Investing in Oklahoma Communities

Quantifying the Social, Economic and Environmental Benefits of Oklahoma's American Recovery and Reinvestment Act Projects

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Table of Contents

I. Project Description 1
II. Project Methodology 1
III. Suggested Uses 2
IV. Detailed Description of Benefits 3
- Impact of Infrastructure Investment on Economic Growth 3
- Increase in Property Values from Enhanced Water Quality 3
- Increase in Property Values from Increased Access to Infrastructure 4
- Reduction in Health Risk from Waterborne Illnesses 5
- Monetary Cost of Waterborne Illnesses Avoided by Infrastructure Investment 5
- Value and Types of Recreation Supported by Clean Water Projects 5
- Energy Cost Savings from Efficiency Upgrades to Infrastructure 5
- Reduction in Greenhouse Gas Emissions as a Result of Facility Design 6
- Phosphorus Reduction (Reduction in Algal Blooms) 6
- Impact of Water Quality and Infrastructure on Quality of Life 7
- Sustainability of Water Infrastructure Facilities 7
- Interest Savings from Using the CWSRF Program 8
- Cost of Delaying Infrastructure Improvements (Construction Inflation) 8

V. OASIS Benefits – Inputs and Output Statements 8
- Impact of Infrastructure Investment on Economic Growth 9
- Increase in Property Values from Enhanced Water Quality 11
- Increase in Property Values from Increased Access to Infrastructure 13
- Reduction in Health Risk from Waterborne Illnesses 15
- Cost of Waterborne Illnesses Avoided by Infrastructure Investment 17
- Value and Types of Recreation Supported by Clean Water Projects 20
- Energy Cost Savings from Efficiency Upgrades to Infrastructure 22
- Reduction in Greenhouse Gas Emissions as a Result of Facility Design 25
- Phosphorus Reduction (Reduction in Algal Blooms) 26
- Impact of Water Quality and Infrastructure on Quality of Life 29
- Sustainability of Water Infrastructure Facilities 33
- Interest Savings from Using the CWSRF Program 35
- Cost of Delaying Infrastructure Improvements (Construction Inflation) 37

VI. Appendices 38
- Appendix A 39
- Appendix B 43
- Appendix C 45
- Appendix D 48
- Appendix E 51
- Appendix F 54
- Appendix G 57
- Appendix H 60
- Appendix I 66
- Appendix J 71

Mock-up of OASIS System — Attachment to PDF report

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I. Project Description

The American Recovery and Reinvestment Act of 2009 (ARRA) provided $31.6 million for Oklahoma water quality projects through the Clean Water State Revolving Fund (CWSRF). As the managing entity for the Oklahoma CWSRF, the Oklahoma Water Resources Board (OWRB) spent a busy year following the passage of ARRA ensuring that every dollar of Recovery Act funds was committed to projects that provided the greatest benefit to the health of Oklahoma's water bodies and to the economic vitality of its communities.

The Clean Water State Revolving Fund has operated successfully in Oklahoma for twenty years, providing more than $620 million in assistance for eligible wastewater infrastructure, nonpoint source and estuary projects. In recent years, OWRB has sought increasingly sophisticated methods – from the CWSRF Benefits Reporting System to the Beneficial Use Monitoring Program and GIS mapping – to capture the environmental and public health benefits of OWRB-funded projects. With the Recovery Act's goal of mitigating the effects of the recession through infrastructure investment, attention turned to the economic and social benefits of the CWSRF program. In addition to their anticipated environmental and public health contribution, the projects funded by ARRA are expected to yield significant direct and indirect economic, social, and "quality of life" benefits as well, through their impact on job creation, aesthetics, recreation, industry, and many other aspects of Oklahoma life. OWRB sought a way to convey the significant contributions of the ARRA investment to community decision makers, state leaders, and the Oklahoma public. This project, a partnership between OWRB, the U.S. Environmental Protection Agency, and Northbridge Environmental Management Consultants, was pursued with the goal of developing a method to quantify the environmental, social, and economic benefits of Oklahoma water infrastructure projects funded by ARRA.

II. Project Methodology

As the first step in the project, Northbridge conducted a wide-reaching literature review to identify studies quantifying the myriad benefits of water infrastructure investment. The purpose of this exercise was to narrow the field of potential benefits measures to those with preexisting research to support them. This initial review yielded a collection of eighteen economic, environmental and social benefits that have exhibited links to water infrastructure investment in prior studies.

The eighteen initial benefits were provided to doctoral students in the University of Oklahoma sociology department for testing at the community level. The students presented the benefits to a variety of community members involved in making water infrastructure decisions in four Oklahoma municipalities and conducted interviews to assess how the community members prioritized and reacted to the eighteen benefits. The students also solicited suggestions for other benefits, not included in the initial suite, that were of interest to community decision makers. Based on this information and in collaboration with OWRB, Northbridge segmented the benefits into two tiers: benefits that were high priority for community members, and benefits that were low priority for community members but high priority for OWRB. The final suite of benefits was as follows:

Tier I Benefits

- Impact of infrastructure investment on economic growth (number of jobs created, increase in household earnings, and increased productivity)
- Increase in property values resulting from enhanced water quality
- Increase in property values resulting from increased access to water infrastructure
- Reduction in health risk from waterborne illnesses as a result of water infrastructure investment
- Monetary cost of waterborne illnesses avoided by water infrastructure investment
- Value of recreation supported by water quality projects
- Types of recreation supported by water quality projects
- Energy cost savings from water and energy efficiency upgrades to water infrastructure facilities
- Reduction in greenhouse gas emissions as a result of water infrastructure facility design
- Phosphorus reduction (reduction in algal blooms) resulting from water infrastructure investment
- Impact of water quality and access to infrastructure on perceived quality of life
- Sustainability of water infrastructure facilities
- Interest rate savings as a result using the CWSRF program
- Cost of delaying infrastructure improvements as a result of construction inflation

Tier II Benefits

- Population served by water infrastructure / reduction in infrastructure needs
- Public valuation of water quality (willingness to pay for infrastructure improvements)
- Cost savings from advanced wastewater treatment (avoidance of additional treatment costs for polluted sources)
- Protection of fish habitat
- Maintaining/improving waterbody beneficial uses

OWRB decided that the remainder of the project would focus on the Tier I benefits, with the Tier II benefits to be pursued at a later date.

As the next step in the project, Northbridge conducted in-depth research and analysis to pinpoint a specific data element that would act as a "multiplier" for each benefit. In conducting this step, we attempted to use Oklahoma-specific data as much as possible. In many cases, this required us to perform original research using Oklahoma data sources. For each benefit, we identified several simple criteria that a community member could select to describe the features of ARRA-funded infrastructure projects, such as the total cost of the project, the population served by the project, the treatment technology utilized, etc. This project information, combined with the multiplier identified for each benefit, generates an output statement describing the specific environmental, social, or economic benefit expected to result from the community's ARRA-funded project. Detailed descriptions of the fourteen Tier I benefits can be found in Section IV of this document. The multipliers and output statements for the Tier I benefits are presented in Section V.

III. Suggested Uses

We anticipate several ways that the multipliers and outputs can be used to convey the benefits of OWRB projects. Due to the broad potential the multipliers and outputs offer for strategic management, outreach, and communications, we will refer to the suite of benefits as the Oklahoma Advantages Assessment and Scoring for Infrastructure Solutions (OASIS) system. Although the data can be used in its current form to generate output statements using a simple Excel worksheet, it would have a much greater impact as a user-friendly computer-based modeling system that community leaders could use to

quickly generate the anticipated benefits of ARRA-funded or planned infrastructure projects. Community leaders can then present these benefits to their citizens or state legislators to show the positive impacts resulting from past or planned infrastructure investments. Such a tool could help communities make well-informed decisions about the types of projects that will best serve their short- and long-term needs and goals, and it will allow state and national legislators to see the benefits of their infrastructure funding contributions. In order to further explore this option, a mock-up of a computer-based OASIS system is included as an attachment to this document.

OWRB managers could use the results from the computer model to enhance public relations efforts and build support for OWRB financing programs at the state and national level. Highlighting the benefits from projects in reports such as OWRB's CWSRF annual report would help convey how OWRB's management of the ARRA funds resulted in exponential benefits at the community level. Reporting the benefits resulting from OWRB-funded projects may also help generate additional interest in the SRF among entities that have not received SRF funds but may have a future interest in the program. In addition, marketing of the SRF program can be enhanced by using fact sheets and case studies about the benefits of particular projects to attract attention from water providers that are considering similar options.

The OASIS benefits could also serve to enhance OWRB's priority ranking system and pre-application priority list questionnaire. Oklahoma's Integrated Priority Ranking System provides a process by which project applications are evaluated and allocated points to determine their priority ranking relative to other projects that apply for funding. The community impact measures could be used to inform future changes to the ranking system by providing greater insight into the potential benefits of different types of projects and their relative importance. For example, as the ARRA Green Project Reserve requirement becomes a more integral part of the SRF program, benefits such as "Greenhouse Gas Emissions Reductions" could inform future changes to the ranking system for green projects.

The OASIS benefits have great potential for enhancing OWRB's CWSRF program, including and beyond the applications described here. Using the OASIS benefits to communicate the anticipated and actual benefits achieved by Oklahoma CWSRF ARRA projects will instill additional public confidence in OWRB's mission and convey the connection between water quality and quality of life.

IV. Detailed Descriptions of Tier I Benefits

Impact of Infrastructure Investment on Economic Growth (Jobs, Earnings and Output)

Investment in infrastructure enhances economic growth by creating jobs in construction and other industries, increasing workers' earnings, and spurring economic activity in many industries. This benefit measures these economic outputs by using regional multipliers specific to Oklahoma that are established by the Bureau of Economic Analysis in the United States Department of Commerce. The economic growth outputs are calculated by inputting the total cost of a wastewater infrastructure project.

Increase in Property Values from Enhanced Water Quality

Researchers have conducted several studies over the years evaluating the correlation between lake water quality and the property values for homes surrounding the waterbody. Many of these studies, including a 2002 study of New Hampshire lakes, a 1996 study of Maine lakes, a 2003 study of Mississippi lakes, and a 1973 EPA study of lakes in California, Oregon, West Virginia and Ohio revealed significant

correlations between water quality and property values.[1] These results have important implications for generating legislative and public support for clean water infrastructure investment.

The OASIS project replicated these studies on two Oklahoma lakes: Lake Hudson and Grand Lake O' the Cherokees. Popular outdoor recreation destinations owned and operated by the Grand River Dam Authority, Lake Hudson and Grand Lake are among the few lakes in Oklahoma where private lakefront development is permitted. As a result, a robust private realty market exists along their shores, making these lakes ideal subjects to test the relationship between water quality and property values. Although most Oklahoma lakes do not have private lakeshore development, it is expected that water quality and clarity will still affect the desirability of lake access and lake view properties, for which there is high demand in Oklahoma. Anecdotes from OWRB staff indicate that the connection between water quality and property values extends as far as retaining ponds in housing developments that trouble homeowners who believe a murky waterbody will impact the marketability of their homes.

As a proxy for water clarity, the Grand Lake and Lake Hudson study used secchi disk depth measurements gathered by the OWRB Beneficial Use Monitoring Program (BUMP) between 2003 and 2007. Water clarity was compared to inflation-adjusted sale prices for homes within one square mile of the lakeshore at the point nearest each BUMP site. The analysis was controlled for other factors likely to affect property values, such as square footage, price per square foot, acreage, and property tax rate. The results of the study indicated that water clarity was significantly correlated with home sales prices at the two lakes, and that an incremental improvement in water clarity was associated with an increase in the price per square foot of nearby homes.

The OASIS "Property Values" benefit requires users to select the receiving waterbody or waterbody impacted by the proposed or completed infrastructure investment. The output statement shows the current water quality rating for the affected waterbody and how the water clarity has improved or declined over time. In addition, the output statement describes the results of the Grand Lake and Lake Hudson study, to demonstrate to users that even a small improvement in water quality can have significant impacts on nearby property values.

Effect on Property Values from Increased Access to Infrastructure

The claim is often made that replacing an onsite septic system with a centralized sewer hookup will increase a home's value. While this claim is difficult to substantiate, it is easier to acknowledge that a failing onsite septic system will decrease a home's value and reduce its marketability. Conversations with several Oklahoma home appraisers confirmed that a home with a failing septic tank would be forced to replace the system prior to selling (at a cost estimated by the Oklahoma Department of Environmental Quality to be between $2,650 and $11,850), or to reduce the home's sale price by the same amount. Consequently, it is expected that a new wastewater treatment plant or decentralized system can preserve home values by $2,650 to $11,850 for every failing septic system replaced or avoided. For these types of projects, this Benefit will estimate the total preserved home value based on the number of new connections served by the project.

[1] Gibbs, Julie, John Halstead, Kevin Boyle and Ju-Chin Huang. A Hedonic Analysis of the Effects of Lake Water Clarity on New Hampshire Lakefront Properties. *Agricultural and Resource Economics Review* 31/1 (April 2002). Krysel, Charles, Elizabeth Marsh Boyer, Charles Parson and Patrick Welle. Lakeshore Property Values and Water Quality: Evidence from Property Sales in the Mississippi Headwaters Region. Mississippi Headwaters Board (June 2003). Michael, Holly, Kevin Boyle and Roy Bouchard. Water Quality Affects Property Prices: A Case Study of Selected Maine Lakes. University of Maine (February 1996). Dornbusch, David and Stephen Barrager. Benefits of Water Pollution Control on Property Values. EPA Office of Research and Development (October 1973).

Reduction in Health Risk from Waterborne Illnesses as a Result of Infrastructure Investment

Oklahoma communities have expressed interest and concern about how wastewater treatment facilities and the technologies that they employ affect health risks that are associated with waterborne illnesses, particularly from human exposures to pathogens such as Giardia, E. Coli, Cryptosporidium and toxins generated from algae found in recreational lakes. The most common symptoms of a Giardiasis infection include chronic diarrhea, abdominal cramps, and general malaise. It is considered to be one of the most commonly identified waterborne intestinal diseases in the United States. Giardiasis displays an inherent resistance to disinfectants commonly used in wastewater treatment processes, so establishing an advanced treatment approach is suggested for maximum efficacy. Symptoms of an E.coli bacterial infection include urinary tract infections, gastrointestinal infections, and diarrhea. More virulent strains of the bacteria have been known to cause neo-natal meningitis and can be life-threatening to infants and small children. Cryptosporidium is a protozoan pathogen, or parasite, that attacks the lower intestine and infection is caused through the ingestion of contaminated soil, water, uncooked or contaminated foods that have been in contact with fecal bacteria. The symptoms of infection include diarrhea, nausea, vomiting, and dehydration lasting between two weeks to one month.

This benefit examines how different treatment technologies selected by a wastewater treatment facility may reduce the risk of waterborne illnesses by showing the effectiveness of the technology to remove these pathogens from effluent. The benefit uses several approaches to measure correlations between the percentage of removal of contaminants of concern by the treatment technology employed by a community wastewater treatment facility and the incidence of waterborne illnesses.

Monetary Cost of Waterborne Illnesses Avoided by Water Infrastructure Investment

Exposure to recreational waters contaminated with viruses, bacteria, and protozoa from human waste can result in multiple illnesses including gastroenteritis, acute respiratory disease, and eye, ear, and skin infections. Many of these illnesses are not serious conditions, but the public health costs related to medical costs and loss of worker productivity are significant. This benefit estimates these costs by using the mean annual salary for Oklahoma and average medical costs of physician visits to estimate the public health costs per illness.

More serious illnesses like E. coli, Crysptosporidiosis, and Giardiasis can also result with much greater public health costs. To demonstrate these more serious costs, this benefit includes reference to case studies examining the public health costs incurred from serious outbreaks in other communities.

Value and Types of Recreation Supported by Water Quality Projects

With more man-made lakes than any other state, Oklahoma's water resources are an important part of the state's outdoor recreation tradition. The Army Corps of Engineers, which owns and operates 75% of the public water recreation acreage in the state, estimated that recreational visitors to Oklahoma lakes generated $330 million in sales in 2006. This benefit specifies the estimated recreational use associated with the planned or constructed water quality project including annual number of visitors, sales generated, personal income generated, number of jobs supported, and the number of picnickers, boaters, fishermen, water skiers, swimmers and sightseers that visit the impacted recreational area each year. Quantifying the economic and social contribution that water recreation areas make to Oklahoma communities can help generate support for the infrastructure investments necessary to protect these resources.

Energy Cost Savings from Efficiency Upgrades to Infrastructure

Communities, local and state governments, as well as wastewater engineers and operators are all interested in energy efficient strategies that will also save money in the long run. The relationship between water and energy is based on the fact that the treating and transport of water is an extremely energy intensive endeavor. In any municipal budget, wastewater treatment operations account for a significant chunk of the monthly energy demand to the tune of 35 percent of municipal energy use. Water and wastewater investment decisions that fail to include energy efficiency in their design and planning have a tendency to increase demands on other sectors like power plants, the extraction and transportation of additional fuel oils, and dwindling water and hydrocarbon reserves. Energy efficiency programs integrated into capital improvement planning can provide substantial value to both municipal water and wastewater utilities and their customers by lowering energy costs, reducing the need for chemical additives in treatment processes, reducing levels of greenhouse gas emissions, and ensuring communities will be served by infrastructure systems with long-term viability.

This "Energy Efficiency" benefit examines how the various components and unit treatment processes of a wastewater treatment system contribute to the overall energy demand of the facility as a whole, what steps can be taken to help mitigate and reduce energy use, and strategies that utility managers can employ to help save money on energy expenses. Specifically, this benefit examines the efficiency ratings and annual operating costs for pumps and motors, blowers, and aeration; the energy consumption and Seasonal Energy Efficiency Ratio (SEER) ratings of HVAC units; the type and depth of bubble diffusers; and the wattage, hours of operation, and type of lighting of the treatment facility, administrative offices, and lift stations. These have been identified as the largest energy consuming components of typical wastewater treatment facilities, offering the best opportunities for efficiency improvement.

Within OASIS, this benefit uses several calculations based on component efficiency ratings and actual energy usage to determine the percentage of energy and estimated dollars saved annually from project improvements. Beyond empirical data associated with energy and cost savings, this benefit also provides suggestions and alternatives that offer additional opportunities to reduce energy demand and cut associated costs. This not only allows communities to quantify the energy efficient benefits of a specific project, but also may help communities plan and design future capital improvement projects to maximize savings.

<u>Greenhouse Gas Emissions Reduction as a Result of Water Infrastructure Facility Design</u>
Carbon dioxide, a greenhouse gas emission that contributes to climate change, is produced by the burning of fossil fuels that provide electrical power for many wastewater treatment facilities. Use of renewable energy sources reduce the emissions associated with this electricity. This benefit calculates the carbon dioxide emissions that are avoided with energy efficiency upgrades by using an estimate of the average emissions rate per kWh of electricity production in Oklahoma as a multiplier. The total amount of carbon dioxide emissions avoided can be determined by inputting the number of kilowatt hours of electricity that are saved per year with planned energy efficiency upgrades.

<u>Phosphorus Reduction from Water Infrastructure Investment</u>
Oklahoma communities have expressed growing concern regarding the number and severity of algae blooms in recreational lakes throughout the state. Concentrations of specific nutrients such as nitrogen and phosphorus can contribute significantly to the trophic state of surface water bodies, especially lakes. The trophic state is a measurement that indicates the nutrient richness, or productivity, of a lake and there are three general trophic classifications: oligotrophic, mesotrophic, and eutrophic. Oligotrophic lakes have excellent water clarity, very little biomass or algae blooms, are oxygen rich and

considered safe for human contact, swimming, fishing and recreation. These lakes are also suitable as a drinking water supply source. Oligotrophic lakes are seldom located in populated or agricultural areas as too many people, heavy use, and run-off from the nutrient rich soils of farms and ranches shift them out of this category. Lakes that are classified as mesotrophic are moderately clear, but have decreased oxygen levels and higher incidence of algae blooms during the summer months and are generally considered safe for swimming, fishing and recreation. Mesotrophic lakes bear a moderate risk of producing more algal biomass associated with increased nutrient loads from wastewater effluent or agricultural run-off. The last trophic classification is eutrophic, which indicates a lake that has murky waters, visible algae and scum, foul odors, incidence of fish kills and is not considered safe for human contact, fishing, swimming, or recreation.

There are a number of variables that may contribute to the trophic state of lakes in Oklahoma that include both point source and nonpoint sources. Because it is not feasible to isolate and measure the amount of phosphorus loads associated with nonpoint sources, this benefit seeks to isolate and identify how wastewater treatment system technologies might contribute to the trophic state of Oklahoma lakes and how they might actually improve surface water quality. By examining the historical total phosphorus, or TP, levels of a treated wastewater effluent from a particular treatment facility, identifying the water body into which the treated effluent is discharged, and analyzing the proposed method of treatment technology that will be implemented at the facility, the amount of phosphorus reduction can be calculated. This calculation will enable communities to measure whether or not the proposed wastewater treatment project will improve the water quality of Oklahoma's lakes by effectively removing nutrients like phosphorus from discharge effluent.

Impact of Water Quality and Access to Infrastructure on Perceived Quality of Life

Many high-profile quality of life indices, including The Economist's annual liveability survey, recognize quality of water infrastructure as an important aspect of human well-being. Although it is easy to grasp how a lack of sufficient water infrastructure can impact quality of life, it is more difficult to quantify how improvements to a functioning infrastructure system can impact community liveability. However, infrastructure planning can significantly influence where and how businesses, service providers, residential areas, transportation corridors and recreational resources are located and used, which in turn can significantly affect the quality of life for people in the community.

This benefit utilizes a list of decisions to be considered during planning, design, construction and operation of the five major types of water quality projects (wastewater treatment plant expansion, replacement or repair of existing infrastructure, stormwater mitigation, decentralized treatment, and nonpoint source projects). Based on smart growth concepts, the list includes practices that make sustainable design, community involvement, local sourcing, and protection of natural and recreational resources integral considerations in the water quality project. Reviewing the list in the OASIS system and considering which ones could apply to the completed or planned project will help city planners and decision makers determine whether their current infrastructure plans will help enhance the quality of life in the target community.

Sustainability of Water Infrastructure Facilities

As demands on water resources and aging wastewater infrastructure continue to rise, communities face increasing challenges to improve water and energy efficiencies and control costs. Success in meeting these challenges and ensuring the long-term viability of wastewater treatment systems requires the implementation of strategies that are practical and sometimes innovative. The American Recovery and Reinvestment Act of 2009 included the Green Project Reserve, which required all state CWSRF programs

to allocate at least 20 percent of their total capitalization grant towards wastewater infrastructure projects that included energy and water efficiency improvements, green infrastructure, and environmentally innovations. The Green Project Reserve will continue in the 2010 funding cycle for the CWSRF base program with the same requirements remaining.

