

5.0 PROPOSED MONITORING PLAN

5.1 GROUNDWATER MONITORING

5.1.1 PROPOSED MONITOR WELL LOCATIONS

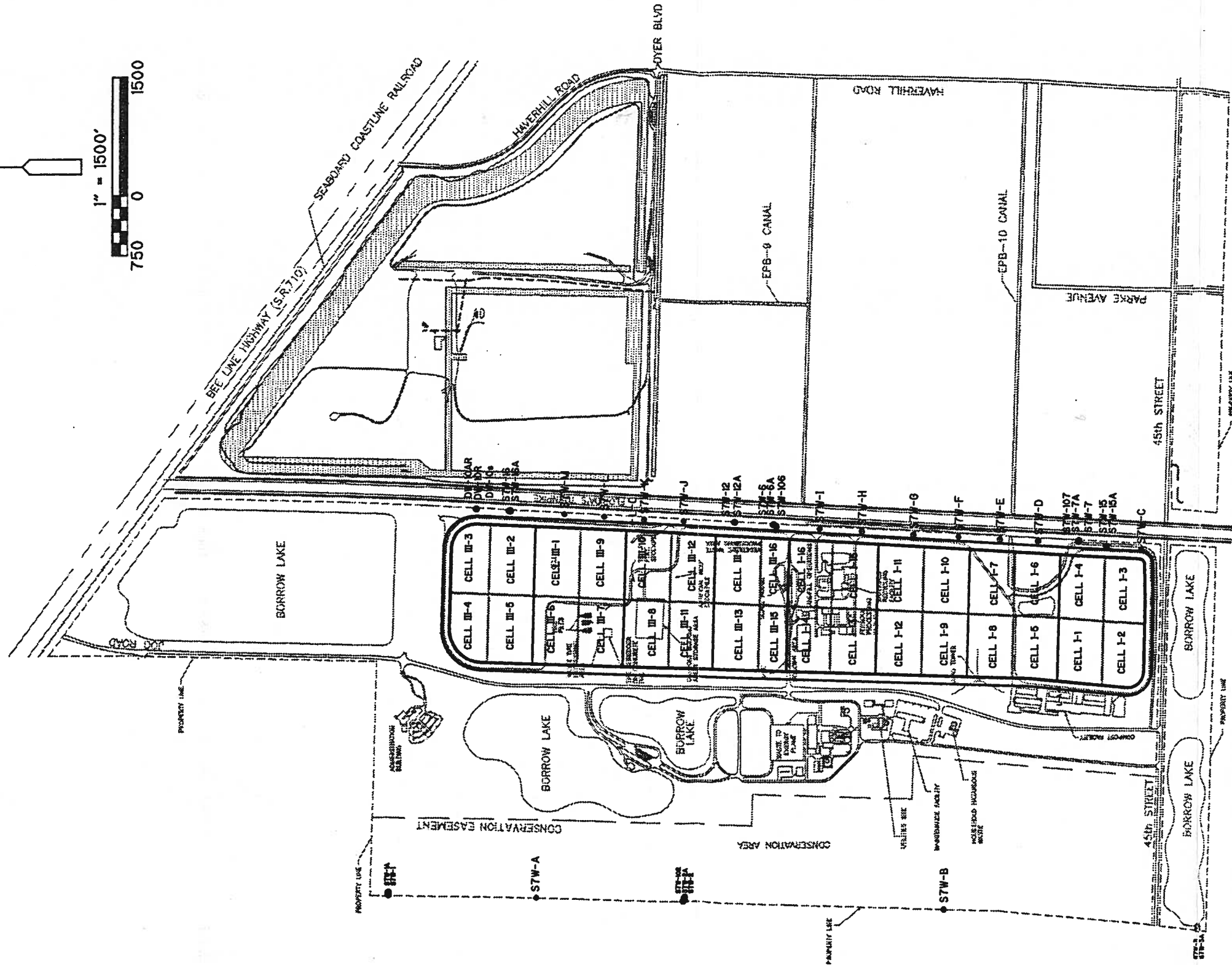
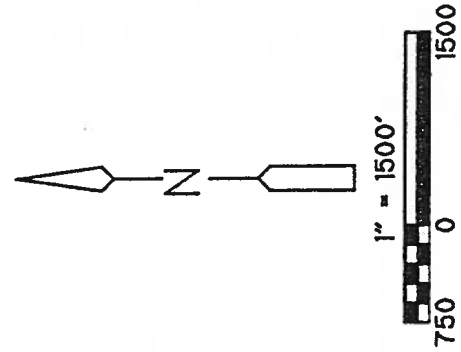
Based on groundwater elevation contour maps presented on Figures 2-6 through 2-9, the direction of shallow groundwater flow at the landfill is from west to east-northeast. Since the landfill cells are concentrated in the eastern side of the site, and the direction of groundwater flow is basically west to east, the western side of the property is considered upgradient. According to the latest revision of Florida Department of Environmental Protection (FDEP) Regulation 17-701, Florida Administrative Code (FAC) (May 19,1994), "monitoring well spacing shall be set no greater than 500 feet apart across the downgradient direction of groundwater flow and no greater than 1,500 feet apart for multiple wells across the upgradient direction of groundwater flow, in the uppermost aquifer within the zone of discharge." In compliance with this latest revision, Camp Dresser & McKee Inc. is proposing the following groundwater monitoring network.

