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GROUNDWATER REMEDY EVALUATION AND FIELD VERIFICATION PLAN

FERNALD CLOSURE PROJECT
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LIST OF ACRONYMS AND ABBREVIATIONS

SSOD	Storm Sewer Outfall Ditch
AWWT	Advanced Wastewater Treatment
CAWWT	Converted Advanced Wastewater Treatment
DOE	Department of Energy
OSDF	On-Site Disposal Facility
GMA	Great Miami Aquifer
WSA	Waste Storage Area
SPIT	South Plume Interim Treatment
IAWWT	Interim Advanced Wastewater Treatment
D&D	Demolition and Disposal
AMSL	Above Mean Sea Level
SER	Site Environmental Report
Kd	Partition Coefficient
EPA	U.S. Environmental Protection Agency
OEPA	Ohio Environmental Protection Agency
IEMP	Integrated Environmental Monitoring Plan
gpm	gallons per minute
μg/L	micrograms per liter

1.0 INTRODUCTION

This Groundwater Remedy Evaluation and Field Verification Plan evaluated two groundwater remedy approaches for the restoration of the Great Miami Aquifer at the Fernald Site for use after modification of the AWWT is initiated. The two groundwater remedy approaches are; 1) A remedy without well-based reinjection, and 2) A remedy without well-based re-injection that includes induced recharge through the SSOD at a rate of 500 gpm. Field methods are outlined that will be used to verify model predictions and assess operational uncertainties associated with the approaches.

This plan fulfills two commitments made by DOE to the U.S. and Ohio EPA in a letter dated May 5, 2004 (DOE-0247-04) concerning the benefits associated with the "carve-down" of the Advanced Wastewater Treatment (AWWT) facility. The two commitments were to prepare a Capture Zone Evaluation Test Plan, and a Storm Sewer Outfall Ditch (SSOD) Re-Injection Test Plan.

Section 2 presents groundwater modeling for a groundwater remedy approach that does not contain well-based re-injection. Section 3 presents groundwater modeling for a groundwater remedy approach that has induced recharge through the SSOD. Section 4 provides a summary of modeling results and presents recommendations. Section 5 presents a field verification plan for:

- Achieving capture of the 30 μg/L uranium plume without well-based re-injection.
- Evaluating the capability of the SSOD and its tributaries to serve as a pathway for 500 gpm of induced recharge to the Great Miami Aquifer.
- Confirming that long-term pumping from the construction wells on the east side of the Fernald Site will not detrimentally affect plume capture.
- Achieving capture of the 30 μg/L uranium plume without well-based re-injection but with induced recharge at 500 gpm down the SSOD and its tributaries; and

1.1 BACKGROUND

With site closure in 2006, several water treatment flows will be eliminated or reduced (i.e. remediation wastewater, sanitary wastewater, storm water runoff) from the scope of the treatment operation. Elimination/reduction of these flow streams provides an opportunity to reduce the size of the water treatment facility that will remain to service the aquifer restoration after site closure. Reducing the size of the treatment facility prior to site closure in 2006 will reduce the amount of impacted materials that may need future off-site disposal. The 1,800 gpm Phase III expansion system of the AWWT will remain, but about 90 percent of the existing facility footprint will be dismantled and placed in the on-site disposal

facility (OSDF). The subsequent placement of the affected debris and underlying soils in the OSDF will be completed in time to meet the 2006 site closure schedule, and result in a protective, more cost effective long term water treatment facility to complete aquifer restoration.

In addition to decreasing the size of the water treatment facility, operational approaches to the aquifer remedy are also under evaluation to determine if a more efficient way of remediating the aquifer can be found. Scenarios under evaluation include:

- Stopping well-based re-injection
- Induced recharge of water through the Storm Sewer Outfall ditch (SSOD)

The current aquifer remedy design is presented as Scenario 1 in the Comprehensive Groundwater Strategy Report. Currently there are 22 extraction wells, 7 re-injection wells, and one injection pond, with plans for the installation of two more extraction wells in the Waste Storage Area (WSA-5 and WSA-6) once source removal excavations are complete in that area (see Figure 1.1).

Groundwater modeling presented in the Comprehensive Groundwater Strategy Report (June 2003) predicts that continued use of large-scale re-injection using current re-injection wells would shorten the aquifer remedy by 4 years, (comparison of Alternatives 1 and 6). These results indicate minimal benefit to maintaining the infrastructure for large-scale well-based re-injection.

Re-Injection is scheduled for shut down in September of 2004 to facilitate the "carve down" of the AWWT into the CAWWT. During CAWWT construction, groundwater treatment capacity will be limited and not enough treated groundwater will be available to support well-based re-injection. The decision has been made to not re-start well-based re-injection after completion of CAWWT. Instead, operations will proceed without well-based re-injection and other operational strategies to enhance the aquifer remedy will be explored, such as inducing recharge to the GMA through the SSOD. Post CAWWT-construction pumping rates will be established in a new groundwater remedy design, pending outcome of field verification activities outlined in Section 5.

In support of the decision to stop large-scale well-based re-injection, groundwater modeling was conducted to predict what would be needed to capture the 30 ug/L uranium plume without well-based re-injection. The initial plume used in the groundwater model was updated with all available monitoring data in order to support this study. The first modeling run resulted in predicted capture of the 30 ug/L uranium plume. These modeling results are presented in Section 2. Additional groundwater modeling

was then conducted to assess the added benefit gained by inducing recharge at a rate of 500 gpm down the SSOD. These modeling results are presented in Section 3

Modeling results and information gathered from field verification exercises outlined in this document will be considered in a final design that will be selected as the path forward for the Aquifer Remedy. Once a final remedy design has been selected, a design document will be issued. If the outcome of the SSOD test is that induced recharge down the SSOD does not provide enough benefit to pursue, DOE will continue to evaluate other methods for improving remedy performance.

2.0 AQUIFER REMEDY WITH NO RE-INJECTION

This approach (designated Approach C) evolved from Scenario 2 of the Comprehensive Groundwater Strategy Report. For modeling purposes, Approach C was divided into five pumping rate periods, Table 2.1.1. Important modeling dates for these pumping periods are;

- 10/1/04, Begin construction of the CAWWT
- 4/1/05, Begin full-scale operation of CAWWT. CAWWT could be ready for operation as early s February 2005.
- 4/1/06, Begin operation of WSA Phase II wells
- 4/1/12, Model prediction that clean-up goals reached off property.

Approach C was developed assuming a groundwater treatment capacity of 800 gpm from SPIT and IAWWT. A treatment capacity of 1200+ gpm will initially be available from CAWWT. At site closure, the CAWWT will provide up to 1800 GPM capacity for groundwater. Although Approach C cannot serve as a final design for the remedy, it can be used to demonstrate cleanup without large scale well-based re-injection. Post CAWWT pumping rates will be established in a new groundwater remedy design, pending outcome of field verification activities outlined in Section 5.

2.1 FLOW MODEL RESULTS

The large VAM3D model (120 x 112 x 12) was used to set boundary conditions for the zoom model. For each pumping period, the large VAM3D model was run to steady state. Steady state head values from the large model at nodes closest to the zoom model boundary nodes were assigned to the zoom model using a FORTRAN program. The zoom model was then run to steady state with the constant head boundaries derived from the larger model.

As discussed in Section 3.2 of the Conceptual Design for Remediation of the Great Miami Aquifer in the Waste Storage and Plant 6 Areas (DOE 2000a), the large VAM3D flow model has been calibrated to an October 1998 groundwater monitoring data set (nominal aquifer conditions). Validation was done to wet and dry season data sets from July 1998 and October 1999, respectively. Predicted groundwater elevations for Approach C are shown for nominal boundary conditions.

Figures 2.1.1 through 2.1.5 show the predicted groundwater elevations for each pumping time period defined in Approach C. Figures 2.1.6 through 2.1.12 show 10-year time-of-travel, non-retarded, particle paths for each pumping time period defined in Approach C. The particles in these figures were seeded in the model at the 30 µg/L uranium plume boundary at an elevation of 510 feet AMSL corresponding to the elevation in the plume where the highest levels of contamination are situated. The 30 µg/L uranium plume shown in Figures 2.1.6 through 2.1.11 is the maximum uranium plume reported for the second half

2003 in the 2003 Site Environmental Report (SER). As discussed in Section 2.2, under Approach C the South Plume, south of Willey Road, will be remediated by the year 2012, at which time pumping from the South Plume Wells will end. Therefore, Figure 2.1.12 (for time period 2012 to the end of the remedy) illustrates capture using the model predicted 30 µg/L uranium plume for the year 2012. The particle path figures illustrate capture of the 30 µg/L uranium plume, at 510 feet AMSL, throughout the aquifer remedy using the pumping rates defined for Approach C. Using the 2003 maximum plume definition to illustrate capture up to year 2012 is conservative in that the plume footprint will actually decrease as the cleanup proceeds. With the exception of Figures 2.1.8 and 2.1.9 all of the particle paths are run under nominal boundary conditions. Particle tracks were also run for the CAWWT construction time period for wet and dry boundary conditions in order to illustrate predicted capture under these boundary conditions as well. Figure 2.1.8 is run for the CAWWT construction time period using dry boundary conditions from October 1999. Figure 2.1.9 is run for the CAWWT construction time period using wet boundary conditions from July 1998.

Particle tracking also indicates that if the re-injection wells are turned off stagnation effects between the South Plume and South Field Extraction Wells will increase. Three additional particle path figures (Figures 2.1.13 to 2.1.15) illustrate this prediction. Particles in Figures 2.1.13 and 2.1.14 were seeded at the extraction wells and tracked backwards to determine zones of influence for each extraction well. Figure 2.1.13 illustrates capture with re-injection. It depicts 10-year time-of-travel particle paths for the groundwater remedy based on target pumping and re-injection rates for 2003. The figure illustrates that re-injection serves to help minimize the stagnation effect by flushing out the area of stagnation. Figure 2.1.14 illustrates capture patterns without re-injection. Without re-injection the model predicts that the stagnation-effect will increases because flushing in the area from the re-injection wells is not taking place. Figure 2.1.15 provides a different view of this model prediction. Figure 2.1.15 is a 10-year, time-of-travel plot, with forward particle tracks, using pumping rates that are planned for the CAWT Construction Time Period. Particles were seeded along Willey Road at an elevation of 510 feet amsl and 520 feet amsl. using nominal boundary conditions. The particle tracks again show an area of stagnation between the South Field and South Plume Extraction Wells.

2.2 TRANSPORT MODEL RESULTS

The VAM3D transport model was run to estimate how the Approach C Design would perform given the observed aquifer concentrations (initial conditions) and the contaminant source terms remaining. Transport runs were made with nominal boundary conditions. A constant Kd of 3.0 liters per kilogram was used for all transport runs. A Kd of 3 liters per kilogram was also used in the Comprehensive Groundwater Strategy Report. Additional information concerning the use of a Kd of 3 liters per kilogram is provided in the Comprehensive Groundwater Strategy Report.

2.2.1 Initial Conditions

As part of a continuing effort to improve transport predictions of wellhead concentrations, and in response to recent informal comments from EPA and OEPA regarding transport model calibration, initial conditions in the model have been updated to reflect the most recent data as of 12/31/03 (compared with 12/31/02 initial conditions in the GW Strategy Report). A comparison of initial conditions modeled for 12-31-02 (updated with one year of modeling) with initial conditions for 12-31-03 is provided in Figure 2.2.1. The 12/31/03 initial conditions show higher uranium concentrations then the 12/31/02 initial conditions. Wellhead concentrations predicted from VAM3D transport runs are in closer agreement to observed concentrations when the most recent data are used as initial conditions and when that data is Kriged with smaller horizontal and vertical ranges. An unexpected benefit to this re-evaluation and updating of initial conditions is a reduction in predicted clean up times by approximately 4 to 5 years over modeling results previously presented in the Comprehensive Groundwater Strategy Report.

The transport model was run with initial conditions for total uranium developed from Kriged monitoring data. The data used for Kriging is current through 2003. The average uranium concentration measured in 2003 at each groundwater monitoring well was combined with a data set containing all available direct-push sampling data through 2003 for the update. Where more recent direct-push sampling data overlapped with older data at the same location, the more recent data were used.

The input total uranium data were Kriged using a 300-foot horizontal search radius and a 20-foot horizontal to vertical anisotropy ratio for an effective vertical search radius of 15 feet. These shorter ranges for Kriging search radii are made possible because of the close horizontal and vertical sampling intervals for direct push samples. Figures 2.2.1 and 2.2.2 show the horizontal and vertical semi-variograms for the input total uranium data. Kriging results used as initial conditions for the zoom model are shown in Figures 2.2.3 through 2.2.6 for model layers 9 through 12.

2.2.2 Transport Model Source Terms

Operable Unit 5 remedial investigation/feasibility study source terms corresponding to sources in the Storm Sewer Outfall Ditch, and WPRAP source terms were retained in the model through year 2006. After 2006, these source terms were removed assuming the complete remediation of all contaminated Fernald Site soils.

2.2.3 Predicted Total Uranium Concentrations

Figures 2.2.7 through 2.2.15 show predicted total uranium concentrations in zoom model layers 11 and 12 at the end of each pumping period under nominal flow boundary conditions. As seen in Figure 2.2.15, the total uranium concentrations in the aquifer are below 30 µg/L in 2020 except in a small area near the Pilot Plant Drainage Ditch. Total uranium concentrations in this area drop below 30 µg/L between 2022 and 2023. Concentrations are shown in zoom model layers 11 and 12 because these two layers contain most of the 30 µg/L uranium plume.

2.3 APPROACH C MODELING CONCLUSIONS

Modeling results indicate that the Operable Unit 5 Record of Decision established target-pumping rate of 4000 gpm can be met or exceeded using Approach C.

Modeling results indicate that the OU5 Record of Decision established discharge limits could be met with pumping rates defined for Approach C.

Particle path figures predict capture of the 30 µg/L uranium plume throughout the life of the aquifer remedy using the pumping rates defined for Approach C. These results are considered conservative in that Approach C only provides for 800 gpm groundwater treatment and up to 1800 gpm will actually be available. This means that higher pumping rates could actually be achieved, which should increase capture and reduce clean up times.

Without re-injection along Willey Road, pumping from the South Field Extraction wells competes for water with the South Plume Optimization Wells creating an area of stagnation along Willey Road. The particle tracks indicate that once large-scale well-based re-injection is discontinued, more attention will need to be given to the area along Willey Road in order to disrupt the stagnation zone as much as possible through actions like pulsed pumping. Evaluation of this stagnation zone area will be limited due to it being under private property and in an area with very few existing monitoring wells. When re-injection is turned off, direct-push sampling should be conducted periodically to assess remediation progress in the area where the stagnation zone is predicted. Additional monitoring wells should also be installed, if landowner permission can be obtained. Direct-push sampling and monitoring of any additional monitoring wells should be handled through the IEMP specified Remedy Performance Monitoring.

Modeled aquifer cleanup for Approach C occurs between 2022 and 2023.

Direct comparison of modeling results from Approach C to modeling results presented in the Comprehensive Groundwater Strategy Report should take into consideration that initial conditions and Kriging used for Approach C have changed from what was used in the Comprehensive Groundwater Strategy Report. See discussion in Section 2.2.1.

3.0 AQUIFER REMEDY WITH INDUCED RECHARGE THROUGH THE SSOD

This approach is referred to as Approach C-Improved. Approach C-Improved enhances Approach C by adding 500 gpm of induced recharge down the SSOD. If implemented, groundwater pumped from construction wells, located on the east side of the Fernald Site property, would be conveyed to the head of the SSOD and allowed to flow into the SSOD at a rate of 500 gpm see Figure 3.1

Approach C-Improved is also based on a groundwater treatment capacity of 800 gpm. As discussed in Section 2 for Approach C, Approach C-Improved cannot serve as a final design for the remedy, but it can be used to demonstrate how the remedy will respond if an induced recharge of 500 gpm through the SSOD is added to the clean-up operation.

3.1 FLOW MODEL RESULTS

The procedure used to model flow in Approach C was also used for Approach C-Improved. The large VAM3D model was used to set boundary conditions for the zoom model. For each pumping time period, the large VAM3D model was run to steady state. Steady state head values from the large model at nodes closest to the zoom model boundary nodes were assigned to the zoom model using a FORTRAN program. The zoom model was then run to steady state with the constant head boundaries derived from the larger model. Predicted groundwater elevations for the Approach C-Improved design are shown for nominal boundary conditions.

Pumping rates for Approach C-Improved are provided in Table 3.1.1. The first two pumping periods (1/1/04 to 10/1/04 and 10/1/04 to 4/1/05) have the same pumping rates as those defined for Approach C (See Section 2). Pumping rates in the last three time periods differ from those defined for Approach C in that Approach C-Improved contains induced recharge through the SSOD at a rate of 500 gpm and some higher pumping rates. The pumping rates in the last three pumping periods of Approach C-Improved are higher than the last three pumping periods of Approach-C because induced recharge into the SSOD allows more pumping from the aquifer without increasing the net extraction rate from the aquifer.

Figures 3.1.1 through 3.1.3 show the predicted groundwater elevations for the last three pumping periods for Approach C-Improved, Model Layer 12. Figures 3.1.4 through 3.1.6 show 10-year time-of-travel, non-retarded, particle paths for the last three pumping periods. The particles modeled for these figures were seeded in the same manner as for Approach C. The 30 μg/L uranium plume shown in Figures 3.1.4 through 3.1.5 is the same maximum uranium plume shown for Approach C. The particle path figures

illustrate capture at the edge of the 30 µg/L uranium plume, at 510 feet amsl, throughout the life of the aquifer remedy using the pumping rates defined for Approach C-Improved. Using the 2003 maximum plume definition to illustrate capture throughout the life of the remedy is conservative, in that the plume footprint will actually decrease as the cleanup proceeds. As discussed in Section 2.2, under Approach C the South Plume, south of Willey Road, will be remediated by the year 2012, at which time pumping from the South Plume Wells will end. Therefore, Figure 3.1.6 (for time period 2012 to the end of the remedy) illustrates capture using the model predicted 30 µg/L uranium plume for the year 2012.

3.2 TRANSPORT MODEL RESULTS

VAM3D transport model scenarios were run to estimate how the Approach C-Improved Design would perform given the observed aquifer concentrations (initial conditions) and the contaminant source terms remaining. Transport runs were made with all three sets of boundary conditions corresponding to nominal, wet, and dry periods. As in Approach C, a constant Kd of 3.0 liters per kilogram was used for all groundwater model transport runs. A Kd of 3 liters per kilogram was also used in the Comprehensive Groundwater Strategy Report. Additional information concerning the use of a Kd of 3 liters per kilogram is provided in the Comprehensive Groundwater Strategy Report.

3.2.1 Initial Conditions

The same initial conditions used for Approach C were also used for Approach C-Improved. See Section 2 for more details.

3.2.2 Transport Model Source Terms

Source terms for Approach C-Improved were the same as those used for Approach C, with the exception of the SSOD. A conservative source term of 5 ppb was used for the water being injected into the SSOD beginning in 4/1/05 and proceeding until the end of the remedy. Figure 3.2.1 illustrates how the recharge in the SSOD was distributed to model blocks in the VAM3D Zoom Model. Selection of these nodes in the model corresponds to the approximate location in the SSOD where the glacial overburden is no longer present (OU5 RI Report, Figure 3-26).

3.2.3 Predicted Total Uranium Concentrations

Figures 3.2.2 through 3.2.6 show predicted total uranium concentrations in zoom model layers 11 and 12 at the end of the last three pumping periods of Approach C-Improved. The model was run with nominal flow boundary conditions corresponding to the October 1998 calibration conditions. As shown in Figure 3.1.6, the total uranium concentrations in the aquifer in 2020 are below 30 µg/L except in a small

area near the Pilot Plant Drainage Ditch. Total uranium concentrations in this area drops below 30 μg/L between 2021 and 2022. Concentrations are shown in zoom model layers 11 and 12 because these two layers contain most of the 30 μg/L uranium plume.

3.3 APPROACH C-IMPROVED MODELING CONCLUSIONS

Modeling results indicate that the Operable Unit 5 Record of Decision established target-pumping rate of 4000 gpm can be met or exceeded using Approach C-Improved.

Modeling results indicate that the OU5 Record of Decision established discharge limits would not be met with pumping rates defined for Approach C-Improved when the CAWWT is operational. This reflects a modeled groundwater treatment capacity of 800 gpm though, when 1200+ gpm will actually be available. The field verification exercise in Section 5 will be used to demonstrate what pumping rates should be used for Approach C-Improved that will achieve best capture of the 30 ug/L uranium plume. Once these new rates are modeled using 1200+ gpm treatment capacity it is felt that discharge limits will be safely met.

Particle path figures predict capture of the 30 μg/L uranium plume throughout the life of the aquifer remedy using the pumping rates defined for Approach C-Improved. These results are considered conservative in that Approach C-Improved only provides for 800 gpm groundwater treatment and up to 1800 gpm will actually be available. This means that higher pumping rates could actually be achieved which should increase capture.

Modeled aquifer cleanup for Approach C-Improved occurs between 2021 and 2022.

It is unknown if the SSOD is capable of delivering 500 gpm recharge to the aquifer, or if some or most of the flow would just be carried off through the SSOD and into Paddys Run. Actual volumes of recharge will be quantified via the field verification plan presented in Section 5.

Direct comparison of results from Approach C-Improved to results presented in the Comprehensive Groundwater Strategy Report should take into consideration that initial conditions and Kriging used for Approach C-Improved have changed from what was used in the Comprehensive Groundwater Strategy Report.

4.0 CONCLUSIONS AND RECOMMENDATIONS

4.1 CONCLUSIONS

- Modeling results indicate that the Operable Unit 5 Record of Decision established target-pumping rate of 4000 gpm can be met or exceeded using either Approach C or Approach C-Improved.

- Modeling results indicate that the OU5 Record of Decision established discharge limits could be met with pumping rates defined for Approach C.

- Modeling results indicate that the OU5 Record of Decision established discharge limits would not be met with pumping rates defined for Approach C-Improved during the period from 4/1/05 to 4/1/06. This reflects a modeled groundwater treatment capacity of 800 gpm though, when 1200+ gpm will actually be available. The field verification exercise in Section 5 will be used to demonstrate what pumping rates should be used for Approach C-Improved during this time period to achieve best capture of the 30 ug/L uranium plume. Once these new rates are modeled using 1200+ gpm treatment capacity the prediction should be that discharge limits will be safely met. However, pumping rates will be adjusted if necessary to meet discharge limits at the Parshall Flume.

- Table 4.1.1 presents cleanup times predicted for each approach. Comparison of Alternatives 1 and 6 from the Comprehensive Groundwater Strategy Report indicates that stopping well-based re-injection will increase overall cleanup times by 4 years.

- Without well-based re-injection (Approach C) predicted cleanup of the aquifer occurs between 2022 and 2023. If induced recharge down the SSOD at a rate of 500 gpm is added to the remedy (Approach C-Improved) predicted cleanup occurs between 2021 and 2022. Adding induced recharge down the SSOD at a rate of 500 gpm to the remedy decreases the predicted clean up time by one year

- Comparison of results from either Approach C or C-Improved to results presented in the Comprehensive Groundwater Strategy Report should take into consideration that initial conditions and Kriging used for Approach C and C-Improved have changed from what was used for modeling done in support of the Comprehensive Groundwater Strategy Report.

- Particle track figures for Approach C and Approach C-Improved predict that capture of the 30 µg/L uranium plume will be maintained throughout the life of the aquifer remedy without well-based re-injection and with or without induced recharge at a rate of 500 gpm through the SSOD.

- Because capture is predicted throughout the aquifer remedy for Approach C-Improved, it is concluded that pumping construction wells on the east side of the Fernald Site property to obtain recharge water for the SSOD will not detrimentally affect plume gradients and flow patterns associated with the aquifer remedy.

- It is unknown if the SSOD is capable of delivering 500 gpm recharge to the aquifer, or if some or most of the flow would just be carried off through the SSOD and into Paddys Run. Actual volume of recharge will be quantified via the field verification plan presented in Section 5.

- Modeling predicts that without reinjection along Willey Road pumping from the South Field Extraction wells will compete for water with pumping from the South Plume Optimization Wells, creating an area of stagnation. Particle track modeling indicates that when reinjection along Willey Road is discontinued, more attention will need to be given to the area during the remedy in order to disrupt the stagnation zone as much as possible through actions like pulsed pumping. Evaluation of this stagnation zone area is hindered due to its location being under private property and in an area with very few existing monitoring wells.

4.2 RECOMMENDATIONS

- Capture of the 30 µg/L uranium plume, without well based re-injection, should be verified in the field using pumping rates defined in the groundwater model for the time period when the CAWWT facility is under construction. The overall pumping rate would be 4575 gpm. If uranium plume capture is not verified, then pumping rates should be field adjusted in order to achieve on-property capture first, then off-property capture. Any field adjustments would be subject to treatment limitations in place during the testing period for maintaining uranium discharge limits at the Parshall Flume.

- Induced recharge at a rate of 500 gpm through the SSOD should be field verified to determine if such an operation is feasible. Given that the model indicates that 500 gpm recharge rate only shortens the remedy by approximately 1 year, it is doubtful that a recharge rate lower than 500 gpm would be beneficial. Therefore, if the SSOD is not capable of transmitting a minimum recharge rate of 500 gpm to the GMA, this operational approach should not be pursued. If induced recharge in the SSOD is not feasible, DOE will continue to evaluate other methods for improving remedy performance.

- Capture of the 30 µg/L uranium plume, without well based re-injection, but with 500 gpm induced recharge down the SSOD, should be verified in the field using pumping rates defined in Approach C-Improved for the first time interval when induced recharge is modeled (4/1/05 to 4/1/06). The total pumping rate would be 5275 gpm, but with induced recharge at a rate of 500 gpm, the net extraction rate is modeled at 4775 gpm. If uranium plume capture is not verified, then pumping rates should be field adjusted in order to achieve best on-property capture first, then best off-property capture. Any field adjustments would be subject to treatment limitations in place during the testing period for maintaining discharge limits at the Parshall Flume. Verifying capture under Approach C-Improved operational conditions will also verify that pumping the construction wells for a supply of induced recharge water for the SSOD does not have a detrimental impact on the aquifer remedy.

- When well-based re-injection is discontinued, special attention should be given to the area where stagnation is predicted. Lack of monitoring points in this area will hinder a detailed field verification of the presence of a stagnation area. Water level map interpretations should be used to try to define its presence. The installation of additional monitoring wells should be pursued, and a routine direct-push sampling effort should be defined and added to the Groundwater Remedy Performance Monitoring specified in the IEMP in order to more closely monitor restoration progress in this area.

- Information learned from the modeling presented in this document and the recommended field verification exercises defined above should be considered in the selection of a path forward for the aquifer remedy. Once an agreed to path is defined, a new design document should be issued with defined operational parameters.

5.0 FIELD VERIFICATION PLAN

Outlined below is a two-part field verification plan to support transitioning groundwater remedy operations from their current operational mode (that includes large-scale well-based re-injection operations) to a post CAWWT construction operational mode that will not include large-scale well-based re-injection operations.

Part I of the plan pertains to achieving capture of the 30 ug/L uranium plume without well-based re-injection. Large-scale, well-based re-injection in the existing re-injection wells will be stopped when construction of the CAWWT Begins. Pumping rates in the extraction wells will go from rates defined in Pumping Period 1 to rates defined in Pumping Period 2, see Tables 2.1.1 or 3.1.1. These two pumping periods are the same for both Approaches C and C-Improved. Pumping Period 1 is the period leading up to CAWWT construction. Pumping Period 2 is the period during CAWWT construction.

Part II of the plan pertains to verifying that induced recharge down the SSOD is feasible at a rate of 500 gpm, and verifying that best capture of the 30 ug/L uranium plume with 500 gpm induced recharge through the SSOD has been achieved. Modeling predicts that such an operation would shorten the aquifer remedy by 1 year.

Information learned from these field verification exercises will be used to:

- Establish new pumping rates for the groundwater remedy that result in best capture of the 30 μg/L total uranium plume without well-based re-injection.
- Determine if induced recharge through the SSOD at a rate of 500 gpm is feasible, and
- Conduct additional groundwater modeling that incorporates field verification results.

Part-I: Verification of plume capture after stopping well-based re-injection.

Part 1 of the verification plan will begin in September of 2004, just after large-scale well based re-injection into existing re-injection wells is stopped, and pumping rates defined for the CAWWT construction time period are implemented. During CAWWT construction groundwater treatment capacity will be limited. Only 1300 gpm of water treatment will be available. It is estimated that 700 gpm of this capacity will be available to treat groundwater.

September/October are usually low precipitation months. If large amounts of precipitation occur during the test, the test may need to be stopped because the objective is to verify capture under non-recharge conditions. Pumping rates for this time period were determined from the Testpump excel spreadsheet. The Testpump spreadsheet calculates a blended average outfall concentration given input of pumping rates, treatment capacities, and treatment effluent concentrations. Table 5.1 is the output from the Testpump spreadsheet that predicts an outfall concentration of approximately 26 μg/L during CAWWT construction.

Verification that capture of the 30 μg/L uranium plume is being maintained will be conducted by measuring water levels, constructing water table map(s), interpreting flow directions and capture from the map(s), and adjusting pumping rates (if needed) to achieve the best available capture. The procedure is outlined below.

- Water level transducers and data loggers will be installed 2 days prior to the shutdown of the re-injection wells in Monitoring Wells 22299, 22300, 22301, 22302, and 22303. Figure 5.1 shows the locations of these wells. These wells are located along Willey Road next to the original five re-injection wells (IW-8, IW-9, IW-10, IW-11, and IW-12). Transducers will monitor the resulting fall in water levels along Willey Road and provide a "tight look" at how much water level fall occurred and provide an indication of when the fall has stabilized.

- Well-based re-Injection will be stopped, and the pumping rates modeled for Approach C during the CAWWT construction time period will be implemented. This is the time period where pumping rates will probably be the lowest due to the low treatment capacity of 700 gpm available for groundwater. Table 2.1.1 indicates lower pumping rates in pumping period three, but in reality pumping is expected to be higher during this time period because groundwater treatment capacity will be 1200+ gpm rather than 800 gpm following construction of the CAWWT

- After water levels have been allowed to stabilize to the new pumping rates for two days, water levels will be measured in all IEMP water level monitoring wells. This task will be coordinated with routine IEMP water level measurement activities if possible.

- A water level map will be constructed using the collected water level measurements. Capture and flow interpretations will be made from the mapped data to determine if capture of the 30 μg/L uranium plume is being achieved.

- If capture interpretations indicate that capture is not being achieved, then pumping rates will be changed in an effort to achieve the best plume capture possible. The first objective will be to achieve the best possible capture of the on-property 30 μg/L uranium plume. The second objective will then be to achieve the best capture possible of the overall 30 μg/L uranium plume. If any pumping rate changes are made, the aquifer will be given two days to adjust before additional water level measurements are collected and capture zone interpretations are made.

- Individual well pumping rates defined for the CAWWT Construction Period are well below the maximum individual pumping rates that could be achieved, with the exception of SF-17. This well is not performing as well as it has in the past and may only be able to achieve a pumping rate of 250 gpm during the test.

