A SURVEY OF SEPTIC SYSTEMS ON LAKE MAXINKUCKEE
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I. INTRODUCTION AND BACKGROUND

A. A HISTORY OF INDIANA'S LAKES

The lakes of northern Indiana were formed after the last glacial period, which ended approximately 12,000 years ago. The lake ecosystems were formed by a combination of physical, chemical and biological processes occurring within the lake watershed, including the inlet streams and the lake itself. This complex process took several thousands of years to stabilize, with the result being the establishment of stable, environmentally balanced lakes.

In the 1820's, increasing settlement, land clearing, and farming throughout northern Indiana impacted the natural ecological balance in the watershed. Later in the century, the ecology of the watershed was further impacted with the channelization of streams and drainage of wetlands. Water quality declined in the lakes as they became polluted from high nutrient and sediment loading. With the increasing popularity of lake homes, many of these lakes have reached or exceeded the carrying capacity for development. Water quality of lakes is affected by lakeshore development, which contribute high loads of pollutants, from surface runoff and subsurface infiltration in the high water table area. Development along lake shorelines represents only the most recent human impact on lake water quality.

The description of a lake as "polluted" or "dead" is relevant only in the context of what is perceived as a unpolluted lake. A lake that is green with algae may be considered "polluted" because humans do not like to swim in an algae-filled lake. This growth of algae is merely a biological response to the ecological state of the lake, which may in fact be the natural equilibrium condition. Why this discussion of "perceived" water quality? First, we must decide what kind of water quality we want for our lakes. It is not possible to recreate the ecological conditions at pre-settlement times because the ecosystem has been changed over the past 100 years. We must accept the fact that water quality conditions will lie somewhere in between the water quality of the pre-settlement lake and the lake we perceive as polluted. We cannot give up on our commitment to preserving our lakes, but we must accept that we cannot recreate the situation as it was in pre-settlement times.

Once the water quality goals are defined, we must determine which parameters will be monitored to evaluate water quality over the long term. For example, if we want water of a certain clarity, we must establish quantifiable limits for those parameters that define clarity. These limits could be the amount of sediment entering the lake from inlet streams or the concentration of phosphorus in the lake which influences the algal population.

Next, lake and watershed problems must be identified which negatively contribute to the parameters to be controlled. For example, if phosphorus is to be a controlled parameter, then practices which contribute excessive amounts of phosphorus to the lake must be identified and managed.

Finally, solutions must be implemented which will control the problem economically and without high maintenance requirements. These solutions should recreate the ecosystems, in small scale, that originally produced high water quality in our lakes. Members of the lake association at Lake Maxinkuckee have been leaders in reestablishing some of these ecosystems, with the construction of engineered wetlands on the inlet streams of the lake. A natural solution is the most desirable, in contrast to an engineering a solution that only moves dirt or builds a structure from concrete or steel. These solutions are expensive, usually require extended maintenance and are short on satisfactory results.

B. DEVELOPMENT OF INDIANA'S LAKES

Indiana's lakes, including Lake Maxinkuckee, experienced minimal development before WWII. Most lakes were developed with small, primitive cottages which were used during the summer season or on weekends. In the late 1960's and into the 1970's, the emphasis was to upgrade the summer cottages to more elaborate summer homes or permanent residences. In many instances, the old structures were demolished and new homes were built, complete with expanded bathroom facilities, automatic washers, garbage disposals, water softeners, dishwashers and other water-using appliances. Attention was given to make the homes "modern" in every detail except with regards to providing proper sewage treatment. In many cases, the new home was connected to the existing treatment system, which were often times improperly installed septic systems, dry wells, or simply 55 gallon barrels used as a septic tank. (Dry wells are not legal in Indiana for sewage treatment). These types of systems may have been sufficient when total sewage volume was 50 gallons or less per day, the home was occupied only a few days per year, and the numbers of weekend guests were minimal. The increased development, combined with improper sewage treatment, impacted the natural balance in the ecosystem and causing decreased water quality.

Concerns about the environment and water quality of Indiana's lakes have been documented since the 1930's. Engel (State Planning Board of Indiana; April, 1938) expressed this concern by stating, "although many fine summer homes and many excellent commercial and amusement buildings have been built with keen appreciation for the natural surroundings, in general, much of the expansions and lake front developments have come about in a haphazard way and with but little planning for the future. As a result, cottages at many resorts have sprung up in mushroom-like fashion. At others, sanitary conditions are proving unsatisfactory and inadequate." Thus, sanitation and unplanned development around the lakes were a concern as long ago as 1938. The problems noted in 1938 still plague us in 1993, only now the problems are very much magnified.

C. PROBLEMS ASSOCIATED WITH USING SEPTIC SYSTEMS FOR SEWAGE TREATMENT.

The first septic system was installed in the United States in 1874. It wasn't until the 1930's and 1940's that these systems became more widely used when rural America brought the plumbing indoors. At this time though, water use in the average rural home was minimal. The Saturday night bath in the metal tub around the kitchen cook stove was the rule. The old bath water was not discarded and new provided for each bather - at best additional hot water was added from the cook stove before each bath. Thus, the volume of wastewater was minimal. Today's lifestyles have changed. Daily bathing by all family members is the norm. Stools are flushed after each use. Water is often allowed to run continuously which brushing one's teeth or washing dishes. Automatic washing machines (just one of many water using appliances found in today's homes) can use 50 gallons of water per load, which is most likely, more than the entire daily water use of the farm home in the 1940's. Water use has increased dramatically, and the 1874 technology is not capable of sufficiently treating this continuous daily loading of wastewater.

A second factor affecting the functioning of septic systems is the presence of chemicals. In the 1940's, household chemicals were almost nonexistent. Ivory soap, borax, vinegar and baking soda were the most commonly used cleaning agents. Today, we use a diverse array of special cleaners for floors, walls, stoves, windows, sinks, drains, bathtubs, toilets, plastics, dishes, metals, carpets, drapes and furniture, not to mention the bleaches, detergents, spot removers, extra brighteners, and softeners for just the laundry. Personal care products fill a similar list. After these chemicals enter the septic tank, they are slowly discharged into the ground in the hopes that they will be removed in the soil before the water reaches the groundwater.