Based on the current understanding of the system, it is proposed that 26 new surficial aquifer monitoring wells (22 detection wells and 4 background) be installed at the site, as indicated on **Figure 5-1**. All of the detection monitoring wells will be installed within 100 feet of the edge of the solid waste disposal unit. Additionally, these wells will also be considered compliance wells due to the close proximity of the edge of the solid waste disposal unit to the property line.

All of the monitoring wells will be installed in clusters of two with each monitoring well or piezometer completed to a distinct depth. This approach is consistent with the layering of the surficial aquifer at the site. The shallow well will be installed into the upper portion of the aquifer and an intermediate depth well will be installed into the regional water supply production zone. The purposes of the well clusters are to detect any variations in water quality with depth, and to measure the vertical hydraulic gradients in the surficial aquifer within the site.

LEGEND:

- PROPOSED GROUNDWATER MONITORING WELL CLUSTER (INCLUDED IN MONITORING NETWORK)
- + LEACHATE QUALITY MONITORING STATION
- SURFACE WATER QUALITY MONITORING STATION
- ZONE OF DISCHARGE



SOLID WASTE AUTHORITY OF PALM BEACH COUNTY
PROPOSED GROUNDWATER, SURFACE WATER,
AND LEACHATE MONITORING NETWORK

Starting with the background wells in the northwest corner of the site, existing monitoring wells S7W-1 and S7W-1A will be used as intermediate depth and deep wells. A new shallow (S7W-As) and intermediate (S7W-Ai) well pair will be installed approximately 1,900 feet south of S7W-1. The letter "s" and letter "i" denote shallow and intermediate well, respectively. Existing monitoring wells S7W-102, S7W-2, and S7W-2A will be used as shallow, intermediate depth and deep wells, respectively. A new two-well cluster (S7W-Bs and S7W-Bi) will be installed approximately 3,300 feet south of existing monitoring wells S7W-2 and S7W-2A. The last set of background monitoring wells will be the existing intermediate depth and deep well cluster (S7W-3 and S7W-3A) located 3,200 feet south of proposed monitoring wells S7W-Bs and S7W-Bi. The spacing of the existing and proposed background wells meets the intent of Section 17-701.510.

A total of 23 new detection/compliance monitoring wells will be installed at the site. These wells will be installed along the entire downgradient boundary of the landfill cells; however, installation will be phased to coincide with the construction of each cell. Their locations and distribution are presented on Figure 5-1 and Attachment 6. Starting with the detection wells in the northeast corner of the site, existing monitoring wells DW-10R and DW-10AR will be used as intermediate depth and deep wells. A new shallow monitoring well DW-10s will be added to the existing well pair. Approximately 450 feet south is the second detection well cluster, S7W-16 and S7W-16A, which is an existing shallow and intermediate depth cluster. There are four new well clusters (S7W-Ms/S7W-Mi, S7W-Ls/S7W-Li, S7W-Ks/S7W-Ki, S7W-Js/S7W-Ji) that are planned to be constructed every 500 feet south of existing well cluster S7W-16 and S7W-16A. The next two clusters of detection/compliance monitoring wells, S7W-12/S7W-12A and S7W-106/S7W-6/S7W-6A, are existing monitoring wells that are associated with landfill cells that will be used after the year 2004 and will not be sampled in the near future. Starting approximately 500 feet south of existing well cluster S7W-106/S7W-6/S7W-6A will be 6 new well clusters, each cluster consisting of a 20-foot shallow well and an 80-foot intermediate well, installed every 500 feet. These well clusters are designated as S7W-Is/S7W-Li, S7W-Hs/S7W-Hi, S7W-Gs/S7W-Gi, S7W-Fs/S7W-Fi, S7W-Es/S7W-Ei, and S7W-Ds/S7W-Di. The three southernmost clusters, S7W-Fs/S7W-Fi, S7W-Es/S7W-Ei, and S7W-Ds/S7W-Di will be installed within six months of permit issuance and sampled for water quality purposes. South of proposed well cluster S7W-D is an existing

three-well cluster designated as S7W-107, S7W-7A, and S7W-7. This three-well cluster consists of a shallow, intermediate, and deep well cluster. Only the shallow and intermediate wells will be sampled for water quality purposes. The deep well will be used for groundwater level measurement purposes. Approximately 400 feet south of existing cluster S7W-7 is another existing well pair, S7W-15 and S7W-15A, that will be incorporated into the program. Monitoring well S7W-15 is a shallow well and S7W-15A is an intermediate depth well. The last detection/compliance monitoring well cluster is S7W-Cs and S7W-Ci, which will be installed approximately 450 feet south of existing well cluster S7W-15 and S7W-15A. Monitoring well S7W-15 is 35 feet deep and S7W-15A is 80 feet deep.

