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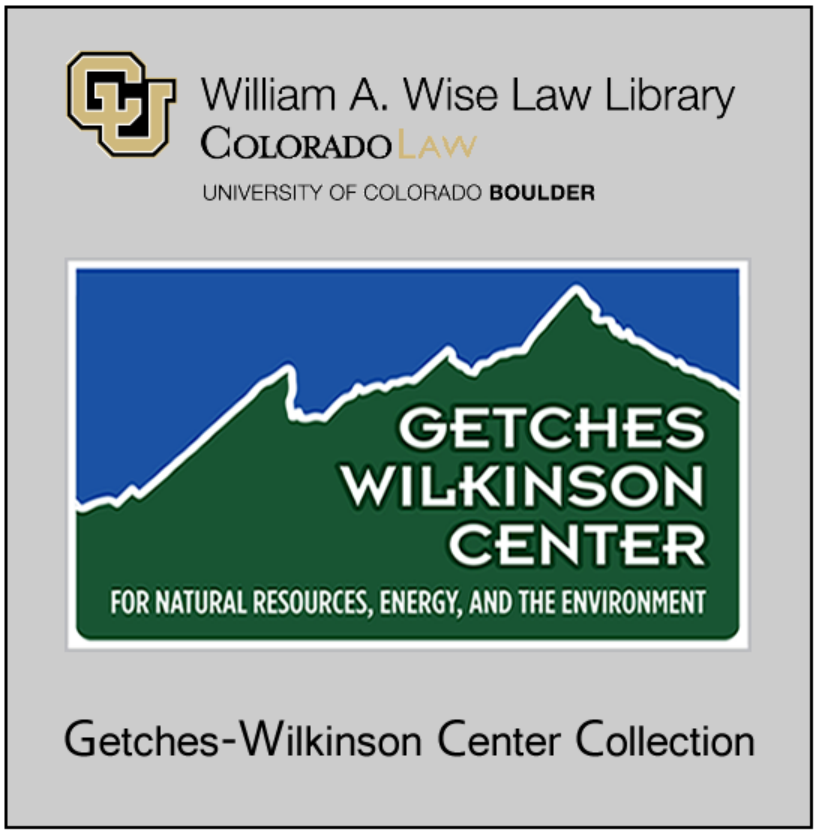
Ground Water Monitoring System and Procedures at Kin-Buc I Landfill Middlesex County New Jersey

Dan D. Raviv



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GROUND WATER MONITORING SYSTEM AND PROCEDURES AT KIN-BUC I LANDFILL MIDDLESEX COUNTY NEW JERSEY

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GROUND WATER: Allocation - Development - Pollution
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GROUND WATER MONITORING SYSTEM AND PROCEDURE AT KIN-BUC I LANDFILL MIDDLESEX COUNTY, NEW JERSEY

I. INTRODUCTION

Litigation has been initiated by the United States against Kin-Buc, Inc. (Kin-Buc) relating to alleged ground water pollution from the Kin-Buc I landfill site. In order to monitor mitigating measures relating to such pollution, a stipulation was signed between the U. S. Environmental Protection Agency (EPA) and Kin-Buc which provided for the implementation of a program to monitor water levels and water quality in the general vicinity (Appendix A.). The well monitoring system is to be based on the joint input of Kin-Buc and EPA.

The primary objectives of this study are: (1) to summarize ground water monitoring work done to date; (2) to propose a ground water monitoring system to include location of wells, preliminary wells specifications, function of wells and procedures and frequency of sampling; (3) to compare results of water sample analyses performed by laboratories contracted by Kin-Buc and EPA.

II. GROUND WATER MONITORING PROGRAM - BACKGROUND

"Monitoring" in this report is defined as "the activity of conducting systematic observations of water parameters related to the Kin-Buc I landfill and which monitoring is intended to provide information relating to ground water levels and water quality aspects with variations in time." The parameters include both (a) physical changes, such as water levels, and (b) water quality changes.

Implementation of a water quality monitoring network requires, at the minimum, definition of the following factors:

1. Type of monitoring network (continuous of periodic)
2. Well locations
3. Parameters to be measured
4. Number and location of sampling sites
5. Methods of sample collection
6. Sampling frequencies
7. Analytical techniques for sample analyses
8. Data transmission and water sample handling technique

This report is limited to the first five items. The procedures included in items 6 through 8 are established in the stipulation between Kin-Buc and EPA

(Appendix A). A slight modification to item 6 in proposed in Section B.1. below.

The rate and direction of ground water movement and water quality trends in the vicinity of Kin-Buc I can probably be best monitored by periodic sampling. Our experience suggests that data based on one time or short periods of water quality surveillance typically results in questionable interpretations. Monitoring over extended time and the establishment of trends in water quality is superior to interpretation based on a single sampling period. The appropriate frequency of sampling as well as the trend established interval will be based on the formation monitored and its hydrologic parameters.The proposed ground water monitoring network includes two major geologic formations in the vicinity of Kin-Buc I and accounts for ground water gradients measured during the past four years. Results of water level measurements and water quality sample analyses will be compared to observations prior to the capping of Kin-Buc I.

Storm water quality will have to be monitored during the initial phases of mound capping in order to develop parameters for NPDES permit. The frequency of analyses will be determined by the number and intensity of precipitation events. This issue will be addressed in a separate report.

