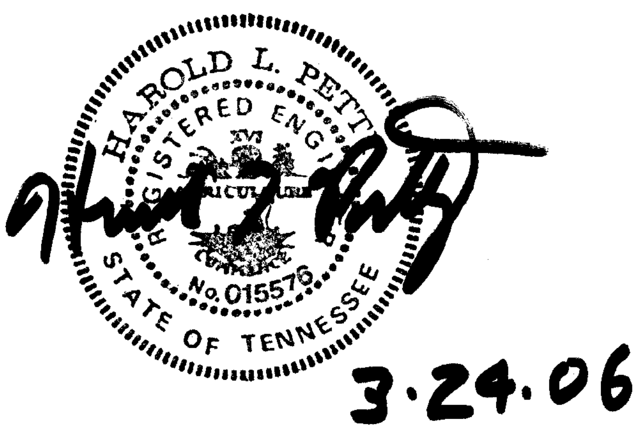
Title: OPERATIONS MANUAL DREDGE CELL LATERAL EXPANSION			DCN # Plant/Unit: KINGSTON FOSSIL PLANT
Vendor	Contract No.	Key Nouns: Permit, Closure/Post-Closure Plan	
Applicable Design Documents	REV	RIMS NUMBER	DESCRIPTION
	R0		June, 2004 Parsons Engineering Proposed Major Modification IDL 73-0094
References	R1		Updated contact names and added reference to waiver request in section 1.6

TENNESSEE VALLEY AUTHORITY
FOSSIL POWER GROUP
FOSSIL ENGINEERING SERVICES
SITE AND ENVIRONMENTAL ENGINEERING



	Revision 0	R1
Date	June, 2004	March, 2006
Prepared	D.R. Smith	LCB
Checked	W.R. Taylor	HLP
Supervised	Harold L. Petty	HLP

OPERATIONS MANUAL
DREDGE CELL LATERAL EXPANSION
TENNESSEE VALLEY AUTHORITY
KINGSTON FOSSIL PLANT

Prepared By:
Tennessee Valley Authority
1101 Market Street
Chattanooga, TN 37401-2801

Revision 0
June 7, 2004

Revision 1
March 24, 2006

NOTE: ADDITIONAL PRINTS MADE 4/15/06

TABLE OF CONTENTS

1 SITE INFORMATION

1.1 Responsible Officials

The following is a list of responsible parties involved with the permitting, design, operation, maintenance, quality control/assurance of the Dredge Cell Lateral Expansion at the Kingston Fossil Plant (KIF).

1. Owner: Tennessee Valley Authority (TVA)
   Contact: Plant Manager
   Tennessee Valley Authority
   Kingston Fossil Plant
   P.O. Box 2000
   Kingston, Tennessee 37763
   (865) 717-2501

   As of the date of this revision, the plant manager is Mr. Michael T. Beckham.

2. State: Tennessee Department of Environment and Conservation
   Division of Solid Waste Management
   Tennessee Department of Environment and Conservation
   2700 Middlebrook Pike, Suite 220
   Knoxville, Tennessee 37921-5602
   Phone:(865) 594-6035
   Fax:(865) 594-6115

   Contact as of the date of this manual is Mr. Larry Cook, Environmental Field Office Manager.

   Tennessee Department of Conservation
   Division of Solid Waste Management
   Central Office
   401 Church Street
   5th Floor, L&C Tower
   Nashville, Tennessee 37243-1535
   Phone:(615) 532-0780
   Fax:(615) 532-0886

   Contact as of the date of this manual is Mr. Mike Apple, Division Director.

1.2 Site Location

The TVA KIF is located near the confluence of the Clinch and Emory Rivers (Watts Bar Lake) at Clinch River mile 2 (Emory River mile 2) in Roane Co. Tennessee, approximately 1 mi northwest of the City of Kingston. Access to the site is by state Highway 70 and Swan Pond Road. Refer to drawing 10W425-21, which depicts the plant layout and location of the existing dredge cells, and proposed dredge cell expansion.

1.3 Site Description

The site selected for the disposal facility is the existing fly ash pond, and is an expansion of the existing dredge cells, as shown on drawing 10W425-21. The ash pond is entirely within the KIF Reservation. Existing benchmarks are located as shown on the drawings.

The area surrounding the KIF is primarily agricultural, industrial, and rural in nature (refer to Drawing 10W425-21). The fossil plant powerhouse is just south of the proposed location for this disposal facility.

The methods of placement of gypsum and coal ash in this facility are discussed in subsequent sections of this operations manual. Ash conveyance to the pond is by sluicing from the plant, and ash is dredged from the pond to the dredge cells. Dikes are progressively raised as cells are filled with waste material. Gypsum will be sluiced to the dredge cell lateral expansion area from the plant or a proposed drying facility, depending on future circumstances regarding the market for gypsum.

1.4 Site Geology and Hydrogeology

The following section briefly summarizes the geology and hydrogeology for this site. Additional detailed information is contained in the hydrogeologic investigation contained in Appendix E. The plant site is located in the Valley and Ridge physiographic province of the Appalachian Highland region. The ash pond area is underlain by the Conasauga Group (middle to upper Cambrian Age) with the exception of the northern tip of the area, where the Rome formation (lower Cambrian Age) is present. Specific geologic groups within the Conasauga Group represented at the site include the Maynardville, Nolichucky, Maryville, Rogersville, Rutledge, and Pumpkin Valley formations. These formations are locally of low water-producing capacity, and predominantly consist of shale with interbedded siltstones, limestones, and conglomerates. Total thickness of the Consauga Group beneath the site is unknown, but is estimated to be approximately 1500 ft. Pine Ridge, which borders the ash pond area to the northwest, is underlain by interbedded shale, sandstone, and siltstone of the Rome formation.

Field and laboratory measurements of hydraulic conductivity for soil, ash, and shallow bedrock were performed for this site and are summarized in Appendix E. In general, the field conductivity measurements are about an order of magnitude larger than the laboratory estimates for the same material. Such differences between field and laboratory measures are commonly observed and are attributed to differences in measurement scale.

The upper weathered bedrock zone exhibited the highest field-measured horizontal hydraulic conductivity (K_h), with values averaging about 2×10^{-5} cm/s. Field estimates of K_h for the "silty clay" alluvium averaged approximately 7×10^{-7} cm/s. A conductivity of approximately 2×10^{-5} cm/s was indicated for the permeameter-tested fly ash sample. During the recent geotechnical investigation for the lateral expansion, field hydraulic conductivity testing was conducted for insitu ash in the outer dike at two locations (B-1 and B-2) near the area that experienced seepage in November 2003. For both locations, vertical hydraulic conductivity was measured at 5.13×10^{-6} cm/s and 3.59×10^{-6} cm/s respectively. Horizontal hydraulic conductivity was measured at 1.42×10^{-5} cm/s and 3.67×10^{-6} cm/s respectively. Laboratory hydraulic conductivity testing was also performed on remolded samples, with hydraulic conductivities ranging from 1.67×10^{-5} to 1.87×10^{-5} cm/s.

Groundwater movement at the plant is generally eastward and southeastward from Pine Ridge toward the reservoir. Because the ash pond area is bounded on two sides by the reservoir, groundwater originating on or upgradient ultimately discharges to the reservoir. Recently acquired potentiometric head data from the interior of the existing dredge cell, along with groundwater level data from MW 16A seem to indicated that the continuous recharge by ash sluice water in the active ash pond produces local on-site mounding of the water table. Similarly, temporary local mounding of the water table may occur during periodic slucing/dredging of ash to the dredge cells.

1.5 Buffer Zone Compliance

The dredge cell lateral expansion is in compliance with all applicable buffer zone standards listed in Tennessee Rule 1200-1-7-.04(3). Reference is made to drawing 10W425-24. Specifically, the lateral expansion is at least 100 feet from the TVA reservation boundary, and at least 500 ft from any residences. The lateral expansion is more than 200 ft from the normal boundary of any stream or lake, although the ash pond itself is adjacent to Watts Bar Lake, because the facility was built in the 1950's. No constructed appurtenances for the fill area are located within 50 ft of the TVA reservation boundary. No private water-supply wells exist down-gradient of the site. Furthermore, there is no potential for development of such wells because Watts Bar Lake bounds the ash pond on two sides. Water wells within a two-mile radius of the proposed disposal facility are listed in the hydrogeological evaluation for this facility (see Appendix E).

1.6 Geologic Buffer System

A mantle of predominantly alluvial soils generally lies above the bedrock in the ash pond area, as described in Appendix E. Soil thickness is highly variable, ranging from about 5 feet along a portion of the northern perimeter of the site to a maximum of 65 feet on the western boundary. The alluvial deposits are unconsolidated and lenticular, and consist of clay, silt, and sand with occasional gravel. A thin layer of residuum is occasionally present directly above the bedrock. The residuum is composed of clay and silt with weathered shale fragments.

The ash and ash-soil fill materials present above the alluvium/bedrock ranged up to 70 feet in thickness at the time Appendix E was prepared (June 1995). Presently the thickness ranges up to 90 feet in thickness, as ash has continued to be dredged into the dredge cells.

On April 26, 2005 TVA received a notice from TDEC that a waiver from the geologic buffer requirements, Rule 12-1-7-.04(4)(b), would be required. On May 10, 2005 TVA requested this wavier. Following this request, TDEC issued a Notice of Completeness on May 13, 2005.

1.7 Access Control

The Dredge Cell Lateral Expansion is located within the TVA KIF Reservation. Access to this facility is via internal plant roads. During normal operating hours, operations personnel are at the site performing dredging operations, maintenance, and inspections as required. TVA security maintains 24-hour surveillance at the plant. The Dredge Cell Lateral Expansion will only be used for disposal of gypsum and coal combustion ash at the KIF or from other TVA fossil generation facilities. Shipments of non-waste will not be accepted for disposal at this facility.

2 DESCRIPTION OF SOLID WASTES, DISPOSAL CAPACITY, AND FACILITY LIFE

2.1 Types of Waste

The plant consists of nine coal-fired units with a maximum generating capacity of approximately 1600 megawatts (MW). The only wastes that will be disposed of in the dredge cells/dredge cell expansion is ash and gypsum from coal combustion at the KIF or other TVA fossil generation facilities. Bottom ash from the Bull Run Fossil Plant (BRF) may be used if necessary in constructing drains and as filter material as shown on the drawings. This facility may also accept gypsum byproduct material from BRF or dispose of ash from other TVA plants if TVA needs additional disposal capacity. No other waste materials from any non-TVA sources or plants will be accepted for disposal.

Coal combustion ash is composed of the non-combustible mineral components contained within the coal during its formation. Fly ash is inert, non-combustible, and does not decay biologically. This ash is sluiced to the ash pond, then dredged into the dredge cells located within the ash pond. The ash sluiced to the ash pond from the plant consists of about 100 percent fly ash (fine particles removed from the flue gases). Bottom ash is sluiced to a separate pond, and is used to construct dikes as the dredge cells are raised. As the facility is operated (see the following section), the ash will eventually dry into a relatively inert, structurally stable material. Additional data regarding the typical characteristics of fly ash and testing of KIF ash pond samples is included in Appendix A.

TVA is proposing to construct and operate a wet scrubber system to remove SO_3 emissions from the flue gas emissions from the plant. This system is expected to become operational in FY 2009. Wet gypsum will be sluiced to the ash pond where the Phase 2 and 3 disposal cells will be constructed as depicted on the 10W425 series drawings. Depending on market availability, TVA may be able to market up to 50% of the wet gypsum generated at KIF to private companies involved in the manufacture of various products. It is uncertain as to the actual percentage of gypsum that can be marketed; therefore, life projections will be made for worst case (no marketing) and best case (50% marketing). Gypsum is inert, non-combustible, and does not decay biologically. It is utilized in the manufacture of gypsum wallboard. Additional data regarding the typical characteristics of gypsum and typical chemical composition (based on TVA's Cumberland Fossil Plant Gypsum) is included in Appendix A.

It should also be noted that this facility is also designed to accept fly ash only without gypsum. The stability analysis (Appendix G) analyzed the facility for both gypsum and ash, or ash only. Stacking configurations and limitations are discussed in Appendix G, and herein.

2.2 Anticipated Volumes and Facility Life

<u>Fly and Bottom Ash</u>

The KIF produces approximately 360,000 tons of fly ash annually (398,000 cubic yards (cy) based on an average of 67 lbs/cubic foot (cf) density). For planning purposes, gypsum production for KIF is expected to be 372,000 tons (327,360 cy) per year, based on a density of 0.88 tons/cy. This is the best available information that TVA has for KIF at this time, as the fuel supply for future years has not yet been determined. Depending on the sulfur content of coal, gypsum production could vary from the estimates presented here. KIF also generates 88,000 tons/year of bottom ash (77,600 cy/year). Bottom ash is used along with fly ash to construct the outer ash dikes when they are raised. TVA has not yet established a start date for gypsum disposal operations, but will notify TDEC at least 180 days before a planned start date for operation. For facility life projections, the scrubber is assumed to become operational in 2009. As described in the attached Closure/Post Closure Plan, TDEC will be notified prior to TVA undertaking any closure activities. Closure is expected to be completed within about two years.

