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GROUNDWATER MODEL IMPROVEMENT SUMMARY LETTER REPORT - MODEL GRID DESIGN OCTOBER 1993

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GROUNDWATER MODEL IMPROVEMENT SUMMARY LETTER REPORT - MODEL GRID DESIGN

Fernald Environmental Management Project
October 1993

Submitted by:
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Groundwater Model Improvement Summary Letter Report
Model Grid Design

Task Objective:

The model grid design task objective was to increase the areal coverage and vertical resolution of the Great Miami Aquifer (GMA) groundwater/solute transport model. The old GMA model grid, consisting of 78 by 102 blocks, was expanded to the east by 5250 feet and to the north by 1250 feet as shown in Figure 1. The new model grid consists of 120 blocks by 112 blocks, each block measuring 125 by 125 feet. This expansion limits interference from model boundaries along the eastern part of the site.

The vertical resolution of the model was increased from five layers to six to provide:

- Better vertical control for contaminant transport modeling;
- A thinner saturated layer at the top of the model, more accurately representing the mixing depth in the aquifer; and
- A closer match between model layers and monitoring well screen elevations, facilitating the calibration process.

Technical Approach:

The GMA model grid is referenced to screen elevations in the 2000, 3000, and 4000 series monitoring wells and structure on the base of glacial overburden and bedrock. The Kriging algorithm contained in Golden Software's SURFER package was used to define grid-cell centroid elevations from input structure maps. Since the model grid area extends beyond the monitoring well network, model interfaces are assumed flat in areas where there is no structural control. The basis for each of these surfaces is described below.

The top of model layer 1 was defined using the "Base of Glacial Overburden" structure map (IT, 1993), and the topographic surface in Paddys Run channel where overburden has been removed completely by erosion. The resulting map is shown in Figure 2. The top of model layer 1 is essentially flat east of the FEMP site at an elevation of 570 feet above mean sea level (msl) and ranges to 535 feet above msl just southwest of the FEMP site.

The top of model layer 2 is referenced to the base of well screens contained in the 2000 series monitoring well network, shown in Figure 3. This surface ranges in depth from 510 feet above

msl in the northwest quarter of the model grid area to 495 feet above msl in the southwest quarter of the model gird area. The 2000 series wells used to construct the map shown in Figure 3 are listed in Table 1.

The top of model layer 3 is referenced to the top of well screens contained in the 3000 series monitoring well network, Figure 4. This surface ranges in depth from 502.8 feet above msl on the northern side of the FEMP site to 453.3 feet above msl just east of the site. The 3000 series wells used to make the map shown in Figure 4 are listed in Table 2.

The top of model layer 4, top of the blue clay interbed, is defined by using Figure 2-13, "Clay Interbed Topographic Surface" from the "Groundwater Modeling Report - Summary of Model Development" (DOE, 1993). The map is reproduced in Figure 5 for reference.

The top of model layer 5, base of the blue clay interbed, is derived from model layer 4 and Figure 2-12, "Clay Interbed Isopach" (DOE, 1993). The resulting map is shown in Figure 6. Since the blue clay interbed exists only in the northwestern part of the grid area, the material properties assigned to layer 4 (porosity, vertical and horizontal hydraulic conductivity) were set to match the properties of model layer 3 in areas where the clay iterbed is not present. A vertical thickness of 2 feet was used for blocks in layer 4 where the clay interbed is not present to facilitate internal bookkeeping by the SWIFT code.

The top of model layer 6 is referenced to the top of well screens contained in the 4000 series monitoring well network, Figure 7. The surface ranges from 429.5 feet above msl at well 4125 to 388.3 feet above msl at well 4013. The wells used to make the map shown in Figure 7 are listed in Table 3.

The bottom of model layer 6, the GMA to bedrock interface, is defined as in the previous GMA model by the basement contour map from the seismic refraction study by Watkins and Spieker, 1971. The structure map, updated by the 4000 series monitoring wells which tagged bedrock (Table 4), is shown in Figure 8. Two of the wells shown in Table 4, 2754 and 3679, encountered bedrock even though they are screened at the 2000 and 3000 elevations respectively.

Once the model layer interfaces were defined as described above, the six model layers were constructed by isopaching the model layer interface maps. Since all the model interface maps contain centroid elevations at each of the cells, a Fortran routine was used to read the layer top and bottom elevations and to write the 3-D model cell centroid and thickness values in the SWIFT data entry format.

After the SWIFT data entry file was completed, the data in the file were checked to see that model geometry was accurately represented. A Fortran program was used to read model cell centroid elevations and thickness values from the file and post them to a series of maps. These maps were visually checked against the input maps to see that the model layer interfaces were correct. The thickness values for each model layer were then posted and contoured, and the

resulting model layer isopach maps are shown in Figures 9 through 14. As the thickness values were being read from the R1-21 file, the following statistics were compiled:

Figure Number	Model Layer	Maximum Thickness (ft.)	Minimum Thickness (ft.)
9	1	69.3	15.6
10	2	59.2	9.27
11	3	47.9	6.54
12	4	22.9	2.00
13	5	57.7	16.5
14	6	36.7	2.00

Model layers 2 to 6 are fully saturated so the saturated thickness of these layers is equal to the total layer thicknesses. Since the GMA groundwater table intersects the 2000 series well screens in the long-term steady-state groundwater flow model, the saturated thickness of model layer 1 is less than the total layer thickness as listed above. It is expected that the average saturated thickness of model layer 1 will be less than 15 feet in the immediate vicinity of the FEMP.

Two model cross sections were constructed. These cross sections and their locations on the model grid are shown in Figures 15, 16, and 17. Figure 16, Cross Section A-A', was drawn so as to terminate against bedrock illustrating that each model layer is bounded by the bedrock surface. This section has also been reproduced as part of the key in Figures 2 through 14.

References:

(DOE 1993) United States Department of Energy, April 1993. *Groundwater Modeling Report Summary of Model Development.* RI/FS. Prepared by IT Corporation. FEMP. Fernald, Ohio.

(IT, 1993) IT Corporation, 1993. *Preliminary Presentation of Geology and Hydrogeology of the Glacial Overburden.* Prepared for Fernald Environmental Restoration Management Corporation.

(Watkins and Spieker, 1971) Watkins, F.S. and Spieker, 1971, "Seismic Refraction Survey of Pleistocene Drainage Channels in the Lower Great Miami River Valley, Ohio," U.S. Geological Survey, Professional Paper, 605-B, U.S. Government Printing Office, Washington, D.C.

October 22, 1993

Table 1: 2000 Series Monitoring Wells Used to Define the Top of Model Layer 2.

2002	2054	2171	2421
2006	2055	2383	2423
2007	2064	2384	2550
2008	2065	2385	2551
2010	2066	2386	2552
2024	2084	2387	2553
2027	2091	2388	2554
2028	2092	2389	2555
2032	2093	2390	2556
2033	2094	2391	2557
2034	2096	2392	2558
2037	2098	2393	2559
2042	2106	2394	2560
2043	2107	2395	2561
2044	2108	2396	2643
2045	2109	2397	2648
2046	2118	2398	2649
2047	2120	2399	2679
2048	2125	2400	2728
2049	2126	2401	2733
2051	2127	2402	2754
2052	2128	2417	2821
2053	2129	2420	2822

Table 2: 3000 Series Monitoring Wells Used to Define the Top of Model Layer 3.

3004	3064	3098	3396
3011	3065	3106	3397
3015	3066	3107	3402
3024	3067	3108	3421
3032	3068	3120	3423
3034	3069	3125	3550
3037	3070	3126	3551
3043	3084	3127	3552
3044	3091	3128	3678
3045	3092	3385	3679
3046	3093	3387	3821
3049	3094	3390	
3051	3096	3391	

Table 3: 4000 Series Monitoring Wells Used to Define the Top of Model Layer 6.

4010	4064	4398	4436
4011	4067	4424	4439
4013	4091	4425	4446
4014	4096	4426	
4016	4125	4432	

Table 4: 4000 Series Monitoring Wells Used to Define Base of Model Layer 6 (Bedrock).

2754+	4016	4398	4967
3679+	4064	4424	41066
4001	4067	4425	RW-1*
4008	4091	4426	RW-2*
4010	4096	4432	RW-3*
4011	4097	4436	RW-4*
4013	4108	4439	RW-5*
4014	4125	4446	

* South Plume Recovery Wells

\+ Although not numbered as such, these wells also encountered bedrock.