The density of septic systems within an area also impacts their function. The increase in development around Indiana's lakes, including Lake Maxinkuckee, and the density of septic systems in these same areas, has magnified the risks associated with improperly treated sewage. The US Environmental Protection Agency has defined a high density septic area as an area having more than one septic per 16 acres and describe such areas as "regions of potential contamination problems" (US EPA. 1977. Report to Congress - Waste Disposal Practices and Their Effects on Ground Water. US EPA, Washington, DC.). Even if the EPA overstated the problem by a factor of 10, that is still one septic per 1.6 acres, and most lakes have at least twice this septic density.

Finally, septic function is affected by the soil types and depth to groundwater. Water, particularly black water with its associated high organic matter, does not infiltrate readily in soils with high clay content. On the other extreme, very sandy soils allow the water to percolate too rapidly and it may be only minimally treated before it enters the groundwater.

All these factors are interrelated and it is very difficult to find the exacting requirements needed for proper septic function on lots where people want to build a home.

In fact, it is possible that such a site may not exist, and if it does exist, the question is, "How many septics, how much waste volume and what type of wastes should be allowed in an acceptable area?" The Indiana State Department of Health determine a septic density by requiring a 50-foot separation between the septic system and a well or a lake, which may not be sufficient since contaminates from septic systems are known to travel farther.

We have talked about septic problems in general, but are there specifics to support these general conclusions? First, let's explore the scientific evidence from other parts of the United States in the data reported in the following articles.

1. Alhajjar, B.J. and S.L. Stramer, *Water Research.* 22(7): 907, 1988.

   Poliovirus was seeded into well-functioning septic systems. Of the poliovirus that was discharged in the septic tank effluent, 88.5% of the virus was transported to the groundwater. No bacteria were found in the groundwater. The "clogging mat", formed under the drainfield, was efficient in removing bacteria but not viruses. As the distance from the drainfield increased, the virus counts in the groundwater samples also increased. Fecal coliform bacteria have shorter survival times in soil and groundwater than some other enteric (intestinal related) pathogens. Thus, although groundwater may appear to be free of fecal contamination, it can still contain pathogens.

2. Postma, F. B. and A.L. Gold. *Journal of Environmental Health*, 55(2), 1992.

   Although more than 5.2 feet of unsaturated soil separated the bottom of the soil absorption system from the groundwater, elevated numbers of fecal coliform and *Clostridium perfringes* were observed at observation wells located 6.5 to 20 feet from the absorption field (the 20 foot well was the furthest well installed from the absorption field). As many as 137 fecal coliform and 442 *Clostridium* bacteria were found at the 20 foot observation wells. Nitrate-nitrogen concentrations were 3 to 4 fold greater than drinking water standard at the 20 foot wells. Septic density ranged from one septic per 1.2 to 3.0 acres. The systems were used seasonally and ranged in age from 7-10 years.

3. Craun, G. F. Waterborne Diseases in the United States. CRC Press. Chapter 5, pp. 73-159, 1986.

   The overflow of seepage, primarily from septic systems and dry wells, was responsible for 58% of the cases of illness caused by the use of contaminated, untreated well water from 1971 to 1980.

4. Yates, M. V. Modeling Microbial Fate in the Substrate Environment. Crit. Rev. Environ. Control, 17: 307, 1988.

> Numerous studies have shown that microorganisms can travel considerable distances in the subsurface. Viruses, in particular, due to their small size and long survival times, can migrate very large distances in soil and groundwater; as much as 1600 m (0.99 miles) have been reported for certain viruses in karst terrain (Gerba, 1984) and up to 400 m (0.25 miles) in sandy soil (Keswick and Gerba, 1980). Other studies have shown viruses can persist for up to 131 days in the groundwater (Stramer, 1984).

NOTE: most government agencies have regulated septic system placement by requiring minimum setback distances between septic systems and drinking-water wells. Setback distances, in different states, range from 50-300 feet (Plews, G., 1977). In Indiana, the minimum setback distance is 50 feet and this distance is not sufficient according to the above data.

5. US EPA, Office of Ground Water Protection, Washington, D.C., July 1986, L00 1984, Sec. F3362

> Chemicals that may enter and contaminate groundwater through septic systems include nitrates, heavy metals (such as lead, copper and zinc), and certain synthetic organic chemicals (such as toluene, trichloroethylene, chloroform, and tetrachloroethylene). Septic systems represent the largest reported cause of groundwater contamination resulting in disease outbreaks in the US. Bacteria and viruses found in household wastewater are the principal identified causes of water-related outbreaks. Groundwater contamination, caused by system failures (other than failure involving surfacing of wastes and backup into the home), is less obvious and can go on for years without being recognized, while residents with nearby wells unknowingly drink contaminated water. In addition, if a septic systems fails to operate effectively, the owner must accept responsibility, which might involve making necessary repairs and compensating injured parties.

6. Personal communication, Elkhart Health Department.

> Samples from 120 septic tanks revealed the tanks contained multiple volatile and semi-volatile compounds, in addition to heavy metals. In total, 45 chemicals and heavy metals were found in 109 of 120 (91%) septic tanks. In a related study from the University of Wisconsin, toluene was found in 70% of the septic tanks tested, while the Elkhart study found toluene in 65.8% of the tanks.

In conclusion, these scientific articles, as well as many others, support the contention that septic systems do not treat wastewater to the degree most people assume. It is difficult, if not impossible, to assure that all septic systems will function satisfactorily due to our changing lifestyles, higher population density, natural site constraints, and engineering design of the system. In fact, in many cases, the evidence from many areas of the US supports the opinion that septic systems are a threat to public health and the environment.

II. DATA COLLECTION

A. HISTORICAL METHODS FOR DETERMINING SUITABILITY OF SEPTIC USE AND DETERMINATION OF SEPTIC PROBLEMS

In the past, little effort was made to determine the suitability of a site for a septic system. Drainage patterns, soil types, permeability, depth to the water table, topography and many other parameters were generally ignored. In fact, it was not unusual, as a method to solve a high water problem, to knock a hole in the septic tank so it would sink in the water. Although this may sound shocking, the main goal of septic suitability and function was to get the septic system in the ground - period. If the toilet flushed, the system was working. Eventually, a system for determining site suitability for a septic system was developed. This system required a determination of soil type, soil permeability, depth to groundwater or other limiting layer which will reduce the soil treatment, and redesign of the absorption fields to utilize the available site conditions to the best advantage. This system for determining site suitability has had a major impact on limiting the use of septic systems, and in some cases, would restrict their use on developed lots where a septic system is presently being used for sewage treatment. Although these advancements allow the construction of systems that function more acceptably, the basic technology has not changed and septic systems continue to rely entirely on the soil for the basic sewage treatment.