Gypsum

For planning purposes, gypsum production for KIF is expected to be 372,000 tons (327,360 cy) per year. It is uncertain at this time whether TVA will be able to market any gypsum from KIF, but has set a target of up to 50 percent as an upper limit. The following sections discuss disposal of each waste stream individually with respect to expansion, and the last section presents projections for facility life using the worst- and best-case waste disposal scenarios.

2.2.1 Existing Dredge Cells

Drawings for the dredge cells have been revised for this permit application. The dredge cells are currently built to elevation 805-810. As-built topography was used for revising these drawings. The final grade is shown on the 10W425 series drawings with the revised as-built topography. The closure contour elevations for the existing dredge cells are unchanged from the last revision, and projected volumes are based on the as-built topography dated October 2003, and the revised final cover design. As of October 2003, there are 4,985,355 cy of disposal capacity available. Assuming a disposal rate of 475,600 cy annually (including bottom and fly ash), there are 10.5 years of capacity remaining.

2.2.2 Phase 1 Lateral Expansion

In order to provide additional fly ash disposal capacity, TVA is constructing an additional dredge cell (Phase 1 expansion) south of the existing dredge cells into the main ash pond. This dredge cell is expected to have 1,169,563 cy of disposal capacity available, and should provide an additional 2.5 years of disposal capacity for fly and bottom ash.

2.2.3 Phase 2 & 3 Lateral Expansion

The disposal capacity of both Phase 2 and 3 are summarized here. Initially, Phase 1 will be constructed, and Phase 2 will be constructed at a later date as determined by TVA. Table 2.1 presents the disposal volume and area of each stage for both Phases 2 and 3.

Table 2.1

Stage	Volume (cy)[1]
Stage 1	2,431,261
Stage 2	3,097,708
Stage 3	3,170,647
Stage 4	2,660897
Stage 5	1,718,399
Stage 6	1,291,505
Total	14,370,417

[1]Capacity includes approximately 148,178 cy for a 1.5 ft thick cover

2.2.4 Projections for Facility Life

The following table depicts the overall life of the facility over time. Table 2.2 assumes 100 percent gypsum disposal and continued fly and bottom ash disposal. Table 2.2 includes the annual gypsum production volumes currently available. The type of coal burned for power production can affect the amount of gypsum produced, and is not finalized at this time. TVA will provide revised waste generation estimates from KIF in the near future, and will advise TDEC DSWM of any significant changes.

If 50 percent of gypsum is marketed, the facility life will increase by about six years, and this is not included in the table at this time.

Table 2.2

Phase	***Facility***	***Waste***	***Start Date***	***End Date***	***Comments***
1	Existing ash dredge cells 1-3	Sluiced ash to el. 844	2004	2015	
		Dry ash above 844	2015	2017	
	Ash dredge cell expansion	Wet sluiced ash	2004	2015	
	Ash dredge cell expansion	Dry stacked ash	2015	2017	
2	Gypsum areas A and B	Wet gypsum to el. 870	2009	2019	Initial filling will be gypsum - assume all gypsum until 2017
		Wet ash until 870	2017	2020	Wet ash disposal in Phase 2
2&3	Gypsum and ash disposal	Wet gypsum/dry ash	2020	2029	Wet gypsum fill to elev 930
	Gypsum and ash disposal	Dry gypsum/dry ash	2029	2030	Dry waste above elev 930
NA	Wet ash disposal Phase 2	Wet ash	2017	2029	Wet ash disposal Phase 2 only to el 870
	Dry ash disposal Phase 2/3	Dry ash	2029	2047	Dry ash disposal
Closure	Entire disposal area	Ash, gypsum	2047	2077	

2.3 Permitted Area

The area within the ash disposal boundary is depicted on drawing 10W425-23, and is approximately 244 acres overall, not including the stilling basin. The stilling pond occupies an approximate 25-acre area. The existing dredge cells occupy approximately 129 acres, Phase 1 approximately 13.5 acres, and Phases 2 and 3 approximately 64 acres. Existing dredge cell areas and lateral expansion areas do not sum to the total area because the remaining ash pond area is not fully developed for the lateral expansion, allowing for an approximate 200-foot setback from the outer dike at elevation 765. The groundwater compliance boundary is defined by the monitoring wells shown on the drawings included in this permit application.

3 WASTE HANDLING

3.1 Waste Handling Operations

3.1.1 Current Ash Handling Operations

Existing Dredge Cells

Bottom ash and fly ash are sluiced through a series of pipes to a point southwest of the active ash pond. Bottom ash is sluiced through separate pipes to a long channel that drains to the active ash pond. The heavier bottom ash settles out in this channel prior to reaching the active ash pond. The bottom ash is removed from the pond using draglines, long reach trackhoes, and scrapers on a continuous basis to be used to construct the dredge cells. Lighter fly ash continues to be sluiced to the active ash pond through a lined channel.

The fly ash and bottom ash effluent drain to the active ash pond. In this area a series of divider dikes and spillway skimmers separate the slucing effluent from the transported ash. Fly ash is transported to the active ash pond, along with finer particles of bottom ash. Lime can be added to effluent discharging from the active ash pond to the stilling basin when required for pH adjustment. The slucing effluent is discharged through weirs to the stilling basin, where it is discharged to the intake channel. Recent modifications were made to this discharge due to the construction of the selective catalytic reduction (SCR) system currently being installed at KIF. Ductile iron pipes equipped with spargers have been attached to the existing discharge pipe from the stilling basin to dissipate ammonia concentrations during times when ash comes in contact with ammonia from the SCR process.

During normal operations, a portable-floating dredge is located in the active ash pond. During normal operation, the dredge is connected to piping that conveys ash to the existing dredge cells located at the north end of the ash pond. Approximately 360,000 tons (398,000 cy) of fly ash are generated annually. The slurry will enter the dredge cells at the northern end, and will flow through the pond. The ash will settle out, and excess water will flow out of the diked area through a metal spillway located as shown on drawing 10W425-28. All dredge water and storm water will exit the facility through this spillway (or the underdrain system) and is directed to the stilling basin located south of the ash pond. The stilling basin discharges to an NPDES permitted out fall as discussed in Section 3.10.

The water level in the dredge cells will be maintained at an elevation at least four ft below the dike elevation. This freeboard will ensure that rainfall and wave action can be contained. The 25-year, 24-hour storm event is estimated to raise the water elevation only 5.5 inches, if no water is discharged from the pond. As the initial volume of ash is conveyed to the facility, water will decant through the metal spillway, and drain to allow ash consolidation.

The dredge cell dikes are constructed out of bottom ash material collected from the bottom ash channel and fly ash. This ash is collected and transported by scrapers to the dredge cell area. Dry fly ash is removed from the active ash pond and also hauled to the dredge cell area. Scrapers, dozers, backhoe/loaders, front-end loaders, and dump trucks are used to place and compact the fly and bottom ash, and shape the ash as shown on the drawings included with this permit application. Construction of the dikes is in accordance with the attached QA/QC Plan. Dust is controlled by utilizing a water truck as required on the haul roads and dikes.

During periods of time when dredging not possible, fly ash is removed from the active ash pond by excavators, draglines or other appropriate equipment, hauled to the dredge cell area by use of pans or dump trucks, and compacted by use of appropriate equipment.

The disposal process is an essentially continuous incremental procedure. No daily earth cover will be required. Intermediate cover may be placed and vegetation established in areas (typically the outer slopes) of the dredge cell that do not achieve final contours during inactive inactive phases of operation. The ash is physically stable, nonputrescible, and does not attract animal vectors or diseases.

3.1.2 Additional Fly Ash Dredge Cell (Phase 1)

The additional fly ash dredge cell is located as shown on the 10W425 series drawings. A dike consisting of bottom and fly ash is constructed along the southern boundary of the dredge cells. The construction methods are the same as those described in Section 3.1.1. As ash is dredged into each cell, bottom and fly ash will be used to raise the dikes to create the cell to the next stage. The height of each cell is as shown on the drawings, and have terraces that roughly coincide with the existing dredge cells for ease of construction.

3.1.3 Installation of Slope Drains and Toe Drain for Existing Dredge Cells

As part of the permit application, TVA has investigated causes of the recent seepage in the existing dredge cells. Based on review of groundwater data, and a seepage analysis (see Appendix K), the hydrostatic head has been raised in the dredge cells as the height of the dredge cells has increased. A model was constructed to simulate conditions at the time the seepage occurred using recently acquired data as part of the geotechnical field program. The model was then used to simulate future conditions to determine a suitable remedy. Slope drains can be retrofitted on the slopes of the existing dredge cells at terrace elevations (approximately) 775, 783, and 795 on three sides. In addition, a toe drain is proposed to intercept seepage at the base of the slope in the ditch adjacent to Swan Pond Road (Detail A73 on 10W425-73 depicts this installation). Initially, the underdrain will be constructed along the dike (original Dike B) parallel to Swan Pond Road. This segment will drain to a manhole/lift station installed at the northeast corner of the dredge cells. Effluent collected in the manhole/lift station will be pumped to the main ash pond.

TVA FES is currently evaluating the financial impacts of this and other options for controlling seepage within the existing dredge cell. TVA will make a final determination and discuss with TDEC DSWM prior to TDEC's completion of this permit application. Dredging of wet ash from the ash pond to the existing dredge cells can resume pending review and concurrence by TDEC on the final approach to be taken.

3.1.4 Gypsum Handling Operations and Construction of Phases 2 and 3

Initial Construction of the Phase 2 Expansion

The following discussion is an approximate sequence of activities that will occur in the construction of the Phase 2 expansion. Because the scrubber is not expected to become operational until about FY2009, detailed schedules for construction have not yet been developed. However, this Operation Plan outlines the sequence of construction activities required, and TVA will develop a schedule in concert with Plant Operations staff and TVA Yard Operations/Heavy Equipment Division, the organization that will oversee and implement construction.

The Phase 2 expansion will be initially constructed as shown on the drawings. Detail A65 on 10W425-65 depicts a typical cross-section for construction of the expansion. New weirs will be installed at the southeast corner of the main ash pond, and the existing discharge weirs will be plugged and abandoned in place. The discharge pipes from the weirs will be equipped with valves so that the water level in the ash pond can be temporarily raised to elevation 760 as part of normal dredging operations. A metal spillway will be installed with stoplogs set at elevation 760. The pond can then be raised by closing the valves and allowing the water to rise to elevation 760, where it will overflow into the metal spillway.

In order to maintain the required free water volume, the dredge located in the main ash pond will deepen the western half of the remaining main ash pond area (drawing 10W425-22 and 24). The dredge will discharge this ash in the eastern area of the main ash pond until the elevation of the ash is raised at or above the pond elevation. Trackhoes will also excavate fly ash out of the pond along the western side as ash is continuously sluiced from the plant. This ash will be dried to a moisture content suitable for placement in dry form. Fly ash will be loaded into dump trucks or scrapers and hauled to the Phase 2 construction area. A base of fly ash will be constructed to form the base of the Phase 2 lateral expansion. The QA/QC plan (Appendix I) contains requirements for construction of the base. The base will slope at a grade less that 1% from the existing dredge cells towards the stilling basin. Initially, bottom ash may be used to create access ramps out into the pond to support equipment. Fly ash will be placed in approximately 6-7 inch loose lifts and compacted using compactors and/or other suitable equipment to achieve the required density as described in the QA/QC Plan. Water trucks will provide moisture control to achieve the desired density as well as suppress dust during construction. The boundary of the Phase 2 expansion is set back 200 feet from existing dikes, as was done for the existing dredge cells.

Upon completion of construction of the fly ash base, a drainage filter layer will be constructed on top of the fly ash base. A two and one half-foot thick layer of bottom ash will be placed, with the lower two feet functioning as a drainage layer. The drainage layer will be placed in 6-7 inch thick loose lifts and lightly compacted with a roller. A six-inch layer of fly ash will then be placed on top of the bottom ash and the fly ash will then be mixed with the uppermost six-inches of bottom ash to form a 1-foot thick filter layer. The bottom ash will also be utilized to construct starter dikes to enclose the Phase 2 area to allow later disposal of gypsum, as described in subsequent paragraphs. A testing program was initiated to study the use of existing materials (fly and bottom ash) as drainage and filter media (Boschuk, 2004). This testing program utilized fly and bottom ash samples taken from KIF, as well as gypsum slurry from TVA's Cumberland Fossil Plant (CUF) to evaluate the drainage characteristics each material, to ensure the filter drainage layer will not clog, yet will retain the gypsum particles while allowing water to drain from the stack. Channels will be constructed to allow the facility to receive gypsum sluiced from the dewatering facility without eroding the filter drainage layer. Metal spillways will be installed as shown on the drawings.