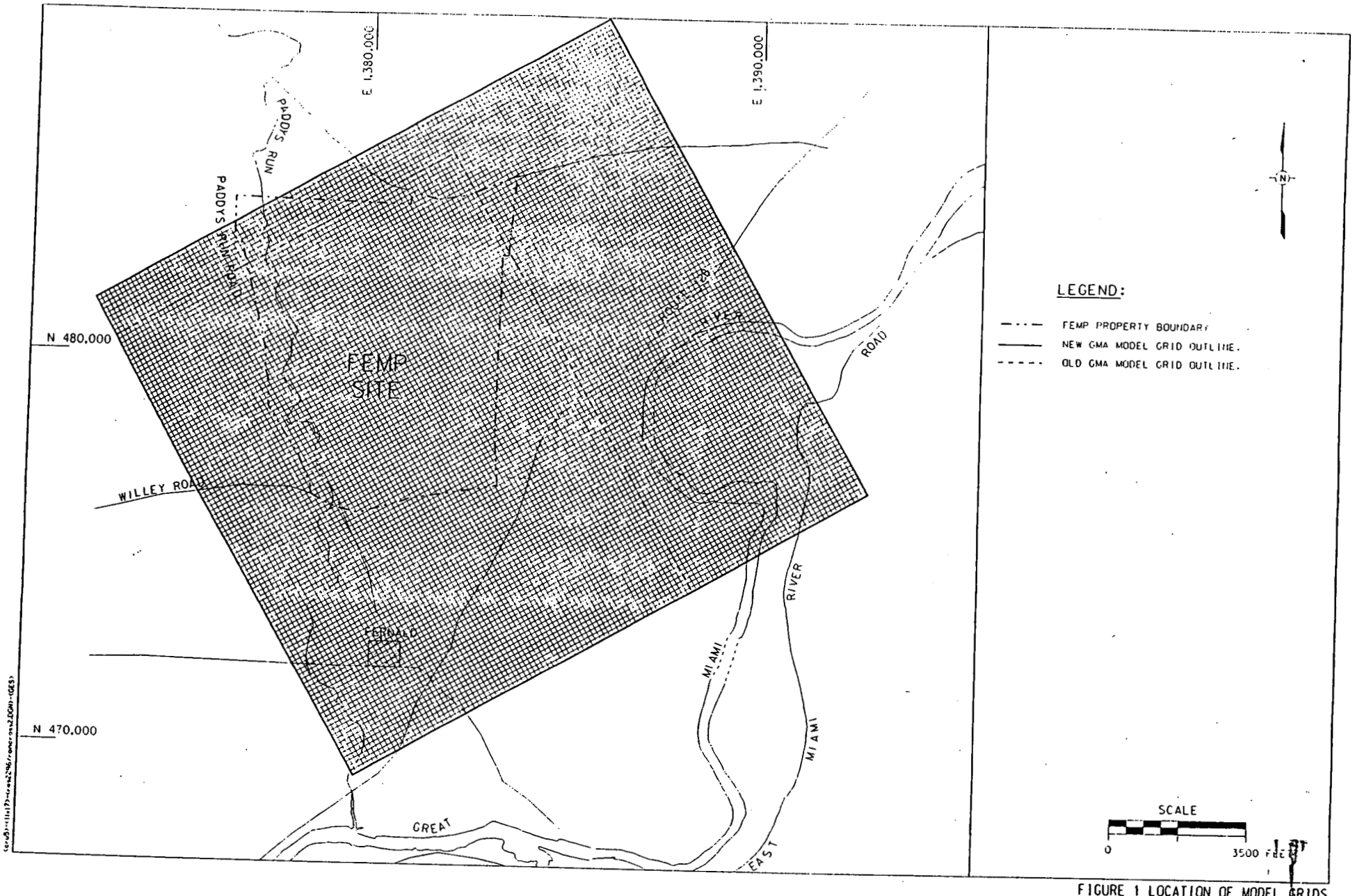

FIGURE 1 LOCATION OF MODEL GRIDS

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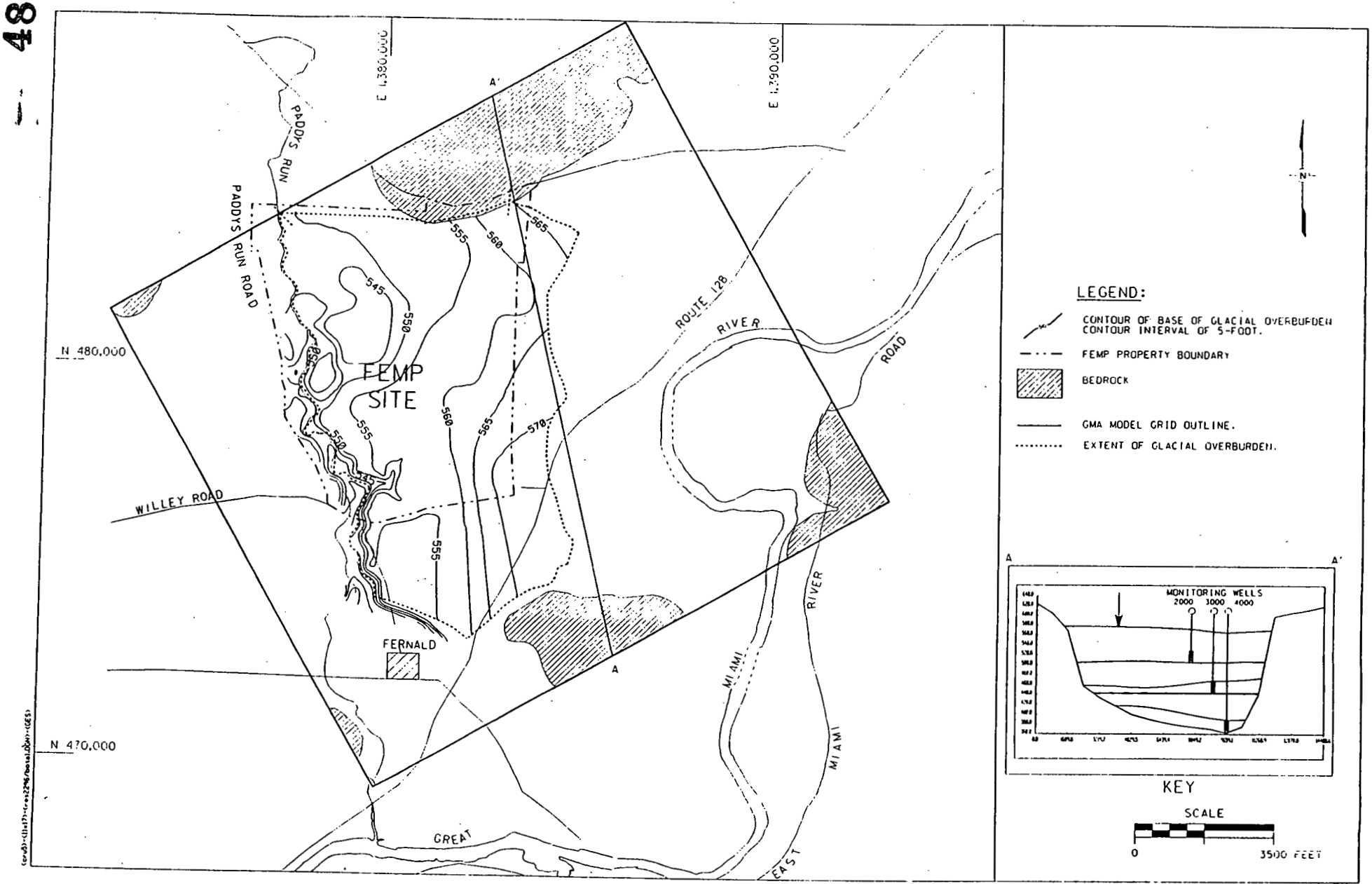
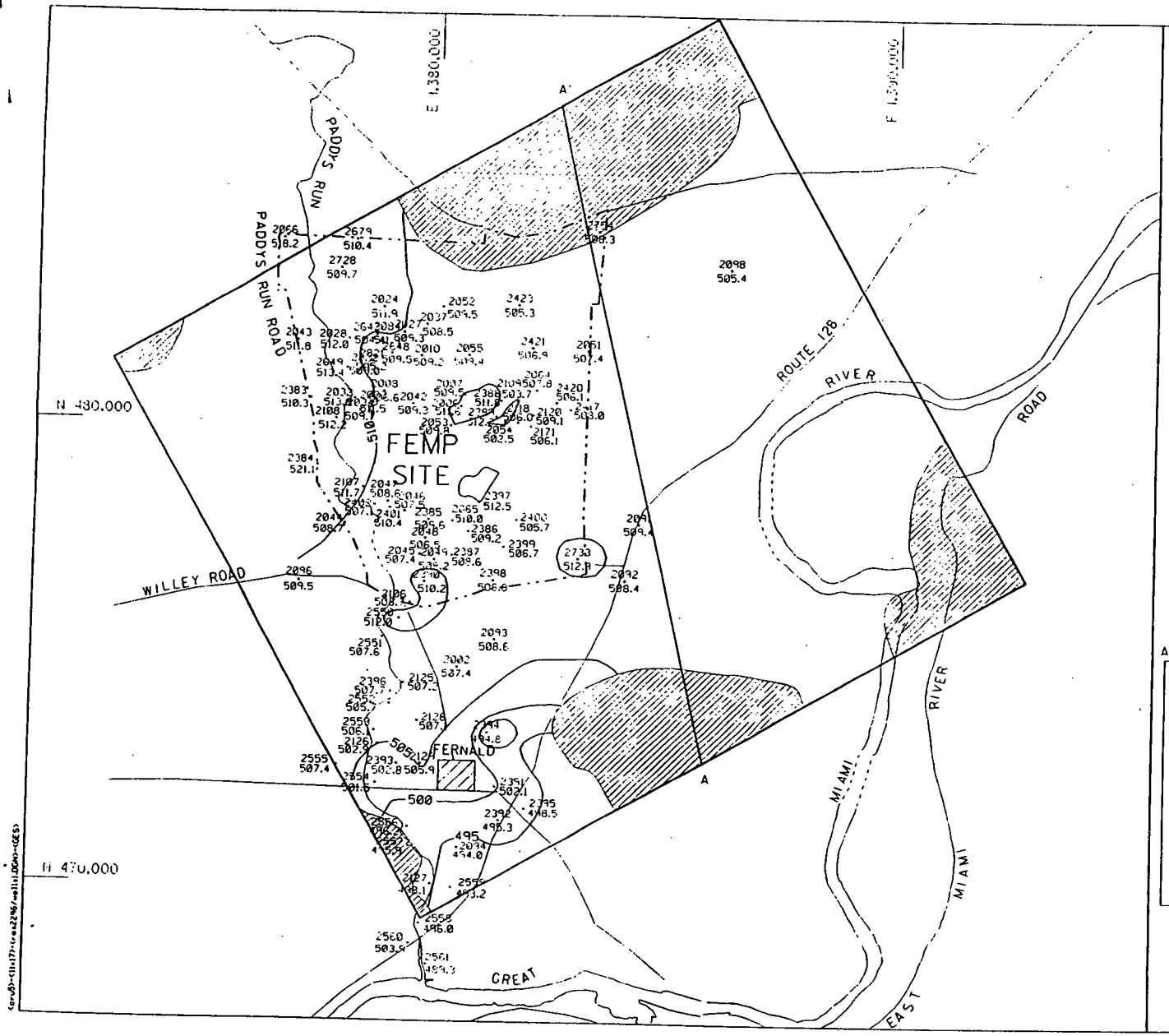


