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Advanced On-Site Sewage Treatment Systems in New Mexico: Performance and Compliance Evaluation

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Introduction

"Advanced treatment" is defined in New Mexico's Liquid Waste Disposal and Treatment Regulation, 20.7.3.7.A.2 NMAC, as "any process of wastewater treatment that removes a greater amount of contaminants than is accomplished through primary treatment; advanced treatment may include physical or chemical processes." The regulations specify definitions and performance standards for secondary, tertiary and disinfection treatment. Advanced treatment is typically utilized to overcome site limitations such as inadequate lot size, clearance and setback. The New Mexico Environment Department (NMED) maintains a list of advanced treatment systems (ATSs) that have been approved for use in the state, http://www.nmenv.state.nm.us/fod/LiquidWaste/adv%20sys.pdf. Many systems approved for secondary or tertiary treatment utilize an aerobic process. Aerobic treatment units (ATUs) are a subcategory of ATSs. Tertiary, nitrogen reducing, treatment is utilized to overcome inadequate lot size. Disinfection, often after secondary treatment, is utilized to overcome inadequate clearance or setback. Other technologies, such as split-flow or non-discharging systems, also can be used to overcome site limitations.

The history of ATS usage in New Mexico was evaluated by McQuillan et al., 2006 who concluded that:

- ATSs comprise about 1% of the on-site systems in New Mexico;
- More than 2000 ATSs had been permitted without effluent monitoring requirements prior to 2003, while several hundred ATSs had been permitted with such requirements;
- Of the several hundred ATSs that had been permitted with effluent monitoring requirements, less than half of the permittees had submitted test data;
- NMED had difficulty in tracking the effluent data that had been submitted;
- Effluent data that had been submitted showed that some systems were working reasonably well and consistently, while others were not;
- Fluctuations in effluent quality and episodes of poor treatment were believed to result largely from lack of maintenance; and
- There was a lack of availability of qualified maintenance service providers in the state. Some ATS distributors/installers were unwilling to provide maintenance

and effluent sampling services. In other cases, ATS manufacturers had either gone out of business or no longer did business in New Mexico.

During the past year, NMED has made the following progress in addressing the problems identified by McQuillan et al. (2006):

- A new liquid waste database application was rolled out in October 2007. Effluent monitoring data, and maintenance service contract information, will be entered into this Oracle-based system which should greatly improve NMED's ability to track compliance with permit requirements.
- Efforts to obtain voluntary compliance with effluent sampling requirements have been partially successful. Many systems have been sampled for the first time, and others are now being sampled on a routine basis. The total number of samples submitted to NMED for all systems statewide has more than doubled.
- A Compliance Officer was created for the Liquid Waste Program to coordinate enforcement activities including cases where voluntary compliance with effluent sampling requirements cannot be obtained.
- The NMED Ruidoso Field Office has initiated quarterly ATS workshops for the benefit of installers and NMED inspectors alike. The workshops have been well attended, not only by installers and inspectors from Lincoln County. Workshops modeled after those in Ruidoso will be conducted elsewhere in the state, although the focus may not always be on ATS depending on local issues and priorities.
- ATSs whose manufacturers fail to provide qualified maintenance service providers, and to comply with the requirements of 20.7.3.903 NMAC, are being removed from the list of wastewater products approved for use in the State of New Mexico.

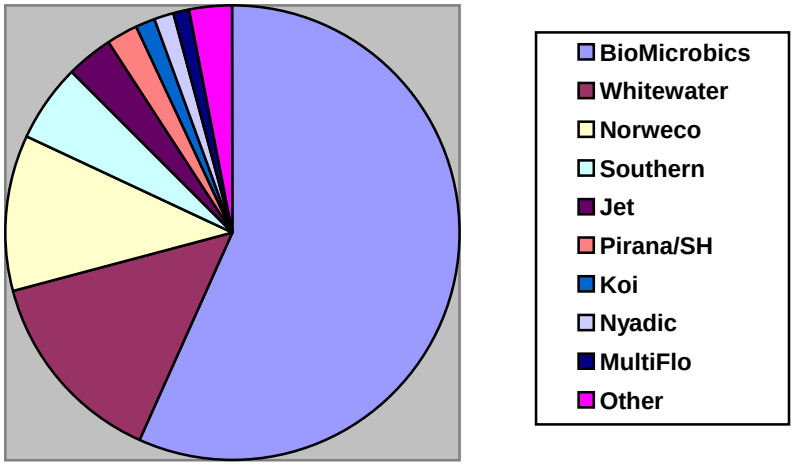
The purpose of this paper is to provide an updated, more specific, evaluation of the performance of ATSs that have been permitted with effluent monitoring requirements.

Permitted Systems

Approximately 528 ATSs, mostly ATUs, are currently operating in the State of New Mexico with Liquid Waste permits approved by NMED that require maintenance service contracts and effluent monitoring. The relative proportions of the types of ATSs are shown in Figure 1.

A number of ATS manufacturers have either gone out of business, are no longer doing business in New Mexico, or have failed to make maintenance service available in accordance with 20.7.3.903 NMAC, if at all. In these cases, the ATSs have been removed from the list of products approved for use in the state (de-listed). Whitewater systems, which comprise the second largest number of systems installed (Figure 1) have been de-listed.

Figure 1. ATS Brand.



Compliance with ATS Effluent Monitoring Requirements

In 2006, no effluent test reports had been submitted for 61% of the ATSs that had been permitted with effluent monitoring requirements, and 6 or more effluent reports had been submitted for 11 (2%) of the systems (Figure 2a). Efforts to obtain voluntary compliance have reduced the no-sample violation percentage to 36%, and 34 (7 %) of the systems now have 6 or more effluent test reports (Figure 2b). A total of 1151 effluent sample reports have been submitted for all systems statewide, which is more than twice the total of 507 samples that had been submitted to NMED a year ago.