- Once best capture has been verified and pumping rates for the best capture have been determined, the system will continue to operate using these rates, unless there is a problem with meeting the discharge limits at the Parshall Flume. Meeting discharge limits at the Parshall Flume will take precedence over maintaining target pumping rates or plume capture.

If capture of the 30 ug/L uranium plume cannot be verified in all areas using water level measurements the use of the colloidal boroscope and tracers in those areas will also be considered. Flow direction measurements using the colloidal boroscope would be attempted first; if they are inconclusive the use of tracers would be considered. Tracers would only be used with the approval of the U.S. and Ohio EPAs.

Upon completion of this first field verification exercise the remedy system will be calibrated to achieve the best possible plume capture, under reduced pumping conditions, without well-based re-injection, and within discharge limits at the Parshall Flume.

Part-II Assessment of Induced Recharge down the SSOD

The groundwater model predicts that if well-based re-injection in the existing re-injection wells is stopped, and induced recharge through the SSOD takes place a rate of 500 gpm, that the remedy would be shortened by 1 year and capture of the 30 μg/L uranium plume will be maintained. Flow model results also indicate that pumping Construction Well 42202 to provide 500 gpm for infiltration down the SSOD does not detrimentally affect plume gradients and flow patterns associated with the aquifer remedy. Part II focuses on verifying these predictions and determining if induced infiltration down the SSOD at a rate of 500 gpm is feasible. Demonstrating capture of the 30 ug/L uranium plume will also verify that the model predication concerning the pumping of Construction Well 42202 is correct in that pumping from it does not affect capture. The greatest unknown concerning this operational approach is whether an induced infiltration rate of 500 gpm can be delivered to the GMA through the SSOD. This unknown will be addressed first.

Part II will be conducted in the late fall of 2004 or early winter 2005. It will take place following the completion of Part 1. 500 gpm of flow into the SSOD will need to be established and maintained for the exercise and a means of measuring discharge from the SSOD will also need to be established. The set-up requirements and procedure are presented below.

Set-Up

A temporary line (6-inch flexible diameter tubing) will be used to convey pumped groundwater from Construction Well 42202 to a discharge point in the east fork of the SSOD. The west fork of the SSOD that runs between the Storm Water Retention Basins contains sediment contamination, so discharge into it

will be avoided. A flow meter will be installed at the discharge point into the SSOD that is capable of measuring flows accurately up to 500 gpm.

A rectangular Weir with end contractions will be installed in the SSOD at the entrance to the culvert that runs beneath the road just south of the former Active Flyash Pile Area, See Figure 3.1. A Weir large enough to measure a 500 gpm flow can be easily installed in this area without causing any flooding over the bank of the SSOD. Following calculations presented in Driscoll (1976) a five-foot long Weir with a head rise of 2 inches, calculates out to a flow of approximately 500 gpm, see Table 5.2. Additional small Weirs may need to be installed at locations where smaller tributaries enter the main channel of the SSOD in which induced recharge is being attempted. An additional Weir will only be needed if significant flow is observed in a tributary prior to the start of the test.

Procedure

The overall approach will be to first determine if the SSOD can be used as a recharge source for the GMA at a rate of 500 gpm. If this capability is verified, Extraction Well pumping rates will be changed to match the pumping rates modeled for the third pumping period of Approach C-Improved, see Table 3.1.1. Capture of the 30 μg/L uranium plume will then be verified in the field similar to the approach used in Part 1 of this verification plan.

- With extraction well pumping rates set at the pumping rates established for capture in Part I above, discharge will be initiated into the SSOD at a flow rate of 500 gpm. Water level at the Weir will be monitored and a discharge rate calculated to determine how much (if any) of the 500 gpm flow failed to infiltrate the base of the SSOD and continues to move through the SSOD towards Paddy's Run. Flow rates at the Weir will be monitored until the flow has equilibrated. Flow through the Weir will be calculated using methods described in Driscoll, 1986. If 500 gpm of induced recharge in the SSOD cannot be verified, then the operation will be terminated.

- If the SSOD is capable of sustaining a recharge rate of 500 gpm to the GMA, then pumping rates will be adjusted to match those of Pumping Period 3 of Modeling Approach C-Improved, see Table 3.1.1. Table 5.3 is the output from the Testpump spreadsheet that predicts an outfall concentration of approximately 30.6 ug/L during this testing period. Capture of the 30 μg/L uranium plume will be verified using the same approach presented in Part I. .

- After water levels have been allowed to stabilize to the new pumping rates for two days, water levels will be measured in all IEMP water level monitoring wells. This task will be coordinated with routine IEMP water level measurement activities if possible.

- A water level map will be constructed using the collected water level measurements. Capture and flow interpretations will be made from the mapped data to determine if capture of the 30 μg/L uranium plume is being achieved.

- If capture interpretations indicate that capture is not being achieved, then pumping rates will be changed in an effort to achieve the best plume capture possible. The first objective will be to

achieve the best possible capture of the on-property 30 μg/L uranium plume. The second objective will then be to achieve the best capture possible of the overall 30 μg/L uranium plume. If any pumping rate changes are made, the aquifer will be given two days to adjust before additional water level measurements are collected and capture zone interpretations are made. Individual well pumping rates defined for the CAWWT Construction Period are well below the maximum individual pumping rates that could be achieved. Discharge limits at the Parshall Flume will limit how high pumping rates can be adjusted.

If capture of the 30 ug/L uranium plume cannot be verified in all areas using water level measurements the use of the colloidal boroscope and tracers in those areas will also be considered. Flow direction measurements using the colloidal boroscope would be attempted first; if they are inconclusive the use of tracers will be considered. Tracers would only be used with the approval of the U.S. and Ohio EPAs.

Once best capture has been verified and pumping rates for the best capture have been determined, a decision will be made to either continue with the SSOD operation or to return the system to pumping rates defined in Part I above.

Data collected from these two field verification exercises will be used to establish a new design for operation of the system following CAWWT construction. New groundwater modeling will be conducted to incorporate increased pumping rates made possible by the 1200+ gpm of available groundwater treatment capacity from the CAWWT.

Table 2.1.1
Pumping Rates for Approach C

	Pumping Periods				
	1 1/1/04 to 10/1/04 (gpm)	2 10/1/04 to 4/1/05 (gpm)	3 4/1/05 to 4/1/06 (gpm)	4 4/1/06 to 4/1/12 (gpm)	5 4/1/12 to End (gpm)
SP 1 (3924)	300	300	200	200	0
SP 2 (3925)	300	300	200	200	0
SP 3 (3926)	300	300	200	200	0
SP 4 (3927)	400	400	200	200	0
SP Opt 6	300	300	200	200	0
SP Opt 7	300	300	200	200	0
Sub Total	1900	1900	1200	1200	0
SF 17	275	275	175	175	175
SF 18	200	200	100	100	100
SF 19	200	200	100	100	100
SF 20	200	200	100	100	400
SF 21	290	100	200	200	300
SF 22	300	300	300	300	400
SF 23	300	300	300	300	400
SF 24	300	100	300	300	300
SF 25	300	300	100	100	100
SF 31	200	100	200	200	300
SF 32	300	100	200	200	400
SF 33	300	300	300	300	400
SF 34	200	200	200	200	200
Sub Total	3365	2675	2575	2575	3575
WSA 1	300	0	300	300	500
WSA 2	400	0	200	200	200
WSA 4	0	0	0	200	200
WSA 5	0	0	0	100	100
WSA 6	0	0	0	100	100
Sub Total	700	0	500	900	1100
Total Extraction	5965	4575	4275	4675	4675
IW 8A	200	0	0	0	0
IW 9A	200	0	0	0	0
IW 10	200	0	0	0	0
IW 10A	200	0	0	0	0
IW 11	200	0	0	0	0
SF 16	200	0	0	0	0
SF INJ 1	100	0	0	0	0
BASINS	100	0	0	0	0
SSOD	0	0	0	0	0
Total Re-injection	1400	0	0	0	0
Net Extraction	4565	4575	4275	4675	4675

Table 3.1.1
Pumping Rates for Approach C-Improved

	Pumping Periods				
	1 1/1/04 to 10/1/04 (gpm)	2 10/1/04 to 4/1/05 (gpm)	3 4/1/05 to 4/1/06 (gpm)	4 4/4/06 to 4/1/12 (gpm)	5 4/1/12 to End (gpm)
SP 1 (3924)	300	300	200	200	0
SP 2 (3925)	300	300	200	200	0
SP 3 (3926)	300	300	200	200	0
SP 4 (3927)	400	400	400	400	0
SP Opt 6	300	300	200	200	0
SP Opt 7	300	300	200	200	0
Sub Total	1900	1900	1400	1400	0
SF 17	275	275	175	175	175
SF 18	200	200	100	100	100
SF 19	200	200	100	100	100
SF 20	200	200	100	100	400
SF 21	290	100	200	200	300
SF 22	300	300	300	300	400
SF 23	300	300	300	300	400
SF 24	300	100	300	300	300
SF 25	300	300	400	400	400
SF 31	200	100	200	200	300
SF 32	300	100	400	400	400
SF 33	300	300	400	400	400
SF 34	200	200	400	400	400
Sub Total	3365	2675	3375	3375	4075
WSA 1	300	0	300	300	500
WSA 2	400	0	200	200	200
WSA 4	0	0	0	200	200
WSA 5	0	0	0	100	100
WSA 6	0	0	0	100	100
Sub Total	700	0	500	900	1100
Total Extraction	5965	4575	5275	5675	5175
IW 8A	200	0	0	0	0
IW 9A	200	0	0	0	0
IW 10	200	0	0	0	0
IW 10A	200	0	0	0	0
IW 11	200	0	0	0	0
SF 16	200	0	0	0	0
SF INJ 1	100	0	0	0	0
BASINS	100	0	0	0	0
SSOD	0	0	500	500	500
Total Re-injection	1400	0	500	500	500
Net Extraction	4565	4575	4775	5175	4675

Table 4.1.1
Model Predicted Aquifer Clean Up Times

	GW Strategy Report[a]			
	Alternatives 1&2	Alternative 6	Approach C	Approach C-Improved
South Plume	2014-2015	2016-2017	2011-2012	2011-2012
South Field	2020-2021	2024-2025	2016-2017	2015-2016
Waste Storage Area	2021-2022	2022-2023	2022-2023	2021-2022

[a] Comparison of Alternatives 1&2 with Alternative 6 indicates that Re-injection shortens the remedy by 4 years.

Note: Comparison of Approach C with Approach C-Improved shows induced recharge down SSOD shortens remedy by 1 year.

Note: Direct comparison of clean up times from Approach C or Approach C-Improved with modeling results from GW strategy Report should take into consideration that initial conditions and Kriging used have changed.

Table 5.1
Test Pump Output for CAWWT Construction Period
Water Treatment Systems

700

System Effluent Conc.	
System ID	Effluent Concentration (ppb)
AWWT/P1	10
AWWT/P2	10
IAWWT/T108	5
IAWWT/T109	5
AWWT/EXP	0
SPIT	2
STP	0

Treatment Excess
(gpm)
0

Remediation Water	
System ID	Capacity (gpm)
AWWT/P1	300
AWWT/P2	0

Storm Water	
System ID	Capacity (gpm)
AWWT/P1	0
AWWT/P2	300
IAWWT/T108	0
IAWWT/T109	0

Sanitary Water	
System ID	Capacity (gpm)
STP	0

Groundwater	
System ID	Capacity (gpm)
AWWT/EXP	0
SPIT	200
IAWWT/T108	300
IAWWT/T109	0
AWWT/P1	200
AWWT/P2	0

Injection Water	
Capacity (gpm)	Concentration (ppb)
0	0

Net Treatment Effluent	
Flow Rate (gpm)	Concentration (ppb)
1300	7.6

Table 5.1 (continued)
Test Pump Output for CAWWT Construction Period
Well Field Systems

South Plume Extraction System

Well ID	Pumping Rate (gpm)	Total U Concentration (ppb)
RW-1	300	23.0
RW-2	300	23.9
RW-3	300	29.3
RW-4	400	3.4
RW-6	300	43.1
RW-7	300	45.4
S. Plume	1900	26.7

South Field Extraction System

Well ID	Pumping Rate (gpm)	Total U Concentration (ppb)
EW 15A	100	57.9
EW 17	275	27.0
EW 18	200	47.6
EW 19	200	44.0
EW 20	200	34.2
EW 21	100	52.6
EW 22	300	63.5
EW 23	300	81.6
EW 24	100	57.7
EW 25	300	47.0
EW 30	100	62.3
EW 31	300	27.5
EW 32	200	10.8
S. Field	2675	46.2

Re-Injection Systems

Well ID	Injection Rate (gpm)	Total U Concentration (ppb)
IW 8A	0	0.0
IW 9A	0	0.0
IW 10	0	0.0
IW 10A	0	0.0
IW 11	0	0.0
IW 12	0	0.0
IW 16	0	0.0
IW 29	0	0.0
Basins	0	0.0
S. Field	0	0.0

Waste Storage Area/Pilot Plant Draingage Ditch System

Well ID	Pumping Rate (gpm)	Total U Concentration (ppb)
EW 26	0	45.0
EW 27	0	48.0
EW 28	0	20.0
5	0	0.0
6	0	0.0
WSA/PPDD	0	0.0

Sorted Well List	T=Treat S = Split B = Bypass X = Not Pumping	Groundwater to Treatment	Groundwater to Bypass
EW 23	T	300	0
EW 22	T	300	0
EW 30	T	100	0
EW 15A	B	0	100
EW 24	B	0	100
EW 21	B	0	100
EW 27	X	0	0
EW 18	B	0	200
EW 25	B	0	300
EW 26	X	0	0
EW 19	B	0	200
EW 20	B	0	200
EW 31	B	0	300
EW 17	B	0	275
S. Plume	B	0	1900
EW 28	X	0	0
EW 32	B	0	200
5	X	0	0
6	X	0	0

Groundwater to Treatment (gpm)	Concentration to Treatment (ppb)
700	71.1

Groundwater to Bypass (gpm)	Concentration to Bypass (gpm)
3875	32.2

Total Pumping All Systems (gpm)	Total Injection All Systems (gpm)	Net Pumping (Extraction - Injection) (gpm)
4575	0	4575

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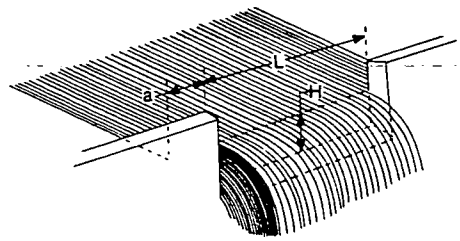
Table 5.1 (continued)
Test Pump Output for CAWWT Construction Period
Concentration Summary

Net Treatment Effluent			
Component	Flow Rate (gpm)	Concentration (ppb)	Mass per Day (lbs)
Net Treated	1300	7.6	0.12
Excess	0	71.1	0.00

Groundwater to Bypass		
Flow Rate (gpm)	Concentration (ppb)	Mass per Day (lbs)
3875	32.2	1.49

Outfall			
Flow Rate (gpm)	Concentration ppb	Mass per Day (lbs)	Mass per Yr (lbs)
5175	26.0	1.61	589

Table 5.2
Discharge from Rectangular Weir with End Contractions



Figures in Table are in Gallons Per Minute								
	Length (L) of weir in feet					Length (L) of weir in feet		
Head (H) in inches	1	3	5	Additional gpm for each ft over 5 ft	Head (H) in inches	3	5	Additional gpm for each ft over 5 ft
1	35.4	107.5	179.8	36.05	8	2338	3956	814
1¼	49.5	150.4	250.4	50.4	8¼	2442	4140	850
1½	64.9	197	329.5	66.2	8½	2540	4312	890
1¾	81	248	415	83.5	8¾	2656	4511	929
2	98.5	302	506	102	9	2765	4699	970
2¼	117	361	605	122	9¼	2876	4899	1011
2½	136.2	422	706	143	9½	2985	5098	1051
2¾	157	485	815	165	9¾	3101	5288	1091
3	177.8	552	926	187	10	3216	5490	1136
3¼	199.8	624	1047	211	10½	3480	5940	1230
3½	222	695	1167	236	11	3716	6355	1320
3¾	245	769	1292	261	11½	3960	6780	1410
4	269	846	1424	288	12	4185	7165	1495
4¼	293.6	925	1559	316	12½	4430	7595	1575
4½	318	1006	1696	345	13	4660	8010	1660
4¾	344	1091	1835	374	13½	4950	8510	1780
5	370	1175	1985	405	14	5215	8980	1885
5¼	395.5	1262	2130	434	14½	5475	9440	1985
5½	421.6	1352	2282	465	15	5740	9920	2090
5¾	449	1442	2440	495	15½	6015	10400	2165
6	476.5	1535	2600	528	16	6290	10900	2300
6¼		1632	2760	560	16½	6565	11380	2410
6½		1742	2920	596	17	6925	11970	2520
6¾		1826	3094	630	17½	7140	12410	2640
7		1928	3260	668	18	7410	12900	2745
7¼		2029	3436	701.5	18½	7695	13410	2855
7½		2130	3609	736	19	7980	13940	2970
7¾		2238	3785	774	19½	8280	14460	3090

From Groundwater and Wells, Second Editions, 1986, Published by Johnson Division, St. Paul, Minesota

Table 5.3
Test Pump Output during SSOD Test
Approach C-Improved Pumping Rates (4/1/05 to 4/1/06)
Water Treatment Systems

700

System Effluent Conc.

System ID	Effluent Concentration (ppb)
AWWT/P1	10
AWWT/P2	10
IAWWT/T108	5
IAWWT/T109	5
AWWT/EXP	0
SPIT	2
STP	0

Remediation Water

System ID	Capacity (gpm)
AWWT/P1	300
AWWT/P2	0

Injection Water

Capacity (gpm)	Concentration (ppb)
0	0

Storm Water

System ID	Capacity (gpm)
AWWT/P1	0
AWWT/P2	300
IAWWT/T108	0
IAWWT/T109	0

Net Treatment Effluent

Flow Rate (gpm)	Concentration (ppb)
1300	7.6

Treatment Excess

(gpm)
0

Sanitary Water

System ID	Capacity (gpm)
STP	0

Groundwater

System ID	Capacity (gpm)
AWWT/EXP	0
SPIT	200
IAWWT/T108	300
IAWWT/T109	0
AWWT/P1	200
AWWT/P2	0

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Table 5.3 (continued)
Test Pump Output during SSOD Test
Approach C-Improved Pumping Rates (4/1/05 to 4/1/06)
Well Field Systems

South Plume Extraction System

Well ID	Pumping Rate (gpm)	Total U Concentration (ppb)
RW-1	200	23.0
RW-2	200	23.9
RW-3	200	29.3
RW-4	400	3.4
RW-6	200	43.1
RW-7	200	45.4
S. Plume	1400	24.5

South Field Extraction System

Well ID	Pumping Rate (gpm)	Total U Concentration (ppb)
EW 15A	200	57.9
EW 17	175	27.0
EW 18	100	47.6
EW 19	100	44.0
EW 20	100	34.2
EW 21	200	52.6
EW 22	300	63.5
EW 23	300	81.6
EW 24	300	57.7
EW 25	400	47.0
EW 30	400	62.3
EW 31	400	27.5
EW 32	400	10.8
S. Field	3375	47.2

Re-Injection Systems

Well ID	Injection Rate (gpm)	Total U Concentration (ppb)
IW 8A	0	0.0
IW 9A	0	0.0
IW 10	0	0.0
IW 10A	0	0.0
IW 11	0	0.0
IW 12	0	0.0
IW 16	0	0.0
IW 29	0	0.0
Basins	0	0.0
S. Field	0	0.0

Waste Storage Area/Pilot Plant Draingage Ditch System

Well ID	Pumping Rate (gpm)	Total U Concentration (ppb)
EW 26	300	45.0
EW 27	200	48.0
EW 28	0	20.0
5	0	0.0
6	0	0.0
WSA/PPDD	500	46.2

Sorted Well List	T=Treat S = Split B = Bypass X = Not Pumping	Groundwater to Treatment	Groundwater to Bypass
EW 23	T	300	0
EW 22	T	300	0
EW 30	B	0	400
EW 15A	B	0	200
EW 24	B	0	300
EW 21	B	0	200
EW 27	B	0	200
EW 18	B	0	100
EW 25	B	0	400
EW 26	B	0	300
EW 19	B	0	100
EW 20	B	0	100
EW 31	B	0	400
EW 17	B	0	175
S. Plume	B	0	1400
EW 28	X	0	0
EW 32	B	0	400
5	X	0	0
6	X	0	0

Groundwater to Treatment (gpm)	Concentration to Treatment (ppb)
600	72.6

Groundwater to Bypass (gpm)	Concentration to Bypass (gpm)
4675	37.0

Total Pumping All Systems (gpm)	Total Injection All Systems (gpm)	Net Pumping (Extraction - Injection) (gpm)
5275	0	5275

000032

6/24/2004 1:57 PM

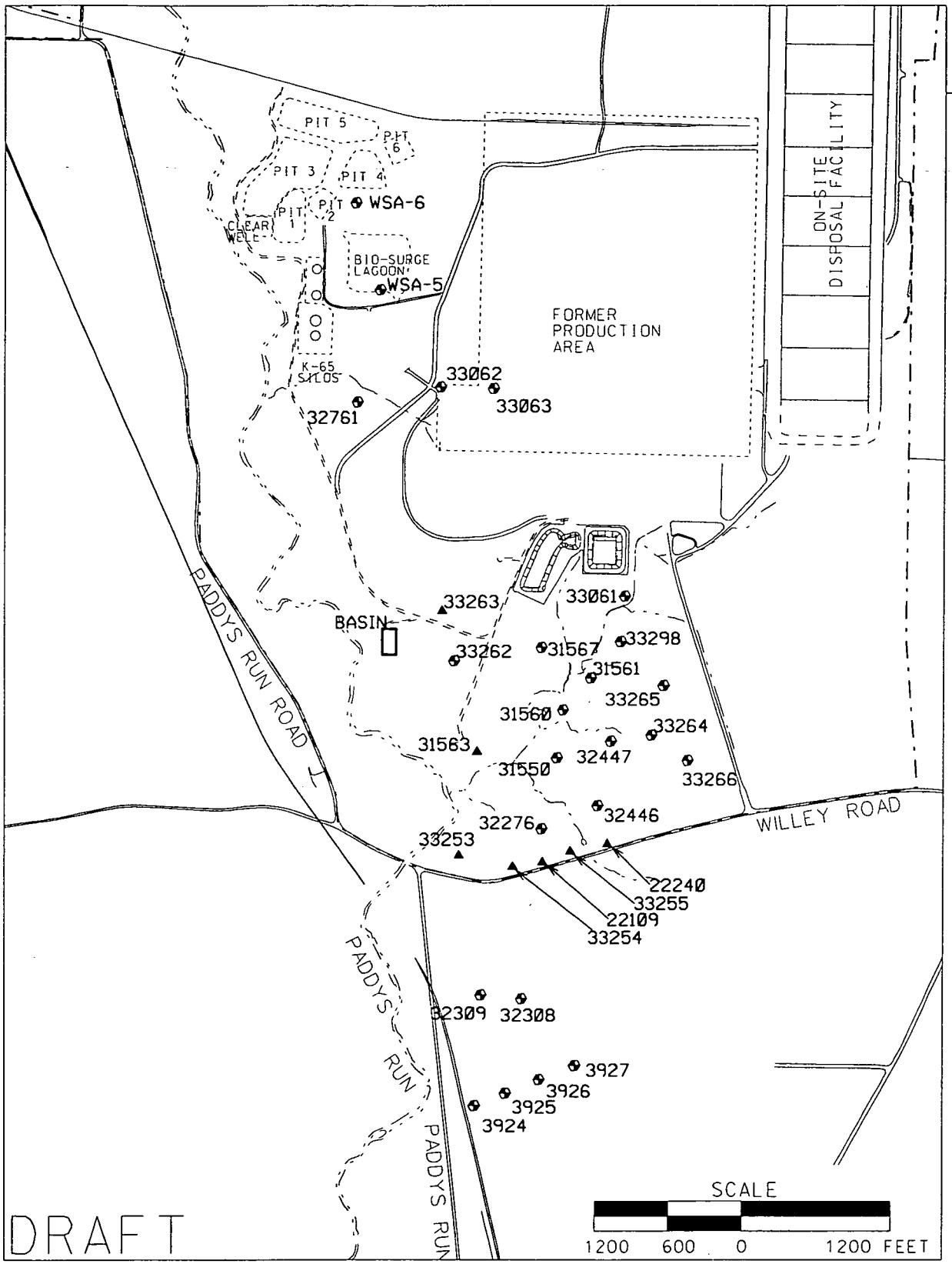
5539

Table 5.3 (continued)
Test Pump Output during SSOD Test
Approach C-Improved Pumping Rates (4/1/05 to 4/1/06)
Concentration Summary

Net Treatment Effluent			
Component	Flow Rate (gpm)	Concentration (ppb)	Mass per Day (lbs)
Net Treated	1300	7.6	0.12
Excess	0	72.6	0.00

Groundwater to Bypass		
Flow Rate (gpm)	Concentration (ppb)	Mass per Day (lbs)
4675	37.0	2.08

Outfall			
Flow Rate (gpm)	Concentration ppb	Mass per Day (lbs)	Mass per Yr (lbs)
5975	30.6	2.19	802



LEGEND:

— · — · — FERNALD SITE BOUNDARY

EXTRACTION WELL

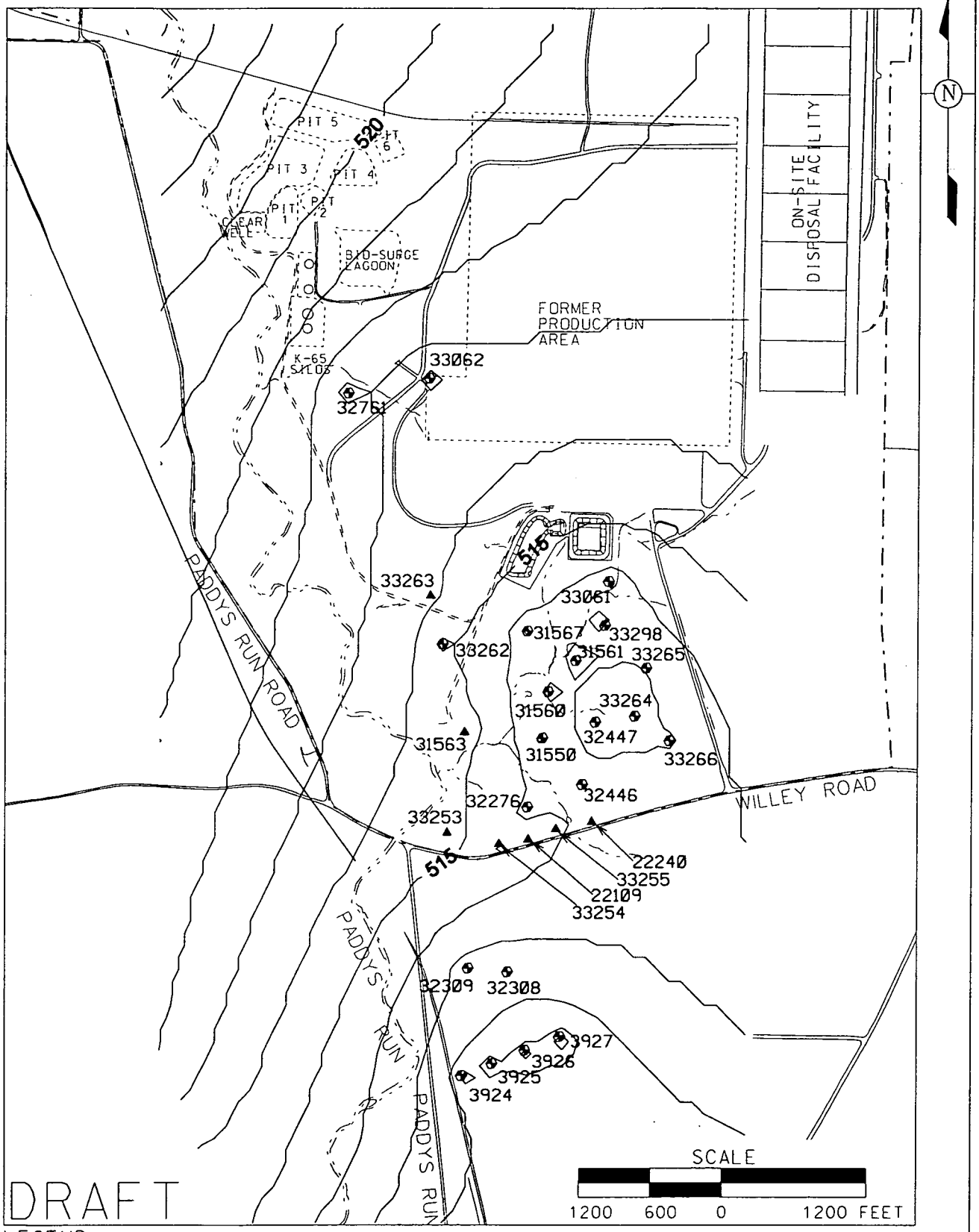
▲ RE-INJECTION WELL

V:\5fgp1\dgn\CZE-TEST-PLAN\cze-test-12.dgn

STATE PLANAR COORDINATE SYSTEM 1983

24-JUN-2004

FIGURE 1.1. WELL LOCATION MAP



LEGEND:

- FERNALD SITE BOUNDARY
- GROUNDWATER ELEVATION CONTOUR
- EXTRACTION WELL
- INJECTION WELL

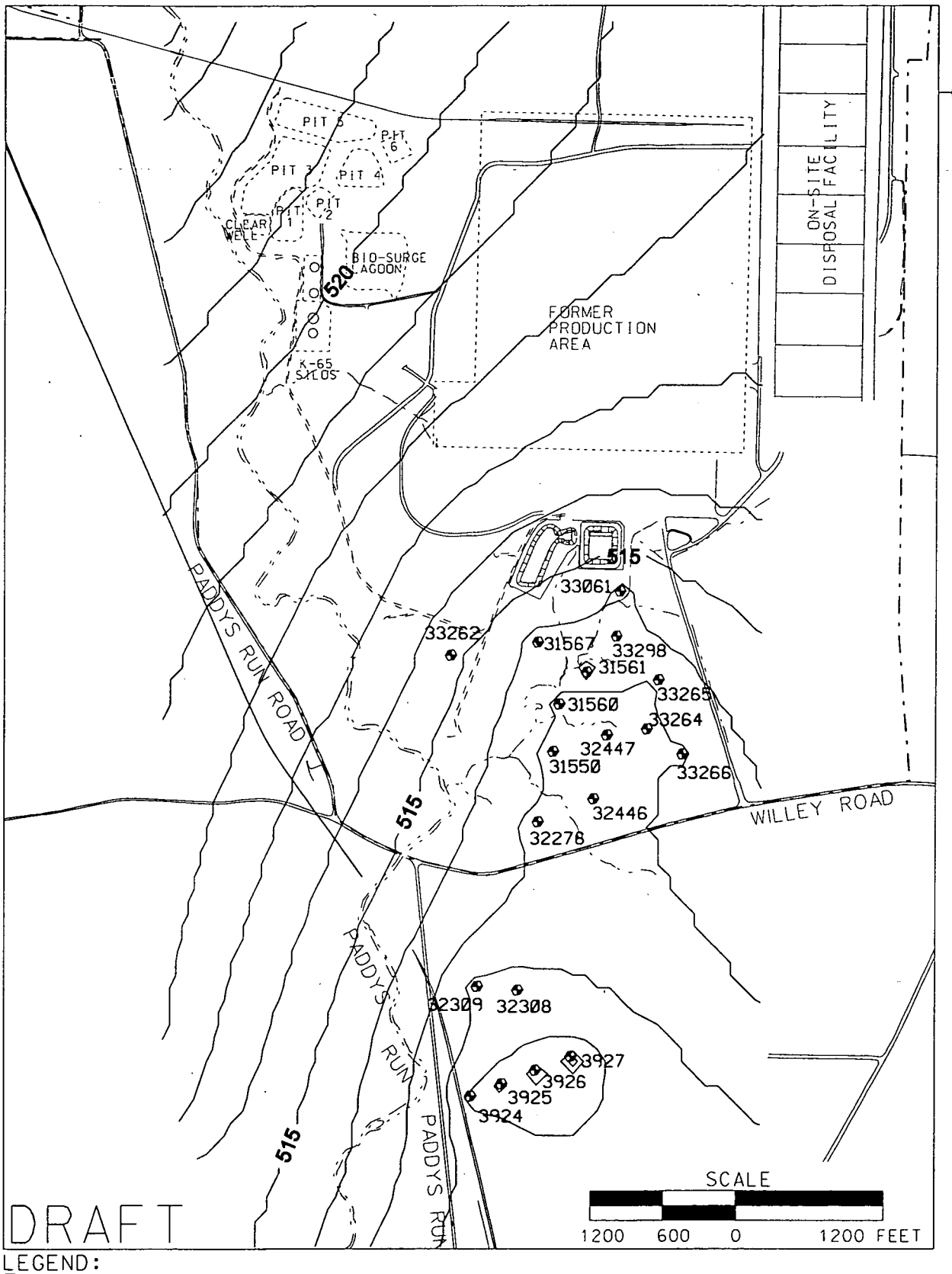
000035

FIGURE 2.1.1. MODELED GROUNDWATER ELEVATION PREDICTIONS, CURRENT TO 10-1-2004

V:\5fgp1\dgn\CZE-TEST-PLAN\CW\cze-tst-gw-07.dgn

STATE PLANAR COORDINATE SYSTEM 1983

22-JUN-2004



LEGEND:

- FERNALD SITE BOUNDARY
- GROUNDWATER ELEVATION CONTOUR
- EXTRACTION WELL

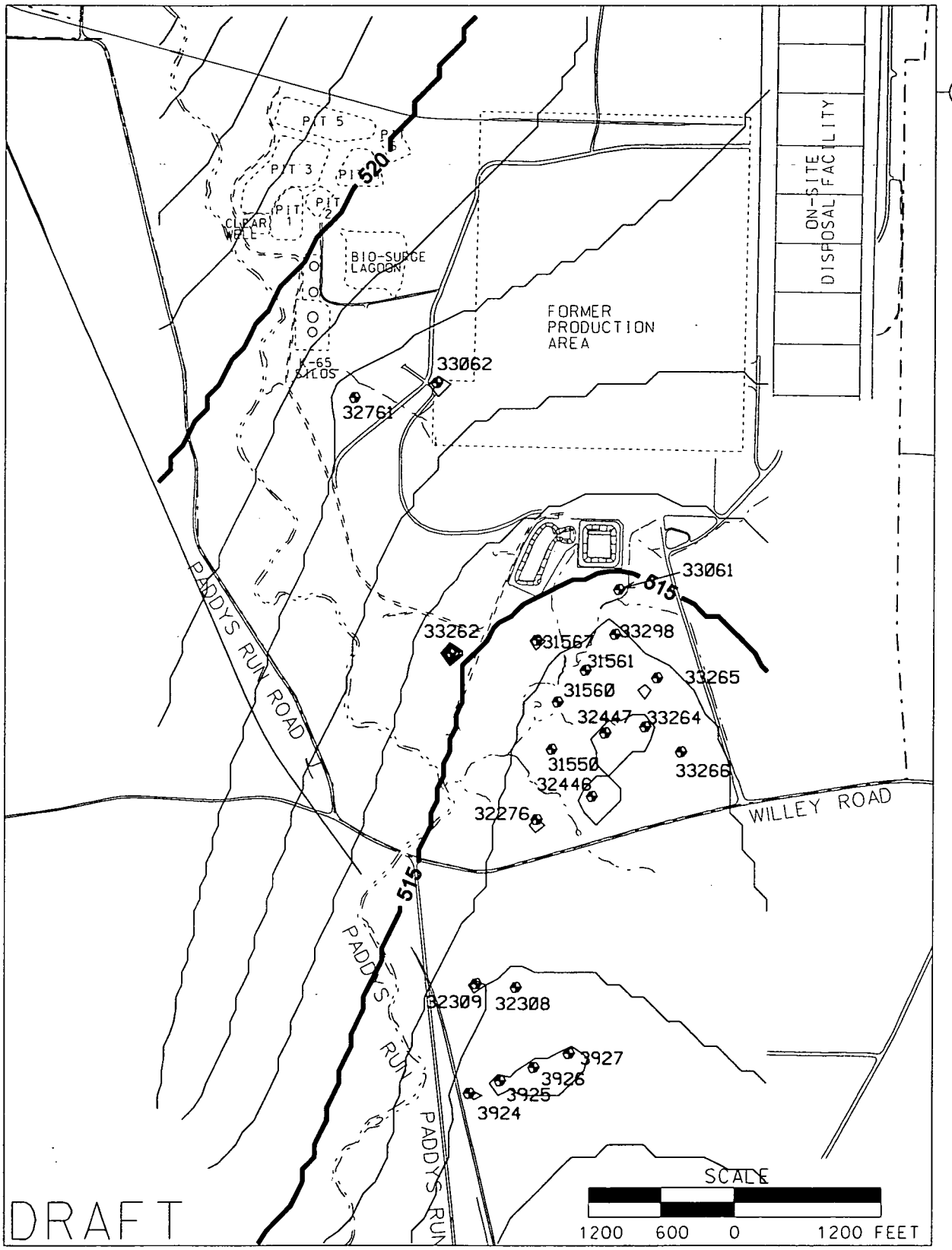
000036

V:\5fqp1\dgn\CZE-TEST-PLAN\CW\cze-tst-gw-06.dgn

STATE PLANAR COORDINATE SYSTEM 1983

22-JUN-2004

FIGURE 2.1.2. MODELED GROUNDWATER ELEVATION PREDICTIONS, CAWWT CONSTRUCTION PERIOD, 10-1-2004 TO 4-1-2005



LEGEND:

— · — · — FERNALD SITE BOUNDARY

——— GROUNDWATER ELEVATION CONTOUR

⊕ EXTRACTION WELL

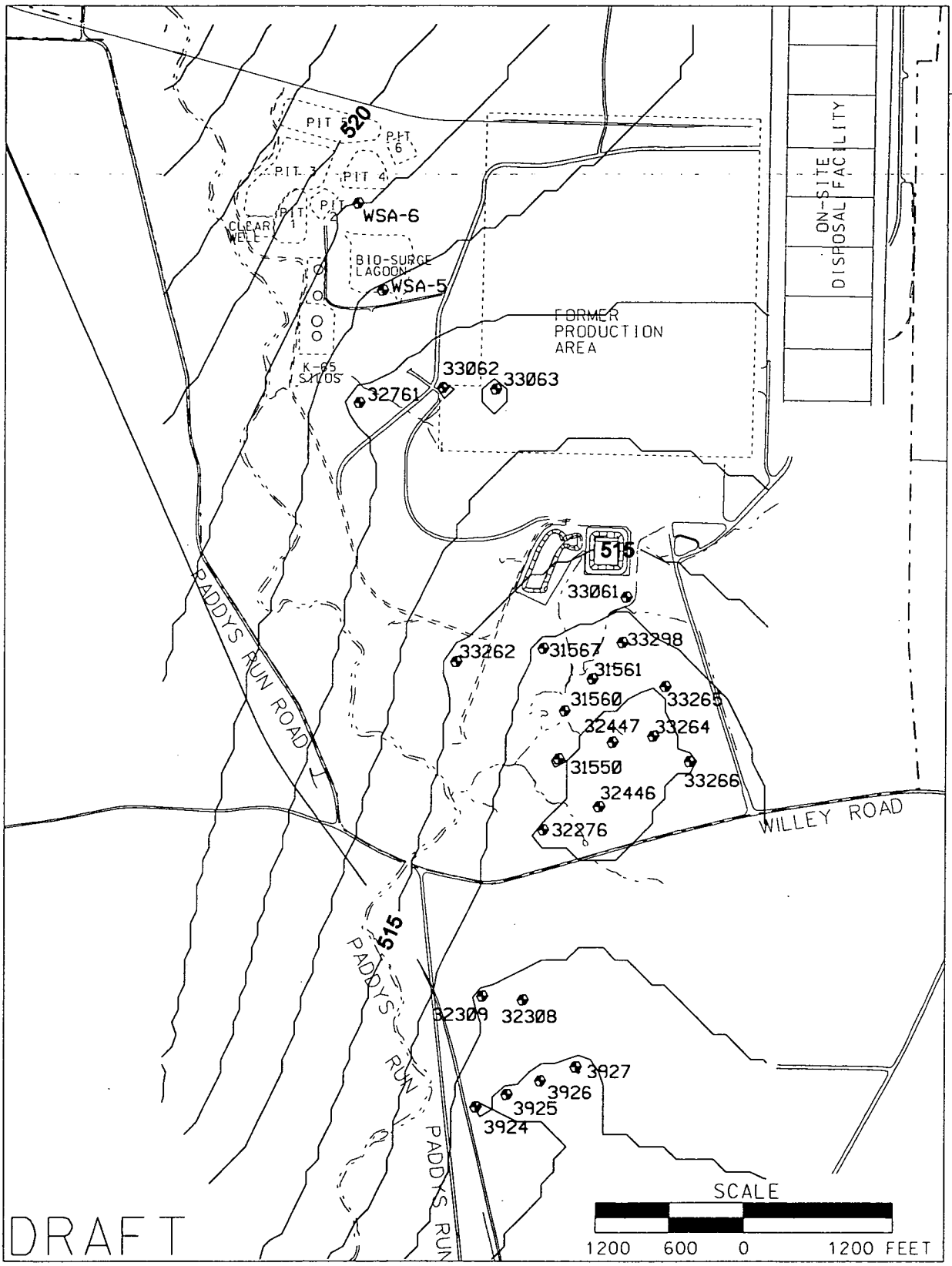
000037

V:\5fgp1\dgn\CZE-TEST-PLAN\CW\czo-test-01.dgn

STATE PLANAR COORDINATE SYSTEM 1983

22-JUN-2004

FIGURE 2.1.3. MODELED GROUNDWATER ELEVATION PREDICTIONS, 4-1-2005 TO 4-1-2006, APPROACH C



LEGEND:

— · — · — FERNALD SITE BOUNDARY

——— GROUNDWATER ELEVATION CONTOUR

⊕ EXTRACTION WELL

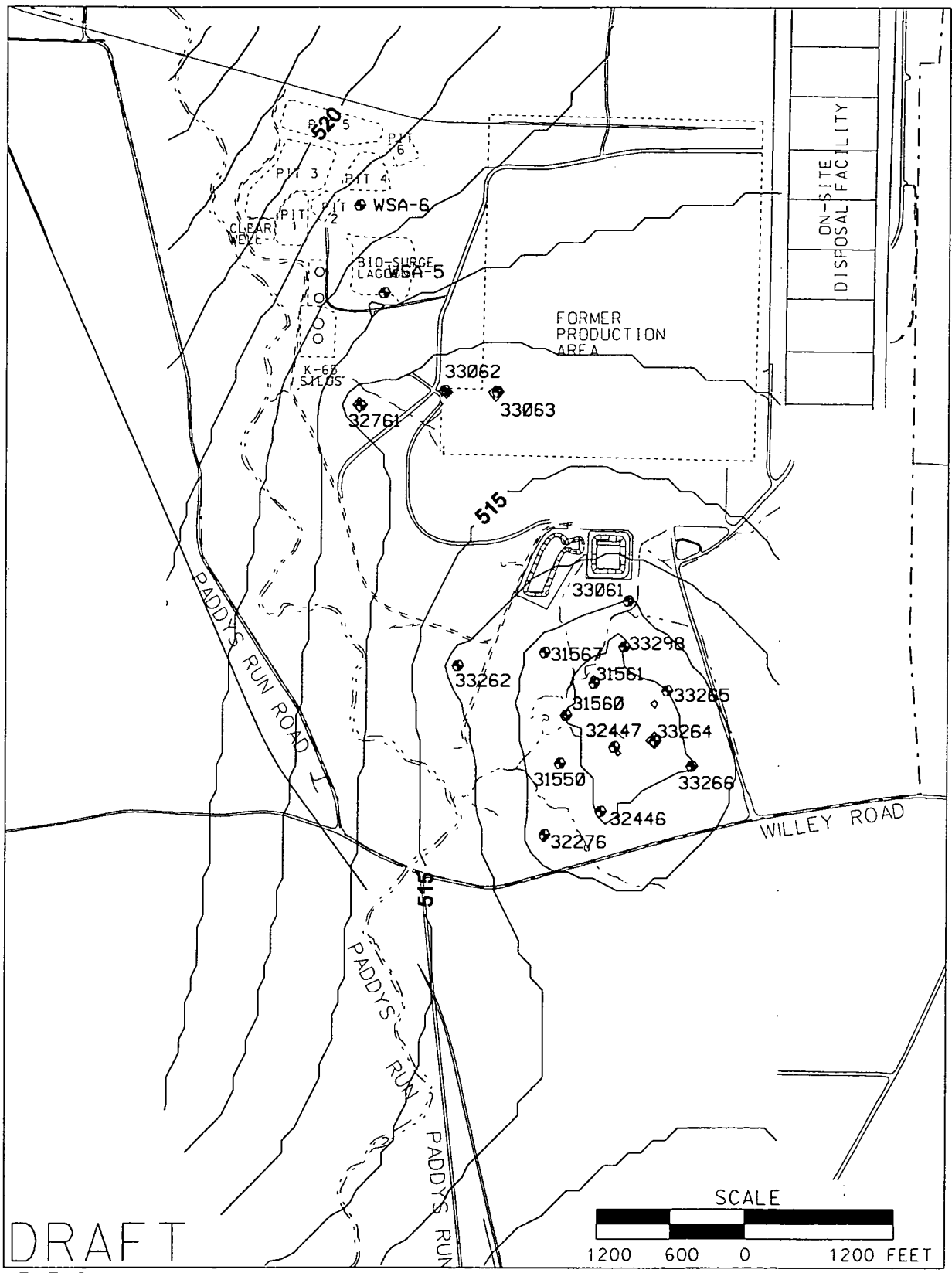
000038

V:\5fgp1\dgn\C2E-TEST-PLAN\GW\c2e-tst-gw-01.dgn

STATE PLANAR COORDINATE SYSTEM 1983

22-JUN-2004

FIGURE 2.1.4. MODELED GROUNDWATER ELEVATION PREDICTIONS, 4-1-2006 TO 4-1-2012, APPROACH C



LEGEND:

- FERNALD SITE BOUNDARY
- GROUNDWATER ELEVATION CONTOUR
- EXTRACTION WELL

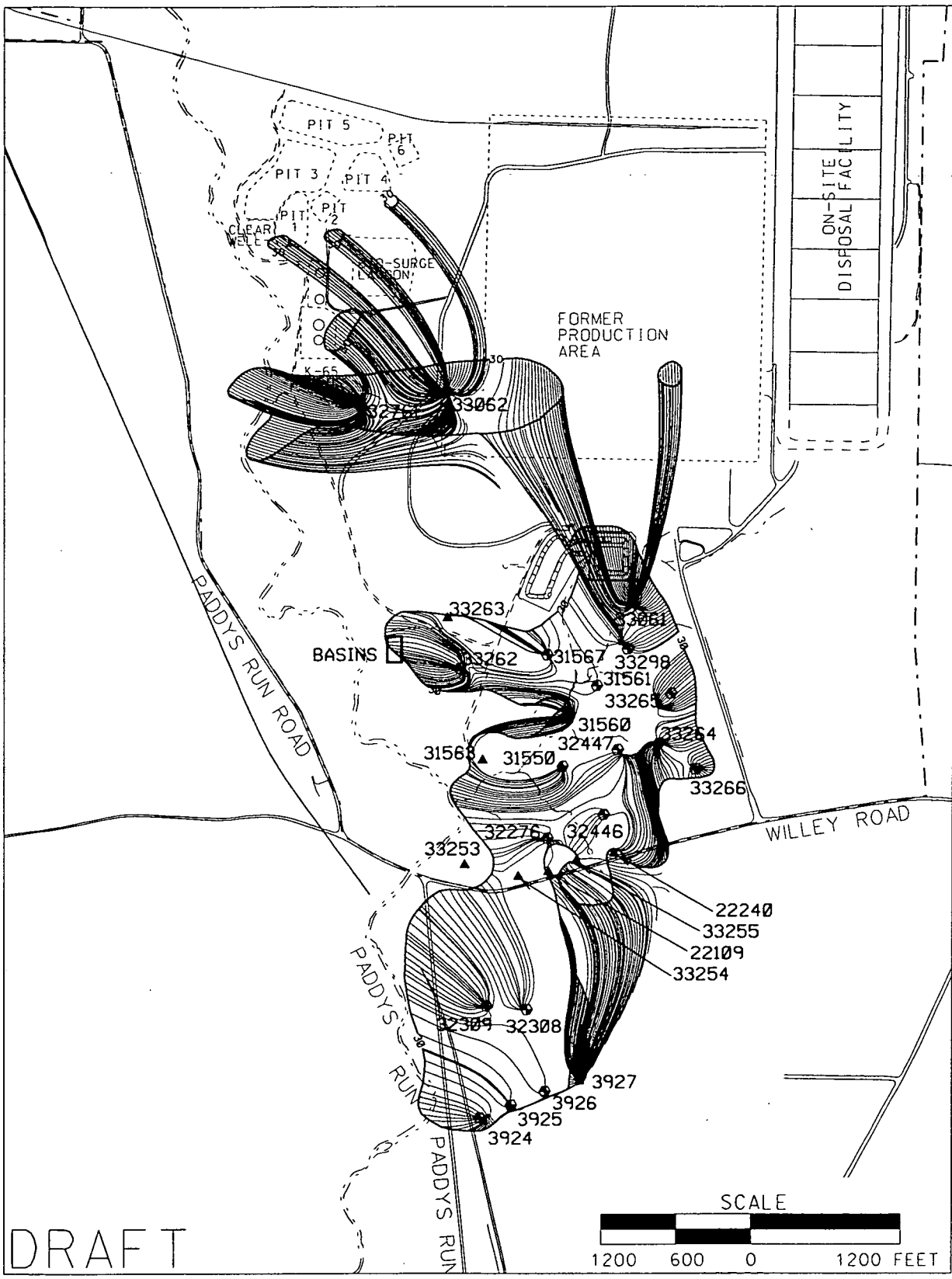
000039

V:\5fgp1\dgn\CZE-TEST-PLAN\CW\c26-1s1-gw-02.dgn

STATE PLANAR COORDINATE SYSTEM 1983

22-JUN-2004

FIGURE 2.1.5. MODELED GROUNDWATER ELEVATION PREDICTIONS, 4-1-2012 TO END, APPROACH C



LEGEND:

- FERNALD SITE BOUNDARY
- PARTICLE TRACK
- EXTRACTION WELL
- RE-INJECTION WELL
- 30 TOTAL URANIUM CONTOUR (30 μg/L) THROUGH SECOND HALF OF 2003

000040

FIGURE 2.1.6. 10-YEAR, NON-RETARDED PARTICLE TRACKS FROM PLUME BOUNDARY, CURRENT TO 10-1-2004

V:\5fgp1\dgn\CZE-TEST-PLAN\czo-test-20.dgn

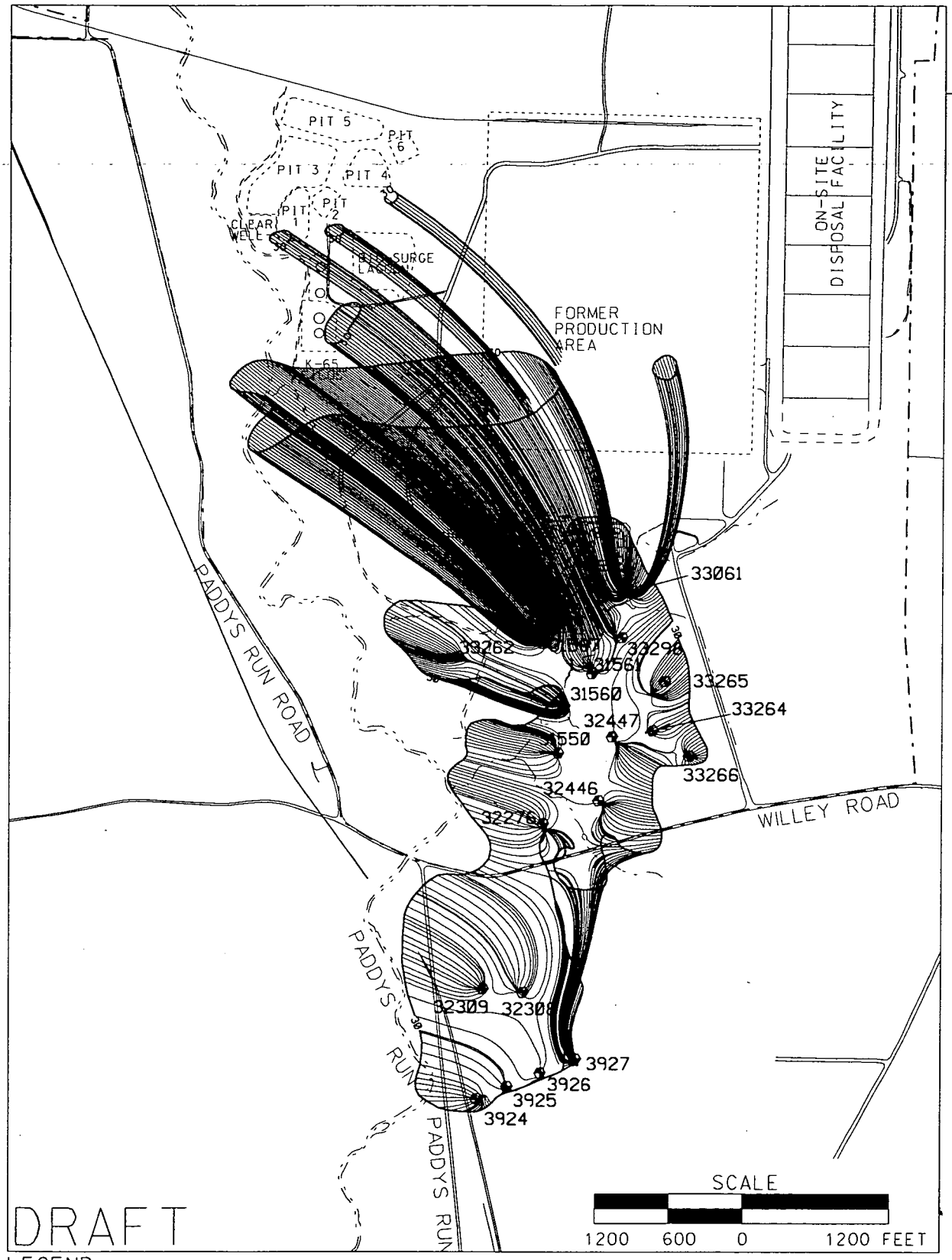
STATE PLANAR COORDINATE SYSTEM 1983

23-JUN-2004

V:\#5fgp1\dgn\CZE-TEST-PLAN\czs-test-08.dgn

STATE PLANAR COORDINATE SYSTEM 1983

23-JUN-2004



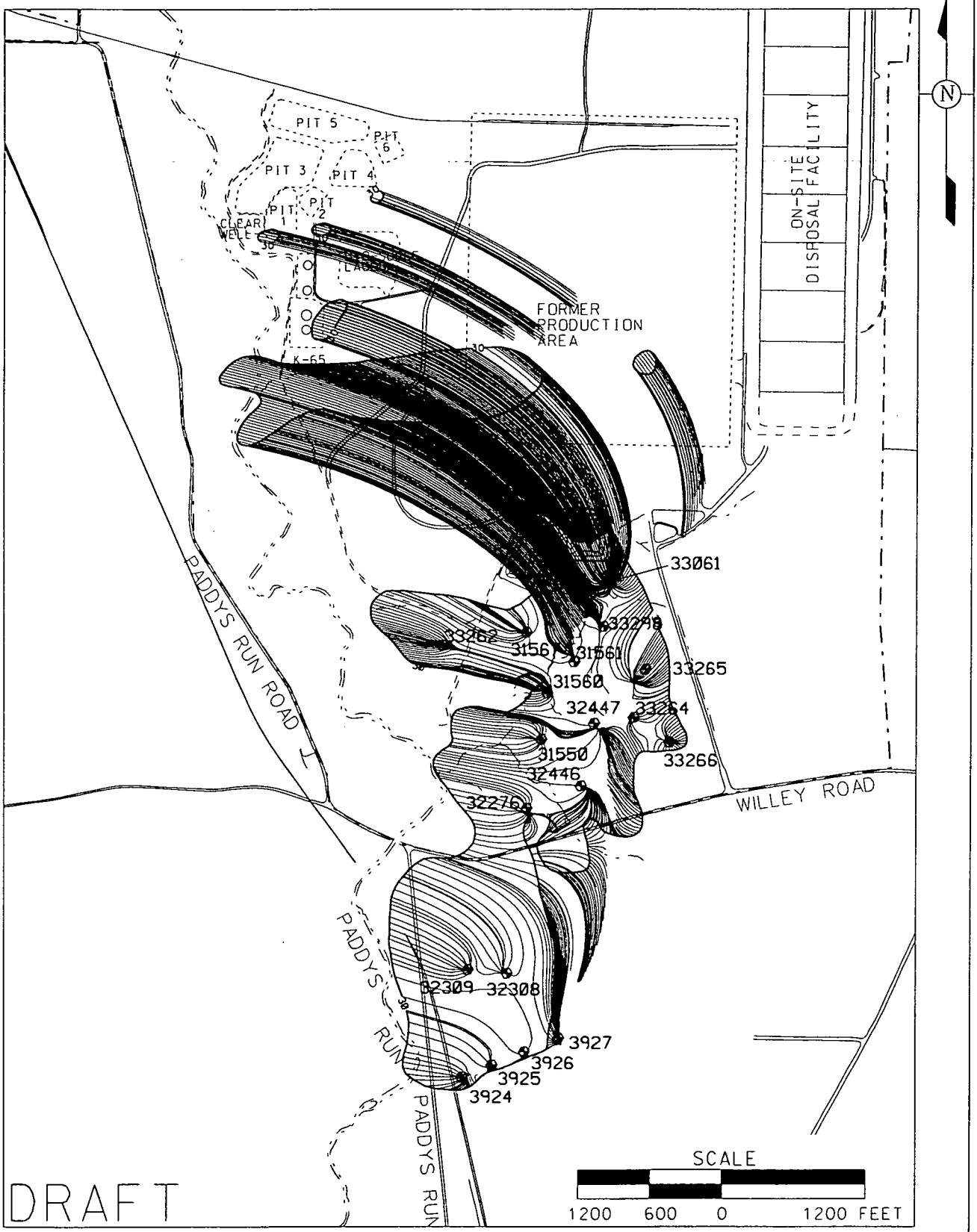
LEGEND:

- FERNALD SITE BOUNDARY
- PARTICLE TRACK
- EXTRACTION WELL
- RE-INJECTION WELL
- 30 — TOTAL URANIUM CONTOUR (30 μg/L) THROUGH SECOND HALF OF 2003

000041

FIGURE 2.1.7. 10-YEAR, NON-RETARDED PARTICLE TRACKS FROM PLUME BOUNDARY, CAWWT CONSTRUCTION PERIOD, 10-1-2004 TO 4-1-2005

V:\5fgp1\dgn\CZE-TEST-PLAN\czo-test-10.dgn



LEGEND:

— · — · — FERNALD SITE BOUNDARY

——— PARTICLE TRACK

EXTRACTION WELL

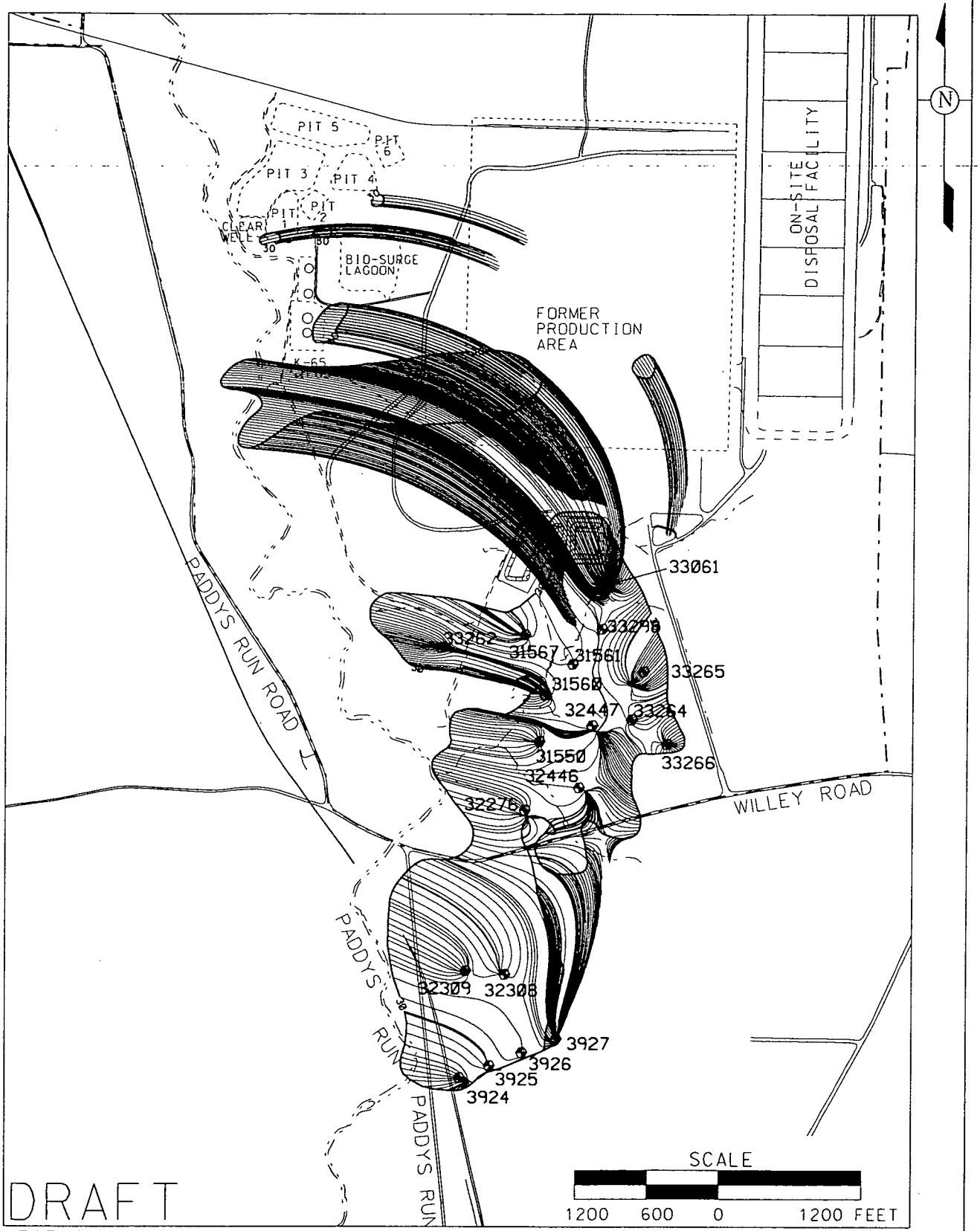
—— 30 —— TOTAL URANIUM CONTOUR (30 μg/L) THROUGH SECOND HALF OF 2003