FIGURE 2 BASE OF GLACIAL OVERBURDEN STRUCTURE



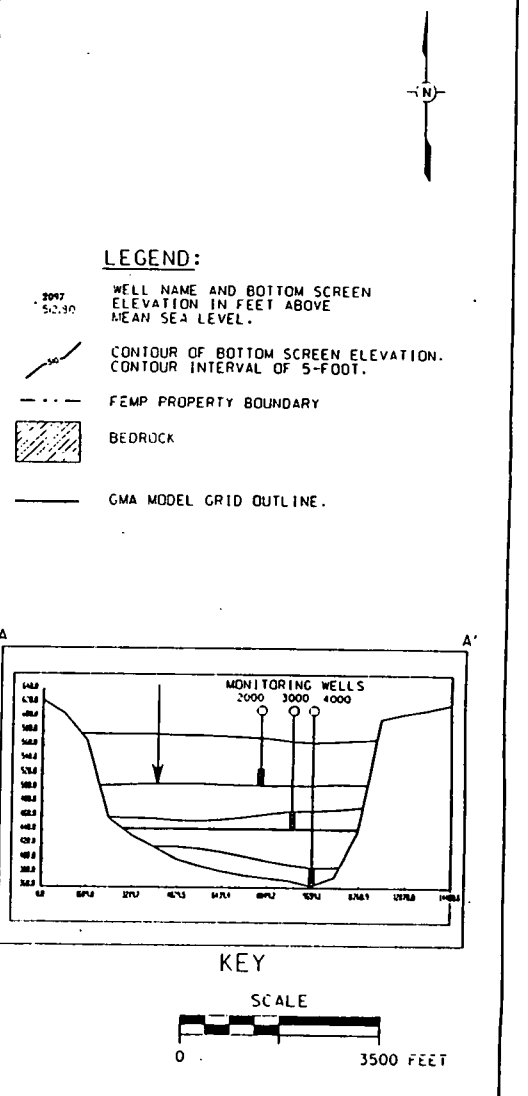


FIGURE 3 WELL SCREEN BOTTOM ELEVATIONS
2000 SERIES MONITORING WELLS

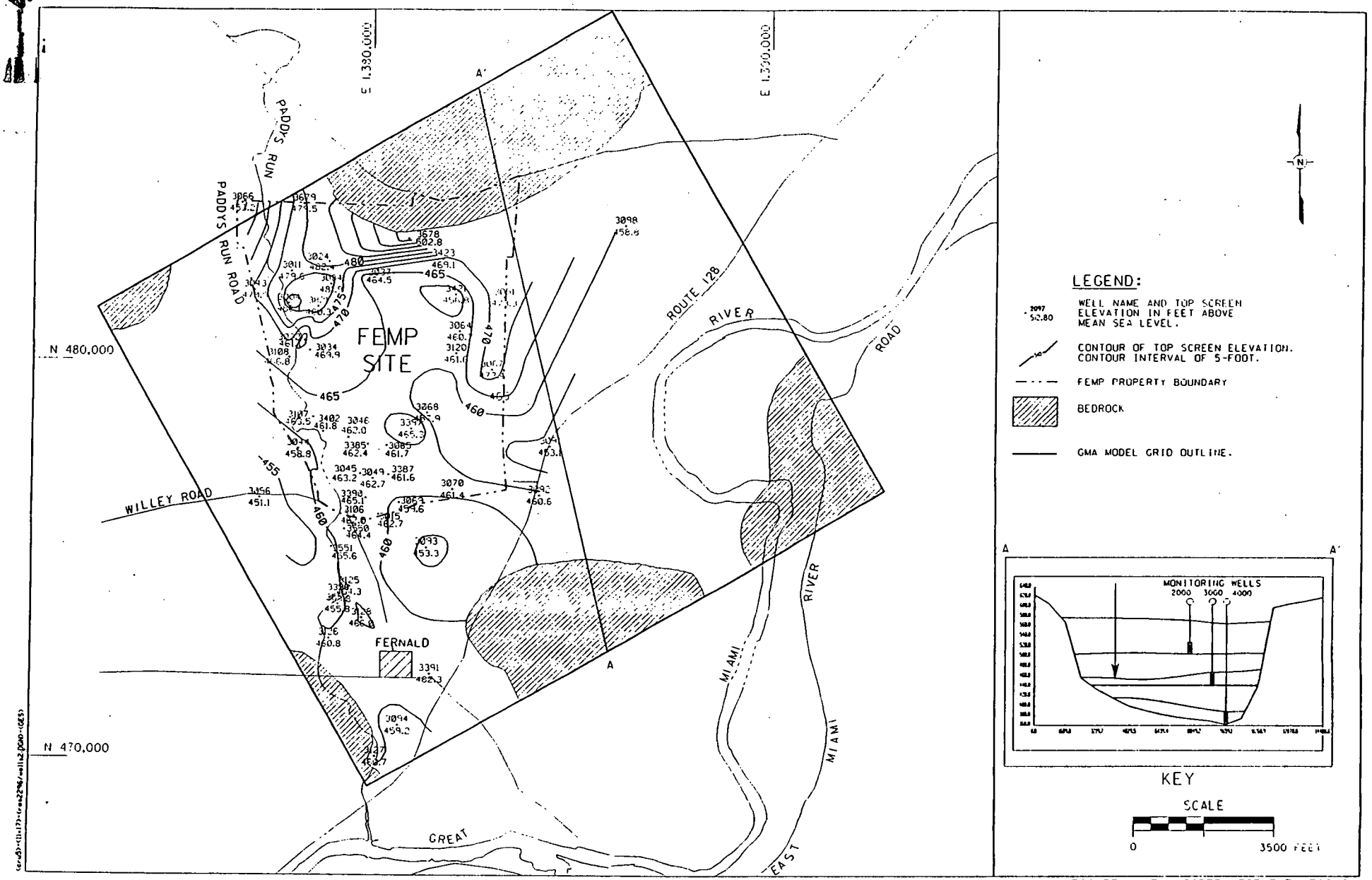


FIGURE 4 WELL SCREEN TOP ELEVATIONS
3000 SERIES MONITORING WELLS

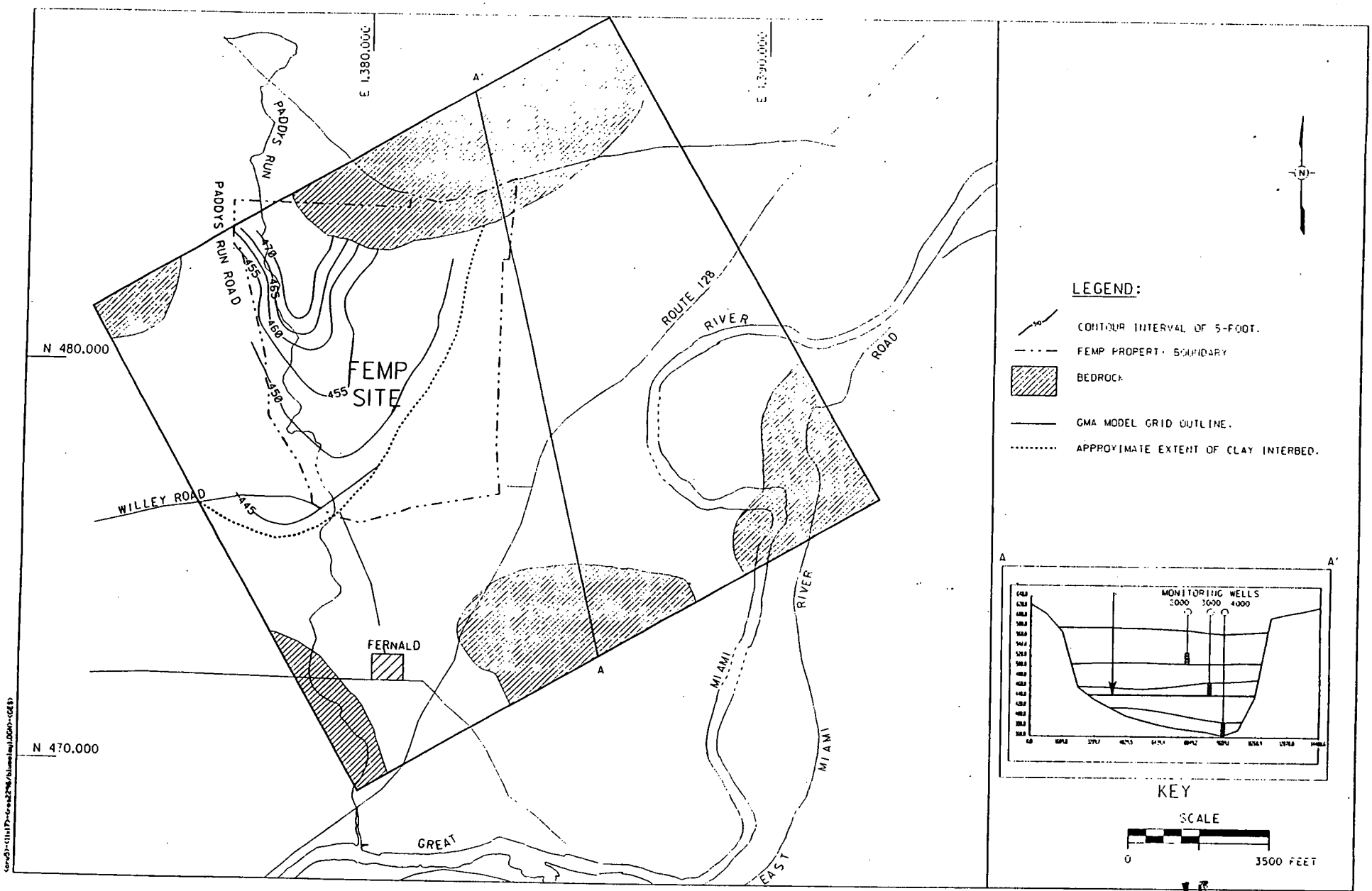


FIGURE 5 TOP OF CLAY INTERBED STRUCTURE

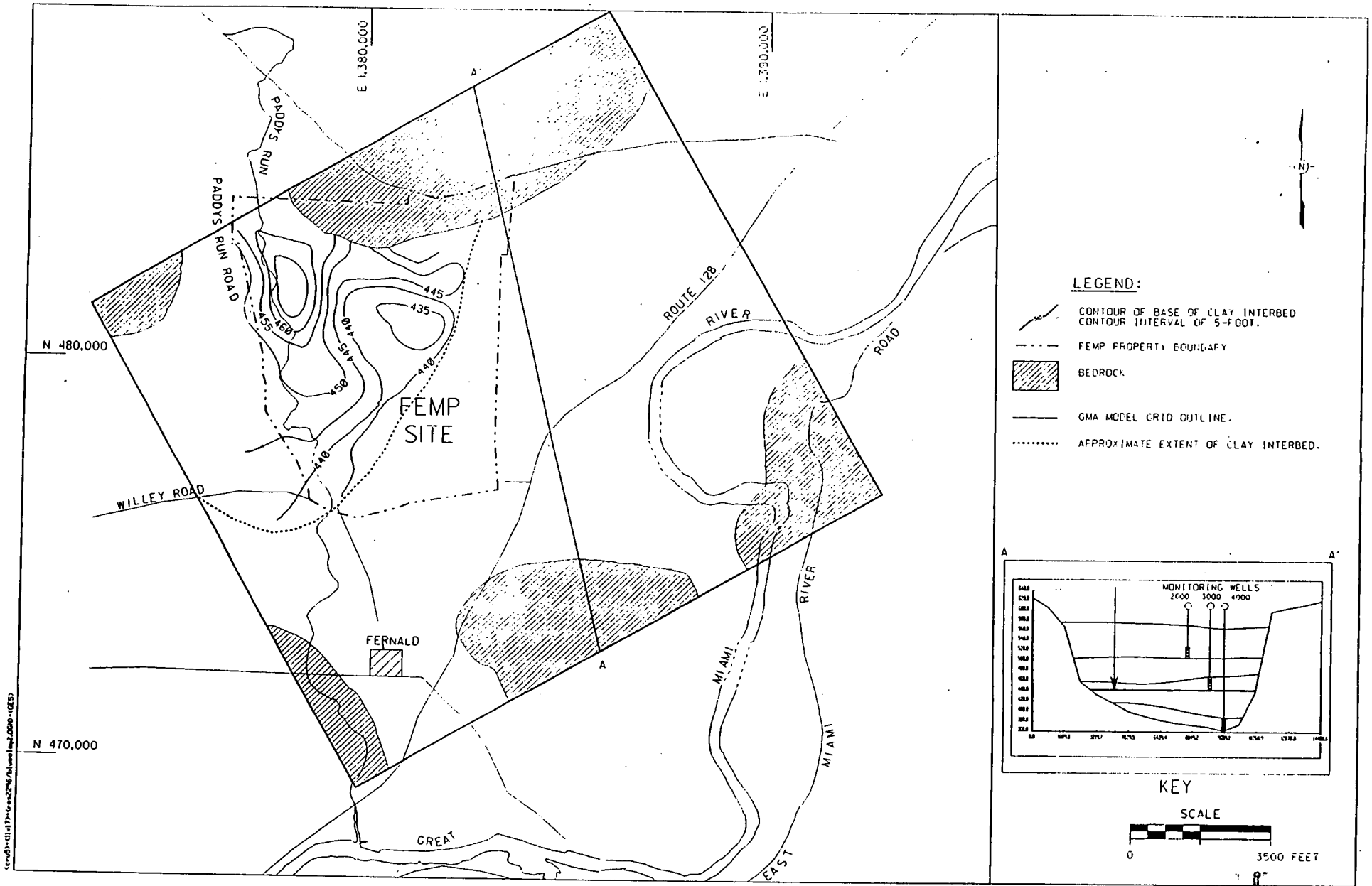