Initial Gypsum Placement into Phase 2/Stage 1

Gypsum slurry will be sluiced from the dewatering facility to the Phase 2 expansion area, and allowed to settle. Decant structures (metal spillways) will be installed to maintain the water surfaced at an appropriate level. Because the bottom will slope, initial filling operations may only partially fill Phase 2 area. Construction of the wet cast gypsum dikes will utilize the upstream method of construction. This method has been employed at other TVA plants for gypsum disposal. Trackhoes will excavate the gypsum from the ponded area and stack the gypsum on the outer slope of the bottom ash starter dike. As the outer dike is constructed, a rim ditch and inner dike will be constructed. The outer dike and rim ditch will be constructed around a portion of the periphery of the Phase 2 expansion area, as shown on drawings 10W425-28 through 31, and –34 through -37. A perimeter underdrain will be installed in each 10-foot lift when the outer dikes are raised as shown on drawing 10W425-68. The perimeter drain will be fitted with outlets spaced throughout the circumference of the drain. The drain will be constructed with a nominal one percent slope with the outlets located at low points. After sufficient gypsum is sluiced into the pond, the Phase 2 Area will be subdivided into three distinct ponds, to allow gypsum sluicing operations to continue in one pond while stacking can continue in the inactive pond. The third (center) pond can be used for ash and/or gypsum disposal, once dikes separating the three ponds are completed. The rim ditches surrounding the gypsum disposal ponds will be elevated above the ponded area to allow the coarser-sized particles to settle out in the rim ditch. It is important that the outlet of the rim ditch remain above the level of the pond. The nominal slope of the rim ditch is 0.25 percent (2.5 feet vertical per 1000 feet horizontal). The ditch will be constructed to the dimensions shown on the drawings. Gypsum slucing will continue to be sluiced into the rim ditch and allowed to decant into the ponded area. The rim ditch can be operated by allowing gypsum to flow along the entire ditch, or the inner wall of the ditch can be breached (sluice cuts) sequentially at various points along the ditch to allow more even distribution of gypsum into the pond. This can be accomplished by plugging existing sluice cuts, and opening new ones opened sequentially throughout the length of the ditch. Another option would be to allow gypsum entry at both the north and south ends of the gypsum area. At the completion of the Stage 1 dikes, the nominal elevation will be 780, less the thickness of the final cover, expected to be between one and one-half and two feet thick.

As an alternative to the rim ditch operation, TVA can provide multiple ports to introduce gypsum along various points along the periphery of the Phase 2 expansion.

Dike Raising in Phase 2/Stage 2

After a sufficient amount of gypsum is placed in the pond, the outer dike of the entire Phase 2 area will be raised in five-foot increments along with the rim ditch and inner dike until the top of the dike is at elevation 810, as shown on 10W425-38 through 41. The metal spillways will be raised and rim ditching activities will continue. After the invert elevation of the rim ditch is above elevation 780, the rim ditch can be constructed completely around the periphery of both gypsum ponds A&B. The subsequent operations will involve continued gypsum slucing into the pond through the rim ditch and construction of divider dikes to maintain three separate ponds. Ash or gypsum can be dredged into the center area.

After the wet-cast outer dikes have been raised to approximately elevation 790, TVA may decide to sluice fly ash into Phase 2, or continue to sluice into the existing dredge cells and Phase 1 until they are filled. Fly ash will be sluiced into the center pond cell for fly ash disposal. This will ensure that gypsum is segregated from the fly ash so that pure gypsum can be utilized for construction of the wet cast outer dikes.

Dike Raising in Phase 2/Stage 3

Stage 3 operation for Phase 2 will likely transition into Phase 3 development, because Gypsum Area B continues to shrink in area due to dike raising. This is evident from examining the plan drawings for the various stages, as well as the cross section shown on 10W425-63. For continued operation of Phase 2 without Phase 3, Gypsum Area A will have to be subdivided to maintain separate filling and dike raising activities. The exact sequence of this transition depends on the ultimate rate of gypsum production from the scrubber, the ability of TVA to market gypsum at KIF, and also the ability to market fly and/or bottom ash. The decision as to when to build Phase 3 will also depend on the need for additional fly ash disposal capacity versus the production of gypsum. For instance, if 50 percent of gypsum is marketed over a consistent timeframe, construction of wet cast outer dikes may not keep pace with ash production.

Alternative internal configurations for separate or combined gypsum and ash disposal are currently being studied by TVA FES and Yard Operations group, in a effort to simplify operational aspects yet allow a flexible disposal facility capable of managing differing waste streams and volumes.

Dike Raising in Phase 3/Stages 1-3

Construction and operation of Phase 3 will be accomplished in a manner similar to that previously discussed for Phase 2. Gypsum disposal areas are located along the outer dike to provide wet gypsum for stacking operations. The only difference is that once Phase 3 is under construction, the plant will have had to convert to dry fly ash disposal due to the loss of free water volume from the ash pond. Dry fly ash can be stacked by using dump truck or scrapers and dozers. Material will be placed in thin lifts and compacted using vehicular traffic from hauling operations. Supplemental compaction can be provided if necessary to obtain the desired compactive effort, which is 90 percent standard proctor density as a minimum.

Subsequent Dike Raising and Stages 4 Through 6

Wet cast dikes will continue to be raised in 5-foot increments, and will be fitted with the peripheral underdrain system, as shown on 10W425-68. At every 30 feet in vertical elevation, the dikes will be constructed with a 15-foot wide (after final cover construction) bench for stability and equipment access.

At 60-foot intervals (nominal elevations 840 and 900), bottom ash horizontal blanket drains will be constructed to provide vertical and lateral drainage within the stack and to keep the phreatic surface as low as possible within the stack. The blanket drains will tied to the perimeter drain, and cross sections for stack development are shown on drawings 10W425-62 through 10W425-64.

3.1.5 Fly Ash Disposal in Phases 2 and 3

Phases 2 and 3 have been designed to dispose of fly ash only, if TVA decides not to dispose of gypsum within the dredge cell area expansion. Briefly, Phase 2 can be constructed in a similar manner described for dike raising and operation of the existing dredge cells and Phase 1. Ash can be disposed of in Phase 2 up to elevation 870. At that point, Phase 3 must become operational and dry fly ash disposal would begin. Dry fly ash only must be placed above elevation 870.

3.2 Covering Program

3.2.1 Daily and Intermediate Cover

No daily or intermediate cover will be required for this facility. The fly ash and gypsum are inert, physically stable, do not biodegrade, and do not attract animals. Therefore, vector control is not needed.

3.2.2 Final Cover

Final closure of the disposal facility will be undertaken as described in the Closure Plan for this facility (Parsons E&C, 2004a). Drawing 10W425-48, 49, and 58-61 depict final closure contours (including the thickness of the final cover). The fill contours of the ash are at 1.5 to 2 ft below the contours shown.

The final cover will consist of a one foot layer of low-permeability soil compacted to achieve a maximum hydraulic conductivity of 1×10^{-6} cm/s overlain by a one foot thick soil layer suitable for sustaining vegetation, as shown on drawing 10W425-75, if a compacted clay liner is constructed. Another option for the final cover consists of the following components (see drawing 10W425-76) placed on top of the final ash and/or gypsum grade: 1) a low density polyethylene geomembrane, 40 mil thick; 2) a geocomposite drainage layer (consisting of an extruded polyethylene net heat bonded on both sides to a non-woven, needlepunched geotextile); 3) a one foot thick layer of soil placed above the geocomposite drainage layer; and 4) a one-half ft thick vegetative soil layer. Material and installation specifications geocomposite materials for the final cover are included as Appendix J to this document.

The design of the final cover meets or exceeds the requirements contained in TDEC Policy Memorandum SW-93 (formerly Policy Memorandum SW-91-2) for coal ash disposal facilities. TVA can obtain soil for the low-permeability soil layer construction from suitable on-reservation borrow areas. The vegetative soil layer will also be constructed using locally available soil from the KIF TVA reservation, or from off-reservation material provided the soil meets the requirements contained in the drawings. Upon placement of the vegetative layer, the soil will be prepared and seeded using the appropriate methods outlined in Appendix B. Additional provisions for quality assurance and quality control are contained in the QA/QC plan for this facility (Parsons, 2004b).

3.3 Operating Equipment

Operating equipment for ash disposal operations is as follows:

- long-reach track-hoes (excavators);
- Hydraulic dredge. The dredge pump is a 14-inch discharge trash pump rated at 15,000 gpm;
- bulldozers;
- scrapers (pans);
- water trucks.

Ash is sluiced from the powerhouse with a solids content approximately 60 to 70 percent. TVA currently conducts dredging with in-house dredging operations. TVA may also supplement disposal operations by contracting with a private company. TVA can provide additional equipment within 24 hours for disposal operations in the event of equipment breakdown.

Operating equipment for gypsum stacking operations consists of:
- long-reach trackhoes;
- bulldozers;
- water trucks.

Gypsum will be sluiced to the dredge cell expansion area using pumps located at the proposed dewatering facility. The solids content of gypsum sluice will be approximately 30 percent.

3.4 Dust and Litter Control

Litter control is not applicable to this disposal facility. Ash will not generate litter. During normal dredging operations, dust will not be generated. If fly or bottom ash is hauled to the facility for disposal at any time, dust control measures are provided at the JOF to prevent a nuisance to adjacent landowners and TVA employees/operations. Water will be used for providing dust suppression when needed. No oil or other chemical substances will be used for dust suppression. Temporary soil cover may be used as needed for dust control. Chemical binding agents, such as Soil Cement or Posi-Shell, may also be used as needed.

3.5 Erosion Control

This site is an existing ash pond and construction of the dredge cell expansion will occur within the pond itself. Therefore, all runoff is directed to the existing stilling basin. Storm water controls to be utilized during construction and operation of the dredge cell lateral expansion are limited to the northeast area where runoff is diverted offsite. Otherwise, stormwater controls used to prevent erosion of soils (i.e., silt fences, etc) are not required during the construction and operation phase of this project. However, during closure activities, when soil is brought to the site for final cover construction, erosion controls may be utilized to reduce sediment loading to the stilling basin, as described in Appendix H.

3.6 Leachate Control and Management System

A mantle of predominantly alluvial soils generally lies above the bedrock in the ash pond area, as described in Appendix E. Soil thickness is highly variable, ranging from about 5 feet along a portion of the northern perimeter of the site to a maximum of 65 feet on the western boundary. The alluvial deposits are unconsolidated and lenticular, and consist of clay, silt, and sand with occasional gravel. A thin layer of residuum is occasionally present directly above the bedrock. The residuum is composed of clay and silt with weathered shale fragments.

The ash and ash-soil fill materials present above the alluvium/bedrock ranged up to 70 feet in thickness at the time Appendix E was prepared (June 1995). Presently the thickness ranges up to 90 feet in thickness, as ash has continued to be dredged into the dredge cells. The construction of the new facility will incorporate blanket drains which will collect and channel drainage from within the stack area. Based upon the results and conclusions presented in the Hydrogeolgic Evaluation Report dated June 1995 (Report No. WR28-2-36-124) and submitted as Appendix D of the Dredge Cell Closure Plan, it is anticipated that the development and closure of the proposed dry fly ash and gypsum stacks will ultimately result in a significant reduction of leachate quantity from current conditions. The Hydrogeolgic Evaluation Report dated June 1995 (Report No. WR28-2-36-124) is being revised and will address this issue more thoroughly.

3.7 Safety Precautions

Ash from the KIF is a by-product produced by the combustion of coal, and therefore poses no threat as a potential fire hazard. Gypsum likewise is an inert material derived from limestone used in the scrubber process, and also poses no threat as a potential fire hazard. However, properly maintained fire suppression equipment will be provided for all ash disposal equipment and vehicles. This will consist of fire extinguishers of the size and type required extinguish the type of fire that may potentially occur in the types of equipment and vehicles required for conducting disposal operations.

3.8 Personnel Facilities

The following personnel facilities are available at the KIF plant site:

- A utility building is on-site for equipment maintenance and yard operations personnel that is accessible by any facility personnel and has adequate screening, heating facilities, and lighting.
- Safe drinking water.
- Sanitary hand-washing facilities.
- Toilet facilities.
- A two-way radio and/or telephone for communications.
- A first aid kit.

All of the above services and facilities are readily available for operations personnel at the KIF.

3.9 Containment of Explosive Gas

Gas collection for coal combustion ash disposal facilities is not applicable per DSWM Policy, February 27, 1991, Item 3 (Appendix C).

3.10 Surface Water Management System

The surface water management system for final closure is depicted on drawings 10W425-48, 49 and 58 through 61. Drawing 10W425-77 depicts an overall view with references to ditch details. During operations, all storm water and dredge water will collect and discharge through a temporary metal spillway to the sediment pond. When sediment within the sediment pond accumulates to the clean-out elevation shown on the drawings, it will be removed and disposed as directed by TVA. The KIF currently discharges various effluents generated during plant operations under NPDES permit number TN0005452 DSN001. Ash pond effluent is discharged from the disposal facility to the Stilling Basin, then through 36-in diameter and 24-in diameter pipes through an NPDES permitted outfall. The outfall was recently modified to include a sparger system recently constructed as part of the SCR modifications at KIF.

3.10.1 Existing Dredge Cell Surface Water Management System

The existing dredge cells are constructed with outer dikes consisting of a mixture of bottom and fly ashes. The exterior dikes form the interior dredge cells. Temporary spillways are constructed as shown on 10W425-27 and 27 to control the height of water over dredged ash, and maintain the maximum water surface within the cell below the elevation of the outer dikes.

The exterior portion of the existing dredge cells are constructed with terrace ditches every 30 feet in vertical height. Terrace ditches are sloped from high to low elevation, and riprap-lined let down channels are provided as shown on 10W425-48 and 49, to allow surface water to drain to collector channels at the base of the dredge cells, and on to the main ash pond and stilling basin.

3.10.2 Phase 1 Lateral Expansion Surface Water Management System

The same concept used for the existing dredge cells will be applied to the Phase 1 Lateral Expansion. The initial dike will be constructed to elevation 780, and ash dredged inside. Temporary spillways will be utilized to maintain the surface water level below the elevation of the top of dike. As the cells are filled, the outer dikes will be raised using a mixture of bottom and fly ashes. Terraces will be constructed every 30 feet in height, and drainage channels constructed to convey stormwater to low point along the terrace ditches.