This benefit is designed to assist Oklahoma communities seeking to meet the water and energy challenges of the future in the most sustainable manner possible by offering management and design strategies, as well as innovative technologies and approaches that will promote liveable communities and help wastewater treatment facilities conserve water, reduce energy demand, minimize greenhouse gas emissions and the impacts of climate change.

This benefit provides a thorough and detailed examination of all stages and elements of a wastewater infrastructure project from site selection, design, planning, construction practices, materials and equipment, and best management practices to assist communities in determining whether or not the project may be categorized as sustainable and what measures may be taken to augment these characteristics. In addition, this benefit may also be used as a tool when planning new capital improvement projects by offering ideas and suggestions that will help communities and engineers design sustainable wastewater treatment facilities and systems in the future.

Interest Rate Savings as a Result of Using the CWSRF Program

The CWSRF program provides substantial savings to communities, not only through below-market interest rates, but also by allowing communities to avoid the extra costs associated with market financing such as bond counsel fees and underwriter fees. This benefit, based on EPA's Financial Alternatives Comparison Tool, allows a user to see how the cost to finance a planned project with the CWSRF program compares to the cost of using other financing sources. The user enters basic information about the project and financing, such as interest rate, repayment period, construction costs, legal costs, financing costs, and other recurring costs, and OASIS will generate a detailed comparison of CWSRF financing costs and up to three other funding sources.

Inflationary Cost of Delaying Infrastructure Improvements

For much of the past decade, prices for heavy construction materials have far outpaced the Consumer Price Index, meaning that the cost to construct an infrastructure project can increase drastically over the course of a few years. This benefit uses average inflation trends for several categories of water quality projects to estimate how much the costs for a planned project will increase over the next one to five years. This benefit highlights the opportunity cost of waiting to invest in infrastructure, providing a case for communities to address infrastructure needs sooner rather than later.

V. OASIS Benefits – Inputs and Output Statements

The following pages contain the multipliers for each of the fourteen benefits as well as examples of the output statements that will be generated when a user inputs information about the completed or planned infrastructure project.

Data

- ***Economic Output***
  - X * 2.37 = EO
    - The Bureau of Economic Analysis estimates that for each additional dollar of revenue of the construction industry in Oklahoma, the increase in revenue that occurs in all industries in Oklahoma is $2.37 in that year.
    - X is the cost of the proposed project
    - Y is the total economic output generated by the project
- ***Household Earnings***
  - X * .7579 = HE
    - BEA estimates that for each additional dollar of construction work performed in Oklahoma, there is a .7579 increase in earnings of households employed by all industries in Oklahoma.
    - X is the cost of the proposed project.
    - HE is the increase in household earnings resulting from the project.
- ***Employment (Jobs)***
  - Total Jobs
    - X * .000024739 = TJ
      - BEA estimates that $1 million invested in construction creates 24.739 jobs.
        - For each construction job in Oklahoma created by the project, 2 jobs are created in all industries in Oklahoma.
      - X is the cost of the proposed project.
      - TJ is the total number of jobs created as a result of the project.
  - Construction Jobs
    - X * .0000118759 = CJ
      - BEA estimates that $1 million invested in construction creates 11.8759 construction jobs in OK.
      - X is the cost of the proposed project.
      - CJ is the number of jobs created in the construction industry as a result of the project.
  - Other Industries
    - Although the project will not create as many jobs in other industries as it does in the construction industry, BEA data indicates that many jobs will also be other industries including manufacturing; professional, scientific, and technical services; retail; finance and insurance; and transportation and warehousing.

OASIS Interface

- ***Input***:
  - Users will input the total cost of the project (preferably in 2006 dollars).
- ***Output***:
  - "This project will enhance economic growth by creating jobs, increasing household earnings, and enhancing economic productivity in Oklahoma."
  - "Jobs. Based on RIMS II regional multipliers established by the Bureau of Economic Analysis (BEA), this project will create an estimated *[TJ]* jobs in Oklahoma communities. Of this total, *[CJ]* construction jobs are estimated. For each initial construction job created by the project, two jobs are created in all industries in Oklahoma including manufacturing; professional, scientific, and technical services; retail; finance and insurance; and transportation and warehousing, among others."

- "Household Earnings. Based on BEA data, this project will increase household earnings in Oklahoma communities by *[HE]*."
- "Economic Productivity. Based on BEA data, this project will increase economic output in Oklahoma communities by *[EO]*."

Notes

- Because the multipliers are based on 2006 data, the input (cost of project) should be in 2006 dollars.
- 2008 OK GDP = $146.4 billion (real GDP in nominal dollars)
  - 11% is manufacturing
  - 4% is construction

Sources

Bureau of Economic Analysis, U.S. Department of Commerce. 2010. *Regional Input-Output Multipliers for Oklahoma (Type II)*.

Bureau of Economic Analysis, U.S. Department of Commerce. 2009. "GDP by State."

Bureau of Economic Analysis, U.S. Department of Commerce. 1997. *Regional Multipliers: A User Handbook for the Regional Input-Output Modeling System*. Available at: http://www.bea.gov/scb/pdf/regional/perinc/meth/rims2.pdf.

Increase in Property Values from Enhanced Water Quality

Data

- A 0.4 – 1.1 centimeter improvement in water clarity (as measured by secchi disk depth) is associated with a $1.00 increase in the price per square foot for homes surrounding the waterbody
- Range is based on a regression analysis of property sales between 2003 and 2007 in the township sections (one square mile area) bordering Grand Lake O' the Cherokees and Lake Hudson, Oklahoma. Sale prices (adjusted to 2009 dollars) were compared to the secchi disk depth measurement (water clarity measure) at the BUMP site nearest to the property in the corresponding year. The analysis included the control variables of square footage, price per square foot, acreage, and property tax rate, and a dummy variable of lake (Grand or Hudson).
- Key results of the analysis:
    - Secchi disk depth is correlated with the price per square foot, and property tax rate at a 99% confidence level.
    - Combined, the variables square footage, lake, price per square foot, tax rate, and secchi disk depth account for 80% of the variation in home sale price.
    - Secchi disk depth contributes to the variation in home sale price at a 94% confidence level, which is statistically significant. The analysis indicates that secchi disk depth is the third most important variable contributing to the variation in sale price, after square footage and price per square foot.
    - Secchi disk depth contributes to the variation in price per square foot at a 99% confidence level, which is statistically significant. The analysis indicates that for every 0.4 to 1.1 centimeter increase in secchi disk depth, the price per square foot will increase by $1.00.

OASIS Interface

Input

- The user will select the waterbody impacted by the project from a drop-down list containing the 131 lakes monitored by the BUMP program
- User will indicate whether the project contributes to water quality improvement, maintenance, or N/A
- OASIS is pre-populated with the BUMP water quality rating for each lake (Poor/Fair/Average/Good/Excellent), and the average range of secchi disk measurements for that lake over the period that BUMP monitoring has taken place.

Output

- OASIS will produce a narrative output that provides information on the water clarity at the affected waterbody, with changes in clarity over time to provide context. The narrative will cite the results of the regression analysis to show users that even a small improvement in water quality can impact property values. Example:
- "This project contributes to water quality **Improvement** at the **Arcadia** waterbody. Water clarity at **Arcadia** is currently rated as **Average** on a scale of Poor-Fair-Average-Good-Excellent. The water clarity at **Arcadia** improved from **52 to 67**centimeters between **2000-2007**. A recent study of two Oklahoma lakes indicated that water clarity is significantly correlated with property values for homes near the lakes. According to the

study, even a very small 0.4 to 1.1 centimeter improvement in water clarity is associated with $1.00 increase in the price per square foot of homes surrounding the lakes*."

*2003-2007 homes sales in one square mile areas bordering Grand Lake O' the Cherokees and Lake Hudson, Oklahoma. Water clarity measured by secchi disk depth.

Notes

- See Appendix A for the full OASIS input-output matrix
- If the waterbody impacted by the project is not included in the list of 131 BUMP waterbodies, the Output statement will just cite the results of the regression study, rather than providing specific information about the waterbody.

Sources

- Gibbs, Julie P., John M. Halstead, Kevin J. Boyle and Ju-Chin Huang. A Hedonic Analysis of the Effects of Lake Water Clarity on New Hampshire Lakefront Properties. *Agricultural and Resource Economics Review* 31/1 (April 2002): 39-46.
- http://oklahoma.usassessor.com retrieved January 8, 2010 and January 25, 2010.
- Oklahoma Water Resources Board Beneficial Use Monitoring Program (BUMP) data provided by Julie Chambers, OWRB.
- Tax rates provided by county assessors' offices in Mayes, Delaware and Ottawa counties.

Effect on Property Values from Access to Infrastructure

Data

- The cost to replace a failing septic system in Oklahoma is between $2,650 and $11,850, according to the Oklahoma Department of Environmental Quality

OASIS Interface

Input

- User inputs the number of new connections served by the project, and the county served by the project

Output

- The output is a narrative explaining that a failing septic tank will likely reduce a home's value, and estimating the value added by new connections, assuming they are replacing septic systems. Example:
- "A failing onsite sewage treatment (septic) system can reduce a home's value from between $2,650 and $11,850, based on the Oklahoma Department of Environmental Quality's estimates of the five-year installation and maintenance cost to replace a septic system. By replacing failing septic systems with new connections, this project can potentially preserve [# of new connections]*[$2,650 - $11,850] in [County] home values".

Notes

- Property tax rates were collected for all Oklahoma counties and can be multiplied by the increase in home values to generate an estimated increase in location property tax revenues, if desired. See Appendix B.

Sources

- Oklahoma Department of Environmental Quality. Subsurface Sewage Treatment Systems: It's Your On-Site System. Retrieved from http://www.deq.state.ok.us/eclsnew/septic.htm
- Property tax rates retrieved from http://oklahoma.usassessor.com/

Data

- Trophic state of lakes receiving treated effluent discharge using the TSI equation
  9.81 x Ln(Chl-a) + 30.6
  - Equation will generate a score that indicates whether or not illness from exposures to toxins generated from cyanobacteria (blue-green algae) are of concern. (See Appendix A)
- Wastewater treatment options and associated Log Reduction Values
  LRV = log10(contaminant concentration in/contaminant concentration out)
  - LRV developed as a way to express levels of decreased biological contamination in water by factors of 10 that can easily be converted to a percent reduction
    - LRV 1 = 90% reduction
    - LRV 2 = 99% reduction
    - LRV 3 = 99.9% reduction
    - LRV 4 = 99.99% reduction
    - LRV 5 = 100% reduction
  - Pre-treatment – trickling filters (LRV 2)
  - Disinfection
    - Chlorine-based (LRV 1)
    - UV disinfection (LRV 4)
    - Ozone disinfection (LRV 3)
  - Enhanced filtration
    - Membrane ultrafiltration (LRV 5)
    - Flocculation & Sedimentation (LRV 2.6)

OASIS Interface

Input

- Community profile information. This will include the population served along with the county where the community/facility is located, and discharge to surface waters
- LRV data
  - Influent concentrations of E.Coli, Cryptosporidium, Giardia
  - Effluent concentrations of E.Coli, Cryptosporidium, Giardia
  - Communities will select proposed configuration of treatment technology at their facility
    - LRV will be automatically generated using the equation
      log10(C-in/C-out)
- Selection of treatment technology in use or anticipated at WWTF

Output

- "Your treatment facility discharges treated effluent into X Lake. This lake is currently classified as [oligotrophic/mesotrophic/eutrophic], which indicates there is a [low/ moderate/high risk of producing algal blooms from the introduction of effluent with elevated levels of phosporous. Blue-green algae can produce toxins that target the nervous system, brain and the liver in humans. You should consider nutrient removal technology to ensure that effluent does not increase the trophic state of this water body."

- "Your facility produces effluent with a "X"% removal of E.Coli bacteria. It is recommended that discharging facilities input technologies that enable them to achieve a 99.99% removal rate to reduce human exposures to bacteria pathogens in surface water bodies."
- "Your facility produces effluent with a "X"% removal of Giardia. It is recommended that discharging facilities input technologies that enable them to achieve a 99.99% removal rate to reduce human exposures to bacteria pathogens in surface water bodies."
- "Your facility produces effluent with "X"% removal of Cryptosporidium. It is recommended that discharging facilities input technologies that enable them to achieve a 99.99% removal rate to reduce human exposures to bacteria pathogens in surface water bodies.

Notes

- See Appendix C for the full input-output matrix
- There is no known national record-keeping system of how many human illnesses are caused by sewage spills from CSOs, WWTF effluent, etc.
    - Vast majority of sewage spills results from CSOs during precipitation events.
- Generally acceptable rate of exposure risk as prescribed by the EPA is between 1e-6 and 1e-4.
- Equation for estimating exposure to contaminated surface water during recreational activities is as follows:

$$INGr = \frac{(CW \times CR \times ABS \times ET \times EF \times ED)}{(BW \times AT)}$$

Where:

INGr	=	ingestion intake, adjusted for absorption (mg/kg-day)
CW	=	contaminant concentration in water (mg/L)
CR	=	contact rate (liters/hour)
ABS	=	bioavailability/gastrointestinal absorption rate factor (%)
ET	=	exposure time (hours/event)
ED	=	exposure duration (years)
BW	=	body weight (kg)
AT	=	averaging time (period over which exposure is averaged – days)

- We cannot isolate source of where contaminants were generated. Other contributing factors like agricultural run-off, wildlife, even human-caused contamination at recreational areas will contribute to concentration levels in surface water bodies.
- We cannot link all incidents of exposure per county to contact made with surface water bodies. Exposure could also occur at swimming pools, in restaurants, food purchased from grocery stores.
- Measuring LRV represents average values of efficacy associated with various treatment technologies. This is our most likely method quantifying a relationship between WWTF activities and incidents of waterborne illness.
    - It is not feasible to have an output that states the number of incidents of waterborne illnesses that were prevented by upkeep of the system. This cannot successfully be measured.
    - Output can measure the percent efficacy of a WWTF selected technology and state that "X technology will ensure a 99.9% effectiveness rate for removing Y bacteria from treated effluent discharged into Lake Z."
    - Want to see systems with an LRV of 4 or better
- WWTF staff (working on compliance) should know the pathogen concentrations of the influent and/or effluent to plug into this equation.

- Research has shown that effluent quality for protozoan bacteria (cryptosporidium and giardia cysts) has proven to be statistically significantly different.

Sources

Asante-Duah, K. (2002). Public Health Risk Assessment for Human Exposure to Chemicals. Kluwer Academic Publishers, Dordricht, The Netherlands.

Bennett, A., (2009). Pathogen Removal from Water – Technologies and Techniques. Available at http://www.filtsep.com/view/829/pathogen-removal-from-water-technologies-and-techniques/.

Cesar, Dana T., Ph.D. (2009). The Role of Blue-Green Algal Toxins in the Development of Alzheimer's, ALS-PDC, and Cancers in Oklahoma. Available at www.ncf-net.org/pdf/**BlueGreenAlgal**Toxins.pdf.

Lonigro, A. et al, (2006). Giardia Cysts and Cryptosporidium Oocysts in Membrane-Filtered Municipal Wastewater Used for Irrigation. Applied Environmental Microbiology 72(12): 7916-7918. Available at http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1694212/.

Oklahoma State Department of Health (2008). Annual Summary of Infection Diseases. Available at http://www.ok.gov/health/Disease,_Prevention,_Preparedness/Acute_Disease_Service/Publications_and_Statistics/2008_Annual_Summary.html.

Rose, Joan B., PhD., et al (2004). Reduction of Pathogens, Indicator Bacteria, and Alternative Indicators by Wastewater Treatment and Reclamation Processes. Water Environment Research Foundation publication No. 00-PUM-2T.

U.S. EPA, (2007). Ultraviolet Disinfection Systems for Secondary Wastewater Effluent and Water Reuse. ETV Water Quality Protection Center, EPA/600/S-07/015. Available at http://www.epa.gov/nrmrl/std/etv/pubs/600s07015.pdf.

Cost of Waterborne Illnesses Avoided by Water Infrastructure Investment

Data

- The cost per gastrointestinal illness is $43.55; the cost per acute respiratory disease is $91.20; the cost per ear infection is $45.67; and the cost per eye infection is $32.19 (see table 1 below).
- These costs are conservative estimates and do not take into account more severe illnesses that result in hospitalizations, extended sickness, and infrequent death. For example, it is estimated that a 1993 waterborne *Cryptosporidium* outbreak in Milwaukee, WI resulted in costs per illness of $239. Another estimate of costs incurred from a giardiasis outbreak in Pennsylvania in 1983-1984 concluded that the average cost per giardiasis illness was $2,860.

OASIS Interface

- ***Input***:
  - No additional user input is necessary for this benefit. Instead, the output can be tacked onto the output for Reduction of Waterborne Illnesses.
- ***Output***:
  - "Exposure to recreational waters contaminated with viruses, bacteria, and protozoa from human waste can result in multiple illnesses including gastroenteritis, acute respiratory disease, and eye, ear, and skin infections. The public health costs are significant in Oklahoma communities. Using estimates of mean annual salary for Oklahoma and average medical costs of physician visits, the estimated costs per illness are as follows: $43.55 for each gastrointestinal illness, $91.20 for each acute respiratory disease, $45.67 for each ear infection, and $32.19 for each eye infection. These costs can result in a substantial public health burden when exposures to polluted water result in thousands of illnesses every year."
  - "These costs are conservative estimates and do not take into account significant costs such as those associated with purchases of over-the-counter medications or hospitalizations, extended sickness, and infrequent death. Severe illnesses such as *Cryptosporidiosis* and *Giardiasis* can cause substantial public health burdens associated with these additional costs. For example, it is estimated that a 1993 waterborne *Cryptosporidium* outbreak in Milwaukee, WI resulted in costs per illness of $239. Another estimated the public health costs from a *Giardiasis* outbreak in Pennsylvania in 1983-1984 to be $2,860 per giardiasis illness."
  - "Wastewater treatment improvements help to prevent these illnesses and thereby reduce public health costs associated with them."

Notes

- On average, ill persons incurred approximately $79 ($117 in 2009 dollars) in medical costs and $160 ($238 in 2009 dollars) in productivity losses in the 1993 waterborne Cryptosporidium outbreak in Milwaukee, WI. Total cost of the outbreak (403,000 estimated illnesses) was $96.2 million ($142.8 million in 2009 dollars).
  - Medical costs included costs for impatient and outpatient health services, ambulance transport, and medication.
  - Productivity losses included time lost by infected persons due to illness and time lost by caregivers or family members.
  - Does not include litigation costs, costs of preventive measures, intangible costs associated with pain and suffering, or the costs to federal, state, and local government to investigate and control the outbreak.

- Range: $116 ($172 in 2009 dollars) average for mild case; $475 ($705 in 2009 dollars) average for moderate case; and $7,808 ($11,592 in 2009 dollars) average for severe case.
- Average cost per illness was $239 ($355 in 2009 dollars).

Table 1. Public health cost from waterborne illness in Oklahoma (2010 dollars)*

Item	Type of Illness				Location-Specific
	GI[a]	ARD[b]	Ear	Eye	OK Estimates
Proportion of those ill who experience lost days per illness[c]					
1 day	0.093	0.074	0.023	0.042	
2 days	0.04	0.148	0.023	0.083	
3 days	0.014	0.037	0.023	0	
Total lost days	0.215	0.481	0.138	0.208	
Effective daily income[d]					$102.12
Fringe benefits[e]					$25.53
Income + fringe					$127.65
Lost income + fringe per illness	$27.44	$61.40	$17.62	$26.55	
Proportion of medical visit per illness[f]	0.12	0.222	0.209	0.042	
Medical cost per visit[g]					$134.25
Medical cost per illness	$16.11	$29.80	$28.06	$5.64	
Total cost per illness	$43.55	$91.20	$45.67	$32.19	

*Adapted from Dwight et al., 2005.
[a] Gastrointestinal illness
[b] Acute respiratory disease
[c] from Fleisher et al., 1998.
[d] 2010 average annual income for OK (OESC, 2010)
[e] 25% of average annual income (adaptation from Corso et al., 2003)
[f] from Fleisher et al., 1998.
[g] average cost of physician visit (from Nichol, 2001) adjusted for inflation

- Table 1 assumptions:
  - It does not include direct non-medical costs, personal out-of-pocket expenses associated with having a prescription filled after a doctor visit, costs of self-medication, intangible costs of impaired quality of life, or costs associated with rare and severe illnesses that can have very high associated health costs, including mortality costs in addition to morbidity costs.
  - There are a range of proportions that have been reported for days of lost work from being ill and the proportion of ill people who seek physician assistance. Proportions used are conservative.
  - While some people receive paid sick-leave, compensating them for time they must take off from work, use of sick-leave is equivalent to a lost opportunity cost because it cannot be used at a later date. And, if a sick person receives sick-leave, the economic burden is merely shifted to the employer who pays for a day of non-productivity.
  - Fleisher et al., 1998 relies on data for exposure to domestic sewage.

Sources

J.M. Fleisher, D. Kay, M.D. Wyer, and A.F. Godfree. 1998. "Estimates of the severity of illnesses associated with bathing in marine recreational waters contaminated with domestic sewage." *International Journal of Epidemiology*. 27:722-726.

K. Nichol. 2001. "Cost benefit analysis of a strategy to vaccinate healthy working adults against influenza." *Archives of Internal Medicine*. 161(5):749-759.

Oklahoma Employment Security Commission. 2010. *Important Numbers for the Year 2010 – Average Annual Wage*. Available at: http://www.ok.gov/oesc_web/Services/Unemployment_Insurance/Taxable_Wage_Base_and_Rates.html.

Phaedra S. Corso, Michael H. Kramer, Kathleen A. Blair, David G. Addiss, Jeffrey P. Davis, and Anne C. Haddix. April 2003. "Cost of Illness in the 1993 Waterborne *Cryptosporidium* Outbreak, Milwaukee, Wisconsin." *Emerging Infectious Diseases*. 9(4):426-431.

Ryan H. Dwight, Linda M. Fernandez, Dean B. Baker, Jan C. Semenza, and Betty H. Olson. 2005. "Estimating the economic burden from illnesses associated with coastal water pollution: a case study in Orange County, California." 76(2):95-103.

Ronnie Levin and Winston Harrington. 1994. "Infectious waterborne disease and disinfection byproducts in the US: costs of disease." International Association of Hydrological Sciences publ. no. 233.

