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1:30 PM – 3:00 PM
SESSION 48: Water Supply and Infrastructure

Impacts of Salmon Carcass Decomposition on Reservoir Eutrophication and Drinking Water Quality in Seattle, Washington - Rebecca Dugopolski, Herrera Environmental Consultants, Seattle, WA (co-author: Rob Zisette)

Chinook salmon (Oncorhynchus tshawytscha), coho salmon (O. kisutch), and steelhead trout (O. mykiss) historically used the waters upstream of the Landsburg Diversion Dam located on the Cedar River in King County, Washington. The dam, which was constructed in 1901 as part of the municipal water supply system for the City of Seattle, blocked the access for anadromous fish until August 2003 when a fish ladder was constructed. Water is diverted from the Cedar River to Lake Youngs, which serves as a regulating basin and treatment location for the unfiltered drinking water supply. Fish passage above the dam is initially limited to a total biomass of 46,000 pounds of adult salmon per year (approximately equivalent to 1,000 Chinook and 4,500 coho salmon) to prevent water quality impacts primarily associated with increased phosphorus loading and eutrophication of Lake Youngs. The maximum number of fish passing the dam since the fish ladder opened occurred in 2007 when 397 Chinook and 142 coho were counted at the Landsburg Diversion Dam from September 2007 through February 2008. An adaptive management plan was prepared for compliance with the habitat conservation plan that specifies procedures for monitoring, data analysis, modeling, research, and contingency actions. Trend analysis of data collected to date show that the flow-corrected total phosphorus concentrations in the river are significantly ($p = 0.039$) correlated to the biomass of salmon passing the dam. A phosphorus loading model and Monte Carlo simulation predicted that the initial salmon carcass limit would contribute less than 0.5 percent of the annual phosphorus load to Lake Youngs. In contrast, an estimated 20 percent of the annual phosphorus load originates from fluoridation of the water before it enters Lake Youngs.

How to Provide 3 Million San Diegans a Safe and Reliable Water Supply - A Case Study on Southern California's Imported Water System and the New San Diego Pipeline 6 Project. - Steve Simon, San Diego County Water Authority, San Diego, CA

San Diego County, home to 3 million residents and a $171 billion economy, thrives in a climate that averages only 10" of rainfall annually. This is accomplished through a diverse mix of supplies that, in addition to local supplies, includes the importation of water from Northern California and the Colorado River. Through a complex system of reservoirs, pipelines, tunnels, canals, pump stations, and valves, this imported water travels hundreds of miles to its final destinations throughout San Diego. The Metropolitan Water District of Southern California (Metropolitan) owns and operates the facilities that deliver imported water to San Diego County. The San Diego County Water Authority (Water Authority), in turn, owns and operates the facilities that deliver this water to the retail agencies throughout San Diego County. The Water Authority's system includes over 300 miles of pipelines up to 9-feet in diameter, providing a total delivery capacity of 900 mgd of treated and untreated water. To meet expected demand increases through the 2030 planning horizon, the Water Authority and Metropolitan are exploring a new pipeline, "Pipeline 6", to increase imported water conveyance capacity. As currently envisioned, Pipeline 6 will be 10-feet in diameter, with a total length of 32 miles and a delivery capacity of 340 mgd. Beyond the technical aspects of constructing a project of this magnitude, key elements of the planning process, include evaluations of project timing, system integration, and demand management. Getting the project built at the right time included an analysis of historical system-wide peak demand factors, effective utilization of existing and planned treatment capacity, a comparison of alternative supplies such as seawater desalination, and operational considerations that assure system reliability goals are achieved as existing pipelines are taken out of service. Project timing goes hand-in-hand with a system integration

analysis in order to find the most efficient balance between treated and untreated capacity. The demand management analysis addresses how to manage peak demands until Pipeline 6 is constructed. Solutions to this challenge include developing seasonal shift storage programs and operating plans with the Water Authority's member agencies to efficiently manage region-wide usage during peak periods.

Determining the Optimal Investment Plan for Water Utilities: The Case of Three Valleys Water - Jon Hecht, ICF International, Fairfax, VA (co-authors: Scott Reid, Ali Chalak)

Private water utilities face difficult choices in how to most efficiently plan for investments that best meet the needs of their customer base. An obvious interest of water utilities is thus to optimize their investment planning to obtain the maximum possible benefits for the costs accrued by the investments. The objective of this article is to demonstrate an approach for a water utility to determine the benefits of investments in different possible service areas. Using a stated preference technique called choice modeling, we estimate the willingness-to-pay of customers of a utility company in Southeast England for various water services that are both private and public in nature. Private water services included the frequency of water restrictions, unplanned interruptions to water service and water quality factors. Public services included the level of abstraction from local rivers, investment in water efficiency programs, and the carbon emissions of the utility. We used the choice modeling results to estimate the marginal utility to customers of the different water service attributes and also customer willingness-to-pay for service improvements. Using state-of-the art econometric methods, we demonstrate how customer preferences can be estimated at the individual level, as opposed to more standard modeling approaches that assume that tastes are homogeneous among the customer population. Willingness-to-pay results were mostly statistically significant for the various private and public services, and results conformed to the expectations of economic theory. We also conduct market simulations to demonstrate how individual-level customer preferences can be used to forecast the preferred alternatives of customers when faced with different possible investment programs. Lastly, we outline how various benefits and costs, including those captured by the willingness-to-pay results, can be used to optimize the water utility's investment planning. The investment optimization approach used in this study allows the utility to develop and select a portfolio of investments that meet the required serviceability and business targets at a given level of risk and within the financial and resource constraints of the business.

Gaseous Cavitation Phenomenon within Drinking Water Infrastructures - Juneseok Lee, San Jose State University , San Jose, CA

This research draws attention to physical parameters of paramount importance at service lines, and within a premise plumbing. It is widely known that water mains are constantly going through steady and unsteady states because myriad of appurtenances (e.g. pump and valves) are highly susceptible to hydraulic transients. Service lines and premise plumbing have their own intrinsic natures of characteristics, but they are also affected by water main's conditions. When pressure drops below the saturation pressure of the constituent gases, bubbles comprised of dissolved gases are formed which is known as gaseous cavitation. It is highly suspected that bubble formation and implosion can be related to pipe failure/noise problems within premise plumbing. An instrumented clear plastic piping system is designed to represent water mains, service lines, and premise plumbing. This will enable us to observe the spatial and temporal variations of the gaseous cavitation phenomenon and to study fundamental behaviors. Specific objectives of this research are: i) to measure pressure and flow variations as the function of valve positions and sudden valve closing/opening with high sensitive sensors, and ii) to observe the gaseous cavitation phenomenon with image acquisition devices (for steady and transient state) through clear plastic piping. The sections of interest are horizontal, vertical section including T-junctions, and bending sections. The signals (pressure/flow variations and images) from the sensors will be collected by DAQ systems. The fundamental knowledge gained on gaseous cavitation and flow conditions will have widespread potential in water distribution, irrigation and other applications. The results of this study should be helpful in identifying the physical parameters that may be responsible for causing pipe failures/ noise problems within drinking water infrastructures, knowing that hydraulic and physical parameters are synergistic to produce adverse effects.