FIGURE 6 BASE OF CLAY INTERBED STRUCTURE

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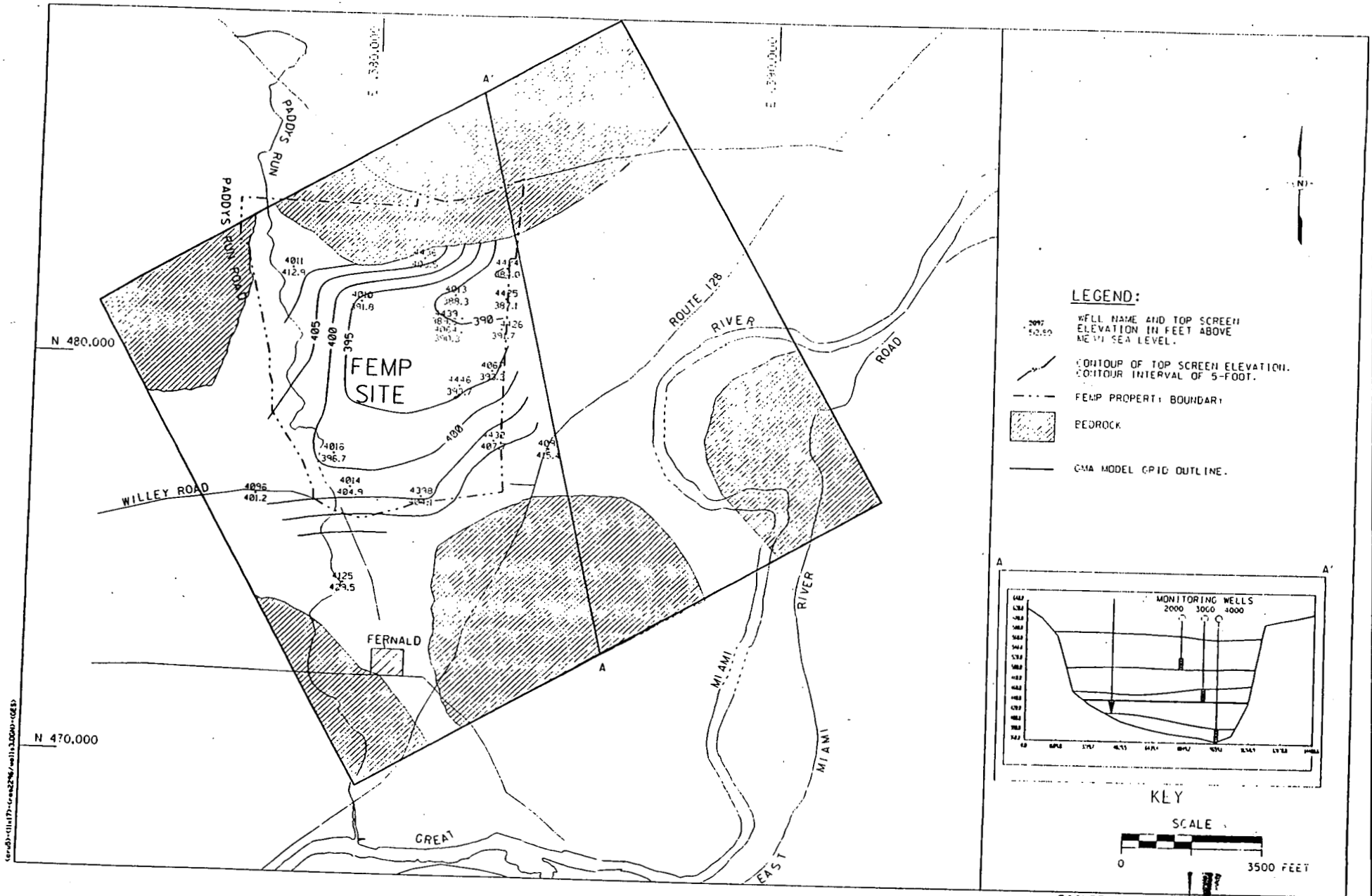

FIGURE 7 WELL SCREEN TOP ELEVATIONS
4000 SERIES MONITORING WELLS

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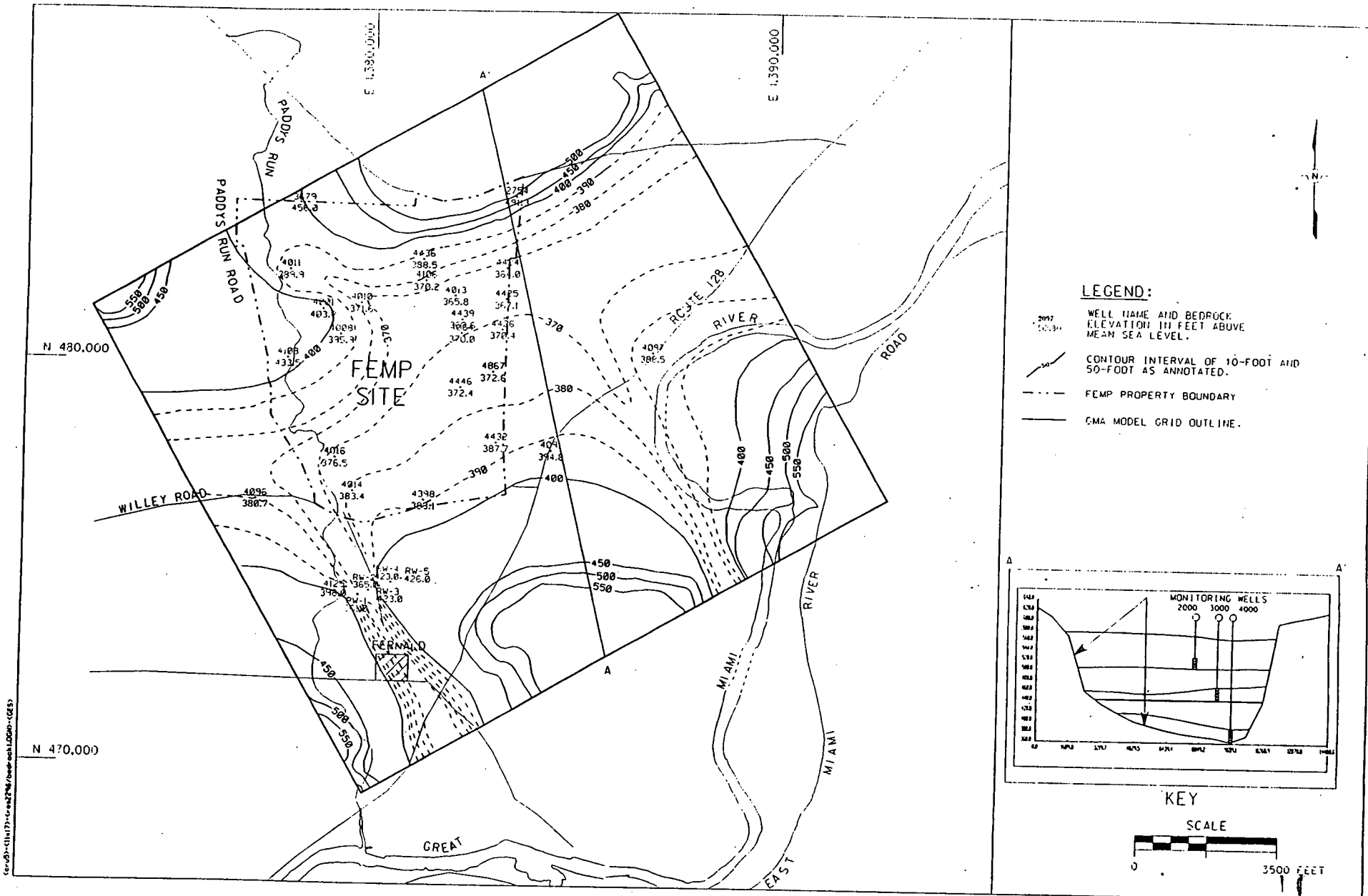

FIGURE 8 BEDROCK STRUCTURE

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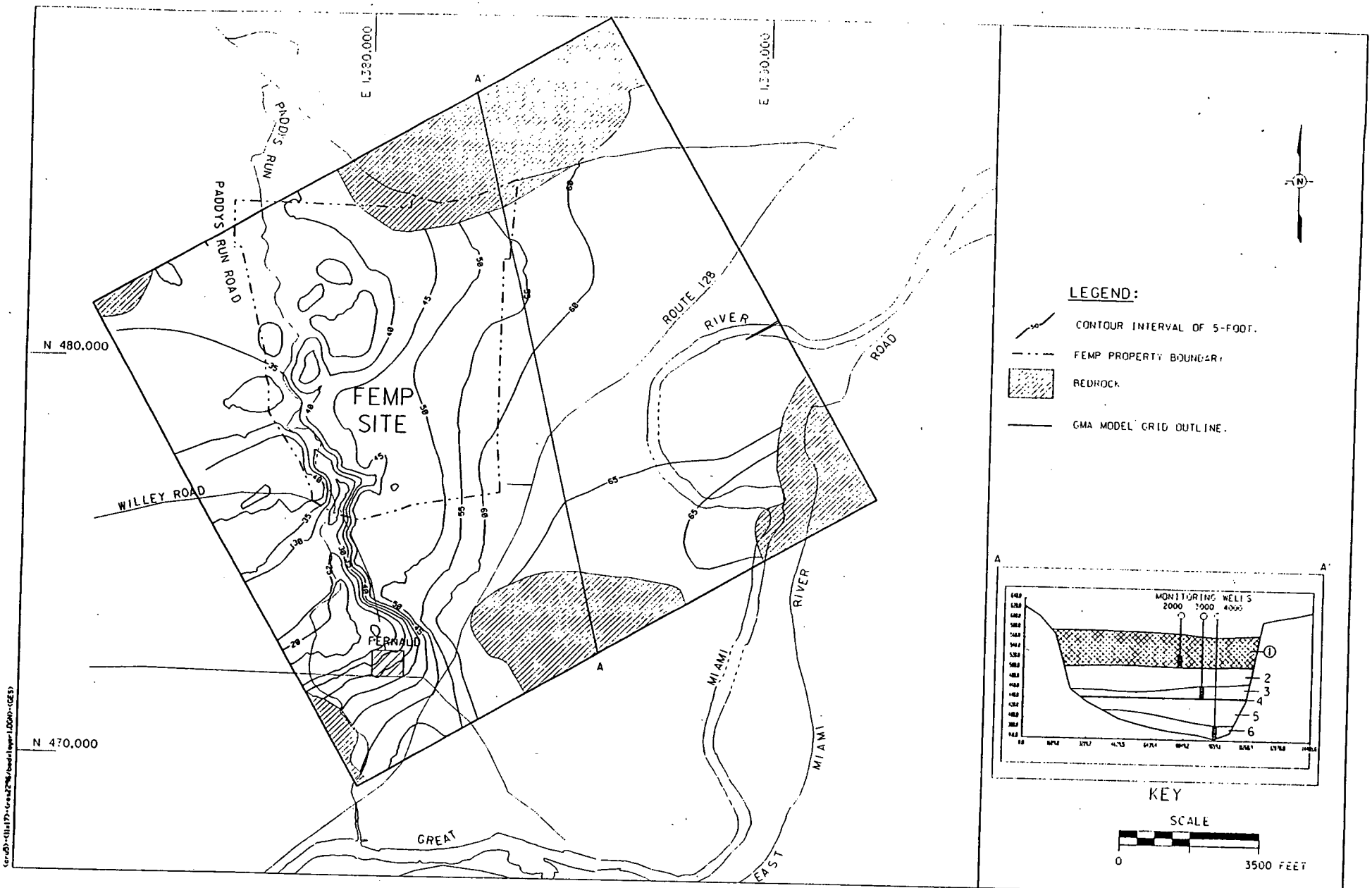