Data

- The Army Corps of Engineers maintains the following data for the year 2006 for thirty of Oklahoma's largest lakes, which account for 75% of the recreational water acreage in the state:
    - Number of Visitors (Annual)
    - Sales Generated ($mil)
    - Personal Income Generated ($mil)
    - Jobs Supported
    - Picnickers (Annual)
    - Swimmers (Annual)
    - Water Skiiers (Annual)
    - Boaters (Annual)
    - Sightseers (Annual)
    - Fishermen (Annual)
- Using a model developed by the Army Corps and visitor attendance data, we were able to populate the same data categories for Grand Lake O' the Cherokees and Lake Hudson, which comprise an additional 14% of Oklahoma's recreational water acreage.
- For the other 100 lakes monitored by the OWRB BUMP program, we estimated the recreational data by averaging known data for the 3-4 lakes closest in size and location to the unknown lake.

OASIS Interface

Input

- The user selects the waterbody impacted by the project from a drop-down list of 132 Oklahoma lakes, or selects "Other"
- OASIS is pre-populated with the data elements listed above for each of the 132 lakes

Output

- OASIS generates a narrative statement of the recreational benefits provided by the waterbody impacted by the project. There are five different versions of the output narrative, depending on whether data for the particular lake is exact, modeled, estimated, or unknown. Examples:
- Output statement for Lake Eufaula (data tracked/modeled by Army Corps): "In a recent year, the waterbody benefitting from this project **Lake Eufaula** received **2,439,782** recreational visitors, including **176,640** picnickers, **745,353** swimmers, **190,547** water skiers, **362,064** boaters, **664,841** sightseers, and **888,813** fishermen. Visitors to this waterbody generated **$61.35** million dollars in sales within 30 miles of the waterbody on motels, hotels, B&Bs, restaurants, groceries and take-out food, gas, auto and boat expenses, entertainment and recreation, sporting goods, souvenirs, and other services and merchandise. These sales resulted in **$24.58** million in personal income generated in the community, in the form of wages and salaries, payroll benefits, profits and rents and indirect business taxes. The sales generated by visitors to the waterbody also supported **767** jobs in the local community surrounding the waterbody."

- Output statement for Foss Lake (data estimated based on similar lakes): "In a recent year, Oklahoma waterbodies similar in size and location to the waterbody benefitting from this project **Foss Lake** received an average of **318,749** recreational visitors, including **19,845** picnickers, **3,318** swimmers, **170** water skiers, **1,682** boaters, **57,808** sightseers, and **44,999** fishermen. Visitors to these waterbodies generated an average of **$4.81** million dollars in sales within 30 miles of the waterbody on motels, hotels, B&Bs, restaurants, groceries and take-out food, gas, auto and boat expenses, entertainment and recreation, sporting goods, souvenirs, and other services and merchandise. These sales resulted in **$1.87** million in personal income generated in the community on average, in the form of wages and salaries, payroll benefits, profits and rents and indirect business taxes. The sales generated by visitors to the waterbody also supported an average of **89** jobs in the local community surrounding the waterbody."
- Output statement generated if the user selects "Other": "In a recent year, Oklahoma waterbodies received more than **16,302,330** recreational visitors, including **1,303,897** picnickers, **2,431,753** swimmers, **811,830** water skiers, **1,727,219** boaters, **5,865,931** sightseers, and **5,417,846** fishermen. Visitors to these waterbodies generated over **$330** million dollars in sales within 30 miles of the waterbody on motels, hotels, B&Bs, restaurants, groceries and take-out food, gas, auto and boat expenses, entertainment and recreation, sporting goods, souvenirs, and other services and merchandise. These sales resulted in more than **$154** million in personal income generated in the community, in the form of wages and salaries, payroll benefits, profits and rents and indirect business taxes. The sales generated by visitors to the waterbody also supported at least **4,672** jobs in the local community surrounding the waterbody. By benefitting an Oklahoma waterbody, this project will help protect the water resources enjoyed by the citizens of Oklahoma."

Notes

- See Appendix D for a complete list of OASIS inputs and outputs for all 132 lakes
- Attendance breakdown between picnickers, swimmers, water skiers, boaters, sightseers, and fishermen is not available for all lakes

Sources

- U.S Army Corps of Engineers (Value to the Nation). 2006 Data. Retrieved from http://www.vtn.iwr.usace.army.mil/recreation/state.asp?state=OK
- U.S Army Corps of Engineers Natural Resources Management Gateway. Recreation Economic Assessment System (REAS). Retrieved from http://corpslakes.usace.army.mil/employees/economic/reas.cfm
- Grand River Dam Authority FERC Form 80 for the year ending 2002. Federal Energy Regulatory Commission. Retrieved from http://www.ferc.gov/docs-filing/elibrary.asp
- Grand River Dam Authority. Draft Recreation Management Plan Markham Ferry Hydroelectric Project FERC Project No. 2183. Prepared October 28, 2005.

Data

- Industry standard efficiency ratings for existing WWTF components
  - Pumps and Motors 77%
  - Blowers 80%
  - Surface Aerators 72%
  - HVAC units 66%
- Bubble Diffusers efficiency ratings are dependent on the type and depth at which they are operating (see Appendix E)
  - Fine pore bubble diffusers are 50% more efficient that coarse bubble diffusers
- Lighting configurations in treatment facility, administrative offices and lift stations
  - Wattage
  - Hours lamps are in operation
  - Number of lamps/bulbs in operation
- Energy costs per kWh in Oklahoma
  - Oklahoma Electric Cooperative
    - Small Commercial Rate
    - June – October $0.10053/kWh
      - November – May
      - $0.08753/kWh for first 600 kWh
      - $0.05653/kWh over 600 kWh used
    - Large Power Rates
      - First 1 MM kWh $0.04243/kWh
      - Over 1 MM kWh $0.03943
  - Oklahoma Gas & Electric Company
    - Municipal Water Pumping Rates (including WWTFs) all prices include a $0.0290/kWh embedded fuel cost
    - June – October $0.0660/kWh
    - November – May $0.05/kWh
  - U.S. Energy Information Administration reports that **average** industrial price of energy/kWh in Oklahoma is $0.0464/kWh
- Cost calculation formulae
  - Pumps & motors/blowers/aerators/diffusers
    - Cost Savings per Year = Current Annual Costs - (Current Annual Costs x current efficiency/proposed efficiency)
    - Percent Savings = Cost Savings per Year/Current Annual Costs
  - HVAC units
    - Existing HVAC BTUs/SEER Rating = kWh consumed
    - Existing kWh consumed - proposed kWh consumed/existing kWh consumed = % Energy Savings
    - (existing kWh consumed * $0.046) - (proposed kWh consumed * $0.046) = actual cost savings
  - Lighting systems
    - (current W - proposed W) x Operating Hours x $0.046 x Number of Lamps x 0.001 = Estimated Annual Savings
    - Note: 0.001 is Watts to kW constant

Energy Cost Savings from Efficiency Upgrades to Infrastructure

OASIS Interface

Input

- Efficiency ratings for existing equipment
- Efficiency ratings for proposed upgrades
- Annual operating costs for existing equipment
- Energy consumption for existing and proposed HVAC units in BTU
- SEER rating of existing and proposed HVAC unit
- Selection of type of bubble diffusers in use at WWTF (drop-down menu)
- Current and proposed wattage of lighting systems in use at lift stations, administrative offices, and treatment facility
- Hours of operation per year of lighting systems in lift stations, administrative offices, and treatment facility
- Number of lamps/bulbs in operation in lift stations, administrative offices, and treatment facility

Output

- "The proposed upgrade will save your utility "X" dollars per year."
- "This upgrade will realize a "Y"% cost savings. The higher the efficiency rating you select, the more money you will save. The industry standard efficiency rating is 77%." (pumps and motors)
- "This upgrade will realize a "Y"% cost savings. The higher the efficiency rating you select, the more money you will save. The industry standard efficiency rating for blowers is 80%." (blowers)
- "This upgrade will realize a "Y"% cost savings. The higher the efficiency rating you select, the more money you will save. The industry standard efficiency rating for surface aerators is 72%." (surface aerators)
- "The current HVAC unit in use at your facility consumes approximately "X" kWh annually, which costs about "$" to operate."
- "The proposed upgrade will consume "X"% less energy to operate and cost "$$" less than the current HVAC unit to operate annually."
- "Fine pore bubble diffusers are 50% more efficient that coarse bubble diffusers. Upgrading to a fine pore bubble diffuser configuration will cut your energy costs in half."
- "This upgrade will realize a "Y"% cost savings. Higher efficiency ratings can be achieved by increasing the depth of the diffuser position. Disc diffusers are more efficient that tube configurations."
- "Upgrading to more efficient lighting in the [lift stations/ administrative offices/ treatment facility] will save you about "X" dollars annually."
- "You can expect "$" in total anticipated savings system-wide from making upgrades to more efficient lighting throughout your treatment facility."

Notes

- See Appendix E for the full input-output matrix

Sources

Environmental Dynamics, Inc., (2009). Diffuser Express Catalog #108-2009. Specification Sheets. Available at http://www.diffuserexpress.com/catalog/pdf/DX_Catalog.pdf.

Environmental Dynamics, Inc. (nd). Fine Bubble Aeration, Technical Bulletin #104. Available at http://www.wastewater.com/pdf/104.pdf.

U.S. Energy Information Administration (2010). Average Retail Price of Electricity to Ultimate Consumers by End-Use Sector, by State. Available at http://www.eia.doe.gov/cneaf/electricity/epm/table5_6_a.html.

U.S. EPA, (2007). Energy Star Performance Ratings; Technical Methodology for Wastewater Treatment Plant. Available at http://www.energystar.gov/ia/business/evaluate_performance/wastewater_tech_desc.pdf.

North Carolina State Energy Office (nd). Utility Savings Initiative Fact Sheet. Available at www.energync.net.

Richards, A., Smith, P. (2003). How Efficient Is Your Pump? Agfacts E5.11, First Edition November 2003

Greenhouse Gas Emissions Reductions Resulting from Facility Design

Data

- X * 1.56 = Y
  - OK emissions rates for CO_2 = 1,562.76 lbs/MWh [1 megawatt = 1000 kilowatt; 1.56 lbs/kWh], which is higher than the national average emission rate (1,329.35 lbs/MWh)
  - Annual OK CO_2 emissions in 2005 = 54,918,161.6 tons.
  - X is the total amount of energy saved (in kWh) annually from efficiency upgrades
  - Y is the total amount (lbs) of CO_2 emissions averted annually

OASIS Interface

Input:

- This should not require a separate input; instead, the input for Energy Cost Savings should also be used to generate this output, and the output for this benefit should be tacked onto the output for Energy Cost Savings.
- Users input the total amount of electricity saved in kilowatt hours (X) annually and OASIS calculates the equivalent amount of CO_2 emissions that would be avoided annually (based on OK emissions average for electricity usage). The output (Y) would be pounds of CO_2 averted annually.

Output:

- "Energy efficiency improvements from this project will reduce CO_2 emissions by an estimated *[Y]* pounds annually."

Notes

- Probably only need the emissions rate for CO_2 in OK.
- In the future, we could add additional inputs and outputs for methane emissions from WWTPs.

Sources

U.S. Environmental Protection Agency. December 2008. *eGrid2007 Version 1.1 Year 2005 Summary Tables*. Available at: http://www.epa.gov/cleanenergy/documents/egridzips/eGRID2007V1_1_year05_SummaryTables.pdf.

Data

- Mean water depth and surface area of Oklahoma lakes part of pre-loaded data set
- Trophic state of Oklahoma Lakes based on levels of Chlorophyll-a (Chl-a) and Total Phosphorus (TP). These are indicators of algal growth in lakes and the measurements have been documented in the 2007-2008 Oklahoma Lakes Report prepared by the Beneficial Use Monitoring Program (see Appendix F).
    - Carlson's Trophic State Index provides the basis which ties Chl-a levels to production of algal biomass and is the methodology used by OWRB in the BUMP
    - It is crucial to use the same method of calculating trophic states as the measurement of Cl-a will not necessarily mirror results of measurements calculated using TP
    - TSI = 9.81 X ln Chl-a(ug/L) + 30.6
    - TSI Index measures can be found in Appendix F
- The Vollenweider Model predicts how concentrations of phosphorus may increase the level of Chl-a in lakes and affect the production of algae blooms.
    - $Cl_a = L_p/Q_s)/[1 + (z/Q_s)^{0.5}]$
    - Relating algal biomass (Cl_a in mg/m^3) to total P input rates (L_p in $g/m^2\ d^{-1}$), mean water depth (z in m), and outflow per unit of lake surface area (Q_s in m/acre)
- Nutrient removal treatment technologies that a community might implement at their wastewater treatment facility and their associated levels of effectiveness

Technology	Anticipated Effluent P Concentrations (A)	5-Year Historical Average of Effluent P (H)	P Reduction (R) R = H-A
Chemical Removal	0.5 mg/L	1.2 mg/L	0.7 mg/L
EBR	0.7 mg/L	1.2 mg/L	0.5 mg/L
EBR + chemical addition	0.1 mg/L	1.2 mg/L	1.1 mg/L
MBR	0.05 mg/L	1.2 mg/L	1.15 mg/L
Tertiary Filtration - Traveling Bridge Sand Filters - Disc filters - Continuous Backwash Filters	 0.2 mg/L 0.1 mg/L 0.1 mg/L	1.2 mg/L	 1.0 mg/L 1.1 mg/L 1.1 mg/L
Ballasted flocculation	0.1 mg/L	1.2 mg/L	1.1 mg/L
Dissolved Air Floatation	0.1 mg/L	1.2 mg/L	1.1 mg/L
Other	1 mg/L	1.2 mg/L	0.2 mg/L

- Oklahoma has not set allowable limits for phosphorus in discharge effluent. This is considered on a case-by-case basis by ODEQ pursuant to the water body affected.
    - In most cases, the recommended limit is 1 mg/L of effluent phosphorus
    - Phosphorus concentrations of 1 mg/L or greater are likely to trigger algae blooms
    - Amount of effluent P reduction (R) in mg/L is calculated by taking the historical average (H) minus the anticipated effluent concentrations (A).
- Effluent P reduction is calculated by H – A/H = % P reduction

Phosphorus Reduction Resulting from Water Infrastructure Investment

OASIS Interface

Input

- Each community or facility inputs data that corresponds to the historical TP levels in their facility treated wastewater flows
- Select water body into which effluent is discharged from drop-down menu
    - This will trigger an automatic calculation of the Carlson TSI using pre-loaded data from the 2007-2008 Oklahoma Lakes Report prepared by the Beneficial Use Monitoring Program. (see Table 1.0)
- Communities will input the historical 5-year average of effluent phosphorus generated by their facility
- Communities will select their new method of treatment from a drop-down menu that has effluent phosphorus concentrations assigned to each.

Output

- "Your treatment facility discharges treated effluent into "X" Lake. This lake is currently classified as oligotrophic which indicates there is a low risk of introducing algal blooms from the introduction of effluent with elevated levels of phosphorous. Oligotrophic waters are clear with plenty of oxygen and may be suitable for use as an unfiltered water supply. Oligotrophic waters are safe for swimming, fishing and recreation."
- "Your treatment facility discharges treated effluent into "X" Lake. This lake is currently classified as mesotrophic which indicates there is a moderate risk of introducing algal blooms from the introduction of effluent with elevated levels of phosporous. Mestotrophic waters are moderately clear, but have an increasing potential for decreased oxygen levels and algal blooms during summer months. Oligotrophic waters may have some taste and odor problems, but they are generally safe for swimming, fishing and recreation. You should consider secondary nutrient treatment technologies to help prevent the deterioration of the trophic state of this water body."
- "Your treatment facility discharges treated effluent into "X" Lake. This lake is currently classified as eutrophic which indicates there is a high risk of introducing algal blooms from the introduction of effluent with elevated levels of phosphorous. Eutrophic waters are murky, with a lot of visible algae scum, and a foul odor. Eutrophic waters are not considered safe for swimming or recreation and are responsible for killing fish. The installation of secondary nutrient treatment technologies at your treatment facility are highly recommended in order to help prevent the deterioration of the trophic state of this waterbody".
- The proposed treatment technology that you anticipate implementing at your facility will reduce effluent Phosphorus by "X" mg/L.
- This represents a "X"% reduction in the amount of effluent Phosphorus being discharged into "Y" Lake.
- Your project will reduce Chlorophyll-a by "X" in Lake "Y". Chlorophyll-a concentrations greater than 40 ug/L are strongly correlated with algal blooms. Lake Y is currently characterized as oligotrophic/mesotrophic/eutrophic/hypereutrophic, meaning that it has (frequent, infrequent, moderate) occurrences of algal blooms.

Notes

- See Appendix F for the full input-output matrix

- In order for the Vollenweider Model formula to work properly, it will be necessary to get pre-loaded data on Qs values (outflow per unit of lake surface area in meters/acre) from ODEQ. Do they have this information?
- While the EPA suggests that the Carlson Trophic Stat[illegible]dex was developed for use with lakes that have few rooted aquatic plants and little non-algal turbidity, the OWRB and ODEQ has cited and used this method of determining the presence of nutrient threats within the State of Oklahoma. While its use within the parameters of OASIS will have imperfections, it does follow the protocol that has previously been observed by the Oklahoma state agencies.

Sources

Carlson, R.E. (1977). A Trophic State Index for Lakes, Limnology and Oceanography, 22:361-369.

Derischweiler, M. (2010). Oklahoma Dept. of Environmental Quality, personal communication on January 14, 2010.

Oklahoma Administrative Code, Title 785, Chapter 46, Implementation of Oklahoma's Water Quality Standards. Available at http://www.epa.gov/waterscience/standards/wqslibrary/ok/ok_6_wrb_chapter46.pdf.

OWRB (nd). 2007-2008 Oklahoma Lakes Report. Beneficial Use Monitoring Program. Available at http://www.owrb.ok.gov/quality/monitoring/bump/pdf_bump/Current/LakesReport.pdf.

OWRB (nd). Guidance for Determining Lake Trophic State for Determination of Nutrient Limited Waters Status.

OWRB (2003). Oklahoma Surface Water Monitoring Strategy, 42 – 46. Available at http://www.owrb.ok.gov/studies/reports/bump/2001/Lakes/lakes_mont_prog.pdf

Data

- Since the impact of infrastructure projects on quality of life is subjective and difficult to measure, this Benefit uses a "Quality of Life" index based on Smart Growth scorecards developed by several cities and EPA.
- The index lists several characteristics that can be considered during planning, design and construction of water quality projects that may help the project contribute to aspects that are typically used to quantify "livability", such as creating a mixed-use, high density community core, encouraging civic engagement, creating educational opportunities, and protecting natural areas.
- By listing the planning considerations that may help a project contribute to positive quality of life, this Benefit can provide community leaders with ideas for making their project design more community-friendly and potentially more appealing to taxpayers, while also encouraging Smart Growth and green infrastructure building techniques.

Oasis Interface

Input

- The user selects the project type from a list of several options:
    - Wastewater Treatment Plant Construction
    - Wastewater Treatment Plant Expansion
    - Repair/Replacement of Existing Infrastructure
    - Stormwater
    - Decentralized Treatment
    - Nonpoint Source (Agricultural BMPs, streambed restoration, other)
- Each project type has a list of "quality of life" characteristics to be considered when planning the project. The user checks a box next to the characteristics that apply to the project.
- The output lists all of the selected characteristics for the project, as well as a narrative explanation how considering these factors can improve quality of life in the community. See examples of checkbox screen and output narratives below.

Oklahoma Benefits OASIS Data Inputs

Impact of Water Quality and Access to Infrastructure on Quality of Life

Wastewater Treatment Plant Construction	
Development Planning	
Percentage of the proposed service area that already contains residential and/or commercial development (closest estimate):	
100%	
75%	
50%	
25%	
Project redirects services to accommodate population migration and/or shrinkage	
Service area includes a prioritized development/redevelopment area	
Distribution/collection system design leaves capacity for future infill expansion, as opposed to outward expansion	
The collection system is designed to serve a variety of customers (industrial, commercial, multi- and single-unit residential)	
Project does not "leap frog" services outside of the current developed area	
Service area contains existing infrastructure (transportation, water, emergency services, etc.)	
Project reuses or rehabilitates existing structures	
Project reuses, rehabilitates or protects historic structures	
If project results in business/resident relocations, the relocations are planned and funded	
Project redevelopes a brownfield or greyfield	
Project follows development concurrency ordinance (ie., before infrastructure is expanded, customers must exist for the new hookups)	
Efficient Use and Protection of Resources	
System design allows for water reuse treatment and distribution	
Local building codes and plumbing codes allow for residential water reuse (irrigation, toilet flushing, etc.)	
If the system incorporates water reuse, the distribution system is designed to reach potential customers (industrial, agricultural, etc.)	
System planning involved consultation with agricultural sector to discuss feasibility for the facility to provide water reuse and land application (fertilizer)	
Project will improve water or energy efficiency	
Project will divert county-managed waste from landfill disposal	
Effluent outfall sites are calibrated to avoid streambed erosion	
The project avoids development on working agricultural or forest lands	
Project design protects or creates onsite wildlife habitat	
Project will improve or maintain compliance with water quality standards for receiving waterbody	
Project will result in septic systems decommissioned/connected to a central sewer	
Creating a Liveable Community	
The project responds to identified community needs	
Project incorporates technology that minimizes disruptions to people and the environment in the surrounding area	
Collection system places lines in areas that will result in minimal disruptions to people and the environment during construction/replacement/repair	
Community uses of discharging water bodies (recreation, drinking water, agricultural uses) were considered when deciding what level of treatment the facility should attain	
If project requires tree removal, trees will be planted elsewhere in equal caliper to those removed (ie., if two 12-inch diameter trees are removed, eight 3-inch diameter trees will be planted)	
Project consolidates utilities in right-of-ways to improve sidewalk design	
The project positively impacts employment in the community	
Project uses local contractors, engineers, architects, consultants and attorneys during the planning and construction phases	
Project utilizes materials from local sources	
Project will utilize small or disadvantaged businesses	
Project will provide direct employment after construction is completed	
Project will result in an increase in the tax base (enhances prosperity/builds competitive edge)	
Encouraging Community Involvement	
Project involves volunteers from the community for portions of the work (ie., tree planting, cleanup, signage, community outreach & education)	
Residents in areas near the project are (will be) engaged in decionmaking and kept informed of the project (for instance, educated on the environmental benefits of the system, notified of changes in traffic patterns, informed of funding sources for the project, etc.)	
Citizen and stakeholder participation is conducted early in the process, when involvement can create change	
Stakeholder concerns are documented and addressed formally	
The project increases community opportunities for training and education. Examples include: Projects with local science/engineering classes; operator certification classes at local trade schools or correctional facilities	
Residents, community stakeholders, and end-user groups are involved in the planning and design process	
Project utilizes community in-kind contributions (examples include design services from a local university, labor for site cleanup/site prep, etc.)	
Project will include "field trip friendly" elements that can be used to educate the local community (examples include goldfish effluent pond, informational signage, tour guide training, etc.)	

