SEACOAST UTILITY AUTHORITY

ADMINISTRATIVE DIVISION
M E M O R A N D U M

TO: Seacoast Utility Authority Board

FROM: Rim Bishop, Executive Director

DATE: June 9, 2005

RE: **WATER TREATMENT ALTERNATIVES ANALYSIS**

Seacoast Utility Authority and its predecessor system owners have been providing lime softened drinking water to North County customers since 1957. Though the process has served these communities well, demands of a growing population, coupled with ever-tightening drinking water quality regulations will soon render lime softening an obsolete treatment technology. The time has come for a change.

North Palm Beach Utilities, Inc., serving North Palm Beach and Lake Park customers, placed the Richard Road Water lime softening water treatment plant in service in 1957. Palm Beach County Utilities Company opened the Lilac Street Water Plant in 1959, adding lime softening capabilities in 1964. Then in 1976, Palm Beach County Utilities Company placed the largest of Seacoast's current water plants, the Hood Road facility in service, delivering water treated by the same process. Currently, all Seacoast customers receive lime softened water.

WATER RESOURCES

SURFACE WATER

There are generally three sources of water available to South Florida drinking water utilities. The first is surface water such as that currently used by the City of West Palm Beach (Clear Lake, Lake Mangonia) and Glades area systems (Lake Okeechobee). This source is generally lower quality, susceptible to contamination, and very challenging to treat to consistently high standards. It is high in bacterial count, organic color, and is frequently characterized by varying taste and odor imparted by decaying vegetation and algae. In terms of availability, there are no acceptable surface water sources available to Seacoast, and even if there were they would not be preferred.

SURFICIAL AQUIFER GROUND WATER

The other two potential sources are both classified as ground water. Of these, the first to discuss is the surficial aquifer system that Seacoast uses. Surficial aquifer water is generally drawn from wells that range from 80 - 200 ft. in depth. While surficial aquifer water quality may vary somewhat from one local wellfield to another, it does not measurably change over time. The lime softening process has historically been well-suited for local surficial aquifer water because that process, with slight modification, is effective in treating offensive constituents most commonly found in local surficial aquifer water - hardness, taste/odor, iron, and to a lesser extent, color and bacteria. Of course, chloramination is used to disinfect Seacoast's water source, but lime treatment has a modest bactericidal effect as well.

Though this source continues to yield consistent quality water for Seacoast, pumping more water out of the surficial aquifer than rainfall and other sources can replenish causes drawdown of lakes, canals and wetlands and can encourage coastal salt water intrusion. While depressed lake and canal levels are unsightly, they are of lesser environmental and regulatory consequence than wetland and salt water impacts. Thus, the limited volume of ground water that can be withdrawn without impacting wetlands or promoting salt water intrusion is known as "safe yield". The authority that regulates resource water withdrawal in this region, South Florida Water Management District, has indicated that the withdrawal proposed by Seacoast over the next five years approaches the aquifer's safe yield.

FLORIDAN AQUIFER GROUND WATER

The other local ground water source is the Floridan aquifer, a water bearing rock formation that extends generally from 800 - 1,500 ft. below land surface. This is a plentiful resource, but in this region, Floridan aquifer water contains a high concentration of chloride (salt), a constituent that lime softening cannot remove. The most effective treatment approach for removing chloride is the process used by the Town of Jupiter water system, reverse osmosis. On a unit cost basis, reverse osmosis is a more expensive treatment process than lime softening, and it produces a 20 - 25% concentrated liquid waste stream ("reject water") for which disposal alternatives must be identified. However, this form of high pressure membrane treatment yields a very high quality drinking water product that does not quickly deteriorate in the water distribution system.

