Decentralized Scalping Plants

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Abstract:

With increasing costs associated with imported water and the operating and maintenance costs associated with large distribution systems, scalping plants are and will be more feasible due to many key issues. Decentralized scalping plants are the type of treatment the industry will see more often in arid regions as they become less dependent on imported water. These plants can provide recycled water to communities without the extensive pipelines and energy and maintenance costs associated with pumping water for long distances. They will provide beneficial reuse to cities and counties for parks, golf courses, etc. that find them feasible. Because these treatment plants typically treat much smaller quantities of water than centralized treatment plants, the unit costs will be higher than large treatment plants.

Introduction

Decentralized scalping plants are an emerging alternative to large centralized treatment plants in areas where water reuse is a necessity. Communities and municipalities in arid climates, common to California, are progressively evaluating the feasibility of constructing scalping plants for reuse of wastewater. A scalping plant, sometimes called a satellite plant, is a small plant that withdraws wastewater from a trunk sewer to produce reclaimed water and return biosolids and non-reclaimable wastewater, such as brine, to the trunk sewer. Areas that do not receive much rain tend to deplete their groundwater sources resulting in water quality and quantity issues. Decentralized scalping plants will allow certain areas to withdraw wastewater from sewers, treat it to a specific limit depending on how the water is planned to be used, and reuse it so the area reduces dependency on scarce natural and imported water resources. This water can be reused in many different ways depending on the level of

treatment at the plant. These remote facilities, that are typically upstream of wastewater treatment plants, reduce transmission costs because they are near users of the reclaimed water (Rimer, 2006). Some key items dealing with satellite plants are: why they are being considered, the level of treatment required for specific types of reuse, design considerations, economic feasibility, and the current implementation of small and large scalping plants in arid climates.

Why Scalping Plants Are Being Considered

Satellite scalping plants are gaining attention because the water purveyors and the general public are becoming aware that water is a scarce resource. Regions that do not naturally have an abundant supply of water must import water and are the areas considering scalping plants because they can reuse the water for things like irrigation, industrial use, seawater barriers, groundwater recharge and indirect potable reuse. This allows arid regions to be less reliant on imported water. The State Water Resources Control Board has stated "the recycling of municipal wastewater has become an integral part of California's water supply" (SWRCB, 2009). Many cities and counties are realizing the cost of water is continuing to escalate and will keep escalating, so they are taking advantage of other alternative resources, such as their own wastewater.

Public perception has been a big issue over the years in water reuse, but is improving, especially with the Orange County Water District's (OCWD) Ground Water Replenishment System (GWRS) where treated wastewater is sent to percolation ponds where it percolates into the groundwater and is extracted for further treatment and potable use. Some areas are overcoming public perception, like the City of San Diego, who now has a Demonstration Project at the North City Water Reclamation Plant where they are treating wastewater to the same quality as GWRS and hope to use the product water to supplement current potable water sources pending the successful outcome of extensive scientific studies, public and regulatory acceptance, permitting, and funding.

Southern California, which is dry and imports over half of their water from Northern California (Bay Delta – State Water Project) and the Colorado River Aqueduct (supplied by the

Metropolitan Water District), and the Owen's River (supplied by the Los Angeles Department of Water and Power), has become popular for water reuse.