FIGURE 9 ISOPACH OF MODEL LAYER 1

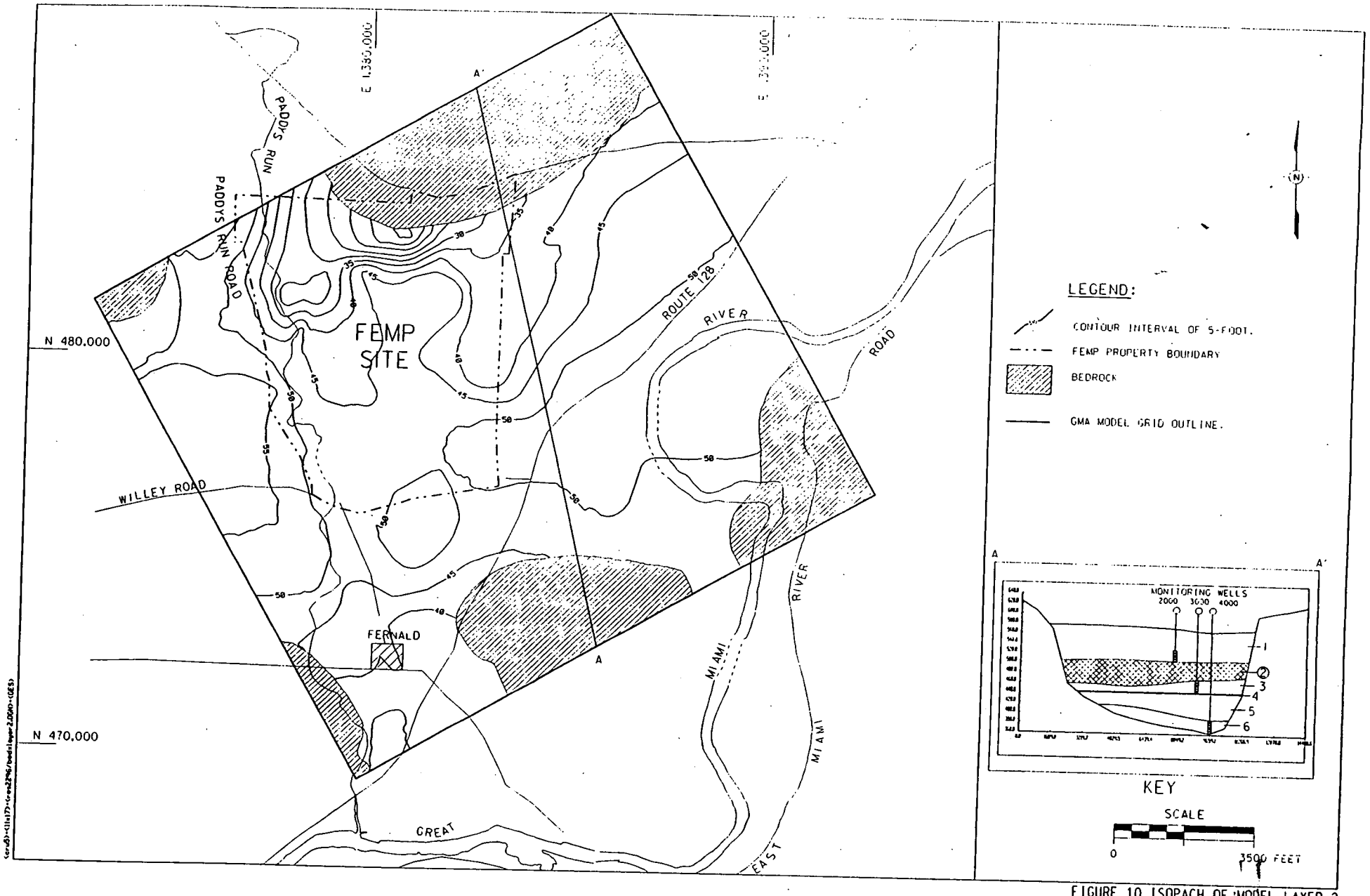

FIGURE 10 ISOPACH OF MODEL LAYER 2

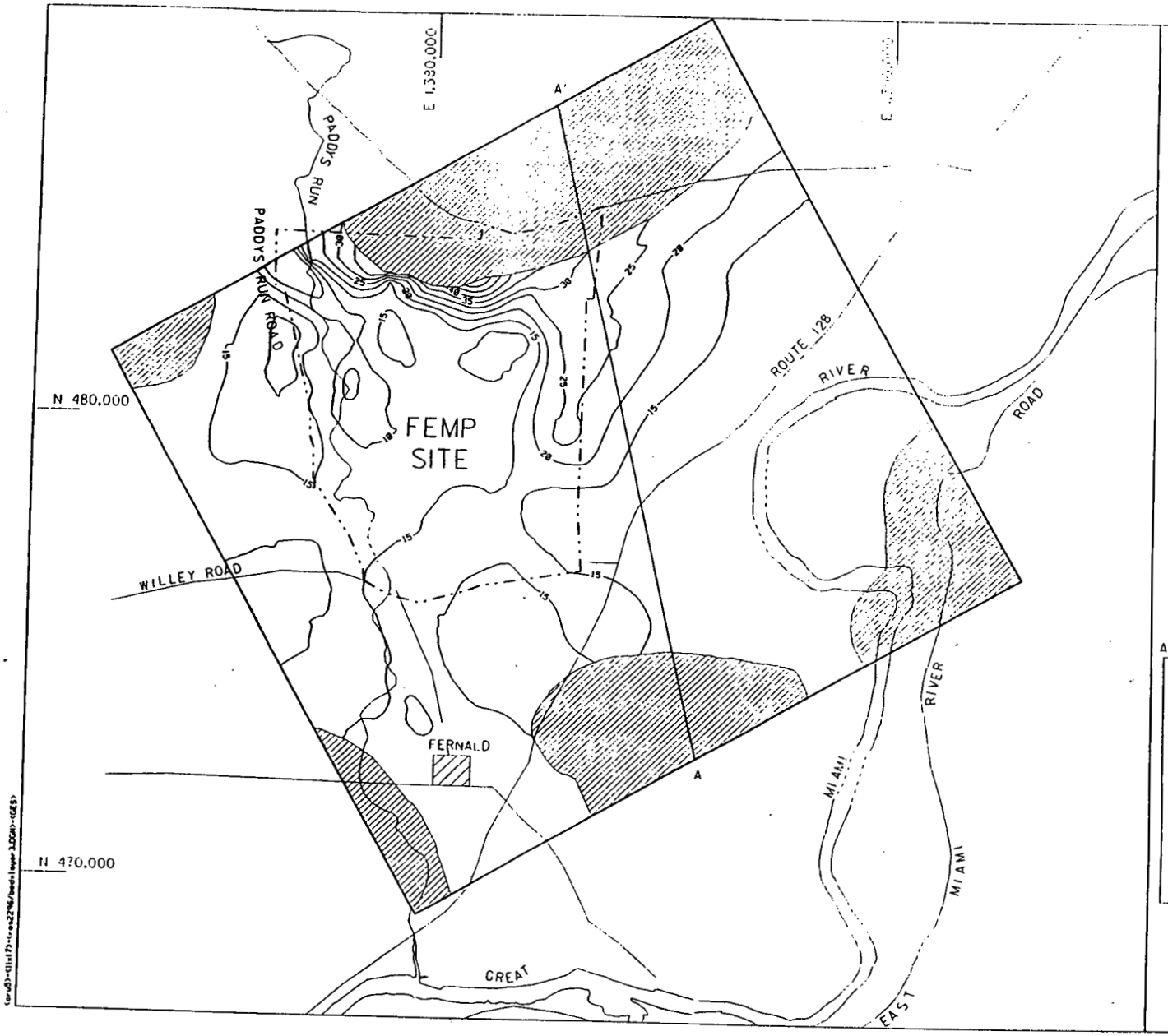

FIGURE 11 ISOPACH OF MODEL LAYER 3

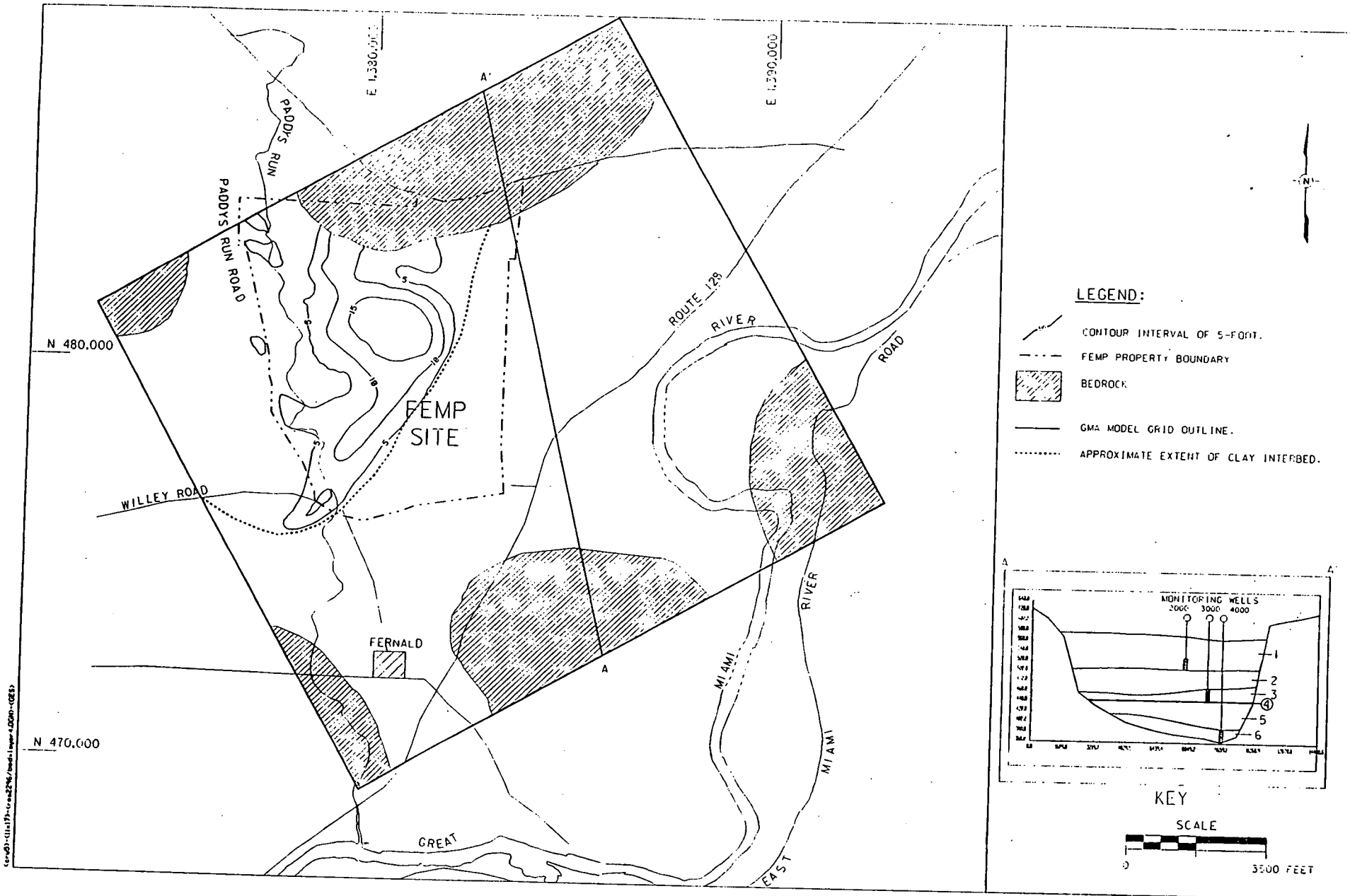

FIGURE 12 ISOPACH OF MODEL LAYER 4

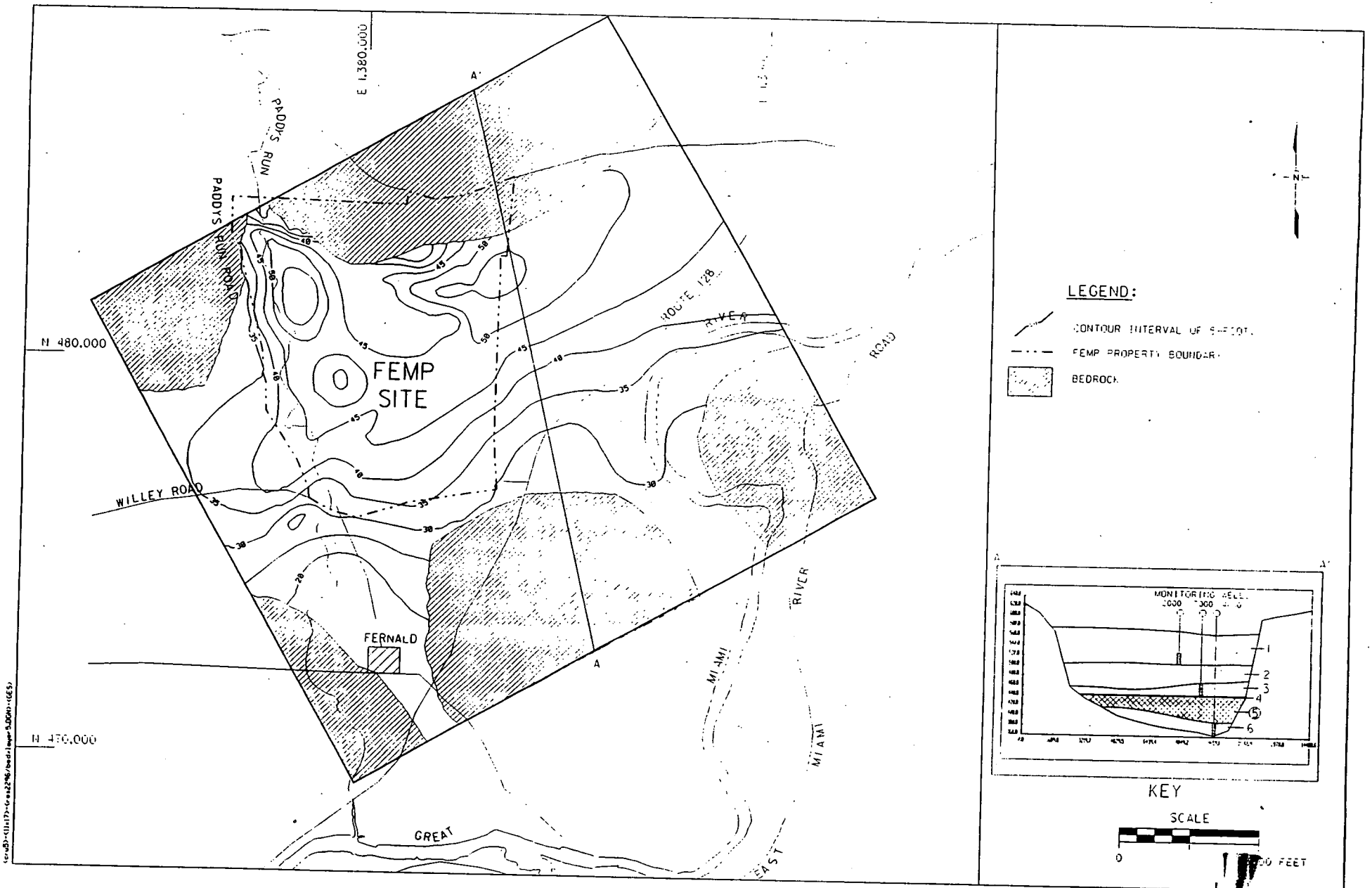

FIGURE 13 ISOPACH OF MODEL LAYER 5

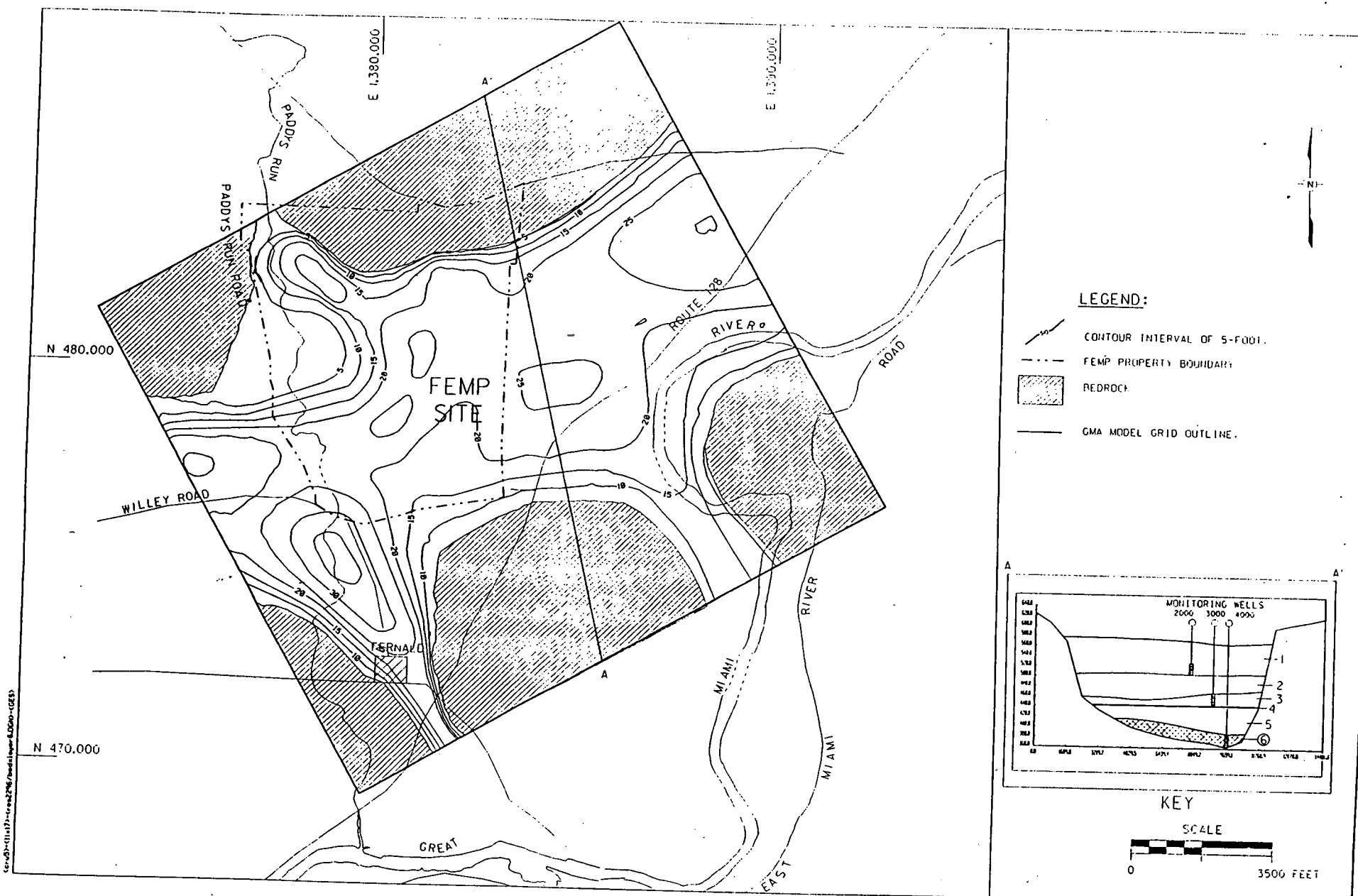

FIGURE 14 ISOPACH OF MODEL LAYER 6

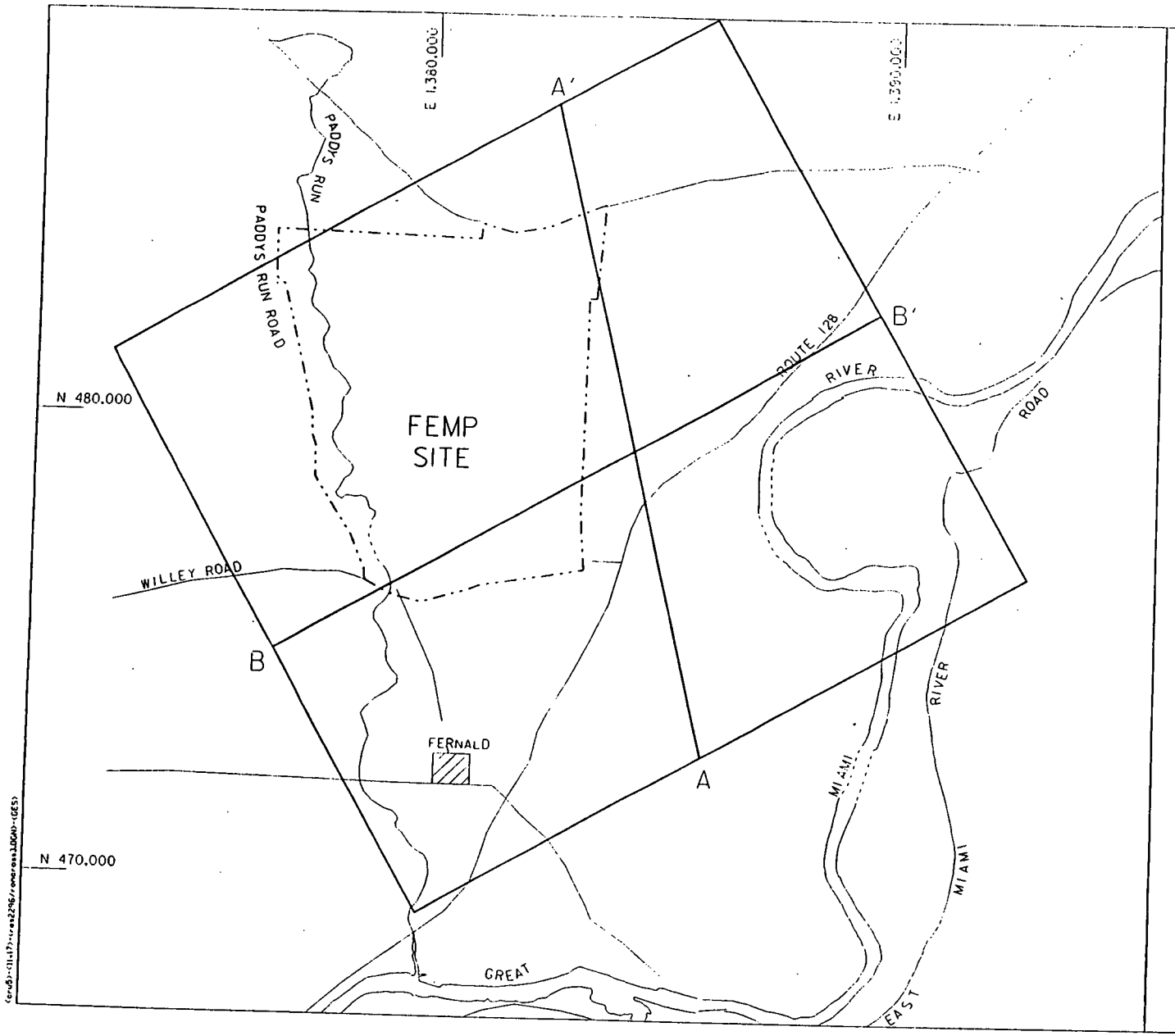

FIGURE 15 LOCATION OF MODEL CROSS SECTION

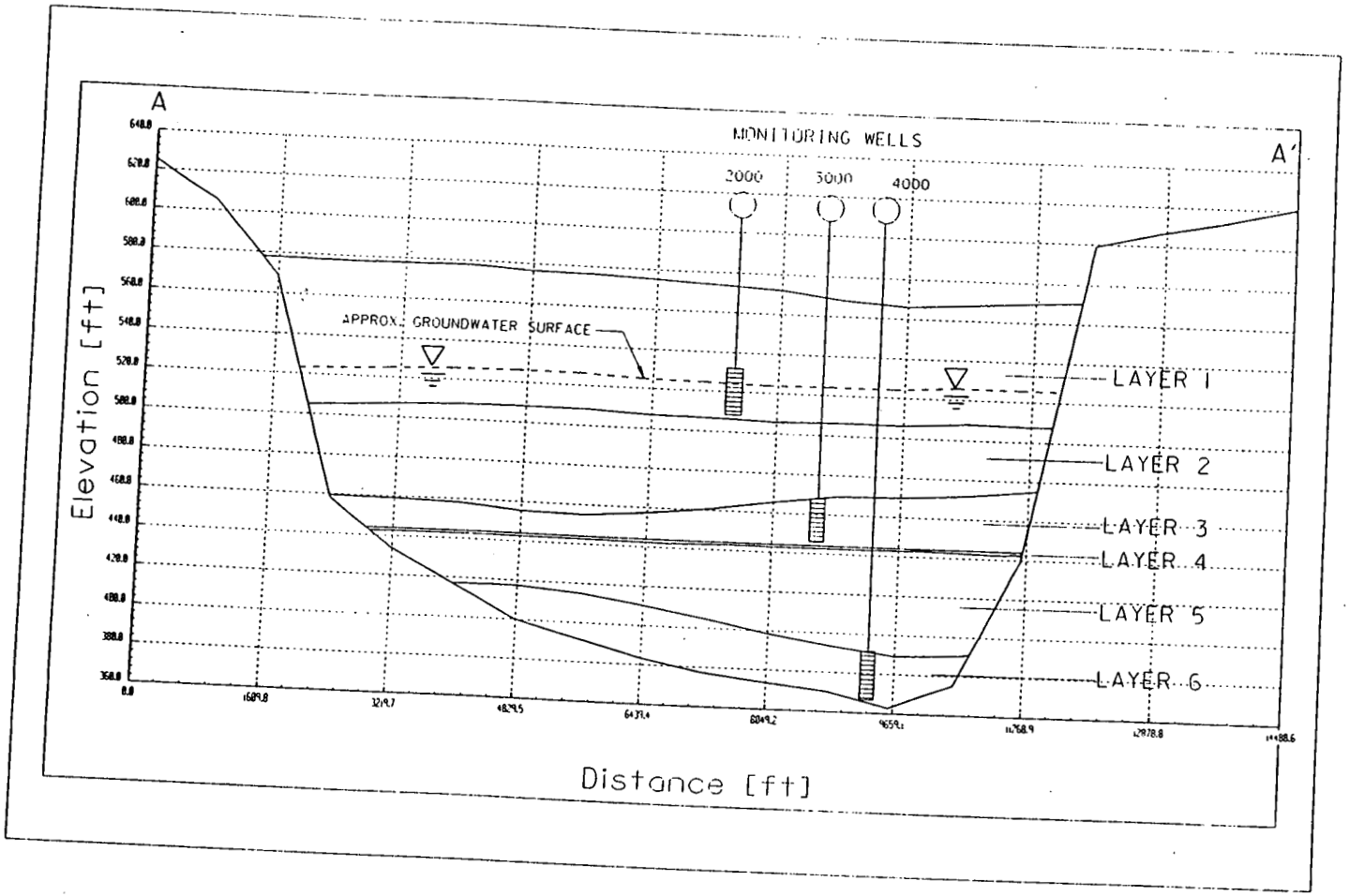

FIGURE 16 MODEL CROSS SECTION A-A'

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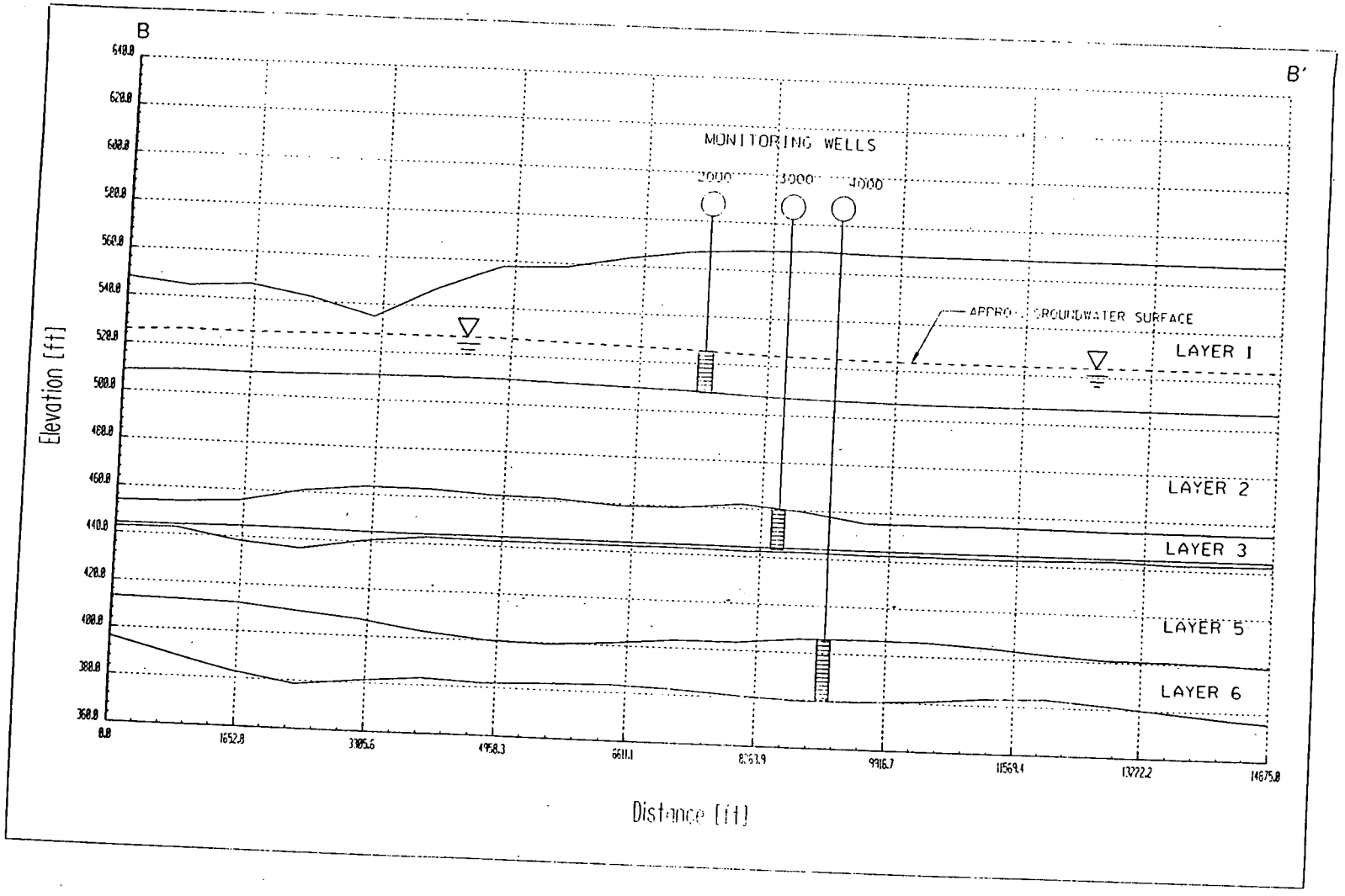

FIGURE 17 MODEL CROSS SECTION B-B'

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Comments on the Site-Wide Integrated Master Schedule and the Operable Unit Level IV Schedules

SUMMARY SCHEDULE

- The summary schedule does not include any activities for Program Management and not to mention, the existing logic ties between the Operable Units activities.

- The submittal of the OU1 ROD to DOE-FN, Activity ID 1B11500200, and the submittal of the OU4 Draft FS/PP/EIS to EPA, Activity ID 4RFSM910, should be reflected as milestones, instead of connecting activities which are not time-phased.

