Attachment 95.7.1.2

ASSESSMENT OF BACTERIAL AND NUTRIENT CONTAMINATION FROM SUBSURFACE DISPOSAL SYSTEMS IN THE SEACOAST AREA

A Final Report to

The New Hampshire Office of State Planning, New Hampshire Coastal Program

Submitted by

Dr. Stephen H. Jones[1,3], Dr. Richard Langan[1], Dr. Lawrence Branaka[2], Mr. Daniel Marquis[1,3] and Dr. Thomas Ballestero[2]

1. Jackson Estuarine Laboratory, University of New Hampshire
2. Department of Civil Engineering, University of New Hampshire
3. Department of Natural Resources, University of New Hampshire

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INTRODUCTION

Coastal areas of New Hampshire and throughout the U.S. are under increasing pressures for expanded development and conflicting uses. Many coastal areas have less than suitable conditions for wide-spread development, especially for adequate subsurface treatment of sewage. Unfortunately, many areas have been developed with residential and commercial buildings and accompanying septic systems located on poorly suited soils. One result has been contamination of groundwater and surface water. In surface waters, microbial contamination poses a public health threat to shellfish consumers and swimmers, while nutrient contaminants threaten critical ecological processes of estuarine and marine habitats.

The most critical of these problems at present in coastal New Hampshire is the microbial pollution, which causes shellfish beds to be closed to prevent public health problems. A great deal of pressure on the State of New Hampshire by citizens in coastal areas has recently resulted in increased attention on re-opening closed shellfish areas. Portions of Hampton Harbor are now conditionally approved, and it is hoped that more areas in the harbor will be opened when the municipal sewage treatment system is complete, and the suspected sources of contaminants, private sewage disposal areas, are no longer functional.

The goal of this study was to take advantage of the situation in Seabrook, where all homes will be hooked up to the municipal treatment system, and study the linkage between on-site sewage disposal systems and surface water contamination. Sites near surface waters were to be studied to determine if groundwater contaminated with either nutrients or bacteria was moving away from effluent disposal areas toward surface waters.

PROCEDURES AND RESULTS

SITE SELECTION PROCESS

The process by which study sites were chosen was dominated by the need to find knowledgeable people willing to participate. Attempts were made to find sites with properties characteristic of a range of conditions, and all sites had to be near to surface waters. The perimeters of areas in Seabrook that were close to tidal waters or freshwater tributaries are encircled in Figure 1. This map was given to the Seabrook Health Officer who then contacted people who may be likely candidates in these areas. Seventeen different lots were identified as potential study sites, and thirteen were chosen for study. Two of the sites were assessed only for implementation of the tidal water assessment forms by Elkind Environmental Associates, Inc. (1994), while at the remaining eleven sites, groundwater wells were installed.

The eleven sites chosen for wellwater assessments are identified on Figure 1 as small circles around the dwelling at the study sites, and labeled using a 2-3 capital letter designation, as described in Table 1. Each owner was interviewed in person and given time to consider participating before signing an access agreement form.

SOILS AND SITE CHARACTERISTICS

The selected sites were located in two general areas: on River St. bordering Hampton Harbor and marshes, and in town at various locations. All selected sites were subject to a thorough assessment that included Order One soils surveys, location and description of septic system/effluent disposal area, and other important site characteristics (Elkind Environmental Assoc., 1994). This preliminary study provided extremely useful information for the ensuing wellwater assessment studies. Generally, the soils are glacial outwash sands and gravels that cover bedrock that is near the surface in many areas. The areas near tidal waters have an organic surface layer overlying sands and gravels. Sites in town are generally on natural soils (except the Walton Rd. site) while the River St. sites are built on filled wetlands/tidal marshes. The soils and characteristics of selected study sites are summarized in Table 2, with a more detailed description of on-site soil properties in Table 3.

Most of the sites had effluent disposal areas (EDAs) located on filled or excavated soils (100A, 299A, 300A), which are not formally classified for soil suitability. However, soils at all sites have severe limitations for septic systems (groundwater contamination) because of the prevalence of sandy soils, which are poor filters for septic system effluent, and the potential for ponding at poorly drained sites (Tables 2 and 3). One site was adjacent to a freshwater marsh, six sites were adjacent to salt marshes, and three sites were adjacent to a beach area. Many of the septic systems were simply cesspools or were so old that they were not state-approved systems. Only two sites, KDB and RC, had state-approved systems (Table 2). All sites were in relatively close proximity to the adjacent marsh or beach.

SEABROOK WELL INSTALLATIONS AND GROUNDWATER FLOW DIRECTIONS

Well Installations

The purpose of the groundwater monitoring wells was to provide the means for obtaining samples of the groundwater both up gradient and down gradient of the sewage disposal system. The results of analyses of the samples would be the basis for evaluating the effect of the disposal system on the local surface water and marshlands. Monitoring wells were installed at each site up gradient and down gradient of the effluent disposal area (EDA). The locations of the disposal areas were obtained from the Elkind Environmental Associates, Inc. report on the selected Seabrook properties (Elkind Environmental Associates, Inc., 1994). Typically, between four and six 1/2-in nominal diameter carbon steel wells were installed at each site. At least one, and more typically, two wells were installed upgradient of the EDA to establish background levels for bacteria and nutrients in the groundwater. Then one well was installed in what was estimated to be the down gradient direction. The directions were estimated based on the direction of the salt marsh, or other surface waters which might act as a discharge point for the groundwater, and the surface topography, since it is not uncommon for local groundwater flow to be influenced by surface topography. A local groundwater direction was established using the water level elevations from the first three wells to verify or modify the estimated groundwater directions. Subsequent wells were installed so that the site had a down gradient well close to the EDA, and also one at a greater distance down gradient. If there was uncertainty as to the exact groundwater direction, additional wells were installed in the down gradient direction with the objective to capture the effluent plume, should it exist.

Additional wells were required at the KDB sites and the REH/RET sites since the marsh was adjacent to more than just one side of the site property. The KDB site had two leach fields situated on what amounted to a small peninsula surrounded by the marsh. Groundwater was expected to emanate from the leach field in several different directions.

At both the River Street sites of RH and RC, the well locations were restricted by the property boundaries and in the case of RC, a buried concrete pad constituting a former parking area. Since these properties were on opposite sides of the RP property, also participating in the study, the water levels at all three sites were used to establish well locations.

The last step in the well installation was to install a well within the EDA (if possible), and a deep well. The deep well consisted of the same type of well used in the other installations, but with the screened interval starting at least one foot below the bottom of the screened interval of the nearest shallow well. As implied, the deep well was installed as a couplet to the closest down gradient shallow well to the EDA.

Each well consisted of 1/2-in nominal diameter carbon steel pipe. The pipe came in 11-ft sections. The well sections had a one-foot section of blank pipe at the well bottom to act as sump for soil particles. Above the sump was a five-foot length of screen, which consisted of two rows of two-inch long slots, 0.10 in. wide, cut into opposite sides of the pipe with a laser. The slots were positioned 1/4-inch apart along the five -foot length and aligned such that the gaps were offset between the two rows to maintain strength. The remaining length of the 11-ft pipe was blank riser. Prior to installation, a hardened carbon steel drove point was inserted into the sump end of the well, held in place by a rubber o-ring. If the final depth of the well was to be greater than 11 ft, an additional blank section of pipe was attached to the well pipe either by threading on a 1/2-inch coupler in the field, or by welding a sleeve over both sections of pipe with a wire feed arc-welder. Both methods were used in Seabrook, but the welded sleeve technique proved to be superior. In two cases, the threads of the coupling did not withstand the vibration of installation.

The wells were installed using an electric hammer drill (in hammer only mode) powered by a portable generator. A ten-foot extension ladder was set-up next to the well site, and the well pipe was positioned next to the ladder. A modified drive point was inserted into the open end of the well, and provided the anvil for the drill to hammer on. The person installing the well "followed" the pipe down the ladder until a minimum depth was reached. An electronic water level sounder was used to check for the water table. If no water was found, the well was vibrated into the sandy soil further. This process was repeated until the screened section was somewhat centered across the measured water table. This method was chosen to allow for seasonal water table fluctuations, with the objective to keep the water table within the screened section for as long during the year as possible. The wells were driven in until at least three feet of the five-foot screens were submerged. The wells were developed using a 1/2-in. OD. polyethylene tube with a Delrin check valve on the bottom to create an inertial bailer. Once developed the wells were allowed to come to equilibrium, and the depth to water was checked to make sure the well was installed to a sufficient depth.

If the well was in a sensitive area (driveway, yard with small children, or where the owner wished to mow) the blank riser pipe was cut off approximately two inches above the ground, and vibrated another 2.5 inches into the ground. A metal cap, six inches long, was tamped over the top of the well for a flush-mount completion. In non-sensitive areas, the well was completed with six-to-48 inches of riser pipe above the ground surface, and only a plastic cap was inserted into the open end of the well. Security of the wells was left to the homeowner.

A summary of the well completions is shown in Table 4. All wells installed had a 12-in. sump and a 5-ft screened section. The table includes the depth below ground surface of the well screen, and the current elevation of the top of the riser (casing). Each well was surveyed relative to each other during installation to establish relative groundwater elevations. A survey of all sites was performed on 6/29/95 following the flush mounting of wells at the CSL home and the KDB sites. The results of this survey are indicated as the current TOC elevations. The FDC site wells were surveyed into an existing benchmark on a near-by utility pole. Both the CSL and WRH sites were surveyed based on a benchmark established at the near-by Seabrook elementary school building. It is suspected this benchmark is a relative (not a geodesic benchmark). All the River Street sites were surveyed relative to a concrete sewer pumping station manhole cover. The survey will be adjusted once the geodesic elevation of the cover is known. The KDB site wells were surveyed relative to each other, assuming KDB-1 as being at elevation 100.00.

Groundwater Flow Directions

The depth to groundwater was measured during well installation, and again during most of the sampling events. The water level data was reduced based on the elevation of the top of the well casing used as a reference for the water depth measurements, and the resulting groundwater elevation data are summarized in Table 5 separated for each of the respective sites. The data presented in this table include water levels from the time of installation up through June 29, 1995. Most of the sites demonstrate a slight lowering of the groundwater table over a period of six months beginning in January. On sites that are relatively distant from the marsh, the decline in the groundwater table was gradual over the entire six month period. This can be seen in Table 5 for the KDB and the FDC sites. The River Street sites show a slight decline in the groundwater levels in the last month. These sites are essentially surrounded by the marsh on one side and the bay on the other, and the tidal fluctuations seem to have a mitigating effect on the regional declining groundwater trend.

The groundwater elevations presented in Table 5 were plotted on site location maps, and the piezometric groundwater surface was contoured based on the groundwater elevations at the monitoring wells. The groundwater flow directions cross the contours at right angles, thus the directions are estimated for each site on the location map (Figures 2-10). Maps were prepared for water levels in the spring(February or March), and for the most recent complete set of readings (May 31 or June 29).

It is interesting to note that the groundwater directions between the early spring readings and the summer data are typically different. In some cases the later data indicate a complete reversal of the groundwater flow directions. These cases include the REH/RET (Figure 2) RP (Figure 5), and RH (Figure 4) sites. All of these sites are in close proximity of either the marsh or the bay, with relatively flat topography. In contrast, the RB (Figure 3) and RC (Figure 6) sites saw little if any change in groundwater flow directions. Similarly, both the KDB (Figure 9) and the FDC (Figure 10) sites showed little change in groundwater directions. The FDC site contours indicated a groundwater mound effect created by the effluent disposal leachfield. The same effect can be seen in Figure 2 for the RET site.

The two sites on opposite sides of the same marsh, CSL and WRH both demonstrated a definitive shift in the groundwater flow directions, but as shown in Figures 7 and 8, respectively, the change represents an acute angle as opposed to a complete reversal of direction. Both of these sites have sloping topography with significant relief from the marsh border to the upper end of the respective property. This relief may be responsible for the smaller effect.

Since the River Street sites are all clustered together (with the exception of the REH/RET sites) the water levels can be compared between sites to gain further insight into the groundwater flow directions. Examining the March 13, 1995 data (Figures 3-6) the groundwater flow direction indicated is from the marsh toward the bay. There is apparently a conduit of higher hydraulic conductivity between the RP site and the RC site which share a common boundary. The groundwater flow directions at the RC site are almost directly toward the RP property. Yet, at the same time the groundwater flow direction beneath the RP property while still primarily flowing toward the bay, has a significant direction component toward the RC site.

During some of the sampling, groundwater was being pumped from the River St. area as part of the construction associated with installing the new sewer lines. This occurred from approximately the third week in March, 1995 into the second week in April, 1995 at a constant rate, and intermittently thereafter into May, 1995. The water was pumped into the harbor through an 8" water hose, which was apparently full and constantly flowing from March into April. This activity could have had a significant impact on groundwater flow direction, and could explain the changes in direction at the RP, RH, REH and RET sites. However, not enough data are available, especially for April, to confirm that the groundwater pumping caused some of the observed changes in groundwater flow direction.

SEABROOK SITE ASSESSMENTS

Wells were sampled for bacterial and nutrient contaminants. Well caps were removed and depth to water level in wells was measured using a field water level indicator. Sterile polyethylene tubing was then inserted into each well to depth of water, and water was removed using a peristaltic pump. Water was collected for analyses after 3 well volumes were evacuated. Water for nutrient analyses was collected into an acid-washed one liter bottle, and two samples for microbiological analyses were collected in sterile one liter bottles. The samples were cooled on ice and transported to JEL.

Samples brought back to JEL were processed for the different analyses, and salinities were recorded using a refractometer. Approximately 500 mls of the nutrient samples were pre-filtered through 0.45μm pore size filters. The filtrates were frozen until analysis for ammonium, nitrate and orthophosphate using a LACHAT autoanalyzer. The filter was dried and weighed to determine total suspended solids and percent organic matter. Microbiological samples were prefiltered using a Whatman 41 (20-25 μm nominal pore size) filter to remove fine suspended sand and silt particles. A steady flow was maintained during vacuum filtration and filters were replaced if filtration rate decreased because of solids build up on the filters. Filtrates were collected in sterile filter flasks and transferred to sterile sample bottles. Appropriate volumes of filtrates were then filtered through 0.45 μm pore size Gelman membrane filters (enterococci, fecal coliform and *E. coli*) or 0.7 μm pore size Millipore membrane filters (*C. perfringens*). Filters were incubated on mTEC agar for fecal coliform and *E. coli*, mE agar for enterococci and on mCP agar for *C. perfringens* analyses. Plates were incubated at 44.5°C for 24 h for all but enterococci, which were incubated at 41°C for 48 h.

Effluent from septic tanks contains high levels of phosphorus, nitrogen and fecal-borne bacteria. The effluent characteristics can vary widely, depending on many variables, and 'typical' contaminant concentrations, based on numerous previous studies, are presented in Table 6. The nitrogen discharged from septic tanks is in the forms of organic nitrogen and ammonium, with no nitrate. Much of the phosphorus is orthophosphate. Thus, detection of nitrate in groundwater is indicative of transformation of the ammonium to nitrate under aerobic (i.e., unsaturated) conditions. The values in Table 6 can serve as a guide for assessing the effectiveness of study systems and potential problem areas. There were no enterococci levels cited in reviewed studies, so fecal streptococci levels, which would include enterococci as a subset, are presented. *C. perfringens* levels were also not cited. These were included in this study as indicators of long-term fecal contamination, as the spores produced by this organism can persist for long periods.

There were two notable developments in this study that warrant mention before reviewing the results of wellwater data. First, initial samples were processed by mixing water with soil particles (M; Table 8, FILTER column) or allowing the prevalent soil particles to settle (S), then analyzing the supernatant. This process resulted in the detection of relatively high levels of bacterial contaminants that remained attached to suspended particles. The sampling and processing protocols were then changed to include prefiltration (PF) to avoid including particulate matter in water samples. However, the initial values were valuable to detect the presence of bacteria from the subsurface at these well sites, even though many of the detected bacteria were probably attached to particles. Second, the changes in groundwater flow direction at some sites shows how detection of distinct contaminant plumes in the subsurface can be complicated as contaminant concentration gradients in groundwater become blurred as contaminants are transported in different directions. The changes measured as part of this study are probably indicative of previous changes in flow direction. Thus, contaminants that persist at previous downgradient sites may remain detectable at later upgradient sites.

The following is a series of discussions about each site and the within site trends and conditions. Sample dates, six for each site, are presented in Table 7. Table 8 is a summary of all data, and is separated into sub-tables, labeled 8A-8J, for each site. The dates for which there are no data presented (labeled "NO B/N"; no bacteria/nutrients, under FILTER column) were days in which the wells did not produce. The sites where sampling was most problematic are sites REH on River St. and FDC, the site abutting a non-tidal marsh on Forest Drive. Some wells produced on every sample date, while others at some sites produced infrequently. In general, the in-town sites developed on natural soils produced better than the River St. sites, which were developed on sandy fill over wetlands.

REH

The effluent disposal area (EDA) at this site consists of separate graywater and blackwater leaching areas. Both areas are located within twenty feet of the adjacent salt marsh, are within the highest observable tide mark, and appear to be in a state of failure. This is indicated by excessive vegetative growth over the blackwater EDA and the ponding of graywater, from a broken pipe, on the soil surface over the graywater EDA.

Analysis of groundwater from the monitoring wells indicates that high levels of total dissolved nitrogen (TDN) have been detected at the edge of the EDA (well #5) and in the down gradient well #2 (Table 8A). Ammonium (NH4) is the prevalent nitrogen form found at the edge of the blackwater EDA (well #5) and appears to be transformed to nitrate (NO3) along the down gradient toward well #2, as both wells 2 and 5 have high nitrate levels. The deep well #6, which is situated between the graywater and blackwater EDA's, shows high levels of ammonium. This may indicate a saturated subsurface environment in which the ammonium is not being oxidized as it leaches downward. The elevated salinities in the wells at this site suggest significant intrusion of tidal waters.

Bacterial contamination (fecal coliforms, *E. coli*) was detected in the deep well at this site. No bacterial contaminants were detected at wells #3, #4 or #5, all of which were sampled only once due to poor well production. Relatively high concentrations of *Clostridium perfringens* were detected in the up gradient well #1 and the down gradient well #2 on the one sample data for both wells (12/7/94).

RET

The EDA at this site lies within 75 feet of poorly drained soils with soil mottling occurring from 28 inches upslope to 20 inches downslope in fill (Elkind Environmental Associates, 1994).

The highest levels of TDN were detected at the up gradient well #3 and at well #2 which is located along the northeast edge of the property (Table 8B). The TDN for all samples were dominated by ammonium, with nitrate reaching its highest, yet relatively low, level (3 mg/L) on 2/7/95 at RET-6, below the EDA. The high levels of TDN at well #2 may indicate contamination coming on-site from the neighboring property. The elevated levels in up gradient well #3 indicate a reversal in the assumed prevailing groundwater flow direction determined on 3/13/95 but are consistent with the groundwater flow direction observed on 5/31/95.

Sometime between the end of March and June there was nearly a complete reversal in groundwater flow direction. This may have been a consequence of sewer line installation which occurred at about this time. Groundwater underneath River Street was continuously pumped for several weeks (end of March to mid-April) to depress groundwater levels in order to accommodate sewer installation.

Down gradient well #4 had the lowest levels of TDN of any well, another strong indication of groundwater flow reversal. Ammonium is the most prevalent form of nitrogen detected in all of the wells and is indicative of a saturated subsurface environment. This corresponds well with the soil mottling observed during the Order One soil survey and noted above.

Microbial contamination was detected in all wells with the greatest levels and/or most consistent contamination occurring in well #2 (near neighbor) and well #5 (edge of EDA). Very little bacterial contamination was detected in well #6 which penetrates the EDA.

<u>RB</u>

The EDA at this site consists of a cesspool and dry well both of which are within 30 feet of very poorly drained soils and the highest observable tide. Overall, this site had the lowest TDN levels of any other site (Table 8C). The TDN was typically dominated by ammonium. Only two samples were obtained from the furthest down gradient well (#1) at this site due to poor well production. Samples taken from well #1 show relatively low levels of TDN with ammonium and nitrate having similar concentrations. No bacterial contamination was detected at well #1.

Closer down gradient wells (#2 & #3) also showed relatively low concentrations of TDN. Well #3 and Well #2, which lie down gradient of the cesspool and adjacent to the dry well, respectively, had moderate bacterial contamination. Well #4, which is situated at the edge of the marsh, had similar TDN levels as the other wells with most of the nitrogen being in the ammonium form. Bacterial contaminants were also detected in Well #4. The highly saline groundwater at this site suggests significant salt water intrusion. The relatively uniform data at this site do not indicate the presence or interception of a contaminant plume moving off site.

<u>RH</u>

The EDA at this site is located on a narrow piece of property squeezed between the property owner's home and the driveway of the abutting property. The EDA is approximately 85 feet to very poorly drained soils and the highest observable tide. Groundwater direction changed at this site sometime between the end of March and the beginning of June. The groundwater pumping occurred in a direction relative to this site that is consistent with the changes in flow direction.

Elevated levels of TDN were detected in up gradient well #1, both before and after the change in groundwater direction, with nitrate being the prevalent form (Table 8D). Down gradient wells (#3, #4 & #5-deep) had lower levels of TDN as compared with up gradient well #1. The prevalent form of nitrogen in deep well #5 was ammonium. Wells #1, #2, and especially #5 had elevated levels of orthophosphate (PO4).

Microbial contamination has been detected in all wells with the greatest incidence occurring in up gradient well #1, which is consistent with the observed change in groundwater direction. Substantial microbial contamination has also been detected in down gradient well #3, which is at the edge of the EDA, and to a lesser extent at well #4 further down gradient.