Output

OASIS will generate a narrative based on the user's selections, such as:

"Development Planning

- 75% of the proposed service area that already contains residential and/or commercial development
- Service area contains existing infrastructure (transportation, water, emergency services, etc.)
- The collection system is designed to serve a variety of customers

Considering these factors in your planning can help ensure that your project is well integrated with other existing city services. Directing services to areas with existing development can help maintain a cohesive city center, and can help prevent "leap-frogging" development that requires outward expansion of all city services. Designing your system to accommodate a variety of structures (single-unit residential, multi-unit residential, commercial, and industrial) encourages mixed-use development that allows people to eat, shop, work and play near to where they live. This reduces traffic congestion and allows citizens to burn less gas and spend more time in community areas."

"Encouraging Community Involvement

- Project involves volunteers from the community for portions of the work (ie., tree planting, cleanup, signage, community outreach & education)
- The project increases community opportunities for training and education.

Viewing the project as an opportunity to engage and educate the public can help citizens better understand the how city services improve their lives and protect the environment. Different types of water quality projects provide different opportunities for community involvement in the form of public meetings, environmental "clean-up" days, school field trips, and other activities. Water quality projects provide many opportunities to partner with local educational institutions, such as teaching biological treatment processes in high school chemistry class, providing operator certification exams at trade schools, or soliciting in-kind engineering and design services from the local university. These types of partnerships can help encourage civic participation and make students aware of different types of career opportunities within the local community."

Notes

- See Appendix G for the full checklist and output narratives

Sources

- U.S. Environmental Protection Agency. October 2009. *Water Quality Scorecard.*
- City of Mobile, AL Planning Department. *Smart Growth Criteria Matrix.*
- Will Fleissig and Vickie Jacobsen. 2002. *Smart Scorecard for Development Projects.*
- State of New Jersey, New Jersey Future. 2002. *Smart Growth Scorecard: Proposed Developments.*
- State of Maryland, Office of Smart Growth. 2002. *Maryland Smart Growth Scorecard.*

- City of Austin, TX, Transportation, Planning and Design Dept. 2001. *Smart Growth Matrix.*
- City of New Westminster, BC, Planning Dept. 2004. *Smart Growth Development Checklist.*
- City of Charlotte, NC Economic Development. 2005. *Charlotte NC Sustainability Index.*

Sustainability of Water Infrastructure Facilities

Data

- Sustainability indicators for the following project elements
  - Planning
    - WWTF technology
    - Site planning
  - Design
  - Construction Methods
  - Energy Efficiency – practices and system components
  - Water Conservation Indicators
  - Renewable Energy Strategies

OASIS Interface

Input

- Communities will answer a series of "yes/no" questions that pertain to the various stages of their project
  - Planning
    - WWTF technology
    - Site planning
  - Design
  - Construction Methods
  - Energy Efficiency – practices
- Communities will use check-boxes to indicate the following sustainable indicators for their project
  - System-specific strategies for energy reduction
  - Water conservation strategies
  - Renewable energy strategies

Output

- Based on the answer provided by the community, the output will either identify why their selection is considered sustainable, or will offer the alternatives that the community might have undertaken in order to make their project more sustainable.
- Appendix H illustrates the interface of all inputs and associated outputs

Notes

- See Appendix H for the full OASIS input-output matrix

Sources

Corcutt, T., et al. (2009). Sustainable Infrastructure: A Best Practices Guide for Arizona Wastewater Utilities. Published by the Water Infrastructure Finance Authority of Arizona.

Environmental Building News (2003). GreenSpec Directory, 4th Edition. BuildingGreen, Inc., Brattleboro, VT, October 2003.

H&H Environmental, LLC ((2007). Feasibility Study of Co-Composting Municipal Solid Waste and Domestic Biosolids. Lakeside, Arizona.

U.S. Environmental Protection Agency (nd). Stormwater Discharges from Construction Activities. Available at http://cfpub.epa.gov/npdes/stormwater/const.cfm.

U.S. Department of Energy (nd). Commercial Buildings: Energy Efficient Building Practices. Available at http://www1.eere.energy.gov/buildings/commercial/.

Whole Building Design Guide (2007). Federal Green Construction Guide for Specifiers. Available at http://www.wbdg.org/ccb/FEDGREEN/fgs_017419.pdf.

Data

- Data is the same as that used to populate the Financing Alternatives Comparison Tool (FACT) Lite

OASIS Interface

Inputs

- User inputs information about the planned project, as well as financing terms for an SRF loan and one (or more) alternative funding sources. The number of data fields depends on OWRB decisions on the desired complexity of the analysis. Some data fields can be pre-populated based on OWRB loan terms and Oklahoma averages. Data fields can include:
    - Funding Source
    - Percent to be Repaid
    - Closing Date
    - Date Interest Charged
    - Basis for Construction Interest
    - Construction Period Interest Rate
    - Length of Disbursement
    - Repayment Period Interest Rate
    - First Interest Payment Due Date
    - Interest Frequency
    - Basis for Repayment Fee
    - Repayment Period Fee
    - Fee Frequency
    - Amortization Method
    - First Principal Payment Due Date
    - Principal Frequency
    - Number of Principal Payments
    - Reserve Basis
    - Reserve Percentage
    - Reserve Duration
    - Reserve Interest Rate
    - Amount Refinanced
    - Project Costs (Construction, Engineering/Technical, Environmental Review, Bidding and Contract, Legal, Land and Right-of-Way, Construction Management, Other)
    - Financing Costs (Financial Advisor, Bond Counsel, Underwriter, Rating Agency Fee, Official Statement, Closing Costs, Bond Insurance, Other)
    - Recurring Costs (Reporting, Accounting, General Administration, Paying Agent, SEC Disclosure, Other)

Output

- OASIS will generate a comparison between the SRF and other selected funding sources, showing:

- Total Costs
- Average Cost per Year
- Net Present Value of Total Costs
- Net Difference
- Percent Difference

Notes

- See Appendix I for FACT Lite screenshots

Cost of Delaying Infrastructure Improvements (Construction Inflation)

Data

- Average annual construction inflation (labor and materials) from 2004-2008 according to the Bureau of Reclamation Construction Cost Index:
    - Wastewater treatment/pumping facility: 6%
    - Pipelines: 6%
    - Canals: 7%
    - Laterals and drains: 9%
    - Other heavy construction: 6%
    - Earth dams and canal earthwork (similar project type to nonpoint source/decentralized): 7.5%

OASIS Interface

Input

- User selects the project type from a drop-down box, and enters the total estimated construction cost

Output

- OASIS generates an output narrative that multiplies the project cost by the inflation multiplier to show the increase in project cost in one, two, three and five years. Example:
- Wastewater treatment facility; project cost of $10,000,000: "Construction costs for **wastewater treatment/pumping facilities** rose an average of **6%** per year from 2004-2008. The estimates below show how the cost to construct this project could increase over time:"
    - Cost in One Year: **$10,600,000**
    - Cost in Two Years: **$11,236,000**
    - Cost in Three Years: **$11,910,160**
    - Cost in Five Years: **$13,382,256**

Notes

- See Appendix J for the full input-output matrix
- The Bureau of Reclamation index is the average for the 17 Western United States, including Oklahoma.

Sources

- Bureau of Reclamation Construction Cost Trends, 2004-2008. Retrieved from http://www.usbr.gov/pmts/estimate/cost_trend.html
- Personal communication with Craig Grush, Estimating, Specifications, and Construction Management Group, U.S. Bureau of Reclamation
- Bureau of Labor Statistics Producer Price Index for materials and supply inputs into other heavy construction (2004-2008 average) combined with Engineering News Record (ENR) Skilled Labor Index (2004-2008), weighted 65% labor/35% materials based on ENR methodology for calculating the Building Price Index

VI. Appendices

Appendix A

Increase in Property Values from Enhanced Water Quality

User Input	User Selections	Multiplier	Version #	Output
Project contributes to water quality:		Water Clarity Rating	**1**	This project contributes to water quality [*User Selection*] at the [*Waterbody Name*] waterbody. Water clarity at [*Waterbody Name]* is currently rated as [*Water Clarity Rating*] on a scale of Poor-Fair-Average-Good-Excellent. The water clarity at [*Waterbody Name*] [*declined/improved*] from [*Change in Secchi Depth*] centimeters between [*Year Range*]. A recent study of two Oklahoma lakes indicated that water clarity is significantly correlated with property values for homes near the lakes. According to the study, even a very small 0.4 to 1.1 centimeter improvement in water clarity is associated with $1.00 increase in the price per square foot of homes surrounding the lakes*.
	Improvement			
	Maintenance			
	Not Applicable			
			2	This project contributes to water quality [*User Selection*] at the affected waterbody. A recent study of two Oklahoma lakes indicated that water clarity is significantly correlated with property values for homes near the lakes. According to the study, even a very small 0.4 to 1.1 centimeter improvement in water clarity is associated with $1.00 increase in the price per square foot of homes surrounding the lakes*.
Waterbody impacted by the project:				

	Water Clarity Rating	Version #	Change in Secchi Depth (cm)	Year Range						
None	None									
Other (Not Listed)		2								
Lugert-Altus	Fair	1	64 to 37	2000-2005						
American Horse	Good	1	222 to 118	2000-2008						
Arbuckle	Excellent	1	120 to 128	2000-2008						
Arcadia	Average	1	52 to 67	2000-2007						
Ardmore City	Excellent	1	76 to 106	2001-2007						
Atoka	Poor	1	20 to 33	1999-2007						
Bell Cow	Average	1	63 to 54	2002-2008						
Birch	Good	1	50 to 90	2000-2007						
Bixhoma	Excellent	1	96 to 146	1999-2006						
Bluestem	Average	1	40 to 84	1999-2006						
Boomer	Average	1	50 to 32	2002-2008						
Broken Bow	Excellent	1	204 to 293	2001-2006						
Brushy Creek	Good	1	126 to 103	2001-2008						
Louis Burtschi	Good	1	75 to 72	2002-2006						
Canton	Average	1	30 to 63	2002-2006						
Carl Albert	Good	1	85 to 90	2001-2008						
Carl Blackwell	Average	1	61 to 37	2002-2008						
Carter	Excellent	1	131 to 121	2001-2008						
Cedar (Mena)	Excellent	1	82 to 162	2001-2006						
Chandler	Average	1	95 to 39	2001-2008						
Chickasha	Good	1	45 to 64	2000-2007						
Lloyd Church	Good	1	69 to 64	2001-2006						
Claremore	Good	1	54 to 41	2002-2006						
Clear Creek	Average	1	86 to 70	2001-2007						

Appendix A

OASIS Benefit #4 Increase in Property Values

	Water Clarity Rating	Version #	Change in Secchi Depth (cm)	Year Range						
Cleveland	Average	1	42 to 56	2002-2007						
Clinton	Poor	1	42 to 23	1999-2004						
Coalgate	Poor	1	17 to 26	2002-2007						
Comanche	Good	1	53 to 87	2001-2008						
Copan	Average	1	35 to 32	2000-2008						
Crowder	Average	1	60 to 65	2002-2006						
Cushing	Poor	1	12 to 43	1999-2007						
Dripping Springs	Average	1	88 to 76	2002-2007						
Duncan	Average	1	56 to 58	2001-2007						
El Reno	Poor	1	45 to 35	2001-2007						
Ellsworth	Fair to Poor	1	57 to 48	1999-2007						
Elmer Thomas	Excellent	1	203 to 175	2000-2007						
Etling, Carl	Fair	1	45 to 22	2001-2004						
Eucha	Excellent	1	118 to 151	2003-2007						
Eufaula	Fair to Poor	1	64 to 62	2000-2007						
Fairfax	Good	1	71 to 73	2002-2007						
Fort Cobb	Good	1	98 to 62	1999-2006						
Fort Gibson	Good	1	82 to 80	2001-2007						
Fort Supply	Fair to Poor	1	21 to 34	1999-2006						
Foss	Average	1	161 to 97	2003-2005						
Frederick	Poor	1	16 to 26	2001-2007						
Fuqua	Average	1	60 to 57	2001-2007						
Grand Lake	Average to Good	1	62 to 93	2001-2006						
Great Salt Plains	Poor	1	23 to 10	1999-2006						
Greenleaf	Good	1	79 to 111	2001-2006						
Guthrie	Average to Good	1	56 to 52	1999-2006						
Healdton	Poor	1	23 to 34	2001-2006						
Hefner	Good	1	65 to 92	1999-2006						
Jim Hall (Henryetta)	Poor	1	17 to 23	2003-2008						
Heyburn	Average	1	32 to 39	2003-2008						
Holdenville	Average to Good	1	78 to 75	2002-2007						
Hominy	Excellent	1	112 to 101	1999-2007						
Hudson Lake	Good	1	65 to 98	1999-2007						
Hugo	Poor	1	37 to 33	2003-2008						
Hulah	Poor	1	34 to 27	2003-2008						
Humphreys	Good to Average	1	78 to 58	2001-2007						
Jean Neustadt	Good	1	70 to 76	2001-2007						
John Wells	Excellent	1	118 to 151	1999-2006						
Kaw	Poor to Average	1	42 to 48	2003-2008						
Robert S. Kerr	Poor	1	48 to 26	2003-2008						
Keystone	Good	1	35 to 62	1999-2006						

Appendix A

OASIS Benefit #4 Increase in Property Values

	Water Clarity Rating	Version #	Change in Secchi Depth (cm)	Year Range						
Keystone	Average to Good	1	35 to 62	1999-2006						
Konawa	Good	1	90 to 82	2002-2008						
Langston	Good	1	83 to 70	2002-2008						
Lawtonka	Good	1	98 to 108	1999-2007						
Liberty	Good	1	53 to 42	1999-2006						
Lone Chimney	Good	1	56 to 63	2002-2004						
R.C. Longmire	Good	1	64 to 67	2001-2008						
Wiley Post Memorial (Maysville)	Poor	1	31 to 16	2002-2008						
McAlester	Average	1	25 to 44	2001-2008						
McGee Creek	Good	1	128 to 132	1999-2007						
McMurtry	Average	1	46 to 48	1999-2008						
Meeker	Fair to Poor	1	10 to 39	1999-2006						
Murray	Excellent	1	144 to 184	2001-2006						
Nanih Waiya	Average	1	132 to 98	2003-2008						
Newt Graham		2								
Wes Watkins Reservoir (North Deer Creek)	Good	1	74 to 92	1999-2006						
Okemah	Average	1	98 to 78	2002-2007						
Okmulgee	Good	1	56 to 99	1999-2007						
Oologah	Average	1	41 to 68	2003-2008						
Optima										
Overholser	Fair to Poor	1	24 to 32	1999-2006						
Ozzie Cobb	Average	1	65 to 56	2003-2008						
Pauls Valley	Poor	1	38 to 37	2001-2008						
Pawhuska	Excellent	1	280 to 195	2003-2008						
Pawnee	Average	1	58 to 44	2002-2007						
Perry	Poor	1	22 to 22	2003-2007						
Pine Creek	Good	1	81 to 89	1999-2004						
Ponca	Good	1	76 to 74	2003-2008						
Prague	Good	1	92 to 78	2003-2008						
Purcell	Good	1	49 to 57	2002-2008						
Raymond Gary	Good	1	74 to 67	2003-2008						
Scott King (Rock Creek)	Good	1	48 to 85	2001-2007						
Rocky (Hobart)	Poor	1	30 to 27	2001-2007						
Sahoma	Fair	1	46 to 73	2002-2006						
Sardis	Average	1	94 to 72	2003-2008						
Shawnee Twin No. 1	Good	1	79 to 67	1999-2006						

Appendix A

OASIS Benefit #4 Increase in Property Values

	Water Clarity Rating	Version #	Change in Secchi Depth (cm)	Year Range						
Shawnee Twin No. 2	Good	1	61 to 89	1999-2008						
Shell Creek	Excellent	1	85 to 83	2002-2006						
Skiatook	Good	1	137 to 98	2003-2007						
Sooner	Excellent	1	126 to 115	2003-2007						
Spavinaw	Excellent	1	124 to 131	2003-2007						
New Spiro	Good	1	44 to 47	2001-2006						
Sportsman	Average	1	56 to 76	1999-2008						
Stanley Draper	Good	1	31 to 133	1999-2006						
Stilwell City	Excellent	1	168 to 161	2001-2006						
Stroud	Excellent	1	105 to 126	2002-2006						
Talawanda No. 1	Excellent	1	175 to 155	2001-2008						
Talawanda No. 2	Excellent	1	125 to 140	2001-2008						
Taylor (Marlow)	Average	1	47 to 41	2003-2008						
Tecumseh	Poor	1	17 to 11	2002-2008						
Tenkiller	Excellent	1	118 to 153	2000-2006						
Texoma	Good to Excellent	1	115 to 78	2003-2008						
Thunderbird	Average	1	59 to 53	2001-2007						
Tom Steed	Average	1	43 to 57	2003-2007						
Vanderwork	Good	1	61 to 59	2002-2008						
Vincent	Good	1	109 to 68	2003-2008						
W.R. Holway	Excellent	1	151 to 161	2003-2007						
Walters (Dave Boyer)	Poor	1	12 to 21	2001-2008						
Waurika	Average	1	48 to 51	2003-2008						
Waxhoma	Excellent	1	79 to 153	1999-2006						
Wayne Wallace	Average	1	105 to 76	2003-2008						
WD Mayo		2								
Webbers Falls	Average	1	57 to 53	2001-2006						
Wetumka	Fair	1	82 to 59	2001-2007						
Wewoka	Poor	1	49 to 35	2002-2007						
Wister	Average	1	26 to 41	2003-2008						

*2003-2007 homes sales in one square mile areas bordering Grand Lake O' the Cherokees and Lake Hudson, Oklahoma. Water clarity measured by secchi disk depth.

Appendix B

Effect on Property Values from Increased Access to Water Infrastructure

User Input	User Selections	Multiplier		Output
Number of new connections served by the project	Text entry	$2,650 - $11,850		A failing onsite sewage treatment (septic) system can reduce a home's value from between $2,650 and $11,850, based on the Oklahoma Department of Environmental Quality's estimates of the five-year installation and maintenance cost to replace a septic system. By replacing failing septic systems with new connections, this project can potentially potentially preserve [*# of new connections*]*[*$2,650 - $11,850*] in [*County*] home values".
County served by the project		**Levy Rate**	**Year**	
	Adair County	$72.29	2008	
	Alfalfa County	$73.49	2008	
	Atoka County	$77.54	2008	
	Beaver County	$60.25	2008	
	Beckham County	$71.27	2008	
	Blaine County	$83.05	2008	
	Bryan County	$81.27	2008	
	Caddo County	$84.11	2008	
	Canadian County	$88.41	2008	
	Carter County	$85.79	2008	
	Cherokee County	$76.31	2008	
	Choctaw County	$77.41	2008	
	Cimarron County	$64.21	2008	
	Cleveland County	$103.25	2008	
	Coal County	$81.89	2008	
	Comanche County	$89.70	2008	
	Cotton County	$79.72	2008	
	Craig County	$79.05	2008	
	Creek County	$97.52	2008	
	Custer County	$81.65	2009	
	Delaware County	$75.27	2008	
	Dewey County	$67.92	2008	
	Ellis County	$75.40	2008	
	Garfield County	$89.04	2008	
	Garvin County	$82.56	2008	
	Grady County	$89.48	2008	
	Grant County	$63.23	2008	
	Greer County	$74.09	2008	
	Harmon County	$74.58	2008	
	Harper County	$68.31	2008	
	Haskell County	$79.67	2008	
	Hughes County	$81.60	2009	

Jackson County	$78.85	2008
Jefferson County	$78.80	2008
Johnston County	$75.84	2008
Kay County	$88.41	2008
Kingfisher County	$78.06	2008
Kiowa County	$80.55	2008
Latimer County	$84.18	2008
Le Flore County	$82.27	2008
Lincoln County	$90.16	2008
Logan County	$89.88	2008
Love County	$87.61	2009
Major County	$87.35	2008
Marshall County	$80.01	2008
Mayes County	$81.37	2008
McClain County	$101.59	2008
McCurtain County	$83.22	2008
McIntosh County	$79.06	2008
Murray County	$80.33	2008
Muskogee County	$89.16	2008
Noble County	$81.67	2008
Nowata County	$91.33	2008
Okfuskee County	$83.21	2008
Oklahoma County	$108.03	2009
Okmulgee County	$84.19	2008
Osage County	$82.43	2007
Ottawa County	$74.00	2008
Pawnee County	$84.67	2008
Payne County	$87.21	2008
Pittsburg County	$78.46	2008
Pontotoc County	$82.15	2008
Pottawatomie County	$93.38	2009
Pushmataha County	$72.88	2008
Roger Mills County	$69.54	2008
Rogers County	$94.94	2008
Seminole County	$87.45	2008
Sequoyah County	$74.43	2008
Stephens County	$79.68	2008
Texas County	$64.25	2008
Tillman County	$83.00	2008
Tulsa County	$112.08	2008
Wagoner County	$93.85	2008
Washington County	$90.48	2007
Washita County	$74.31	2008
Woods County	$78.88	2008
Woodward County	$79.85	2008

Appendix C

Reduction in health risk from waterborne illnesses as a result of water infrastructure investment