ATS Performance and Compliance with Effluent Limitations

Effluent monitoring time trends for 40 ATSs are graphed in Appendix A, grouped by system brand and geographic location. Effluent quality can vary considerably in the same system between consecutive samples. Effluent reports for 13 ATSs consistently show total nitrogen at or less than the TAC target concentration of 20 mg/L (Figure 3). Starting in late 2004, BioMicrobics systems in Ruidoso were installed with air pumps with greater horsepower to accommodate the relatively high altitude of the community, and to increase the dissolved oxygen content of the wastewater being nitrified. BioMicrobics systems permitted and installed after this date generally produce effluent with lower total nitrogen (Figure 4).

Some systems, however, have episodes of poor treatment (Figure 5). ATSs treating non-residential wastewater sometimes produce effluent greatly exceeding 60 mg/L total nitrogen (Figure 6). System LC000851 serves a medical clinic, DA020372 serves a child day care facility, and RU020198 serves a restaurant. System RU050327 receives only black water, with gray water diverted for irrigation, and produces effluent with relatively high total nitrogen (Figure 7).

The Megastructure experimental ATS experienced both structural and treatment failures. Megastructure effluent data show little if any nitrogen reduction (Figure 8). Megastructure was de-listed and two of the five systems that had been installed have been replaced with other ATSs pursuant to on-going enforcement actions. Megastructure is the first ATS for which NMED has taken enforcement action for failure of the ATS to provide wastewater treatment to levels required by the Liquid Waste Permit.

Figure 2a. Compliance with Effluent Monitoring Requirements, Dec. 2006.

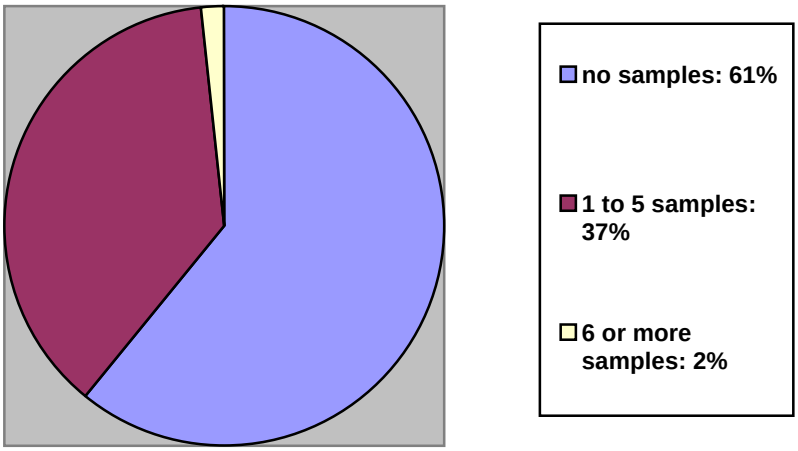


Figure 2b. Compliance with Effluent Monitoring Requirements, Dec. 2007.

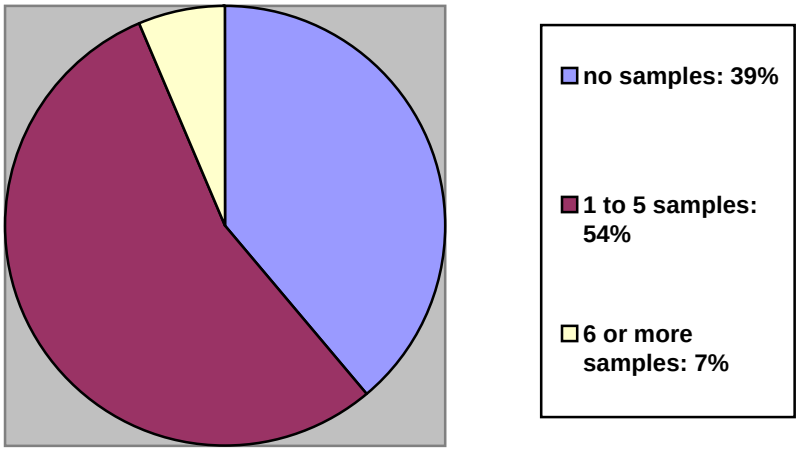


Figure 3. Total N Consistently at or Less than 20 mg/L.

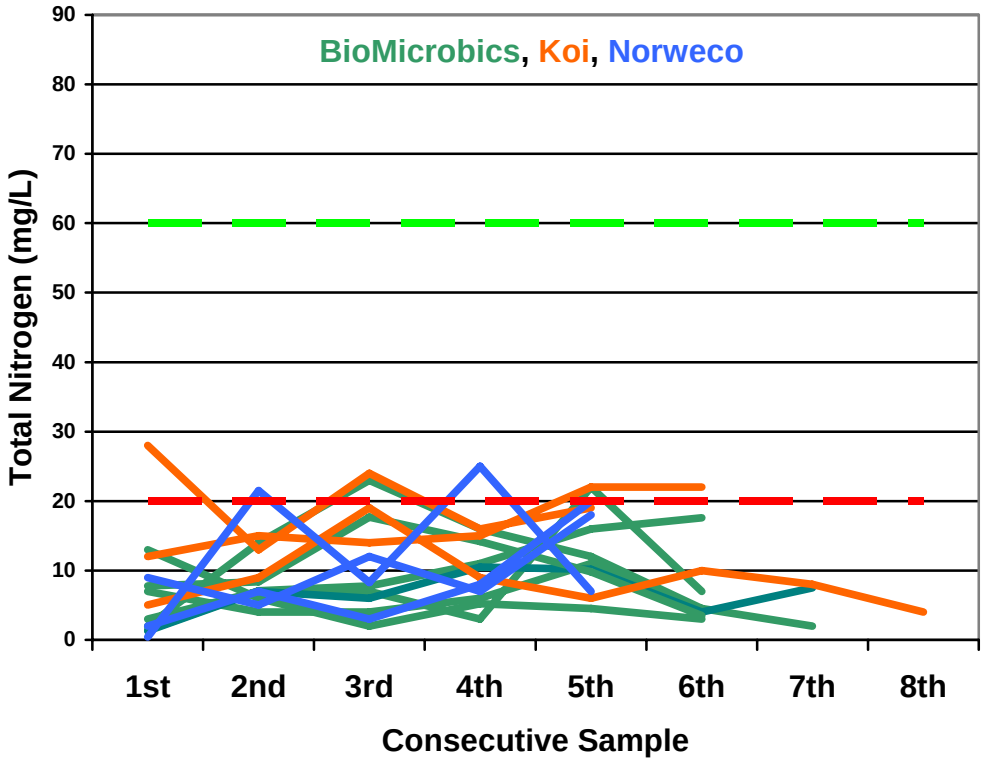


Figure 4. BioMicrobics, Ruidoso.