RP

This site is served by a single EDA which is approximately 90 feet to very poorly drained soils and the highest observable tide. There was a complete reversal in groundwater direction at this site occurring sometime between the end of March and the beginning of June. The TDN levels in the wells at this site were relatively low (Table 8E). There did not appear to be any discernible trends or changes in ammonium or nitrate concentrations in any of the wells with relation to the change in groundwater direction. Elevated salinities at this site suggest intrusion of tidal waters into the subsurface environment.

Well #1, located at the edge of the EDA, had the highest TDN levels of all wells with a couple of samples especially elevated in nitrate. Well #2, the up gradient well, had relatively low levels of TDN consistently throughout the sampling period. Down gradient wells #3, #4, and #5 all had relatively low levels of TDN with ammonium being the prevalent form in well #5 (deep). Well #5 also had elevated levels of orthophosphate but had no bacterial contamination during the sampling period. Bacterial contamination was detected intermittently in all other wells but was greatest in well #1, which is adjacent to the EDA but neither up gradient nor down gradient.

RC

This site is serviced by a state-approved system with the EDA located approximately 70 feet to very poorly drained soils and the highest observable tide. The well locations are not consistent with an up gradient and down gradient orientation seen at other sites, especially the location at which the effluent enters the subsurface from this chambered system is unknown. Elevated levels of TDN were detected at well #4 which penetrates the EDA (Table 8F). Ammonium was the prevalent nitrogen form found in samples from this well. There was some microbial contamination detected at this well although much lower than levels seen in the up gradient wells.

Up gradient wells #1 (deep) and #3 also had highly elevated levels of TDN and considerable bacterial contamination was detected in both wells. It is likely that these wells are intercepting a contaminated plume from the abutting property since groundwater is moving on-site from the adjacent property. Interestingly, no bacterial contamination was detected in well #2 (shallow) which is adjacent to well #1. In addition, well #2 had considerably lower levels of TDN as compared to well #1. Groundwater depths at wells #1 and #2 indicate that the groundwater is moving vertically downward which may account for the differences between these wells. All wells had elevated levels of orthophosphate.

CSL

The EDA at this site consists of a leach field and a dry well both of which are within 60 feet to poorly drained soils. Soil morphology indicates a down gradient water table of 30 inches based upon iron redox depletions (Elkind Environmental Associates, 1994).

Groundwater sampling shows elevated levels of TDN within the EDA (well #4) and at the down gradient edge of the EDA (wells #3 & #5) (Table 8F). Ammonium is the prevalent form of nitrogen within the EDA and may suggest an inadequate unsaturated zone for conversion of ammonium to nitrate as the water percolates downward through the leachfield. However, nitrate is the prevalent form of nitrogen seen at the down gradient edge of the EDA and suggests that ammonium is converted to nitrate as the groundwater moves laterally down gradient. Similar levels of TDN at down gradient (#3, #5, & #6) and up gradient (#1 & #2) wells indicate that no significant contamination plume from the EDA at this site exists or was intercepted. Nitrate was the prevalent form of nitrogen found in these wells. Microbial contamination was detected frequently within the EDA while up gradient and down gradient wells showed only occasional contamination.

WRH

The EDA at this site was raised by fill and lies within 50 feet of poorly drained soils and marsh. Elevated levels of ammonium and nitrate have been detected in up gradient (#1 & #2) and down gradient (#3, #4 & #6) wells (Table 8H). High levels of ammonium prevail within the EDA (well #5) and in the shallow well at the down gradient edge of the EDA (#4). The deep well #3, also located at the down gradient edge of the EDA, shows high levels of nitrate indicating conversion of ammonium to nitrate as effluent moves vertically downward. The furthest down gradient well #6 has elevated levels of nitrate and may indicate the interception of a plume.

Microbial contaminants were detected in all of the wells at this site. Interestingly, the deep well #3 and shallow well #4 at the edge of the EDA showed extremely low and relatively high levels of contamination, respectively. Relatively low levels of microbial contamination were seen in the most down gradient well #6 as compared to the up gradient wells (#1 & #2). High levels of ammonium, nitrate, and microbial indicators in the up gradient wells may indicate contamination coming from off site.

KDB

This state-approved system consists of two raised and adjacent EDA's that lie within 100 feet of poorly drained soils and marsh. All down gradient wells (#5, #6, #7, #8; well #9 did not produce) had highly elevated levels of TDN over up gradient wells (#1 & #2) (Table 8I). The form of nitrogen seen in the down gradient wells was almost exclusively nitrate. Nitrate was also the prevalent form of nitrogen detected in the up gradient wells, although at much lower concentrations.

Samples taken from wells within each of the EDA's (wells #3 & #4) also showed elevated levels of nitrate. Interestingly, well #4, which samples the EDA on the family side of this duplex, has much higher nitrate levels than well #3, which samples the EDA on the single occupant side of the duplex. This difference could be attributed to the different loading rates on each EDA as affected by the the number of occupants. The prevalence of nitrate in all of the wells suggests that there is a sufficient unsaturated zone beneath the EDA's for conversion of ammonium to nitrate. However, the high levels of nitrate in all of the down gradient wells indicates that contamination is moving off site.

Bacterial contamination was detected at relatively low levels at all of the wells except well #4 (family EDA). The greatest and most consistent bacterial contamination was detected in well #3 which sampled the EDA on the single occupant side of the duplex. Lack of an exact location for the EDA's may account for the absence of microbial contamination in well #4 as its location may be on the up gradient edge of the EDA and thus might miss any bacteria leaching under the EDA. Bacterial contaminates were most consistently detected in well #6, which is down gradient of the family side of the EDA.

FDC

This site consists of graywater and blackwater disposal areas which are located 75 feet and 100 feet from poorly drained soils, respectively. This site is not influenced by nor situated near any tidal areas. Only the down gradient well #5 at this site has produced samples on a consistent basis. The ammonium, nitrate, orthophosphate, and bacterial levels in well #5 were very low (Table 8J), and did not indicate the presence or interception of a contaminant plume.

Wells #2 and #3 were sampled only twice during the sampling period. At both wells the ammonium and nitrate levels fluctuated considerably between sampling dates, making it difficult to identify any trends. The highest measured nitrate level (28 mg N/L) in this study was recorded for the 1/9/95 sample at FDC-2. It should be noted that well #2 (up gradient) and well #3 (down gradient) had elevated levels of TDN on both sample dates.

Little microbial contamination was detected at any of the wells at this site. Only a total of 12 groundwater samples were taken among the five wells between January and June because of lack of well production.

Inter-site Comparisons

Shallow, 1" diameter cores were taken from the surface soils overlying the EDAs or in adjacent beach sands at sites with designed subsurface EDAs (REH, RP, RC, KDB). Microbial analyses were conducted and estimates of fecal coliforms and *C. perfringens* were made. The sample at RP/RC was taken from the intertidal beach just in front of these two adjacent properties and was 24" deep. The deepest core was 29" below the surface (REH) and the others were to 12". The soils were sands, with organic matter at the surface, except for KDB which was a sandy loam. In each case (except RP/RC) coring was limited by gravel layers in the EDAs. Only the core from above the EDA at REH was positive for fecal coliforms (~30/g soil). All of the sites tested for *C. perfringens* were positive at ~ 200/g soil except the deeper sample from the RP/RC site (90/g soil). Thus, the surface soils above the systems exhibited some evidence of past fecal contamination, with the REH site probably having more recent fecal contamination.

The initial samples that were either mixed or sampled from the supernatant were of interest to locate areas where bacterial contaminants were present in the groundwater or attached to particles. The wells where bacteria were detected in these samples were not always wells where bacteria were later detected in groundwater, and included wells that were upgradient, down gradient, deep and within the EDAs, with no consistent location at the sites. The most commonly detected bacterial indicator in these samples was *C. perfringens*, which is naturally associated with particulate matter in soil and aquatic environments.

The ranges of contaminant concentrations for all of the wells at each site are summarized in Table 9. The lowest values in the concentration ranges presented are considered indicative of background levels at each site. The River St. sites had higher background and much higher 'high' concentrations of phosphates compared to the in-town samples. In addition, the background levels of ammonium showed the same trend. The high phosphate levels may reflect the extreme high density of houses and septic systems on River St. and accompanying high P-loading rates, compared to the in-town sites. High ammonium levels suggest incomplete nitrification occurring in the soils of River St., possibly a result of development on relatively shallow fill soils overlying wetland soils that have more limited aerobic unsaturated soils required for nitrification.

The background nitrate levels were very low at the River St. sites and at two of the four in-town sites. These are not necessarily indicative of clean areas, rather, they may also reflect the presence of wells, often under EDAs, that have little nitrate produced relative to TDN. The two sites with highest 'background' nitrate levels are CSL and KDB, both located in relatively less dense housing areas. These also have the highest average nitrate:ammonium ratios (Table 9). These latter data indicate a high rate of nitrification relative to TDN. The River St. sites are again apparently different from the in-town sites in that their ratios are all relatively low, with most below 1.0, while in-town sites have higher ratios, most well above 1.0. Thus, much of the TDN at in-town sites has been nitrified, compared to a lower conversion at sites with low ratios.

The high values in the presented concentration ranges for contaminants in Table 9 can be compared to septic tank effluent concentrations in Table 6. Bacterial contaminant concentrations never came close to estimated effluent concentrations. Orthophosphate concentrations were nearly equal to the estimated effluent concentration (11 mg P/L) at RH, RP and RC, with concentrations ranging from 6.9 to 8.9 mg P/L. Ammonium reached concentrations nearly equal to the estimated effluent concentration (30 mg N/L) at sites REH, RET, RC, CSL, WRH, and FDC, all with concentrations of 18-22 mg N/L. Nitrate is not discharged with septic tank effluent. However, TDN concentrations from REH, RH, RC, CSL, WRH, KDB and FDC were >20 mg N/L on one or more occasions (Table 8). This occurred most consistently at RC and KDB.

Temporal trends for all of the sites are typically quite variable (Table 8). Trends for nitrogen species and phosphate at three sites are presented in Figures 11-14. These sites, KDB, RC and RB were chosen to represent in-town, River St., and unoccupied sites, respectively. Overall, site RB had the lowest levels of nitrogens than other sites, yet phosphates were still relatively high (Table 9). At KDB, nitrate levels at upgradient wells were always lower than at down gradient wells (Figure 11), indicative of downstream contamination from the EDAs at this site. Ammonium levels remained relatively low throughout the sampling period except for April-May, 1995 at KDB-7, a down gradient well. The higher ammonium levels (2.5 mg N/L) on 4/4/95 were accompanied by the second highest nitrate levels recorded in this study (27.3 mg N/L). Thus, springtime conditions appeared to increase the nitrogen loading from this site, apparently beyond the potential nitrification rate.

At RC, levels of nitrate were variable at the different wells, while ammonium levels dropped from high levels to lower levels with time (Figure 12). Nitrate levels were not as high as down gradient wells at KDB, but ammonium levels were generally much higher than at KDB. At RB, nitrate levels were quite low, especially after the first sampling in December, 1994 (Figure 13). Ammonium levels were also quite low, more similar to the KDB site than the RC site. Figure 14 shows phosphate levels at KDB and RC. Levels at RC were much greater than at KDB and more variable. Levels of phosphate were extremely low at KDB, while the highest levels at RC were at RC-4.

Surface Water Sampling and Evidence of Off-Site Transport of Contaminants

The concern with all of the contaminants is that they may be transported with groundwater into surrounding surface waters. The sites that had wells installed in close proximity to surface water or marshes are REH, RB, RC, CSL, WRH, KDB and FDC. The other sites, RET, RH and RP had wells that were not very distant from the EDAs and were not that close to surface waters. Of the sites with wells near marshes or surface waters, high nitrate concentrations were detected at REH (11.5 mg N/L), RC (14.1 mg N/L), WRH (11 mg N/L) and KDB (27.3 mg N/L). Thus, these sites are likely to be contributing nitrogen to the surrounding waters. In all cases, the nitrogen loading from the EDAs is relatively high and the distance to the marsh/surface water from the EDA is apparently inadequate to promote dilution or transformation of the highly mobile nitrate.

A shoreline survey was conducted on 6/2/95 to find any evidence of septic system 'failure' at River St. sites. This exercise compliments the well monitoring in that it can help to determine if any surface runoff from 'failed' septic systems could contribute to surface water contamination. The results and descriptions of suspected contamination sources are presented in Table 10. Five potential problem sites are listed between houses 14 and 37 on River St. The seepage from under a retaining wall on the beach in front of house #14 showed no contamination. However, the seepage and pipe effluents at houses 14, 30 and 31 gave detectable fecal contamination.

Surface water samples collected in streams or harbor waters near to every site (Figure 1)

were analyzed for bacterial contaminants in June, 1995 (Table 11). Values may be compared to the state limits for approved shellfishing (14 FC/100 ml), marine swimming waters (35 enterococci/100 ml) and freshwater swimming areas (47 *E. coli*/100 ml).
The geometric mean fecal coliform concentrations at every site were >14/100 ml, with the highest levels at sites 3-5 and 7 near Causeway St. in the Shepard Brook area. A high percentage of fecal coliforms were in fact *E. coli* (Table 11). Enterococci levels also were greater than the 35/100 ml limit at all sites except for site 6 in the relatively large Blackwater River at the Rt. 286 bridge (Brown's Bridge) and the Forest Drive pond. However, the latter site is a freshwater body, and it does not meet freshwater swimming limit of 47 *E. coli*/100 ml. All of the surface water sites except for site 6 were on small tidal or freshwater streams that eventually empty into Hampton Harbor.

There were no obvious upstream-downstream gradients for bacterial contaminants relative to the study sites. Obviously ,the study sites are not the only houses that abut the target surface waters, and other sources of bacterial contaminants are apparently contributing to the impacted surface waters. The results of analysis of these surface water samples are not yet available, and should help to determine potential impacts of specific sites on surface water quality.

CONCLUSIONS

The sites selected for study were not uniform in anyway that would facilitate a systematic, scientific assessment of factors associated with the effectiveness of subsurface sewage treatment. However, the selected sites probably are a reasonable reflection of actual systems in older coastal developed areas. It is unfortunate that a wider range of soil types could not be included in this study. However, again, the sites selected were limited to sites within Seabrook and in close proximity to tidal or tributary surface waters, thus excluding many areas that could represent a wider range of coastal New Hampshire soils. In the final analysis, it is amazing to find so many willing participants for such a study.

Despite the observed changes in groundwater flow direction that complicated the location of distinct contaminant plumes at some sites, it is apparent that most of the study sites have relatively contaminated groundwater. Even RB, which has not been occupied for a few years so that the EDA has not been used, has elevated levels of phosphate in groundwater even out near the marsh edge. The contaminated groundwater probably has some impact on adjacent surface waters, especially in high density housing areas. The areas of highest housing density are the River St. sites and FDC, which is at the edge of an older high density housing development. In addition, WRH is located next to and downgradient from an elementary school on septic systems and numerous other houses, while KDB is at the end of a new development with a relatively high density of houses and associated mounded effluent disposal areas. All of these sites are in close proximity to surface waters, and the loading rate of nutrients, especially nitrate, measured in wells probably exceeds the capacities of the remaining or nonexistent riparian zones to effectively treat contaminants.

The bacterial contaminants were not transported consistently or in high quantities via groundwater. Bacteria are not as mobile as nitrate, and are probably more tightly associated with soil particles. However, especially in initial samples that included some particulate matter, fecal-borne bacteria were detected in wells away from EDAs, evidence of past transport to those areas by some mechanism. The method adopted for routine sampling of wellwater for bacteria is a conservative approach that excludes most particle-associated bacteria. Some frequency of including particulate matter in samples in the future would give temporal documentation of the presence or absence of bacterial contaminants at downgradient sites.

REFERENCES

Elkind F. and D.J. Allain. 1994. Tidal water site assessment: Implementyation of tidal water assessment forms for selected Seabrook properties and Order One soil surveys. Report to NH Coastal Program, Office of State Planning, Concord NH.

Table 1. Seabrook study site descriptions and designations.

RIVER STREET

REH -Year-round home on south side of River St.abutting marsh; lot #48.

RET -Year-round trailer on lot on south side of River St.; lot #48.

RH -Year-round home on north side of River St.; lot #14.

RP -Year-round home on north side of River St.; lot #15.

RC -Year-round home on north side of River St.; lot #15A.

RB -Infrequently occupied home on south side of River St. abutting marsh; lot #33.

WALTON ROAD

WRH -Year-round home near corner of Causeway St. and Walton Rd. abutting Shephard Bk. marsh; lot #46C.

CAUSEWAY STREET

CSL -Year-round home on east side of Causeway St. abutting Shephard Bk. marsh.

KIMBERLY DRIVE

KDB -Two adjoined year-round homes at end of Kimberly Drive abutting Farm Brook.

FOREST DRIVE

FDC -Year-round home on south side of Forest Dr. abutting non-tidal Cains Brook; lot #141.

Table 2. Soils and subsurface characteristics of study sites.

Site	Soil map symbol for EDA area	Septic system limitation	Depth to mottling/water	Dominant soil downgradient	Septic system limitation	Wet area	System age (y)	State approval
			Adjacent to freshwater marsh					
FDC	313A	Severe	37"	915C	?	marsh	10+	?
			Adjacent to tidal marshes; in town					
WRH	100A	?	28"	100A/B	?	marsh	7	no
CSL	26A	Severe	30"	313A	Severe	marsh	37	no
KDB	299A	?	29"	299E/313A	Severe	marsh	7	yes
			Adjacent to tidal marshes or beach: River St.					
RH	300A	?	-	300A/C	?	beach	5	?
RP	300A	?	-	300A/C	?	beach	40+	no
RC	300A	?	-	300A/C	?	beach	8+	yes
RB	100A	?	17"	100A/797A	Severe	marsh	30+	no
RET	100A	?	20"	100A	?	marsh	2+	no
REH	100A	?	20"	100A/797A	Severe	marsh	10+	no

Table 3. Numbers, names and properties for soils at study sites.

26A	**Windsor**:	
		Very deep, excessively drained sandy loam/loamy sand/sand
		severe septic system limitation-poor filter
100	**Udorthents**, wet substratum:	
		poorly drained sandy loam filled w/moderately well drained sandy loam/sand fill
	or	granular fill/black loamy sand over saturated wetland
299	**Udorthents**, smoothed:	
		well drained smoothed sandy loam filled over w/loamy fill
300	**Udipsamment**:	
		excessively drained excavated and eolian sand
313	**Deerfield**:	
		Deep, moderately well drained sandy loam/loamy sand/sand
		severe septic system limitation-wetness, poor filter
497	**Pawcatuck**:	
		very deep, very poorly drained saturated hemic material/fsl/ls on tidal marsh fringe
		severe septic system limitation-ponding, poor filter
797	**Matunuck**	
		tidal marsh, flooded at high tide, very poorly drained saturated organic fibers/sands
		severe septic system limitation
915	Unnamed aquic **Udipsamment**:	
		Deerfiled-like profiles filled over w/moderately well drained sandy fill

Table 4. Installed well characteristics.