- Several of the schedule activities are logically tied to activities indicated as "Completion Milestones", which are not time-phased activities. In the summary schedule, for example, there are two OU4 completion indicators (same activity ID's) reflecting logic ties to different activities. This is also true for OU5. The schedules should be more specific and indicate what the exact successors are for any given activity, primarily at the detailed level. This was also demonstrated in the detailed schedules.

- There is no clear justification for the correlation for several of the schedule activities. Some of the unclear logic ties between these activities include the following: Activity ID 1H32100401, "OU4 Determine Quantity of Waste to be Stored in EWMF" is logically tied to the submittal of the Draft ROD to EPA, Activity ID 4RODM905 and the receipt of EPA's comments on the Draft ROD; Activity ID 5B15X01101, Submit OU5 Draft FS/PP to DOE is logically tied to OU3 FS Submittal to DOE, Activity ID 3B15X01101; and Activity ID 2B15X02235, Prepare Draft FS/PP is logically tied to Activity ID 1B11300100, Submit Draft OU1 FS Report to DOE/FN.

- There are not any Remedial Design/Removal Action Work Plans (RD/RA Work Plans) reflected in the summary schedule. These plans should be indicated as milestones on the summary schedule, because they are interdependent of the specific Operable Unit RODs. Per the Consent Agreement, the RD Work Plan should be submitted sixty (60) days following the finalization of the RODs. Accordingly, the submittal dates for the RA Work Plan will be established in the RD Work Plan.