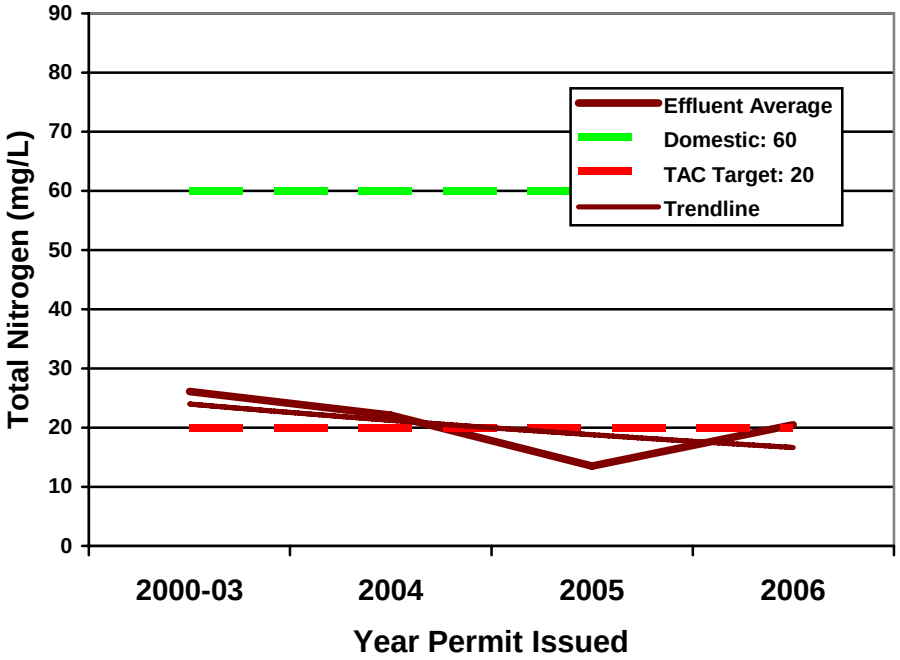


Figure 5. Episodes of Poor Treatment.

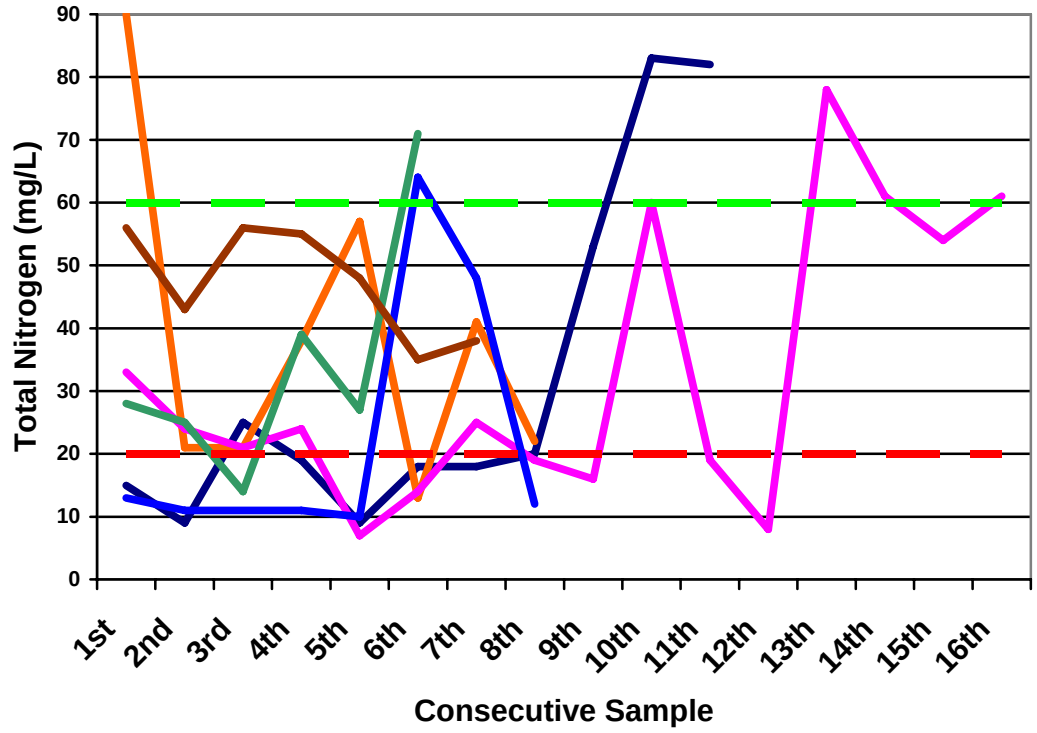


Figure 6. Non-Residential Waste.
(note change in scale from Figs. 3-5)