Few methods are available to determine if a septic system is functioning properly. Usually, an improperly functioning system is discovered when sewage backs up into the house or is visible on the ground surface. Many other failures are less obvious and can go on for years without being recognized (See previously referenced EPA article). Certain tracers and dyes are available that can indicate groundwater contamination from septic systems or detect direct discharges, but these methods have severe limitations (ie: dye may be bound to the soil particles or diluted in the water thus making the dye undetectable).

In the final analysis, it is a questionable practice to use a sewage treatment system that is, at best, difficult to monitor and determine that it is functioning properly. Any system to be used must have an operation mode that allows control of those variables which impair proper function. In addition a sewage treatment system should lend itself to monitoring. Septic systems do not meet these criteria.

B. LEACHATE DETECTOR AS A METHOD OF SURVEYING LAKES FOR SEPTIC PROBLEMS.

A septic leachate detector is an instrument that detects by-products of human urine and records the signal on a graph and is a useful tool to survey a lake for discharges from septic systems. A study completed for the US EPA reports that "the primary advantage of septic leachate detectors is that they can locate otherwise invisible effluent plumes, thereby dramatically increasing the efficiency, comprehensiveness, and lowering the cost of water quality surveys of septic tank effects on lakes" (EPA contract 68-01-4612, Wapora, Inc., March 12, 1984). This instrument should not be used for enforcement purposes to require septic repairs because it cannot definitively identify the source of the septic plume. Many factors affect the outcome of a survey, including wind and wave action on the lake, recent heavy rains, seasonal high water table, and time of day. When the instrument is used to investigate lakes with septic systems, multiple effluent plumes can be detected on most shore areas. In fact, the instrument's response can be correlated with the visible conditions seen along the shore (See Section II C. and the discussion of the instrument's response in the area of the public access). The effectiveness of the instrument has been verified by performing surveys on lakes without residential development or on lakes where residences are connected to sewers. Under these conditions, the instrument did not detect any septic leachate, which is to be expected. Additional tests are sometimes performed to measure phosphorus and fecal bacteria, as septic tank effluent contains large concentrations of these two pollutants. Phosphorus is a major nutrient pollutant which causes excessive plant and algae growth in the lakes, and this growth begins a domino effect towards declining water quality. Samples obtained from lakeshore areas where septic leachate was detected had phosphorus concentration 2-10 times higher than samples obtained from mid-lake. Researchers at the University of Montana used a leachate detector for invisible plume detection at Flathead Lake (Verification of Shoreline Sewage Leachates in Flathead Lake, Montana, 1985). Water samples taken in areas of detectable plumes were analyzed for phosphorus and they found phosphorus concentrations were greater than 10 times higher in lakeshore areas.

The leachate detector has also been used to identify areas of high fecal bacteria counts. It is difficult to identify sampling sites for fecal bacteria because these bacteria do not thrive in fresh water and the high dilution factor in a lake. Fecal bacteria in lakes is a public health concern due to the potential presence of harmful pathogenic microorganisms to be present as well. One cup of effluent from a septic tank can contain several million fecal bacteria. The leachate detector can dramatically reduce sampling error when sampling for bacteria.

In summary, the leachate detector is a valuable tool for the investigation of proper septic function on lakes. In many cases, the instrument provides the only method available to conduct inexpensive and reliable surveys of septic plume detection in lakes.

C. LEACHATE DETECTOR RESULTS ON LAKE MAXINKUCKEE

The East Shore was the first area investigated with the leachate detector. This area demonstrated no severe contamination, although there was possible leachate detection in several locations as compared to the base line setting away from shore. This signal was very diffuse (a slow, increased drift from base line), making it difficult to conclusively demonstrate the presence of invisible septic plumes entering the lake. In one area, approximately in the middle of the East Shore, a demonstrable plume was found. A second pass through the same positive area confirmed the presence of this plume (Figure 1).

Very high levels were detected in the channel at Venetian Village. After the base line was established out in the lake, the instrument responded immediately upon entering the mouth of the channel. The signal peaks increased in strength farther into the channel. The south end of the channel demonstrated the greatest concentration of effluent plumes, and the peaks on the graph gradually diminished in strength along the east side of the channel and back out into the lake (Figure 2).

Septic leachate was detected along the West Shore south of the public access, and the South Shore east to Venetian Village. Along this portion of the shoreline, the readings were 2-3 times greater than the readings for the 0.1% urine standard. The turbulence from boat traffic created some difficulty in stabilizing the instrument in areas between the docks. A portion of this area was reinvestigated early the following morning (6:30 am), before many speed boats were on the lake. Again, the instrument responded to effluent plumes in the same areas as the previous day (Figure 3).

The shore area from Long Point to the public access site also demonstrated the presence of invisible effluent plumes entering the lake. Several of these plumes were quite strong (Figure 4).

The North Shore of the lake did not have as many positive response areas as other portions of the lake. A signal was observed at the Academy Apartments. A second pass through this area also detected septic leachate. These results are not conclusive though, because these peaks are small and diffuse, probably as a result of not being able to approach close to shore. A second response area was in the marina marked on the printout as Town of Culver #. The instrument responded to conditions in this area twice and again on the opposite side of the dock located in the response area. A third possible response area is marked as E. of Beach. Again, the instrument response was diffuse, and, thus, does not allow for conclusive results. The instrument did not respond in the remaining areas of the north shore area (Figure 5).

