19,325
Total	**2628**		**11,687,879**	**$ 597,484**

The total annual predicted power cost of $597,484 corresponds well with the observed 2008 power cost of $603,000 so the power cost calculation confirms this method of analysis.

Appendix D
Summary of Water Demand Forecast Methodology

Summary of Water Demand Forecast Methodology

Future water demands were projected for the City of Bend's master planning effort (Future Demand section of the *Water Model Development Documentation for Water System Optimization* by MSA, Dec 2009). The demand forecast included a comprehensive analysis of available data pertaining to historical demand and population information, current and future land use, and near-term developer plans to generate water demand projections for the year 2020 and for the Build-out situation. Two specific data sets – the *Buildable Lands Inventory (BLI)* database and the *Parcel Inventory & Alternative 4A UGB Proposal Data for the Area Outside the Existing UGB (Framework Plan)* provide future land use zoning for parcels within the City, as well as low (min), mean, and high (max) dwelling unit per acre density estimates. In the 2007 Master Plan Update, expected demand growth was distributed within the existing UGB through infill of under-developed areas up to the maximum number of potential dwelling units for the relevant zoning designation. The same philosophy has been applied in the most recent demand projection where MSA has used the low, medium and high dwelling unit per acre density values to develop future demand estimates.

Resolution to Adopt 2012-2017 Capital Improvement Program
Exhibit A

Water
Five Year Capital Improvement Program (CIP) Schedule

	Class Level	2012-13	2013-14	2014-15	2015-16	2016-17	5 yr. Budget Total
			INFRASTRUCTURE REPAIRS, REPLACEMENT & UPGRADES				
Water Line Rehabilitation	N/A	$ 449,000	$ 750,000	$ 750,000	$ 500,000	$ 500,000	$ 2,949,000
Pump Station Replacement	N/A	80,000	80,000	80,000	80,000	80,000	400,000
Communications (SCADA Upgrade)	5	237,300	200,000	200,000	200,000	200,000	1,037,300
Total Repair & Maintenance		$ 766,300	$ 1,030,000	$ 1,030,000	$ 780,000	$ 780,000	$ 4,386,300
				GROWTH RELATED			
Continuing Projects:							
Water Resources							
WA0422 Water Rights Acquisition	N/A	$ 230,000	$ 150,000	$ 150,000	$ 150,000	$ 150,000	830,000
WA10DA Water MCP	N/A	-	75,000	75,000	75,000	75,000	300,000
Water Infrastructure							
WA0405 Outback Reservoir #3	5	100,000	-	-	-	-	100,000
WA0902 Surface Water Improvement*	2	19,461,800	5,057,580	-	-	-	24,519,380
WA10FA Water Modeling	N/A	100,000	100,000	100,000	100,000	100,000	500,000
New Projects:							
Water Infrastructure							
ashington / Simpson Waterline	5	360,000	-	-	-	-	360,000
3AA Mtn. High Waterline Ext.	4	937,100	1,100,000	-	-	-	2,037,100
Pilot Butte to 11th St. Waterline Ext.	5	-	-	-	-	271,400	271,400
WA12AA 18th St. Waterline Ext. JR	3	85,000	-	-	-	-	85,000
Total Growth Related		$ 21,273,900	$ 6,482,580	$ 325,000	$ 325,000	$ 596,400	$ 29,002,880
TOTAL Water CIP		**$ 22,040,200**	**$ 7,512,580**	**$ 1,355,000**	**$ 1,105,000**	**$ 1,376,400**	**$ 33,389,180**

* Pipe and Intake Only

The City of Bend uses the cost estimate classification system from the Association for the Advancement of Cost Engineering International (AACE). The AACE provides cost estimate ranges (1-5) for the various stages of project development. Class 5 estimate is based on conceptual design (least amount of information) which make it subject to a wider range of costs due to the inherent uncertainty at this stage of project development. Class 1 estimate is based on final design (most amount of information) which make it subject to a narrower range of costs due to a higher degree of certainty associated with final design. CIP projects in the construction phase after final design are still subject to change anywhere from five to ten percent for reasons including but not limited to; owner requested schedule adjustments, equipment availability or non-availability, weather, ROW purchase/sale delays, operational issues and other unknowns that are only found during construction and could not be predicted in the design phase of the project. In addition, Public Works can not guarantee that the construction costs estimated in any given year are spent in that year. Construction costs may be higher in any given year of the project if the contractor is able to construct more than previously thought or planned. In the case of a utility project, this expedited construction schedule could impact any pre-planned utility rates for upcoming years.