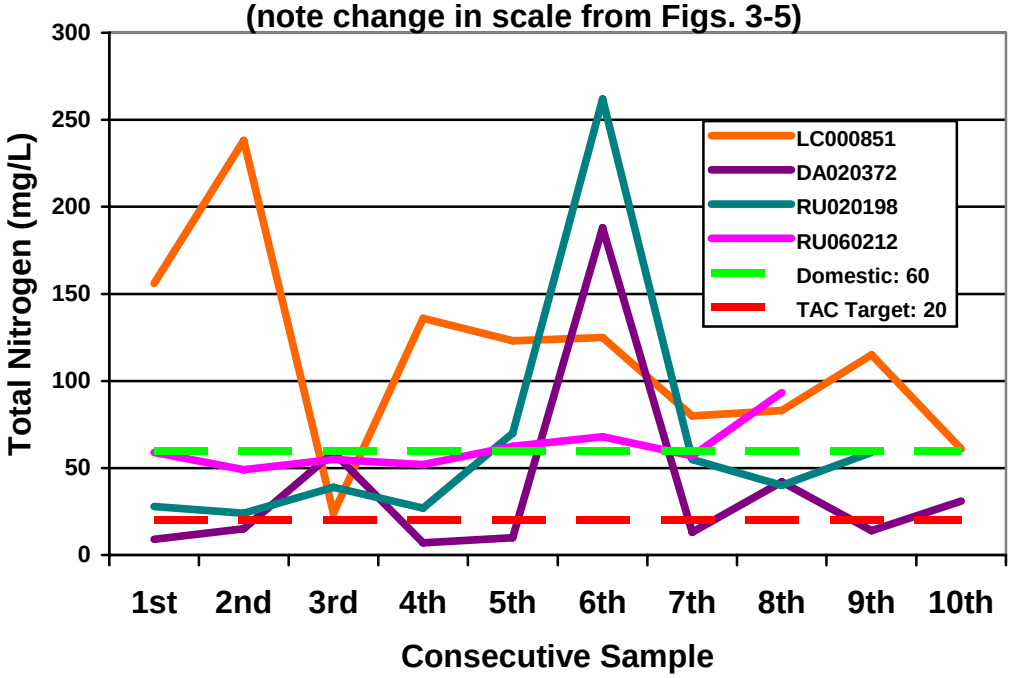


Figure 7. Black Water Only.

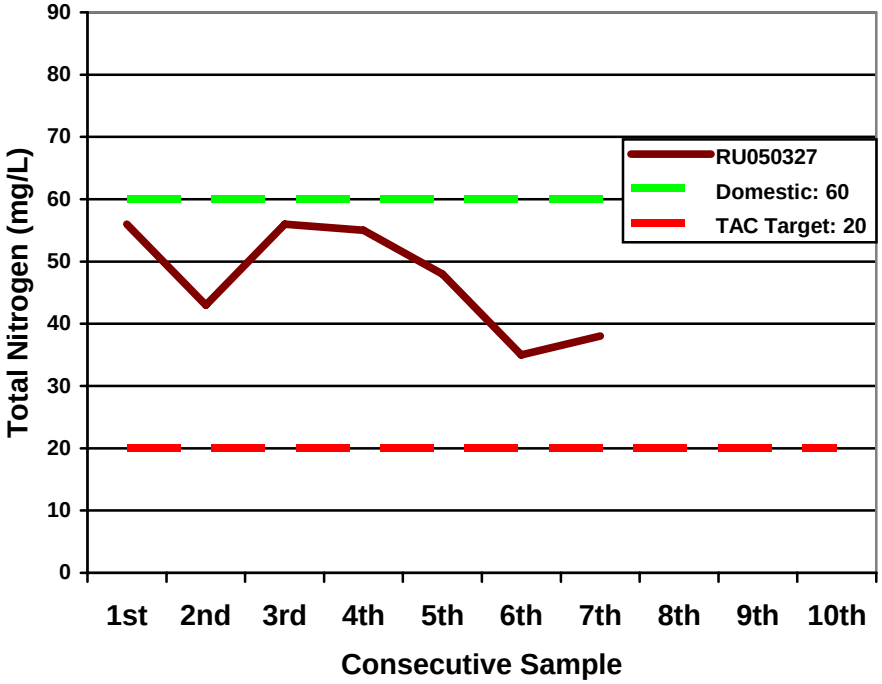
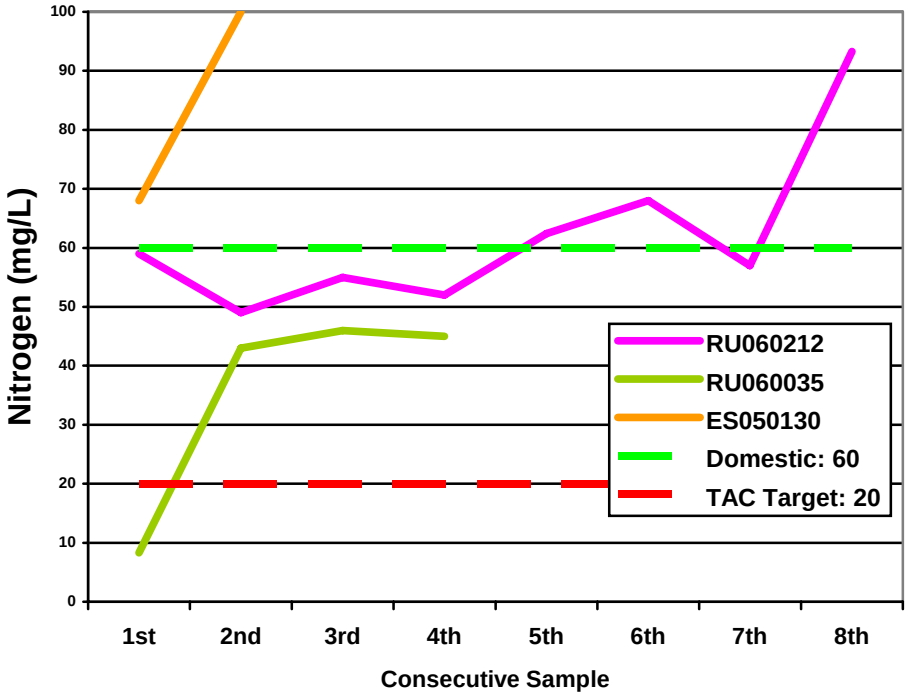


Figure 8. Megastructure.



Discussion

The new database should greatly reduce the amount of staff time that NMED spends to track compliance with effluent monitoring and maintenance service contract requirements. Non-compliant systems should be more easily identified resulting in swifter efforts to obtain voluntary compliance or to pursue enforcement as necessary.

NMED's efforts to obtain voluntary compliance with effluent monitoring requirements have significantly reduced the number of non-compliant systems (Figures 2a and 2b). Voluntary compliance, however, will not be obtained in all cases, and a significant commitment of staff resources will be needed to obtain compliance through enforcement actions. The Compliance Officer that was recently created for the Liquid Waste Program will spend a considerable amount of time on enforcement actions for non compliant ATSs. Compliance with effluent monitoring requirements is critical for determining if ATSs are in fact operating as designed and treating effluent to the levels required by the Liquid Waste Regulations and by approved Liquid Waste permits.

