



Sheaffer & Roland Technology Report



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1. Wastewater Reclamation & Reuse

Developed over the course of the last two decades, Sheaffer & Roland's *Wastewater Reclamation and Reuse (WWRR)* system provides an environmentally sensitive and odor-free approach to wastewater management. In this system, the wastewater is first reclaimed in deep aerated cells, followed by filtration and disinfection.

The product is reclaimed water which is reused to irrigate and fertilize agricultural crops, landscape vegetation or recreational turf. It is applied at a rate consistent with plant needs, climatic environment and soil conditions.

Such a system is frequently referred to as "circular." It is based on the ecological principle that everything must be someplace and pollutants are merely resources out of place.

When wastewater is reclaimed and reused there is no effluent disposal or discharge site. Rather, there is a *utilization* site where reclaimed, virtually pathogen-free water containing basic plant nutrients nitrogen, phosphorous and potassium (N, P & K) are used to irrigate and fertilize growing plants. The water is cleansed further by the 'living filter' of plants, soil and geology, and then may help to recharge groundwater supplies.

Regarding the utilization of this technology in Kane County, the Kane County 2020 Land Resource Management Plan states:

“ . . . Manage wastewater treatment in an effective and environmentally sound manner conducive to public health, including the encouragement of wastewater recycling and reuse systems with land application to eliminate point discharge of wastewater into creeks.”



The golf course is the reuse site for the reclaimed water at Mill Creek near Geneva, Illinois.

2. Elements of the Deep Cell WWRR System

The following elements typically comprise the treatment and reuse train for a deep-cell WWRR system in an urban setting as designed by Sheaffer & Roland, Inc. An example is shown in the picture.

- **COMMINUTOR**
This "garbage disposal" grinds up solids before the wastewater enters the aerated cells. The comminutor is covered to prevent odors.
- **AERATED TREATMENT CELLS (A)**
There usually are two deep aerated treatment cells with a total retention time of two to five weeks. Wastewater enters at the bottom of the aerated cells to prevent odors. The cells are designed to allow for the settling of solids, which collect in the containment area where final decomposition occurs. The small volume of residual solids may be removed once every 20-40 years.
- **STORAGE RESERVOIR (B)**
Storage is provided for the reclaimed water during cold weather, precipitation, or other non-irrigation periods.
- **FILTRATION (C)**
Filtration increases the efficiency of the disinfection process (see below) and minimizes clogging of irrigation equipment. It is not needed for agricultural irrigation. Intermittent slow rate sand filters or gravity sand filters normally are used.
- **DISINFECTION (D)**
Disinfection is commonly used in situations where there is a high degree of human activity in the irrigation area such as with golf courses, public parks, sports fields or other recreation or picnic areas. Disinfection is typically accomplished by chlorination.

- **OPERATIONS BUILDING (D)**

The operations building usually is a small structure which houses the blowers, electrical controls, telemetry equipment, and disinfection equipment, if needed.

- **IRRIGATION AREAS (E)**

The irrigation area can be centralized at one location or take place at a number of sites. Some systems irrigate primarily agricultural land to capitalize on the valuable nutrients. But golf courses, parks, landscaping, forested areas and athletic fields -- virtually any area with growing plants -- also may be irrigated, thus adding value to the land. Irrigation occurs only when plants are growing and climatic conditions are favorable. Reclaimed water also has been used to make snow for ski slopes and ice for skating ponds.

The Chancellery luxury hotel and office complex, Itasca, is the site of the first of many modern wastewater reclamation and reuse systems in northern Illinois designed by Sheaffer & Roland, Inc.



3. Benefits of the WWRR...

- **“NO DISCHARGE GOAL”**

With Sheaffer & Roland (S&R) technology it is usually unnecessary to obtain a National Pollution Discharge Elimination System (NPDES) permit which would need to be renewed every five years. When the reclaimed wastewater is reused beneficially, no pollutants are discharged into our nation's navigable waters.

- **USES SEWAGE AS A RAW MATERIAL**

A city of 100,000 produces 10 million gallons per day (gpd) (37,854 cubic meters) of wastewater which typically contains 4,587 pounds of nitrogen, phosphorus and potassium (N-P-K) in a 35-10-10 ratio. In the S&R system much of the nitrogen is lost to the atmosphere, but over the period of a year, more than 1.5 million lbs. of N-P-K in about a 10-10-10 ratio are available in the wastewater as plant fertilizer.

In addition, the 10 million gpd of wastewater amounts to 11,200 acre-feet of irrigation water per year. If a cost of just \$0.25/1,000 gallons is placed on the irrigation water alone, it has an annual value of \$912 500.