3.10.3 Phase 2 Lateral Expansion Surface Water Management System

After completion of the initial Stage 1 dike construction to elevation 775, dredging activities for gypsum disposal for the lateral expansion will commence, and the temporary spillway will be abandoned or removed, and constructed (or relocated) as shown on drawings 10W425-28-31. A temporary let down channel will be constructed to receive discharge from the temporary metal spillway to prevent erosion of the dike slope constructed for Stage 1. Wet gypsum stacking operations will raise this dike to elevation 780 to complete Stage 1 dike construction. As the Stage 1 dredging operation is completed, the initial Stage 2 dike will be constructed using the wet cast method of construction. This process will be repeated for subsequent stages. Terraces will be constructed at the beginning of each new stage, as discussed earlier. The terraces will be graded to covey storm water to additional let down channels away from dredging operations.

Drawings 10W425-48, 49, and 58-61 show the final configuration of the closed facility, including drainage features. Terrace ditches will covey storm water from the uppermost portion of the facility to the base of the facility by use of riprap-lined letdown channels, and on to the stilling basin. Surface water drainage was designed in accordance with Rule 1200-1-7, and calculations are included in Appendix D.

4 PLANNED GROUNDWATER MONITORING PROGRAM

4.1 Compliance Monitoring Boundary and Monitoring Program

The groundwater compliance monitoring boundary is defined by the segment of the ash pond area perimeter lying between the three down-gradient monitoring wells. The approximate location of the groundwater monitoring wells is shown on 10W425-26-33, and in Appendix E. The approach to the detection groundwater monitoring program is a conventional program of monitoring one up-gradient and three down-gradient wells. The up-gradient monitoring well is 16A. The down-gradient monitoring wells are 4B, and 6A, and 13B. Other wells that have been monitored groundwater levels include 13A, 13B, 16B, and 6B. Construction logs for all wells constructed for this facility are in Appendix E.

4.2 Detection Monitoring Program

4.2.1 Monitoring Well Design and Construction

All monitoring wells for this facility were installed, developed, and sampled previously prior to submittal of the Closure/Post Closure Plan for the existing dredge cells. Monitoring wells were drilled with hollow stem auger and constructed of two-inch diameter PVC casing. Wells generally have a 10 ft length slotted PVC well screen (0.1 in slots) installed in 11inch diameter boreholes, packed with filter sand and sealed with bentonite and grout. All wells have vented PVC caps, lockable steel outer casing secured in a concrete pad, and are protected with steel bollards set in concrete. Construction logs for monitoring wells are included in Appendix E.

4.2.2 Sampling and Analysis Program

The sampling and analysis program will be conducted at the following frequencies:

Preconstruction – Four independent samples have been collected and analyzed from each monitoring well for the constituents listed below. The results are listed in Appendix E.

Operation, closure, and post-closure period – collect and analyze one sample from each monitoring well for the constituents listed below, on a semi-annual basis.

Should a statistically significant increase in constituent concentrations be observed, TDEC will be contacted in accordance with Rule 1200-1-7-.04 (7).

The samples will be analyzed for the following constituents listed in Tables 1 and 2:

Table 1 - Groundwater Parameter List

Field Analyses

Acidity	Dissolved Oxygen
Alkalinity	Temperature
Conductivity	pH
Depth to Water	ORP

Laboratory Analyses - Unfiltered samples

ICP2: Copper, zinc;
ICP: Barium, beryllium, silver, vanadium;
GFAA: Antimony, arsenic, cadmium, chromium, cobalt, lead, nickel, selenium, thallium;
OTHER: Fluoride, mercury.

Table 2 - Analytical Methods For Specific Parameters

Parameter	Instrument	Method
Fluoride	ISE	1-EPA 340.2
Ag, Ba, Be, Cu, V, Zn	ICP	2-EPA 6010B
As	ICP-MS	2-EPA 6020
Sb	ICP-MS	2-EPA 6020
Cd	ICP-MS	2-EPA 6020
Co	ICP-MS	2-EPA 6020
Cr	ICP-MS	2-EPA 6020
Pb	ICP-MS	2-EPA 6020
Se	ICP-MS	2-EPA 6020
Tl	ICP-MS	2-EPA 6020
Ni	ICP-MS	2-EPA 6020

Hg	CVAA	2-EPA 7470A

Method Key

Code	Reference
1-EPA	Methods for Chemical Analysis of Water and Wastes, EPS-600/4-79-020, Revised March 1983.
2-EPA	Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, Revision 3, May, 1997.

Samples will be collected according to procedures detailed in TVA's Quality Assurance Procedure *Groundwater Sample Collection Techniques* (See Appendix F). It contains requirements for sample collection, preservation, shipment, chain of custody, and quality assurance and quality control.

4.2.3 Recordkeeping and Reporting

Results for each sample, including analysts' initials, date of analysis, and method number for each parameter will be reported. Records of compliance groundwater sample results will be kept at the facility. Results will be submitted to the Tennessee Division of Solid Waste Management within 30 days after all analyses are completed.

5 ENVIRONMENTAL PROTECTION STATEMENTS

5.1 Floodplain

This facility is not in a 100-year floodplain. The toe of the outermost slope adjacent is elevation XXX. The 100-year flood elevation taken from TVA data is 746 feet above mean sea level, and is lower than the top of the outer dike (elevation 765).

5.2 Other Environmental Impacts

Because construction activities on this project would occur within the existing footprint of the ash pond, which is sufficiently removed from the Clinch River/Watts Bar Lake and Emory River, as well as any tributary streams, there would be no adverse impacts to sensitive aquatic animals from this proposed project. Environmental impacts to groundwater are addressed in Appendix E.

The construction of this lateral expansion of the dredge cells and the associated operational activities are not expected to have negative effects on any federal- or state-listed plant species or sensitive habitat for such species.

6 RANDOM INSPECTION PROGRAM

A random inspection program for this facility is not required. This is because the disposal facility will only dispose of ash and gypsum from TVA facilities. In addition, minor quantities of bottom ash (for use in constructing drainage filters and gypsum from BRF may be co-disposed with KIF waste streams, in the event additional bottom ash is needed for KIF, or due to lack of disposal space at BRF. Therefore, a random inspection program for unauthorized wastes is not required. See DSWM Policy, February 27, 1991 Item 5 (Appendix C).

7 CLOSURE AND POST CLOSURE

Closure and post-closure provisions for this facility are discussed in the Closure Plan (Parsons, 2004a) appended to this Operations Manual (see Appendix H).

8 QUALITY ASSURANCE/QUALITY CONTROL

Quality assurance and quality control for construction and closure of this facility are addressed in the Quality Assurance and Quality Control Plan for the KIF Dredge Cell Lateral Expansion Quality Assurance and Quality Control Plan (Parsons, 2004b) appended to this Operations Manual (see Appendix I).

9 REFERENCES

Parsons2004a, *Closure/Post-Closure Plan Dredge Cell Lateral Expansion, Kingston Fossil Plant*, June 2004

Parsons2004b, *Construction Quality Assurance/Quality Control Plan, Closure Plan Dredge Cell Lateral Expansion, Kingston Fossil Plant*, June 2004

TVA 2004, *Kingston Fossil Plant Hydrogeologic Evaluation of Dredge Cell Lateral Expansion*, River System Operations and Environment, Norris, TN (Currently being prepared for delivery to TDEC in July 2004).

Boschuk, John 2004, *TVA Kingston Fossil Plant - Dredge Cell Lateral Expansion - Bottom Ash Filter Drain Study, JLT Laboratories*

APPENDIX A

Ash and Gypsum Testing

| TVA Environmental Chemistry | Chattanooga, Tennessee |
| 03/02/92 | FINAL DATA REPORT | 15:04 |

Page 1

Lab Sample Number :92/01018   Project Leader :David M. Varnell

Sample ID Information :KIF-92-1
Sample comments :KINGSTON DREDGED ASH
Sample type/matrix :WASTE
Sample login date :920129   Sample received by lab :920128
Sample account number :8616-767000-X1340H

Alt. IDC	Analysis Performed	result	units
D004'AS	Arsenic, TCLP Extract	230.	ug/L
D010'SE	Selenium, TCLP Extract	11.	ug/L
D006'CD	Cadmium, TCLP Extract	5.	ug/L
D008'PB	Lead, TCLP Extract	25.	ug/L
D007'CR	Chromium, TCLP Extract	5.	ug/L
D005'BA	Barium, TCLP Extract	2100.	ug/L
D011'AG	Silver, TCLP Extract	< 10.	ug/L
D009'HG	Mercury, TCLP Extract	< 2.0	ug/L
TCLP'MET	Tox. Char. Leach. Metals	02/04/92	
RES'RCRA	Residue, RCRA Waste	980000.	mg/L
PH'RCRA	pH on RCRA Waste	7.6	pH Units

KINGSTON FOSSIL PLANT
ASH ANALYSIS

CHEMICAL ANALYSIS	FLY ASH 01/10/92 UNIT 5	FLY ASH 03/10/88 UNIT 7	FLY ASH 02/19/81 UNIT 6
SiO2	49.45	69.29	55.73
Al2O3	27.83	17.01	26.19
Fe2O3	13.16	7.15	6.53
CaO	2.29	1.2	2.72
MgO	0.88	1.66	1.11
SO3	0.03	0.36	0.29
Na2O	0.74	0.12	
K2O	2.32	1.2	
L.O.I.	5.35	0.04	

KINGSTON FOSSIL PLANT
BY-PRODUCT TCLP ANALYSIS

PARAMETER	DRINKING WATER STANDARD	TCLP BOTTOM ASH 12/90 5-SAMPLES	TCLP DREDGED ASH 03/92 KIF-92-1	TCLP FLY ASH 10/93 KFP FA 93
ARSENIC, (mg/L)	0.05	<0.05	0.23	2.2
BARIUM, (mg/L)	1	0.31-0.91	2.1	0.72
CADMIUM,(mg/L)	0.01	<0.01	0.005	0.001
CHROMIUM,(mg/L)	0.05	<0.01	0.005	<0.01
LEAD, (mg/L)	0.05	<0.05	0.025	0.002
MERCURY, (mg/L)	0.002	<0.0005	<0.002	<0.0002
SELENIUM, (mg/L)	0.01	<0.01	0.011	0.049
SILVER, (mg/L)	0.05	<0.01	<0.01	<0.01
pH		7.6		

Data Report Number: 020531-73830
Report of Results: Environmental

TENNESSEE VALLEY AUTHORITY
CENTRAL LABORATORIES SERVICES
1101 Market Street, PSC 1B-C
Chattanooga, Tennessee 37402-2801

Phone: (423) 697 - 4318 • Fax: (423) 697 - 4137

Shipping Address:
Chickamauga Power Service Center
North Side Chickamauga
Reservation
Chattanooga, Tennessee 37415

Customer Address: Kathy Harper
LP 5H-C
Phone: 751-2634
Fax : 751-6619
E-Mail: kharper@tva.gov

Location Code: MISC
Field ID: 257745
Sample Description: CUF SCRUBBER GYPSUM FROM POND

Sample ID: AC04193 **LRF ID:** 02020235
Matrix: Solids **Reg:** RCRA
Date Collected: 02/05/2002
Time Collected: 0:00 EST
Date Received: 02/05/2002
Time Received: 10:40
Project Manager: Pamela L. Whitt