A. Objectives

The objectives of a ground water monitoring program must be defined before a network can be properly designed. The primary objectives of the monitoring program for Kin-Buc I can be summarized as follows:

1. To provide a basis for evaluation of trends and changes in ground water quality in the vicinity of Kin-Buc I.
2. To provide a basis for comparison with other non-point pollution sources in the vicinity of Kin-Buc I.
3. To observe and project trends in ground water quality based on measurement of baseline water quality levels obtained in the summer of 1979.
4. To establish a data base for the planning and development of ground water pollution control and abatement measures.
5. To assess the overall compliance with limitations and standards posed by the enforcement agency.

Different objectives can lead to radically different requirements. Although most sampling programs resulting in analytical analyses are related to maximum or minimum values, the present objective is

the establishment of an overall long-term trend in water quality. The proposed ground water monitoring network involves strategically located sampling stations having different functions depending on their location.

Water level monitoring is equally important with the monitoring of water quality. Water level in the vicinity of Kin-Buc I are influenced by four major components, including: (a) the state of saturation within Kin-Buc I; (b) the ground water mound within the Edison Township landfill; (c) local direct precipitation and (d) tidal effects created by the Raritan River. Any modification of the ground water regime such as the capping of Kin-Buc I could greatly increase the influence of other factors on the overall ground water flow beneath and in the vicinity of Kin-Buc I.

B. Spatial Distribution of Monitoring Wells

A primary consideration inthe design of a monitoring system relates to the number and location of sampling stations. In an abatement monitoring network, preferred locations for well are at point close to the pollution source and at points aligned along approximate flow paths of ground water. Past programs of drilling and sampling have provided knowledge on

spatial distribution of ground water pollution in the vicinity of Kin-Buc I and Edison Township landfills. Spatial distribution of pollution in the vicinity of Kin-Buc I varies from pollutant to pollutant due to the differences in the location of their sources and the differing transport parameters influencing their movement through the soils, i.e., prevailing ground water gradients and the resulting direction of ground water movement.

C. Frequency of Sampling

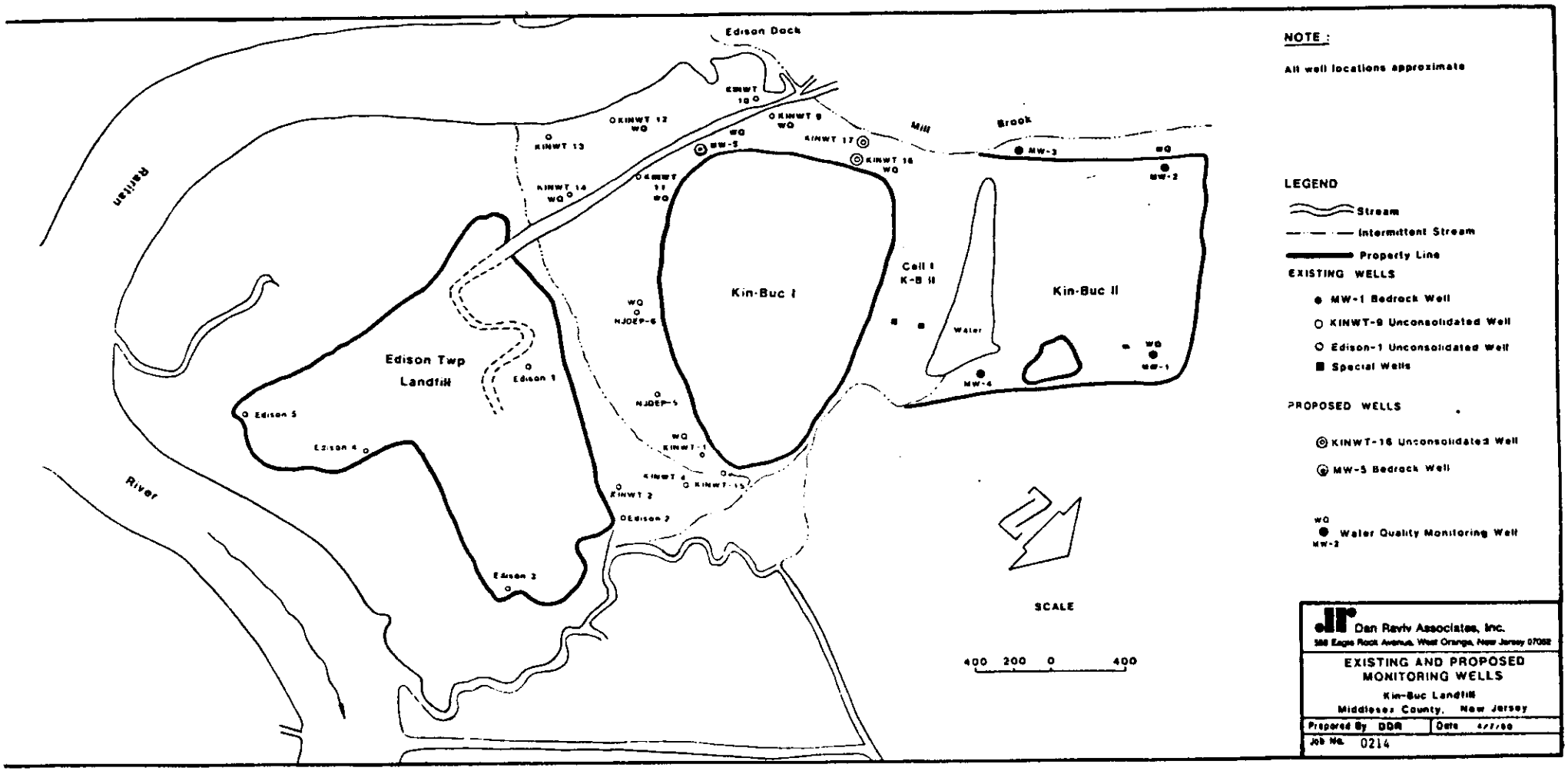
Water quality measurements are necessary to better understand the rate of migration, water quality changes and to develop conclusions. Desired frequency of measurement is a function of:

1. Velocity of ground water movement, i.e., response time of the system.
2. Seasonal fluctuations of the systems.
3. Variability of parameters.
4. Magnitude of the variability or dilution.
5. Short-term pollution events, i.e., unobservable events occurring within the landfill mound.