- **CAPITALIZES ON SPECIFIC SITE/UTILIZATION OPPORTUNITIES**

S&R employs a proven planning process in order to integrate the system into land use plans and to take advantage of specific opportunities at the location in question. Working as part of the planning/development team from the onset of the project, S&R scientists and engineers contribute to the development's cost-effectiveness through creative concepts.

- **REDUCES THE ACCUMULATION OF SOLIDS OR SLUDGE**

The best way to handle sludge is to not produce it. The decomposition of organic matter provides for the reduction of more than 90 percent of the accumulated solids (sludge). The solids which do not break down are stored in the bottom of the treatment cells. Sufficient space is provided so that solids handling occurs no more than once every two decades.

- **ADDS VALUE TO THE LAND**

Research has shown that land values in the vicinity of well-managed irrigation sites are enhanced by this utilization. Thus, the utilization site should be managed as a community and economic development asset. Irrigation with nutrient-rich reclaimed water has proven to greatly increase crop yields on certain utilization sites. This results in a "win-win" rural-urban cooperation situation: farmers' profits go up while the urban dwellers have more affordable user fees. Some utilization sites are managed as recreation and open space amenities such as golf courses, parks, woodlands or forest preserves, athletic fields, or landscaping for business campuses or housing subdivisions, thus maximizing local land values.



4. Wastewater Reclamation and Reuse is Versatile



WILLOWMERE - COMMUNITY PARK
S. Barrington (Cook County) IL



WHITETAIL - SKI RESORT
Pennsylvania



MILL CREEK - GOLF COURSE
Geneva (Kane County) IL



FOX MILL - AGRICULTURE
St. Charles (Kane County) IL

5. Examples of Operating Projects

AGRICULTURE

- NORTHGLENN (Colorado)
- FIELDS OF LONG GROVE (Lake Co.)
- SADDLEBROOK FARMS (Lake Co.)
- UNIV. OF PENNSYLVANIA School of Veterinary Medicine
- FOX MILL (Kane Co.)
- LUBBOCK (Texas)
- VALLEY HI NURSING HOME (McHenry Co.)

OFFICE PARK/ COMMUNITY

- THE CHANCELLORY (DuPage Co.)
- ROSE PACKING (Cook Co.)
- THE HOMESTEAD (Michigan)
- WHITETAIL SKI RESORT (Penn.)
- SILVER GLEN (Kane Co.)
- GLENWOOD SCHOOL FOR BOYS (Kane Co.)
- BANNER DAY CAMP (Lake Co.)
- WILLOWMERE (Cook Co.)

GOLF COURSES

- WYNSTONE (Lake Co.)
- IVANHOE GOLF CLUB (Lake Co.)
- ROYAL MELBOURNE (Lake Co.)
- MILL CREEK (Kane Co.)

6. Public Health Aspects of a Typical WWRR System

In the S&R system, aggressive aeration, along with filtration, disinfection and redundancy, provides the highest level of protection against potential public health problems. The following treatment processes are part of S&R's system:

1. More than a month's total detention in the aerated treatment cells.
2. Up to 150 days of retention in the storage reservoir also provides for significant pathogen reduction;
3. Sand Filters -- the same method used to purify public drinking water supplies -- to further assure removal of suspended solids and to break up biological "clumps" prior to disinfection;
4. Chlorination -- also as used in public water supply purification -- to assure a pathogen-free irrigation water supply.
- 5.

The resulting high level of purity presents no threat to human contact. This has been corroborated by the environmental protection agencies of Illinois and several other states.