Analyte	CAS Number[1]	Result	Units	MDL[2]	Analysis Date	Analysis Time	Analyst	Method Reference
Barium, TCLP Extract	7440-39-3	0.036	mg/L	0.01	03/02/2002	16:17	LRP	EPA 6010B
Cadmium, TCLP Extract	7440-43-9	< MDL	mg/L	0.005	03/02/2002	16:17	LRP	EPA 6010B
Chromium, TCLP Extract	7440-47-3	< MDL	mg/L	0.05	03/02/2002	16:17	LRP	EPA 6010B
Lead, TCLP Extract	7439-92-1	< MDL	mg/L	0.05	03/02/2002	16:17	LRP	EPA 6010B
Silver, TCLP Extract	7440-22-4	< MDL	mg/L	0.01	03/02/2002	16:17	LRP	EPA 6010B
Mercury , TCLP Extract	7439-97-6	< MDL	mg/L	0.002	03/02/2002	14:19	ALB	EPA 7470
Aluminum, Total	7429-90-5	140	mg/Kg	5.0	03/04/2002	14:15	LRP	EPA 6010B
Antimony, Total	7440-36-0	< MDL	mg/Kg	10.0	03/04/2002	14:15	LRP	EPA 6010B
Barium, Total	7440-39-3	11	mg/Kg	1.0	03/04/2002	14:15	LRP	EPA 6010B
Beryllium, Total	7440-41-7	< MDL	mg/Kg	0.1	03/04/2002	14:15	LRP	EPA 6010B
Cadmium, Total	7440-43-9	< MDL	mg/Kg	0.5	03/04/2002	14:15	LRP	EPA 6010B
Calcium, Total	7440-70-2	220000	mg/Kg	10.0	03/04/2002	14:15	LRP	EPA 6010B
Chromium, Total	7440-47-3	< MDL	mg/Kg	5.0	03/04/2002	14:15	LRP	EPA 6010B
Cobalt, Total	7440-48-4	< MDL	mg/Kg	5.0	03/04/2002	14:15	LRP	EPA 6010B
Copper, Total	7440-50-8	1.6	mg/Kg	1.0	03/04/2002	14:15	LRP	EPA 6010B
Iron, Total	7439-89-6	300	mg/Kg	1.0	03/04/2002	14:15	LRP	EPA 6010B
Lead, Total	7439-92-1	< MDL	mg/Kg	5.0	03/04/2002	14:15	LRP	EPA 6010B
Magnesium, Total	7439-95-4	2500	mg/Kg	1.0	03/04/2002	14:15	LRP	EPA 6010B
Manganese, Total	7439-96-5	11	mg/Kg	0.5	03/04/2002	14:15	LRP	EPA 6010B
Molybdenum, Total	7439-98-7	< MDL	mg/Kg	2.0	03/04/2002	14:15	LRP	EPA 6010B
Nickel, Total	7440-02-0	< MDL	mg/Kg	5.0	03/04/2002	14:15	LRP	EPA 6010B
Silver, Total	7440-22-4	< MDL	mg/Kg	1.0	03/04/2002	14:15	LRP	EPA 6010B
Strontium, Total	7440-24-6	280	mg/Kg	5.0	03/04/2002	14:15	LRP	EPA 6010B
Tin, Total	7440-31-5	< MDL	mg/Kg	5.0	03/04/2002	14:15	LRP	EPA 6010B
Titanium, Total	7440-32-6	< MDL	mg/Kg	0.5	03/04/2002	14:15	LRP	EPA 6010B
Vanadium, Total	7440-62-2	< MDL	mg/Kg	1.0	03/04/2002	14:15	LRP	EPA 6010B
Zinc, Total	7440-66-6	11	mg/Kg	1.0	03/04/2002	14:15	LRP	EPA 6010B
Arsenic, Total	7440-38-2	< MDL	mg/Kg	10.0	03/04/2002	14:15	LRP	EPA 6010B
Selenium, Total	7782-49-2	< MDL	mg/Kg	10.0	03/04/2002	14:15	LRP	EPA 6010B
Thallium, Total	7440-28-0	< MDL	mg/Kg	10.0	03/04/2002	14:15	LRP	EPA 6010B
Lithium, Total	7439-93-2	0.8	mg/Kg	0.5	04/10/2002	14:40	ALP	
Selenium, TCLP Extract	7782-49-2	< MDL	mg/L	0.001	04/10/2002	22:21	ALP	EPA 7740
Asrenic, TCLP Extract	7440-38-2	0.0082	mg/L	0.001	04/10/2002	8:44	ALP	EPA 7060A
Mercury, RCRA Total	7439-97-6	0.10	mg/Kg	0.1	04/25/2002	15:06	ALB	EPA 7470

05/31/2002

[1] Chemical Abstracts Service Registry Number [2] Method Detection Limit

TENNESSEE VALLEY AUTHORITY
CENTRAL LABORATORIES SERVICES

1101 Market Street, PSC 1B-C
Chattanooga, Tennessee 37402-2801
Phone: (423) 697 - 4318 • Fax: (423) 697 - 4137

Shipping Address:
Chickamauga Power Service Center
North Side Chickamauga
Reservation
Chattanooga, Tennessee 37415

Customer Address: Kathy Harper
LP 5H-C
Phone: 751-2634
Fax : 751-6619
E-Mail: kharper@tva.gov

Location Code: MISC

Field ID: 257745

Sample Description: CUF SCRUBBER GYPSUM FROM POND

Sample ID: AC04193 **LRF ID:** 02020235
Matrix: Solids **Reg:** RCRA
Date Collected: 02/05/2002
Time Collected: 0:00 EST
Date Received: 02/05/2002
Time Received: 10:40
Project Manager: Pamela L. Whitt

Analyte	CAS Number[1]	Result	Units	MDL[2]	Analysis Date	Analysis Time	Analyst	Method Reference

Sample Comments: No collection date or time documented. Received date used.

[1] Chemical Abstracts Service Registry Number [2] Method Detection Limit

Environmental Chemistry Laboratory data report number 020531-73830 was electronically approved using Labworks Enterprise Version 4.6, Build 253 on 05/07/2002 at 15:19 by *Pamela L. Whitt*.

Vanessa L. Ramey, Lab Director
Pamela L. Whitt, Project Manager
Scott R. McNabb, Project Manager
Lisabeth R. Pearson, Quality Assurance Specialist
Ricardo I. Gilbert, Senior Analytical Chemist

This report contains sample results for the following samples, Login Reference File number: 02020235

AC04193

[1] Chemical Abstracts Service Registry Number [2] Method Detection Limit

CUF gypsum

COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 1919 SOUTH HIGHLAND AVE., SUITE 210-B, LOMBARD, ILLINOIS 60148 • TEL: 630-953-9300 FAX: 630-953-9306

SINCE 1908®

SGS Member of the SGS Group (Société Générale de Surveillance)

ADDRESS ALL CORRESPONDENCE TO:
4665 PARIS STREET
SUITE B-200
DENVER, CO 80239
TEL: (303) 373-4772
FAX: (303) 373-4791
www.comteco.com

May 30, 2002

TENNESSEE VALLEY AUTHORITY
1101 Market Street PSC 1A
Chattanooga TN 37402
RENEE B. MERRELL

Sample identification by
TENNESSEE VALLEY AUTHORITY

SAMPLE No.: 257745
SAMPLE TYPE: SCRUBBER GYPSUM
REMARKS: SPC

Kind of sample SPC

Sample taken by TENNESSEE VALLEY AUTHORITY

Date received March 5, 2002

Analysis report no. 72-470142

PARAMETER	RESULTS
Calcium, Ca	28.90
Magnesium, Mg	0.51
Acid Insolubles	0.91

Procedure: Acid Insoluble was analyzed per ASTM Volume 04.01, Method C25.

Calcium & Magnesium were analyzed by X-ray Fluorescence Spectrometry.

Results: Results are reported in weight percent (Wt.%), on a dry basis.

NQA ISO9002 REGISTERED COMPANY
Certificate No. 7061/1

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

Denver Laboratory

MEMBER ACIL

F-465

Original Watermarked For Your Protection

TERMS AND CONDITIONS ON REVERSE

CUF gypsum

COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 1919 SOUTH HIGHLAND AVE., SUITE 210-B, LOMBARD, ILLINOIS 60148 • TEL: 630-953-9300 FAX: 630-953-9306

SINCE 1908®

SGS Member of the SGS Group (Société Générale de Surveillance)

ADDRESS ALL CORRESPONDENCE TO:
4665 PARIS STREET
SUITE B-200
DENVER, CO 80239
TEL: (303) 373-4772
FAX: (303) 373-4791
www.comteco.com

May 31, 2002

TENNESSEE VALLEY AUTHORITY
1101 Market Street PSC 1A
Chattanooga TN 37402
RENEE B. MERRELL

SAMPLE No.: 257745
SAMPLE TYPE: SCRUBBER GYPSUM
REMARKS: SPC

Kind of Sample SPC
Date Received March 5, 2002
Analysis report no. 72-470142

PROXIMATE ANALYSIS

	As Received	Dry Basis
% Moisture	9.40	xxxxxx
% Ash	74.84	82.60
% Volatile	9.42	10.40
% Fixed Carbon	6.34	7.00
	100.00	100.00
Btu/lb	< 91	< 100
% Sulfur	14.11	15.57
MAF Btu/lb	575	

ULTIMATE ANALYSIS

	As Received	Dry Basis
% Moisture	9.40	xxxxxx
% Carbon	0.45	0.50
% Hydrogen	1.16	1.28
% Nitrogen	0.03	0.03
% Sulfur	14.11	15.57
% Ash	74.84	82.60
% Oxygen	0.01	0.02
	100.00	100.00

ALYSIS OF ASH — % Weight Ignited Basis

Silica, SiO_2	1.12
Alumina, Al_2O_3	0.33
Titania, TiO_2	0.06
Ferric Oxide, Fe_2O_3	0.17
Lime, CaO	40.48
Magnesia, MgO	0.85
Potassium Oxide, K_2O	0.02
Sodium Oxide, Na_2O	0.05
Sulfur Trioxide, SO_3	56.71
Phosphorous Pentoxide, P_2O_5	0.03
Strontium Oxide, SrO	0.08
Barium Oxide, BaO	0.03
Manganese Oxide, Mn_3O_4	0.07
Undetermined	0.00
Alks. as Na_2O, Dry Coal Basis	0.05
Base:Acid Ratio	27.53
T250 Temperature	2447

Silica Value	2.63
Type of Ash	LIGNITIC
Fouling Index	0.05
% MAF Fixed Carbon	40.23
% MAF Volatile	59.77

NQA ISO9002 REGISTERED COMPANY
Certificate No. 7061/1

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.
Denver Laboratory

MEMBER ACIL

F-465
Original Watermarked For Your Protection

TERMS AND CONDITIONS ON REVERSE

APPENDIX B

TVA Vegetation Specifications

SECTION 580 - Seeding (Pay Item 580)

580.1 -- Description

This specification consists of furnishing and placing seed, commercial fertilizer, and agricultural limestone on roadway slopes, shoulders, borrow pits, channel banks, waste areas, lawns, meadows, beaches, open play areas, and other areas specified by the plans or the Engineer and in accordance with the methods outlined by these specifications.

580.2 -- Materials

1. Seeds

Seeds shall meet the requirements of applicable seed laws and shall be tested in accordance with the most current edition of the U.S. Department of Agriculture Handbook No. 30, Testing Agricultural and Vegetable Seed. Seeds shall be from the last preceding crop and comply with the requirements outlined below for purity and germination. Each variety of seed shall be furnished in separate, strong bags with each bag being fully tagged or labeled to show the variety, weight, purity, germination, and test data prescribed by law. All test results shall be fully certified by the vendor or by a recognized seed testing agency. TVA reserves the right to require that samples be furnished, and to inspect and test the seeds after delivery. Seeds found not to comply with specification requirements shall be subject to rejection.

When mixing or forming seed mixtures, the seeds shall be carefully and uniformly mixed. Seeds shall not be mixed until each variety of seed to be used in the mix has been inspected and/or tested separately and approved.

Seed Varieties	Purity, Minimum %	Germination, Minimum %	
Korean Lespedeza (Lespedeza stipulacea), scarified . . .	90	85	
Sericea Lespedeza (Lespedeza cuneata), scarified	95	85	
Interstate Sericea Lespedeza (Lespedeza cuneata, variety Interstate), scarified	95	85	1
White Clover (Trifolium repens)	95	85	
Alsike Clover (Trifolium repens hybridum)	95	85	

TVA-00001628

580.2 -- Materials (Continued)

Seed Varieties	Purity, Minimum %	Germination, Minimum %	
Red Clover (Trifolium pratense)	85	95	
Crownvetch (Coronilla varia), scarified	95	80	
Foxtail Millet (Setaria italica)	80	98	
Bermuda Grass (Cynodon dactylon), hulled	95	80	
Annual Rye (Lolium multiflorum)	90	90	
Perennial Rye (Lolium perenne)	90	90	
Kentucky 31 Fescue (Festuca arundinacea, variety Ky 31)	95	85	
Rebel Fescue (Festuca arundinacea, variety Rebel)	95	85	1
Hard Fescue (Festuca ovina, duriuscula)	95	85	
Kentucky Bluegrass (Poa pratensis)	95	90	
Creeping Red Fescue (Festuca rubra)	95	90	
Centipede Grass (Eremochloa ophiuroides)	90	75	
Weeping Lovegrass (Eragrostis curvula)	95	90	
Switchgrass (Panicum virgatum)	80	75	1
Zoysia Grass (Zoysia japonica)	95	80	
Little Bluestem Grass (Andropogon scoporius)	40	60	
Bahia Grass (Paspalum notatum)	75	80	
Buffalo Grass (Buchloe dactyloides)	85	50	

580.2 -- Materials (Continued)

Seeding materials shall be free from seeds or bulbets of Wild Onion (Allium vineale), Canada Thistle (Cirsium arvense), and Johnson Grass (Sorghum halepense).

Seed species shall not contain more than six seeds per ounce of the seed of any of the following noxious weeds or the seeds of any other weed specifically listed as noxious:

Bindweed (Convolvulus arvensis)
Buckthorn (Plantago lanceolata)
Corncockle (Agrostemmo githago)
Dodder (Cuscuta species)
Oxeyedaisy (Chrysanthemum leucantheumum)
Quackgrass (Agropyron repens)
Sorrel (Rumex acetosella)

Seed species shall not contain an excess of 2 percent by weight of weed seeds, noxious or otherwise.

2. Seed or seed mixtures, rates, and seasons

Seeding mixtures, rates, and seasons shall be those specified herein. The types to be used for each area or project will be specified by the drawings or by memorandum. Mixtures or rates of application other than those specified shall be used only when specified by the plans or the Engineer. Seeding shall be planted during the season and between the dates specified. Temporary cover shall be planted when it is required during seasons not suitable for planting the seed specified by the plans.

a. Lawns

Type 1: Spring or fall seeding (Plant between March 15 and May 1, or between August 15 and October 15).