As evident from the discussion above, some of the existing monitoring wells installed for previous permits will be incorporated into the proposed monitoring well network. A list of the monitoring wells to be included in the proposed groundwater monitoring plan is presented in Table 5-1.

5.1.2 MONITOR WELL CONSTRUCTION DETAILS

The well clusters will be installed to show vertical movement (if any) of the groundwater at the site. A schematic of the proposed monitoring well cluster is shown on Figure 5-2.

All monitoring wells will be installed in accordance with American Society of Testing and Materials (ASTM) D 5092-90, Standard Practice For Design and Installation of Groundwater Monitoring Wells in Aquifers.

All shallow monitoring wells will be installed using a hollow stem auger. Intermediate depth monitoring wells will be installed using mud rotary methods. All monitoring wells will be constructed of 2-inch diameter, threaded schedule 40 polyvinyl chloride pipe. The gradation of the filter pack and the screen slot size will be determined based on soil samples collected previously at the site.

The sealant above the filter pack will consist of a poorly graded fine sand (SP) with a fines content <5 percent passing the No. 200 United States Standard Sieve. This fine sand sealant

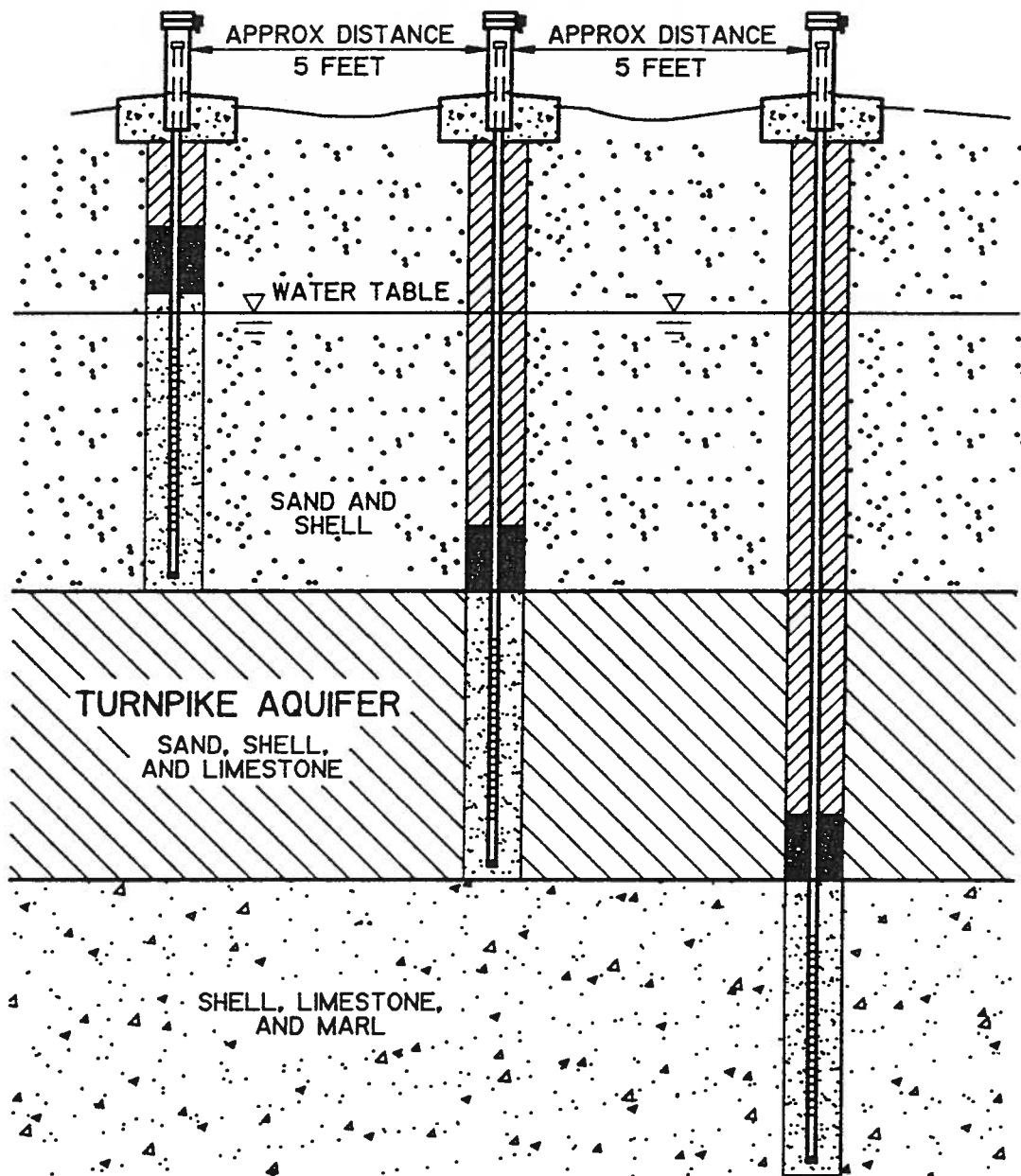
Table 5-1. Proposed Groundwater Monitoring Network