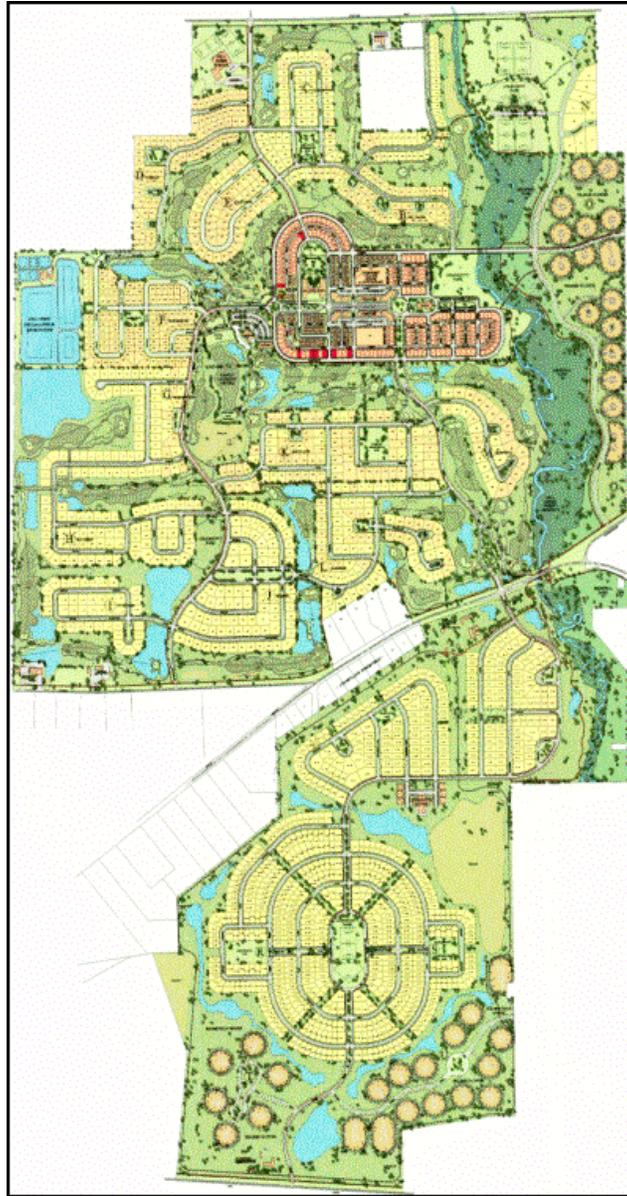
7. Odors in Wastewater Treatment Processes

Under certain conditions, offensive odors are produced when organic compounds decompose *and* come into contact with the atmosphere. In conventional sewage treatment methods odors typically can emanate from two principal sources: 1. open sewage treatment facilities; and 2. sludge handling operations. Odors also are generated in conventional systems when they are "upset" by a biological imbalance or when flows exceed the capacity of the system.

Odors are prevented in the S&R exclusive deep-cell system under virtually all conditions. First, untreated sewage is not exposed to the surface; it is introduced near the bottom of the cell, where it is covered by from 15 to 25 feet of heavily aerated water. During the ongoing treatment process the organics are decomposed by oxidation. The residual solids are deposited on the bottom in a storage area where the remaining organics decompose in the absence of oxygen (anaerobically) for years. The S&R system is designed so that even under highly variable wastewater flows and characteristics there will be no difference in treatment effectiveness. Reserve aeration capacity is just one of the keys to this quality.

S&R systems solve the sludge odor issue by not producing sludge in the first place. Thus, unlike conventional sewage treatment plants that produce sludge which must be removed as part of their regular operation, there simply are no odors associated with sludge removal.

8. Wastewater Reclamation and Reuse is a Planning Tool



*Site plan for the Mill Creek development.
Note wastewater reclamation and reuse site at upper left.*



Water features are found throughout the Mill Creek development.



Cell I of the odor-free, 650,000 gallons-per-day capacity deep-cell wastewater treatment facility at Mill Creek. Note the proximity of housing.

9. Comparison of Treatment Alternatives:

CIRCULAR SYSTEM: WASTEWATER RECLAMATION & REUSE

NO DISCHARGE OF POLLUTANTS

- Reclaimed water is used as a resource to irrigate plants
- Valuable nutrients are recycled by growing plants
- Reclaimed water helps recharge groundwater supplies
- No sludge handling on a regular basis
- No odor nuisances

LINEAR SYSTEM: CONVENTIONAL ADVANCED SEWAGE TREATMENT

DISCHARGE OF EFFLUENT TO LAKES AND STREAMS

- Treatment process produces large amounts of sludge which must be disposed of
- Nutrients are discharged into streams and lakes where they are pollutants (resources out of place)
- Unpleasant odors frequently cause nuisances
- Peak flows frequently bypass the treatment process resulting in increased pollution
- Performance of plant reported only in terms of 30-day average; periodic upsets in treatment performance can cause episodes of water quality degradation with subsequent fish kills and other biological damage

THE MATTER OF SLUDGE

Sewage sludge is difficult and expensive to relocate, and the relocation process can produce odors. The sludge produced by the two systems resulting from the treatment of 1 million gallons is approximately:

Sheaffer System = 60 lbs. Conventional STP = 2,000 lbs. (1 dry ton)

The best way to deal with sludge is not to produce it at all!

“The conclusion . . . is that these systems – when properly designed, constructed and operated – do not smell, do not disperse pathogens, are not unsightly, are cost-effective, recycle water and nutrients, and eliminate point source discharges. . . From my experience . . . it would seem that a water reclamation and recycling system designed by Sheaffer & Roland is a viable environmental and financial alternative that deserves your close attention.”

***Philip S. Bus, Executive Director
Kane County Development Department***

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