WATER REUSE STUDY
ROCKLAND COUNTY SEWER DISTRICT NO. 1
ROCKLAND COUNTY, NEW YORK

Prepared for

ROCKLAND COUNTY, NEW YORK

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December 2002

Project No. 1000884

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CHAPTER 1

EXECUTIVE SUMMARY

During the summer of 2002, Rockland County was facing one of the most critical and potentially devastating issues it has every faced: the possible lack of water for everyday use. While drought is not a new issue, after five consecutive years of below-normal rainfall, in 2002, the County was forced to declare a Stage 3 drought warning, the highest level of drought ever declared in its history. Fortunately, the County was temporary spared a crisis by above-normal rainfall during the months of October and November 2002.

Had this rainfall not occurred, the County may have had to call for Stage 4 or 5 restrictions. Stage 5, being the highest restriction available, would limit water usage to 50 gallons per person per day and prohibit all watering of lawns and golf courses, landscaping, washing of vehicles, operation of private pools, and would place restrictions on the use of water for agricultural, commercial, and industrial purposes.

While the recent rainfall has raised the level of Lake DeForest to a normal level for the first time this year, the reservoir had previously been as low as 46 percent of capacity. The Lake DeForest reservoir accounts for one-third of the County's water supply.

The flow in the Ramapo River also increased, allowing United Water to resume full operation of the wellfield adjacent to the Ramapo River. This wellfield also provides roughly one-third of the County's water. The remaining water is provided from bedrock wells throughout Rockland County. This means that nearly two-thirds of all the water utilized in Rockland County comes from groundwater sources that depend heavily on long-term rainfall conditions. Since recharging the groundwater is a much slower process than filling a reservoir, monitoring of the groundwater is continuing throughout the County, and in some areas is showing minimal recovery. Therefore, Stage 1 restrictions are still in effect.

Each time the County is faced with prolonged drought conditions, the situation becomes more critical. This is because the demand for water is increasing along with the rise in population, yet the sources of water within the County have remained constant. The reason Rockland County is particularly prone to drought conditions is that it must depend on getting water from sources primarily within its own borders. These sources are either precipitation or flow from the Ramapo or Hackensack Rivers. The County does not have access to any of the aqueducts serving New York City, and the Hudson River to the east is a poor source because of its salinity.

Unless Rockland County increases its water resources, it will not be able to maintain the quality of life residents have come to expect. This is a long-term problem. Fortunately, there are now options available that were unthinkable until recently. One such option which is gaining acceptance in other drought-prone areas across the nation is to increase the level of treatment of wastewater effluent and return it to the sources of water supply.

The County has the opportunity to solve their water shortage by recycling reuse water back to either the Ramapo or Hackensack River basins to augment these two major sources of water. As outlined in this study, the proposed Western Ramapo advanced wastewater treatment plant could recharge the Ramapo River with up to 5 mgd of highly treated effluent that meets drinking water standards. In addition, 15 mgd of existing effluent from the Rockland County Sewer District No. 1 plant located in Orangeburg could be further treated to similar drinking water standards and pumped to the Hackensack Basin to recharge this source of water. The combined flow form both of these plants could recycle nearly 20 million gallons of usable water back to the County each day regardless of rainfall. By capturing 20 mgd and returning it to the same drainage basin from which it came, Rockland County's water shortage crisis could be solved.

While the County avoided a water crisis in 2002, it may take several years for the water table to recover to safe levels. The opportunity exists to become independent from Mother Nature. The leaders of Rockland County have the choice to take action now to protect and continue to provide a reliable supply of water to County residents regardless of rainfall, or do nothing and gamble that seasonal rainfalls will once again "bail them out" of a crisis. The choice is yours.

CHAPTER 2

BACKGROUND

In 2002, Rockland County reservoirs and groundwater supplies were at record low levels as a result of below-normal rainfall over the past five years. To avoid a major crisis, the Rockland County Department of Health was forced to implement, for the first time ever, water restrictions to a Stage 3 drought warning. At Stage 3, watering of lawns is prohibited, golf course watering is further restricted, water is not served in restaurants unless requested, and only commercial car washes that recycle water are allowed to operate. Had the drought continued, the County would have had to implement Stage 4, which would have been very unpopular since all watering of golf courses, gardens, and landscaped areas would have been prohibited along with all commercial washing of vehicles and operation of private pools. The damage to all types of vegetation would have been costly.

While the County avoided implementing Stage 4 or 5 (5 being the highest level, which would have limited residents to 50 gallons per day and prevented use of water for all lawns, gardens, golf courses, and landscaped areas), it cannot disregard the existing water shortage; even an entire season of heavy rainfall will not correct the shortfall caused by five consecutive years of below-normal rainfall.

What makes Rockland County particularly prone to drought conditions is that it must depend on getting its water from sources within its borders, either from precipitation or flow from the Ramapo or Hackensack Rivers. The County does not have access to any of the aqueducts serving New York City, and the Hudson River to the east is a poor source because of the salinity coming from the ocean. During prolonged drought conditions, all the above sources of water obviously become extremely stressed. Unless Rockland County increases its water resources in some way to accommodate the continued population growth in the area, it will not be possible to maintain the quality of life residents have come to expect.

Rather than waiting for the inevitable water shortage to occur, Rockland County officials are looking at several exciting creative options which, if implemented, would provide enough usable water to avoid future water restriction for generations to come. One such option, which is gaining acceptance in other drought-prone areas across the nation, is to increase the level of treatment of wastewater effluent and return it to the water supply. The County can no longer afford to continue to discharge millions of gallons of treated wastewater every day into the Hudson River. Presently, the RCSD No. 1 plant in Orangeburg discharges over 20 million gallons of effluent to the Hudson River each day, which is a lost source of water to the County forever.

If only a portion (say 15 million gallons per day [mgd]) of the discharge could be treated to a higher lever by adding treatment components utilized in the drinking water industry, such as sand filtration for microfiltration, the highly treated effluent could be recycled back to Rockland County's existing water resources. In addition, the flow from the proposed Western Ramapo wastewater treatment plant, which is already planned to produce highly treated effluent, could help supplement the Ramapo River source of water by as much as 5 mgd. The combined flow from both the above two plants could recycle nearly 20 million gallons of usable water back to the County each day regardless of the rainfall.

Reusing this water would go a long way towards solving the County's water shortage. "The technology in water re-use has been advancing in the past 10 years," according to Mr. Alan Grey, Deputy Executive Director of the Water Environment Federation. "We can now take wastewater to the point where its quality is suitable for use as drinking water."

While the technology exists to utilize treated wastewater for drinking water, there are many other uses that will enable the County to withstand future prolonged droughts that may be more acceptable. For example, water now being used to water golf courses and landscaping could be replaced by recycled wastewater. Other options would include pumping the highly treated effluent back to streams or pipes that lead into either aquifers or reservoirs within the County rather than sending it out of the County into the Hudson River. Once the water percolates into the groundwater or makes its way to one of the County's reservoirs, it would be treated and disinfected the same way any other water is before being distributed to residents throughout the County.

There is a fixed quantity of water on this Earth that is used over and over again. With the technology available today it is possible to do what nature does, but on a fast track basis. The potential for a water crisis to occur in Rockland County in the near future is real. It can be avoided if action is taken now to move forward with a program to recycle highly treated wastewater. Water reuse has already been proven successful in Fairfax County, VA and San Diego, CA, and can be successful in Rockland County.

Other options are being evaluated by United Water of New York, including construction of a new reservoir within the Hackensack Basin or construction of a desalinization plant to utilize the Hudson River as a source. The time required to build a new reservoir or a desalinization plant to avoid the next drought is a concern.