III. DISCUSSION OF LEACHATE DETECTOR RESULTS

The East Shore area had one demonstrable problem area, although a gradual increased response above base line reading was recorded in several areas. The East Shore

FIGURE 1: EXAMPLES OF LEACHATE DETECTOR GRAPH FROM THE EAST SHORE

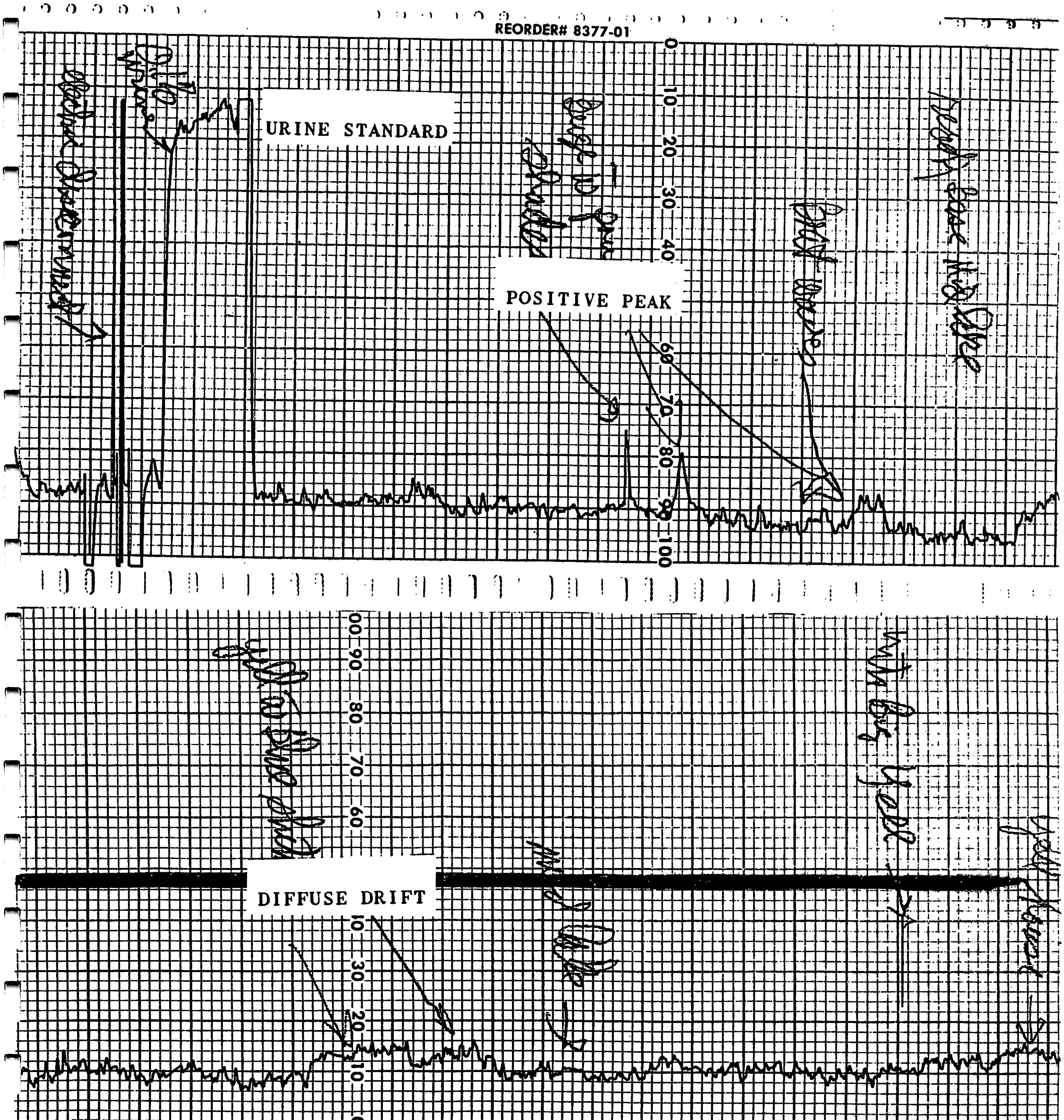
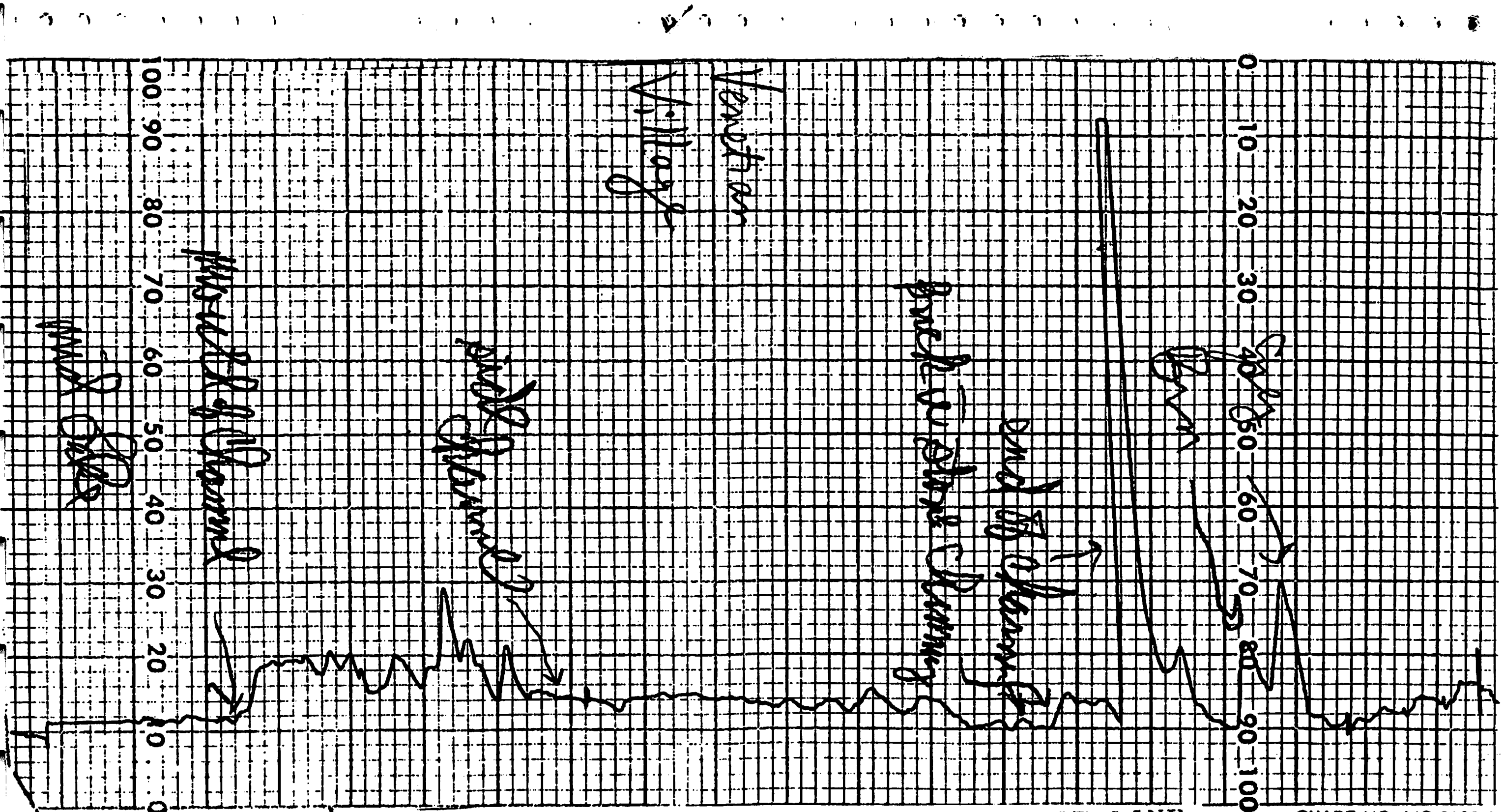