List of Oklahoma Lakes Sampled in 2007-2008

Lake Name	County	Surface Area	Volume	TSI	Year Sampled	Threats or Impairments	Carlson's TSI
American Horse	Blaine	100	2,200	38	2008	D.O., Color	Oligotrophic
Arbuckle	Murray	2,350	72,400	50	2008	D.O.	Mesotrophic
Bell Cow	Lincoln	1,153		52	2008	D.O., Color, Turbidity	Eutrophic
Boomer	Payne	260	3,200	51	2008	D.O., Color, Turbidity, Ent	Eutrophic
Brushy Creek	Sequoyah	358	3,258	53	2008	D.O	Eutrophic
Carl Albert	Latimer	183	2,739	41	2008	D.O., Ph, Color	Mesotrophic
Carl Blackwell	Payne	3,370	61,500	53	2008	D.O., Color, Turbidity, Ent	Eutrophic
Carter	Marshall	108	990	40	2008		Oligotrophic
Chandler	Lincoln	129	2,778	60	2008	D.O., Color, Turbidity	Eutrophic
Comanche	Stephens	184	2,500	49	2008		Mesotrophic
Copan	Washington	4,850	43,400	60	2008	Color, Turbidity	Eutrophic
Henryetta	Okmulgee	450	6,600	45	2008	Color, Turbidity, Lead	Mesotrophic
Heyburn	Creek	880	7,105	49	2008	D.O., Color, Turbidity	Mesotrophic
Hugo	Choctaw	13,250	157,600	54	2008	Color, Turbidity	Eutrophic
Hulah	Osage	3,570	31,160	55	2008	Color, Turbidity, Nlw	Eutrophic
Kaw	Osage	17,040	428,600	49	2008		Mesotrophic
Kerr, Robert S.	Sequoyah	43,380	525,700	50	2008	Color, Turbidity	Mesotrophic
Konawa	Seminole	1,350	23,000	57	2008		Eutrophic
Langston	Logan	304	5,792	44	2008		Mesotrophic
Longmire, R.C.	Garvin	918		57	2008		Eutrophic
Maysville (Wiley Post)	Mcclain	302	2,082	51	2008	Color, Turbidity	Eutrophic
Mcalester	Pittsburg	1,521	13,396	50	2008	Color, Turbidity	Mesotrophic
Mcmurtry	Noble	1,155	19,733	48	2008	D.O., Color, Turbidity	Mesotrophic
Nanih Waiya **	Pushmataha	131	1,064	45	2008	Color	Mesotrophic
Oologah	Rogers	29,460	553,400	54	2008		Eutrophic
Ozzie Cobb **	Pushmataha	116	833	59	2008		Eutrophic
Pauls Valley	Garvin	750	8,730	50	2008	Color, Turbidity	Mesotrophic
Pawhuska	Osage	96	3,600	41	2008	D.O	Mesotrophic
Lake Name	County	Surface Area	Volume	TSI	Year Sampled	Threats or Impairments	Carlson's TSI
Pine Creek	Mccurtain	3,750	53,750	53	2008	D.O., Ph, Color	Eutrophic
Ponca	Kay	805	14,440	48	2008	D.O., Color	Mesotrophic
Prague	Lincoln	225	2,415	51	2008	D.O., Color	Eutrophic
Purcell	Mcclain	150	2,600	54	2008	D.O.	Eutrophic
Raymond Gary	Choctaw	263	1,681	55	2008	D.O., Color	Eutrophic
Sardis	Pushmataha	13,610	274,330	46	2008	D.O., Color	Mesotrophic
Shawnee No. 2	Pottawatomie	1,100	11,400	43	2008	D.O.	Mesotrophic
Sportsman	Seminole	354	5,349	43	2008	D.O.	Mesotrophic
Talawanda No. 1	Pittsburg	91	1,200	42	2008	D.O.	Mesotrophic
Talawanda No. 2	Pittsburg	195	2,750	45	2008		Mesotrophic
Taylor (Marlow)	Grady	227	1,877	64	2008	Turbidity, Nlw	Hypereutrophic
Tecumseh	Pottawatomie	127	1,118	49	2008	Color, Turbidity, Lead	Mesotrophic
Texoma	Bryan	88,000		55	2008	D.O., Color, Turbidity	Eutrophic
Vanderwork	Wahita	135	1,578	64	2008	D.O., Nlw	Hypereutrophic
Vincent, Loyd	Ellis	160	2,579	46	2008		Eutrophic
Walters (Dave Boyer)	Cotton	148	861	51	2008	Color, Turbidity	Eutrophic
Waurika	Jefferson	10,100	203,100	54	2008	Color, Turbidity	Eutrophic
Wayne Wallace	Latimer	94	1,746	48	2008	Ph, Color	Mesotrophic
Wister	Leflore	7,333	62,360	61	2008	D.O., Ph, Color, Turbidity, Nlw	Hypereutrophic

Appendix C

Reduction in health risk from waterborne illnesses as a result of water infrastructure investment

OASIS Input-Output Matrix

	Input Data		Output Data	
Answer	Item	Item Description		
		1 Treatment Facility Description		
	1a	Name of facility	Item	Comments
	1a (1)	Location of facility (City/Town)	1a	
	1a (2)	Location of facility (County)		
	1b	Facility Discharge Information		
	1b (1)	Select from drop-down menu listing all lakes in Oklahoma	1b	Your treatment facility discharges treated effluent into X Lake. This lake is currently classified as [oligotrophic/mesotrophic/eutrophic], which indicates there is a [low/ moderate/high risk of producing algal blooms from the introduction of effluent with elevated levels of phosporous. Blue-green algae can produce toxins that target the nervous system, brain and the liver in humans. You should consider nutrient removal technology to ensure that effluent does not increase the trophic state of this water body.
		2 Log Reduction Values		
	2a	Influent concentration of E.Coli	2a	Your facility produces effluent with a "X"% removal of E.Coli bacteria. It is recommended that discharging facilities input technologies that enable them to achieve a 99.99% removal rate to reduce human exposures to bacteria pathogens in surface water bodies.
	2a(2)	Effluent concentraton of E.Coli	2b	Your facility produces effluent with a "X"% removal of Giardia. It is recommended that discharging facilities input technologies that enable them to achieve a 99.99% removal rate to reduce human exposures to bacteria pathogens in surface water bodies.
	2b	Influent concentration of Giardia	2c	Your facility produces effluent with "X"% removal of Cryptosporidium. It is recommended that discharging facilities input technologies that enable them to achieve a 99.99% removal rate to reduce human exposures to bacteria pathogens in surface water bodies.
	2b(2)	Effluent concentration of Giardia		
	2c	Influent concentration of Cryptosporidium		
	2c(2)	Effluent concentration of Cryptosporidium		
		3 Biological Treatment		
	3a	Activated Sludge		
	3b	De-nitrification		
	3c	Biological Nutrient Removal		
	3d	Facility does not use biological treatment technologies	3d	Your facility does not adequately address the removal of nutrients such as nitrogen and phosphorous from discharge effluent. This can have harmful effects on surface water bodies and contribute to algal blooms in lakes, and the production of cyanobacteria which can be toxic and dangerous to aquatic species as well as human health.
		4 Effluent Water Quality - Turbidity		
	4a	How many times has turbidity been > 5 NTU in the past 12 months?		
	4b	0 times (never exceeds 5 NTU		
	4c	1 time	4c, 4d	Any event where turbidity is greater than 5.0 NTU should be cause for concern regarding microbial contamination
	4d	2 or more times		

Appendix C

Reduction in health risk from waterborne illnesses as a result of water infrastructure investment

5	Disinfection -Type		
5a	Chemical pre-treatment used		
5a (1)	Chlorine (includes hpyochlorite)		
5a (2)	Alum		
5a (3)	No chemical pre-treatment	5a (3)	In order to attain a removal rate of 99.99% or better for the removal of pathogens from discharge effluent, your facility should consider adding a chemical pre-treatment to the disinfection process.
5b	Type of primary disinfection used to treat wastewater influent		
5b (1)	Chlorine (includes hpyochlorite)	5b (1)	Chlorine-based disinfection generally cannot destroy the resistant stages of pathogens like giardia and cryptosporidium. It is most effective with greater contact times and also when paired with another treatment technology. This will help to generate a more effective removal rate of bacterial pathogens.
5b (2)	Chloramines (ammonia + chlorine)	5b (2)	Chloramines are generally not effective as a primary disinfectant.
5b (3)	Ozone	5b (3)	This technology has shown an average removal rate of 99.9% for removing pathogens like giardia, cryptosporidium, and E.Coli.
5b (4)	UV Light	5b (4)	This technology has shown an average removal rate 99.99% for removing pathogens like giardia, cryptosporidium, and E.Coli.
6	Disinfection - Facilities & Equipment		
6a	Sufficient capacity to meet UV-dose requirements at all flow rates		
6b	Control of disinfectant feed rates	6b (2)	Consider changing how flow rate is controlled so that disinfectant feed is uniform.
6b (1)	Automatic control		
6b (2)	Manual control only	6c (1)	It is important that the flow rate through a UV disinfection unit be carefully controlled.
6c	UV Light Disinfection (if it applies)		
6c (1)	Automatic flow rate control	6c (4)	Install a complete backup UV disinfection unit that can be quickly put online. Consider installing back-up facilities to add chlorine during emergencies.
6c (2)	Complete back-up UV unit		
6c (3)	Back-up chlorinator if UV unit fails		
6c (4)	No back up		
7	Filtration	7a (1)	To maximize removal of mircrobial contaminants, it is important to understand the operation of the filter system.
7a	Type of filtration system		
7a (1)	Not sure of the type of filtration	7a (2)	This technology is especially effective in reducing algae and can reduce protozoan concentrations (giardia and cryptosporidium) to a removal rate between 99% and 99.9% readily. However, it is recommended that this technology be paired with an effective disinfection treatment in order to achieve a removal rate of 99.99% or better.
7a (2)	Traveling Bridge		
7a (3)	Monomedia		
7a (4)	Dual Media		
7a (5)	Membrane	7b (1)	Microfiltration removes algae, protozoa, and many bacteria effectively with a removal rate between 99.99% and 100% for giardia and cryptospordium. However, these types of membrane filters require consistent cleaning and maintenance to keep them clean of bacterial growth.
7b	Type of Membrane		
7b (1)	Microfiltration	7b (2)	Ultrafiltration is more effective than microfiltration at removing virus species and also effecitvely removes giardia and cryptosporidium effectively with a removal rate between 99.99% and 100%.
7b (2)	Ultrafiltration		
7b (3)	Reverse Osmosis	7b (3, 4)	Reverse Osmosis (RO) and nanofiltration (NF) are well-established as effectively removing viruses, pathogens, and bacteria when paired with UV disinfection.
7b (4)	Nanofiltration		

Appendix D

Value and Types of Recreation Supported

User Input	User Selections	Output
	\/	**Version 1:** In a recent year, the waterbody benefitting from this project (*Waterbody Name*) received ____ recreational visitors, including ____ picnickers, _____swimmers, _____ water skiers, _____ boaters, _____ sightseers, and _____ fishermen. Visitors to this waterbody generated $____ million dollars in sales within 30 miles of the waterbody on motels, hotels, B&Bs, restaurants, groceries and take-out food, gas, auto and boat expenses, entertainment and recreation, sporting goods, souvenirs, and other services and merchandise. These sales resulted in $_____ million in personal income generated in the community, in the form of wages and salaries, payroll benefits, profits and rents and indirect business taxes. The sales generated by visitors to the waterbody also supported ____ jobs in the local community surrounding the waterbody.
	\/	**Version 2:** In a recent year, the waterbody benefitting from this project (Waterbody Name) received ____ recreational visitors. Visitors to this waterbody generated $____ million dollars in sales within 30 miles of the waterbody on motels, hotels, B&Bs, restaurants, groceries and take-out food, gas, auto and boat expenses, entertainment and recreation, sporting goods, souvenirs, and other services and merchandise. These sales resulted in $_____ million in personal income generated in the community, in the form of wages and salaries, payroll benefits, profits and rents and indirect business taxes. The sales generated by visitors to the waterbody also supported ____ jobs in the local community surrounding the waterbody.
	\/	**Version 3:** In a recent year, Oklahoma waterbodies similar in size and location to the waterbody benefitting from this project (*Waterbody Name*) received an average of ____ recreational visitors, including ____ picnickers, _____swimmers, _____ water skiers, _____ boaters, _____ sightseers, and _____ fishermen. Visitors to these waterbodies generated an average of $____ million dollars in sales within 30 miles of the waterbody on motels, hotels, B&Bs, restaurants, groceries and take-out food, gas, auto and boat expenses, entertainment and recreation, sporting goods, souvenirs, and other services and merchandise. These sales resulted in $_____ million in personal income generated in the community on average, in the form of wages and salaries, payroll benefits, profits and rents and indirect business taxes. The sales generated by visitors to the waterbody also supported an average of ____ jobs in the local community surrounding the waterbody.
	\/	**Version 4:** In a recent year, waterbodies similar in size and location to the waterbody benefitting from this project (Waterbody Name) received an average of ____ recreational visitors, including ____ picnickers, _____swimmers, _____ water skiers, _____ boaters, _____ sightseers, and _____ fishermen. Visitors to these waterbodies generated an average of $____ million dollars in sales within 30 miles of the waterbody on motels, hotels, B&Bs, restaurants, groceries and take-out food, gas, auto and boat expenses, entertainment and recreation, sporting goods, souvenirs, and other services and merchandise. These sales resulted in $_____ million in personal income generated in the community on average, in the form of wages and salaries, payroll benefits, profits and rents and indirect business taxes. The sales generated by visitors to the waterbody also supported an average of ____ jobs in the local community surrounding the waterbody.
	\/	**Version 5:** In a recent year, Oklahoma waterbodies received more than ____ recreational visitors, including ____ picnickers, _____swimmers, _____ water skiers, _____ boaters, _____ sightseers, and _____ fishermen. Visitors to these waterbodies generated over $____ million dollars in sales within 30 miles of the waterbody on motels, hotels, B&Bs, restaurants, groceries and take-out food, gas, auto and boat expenses, entertainment and recreation, sporting goods, souvenirs, and other services and merchandise. These sales resulted in more than $_____ million in personal income generated in the community, in the form of wages and salaries, payroll benefits, profits and rents and indirect business taxes. The sales generated by visitors to the waterbody also supported at least ____ jobs in the local community surrounding the waterbody. By benefitting an Oklahoma waterbody, this project will help protect the water resources enjoyed by the citizens of Oklahoma.

Waterbody impacted by the project (Drop-down list)	Output Version	Number of Visitors (annual)	Sales Generated ($mil)	Personal Income Generated ($mil)*	Jobs Supported**	Picnickers	Swimmers	Water Skiers	Boaters	Sightseers	Fisherman
None	No Output										
Eufaula	1	2,439,782	$61.35	$24.58	767	176,640	745,353	190,547	362,064	664,841	888,813
Texoma	2	6,068,032	$165.78	$47.93	1964	-	-	-	-	-	-
Grand Lake O' the Cherokees†	2	4,000,000	$111.10	$32.68	1203	-	-	-	-	-	-
Kerr, Robert S.	2	690,267	$12.17	$3.76	203	-	-	-	-	-	-
Oologah	1	871,915	$23.81	$12.45	250	86,843	123,202	27,204	93,121	299,590	394,629
Keystone	1	1,232,071	$18.50	$9.68	345	61,727	161,894	40,535	170,026	432,703	398,082
Kaw	1	232,974	$5.17	$2.11	71	13,909	37,183	7,968	18,871	81,820	79,863
Fort Gibson	1	2,359,356	$47.95	$20.43	580	170,110	257,170	32,795	155,482	819,640	929,350
Broken Bow	1	846,706	$11.56	$5.75	219	50,802	103,721	39,287	49,786	373,990	298,633
Sardis	2	104,969	$2.36	$0.70	27	-	-	-	-	-	-
Hugo	1	487,963	$8.50	$4.40	122	22,056	32,352	3,367	48,650	248,324	156,295
Tenkiller	1	2,484,234	$48.81	$15.10	808	-	-	-	-	-	-
Webbers Falls	1	531,987	$9.19	$2.88	158	-	-	-	-	-	-
Lake Hudson††	1	74,491	$1.59	$0.47	17	-	-	-	-	-	-
Skiatook	1	467,104	$12.62	$4.34	133	-	-	-	-	-	-
Waurika	1	483,179	$7.51	$2.65	136	-	-	-	-	-	-
Foss	3	318,749	$4.81	$1.87	88.5	19,845	3,318	170	1,682	57,808	44,999
Great Salt Plains	1	154,318	$2.11	$1.08	41	19,845	3,318	170	1,682	57,808	44,999

Canton	1	580,441	$8.46	$4.15	169	62,339	89,388	43,359	89,852	244,598	131,760
Wister	2	149,575	$2.10	$0.69	40	-	-	-	-	-	-
Tom Steed	3	88,481	$1.59	$0.61	24	4,949	8,323	722	5,221	23,975	19,351
Altus-Lugert	3	88,481	$1.59	$0.61	24	4,949	8,323	722	5,221	23,975	19,351
Thunderbird	3	88,481	$1.59	$0.61	24	4,949	8,323	722	5,221	23,975	19,351
Murray	3	57,935	$1.34	$0.57	16.5	4,949	8,323	722	5,221	23,975	19,351
Atoka	3	57,935	$1.34	$0.57	16.5	4,949	8,323	722	5,221	23,975	19,351
Ellsworth	3	57,935	$1.34	$0.57	16.5	4,949	8,323	722	5,221	23,975	19,351
Sooner	3	57,935	$1.34	$0.57	16.5	4,949	8,323	722	5,221	23,975	19,351
Optima	1	19,660	$0.43	$0.17	5	1,748	743	-	167	9,716	2,613
Copan	1	96,209	$2.26	$0.97	28	8,149	15,903	1,443	10,275	38,233	36,088
Fort Cobb	3	119,392	$2.11	$1.00	32	12,364	16,931	1,122	13,849	33,710	49,918
McGee Creek	3	119,392	$2.11	$1.00	32	12,364	16,931	1,122	13,849	33,710	49,918
Pine Creek	1	294,270	$4.41	$2.26	78	36,078	48,407	1,148	41,257	56,824	141,132
Hulah	1	67,427	$1.36	$0.59	17	3,479	2,670	1,895	3,695	30,066	19,837
Carl Blackwell	3	159,524	$4.11	$2.07	45	16,598	9,488	1,514	10,680	52,059	76,585
Stanley Draper	3	159,524	$4.11	$2.07	45	16,598	9,488	1,514	10,680	52,059	76,585
Eucha	3	159,524	$4.11	$2.07	45	16,598	9,488	1,514	10,680	52,059	76,585
Hefner	3	159,524	$4.11	$2.07	45	16,598	9,488	1,514	10,680	52,059	76,585
Lawtonka	3	159,524	$4.11	$2.07	45	16,598	9,488	1,514	10,680	52,059	76,585
Arbuckle	3	159,524	$4.11	$2.07	45	16,598	9,488	1,514	10,680	52,059	76,585
Chouteau	1	251,620	$6.86	$3.54	73	29,716	16,305	1,132	17,664	74,052	133,333
Arcadia	1	620,724	$15.18	$8.24	174	106,578	45,561	24,829	87,026	179,327	195,342
Fort Supply	1	283,730	$3.86	$2.03	71	11,349	15,236	227	5,958	72,238	79,671
WD Mayo	2	152,236	$3.02	$0.96	46	-	-	-	-	-	-
Spavinaw	3	211,777	$5.08	$2.35	60.5	25,911	15,655	2,496	18,124	91,298	142,116
McAlester	3	211,777	$5.08	$2.35	60.5	25,911	15,655	2,496	18,124	91,298	142,116
Fuqua	3	211,777	$5.08	$2.35	60.5	25,911	15,655	2,496	18,124	91,298	142,116
Overholser	3	211,777	$5.08	$2.35	60.5	25,911	15,655	2,496	18,124	91,298	142,116
Newt Graham	1	271,317	$7.13	$3.74	75	25,911	15,655	2,496	18,124	91,298	142,116
Konawa	3	137,962	$3.38	$1.62	39.75	17,735	16,713	3,659	9,094	44,961	53,986
Shawnee Twin No. 1	3	137,962	$3.38	$1.62	39.75	17,735	16,713	3,659	9,094	44,961	53,986
McMurtry	3	137,962	$3.38	$1.62	39.75	17,735	16,713	3,659	9,094	44,961	53,986
Bell Cow	3	137,962	$3.38	$1.62	39.75	17,735	16,713	3,659	9,094	44,961	53,986
Dripping Springs	3	137,962	$3.38	$1.62	39.75	17,735	16,713	3,659	9,094	44,961	53,986
North Deer Creek (Wes Watkins Reservoir)	3	137,962	$3.38	$1.62	39.75	17,735	16,713	3,659	9,094	44,961	53,986
Birch	1	45,597	$1.06	$0.56	13	5,007	6,689	2,850	3,155	15,138	8,577
Shawnee Twin No. 2	3	64,148	$1.69	$0.89	19	13,647	17,242	4,241	4,580	21,793	9,921
Frederick	3	64,148	$1.69	$0.89	19	13,647	17,242	4,241	4,580	21,793	9,921
Greenleaf	3	64,148	$1.69	$0.89	19	13,647	17,242	4,241	4,580	21,793	9,921
Longmire, R.C.	3	64,148	$1.69	$0.89	19	13,647	17,242	4,241	4,580	21,793	9,921
Humphreys	3	64,148	$1.69	$0.89	19	13,647	17,242	4,241	4,580	21,793	9,921
Heyburn	1	82,699	$2.32	$1.21	25	22,287	27,795	5,632	6,004	28,448	11,264
Chickasha	3	82,699	$2.32	$1.21	25	22,287	27,795	5,632	6,004	28,448	11,264
Ponca	3	82,699	$2.32	$1.21	25	22,287	27,795	5,632	6,004	28,448	11,264
Bluestem	3	82,699	$2.32	$1.21	25	22,287	27,795	5,632	6,004	28,448	11,264
Okemah	3	82,699	$2.32	$1.21	25	22,287	27,795	5,632	6,004	28,448	11,264
Pauls Valley	3	82,699	$2.32	$1.21	25	22,287	27,795	5,632	6,004	28,448	11,264
Clear Creek	3	82,699	$2.32	$1.21	25	22,287	27,795	5,632	6,004	28,448	11,264
W.R. Holway	3	82,699	$2.32	$1.21	25	22,287	27,795	5,632	6,004	28,448	11,264
Okmulgee	3	82,699	$2.32	$1.21	25	22,287	27,795	5,632	6,004	28,448	11,264
Perry	3	82,699	$2.32	$1.21	25	22,287	27,795	5,632	6,004	28,448	11,264
Stroud	3	82,699	$2.32	$1.21	25	22,287	27,795	5,632	6,004	28,448	11,264
Cushing	3	82,699	$2.32	$1.21	25	22,287	27,795	5,632	6,004	28,448	11,264
Shell Creek	3	82,699	$2.32	$1.21	25	22,287	27,795	5,632	6,004	28,448	11,264
Holdenville	3	82,699	$2.32	$1.21	25	22,287	27,795	5,632	6,004	28,448	11,264