Well	TOC Elevation (ft)	Total Length of Well (ft)	Stick-up (in)	Total Well Depth BGS (ft)	d Interval Dept Top (ft)	Bottom (ft)	Current TOC Elevation (ft)	Current Stick-up (in)	Depth to Screen Bottom from TOC (ft)
CSL-1	91.25	11.00	48.00	7.00	1.00	6.00	87.22	0.00	6.00
CSL-2	87.34	11.00	48.00	7.00	1.00	6.00	87.36	0.00	6.00
CSL-3	89.67	11.00	48.00	7.00	1.00	6.00	85.61	0.00	6.00
CSL-4	90.51	11.00	48.00	7.00	1.00	6.00	86.47	0.00	6.00
CSL-5D	86.37	16.83	49.00	12.75	6.75	11.75	85.61	0.00	11.75
CSL-6	88.50	11.00	47.50	7.04	1.04	6.04	84.55	0.00	6.04
WRH-1	90.26	11.00	48.00	7.00	1.00	6.00	90.26	48.00	10.00
WRH-2	90.56	11.00	49.00	6.92	0.92	5.92	90.56	49.00	10.00
WRH-3D	88.48	17.83	38.00	14.67	8.67	13.67	88.48	38.00	16.83
WRH-4	88.79	11.00	42.50	7.46	1.46	6.46	88.79	42.50	10.00
WRH-5	90.53	11.00	48.00	7.00	1.00	6.00	90.53	48.00	10.00
WRH-6	87.68	11.00	48.00	7.00	1.00	6.00	87.68	48.00	10.00
RB-1	103.61	11.25	48.00	7.25	1.25	6.25	103.61	48.00	10.25
RB-2	103.32	11.00	45.50	7.21	1.21	6.21	103.32	45.50	10.00
RB-3	103.30	10.96	48.00	6.96	0.96	5.96	103.30	48.00	9.96
RB-4	103.38	10.71	44.13	7.03	1.03	6.03	103.38	44.13	9.71
RH-1	102.97	11.00	24.00	9.00	3.00	8.00	102.97	12.00	9.00
RH-2	102.79	11.00	12.50	9.96	3.96	8.96	102.79	12.50	10.00
RH-3	103.09	11.00	12.00	10.00	4.00	9.00	103.09	10.50	9.88
RH-4	102.35	10.67	8.40	9.97	3.97	8.97	102.35	6.88	9.54
RH-5	103.22	21.17	5.26	20.73	14.73	19.73	103.22	13.00	20.81
RP-1	98.13	10.71	7.00	10.12	4.12	9.12	101.46	0.00	9.12
RP-2	98.35	11.00	6.50	10.46	4.46	9.46	102.00	5.00	9.88
RP-3	98.46	11.00	6.00	10.50	4.50	9.50	102.57	7.13	10.09
RP-4	101.90	11.00	4.00	10.67	4.67	9.67	101.90	0.00	9.67
RP-5	101.96	21.50	39.00	18.25	12.25	17.25	101.96	0.00	17.25
RC-1	105.23	20.25	74.00	14.08	8.08	13.08	105.23	12.30	14.11
RC-2	104.72	11.00	0.00	11.00	5.00	10.00	104.72	6.00	10.50
RC-3	103.57	11.00	7.00	10.42	4.42	9.42	103.57	0.00	9.42
RC-4	102.12	11.00	5.72	10.52	4.52	9.52	102.12	0.00	9.52
KDB-1	100.00	11.00	19.50	9.38	3.38	8.38	100.00	0.00	8.38
KDB-2	100.26	11.00	2.50	10.79	4.79	9.79	100.26	0.00	9.79
KDB-3	100.29	11.00	18.00	9.50	3.50	8.50	100.29	0.00	8.50
KDB-4	100.15	11.00	19.20	9.40	3.40	8.40	100.15	0.00	8.40
KDB-5	97.02	10.38	18.84	8.81	2.81	7.81	97.02	0.00	7.81
KDB-6	97.10	11.00	21.84	9.18	3.18	8.18	97.10	0.00	8.18
KDB-7	98.70	11.00	21.36	9.22	3.22	8.22	98.70	0.00	8.22
KDB-8	97.57	11.00	9.60	10.20	4.20	9.20	97.57	0.00	9.20
KDB-9	98.39	21.00	56.40	16.30	10.30	15.30	98.39	0.00	15.30
FDC-1	100.00	11.00	9.72	10.19	4.19	9.19	29.69	0.00	9.19
FDC-2	99.90	11.00	25.20	8.90	2.90	7.90	29.61	0.00	7.90
FDC-3	99.98	11.00	20.40	9.30	3.30	8.30	29.87	0.00	8.30
FDC-4	100.18	11.00	4.80	10.60	4.60	9.60	29.90	0.00	9.60
FDC-5	94.19	14.17	40.50	10.80	4.80	9.80	24.49	40.50	13.17
RET-1	98.17	10.00	43.50	6.38	0.38	5.38	98.17	0.00	5.38
RET-2	101.55	11.00	47.00	7.08	1.08	6.08	101.55	45.75	9.90
RET-3	98.31	10.58	41.50	7.12	1.12	6.12	98.31	0.00	6.12
RET-4	100.59	11.00	48.25	6.98	0.98	5.98	100.59	24.00	7.98
RET-5	100.54	11.00	47.50	7.04	1.04	6.04	100.54	18.33	7.57
RET-6	98.85	11.00	47.25	7.06	1.06	6.06	98.85	0.00	6.06
REH-1	100.79	10.42	40.50	7.05	1.05	6.05	100.79	40.50	9.42
REH-2	100.93	10.33	40.50	6.96	0.96	5.96	100.93	40.50	9.33
REH-3	100.66	11.00	47.50	7.04	1.04	6.04	100.66	46.50	9.92
REH-4	101.06	11.00	47.00	7.08	1.08	6.08	101.06	43.13	9.68
REH-5	100.93	11.00	47.75	7.02	1.02	6.02	100.93	44.50	9.73
REH-6	101.10	21.00	45.60	17.20	11.20	16.20	101.10	43.75	19.85

Table 5. Groundwater elevations at Seabrook study sites.

CSL	GROUNDWATER ELEVATIONS (ft)						
	12/14/94 (ft)	2/16/95 (ft)	2/23/95 (ft)	3/30/95 (ft)	5/11/95 (ft)	6/5/95 (ft)	6/29/95 (ft)
CSL-1	83.95	83.58	83.90	84.25	83.28	83.25	82.73
CSL-2	83.62	83.30	83.54	86.51	83.02	83.01	82.56
CSL-3	83.18		83.07	83.00	82.45	82.47	81.86
CSL-4	83.56		83.51	83.48	82.94	82.84	82.32
CSL-5D	83.24	91.66	91.83	91.83	82.69	82.84	81.98
CSL-6	82.50		82.40	82.20	81.83	81.73	81.05

WRH	12/14/94	2/16/95	3/2/95	3/30/95	4/6/95	5/11/95	6/29/95
WRH-1	82.94	83.35	83.66	83.27	83.09	82.51	81.45
WRH-2	83.35	90.56	84.46	83.37	83.13	82.49	82.12
WRH-3D	85.12	82.83	82.96	82.81	82.61	82.09	81.23
WRH-4	82.99	88.79	82.98	82.81	82.59	82.04	81.12
WRH-5	82.31	90.53	83.29	83.27	82.85	82.31	81.58
WRH-6	82.76	87.68	82.43	82.32	82.10	81.74	80.68

RB	12/6/94	3/15/95	5/31/95	6/6/95	6/29/95
RB-1	96.4				
RB-2	97.04	96.46	95.27	94.87	95.05
RB-3	98.04	96.47	95.28	94.95	95.06
RB-4	97.39	98.81	95.83	95.17	95.42

RH	12/6/94	12/7/94	3/15/95	5/24/95	6/6/95	6/29/95
RH-1	95.13	96.42	99.73	94.81	94.52	94.49
RH-2	96.29	96.45	98.52	94.79	94.54	94.55
RH-3	96.17	96.34	95.68	94.96	94.58	94.53
RH-4	102.35	102.35	97.39	95.17	94.75	94.69
RH-5	103.22	92.20	96.84	95.75	92.44	95.46

RP	12/10/94	3/15/95	5/18/95	5/24/95	6/29/95
RP-1	94.85	94.71	94.25	93.91	93.40
RP-2	95.21	98.49	94.10	93.57	93.25
RP-3	95.29	94.75	94.27	94.46	93.56
RP-4	94.90	94.71	94.35	94.52	93.40
RP-5	#VALUE!	95.78	90.76	93.31	93.71

RC	12/10/94	3/23/95	5/18/95	5/24/95	6/29/95
RC-1	96.20	96.02	96.23	95.08	95.00
RC-2	98.97	93.72	91.22	95.60	94.29
RC-3	#VALUE!	97.22	95.67	95.72	94.73
RC-4	#VALUE!	96.12	95.17	97.82	94.37

KDB	12/22/94	3/7/95	3/23/95	4/4/95	5/2/95	5/22/95	6/29/95
KDB-1	7.51	5.32	4.96	5.48	5.83	5.82	7.06
KDB-2	8.26 X	X		5.90	6.22	6.17	7.12
KDB-3	7.82	5.85	5.57	6.04	6.26	6.23	7.34
KDB-4	8.02	6.04	5.73	6.18	6.46	6.40	7.75
KDB-5	5.73	4.00	3.48	3.96		4.46	5.78
KDB-6	7.64	5.53	5.24	5.80	6.23	6.22	8.81
KDB-7	6.42	7.45	4.19	4.71	5.22	5.20	6.56
KDB-8		5.59	5.06	5.70	6.31	6.10	8.22
KDB-9		4.80	1.67	4.48	10.04	5.11	6.12

FDC	12/22/95	3/9/95	4/6/95	5/2/95	5/22/95	6/5/95	6/29/95
FDC-1	93.05	23.69	23.54	23.26	23.41	23.15	22.82
FDC-2	94.54	25.19	24.79	24.39	24.46	24.38	23.99
FDC-3	93.04	24.28	23.84	23.33	23.82	23.48	21.46
FDC-4	94.43	24.80	24.69	24.24	24.57	24.15	23.67
FDC-5	88.13	19.17	18.29	18.20	18.39	17.92	17.38

RET	10/3/94	3/13/95	4/13/95	5/4/95	5/31/95	6/29/95
RET-1	94.56	97.52	95.73	95.73	94.75	94.1
RET-2	96.325	96.845	96.845	97.365	94.785	94.095
RET-3	94.77	97.61	96.99	95.7	92.98	94.17
RET-4	94.41	97.94	96.79	96.07	95.09	#VALUE!
RET-5	93.955	98.525	96.705	96.045	95.035	94.085
RET-6	92.815	98.845	96.985	89.435	94.615	#VALUE!

REH	10/3/94	3/13/95	4/13/95	5/4/95	5/31/95	6/29/95
REH-1	96.92	96.89	96.14	95.27	94.59	94.27
REH-2	96.93	96.05	96.23	96.22	96.20	95.80
REH-3	96.76	95.11	95.26	95.36	95.33	94.80
REH-4	95.91	96.06	96.03	95.30	95.09	94.49
REH-5	95.47	95.31	95.31	95.31	95.13	94.88
REH-6	101.10	96.31	96.05	91.69	93.00	94.36

Table 6. Estimated concentrations for bacteria and nutrients in septic tank effluent.

BACTERIA	
Fecal coliforms	1.00E+06 per 100 ml
Fecal streptococci	1.00E+05 per 100 ml
NUTRIENTS	
Nitrogen	40 mg/l
NH4	30 mg/l
organic	10 mg/l
Total P	13 mg/l
PO4	11 mg/l

Table 7. Sampling dates for all sites in Seabrook.									
				SITES					
DATE	REH	RET	RB	RH	RP	RC	CSL	WRH	FDC	KDB
12/7/94	X	X	X	X						
1/3/95							X	X		
1/9/95									X	X
1/16/95					X	X				
2/7/95	X	X	X							
2/9/95				X	X	X				
2/16/95							*	*		
2/23/95							X			
3/2/95								X		
3/7/95										X
3/9/95									X	
3/13/95	X	X								
3/15/95			X	X	X					
3/23/95						X				X
3/30/95							X	X		
4/4/95										X
4/6/95								X	X	
4/13/95	X	X								
4/18/95			X	X						
4/20/95					X	X				
4/25/95							X	X		
5/2/95									X	X
5/4/95	X	X								
5/9/95								*		
5/11/95							X	X		
5/18/95					X	X				
5/22/95									X	X
5/24/95				X	X	X				
5/31/95	X	X	X							
6/5/95							X		X	
6/6/95			X	X						

Table 8. Water quality data for Seabrook well water.

Table 8A. REH site.																		
WELL: REH-1										um	mg/L	um	mg/L	mg/L	um	mg/L		
DATE	SALINITY	TEMP	pH	CONDUCT	H20 DEPTH	FC	Ec	Enterococci	CP	NO3	NO3-N	NH4	NH4-N	NO3/NH4-N	PO4	PO4	TIDE	FILTER
12/7/94	15					0	0	0	700	10.96	0.15	121.71	1.70	1.86	0.32	0.03	?	M
2/7/95																	L	FROZEN
3/13/95	9.8	5.2		11500	3.9	0	0	0	0	5.696	0.08	39.66	0.56	0.63	0.1037	0.01	L	PF
4/13/95					4.65												H	NO B/N
5/4/95	6				5.52					5.247	0.07	162.35	2.27	2.35	0.022	0.00	L	NO B
5/31/95					6.2												L	NO B/N
										MEAN=	0.10		1.51	1.61		0.01		
WELL:	REH-2																	
DATE	SALINITY	TEMP	pH	CONDUCT	H20 DEPTH	FC	Ec	Enterococci	CP	NO3	NO3-N	NH4	NH4-N	NO3/NH4-N	PO4	PO4	TIDE	FILTER
12/7/94	13					0	0	0	63	817.61	11.45	84.66	1.19	12.63	0.11	0.01	?	M
2/7/95																	L	FROZEN
3/13/95	3.4	8.6		2950	4.88												L	NO B/N
4/13/95					4.7												H	NO B/N
5/4/95					4.71												L	NO B/N
5/31/95					4.73												L	NO B/N
										MEAN=	11.45		1.19	12.63		0.01		
WELL:	REH-3																	
DATE	SALINITY	TEMP	pH	CONDUCT	H20 DEPTH	FC	Ec	Enterococci	CP	NO3	NO3-N	NH4	NH4-N	NO3/NH4-N	PO4	PO4	TIDE	FILTER
12/7/94	15					0	0	0	0	54.95	0.77	70.02	0.98	1.75	0.1	0.01	?	M
2/7/95																	L	FROZEN
3/13/95	9	10		12200	5.55												L	NO B/N
4/13/95					5.4												H	NO B/N
5/4/95					5.3												L	NO B/N
5/31/95					5.33												L	NO B/N
										MEAN=	0.77		0.98	1.75		0.01		
WELL:	REH-4																	
DATE	SALINITY	TEMP	pH	CONDUCT	H20 DEPTH	FC	Ec	Enterococci	CP	NO3	NO3-N	NH4	NH4-N	NO3/NH4-N	PO4	PO4	TIDE	FILTER
12/7/94	15							0	0	5.93	0.08	233.94	3.28	3.36	0.13	0.01	?	M
2/7/95																	L	FROZEN
3/13/95					5												L	NO B/N
4/13/95					5.03												H	NO B/N
5/4/95					5.76												L	NO /BN
5/31/95					5.97												L	NO B/N
										MEAN=	0.08		3.28	3.36		0.01		
WELL:	REH-5																	
DATE	SALINITY	TEMP	pH	CONDUCT	H20 DEPTH	FC	Ec	Enterococci	CP	NO3	NO3-N	NH4	NH4-N	NO3/NH4-N	PO4	PO4	TIDE	FILTER
12/7/94	4					0	0	0	0	1090.8	15.27	1378.97	19.31	34.58	0.2	0.02	?	M
2/7/95	6.5	1	7.38							9.94	0.14	1435.73	20.10	20.24	0.104	0.01	L	NO B
3/13/95	1.8	8.5		1900	5.62												L	NO B/N
4/13/95					5.62												H	NO B/N
5/4/95					5.62												L	NO B/N
5/31/95					5.8												L	NO B/N
										MEAN=	7.70		19.70	27.41		0.01		
WELL:	REH-6 DEEP																	
DATE	SALINITY	TEMP	pH	CONDUCT	H20 DEPTH	FC	Ec	Enterococci	CP	NO3	NO3-N	NH4	NH4-N	NO3/NH4-N	PO4	PO4	TIDE	FILTER
12/7/94																	?	NO WELL
2/7/95	13.9	3.5		12500		29	3	0	0	0.33	0.00	772.371	10.81	10.82	0.032	0.00	L	S
3/13/95	10.2	7.6		13000	4.79	7	0.75	0	0	3.71	0.05	48.786	0.68	0.73	3.9868	0.31	L	PF
4/13/95	2				5.05	0	0	0	0	5.24	0.07	217.51	3.05	3.12	10.708	0.85	H	PF
5/4/95	10				9.41	0	0	0	0	0.764	0.01	399.23	5.59	5.60	9.98	0.79	L	PF
5/31/95	13				8.1	0	0	0	0	2.552	0.04	442.841	6.20	6.24	12.235	0.97	L	PF
										MEAN=	0.04		5.27	5.30		0.58		

Table 8B. RET site

WELL: RET 1

DATE	SALINITY	TEMP	pH	CONDUCT	H20 DEPTH	FC	EC	Enteroccoci	CP	um NO3	mg/L NO3-N	um NH4	mg/L NH4-N	mg/L NO3/NH4-N	um PO4	mg/L PO4	TIDE	FILTER
12/7/94	0					0	0	0	0	14.44	0.20	184.62	2.58	2.79	0.14	0.01	?	M
2/7/95																	L	NO B/N
3/13/95	2.2	3		2000	0.65	0	0	0	0	5.03	0.07	313.23	4.39	4.46	0.152	0.01	L	PF
4/13/95	1				1.17	0	0	0.5	1	3.96	0.06	313.31	4.39	4.44	0.185	0.01	H	PF
5/4/95	2				2.44	0	0	0	0.25	0.014	0.00	185.85	2.60	2.60	0.017	0.00	L	PF
5/31/95					3.42												L	NO B/N
										MEAN=	**0.08**		**3.49**	**3.57**		**0.01**		

WELL: RET 2

DATE	SALINITY	TEMP	pH	CONDUCT	H20 DEPTH	FC	EC	Enteroccoci	CP	NO3	NO3-N	NH4	NH4-N	NO3/NH4-N	PO4	PO4	TIDE	FILTER
12/7/95	0					0	0	40	60	44.54	0.62	136.69	1.91	2.54	0.12	0.01	?	M
2/7/95	0.5	1	7.42	395		21	21	22	6	8.18	0.11	321.94	4.51	4.62	0.019	0.00	L	S
3/13/95	0.4	5.8		345	4.7	0.75	0.75	20.25	0	45.35	0.63	64.75	0.91	1.54	0.611	0.05	L	PF
4/13/95	0					0.25	0.25	3.5	18.75	53.84	0.75	1037.06	14.52	15.27	0.113	0.01	H	PF
5/4/95	0				4.18	17	16	7.5	0	105.84	1.48	1169.83	16.38	17.86	0.061	0.00	L	PF
5/31/95					6.76												L	NO B/N
										MEAN=	**0.72**		**7.64**	**8.37**		**0.01**		

WELL: RET 3

DATE	SALINITY	TEMP	pH	CONDUCT	H20 DEPTH	FC	EC	Enteroccoci	CP	NO3	NO3-N	NH4	NH4-N	NO3/NH4-N	PO4	PO4	TIDE	FILTER
12/7/94	0					0	0	0	0	18.32	0.26	1146.15	16.05	16.30	0.17	0.01	?	M
2/7/95																	L	NO B/N
3/13/95	4	3.8		4080	0.7	0	0	0	0	7.14	0.10	73.16	1.02	1.12	0.082	0.01	L	PF
4/13/95	1				1.32	0	0	3	2	0	0.00	1346.47	18.85	18.85	1.982	0.16	H	PF
5/4/95	3				2.61	0	0	0	0	0.3	0.00	743.35	10.41	10.41	0.023	0.00	L	PF
5/31/95																	L	NO B/N
										MEAN=	**0.09**		**11.58**	**11.67**		**0.04**		

WELL: RET 4

DATE	SALINITY	TEMP	pH	CONDUCT	H20 DEPTH	FC	EC	Enteroccoci	CP	NO3	NO3-N	NH4	NH4-N	NO3/NH4-N	PO4	PO4	TIDE	FILTER
12/7/94	0					0	0	0	0	27.13	0.38	91.46	1.28	1.66	0.4	0.03	?	M
2/7/95	3.2	1		3100		0	0	2	8								L	S, NO N
3/13/95	2.2	3.8		2250	2.65	2.5	0	0.5	0	4.43	0.06	16.8	0.24	0.30	0.037	0.00	L	PF
4/13/95	2				3.8	0	0	0.5	0	2.7	0.04	82.72	1.16	1.20	0.304	0.02	H	PF
5/4/95	0				4.52	0	0	0.75	0	1.15	0.02	49.58	0.69	0.71	0.018	0.00	L	PF
5/31/95	0	15.2			5.5	0	0	0.5	0	2.124	0.03	57.332	0.80	0.83	0.294	0.02	L	PF
										MEAN=	**0.11**		**0.83**	**0.94**		**0.02**		

WELL: RET 5

DATE	SALINITY	TEMP	pH	CONDUCT	H20 DEPTH	FC	EC	Enteroccoci	CP	NO3	NO3-N	NH4	NH4-N	NO3/NH4-N	PO4	PO4	TIDE	FILTER
12/7/94	0					0	0	0	0	71.01	0.99	55.64	0.78	1.77	0.15	0.01	?	M
2/7/95	2	1		1920		0	0	0	0	1.68	0.02	137.19	1.92	1.94	0.038	0.00	L	S
3/13/95	3	4		2900	2.01	0	0	0	0	14.57	0.20	16.39	0.23	0.43	0.093	0.01	L	PF
4/13/95	1				3.83	0.25	0.25	0	0.25	16	0.22	54.11	0.76	0.98	0.372	0.03	H	PF
5/4/95	1				4.49	8.75	6.75	0.5	0	1.95	0.03	168.2	2.35	2.38	0.077	0.01	L	PF
5/31/95	0	13.5			5.5	0	0	0	0	0.009	0.00	46.145	0.65	0.65	0.258	0.02	L	PF
										MEAN=	**0.25**		**1.11**	**1.36**		**0.01**		

WELL: RET 6

DATE	SALINITY	TEMP	pH	CONDUCT	H20 DEPTH	FC	EC	Enteroccoci	CP	NO3	NO3-N	NH4	NH4-N	NO3/NH4-N	PO4	PO4	TIDE	FILTER
12/7/94																		NO WELL
2/7/95	2.2	1		1600		0	0	0	0	212.43	2.97	269.29	3.77	6.74	0.07	0.01	L	S
3/13/95	2.8	5		2950	0	0	0	0	0	6.14	0.09	27.32	0.38	0.47	3.097	0.24	L	PF
4/13/95	2				1.86	0	0	0.25	0	5.63	0.08	190.93	2.67	2.75	7.812	0.62	H	PF
5/4/95																	L	NO B/N
5/31/95					4.23												L	NO B/N
										MEAN=	**1.05**		**2.28**	**3.32**		**0.29**		

Table 8C. RB site.