SEACOAST'S WATER TREATMENT PLANTS

At the present time, Seacoast owns and operates two lime softening treatment plants, the Richard Road (RRWTP) facility with a peak daily treatment capacity of 7.5 million gallons per day (MGD), and the Hood Road plant with a peak daily capacity of 23.0 MGD. The RRWTP receives its water from the Burma Road wellfield located along the west side of the C-17 canal near Costco and from a number of plant-site wells. Over the past year, RRWTP has treated approximately 4.0 MGD. The Hood Road plant (HRWTP) treats water from the Hood Road wellfield located just east of the turnpike in what is now Old Palm and the Palm Beach Gardens wellfield arrayed to the north and to the west of Palm Beach Gardens High School. The HRWTP has treated approximately 16.0 MGD over the past year with some 13.0 MGD of that amount taken from the Hood Road wellfield.

While treatment nuances such as chemical dosage and application points vary between the two Seacoast plants, the processes are essentially the same. Operators determine customer demand and activate wells needed to meet that demand. Water entering the plant is dosed with ammonia and chlorine which combine to form chloramine for disinfection. Potassium permanganate is added to reduce naturally occurring organic acids that cause color and deplete disinfectant. The water is aerated to remove odor-causing hydrogen sulfide and lime-consuming carbon dioxide, and also to oxidize dissolved iron and thus facilitate removal in subsequent treatment phases.

After aeration, the water flows to the softeners which are known as "solids contact upflow" units. Lime, coagulants and coagulant aids are added and vigorously mixed in these units. Once fully mixed, the oxidized iron, chemically altered calcium, and other settleable constituents fall to the bottom of the settling tank, and the clear water flows off the top to multi-media sand filters for final polishing. After the filtration, finished water is sent to storage and is delivered to the customer on demand.

WATER QUALITY CHARACTERISTICS

There is one critical water quality characteristic that sets Hood Road wellfield water apart from all other Seacoast sources. Certain high producing wells in the Hood Road wellfield contain high total organic carbon (TOC), dissolved organic material absorbed as the water flows over and through the earth to recharge the aquifer. This is characteristic of all local surficial aquifer supplies, but as a rule, the further inland the wellfield, the higher the organic content. Oversimplifying, this reflects the fact that aquifer recharge water flows from west to east, picking up organics from the muck soils and vegetation of the Everglades along the way. As Seacoast's most productive and westernmost wellfield, it is not surprising that Hood Road Water Plant product contains a disproportionately high level of organics.

It is this dissolved organic material that imparts a yellowish tint to the water. Prior to 1983, Seacoast, like all local water suppliers, applied free chlorine in sufficient dosages to chemically destroy organic color. However, responding to research indicating that exposing dissolved organics to free chlorine creates potentially carcinogenic compounds, the federal government effectively banned that practice for most utilities in August 1983. The answer for Seacoast was to chemically bind chlorine with ammonia creating monochloramine, a slightly less aggressive disinfectant with substantially less potential to create carcinogenic byproducts. The unfortunate consequence was, and remains, that yellowish-colored naturally occurring organics now survive the treatment process.

LIMITATIONS OF LIME SOFTENING TREATMENT

OPERATIONAL COMPLEXITY

While Seacoast has successfully applied its version of the lime softening process for nearly 50 years, the process is not without challenges and limitations. Maintaining and operating equipment designed to convert pebble quicklime into paste, then into slurry, then consistently deliver the slurry to treatment units in just the right amount is tedious and demanding work. At the same time, operators must monitor the treatment process around the clock and adjust other chemical feed systems (chlorine, ammonia, coagulants, coagulant aids, and potassium permanganate) such that varying customer demand can be met with the highest quality drinking water product possible. In short, the lime softening process practiced here at Seacoast requires the most highly trained, experienced and focused water treatment plant operators - inattentiveness can have significant consequences.

LIME SLUDGE DISPOSAL

Applying their collective 300 years of lime softening experience, Seacoast's 24 licensed water plant operators have, over time, optimized facility performance. However, as we all know, matter, including objectionable matter in raw water sources, is never actually created or destroyed. Most material removed during the lime softening process precipitates - that is, settles to the bottom as "lime sludge", creating a byproduct that must be disposed of or reused. At the present time, Seacoast generates several tons of lime sludge per day, stockpiling it on site until road builders remove it for use in road bed stabilization. Within the next several years however, area road construction will wind down, and lime softening operations will be forced to landfill their sludge.