Lone Chimney	3	82,699	$2.32	$1.21	25	22,287	27,795	5,632	6,004	28,448	11,264
Duncan	3	82,699	$2.32	$1.21	25	22,287	27,795	5,632	6,004	28,448	11,264
Claremore	3	82,699	$2.32	$1.21	25	22,287	27,795	5,632	6,004	28,448	11,264
Jean Neustadt	3	82,699	$2.32	$1.21	25	22,287	27,795	5,632	6,004	28,448	11,264
Henryetta	3	82,699	$2.32	$1.21	25	22,287	27,795	5,632	6,004	28,448	11,264
Wewoka	4	15,866	$0.33	$0.15	5	470	-	-	7,092	6,786	7,195
Healdton	4	15,866	$0.33	$0.15	5	470	-	-	7,092	6,786	7,195
Brushy Creek	4	15,866	$0.33	$0.15	5	470	-	-	7,092	6,786	7,195
Sportsman	4	15,866	$0.33	$0.15	5	470	-	-	7,092	6,786	7,195
Coalgate	4	15,866	$0.33	$0.15	5	470	-	-	7,092	6,786	7,195
Rocky (Hobart)	4	15,866	$0.33	$0.15	5	470	-	-	7,092	6,786	7,195
Clinton	4	15,866	$0.33	$0.15	5	470	-	-	7,092	6,786	7,195
Elmer Thomas	4	15,866	$0.33	$0.15	5	470	-	-	7,092	6,786	7,195
Sahoma	4	15,866	$0.33	$0.15	5	470	-	-	7,092	6,786	7,195
Langston	4	15,866	$0.33	$0.15	5	470	-	-	7,092	6,786	7,195
Maysville (Wiley Post)	4	15,866	$0.33	$0.15	5	470	-	-	7,092	6,786	7,195
Guthrie	4	15,866	$0.33	$0.15	5	470	-	-	7,092	6,786	7,195
Raymond Gary	4	15,866	$0.33	$0.15	5	470	-	-	7,092	6,786	7,195
Boomer	4	15,866	$0.33	$0.15	5	470	-	-	7,092	6,786	7,195
Pawnee	4	15,866	$0.33	$0.15	5	470	-	-	7,092	6,786	7,195
Spiro, New	4	15,866	$0.33	$0.15	5	470	-	-	7,092	6,786	7,195
Meeker	4	15,866	$0.33	$0.15	5	470	-	-	7,092	6,786	7,195
Hudson Lake	4	15,866	$0.33	$0.15	5	470	-	-	7,092	6,786	7,195
Rock Creek	4	15,866	$0.33	$0.15	5	470	-	-	7,092	6,786	7,195
Taylor (Marlow)	4	15,866	$0.33	$0.15	5	470	-	-	7,092	6,786	7,195
Prague	4	15,866	$0.33	$0.15	5	470	-	-	7,092	6,786	7,195
Waxhoma	4	15,866	$0.33	$0.15	5	470	-	-	7,092	6,786	7,195
Talawanda No. 2	4	15,866	$0.33	$0.15	5	470	-	-	7,092	6,786	7,195
John Wells	4	15,866	$0.33	$0.15	5	470	-	-	7,092	6,786	7,195
Stilwell	4	15,866	$0.33	$0.15	5	470	-	-	7,092	6,786	7,195
Comanche	4	15,866	$0.33	$0.15	5	470	-	-	7,092	6,786	7,195
Carl Albert	4	15,866	$0.33	$0.15	5	470	-	-	7,092	6,786	7,195
Burtschi, Louis	4	15,866	$0.33	$0.15	5	470	-	-	7,092	6,786	7,195
El Reno	4	15,866	$0.33	$0.15	5	470	-	-	7,092	6,786	7,195
Wetumka	4	15,866	$0.33	$0.15	5	470	-	-	7,092	6,786	7,195
Liberty	4	15,866	$0.33	$0.15	5	470	-	-	7,092	6,786	7,195
Hominy	4	15,866	$0.33	$0.15	5	470	-	-	7,092	6,786	7,195
Church, Lloyd	4	15,866	$0.33	$0.15	5	470	-	-	7,092	6,786	7,195
Vincent, Loyd	4	15,866	$0.33	$0.15	5	470	-	-	7,092	6,786	7,195
Cleveland	4	15,866	$0.33	$0.15	5	470	-	-	7,092	6,786	7,195
Etling, Carl	4	15,866	$0.33	$0.15	5	470	-	-	7,092	6,786	7,195
Crowder	4	15,866	$0.33	$0.15	5	470	-	-	7,092	6,786	7,195
Purcell	4	15,866	$0.33	$0.15	5	470	-	-	7,092	6,786	7,195
Walters (Dave Boyer)	4	15,866	$0.33	$0.15	5	470	-	-	7,092	6,786	7,195
Ardmore City	4	15,866	$0.33	$0.15	5	470	-	-	7,092	6,786	7,195
Vanderwork	4	15,866	$0.33	$0.15	5	470	-	-	7,092	6,786	7,195
Nanih Waiya	4	15,866	$0.33	$0.15	5	470	-	-	7,092	6,786	7,195
Chandler	4	15,866	$0.33	$0.15	5	470	-	-	7,092	6,786	7,195
Tecumseh	4	15,866	$0.33	$0.15	5	470	-	-	7,092	6,786	7,195
Ozzie Cobb	4	15,866	$0.33	$0.15	5	470	-	-	7,092	6,786	7,195
Fairfax	4	15,866	$0.33	$0.15	5	470	-	-	7,092	6,786	7,195
Bixhoma	4	15,866	$0.33	$0.15	5	470	-	-	7,092	6,786	7,195
Carter	4	15,866	$0.33	$0.15	5	470	-	-	7,092	6,786	7,195
American Horse	4	15,866	$0.33	$0.15	5	470	-	-	7,092	6,786	7,195
Pawhuska	4	15,866	$0.33	$0.15	5	470	-	-	7,092	6,786	7,195
Wayne Wallace	4	15,866	$0.33	$0.15	5	470	-	-	7,092	6,786	7,195
Talawanda No. 1	4	15,866	$0.33	$0.15	5	470	-	-	7,092	6,786	7,195
Cedar (Mena)	4	15,866	$0.33	$0.15	5	470	-	-	7,092	6,786	7,195
Other (Not Listed)	5	16,302,330	$330.01	$154.17	4,672	1,303,897	2,431,753	811,830	1,727,219	5,865,931	5,417,846

Source: U.S Army Corps of Engineers (Value to the Nation). 2006 Data
*wages & salaries, payroll benefits, profits and rents and indirect business taxes
**jobs supported in the local community surrounding the lake
†based on 2002 attendance estimates from GDRA, using USACE model assuming 30% above-average spending and $0 in recreation/activity fees
††based on 2005 attendance estimates from the Grand River Dam Authority, using USACE model assuming average spending and $0 in recreation/activity fees

Fine Pore Bubble Diffusers – Oxygen Transfer Efficiency and Depth Metrics

Type	Diffuser Depth	Average % OTE Efficiency
Tube	5 feet	8%
	10 feet	15%
	15 feet	20%
	20 feet	25%
	25 feet	30%
Disc	5 feet	11%
	10 feet	21%
	15 feet	30%
	20 feet	38%
	25 feet	50%

OASIS Input-Output Matrix

Input Data			Output Data	
Answer	Item	Item Description	Item	Comments
	1	Pumps and Motors	1	The proposed upgrade will save your utility "X" dollars per year."
		Efficiency rating for existing equipment Efficiency rating for proposed upgrade Annual pumping costs for existing equipment	1(a)	This upgrade will realize a"Y"% cost savings. The higher the efficiency rating you select, the more money you will save. The industry standard efficiency rating is 77%.
	2	Blowers		
		Efficiency rating for existing equipment	2	The proposed upgrade will save your utility "X" dollars per year."
		Efficiency rating for proposed upgrade Annual operating costs for existing equipment	2(a)	This upgrade will realize a"Y"% cost savings. The higher the efficiency rating you select, the more money you will save. The industry standard efficiency rating for blowers is 80%.
	3	Aeration		
		Efficiency rating for existing equipment	3	The proposed upgrade will save your utility "X" dollars per year.
		Efficiency rating for proposed upgrade Annual operating costs for existing equipment	3(a)	This upgrade will realize a"Y"% cost savings. The higher the efficiency rating you select, the more money you will save. The industry standard efficiency rating for surface aerators is 72%.
	4	HVAC		
		Current energy consumption of existing HVAC unit (in BTU) SEER rating of existing HVAC unit Energy consumption of proposed HVAC unit (in BTU)	4	The current HVAC unit in use at your facility consumes approximately "X" kWh annually, which costs about "$" to operate.
		SEER rating of proposed HVAC unit	4(a)	The proposed upgrade will consume "X"% less energy to operate and cost "$$" less than the current HVAC unit to operate annually."
	5	Bubble Diffusers		
Drop-Down Menu		Please select the type and depth of bubble diffuser that your facility current uses:		
		Coarse bubble diffuser	5	Fine pore bubble diffusers are 50% more efficient that coarse bubble diffusers. Upgrading to a fine pore bubble diffuser configuration will cut your energy costs in half.
		Tube (fine pore)		
		5 feet		
		10 feet		
		15 feet		
		20 feet		
		25 feet		
		Disc (fine pore)		
		5 feet		
		10 feet		
		15 feet		
		20 feet		
		25 feet 5		The proposed upgrade will save your utility "X" dollars per year."
			5(a)	This upgrade will realize a"Y"% cost savings. Higher efficiency ratings can be achieved by increasing the depth of the diffuser position. Disc diffusers are more efficient that tube configurations.
		Please select the type and depth of diffuser that you propose to implement at your facility:		
		Tube		
		5 feet		
		10 feet		
		15 feet		
		20 feet		
		25 feet		
		Disc		
		5 feet		
		10 feet		
		15 feet		
		20 feet		
		25 feet		
	6	Lighting		
		Lift Stations		
		What is the current wattage of the lighting in use in lift stations?		
		What is the wattage of your proposed upgrade? How many hours per year are the lights in operation? How many bulbs/lamps are in operation?	6(a)	Upgrading to more efficient lighting in the lift stations will save you about "X" dollars annually.
		Administrative Offices		
		What is the current wattage of the lighting in use in adminstrative facilities? What is the wattage of your proposed upgrade? How many hours per year are the lights in operation? How many bulbs/lamps are in operation?	6(b)	Upgrading to more efficient lighting in the administrative offices will save you about "X" dollars annually.
		Treatment Facility		
		What is the current wattage of the lighting in use at your facility? What is the wattage of your proposed upgrade? How many hours per year are the lights in operation? How many bulbs/lamps are in operation?	6(c)	Upgrading to more efficient lighting in the treatment facility will save you about "X" dollars annually.
			6(d)	You can expect "$" in total anticipated savings system-wide from making upgrades to more efficient lighting throughout your treatment facility.

Appendix E

Energy Cost Savings from Efficiency Upgrades

Output Calculations	
1	Cost Savings per Year = Current Annual Costs - (Current Annual Costs x current pump efficiency/proposed pump efficiency)
1(a)	Percent Savings = Cost Savings per Year/Current Annual Costs
2	Cost Savings per Year = Current Annual Costs - (Current Annual Costs x current blower efficiency/proposed blower efficiency)
2(a)	Percent Savings = Cost Savings per Year/Current Annual Costs
3	Cost Savings per Year = Current Annual Costs - (Current Annual Costs x current aerator efficiency/proposed aerator efficiency)
3(a)	Percent Savings = Cost Savings per Year/Current Annual Costs
4	Existing HVAC BTUs/SEER Rating = kWh consumed
4(a)	Proposed HVAC BTUs/SEER Rating = Proposed kWh consumed
4(c)	existing kWh consumed - proposed kWh consumed/existing kWh consumed = % Energy Savings
4(d)	(existing kWh consumed * $0.046) - (proposed kWh consumed * $0.046) = actual cost savings
5	Cost Savings per Year = Current Annual Costs - (Current Annual Costs x current diffuser efficiency/proposed diffuser efficiency)
5(a)	Percent Savings = Cost Savings per Year/Current Annual Costs
6(a), (b), (c)	(current W - proposed W) x Operating Hours x $0.046 x Number of Lamps x 0.001 = Estimated Annual Savings *Note: 0.001 is Watts to kW constant
6(d)	Sum of 6 (a) + 6 (b) + 6(c)

Comparison of Methods Used to Calculate Carlson's TSI 2007-2008

Lake Name	Chl-A	Trophic State	Total P	Trophic State	Secchi	Trophic State
Konawa	57	Eutrophic	55	Eutrophic	63	Hypereutrophic
Langston	44	Mesotrophic	41	Mesotrophic	65	Hypereutrophic
Longmire, R.C.	57	Eutrophic	53	Eutrophic	66	Hypereutrophic
Maysville	51	Eutrophic	72	Hypereutrophic	86	Hypereutrophic
Mcalester	50	Mesotrophic	57	Eutrophic	72	Hypereutrophic
Mcmurtry	48	Mesotrophic	52	Eutrophic	71	Hypereutrophic
Nanih Waiya	45	Mesotrophic	50	Mesotrophic	60	Eutrophic
Ologah	54	Eutrophic	60	Eutrophic	66	Hypereutrophic
Ozzie Cobb	59	Eutrophic	59	Eutrophic	68	Hypereutrophic
Pauls Valley	50	Mesotrophic	57	Eutrophic	74	Hypereutrophic
Pawhuska	41	Mesotrophic	32	Oligotrophic	50	Mesotrophic
Pine Creek	53	Eutrophic	52	Eutrophic	63	Hypereutrophic
Ponca	48	Mesotrophic	56	Eutrophic	64	Hypereutrophic
Prague	51	Eutrophic	51	Eutrophic	64	Hypereutrophic
Purcell	54	Eutrophic	52	Eutrophic	68	Hypereutrophic
Raymond Gary	55	Eutrophic	55	Eutrophic	66	Hypereutrophic
Sardis	46	Mesotrophic	50	Mesotrophic	65	Hypereutrophic
Shawnee #2	43	Mesotrophic	42	Mesotrophic	62	Hypereutrophic
Sportsman	43	MesotrOphic	47	Mesotrophic	64	Hypereutrophic
Talawanda #1	42	Mesotrophic	41	Mesotrophic	54	Eutrophic
Talawanda #2	45	Mesotrophic	37	Oligotrophic	55	Eutrophic
Taylor	64	Hypereutrophic	76	Hypereutrophic	73	Hypereutrophic
Tecumseh	49	Mesotrophic	71	Hypereutrophic	92	Hypereutrophic
Texoma	55	Eutrophic	60	Eutrophic	64	Hypereutrophic
Vanderwork	64	Hypereutrophic	64	Hypereutrophic	68	Hypereutrophic
Vincent	46	Mesotrophic	47	Mesotrophic	66	Hypereutrophic
Walters	51	Eutrophic	67	Hypereutrophic	82	Hypereutrophic
Lake Name	Chl-A	Trophic State	Total P	Trophic State	Secchi	Trophic State
American Horse	38	Oligotrophic	55	Eutrophic	58	Eutrophic
Arbuckle	50	Mesotrophic	46	Mesotrophic	56	Eutrophic
Bellcow	52	Eutrophic	53	Eutrophic	69	Hypereutrophic
Boomer	51	Eutrophic	61	Hypereutrophic	76	Hypereutrophic
Brushy Creek	53	Eutrophic	50	Mesotrophic	60	Eutrophic
Carl Albert	41	Mesotrophic	49	Mesotrophic	61	Hypereutrophic
Carl Blackwell	53	Eutrophic	56	Eutrophic	74	Hypereutrophic
Carter	40	Oligotrophic	41	Mesotrophic	57	Eutrophic
Chandler	60	Eutrophic	61	Hypereutrophic	74	Hypereutrophic
Comanche	49	Mesotrophic	48	Mesotrophic	62	Hypereutrophic
Copan	60	Eutrophic	68	Hypereutrophic	76	Hypereutrophic
Henryetta	45	Mesotrophic	67	Hypereutrophic	81	Hypereutrophic
Heyburn	49	Mesotrophic	57	Eutrophic	74	Hypereutrophic
Hugo	54	Eutrophic	63	Hypereutrophic	76	Hypereutrophic
Hulah	55	Eutrophic	63	Hypereutrophic	79	Hypereutrophic
Kaw	49	Mesotrophic	80	Hypereutrophic	71	Hypereutrophic
Kerr, R.S.	50	Mesotrophic	76	Hypereutrophic	79	HypereutropHic

Appendix F

Phosphorus Reduction (Reduction in Algae Blooms) Resulting from Water Infrastructure Investment

Trophic State Index Measures

Trophic State Index	Chl (ug/L)	Secci Depth (m)	Total P (ug/L)	Attributes	Water Supply	Fisheries & Recreation
<30	<0.95	>8	<6	**Oligotrophy:** Clear water, oxygen throughout the year in the hypolimnion	Water may be suitable for an unfiltered water supply.	Salmonid fisheries dominate
30-40	0.95-2.6	8-4	6-12	Hypolimnia of shallower lakes may become anoxic		Salmonid fisheries in deep lakes only
40-50	2.6-7.3	4-2	12-24	**Mesotrophy:** Water moderately clear; increasing probability of hypolimnetic anoxia during summer	Iron, manganese, taste, and odor problems worsen. Raw water turbidity requires filtration.	Hypolimnetic anoxia results in loss of salmonids. Walleye may predominate
50-60	7.3-20	2-1	24-48	**Eutrophy:** Anoxic hypolimnia, macrophyte problems possible		Warm-water fisheries only. Bass may dominate.
60-70	20-56	0.5-1	48-96	Blue-green algae dominate, algal scums and macrophyte problems	Episodes of severe taste and odor possible.	Nuisance macrophytes, algal scums, and low transparency may discourage swimming and boating.
70-80	56-155	0.25-0.5	96-192	**Hypereutrophy:** (light limited productivity). Dense algae and macrophytes		
>80	>155	<0.25	192-384	Algal scums, few macrophytes		Rough fish dominate; summer fish kills possible

OASIS Input-Output Matrix

Input Data			Output Data	
Answer	Item	Item Description		
		1 Treatment Facility Description		
	1a	Name of facility	Item	Comments
	1a (1)	Location of facility (City/Town)		
	1a (2)	Location of facility (County)		
	1a (3)	OPDES Permit Number		
	1b	Facility Discharge Information	1b - v1	Your treatment facility discharges treated effluent into "X" Lake. This lake is currently classified as oligotrophic which indicates there is a low risk of introducing algal blooms from the introduction of effluent with elevated levels of phosporous. Oligotrophic waters are clear with an ample distribuion of oxygen and may be suitable for use as an unfiltered water supply. Oligotrophic waters are safe for swimming, fishing and recreation.
	1b (1)	Select from drop-down menu listing all lakes in Oklahoma	1b - v2	Your treatment facility discharges treated effluent into "X" Lake. This lake is currently classified as mesotrophic which indicates there is a moderate risk of introducing algal blooms from the introduction of effluent with elevated levels of phosporous. Mestotrophic waters are moderately clear, but have an increasing potential for decreased oxygen levels and algal blooms during summer months. Mesotrophic waters may have some taste and odor problems, but they are generally safe for swimming, fishing and recreation. You should consider secondary nutrient treatment technologies to help prevent the deterioration of the trophic state of this water body.
			1b - v3	Your treatment facility discharges treated effluent into "X" Lake. This lake is currently classified as eutrophi which indicates there is a high risk of introducing algal blooms from the introduction of effluent with elevated levels of phosporous. Eutrophic waters are murky, with a lot of visible algae scum, and a foul odor. Eutrophic waters are not considered safe for swimming or recreation and are responsible for killing fish. The installation of secondary nutrient treatment technologies at your treatment facilitiy are highly recommended in order to help prevent the deterioration of the trophic state of this waterbody.
		2 Treatment Technology		
	2a	What is the 5-year historical average of effluent Phosphorus at your facility? (milligrams/liter)	2a	
	2b(1)	Select treatment anticipated treatment technology of project	2b(1)	The proposed treatment technology that you anticipate implementing at your facility will reduce effluent Phosphorus by "X" mg/L.
Drop-down menu		Chemical Removal (0.5 mg/L)	2b(2)	This represents a "x"% reduction in the amount of effluent Phopshorus being discharged into "Y" Lake.
Check Box		EBR (0.7 mg/L) EBR + Chemical Addition (0.1 mg/L) MBR (0.05 mg/L) Traveling Bridge - tertiary filtration (0.2 mg/L) Disc filters (0.1 mg/L) Continuous backwash filters (0.1 mg/L) Ballasted flocculation (0.1 mg/L) Dissolved Air Floatation (0.1 mg/L) Other (1 mg/L)	2b(3)	Your project will reduce Chlorophyll-a by "X" in Lake "Y". Chlorophyll-a concentrations greater than 40 ug/L are strongly correlated with algal blooms. Lake Y is currently characterized as oligotrophic/mesotrophic/eutrophic/hypereutrophic, meaning that it has (frequent, infrequent, moderate) occurrences of algal blooms and low transparency

Input	Measure to be Calculated	Formula	Notes
1b(1)	Trophic state of discharge water body	TSI = 9.81 ln Chl-a(ug/L) + 30.6	This calculation should not be necessary as all necessary pre-loaded data is available from the Oklahoma Lakes Report 2007-2008
2b(1)	Amount of effluent P reduction	5-year historical average (H) - anticipated treatment technology (A -from checked box) H - A = R	
2b(2)	Percent of P reduction	H-A/H = % Reduction	
2b(3)	Reduction of Cl-a	$Cl_a = L_p/Q_s)/[1 + (z/Q_s)^{0.5}]$	This can only be measured if we can get the Qs values necessary to complete the formula. ODEQ may have these?