While NMED staff members in two of our five field districts have collected a small number of independent effluent samples, most of the data that this report is based on has been generated by third parties. Field Office personnel have been encouraged to collect additional independent effluent samples.

It is somewhat encouraging that three different brands of ATSs, each with multiple installation locations, consistently produce effluent with total nitrogen at or less than the TAC treatment standard of 20 mg/L total nitrogen (Figure 3). Some of the extremely low concentrations in Figure 3, however, may be related to continuous ATS operation with seasonal wastewater flows where, at times, the effluent is almost completely denitrified. It is also encouraging that the design modifications made for BioMicrobics systems late in 2004 have apparently improved the overall performance of systems installed after that time (Figure 4).

The data gathered so far indicate that episodes of poor treatment in some ATSs (Figure 5) result largely from lack of maintenance and/or improper operation. In light of these episodes of poor treatment, the effluent monitoring frequency of quarterly for the first year, semi-annual for the second year, and annually thereafter as prescribed by the Liquid Waste Regulations does not provide a high level of confidence for determining whether or not systems are functioning properly overall, and for identifying malfunctioning systems in a timely manner.

Effluent from non-residential ATSs sometimes greatly exceeds 60 mg/L, the presumed concentration for domestic wastewater (Figure 6). This is clearly due to the systems being under-designed to treat the high strength waste that they receive.

The Megastructure failure has created significant demands on NMED technical and legal staff resources. The system was reviewed by the TAC and approved by NMED as a tertiary treatment system for up to six experimental installations. The manufacturer

failed to construct the system with the specific materials and components that had been approved by NMED. These deviations from approved design were not caught by the NMED Field Inspectors and were only observed after the program Engineer conducted detailed site inspections. The plastic Megastructure tank, which was a different tank from what was approved by NMED, failed catastrophically on three of the five systems that were installed. Two such tanks were repaired by the manufacturer. Additionally, the air pumps and other treatment components installed on the Megastructure units were different from what had been approved by NMED, and the manufacturer failed to test the effluent in accordance with the parameters and frequency specified in the Liquid Waste Permits. The data that were submitted (Figure 8), however, showed that the Megastructure ATS was accomplishing little if any nitrogen reduction. The manufacturer was allowed to replace system components but was unable to make the Megastructure ATS achieve adequate treatment. Consequently, the Megastructure ATS was de-listed for use in the State of New Mexico.

There continues to be a problem with lack of availability of qualified maintenance service providers. We believe that the training initiative for the ATS industry in the Ruidoso area has contributed to the increase in compliance with effluent sampling requirements (Figures 2a and 2b). The quarterly Ruidoso workshops are being used as a model for industry training in other areas of the state.

Some ATS distributors/installers have not been willing to provide maintenance and effluent sampling services. In these cases, if the ATS manufacturer does not designate and train other persons to maintain their systems, NMED will remove their product from the list of products approved for use in the state. In other cases, ATS manufacturers have either gone out of business or are no longer doing business in New Mexico. It is somewhat troubling that Whitewater systems, which comprise the second largest number of systems installed in the state (Figure 1), have been de-listed due to failure of the manufacturer to comply with 20.7.3.903 NMAC.

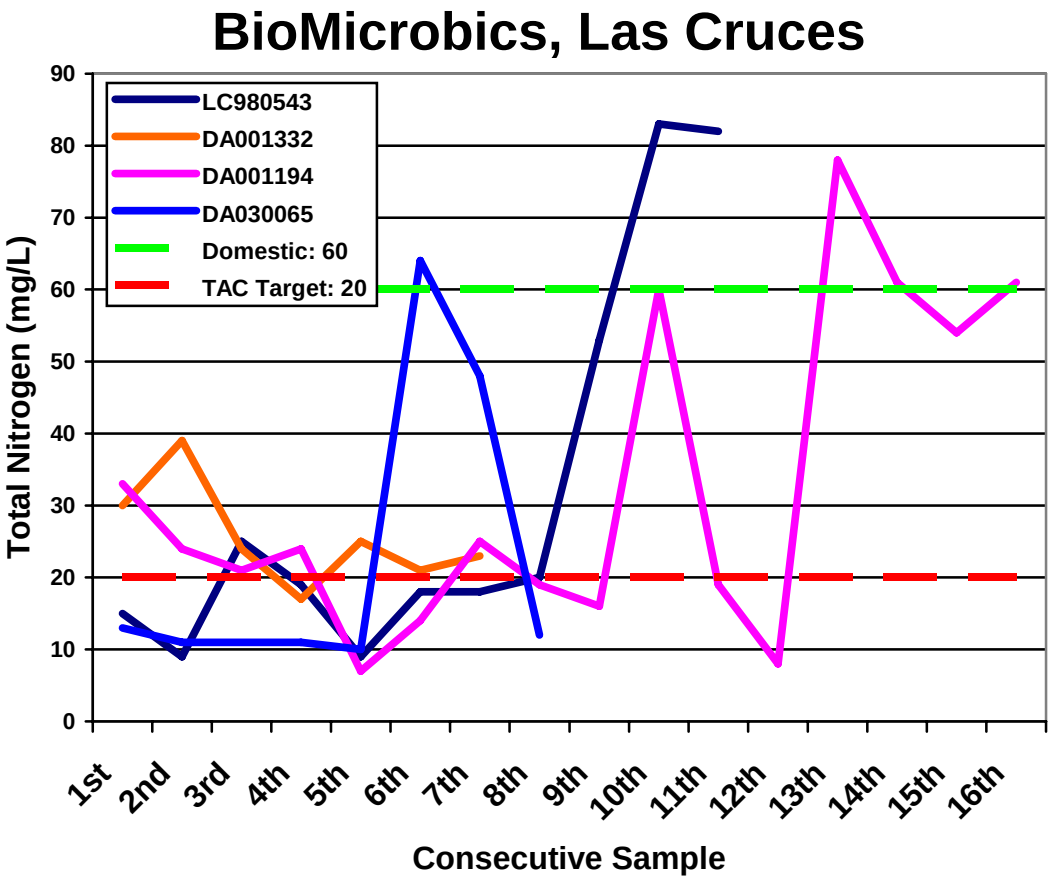
NMED is concerned about the staff resources that will be required to obtain compliance with effluent monitoring requirements and with permitted effluent limitations in cases where ATSs fail to treat to required levels. Liquid Waste Permits for conventional systems require staff resources at the time of permitting. After a conventional system passes its final inspection, no additional NMED staff resources are required until such time that the system is modified or replaced, or at the time of property transfer. ATSs, however, will require NMED staff resources both during the initial permitting process and throughout the life of the system to track compliance with effluent monitoring and maintenance service contract requirements, and to conduct enforcement when necessary when these requirements are not met. We estimate that there are well over 100,000 undeveloped lots in the state platted at less than ¾ acre in size. The small lot "Grandfather" provisions in the Liquid Waste Regulations, that allow installation of conventional septic systems on small lots with onsite and offsite domestic water sources, will expire in September of 2008 and 2010 respectively. As the number of permitted ATSs increases, long term increases on NMED staff resources also will occur.