6. Changes in flow conditions due to capping of a landfill next to an active landfill.

If the response time is slow as in ground water flow, frequent sampling will provide little or no useful information. On the other hand, highly variable parameters will have to be sampled frequently as opposed to those which change little with time. The parameters of concern in the case of Kin-Buc I are primarily having little change with time. The monitoring system for the major problem area has been identified and priorities established in numerous meetings and discussions between Kin-Buc and EPA. Additionally, all participants generally have concurred in the type of monitoring system relating to pollution abatement strategies, evaluation of trends and separation of neighboring non-point pollution sources.

The general overall ground water monitoring system is shown on Figure 1. Figure 1 includes all accessible existing wells to be used for water level and water quality monitoring and the proposed location of new wells to be constructed by Kin-Buc. Table 1 provides a summary and functional use of each well included in the monitoring system network.


Edison Dock
Raritan
River
Mill
Brook
KINWT 10
KINWT 12
WQ
KINWT 9
WQ
KINWT 13
KINWT 17
KINWT 16
WQ
MW-5
MW-3
WQ
MW-2
KINWT 14
WQ
KINWT 11
WQ
Kin-Buc I
Cell I
K-B II
Kin-Buc II
Water
WQ
NJDEP-6
Edison Twp
Landfill
Edison 1
Edison 5
Edison 4
NJDEP-5
WQ
KINWT-1
KINWT 4
KINWT-15
KINWT 2
Edison 2
Edison 3
MW-4
WQ
MW-1
NOTE :
All well locations approximate
LEGEND
Stream
Intermittent Stream
Property Line
EXISTING WELLS
MW-1 Bedrock Well
KINWT-9 Unconsolidated Well
Edison-1 Unconsolidated Well
Special Wells
PROPOSED WELLS
KINWT-16 Unconsolidated Well
MW-5 Bedrock Well
WQ
MW-2
Water Quality Monitoring Well
SCALE
400 200 0 400
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EXISTING AND PROPOSED
MONITORING WELLS
Kin-Buc Landfill
Middlesex County, New Jersey
Prepared By DDR
Date 4/7/88
Job No. 0214

Figure 1

III. GROUND WATER MONITORING SYSTEM - IMPLEMENTATION

The monitoring system is described in three parts, namely: (1) the spatial distribution of wells; (2) water level measurements and sampling frequencies; and (3) the sampling procedures and laboratory analyses. A special section is added to this report to summarize and compare results of recent ground water sampling because of various concerns expressed in recent meetings regarding laboratory procedures and analyses of water samples containing trace quantities of various organic compounds.

Inventory of existing wells near Kin-Buc I landfill, Kin-Buc II landfill and Edison Township landfill was conducted and is presented in Figure 1.

A discussion of the monitoring system follows:

A. Spatial Distribution of Wells

1. Existing Wells

Locations of presently accessible wells in the vicinity of Kin-Buc I are shown on Figure 1. These wells were installed by various agencies or other parties and are of different specifications. Some of the wells are 2" I.D. diameter (USEPA) where others are 4" I.D. diameter (Kin-Buc, Edison Twp. & NJDEP). Overall, there are two groups of wells. One group

penetrates the Bedrock Aquifer, or the Brunswick Shale, and the second group penetrates the unconsolidated material, primarily the Cape May Formation.

Monitoring wells MW-1 through MW-4 were installed by Kin-buc, within the area of the proposed Kin-Buc II landfill. Monitoring wells KINWT-1, 2, and 4 are all that remain of six to seven monitoring wells installed in 1976 for an EPA study. Monitoring wells Edison-1 through Edison-5 were installed by Edison Township in compliance with requirements of the New Jersey Department of Environmental Protection (NJDEP). Monitoring wells KINWT-9 through KINWT-15 were completed during May and June of 1979 by EPA Region II with regard to ground water contamination near Kin-Buc I.

Monitoring wells NJDEP-5 and NJDEP-6 were drilled and completed by Kin-Buc during July, 1979 as part of its closure agreement with NJDEP. Well NJDEP-1 was also completed and is located on the Edison Township landfill property in the vicinity of wells Edison-4 and Edison-5. Well NJDEP-1 is not shown on Figure 1 although it will be added following completion of the proposed new monitoring wells.