Well ID	Unit	Well Depth (feet bgs)	Screen Interval (feet bgs)	Purpose	Status	Proposed Date of Installation
S7W-1	intermediate	57	5-56	background	existing	
S7W-1A	deep	132	61-131	water elevation	existing	
S7W-As	shallow	20	10-20	background	proposed	1995
S7W-Ai	intermediate	80	70-80	background	proposed	1995
S7W-102	shallow	18	8-18	background	existing	
S7W-2	intermediate	52	5-51	background	existing	
S7W-2A	deep	131	61-131	water elevation	existing	
S7W-Bs	shallow	20	10-20	background	proposed	1995
S7W-Bi	intermediate	80	70-80	background	proposed	1995
S7W-3	intermediate	47	5-48	background	existing	
S7W-3A	deep	158	55-125	water elevation	existing	
S7W-Cs	shallow	20	10-20	detection	proposed	1995
S7W-Ci	intermediate	80	70-80	detection	proposed	1995
S7W-15	shallow	35	20-35	detection	existing	
S7W-15A	intermediate	80	70-80	detection	existing	
S7W-107	shallow	18	8-18	detection	existing	
S7W-7	intermediate	46	5-45	detection	existing	
S7W-7A	deep	126	55-125	water elevation	existing	
S7W-Ds	shallow	20	10-20	detection	proposed	1995
S7W-Di	intermediate	80	70-80	detection	proposed	1995
S7W-Es	shallow	20	10-20	detection	proposed	1995
S7W-Ei	intermediate	80	70-80	detection	proposed	1995
S7W-Fs	shallow	20	10-20	detection	proposed	1998
S7W-Fi	intermediate	80	70-80	detection	proposed	1998
S7W-Gs	shallow	20	10-20	detection	proposed	2000
S7W-Gi	intermediate	80	70-80	detection	proposed	2000
S7W-Hs	shallow	20	10-20	detection	proposed	2004
S7W-Hi	intermediate	80	70-80	detection	proposed	2004
S7W-Is	shallow	20	10-20	detection	proposed	2004
S7W-Ii	intermediate	80	70-80	detection	proposed	2004
S7W-106	shallow	20	8-18	detection	existing	
S7W-6	intermediate	80	5-50	detection	existing	
S7W-6A	deep	130	55-125	water elevation	existing	
S7W-12	shallow	31	15-30	detection	existing	
S7W-12A	intermediate	89	55-85	detection	existing	
S7W-Js	shallow	20	10-20	detection	proposed	2002
S7W-Ji	intermediate	80	70-80	detection	proposed	2002
S7W-Ks	shallow	20	10-20	detection	proposed	1998
S7W-Ki	intermediate	80	70-80	detection	proposed	1998
S7W-Ls	shallow	20	10-20	detection	proposed	1995
S7W-Li	intermediate	80	70-80	detection	proposed	1995
S7W-Ms	shallow	20	10-20	detection	proposed	1995
S7W-Mi	intermediate	80	70-80	detection	proposed	1995
S7W-16	shallow	35	20-35	detection	existing	
S7W-16A	intermediate	80	70-80	detection	existing	
DW-10s	shallow	20	10-20	detection	proposed	1994
DW-10R	intermediate	53	5-50	detection	existing	
DW-10AR	deep	126	55-70	water elevation	existing	

SHALLOW (1)

INTERMEDIATE (2)

DEEP (3)



- (1) SEE FIGURE 5-3 FOR TYPICAL DETAIL
- (2) SEE FIGURE 5-4 FOR TYPICAL DETAIL
- (3) EXISTING WELLS ONLY

SOLID WASTE AUTHORITY OF PALM BEACH COUNTY

TYPICAL MONITORING WELL CLUSTER INSTALLATION

CDM

environmental engineers, scientists,
planners, & management consultants

Figure No. 5-2

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will be no less than two feet thick. A grout seal, consisting of Type I portland cement, will be placed on top of the fine sand seal and will extend upward to the land surface. Each well head will be enclosed in a steel protective casing with a lockable cap. The approximate depth and screen length for all of the monitoring wells that will be incorporated into the groundwater monitoring program are summarized in Table 5-1. The screen length of all of the proposed monitoring wells will be 10 feet. Typical monitoring well details for the proposed monitoring wells are attached as Figures 5-3 and 5-4.

5.1.3 INITIAL SAMPLING

Within 30 days of well installation and development, all of the new background monitoring wells (See Table 5-1) will be sampled for the list of parameters in Table 5-2, as well as the list of parameters presented in Title 40 Code of Federal Regulations (CFR), Part 258, Appendix II (see Appendix D). The proposed detection/compliance wells (See Table 5-1) will only be monitored for the list of parameters listed in Table 5-2 during the initial sampling event. Select existing background and detection/compliance monitoring wells may be included in this sampling event.