FIGURE 2: EXAMPLES OF LEACHATE DETECTOR GRAPH FROM VENETIAN VILLAGE



IMMEDIATE RESPONSE AND PROLONGED PEAK ABOVE BASE LINE INDICATES HIGH VOLUMES OF EFFLUENT

FIGURE 3: EXAMPLES OF LEACHATE DETECTOR GRAPH FROM THE WEST AND SOUTH SHORES

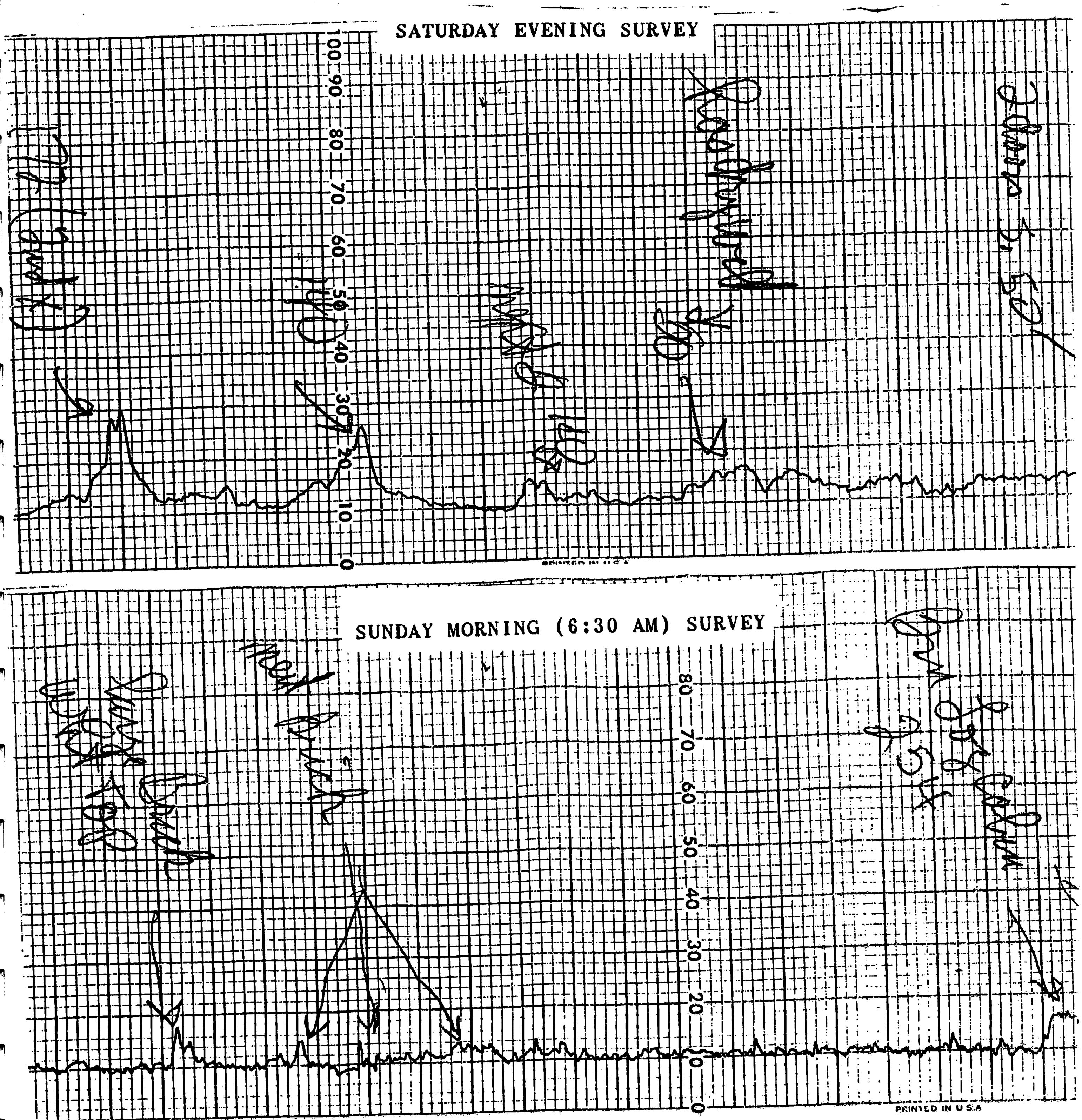


FIGURE 4: EXAMPLES OF LEACHATE DETECTOR GRAPH FROM LONG POINT TO PUBLIC ACCESS

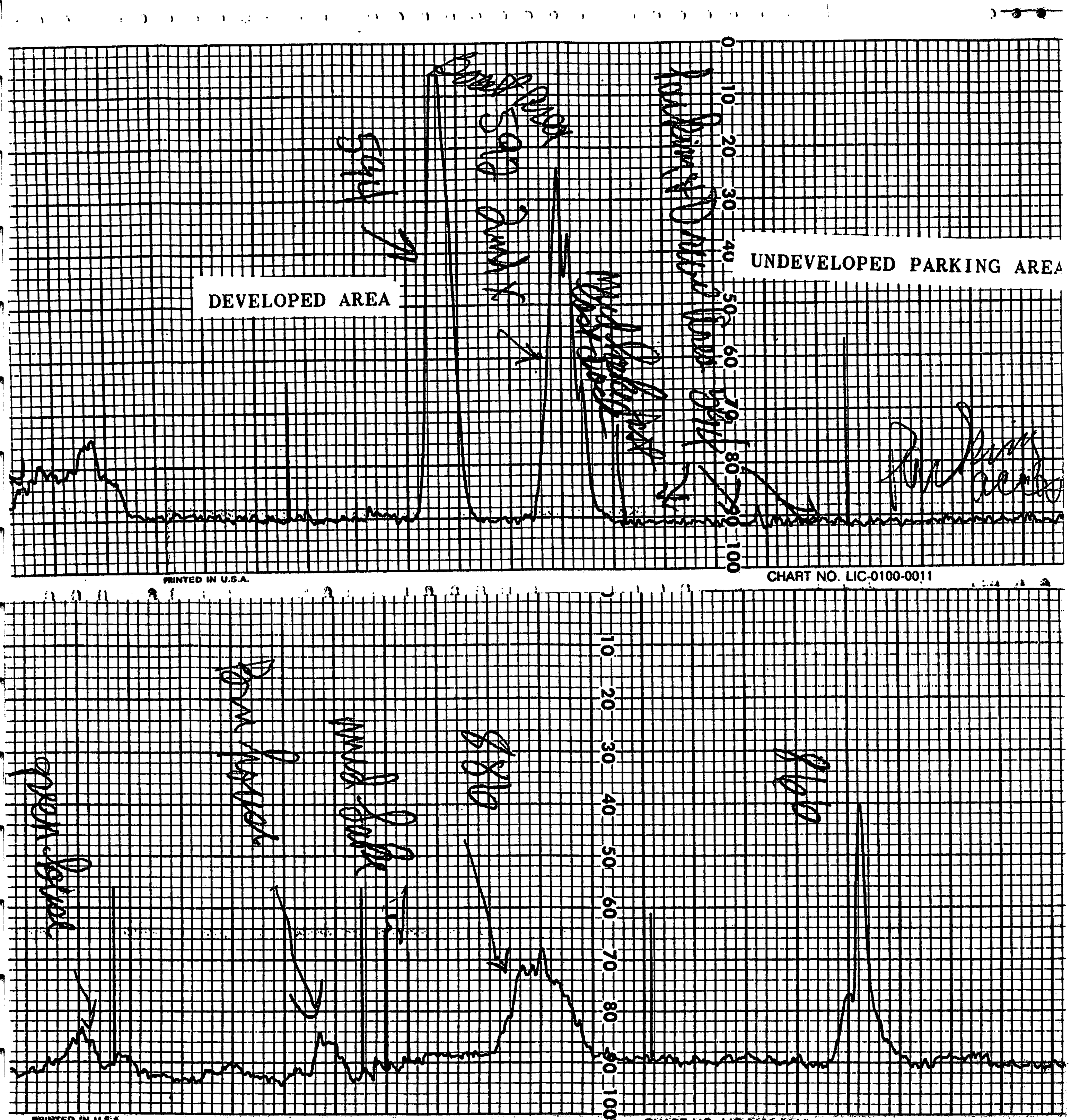
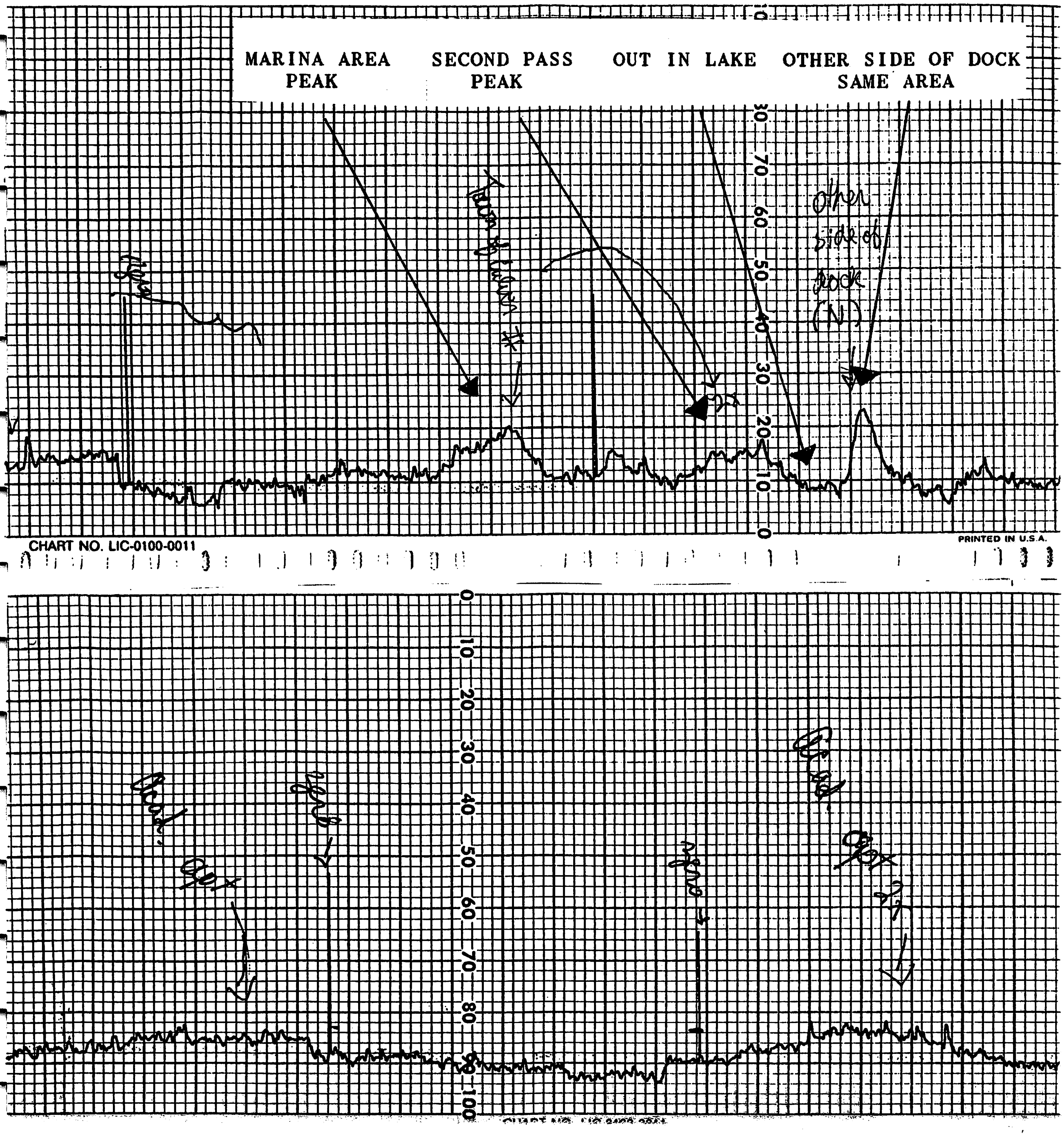