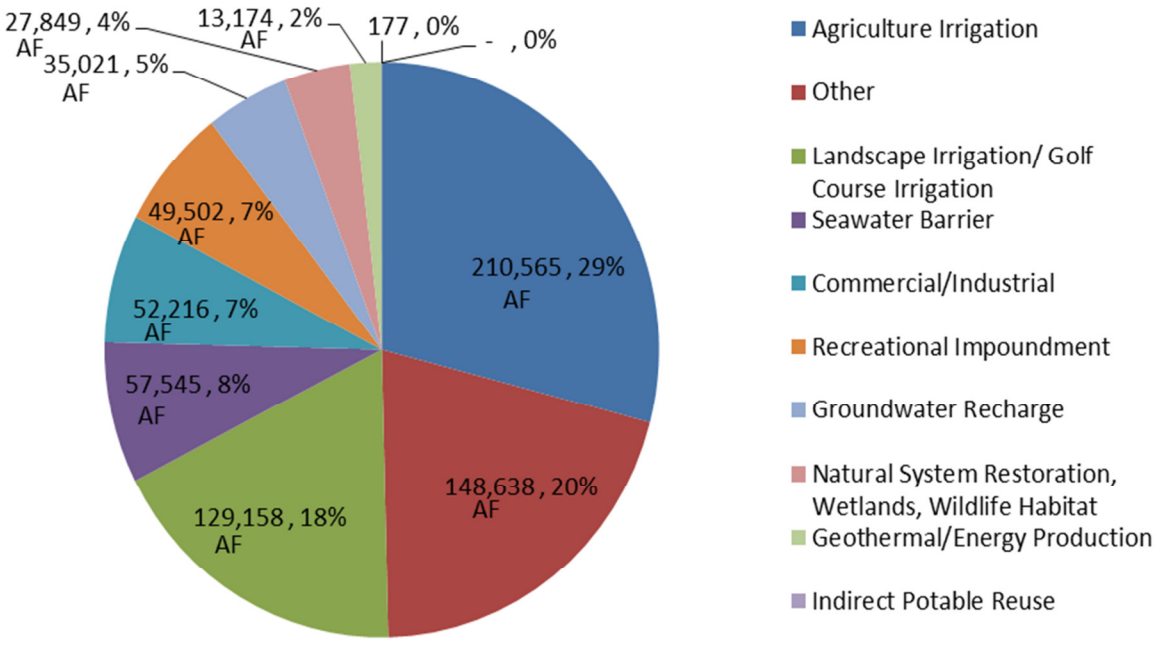
Regulations Governing Treatment for Reuse

Recycled water can be used in many different ways including landscape irrigation (golf courses, parks, schools), power plant cooling, boiler makeup, toilet flushing, indirect potable reuse, and wetlands augmentation. Currently, recycled water has been used mostly for irrigation purposes, but with new developments, dual piping can be installed increasing the use to the residential and commercial level. All of these are great uses of recycled water because it is reused instead of purchasing imported water for uses that do not require fresh water, but they all require different levels of treatment. In California, recycled water is regulated by the California Code of Regulations (CCR) and permitted by the Regional Water Quality Control Board (RWQCB). The health laws related to recycled water are compiled in "The Purple Book," named due to the purple color used to identify recycled water pipelines. In California, the different uses of recycled water have different treatment requirements, which are summarized in the table below (CDPH, 2001):

Recycled Water Type	Treatment Process	Median Total Coliform (MPN/100 ml) (1)	Maximum Total Coliform (MPN/100 ml) (2)	Uses
Disinfected Tertiary	Filtered, Disinfected(3)	2.2	23(4)	Surface irrigation of food crops including edible portion, parks and playgrounds, school yards, residential landscaping, unrestricted access golf courses
Disinfected Secondary - 2.2	Oxidized, Disinfected	2.2	23	Irrigation of food crops where the edible portion is above ground and is not contacted by recycled water
Disinfected Secondary - 23	Oxidized, Disinfected	23	240	Irrigation of cemeteries, freeway landscaping, restricted access golf courses
Undisinfected Secondary	Oxidized(5)	N/A	N/A	Surface irrigation for orchards, vineyards, non-food bearing trees, seed crops, ornamental nursery stock(6)
(1) Utilizing bacteriological results of the last 7 days for which analysis were completed				

(2) Does not exceed in more than one (1) sample in any 30 day period
(3) See Regulation 60301.230 in CDPH Recycled Water Regulations
(4) No sample shall exceed a MPN of 240 coliform bacteria per 100 milliliters
(5) See Regulation 60301.320 in CDPH Recycled Water Regulations
(6) Cannot come in contact with edible portion of plant or seed

In some cases, recycled water can be of higher quality than raw surface and ground water. Even though the quality of water can be better than raw water, the perception of "Toilet to Tap" has led to the struggle with water reuse. OCWD's GWRS water is sent back to the drinking water supply, but goes through the natural process of percolation to the groundwater basins, where it comingles with natural recharge and is considered Indirect Potable Reuse. Indirect Potable Reuse, as well as other types of reuse, have prevailed over the years. Below is a chart (SWRCB, 2009) from a survey prepared by the State Water Resources Control Board showing how 669,000 acre-feet of recycled water was beneficially reused in 2009:



Treatment Options for Scalping Plants

Scalping plants do not require as much space as normal wastewater and water treatment plants because they do not require the solids handling that wastewater treatment plants do. Some scalping plants use Membrane Bioreactors (MBR) because they provide tertiary quality water with a much smaller footprint than conventional treatment methods. MBR's have less restrictions on site location because they require less land, but they can have high capital and operating costs. MBR's combine the suspended growth activated sludge process and membrane filtration to produce a high quality effluent. These systems can replace conventional secondary clarifiers and sand filters with a single process tank. MBR's have a smaller footprint because there is no secondary clarifier or filter, there are higher mixed liquor concentrations allowing the aeration basin volume to be reduced while maintaining high solids retention times (SRT), which are key factors in biological process performance (WEF, 2006). MBR's may become a widespread treatment train for scalping plants because they require less space, but conventional systems should still be considered if space allows and cost is of concern. Regardless of whether conventional or MBR treatment is used, California scalping plants will likely require disinfected, tertiary 2.2 recycled water because the intended use will be public oriented such as golf courses, parks, schools, and landscaping.

Design Considerations

Certain design considerations must be taken into account when determining the feasibility of a satellite wastewater treatment plant. It is not always economically feasible to build the infrastructure for recycled water from a large plant to a specific city that has the capability to reuse water. Decentralized scalping plants are located near the point of water reuse. The cities that have the main wastewater / water treatment facilities do not always have large golf courses or industrial businesses that can use recycled water. As with any facility handling and conveying liquids, it must be sited in a hydraulically practical location that will minimize pumping costs. Constructing a Water Reclamation Facility (WRF) near major demand areas can minimize the amount of conveyance infrastructure needed. In order to maximize

efficiency, scalping plants are located in areas where the sewer has a substantial amount of flow and where there is potential for reuse. Flows are a big concern for the site of a scalping plant. Adequate flow must be available in the sewer to deliver the amount of reused water to the necessary customers and to keep the solids returned to the sewer in suspension to avoid deposition and potential pipe restrictions or plugging. Since a scalping plant taps into existing sewers for its water source, the baseline flow must meet recycled water demands. Wastewater flow is variable throughout the day and if recycled water demands cannot be met, storage or equalization will be required. Once recycled water users are identified and the desirable design considerations are achieved, a level of treatment is specified, and a decentralized scalping plant can be designed and constructed.

Economic Feasibility

The costs associated with scalping plants can be very high, especially because these plants typically treat small quantities of flow. Treatment plants have high unit costs per gallon when the flow entering the plant is less than 1 million gallons per day (Salveson, 2008). The costs for treatment plants with capacities between 0.1 MGD and 1 MGD cost more per gallon to construct because site development efforts, storage, and equipment do not benefit from economy of scale. These are the capacities scalping plants are likely to see, and the unit costs are high, but can likely be worth it depending on the capital cost for transmission mains and continuous maintenance costs associated with pump stations, reservoirs, and pipelines. The treatment train deemed feasible for the plant must also be evaluated based on cost. MBR's tend to be very expensive compared to conventional clarifier and filter treatment. MBR's have a high capital cost and as well as operational costs. MBR's use substantial amounts of energy for the air scour blowers, biological process blowers, and recycle pumps, which can be maintenance intensive as well (WEF, 2006). A cost-benefit analysis must be completed in order to determine if a conventional treatment system or a MBR system should be implemented at the scalping plant site. Both MBR's and the conventional treatment are currently in construction or operating at scalping plants in Southern California.