5.1.4 ROUTINE MONITORING

After the initial round of sampling for the proposed monitoring wells, the 23 proposed detection/compliance wells and 11 existing detection/compliance wells in the upper portion of the surficial aquifer (S7W-15, S7W-15A, S7W-107, S7W-7, S7W-106, S7W-6, S7W-12, S7W-12A, S7W-16, S7W-16A, and DW-10R) will be sampled semi-annually for the list of parameters in Table 5-2. The eight background monitoring wells (S7W-1, S7W-As, S7W-Ai, S7W-102, S7W-2, S7W-Bs, S7W-Bi, and S7W-3) in the upper portion of the surficial aquifer (shallow and intermediate well in Table 5-1) will be sampled annually for the parameters listed in Table 5-2. The six deep monitoring wells (both background and detection) will only be used for water elevation data.

The relationship between routine and assessment groundwater monitoring and possible corrective actions is summarized on Figure 5-5.

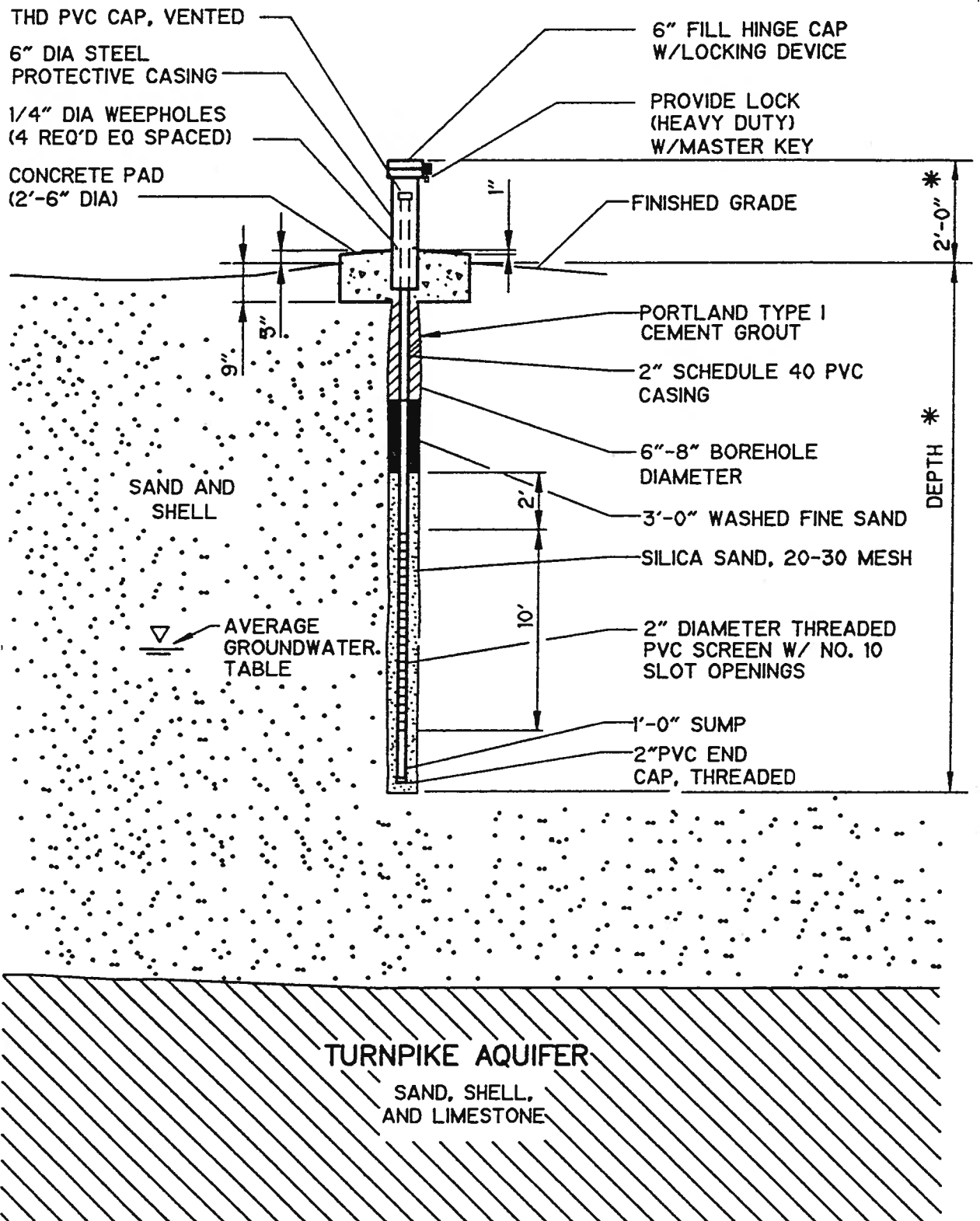
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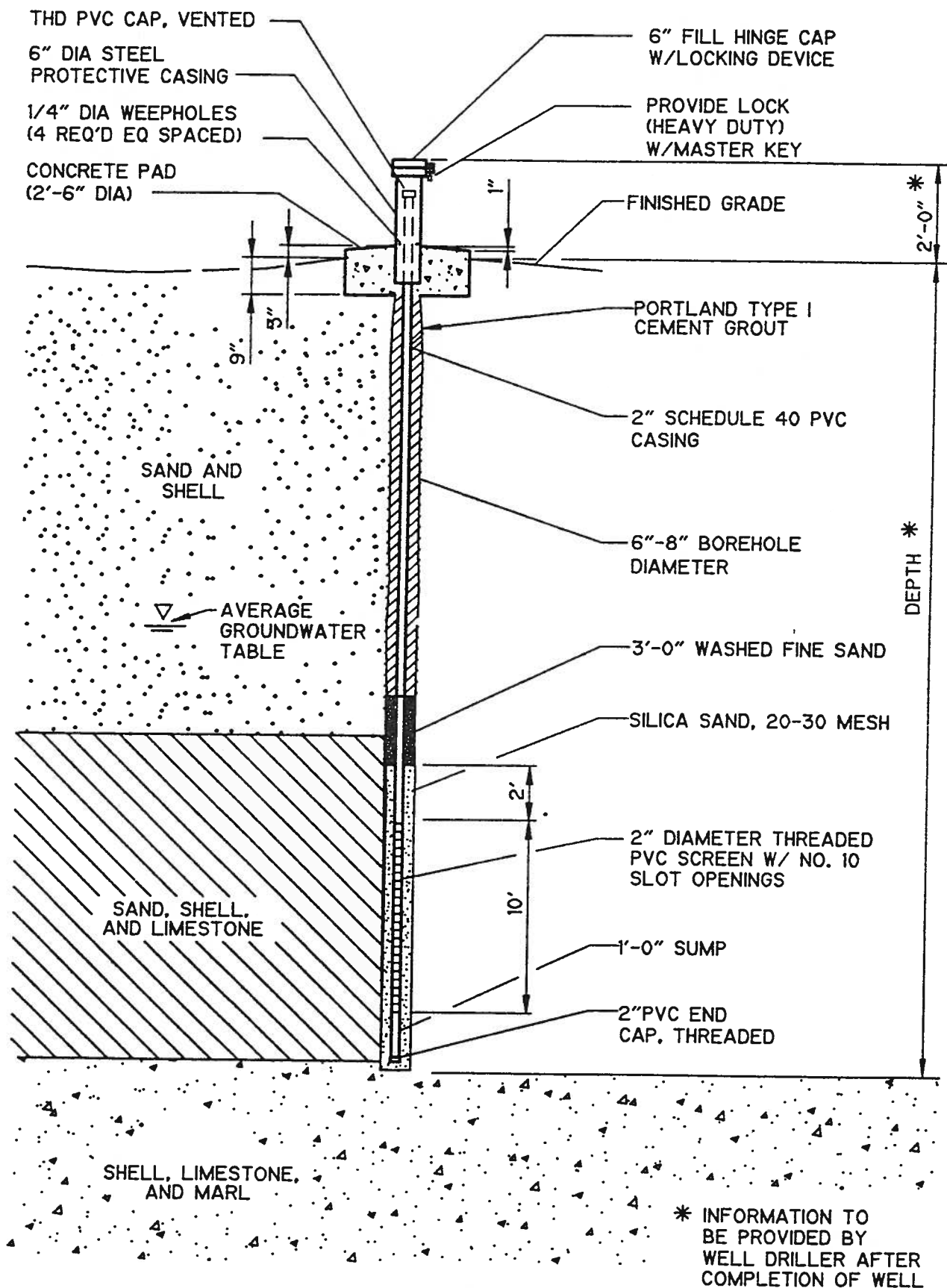
* INFORMATION TO BE PROVIDED BY WELL DRILLER AFTER COMPLETION OF WELL