- Activity ID 4VP1M038, Start Phase I Pilot Plant Operations, is occurring in FY 1995, which is before the Completion of the EWMF Design, Activity ID 1H32300260, FY 1997.

- The following EWMF related activities are not logically tied to anything: Activity ID 1H32300200, EWMF Operations Planning; Activity ID 1H32300260, EWMF Operational Readiness Review; and Activity ID 1H32300280, EWMF Training Plan. These activities should precede the commencement of EWMF operations, Activity ID 1H32300210.

- There were no schedules provided for 16-C3 or 68-D1.

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Comments on the Site-Wide Integrated Master Schedule and the Operable Unit Level IV Schedules

- It is not clear what scope of work the Work Plan in Activity ID EA02F01601, pertains to. It is also unclear why this activity is logically tied to the OU3 Draft ROD to EPA, Activity ID 3B19X01603.

- It is not clear why the majority of the OU2 schedule activities are on the critical path, primarily the Remediation Phases of the Solid Waste Landfill, the Lime Sludge Ponds, the South Fields, and the Active and Inactive Flyash Piles. These activities are not on the critical path on the detail schedules for OU2.

- Activity ID 1H32100810, Complete EWMF Design, should be logically tied to Activity ID 1H32300100, EWMF Operations. Design of the EWMF facility will definitely drive the commencement of the operations.