This report provides details in support of water reuse. Such an effort will ensure the standard quality of life will be maintained and continued for the residents of Rockland County.

CHAPTER 3

SUMMARY OF WATER RESOURCES

3.1 DRINKING WATER RESOURCES

Rockland County is unique in that most of its drinking water resources originate from within the County.[1] There are 80 public water supply systems in Rockland County and 6,000 to 8,000 private wells.[1] United Water of New York (United Water) provides the majority of water to Rockland County residents. United Water generates approximately 30 mgd of water to serve approximately 265,000 Rockland County residents via one surface water source, the Hackensack River, and multiple wells.[2] All other systems that provide drinking water to Rockland County residents use groundwater wells. United Water operates several wells throughout Rockland County, but the largest group is the Ramapo Valley Wellfield, located adjacent to the Ramapo River. When the wells operate during low river flow conditions, they actually draw the level of the Ramapo River even lower and reduce the flow.

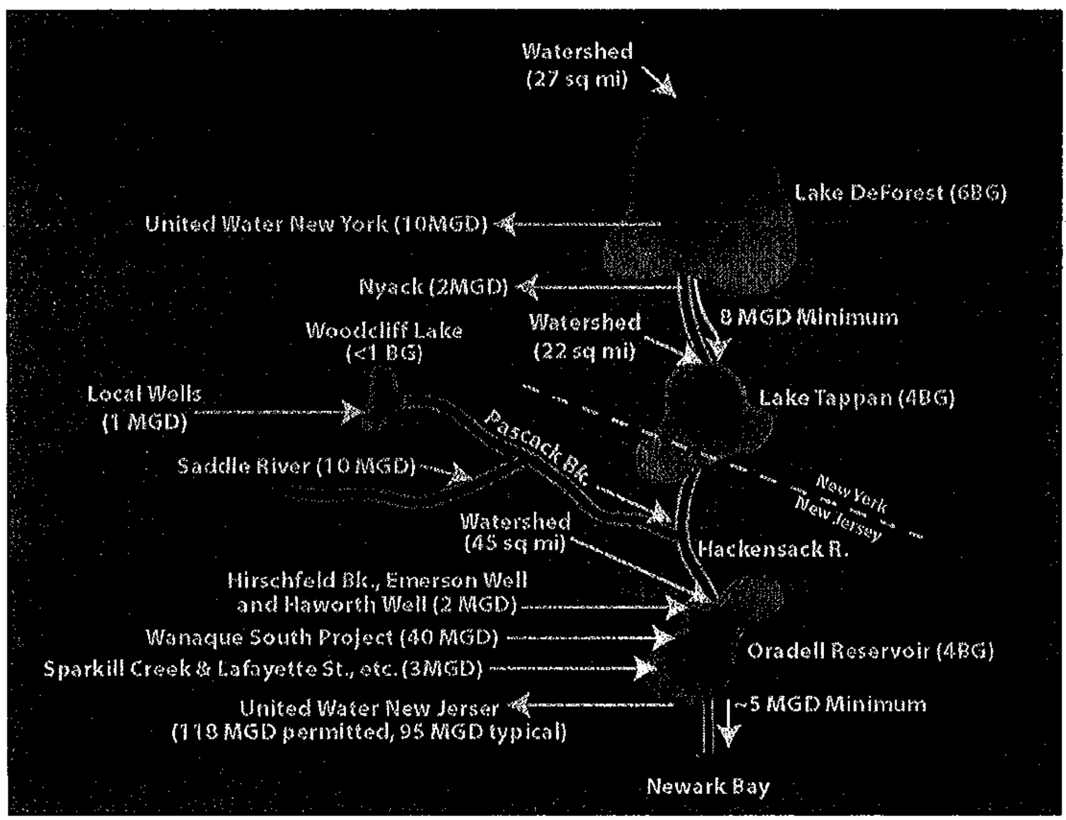
A. **Ramapo Basin**. The wellfields adjacent to the Ramapo River supply water to Rockland County residents only. All of United Water's wells in the County combined provide about 62 percent (20 mgd) of Rockland County's water. The Ramapo wellfield alone provides 8 to 10 mgd when in service.

Based on studies performed by Lawler, Matusky and Skelly Engineers (LMS), there is a quantifiable relationship between the Ramapo River flows and the well operations, particularly during low river flow periods. The Ramapo River provides recharge to the Ramapo Valley aquifer which is utilized for drinking water, via United Water wells, to users in Rockland County and New Jersey. The aquifer is a federally designated, sole-source aquifer which accounts for 30 percent of Rockland County's water supply. An agreement exists whereby United Water cannot operate their wellfields when the flow in the Ramapo River drops below 8 mgd, as measured by the regulatory weir located just upstream of the New York-New Jersey state line. When this occurs, United Water must draw water from other sources or reduce demand. For reference, these wells have been off line about 10 percent of the time[3] due to low flows in the Ramapo River over the past 20 years.

B. **Hackensack Basin**. The Hackensack Basin via Lake DeForest accounts for about 33 percent (10 mgd) of United Water's water production for its customers within Rockland County.(2) The Hackensack Basin includes a total of four drinking water reservoirs: Lake DeForest, Lake Tappan, Woodcliff Lake, and the Oradell Reservoir.

The following figure graphically represents the entire Hackensack Basin. As shown in the diagram, there are man-made inflow sources such as wells or aqueducts within the basin that supplement normal stream or river flow; however, Lake DeForest, which is the only reservoir in the basin used by Rockland County, relies entirely on rainfall as its source of water.

HACKENSACK SYSTEM WATER BALANCE
(with representative inflows and transfers)(4)



1. **Lake DeForest.** Lake DeForest is completely located within Rockland County. Its storage capacity is 5.6 billion gallons. United Water owns and operates a water treatment plant with a direct intake from the lake and withdraws about 10 mgd from this source. The Village of Nyack also owns and operates a water treatment plant that uses water from Lake DeForest; however, Nyack's intake is immediately downstream of the lake. The Village of Nyack water treatment plant's permitted capacity is 2 mgd. Thus, a total of 12 mgd can be withdrawn from the lake for Rockland County residents (60 percent of the yield).

To maintain flow in the Hackensack River, United Water must discharge another 7.75 mgd from the lake. This is done not only to support aquatic life, but also to supply the Oradell Reservoir in New Jersey where United Water of New Jersey owns and operates a water treatment plant.

2. **Lake Tappan.** Lake Tappan is located partly in Rockland County and partly in New Jersey. Its storage capacity is 3.83 billion gallons. There are no wells or aqueducts that supply water to the lake, and there are no publicly owned water treatment facilities that withdraw from the lake.

3.2 WASTEWATER TREATMENT FACILITIES

There are six municipal wastewater treatment plants in Rockland County.[5] As indicated below, the largest plants all discharge directly to the Hudson River, which is an out-of-County discharge of wastewater that cannot be recovered. Thus, Rockland County does not benefit from indirect reuse of any of its wastewater, such as recharging the groundwater, as many other communities do.

wastewater treatment plant	permitted capacity	discharge point
Haverstraw Joint Regional wastewater treatment plant	8.0 mgd	Hudson River
Orangetown Sewage District No. 2 wastewater treatment plant	12.75 mgd	Hudson River
Rockland County Sewer District No. 1 wastewater treatment plant	26.0 mgd	Hudson River
Stony Point wastewater treatment plant	1.0 mgd	Hudson River
Sloatsburg wastewater treatment plant (Lincoln Park)	0.03 mgd	Ramapo River
Suffern Village wastewater treatment plant	1.8 mgd	Ramapo River

CHAPTER 4

SUMMARY OF EXISTING WATER SUPPLY CONDITIONS

4.1 CURRENT DROUGHT CONDITIONS

Due to below-average precipitation over the past five years, the Rockland County Department of Health ordered water restrictions to ensure a sufficient water supply for sanitation and fire protection needs[1]. More recently, from September 2001 through August 2002, the actual precipitation was only 34 inches, which is nearly 8 inches below the historic average of 42 inches. On March 6, 2002, the Department of Health upgraded the water restrictions to a Stage 3 Drought Warning, which prohibited watering of lawns and further restrictions on watering of golf courses and plant nurseries plus restrictions on vehicle washing.[6] Stage 5 is considered the worst and is referred to as a Severe Drought Emergency that would limit residents to 50 gpd and no watering of any lawns or outdoor plantings, golf courses, etc.