FIGURE 5: EXAMPLE OF LEACHATE DETECTOR GRAPH FROM THE NORTH SHORE



development is located on elevated shorelines (10-20 foot above lake level), the lots are of large size, and homes are built back from the lake shore. The soil types on this side of the lake are also more favorable for septic systems (Figure 6).

The area known as Venetian Village had some of the highest levels detected in the lake. The homes in this area are only a few feet above lake level and the septic systems are in mainly muck soils, which are rated by the Soil Conservation Service Soils Manual as having severe limitations for septic systems (Figure 6). These soils have poor percolation capacities and septic effluent travels horizontally underneath the surface and flows into the lake. This problem has been demonstrated on other Indiana lakes and at Flathead Lake in Montana (see above) where leachate detector surveys have been supported with analyses of water samples for fecal bacteria and phosphorus. If the soils are incapable of treating sewage or if the volume of sewage is too great, the water and its accompanying pollutants travel the path of least resistance into the lake.

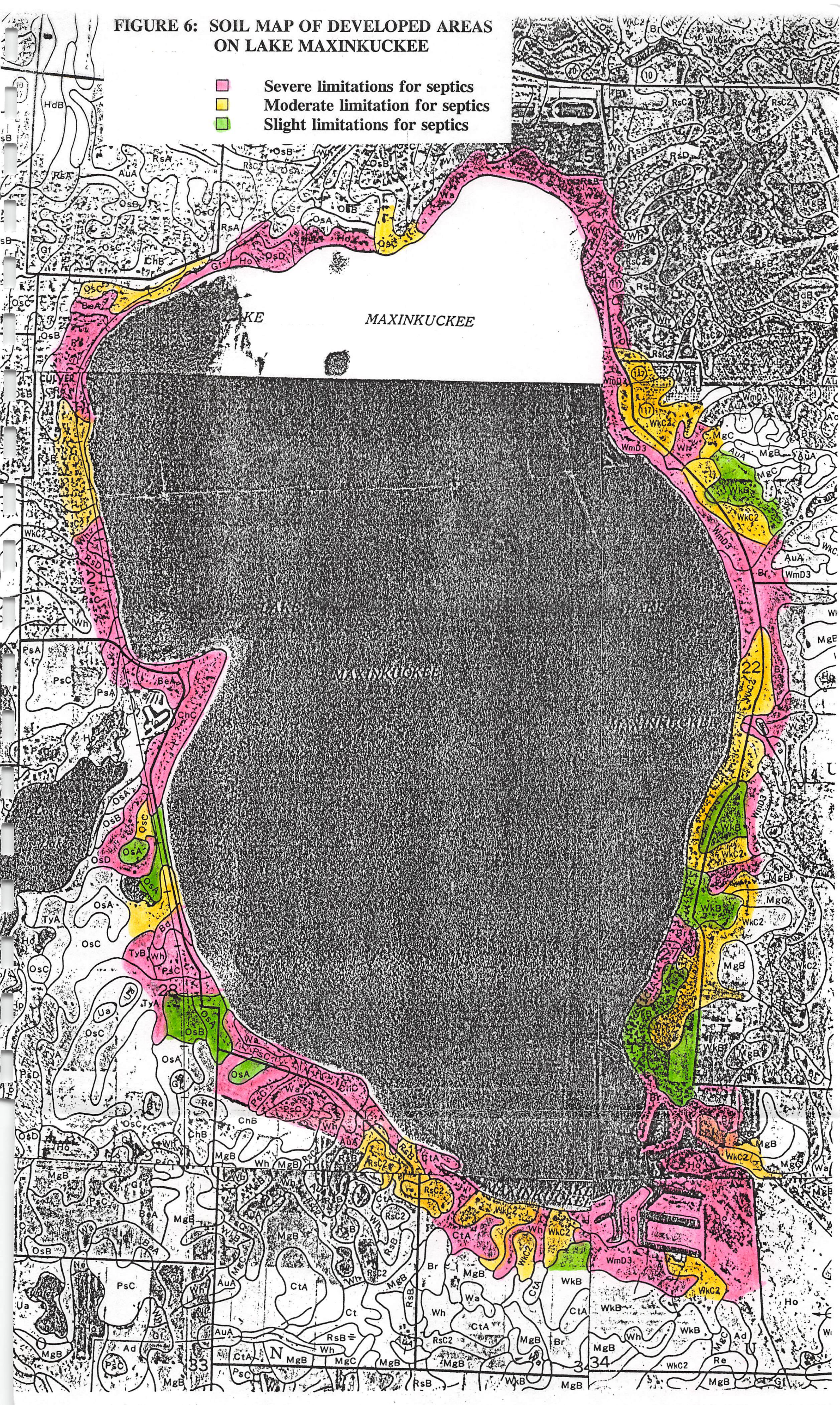
The West and South Shores combine the problems of soils with severe limitations for septic use and small lot size. The sandy soils in these areas have such high percolation rates that they are incapable of filtering and treating the septic effluent. If microorganisms have been found to travel up to 0.25 miles (1300 feet) in sandy soil (see Yates, M.V., 1988 above), it is not surprising to find solubilized materials from septic systems traveling through the soil and into the lake. The small lot size effectively increase the volume of effluent discharged into a given area, and the larger the volume the greater the potential for problems. Some of these lots are so small it is impossible to install a normal septic system, and dry wells are used instead. Dry wells, because they can be installed 8-12 feet in the ground, increase the probability of discharging effluent into the lake. Thus, this combination of soils with high percolation rates, the high volume of effluent discharge per square foot of surface area, and improperly designed systems simply increases the risk associated with using a sewage treatment system that has only marginal capabilities for proper sewage treatment.