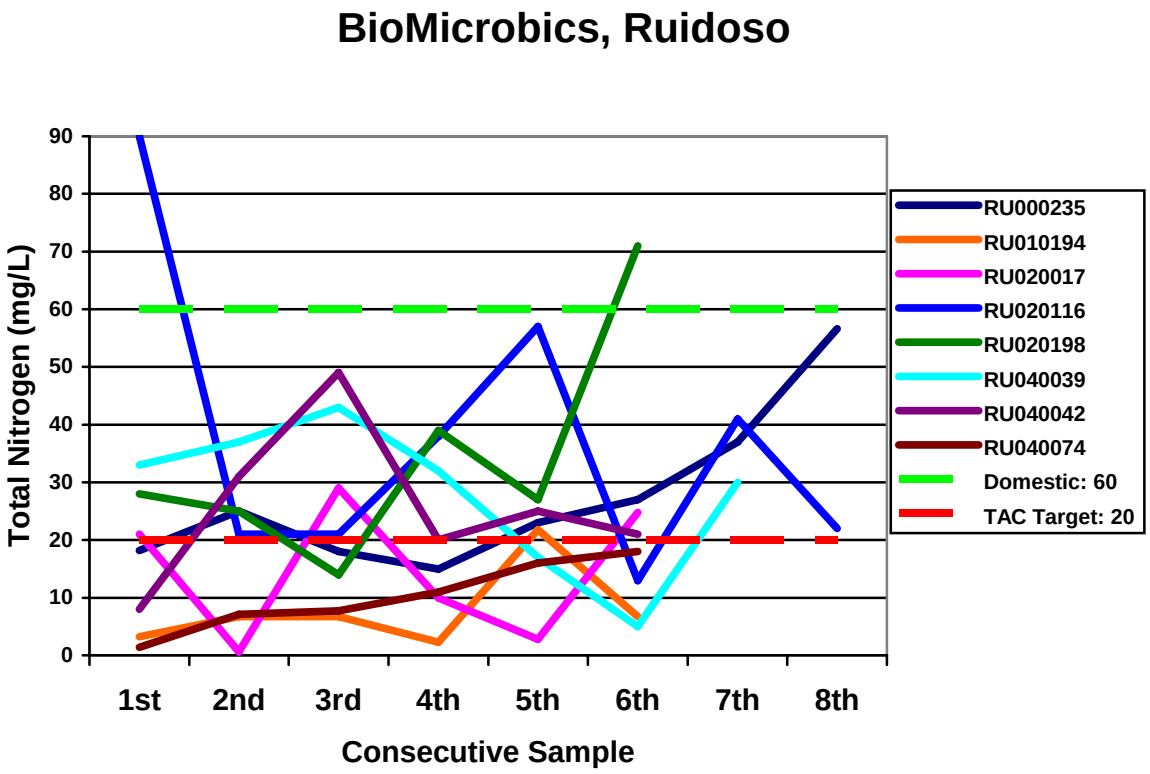
Reference Cited

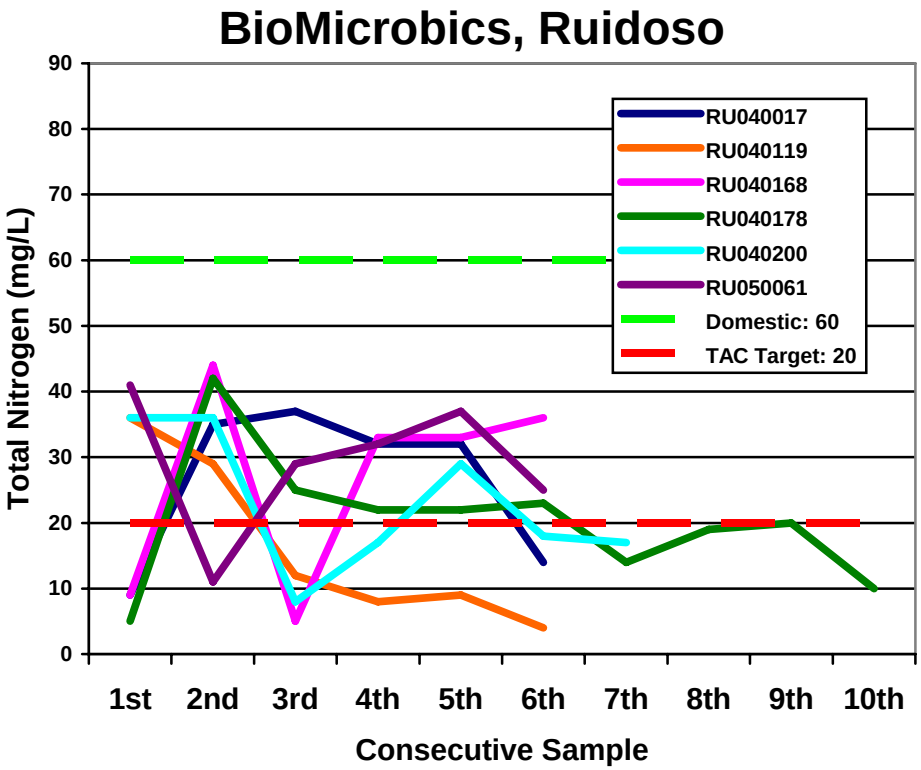
McQuillan, D., J. King and K. Smith. 2006. Advanced On-Site Sewage Treatment Systems in New Mexico. NMED Open File Report, 7 pp, http://www.nmenv.state.nm.us/fod/LiquidWaste/ATS%20report%20WTAC.pdf.