4.2 STATUS OF LAKE DEFOREST

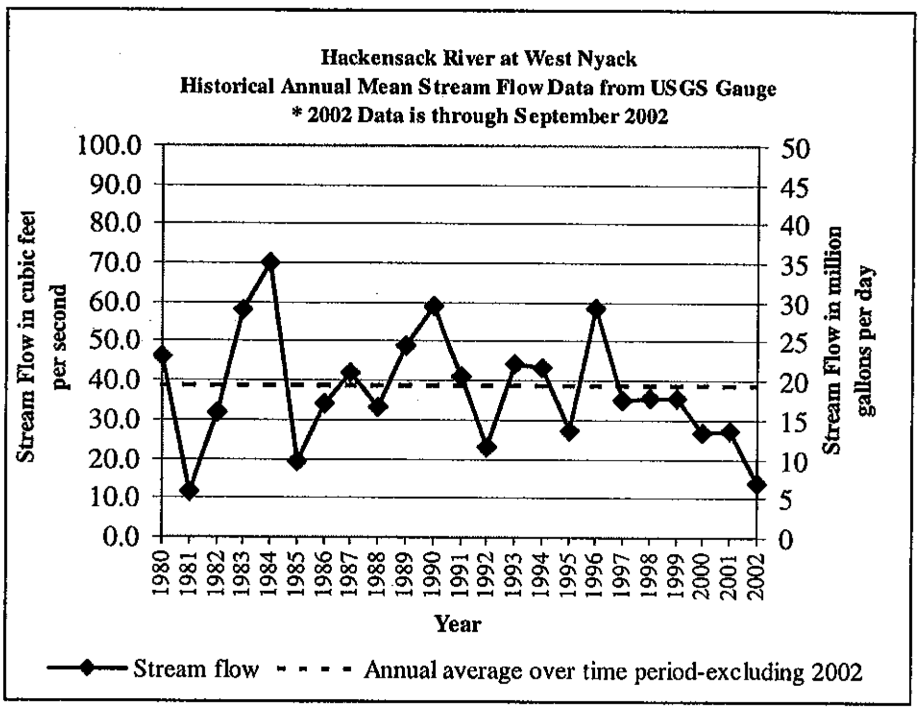
As a result of several years of below-average precipitation, Lake DeForest was at 56.47 percent of its total capacity on September 4, 2002.[1] Its normal capacity at that time of year is 81.75 percent of total capacity; thus, Lake DeForest was 1.4 billion gallons below its normal capacity. Fortunately, after above-average rainfall conditions during October and November, all water restrictions were removed on December 9, 2002. However, Rockland County Health Commissioner Dr. Facello urged residents and businesses to continue water conservation measures to help recharge Rockland County water resources. Lake DeForest has risen to 85 percent of its capacity, which is good for the month of December.

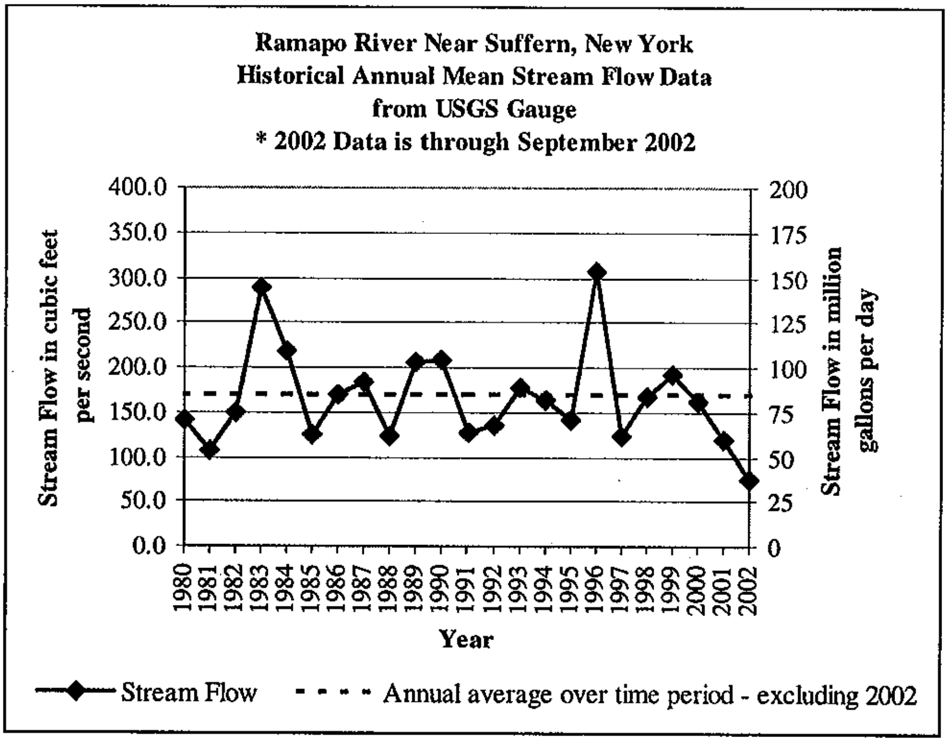
4.3 STATUS OF RAMAPO VALLEY WELLFIELDS

As indicated earlier, the Ramapo River wellfields supply water to about one third of United Water of New York's customers. However, when the wells are not operated (on average, 33 days per year since 1979) due to low river flow resulting from lack of precipitation, water restrictions are enacted and other system sources must make up any difference. This causes an increased demand on the use of water from Lake DeForest, which is dependent entirely on rainfall. During prolonged drought conditions, Rockland County's two main sources of water are severely stressed.

4.4 RIVER FLOW RECORDS

The following graphs summarize historical flows in the Hackensack and Ramapo Rivers. As of September 2002, the Ramapo River near Suffern was at a 20-year low flow condition. Had the rainfall not increased during October and November 2002, drought conditions would have become critical.




Ramapo River Near Suffern, New York
Historical Annual Mean Stream Flow Data
from USGS Gauge
* 2002 Data is through September 2002
Stream Flow in cubic feet per second
Stream Flow in million gallons per day
400.0
350.0
300.0
250.0
200.0
150.0
100.0
50.0
0.0
200
175
150
125
100
75
50
25
0
1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002
Year
Stream Flow
Annual average over time period - excluding 2002

CHAPTER 5

DESCRIPTION OF ALTERNATIVES FOR ENHANCING ROCKLAND COUNTY'S WATER RESOURCES

5.1 ALTERNATIVES

There are four alternatives that have been developed for supplementing Rockland County's water resources. They are:

1. Recharge Ramapo River via reuse water generated at a new advanced wastewater treatment plant located in Hillburn and recharge Hackensack River Basin via reuse water from an upgraded RCSD No. 1 wastewater treatment plant in Orangeburg. The proposed Western Ramapo wastewater treatment plant would treat all flows from Western Ramapo and possibly flows that are currently tributary to the Mahwah Pump Station.

