

## **Partial Denitrification at Wayne Township**

**By**

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Operations Superintendent**

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The possibility of obtaining substantial denitrification within a facility that has been designed for nitrification does exist. If the plant has been designed with higher operating sludge ages, then there exists the possibility that a portion of the treatment train can be set aside for denitrification without the degradation of any existing permit parameters. If the facility has spare capacity, the chances of a successful denitrification operation increase.

### **Wayne Township Process Description**

The Mountain View STP owned and operated by the Township of Wayne, is a 13.5-mgd plug flow system. The plant consists of primary treatment, equalization, aeration, using surface aerators which provide a complete mix within each of four basins, lime addition, secondary settling, chlorination/dechlorination and post aeration. Currently, the daily flow ranges between 5.5 and 7.5 mgd with a yearly average of 6.8 mgd.

The aeration system has been altered to operate as a modified step aeration facility. In that mode and additional alterations made to the secondary tanks, the facility has performed consistently well. It has produced an effluent with a CBOD5 and TSS in 1-3 mg/l range and ammonia-N in the 0.1 to 0.2 mg/l range for the last decade.

The facility discharges to the Singac Brook, which directly feeds the Passaic River just below the joining of the Passaic and Pompton Rivers at Two Bridges. This entry point in the Passaic is between the two drinking water intakes of the Passaic Valley Water Company. Depending on the water companies pumping configuration, the Mountain View effluent can enter either of the two drinking water intakes.

### **Increasing Drought Conditions**

During the last decade, the area has seen an increasing number of droughts with increased severity when they do occur. During these extreme conditions, the treatment plants effluents become the majority of the flow in the Passaic and Pompton Rivers. All treatment plants in this area have been designed to nitrify, but with the exception of one; none have designed denitrification capability.

Hence, most of the ammonia-N conversion to nitrate-N is placed directly to the Pompton or Passaic Rivers. During normal river flows, this nitrate-N is not a problem. However during a drought, the situation changes if the drought happens to continue as the river temperature decreases. Nitrate-N concentrations then begin to increase with the drastic drop in nutrient utilization by river algae.

### **Drinking Water Concerns**

As this nitrate-N build up occurs, the topology and use requirements of the river are such that this increase presents itself at the drinking water intakes of the Passaic Valley Water Commission and the pumping intakes for the North Jersey District Water Company. The North Jersey District pumping extracts water from the Pompton and Passaic rivers and discharges it to the Wanaque Reservoir upstream.

The water companies are faced with a "Maximum Contaminant Level (MCL)" limiting nitrate-N to 10 mg/l. Above this concentration, there is a real concern for the health and safety of the public. The water companies do not have the ability to remove this material. Since the droughts are becoming more severe; the water intake concentration of nitrate-N has been

increasing over the years. In the 1999 drought, just before hurricane Floyd, the concentration raised to levels in the high 9-ppm range at these intakes. Clearly, there was (is) a problem.

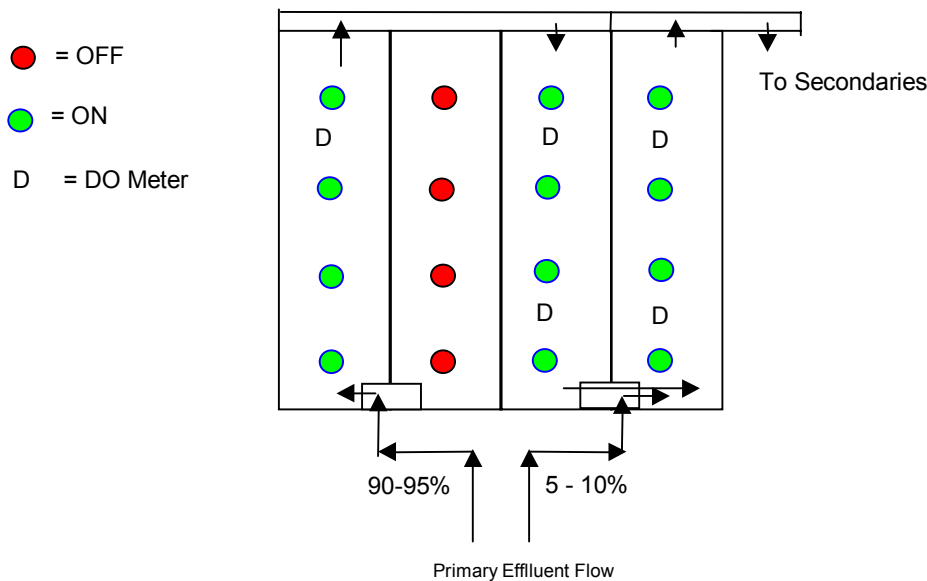
### Drought Committee Formation and Progress

As this 1999 drought progressed, a “Drought Committee” was formed which included representatives from water, wastewater and NJDEP to deal with the problem. Among other duties given, we were all charged with the responsibility of analyzing various aspects of the river and our effluents to determine whether a public health problem could exist. Various methods were discussed on how to best deal with the situation. Out of these series of meetings came a willingness on the part of many sewage dischargers to attempt to deal with the nitrate-N concentration of their effluents. Consultants were either hired by the State to look over dischargers processes or solicited by the discharges directly to see what could be done. It was decided that some of the plants in the area may be able to reduce nitrate-N biologically.