We recommend all existing wells shown on Figure 1 (and proposed wells) be part of the water level

monitoring system for Kin-Buc I. The monitoring of changes in the local ground water flow regime which are influenced by both Kin-Buc I and Edison Township landfills is essential for future interpretations of water quality monitoring. It is anticipated capping of the Kin-Buc I mound will affect the local ground water gradients in the proximity of the mound. The proposed monitoring system based on the existing wells near Kin-Buc I will be comprised of four Bedrock wells ad eighteen unconsolidated or shallow wells. We recommend the following existing wells be used for water quality monitoring:

a. Bedrock wells

   MW-1 and MW-2

b. Unconsolidated wells

   KINWT-1, NJDEP-6, KINWT-11, KINWT-14, KINWT-12 and KINWT-10

Detailed logs are available for wells NW-1, MW-2 and NJDEP-6. Existing wells and their function as part of the ground water monitoring system are shown on Figure 1 and are summarized in Table 1 according to their ownership. Water quality monitoring wells are designated with the letters QW.

2. Proposed New Wells

Three new monitoring wells are proposed (see Figure 1). Proposed Bedrock MW-5 will be south of the Kin-Buc I mound and north of Meadow Road. Cape May monitoring wells KINWT-16 and KINWT-17 are proposed southwest of the Kin-Buc I mound between the mound and Mill Brook. All three new wells will be added to the water level monitoring program and wells MW-5 and KINWT-16 will be added to the water quality monitoring system. Table 1 identifies the proposed new wells and their function within the overall ground water monitoring system.

Well cross-sections for the three new wells are given in Figures 2 and 3. The well drilling specifications will be given to the well driller and the Hydrogeologist who will monitor well drilling, well completion and well development.

As noted in Figure 3, special precaution must be taken in the drilling and completion of proposed Bedrock well, MW-5. This should reasonably assure no vertical migration of contaminated ground water between the unconsolidated materials and the Bedrock Aquifer.

TABLE 1

SUMMARY OF PROPOSED GROUND WATER MONITORING PROGRAM
AT KIN-BUC I

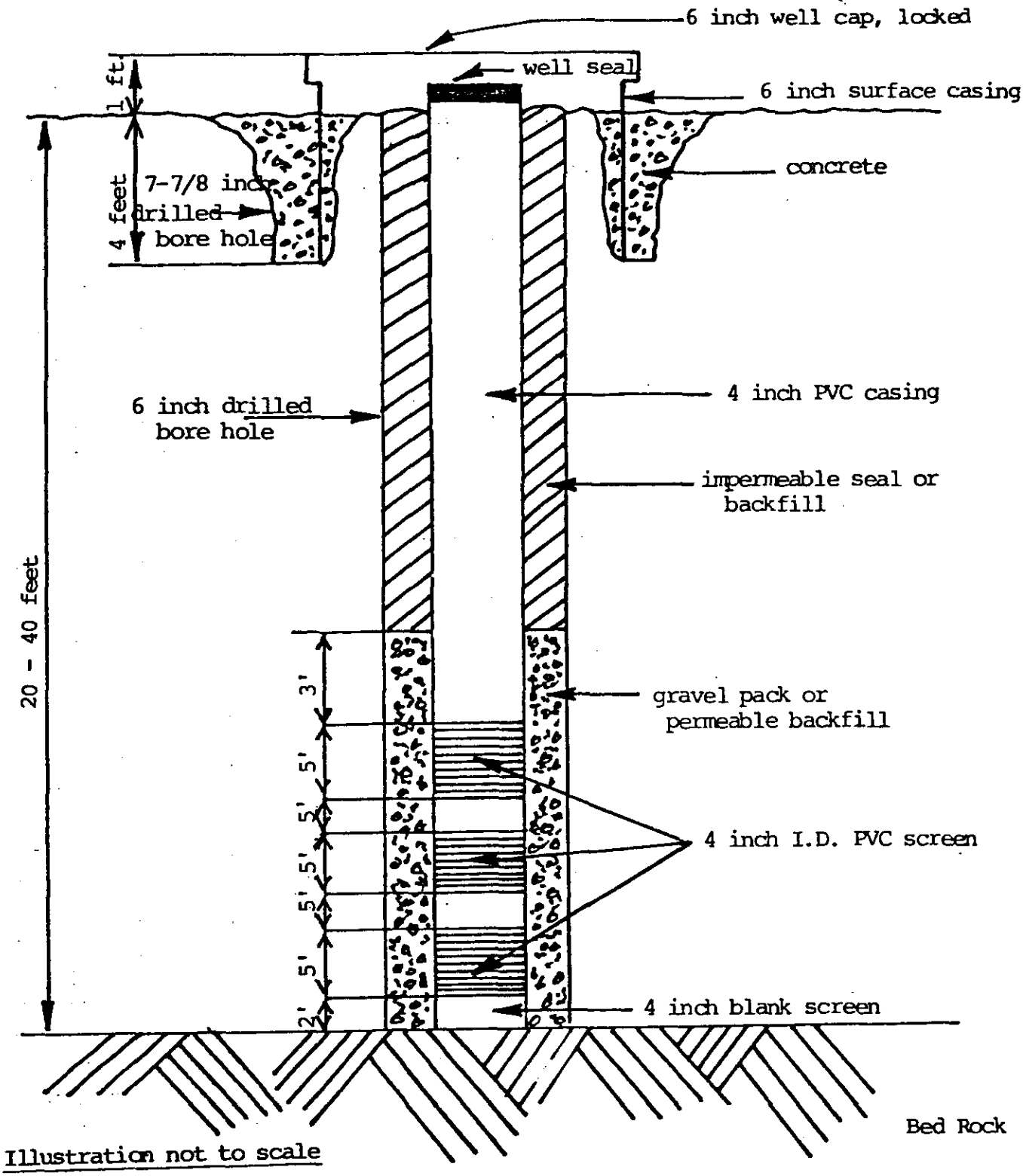
Existing Well No. (flow regime)	Proposed New Well No. (flow regime)	Monitoring Parameters: Water Levels	Monitoring Parameters: Water Quality
Bedrock Wells			
MW-1 (K-B II)		X	X
MW-2 (K-B II)		X	X
MW-3 (K-B II)		X	
MW-4 (K-B II)		X	
	MW-5 (K-B I)	X	X
Water Table Wells			
KINWT 1 (K-B I & Edison LF)		X	X
KINWT 2 (K-B I & Edison LF)		X	
KINWT 4 (K-B I & Edison LF)		X	
KINWT 9 (K-B I)		X	
KINWT 10 (K-B I)		X	X
KINWT 11 (K-B I)		X	X
KINWT 12 (K-B I)		X	X
KINWT 13 (K-B I)		X	
KINWT 14 (K-B I)		X	X
KINWT 15 (K-B I & Edison LF)		X	
	KINWT 16 (K-B I)	X	X
	KINWT 17 (K-B I & Mill Brook)	X	X(1)
NJDEP-1 (Edison LF)(2)		X	
NJDEP-5 (K-B I)		X	
NJDEP-6 (K-B I)		X	X