2. Recharge Ramapo River and Hackensack River Basin via reuse water generated from an upgraded RCSD No. 1 wastewater treatment plant in Orangeburg. This option would not require the construction of a new wastewater treatment plant in Hillburn, but would require infrastructure to convey wastewater to RCSD No. 1's wastewater treatment plant and a reuse water system to return water to the Ramapo River and Mahwah River.

3. United Water would build a new reservoir (Ambrey Pond) upstream of Lake DeForest to supply additional water to Rockland County. This option would require rebuilding the currently decommissioned Cedar Pond water treatment plant in Stony Point. For the purposes of this analysis, it is anticipated that wastewater tributary to a Western Ramapo wastewater treatment plant would receive advanced treatment and be discharged to the Ramapo River to satisfy NYSDEC's requirement that transferring water from the Ramapo Basin to any other basin is not permitted.

4. United Water would construct a desalination facility using the Hudson River water to supply additional water to Rockland County. For the purposes of this analysis, the Western Ramapo wastewater treatment plant would receive advanced treatment and be discharged to the Ramapo River as mentioned above.

A detailed discussion of each alternative is as follows:

A. **Alternative No. 1, Recharge Ramapo River Via Reuse Water Generated at a New Wastewater Treatment Plant in Hillburn and Recharge Hackensack River Basin Via Reuse Water From An Upgraded RCSD No. 1 Wastewater Treatment Plant in Orangeburg.**

1. **Overview.** This option involves the construction of a new advanced wastewater treatment plant in Hillburn and upgrade of the RCSD No. 1 wastewater treatment plant in Orangeburg. One major advantage of this option is that it would resolve the water shortage problems in Rockland County regardless of the annual rainfall. Both plants would be designed to generate reuse water to a level that meets or exceeds NYSDEC Class A water source requirements and U.S. Environmental Protection Agency Guidelines for Water Reuse when using municipal effluent for augmenting water supplies. These requirements will result in a reuse water quality that would exceed the current water quality level of both the Ramapo River and Hackensack River. Reuse water from the new wastewater treatment plant in Hillburn would be used to recharge the Ramapo River Basin during low flow periods. Reuse water from the upgraded Orangeburg wastewater treatment plant would serve to recharge the Hackensack River Basin. Figure 1 shows the proposed location of each advanced wastewater treatment plant and the proposed routing of a water reuse conveyance system.

2. **Description of Advanced Wastewater Treatment Processes.** A description of the proposed facilities at each wastewater treatment plant is as follows:

a. **Western Ramapo Advanced Wastewater Treatment Plant.** A new advanced wastewater treatment plant capable of treating flows up to 5 mgd would be constructed in Hillburn. The 5 mgd design criterion is based on United Water's estimate of reuse water necessary to significantly reduce downtime of its Ramapo Valley wellfield. The new treatment facility would treat all flows from Western Ramapo and have the ability to be expanded to treat flows that are currently tributary to the Mahwah Pump Station. The Mahwah Pump Station currently pumps wastewater to the existing RCSD No. 1 wastewater treatment plant located in Orangeburg. By redirecting Mahwah's flow to a proposed Western Ramapo wastewater treatment plant, water would be returned to where it originated within the

Ramapo basin rather than to the Hudson River. Given the close proximity of the Mahwah Pump Station to the proposed Ramapo plant, the pump station would require pump replacement and construction of a new force main to redirect wastewater flow to the proposed plant.

The proposed Western Ramapo wastewater treatment plant would provide advanced treatment using the following processes which are above and beyond those required for a conventional secondary treatment process:

- single-stage nitrification/denitrification activated sludge process for removal of biochemical oxygen demand, ammonia, and nitrogen
- tertiary sand filtration with chemical addition for removal of phosphorous
- membrane filtration for removal of microbial contaminants
- ultraviolet disinfection for deactivation of fecal coliform
- post-aeration to increase the dissolved oxygen concentration in the effluent
- reuse water pump station

The reuse water could be pumped upstream to recharge the Ramapo River Basin or discharged (near the regulating weir) by gravity to the Ramapo River.

b. **Upgraded RCSD No. 1 Wastewater Treatment Plant in Orangeburg.** The current unit processes utilized at the RCSD No. 1 wastewater treatment plant in Orangeburg are capable of treating nearly 29 mgd during a maximum 30-day period while still meeting the current State Pollutant Discharge Elimination System (SPDES) requirements. The proposed facility upgrade would provide advanced treatment that would produce up to 15 mgd of Class A reusable water. The 15 mgd design criterion is based on United Water's estimate of reuse water necessary to adequately recharge the Hackensack River Basin. The proposed advanced treatment system addition would provide a series of three modules capable of treating 5 mgd each. The major components necessary to produce reusable water include:

- tertiary pump system for conveying the existing secondary effluent to the biological aerated filters (BAFs) for ammonia removal
- denitrification filters for nitrate removal
- membrane filters for removal of microbial contaminants

- chlorine disinfection for microbial pathogen destruction and reduction of regrowth potential within the reuse conveyance system
- main reuse water pump station to transfer flow to the Hackensack River Basin

3. **Description of Reuse Water Infrastructure.** A description of the infrastructure associated with each reuse system is as follows:

a. **Western Ramapo Reuse Infrastructure.** A 5 mgd reuse water pump station would be required at the Western Ramapo advanced wastewater treatment plant. The force main would extend north from the wastewater treatment plant to one discharge point in Hillburn. Dechlorination of reuse water prior to discharge would be provided to prevent any chlorine residual in the Ramapo River. The reuse pumping system would operate on an as-needed basis.

b. **RCSD No. 1 Advanced Wastewater Treatment Plant in Orangeburg Reuse Infrastructure.** Reuse water from the upgraded RCSD No. 1 treatment plant would be pumped from a main reuse water pump station to a second reuse water pump station that would be located near Town Line Road. From there, the water could be pumped to three discharge locations, including Lake Tappan near the Palisades Interstate Parkway, the Hackensack River at the outlet of Lake DeForest, or to another pump station located at the western side of Lake DeForest. From that pump station, the reuse water could be pumped to the northern end of Lake DeForest at Congers Road. Dechlorination facilities would be provided at each discharge point to protect aquatic life.

B. **Alternative No. 2, Convey Western Ramapo Wastewater to RCSD No. 1 Wastewater Treatment Plant in Orangeburg, Which Would Be Upgraded to Generate up to 20 mgd Reuse Water for Recharge of the Ramapo River and Hackensack River Basins.**

1. **Overview.** All flow from Western Ramapo would be conveyed to the existing RCSD No. 1 wastewater treatment plant in Orangeburg to eliminate construction of a separate Western Ramapo wastewater treatment plant. Thus, all flow from the Western Ramapo collection system currently being designed would eventually be conveyed to a single pump station located in Hillburn. From the proposed Hillburn Pump Station, all Western Ramapo

flow would then be pumped to a new wastewater conveyance system extending to RCSD No. 1's plant in Orangeburg. The proposed conveyance system includes parallel facilities along the Ramapo Interceptor, Upper Main Interceptor, and Lower Main Interceptor, plus upgrade of the Union Hill Pump Station and the Tallman Pump Station.

A reuse water conveyance system would also be constructed to convey reuse water back to the Hackensack River Basin (10 to 15 mgd) and Ramapo/Mahwah River basins (5 mgd to Ramapo River and 5 mgd to Mahwah River). NYSDEC, United Water, and Rockland County's Department of Health have requested that any improvements to the existing RCSD No. 1 treatment facility be required to generate effluent that meets the state's Class A water source standards. Under this option, the upgraded plant would be designed to treat to a level that meets or exceeds NYSDEC Class A water source requirements and U.S. Environmental Protection Agency's Guidelines for Water Reuse when using municipal effluent for augmenting water supplies. These requirements will result in a reuse water quality that would exceed the current water quality level of both the Ramapo River and Hackensack River.