(1) Kentucky 31 Fescue . . . 120 pounds per acre
(2) Rebel Fescue . . . . 120 pounds per acre | 1
(3) Creeping Red Fescue . . 80 pounds per acre

Type 2: Fall seeding (Plant between August 15 and October 15).

(1) Perennial Ryegrass . . . 120 pounds per acre
(2) Kentucky Bluegrass . . . 80 pounds per acre

Type 3: Spring seeding (Plant between March 15 and May 1).

Bermuda Grass . . . . 40 pounds per acre

580.2 -- Materials (Continued)

b. Meadows

Type 4: Spring seeding (Plant between March 15 and May 1).

Mixture:

(1) Kentucky 31 Fescue . . . 50 pounds per acre
Korean Lespedeza
(scarified) . . . . . . 10 pounds per acre
Alsike Clover . . . . . 10 pounds per acre
Total mixture . . . 70 pounds per acre

(2) Bermuda Grass
(hulled) . . . . 40 pounds per acre
Korean Lespedeza
(scarified) . . . . . . 10 pounds per acre
Total mixture . . . 50 pounds per acre

(3) Sericea Lespedeza
(scarified) . . . . . . 30 pounds per acre
Kentucky 31 Fescue . . . 30 pounds per acre
Total mixture . . . 60 pounds per acre

(4) Interstate Sericea Lespedeza
(scarified) . . . . . . 30 pounds per acre 1
Kentucky 31 Fescue . . . 30 pounds per acre
Total mixture . . . 60 pounds per acre

(5) Crownvetch (inoculated
and scarified) . . . . 30 pounds per acre
Kentucky 31 Fescue . . . 30 pounds per acre
Total mixture . . . 60 pounds per acre

Type 5: Fall seeding (Plant between August 15 and October 15).

Mixture:

(1) Kentucky 31 Fescue . . . 50 pounds per acre
White Clover . . . . . . 15 pounds per acre
Total mixture . . . 65 pounds per acre

(2) Bluegrass . . . . 50 pounds per acre
White Clover . . . . . . 15 pounds per acre
Total mixture . . . 65 pounds per acre

(EVIRO BLEND.)
PE 123-

580.2 -- Materials (Continued)

c. Channel Banks, Cuts, Fill Slopes, Waste Areas, and Other Disturbed Areas

Type 6: Spring seeding only (Plant between March 15 and May 15).

Mixture:

(1) Kentucky 31 Fescue . . . 60 pounds per acre

(2) Bermuda Grass (hulled) . 40 pounds per acre

(3) Creeping Red Fescue . . 80 pounds per acre
(Shaded slopes only)

(4) Weeping Lovegrass . . . 15 pounds per acre
Korean Lespedeza
(scarified) . . . . . . 10 pounds per acre
Total mixture . . . 25 pounds per acre

(5) Sericea Lespedeza
(scarified) . . . . . . 30 pounds per acre
Kentucky 31 Fescue . . . 30 pounds per acre
Total mixture . . . 60 pounds per acre

(6) Interstate Sericea
Lespedeza (scarified) . 30 pounds per acre 1
Rebel Fescue . . . . . . 30 pounds per acre
Total mixture . . . 60 pounds per acre

(7) Crownvetch (scarified
and inoculated) . . . . 30 pounds per acre
Kentucky 31 Fescue . . . 30 pounds per acre
Total mixture . . . 60 pounds per acre

(8) Bahia Grass . . . . . . 40 pounds per acre
Bermuda Grass . . . . . 20 pounds per acre
Switch Grass . . . . . . 10 pounds per acre
Total mixture . . . 70 pounds per acre 1

(9) Rebel Fescue . . . . . . 40 pounds per acre
Hard Fescue . . . . . . 10 pounds per acre
White Clover . . . . . . 5 pounds per acre
Total mixture . . . 55 pounds per acre

580.2 -- Materials (Continued)

c. Channel Banks, Cuts, Fill Slopes, Waste Areas, and Other Disturbed Areas (Continued)

Type 7: Summer seeding (Plant between May 15 and July 15).

Mixture:

(1)	Bermuda Grass (hulled)	40 pounds per acre
	Korean Lespedeza (scarified)	10 pounds per acre
	Total mixture	50 pounds per acre
(2)	Buffalo Grass	40 pounds per acre
	Korean Lespedeza (scarified)	10 pounds per acre
	Total mixture	50 pounds per acre

Type 8: Fall seeding (Plant between August 15 and October 15).

(1)	Kentucky 31 Fescue	60 pounds per acre
	White Clover	15 pounds per acre
	Total mixture	75 pounds per acre
(2)	Hard Fescue	10 pounds per acre
	Rebel Fescue	40 pounds per acre
	White Clover	5 pounds per acre
	Total mixture	55 pounds per acre
(3)	Rebel Fescue	40 pounds per acre
	Hard Fescue	10 pounds per acre
	White Clover	5 pounds per acre
	Total mixture	55 pounds per acre

1

d. Highway Shoulders

The planting dates and seed mixtures for each type listed here are described above.

Type 6: Spring seeding [Mixture (1), (2), (3) or (9)]

Type 7: Summer seeding [Mixture (1) or (3)] 1

Type 8: Fall seeding [Mixture (2)]

580.2 -- Materials (Continued)

e. Temporary Cover

Type 9: Temporary winter seeding (Plant between October 15 and March 15).

Annual Ryegrass	80 pounds per acre
White Clover	10 pounds per acre
Total mixture . . .	90 pounds per acre

Type 10: Temporary summer seeding (Plant between May 1 and August 15).

Mixture:

(1)	Korean Lespedeza (scarified)	20 pounds per acre
	Foxtail Millet	20 pounds per acre
	Total mixture . . .	40 pounds per acre
(2)	Red Clover	20 pounds per acre
	Weeping Lovegrass . . .	10 pounds per acre
	Total mixture . . .	30 pounds per acre

3. Fertilizer

Fertilizers shall be those readily available commercially. The application of fertilizer shall be at a rate of 200 pounds Ureaform (38-0-0) per acre with either 400 pounds of 15-15-15 per acre or 600 pounds of 6-12-12, unless specified otherwise by the drawings or memorandum.

Ammonium nitrate (NH_4NO_3) may be used for supplemental fertilization when specified by the Engineer.

4. Agricultural Limestone

Limestone shall contain no less than 85 percent calcium carbonate by weight. It shall be crushed so that at least 85 percent will pass a No. 10 sieve. The application of limestone shall be at the rate of 2 tons per acre unless specified otherwise by the drawings or memorandum. Hydrated lime may be substituted at a rate of 1 ton per acre.

580.3 -- Topsoil

All lawn areas to be seeded shall have a 2-inch minimum depth of topsoil immediately below finish grade. Topsoil requirements for other areas, if any, will be determined by field inspection and shall comply with Section 581.3.

TVA 10535 (EN DES-7-77)

TVA-00001634

580.4 -- Soil Preparation

Areas to be seeded shall have approved cross sections and grades. Objects such as large roots, stones, stumps, coarse vegetation, debris, or any other items that might impede mechanical mowing shall be removed and disposed of satisfactorily.

Seedbeds shall be plowed, disked, harrowed, scarified, or cultivated to the approved depth. In areas where it is practical, this work shall be done with farm-type equipment. On steep slopes, preparation of seedbeds shall be done with the tools and methods specified by the Engineer. It is strongly recommended that scarifying and preparation of seedbeds on cut and fill slopes be accomplished with tools or equipment specially designed for this purpose. Small furrows or grooves formed in the slopes shall be horizontal or as nearly horizontal as practical. The work shall be performed only when the ground is in a workable and tillable condition as determined by good farming practices.

580.5 -- Special Hydroseeding Equipment

Equipment to be used for the hydraulic application of planting materials shall be a Finn Hydro-Seeder, Bowie Hydro Mulcher, Toro Environmental Control Unit, or an approved equal. The equipment shall have mixing tanks with built-in agitators having operating capacities sufficient to agitate, suspend, and homogeneously mix slurries of water and planting materials. Tanks shall have capacities of 1000 gallons or more, and shall be mounted on traveling units that can be either self-propelled or towed by a separate vehicle. The slurry distribution lines shall be large enough to prevent clogging or stoppage. Discharge lines shall be equipped with sets of different sized hydraulic spray nozzles capable of providing for even distribution of varying slurry mixtures on areas to be seeded. Slurry mixture rates are described in Section 580.6.

580.6 -- Seeding Methods

Seeds shall be sown with approved mechanical power-drawn drills or seeders, hand cyclone seeders, or with special hydroseeding equipment. Rates specified in Section 580.2 shall be maintained in a manner that will guarantee uniform coverage. Seeding operations shall not be performed when drought, high winds, and excessive moisture or other factors may defer satisfactory results.

On slopes where the use of drills or seeders is not practical and in other areas specified by plans or by memorandum, seeding shall be accomplished using hydroseeding equipment.

Drill seeding shall be performed in rows with spacing suitable for the type of seed or mixture used. Fertilizer may be drilled simultaneously if drills are equipped for this type of operation. Where fertilizer is not drilled, it may be applied during the cultivation operation described in Section 580.4. When fertilizer and seed are applied separately, the fertilizer shall be spread uniformly over the prepared seedbeds prior to final filling. Rates of application shall be those specified by the plans or the Engineer or those specified in this section. It shall be thoroughly mixed with soil for a depth of 1/2-inch.

580.6 -- Seeding Methods (Continued)

Care shall be taken to ensure that seed and fertilizer remain uniformly and thoroughly mixed in the seeding equipment. Additional mixing shall be performed if necessary to avoid segregation of the seed or seed and fertilizer.

Hydroseeding is the method of applying lime, fertilizer, seed, and mulch combined with water in a single operation. Using the equipment described in Section 580.5, mixing tanks shall be filled with water to the level indicated inside of the tanks. With the engines turned on and the agitators running, the following materials shall be added: (1) limestone at the specified rate of 1/5 per acre (finely ground); (2) fertilizer; (3) seed (Section 580.2); and (4) wood fiber mulch (Section 582.2), for each 1000 gallons of water. The resulting slurries shall be applied to seedbeds at a rate of 5000 gallons per acre.

When hydroseeding slopes are 2:1 or steeper, a vinyl or plastic mulch (Section 582.2) shall be added to the slurries at the rate specified by the manufacturer.

Discharge lines are activated by opening bypass valves with hand levers that allow the slurries to spray through the nozzles. Slurries shall be sprayed on the seedbeds as the spraying vehicles move slowly across the area. Care shall be taken to ensure that all areas are evenly covered. If wind or rough terrain causes skips to occur, additional applications shall be made before moving to other areas. To provide for the even distribution of a slurry, hydroseeding should be performed with the wind or preferably with no wind at all.

For steep slopes, even coverage is best obtained when an application is begun at the top and worked down a slope with successive overlapping passes. When a hydroseeder is located on top of a slope, the reverse is true.

Seed not sown by drills or hydroseeders shall be covered to a depth of approximately 1/4-inch by lightly harrowing or raking. Raking or harrowing shall follow contours as closely as practical.

Where mulching is to be done, the mulch shall be applied immediately after the seeding is completed to avoid the loss of soil moisture or possible erosion. Mulching shall comply with Section 182.

When specified by the Engineer, one or more applications of fertilizer shall be made after a stand of grass has been obtained and allowed to grow for a period of from 3 to 6 weeks. The grade and rate of application of the fertilizer will be specified by the Engineer. When ammonium nitrate or a similar soluble fertilizer is used alone, areas shall be thoroughly soaked as soon as an application is completed.

580.7 -- Maintenance

Seeded areas shall be maintained until a satisfactory cover of plant material is secured, unless stipulated otherwise. All areas shall be preserved, repaired, and protected as specified for this purpose. Areas having poor stands of plant material shall be seeded again and fertilized at the proper rates.

Watering shall be accomplished during the maintenance period to the extent necessary.

580.8 -- Method of Measurement

Seeded areas will be measured in square yard units and include the seeded areas along slopes.

580.9 -- Costs

Costs for Pay Item 580 shall include all materials, labor, tools, equipment, and incidentals necessary to complete the work for this item.

APPENDIX C

DSWM Policy Memorandum SW-91-2

TENNESSEE DEPARTMENT OF ENVIRONMENT AND CONSERVATION
DIVISION OF SOLID WASTE MANAGEMENT

DATE: February 27, 1991

TO: DSWM Staff

FROM: Tom Tiesler, Director, Division of Solid Waste Management

SUBJECT: Variance Agreement for Fossil Fuel Fly Ash and Bottom Ash Disposal Within a Class II Facility

The purpose of this memorandum is to establish the criteria by which a fossil fuel fly and bottom ash disposal facility will be permitted as a Class II facility with the following variances:

1. The geologic buffer required will be 3 fuel in total thickness with a maximum hydraulic conductivity of 1×10^{-6} cm/sec. The thickness will be measured from the base of the fill to the seasonal high water table of the uppermost unconfined aquifer, or the top of the formation aquifer;
2. No leachate migration control system will be required;
3. No gas migration control system will be required;
4. The final cover shall be 24 inches of compacted soil with a minimum of 6 inches which shall support vegetative cover; and
5. No random inspection program will be required.

Any other variances to the Class II facility permit criteria will require the Commissioner's approval.