										um	mg/L	um	mg/L	mg/L	um	mg/L		
WELL: RB-1																		
DATE	SALINITY	TEMP	pH	CONDUCT	H20 DEPTH	FC	EC	Enteroccoci	CP	NO3	NO3-N	NH4	NH4-N	NO3/NH4-N	PO4	PO4	TIDE	FILTER
12/7/94	10					0	0	0	0	21.790	0.305	27.490	0.385	0.690	0.460	0.036	?	M
2/7/95																	L	NO B/N
3/15/95	3.8	5.5		6200		0	0	0	0	10.550	0.148	26.090	0.365	0.513	13.115	1.036	H	PF
4/18/95																	L	NO B/N
5/31/95																	L	NO B/N
6/6/95																	E	NO B/N
										MEAN=	0.226		0.375	0.601		0.536		
WELL: RB-2																		
DATE	SALINITY	TEMP	pH	CONDUCT	H20 DEPTH	FC	EC	Enteroccoci	CP	NO3	NO3-N	NH4	NH4-N	NO3/NH4-N	PO4	PO4	TIDE	FILTER
12/7/94	13					65		830	0	12.890	0.180	41.610	0.583	0.763	0.170	0.013	?	M
2/7/95																	L	NO B/N
3/15/95	15.5	5		17200	6.86	0.25	0.25	0.75	0	0.000	0.000	62.100	0.869	0.869	4.966	0.392	H	PF
4/18/95	23					0	0	1	0	0.281	0.004	28.245	0.395	0.399	1.368	0.108	L	PF
5/31/95	23	16			8.05	0.5	0.5	0.25	0	0.000	0.000	79.821	1.117	1.117	5.352	0.423	L	PF
6/6/95	29				8.45	3	3	0.75	0	1.829	0.026	39.822	0.558	0.583	1.015	0.080	E	PF
										MEAN=	0.042		0.704	0.746		0.203		
WELL: RB-3																		
DATE	SALINITY	TEMP	pH	CONDUCT	H20 DEPTH	FC	EC	Enteroccoci	CP	NO3	NO3-N	NH4	NH4-N	NO3/NH4-N	PO4	PO4	TIDE	FILTER
12/7/94	11					0	0	0	875	47.450	0.664	21.610	0.303	0.967	0.340	0.027	?	M
2/7/95	16.5	1.2	6.99	16500		0	0	48	0	1.080	0.015	101.053	1.415	1.430	0.005	0.000	L	S
3/15/95	21	5		20200	6.83	0	0	0.25	0	3.520	0.049	25.160	0.352	0.402	14.798	1.169	H	PF
4/18/95	26									1.818	0.025	24.225	0.339	0.365	0.115	0.009	L	NO B
5/31/95	24	19			8.02					0.047	0.001	17.544	0.246	0.246	1.909	0.151	L	NO B
6/6/95					8.35												E	NO B/N
										MEAN=	0.151		0.531	0.682		0.271		
WELL: RB-4																		
DATE	SALINITY	TEMP	pH	CONDUCT	H20 DEPTH	FC	EC	Enteroccoci	CP	NO3	NO3-N	NH4	NH4-N	NO3/NH4-N	PO4	PO4	TIDE	FILTER
12/7/94	15					0	0	60	245	48.900	0.685	27.330	0.383	1.067	0.660	0.052	?	M
2/7/95	18.5	2		26000		9	9	85	0	0.800	0.011	122.920	1.721	1.732	0.076	0.006	L	S
3/15/95	15.5	4.5		17200	4.57	2.5	2.5	0	0	0.000	0.000	55.160	0.772	0.772	9.225	0.729	H	PF
4/18/95	25					0	0	0.5	0	2.156	0.030	21.911	0.307	0.337	0.232	0.018	L	PF
5/31/95					7.55												L	NO B/N
6/6/95					8.21												E	NO B/N
										MEAN=	0.181		0.796	0.977		0.201		

Table 8D. RH site.

										um	mg/L	um	mg/L	mg/L	um	mg/L		
WELL: RH-1																		
DATE	SALINITY	TEMP	pH	CONDUCT	H20 DEPTH	FC	EC	Enteroccoci	CP	NO3	NO3-N	NH4	NH4-N	NO3/NH4-N	PO4	PO4	TIDE	FILTER
12/7/94	9					5		35	285	742.60	10.40	3.66	0.05	10.45	0.39	0.03	?	M
2/9/95	11	6.5	7.31	13500		TNTC	TNTC	203	130	202.85	2.84	698.59	9.78	12.62	0.22	0.02	L	S
3/15/95	6.5	6.2		7500	3.24	230	220	2.5	0	81.66	1.14	6.33	0.09	1.23	6.34	0.50	H	FF
4/18/95	4					7.75	6.5	26.75	0	1,413.31	19.79	142.65	2.00	21.78	112.22	8.86	L	FF
5/24/95	10				8.16	1	1	0		753.50	10.55	76.96	1.08	11.63	3.67	0.29	H	FF
6/6/95	7				8.45	1.5	1.5	2	0	146.35	2.05	28.52	0.40	2.45	0.18	0.01	E	FF
										MEAN=	**7.79**		**2.23**	**10.03**		**1.62**		
WELL: RH-2																		
DATE	SALINITY	TEMP	pH	CONDUCT	H20 DEPTH	FC	EC	Enteroccoci	CP	NO3	NO3-N	NH4	NH4-N	NO3/NH4-N	PO4	PO4	TIDE	FILTER
12/7/94						0	0	350	10									M, NO N
2/9/95	15	7		17000		0	0	3	0	47.33	0.66	45.24	0.63	1.30	0.30	0.02	L	S
3/15/95	16	5.8		16100	4.27	0	0	0	0	20.42	0.29	20.06	0.28	0.57	9.95	0.79	H	FF
4/18/95	13					0	0	0	0	16.33	0.23	29.16	0.41	0.64	0.83	0.07	L	FF
5/24/95					8												H	NO B/N
6/6/95	5				8.25					1,101.82	15.43	110.95	1.55	16.98	0.19	0.02	E	NO B
										MEAN=	**4.15**		**0.72**	**4.87**		**0.22**		
WELL: RH-3																		
DATE	SALINITY	TEMP	pH	CONDUCT	H20 DEPTH	FC	EC	Enteroccoci	CP	NO3	NO3-N	NH4	NH4-N	NO3/NH4-N	PO4	PO4	TIDE	FILTER
12/7/94	3					0	0	10	145	938.26	13.14	38.25	0.54	13.67	11.07	0.87	?	M
2/9/95	11.5	8		14500		28	24	0	0	113.87	1.59	24.47	0.34	1.94	0.25	0.02	L	S
3/15/95	17.4	7		20500	7.41	505	470	3.5	0	75.34	1.05	19.72	0.28	1.33	14.06	1.11	H	FF
4/18/95	10					1.5	1.5	0.5	0	39.21	0.55	28.66	0.40	0.95	0.60	0.05	L	FF
5/24/95	10				8.13	0	0	0		53.73	0.75	36.87	0.52	1.27	1.07	0.08	H	FF
6/6/95	10				8.51					123.39	1.73	58.63	0.82	2.55	0.18	0.01	E	NO B
										MEAN=	**3.14**		**0.48**	**3.62**		**0.36**		
WELL: RH-4																		
DATE	SALINITY	TEMP	pH	CONDUCT	H20 DEPTH	FC	EC	Enteroccoci	CP	NO3	NO3-N	NH4	NH4-N	NO3/NH4-N	PO4	PO4	TIDE	FILTER
12/7/95																		NO WELL
2/9/95	14	8		16500		18	11	61	0	65.96	0.92	112.81	1.58	2.50	10.25	0.81	L	S
3/15/95	13.1	8		16400	4.96	1.25	1	0	0	16.51	0.23	35.53	0.50	0.73	31.89	2.52	H	FF
4/18/95	12					0.5	0.5	0.5	0	134.12	1.88	73.95	1.04	2.91	0.27	0.02	L	FF
5/24/95					7.18												H	NO B/N
6/6/95					7.6												E	NO B/N
										MEAN=	**1.01**		**1.04**	**2.05**		**1.12**		
RH-5DEEP																		
DATE	SALINITY	TEMP	pH	CONDUCT	H20 DEPTH	FC	EC	Enteroccoci	CP	NO3	NO3-N	NH4	NH4-N	NO3/NH4-N	PO4	PO4	TIDE	FILTER
12/7/95																		NO WELL
2/9/95	4	10		6500		0	0	134	0								L	S, NO N
3/15/95	11.5	8		14000	6.38	0	0	0	0	5.00	0.07	134.79	1.89	1.96	72.53	5.73	H	FF
4/18/95	2					0	0	0.5	0	0.00	0.00	163.92	2.29	2.29	0.17	0.01	L	FF
5/24/95	2				7.47	0	0	0		5.54	0.08	167.41	2.34	2.42	18.97	1.50	H	FF
6/6/95	3				10.78	0	0	0	0	0.44	0.01	254.78	3.57	3.57	79.28	6.26	E	FF
										MEAN=	**0.04**		**2.52**	**2.56**		**3.38**		

Table 8E. RP site.

WELL: RP-1

DATE	SALINITY	TEMP	pH	CONDUCT	H20 DEPTH	FC	EC	Enteroccoci	CP	NO3	NO3-N	NH4	NH4-N	NO3/NH4-N	PO4	PO4	TIDE	FILTER
1/16/95	10	10		11200		10	10	5	60	725.80	10.16	30.09	0.42	10.58	0.16	0.01	H	M
2/9/95	7.5	8		10500		0	0	0	0	986.95	13.82	21.90	0.31	14.12	0.27	0.02	L	S
3/15/95	5.5	7		7000	6.75	71	42	0	0	23.77	0.33	32.24	0.45	0.78	3.99	0.31	H	PF
4/20/95	3					0.25	0	0	0	50.37	0.71	26.19	0.37	1.07	0.67	0.05	L	PF
5/18/95	8				7.21	0	0	0	0	0.32	0.00	39.20	0.55	0.55	4.91	0.39	L	PF
5/24/95	6				7.55	0	0	0	0	1.47	0.02	36.53	0.51	0.53	1.43	0.11	H	PF
										MEAN=	**4.17**		**0.43**	**4.61**		**0.15**		

WELL: RP-2

DATE	SALINITY	TEMP	pH	CONDUCT	H20 DEPTH	FC	EC	Enteroccoci	CP	NO3	NO3-N	NH4	NH4-N	NO3/NH4-N	PO4	PO4	TIDE	FILTER
1/16/95	13	8.9		16200		0	0	18	10	201.35	2.82	102.54	1.44	4.25	1.74	0.14	H	M
2/9/95	11	6	7.19	13000		0	0	1	0	39.96	0.56	54.45	0.76	1.32	0.08	0.01	L	S
3/15/95	6.8	5.4		8000	3.51	0	0	0.5	0	9.97	0.14	14.23	0.20	0.34	12.84	1.01	H	PF
4/20/95	3					0	0	0	0	1.42	0.02	29.51	0.41	0.43	0.37	0.03	L	PF
5/18/95	4				7.9	0	0	0	0	6.30	0.09	26.94	0.38	0.47	1.92	0.15	L	PF
5/24/95	7				8.43	0	0	0	0	6.76	0.09	43.04	0.60	0.70	3.90	0.31	H	PF
										MEAN=	**0.62**		**0.63**	**1.25**		**0.27**		

WELL: RP-3

DATE	SALINITY	TEMP	pH	CONDUCT	H20 DEPTH	FC	EC	Enteroccoci	CP	NO3	NO3-N	NH4	NH4-N	NO3/NH4-N	PO4	PO4	TIDE	FILTER
1/16/95	8.8	9.9	7.44	11500		0	0	100	0	74.50	1.04	20.86	0.29	1.34	1.22	0.10	H	M
2/9/95	7.5	6		9000		0	0	0	0	105.72	1.48	34.34	0.48	1.96	0.08	0.01	L	S
3/15/95	6.5	6		7800	7.82	0	0	0	0	8.87	0.12	224.64	3.14	3.27	1.02	0.08	H	PF
4/20/95	5					0	0	0	0.25	226.09	3.17	703.97	9.86	13.02	1.42	0.11	L	PF
5/18/95	6				8.3	0	0	0	0	85.16	1.19	24.03	0.34	1.53	0.75	0.06	L	PF
5/24/95	5				8.11	0	0	0	0	46.96	0.66	42.81	0.60	1.26	7.84	0.62	H	PF
										MEAN=	**1.28**		**2.45**	**3.73**		**0.16**		

WELL: RP-4

DATE	SALINITY	TEMP	pH	CONDUCT	H20 DEPTH	FC	EC	Enteroccoci	CP	NO3	NO3-N	NH4	NH4-N	NO3/NH4-N	PO4	PO4	TIDE	FILTER
1/16/95	16.9	9.1		20200		0	0	0	8	75.46	1.06	116.97	1.64	2.69	0.83	0.07	H	M
2/9/95	8	6		12000		0	0	0	0	70.56	0.99	52.13	0.73	1.72	0.04	0.00	L	S
3/15/95	13.9	6.8		10000	7.19	0	0	0	0	12.37	0.17	19.57	0.27	0.45	4.33	0.34	H	PF
4/20/95	5					0	0	0.25	0	23.92	0.33	38.42	0.54	0.87	1.85	0.15	L	PF
5/18/95	8				7.55	0.25	0.25	0	0	21.74	0.30	57.61	0.81	1.11	14.26	1.13	L	PF
5/24/95	10				7.38	0	0	0		2.29	0.03	58.40	0.82	0.85	7.32	0.58	H	PF
										MEAN=	**0.48**		**0.80**	**1.28**		**0.38**		

LL: RP-5 DEEP

DATE	SALINITY	TEMP	pH	CONDUCT	H20 DEPTH	FC	EC	Enteroccoci	CP	NO3	NO3-N	NH4	NH4-N	NO3/NH4-N	PO4	PO4	TIDE	FILTER
1/16/95	7.7	10.9		10000		0	0	0	0	0.00	0.00	278.58	3.90	3.90	105.79	8.36	H	M
2/9/95																	L	NO B/N
3/15/95	8.5	8.2		9000	6.18	0	0	0	0	5.16	0.07	141.74	1.98	2.06	22.50	1.78	H	PF
4/20/95																	L	NO B/N
5/18/95	5				11.2	0	0	0	0	0.81	0.01	367.24	5.14	5.15	50.85	4.02	L	PF
5/24/95	6				8.65	0	0	0		1.50	0.02	206.96	2.90	2.92	17.51	1.38	H	PF
										MEAN=	**0.03**		**3.48**	**3.51**		**3.88**		

Table 8F. RC site.

LL: RC-1 DEEP

DATE	SALINITY	TEMP	pH	CONDUCT	H20 DEPTH	FC	EC	Enteroccoci	CP	NO3 (um)	NO3-N (mg/L)	NH4 (um)	NH4-N (mg/L)	NO3/NH4-N (mg/L)	PO4 (um)	PO4 (mg/L)	TIDE	FILTER
1/16/95	8.8	11		12000		17		0	30	1071.87	15.01	1167.06	16.34	31.35	7.38	0.58	H	S
2/9/95	9.5	8	7.09	12500		57	50	6	50	139.22	1.95	1193.34	16.71	18.66	0.16	0.01	L	S
3/23/95	10				9.21	7.5	7	2.75	0	31.01	0.43	837.91	11.73	12.16	1.16	0.09	L	PF
4/20/95	6					1	0	6.25	0	1285.62	18.00	644.29	9.02	27.02	61.17	4.83	L	PF
5/18/95	6				9	7	7	0.25	0	217.84	3.05	612.42	8.57	11.62	5.59	0.44	L	PF
5/24/95	6				10.15	3.5	1	1.5	0	135.15	1.89	492.77	6.90	8.79	5.10	0.40	H	PF
										MEAN=	**6.72**		**11.54**	**18.27**		**1.06**		

WELL: RC-2

DATE	SALINITY	TEMP	pH	CONDUCT	H20 DEPTH	FC	EC	Enteroccoci	CP	NO3	NO3-N	NH4	NH4-N	NO3/NH4-N	PO4	PO4	TIDE	FILTER
1/16/95	9.3	11		12900		0	0	0	0	5.47	0.08	236.61	3.31	3.39	31.62	2.50	H	S
2/9/95																	L	NO B/N
3/23/95					11												L	NO B/N
4/20/95	4									8.61	0.12	582.19	8.15	8.27	32.76	2.59	L	NO B
5/18/95	6				13.5	0	0	0	0	2.12	0.03	377.00	5.28	5.31	65.03	5.14	L	PF
5/24/95	8				9.12	0	0	0	0	0.62	0.01	216.89	3.04	3.05	65.85	5.20	H	PF
										MEAN=	**0.06**		**4.94**	**5.00**		**3.86**		

WELL: RC-3

DATE	SALINITY	TEMP	pH	CONDUCT	H20 DEPTH	FC	EC	Enteroccoci	CP	NO3	NO3-N	NH4	NH4-N	NO3/NH4-N	PO4	PO4	TIDE	FILTER
1/16/95	4.7	10.5		6100		1144		TNTC	388	1003.48	14.05	1161.34	16.26	30.31	11.97	0.95	H	S
2/9/95	7	8.5		9000		288	175	TNTC	333	73.47	1.03	1104.66	15.47	16.49	3.95	0.31	L	S
3/23/95	16.5				6.35	10	10	0	0	722.19	10.11	1145.98	16.04	26.15	13.44	1.06	L	PF
4/20/95	5					4.75	3	1	0	79.57	1.11	10.39	0.15	1.26	8.95	0.71	L	PF
5/18/95	2				7.9	1	1	1.25	0	125.12	1.75	320.16	4.48	6.23	53.34	4.21	L	PF
5/24/95	8				7.85	0.25	0.25	0.75	0	204.96	2.87	107.61	1.51	4.38	12.02	0.95	H	PF
										MEAN=	**5.15**		**8.98**	**14.14**		**1.36**		

WELL: RC-4

DATE	SALINITY	TEMP	pH	CONDUCT	H20 DEPTH	FC	EC	Enteroccoci	CP	NO3	NO3-N	NH4	NH4-N	NO3/NH4-N	PO4	PO4	TIDE	FILTER
1/16/95	15.1	8.9		18300		0	0	3	0	21.15	0.30	1303.97	18.26	18.55	39.71	3.14	H	S
2/9/95	14	11.8		30000		0	0	0	0	59.20	0.83	1097.87	15.37	16.20	0.42	0.03	L	S
3/23/95	5				6	1	1	0.25	0	38.41	0.54	612.86	8.58	9.12	84.46	6.67	L	PF
4/20/95	6					0	0	0	0	128.06	1.79	1123.64	15.73	17.52	3.30	0.26	L	PF
5/18/95	6				6.95	0	0	3.5	0	1237.08	17.32	447.13	6.26	23.58	50.66	4.00	L	PF
5/24/95	8				4.3	0	0	0	0	169.19	2.37	465.77	6.52	8.89	87.45	6.91	H	PF
										MEAN=	**3.86**		**11.79**	**15.64**		**3.50**		

Table 8G. CSL site.

DATE	SALINITY	TEMP	pH	CONDUCT	H20 DEPTH	FC	EC	Enteroccoci	CP	um NO3	mg/L NO3-N	um NH4	mg/L NH4-N	mg/L NO3/NH4-N	um PO4	mg/L PO4	TIDE	FILTER
VELL: CSL-1																		
1/3/95	0.3	6	6.83	161		0	0	0	15	162.00	2.27	4.80	0.07	2.34	0.07	0.01	H	M
2/16/95	0.3	7	7.81	330	7.67	0	0	0	0	87.78	1.23	1.46	0.02	1.25	0.01	0.00	L	S
2/23/95	0.2	6		200	7.35	0	0	1	0	75.16	1.05	22.50	0.32	1.37	0.02	0.00	L	PF
3/30/95	0				7	0	0	0	0	66.86	0.94	2.15	0.03	0.97	0.93	0.07	H	PF
4/25/95	0					0	0	0	0	71.99	1.01	3.67	0.05	1.06	0.05	0.00	H	PF
5/11/95	0				3.94					78.95	1.11	1.59	0.02	1.13	0.18	0.01	E	NO B
6/5/95	0				3.97					58.831	0.82	6.613	0.09	0.92	0.16	0.01	E	NO B
										MEAN=	1.20		0.09	1.11		0.02		
VELL: CSL-2																		
DATE	SALINITY	TEMP	pH	CONDUCT	H20 DEPTH	FC	EC	Enteroccoci	CP	NO3	NO3-N	NH4	NH4-N	NO3/NH4-N	PO4	PO4	TIDE	FILTER
1/3/95	0.3	5	6.65	236		0	0	0	0	922.08	12.91	3.42	0.05	12.96	0.02	0.00	H	M
2/16/95	0.3	5.1	6.6	310	4.04	0	0	76	12	98.67	1.38	2.67	0.04	1.42	0.01	0.00	L	S
2/23/95	0.2	5.2		255	3.8	0	0	0	0	145.98	2.04	1.67	0.02	2.07	0.02	0.00	L	PF
3/30/95	0				0.83	0	0	0	0	86.48	1.21	1.75	0.02	1.24	0.10	0.01	H	PF
4/25/95	0					0	0	0	0	56.43	0.79	2.03	0.03	0.82	0.05	0.00	H	PF
5/11/95	0				4.34	0	0	0	0	47.98	0.67	5.12	0.07	0.74	0.00	0.00	E	PF
6/5/95	0				4.35	0	0	0	0	43.33	0.61	0.23	0.00	0.61	0.06	0.00	E	PF
										MEAN=	2.80		0.03	2.84		0.00		
VELL: CSL-3																		
DATE	SALINITY	TEMP	pH	CONDUCT	H20 DEPTH	FC	EC	Enteroccoci	CP	NO3	NO3-N	NH4	NH4-N	NO3/NH4-N	PO4	PO4	TIDE	FILTER
1/3/95	0.3	5.5	6.75	155		0	0	0	30	357.53	5.01	39.36	0.55	5.56	0.02	0.00	H	M
2/16/95																	L	ldn't sam
2/23/95	0.2	5.8		180	6.6	0	0	0	0	62.29	0.87	31.91	0.45	1.32	0.02	0.00	L	PF
3/30/95	0				6.67	0	0	0	0	156.34	2.19	11.31	0.16	2.35	0.04	0.00	H	PF
4/25/95	0					0	0	0	0.25	148.42	2.08	41.41	0.58	2.66	0.06	0.00	H	PF
5/11/95	0				3.16	0	0	0	0	144.04	2.02	44.27	0.62	2.64	0.03	0.00	E	PF
6/5/95	0				3.14	0	0	0	0	126.74	1.77	45.53	0.64	2.41	0.08	0.01	E	PF
										MEAN=	2.32		0.50	2.82		0.00		
VELL: CSL-4																		
DATE	SALINITY	TEMP	pH	CONDUCT	H20 DEPTH	FC	EC	Enteroccoci	CP	NO3	NO3-N	NH4	NH4-N	NO3/NH4-N	PO4	PO4	TIDE	FILTER
1/3/95	0.3	6	6.74	240		0	0	0	490	988.15	13.83	18.33	0.26	14.09	0.60	0.05	H	M
2/16/95																	L	ldn't sam
2/23/95	0.2	6		285	7	1	1	0	0	110.40	1.55	24.59	0.34	1.89	0.19	0.01	L	PF
3/30/95	0				7.03	0	0	0.5	0.5	139.35	1.95	113.46	1.59	3.54	3.58	0.28	H	PF
4/25/95	0					0	0	0	22	23.48	0.33	1261.75	17.66	17.99	0.37	0.03	H	PF
5/11/95	0				3.53	0.25	0.25	0	0	189.39	2.65	1270.28	17.78	20.44	0.09	0.01	E	PF
6/5/95	0				3.63	0	0	0	2	106.71	1.49	1259.25	17.63	19.12	1.85	0.15	E	PF
										MEAN=	3.63		9.21	12.85		0.09		
L: CSL-5 DEEP?																		
DATE	SALINITY	TEMP	pH	CONDUCT	H20 DEPTH	FC	EC	Enteroccoci	CP	NO3	NO3-N	NH4	NH4-N	NO3/NH4-N	PO4	PO4	TIDE	FILTER
1/3/95	0.3	6.8	6.86	220		0	0	0	0	142.99	2.00	5.43	0.08	2.08	0.18	0.01	H	M
2/16/95	0.3	10		380	6.77	0	0	0	0	1209.94	16.94	7.69	0.11	17.05	0.07	0.01	L	S
2/23/95	0.2	7.8		318	6.6	0	0	0	0	93.70	1.31	10.01	0.14	1.45	0.43	0.03	L	PF
3/30/95	0				6.6	0	0	0	0	86.29	1.21	2.15	0.03	1.24	0.11	0.01	H	PF
4/25/95	0					0	0	0	0	78.66	1.10	2.77	0.04	1.14	0.15	0.01	H	PF
5/11/95	0				2.92	0	0	0	0	79.32	1.11	3.91	0.05	1.17	0.04	0.00	E	PF
6/5/95	0				2.77	0	0	0.25	0	78.90	1.10	1.88	0.03	1.13	0.12	0.01	E	PF
										MEAN=	3.54		0.07	3.61		0.01		
VELL: CSL-6																		
DATE	SALINITY	TEMP	pH	CONDUCT	H20 DEPTH	FC	EC	Enteroccoci	CP	NO3	NO3-N	NH4	NH4-N	NO3/NH4-N	PO4	PO4	TIDE	FILTER
1/3/95	0.2	6	6.79	130		0	0	0	170	254.30	3.56	158.77	2.22	5.78	0.19	0.02	H	M
2/16/95																	L	ldn't sam
2/23/95	0.2	6		100	6.1	2	2	0	0	92.84	1.30	8.43	0.12	1.42	0.12	0.01	L	PF
3/30/95	0				6.3	0	0	0	0	65.01	0.91	2.45	0.03	0.94	0.10	0.01	H	PF
4/25/95	0					0	0	0	0	73.51	1.03	6.82	0.10	1.12	0.05	0.00	H	PF
5/11/95	0				2.72	0	0	0	0	79.56	1.11	6.23	0.09	1.20	0.02	0.00	E	PF
6/5/95	0				2.82	0	0	0	0	70.79	0.99	9.16	0.13	1.12	0.10	0.01	E	PF
										MEAN=	1.48		0.45	1.93		0.01		