Figure 2 identifies the location of the proposed Hillburn Pump Station, those wastewater pump stations that require upgrade, the proposed alignment of sanitary sewer interceptors to Orangeburg, the proposed location of reuse water system pump stations, the proposed alignment of reuse water force main, and proposed location of reuse water discharge points.

2. **Description of Wastewater Conveyance System Upgrades.** Modifications to the conveyance system to transport wastewater from Western Ramapo to the RCSD No. 1 wastewater treatment plant in Orangeburg would include:

a. Construction of a pump station in Hillburn to pump all Western Ramapo flow to a new pump station located at or near the Union Hill Pump Station. Upgrade of the Union Hill Pump Station and the Tallman Pump Station, along with construction of a second force main at each station, would be required to convey the additional flow to a parallel Ramapo Interceptor. All new force mains would generally follow the alignment of the existing force mains.

b. Construction of a new interceptor dedicated to Western Ramapo that extends from South Monsey Road to the existing wastewater treatment plant in Orangeburg.

This interceptor would generally follow the same alignment as the existing Ramapo, Upper Main, and Lower Main Interceptors, except where a pump station is required near Townline Road to pump around an existing recreational facility. The interceptor would cross the Hackensack River, Palisades Interstate Parkway, New York State Thruway (twice), and various local streets and New York State highways. The interceptor would discharge at the RCSD No. 1 wastewater treatment plant in Orangeburg.

For a more detailed discussion of the proposed modifications to the existing conveyance system see Exhibit A, Ramapo Interceptor, Upper Main Interceptor and Lower Main Interceptor Modeling Report.

3. **Description of Advanced Wastewater Treatment Processes.** The current unit processes located at the RCSD No. 1 wastewater treatment plant in Orangeburg allows for the treatment of up to nearly 29 mgd during a maximum 30-day period. The existing treatment systems at the wastewater treatment plant are capable of accommodating the additional hydraulic and organic loadings from Western Ramapo.

The proposed upgrade to the facility would provide advanced treatment of up to 20 mgd of flow. The 20 mgd design criterion is based on United Water's estimate of reuse water necessary to adequately recharge the Hackensack River Basin plus the Ramapo River Basin. The proposed advanced treatment system would provide a series of modules capable of treating 5 mgd each. Thus, four modules would be necessary to treat up to 20 mgd. The system would be similar to that provided for the 15 mgd treatment plant upgrade with one added module.

4. **Description of Reuse Water Infrastructure.** Reuse water from the upgraded RCSD No. 1 treatment plant would be pumped from a new pump station at the plant to the proposed Water Pump Station No. 1 located near Town Line Road. From there, the water would essentially be split and distributed to two different areas to augment the water resource -- one for the Hackensack Basin and one for the Ramapo Basin.

The Hackensack reuse water distribution system would be designed to distribute flow to three locations, including Lake Tappan near the Palisades Interstate Parkway, the Hackensack River at the outlet of Lake DeForest, or to Reuse Water Pump Station No. 4

located at the western side of Lake DeForest. From Reuse Water Pump Station No. 4, the reuse water system would continue to parallel the Upper Hackensack interceptor and discharge at the northern end of Lake DeForest at Congers Road.

The Ramapo Basin reuse water system would convey flow to Reuse Water Pump Station No. 2 located near Middletown Road. The alignment of the Ramapo River reuse system would generally parallel the Upper Main interceptor and Ramapo interceptor. From there, the reuse water would be pumped to Reuse Water Pump Station No. 3 located along Route 59 near Spring Valley. Reuse Water Pump Station No. 3 would discharge to either one of two Ramapo River discharge points or discharge to the Mahwah River near Pomona Heights. All discharge points would be provided with dechlorination facilities to protect aquatic life.

C. Alternative No. 3, Construct New Ambrey Pond Reservoir and Upgrade Cedar Pond Water Treatment Plant at Stony Point to Supply Additional Water to Rockland County.

1. **Overview.** This option requires the construction of a reservoir north of Lake DeForest by United Water to provide additional raw water storage. This reservoir has been designated as the Ambrey Pond Reservoir. To deliver additional treated water to Rockland County, the currently decommissioned Cedar Pond water treatment plant in Stony Point must be reconstructed/upgraded to treat raw water. Details of this option are being developed by United Water. In this option, additional water can be supplied to the County. However, an additional reservoir is still subject to prolonged drought conditions since it is totally dependent on rainfall.

D. Alternative No. 4, Construct Desalinization Facility on Hudson River to Supply Water to Rockland County.

1. **Overview.** This option would provide significant amounts of treated water for distribution in Rockland County. A desalinization plant would be constructed by United Water to treat water from the Hudson River and use it in the distribution system. In this option, additional water would be supplied to the County at a cost being developed by United Water. Historically, the high cost of constructing and operating a desalinization plant has discouraged this option in the past since other alternatives have been less costly. Regardless of which option is selected, the wastewater flows from Western Ramapo will be

treated and used to recharge the Ramapo River basin. Figure 4 shows the proposed location of the desalination water treatment plant and the Western Ramapo wastewater treatment plant.

CHAPTER 6

BENEFITS OF WATER REUSE

6.1 BACKGROUND

The United States has abundant supplies of fresh water, and utilization of available freshwater sources has normally been the first choice for economical and health reasons. More stringent water quality requirements and the increased costs associated with meeting the requirements may change this reliance on fresh water. More broadly, and as reported by AWWA Research Foundation[7], several factors make it difficult for freshwater supplies to meet the demand for potable water consumption. They are as follows:

A. **Supply Factors.**

1. Freshwater supplies are finite (97 percent of earth's water is contained in the oceans; 2 percent is present as ice at the polar caps and as glaciers; 0.3 percent is in the atmosphere; 0.1 percent is in rivers and lakes, and 0.6 percent in groundwater aquifers)

2. The distribution of surface and underground freshwater sources is uneven.

3. Rain does not fall uniformly over time and within a given region, and much rain is lost to ground seepage, evaporation, and runoff to streams not easily accessed for use.

4. A local storage area is frequently insufficient to capture excess runoff.

B. **Demand Factors.**

1. There is an ever-increasing demand for water, and demand may outgrow supply.

2. Local overuse of freshwater supplies raises additional problems; for example, excessive underground pumping lowers the water table and the chain reaction of detrimental effects includes reduced well water capacity, reduced agricultural production, and salination of groundwater in coastal areas due to salt water intrusion.

C. **Political and Environmental Factors.**

1. It is increasingly difficult to undertake projects that include shifting available freshwater supplies to new areas of demand, especially if the project involves crossing political boundaries or drainage basin boundaries.

2. If existing water resources are contaminated by an accident, less raw water would be available.

3. Virtually every major surface water body in the United States contains some domestic sewage treatment plant effluent, industrial wastewater treatment plant effluent, or urban and agricultural runoff, which amounts to de facto reuse of treated wastewater as drinking water. A similar situation exists for groundwater resources because hundreds of publicly owned treatment works (POTWs), industrial wastewater treatment plants, and private sewage systems dispose of their effluents to the land.

4. Increased environmental awareness and resulting legislation to protect the environment, along with the above contamination factors, have made it more difficult for fresh water sources to meet the drinking water standards with or without treatment, and more stringent regulations cause costs to increase.

The increasing demand for water sources, coupled with the goal of improving the quality of the environment, necessitates a review of all available water resources. The question is how to provide adequate supplies of water for municipal, agricultural, parks, and industrial use without adversely impacting humankind or nature, or at least minimizing such impacts.