"Recalcining" is a process by which lime sludge is burned and reusable lime is produced. On a large scale, operating related transportation, loading and furnace facilities is practical, but it is clearly impractical for a utility Seacoast's size. Several years ago, the Solid Waste Authority began in initiative to construct a regional recalcining facility in West Palm Beach, but interest in the project has declined since more and more water suppliers are abandoning lime softening. Seacoast had signed the required participation letter, but now there is no assurance that the facility will ever be built. This leaves landfilling as the only long term disposal option, one that is far too expensive and inconsistent with Seacoast's strong commitment to resource recovery.

PROCESS EFFECTIVENESS

Though operational complexities and byproduct disposal issues are highly challenging, tightening drinking water quality regulations are the death knell of Seacoast's lime softening operation. Explaining this will require the reader to refer to earlier sections of this report. I will discuss the most obvious limitation first, the one that drives Seacoast to alternative water supply sources and to other treatment alternatives as a result.

It appears that South Florida Water Management District has determined the safe yield of Seacoast's surficial aquifer wellfields to be in the area of 23.0 MGD. Knowing this, Seacoast prepared a water supply master plan in 1995 that proposes obtaining the remaining 6.0 MGD needed for service area buildout from the Floridan aquifer. As mentioned earlier, this water is too brackish to be treated successfully with lime softening. Thus, in addition to deep Floridan aquifer wells and raw water transmission piping, it will be necessary to construct a high pressure reverse osmosis water treatment facility. These improvements are included in Seacoast's 1995 Master Plan document, and Seacoast has been collecting connection charges to support them since that time. Of course, this provides ***future*** water supply, but it does not necessarily address issues with existing surficial water supply resources or associated lime softening issues.

As mentioned earlier, federal drinking water regulators began establishing disinfection byproduct (DBP) drinking water standards in the early 1980s. The first of these was for substances collectively identified as "trihalomethanes" (THM). By replacing the practice of free chlorination with chloramination (combined chlorine and ammonia), most local utility providers, including Seacoast, were able to maintain concentrations of these suspected carcinogens within the earliest established standards. Over time, new DBP compounds were identified and regulated and the standard for allowable THM concentration was reduced. Again and again, Seacoast's operations staff rose to the occasion, tweaking treatment practices to comply with ever-tightening standards.

The final regulatory hurdle, the one for which there there appears to be no environmentally responsible and technically feasible operating protocol, became effective in January 2004. That is when a new standard setting a maximum concentration level for chloramine itself was implemented. This meant that water suppliers disinfecting with chloramine would now be required to maintain residual monochloramine levels between the regulatory minimum of 0.6 milligrams per liter (mg/l) and the newly established maximum of 4.0 mg/l. Through long experience, Seacoast had learned that optimum systemwide water quality could be maintained with an average system monochloramine residual of 5.0 mg/l and modest routine system flushing. While technical staff at first hoped that the consequences of reducing chloramine dosage by 1.0 mg/l would be minimal, that was not to be the case.

Almost immediately after reducing chloramine dosage, water quality issues began surfacing in the Horseshoe Acres/Steeplechase area, a remote corner of Seacoast's water distribution system characterized by low flows and large diameter pipe size. Residual chloramine depletes naturally over time, and the longer that water remains in the pipeline, and the higher the organic content of the water, the more depletion occurs. Chloramine eventually dissipates to the point that non-disease causing bacteria form a "biofilm" on the pipeline wall. This biofilm thrives in the presence of low residual chloramine and can convert low levels of monochloramine, which normally has no taste or odor in drinking water concentrations, to dichloramine or perhaps even trichloramine, both of which impart an extremely foul taste and have virtually no disinfection capacity. This process, known as "nitrification", is generally identified by four symptoms - extremely low monochloramine concentration, high non-pathogenic bacterial plate counts, declining pH, and numerous water quality complaints. Seacoast experienced all four.