The response of the leachate detector in two areas of the North Shore is puzzling, since these areas are serviced by sanitary sewers. One possible explanation is that the signals were recorded near inlet streams which may receive contaminated effluent discharged upstream from the lake and the town's sewer system.

IV. CONCLUSION OF LEACHATE DETECTOR SURVEY

The results of the leachate detector survey indicate the discharge of septic effluent into Lake Maxinkuckee. The use of septic systems, especially in areas of high density, high waste volumes and marginal soil conditions, creates potential contamination problems. First, the environmental quality of the lake is being degraded. Septic effluent contains high concentrations of nutrients, especially phosphorus, which create conditions that impact water quality. Previous water quality studies completed on Lake Maxinkuckee mention increased

FIGURE 6: SOIL MAP OF DEVELOPED AREAS ON LAKE MAXINKUCKEE



concentrations of total and soluble phosphorus, total nitrogen and alkalinity in the lake. Septic discharges are one contributor to these high nutrient levels.

Other sources of nutrient input include stormwater runoff from yards, roads and parking areas around the lake. The impact of the watershed on the water quality of Lake Maxinkuckee is evident from oxygen data obtained as early as 1907. As mentioned in the Introduction, the impact of the deforestation, farming and drainage practices had an effect on the water quality of lakes in Indiana, and this impact was evident as early as 1907 on Lake Maxinkuckee. The additional impact of lake development on water quality may not be completely evident as yet, but when changes in water quality conditions are observable to the average lake resident, it may be impossible to influence the outcome.

In addition to the environmental impact of septics, the impact on public health must be considered. This problem was alluded to in the previously cited scientific articles. If the leachate detector detects septic effluent entering the lake, can certain disease organisms, normally associated with untreated sewage, also be entering the lake? If the answer is yes, then caution should be exercised by those who swim in the lake, since there is a wealth of data available on the spread of human disease caused by untreated sewage. The question is just how "untreated" is the effluent entering Lake Maxinkuckee. To determine the complete answer to this question would require extensive and expensive studies. But it may be possible to provide the answer indirectly.

As discussed previously, numerous scientific articles provide evidence of contamination of groundwater by septic systems. In addition to chemical contamination, bacteria and viruses have been introduced into the groundwater by septic systems. In fact, septic systems are the principal known cause of water-related disease outbreaks. These contaminants are discharged from the septic tank and travel through the soil, into the groundwater or lake. With the high number of homes in the shore areas of the lake, the small lots, and poor soils, the concern about water quality is not limited to the lake but also to the drinking water wells on the lake.

The conclusion of the present study and numerous other studies on septic systems and their potential threat to public health indicates that a solution to present methods of sewage treatment must be found for the residents on Lake Maxinkuckee.

V. IDENTIFICATION OF POTENTIAL SOLUTIONS

A. INSTALLATION OF SEPTIC SYSTEMS OF IMPROVED DESIGN OR A "DO NOTHING" SOLUTION

The requirement for the installation of septic systems of improved design simply ignores the fact that the septic systems created the problem in the first place. Even the most advanced septic design is based on the 1874 technology of the first septic installation (See Section IC). In addition, the conditions, such as poor soils and high water, found in the near-shore areas of Lake Maxinkuckee are not suitable for septic systems.

Also, if the US EPA is correct in describing an area with more than one septic per 16 acres as an area of high septic density (See US EPA, 1977), how is it possible to correct for the high density on Lake Maxinkuckee without condemning homes to reduce the present density? How can the lake and drinking water supplies of the lake residents be best protected. These questions will not be satisfactorily answered if the solution to the present sewage treatment problem is new and different septic systems.

B. INSTALLATION OF CENTRALIZED SANITARY SEWER SYSTEM

Centralized sanitary sewer systems were originally designed for densely populated areas, such as cities and could be described as "City Systems". A treatment facility was built on the outskirts of the city, usually next to a river to allow easy discharge of the treated wastewater, and sewer pipes were extended into the city to carry sewage to the treatment facility. Centralized treatment systems are expensive to design and build, and specially trained personnel are required to operate and maintain them. The user fees collected from the large number of connections and government funds helped to finance these treatment plants. The North Shore of Lake Maxinkuckee is connected to the wastewater treatment plant in Culver and the option to extend these services to the other portions of the lake should be addressed in any feasibility study to upgrade wastewater treatment around the lake.

C. INSTALLATION OF DECENTRALIZED SANITARY SEWER SYSTEM WITH SMALL DIAMETER SEWERS

Decentralized sanitary sewer systems are customized to meet the wastewater treatment needs of a localized area. Where the density of the homes is low and the cost per home is high for centralized treatment systems, decentralized systems can minimize the cost of the collection system and may be more economically feasible.

There are several types of decentralized wastewater treatment systems, however only two types of treatment facilities, cluster and constructed wetland treatment systems, meet the low cost criteria for both construction and maintenance, but there are major differences in the degree of wastewater treatment. The cluster system is essentially a large septic absorption field serving several homes, discharges untreated septic effluent directly into the soil, as with individual septic systems. With a constructed wetland treatment system, the septic effluent is collected and treated in a constructed wetland specially designed to remove nutrients, bacteria, and pathogens. The treated water is then discharged into the soil. This secondary treatment provided by the soil acts as a further safeguard against groundwater contamination.

VI. CONCLUSIONS AND RECOMMENDATIONS

The main method of sewage treatment on Lake Maxinkuckee are septic systems. Only the north side of the lake, which is included within the town of Culver, is connected to a sanitary sewer system. These septic systems are discharging effluent into the lake. This study utilized a leachate detector to investigate only the lake septic problems and did not include analyzing water samples for nutrient or fecal bacteria inputs from these septic systems. Based on previous studies completed by this author and by many others, it is likely that high levels of nutrients and fecal bacteria are also present. The results of the leachate detector survey conclude that septics are impacting both the environmental quality of the lake and the public health of those using the lake.

The recommendation from this study is that the residents of Lake Maxinkuckee organize, under the laws of the State of Indiana, with the purpose of installing a sanitary sewer system as soon as feasibly possible. With the installation of facilities for proper sewage treatment, the future of the lake and the public health can be protected from the impact created by the present system of treatment.