Input	Output
Intro Page: Quality of Life Index Infrastructure planning can significantly influence where and how businesses, service providers, residential areas, transportation corridors and recreational resources are located and used, which in turn can significantly affect the quality of life for people in the community. This index will help city planners and decision makers determine whether their current infrastructure plans will help enhance the quality of life in the community.	This project incorporates the following characteristics contributing to the Quality of Life in your community: **Development Planning** *List checked characteristics and include the following narrative:* Considering these factors in your planning can help ensure that your project is well integrated with other existing city services. Directing services to areas with existing development can help maintain a cohesive city center, and can help prevent "leap-frogging" development that requires outward expansion of all city services. Designing your system to accommodate a variety of structures (single-unit residential, multi-unit residential, commercial, and industrial) encourages mixed-use development that allows people to eat, shop, work and play near to where they live. This reduces traffic congestion and allows citizens to burn less gas and spend more time in community areas.
Input: User selects project type from drop-down box: Wastewater Treatment Plant Construction Wastewater Treatment Plant Expansion Replacement/Repair of Existing Infrastructure Stormwater Decentralized Treatment Nonpoint Source (AgBMPs, streambed restoration) **Checklist is populated with the characteristics listed under each project type, below. User checks the box for characteristics that apply to the project.**	**Efficient Use and Protection of Resources:** *List checked characteristics and include the following narrative:* Designing your project to allow the end products (treated water, sludge, etc.) to be reused for agricultural, industrial or residential purposes can provide a valuable service to others in the community and can provide a supplementary source of income for the treatment facility. For example, allowing a nearby farmer to purchase sludge to use as fertilizer will provide the farmer with a local, low-cost fertilizer source and will save the community the cost of transporting the waste to a landfill. Providing treated water to homeowners to use for watering lawns or washing cars can provide a supplementary water source during drought conditions and may save homeowners money on their water bills. Ensuring that the project uses construction practices that maintain or improve natural resources will help preserve scenic areas for the community to enjoy.
\/	**Creating a Liveable Community** *List checked characteristics and include the following narrative:* Considering how the project construction and operations will impact the areas where citizens live, drive, walk and play will help ensure that the project is a welcome addition to the community. Using local sources of labor, services and materials during the project planning and construction can keep public dollars in the local community, stimulate direct and indirect economic activity, and increase the local tax base.
\/	**Encouraging Community Involvement** *List checked characteristics and include the following narrative:* Viewing the project as an opportunity to engage and educate the public can help citizens better understand the how city services improve their lives and protect the environment. Different types of water quality projects provide different opportunities for community involvement in the form of public meetings, environmental "clean-up" days, and school field trips. Water quality projects provide many opportunities to partner with local educational institutions, such as teaching biological treatment processes in high school chemistry class, providing operator certification exams at trade schools, or soliciting in-kind engineering and design services from the local university. These types of partnerships can help encourage civic participation and make students aware of career opportunities within the local community.
\/	

Wastewater Treatment Plant Construction	Wastewater Treatment Plant Expansion	Replacement/Repair of Existing Infrastructure	Stormwater	Decentralized Treatment	Nonpoint Source (AgBMPs, streambed restoration)
Development Planning	**Development Planning**	**Development Planning**	**Development Planning**	**Development Planning**	**Development Planning**
Percentage of the proposed service area that already contains residential and/or commercial development (closest estimate):	Percentage of the proposed service area that already contains residential and/or commercial development (closest estimate):			Percentage of the proposed service area that already contains residential and/or commercial development (closest estimate):	
100%	100%			100%	
75%	75%			75%	
50%	50%			50%	
25%	25%			25%	
Project redirects services to accommodate population migration and/or shrinkage	Project redirects services to accommodate population migration and/or shrinkage	Project redirects services to accommodate population migration and/or shrinkage		Project redirects services to accommodate population migration and/or shrinkage	
Service area includes a prioritized development/redevelopment area	Service area includes a prioritized development/redevelopment area	Service area includes a prioritized development/redevelopment area	Service area includes a prioritized development/redevelopment area	Service area includes a prioritized development/redevelopment area	Service area includes a prioritized development/redevelopment area
Distribution/collection system design leaves capacity for future infill expansion, as opposed to outward expansion	Distribution/collection system design utilizes infill expansion in addition to or instead of outward expansion	Distribution/collection system design utilizes infill expansion in addition to or instead of outward expansion		Distribution/collection system design leaves capacity for future infill expansion, as opposed to outward expansion	
The collection system is designed to serve a variety of customers (industrial, commercial, multi- and single-unit residential)	The collection system is designed to serve a variety of customers (industrial, commercial, multi- and single-unit residential)	The collection system is designed to serve a variety of customers (industrial, commercial, multi- and single-unit residential)			
Project does not "leap frog" services outside of the current developed area	Project does not "leap frog" services outside of the current developed area			Project does not "leap frog" services outside of the current developed area	
Service area contains existing infrastructure (transportation, water, emergency services, etc.)	Service area contains existing infrastructure (transportation, water, emergency services, etc.)				
Project reuses or rehabilitates existing structures	Project reuses or rehabilitates existing structures		Project reuses or rehabilitates existing structures		
Project reuses, rehabilitates or protects historic structures	Project reuses, rehabilitates or protects historic structures	Project reuses, rehabilitates or protects historic structures	Project reuses, rehabilitates or protects historic structures		
If project results in business/resident relocations, the relocations are planned and funded	If project results in business/resident relocations, the relocations are planned and funded		If project results in business/resident relocations, the relocations are planned and funded	If project results in business/resident relocations, the relocations are planned and funded	
Project redevelopes a brownfield or greyfield	Project redevelopes a brownfield or greyfield		Project redevelopes a brownfield or greyfield	Project redevelopes a brownfield or greyfield	Project redevelopes a brownfield or greyfield
Project follows development concurrency ordinance (ie., before infrastructure is expanded, customers must exist for the new hookups)					
				Decentralized system allows for multiple (10+) connections in a concentrated area	

Appendix G

Impact of Infrastructure on Quality of Life

Wastewater Treatment Plant Construction	Wastewater Treatment Plant Expansion	Replacement/Repair of Existing Infrastructure	Stormwater	Decentralized Treatment	Nonpoint Source (AgBMPs, streambed restoration)
Efficient Use and Protection of Resources	**Efficient Use and Protection of Resources**	**Efficient Use and Protection of Resources**	**Efficient Use and Protection of Resources**	**Efficient Use and Protection of Resources**	**Efficient Use and Protection of Resources**
System design allows for water reuse treatment and distribution	System design allows for water reuse treatment and distribution	System design allows for water reuse treatment and distribution	System design allows for water reuse treatment and distribution	System design allows for water reuse treatment and distribution	System design allows for water reuse treatment and distribution
Local building codes and plumbing codes allow for residential water reuse (irrigation, toilet flushing, etc.)	Local building codes and plumbing codes allow for residential water reuse (irrigation, toilet flushing, etc.)		Local building codes and plumbing codes allow for residential water reuse (irrigation, toilet flushing, etc.)	Local building codes and plumbing codes allow for residential water reuse (irrigation, toilet flushing, etc.)	Local building codes and plumbing codes allow for residential water reuse (irrigation, toilet flushing, etc.)
If the system incorporates water reuse, the distribution system is designed to reach potential customers (industrial, agricultural, etc.)	If the system incorporates water reuse, the distribution system is designed to reach potential customers (industrial, agricultural, etc.)	If the system incorporates water reuse, the distribution system is designed to reach potential customers (industrial, agricultural, etc.)	If the system incorporates water reuse, the distribution system is designed to reach potential customers (industrial, agricultural, etc.)	If the system incorporates water reuse, the distribution system is designed to reach potential customers (industrial, agricultural, etc.)	If the system incorporates water reuse, the distribution system is designed to reach potential customers (industrial, agricultural, etc.)
System planning involved consultation with agricultural sector to discuss feasibility for the facility to provide water reuse and land application (fertilizer)	System planning involved consultation with agricultural sector to discuss feasibility for the facility to provide water reuse and land application (fertilizer)	System planning involved consultation with agricultural sector to discuss feasibility for the facility to provide water reuse and land application (fertilizer)	System planning involved consultation with agricultural sector to discuss feasibility for the facility to provide water reuse and land application (fertilizer)	System planning involved consultation with agricultural sector to discuss feasibility for the facility to provide water reuse and land application (fertilizer)	
Project will improve water or energy efficiency	Project will improve water or energy efficiency	Project will improve water or energy efficiency	Project will improve water or energy efficiency	Project will improve water or energy efficiency	Project will improve water or energy efficiency
Project will divert county-managed waste from landfill disposal	Project will divert county-managed waste from landfill disposal	Project will divert county-managed waste from landfill disposal	Project will divert county-managed waste from landfill disposal		
Effluent outfall sites are calibrated to avoid streambed erosion	Effluent outfall sites are calibrated to avoid streambed erosion	Effluent outfall sites are calibrated to avoid streambed erosion	Effluent outfall sites are calibrated to avoid streambed erosion	Effluent outfall sites are calibrated to avoid streambed erosion	
The project avoids development on working agricultural or forest lands	The project avoids development on working agricultural or forest lands		The project avoids development on working agricultural or forest lands	The project avoids development on working agricultural or forest lands	The project avoids development on working agricultural or forest lands
Project design protects or creates onsite wildlife habitat	Project design protects or creates onsite wildlife habitat		Project design protects or creates onsite wildlife habitat	Project design protects or creates onsite wildlife habitat	Project design protects or creates onsite wildlife habitat
Project will improve or maintain compliance with water quality standards for receiving waterbody	Project will improve or maintain compliance with water quality standards for receiving waterbody	Project will improve or maintain compliance with water quality standards for receiving waterbody	Project will improve or maintain compliance with water quality standards for receiving waterbody	Project will improve or maintain compliance with water quality standards for receiving waterbody	Project will improve or maintain compliance with water quality standards for receiving waterbody
Project will result in septic systems decommissioned/connected to a central sewer	Project will result in septic systems decommissioned/connected to a central sewer			Project will result in septic systems decommissioned/connected to a centralized system	
Creating a Liveable Community	**Creating a Liveable Community**	**Creating a Liveable Community**	**Creating a Liveable Community**	**Creating a Liveable Community**	**Creating a Liveable Community**
The project responds to identified community needs	The project responds to identified community needs	The project responds to identified community needs	The project responds to identified community needs	The project responds to identified community needs	The project responds to identified community needs
Project incorporates technology that minimizes disruptions to people and the environment in the surrounding area	Project incorporates technology that minimizes disruptions to people and the environment in the surrounding area	Project incorporates technology that minimizes disruptions to people and the environment in the surrounding area	Project incorporates technology that minimizes disruptions to people and the environment in the surrounding area	Project incorporates technology that minimizes disruptions to people and the environment in the surrounding area	Project incorporates technology that minimizes disruptions to people and the environment in the surrounding area
Collection system places lines in areas that will result in minimal disruptions to people and the environment during construction/replacement/repair	Collection system places lines in areas that will result in minimal disruptions to people and the environment during construction/replacement/repair	Collection system places lines in areas that will result in minimal disruptions to people and the environment during construction/replacement/repair	Collection system places lines in areas that will result in minimal disruptions to people and the environment during construction/replacement/repair	Collection system places lines in areas that will result in minimal disruptions to people and the environment during construction/replacement/repair	
Community uses of discharging water bodies (recreation, drinking water, agricultural uses) were considered when deciding what level of treatment the facility should attain	Community uses of discharging water bodies (recreation, drinking water, agricultural uses) were considered when deciding what level of treatment the facility should attain	Community uses of discharging water bodies (recreation, drinking water, agricultural uses) were considered when deciding what level of treatment the facility should attain	Community uses of discharging water bodies (recreation, drinking water, agricultural uses) were considered when deciding what level of treatment the facility should attain	Community uses of discharging water bodies (recreation, drinking water, agricultural uses) were considered when deciding what level of treatment the facility should attain	
			Project adds green space	Project adds green space	Project adds green space
		Project design makes the area more walkable	Project design makes the area more walkable		
If project requires tree removal, trees will be planted elsewhere in equal caliper to those removed (ie., if two 12-inch diameter trees are removed, eight 3-inch diameter trees will be planted)	If project requires tree removal, trees will be planted elsewhere in equal caliper to those removed (ie., if two 12-inch diameter trees are removed, eight 3-inch diameter trees will be planted)	If project requires tree removal, trees will be planted elsewhere in equal caliper to those removed (ie., if two 12-inch diameter trees are removed, eight 3-inch diameter trees will be planted)	If project requires tree removal, trees will be planted elsewhere in equal caliper to those removed (ie., if two 12-inch diameter trees are removed, eight 3-inch diameter trees will be planted)	If project requires tree removal, trees will be planted elsewhere in equal caliper to those removed (ie., if two 12-inch diameter trees are removed, eight 3-inch diameter trees will be planted)	If project requires tree removal, trees will be planted elsewhere in equal caliper to those removed (ie., if two 12-inch diameter trees are removed, eight 3-inch diameter trees will be planted)
Project consolidates utilities in right-of-ways to improve sidewalk design					
The project positively impacts employment in the community	The project positively impacts employment in the community	The project positively impacts employment in the community	The project positively impacts employment in the community	The project positively impacts employment in the community	The project positively impacts employment in the community
Project uses local contractors, engineers, architects, consultants and attorneys during the planning and construction phases	Project uses local contractors, engineers, architects, consultants and attorneys during the planning and construction phases	Project uses local contractors, engineers, architects, consultants and attorneys during the planning and construction phases	Project uses local contractors, engineers, architects, consultants and attorneys during the planning and construction phases	Project uses local contractors, engineers, architects, consultants and attorneys during the planning and construction phases	Project uses local contractors, engineers, architects, consultants and attorneys during the planning and construction phases
Project utilizes materials from local sources			Project uses stormwater best management practices, exceeding permit requirements		
Project will utilize small or disadvantaged businesses			Project design includes traffic calming devices (bump-outs, etc.)		
Project will provide direct employment after construction is completed	Project will provide direct employment after construction is completed	Project will provide direct employment after construction is completed	Project will provide direct employment after construction is completed	Project will provide direct employment after construction is completed	Project will provide direct employment after construction is completed
Project will result in an increase in the tax base (enhances prosperity/builds competitive edge)	Project will result in an increase in the tax base (enhances prosperity/builds competitive edge)		Project will result in an increase in the tax base (enhances prosperity/builds competitive edge)	Project will result in an increase in the tax base (enhances prosperity/builds competitive edge)	Project will result in an increase in the tax base (enhances prosperity/builds competitive edge)

Appendix G

Impact of Infrastructure on Quality of Life

Wastewater Treatment Plant Construction	Wastewater Treatment Plant Expansion	Replacement/Repair of Existing Infrastructure	Stormwater	Decentralized Treatment	Nonpoint Source (AgBMPs, streambed restoration)
Encouraging Community Involvement	**Encouraging Community Involvement**	**Encouraging Community Involvement**	**Encouraging Community Involvement**	**Encouraging Community Involvement**	**Encouraging Community Involvement**
Project involves volunteers from the community for portions of the work (ie., tree planting, cleanup, signage, community outreach & education)	Project involves volunteers from the community for portions of the work (ie., tree planting, cleanup, signage, community outreach & education)	Project involves volunteers from the community for portions of the work (ie., tree planting, cleanup, signage, community outreach & education)	Project involves volunteers from the community for portions of the work (ie., tree planting, cleanup, signage, community outreach & education)	Project involves volunteers from the community for portions of the work (ie., tree planting, cleanup, signage, community outreach & education)	Project involves volunteers from the community for portions of the work (ie., tree planting, cleanup, signage, community outreach & education)
Residents in areas near the project are (will be) engaged in decionmaking and kept informed of the project (for instance, educated on the environmental benefits of the system, notified of changes in traffic patterns, informed of funding sources for the project, etc.)	Residents in areas near the projec were engaged in decionmaking and kept informed of the project (for instance, educated on the environmental benefits of the system, notified of changes in traffic patterns, informed of funding sources for the project, etc.)	Residents in areas near the projec were engaged in decionmaking and kept informed of the project (for instance, educated on the environmental benefits of the system, notified of changes in traffic patterns, informed of funding sources for the project, etc.)	Residents in areas near the projec were engaged in decionmaking and kept informed of the project (for instance, educated on the environmental benefits of the system, notified of changes in traffic patterns, informed of funding sources for the project, etc.)	Residents in areas near the projec were engaged in decionmaking and kept informed of the project (for instance, educated on the environmental benefits of the system, notified of changes in traffic patterns, informed of funding sources for the project, etc.)	Residents in areas near the projec were engaged in decionmaking and kept informed of the project (for instance, educated on the environmental benefits of the system, notified of changes in traffic patterns, informed of funding sources for the project, etc.)
Citizen and stakeholder participation is conducted early in the process, when involvement can create change	Citizen and stakeholder participation is conducted early in the process, when involvement can create change	Citizen and stakeholder participation is conducted early in the process, when involvement can create change	Citizen and stakeholder participation is conducted early in the process, when involvement can create change	Citizen and stakeholder participation is conducted early in the process, when involvement can create change	Citizen and stakeholder participation is conducted early in the process, when involvement can create change
Stakeholder concerns are documented and addressed formally	Stakeholder concerns are documented and addressed formally	Stakeholder concerns are documented and addressed formally	Stakeholder concerns are documented and addressed formally	Stakeholder concerns are documented and addressed formally	Stakeholder concerns are documented and addressed formally
The project increases community opportunities for training and education. Examples include: Projects with local science/engineering classes; operator certification classes at local trade schools or correctional facilities	The project increases community opportunities for training and education. Examples include: Projects with local science/engineering classes Operator certification classes at local trade schools or correctional facilities	The project increases community opportunities for training and education. Examples include: Projects with local science/engineering classes Operator certification classes at local trade schools or correctional facilities	The project increases community opportunities for training and education. Examples include: Projects with local science/engineering classes Operator certification classes at local trade schools or correctional facilities	The project increases community opportunities for training and education. Examples include: Projects with local science/engineering classes Operator certification classes at local trade schools or correctional facilities	The project increases community opportunities for training and education. Examples include: Projects with local science/engineering classes Operator certification classes at local trade schools or correctional facilities
Residents, community stakeholders, and end-user groups are involved in the planning and design process	Residents, community stakeholders, and end-user groups are involved in the planning and design process	Residents, community stakeholders, and end-user groups are involved in the planning and design process	Residents, community stakeholders, and end-user groups are involved in the planning and design process	Residents, community stakeholders, and end-user groups are involved in the planning and design process	Residents, community stakeholders, and end-user groups are involved in the planning and design process
Project utilizes community in-kind contributions (examples include design services from a local university, labor for site cleanup/site prep, etc.)			Project design provides/maintains streetside sidewalk network		
Project will include "field trip friendly" elements that can be used to educate the local community (examples include goldfish effluent pond, informational signage, tour guide training, etc.)			Project utilizes low-impact stormwater treatment in areas not suitable for construction		

OASIS Input-Output Matrix

	Input Data	
Answer	**Item**	**Item Description**
	1	**General Information**
	1a	Name of facility
	1a (1)	Location of facility (City/Town)
	1a (2)	Location of facility (County)
	1a (3)	OPDES Permit Number
Yes/No	**2**	**Planning**
		Wastewater Treatment Plant:
	2a	**Technology**
	2a(1)	Evaluate treatment alternatives with an emphasis on methods that minimize the need for chemical treatment and energy consumption.
	2a(2)	Analyze effluent discharge alternatives, considering reuse as the preferred alternative when possible. Reuse must be closely related to the treatment effluent quality. Identify reuse options and potential users.
	2a(3)	Identify potential by-products of the wastewater treatment process that could provide energy cost savings and/or further enhance the environment. Evaluate the technical and financial feasibility for the use of these by-products for power co-generation or other beneficial use (on- or off-site).
	2a(4)	Determine appropriate capacity needs to reduce the risk of overbuilding.
	2a(5)	Conduct a present worth analysis prior to selecting an alternative.
	2a(6)	Consider use of renewable energy.
	2a(7)	Consider biosolids re-use, biosolids co-composting or biodegeneration
	2b	**Site**
	2b(1)	Develop site selection criteria which consider the technical, financial and environmental feasibility of the potential sites.
	2b(2)	Site preserves native trees, vegetation, soils and maintains natural drainage patterns
	2b(3)	Site directs runoff to natural drainage areas and encourages infiltration and recharge of streams, wetlands and aquifers
	2b(4)	Site has features that mimic natural hyrology features
	2b(5)	Minimize the requirements for pervious surfaces, landscape disturbance, and intrusive construction practices.
	2c	**Collection System:**
		Layout, Materials and Equipment
	2c(1)	Evaluate system layouts which minimize energy intensive operations.
	2c(2)	Maximize the use of the natural topography.
	2c(3)	Evaluate alternative materials (i.e. pipe) and equipment options which are environmentally preferable or achieve greater operating efficiencies.
Yes/No	**3**	**Design**
	3a	Design is intended to achieve operating efficiency and to incorporate appropriate capacity needs.
	3a(1)	Utilization of recommended design criteria and identified vendors, materials or products which induce operating efficiencies, use of local materials, and good resource utilization.
	3a(2)	Design includes considerations for minimizing energy and chemical usage, in addition to integrating elements for conservation and/or improvements to the ecosystem
	3a(3)	The suggested environmentally preferable products, criteria for a material's environmental performance/ characteristic, and use of potential treatment process by-products are evaluated for appropriate use and feasibility considering a cost-benefit analysis that factor in maintenance, durability, and replacement cost over the project life-cycle.
	3a(4)	Facility will be designed to reduce the amount of material going to landfills by providing on-site compost bins, recycling bins, and finding opportunities for biosolids re-use applications.
	3a(5)	Design implements and utlizes LEED criteria
Yes/No	**4**	**Construction**
	4(a)	Specifies methods of construction that minimize waste, reduce pollution, and maximize resource efficiency, as well as the requirements for clean-up and waste disposal, reuse of materials, and use of on-site materials.
	4a(1)	Implement the necessary measures to protect onsite vegetation, trees, natural habitats and other designated elements
	4a(2)	Implement necessary activities to reclaim onsite materials not previously identified as suitable for use in the project.
	4a(3)	Lists the native, environmentally friendly post-consumer recycled and/or reclaimed materials that could be used within the project
	4b	Plan equipment and vehicle access to minimize and confine soil disturbance and compaction to designated areas.
	4b(1)	Do not disturb topsoil and vegetation outside of the area indicated in drawings.
	4b(2)	Provide erosion control and seeding with native plant species to protect slopes. Provide protected on-site storage for excavated rock, soil and vegetation.