### Mountain View STP’s Participation

Pre-denitrification Operation: Prior to our starting the investigation for denitrification, Wayne Township had modified the aeration system from the typical complete mix/plug-flow system to a modified step aeration operation. Diagram 1 below shows how the system was operated prior to the introduction of a denitrification zone:

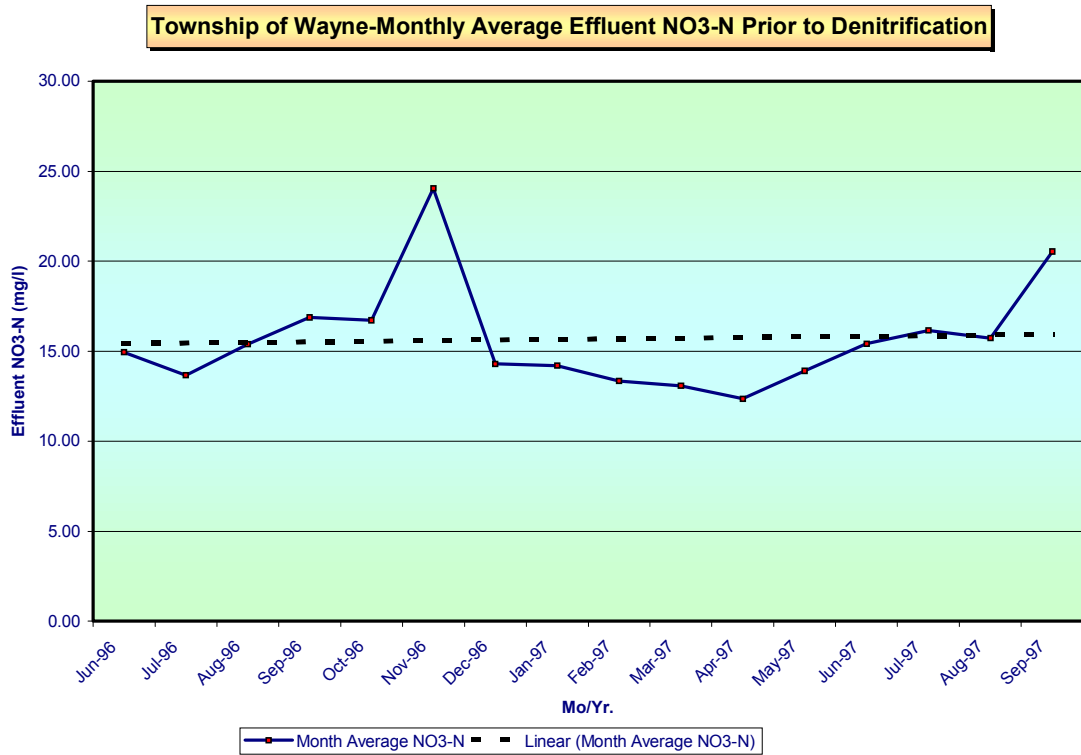
**Diagram 1 : Township of Wayne - Aeration Tank Process Schematic Before Denitrification**



The original system was operated by keeping the dissolved oxygen in the last two aeration tanks at a level between two and three mg/l. Some of the aerators would be turned to slow or off occasionally to maintain this DO level.

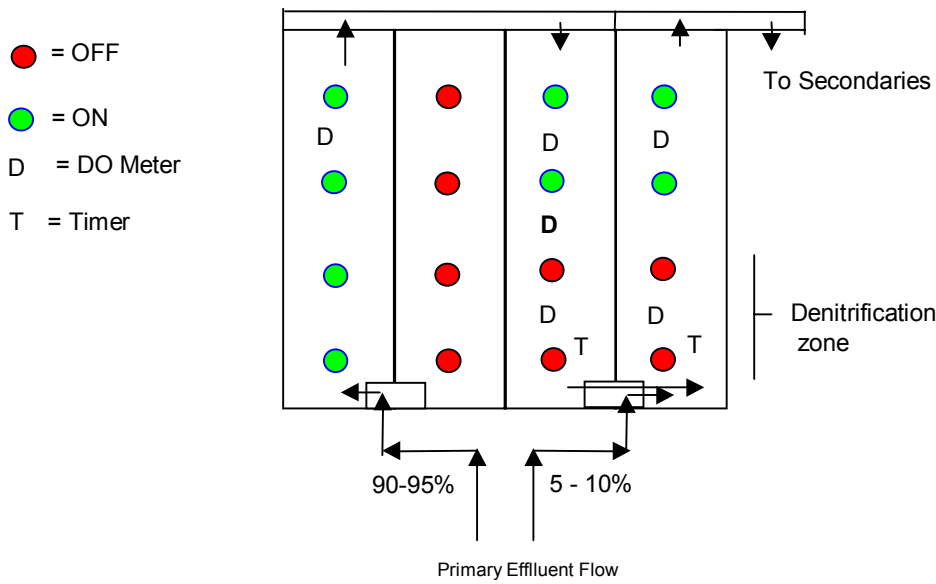
Additionally, our effluent permit conditions are met at the end of the second aeration tank. The third tank was kept on line to run the system in an extended mode to reduce sludge volume for incineration. Graph 1 shows typically how much monthly average nitrate-N was produced from this system:

Graph 1:



Post-denitrification Operation: After a trial period, a new operational method was established which incorporated a denitrification zone at the end of the second aeration tank to the beginning of the third. Timers were installed in selected aerators such that they could be turned on at low speed for short periods for mixing purposes only. The current operational schematic is shown in Diagram 2.

**Diagram 2 : Township of Wayne - Aeration Tank Process Schematic  
After Denitrification**



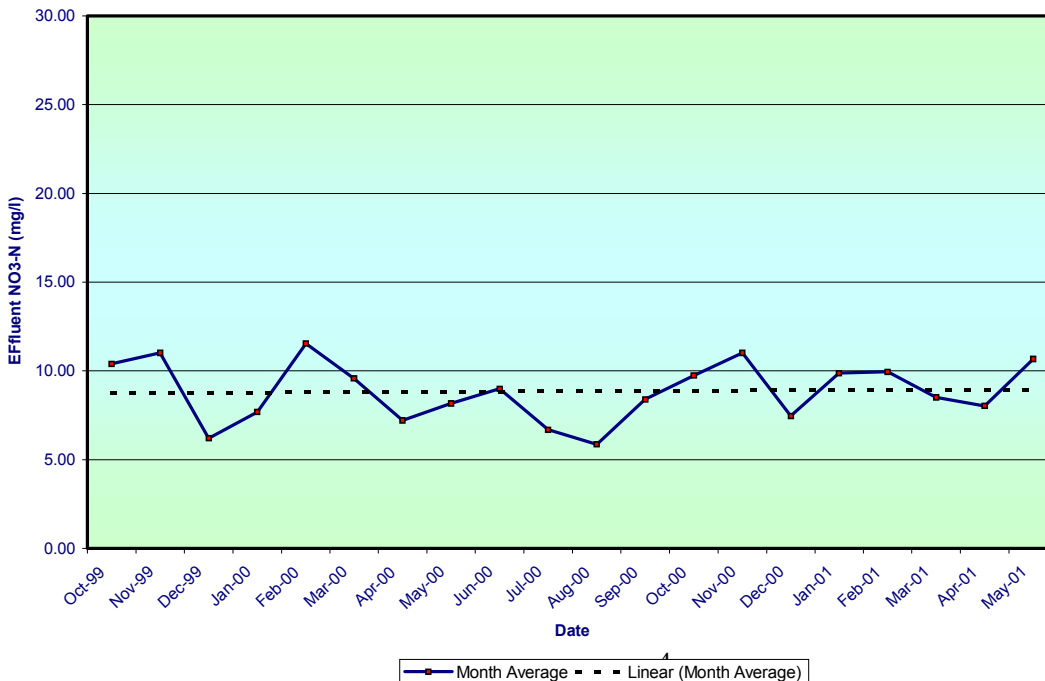
Most of the time, the four additional aerators indicated in red are kept off. The two aerators that are on timer are currently operated for fifteen minutes four times/day on slow speed, merely to prevent excessive settling of the activated sludge. Occasionally, a third aerator in the second tank may have to be placed on for short periods. To adjust DO we attempt to maintain a two to three mg/l DO at the beginning of the second aeration tank and the end of third tank. Once the 2-3 ppm DO is reached, the rest of the second aeration tank is used do drop the DO low as possible, hopefully to zero. Once the rest of the flow enters the third aeration tank, any remaining Dissolved Oxygen drops to zero.

In addition, this system has not produced any additional sludge in comparison to the extended step aeration mode operated prior to adding the denitrification zone!

Typical nitrate-N levels in the new configuration are offered in the following Graph 2.

**Graph 2:**

**Township of Wayne-Monthly Average Effluent NO3-N After Denitrificaton**



An estimated 80 horsepower is being saved each day the plant is being operated in this manner.

Additionally, we are experimenting with different oxygen values in other parts of the system in hopes of increasing nitrate-N removals.

Due to reliability that has been incorporate into the modification, we will continue to operate in this manner and reduce as much nitrate-N as possible as long as the Township's NJDEP permit parameters continue to be met.

If there are any questions, please contact Mr. Philip Bober at "boberp@waynetownship.com.