(1) Proposed well KINWT 17, near Mill Brook will be sampled for selected parameters only.

(2) NJDEP well-1 not shown in Figure 1; well will be surveyed after completion of proposed new wells.

TABLE 1
(continued)

Existing Well No. (flow regime)	Proposed New Well No. (flow regime)	Monitoring Parameters: Water Levels	Monitoring Parameters: Water Quality
Edison #1 (Edison LF)		X	
Edison #2 (Edison LF & K-B I)		X	
Edison #3 (Edison LF)		X	
Edison #4 (Edison LF)		X	
Edison #5 (Edison LF)		X	



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GROUND WATER MONITORING
WELL SPECIFICATIONS
CAPE MAY FORMATION

Prepared By	DDR	Date	2/25/80
Job No.	0214	Figure 2	

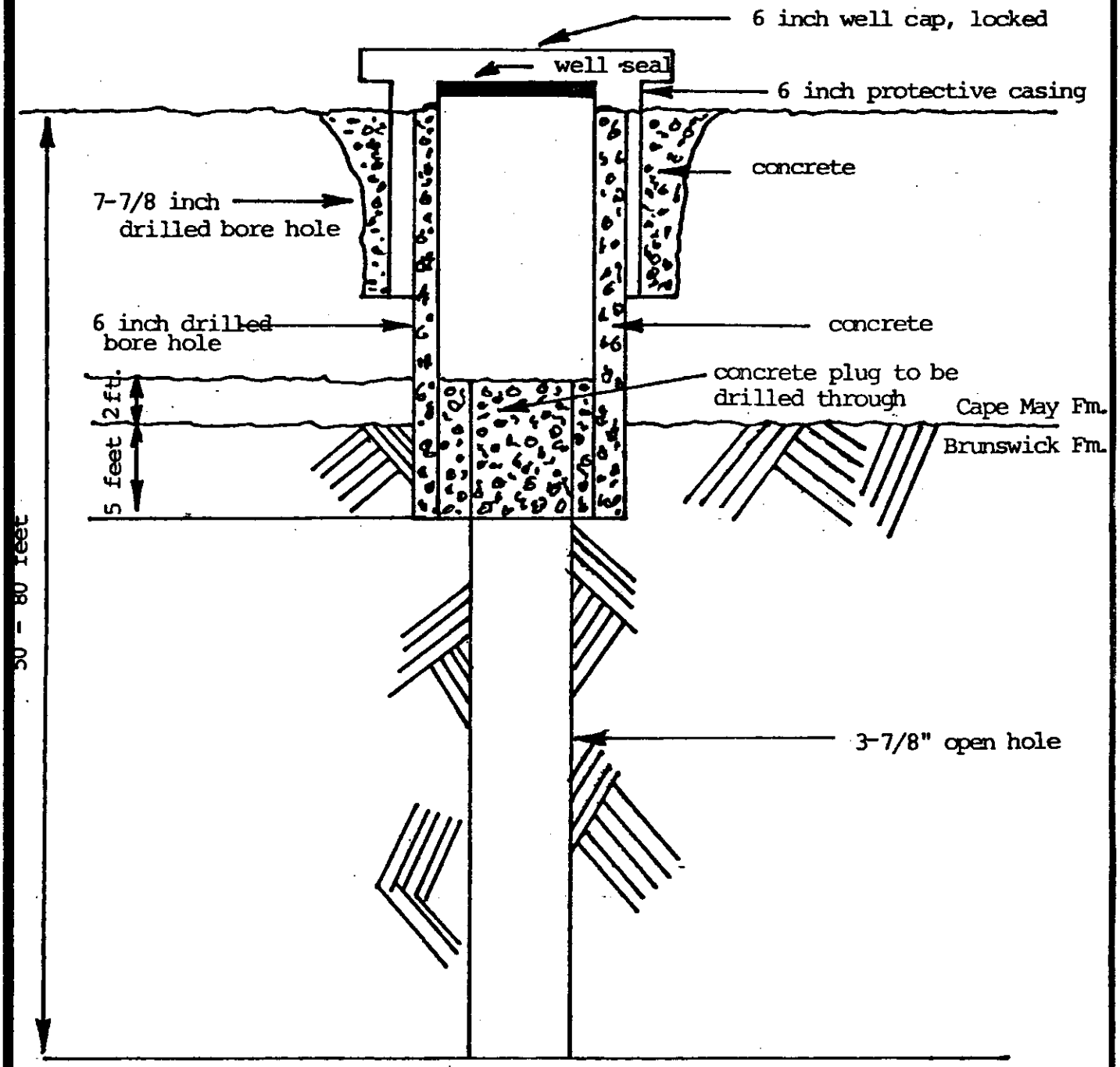

Illustration not to scale

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GROUND WATER MONITORING
WELL SPECIFICATIONS
BRUNSWICK SHALE

Prepared By	DDR	Date	2/25/80
Job No.	0214	Figure 3	

3. Summary

The ground water monitoring system proposed in compliance with the stipulation (Appendix A) is summarized by Figure 1 and Table 1. A total of five Bedrock wells and twenty shallow wells will be monitored for water table changes. Three Bedrock wells and seven unconsolidated wells will be sampled for water quality analysis. However, we recommend the following additions to the stipulation signed by Kin-Buc and EPA to reasonably assure meaningful operation of the monitoring system.

a. Permission should be obtained to measure water levels within the Edison Township landfill when ever water levels are measured within the Kin-Buc property.

b. A base map, similar to Figure 1 and approved by a land surveyor, should be agreed on by Kin-Buc and EPA. The map can be used to plot ground water levels during each sampling period from which water level contours can be prepared of the ground water flow regime. These contour maps should become part of the permanent record and be used in conjunction with water quality interpretations.

B. Future Operation of the Ground Water Monitoring System

1. Frequency of Sampling and Measurements

The stipulation requires initial sampling one month following well construction and at intervals of one month, three months and six months following the capping of the Kin-Buc I mound. Therefore, sampling will be conducted bi-annually, commencing with the second year.

In our opinion, the construction of new wells generally should coincide with the final phase of capping of Kin-Buc I. The first sampling is planned immediately following the capping of the mound. We recommend the deferral of sampling until capping of Kin-Buc I because: (a) construction and earth moving operations could destroy the proposed three new wells which are in close proximity to the mound (Figure 1); (2) It is doubtful if any material changes in water quality will occur within one month following well construction and the capping of Kin-Buc I; (3) The extensive sampling that took place during August, 1979 provides sufficient baseline information relating to ground water quality in the vicinity of Kin-Buc I.

Water quality sampling of the designated wells identified on Figure 1 and Table 1 will be sampled in

accordance with the stipulation.

2. Sampling Procedure