POLICY/notebook/93

APPENDIX D

Stormwater And Pond Design Calculations

TVA 30494A [8/95]

PARSONS

CALCULATION COVER SHEET

CLIENT	Tennessee Valley Authority – Fossil Engineering Services
PROJECT	Kingston Fossil Plant – Solid Waste Permit Application for Dredge Cell Lateral Expansion
SUBJECT	Stormwater Calculations
JOB NUMBER	55090501 WBS NUMBER NA
CALCULATION NO.:	

DESCRIPTION/PURPOSE

Design stormwater drainage system to comply with the requirements of the State of Tennessee. The pond is existing but will provide detention for the 25-year storm and can discharge the 100-year storm.

METHOD OF ANALYSIS

Use TR-55 to generate runoff. Use Haestad Methods', "Pondpack" and Flowmaster" to design the system. Design soil erosion and sedimentation control measures in accordance with manuals.

CODES AND STANDARDS

1. " Rules of Tennessee Dept. Of Health and Environment, Chapter 1200-7, Solid Waste Processing and Disposal" Regulations.

INFORMATION SOURCES

1. Design Drawings
2.

ASSUMPTIONS

Contained in body of calculations

CONCLUSIONS OR RESULTS

Ditches are capable of discharging the 25- year 24- hour storm event as required by TDEC rules. The Ash pond and stilling basin are capable of discharging the 100-year storm event.

REV	DATE	DESCRIPTION	PAGES REVISED	PAGES ADDED	PAGES DELETED	BY/DATE	REV/DATE	LDE/DATE
4								
3								
2								
1								
0	6/9/04	ORIGINAL	BY: DRS	REV'D: WPT	------	--- / -----	---/-------	---/-------

THIS IS A DESIGN RECORD Form EP3-1 12/96

PARSONS	CLIENT NAME: Tennessee Valley Authority PROJECT NAME:					JOB NO.: 55090501
	SUBJECT: Stormwater Calculations for KIF Dredge Cell Lateral Expansion					CALC NO.:
STANDARD CALCULATION SHEET	REVISION	0	1	2	3	PAGE 2 OF 3
	ORIGINATOR	DRS				
	REVIEWER	WPT				
	DATE:	06/09/04				

STORMWATER DRAINAGE DESIGN CRITERIA

1. Use TR-55 for runoff calculation (Pond Pack version 8).
2. Use the existing stilling basin to detain the 25-year storm event and discharge the 100-year storm event per Tennessee Rule Chapter 1200-7.

STORMWATER DRAINAGE CALCULATIONS

1. General Approach: Design the facility to drain to the south to the existing stilling basin. The vast majority of areas within the outer dikes (at elevation 765) drain to the stilling basin, with exceptions as noted in the calculations. Design perimeter ditches to intercept flow and convey to the stilling basin. Ditches shall be designed with a minimum slope of 0.5% in most cases, with 0.25% slope in one case. The site will be graded so that no run-on is accepted from the adjacent areas.
2. Runoff Curve Numbers: See Attachments 1 and 2 to these calculations.
3. Drainage Areas: See Attachment 3.
4. Time of Concentration and Rainfall Intensity: A time of concentration has been determined for the post development conditions (see Attachment 1). Post developed conditions assume that 3:1 slopes are covered with soil and vegetated, and flatter slopes at the top of the stack (5% and 10% approximately for the existing dredge cell and Phase 2&3 areas respectively) are conservatively assumed to be unvegetated. Ditch flows were calculated using TR-55 with T_c derived from the post-developed watershed model.
5. Letdown Channel and Rock Chute Design: Letdown channels have been designed for a 25-year storm.

List of Attachments:

1 Pond Routing - Pond Pack Version 8 output, including runoff CN, time of concentration calculations to stilling basin, synthetic rainfall generated for the 25 and 100 year storm events. Drawing 10W425-34 F (Attachment 3) depicts the drainage areas used for this model.

2 Ditch Flow Calculations

2.1 Ditch 1 Model for Ditch Flows (Drawing 10W425-34E [Attachment 3] depicts the drainage areas used for ditches)

2.2 Ditch 2 Model for Ditch Flows

2.3 Offsite Ditch Flows – Model

Appendix A – Ditch Hydraulic Design

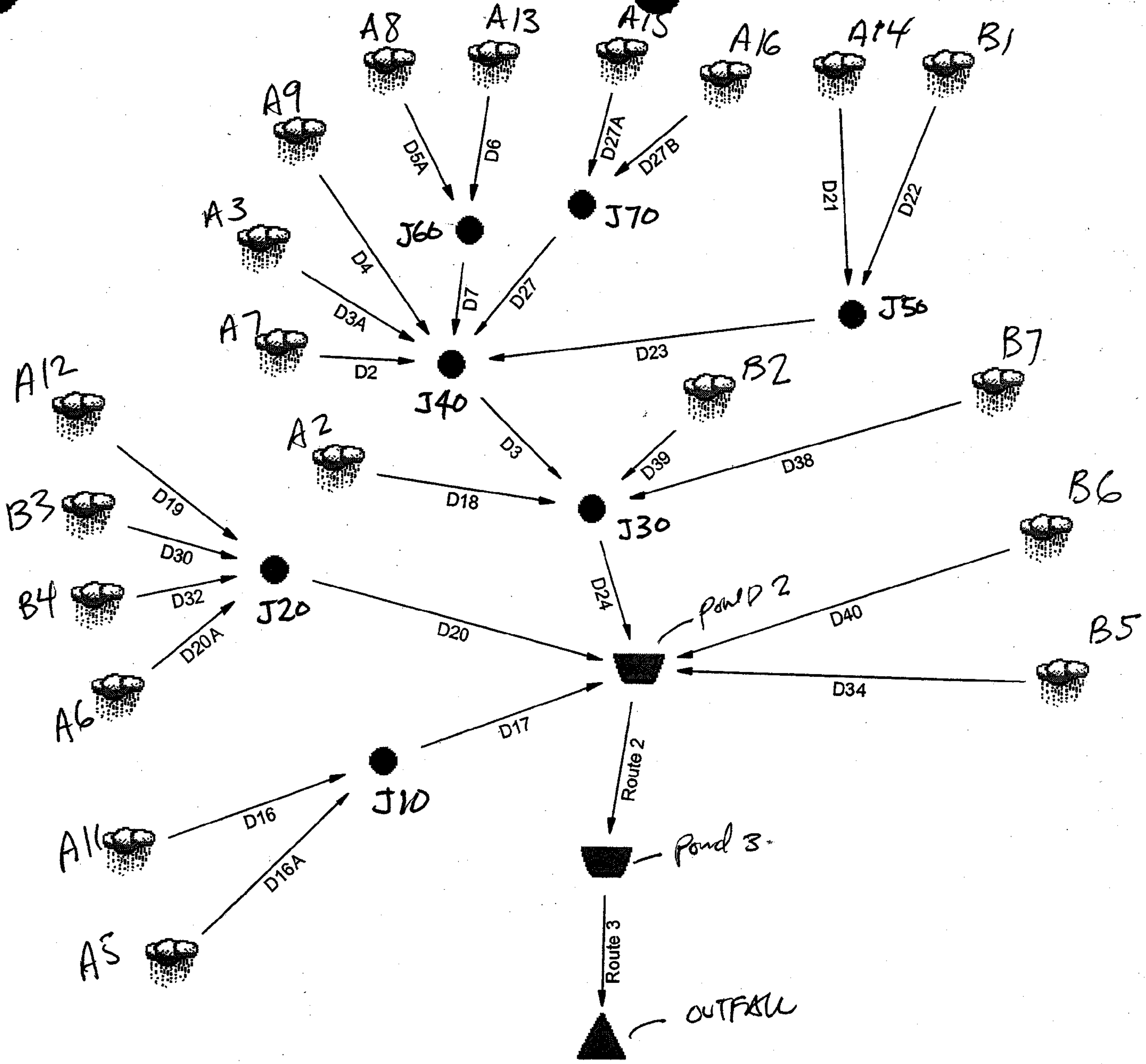
Appendix B – Riprap

Appendix C – Rock Chute Design

3 Drainage area maps.

THIS IS A DESIGN RECORD

ATTACHMENT 1 – POND ROUTING


A8
A13
A15
A16
A14
B1
A9
D5A
D6
D27A
D27B
D21
D22
J66
J70
A3
D4
D3A
D7
D27
J50
A7
D2
D23
J40
A12
B2
B7
A2
D3
D39
D38
D19
D18
B3
J30
B6
D30
D24
B4
D32
J20
Pond 2
D40
D20A
D20
B5
A6
D34
D17
J10
Route 2
A11
D16
Pond 3
D16A
A5
Route 3
OUTFALL

FINAL COVER

=========================
JOB TITLE
=========================

Project Date: 5/3/2004
Project Engineer: Daniel R. Smith
Project Title: KIF Lat Exp Interim Operation w/phase2&3 pond
Project Comments:
This model analyzes the cond of the expan during operation, while Phase 2/3 has a pond. The time of concentration is minimized due to the pond.

Table of Contents

Table of Contents (continued)

Table of Contents (continued)

Table of Contents (continued)

MASTER DESIGN STORM SUMMARY

Network Storm Collection: KIF

Return Event	Total Depth in	Rainfall Type	RNF ID
2yr	3.2500	Synthetic Curve	TypeII 24hr
10yr	3.6000	Synthetic Curve	TypeII 24hr
25yr	5.5000	Synthetic Curve	TypeII 24hr
100yr	6.5000	Synthetic Curve	TypeII 24hr

ICPM CALCULATION TOLERANCES

Target Convergence= .000 cfs +/-
Max. Iterations = 35 loops
ICPM Time Step = .0400 hrs
Output Time Step = .0400 hrs
ICPM Ending Time = 35.0000 hrs

MASTER NETWORK SUMMARY
SCS Unit Hydrograph Method

(*Node=Outfall; +Node=Diversion;)
(Trun= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left&Rt)

Node ID	Type	Return Event	HYG Vol ac-ft	Trun	Qpeak hrs	Qpeak cfs	Max WSEL ft	Max Pond Storage ac-ft
JUNC 10	JCT	2	.987		12.1200	11.59		
JUNC 10	JCT	10	1.225		12.1200	14.74		
JUNC 10	JCT	25	2.718		12.0800	34.40		
JUNC 10	JCT	100	3.593		12.0800	45.81		
JUNC 20	JCT	2	4.997		12.0000	79.74		
JUNC 20	JCT	10	5.904		12.0000	94.34		
JUNC 20	JCT	25	11.212		12.0000	177.59		
JUNC 20	JCT	100	14.174		12.0000	222.80		
JUNC 30	JCT	2	13.350		12.1200	116.50		
JUNC 30	JCT	10	15.794		12.1200	138.85		
JUNC 30	JCT	25	30.189		12.1200	268.50		
JUNC 30	JCT	100	38.259		12.1200	339.91		
JUNC 40	JCT	2	8.913		12.1600	66.32		
JUNC 40	JCT	10	10.519		12.1600	78.74		
JUNC 40	JCT	25	19.952		12.1600	150.69		
JUNC 40	JCT	100	25.229		12.1600	190.34		
JUNC 50	JCT	2	2.278		12.1200	27.34		
JUNC 50	JCT	10	2.624		12.1200	31.35		
JUNC 50	JCT	25	4.554		12.0800	53.43		
JUNC 50	JCT	100	5.591		12.0800	65.00		

ICPM CALCULATION TOLERANCES

```
Target Convergence=      .000 cfs +/-
Max. Iterations    =       35 loops
ICPM    Time Step  =    .0400 hrs
Output Time Step   =    .0400 hrs
ICPM Ending Time   =  35.0000 hrs
```

MASTER NETWORK SUMMARY
SCS Unit Hydrograph Method

(*Node=Outfall; +Node=Diversion;)
(Trun= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left&Rt)

Node ID	Type	Return Event	HYG Vol ac-ft	Trun	Qpeak hrs	Qpeak cfs	Max WSEL ft	Max Pond Storage ac-ft
JUNC 60	JCT	2	1.744		12.3200	12.89		
JUNC 60	JCT	10	2.055		12.3200	15.36		
JUNC 60	JCT	25	3.876		12.3200	29.60		
JUNC 60	JCT	100	4.892		12.3200	37.43		
JUNC 70	JCT	2	1.410		12.1600	14.20		
JUNC 70	JCT	10	1.693		12.1600	17.26		
JUNC 70	JCT	25	3.398		12.1600	35.41		
JUNC 70	JCT	100	4.371		12.1600	45.61		
*OUT 20	T-E	2	21.305		12.5600	91.71	746.00	
*OUT 20	T-E	10	25.360		12.5200	117.41	746.00	
*OUT 20	T-E	25	49.422		12.5200	200.47	746.00	
*OUT 20	T-E	100	63.029		12.6000	226.84	746.00	
POND 2	POND	2	21.241		12.0400	203.56		
POND 2	POND	10	25.291		12.0400	245.16		
POND 2	POND	25	49.370		12.0400	489.25		
POND 2	POND	100	62.967		12.0400	624.90		
POND 2 OUT	POND	2	21.295		12.4800	92.23	758.54	13.932
POND 2 OUT	POND	10	25.349		12.4400	118.19	758.63	14.813
POND 2 OUT	POND	25	49.413		12.4800	200.74	759.29	21.436
POND 2 OUT	POND	100	63.018		12.5200	227.14	759.75	26.263
POND 3	POND	2	21.295		12.4800	92.23		
POND 3	POND	10	25.349		12.4400	118.19		
POND 3	POND	25	49.413		12.4800	200.74		
POND 3	POND	100	63.018		12.5200	227.14		
POND 3 OUT	POND	2	21.305		12.5600	91.71	757.54	24.995
POND 3 OUT	POND	10	25.360		12.5200	117.41	757.62	25.020
POND 3 OUT	POND	25	49.422		12.5200	200.47	757.90	25.102
POND 3 OUT	POND	100	63.029		12.6000	226.84	757.99	25.127
SUBAREA 15	AREA	2	.643		12.1200	7.57		
SUBAREA 15	AREA	10	.741		12.1200	8.69		
SUBAREA 15	AREA	25	1.286		12.1200	14.77		
SUBAREA 15	AREA	100	1.579		12.1200	17.95		
SUBAREA 16	AREA	2	.767		12.2000	7.11		
SUBAREA 16	AREA	10	.952		12.2000	9.11		
SUBAREA 16	AREA	25	2.112		12.2000	21.44		
SUBAREA 16	AREA	100	2.791		12.2000	28.55		