Approaches available to resolve water availability and demand problems include conservation, water reclamation, water reuse, and the desalinization of brackish groundwater and seawater. In addition, it is important to match water use with available water quality and to use freshwater resources where they are most needed -- for drinking water. Continued growth also requires new water sources.

For many years, the nation has been experiencing a shift in population growth from cold northern states to the warm southern coastal states. The rapid population growth in these states, although favorable to local economies, has also strained natural resources and the utilities that must support the growth. In many such fast growing communities, the demand for fresh water has exceeded the natural supply. This pressure is particularly apparent in California and Florida. In addition to population growth, the availability of fresh water in these two states has been further impacted periodically by drought. As the sources of naturally occurring fresh water have been depleted, attention has turned to technologies that can produce potable water from non-potable saline and brackish water sources, and not just in California and Florida, but in other areas of the nation as well.

Further processing of high quality wastewater treatment plant effluent is also a viable option. It can be used to augment the natural drinking water sources, as they are depleted after serious drought conditions.

6.2 WHY SHOULD ROCKLAND COUNTY CONSIDER WATER REUSE OR WATER RECLAMATION?

In the past several years, Rockland County has experienced serious drought conditions, causing a depletion of some reservoirs and groundwater supplies. Restrictions on water use have negatively impacted the lives of Rockland County citizens as well as its economic vitality. These drought conditions will most likely be repeated in the future and could be more severe as the population increases. Thus, the County is currently exploring the possibility of implementing water reuse measures to recharge the Hackensack River Drainage Basin and Ramapo aquifer with reclaimed effluent from a new or upgraded wastewater treatment plant, or by building a desalinization plant to treat water from the Hudson River, or construction of another reservoir and water treatment plant.

The following benefits may derive from water reuse within the County limits:

A. **Recharge of Ramapo Valley Aquifer, An Existing Drinking Water Resource, With High Quality Effluent.** The 5.0 mgd of wastewater from Western Ramapo could be treated to a high level and discharged to the Ramapo River. This flow would improve the quantity and quality of the Ramapo River.

B. **Recharge of Hackensack or Mahwah River Basins, An Existing Drinking Water Resource With High Quality Effluent From a New Wastewater Treatment/Water Reuse Facility.** By the addition of new treatment components to the existing RCSD No. 1 wastewater treatment plant, 15.0 mgd of treated wastewater currently being discharged to the Hudson River could be returned to the Hackensack or Mahwah River Basins where it originated. This could substantially increase the quantity and quality of available water for Rockland County's residents.

C. **Enhancement of County's Existing Water Resources**. The quality of effluent from the currently proposed water reclamation treatment systems would be better than the background water quality of the Ramapo River and the Hackensack River.

D. **Alleviation of County's Current Drought Conditions**. By adding a total of 15.0 mgd of reuse water to both basins, Rockland County's water resources would be dramatically increased. According to Article V, Mandatory Water Conservation Measures, the County's Commissioner of Health is required to follow certain benchmarks for establishing when water conservation measures are necessary. Since the lack of precipitation is one of the primary indicators of a drought and does not recognize the benefits of water reuse as part of the conservation plan, Article V may need to be rewritten.

E. **Possible Elimination of the County's Largest Potable Water Users**. There may be many existing large users of potable water (such as golf courses) that do not need to use drinking water for maintenance and could cost effectively connect to a reuse water system. If this were to occur, the quantity of drinking water currently consumed by these types of facilities would be significantly reduced, freeing up the existing water resources for their actual intended use of drinking water.

F. **Control the County's Destiny With Respect to Growth, Industrialization and Other Issues Associated With Water Availability**. The water resources become more dependable and could become locally controlled by Rockland County for the greatest benefit of its citizens.

G. **May be More Cost Effective for Rockland County's Residents Than Construction of Ambrey Pond**. United Water is currently investigating the feasibility of constructing a new water supply reservoir and retrofit of the abandoned Stony Point water treatment plant. This may not be required if a reuse system were in operation. Also, water reuse does not depend on precipitation.

H. **Reuse of Water Produced by a Future Wastewater Treatment/Reclamation Facility**

Appears to be More Cost Effective for Rockland County Residents Than a Desalinization Facility on Hudson River. United Water is currently investigating the possibility of constructing a Desalinization facility on the Hudson River. While this resolves the issue of returning water to the Hackensack Basin, it is extremely expensive to construct and operate.

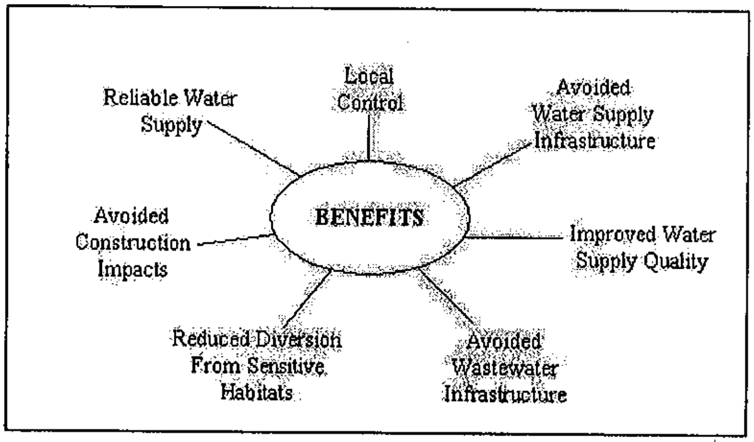
1. The disposal of desalinization plant rejects (called sometimes concentrate) is currently considered as an industrial discharge by several regulatory bodies in the U.S. Concentrate treatment could be very costly if the material has some trace contaminants, such as PCBs, metals, etc. (possibly present in Hudson River).

2. Desalinization solids might not be acceptable for land application. Costs to handle such waste might be very high and eventually could require disposal in a hazardous waste facility.

I. **Additional Benefits as Identified by a Recently Published Article in California Entitled "*White Paper on the Indirect Potable Reuse*."** It includes a list of common benefits attributed to water reuse. They cover:

> " Indirect potable reuse projects provide an array of benefits, some consistent with conventional non-potable applications and others unique to indirect potable applications.
>
> - Provides a reliable local water supply, which could alleviate future droughts and potential uncertainty associated with traditional water supplies.
> - Enables some water suppliers to reduce imports during average and above-average years, and "bank" this imported water for use during dry years.
> - Provides economic benefits by retaining businesses, and by attracting new businesses with a reliable water supply, (lower cost?).
> - May improve environmental conditions by reducing the need to divert additional supply from sensitive watersheds.
> - Reduces the quantity of treated wastewater discharged into the environment.
> - May reduce the cost of wastewater treatment and disposal.
> - Recycled water projects that include a demineralization step provide a significant enhancement to water quality.
>
> The yield of indirect potable water reuse optimizes a recycled water project through the use of the existing water supply infrastructure, including seasonal storage and

distribution facilities."



*California *"White Paper on Indirect Potable Reuse,"* 1999.

6.3 EXISTING WATER REUSE SYSTEMS WITHIN THE UNITED STATES

Most of the operational projects in the U.S. are either non-potable reuse of reclaimed wastewater (irrigation, groundwater recharge, industrial usage, etc.) or indirect potable water reuse involving the discharge and reuse of highly treated wastewater into fresh surface or underground waters, reused afterward in its diluted form.