STATE PLANAR COORDINATE SYSTEM 1983

22-JUN-2004

000042

FIGURE 2.1.8. 10-YEAR, NON-RETARDED PARTICLE TRACKS FROM PLUME BOUNDARY, DRY BOUNDARY CONDITIONS, CAWWT CONSTRUCTION PERIOD, 10-1-2004 TO 4-1-2005



LEGEND:

- FERNALD SITE BOUNDARY
- PARTICLE TRACK
- EXTRACTION WELL
- 30 TOTAL URANIUM CONTOUR (30 µg/L) THROUGH SECOND HALF OF 2003

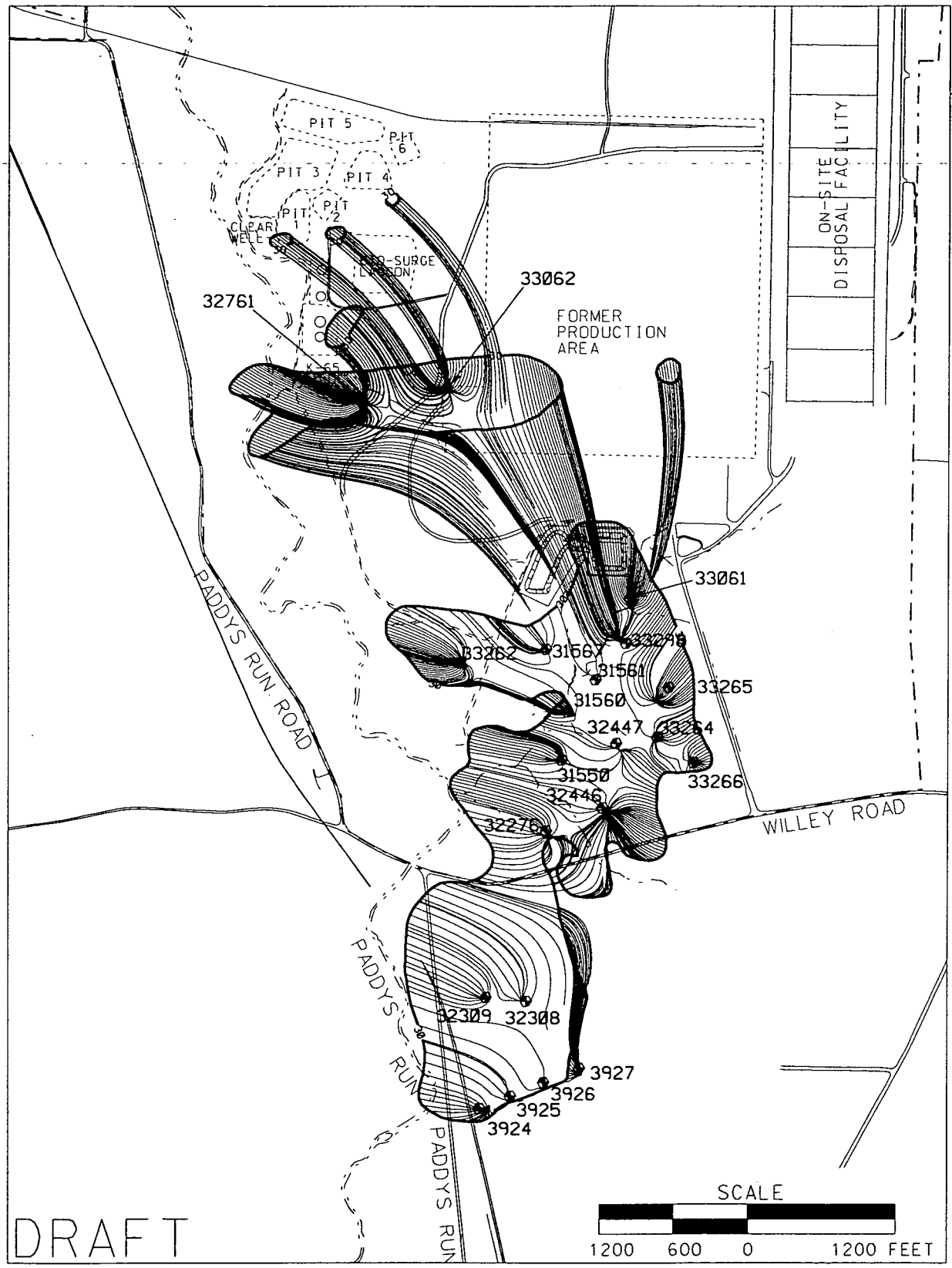
000043

FIGURE 2.1.9. 10-YEAR, NON-RETARDED PARTICLE TRACKS FROM PLUME BOUNDARY, WET BOUNDARY CONDITIONS, CAWWT CONSTRUCTION PERIOD, 10-1-2004 TO 4-1-2005

V:\#5fgp1\dgn\C2E-TEST-PLAN\c2e-test-11.dgn

STATE PLANAR COORDINATE SYSTEM 1983

22-JUN-2004



LEGEND:

— · — · — FERNALD SITE BOUNDARY

——— PARTICLE TRACK

● EXTRACTION WELL

—— 30 —— TOTAL URANIUM CONTOUR (30 μg/L) THROUGH SECOND HALF OF 2003

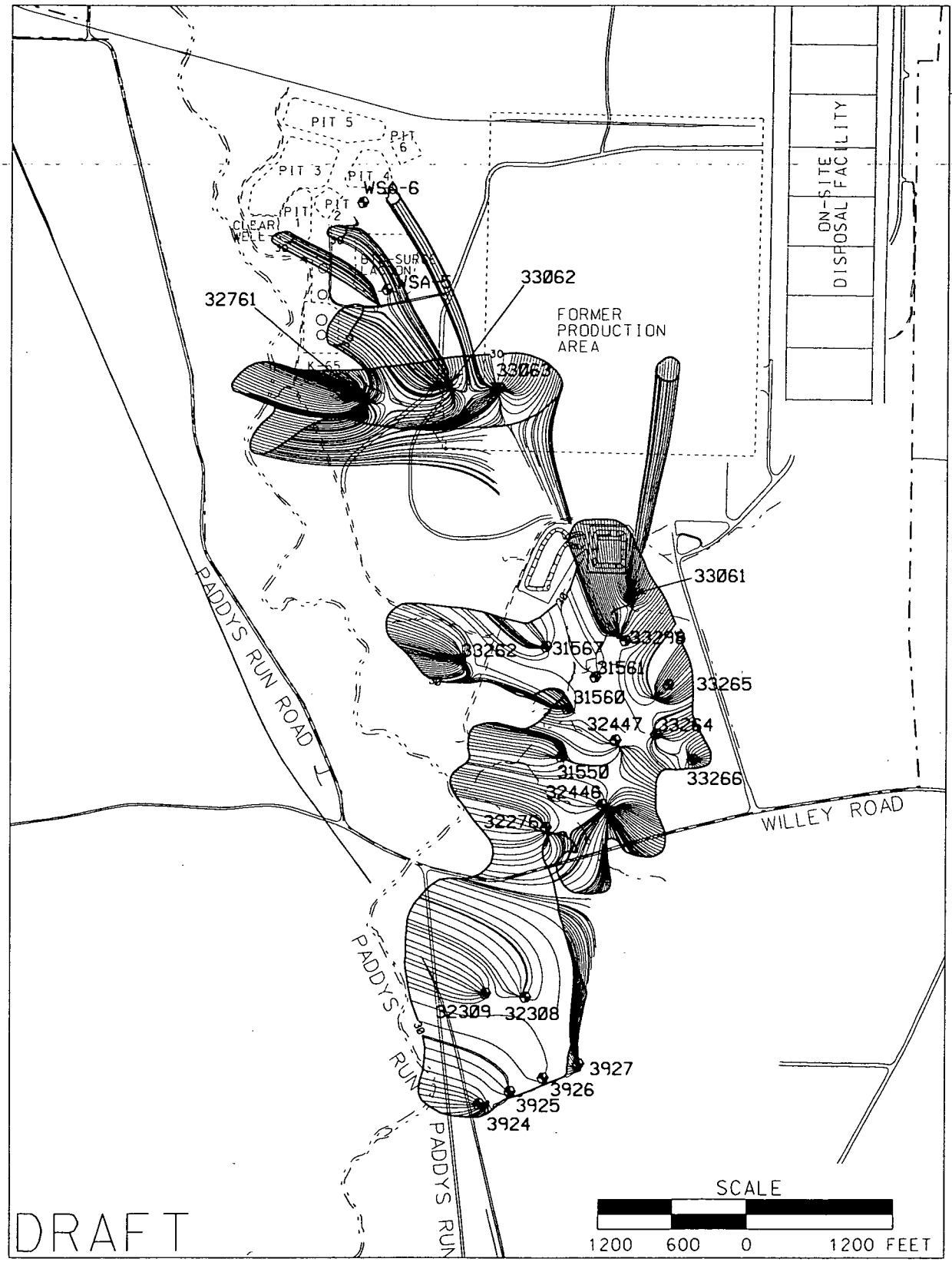
V:\5fqp1\dgn\C2E-TEST-PLAN\c2e-test-02.dgn

STATE PLANAR COORDINATE SYSTEM 1983

22-JUN-2004

000044

FIGURE 2.1.10. 10-YEAR, NON-RETARDED PARTICLE TRACKS FROM PLUME BOUNDARY, APPROACH C, 4-1-2005 TO 4-1-2006



LEGEND:

- FERNALD SITE BOUNDARY
- PARTICLE TRACK
- EXTRACTION WELL
- 30 — TOTAL URANIUM CONTOUR (30 μg/L) THROUGH SECOND HALF OF 2003

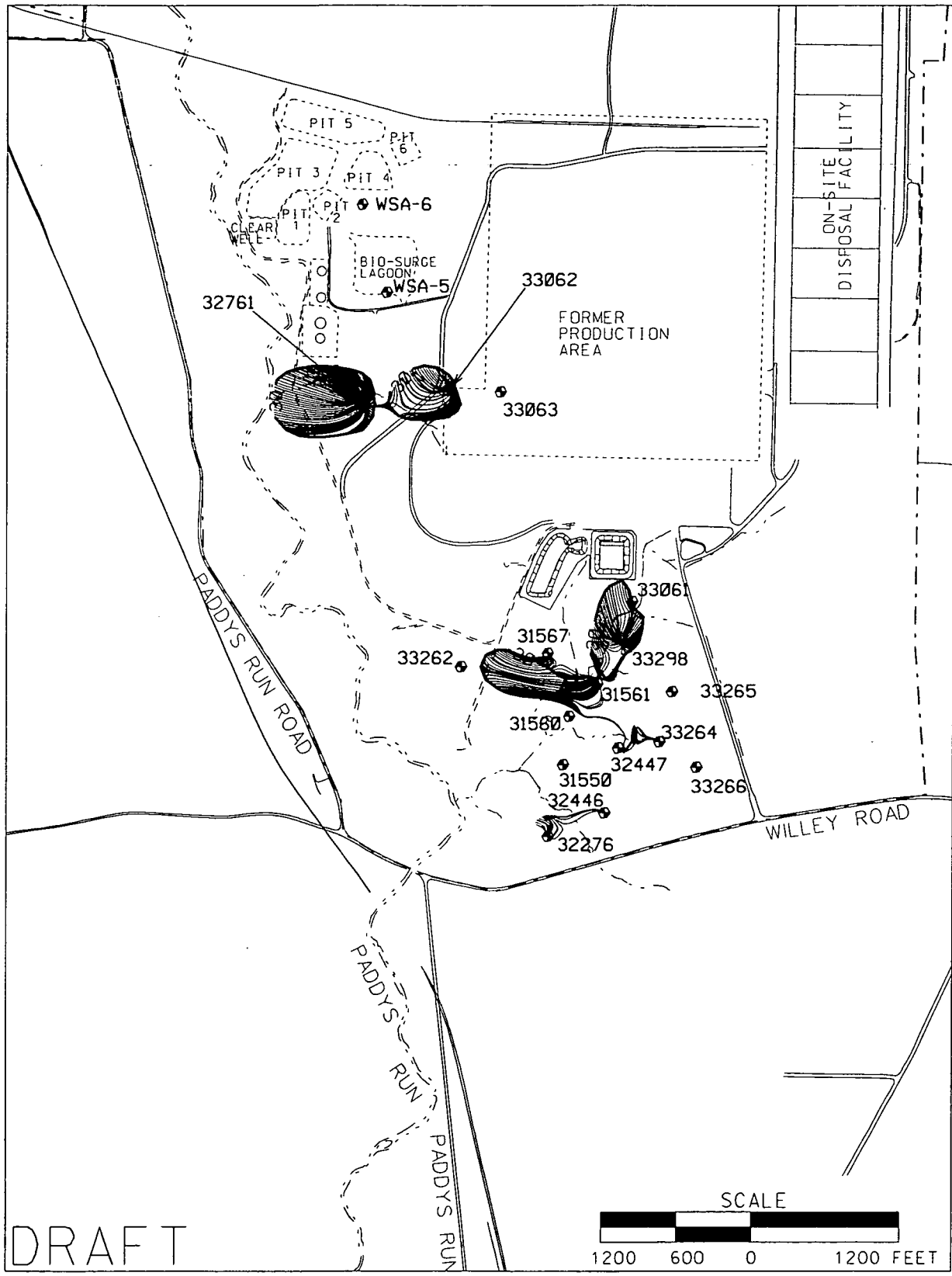
000045

FIGURE 2.1.11. 10-YEAR, NON-RETARDED PARTICLE TRACKS FROM PLUME BOUNDARY, APPROACH C, 4-1-2006 TO 4-1-2012

V:\5fgp1\dgn\C2E-TEST-PLAN\c2e-test-03.dgn

STATE PLANAR COORDINATE SYSTEM 1983

22-JUN-2004



LEGEND:

- FERNALD SITE BOUNDARY
- PARTICLE TRACK
- EXTRACTION WELL
- PREDICTED TOTAL URANIUM CONTOUR (30 μg/L) IN MODEL LAYER 12 AT 4-1-12

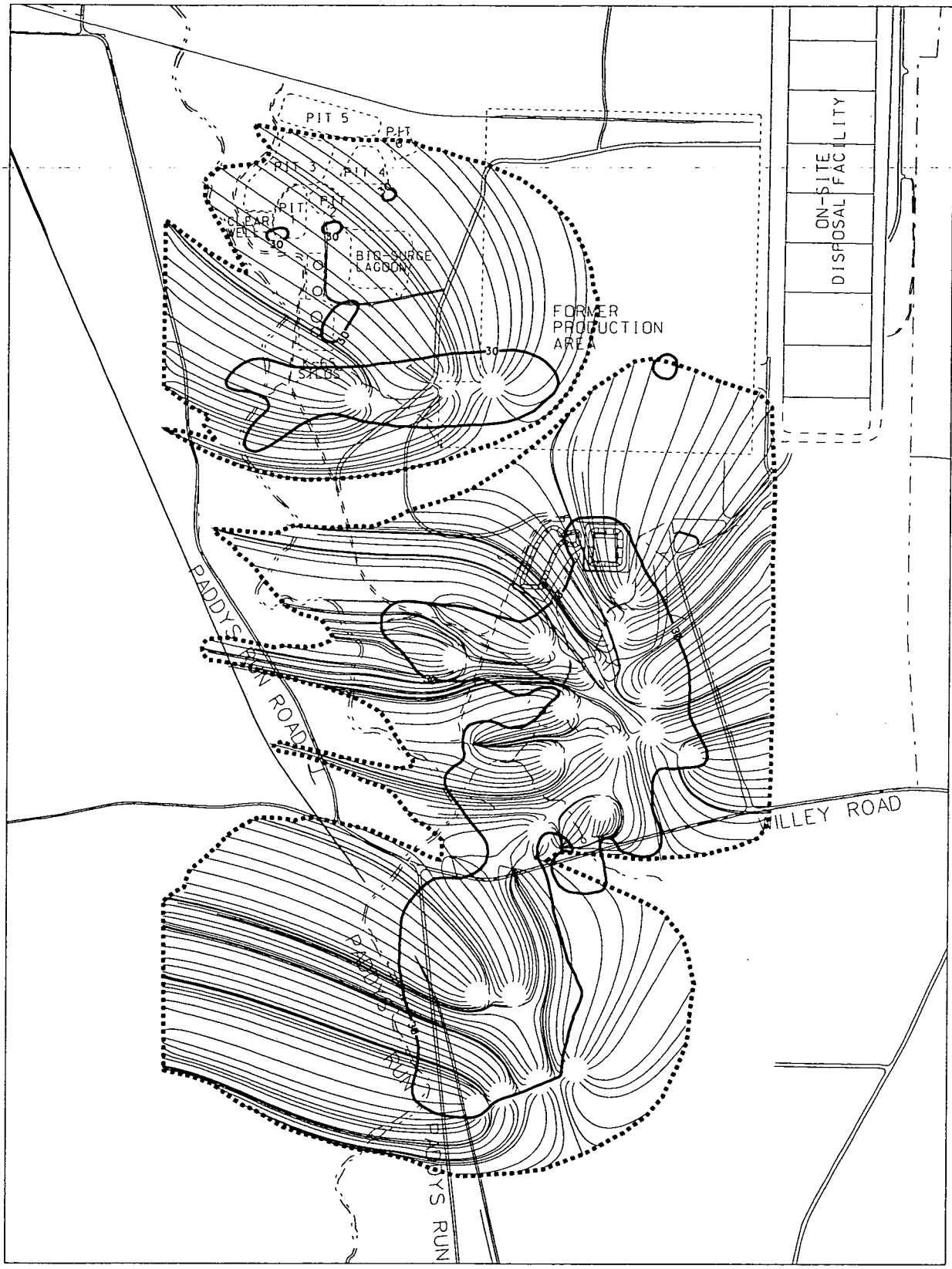
000046

FIGURE 2.1.12. 10-YEAR, NON-RETARDED PARTICLE TRACKS FROM PLUME BOUNDARY, APPROACH C, 4-1-2012 TO END

V:\5fgp1\dgn\C2E-TEST-PLAN\c2e-test-04.dgn

STATE PLANAR COORDINATE SYSTEM 1983

22-JUN-2004



LEGEND:

- FERNALD SITE BOUNDARY
- 10 YEAR, TIME-OF-TRAVEL REMEDIATION FOOTPRINT
- MODELED PARTICLE TRACKS
- 30 μg/L TOTAL URANIUM PLUME FROM SECOND HALF OF 2003

SCALE

1200 600 0 1200 FEET

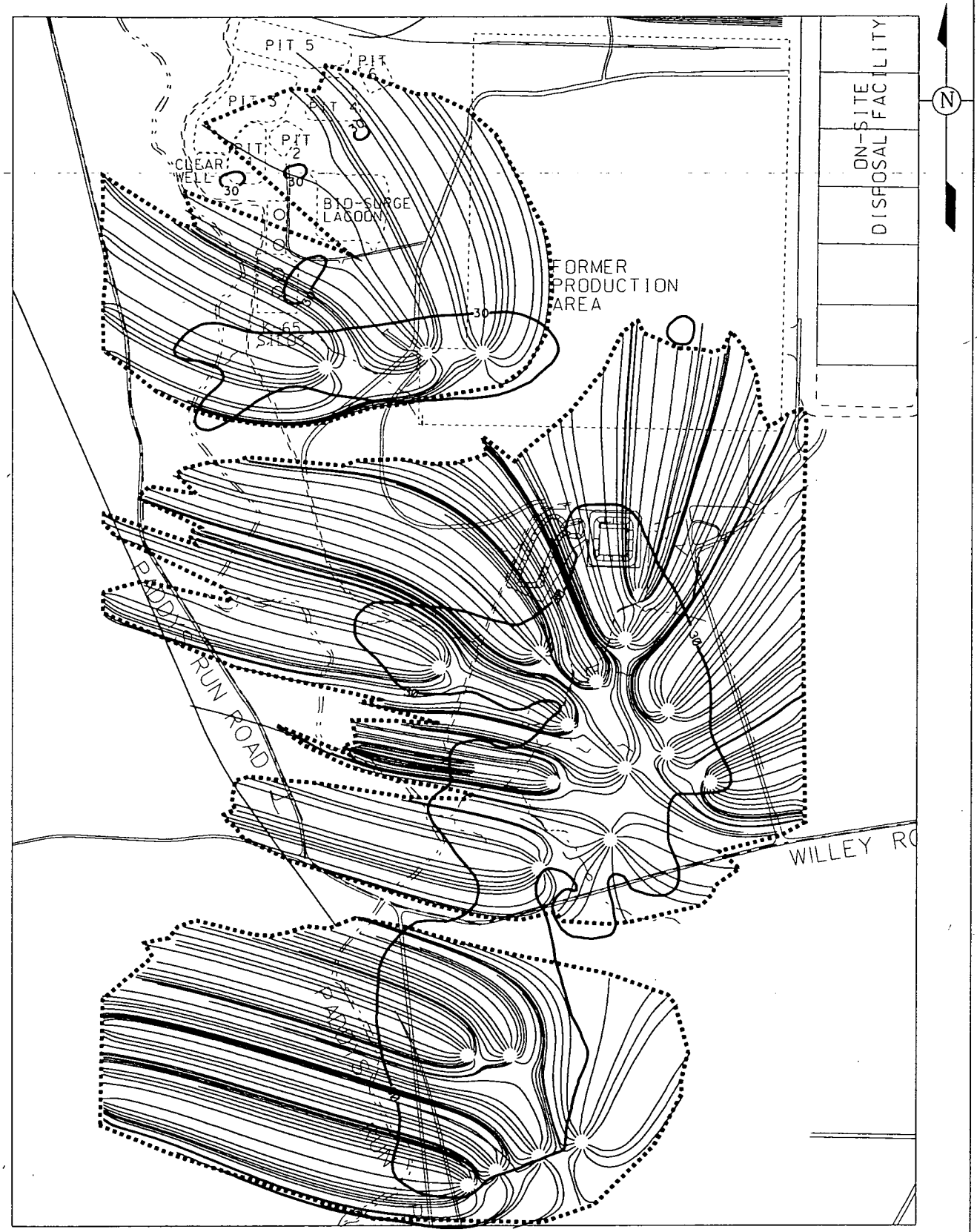
DRAFT

FIGURE 2.1.13. 10 YEAR, TIME-OF-TRAVEL REMEDIATION FOOTPRINT, WITH RE-INJECTION

V:\5fgp1\dgn\CZE-TEST-PLAN\cze-test-16.dgn

STATE PLANAR COORDINATE SYSTEM 1983

22-JUN-2004



LEGEND:

- FERNALD SITE BOUNDARY
- 10-YEAR, TIME-OF-TRAVEL REMEDIATION FOOTPRINT
- PARTICALE TRACK
- TOTAL URANIUM FOOTPRINT SECOND HALF 2003

SCALE

1000 500 0 1000 FEET

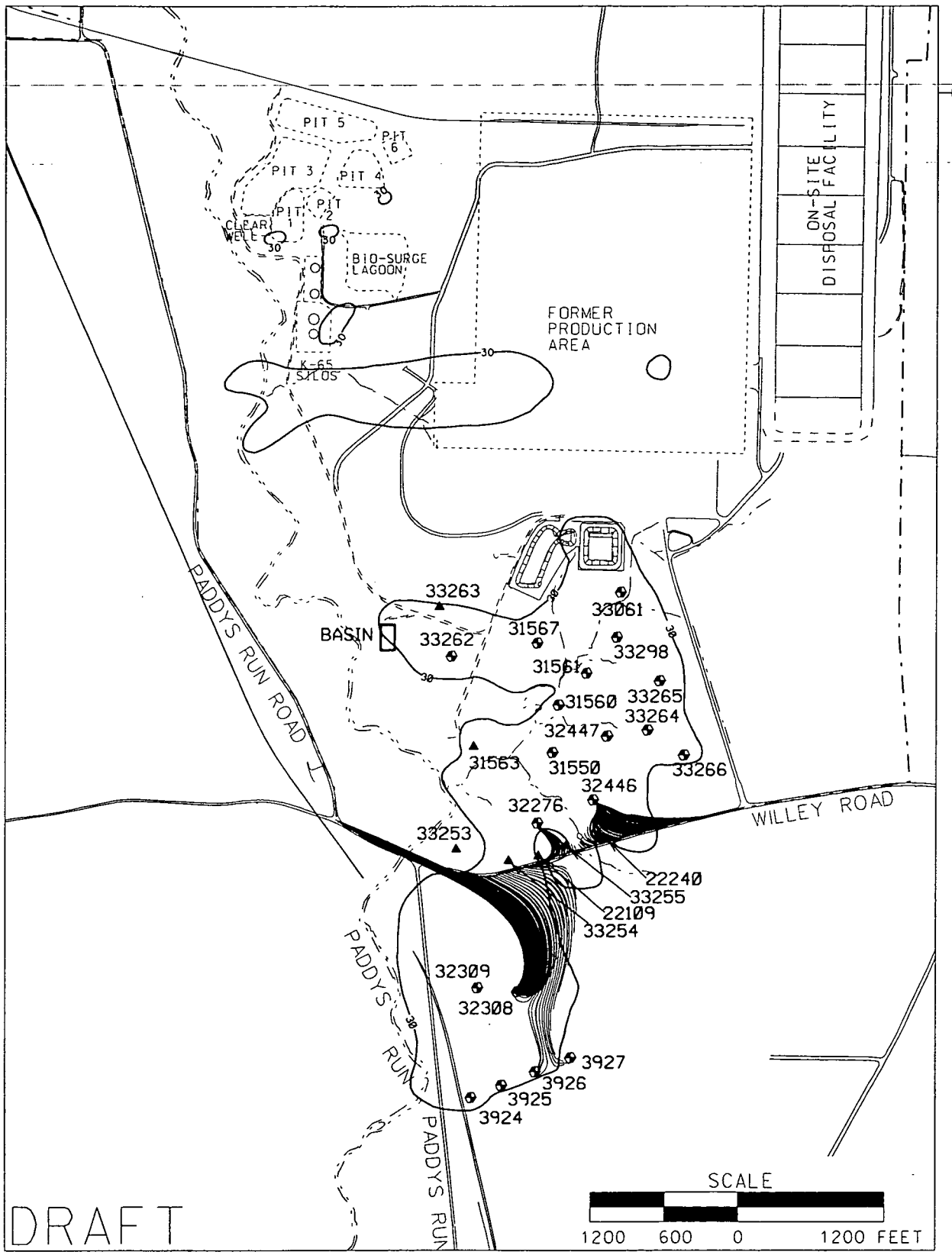
DRAFT

V:\5fgp1\dgn\CZE-TEST-PLAN\cze-test-17.dgn

STATE PLANAR COORDINATE SYSTEM 1983

22-JUN-2004

FIGURE 2.1.14. 10-YEAR TIME-OF-TRAVEL REMEDIATION FOOTPRINT, WITHOUT RE-INJECTION



LEGEND:

— · — · — FERNALD SITE BOUNDARY

— · — · — PARTICLE TRACK

▲ RE-INJECTION WELL

EXTRACTION WELL

— 30 — 30 μg/L TOTAL URANIUM PLUME FROM SECOND HALF OF 2003

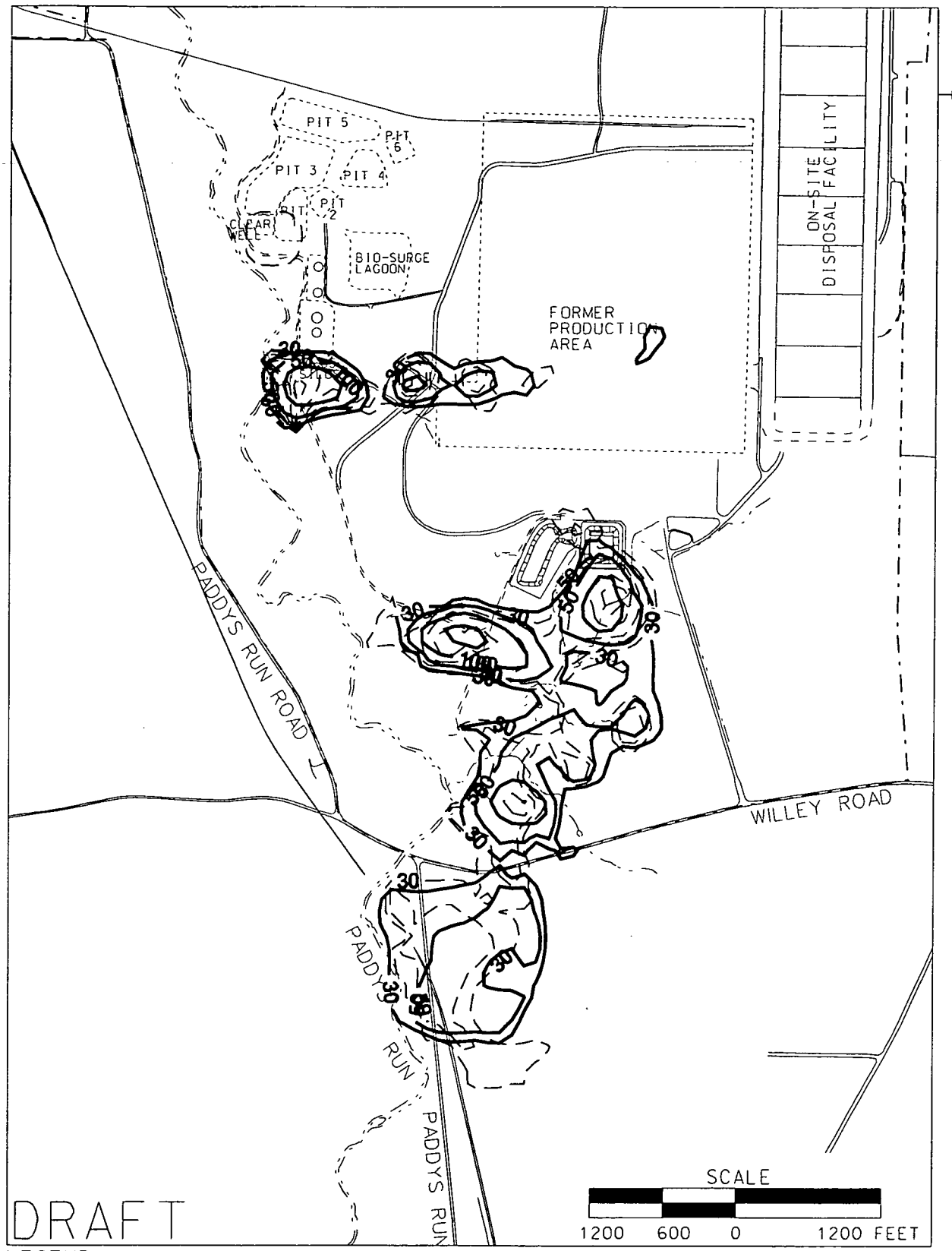
000049

FIGURE 2.1.15. 10-YEAR, TIME OF TRAVEL PARTICLE PATHS. NO RE-INJECTION. PARTICLES SEEDED ALONG WILLEY ROAD.