Small-scale Scalping Plant

In Orange County, the City of Anaheim is currently constructing a scalping plant at their City Hall. They are taking wastewater from a main trunk sewer that would normally go to the Orange County Sanitation District (OCSD) in Fountain Valley or Huntington Beach. The City of Anaheim will still discharge the solids back into the sewer for OCSD to treat and remove, but the wastewater scalped from the sewer will be treated with a Membrane Bioreactor, ozonation, and UV disinfection and the water will be reused locally within the City and around City Hall. The City of Anaheim is hoping to set an example for Orange County by being the first in the County to have such a Plant and reuse the wastewater locally. The scalping plant will have a capability to produce 100,000 gallons per day and will produce water that meets Title 22 requirements based on the California Department of Public Health (Moore, 2009). This is a very small treatment plant (between 0.1 MGD and 1 MGD) and has a very high construction cost per gallon of wastewater treated not only because of the MBR, but because it was built for public viewing and is intended for marketing. Because a small footprint was required for this facility, MBR technology was implemented. Cities and counties in Los Angeles, Orange County, and San Diego will likely be seeing more of these scalping plants. Southern California is very populated and large, open spaces aren't readily available for siting such facilities in proximity to beneficial reuse, so small-scale scalping plants will likely be feasible in densely populated areas that require water reuse.

Large-scale Scalping Plant

San Diego County is one of the counties at the end of the line for imported water in California. San Diego imports 85 to 90% of their water and have been taking steps to recycle water and use their local resources so they are not as reliant on imported water. One of the major, and large, scalping plants in the City of San Diego is the North City Water Reclamation Plant (NCWRP). This satellite plant currently produces recycled water and already has purple pipe infrastructure in place that feeds many golf courses. The NCWRP sends their biosolids to the Metro Biosolids Center in San Diego. The North City Plant treats wastewater from homes

and businesses and treats it to a level that is safe for irrigation and industrial uses (Pure Water San Diego, 2011b). NCWRP is capable of treating 30 MGD of wastewater and the reclaimed water is distributed throughout San Diego with 79 miles of distribution pipelines. NCWRP's treatment is conventional and includes preliminary screening for grit removal, primary sedimentation, aeration, and granular media filters. Their tertiary treatment has sand filters, chlorine disinfection and electrodialysis reversal for salinity reduction (City of San Diego).

Recently, the 1 MGD Advanced Water Purification Demonstration was constructed to perform extensive studies on the advanced water treatment, modeling of the San Vicente Reservoir, and to develop data that demonstrates protection of human health for the proposed indirect potable reuse. The treatment process of this plant is very similar to the Groundwater Replenishment System in Orange County. The Demonstration Project takes tertiary treated water from the North City Reclamation Plant and treats it further using micro- and ultra-filtration, reverse osmosis, and Advanced Oxidation (Ultraviolet light and Hydrogen Peroxide). If San Diego is able to validate the project through public outreach and permitting, purified water produced will be sent to the San Vicente Reservoir for reservoir augmentation that will be reintroduced to the drinking water supply (Pure Water San Diego, 2011a). The NCWRP, although having advanced treatment, employs conventional treatment for a majority of its water recycling and treatment. This is a much larger scalping plant than the MBR facility at City Hall in Anaheim. NCWRP had the land available to build a conventional facility for a large amount of flow and served the dual purpose to relieve loading on the Point Loma Wastewater Treatment Plant. Facilities like NCWRP may be seen more often in cities or counties that are not fully developed and have parcels of land available to build on. The popularity of satellite plants is sure to increase in the coming years, not only in Southern California, but elsewhere in the United States where supplemental water supplies are needed.

Conclusion

Decentralized scalping plants are a new topic of study for many agencies and cities that have arid climates. Scalping plants are being considered specifically because of their economic

feasibility to reclaim water and reuse it locally instead of having long, expensive transmission mains transporting the water for miles until it reaches an area where reclaimed water can be used. Scalping plants have gained attention specifically because of the requirement for less infrastructure and the endless need for water in areas that import most of their water. Scalping plants in California will typically treat water to a tertiary level to maximize the reuse potential within the regulatory framework. Certain design considerations have to be taken into account, especially the flow in the sewer the scalping plant will be removing wastewater from. The flow must be large enough to meet the demands of the users, but must also be large enough to keep the solids that are discharged back into the sewer suspended. It very likely that more satellite plants in San Diego and Orange County will be designed and constructed because they import most of their water and are at the end of the line to receive their water from Northern California and the Colorado River. Decentralized scalping plants will likely emerge throughout the United States, especially in areas that have drought conditions, because of the water shortage.

Acknowledgement:

I would like to thank Tom Falk, my supervisor at Dudek, for introducing me to scalping plants and sparking my interest in how they work and the future of them.

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