While numerous successful groundwater recharge projects have been operated for many years, particularly in the western U.S., planned augmentation of surface water reservoirs has been less common. Some existing projects have operated for several years, such as the Upper Occoquan Sewage Authority. The 11 billion gallon Occoquan Reservoir is a critical source of water for about 1,000,000 people in Northern Virginia. The Virginia Water Control Board adopted a comprehensive policy for water quality management in the 1970s, mandating the replacement of 11 small wastewater treatment plants with 1 highly sophisticated regional reclamation facility. Very stringent effluent limits set the stage for an advanced wastewater reclamation plant. All effluent criteria have consistently been met since the startup of the 15 mgd facility in 1978. In fact, this facility has received two upgrades to increase the quantity of highly treated effluent. In addition, recovered water has historically accounted for 10 to 15 percent of the reservoir volume, but during extended droughts, has accounted for as much as 90 percent of the inflow to the reservoir.

In California, the West Basin Municipal Water District (WBMWD), created in the late 1950s, implemented a groundwater augmentation project, which has successfully allowed the Metropolitan Water District of South California to reduce imported water quantities. WBMWD has implemented the West Basin Water Recycling Program, which includes reclaiming secondary effluent from the City of Los Angeles' Hyperion treatment plant and distributing the reclaimed water for beneficial uses, including injection into the West Coast Barrier Project that prevents inland saltwater intrusion.

Overall, about 72 mgd of wastewater is reclaimed in California and reused in 350 sites, such as parks, golf courses, landscaping projects, industries, municipalities, and groundwater recharge. Groundwater recharge accounted for 61.7 percent of all reclaimed reuse.

Another project includes the New York City water system. Currently, communities that surround New York City's reservoirs discharge highly treated wastewater to the reservoir system. The reservoir (water supply) to New York City is currently unfiltered prior to consumptive use.

6.4 ISSUES IN WATER REUSE

The main issues that warrant thorough consideration from the initial planning stages are:

1. The capacity of the advanced treatment technologies to remove all known and potentially present chemical contaminants (inorganic chemicals, chemicals created by the industry, and chemicals added during water and wastewater treatment and distribution).

2. Microbial contaminants in reuse systems, including not only historical indicators such as coliforms, but emerging pathogens and viruses.

3. Reliability of reuse systems in respect to the "barrier principle" (different contaminants require a different process or combination of processes). In general, reuse systems require more robust multiple process barriers than conventional systems, especially for microbiological contaminants.

4. Performance evaluation and monitoring as related to "sentinel"-type parameters, readily measurable (even on an instantaneous basis), correlating very well with high contaminant breakthrough.

5. Public perception and acceptance is the factor of greatest importance from a social point of view. Two recently rejected projects (Tampa Water Resource Recovery Project and San Diego Water Repurification Facility) illustrate that some projects did not go forward not because of unacceptable engineering design, but rather a combination of factors such as misperception regarding recycled water, concerns regarding safety of the treated water, polarization of the community, and lack of support by local/state politicians and community leaders.

6. Water supply planners must address the legal aspects of water reuse, taking into consideration that national regulations for water reuse do not exist.

The American Water Works Association's Research Foundation reports that urban irrigation (irrigation of public areas such as golf courses and parks), industrial reuse, and agricultural reuse projects are easiest to accomplish. When implementing these projects is economically appropriate, few obstacles exist. The principal obstacle limiting either direct or indirect potable reuse is public perception. This includes a lack of confidence in methods to substantiate safety and a desire on the part of the public to become more involved in utility affairs if this level of reuse is to be practiced. Economic factors were also a significant obstacle to direct potable water reuse. Utilities practicing indirect potable reuse found public awareness of water shortages to be the best way to overcome a negative public attitude. The primary need identified by the American Water Works Association study was the development of water quality and health effects standards to guide implementation and reuse.

Researchers, futurists, and practitioners agree that all wastewater in arid and semi-arid portions of the Western United States will someday be recycled. As much as 30 to 50 percent of total wastewater generated is currently used for non-potable applications in some western cities. However, if reuse is to be maximized, some level of indirect potable application will also be necessary. Public acceptance and support for these indirect applications is critical to the full utilization of recycled water.

For a successful Rockland County water reuse project, it is essential to build a multi-disciplinary advisory committee composed of people from different backgrounds at the beginning of the project. One of the main objectives of the committee will be to "generate public awareness" of the project at the planning stage, and to identify all issues critical to gaining public acceptance of the water reuse project.

6.5 WATER QUALITY ISSUES

Several indirect potable reuse systems currently operating in the U.S. produce reclaimed water that meets or exceeds the quality of raw water into which they discharge, as measured by current standards. In addition, several studies have concluded that planned, indirect potable reuse is a viable application of reclaimed water, but only when there is a careful, thorough project-specific assessment that includes contaminant monitoring, health and safety testing, and reliability evaluation. The requirements for indirect potable reuse systems thus should exceed the requirements that apply to conventional drinking water treatment facilities

With the exception of current drinking water regulations, no enforceable federal regulations specifically address potable reuse. The U.S. Environmental Protection Agency has developed suggested guidelines for individual potable reuse water, and a few states have developed regulatory criteria. California and Florida are in the forefront of promulgating specific criteria for planned indirect potable reuse. California has prepared draft criteria for groundwater recharge, and Florida has adopted criteria for both groundwater recharge and surface water augmentation. In Arizona, regulations addressing groundwater recharge with treated wastewater are independent from the state's reuse criteria.

The planned advanced water reuse facility for RCSD No. 1, as well as the Western Ramapo plant, would include treatment steps that would allow those plants to produce final effluent as per the U.S. Environmental Protection Agency's regulation and/or meeting or exceeding current U.S. drinking water regulations. The U.S. Environmental Protection Agency's *Suggested Guidelines for Reuse* relating to municipal wastewater treatment plant effluent include the following criteria:

1. **Level of Treatment.** Secondary, filtration, disinfection, advanced wastewater treatment.

2. **Reclaimed Water Quality:** Included, but not limited to the following:

- pH = 6.5 to 8.5.
- Turbidity <2 NTU.
- No detectable fecal coliform per 100 mL.
- Residual chlorine >1 mg/L.
- Meet drinking water standards.

3. **Reclaimed Water Monitoring.** Included, but not limited to, pH (daily), turbidity (continuous), coliform (daily), residual chlorine (continuous), drinking water standards (quarterly), other (dependent on constituents).

6.6 SUMMARY OF SUCCESSFUL U.S. WATER RECLAMATION FACILITIES

Several successful facilities in the United States have implemented advanced water reclamation technologies to provide water with equal or higher quality than current drinking water supplies and reuse it to replenish their natural supplies. Some of those are summarized below.

A. **Upper Occoquan Sewage Authority.** The 11 billion gallon Occoquan Reservoir is a critical source of water for about 1,000,000 people in Northern Virginia. Following tremendous growth during 1960s, the watershed feeding the reservoir started to adversely affect the water quality in the reservoir. In response to this deterioration, the Virginia Water Control Board conducted extensive studies and held public hearings (including consideration of exporting all wastewater out of the Occoquan watershed) and adopted a comprehensive policy for water quality management in the watershed. The policy mandated the replacement of 11 small secondary treatment facilities with 1 highly sophisticated regional wastewater reclamation facility. In 1971, the Upper Occoquan Sewage Authority, a regional agency, was created. Very stringent effluent limits set the stage for an advanced wastewater reclamation plant.

B. **El Paso, Texas.** The Hueco Bolson Recharge Project is a full-scale operating program in which wastewater is treated to potable water quality and injected directly into the primary drinking water source for the City of El Paso, TX. Most of the wastewater collected for treatment at the Fred Harvey water reclamation plant (FHWRP) is domestic, with less than 0.01 percent generated by industrial dischargers. Reclaimed water from the FHWRP is pumped from the clearwell at the plant via a pipeline to the injection wells for recharge. Production wells in the recharged wellfield pump water to the El Paso Water Utilities (EPWU) water supply system, where it is mixed with other well water, chlorinated, and delivered to a population of more than 250,000 people. To protect the Hueco Bolson aquifer, the EPWU goal is to produce water at the FHWRP that meets the U.S. Environmental Protection Agency's drinking water standards.