Table 8H. WRH site.

VELL: WRH-1																		
DATE	SALINITY	TEMP	pH	CONDUCT	H20 DEPTH	FC	EC	Enterococci	CP	NO3	NO3-N	NH4	NH4-N	NO3/NH4-N	PO4	PO4	TIDE	FILTER
1/3/95			7.07			TNTC	TNTC	35	75	150.68	2.11	1250.83	17.51	19.62	1.54	0.12	H	M
2/16/95					6.91												L	NO B/N
3/2/95					6.6												L	NO B/N
3/30/95					6.99												H	NO B/N
4/6/95					7.17												L	NO B/N
4/25/95																	H	NO B/N
5/11/95					7.75												E	NO B/N
										MEAN=	2.11		17.51	19.62		0.12		
VELL: WRH-2																		
DATE	SALINITY	TEMP	pH	CONDUCT	H20 DEPTH	FC	EC	Enterococci	CP	NO3	NO3-N	NH4	NH4-N	NO3/NH4-N	PO4	PO4	TIDE	FILTER
1/3/95	0.5	5	6.55	310		1160	808	153	330	458.28	6.42	48.87	0.68	7.10	0.14	0.01	H	M
2/16/95																	L	didn't samp
3/2/95	0.2	4		356	6.1												L	NO B/N
3/30/95					7.19												H	NO B/N
4/6/95	0	4		329	7.43	67.25	51	23	0	733.39	10.27	164.21	2.30	12.57	0.05	0.00	L	PF
4/25/95																	H	NO B/N
5/11/95					8.07												E	NO B/N
										MEAN=	8.34		1.49	9.83		0.01		
L: WRH-3 DEEP																		
DATE	SALINITY	TEMP	pH	CONDUCT	H20 DEPTH	FC	EC	Enterococci	CP	NO3	NO3-N	NH4	NH4-N	NO3/NH4-N	PO4	PO4	TIDE	FILTER
1/3/95	0.9	6.5	6.64	6500		0	0	0	13	1370.67	19.19	37.30	0.52	19.71	0.06	0.00	H	M
2/16/95	0.3	10	5.91	550	5.65	7	3	0	0	20.21	0.28	126.40	1.77	2.05	0.02	0.00	L	S
3/2/95	0.7	8	5.22	580	5.52	0	0	0	0	1263.62	17.69	34.13	0.48	18.17	0.04	0.00	L	PF
3/30/95	0				5.67	0	0	0	0	1284.02	17.98	34.43	0.48	18.46	0.07	0.01	H	PF
4/6/95	0	6.9		339	5.87	0	0	0	0	1488.31	20.84	74.40	1.04	21.88	0.07	0.01	L	PF
4/25/95	0					0	0	0	0	1246.49	17.45	81.55	1.14	18.59	0.04	0.00	H	PF
5/11/95	0				6.39	1.5	1.5	0	0	1325.28	18.55	1129.83	15.82	34.37	4.27	0.34	E	PF
										MEAN=	16.00		3.04	19.03		0.05		
VELL: WRH-4																		
DATE	SALINITY	TEMP	pH	CONDUCT	H20 DEPTH	FC	EC	Enterococci	CP	NO3	NO3-N	NH4	NH4-N	NO3/NH4-N	PO4	PO4	TIDE	FILTER
1/3/95	0.9	6.2	6.68	7000		18	8	5	240	199.23	2.79	168.75	2.36	5.15	0.22	0.02	H	S
2/16/95																	L	didn't samp
3/2/95	0.5	5	6.18	462	5.81	390	205	185	0	1.14	0.02	219.30	3.07	3.09	12.05	0.95	L	PF
3/30/95	0				5.98	330	210	0	7	0.78	0.01	224.42	3.14	3.15	21.44	1.69	H	PF
4/6/95	0	4.9		500	6.2	350	200	20	6.75	5.38	0.08	1069.12	14.97	15.04	7.07	0.56	L	PF
4/25/95	0					1055	950	1	29.25	1.96	0.03	1068.35	14.96	14.98	14.46	1.14	H	PF
5/9/95	0									8.37	0.12	1245.79	17.44	17.56	2.60	0.21	H	NO B
5/11/95	0				6.75	1380	1090	0	0	2.29	0.03	51.32	0.72	0.75	0.16	0.01	E	PF
										MEAN=	0.44		8.09	8.53		0.65		
VELL: WRH-5																		
DATE	SALINITY	TEMP	pH	CONDUCT	H20 DEPTH	FC	EC	Enterococci	CP	NO3	NO3-N	NH4	NH4-N	NO3/NH4-N	PO4	PO4	TIDE	FILTER
1/3/95			6.98			TNTC	TNTC	420	0	1.15	0.02	1377.67	19.29	19.30	1.17	0.09	H	M
2/16/95																	L	didn't samp
3/2/95	0.5	6	6.34	458	7.24	35.5	29.25	12	0	0.00	0.00	354.34	4.96	4.96	1.25	0.10	L	PF
3/30/95	0				7.26					0.03	0.00	349.54	4.89	4.89	1.79	0.14	H	NO B
4/6/95	0	5		382	7.68	16.25	6.25	2.75	0	3.47	0.05	1574.46	22.04	22.09	0.13	0.01	L	PF
4/25/95	0					2.75	2.25	3	0	2.09	0.03	1346.23	18.85	18.88	0.47	0.04	H	PF
5/11/95	0				8.22					0.85	0.01	1344.68	18.83	18.84	0.02	0.00	E	NO B
										MEAN=	0.02		14.81	14.83		0.06		
VELL: WRH-6																		
DATE	SALINITY	TEMP	pH	CONDUCT	H20 DEPTH	FC	EC	Enterococci	CP	NO3	NO3-N	NH4	NH4-N	NO3/NH4-N	PO4	PO4	TIDE	FILTER
1/3/95	0.3	6	6.58	310		0	0	0	160	100.79	1.41	3.61	0.05	1.46	0.12	0.01	H	M
2/16/95																	L	didn't samp
3/2/95	0.4	5	5.94	306	5.25	0	0	0	0	785.89	11.00	2.11	0.03	11.03	0.11	0.01	L	PF
3/30/95	0				5.36	0	0	0	1.5	738.43	10.34	1.35	0.02	10.36	0.11	0.01	H	PF
4/6/95	0	4.9		295	5.58	0	0	0	1	302.66	4.24	7.01	0.10	4.34	0.06	0.00	L	PF
4/25/95	0					0	0	0	0	229.42	3.21	11.73	0.16	3.38	0.07	0.01	H	PF
5/11/95	0				5.94	0	0	0	0.25	305.90	4.28	7.30	0.10	4.38	0.02	0.00	E	PF
										MEAN=	5.75		0.08	5.82		0.01		

Table 8I. KDB site.

VELL: KDB-1																		
DATE	SALINITY	TEMP	pH	CONDUCT	H20 DEPTH	FC	EC	Enteroccoci	CP	NO3	NO3-N	NH4	NH4-N	NO3/NH4-N	PO4	PO4	TIDE	FILTER
1/9/95	0.2	5.5	6.27	220		0	0		10	526.25	7.37	52.83	0.74	8.11	0.07	0.01	?	M
3/7/95	0.2	5.2		220	5.32	0	0	0	0	1163.04	16.28	16.58	0.23	16.51	0.03	0.00	L	FF
3/23/95	0				4.96	0	0	0	1	203.67	2.85	12.33	0.17	3.02	0.07	0.01	L	FF
4/4/95	0				5.48	0	0	0	0.25	169.93	2.38	44.65	0.63	3.00	0.06	0.00	L	FF
5/2/95	0				5.83	0	0	0	0.25	339.31	4.75	33.96	0.48	5.23	0.04	0.00	L	FF
5/22/95	0				5.82	0	0	0	0.25	236.67	3.31	36.42	0.51	3.82	0.98	0.08	H	FF
										MEAN=	6.16		0.46	6.62		0.02		
VELL: KDB-2																		
DATE	SALINITY	TEMP	pH	CONDUCT	H20 DEPTH	FC	EC	Enteroccoci	CP	NO3	NO3-N	NH4	NH4-N	NO3/NH4-N	PO4	PO4	TIDE	FILTER
1/9/95																	?	didn't sam
3/7/95																	L	didn't sam
3/23/95																	L	didn't sam
4/4/95	0				5.9	0	0	0	14.25	631.92	8.85	10.05	0.14	8.99	0.04	0.00	L	FF
5/2/95	0				6.22	0	0	0	2	145.24	2.03	6.23	0.09	2.12	0.03	0.00	L	FF
5/22/95	0				6.17	0	0	0	2.25	81.69	1.14	8.45	0.12	1.26	0.76	0.06	H	FF
										MEAN=	4.01		0.12	4.12		0.02		
VELL: KDB-3																		
DATE	SALINITY	TEMP	pH	CONDUCT	H20 DEPTH	FC	EC	Enteroccoci	CP	NO3	NO3-N	NH4	NH4-N	NO3/NH4-N	PO4	PO4	TIDE	FILTER
1/9/95	0.2	5.2	6.27	251		860	615		115	184.45	2.58	79.82	1.12	3.70	0.07	0.01	?	M
3/7/95	0.2	5		328	5.85	75	71.5	0	0	382.50	5.36	8.88	0.12	5.48	0.03	0.00	L	FF
3/23/95	0				5.57	1.5	1.5	0	0.25	488.65	6.84	15.19	0.21	7.05	0.03	0.00	L	FF
4/4/95	0				6.04	0	0	0	0.5	266.12	3.73	49.52	0.69	4.42	0.04	0.00	L	FF
5/2/95	0				6.26	0	0	0	0.75	67.36	0.94	28.41	0.40	1.34	0.02	0.00	L	FF
5/22/95	0				6.23	0	0	0	0	123.53	1.73	47.45	0.66	2.39	0.75	0.06	H	FF
										MEAN=	3.53		0.53	4.06		0.01		
VELL: KDB-4																		
DATE	SALINITY	TEMP	pH	CONDUCT	H20 DEPTH	FC	EC	Enteroccoci	CP	NO3	NO3-N	NH4	NH4-N	NO3/NH4-N	PO4	PO4	TIDE	FILTER
1/9/95																	?	NO B/N
3/7/95	0.2	6		320	6.04	0	0	0	0	1414.94	19.81	3.49	0.05	19.86	0.03	0.00	L	FF
3/23/95	0				5.73	0	0	0	0	1268.80	17.76	7.66	0.11	17.87	0.06	0.00	L	FF
4/4/95	0				6.18	0	0	0	0	1344.48	18.82	28.42	0.40	19.22	0.08	0.01	L	FF
5/2/95	0				6.46					1247.32	17.46	36.75	0.51	17.98	0.01	0.00	L	NO B
5/22/95	0				6.4					1317.87	18.45	28.40	0.40	18.85	0.77	0.06	H	NO B
										MEAN=	18.46		0.29	18.75		0.01		
VELL: KDB-5																		
DATE	SALINITY	TEMP	pH	CONDUCT	H20 DEPTH	FC	EC	Enteroccoci	CP	NO3	NO3-N	NH4	NH4-N	NO3/NH4-N	PO4	PO4	TIDE	FILTER
1/9/95																	?	NO B/N
3/7/95	0.8	5		720	4	0	0	0	0	1656.88	23.20	3.08	0.04	23.24	0.04	0.00	L	FF
3/23/95	0				3.48	0	0	0	0	1585.38	22.20	4.11	0.06	22.25	0.05	0.00	L	FF
4/4/95	0				3.96	0	0	0	0	1823.24	25.53	15.04	0.21	25.74	0.07	0.01	L	FF
5/2/95	0					0	0	0	0	1100.43	15.41	11.17	0.16	15.56	0.12	0.01	L	FF
5/22/95	0				4.46	0	0	0	0.25	1378.24	19.30	13.29	0.19	19.48	0.79	0.06	H	FF
										MEAN=	21.12		0.13	21.25		0.02		
VELL: KDB-6																		
DATE	SALINITY	TEMP	pH	CONDUCT	H20 DEPTH	FC	EC	Enteroccoci	CP	NO3	NO3-N	NH4	NH4-N	NO3/NH4-N	PO4	PO4	TIDE	FILTER
1/9/95	0.3	6.1	6.27	295		0	0		5	1397.04	19.56	22.23	0.31	19.87	0.11	0.01	?	M
3/7/95	0.2	5.5		300	5.53	7.5	7.25	1.75	0	1381.73	19.34	5.39	0.08	19.42	0.13	0.01	L	FF
3/23/95	0				5.24	0	0	0	0.25	1479.30	20.71	3.58	0.05	20.76	0.10	0.01	L	FF
4/4/95	0				5.8	0	0	0	0.5	1625.20	22.75	17.44	0.24	23.00	0.07	0.01	L	FF
5/2/95	0				6.23					1291.66	18.08	15.08	0.21	18.29	0.05	0.00	L	NO B
5/22/95	0				6.22					1351.58	18.92	41.74	0.58	19.51	0.77	0.06	H	NO B
										MEAN=	19.90		0.25	20.14		0.02		
VELL: KDB-7																		
DATE	SALINITY	TEMP	pH	CONDUCT	H20 DEPTH	FC	EC	Enteroccoci	CP	NO3	NO3-N	NH4	NH4-N	NO3/NH4-N	PO4	PO4	TIDE	FILTER
1/9/95	0.3	6	6.27	212		0	0		0	1360.82	19.05	1.59	0.02	19.07	0.05	0.00	?	M
3/7/95	0.5	5		410	4.75	1	1	1	0	1401.56	19.62	8.84	0.12	19.75	0.05	0.00	L	FF
3/23/95	0				4.19	0	0	0	1.5	1702.88	23.84	13.44	0.19	24.03	0.04	0.00	L	FF
4/4/95	0				4.71	0	0	0	0.25	1947.92	27.27	179.58	2.51	29.79	0.06	0.00	L	FF
5/2/95	0				5.22	0	0	0	0	1461.00	20.45	219.86	3.08	23.53	0.04	0.00	L	FF
5/22/95	0				5.2												H	NO B/N
										MEAN=	22.05		1.19	23.23		0.00		
VELL: KDB-8																		
DATE	SALINITY	TEMP	pH	CONDUCT	H20 DEPTH	FC	EC	Enteroccoci	CP	NO3	NO3-N	NH4	NH4-N	NO3/NH4-N	PO4	PO4	TIDE	FILTER
1/9/95																	?	NO WELL
3/7/95	0.5	4.8		442	5.59	0	0	0	0	1655.28	23.17	3.34	0.05	23.22	0.04	0.00	L	FF
3/23/95	0				5.06	0	0	0.75	1	1659.90	23.24	3.54	0.05	23.29	0.07	0.01	L	FF
4/4/95	0				5.7	0	0	0	0	1797.84	25.17	9.76	0.14	25.31	0.06	0.00	L	FF
5/2/95	0				6.31	0	0	0	0	1526.21	21.37	12.10	0.17	21.54	0.05	0.00	L	FF
5/22/95	0				6.1	0	0	0	0.25	1748.23	24.48	16.13	0.23	24.70	0.77	0.06	H	FF
										MEAN=	23.48		0.13	23.61		0.02		
L: KDB-9 DEEP																		
DATE	SALINITY	TEMP	pH	CONDUCT	H20 DEPTH	FC	EC	Enteroccoci	CP	NO3	NO3-N	NH4	NH4-N	NO3/NH4-N	PO4	PO4	TIDE	FILTER
1/9/95																	?	NO WELL
3/7/95					4.8												L	NO B/N
3/23/95					1.67												L	NO B/N
4/4/94					4.48												L	NO B/N
5/2/95					10.04												L	NO B/N
5/22/95					5.11												H	NO B/N

Table 8J. FDC site.