- There are no activities or milestones included in the summary schedule for the Soil Washing Decontamination facility and the Central Storage Facility. This activity should be reflected on the summary schedule and also demonstrate the logic ties between interdependent OU activities. Additionally, interdependent logic ties should be demonstrated for the EWMF facility, the Soil Washing facility, and the Central Storage Facility.

OPERABLE UNIT 1

- This schedule is the same as that given in the Operable Unit 1 (OU1) Baseline Blue Book of September 1993, which contains a sufficient number of serious problems that it is of no value to the project. Some of the specific comments below were discussed at the baseline comment review meeting held at the FEMP site on October 19-20, 1993. These comments concern the duration and sequencing of activities within OU1, as well as the logic ties to other operable units. The activity duration and sequencing problems are of particular concern because of dependency relationships among the activities. When the OU1 schedule comments are addressed satisfactorily, one result will be a lengthening of the schedule which, in the near term, will illustrate that the on-time completion of Amended Consent Agreement milestones is in jeopardy.

- The schedule does not reflect understanding of the review periods for primary documents as given by the Amended Consent Agreement (ACA). Activity No. 1B11100350, Receive EPA OU1 Draft RI Report Comments, allows EPA only 29 days after submission to complete its review. The ACA provides for a 60-day EPA review period for all primary documents, and the FEMP has no experience to indicate that EPA would complete a review in a significantly shorter period. Planning an important project schedule on this basis is likely to result in schedule failure. The OU1 schedule should include a 60-day EPA review period for all primary documents unless those periods are changed through negotiation and agreement with EPA.

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Comments on the Site-Wide Integrated Master Schedule and the Operable Unit Level IV Schedules

- There are several problems regarding sequencing of dependent activities. Activity No. 1B11300200, Submit Draft OU1 FS/PP to EM-1, is incorrect in three respects. First, the document would not be submitted to EM-1; it would be submitted to the DOE-HQ Program Office. Second, it would be submitted to DOE-FN and DOE-HQ simultaneously for parallel review, on November 9, 1993, in this case. Third, if sequential review were to be used within DOE, the DOE-FN comments would be incorporated before submission to DOE-HQ; otherwise, there would be no value in sequential review. Subsequent to the November 9, 1993, date, only 19 days are allotted for completion of the DOE-HQ review and incorporation of the comments before the document is submitted to the EPA in Activity No. 1B31130300, whereas 29 days are allotted later for incorporation of EPA comments (Activity No. 1B11200210), even though experience indicates that DOE comments are likely to be more extensive.

- The schedule presents a major problem in its failure to include public review of the Proposed Plan. Further, it shows Activity No. 1B31130400, Submit Final Draft FS/PP Report to EPA, occurring on April 29, 1994, but also shows submission of a Responsiveness Summary to DOE-FN three weeks earlier on April 5, 1994. A public review period would follow EPA review and approval of a FS/PP. In addition, a Responsiveness Summary (RS) is a result of public review of a document; if there is no public review, there can be no RS. These schedule discrepancies must be resolved.

- This schedule contains a number of "CRU 1 Completion Milestones" labeled Z199999999 that are undefined. Their meaning must be specified.

- The schedule shows a logic tie between OU1 and OU2, with the OU2 Activity No. 2B15X01150, Submit OU2 Draft FS/PP to DOE, on the critical path and dependent upon OU1 Activity No. 1B11400010, Submit Final Draft Treatability Report to DOE-FN. This is incorrect; there are no dependency relationships between OU1 and OU2.

- The dependency relationships between OU1 and OU4 are only partially correct, in that there are logic ties, but they are shown incorrectly. One is between OU4 Activity No. 4RFSM910, Submit Draft FS/PP/EIS to EPA, and OU1 Activity No. 1B11200210, Complete OU1 FS/PP, where the schedule indicates that the OU4 activity is a predecessor to the OU1 activity. However, the OU1 schedule chart shows that the OU4 activity is completed 2 months later than the dependent OU1 activity. The other logic tie between the two is that following OU4 Activity No. 4RODM905, Submit Draft ROD to EPA (CA), which leads to a milestone "OU4 Determine Qty. of Waste to be Stored in EWMF." This latter OU4 activity is identified on the schedule chart by OU1 Activity No. 1H32100401 rather than by an OU4 activity number. Further, this OU4 activity is not connected to anything in the OU1 schedule, i.e., it is simply left dangling. It should probably be connected to OU1 Activity No. 1H32100800, EWMF Design. The logic tie should be shown correctly and completely.

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Comments on the Site-Wide Integrated Master Schedule and the Operable Unit Level IV Schedules

- The logic tie between OU1 and OU5 is shown as OU1 Activity No. 1H13100201, Soil Washing/WWTF On-Line (OU-5); however, it is not connected to anything in the OU1 schedule, it is left dangling on the time line. The logic tie needs to be shown correctly and completely.

- OU1 Activity No. 1H11200600, DOE Approve & Submit Draft RD Workplan to EPA, is shown as occurring in February 1995. It is immediately followed by Activity No. 1H11200002, Submit OU1 Draft RD Workplan to EPA (CA). It appears that there are two activities to accomplish the same thing; one would seem to be enough. The other problem here is that the Amended Consent Agreement requires that these workplans be submitted to EPA within 60 days after signing of the ROD; however, the schedule shows that the OU1 ROD is signed in March 1995, i.e., the month <u>after</u> submission of the RD Workplan.

- The schedule shows two apparently unrelated OU1 EWMF engineering certification activities, Activities Nos. 1H21200110 and 1H21200105. The first is labeled "Complete EWMF Engineering Certification," and occurs in January 1998. The second is labeled "EWMF Engineering Certification (Vaults 2-17), begins in May 1998 and extends at least through FY 2002. The relationship between these two needs to be indicated, especially since the first simply states "complete."

<u>OPERABLE UNIT 2</u>

- None of the RI milestones contained in the detailed schedule are shown on the summary schedule.

- There are not any predecessors for Activity ID 2B15X02235, OU2 Draft FS/PP, on Page 1 of 3. This milestone should be a successor to the RI process.

- Activity ID 2B19X01604, Submit Responsiveness Summary, should be logically tied to the OU2 Public Comment Period. The detailed schedule (and also the schedule in the baseline) indicates that the Responsiveness Summary will be submitted one day following the Public Comment Period.

- Activity ID 2B15X02600, EPA OU2 Draft FS/PP Review/Comment/Approve, is approximately three months, when instead EPA should only be allowed to review this document for sixty (60) days. Additionally, the receipt of EPA's comments is indicated as June of 1994, when the review period is from May 1994 to September 1994. Activity ID 2B06X02520, EPA OU2 RI Review and Approve is approximately three months. As indicated in previous baseline comments, the EPA review period should be thirty (30) days for secondary documents and sixty (60) days for primary documents.

- There are not any logic ties demonstrated on Page 2 of 3 of the OU2 summary schedules between the Final ROD submittal to EPA and the RD/RA Work Plans.

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Comments on the Site-Wide Integrated Master Schedule and the Operable Unit Level IV Schedules

- There is no clear justification of the logic ties between the OU2 Draft RI, Activity ID 2B06X01625, and OU5 Draft FS/PP, Activity ID 5B15X01101. The logic tie between the same OU2 activity and OU1 Submit Draft FS Report, Activity ID 1B11300100, is also unclear. It appears that these activities are logically tied together for convenience only.

- Activity ID 2R25E02H00, CRU management, should be a hammock activity extending through the life of the project for OU2 activities.

- None of the Remedial Action activities are going beyond the CFC phase. None of the Remedial Action design activities (including Solid Waste Landfill, Active and Inactive Flyash Pile, South Field, and Lime Sludge Ponds) are tied as predecessors to the actual Remediation phase.

OPERABLE UNIT 3

- The schedule does not have any logic ties between activity 3B03X02000 (field investigation) and activity 3B06X02000 (remedial investigation).

- The schedule does not have any logic ties between activity 3B05X02000 (treatability study) and activity 3B06X02000 (remedial investigation).

- Activity 3B06X02000 (remedial investigation) should be a hammock activity with several activities tied to it. Activity 3B06X02000 (remedial investigation) is only tied to CRU 3 completion milestone.

- Activity 3B08X02000 (interim RD/RA work plan) is not tied to anything.

- Most activities are tied to only one thing - CRU 3 completion milestone.

OPERABLE UNIT 4

- The schedule does not have any logic ties between activity 4JP20258 (Vitrification Pilot Plant Phase II Construction) and activity 4JP20267 (Phase II Operations).

- The schedule does not have any logic ties between activity 4RFS0500 (FS/PP/EIS Public Comment Period) and milestone 4RFSM940 (Submit Responsiveness Summary to DOE). The responsiveness summary is a document that summarizes the response to public comments.

- The schedule does not have any logic ties between activity 4CRD0107 (DOE-FN Review RD Work Plan) and activity 4CRD0111 (DOE-FN Approve RD Work Plan/Submit to EPA).

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Comments on the Site-Wide Integrated Master Schedule
and the Operable Unit Level IV Schedules

- OU1 activity 1H32100810 (Complete EWMF Design) is inappropriately tied as a successor to OU4 milestone 4VP1M038 (Start Phase I Pilot Plant Operations). Additionally, the OU1 activity cited above is shown as critical path and occurring early in FY 96 on the OU4 schedule, but is shown as a milestone occurring late in FY 97 on the integrated logic tie schedule. Further, the OU1 activity 1H32100401 (OU4 Determine Qty of Waste to be Stored in EWMF) shown on the OU4 schedule does not have any logic ties to 1H32100810 (Complete EWMF Design).

- The schedule sheet that shows inter-dependent ties inappropriately depicts the OU4 milestone 4CP3MM61 (Start Removal/Treatment of Silo Contents) as a predecessor to the OU1 activity 1H32300210 (Complete EWMF Operations Planning) and shows it occurring in early FY 99. Additionally, the OU4 schedule shows the 4CP3MM61 milestone as occurring in FY 97.

- The schedules inappropriately show milestone 4CP3M39 (DOE Approves FSAR for Silo Content Removal/Treatment) as a predecessor for OU1 activity 1H13200302 (Modify Vit Plant Construction Per OU1 Design). Modification of the OU4 vitrification plant to process OU1 wastes cannot begin until milestone 4CP3MM69 (Complete Removal/Treatment of Silo Contents) occurs.

OPERABLE UNIT 5

- Milestones reflecting RI and FS/PP development are not tied to any activity bars reflecting report preparation.

- The schedule does not have any logic ties between RI sampling completion milestone and preparation of RI report.

- The schedule does not have any logic ties between internal RI development milestones and DOE comments.

- There is no clear distinction between Removal Action 1 and Perched Water Removal Action.

- The schedule does not show a design period for Phase IV of AWWT.

- The schedule does not show a design period for Part B of Soil Decon Plant.

- The schedule does not have any logic ties between South Plume Recovery Well Access Road and any aspect of South Plume Removal Action.

- The schedule does not have any logic ties between any Phase of AWWTP and the Soil Decon Plant (Parts A or B). Instead, the OU5 ROD is linked to the Construction of the AWWTP, Phase III.

- The OU5 Soil Decon Plant not represented on the summary schedule. This activity is critical to disposal of contaminated soils from other OU's.

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Comments on the Site-Wide Integrated Master Schedule and the Operable Unit Level IV Schedules

- There is no logic tie between designing the Soil Decon Plant (OU5) and development of soil volume estimates from other OU's.

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