Construction of the FHWRP and the recharge facilities included 1 holding tank, 7 observation wells, and 10 injection wells, as completed in 1984. Actual recharge operations began in May 1985. Quality guidelines for the project were the National Interim Primary Drinking Water Regulations, including the proposed organic chemical requirements, and the TNRCC Drinking Water Standards. The regulatory requirements in place for the Water Factory 21 project located in California were also considered.

C. **Scottsdale Water Campus, Arizona.** In the 1980s, city managers in Scottsdale, AZ investigated ways to meet the water needs of its rapidly growing population. It was decided to treat Central Arizona Project water and reuse it again. A microfiltration pilot plant was built and operated on campus, providing design criteria for the full-scale system. The full-scale plant consists of a 12 mgd water reclamation plant which treats reclaimed water to a level acceptable for irrigation (primarily golf courses). Another plant with 10 mgd capacity provides advanced water treatment to levels exceeding drinking water standards. Water from this plant, treated by microfiltration and reverse osmosis, is then used to recharge an aquifer via injection wells.

D. **West Basin Municipal Water District Groundwater Augmentation Project, California.** The West Basin Municipal Water District (WBMWD) was formed in 1948 under the California Municipal Water Act to bring supplemental imported water supplies from the Metropolitan Water District of South California to the South Bay area because the west coast groundwater basin was in serious overdraft condition and incapable of meeting the area's needs. Imported water used in the West Basin to supplement local water supplies represents about 90 percent of the basin water supply. The decreasing availability and increasing cost of imported water have heightened the need to develop new sources of water for the basin, including the use of reclaimed water. WBMWD has implemented the West Basin Water Recycling Program, which includes reclaiming secondary effluent from the City of Los Angeles's Hyperion treatment plant and distributing the reclaimed water for beneficial uses, including injection into the West Coast Barrier Project for mitigation of saltwater intrusion.

In June 1995, the WBMWD began supplying 5 mgd of highly treated recycled water to blend with the Metropolitan Water District's imported surface water for injection. The source of wastewater is secondary effluent from the Hyperion treatment plant. The blend ratio at the blend station can be varied from 0 to 100 percent of either recycled water or imported water.

E. **Orlando Wetlands.** The City of Orlando, FL constructed a 1,220-acre wetlands system using reclaimed water from the Iron Bridge advanced wastewater treatment facility. The wetlands are the centerpiece of a public park and nature preserve featuring hiking, jogging, biking, and nature observation. Up to 20,000,000 gallons of reclaimed water may be used to supply this wetland system. In 2000, about 17,600,000 gallons of reclaimed water was used in the wetlands system.

Successful implementation of water reuse within Rockland County's water resource management program requires careful planning; economic and financial analysis; and effective design, operation, and management of wastewater reclamation, storage, and distribution facilities. Modern wastewater reclamation technologies produce water of almost any quality, often superior to existing supplies. The ultimate decision to utilize reclaimed wastewater is dependent on public acceptance, economic, regulatory, and public policy factors reflecting the demand and need for a dependable water supply.

CHAPTER 7

COST COMPARISON OF ALTERNATIVES

As discussed in Chapter 5, several alternatives have been evaluated to supplement the County's water needs. The cost associated with each alternative is as follows:

7.1 ALTERNATIVE NO. 1

This alternative involves the construction of a new 5 mgd Western Ramapo advanced wastewater treatment plant in Hillburn and upgrade of the RCSD No. 1 wastewater treatment plant in Orangeburg to generate another 15 mgd of reuse water. Reuse water from the proposed Western Ramapo wastewater treatment plant in Hillburn would be used to recharge the Ramapo River Basin during low flow periods. Reuse water from the upgraded Orangeburg wastewater treatment plant would serve to recharge the Hackensack River Basin. The following table summarizes the estimated project cost (anticipating modular construction) and annual operation and maintenance cost.

item	estimated capital cost	estimated fiscal, legal, engineering	project cost	estimated annual o&m
Western Ramapo wastewater treatment facility and reuse system	$68,200,000	$20,500,000	$88,700,000	$1,730,000
Upgrade RCSD No. 1's wastewater treatment and reuse system	55,400,000	16,600,000	72,000,000	2,000,000
total cost	**$123,600,000**	**$37,100,000**	**$160,700,000**	**$3,730,000**

7.2 ALTERNATIVE NO. 2

This alternative involves construction of a wastewater conveyance system to transfer all Western Ramapo wastewater to the existing RCSD No. 1 wastewater treatment plant in Orangeburg. This eliminates the construction of a separate Western Ramapo wastewater treatment plant. The existing RCSD No. 1 wastewater treatment plant would be upgraded to generate 20 mgd of reuse water. A reuse water conveyance system would also be constructed to convey reuse water back to the Hackensack River Basin (10 to 15 mgd) and Ramapo/Mahwah River Basin (5 to 10 mgd). The following table summarizes the estimated project cost (anticipating modular construction) and annual operation and maintenance cost.

item	estimated capital cost	estimated fiscal, legal, engineering	project cost	estimated annual o&m
Wastewater conveyance system, upgrade existing RCSD No. 1 wastewater treatment plant, and reuse system	$114,800,000	$34,500,000	$149,300,000	$2,650,000

7.3 ALTERNATIVE NO. 3

This alternative involves United Water constructing a new reservoir (Ambrey Pond) and retrofitting the Cedar Pond water treatment plant in the Hackensack Basin. RCSD No. 1 could treat the 5 mgd of wastewater from Western Ramapo at a new Western Ramapo advanced wastewater treatment plant or convey and treat it at the existing RCSD No. 1 wastewater treatment plant in Orangeburg with an effluent water pump system pumping the treated water back to the Ramapo River. The following table summarizes the estimated project cost (anticipating modular construction) and annual operation and maintenance cost.

item	estimated capital cost	estimated fiscal, legal, engineering	project cost	estimated annual o&m
Western Ramapo wastewater treatment facility and reuse system	$68,200,000	$20,500,000	$88,700,000	$1,730,000
Ambrey Pond and retrofitted Cedar Pond water treatment plant	***Awaiting costs from United Water***			
total cost				

7.4 ALTERNATIVE NO. 4

This alternative involves United Water constructing a desalination plant to treat water from the Hudson River. The treatment plant would discharge directly to drinking water distribution system. However, regardless of the construction of a desalination facility, the flows from Western Ramapo would need to be treated. This could be accomplished with a new 5 mgd wastewater treatment plant in Western Ramapo as described in Alternative No. 1. The following table summarizes the estimated project cost (anticipating modular construction) and annual operation and maintenance cost.

item	estimated capital cost	estimated fiscal, legal, engineering	project cost	estimated annual o&m
Western Ramapo wastewater treatment facility and reuse system	$68,200,000	$20,500,000	$88,700,000	$1,730,000
Ambrey Pond and retrofitted Cedar Pond water treatment plant	***Awaiting costs from United Water***			
total cost				

CHAPTER 8

PERMITS

The following permits would be necessary for any reuse projects:

1. State Environmental Quality Review?

2. U.S. Army Corps of Engineers under Section 404 of the Clean Water Act.

3. NYSDEC under Section 401 of the Clean Water Act (Water Quality Certification) and under Articles 15 (Stream Protection) and 25 (Freshwater Wetlands) of the New York State Environmental Conservation Law (NYSECL)

4. USEPA Environmental Information Document.

CHAPTER 9

IMPLEMENTATION PLAN AND SCHEDULE