WELL: FDC-1																		
DATE	SALINITY	TEMP	pH	CONDUCT	H20 DEPTH	FC	EC	Enteroccoci	CP	NO3	**NO3-N**	NH4	**NH4-N**	**NO3/NH4-N**	PO4	**PO4**	TIDE	FILTER
1/9/95	0.5	3.8		408		0	0		160								N/A	M, NO N
3/9/95					6												N/A	NO B/N
4/6/95					6.15												N/A	NO B/N
5/2/95					6.43												N/A	NO B/N
5/22/95					6.28												N/A	NO B/N
6/5/95					6.54												N/A	NO B/N
WELL: FDC-2																		
DATE	SALINITY	TEMP	pH	CONDUCT	H20 DEPTH	FC	EC	Enteroccoci	CP	NO3	**NO3-N**	NH4	**NH4-N**	**NO3/NH4-N**	PO4	**PO4**	TIDE	FILTER
1/9/95	0.9	4.3	6.61	780		0	0		25	2003.05	28.04	1324.10	18.54	46.58	0.78	0.06	N/A	M
3/9/95	0.8	3.8		690	4.42	0.5	0.5	0	0	176.21	2.47	7.71	0.11	2.57	0.15	0.01	N/A	PF
4/6/95					4.82												N/A	NO B/N
5/2/95					5.22												N/A	NO B/N
5/22/95					5.15												N/A	NO B/N
6/5/95					5.23												N/A	NO B/N
										MEAN=	**15.25**		**9.32**	**24.58**		**0.04**		
WELL: FDC-3																		
DATE	SALINITY	TEMP	pH	CONDUCT	H20 DEPTH	FC	EC	Enteroccoci	CP	NO3	**NO3-N**	NH4	**NH4-N**	**NO3/NH4-N**	PO4	**PO4**	TIDE	FILTER
1/9/95	0.5	6	6.61	600		0	0		0	83.98	1.18	15.56	0.22	1.39	0.16	0.01	N/A	M
3/9/95	0.8	6		570	5.59	0	0	0	0	1849.10	25.89	368.64	5.16	31.05	0.05	0.00	N/A	PF
4/6/95					6.03												N/A	NO B/N
5/2/95					6.54												N/A	NO B/N
5/22/95					6.05												N/A	NO B/N
6/5/95					6.39												N/A	NO B/N
										MEAN=	**13.53**		**2.69**	**16.22**		**0.01**		
WELL: FDC-4																		
DATE	SALINITY	TEMP	pH	CONDUCT	H20 DEPTH	FC	EC	Enteroccoci	CP	NO3	**NO3-N**	NH4	**NH4-N**	**NO3/NH4-N**	PO4	**PO4**	TIDE	FILTER
1/9/95	1	1.8	6.61	1120		0	0		50								N/A	M
3/9/95	0.4	2.5		320	5.1												N/A	NO B/N
4/6/95					5.21												N/A	NO B/N
5/2/95					5.66												N/A	NO B/N
5/22/95					5.33												N/A	NO B/N
6/5/95					5.75												N/A	NO B/N
WELL: FDC-5																		
DATE	SALINITY	TEMP	pH	CONDUCT	H20 DEPTH	FC	EC	Enteroccoci	CP	NO3	**NO3-N**	NH4	**NH4-N**	**NO3/NH4-N**	PO4	**PO4**	TIDE	FILTER
1/9/95	0.2	7	6.61	410		0	0		0	1.45	0.02	1.94	0.03	0.05	0.82	0.06	N/A	M
3/9/95	0.5	5.8		435	5.32	0.25	0.25	0	0	5.10	0.07	1.08	0.02	0.09	0.09	0.01	N/A	PF
4/6/95	0	6		459	6.2	0	0	0	0	0.00	0.00	1.34	0.02	0.02	0.03	0.00	N/A	PF
5/2/95	0				6.29	0	0	0	0	4.88	0.07	2.74	0.04	0.11	0.17	0.01	N/A	PF
5/22/95	0				6.1	0	0	0	0.25	1.05	0.01	2.77	0.04	0.05	0.80	0.06	N/A	PF
6/5/95	0				6.57	0	0	0	0	5.01	0.07	0.72	0.01	0.08	0.12	0.01	N/A	PF
										MEAN=	**0.04**		**0.02**	**0.07**		**0.03**		

Table 9. Ranges of contaminant concentrations from all wells at each site

Site	Salinity PPT	Fecal coliforms CFU/100 ml	Enterococci CFU/100 ml	*C. perfringens* CFU/100 ml	Nitrate mg/L	Ammonium mg/L	Phosphate mg/L	Average NO3/NH4 ratio*
			River	**Street**				
REH	3 to 15	0 to 29	0	0 to 700	<0.01 to 15.3	0.56 to 20.1	<0.01 to 0.97	1.8
RET	0 to 4	0 to 21	0 to 40	0 to 60	<0.01 to 3.0	0.23 to 18.9	<0.01 to 0.62	0.16
RB	4 to 26	0 to 65	0 to 830	0 to 875	<0.01 to 0.7	0.25 to 1.7	<0.01 to 1.2	0.29
RH	2 to 17	0 to 500	0 to 200	0 to 285	<0.01 to 19.8	0.05 to 9.78	0.01 to 8.9	3.3
RP	3 to 17	0 to 71	0 to 100	0 to 60	<0.01 to 13.8	0.20 to 9.9	<0.01 to 8.4	2.4
RC	2 to 16	0 to 1140	0 to 250	0 to 390	0.01 to 18.0	0.15 to 18.3	0.01 to 6.9	0.38
			In	**Town**				
CSL	0	0 to 2	0 to 76	0 to 490	0.33 to 16.9	<0.01 to 17.8	<0.01 to 0.28	27.6
WRH	0 to 1	0 to 1380	0 to 420	0 to 330	<0.01 to 20.9	0.02 to 22.0	<0.01 to 1.7	13.8
KDB	0 to 1	0 to 860	0 to 2	0 to 115	0.94 to 27.3	0.02 to 3.1	<0.01 to 0.08	69.7
FDC	0 to 1	0 to 1	0	0 to 160	<0.01 to 28	0.01 to 18.5	<0.01 to 0.06	2.9

* The ratios for mean nitrate divided by mean ammonium levels for each well were calculated, summed, and averaged for each site.

Table 10. Hampton Harbor shoreline survey on 6/2/95, at River St. and Cross Beach Rd., Seabrook, NH: Fecal coliform levels.

House #	Location	Description	Map #	FC/100ml
14	14 River St.	Seepage-1	SB 1	<5
14	14 River St.	Seepage-2	SB 1	<5
30	30 River St.	Gray water pipe	SB 1	Bkgd *
31	31 River St.	Septic seepage	SB 1	60
36/37	Between 36 & 37 River St.	Septic seepage	SB 1	~200000
NA	Harbor at River St.	Harbor sample	SB 1	<5
NA	Rocks at Yankee Coop	Groundwater	SB 1	1

* Bkgd- Background growth interference extensive; couldn't read

Table 11. Concentrations (per 100 ml) for bacterial indicators in surface water around study sites.

SITE: 1 (REH DOWN STREAM)

DATE	SALINITY	TEMP.	Fecal coliform	*E. coli*	Enterococci	*C. perfringens*
6/8/95	29.7	16	45.5	44.5	44.5	8
6/19/95	27	29.5	61.5	61.5	103.5	18.25
6/22/95	29	25	47	43	27	4
	Geometric mean =		**51**	**49**	**50**	**8**

SITE: 2 (REH UP STREAM)

DATE	SALINITY	TEMP.	Fecal coliform	*E. coli*	Enterococci	*C. perfringens*
6/8/95	29.7	16	34	34	48.5	6.5
6/19/95	28	23.4	390	370	247.5	2.5
6/22/95	28	21	305	290	38.75	9.5
	Geometric mean =		**159**	**154**	**77**	**5**

SITE: 3 (CAUSEWAY STREET BRIDGE)

DATE	SALINITY	TEMP.	Fecal coliform	*E. coli*	Enterococci	*C. perfringens*
6/8/95	1	18	535	465	206.5	25
6/19/95	0	23.8	800	490	43.75	17.5
6/22/95	5	21	605	340	36	6
	Geometric mean =		**637**	**426**	**69**	**14**

SITE: 4 (TIDAL CREEK BEHIND HUBERT)

DATE	SALINITY	TEMP.	Fecal coliform	*E. coli*	Enterococci	*C. perfringens*
6/8/95	0	17.5	460	397.5	168	2.5
6/19/95	0	28.1	830	407.5	151.2	6.75
6/22/95	2	20.5	670	340	101.25	8
	Geometric mean =		**635**	**380**	**137**	**5**

SITE: 5 (CSL DOWN STREAM)

DATE	SALINITY	TEMP.	Fecal coliform	*E. coli*	Enterococci	*C. perfringens*
6/8/95	0	18	134.5	126.5	60	33.5
6/19/95	0	25	545	460	144	83.5
6/22/95	0	23.7	795	785	95	46
	Geometric mean =		**388**	**357**	**94**	**50**

SITE: 6 (RT. 286 BROWN'S BRIDGE)

DATE	SALINITY	TEMP.	Fecal coliform	*E. coli*	Enterococci	*C. perfringens*
6/8/95	26	14	26.5	24	15	4
6/19/95	28	21	62	42.5	13.5	2.25
6/22/95	28	18.9	9	9	9.25	3.75
	Geometric mean =		**25**	**21**	**12**	**3**

SITE: 7 (CSL UP STREAM)

DATE	SALINITY	TEMP.	Fecal coliform	*E. coli*	Enterococci	*C. perfringens*
6/8/95	0	15.5	255	230	136.5	44.5
6/19/95	0	18.5	400	340	430	TNTC
6/22/95	0	14.5	380	370	468.75	140
	Geometric mean =		**338**	**307**	**302**	**79**

SITE: 8 (KDB DOWN STREAM)

DATE	SALINITY	TEMP.	Fecal coliform	*E. coli*	Enterococci	*C. perfringens*
6/8/95	0	20.5	365	330	233	8
6/19/95	0	27.3	120	110	496.25	7.75
6/22/95	1	26	0.5	0.5	3040	16
	Geometric mean =		**28**	**26**	**706**	**10**

SITE: 9 (KDB UP STREAM)

DATE	SALINITY	TEMP.	Fecal coliform	*E. coli*	Enterococci	*C. perfringens*
6/8/95	0	20.5	285	240	197.5	6
6/19/95	0	26.8	205	155	605	12.75
6/22/95	0	25.3	0.4	0.4	470	4.75
	Geometric mean =		**29**	**25**	**383**	**7**

SITE: 10 (END OF FOREST DRIVE)

DATE	SALINITY	TEMP.	Fecal coliform	*E. coli*	Enterococci	*C. perfringens*
6/8/95						
6/19/95	0	16.5	287.5	147.5	103.75	8
6/22/95	0	15	95	72.5	77	2
	Geometric mean =		**165**	**103**	**89**	**4**

SITE: 11 (FOREST DRIVE POND)

DATE	SALINITY	TEMP.	Fecal coliform	*E. coli*	Enterococci	*C. perfringens*
6/8/95	0	19.5	184.5	176.5	87	14.5
6/19/95	0	25.4	66.25	52.5	35	1.75
6/22/95	0	22.5	42	42	4	1.5
	Geometric mean =		**80**	**73**	**23**	**3**

SITE: 12 (RT. 1 CULVERT))

DATE	SALINITY	TEMP.	Fecal coliform	*E. coli*	Enterococci	*C. perfringens*
6/8/95	0	23	255	232.5	198	29
6/19/95	0	28.1	252.5	202.5	46.25	7.75
6/22/95	0	25.9	52.5	50	19	13.5
	Geometric mean =		**150**	**133**	**56**	**14**

Figure 1. Focus areas with selected study sites (2-3 CAPITOL LETTERS) and surface water sample stations (#1-12).

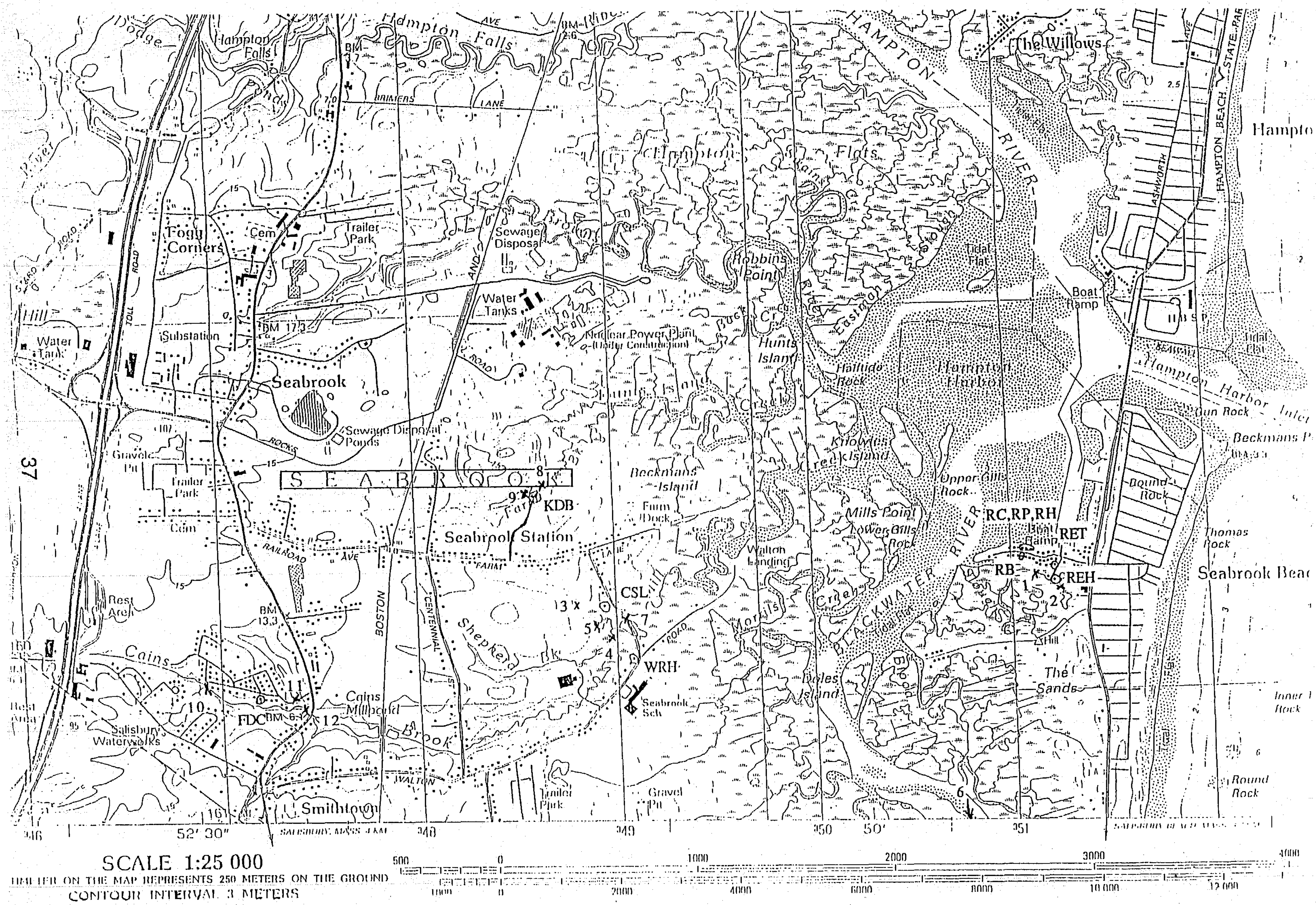


Figure 2. Lot layout, EDA location, groundwater flow direction and installed wells at REH AND RET.

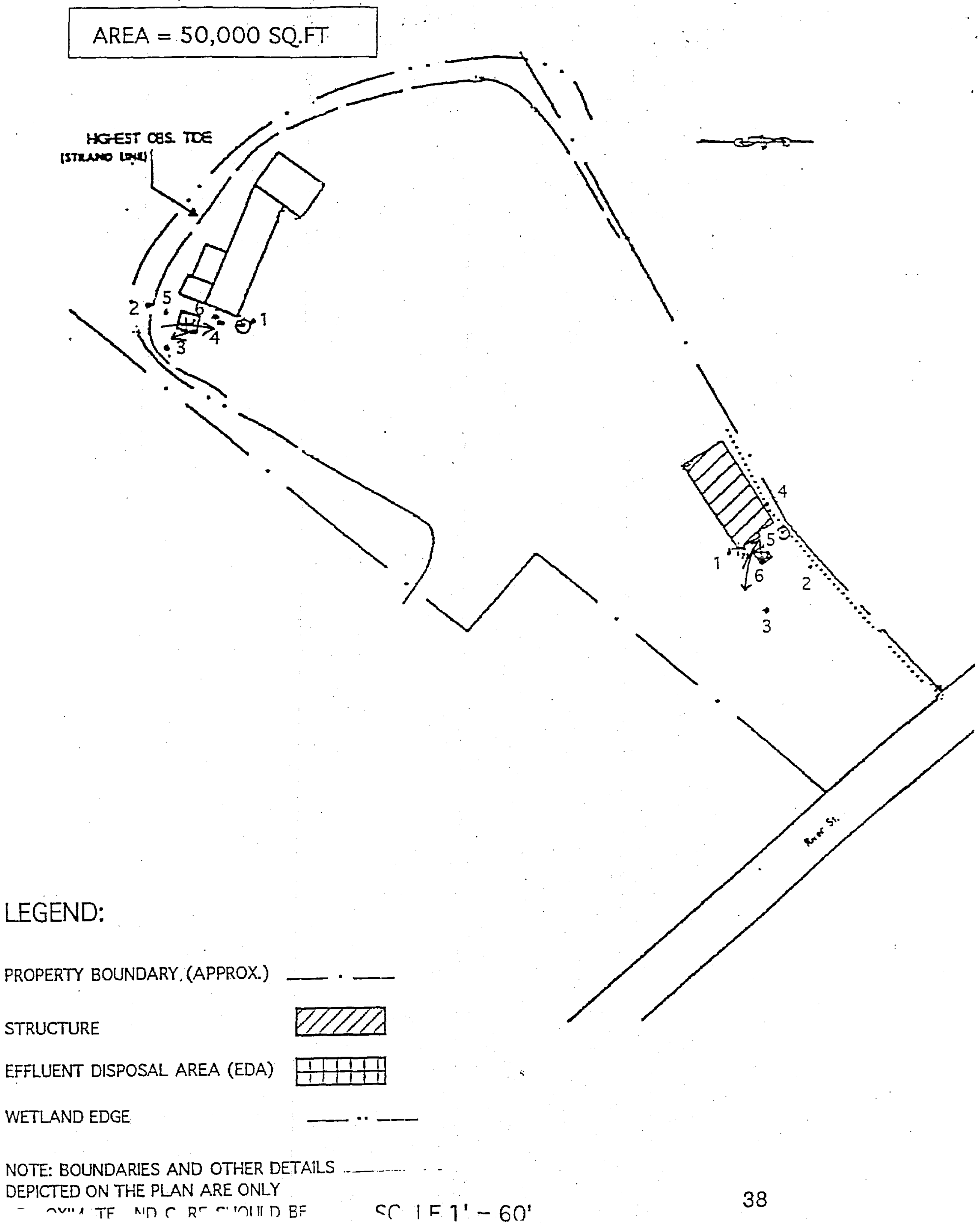


Figure 3. Lot layout, EDA location, groundwater flow direction and installed wells at RB.

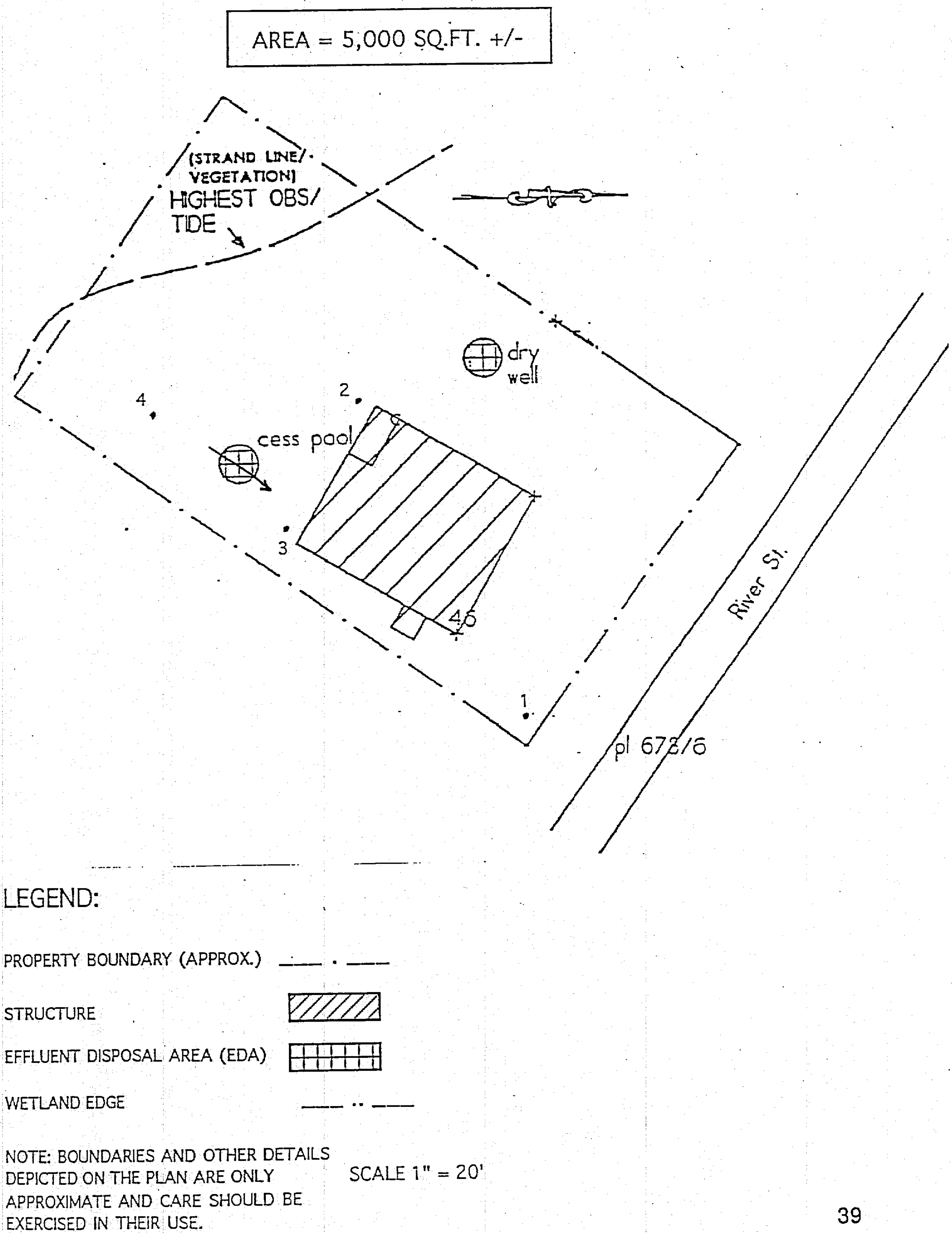


Figure 4. Lot layout, EDA location, groundwater flow direction and installed wells at RH.