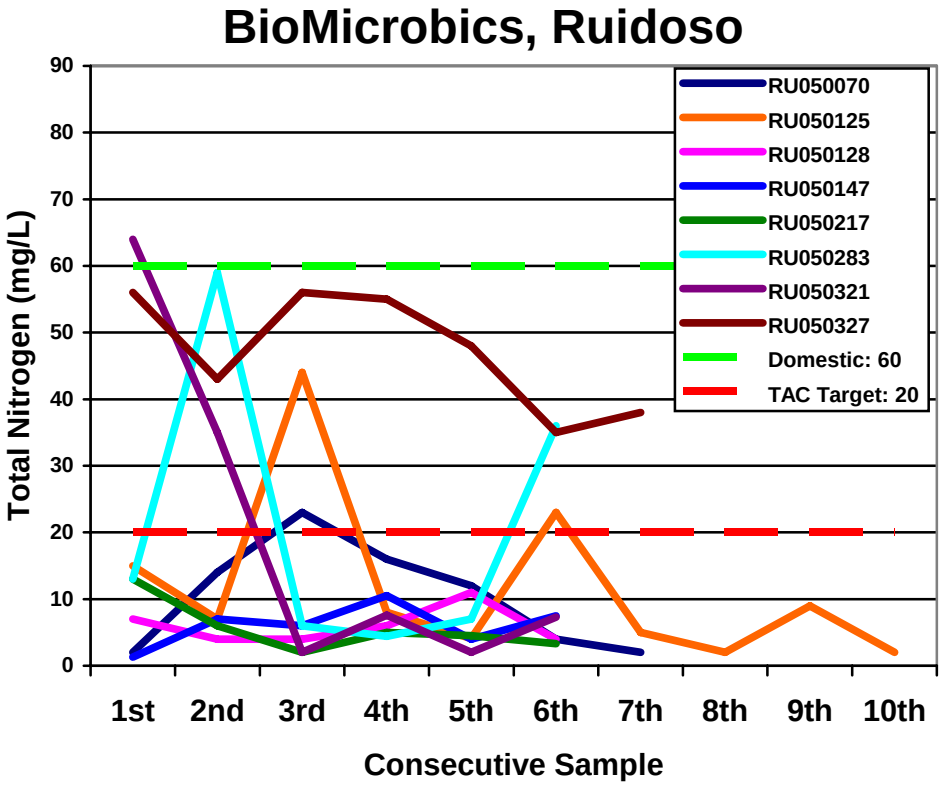
Appendix A
Effluent Quality Time Trends for Individual ATSs

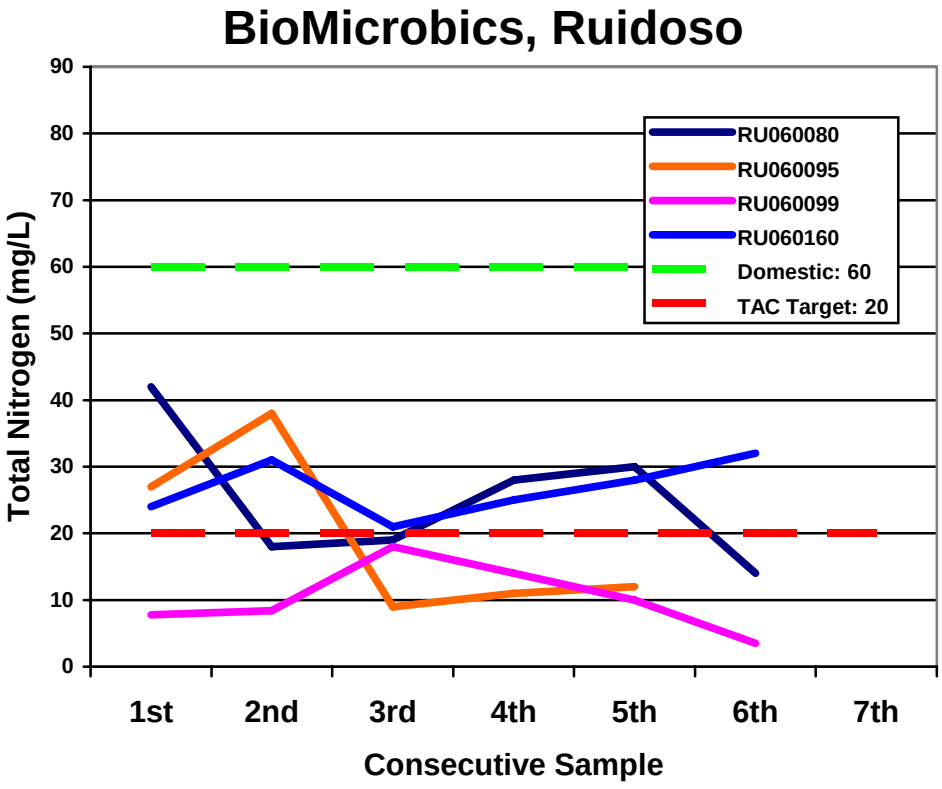
Effluent quality data for 40 ATSs are presented below. The dashed green line represents 60 mg/L total nitrogen, which is the concentration assumed to be in domestic wastewater as specified in 20.7.3.603 NMAC. The dashed red line represents 20 mg/L total nitrogen, which is the target concentration used by the Wastewater Technical Advisory Committee (TAC) to approve ATSs for tertiary treatment.