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TYPICAL SHALLOW SURFICIAL AQUIFER
GROUNDWATER MONITORING WELL

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Figure No. 5-3



SOLID WASTE AUTHORITY OF PALM BEACH COUNTY
TYPICAL INTERMEDIATE SURFICIAL AQUIFER
GROUNDWATER MONITORING WELL

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Figure No. 5-4

TABLE 5-2

PROPOSED GROUNDWATER MONITORING PARAMETER LIST¹

Semi-Annually (Field)	EPA Method Codes
Static Water Level in Wells Before Purging	N/A
Specific Conductivity	120.1
pH	150.1
Dissolved Oxygen (DO)	360.1
Turbidity	180.1
Temperature	170.1
Colors and Sheens	110.2
Semi-Annually (Laboratory)	
Total Ammonia Nitrogen	350.1
Chlorides	352.2
Iron	200.7
Mercury	245.1
Nitrate	353.2
Sodium	200.7
Total Dissolved Solids (TDS)	160.1
Parameters Listed in 40 CFR Part 258 Appendix I	See Table D-1 in Appendix D

¹ Taken from Chapter 17-701.510(8)(a), FAC (May 19, 1994).

**Detection
Monitoring**

Semi-annual Sampling

Repeat Analysis for
Any Exceedances
If Desired

Statistical Analysis
Comparison of Detection
and Background Wells for
Indicator Parameters

Starting after
Second Semi-annual
Sampling Event

**Assessment
Monitoring**

If For Any
Detection Well:

No Exceedances

- Statistically Sig. Increase
in Indicator Parameters
or
- Exceedances of Background
Well Concentrations,
or
- Exceedances of MCLs

After Every
Annual Sampling
Event

Then Immediately:

- Perform Appendix II Analysis
for all Wells
- Repeat Analysis for any
Constituents Detected

If Not Detected

**Compliance
Monitoring**

If Detected:

Permit Modification for
Compliance Monitoring

Corrective Action Plan

SOLID WASTE AUTHORITY OF PALM BEACH COUNTY

**OVERVIEW OF
GROUNDWATER MONITORING PROGRAM**

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Figure No. 5-5

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5.1.5 ASSESSMENT MONITORING

If indicator parameters are detected in detection/compliance wells in concentrations that are significantly above background water quality, or that are at levels above the FDEP water quality standards or criteria specified in Chapter 17-520, FAC, the Solid Waste Authority (SWA) would have 15 days to resample the wells after the sampling data are received to confirm the data. If the data are confirmed, the SWA is required to notify FDEP in writing within 14 days of this finding. Upon notification to FDEP, the SWA would initiate assessment monitoring as follows:

1. Routine monitoring of all monitoring wells, surface water monitoring locations, and leachate sampling locations will occur on a semi-annual basis for the parameters listed in Tables 5-2, 5-3, and 5-4, respectively.
2. Within 90 days of initiating assessment monitoring and annually thereafter, the SWA would sample and analyze a representative sample of the background wells and all affected detection/compliance wells for the parameters listed in Table D-2 in Appendix D. Any new parameters detected and confirmed in the affected downgradient wells would be added to the routine groundwater monitoring parameter list presented in Table 5-2.
3. Within 90 days of initiating assessment monitoring, the SWA will sample and analyze the detection/compliance wells for the parameters listed in Table 5-2 and in Table D-2 in Appendix D.
4. Within 180 days of initiating assessment monitoring, the SWA would be required to submit a contamination assessment plan (CAP) to FDEP. This plan will be designed to delineate the extent and cause of the contamination to predict the likelihood that FDEP water quality standards will be violated outside the zone of discharge, and to evaluate methods to prevent any such violations. Upon approval by FDEP, the SWA would implement this CAP and submit a contamination assessment report (CAR) in accordance with the plan.

5. If for two consecutive sampling events the concentrations of all indicator parameters and the parameters listed in Table D-2 in Appendix D are at or below background values, the SWA, will notify FDEP and will discontinue assessment monitoring and return to the routine monitoring requirements as described in Section 5.1.4 of this report.

5.1.6 CORRECTIVE ACTIONS

1. If the CAR indicates that water quality standards are likely to be violated outside the zone of discharge, the SWA is required, within 90 days, to submit a remedial action plan (RAP) to FDEP. Upon approval, the SWA would initiate corrective actions to prevent such violations.
2. If any contaminants are detected and confirmed in compliance wells in concentrations that exceed both background levels and FDEP water quality standards or criteria, or are detected and confirmed in detection wells in concentrations that are above FDEP water quality minimum criteria, the SWA must notify FDEP within 14 days of this finding and initiate corrective actions. Assessment monitoring will continue according to the requirements of Section 5.1.5.

5.2 SURFACE WATER QUALITY MONITORING

According to Section 17-701.510(4)(a), FAC, all surface water bodies that may be affected by a contaminant release from the facility will be monitored, except bodies of water contained completely within the property boundaries of the disposal site that do not discharge from the site to surface waters. However, discharges from detention ponds for stormwater will be sampled at the point of discharge to waters of the state or from the property, whichever is closer to the detention pond. Given these criteria, only the discharge from the stormwater detention pond to the EPB-10 Canal will be monitored for water quality. Water samples will be collected semi-annually at the control structure in the EPB-10 Canal and analyzed for the parameters listed in Table 5-3.

TABLE 5-3

PROPOSED SURFACE WATER MONITORING PARAMETER LIST¹

Semi-Annually (Field)	EPA Method Codes
Specific Conductivity	120.1
pH	150.1
Dissolved Oxygen (DO)	360.1
Turbidity	180.1
Temperature	170.1
Colors and Sheens	110.2
Semi-Annually (Laboratory)	
Unionized Ammonia (NH ₃)	350.1
Total Hardness	SM 2340B
Biochemical Oxygen Demand (BOD ₅)	SM 5210B
Copper	200.7
Iron	200.7
Mercury	200.7
Nitrate	353.2
Zinc	200.7
Total Dissolved Solids (TDS)	160.1
Total Organic Carbon (TOC)	SM 5310C
Fecal Coliform	SM 9222D
Total Phosphates	365.1
Chlorophyll A	SM 10200H
Total Nitrogen	SM 4500N
Chemical Oxygen Demand	410.4
Total Suspended Solids (TSS)	160.2
Parameters Listed in 40 CFR Part 258 Appendix I	See Table D-1 in Appendix D

¹ Taken from Chapter 17-701.510(8)(b), FAC (May 19, 1994).

SM is the method outlined in Standard Methods for the Examination of Water and Wastewater.

The results of the surface water quality analyses will be compared to FDEP Class III surface water quality standards (Chapter 17-302.530) for compliance purposes.