AACE Cost Estimate Classification System:
Class 5 (0% - 2%) = +100%/-50%
Class 4 (1% - 15%) = +50%/-30%
Class 3 (10% - 40%) = +30%/-20%
Class 2 (30% - 70%) = +20%/-15%
Class 1 (50% - 100%) = +15%/-10%

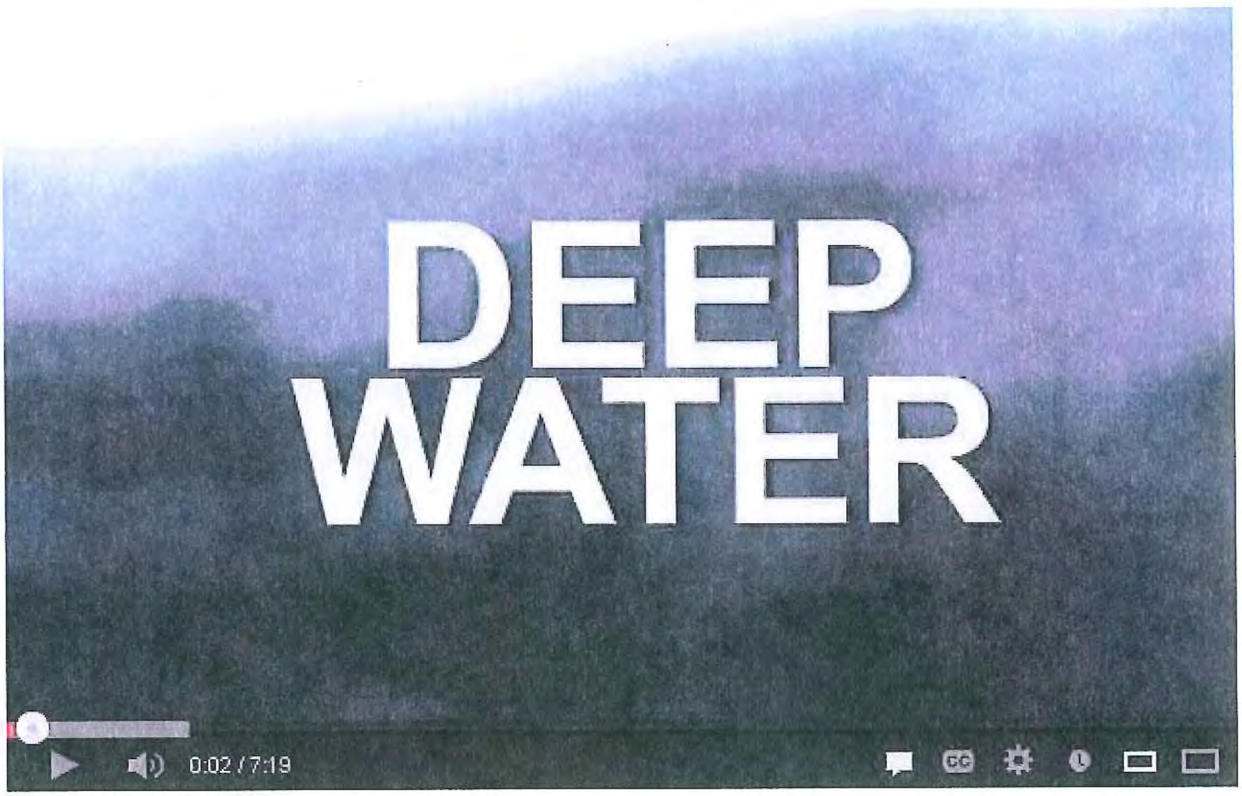
Project Definition 3% - 5%
P...matic Design 15% - 20%
...n Development 35% - 45%
Construction Documents 90% - 100%

Construction Cost Summary
Bridge Creek Pipeline/Intake

	Estimates	Project Increase/(Decrease)
30% Estimate (pipeline & Intake)	$26,600,000	
Steel Pipe Bid		($1,700,000)
Design Changes from VE		($2,200,000)
60% Estimate (pipeline & Intake)	$22,700,000	
Design Changes 60% to 90%		$623,000
90% Estimate GMP (pipeline & Intake)	$23,300,000	
HDPE Pipe		($330,000)
HDPE Pipe Installation		($464,000)
Steel Pipe Installation		($3,155,000)
EA/Permits/Survey/Geotech		$562,000
Current Project Estimate (pipeline & intake)	**$20,700,000**	**($5,900,000)**

Link for Central Oregon Land Watch Video on Groundwater:

http://www.youtube.com/watch?v=rQ6gCTQtnDU



Deep Water: Protecting Spring Waters and Native Fish of the Deschutes County

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