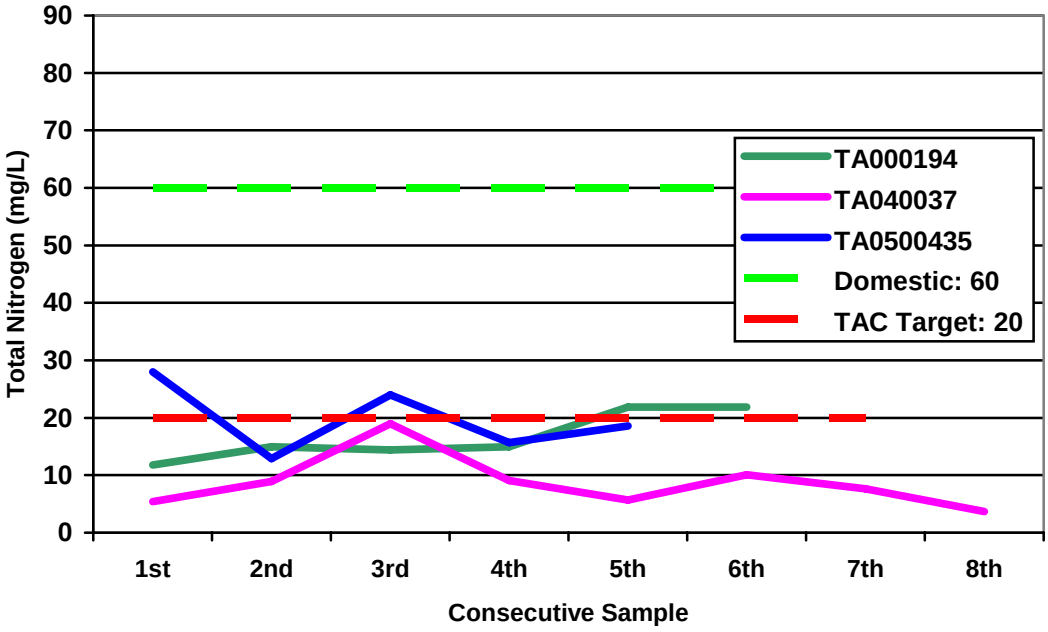

BioMicrobics, Ruidoso
Total Nitrogen (mg/L)
90
80
70
60
50
40
30
20
10
0
1st
2nd
3rd
4th
5th
6th
7th
8th
Consecutive Sample
RU000235
RU010194
RU020017
RU020116
RU020198
RU040039
RU040042
RU040074
Domestic: 60
TAC Target: 20

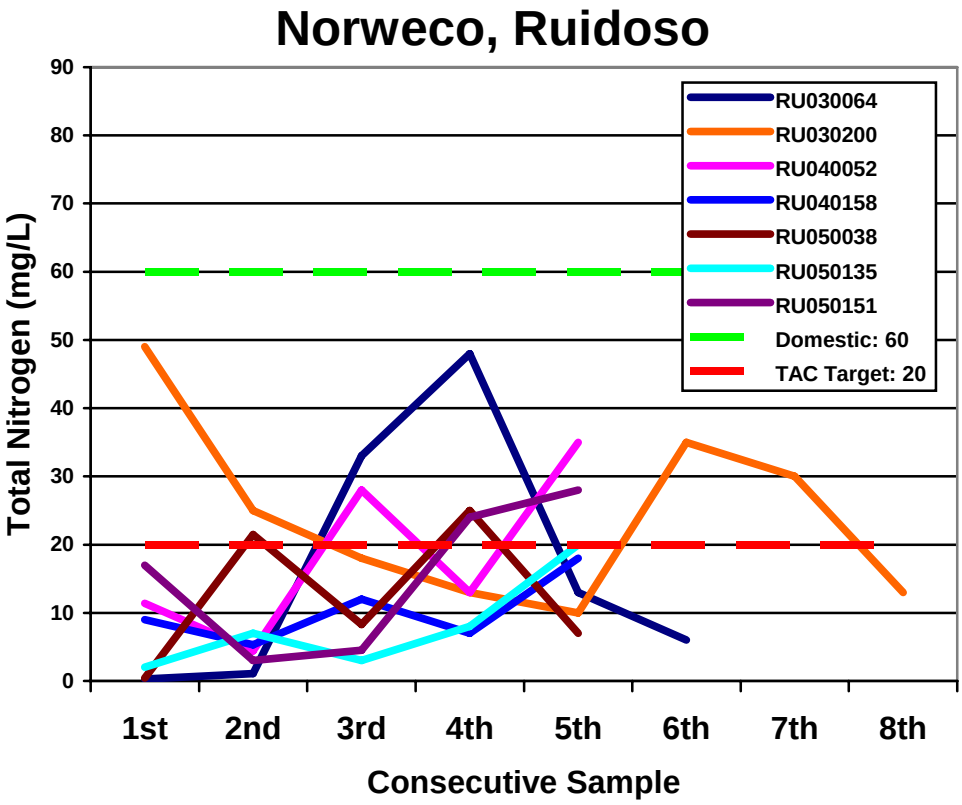

BioMicrobics, Ruidoso
Total Nitrogen (mg/L)
90
80
70
60
50
40
30
20
10
0
1st
2nd
3rd
4th
5th
6th
7th
8th
9th
10th
Consecutive Sample
RU040017
RU040119
RU040168
RU040178
RU040200
RU050061
Domestic: 60
TAC Target: 20


BioMicrobics, Ruidoso
Total Nitrogen (mg/L)
90
80
70
60
50
40
30
20
10
0
1st
2nd
3rd
4th
5th
6th
7th
8th
9th
10th
Consecutive Sample
RU050070
RU050125
RU050128
RU050147
RU050217
RU050283
RU050321
RU050327
Domestic: 60
TAC Target: 20


BioMicrobics, Ruidoso
Total Nitrogen (mg/L)
90
80
70
60
50
40
30
20
10
0
1st
2nd
3rd
4th
5th
6th
7th
Consecutive Sample
RU060080
RU060095
RU060099
RU060160
Domestic: 60
TAC Target: 20

KOI, Taos


90
80
70
60
50
40
30
20
10
0
Total Nitrogen (mg/L)
1st
2nd
3rd
4th
5th
6th
7th
8th
Consecutive Sample
TA000194
TA040037
TA0500435
Domestic: 60
TAC Target: 20


Norweco, Ruidoso
Total Nitrogen (mg/L)
90
80
70
60
50
40
30
20
10
0
1st
2nd
3rd
4th
5th
6th
7th
8th
Consecutive Sample
RU030064
RU030200
RU040052
RU040158
RU050038
RU050135
RU050151
Domestic: 60
TAC Target: 20