Yes/No	5	**Energy Efficiency**
	5a(1)	Facility has established objectives and targets for energy reduction opportunities. Objectives are the goals the utility establishes to improve performance; targets are measurable performance goals that support the objectives.
	5a(2)	Facility has established performance indicators. Performance indicators are used to measure energy performance over time in relation to specific targets. Common performance indicators include energy costs, energy consumption.
	5a(3)	Facility has performed a professional energy audit
	5a(4)	Facility has developed an Energy Conservation Plan
	5b	**Energy Conservation - General Measures**
	5b(1)	Motors have been sized properly for the expected load
	5b(2)	You have selected energy-efficient motors to repair or replace older, existing motors in the facility
	5b(3)	Motors are properly maintained, operating as close to nameplate voltage as practicable, and the connection on switches on all major power-driven equipment is checked at least once annually.
Check Box	5c	**System-Specific Measures (select all features that apply)**
	5c(1)	High-efficiency pumps have been selected
	5c(2)	Facility uses variable frequency drives to improve pump efficiency
	5c(3)	Pump operations are automated
	5c(4)	Pumps are maintained to keep them at or near their original design and efficiency rating
	5c(5)	Facility uses variable and multiple staged single-speed blowers
	5c(6)	Blowers have a 70-80% efficiency rating and are properly sized to operate at or near their best efficiency point
	5c(7)	Facility uses digester gas to fuel engine-driven blowers
	5c(8)	Facility uses two-speed mechanical aerators where mechanical aeration is used
	5c(9)	Facility uses fine pore bubble diffusers where diffusion aeration is used
	5c(10)	Facility uses mechanical mixing and diffused aeration
	5c(11)	Surface aerators have an efficiency rating of 70% or higher
	5c(12)	Facility implements continuous DO monitoring
	5c(13)	There are automated aeration control systems installed
	5c(14)	Natural light is used to the greatest extent possible throughout facility
	5c(15)	Facility has installed energy efficient lighting with an efficiency rating of 60% or better
	5c(16)	High-efficiency ballasts for fluorescent lighting have been installed/retrofitted
	5c(17)	For areas with intermittent occupancy, motion-sensitive lighting controls have been installed.
	5c(18)	HVAC units have a high-efficiency SEER rating (17)
	5c(19)	Facility uses programmable thermostats
	5c(20)	Facility has assessed building insulation R-Values and sealed leaks
Check Box	6a	**Water Conservation Measures**
	6a(1)	Facility has established objectives and targets for water reduction opportunities. Objectives are the goals the utility establishes to improve performance; targets are measurable performance goals that support the objectives.
	6a(2)	Facility has established performance indicators. Performance indicators are used to measure water conservation over time in relation to specific targets. Common performance indicators include water throughput, treatment costs.
	6a(3)	Facility has developed an Water Conservation Program
	6a(4)	Facility has undertaken measures to implement pressure management controls throughout collection system
	6a(5)	Facility utilizes leak detection equipment and protocols to address leaks, collapses, inflow and infiltration issues in the collection system
	6b	**Water Re-Use and Recycling**
	6b(1)	Facility has developed and employed mechanisms to recycle gray water
	6b(2)	Facility produces Class II treated effluent used for agricultural applications and industrial operations, fire flow protection, groundwater recharge, etc.
	6b(3)	Facility produces Class I treated effluent used for landscape irrigation, fire flow protection, or groundwater recharge
Check Box	7a	**Renewable Energy Strategies**
	7a(1)	Facility offsets electrical power demand through the integration of solar power
	7a(2)	Facility offsets electrical power demand through the integration of wind power
	7a(3)	Facility offsets electrical power demand through the integration of hydroelectric power
	7a(4)	Facility has implemented CHP or cogeneration technologies to produce power for operations
	7a(5)	Facility is capable of biofuels production

Output Data

Item	Version	Comments
1b	1	Your treatment facility discharges treated effluent into [name of waterbody]. This lake is currently classified as oligotrophic, which indicates there is a low risk of introducing algal blooms from the introduction of effluent with elevated levels of phosporous.
1b	2	Your treatment facility discharges treated effluent into [name of waterbody]. This lake is currently classified as mesotrophic, which indicates there is a low to moderate risk of introducing algal blooms from the introduction of effluent with elevated levels of phosporous. You should consider nutrient removal technology to ensure that effluent does not increase the trophic state of this water body.
1b	3	Your treatment facility discharges treated effluent into [name of waterbody]. This lake is currently classified as eutrophic, which indicates there is a high risk of introducing algal blooms from the introduction of effluent with elevated levels of phosporous. Your facility should implement nutrient removal technology to ensure that effluent does not increase the trophic state of this water body.
2		
2a(1) - 2a(7)	Yes	You have undertaken the appropriate planning steps to properly assess the energy demands and tehcnological capabilities of your facility. This will enable the facility to employ sustainable practices that save energy, conserve water and reduce waste.
2a(1)-2a(6)	No	Taking these important planning steps will allow you to properly assess the energy demands and tehcnological capabilities of your facility. This will enable the facility to employ sustainable practices that save energy, conserve water and reduce waste.
2a(7)	No	Landfilling biosolids is a problem worldwide. More communities are looking to innovative processes to convert waste streams to usalbe, beneficial compost.
2b(1) - 2c(3)	Yes	Your planning strategy utilizes site fingerprinting, which is considered a sustainable approach. Site fingerprinting is a preparation technique that aims for the minimal disturbance of existing vegetation and soils by identifying the smallest possible area necessary for the future facility footprint and delineating that area clearly. By minimizing the total area of impervious surfaces, preserving existing topography and natural drainages and flow paths, opportunities for increased infiltration and reduced storm water run-off can be naturally achieved.
2b(1)	No	When you begin your site planning process, take into consideration topographic and geologic features, as well as the existence of any drainage divides. Also be mindful of any areas that are to be protected, such as wetlands, stream buffers, or washes.
2b(2)	No	Wherever possible, use natural drainage ways to convey runoff from the site and protect them with a vegetated buffer.
2b(3)	No	By minimizing the total area of impervious surfaces, preserving existing topography and natural drainages and flow paths, opportunities for increased infiltration and reduced storm water run-off can be naturally achieved.
2b(4)	No	Wherever possible, use natural drainage ways to convey runoff from the site and protect them with a vegetated buffer.
2b(5)	No	By minimizing the total area of impervious surfaces, preserving existing topography and natural drainages and flow paths, opportunities for increased infiltration and reduced storm water run-off can be naturally achieved.
2c(1)	No	Try to minimize the use of mechanical pumping by taking advantage of natural topography and gravity-fed systems where applicable.
2c(2)	No	Plan the operation to complement existing site features. Try to avoid slopes that have a grade of 15% or higher. A grade of 0-7% is optimal for low erosion hazards. Wherever possible, use natural drainage ways to convey runoff from the site and protect them with a vegetated buffer.
2c(3)	No	When selecting pumps and motors for lift stations, try to aim for a 77% combined efficiency rating or better in order to maximize efficiency and reduce energy demands and costs.

		In order to maximize efficiency and reduce energy demands and costs.
3		
3a - 3a(4)	Yes	The success of green building practices is greatly enhanced by including sustainability considerations in the planning and design phases. Applying these practices and products may offer substantial savings during the construction and operation of the projects and, more importantly, they enhance the quality of life by providing human and environmental benefits.These sustainable, energy-efficiency programs can provide substantial value to municipal water and wastewater utilities and their customers. The potential benefits to municipalities include lower energy costs as well as non-energy benefits, such as reducing the need for chemical additives, reducing solids accumulation and deferral/reduction of capital expenses. Taking advantage of the opportunity to source materials locally whenever possible is also considered a good, sustainable practice.
3a - 3a(3)	No	There are a many environmentally sound products and practices that the planning and/or design professional may select when developing infrastructure projects. Some of these products and practices may be found at http://www.wbdg.org/design/greenspec.php, BuildingGreen.com, GreenSpec.com, in the GreenSpec directory, and the LEED (Leadership in Energy and Environmental Design) standards
3a(4)	No	Incorporating recycling and re-use and minimizing additional impacts on the environment through reducing landfill mass is a fundamental approach to sustainable design. Try to find opportunities to include processes for biosolids re-use, composting, recyling of materials used during construction and then continuously as the facility moves into operation.
3a(5)	Yes	Choosing to utilize LEED criteria in your facility's design is an extension of your commitment to sustainability and environmental stewardship, which will position the facility as a good community neighbor. Facilities that are engineered and constructed to LEED specifications enjoy a certain amount of prestige within their communities, but more importantly enjoy a structural life cycle that produces long-term cost and energy savings to those that employ this design strategy into their facilities.
3a(5)	No	You can begin by establishing sustainability requirements such as setting energy efficiency targets or using recycled materials. This will help prepare you in selecting LEED credits that are most applicable to your facility and budget.
4		
4a - 4a(3)	Yes	This project reduces waste, pollution, and environmental degradation, which is a key component to effectively applying sustainable construction practices. These construction practices focus on preserving existing habitats and vegetation to the largest extent practicable while also seeking to source materials that are locally produced and available in quantities sufficient to meet the design specifications, and employ practices to recycle unused, excess or deconstruction materials generated during the construction process.
4a - 4a(2)	No	Sustainable construction practices try to reduce waste, pollution, and environmental degradation. You should try to reduce the development envelope, preserve existing habitats and vegetation to the largest extent practicable during the construction process. If at all possible, try to source materials that are locally produced and available in quantities sufficient to meet the design specifications, and employ practices to recycle unused, excess or deconstruction materials generated during the construction process.
4a(3)	No	Try to select building materials that are rapidly renewable, lumber from forests certified to be sustainably managed, ecology blocks, dimension stone, recycled stone, recycled metal, and other products that are non-toxic, reusable, renewable, and/or recyclable . You can also use recycled industrial goods, such as coal combustion products, foundry sand, and demolition debris in construction projects. Building materials should be extracted and manufactured locally to the building site to minimize the energy embedded in their transportation.
4b - 4b(2)	Yes	This project reduces pollution and environmental degradation, which is a key component to effectively applying sustainable construction practices. These construction practices focus on preserving existing habitats and vegetation to the largest extent practicable, while also limiting any surface disturbances to the development envelope that has been delineated on the design plans.
4b - 4b(1)	No	Try to minimize the amount of surface areas disturbed during the construction process by limiting traffic, grading, and ingress-egress activities to the development envelope identified on the design plans.
4b(2)	No	In order to protect against erosion damage to topsoil during construction, protect slopes with seeding of natural vegetative cover, which will assist in soil stabilization. If you are storing rocks, shrubs, or other natural vegetation that you intend to re-establish after construction is complete, store them in a covered environment where they will be protected.

5		Energy Management
5a(1)	Yes	Your wastewater treatment facility demonstrates that there are measures being taken to conserve energy, reduce greenhouse gas emissions, and reduce costs associated with powering treatment operations. These measures demonstrate active energy management which plays a strategic role in sustainability.
	No	Responsible energy management has a strategic role in sustainability. Energy costs can account for more than 30% of the total operations and management costs for wastewater treatment facilities and each kWh produced results in approximately 1.5 pounds of greenhouse gas emissions. Wastewater treatment facilities have high potential to implement energy use reductions.
5a(2)	Yes	Your wastewater treatment facility demonstrates that there are measures being taken to conserve energy, reduce greenhouse gas emissions, and reduce costs associated with powering treatment operations. These measures demonstrate active energy management which plays a strategic role in sustainability.
	No	Responsible energy management has a strategic role in sustainability. Energy costs can account for more than 30% of the total operations and management costs for wastewater treatment facilities and each kWh produced results in approximately 1.5 pounds of greenhouse gas emissions. Wastewater treatment facilities have high potential to implement energy use reductions.
5a(3)	Yes	Your wastewater treatment facility demonstrates that there are measures being taken to conserve energy, reduce greenhouse gas emissions, and reduce costs associated with powering treatment operations. These measures demonstrate active energy management which plays a strategic role in sustainability.
	No	Responsible energy management has a strategic role in sustainability. Energy costs can account for more than 30% of the total operations and management costs for wastewater treatment facilities and each kWh produced results in approximately 1.5 pounds of greenhouse gas emissions. Wastewater treatment facilities have high potential to implement energy use reductions.
5a(4)	Yes	Your wastewater treatment facility demonstrates that there are measures being taken to conserve energy, reduce greenhouse gas emissions, and reduce costs associated with powering treatment operations. These measures demonstrate active energy management which plays a strategic role in sustainability.
	No	Responsible energy management has a strategic role in sustainability. Energy costs can account for more than 30% of the total operations and management costs for wastewater treatment facilities and each kWh produced results in approximately 1.5 pounds of greenhouse gas emissions. Wastewater treatment facilities have high potential to implement energy use reductions.
		Energy Conservation- General Measures
5b(1)	Yes	Motors are expensive, require recurring maintenance, and require significant energy to operate. Your facility has properly selected models that will help reduce energy costs and improve reliability.
	No	Proper selection and maintenance will help reduce energy costs and improve reliability.
5b(2)	Yes	Your facility has properly selected models that will help reduce energy costs and improve reliability.
	No	Motors are available in standard and high-efficiency models. Look for a pump and motor combination that can achieve in the area of a 77% combined efficiency for optimal energy saving results.
5b(3)	Yes	The diligence demonstrated in the maintenance of facility equipment will help to extend its lifetime and overall efficiency and performance.
	No	Proper maintenance of motors will extend their lifetime and improve energy efficiency.
5c		**System Specific Measures**
5c(1)-5c(20)	Checked Box	Your facility is implementing energy efficient system components that successfully reduce its energy demand and increase its level of sustainability. Energy costs can account for more than 30% of the total operations and management costs for wastewater treatment facilities and each kWh produced results in approximately 1.5 pounds of greenhouse gas emissions.

6a		**Water Conservation Measures**
6a(1) - 6a(5)	Checked Box	Your facility is implementing water conservation and management strategies that will minimize water usage and losses throughout the system. This reduces unnecessary costs, maximizes efficiency and the effectiveness of the facility's conservation program.
6b		**Water Re-use and Recycling**
6b(1) - 6b(3)	Checked Box	Your facility is participating in one of the most important sustainable functions of wastewater treatment. By treating wastewater to a condition suitable for re-use applications, your facility is helping to conserve limited water resources, benefitting not only municipal, agricultural and industrial sectors, but also serving the natural environment through the development of wetlands and wildlife habitat.
7a		**Renewable Energy Strategies**
7a(1)-7a(5)	Checked Box	Wastewater treatment facilities are the largest energy consumers for any municipality. Your facility has implemented the use of renewable energy technologies to help mitigate the rising costs of traditional energy sources, reduce greenhouse gas emissions and operational expenses, and conserve natural resources.

Appendix I
Interest Rate Savings from Using the CWSRF Program

Home Page | Financing Scenarios | Financing Assumptions | Planning, Design, and Construction Costs | Financing Costs | Recurring Costs | Results

1. Select Financing Analysis to Work with: Town of Simplicity

Preview/Print Financing Assumptions

Help and Definitions

2. Enter Assumptions: Financing Option-> / Financing Source->	Option 1 Direct Loan	Option 1 Leveraged Loan
Type of Source	SRF Direct Loan	SRF Reserve Leverage Lo
Percent to be Repaid	100	100
Closing Date (month and year)	2 / 2010	2 / 2010
Date Interest Charged From (mo and yr)	2 / 2010	2 / 2010
Construction Interest Based On	Amount Disbursed	Amount Borrowed
Construction Period Interest Rate (%)	2.00000	2.00000
Length of Disbursement (months)	12	12
Repayment Period Interest Rate (%)	2.00000	2.00000
First Interest Payment Date (mo and yr)	2 / 2011	2 / 2011
Interest Frequency (every x months)	12	12
Repayment Fee Based on	No Fee	No Fee
Repayment Period Fee % or amount	0.00	0.00
Fee Frequency (every x months)	12	12
Amortization Method	Level Debt Service	Level Debt Service
First Principal Payment Date (mo and yr)	2 / 2012	2 / 2012
Principal Frequency (every x months)	12	12
Number of Principal Payments (calc yrs)	20 20.0 years	20 20.0 years
Reserve Basis	No Reserve	Balance Outstanding
Reserve Percentage	0	50
Reserve Duration (years)	0	20
Reserve Interest Rate (%)	0.00000	2.00000
Amount Refinanced by this Source	0	0
Amount of this Source Refinanced by Another Source	0	0

Home Page | Financing Scenarios | Financing Assumptions | **Planning, Design, and Construction Costs** | Financing Costs | Recurring Costs | Results

1. Select Financing Analysis to Work with: Town of Simplicity

Preview/Print Cost Assumptions

Help and Definitions

2. Enter Applicable Costs for Each Line Item and Financing Source

Financing Option-> Financing Source->	Option 1 Direct Loan	Option 1 Leveraged Loan	Option 1 Total
Construction	3,000,000	3,000,000	6,000,000
Engineering/Technical	0	0	0
Environmental Review	0	0	0
Bidding and Contracts	0	0	0
Legal Fees	0	0	0
Land and Right-of-Way	0	0	0
Construction Management	0	0	0
Other	0	0	0
Other	0	0	0
	3,000,000	3,000,000	6,000,000

Input the costs that are associated with the planning, design, and construction of a project. It can also include costs associated with specialized requirements such as conducting an environment review. It is important to note that these costs should only be input under the financing sources that are providing the proceeds to pay for these costs.

Home Page | Financing Scenarios | Financing Assumptions | Planning, Design, and Construction Costs | Financing Costs | Recurring Costs | Results

1. Select Financing Analysis to Work with: Town of Simplicity

Preview/Print Cost Assumptions

Help and Definitions

2. Enter Applicable Costs for Each Financing Cost and Financing Source

Financing Option-> Financing Source->	Option 1 Direct Loan	Option 1 Leveraged Loan	Option 1 Total
Financial Advisor	0	0	0
Check to Use Typical Values, if listed	☐ $2 per 1000	☐ $2 per 1000	
Bond Counsel	0	0	0
Check to Use Typical Values, if listed	☐ $3 per 1000	☐ $3 per 1000	
Underwriter	0	0	0
Check to Use Typical Values, if listed	☐ $0 per 1000	☐ $0 per 1000	
Rating Agency Fee	0	0	0
Check to Use Typical Values, if listed	☐ $0	☐ $0	
Official Statement	0	0	0
Check to Use Typical Values, if listed	☐ $0	☐ $0	
Closing Costs/Fees	0	0	0
Check to Use Typical Values, if listed	☐	☐	
Bond Insurance	0	0	0
Check to Use Typical Values, if listed	☐ $0 per 1000	☐ $0 per 1000	
Other	0	0	0
Check to Use Typical Values, if listed	☐	☐	
	0	0	0

Input one time upfront costs associated with obtaining and managing a specific financing source. For some of these costs, a user can have the model input a "typical value". This is done by "checking" the box that can be found directly under the cost in question.

Home Page | Financing Scenarios | Financing Assumptions | Planning, Design, and Construction Costs | Financing Costs | Recurring Costs | Results

1. Select Financing Analysis to Work with: Town of Simplicity

Preview/Print Cost Assumptions

Help and Definitions

2. Enter Applicable Annual Recurring Costs for each Financing Source

Financing Option-> Financing Source->	Option 1 Direct Loan	Option 1 Leveraged Loan	Option 1 Total
Reporting	0	0	0
Check to Use Typical Values, if listed	☐	☐	
Accounting	0	0	0
Check to Use Typical Values, if listed	☐	☐	
General Administrative	0	0	0
Check to Use Typical Values, if listed	☐	☐	
Paying Agent Fee	0	0	0
Check to Use Typical Values, if listed	☐ $0 per yr	☐ $0 per yr	
SEC Disclosure	0	0	0
Check to Use Typical Values, if listed	☐ $0 per yr	☐ $0 per yr	
Other	0	0	0
Check to Use Typical Values, if listed	☐	☐	
Other	0	0	0
Check to Use Typical Values, if listed	☐	☐	
	0	0	0

Input the costs that occur on an annual basis throughout the life of the financing source. For some of these costs, a user can have the model input a "typical value". This is done by "checking" the box that can be found directly under the cost in question.

Home Page | Financing Scenarios | Financing Assumptions | Planning, Design, and Construction Costs | Financing Costs | Recurring Costs | Results

1. Select Financing Analysis to Work with: Town of Simplicity

2. Select Discount Rate: 4.00 %

Choose Summary Report/Graph: Summary Report

Preview/Print Selection

Help and Definitions

Financing Option-> / Financing Source->	Option 1 Direct Loan	Option 1 Leveraged Loan	Option 1 Total
Amount Financed - New Costs	3,000,000	3,000,000	6,000,000
Amount Financed - Refinance Costs	0	0	0
Amount Funded from Grants	0	0	0
Total Amount Funded	**3,000,000**	**3,000,000**	**6,000,000**
Total Principal	3,000,000	3,000,000	6,000,000
Total Interest	686,332	729,403	1,415,735
Total Repayment Fees	0	0	0
Total Recurring Costs	0	0	0
Total Other Costs/(Earnings)	0	-351,577	-351,577
Total Costs	**3,686,332**	**3,377,827**	**7,064,159**
Years of Repayment	21.0	21.0	21.0
Average Cost per Year	175,540	160,849	336,389
Net Present Value of Total Costs	**2,397,384**	**2,168,576**	**4,565,960**
Comparison to Lowest NPV Cost Option:			
Net Difference			**0**
Percent Difference			**0.0%**

Preview Detailed Reports—>>

- Summary Level Report
- Detail Level Report

Disclaimer: FACT was developed for the U.S. Environmental Protection Agency (EPA) by Northbridge Environmental Management Consultants. This financial tool is based on user assumptions and estimations that may or may not materialize. The U.S. EPA does not claim to provide any legal, financial, or other advice. The U.S. EPA shall not be liable and is not responsible for any loss or damage that results from the use of this tool.

Appendix J

Construction Inflation

User Input	User Selections	Multiplier	Version #
Project Type (Drop-down menu)	Wastewater treatment/pumping facility	6%	1
	Pipelines	6%	1
	Canals	7%	1
	Laterals and drains	9%	1
	Other	6%	2
	Decentralized System	7.5%	3
	Nonpoint Source	7.5%	3
Total Estimated Construction Cost (Text Box)	Text Entry		

Output				
Version 1:	Construction costs for (*User Selection*) rose an average of (*Multiplier*) per year from 2004-2008. The estimates below show how the cost to construct this project could increase over time.*			
	Cost in One Year:	Cost in Two Years:	Cost in Three Years:	Cost in Five Years:
	[Construction Cost * Multiplier]	[Construction Cost * Multiplier]	[Construction Cost * Multiplier]	[Construction Cost * Multiplier]
Version 2:	Heavy construction costs rose an average of (Multiplier) per year from 2004-2008. The estimates below show how the cost to construct this project could increase over time.**			
	Cost in One Year:	Cost in Two Years:	Cost in Three Years:	Cost in Five Years:
	[Construction Cost * Multiplier]	[Construction Cost * Multiplier]	[Construction Cost * Multiplier]	[Construction Cost * Multiplier]
Version 3:	Construction costs for similar types of projects (earth dams and canal earthwork) rose an average of (Multiplier) per year from 2004-2008. The estimates below show how the cost to			
	Cost in One Year:	Cost in Two Years:	Cost in Three Years:	Cost in Five Years:
	[Construction Cost * Multiplier]	[Construction Cost * Multiplier]	[Construction Cost * Multiplier]	[Construction Cost * Multiplier]

*Source: Bureau of Reclamation Construction Cost Trends, 2004-2008 average

**Source: Bureau of Labor Statistics Producer Price Index for materials and supply inputs into other heavy construction (2004-2008 average) combined with Engineering News Record (ENR) Skilled Labor Index (2004-2008), weighted 65% labor/35% materials based on ENR methodology for calculating the Building Price Index