At the presented frequency, a sample of ground water will be withdrawn from each monitoring well, stored in the appropriate container and shipped to the laboratory for analysis. All wells will be pumped for at least fifteen minutes prior to sampling to assure that water samples are representative of the formation. Sampling will be conducted with specially constructed bailers constructed of PVC tubing to will fit inside the well casings. Each of the bailers will be fitted with a removable cap on the bottom to facilitate cleaning. Outside the bottom plug a weight will be attached to submerge the bailer into the water. The attached weight will be contained inside an inert pocket to isolate it from the ground water. Each well will have its own bailer. Prior to each sampling, the bailer will be rinsed with diluted acid followed by distilled water and covered with a special cap to prevent entry of contaminants.

The glass bottles to be used for the volatile organics and non-volatile organics will be washed with soap and water, rinsed with distilled water, soaked in Chromic acid cleaning solution, again rinsed with distilled water and finally rinsed with reagent grade acetone to air dry them.

Each sample will be preserved in accordance with EPA guidelines depending on the type of analysis to be performed. Ten containers will be filled at each well site. Table 2 is a summary of type of containers, volume required and sample preservation.

Each sample container will be labelled separately with the following information:

a. Location sampled

b. Well number

c. Date and time sampled

d. Name of person sampling

e. Preservative added and type of analysis to be performed.

During each sampling period, one duplicate sample will be obtained as an internal quality control. Samples will be shipped to the approved laboratories within 24 hours of collection.

On the day and prior to sampling, all wells will be opened and water levels measured. All water level measurements will be conducted within a few hours so as to offset any tidal effects on water levels in wells completed near the Raritan River.

3. Proposed Laboratories and Analysis

Two laboratories are presently under consideration for the analysis of ground water samples. Laboratory X is considered for the analysis of metals,

TABLE 2

SAMPLE SIZE AND PRESERVATION PROCEDURES
FOR WATER QUALITY ANALYSES

Type of Analyses	Type of Container and Volume	Sample Preservation
Volatile Organics	4 x 40-ml glass vials, Teflon-lined lid.	Maintain at 4°C; if residual chlorine is present (KI paper turns blue), then add 0.03 ml of ten percent $Na_2S_2O_3$ to each bottle.
Nonvolatile Organic (Base/Neutral, Acid, Pesticides)	1 x 1-gallon amber jug, Teflon-lined lid.	Maintain at 4°C.
Chemical Oxygen Demand (COD)	1 x 250-ml plastic bottle	Adjust pH to <2 with conc. H_2SO_4 (about 2 ml/l of sample).
Total Organic Carbon (TOC)	1 x 250-ml glass bottle, Teflon-lined lid	Maintain at 4°C, conc. H_2SO_4 2 ml/l of sample.
Phenol (total)	1 x 500-ml glass bottle	0.5 g $CuSO_4$ at beginning, adjust pH $\leq$ 4 with 1:10 H_3PO_4 maintain at 4°C.
Cyanide (total)	1 x 500-ml plastic bottle	Adjust pH to $\leq$ 12 with 10 N NaOH, maintain at 4°C.
Metals	1 x 1,000-ml plastic bottle	Maintain at 4°C; when sample received, 5 ml of ultrapure HNO3 will be added.

total phenols, total cyanide, COD and TOC. Laboratory Y is being considered for the volatile organics and non-volatile organics analyses. The competitive costs and the reputation of these two laboratories are excellent and we recommend their use in the analyses of ground water samples. Under separate cover we are transmitting an estimated annual cost analysis for the ground water monitoring operation.