V:\6fgp1\dgn\CZE-TEST-PLAN\cze-test-24.dgn

STATE PLANAR COORDINATE SYSTEM 1983

24-JUN-2004



LEGEND:

- —·—·— FERNALD SITE BOUNDARY
- ——— 12-31-2002 INITIAL CONDITIONS PLUS 1 YEAR, PUMPING MODEL LAYER 12
- — — — 12-31-2003 INITIAL CONDITIONS MODEL LAYER 12

FIGURE 2.2.1. COMPARISON OF INITIAL CONDITIONS

V:\5fgp1\dgn\CZE-TEST-PLAN\cze-test-22.dgn
STATE PLANAR COORDINATE SYSTEM 1983
24-JUN-2004

Figure 2.2.2 Horizontal Variograms

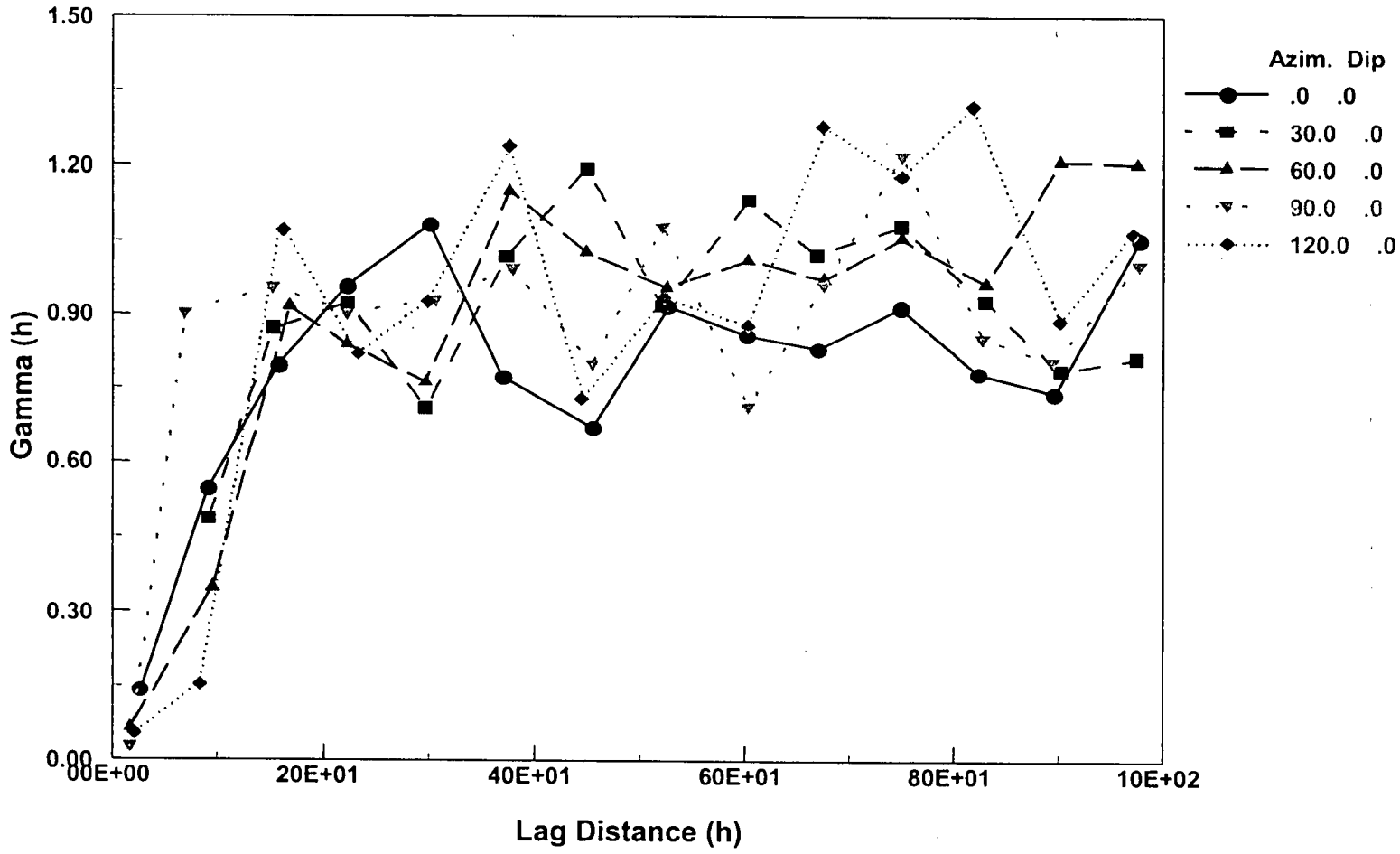
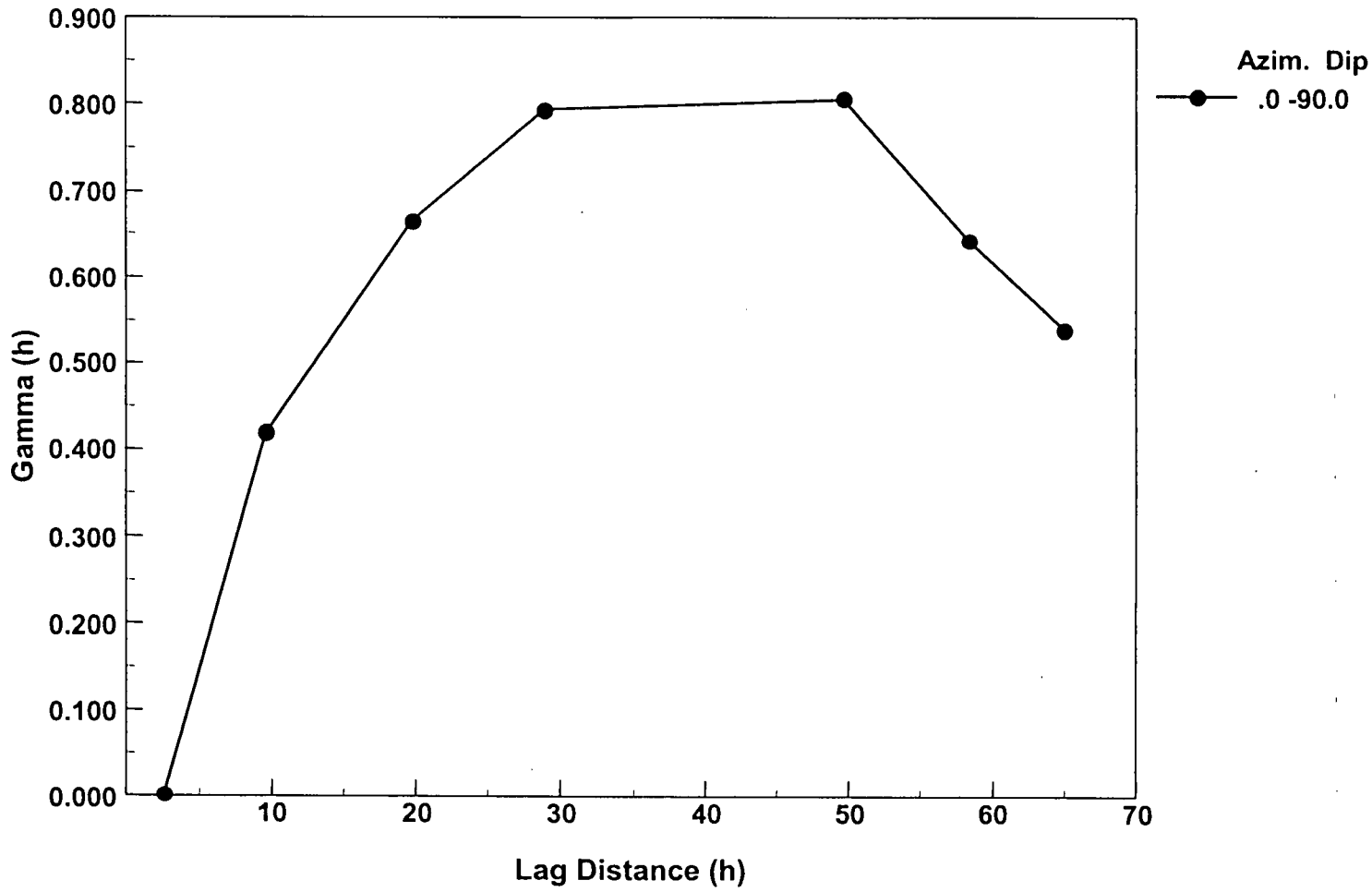
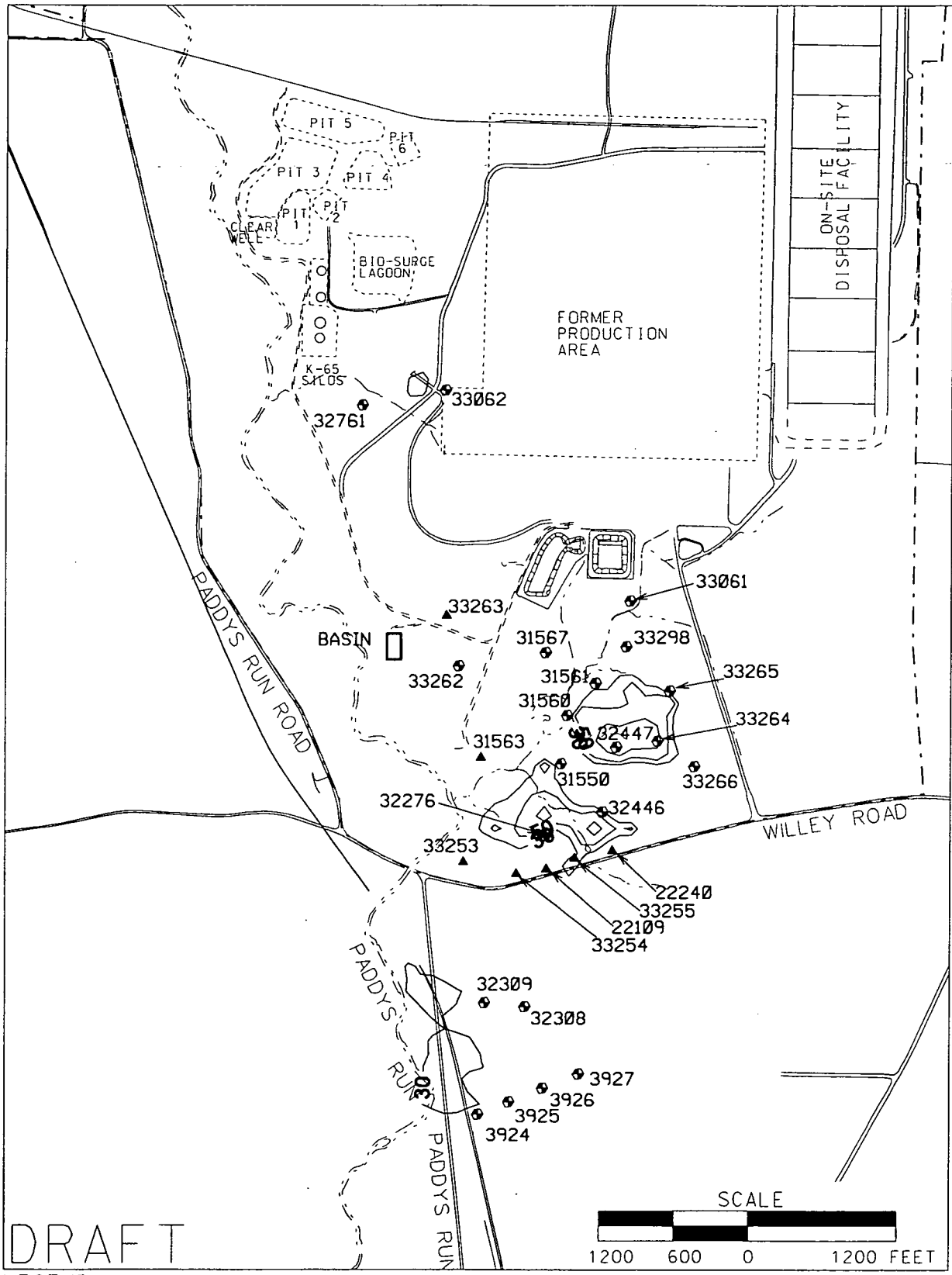


Figure 2.2.3 Vertical Variogram





LEGEND:

- FERNALD SITE BOUNDARY
- TOTAL URANIUM CONTOUR
- EXTRACTION WELL
- INJECTION WELL

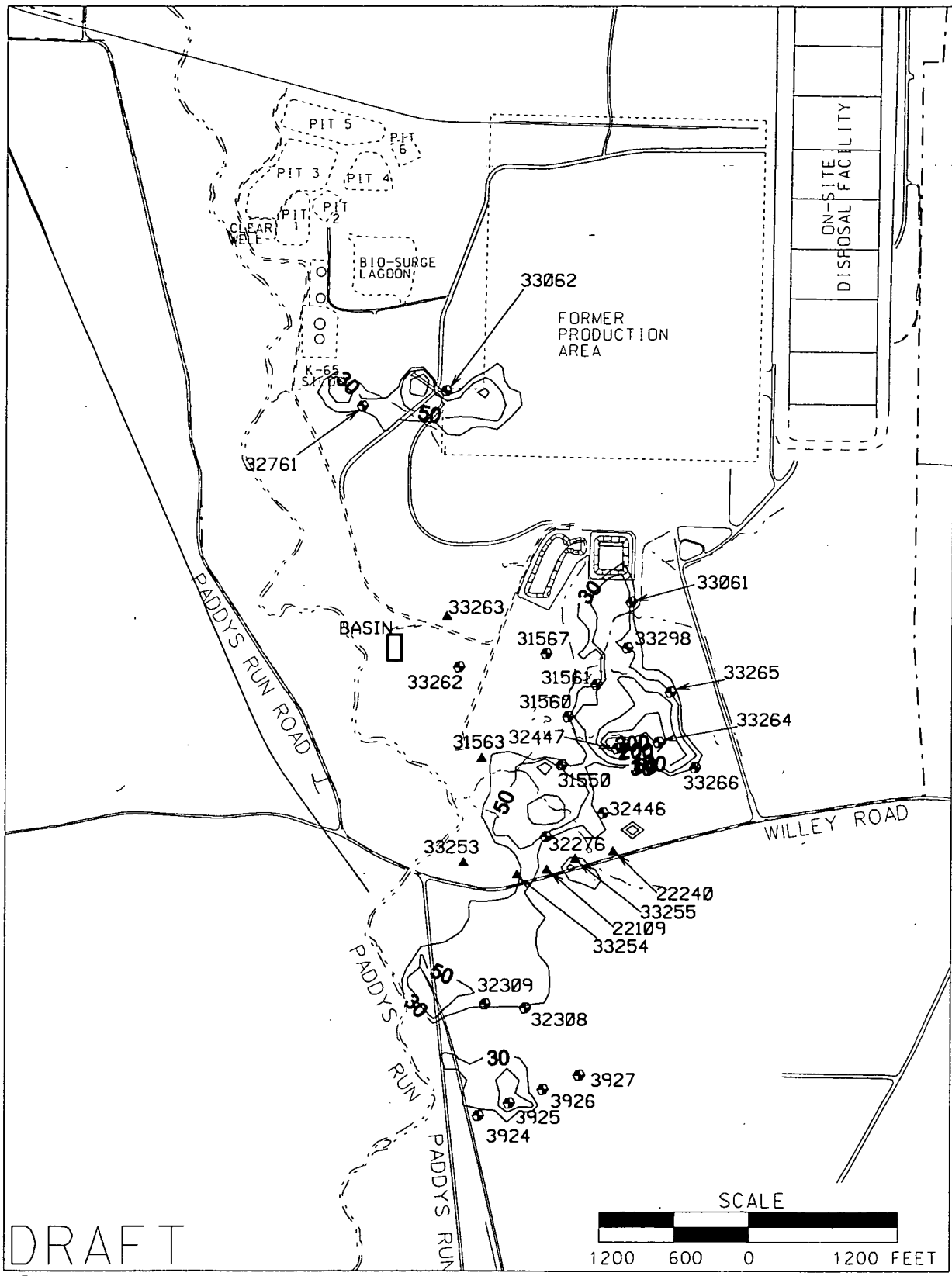
000053

FIGURE 2.2.4. MODEL LAYER 9, INITIAL CONDITIONS

V:\5fgp1\dgn\C2C-TEST-PLAN\INT-COND\c2e-tst-int-cnd-04.dgn

STATE PLANAR COORDINATE SYSTEM 1983

24-JUN-2004



LEGEND:

- FERNALD SITE BOUNDARY
- TOTAL URANIUM CONTOUR
- EXTRACTION WELL
- INJECTION WELL

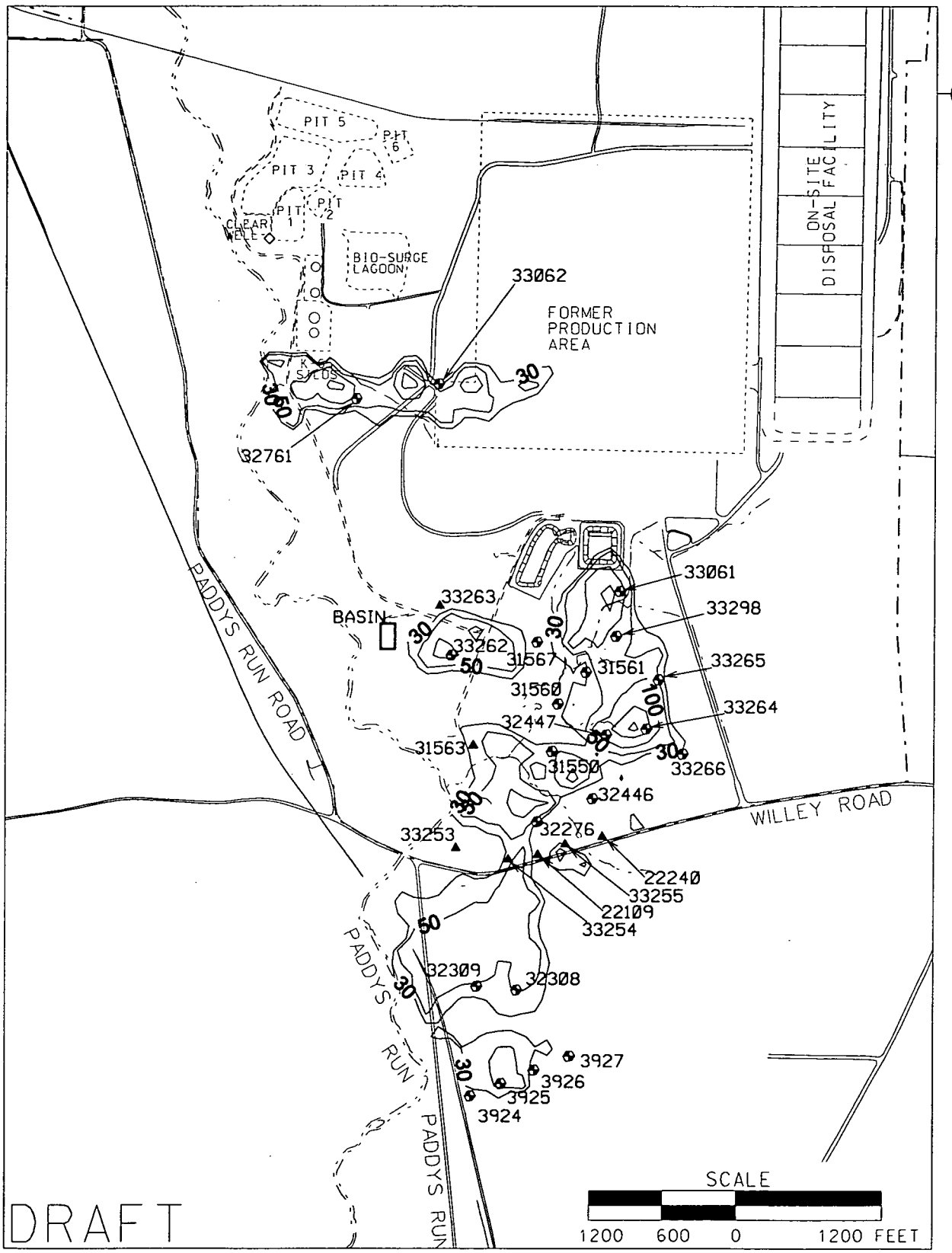
000054

FIGURE 2.2.5. MODEL LAYER 10, INITIAL CONDITIONS

V:\5fgp1\dgn\CZE-TEST-PLAN\INT-COND\cze-tst-int-cnd-01.dgn

STATE PLANAR COORDINATE SYSTEM 1983

24-JUN-2004



LEGEND:

- FERNALD SITE BOUNDARY
- TOTAL URANIUM CONTOUR
- EXTRACTION WELL
- INJECTION WELL

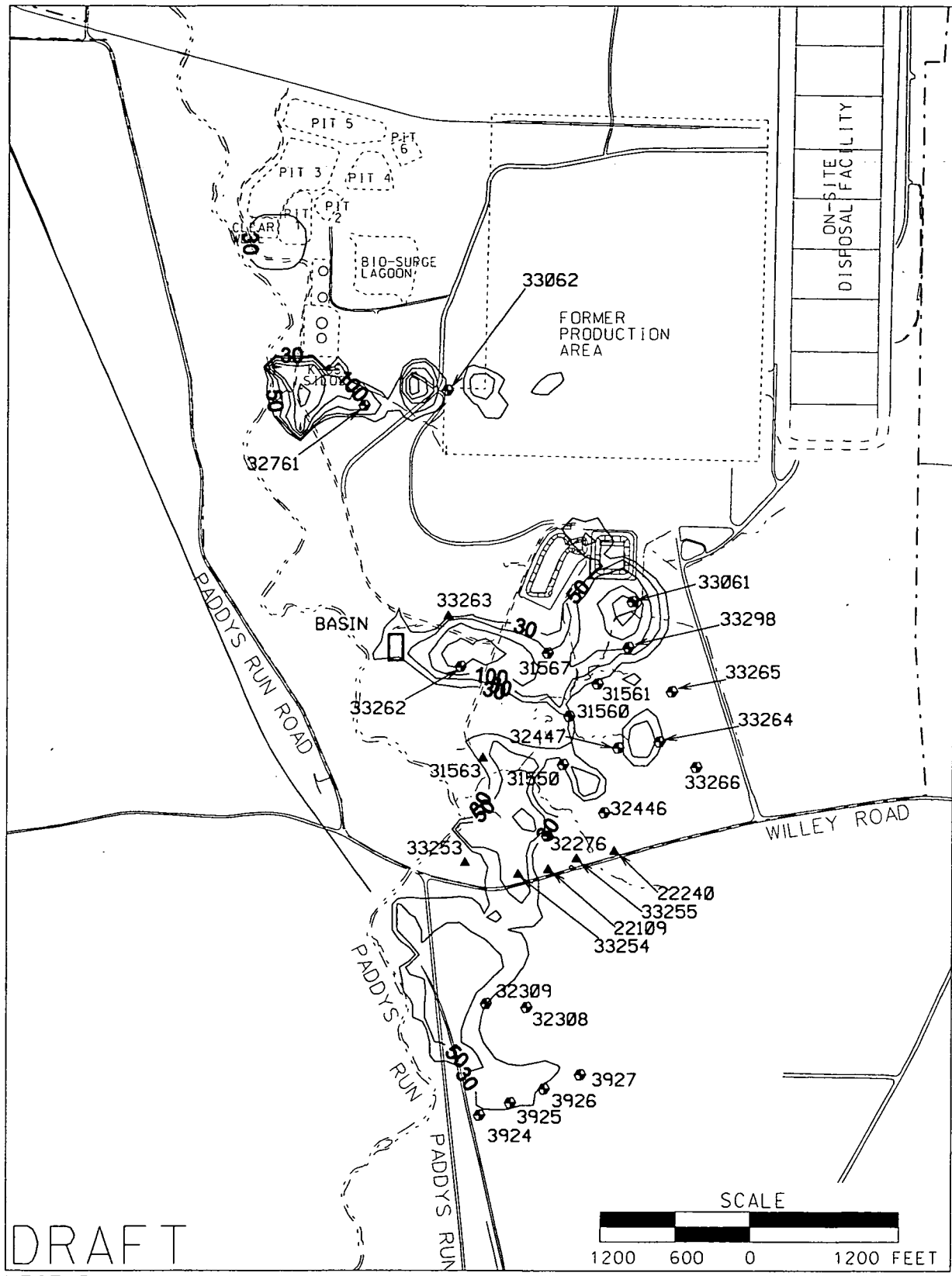
000055

FIGURE 2.2.6. MODEL LAYER 11, INITIAL CONDITIONS

V:\5fqp1\qpn\CZE-TEST-PLAN\INT-COND\cze-tst-int-cnd-02.dgn

STATE PLANAR COORDINATE SYSTEM 1983

24-JUN-2004



LEGEND:

- FERNALD SITE BOUNDARY
- TOTAL URANIUM CONTOUR
- EXTRACTION WELL
- INJECTION WELL

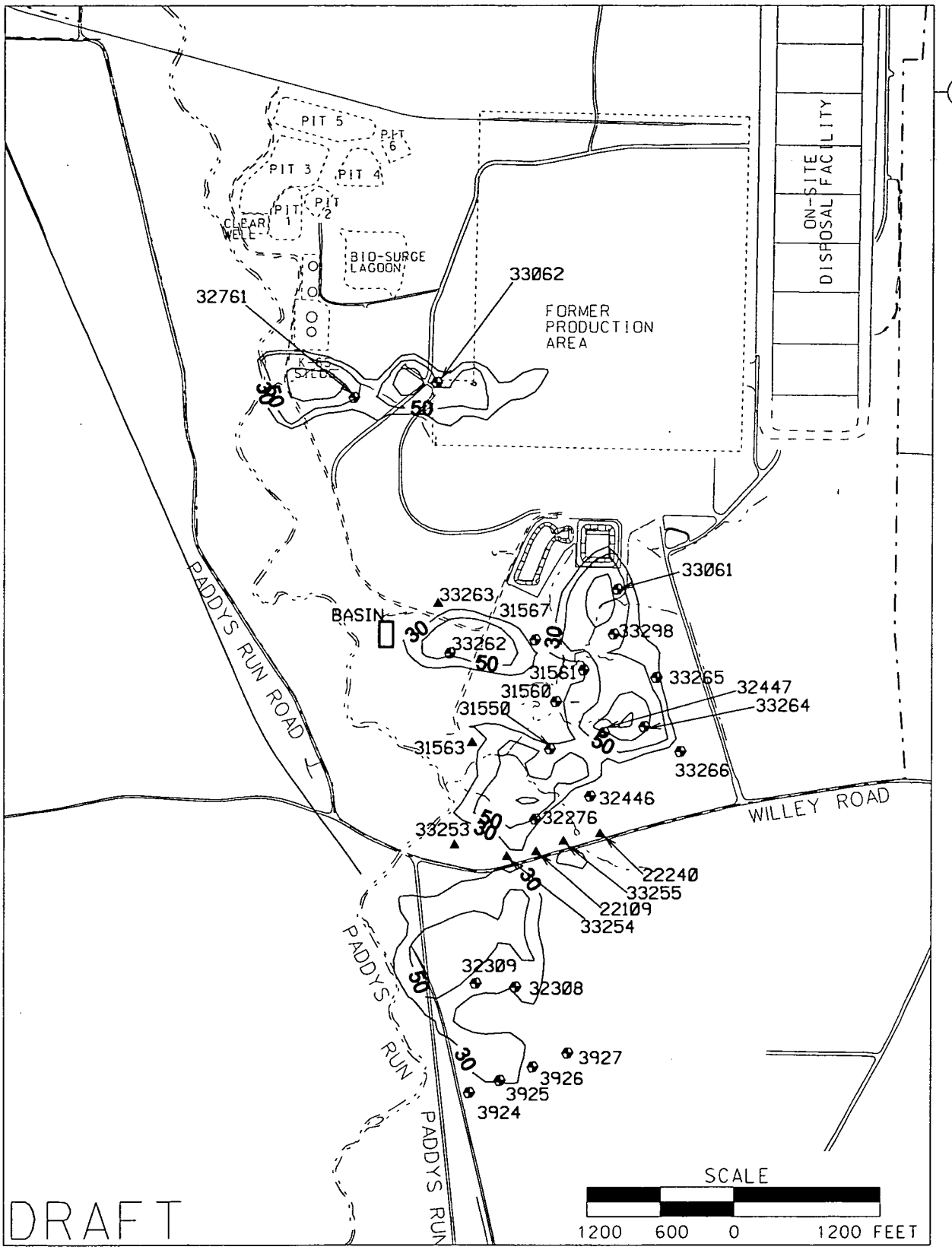
000056

FIGURE 2.2.7. MODEL LAYER 12, INITIAL CONDITIONS

V:\5fgp1\cgn\CZE-TEST-PLAN\INT-COND\czo-1st-int-cnd-03.cgn

STATE PLANAR COORDINATE SYSTEM 1983

24-JUN-2004



LEGEND:

- FERNALD SITE BOUNDARY
- TOTAL URANIUM CONTOUR
- EXTRACTION WELL
- INJECTION WELL

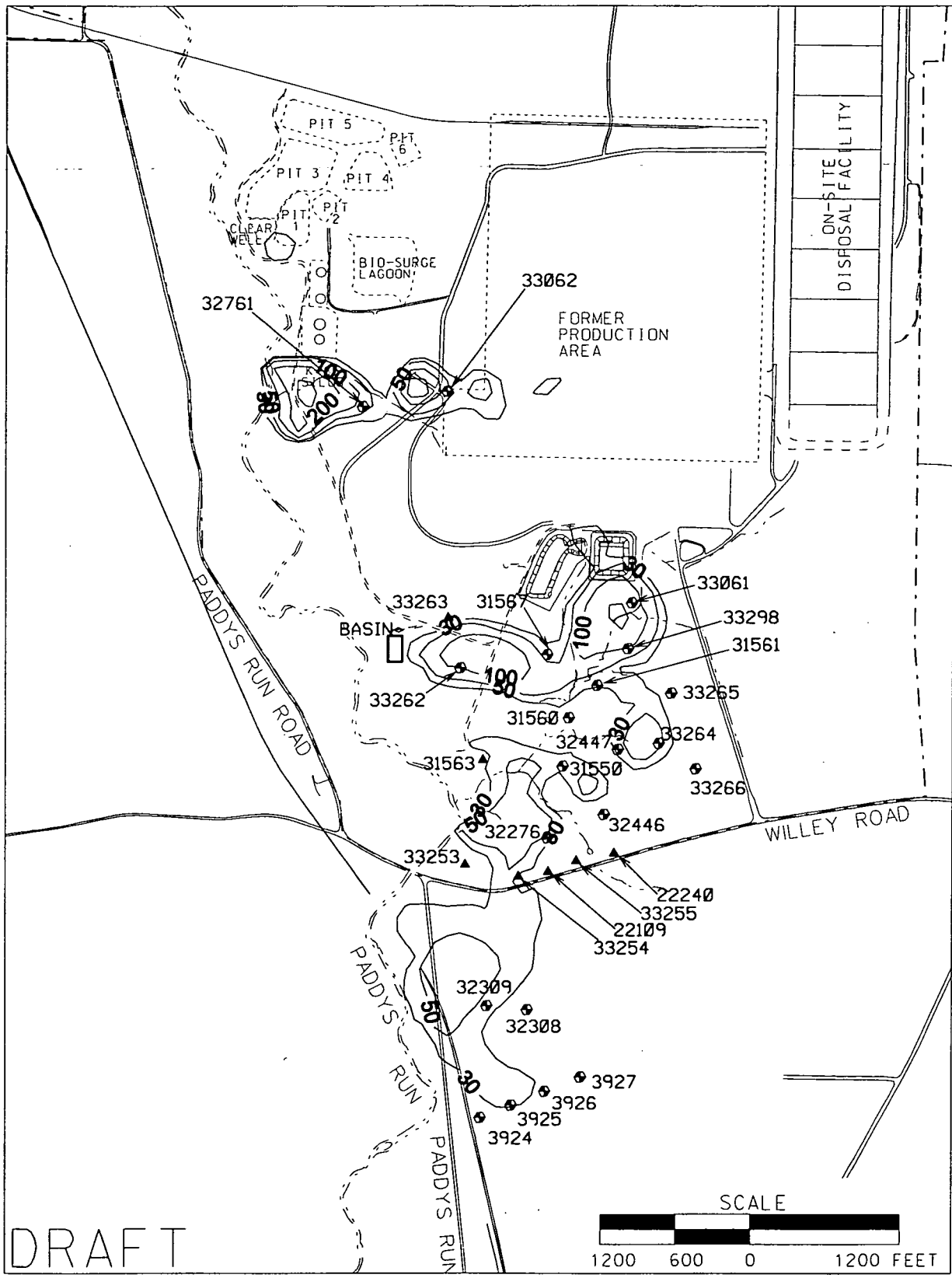
000057

FIGURE 2.2.8. MODEL LAYER 11, PLUME AT 10-1-2004

V:\5fgp1\dgn\CZE-TEST-PLAN\TRANSPORT\cze-tst-trans-01.dgn

STATE PLANAR COORDINATE SYSTEM 1983

24-JUN-2004



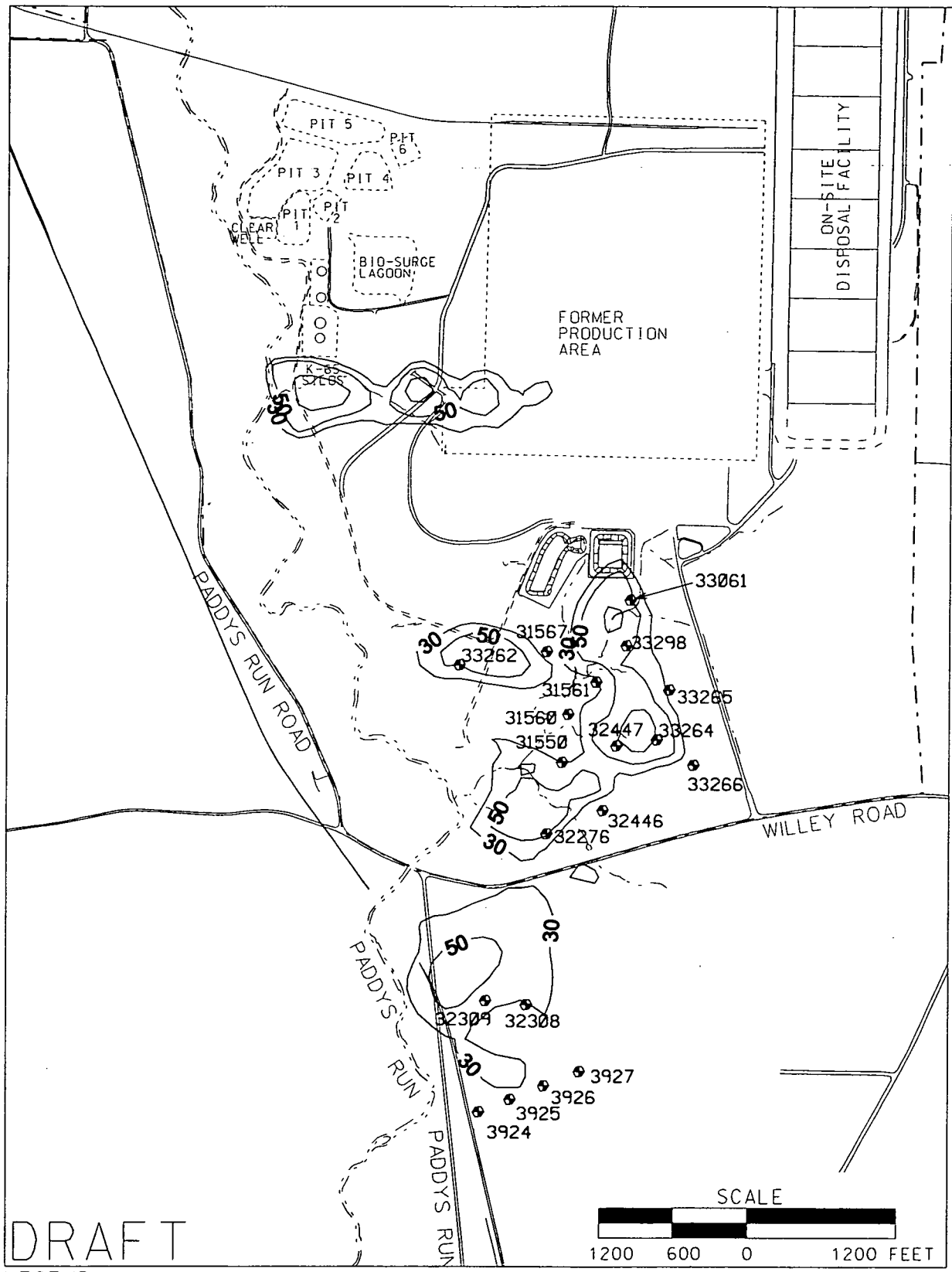
LEGEND:

- FERNALD SITE BOUNDARY
- TOTAL URANIUM CONTOUR
- EXTRACTION WELL
- INJECTION WELL

000058

FIGURE 2.2.9. MODEL LAYER 12, PLUME AT 10-1-2004

V:\5fqp1\dgn\CZE-TEST-PLAN\TRANSPORT\cze-tst-trans-07.dgn STATE PLANAR COORDINATE SYSTEM 1983 24-JUN-2004



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LEGEND:

— · — · — FERNALD SITE BOUNDARY

——— TOTAL URANIUM CONTOUR

● EXTRACTION WELL

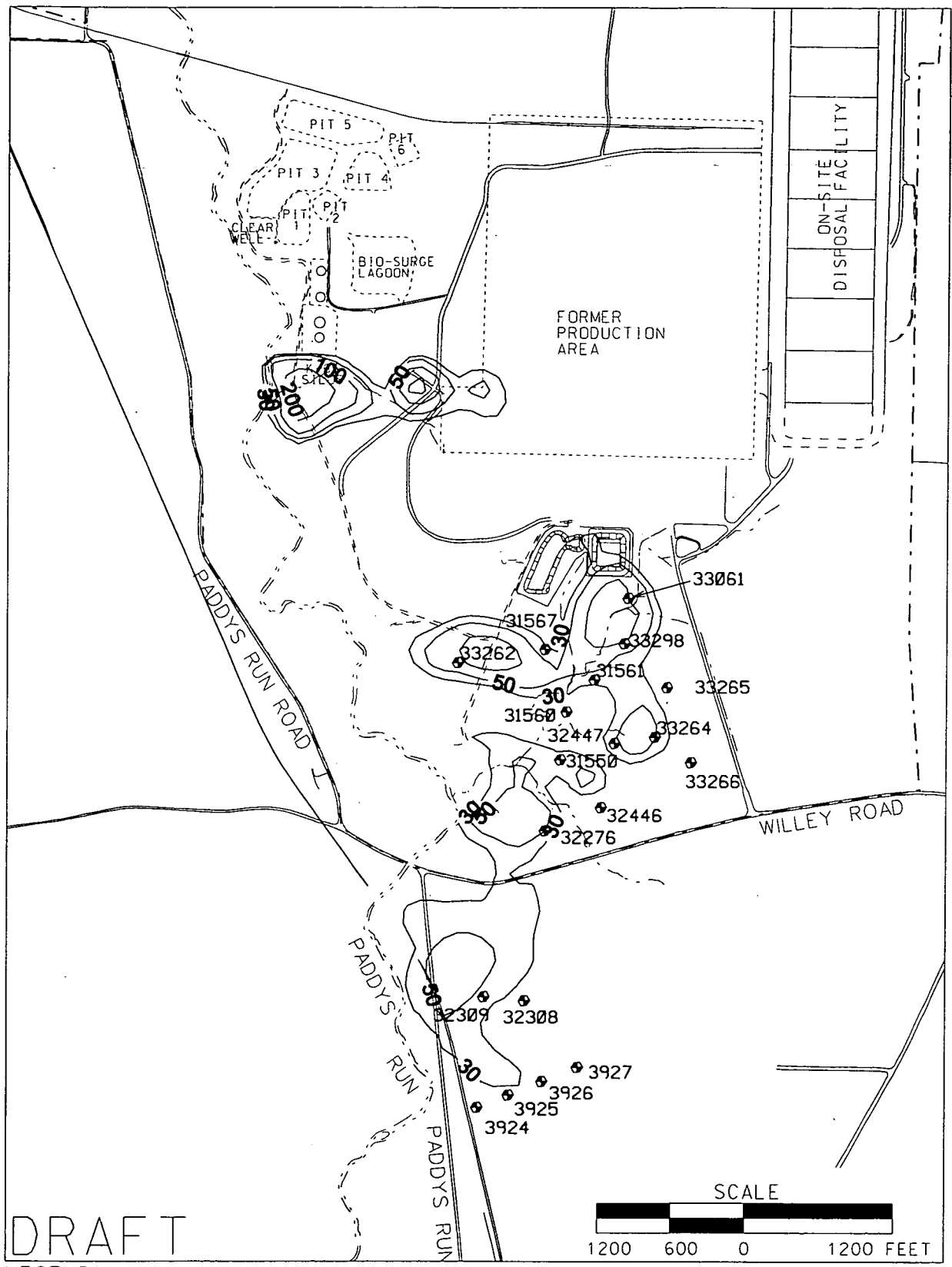
000059

FIGURE 2.2.10. MODEL LAYER 11, PLUME AT 4-1-2005

V:\5fgp1\dgn\CZE-TEST-PLAN\TRANSPORT\czo-tst-trans-02.dgn

STATE PLANAR COORDINATE SYSTEM 1983

24-JUN-2004



LEGEND:

— · — · — FERNALD SITE BOUNDARY

——— TOTAL URANIUM CONTOUR

● EXTRACTION WELL

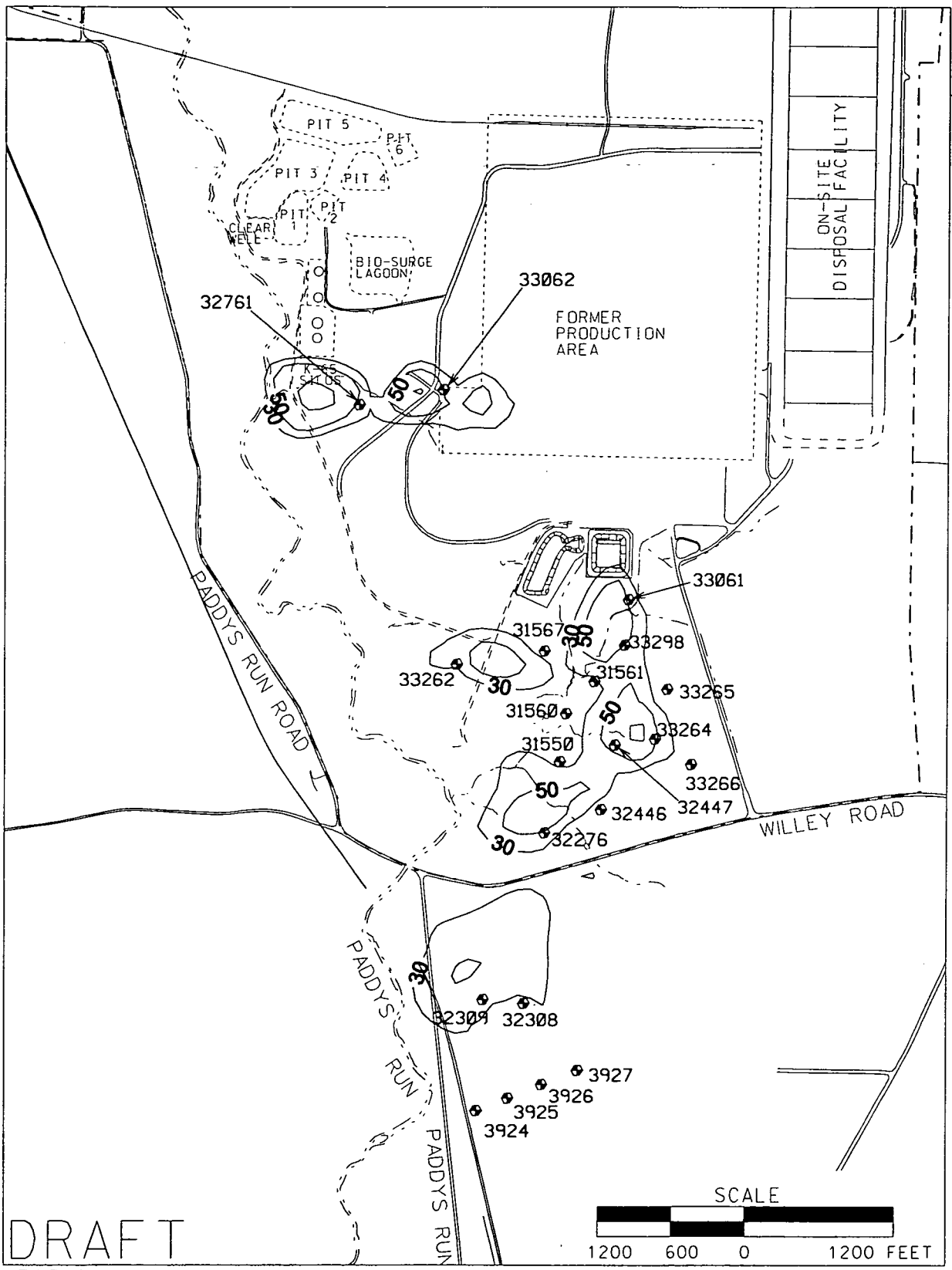
000060

FIGURE 2.2.11. MODEL LAYER 12. PLUME AT 4-1-2005

V:\5fgpi\dgn\CZE-TEST-PLAN\TRANSPORT\cze-tst-trans-08.dgn

STATE PLANAR COORDINATE SYSTEM 1983

24-JUN-2004



LEGEND:

- — · — · — FERNALD SITE BOUNDARY
- ——— TOTAL URANIUM CONTOUR
- ⊕ EXTRACTION WELL

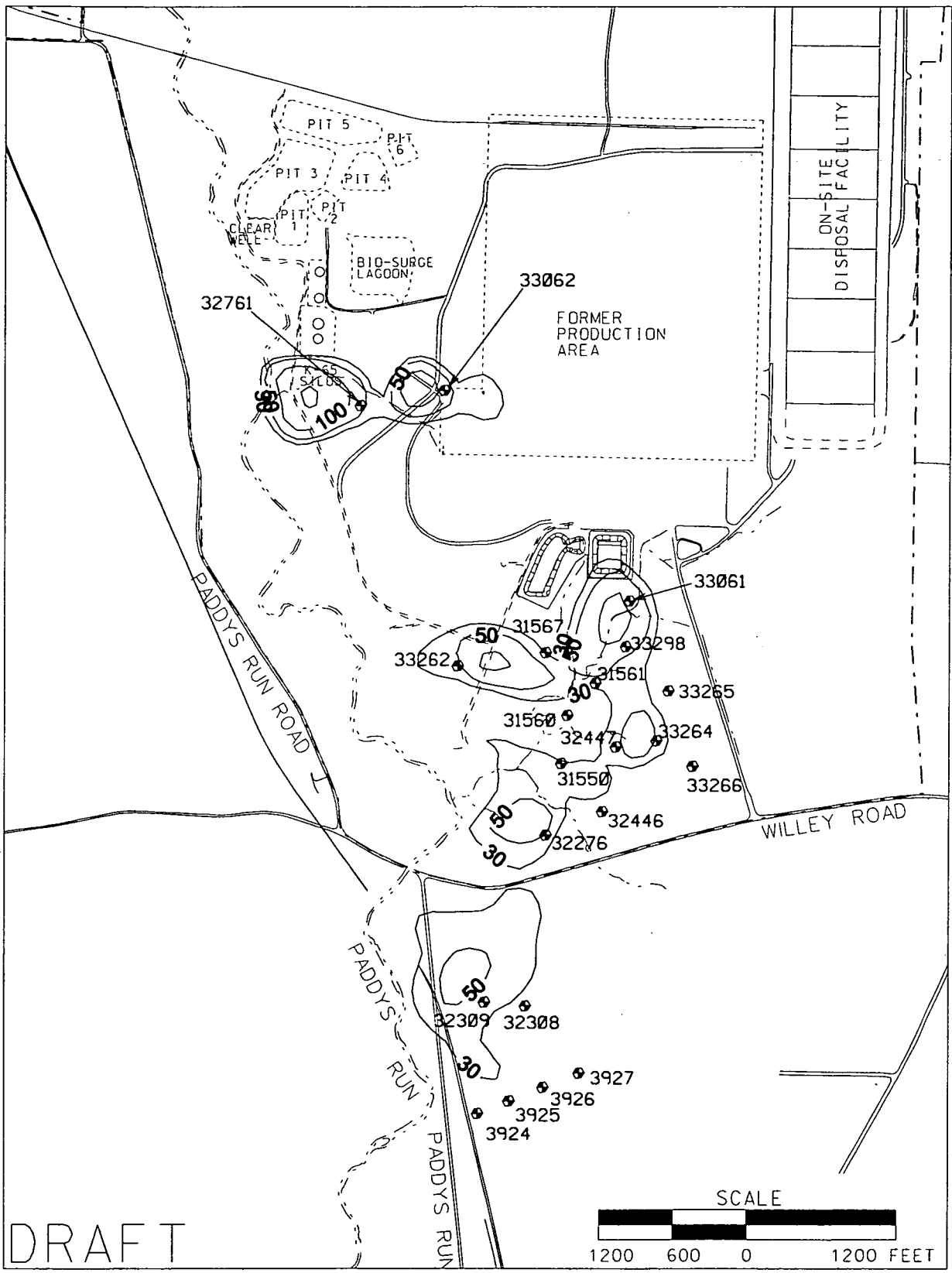
000061

V:\5fgp1\dgn\CZE-TEST-PLAN\TRANSPORT\cze-tst-trans-03.dgn

STATE PLANAR COORDINATE SYSTEM 1983

24-JUN-2004

FIGURE 2.2.12. MODEL LAYER 11, PLUME AT 4-1-2006, FOR APPROACH C



LEGEND:

— · — · — FERNALD SITE BOUNDARY

——— TOTAL URANIUM CONTOUR

⊕ EXTRACTION WELL

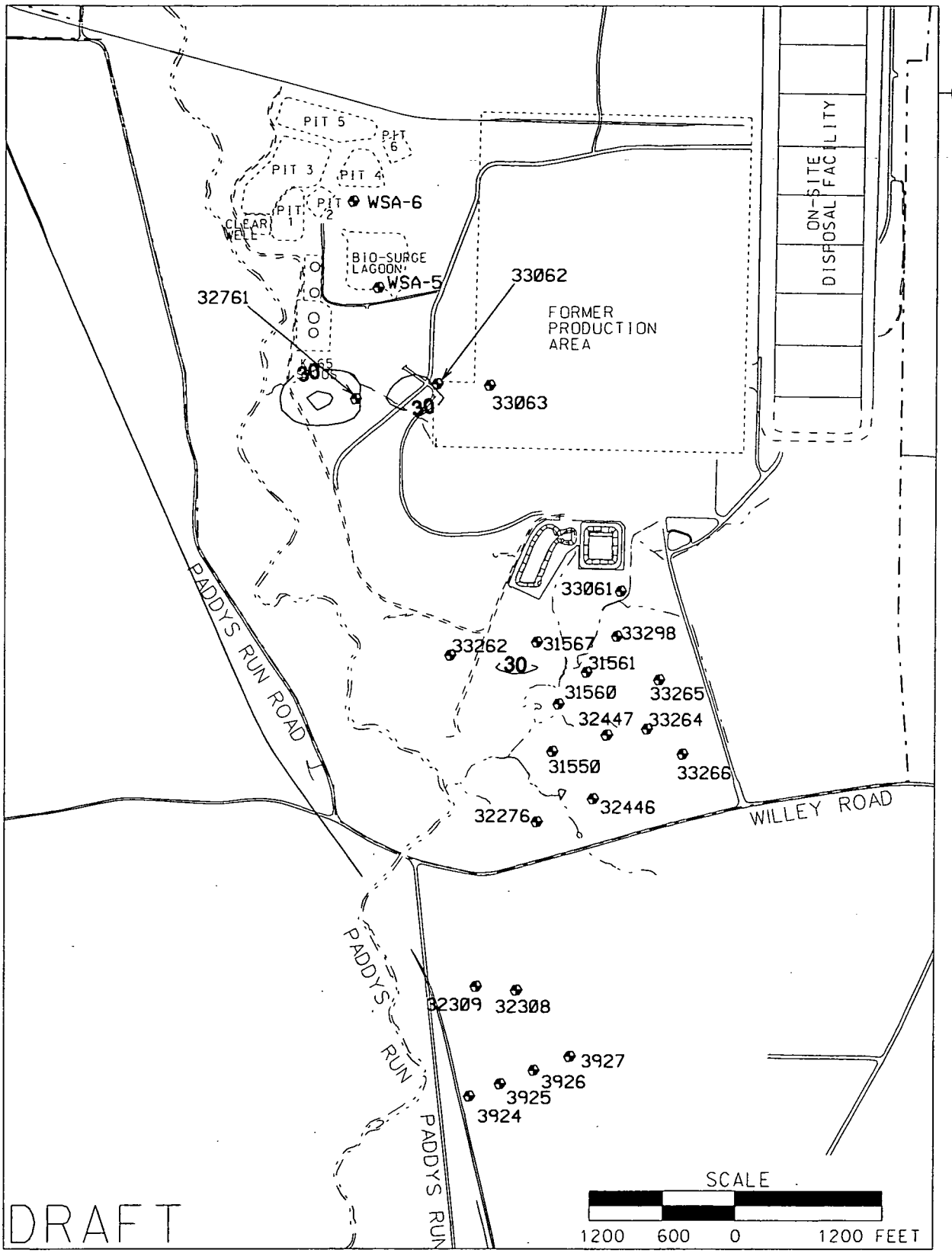
000062

FIGURE 2.2.13. MODEL LAYER 12, PLUME AT 4-1-2006, FOR APPROACH C

V:\5fgp1\dgn\CZE-TEST-PLAN\TRANSPORT\czg-tst-trans-09.dgn

STATE PLANAR COORDINATE SYSTEM 1983

24-JUN-2004



LEGEND:

- FERNALD SITE BOUNDARY
- TOTAL URANIUM CONTOUR
- EXTRACTION WELL

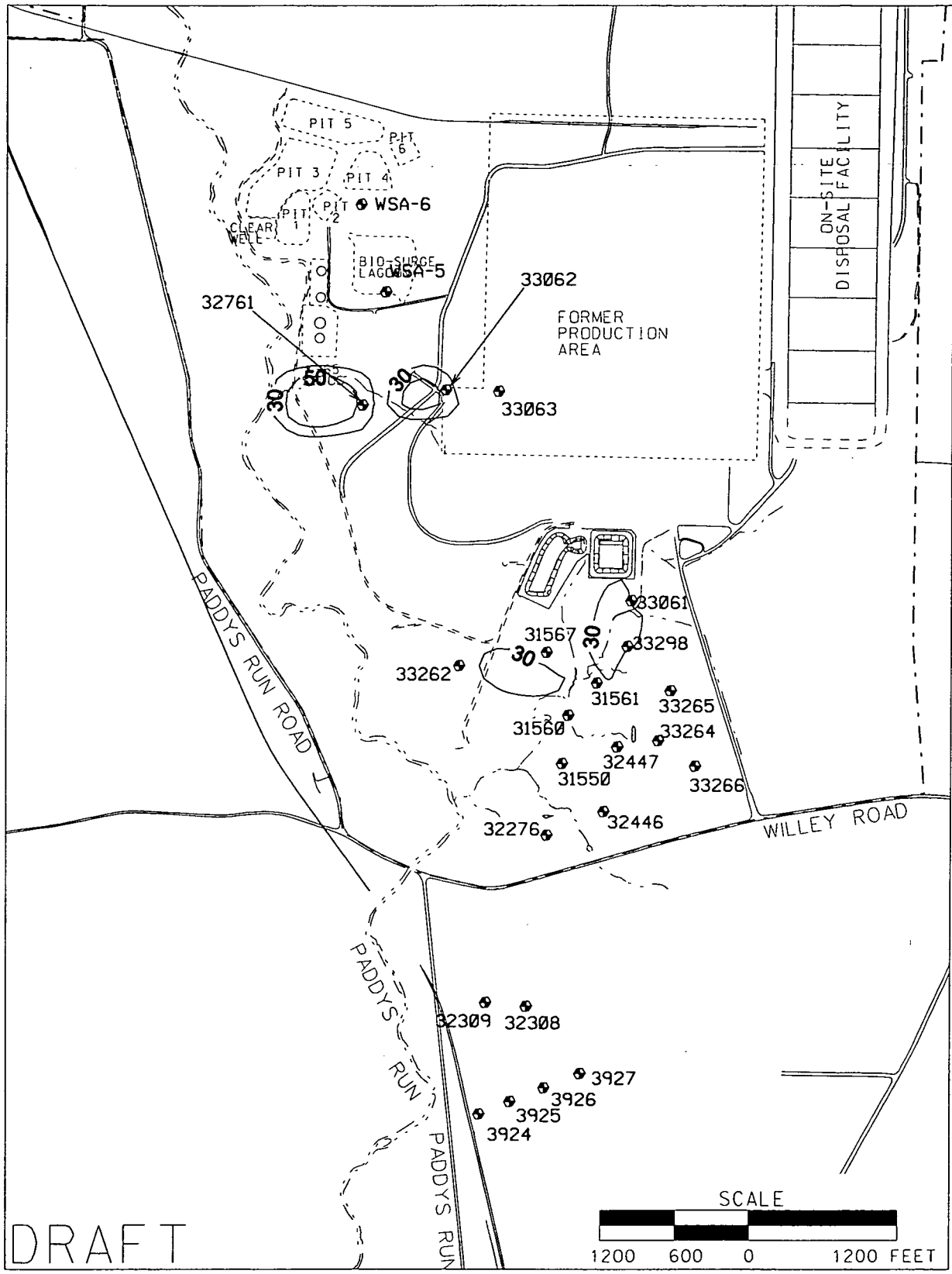
000063

FIGURE 2.2.14. MODEL LAYER 11, PLUME AT 4-1-2012, FOR APPROACH C

V:\5fgp1\dgn\CZE-TEST-PLAN\TRANSPORT\czp-tst-trans-05.dgn

STATE PLANAR COORDINATE SYSTEM 1983

24-JUN-2004



LEGEND:

- — · — · — FERNALD SITE BOUNDARY
- ——— TOTAL URANIUM CONTOUR
- ⊕ EXTRACTION WELL

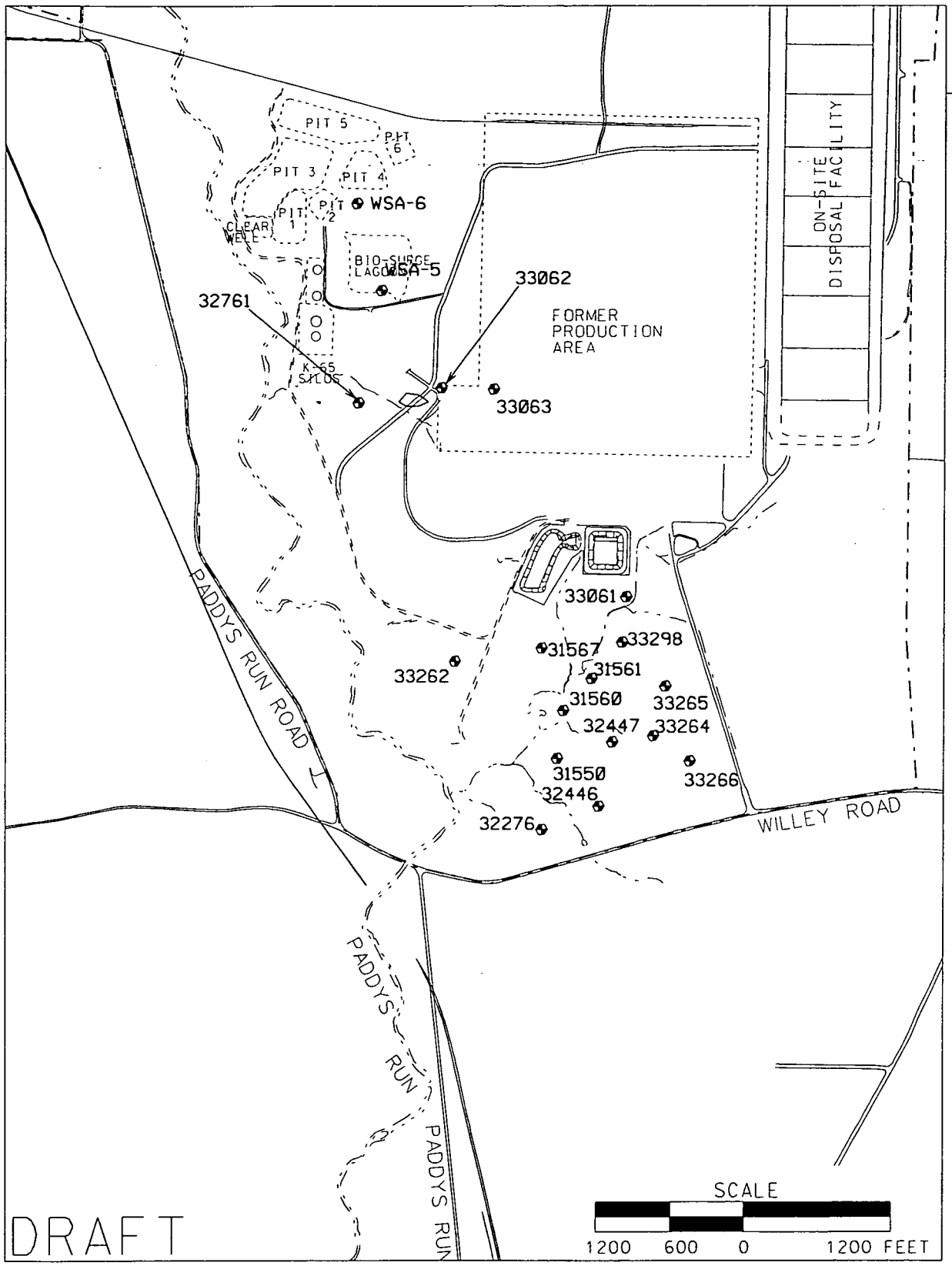
000064

V:\5fgp1\dgn\CZE-TEST-PLAN\TRANSPORT\cze-tst-trans-11.dgn

STATE PLANAR COORDINATE SYSTEM 1983

24-JUN-2004

FIGURE 2.2.15. MODEL LAYER 12, PLUME AT 4-1-2012, FOR APPROACH C



LEGEND:

— · — · — FERNALD SITE BOUNDARY

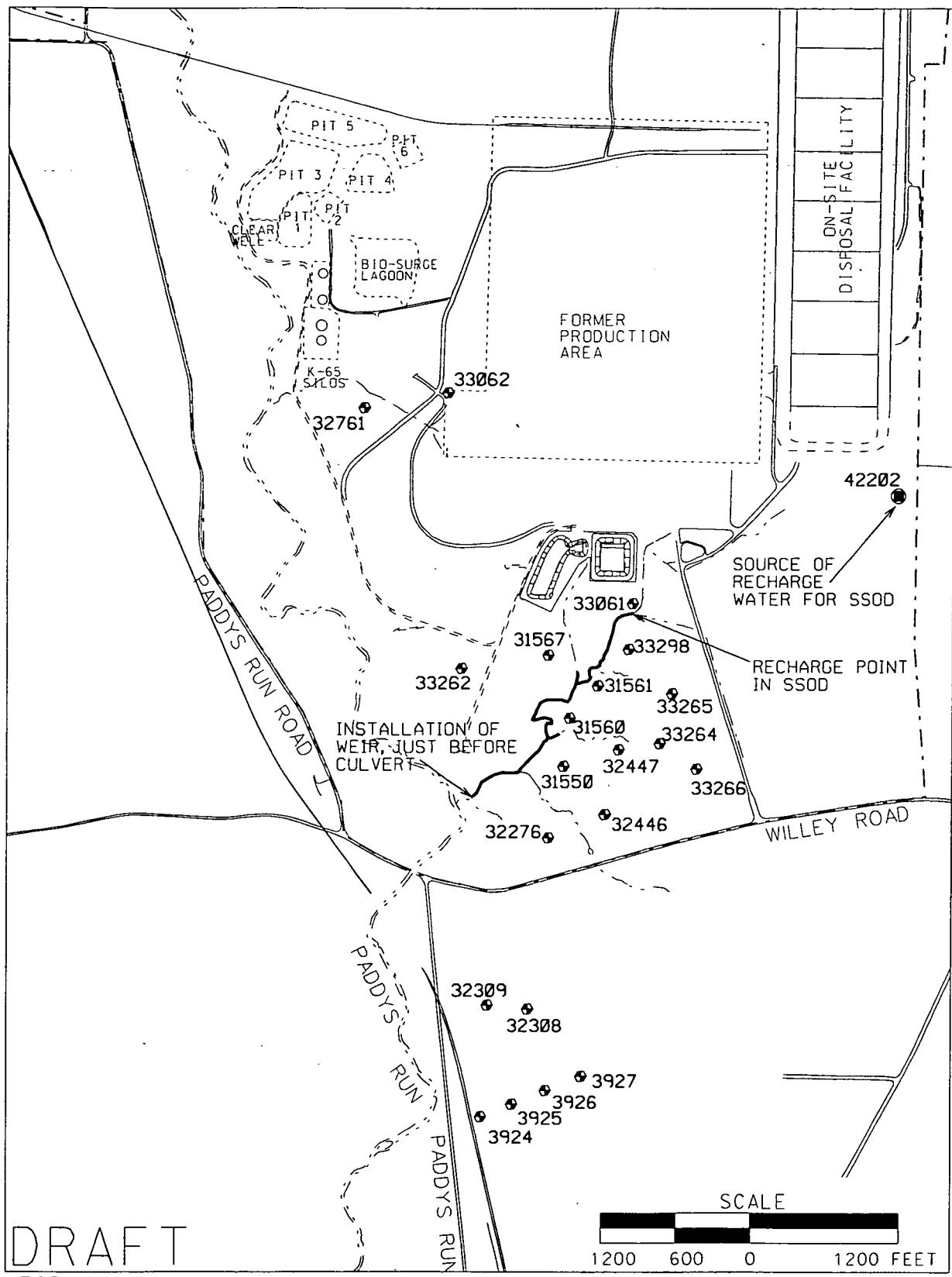
——— TOTAL URANIUM CONTOUR

⊕ EXTRACTION WELL

000065

FIGURE 2.2.16. MODEL LAYER 12, PLUME AT 4-1-2020, FOR APPROACH C

V:\51fgp1\dgn\CZE-TEST-PLAN\TRANSPORT\czo-tst-trans-13.dgn STATE PLANAR COORDINATE SYSTEM 1983 24-JUN-2004



LEGEND:

— · — · — FERNALD SITE BOUNDARY

——— SSOD

EXTRACTION WELL

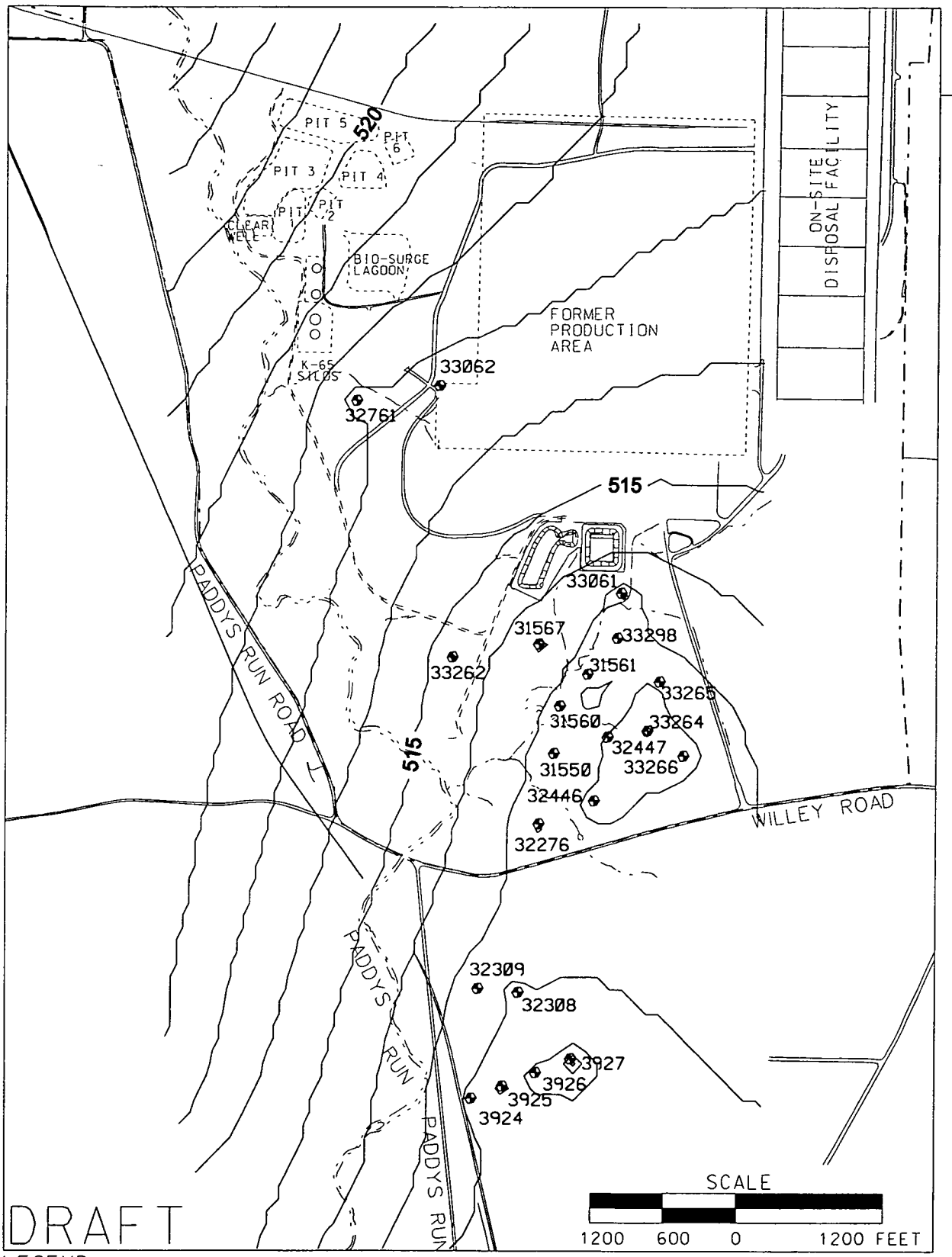
000066

FIGURE 3.1. LOCATION MAP FOR APPROACH C-IMPROVED FIELD VERIFICATION

V:\5fgp1\dgn\CZE-TEST-PLAN\cze-test-18.dgn

STATE PLANAR COORDINATE SYSTEM 1983

24-JUN-2004



LEGEND:

— · — · — FERNALD SITE BOUNDARY

——— GROUNDWATER ELEVATION CONTOUR

● EXTRACTION WELL

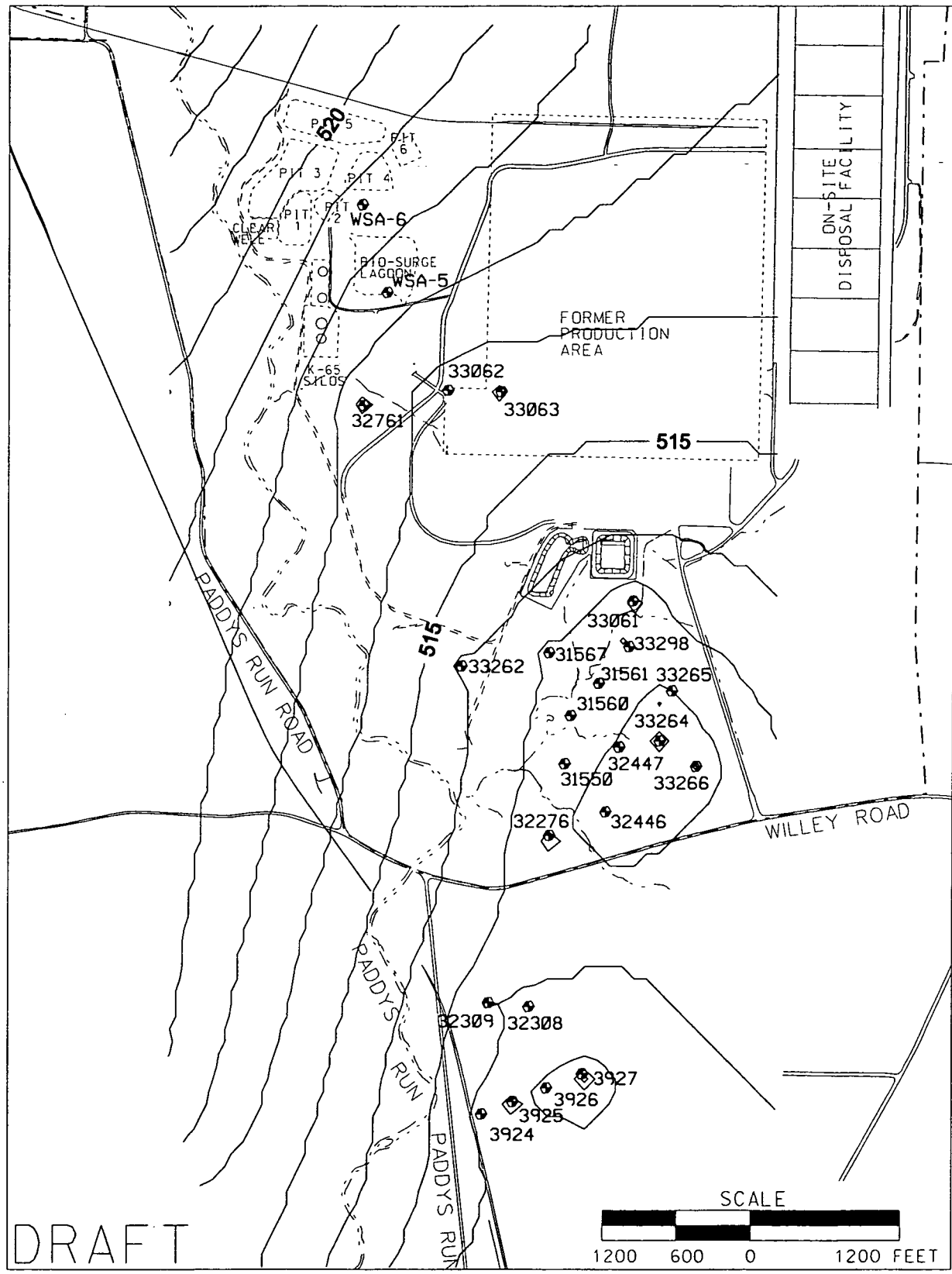
000067

V:\5fgp1\dgn\CZC-TEST-PLAN\CW\CZO-1st-qw-05.dgn

STATE PLANAR COORDINATE SYSTEM 1983

22-JUN-2004

FIGURE 3.1.1. MODELED GROUNDWATER ELEVATION PREDICTIONS, 4-1-2005 TO 4-1-2006, APPROACH C-IMPROVED



LEGEND:

— · — · — FERNALD SITE BOUNDARY

——— GROUNDWATER ELEVATION CONTOUR

EXTRACTION WELL

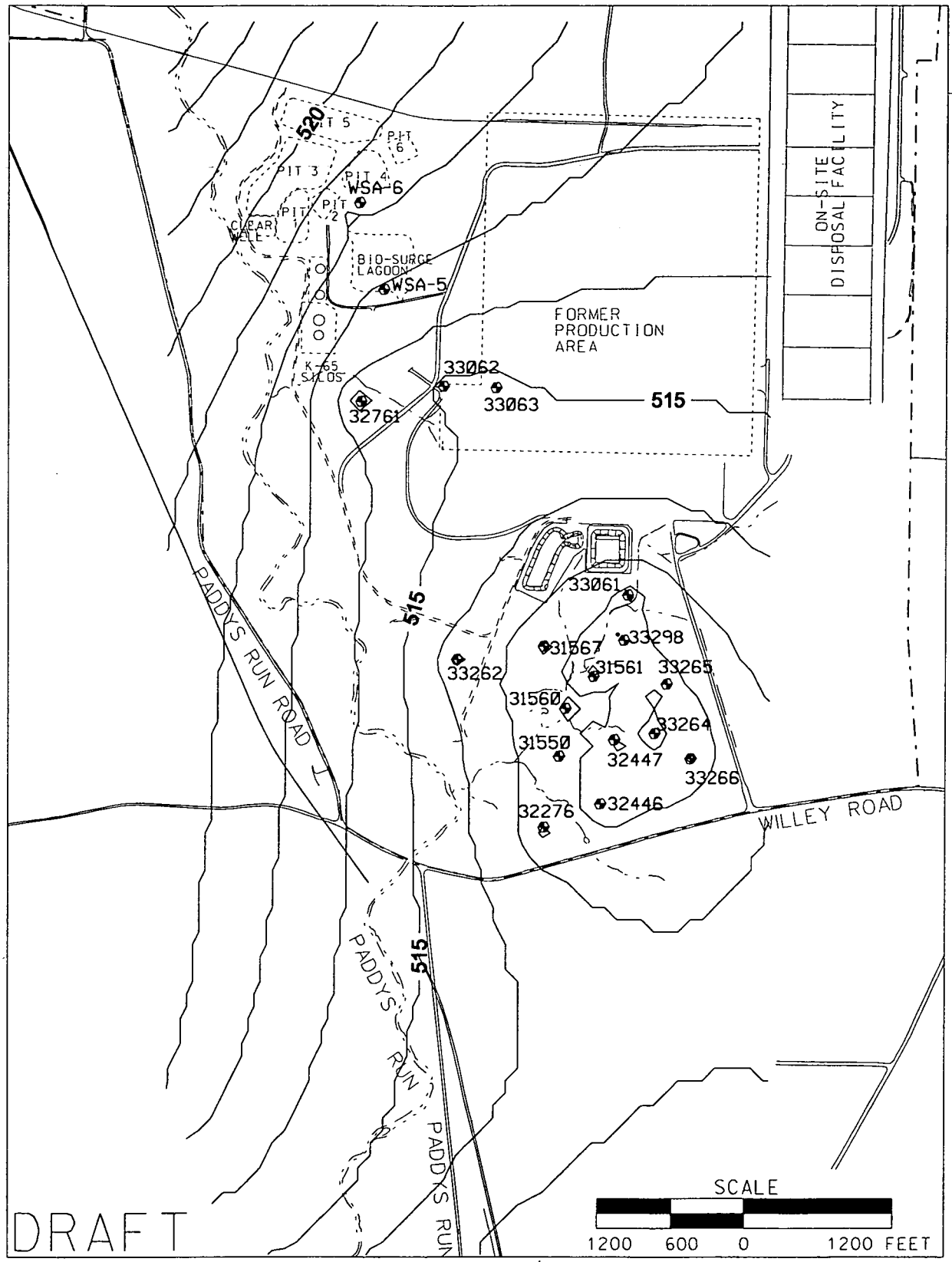
000068

V:\5fgp1\dgn\C2E-TEST-PLAN\CW\c2e-tst-gw-04.dgn

STATE PLANAR COORDINATE SYSTEM 1983

22-JUN-2004

FIGURE 3.1.2. MODELED GROUNDWATER ELEVATION PREDICTIONS, 4-1-2006 TO 4-1-2012, APPROACH C-IMPROVED



LEGEND:

— · — · — FERNALD SITE BOUNDARY

——— GROUNDWATER ELEVATION CONTOUR

⊕ EXTRACTION WELL

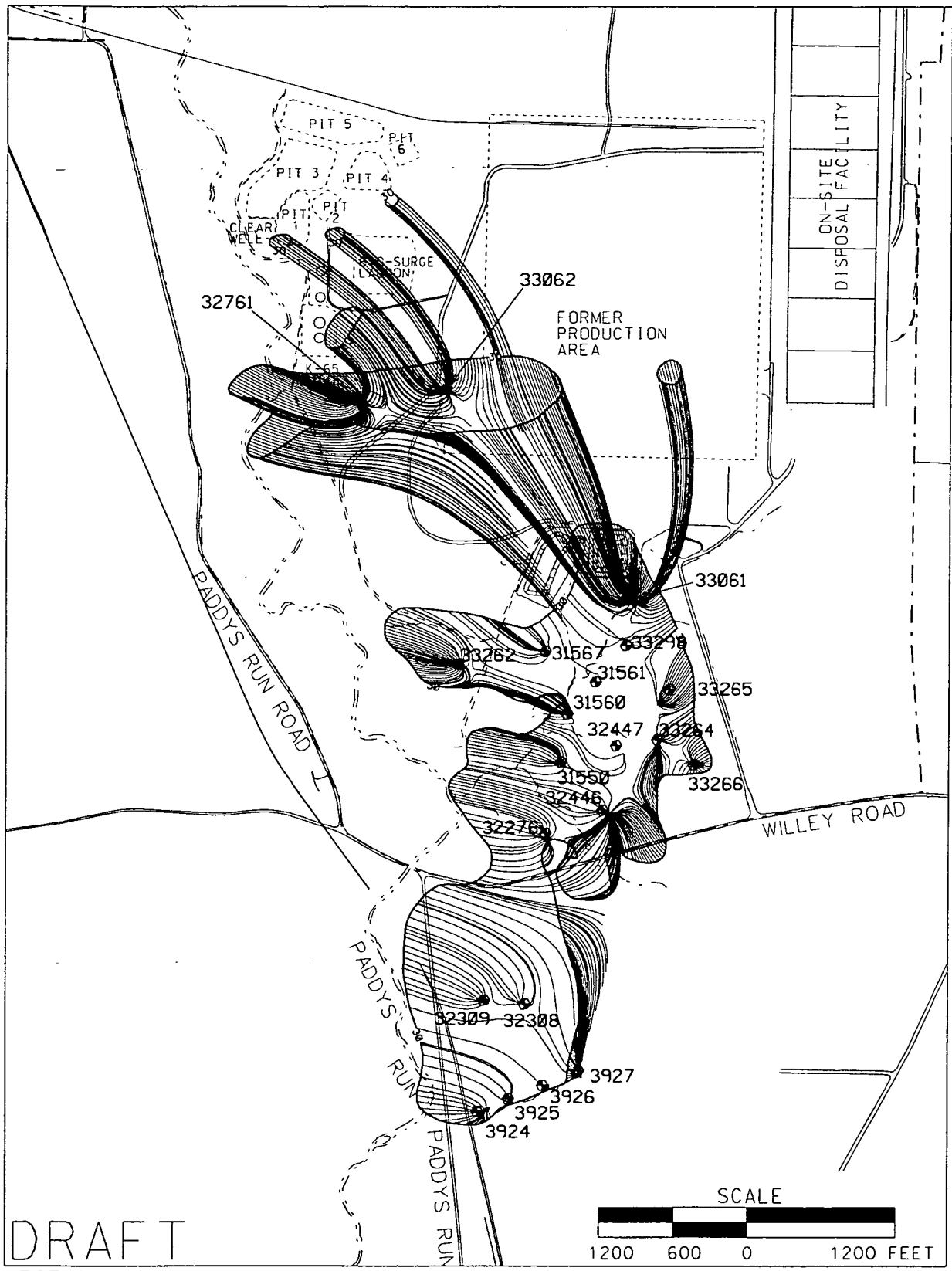
000069

FIGURE 3.1.3. MODELED GROUNDWATER ELEVATION PREDICTIONS, 4-1-2012 TO END, APPROACH C-IMPROVED

V:\5fgp1\dgn\C2E-TEST-PLAN\GW\c2e-tst-gw-03.dgn

STATE PLANAR COORDINATE SYSTEM 1983

22-JUN-2004



LEGEND:

- FERNALD SITE BOUNDARY
- PARTICLE TRACK
- EXTRACTION WELL
- 30 — TOTAL URANIUM CONTOUR (30 μg/L) THROUGH SECOND HALF OF 2003

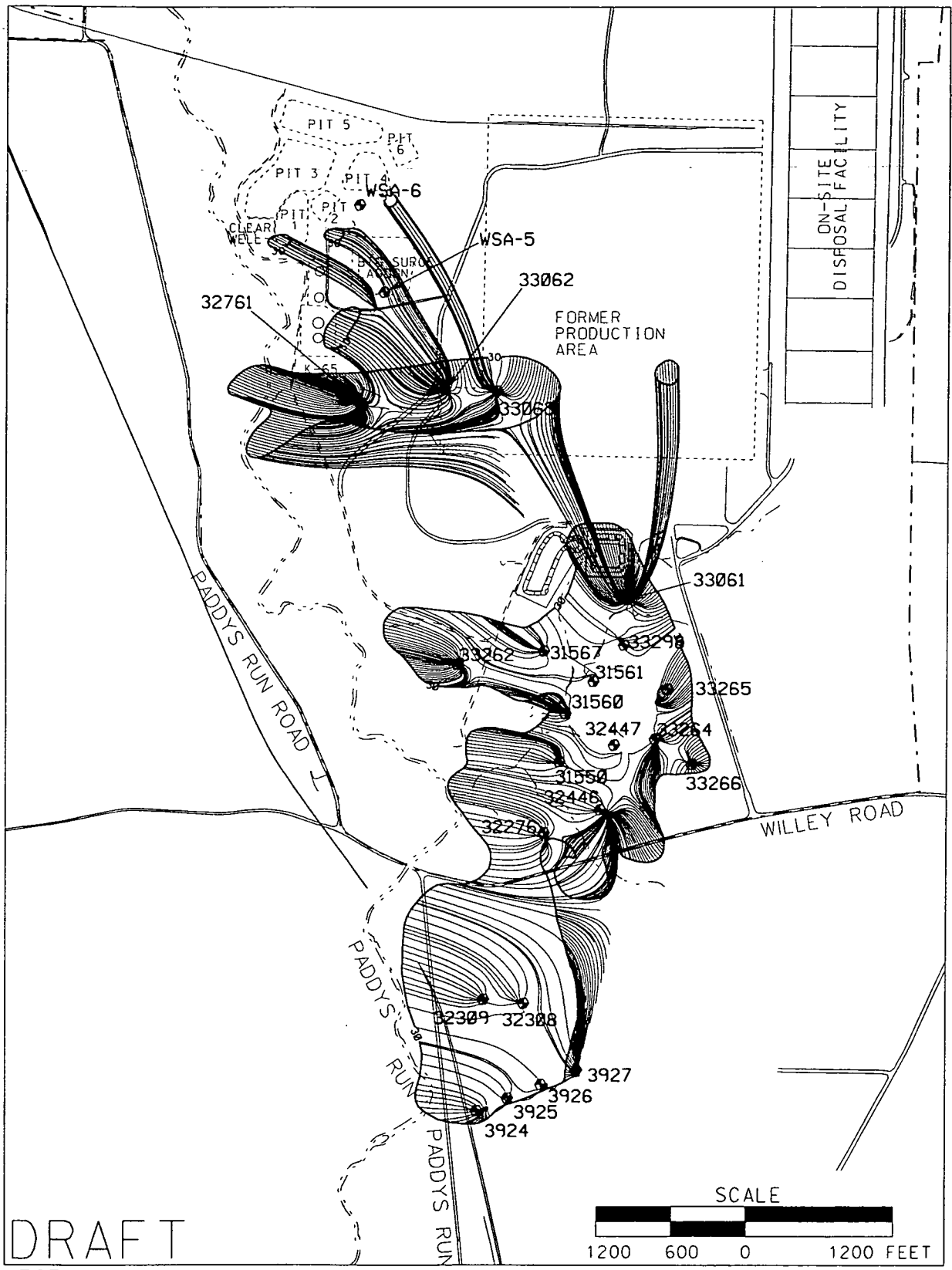
000070

FIGURE 3.1.4. 10-YEAR, NON-RETARDED PARTICLE TRACKS FROM PLUME BOUNDARY, APPROACH C-IMPROVED, 4-1-2005 TO 4-1-2006

V:\5fop1\dgn\CZE-TEST-PLAN\cze-test-05.dgn

STATE PLANAR COORDINATE SYSTEM 1983

22-JUN-2004



DRAFT

LEGEND:

- FERNALD SITE BOUNDARY
- PARTICLE TRACK
- EXTRACTION WELL
- 30 — TOTAL URANIUM CONTOUR (30 μg/L) THROUGH SECOND HALF OF 2003

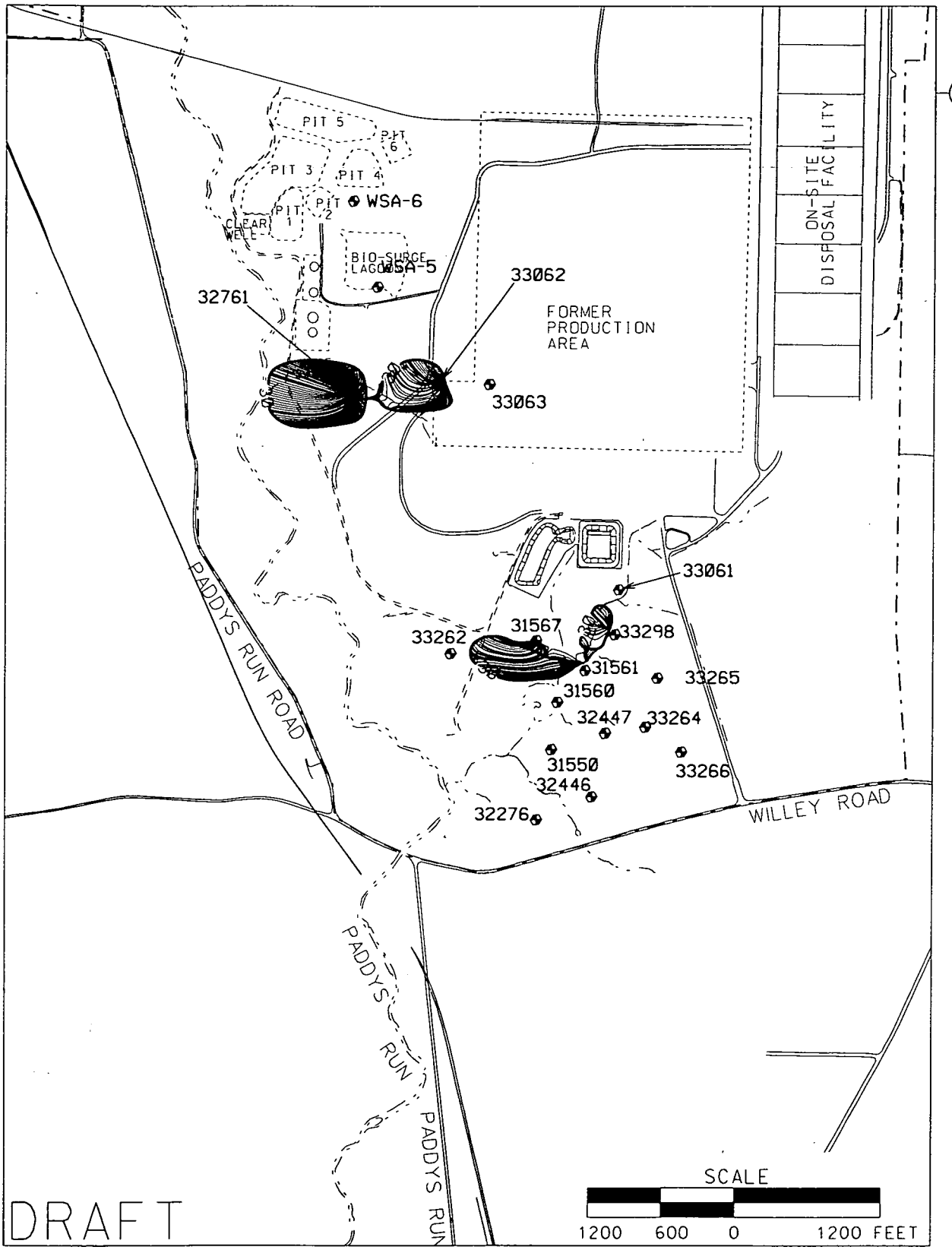
000071

FIGURE 3.1.5. 10-YEAR, NON-RETARDED PARTICLE TRACKS FROM PLUME BOUNDARY, APPROACH C-IMPROVED, 4-1-2006 TO 4-1-2012

V:\5fgp1\dgn\CZE-TEST-PLAN\czo-test-06.dgn

STATE PLANAR COORDINATE SYSTEM 1983

22-JUN-2004



LEGEND:

- FERNALD SITE BOUNDARY
- PARTICLE TRACK
- EXTRACTION WELL
- 30 — PREDICTED TOTAL URANIUM CONTOUR (30 μg/L) IN MODEL LAYER 12 AT 4-1-12

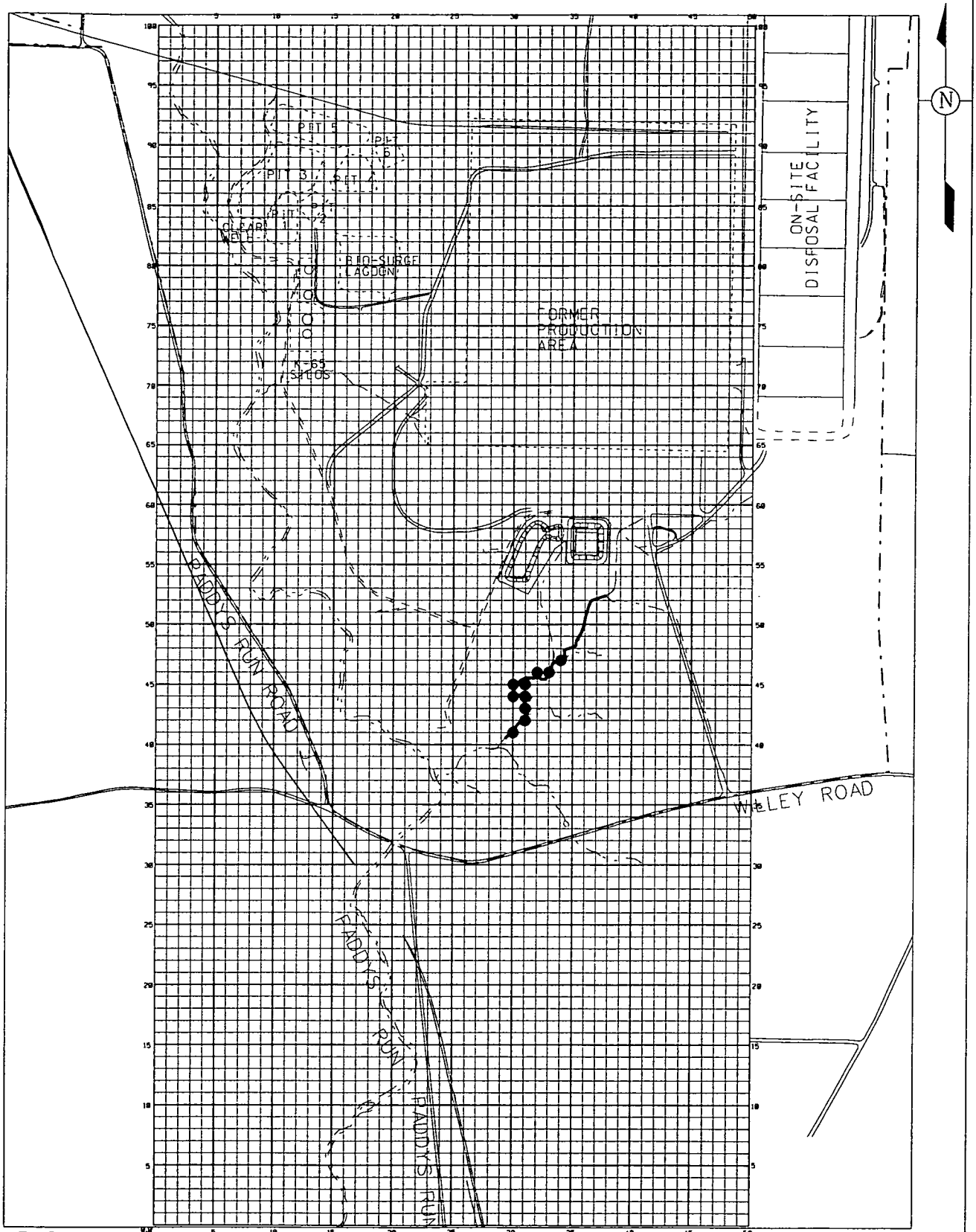
000072

FIGURE 3.1.6. 10-YEAR, NON-RETARDED PARTICLE TRACKS FROM PLUME BOUNDARY, APPROACH C-IMPROVED, 4-1-2012 TO END

V:\5fgp1\dgn\C2E-TEST-PLAN\c2e-test-07.dgn

STATE PLANAR COORDINATE SYSTEM 1983

22-JUN-2004



LEGEND:

FERNALD SITE BOUNDARY

SSOD

MODELING NODE

MODEL GRID

SCALE

1200 600 0 1200 FEET

DRAFT

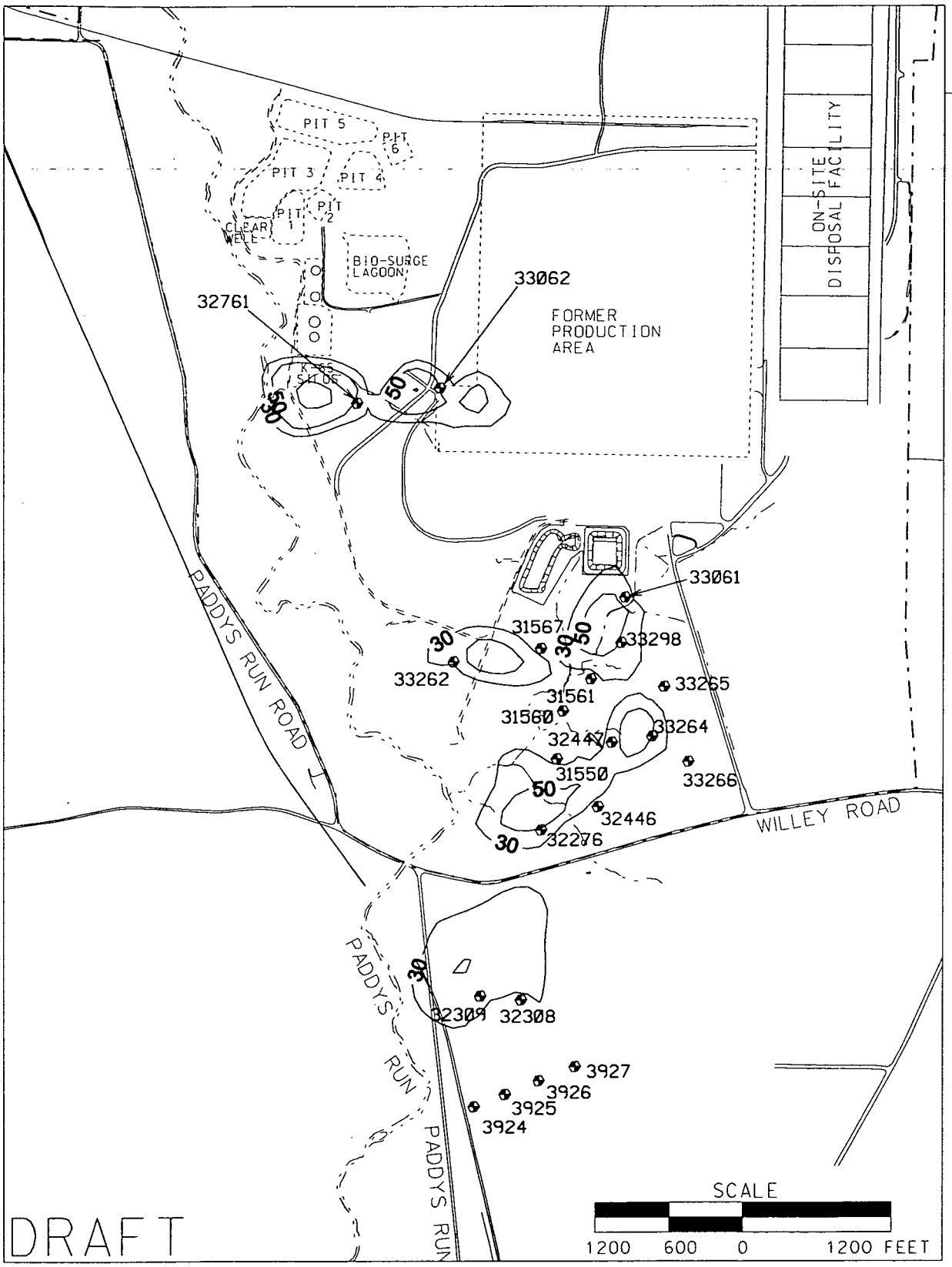
000073

FIGURE 3.2.1. MODEL BLOCKS USED FOR SSOD RECHARGE

V:\5fgp1\dgn\CZE-TEST-PLAN\cze-test-13.dgn

STATE PLANAR COORDINATE SYSTEM 1983

22-JUN-2004



LEGEND:

— · — · — FERNALD SITE BOUNDARY

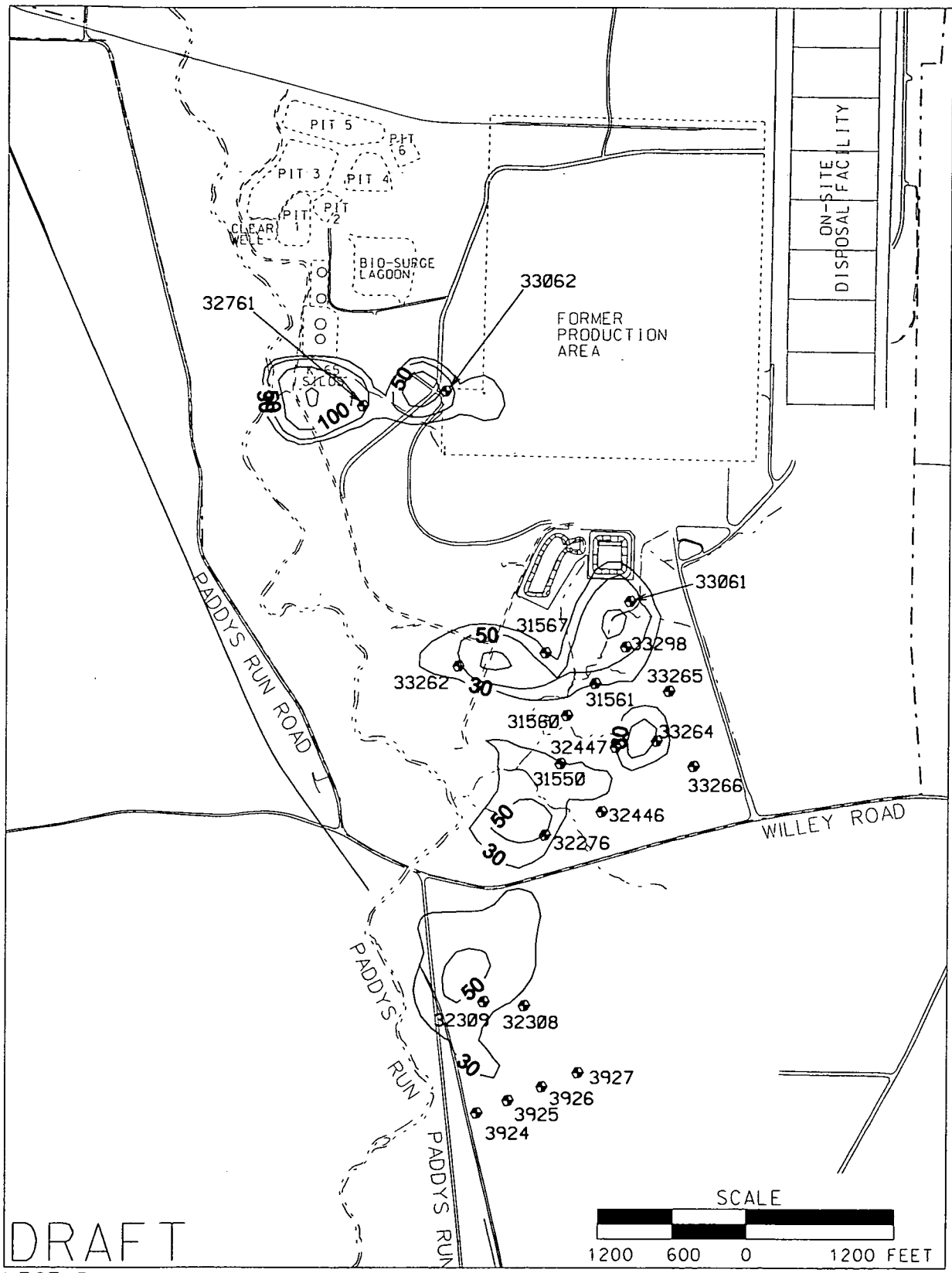
——— TOTAL URANIUM CONTOUR

⊕ EXTRACTION WELL

000074

FIGURE 3.2.2. MODEL LAYER 11, PLUME AT 4-1-2006, FOR APPROACH C-IMPROVED

V:\5fgp1\dgn\CZE-TEST-PLAN\TRANSPORT\cze-tst-trans-04.dgn STATE PLANAR COORDINATE SYSTEM 1983 22-JUN-2004



LEGEND:

— · — · — FERNALD SITE BOUNDARY

——— TOTAL URANIUM CONTOUR

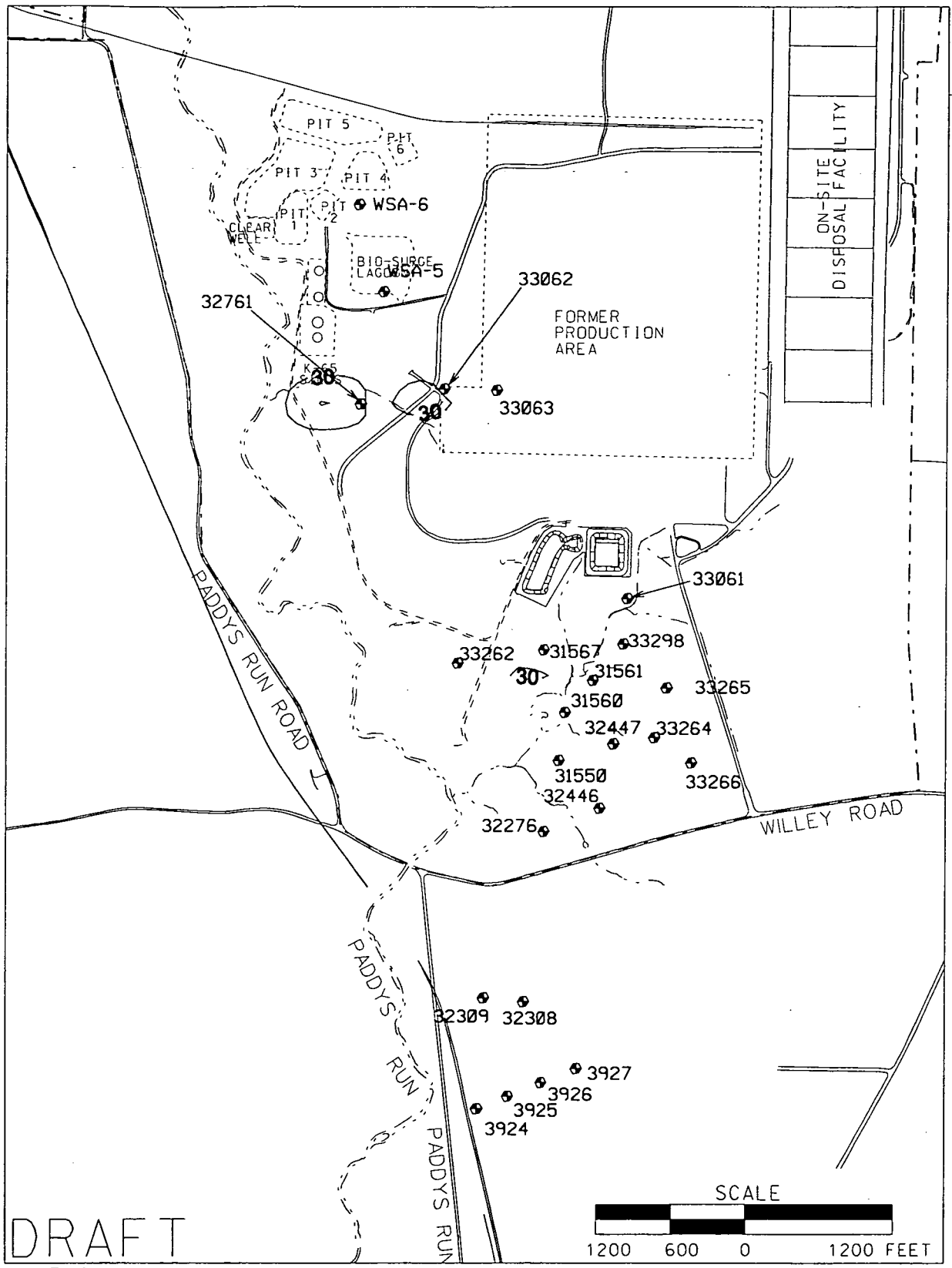
EXTRACTION WELL

V:\51gp1\dgn\CZE-TEST-PLAN\TRANSPORT\cze-tst-trans-10.dgn

STATE PLANAR COORDINATE SYSTEM 1983

22-JUN-2004

FIGURE 3.2.3. MODEL LAYER 12, PLUME AT 4-1-2006, FOR APPROACH C-IMPROVED



LEGEND:

— · — · — FERNALD SITE BOUNDARY

——— TOTAL URANIUM CONTOUR

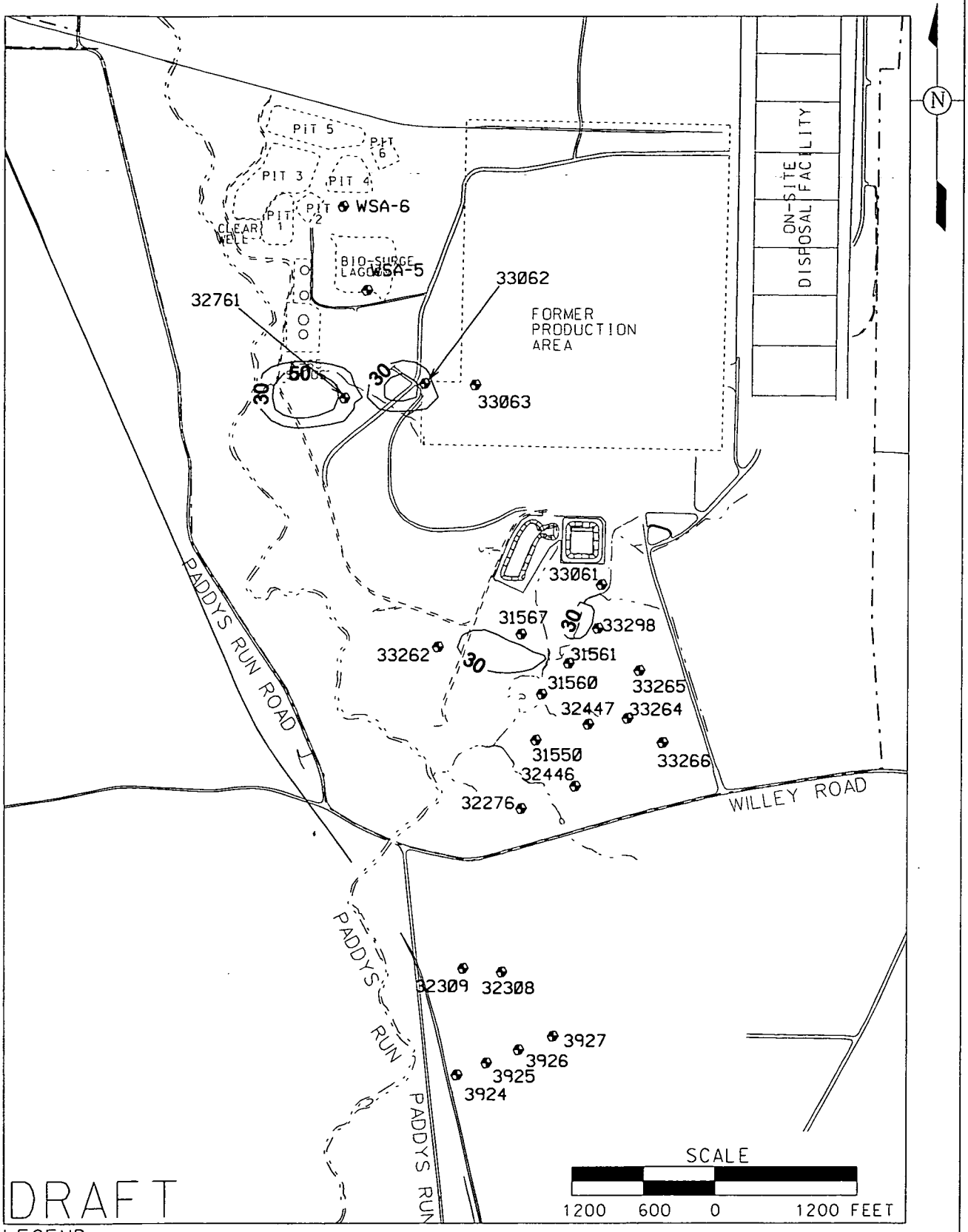
● EXTRACTION WELL

V:\5fgp1\dgn\CZE-TEST-PLAN\TRANSPORT\czo-tst-trans-06.dgn

STATE PLANAR COORDINATE SYSTEM 1983

22-JUN-2004

FIGURE 3.2.4. MODEL LAYER 11, PLUME AT 4-1-2012, FOR APPROACH C-IMPROVED



LEGEND:

— · — · — FERNALD SITE BOUNDARY

——— TOTAL URANIUM CONTOUR

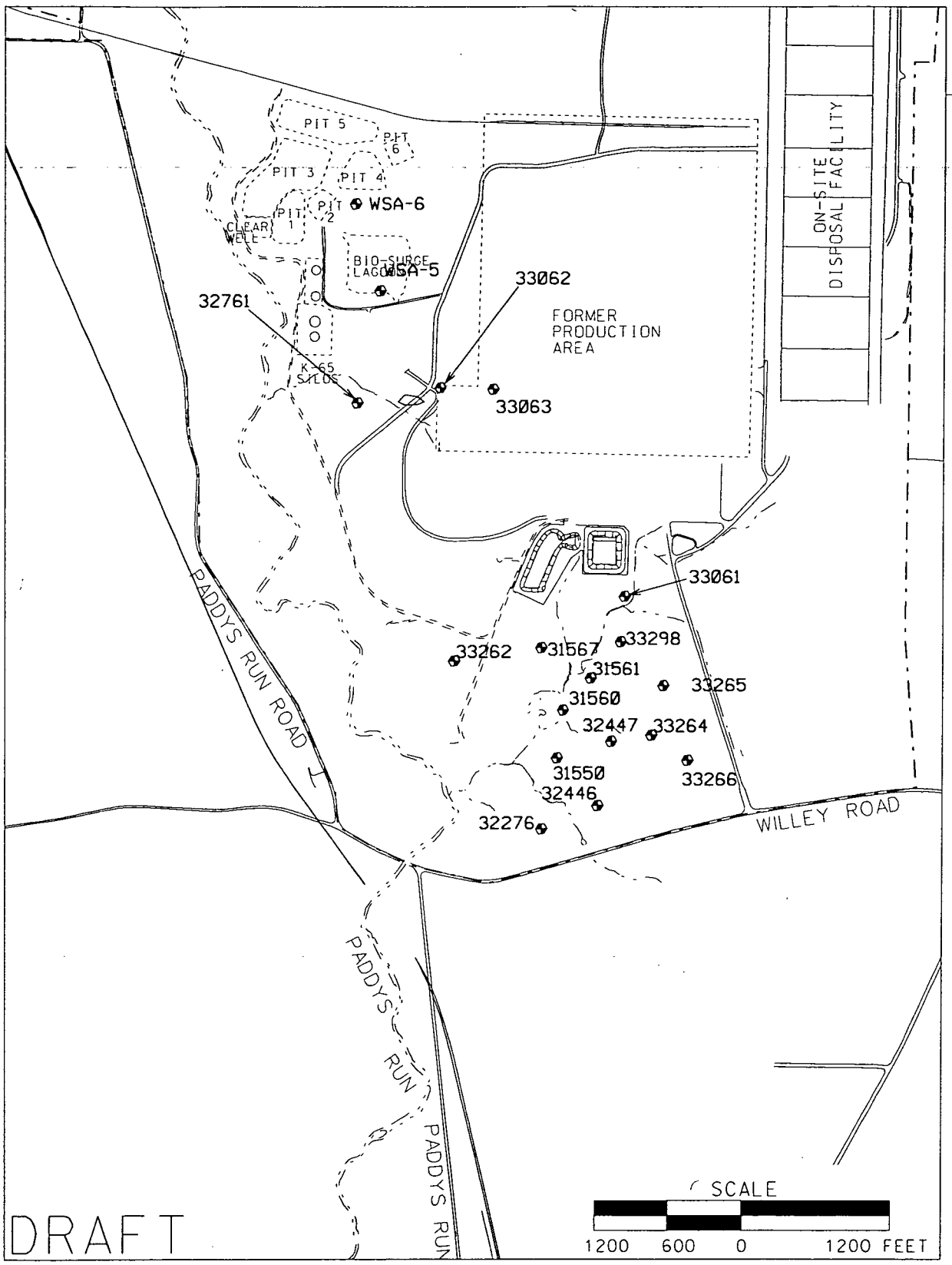
⊕ EXTRACTION WELL

V:\5fgp1\dgn\CZE-TEST-PLAN\TRANSPORT\czo-tst-trans-12.dgn

STATE PLANAR COORDINATE SYSTEM 1983

22-JUN-2004

FIGURE 3.2.5. MODEL LAYER 12, PLUME AT 4-1-2012, FOR APPROACH C-IMPROVED



LEGEND:

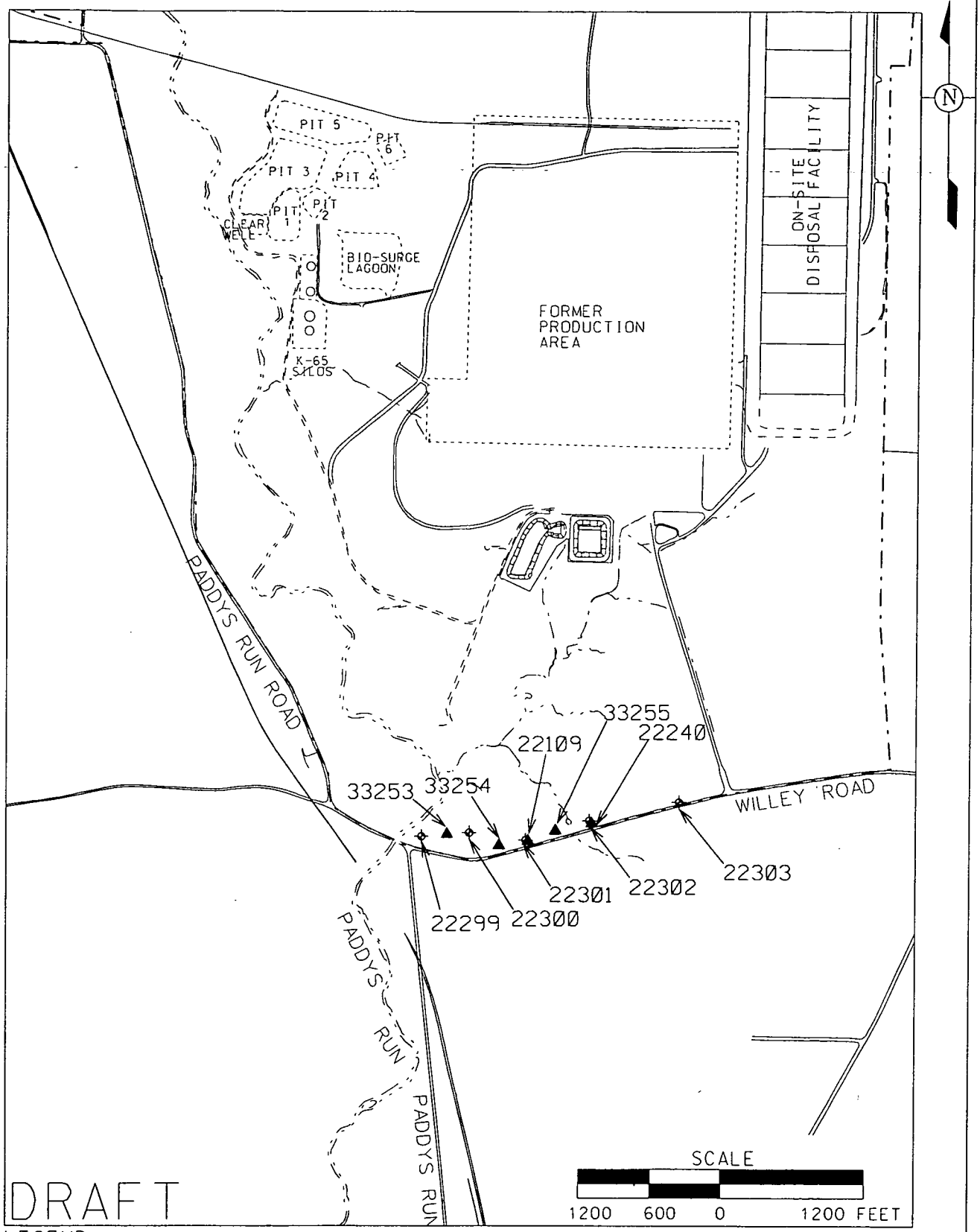
— · — · — FERNALD SITE BOUNDARY

——— TOTAL URANIUM CONTOUR

⊕ EXTRACTION WELL

FIGURE 3.2.6. MODEL LAYER 12, PLUME AT 4-1-2020, FOR APPROACH C-IMPROVED

V:\5fgp1\dgn\CZE-TEST-PLAN\TRANSPORT\cze-tst-trans-14.dgn
STATE PLANAR COORDINATE SYSTEM 1983
22-JUN-2004



LEGEND:

- FERNALD SITE BOUNDARY
- ▲ RE-INJECTION WELL
- EXTRACTION WELL
- MONITORING WELL

0079

FIGURE 5.1. LOCATION MAP FOR PART-1 FIELD VERIFICATION

V:\5fgp1\dgn\CZE-TEST-PLAN\cze-test-19.dgn

STATE PLANAR COORDINATE SYSTEM 1983

24-JUN-2004