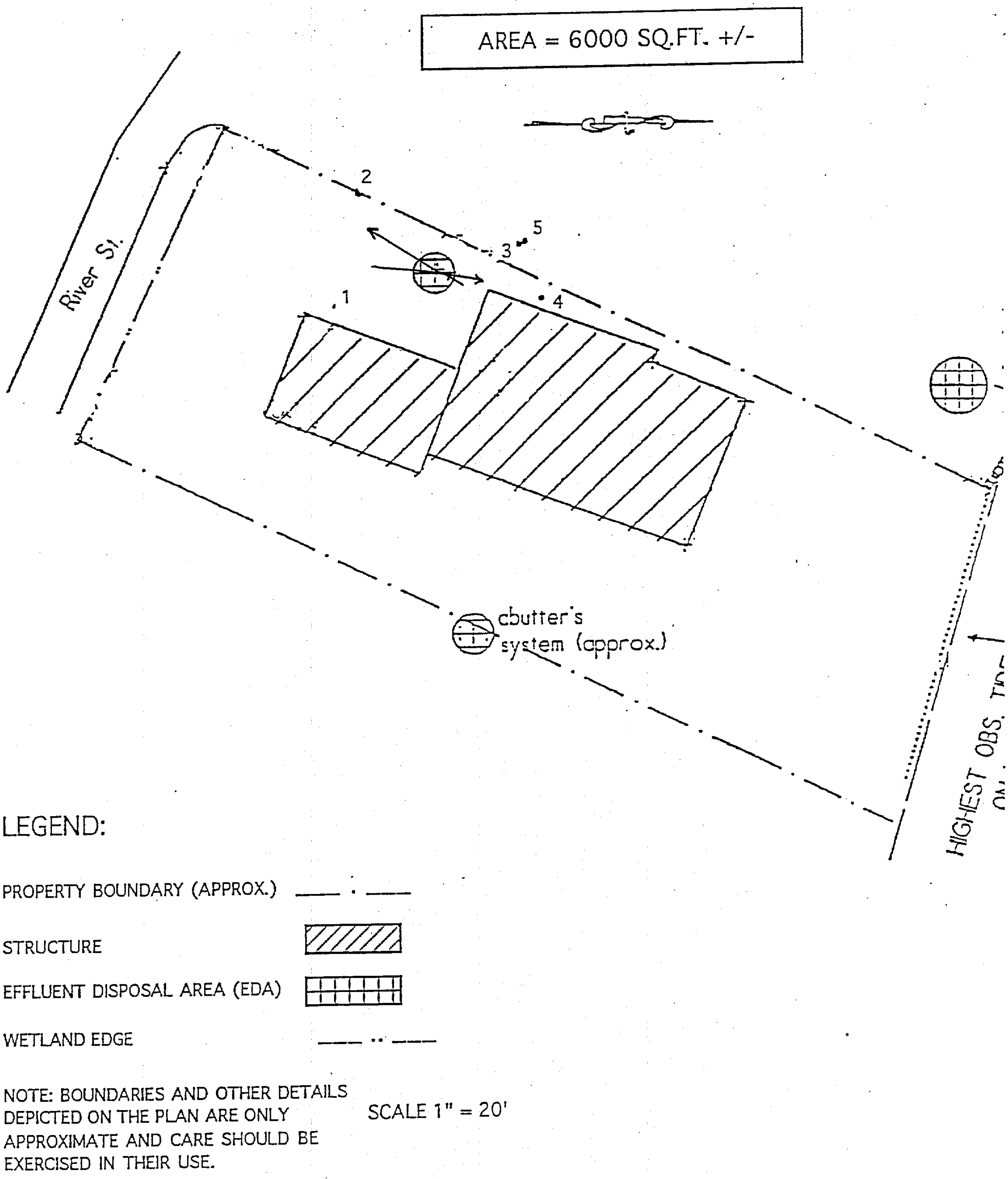
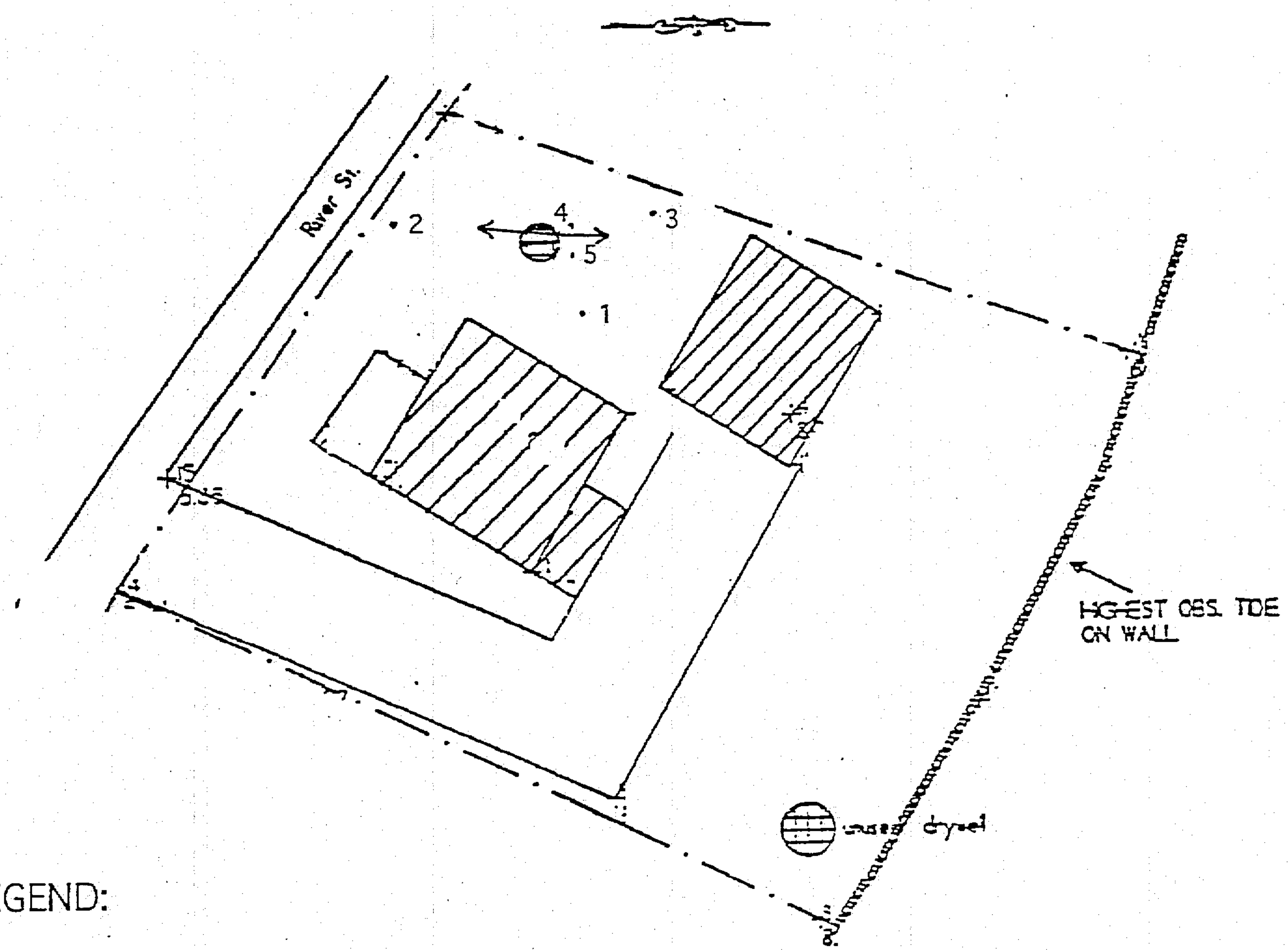


Figure 5. Lot layout, EDA location, groundwater flow direction and installed wells at RP.

AREA = 12,000 SQ.FT +/-



LEGEND:

PROPERTY BOUNDARY (APPROX.)

STRUCTURE

EFFLUENT DISPOSAL AREA (EDA)

WETLAND EDGE

NOTE: BOUNDARIES AND OTHER DETAILS DEPICTED ON THE PLAN ARE ONLY APPROXIMATE AND CARE SHOULD BE EXERCISED IN THEIR USE.

SCALE 1" = 30'

Figure 6. Lot layout, EDA location, groundwater flow direction and installed wells at RC.

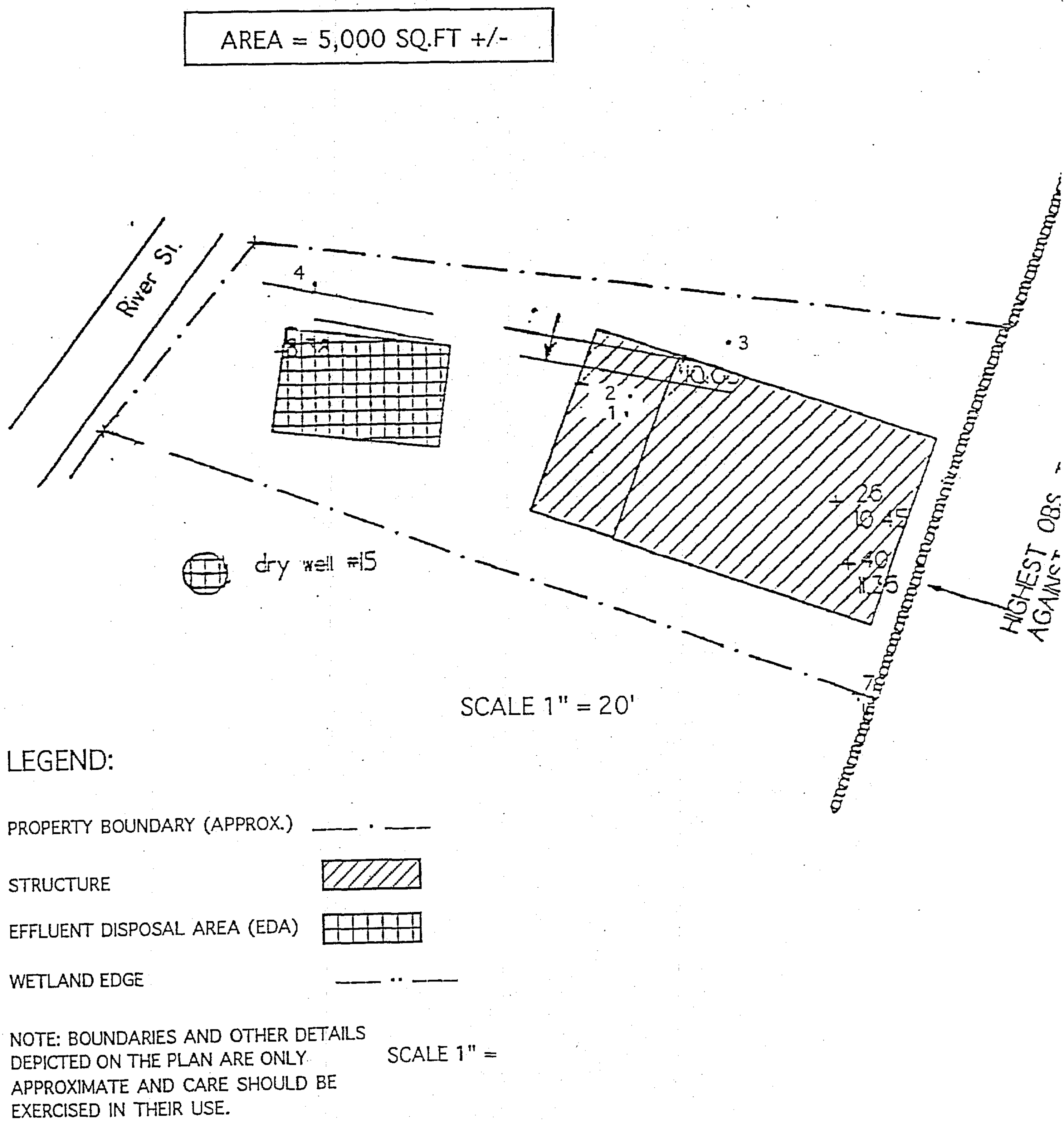
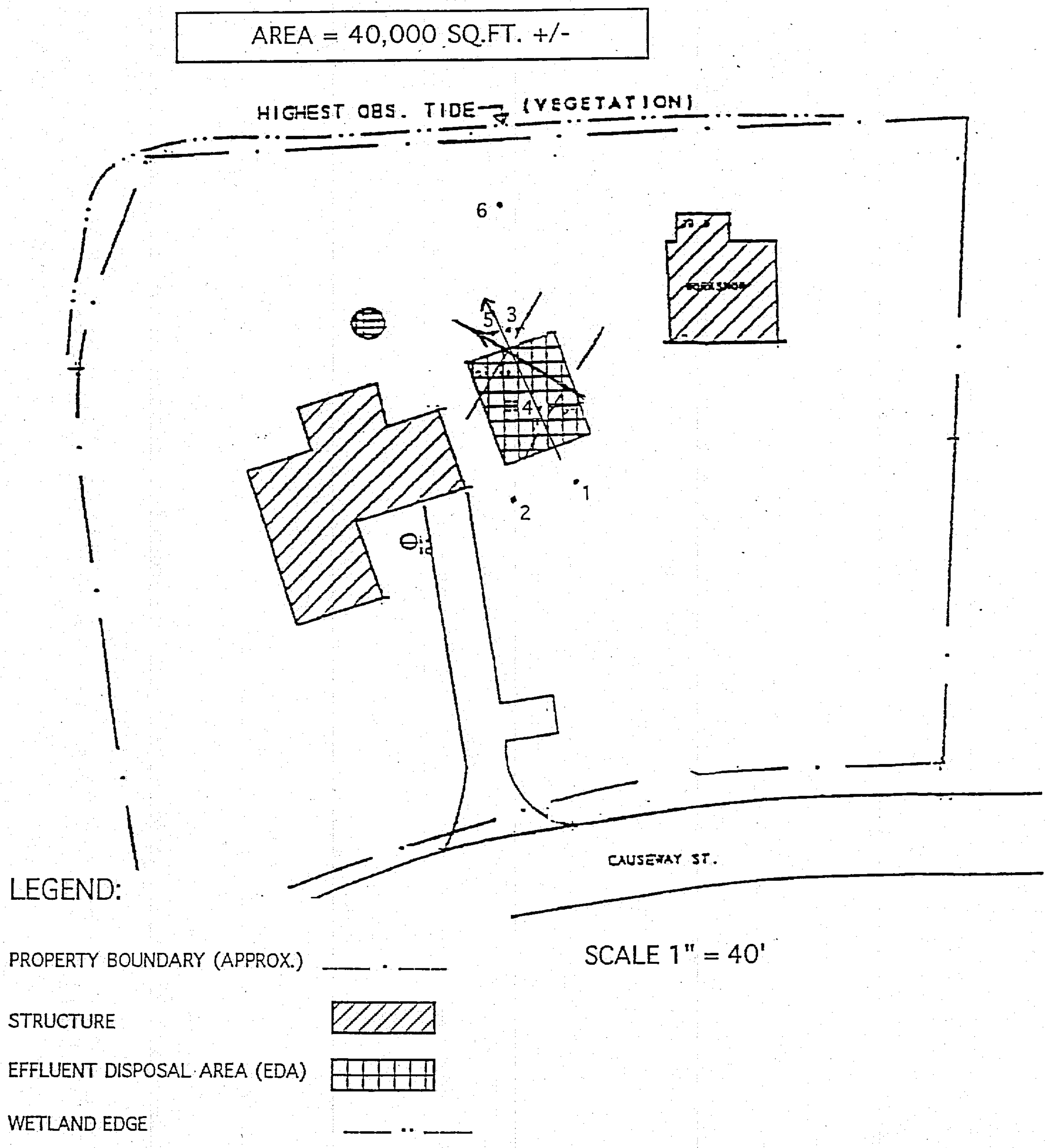


Figure 7. Lot layout, EDA location, groundwater flow direction and installed wells at CSL.



NOTE: BOUNDARIES AND OTHER DETAILS DEPICTED ON THE PLAN ARE ONLY APPROXIMATE AND CARE SHOULD BE EXERCISED IN THEIR USE.

Figure 8. Lot layout, EDA location, groundwater flow direction and installed wells at WRH.

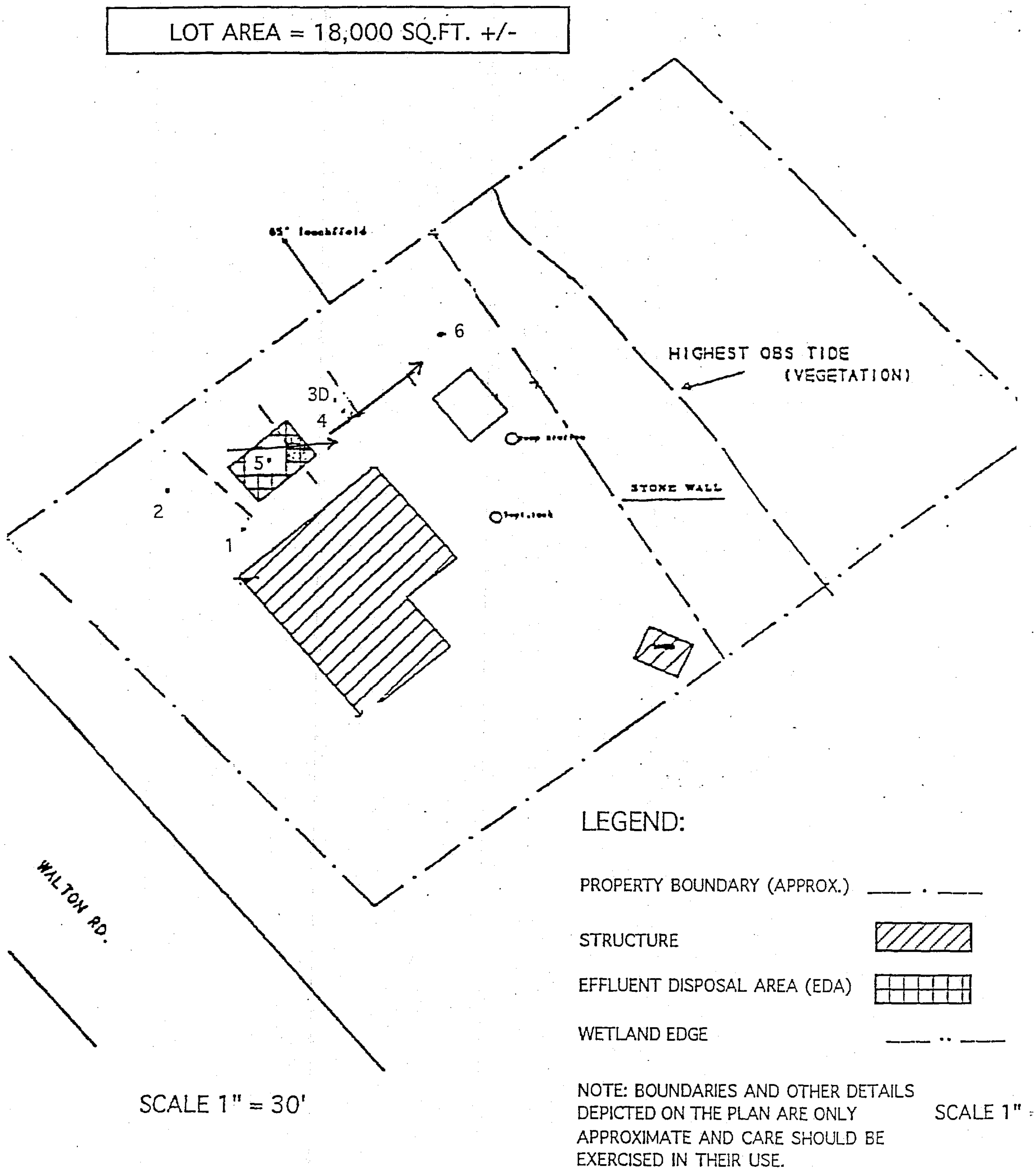
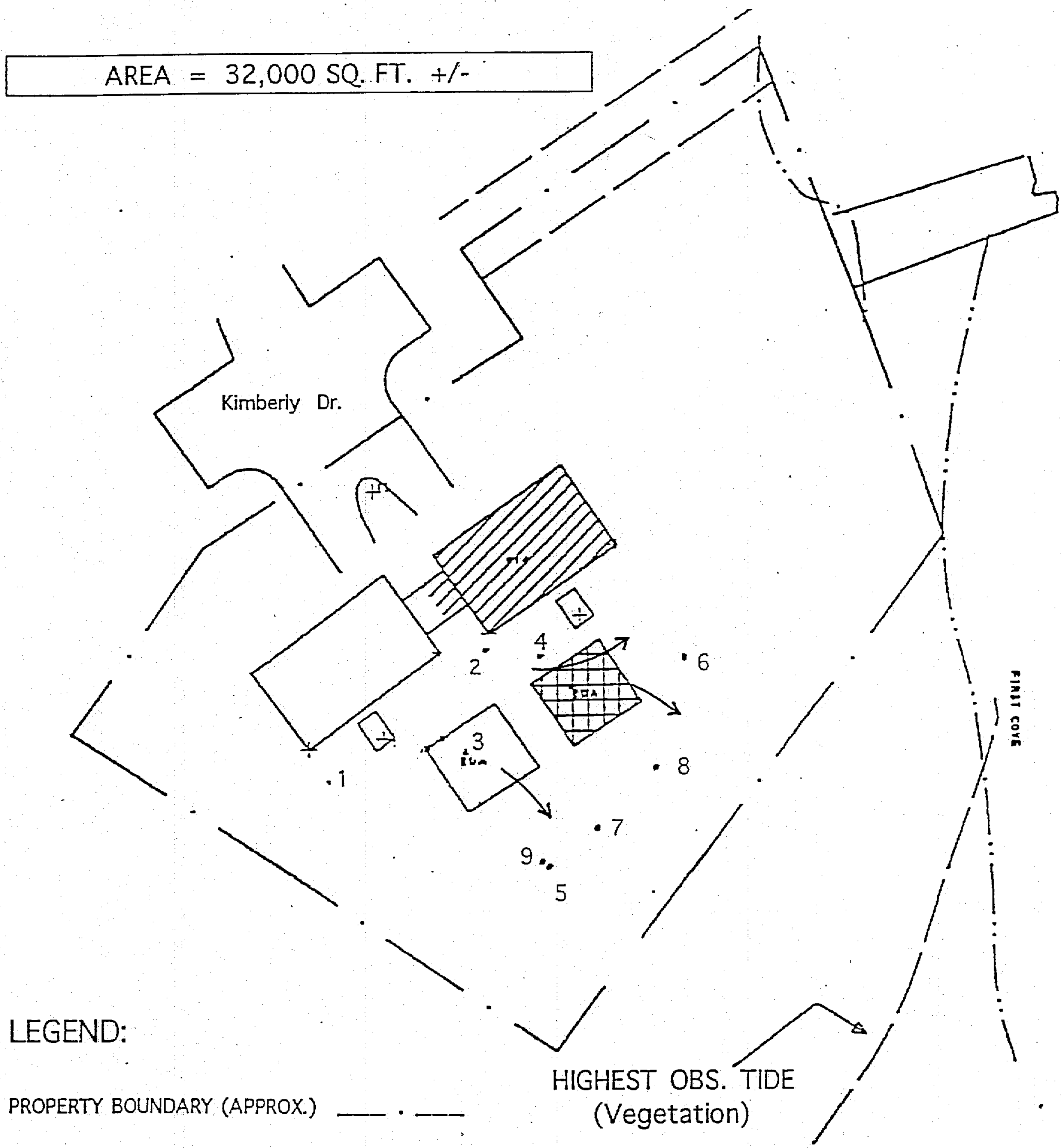


Figure 9. Lot layout, EDA location, groundwater flow direction and installed wells at KDB.