IV. SUMMARY AND RECOMMENDATIONS

1. Three new wells are proposed to supplement the existing wells in the vicinity of Kin-Buc I, including one Bedrock well on the south-southwest side of Kin-Buc I and two unconsolidated wells on the southwest side of Kin-Buc I (Figure 1). Plans and specifications for the wells are presented in Figures 2 and 3.
2. Construction of the new wells should commence following the capping of Kin-Buc I mound. The first month of sampling will coincide with both well completion and mound capping. As such, one sampling period indicated by the stipulation will be omitted.
3. Existing wells in the vicinity of Kin-Buc I and within the Edison Township landfill

property should be a part of the water level monitoring system. We recommend a permit be obtained to enter the Edison Township landfill for the purpose of water level measurements, during periods of routine water quality sampling at Kin-Buc I and at such other times and purposes as required for the overall management of the monitoring system.

4. Periodic ground water level measurements should be plotted on a base map (update of Figure 1) and water level contours with the inferred flow direction plotted. These maps should be used in conjunction with water quality interpretations.

5. Two water quality laboratories are recommended for the ground water monitoring program. Laboratory Y (organic analysis by the gc/ms and gc/ecd methods) is presently used by USEPA.

6. The question of duplicate samples to be taken by EPA and sent to a subcontract laboratory for quality control should be resolved prior to first sampling. Unless an inter-laboratory comparison routine is devised by the QC/QA personnel of EPA, duplicate sample analyses may result in

erroneous interpretations and controversy.

7. The initial scan of the priority pollutant list of 113 parameters will probably result in an eventual permanent list of between 20 and 30 parameters. These numbers are based on results of the EPA sampling of August 14, 1979.

8. We recommend detection limits for the various substances listed in the priority pollutant list be considered as the threshhold for quantification.

APPENDIX A

Construction Schedule and Ground Water
Monitoring Program - An Appendix
to Stipulation of Settlement
(U.S. vs. Kin-Buc, Inc., etal)

CONSTRUCTION SCHEDULE
Cover and Containment System

A. A Crown shall be constructed on the present top surface of the Mound which shall consist of one or more apexes each of which shall slope towards a runoff collection system at a minimum 3% grade. In constructing the Crown, there shall be no depositing of new solid waste.

B. A Final Cover shall be placed on the Crown.

1. The Cover shall consist of at least:

a. Two layers of clay, each 9" or less in depth and together totalling 12" or more, covered by

b. One layer of 20 mil plastic, covered by

c. One 6" layer of sand, covered by

d. One 12" layer of soil suitable for vegetative growth

2. Each layer of clay shall be separately compacted until it attains a permeability factor of 1 x 10-7 cm/sec or less.

3. Representative samples of the clay shall be analyzed by an independent laboratory approved by EPA to determine the density necessary to attain a permeability factor of 1 x 10-7 cm/sec or less; permeability shall be measured for a range of densities; all resultant data shall be provided to EPA prior to placement of the clay.

4. A sufficient number of field tests shall be conducted with a nuclear density meter at the time of placement and compaction of the clay to enable certification by a licensed engineer that the permeability factor has been met.

5. Upon completion of the above, at least six (6) undisturbed (e.g., Shelby tube) samples shall be taken at representative locations and laboratory-tested for permeability to confirm the results of field testing; the

location of the borings and the results of the lab tests shall be provided to EPA prior to the placement of plastic on top of the clay.

6. The clay material to be used shall be identified to EPA according to the Unified Soil Classification System and shall be approved by EPA.

7. Certification as to the thickness and permeability of the clay layer shall be forwarded.

8. The soil layer directly below the plastic liner shall be free of rubble, rocks, and objects which may cause tearing of the plastic.

9. The vegetative soil to be used shall be identified to EPA; compaction shall be sufficient to keep the soil in place and to enhance the support of vegetation.

10. Certification as to the thickness of each layer of sand and vegetative soil shall be forwarded to EPA as soon as received.

11. Vegetation shall be seeded, fertilized, and established in the uppermost layer; the seeding mixture shall consist of the following: fifteen (15) pounds of Crown Vetch, fifteen (15) pounds of Tall Fescue, two (2) pounds of Weeping Lovegrass, and ten (10) pounds of Perenniel Rye per acre.

C. A Final Cover shall be placed on the Side Slopes of the Mound.

1. The Cover shall consist of at least:

a. One layer of clay at least 12" in depth, except in an area depicted on the attached engineering plans which shall have a layer of clay at least 6" in depth, both covered by

b. One 12" layer of soil suitable for vegetative growth.

2. The clay layer shall be compacted until it attains a permeability factor of 1×10^{-7} cm/sec or less.

3. Representative samples of clay shall be analyzed by an independent laboratory approved by EPA to determine the density necessary to attain a permeability factor of 1×10^{-7} cm/sec or less; permeability shall be measured for a range of densities; all resultant data shall be provided to EPA prior to placement of the clay.