After evaluating several options including free chlorinating the system to remove biofilm (allowed by rule on a routine basis), installation of remote chloramination booster facilities and enhanced flushing, staff determined that flushing and replacement of old oversized mains was the best approach. From early 2004 to the present time, distribution crews have tested various valving arrangements aimed at steering the freshest water possible into the Horseshoe Acres area. In addition, Seacoast recently replaced approximately $700,000 of old, large diameter Horseshoe Acres water mains with smaller lines. The theory of this replacement is that the smaller the line, the faster the water will move through it, and thus the less likely it will be that monochloramine residual will dissipate to critical levels. If the theory held true, this would allow Seacoast to throttle back its flushing, allowing normal usage to provide the water flow needed to keep the water fresh.

The smaller replacement mains have been in service for approximately 3 months at this point, and a significant reduction in flushing water has been achieved. At one time, approximately 10% of Seacoast's 19.0 MGD water production was being flushed for the sole purpose of maintaining water quality in certain areas. While water lost to flushing has been reduced to less than 0.5 MGD, this experience compels Seacoast to look seriously at treatment alternatives for its surficial aquifer water source. Seacoast’s customers deserve a process that can effectively and reliably reduce organics and their resulting monochloramine demand without creating prohibited concentrations of potentially carcinogenic DBPs.

The problems described in this summary are not unique to Seacoast, and aside from an unusually high concentration of total organic carbon (organics), every public water supplier in southeast Florida faces them. Accordingly, they have been studied extensively, and in each case, the answers have been the same.

1. If a water utility needs more water to meet buildout demands than its surficial aquifer safe yield can provide, the marginal additional water is taken from the Floridan aquifer. That water is treated using high pressure reverse osmosis.
2. To deal with growing concerns over the disposal of lime sludge and with the consequences of high organics levels in surficial aquifer supplies, lime softening processes are replaced with membrane softening or "nanofiltration".

Of the mid-size to large public water supply utilities along the southeast coast, only Seacoast, Riviera Beach, and West Palm Beach have not yet considered moving away from lime softening toward membranes. Riviera Beach's water supply contains less dissolved organics than Seacoast's and thus faces fewer disinfection byproducts challenges. As a surface water supplier, West Palm Beach must consider overhauling its entire water supply and treatment system, not just converting the treatment process itself. Diligently, skillfully, and with unfailing concern for public health, the environment, and customer cost, Seacoast has extracted a half century of service from its lime softening facilities. It is now time to move on.

Accordingly, staff has asked Seacoast's general engineering consultant to evaluate water treatment alternatives and prepare a report for the board. While a discussion of options other than reverse osmosis and nanofiltration will be encouraged, Seacoast's issues and the technologies available to address them are well known. Thus, we anticipate the engineer's report to be more of a preliminary engineering report than a treatment alternatives evaluation. We will ask the engineer to refine and perhaps expand the following schedule of improvements as necessary and to provide an estimated cost for each:

Hood Road WTP

3.0 MGD High Pressure Reverse Osmosis Treatment Plant
5 Floridan Aquifer Wells
Approximately 15,000 ft. of Raw Water Main
8.0 MGD Tube and Packer Deep Injection Well and Pump Station

23.0 MGD Low Pressure Nanofiltration Treatment Plant
Reject Water Connection to Seacoast's Sanitary Sewer System, or
Reject Water Connection to Tube and Packer Deep Injection Well and Pump Station

Richard Road WTP

7.0 MGD Low Pressure Nanofiltration Treatment Plant
Reject Water Connection to Seacoast's Sanitary Sewer System

Of course, staff will ask the consultant to evaluate blending with existing lime softening facilities, phasing and sequencing of different improvements, and the consequences of discharging reject water into the sanitary sewer system. Further, staff will request that the engineer suggest alternatives that will allow Seacoast to meet its current and future customer needs in the most cost-effective manner possible, including bulk water purchases from neighboring utilities.

Once completed, staff will present the engineer's report to the board, accompanied by a financial and rate impact analysis and recommendation. If implemented in its entirety, the program outlined above will be quite costly. That is why we seek greater expertise than our own before formalizing a board recommendation. The purpose of this memo is to express staff's current thinking to the board, provide background information supporting our preliminary conclusions, outline the plan for addressing them, and solicit early board member comment and questions.

Thank you for your attention and consideration.