LEGEND:

PROPERTY BOUNDARY (APPROX.) —— · ——

STRUCTURE

EFFLUENT DISPOSAL AREA (EDA)

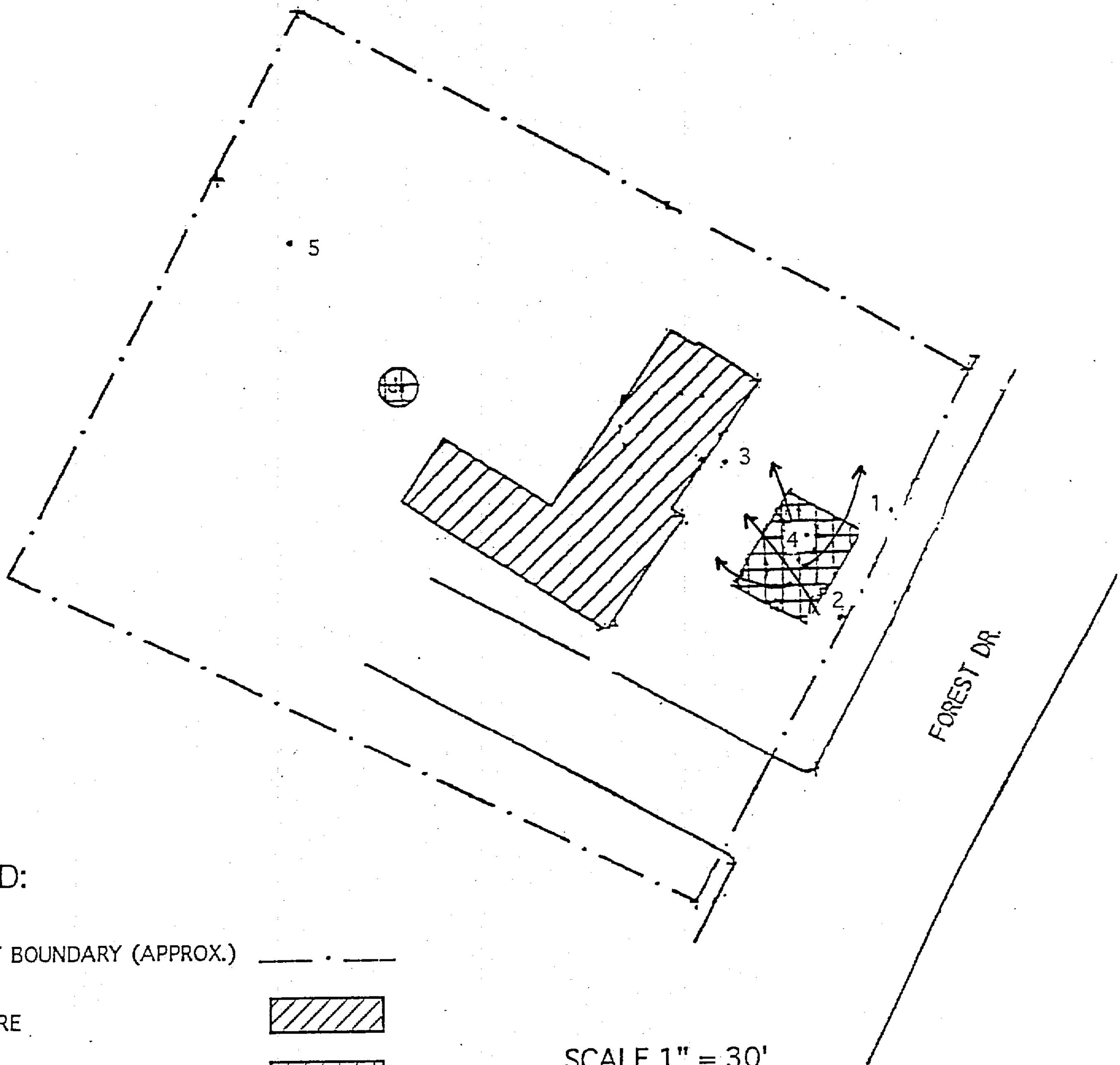
WETLAND EDGE —— ·· ——

NOTE: BOUNDARIES AND OTHER DETAILS DEPICTED ON THE PLAN ARE ONLY APPROXIMATE AND CARE SHOULD BE EXERCISED IN THEIR USE.

SCALE 1" = 50'

Figure 10. Lot layout, EDA location, groundwater flow direction and installed wells at FDC.

AREA = 13,900 SQ.FT. +/-



LEGEND:

PROPERTY BOUNDARY (APPROX.)

STRUCTURE

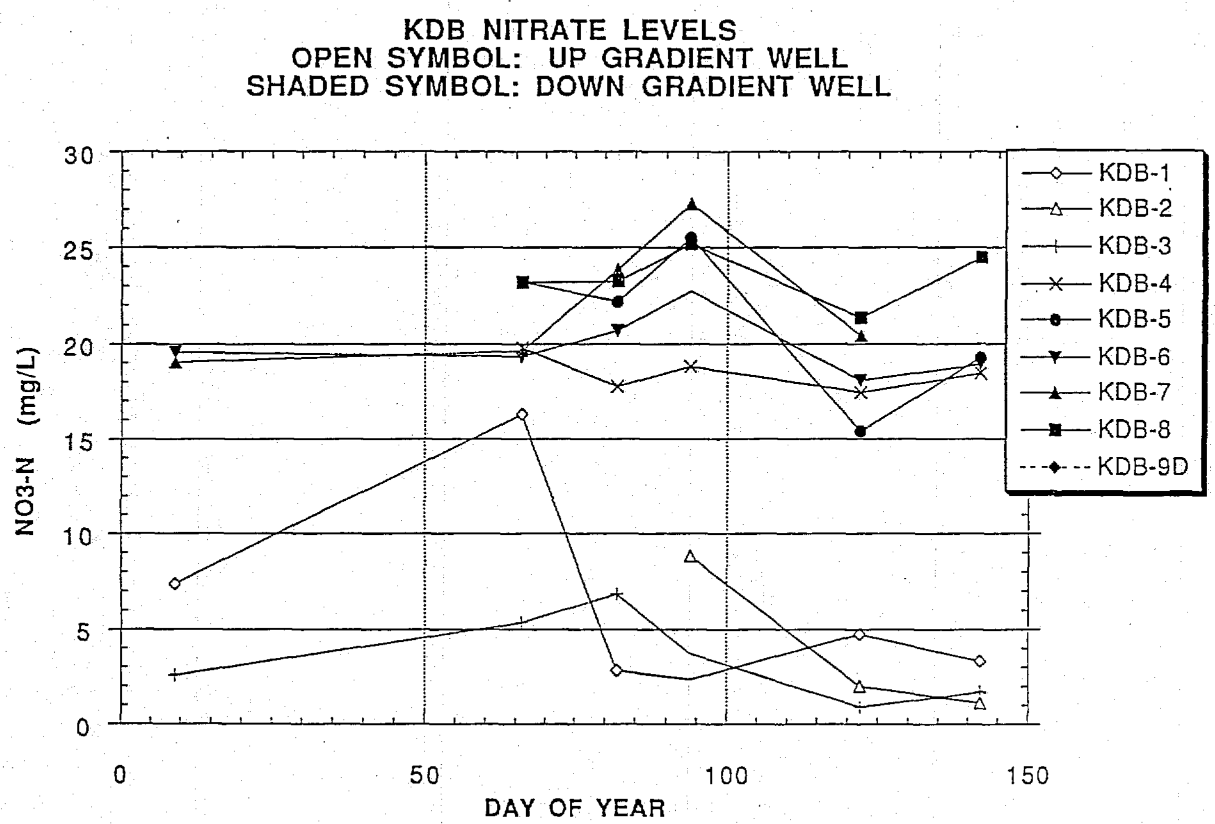
EFFLUENT DISPOSAL AREA (EDA)

WETLAND EDGE

SCALE 1" = 30'

NOTE: BOUNDARIES AND OTHER DETAILS DEPICTED ON THE PLAN ARE ONLY APPROXIMATE AND CARE SHOULD BE EXERCISED IN THEIR USE.

Figure 11. Nitrate and ammonium concentrations in KDB wells.



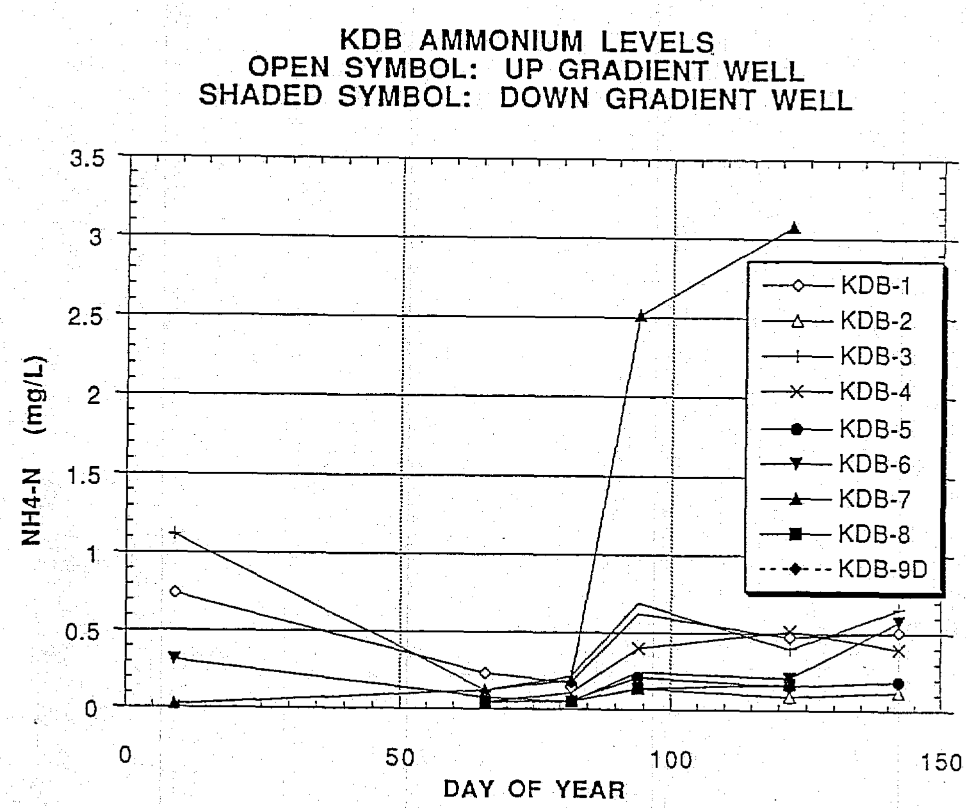
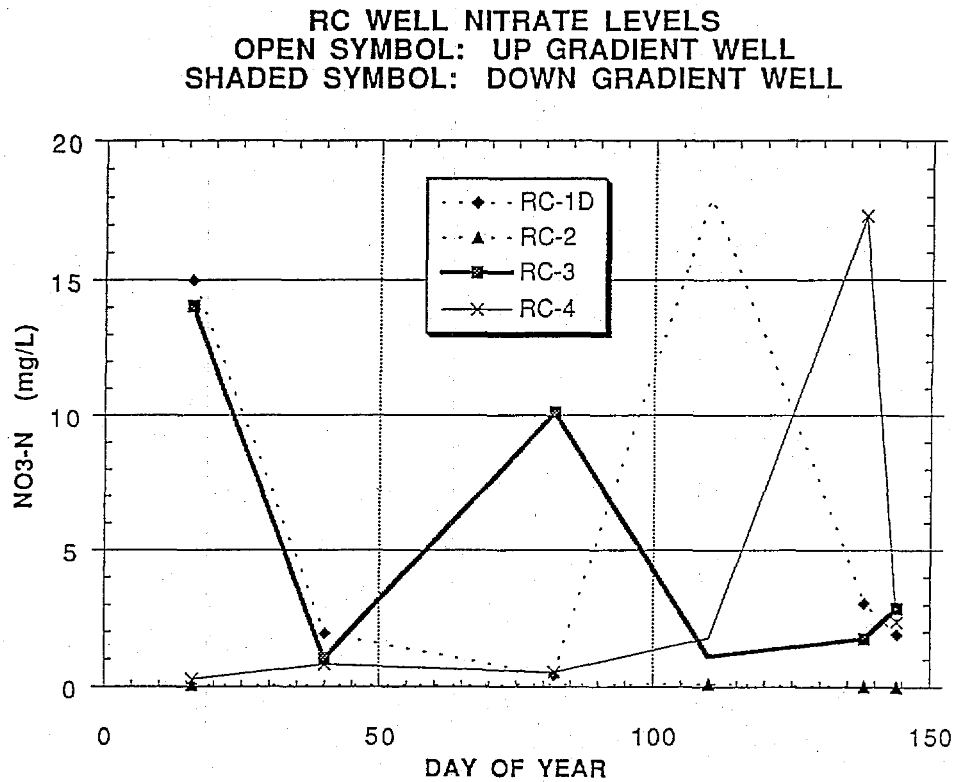


Figure 12. Nitrate and ammonium concentrations in RC wells.



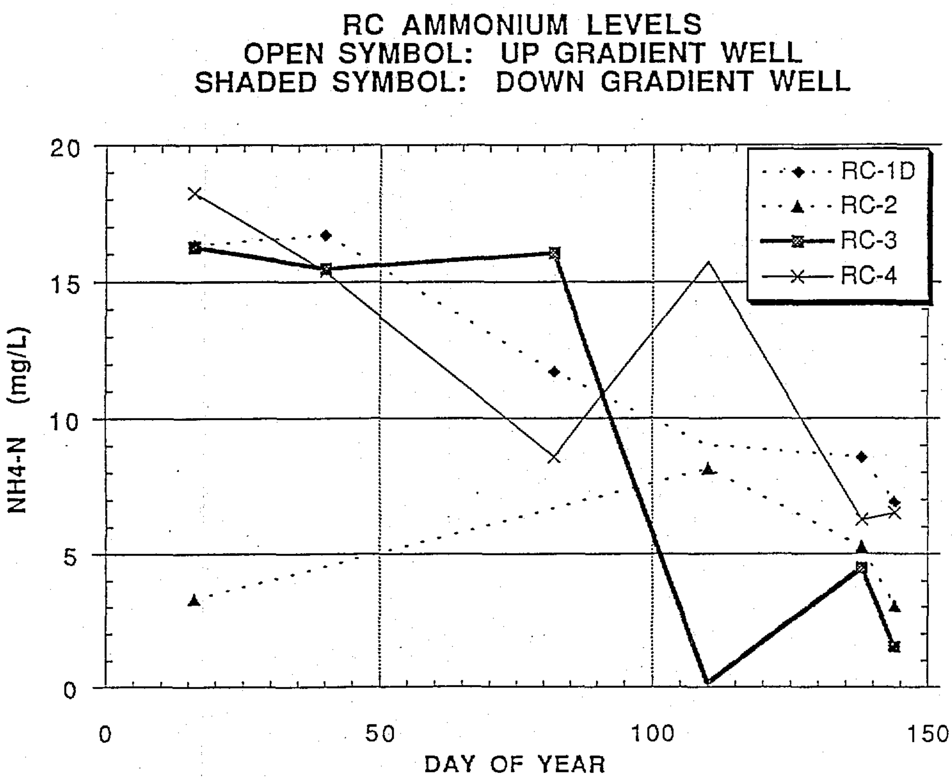
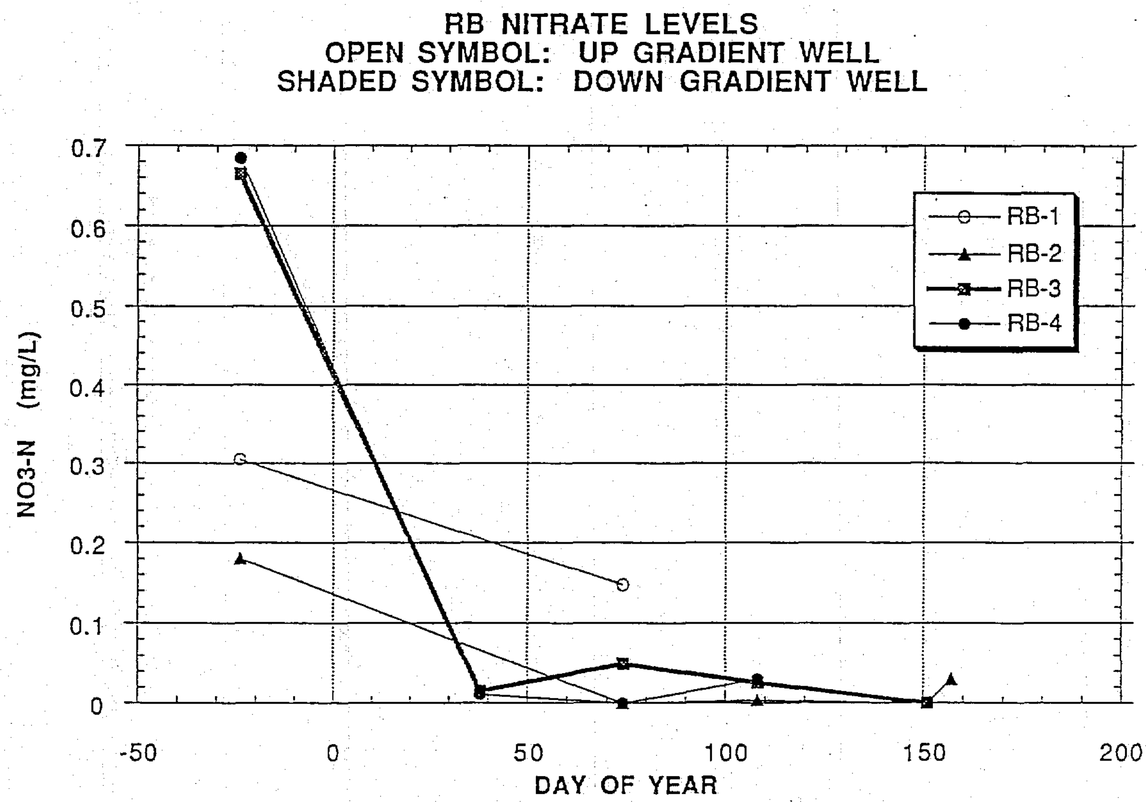


Figure 13. Nitrate and ammonium concentrations in RB wells.



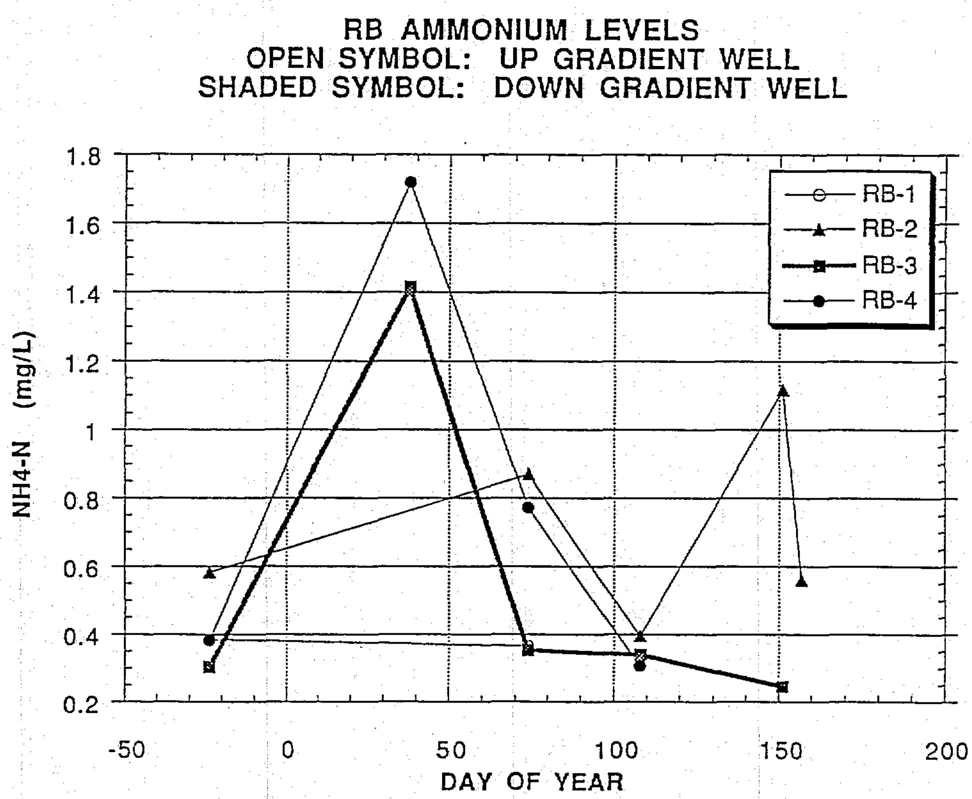


Figure 14. Phosphate concentrations in KDB and RC wells.