4. A sufficient number of field tests shall be conducted with a nuclear density meter at the time of placement and compaction to enable certification by a licensed engineer that the permeability factor has been met.

5. Upon completion of the above, at least six (6) undisturbed (e.g., Shelby tube) samples shall be taken at representative locations and laboratory-tested for permeability to confirm the results of field testing; the location of the borings and the results of the lab tested shall be provided to EPA prior to the placement of soil on top of the clay.

6. The clay material to be used shall be identified to EPA according to the Unified Soil Classification System and shall be approved by EPA.

7. Certification as to the thickness and permeability of the clay layer shall be forwarded to EPA as soon as received.

8. The vegetative soil to be used shall be identified to EPA; compaction shall be sufficient to keep the soil in place and to enhance the support of vegetation.

9. Certification as to the thickness of the layer of vegetative soil shall be forwarded to EPA as soon as received.

10. Vegetation shall be seeded, fertilized, and established in the uppermost layer; the seeding mixture shall consist of the following: fifteen (15) pounds of Crown

Vetch; fifteen (15) pounds of Tall Fescue, two (2) pounds of Weeping Lovegrass, and ten (10) pounds of Perenniel Rye per acre.

D. At least four Gas Vents shall be installed in the Crown.

1. Each vent shall be sunk below the clay layer and shall surface above the uppermost layer of the Cover.

2. Each vent shall be installed with a mechanism which will allow periodic pressure testing and sampling.

3. Each vent shall be capable of being opened if flaring or other form of treatment of gaseous vapors collected becomes necessary.

E. A Runoff Collection System shall be constructed around the Mound.

1. The system shall utilize one runoff collection structure around the entire perimeter of the Crown and another around the entire perimeter of the Base of the Mound.

2. The system shall be designed to collect all surface runoff and all subsurface runoff along the interface of the permeable (sand and soil) and impermeable (clay and plastic) layers from the Crown and from the Side Slopes of the Mound.

3. The system shall be designed to discharge all runoff into the Raritan River or one of its tributaries after siltation; application for a NPDES permit shall be submitted to EPA within thirty (30) days of the entry of the Stipulation and Agreement to which this Schedule is attached.

4. The entire system shall have an impermeable liner to prevent infiltration and shall slope in a manner that ensures drainage.

5. The runoff collection structure around the Base shall rise to a maximum level of 30 feet above sea level and shall slope in a manner which will prevent pooling.

6. The system shall be constructed to handle runoff from a 24 hour/25 year storm.

F. A series of Wells shall be sunk around the perimeter of the Mound for the purpose of allowing monitoring of groundwater.

1. Seven wells shall be sunk and developed into the Cape May-Farrington Sands aquifer on the easterly, southerly and westerly sides of the Mound at locations and in a manner approved by EPA.

2. Five separate wells shall be sunk into the Brunswich Formation on the northerly and southwesterly sides of the Mound at locations and in a manner approved by EPA.

3. Each well shall be lock-capped and the key shall be retained by Kin-Buc, Inc.

GROUNDWATER MONITORING PROGRAM

A Groundwater Monitoring Program shall be instituted for a period of ten (10) years, provided that the program may be terminated after five (5) years by approval of Plaintiff or upon a showing satisfactory to the Court that continuation is not necessary and may be extended beyond ten (10) years by approval or upon a showing satisfactory to the Court that continuation is necessary.

1. Samplings shall be taken from each of the wells referred to in subparagraph F(1) of the Construction Schedule and from three of the five wells, as approved by EPA, referred to in subparagraph F(2) of the Construction Schedule for analysis by an independent laboratory approved by EPA; any such laboratory shall have a Quality Assurance and Quality Control Program approved by EPA.

2. Water level measurements shall be taken from each of the above wells and from nine additional wells sunk into the Cap May - Farrington sands aquifer at the time of each sampling.

3. An initial analysis of samples from each of the above wells shall be begun during the first month after they have been sunk; such analysis shall consist of a) a gas chromatograph/mass spectrograph (gc/ms) scan and a metals test for all substances on EPA's Priority Pollutant List published pursuant to the provisions of Section 307 (a) (1) of the Clean Water Act, 33 U.S.C. § 1317 (a) (1), b) specific quantification of all such substances which exceed ten (10) parts per billion (ppb) or micrograms per liter (ug/1), and (c) both Total Organic Carbon and Chemical Oxygen Demand quantifications.

4. Subsequent analyses of samples from each of the above wells shall be conducted during the first, third, and sixth month following completion of construction of the cover and containment system and during every subsequent sixth month; such analyses shall consist of a) a gas chromatograph/mass.

5. The time schedule referred to in paragraph 4

above shall be flexible and may be altered by approval of both parties or by the Court.

6. In identifying substances for analysis pursuant to paragraph 4 above, EPA shall attempt to limit itself to those on its Priority Pollutant List but may add a limited number of substances not appearing on the List if warranted. The substances thus identified for analysis shall be flexible and may be altered by approval of both parties or by the Court.

7. Five (5) days' notice shall be given to EPA prior to each sampling and analysis.

8. Upon request, split or duplicate samples shall be furnished to EPA.

9. Samples shall be submitted for laboratory analysis immediately after acquisition; results shall be provided within sixty (60) days.

10. Results of analyses and water level measurements shall be forwarded to EPA immediately upon receipt.

11. A log shall be maintained for each occasion on which the lock-capped wells are entered; the log shall record the date, time, duration, and purpose of entry and the name of the person (s) entering.