5.3 LEACHATE MONITORING

Leachate samples will be collected from the wet well of leachate pump station A for the Class I landfill and the wet well of leachate pump station C for the Class III landfill on a semi-annual basis. These samples will be analyzed for the parameters listed in Table 5-4. On the second semi-annual sampling event in each year the leachate sample will be analyzed for the list of parameters presented in Title 40 CFR, Part 258, Appendix II (see Appendix D).

If the results of the annual analysis indicate that a contaminant listed in 40 CFR 261.24 (Appendix E) exceeds the stated regulatory level, the SWA would be required to initiate a monthly sampling and analysis program and notify FDEP in writing. If, in any three consecutive months, the same listed contaminant exceeded the regulatory level, the SWA would be required to notify FDEP within 90 days to initiate a program. The program will be designed to identify the source and reduce the presence of the contaminant in the leachate so that it no longer exceeds the regulatory level. If, in any three consecutive months, no listed contaminant was found to exceed the regulatory level, the SWA would discontinue the monthly sampling and analysis and return to quarterly sampling and analysis for the parameters listed in Table 5-4.

5.4 WATER QUALITY DATA REPORTING

All water quality data must be submitted to FDEP on a semi-annual basis. A report, will be submitted to FDEP within 90 days of the end of the semi-annual period and, will include the following items:

TABLE 5-4

PROPOSED LEACHATE MONITORING PARAMETER LIST¹

Semi-Annually (field)	EPA Method Codes
Specific Conductivity	120.1
pH	150.1
Dissolved Oxygen (DO)	360.1
Colors, Sheens	110.2
Semi-Annually (Laboratory)	
Total Ammonia Nitrogen	350.1
Bicarbonate	SM 2320B
Chlorides	352.2
Iron	200.7
Mercury	245.1
Nitrates	253.2
Sodium	200.7
Total Dissolved Solids (TDS)	16.01
Parameters Listed in 40 CFR, Part 258 Appendix I	See Table D-1 in Appendix D
Annually (Laboratory)	
Parameters Listed in 40 CFR, Part 258 Appendix II	See Table D-2 in Appendix D

¹ Taken from Chapter 17-701.510(8)(c), FAC (May 19, 1994).

SM is the method outlined in Standard Methods for the Examination of Water and Wastewater.

1. The facility name and identification number, sample collection dates, and analysis dates;
2. All analytical results, including all peaks even if below maximum contaminant levels;
3. Identification numbers and designations of all surface water and groundwater monitoring points;
4. Applicable water quality standards;
5. Quality assurance, quality control notations;
6. Method detection limits;
7. STORET code numbers for all parameters;
8. Water levels recorded prior to evaluating wells or sample collections. Elevation references will include the top of the well casing and land surface at each well site at a precision of plus or minus 0.01 foot National Geodetic Vertical Datum;
9. An updated groundwater table contour map, with contours at no greater than one foot intervals, which indicates groundwater elevations and flow direction; and
10. A summary of any water quality standards or criteria that are exceeded.

As stated in Section 17-701.510(9)(b), FAC, every two years and at the time of permit renewal, a technical report, prepared, signed, and sealed by a professional geologist or professional engineer with experience in hydrogeologic investigations, will be submitted to the FDEP. The report will summarize and interpret the water quality data and water level measurements collected during the past two years. The report will contain at a minimum, the following:

1. Tabular and graphical displays of the data, including hydrographs for all of the monitoring wells;
2. Trend analyses of any detected monitoring parameters;
3. Comparisons among shallow, middle, and deep zone wells;
4. Comparisons between upgradient and downgradient wells;
5. Correlations between related parameters such as total dissolved solids and specific conductance;
6. Discussion of erratic and/or poorly correlated data;

7. An interpretation of groundwater contour maps and estimation of groundwater flow rates; and
8. An evaluation of the adequacy of the water quality monitoring frequency and sampling locations based on site conditions.

6.0 CONCLUSIONS AND RECOMMENDATIONS

The purpose of this study was to develop a groundwater, surface water, and leachate monitoring plan, in accordance with the latest revisions to Chapter 17-701, Florida Administrative Code (FAC). More specifically, the information provided in this report addresses Section 17-701.510, FAC (Water Quality and Leachate Monitoring Requirements).

Based on the groundwater elevation contour maps developed for this study, the direction of shallow groundwater flow at the landfill is from west to east-northeast. Since the landfill cells are concentrated in the northeast and southeast corners of the site, and the direction of groundwater flow is basically west to east, the western portion of the property is considered upgradient (background) and the eastern portion is downgradient (detection).

In summary, it is proposed that 26 new surficial aquifer monitoring well pairs (4 background well pairs and 22 detection/compliance well pairs) be installed at the site. All of the shallow and intermediate monitoring wells, the two surface water monitoring stations, and the two leachate monitoring points will be sampled semi-annually and analyzed for indicator parameters. The deep monitoring wells will be used to monitor only groundwater elevations on a semi-annual basis. The monitoring wells will be installed in phases to coincide with the construction of the landfill cells.