ICPM CALCULATION TOLERANCES

Target Convergence= .000 cfs +/-
Max. Iterations = 35 loops
ICPM Time Step = .0400 hrs
Output Time Step = .0400 hrs
ICPM Ending Time = 35.0000 hrs

MASTER NETWORK SUMMARY
SCS Unit Hydrograph Method

(*Node=Outfall; +Node=Diversion;)
(Trun= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left&Rt)

Node ID	Type	Return Event	HYG Vol ac-ft	Trun	Qpeak hrs	Qpeak cfs	Max WSEL ft	Max Pond Storage ac-ft
SUBAREA A11	AREA	2	.289		12.1200	3.43		
SUBAREA A11	AREA	10	.358		12.1200	4.36		
SUBAREA A11	AREA	25	.795		12.0800	10.20		
SUBAREA A11	AREA	100	1.050		12.0800	13.57		
SUBAREA A12	AREA	2	1.592		11.9600	26.27		
SUBAREA A12	AREA	10	1.847		11.9600	30.41		
SUBAREA A12	AREA	25	3.284		11.9600	53.08		
SUBAREA A12	AREA	100	4.062		11.9600	65.01		
SUBAREA A13	AREA	2	1.227		12.4000	8.76		
SUBAREA A13	AREA	10	1.413		12.4000	10.07		
SUBAREA A13	AREA	25	2.452		12.3200	17.28		
SUBAREA A13	AREA	100	3.011		12.3200	21.07		
SUBAREA A14	AREA	2	1.241		12.0800	15.43		
SUBAREA A14	AREA	10	1.429		12.0800	17.71		
SUBAREA A14	AREA	25	2.481		12.0800	30.14		
SUBAREA A14	AREA	100	3.046		12.0800	36.64		
SUBAREA A2	AREA	2	.281		12.1600	2.84		
SUBAREA A2	AREA	10	.349		12.1600	3.63		
SUBAREA A2	AREA	25	.773		12.1600	8.51		
SUBAREA A2	AREA	100	1.022		12.1200	11.34		
SUBAREA A3	AREA	2	.807		12.5200	4.88		
SUBAREA A3	AREA	10	1.002		12.5200	6.25		
SUBAREA A3	AREA	25	2.222		12.4400	14.92		
SUBAREA A3	AREA	100	2.937		12.4000	19.96		
SUBAREA A5	AREA	2	.698		12.1200	8.16		
SUBAREA A5	AREA	10	.867		12.1200	10.38		
SUBAREA A5	AREA	25	1.923		12.0800	24.20		
SUBAREA A5	AREA	100	2.542		12.0800	32.24		
SUBAREA A6	AREA	2	.157		11.9600	2.69		
SUBAREA A6	AREA	10	.195		11.9200	3.41		
SUBAREA A6	AREA	25	.432		11.9200	7.99		
SUBAREA A6	AREA	100	.570		11.9200	10.62		
SUBAREA A7	AREA	2	.738		12.5200	4.08		
SUBAREA A7	AREA	10	.916		12.5200	5.26		
SUBAREA A7	AREA	25	2.032		12.5200	12.59		
SUBAREA A7	AREA	100	2.687		12.5200	16.85		

ICPM CALCULATION TOLERANCES

Target Convergence=	.000	cfs +/-
Max. Iterations =	35	loops
ICPM Time Step =	.0400	hrs
Output Time Step =	.0400	hrs
ICPM Ending Time =	35.0000	hrs

MASTER NETWORK SUMMARY
SCS Unit Hydrograph Method

(*Node=Outfall; +Node=Diversion;)
(Trun= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left&Rt)

Node ID	Type	Return Event	HYG Vol ac-ft	Trun	Qpeak hrs	Qpeak cfs	Max WSEL ft	Max Pond Storage ac-ft
SUBAREA A8	AREA	2	.517		12.2800	4.22		
SUBAREA A8	AREA	10	.642		12.2800	5.41		
SUBAREA A8	AREA	25	1.423		12.2400	12.85		
SUBAREA A8	AREA	100	1.882		12.2400	17.16		
SUBAREA A9	AREA	2	1.936		12.4000	13.88		
SUBAREA A9	AREA	10	2.229		12.4000	15.95		
SUBAREA A9	AREA	25	3.870		12.4000	27.28		
SUBAREA A9	AREA	100	4.751		12.4000	33.22		
SUBAREA B1	AREA	2	1.037		12.1200	12.13		
SUBAREA B1	AREA	10	1.194		12.1200	13.92		
SUBAREA B1	AREA	25	2.073		12.1200	23.66		
SUBAREA B1	AREA	100	2.545		12.1200	28.76		
SUBAREA B2	AREA	2	2.867		12.1200	33.69		
SUBAREA B2	AREA	10	3.326		12.1200	39.00		
SUBAREA B2	AREA	25	5.913		12.1200	68.19		
SUBAREA B2	AREA	100	7.313		12.1200	83.57		
SUBAREA B3	AREA	2	2.095		12.0000	32.64		
SUBAREA B3	AREA	10	2.430		12.0000	37.74		
SUBAREA B3	AREA	25	4.320		12.0000	65.71		
SUBAREA B3	AREA	100	5.343		12.0000	80.41		
SUBAREA B4	AREA	2	1.154		12.0000	18.38		
SUBAREA B4	AREA	10	1.433		12.0000	23.23		
SUBAREA B4	AREA	25	3.177		12.0000	52.83		
SUBAREA B4	AREA	100	4.200		12.0000	69.71		
SUBAREA B5	AREA	2	.161		12.0400	2.48		
SUBAREA B5	AREA	10	.200		12.0000	3.14		
SUBAREA B5	AREA	25	.444		12.0000	7.22		
SUBAREA B5	AREA	100	.587		12.0000	9.55		
SUBAREA B6	AREA	2	1.745		12.1600	17.39		
SUBAREA B6	AREA	10	2.167		12.1600	22.27		
SUBAREA B6	AREA	25	4.806		12.1600	52.39		
SUBAREA B6	AREA	100	6.354		12.1600	69.77		
SUBAREA B7	AREA	2	1.290		12.0800	15.68		
SUBAREA B7	AREA	10	1.601		12.0800	20.01		
SUBAREA B7	AREA	25	3.551		12.0800	46.67		
SUBAREA B7	AREA	100	4.695		12.0800	62.00		

NETWORK SUMMARY -- LINKS

(UN=Upstream Node; DL=DNstream End of Link; DN=DNstream Node)
(Trun.= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left & Rt)

DEFAULT Design Storm File,ID = KIF

Storm Tag Name = 25yr

Data Type, File, ID = Synthetic Storm TypeII 24hr
Storm Frequency = 25 yr
Total Rainfall Depth= 5.5000 in
Duration Multiplier = 1
Resulting Duration = 24.0000 hrs
Resulting Start Time= .0000 hrs Step= .1000 hrs End= 24.0000 hrs

ICPM CALCULATION TOLERANCES

Target Convergence= .000 cfs +/-
Max. Iterations = 35 loops
ICPM Time Step = .0400 hrs
Output Time Step = .0400 hrs
ICPM Ending Time = 35.0000 hrs

Link ID	Type		HYG Vol ac-ft	Trun.	Peak Time hrs	Peak Q cfs	End Points
D16	ADD	UN	.795		12.0800	10.20	SUBAREA A11

		DL	.795	12.0800	10.20	
		DN	2.718	12.0800	34.40	JUNC 10
D16A	ADD	UN	1.923	12.0800	24.20	SUBAREA A5
		DL	1.923	12.0800	24.20	
		DN	2.718	12.0800	34.40	JUNC 10
D17	ADD	UN	2.718	12.0800	34.40	JUNC 10
		DL	2.718	12.0800	34.40	
		DN	49.370	12.0400	489.25	POND 2
D18	ADD	UN	.773	12.1600	8.51	SUBAREA A2
		DL	.773	12.1600	8.51	
		DN	30.189	12.1200	268.50	JUNC 30
D19	ADD	UN	3.284	11.9600	53.08	SUBAREA A12
		DL	3.284	11.9600	53.08	
		DN	11.212	12.0000	177.59	JUNC 20

NETWORK SUMMARY -- LINKS
(UN=Upstream Node; DL=DNstream End of Link; DN=DNstream Node)
(Trun.= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left & Rt)

Link ID	Type		HYG Vol ac-ft	Trun.	Peak Time hrs	Peak Q cfs	End Points
D2	ADD	UN	2.032		12.5200	12.59	SUBAREA A7
		DL	2.032		12.5200	12.59	
		DN	19.952		12.1600	150.69	JUNC 40
D20	ADD	UN	11.212		12.0000	177.59	JUNC 20
		DL	11.212		12.0000	177.59	
		DN	49.370		12.0400	489.25	POND 2
D20A	ADD	UN	.432		11.9200	7.99	SUBAREA A6
		DL	.432		11.9200	7.99	
		DN	11.212		12.0000	177.59	JUNC 20
D21	ADD	UN	2.481		12.0800	30.14	SUBAREA A14
		DL	2.481		12.0800	30.14	
		DN	4.554		12.0800	53.43	JUNC 50
D22	ADD	UN	2.073		12.1200	23.66	SUBAREA B1
		DL	2.073		12.1200	23.66	
		DN	4.554		12.0800	53.43	JUNC 50
D23	ADD	UN	4.554		12.0800	53.43	JUNC 50
		DL	4.554		12.0800	53.43	
		DN	19.952		12.1600	150.69	JUNC 40
D24	ADD	UN	30.189		12.1200	268.50	JUNC 30
		DL	30.189		12.1200	268.50	
		DN	49.370		12.0400	489.25	POND 2
D27	ADD	UN	3.398		12.1600	35.41	JUNC 70
		DL	3.398		12.1600	35.41	
		DN	19.952		12.1600	150.69	JUNC 40
D27A	ADD	UN	1.286		12.1200	14.77	SUBAREA 15
		DL	1.286		12.1200	14.77	
		DN	3.398		12.1600	35.41	JUNC 70
D27B	ADD	UN	2.112		12.2000	21.44	SUBAREA 16
		DL	2.112		12.2000	21.44	
		DN	3.398		12.1600	35.41	JUNC 70

NETWORK SUMMARY -- LINKS
(UN=Upstream Node; DL=DNstream End of Link; DN=DNstream Node)
(Trun.= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left & Rt)

Link ID	Type		HYG Vol ac-ft	Trun.	Peak Time hrs	Peak Q cfs	End Points
D3	ADD	UN	19.952		12.1600	150.69	JUNC 40
		DL	19.952		12.1600	150.69	
		DN	30.189		12.1200	268.50	JUNC 30
D30	ADD	UN	4.320		12.0000	65.71	SUBAREA B3
		DL	4.320		12.0000	65.71	
		DN	11.212		12.0000	177.59	JUNC 20
D32	ADD	UN	3.177		12.0000	52.83	SUBAREA B4
		DL	3.177		12.0000	52.83	
		DN	11.212		12.0000	177.59	JUNC 20
D34	ADD	UN	.444		12.0000	7.22	SUBAREA B5
		DL	.444		12.0000	7.22	
		DN	49.370		12.0400	489.25	POND 2
D38	ADD	UN	3.551		12.0800	46.67	SUBAREA B7
		DL	3.551		12.0800	46.67	
		DN	30.189		12.1200	268.50	JUNC 30
D39	ADD	UN	5.913		12.1200	68.19	SUBAREA B2
		DL	5.913		12.1200	68.19	
		DN	30.189		12.1200	268.50	JUNC 30
D3A	ADD	UN	2.222		12.4400	14.92	SUBAREA A3
		DL	2.222		12.4400	14.92	
		DN	19.952		12.1600	150.69	JUNC 40
D4	ADD	UN	3.870		12.4000	27.28	SUBAREA A9
		DL	3.870		12.4000	27.28	
		DN	19.952		12.1600	150.69	JUNC 40
D40	ADD	UN	4.806		12.1600	52.39	SUBAREA B6
		DL	4.806		12.1600	52.39	
		DN	49.370		12.0400	489.25	POND 2
D5A	ADD	UN	1.423		12.2400	12.85	SUBAREA A8
		DL	1.423		12.2400	12.85	
		DN	3.876		12.3200	29.60	JUNC 60

NETWORK SUMMARY -- LINKS
(UN=Upstream Node; DL=DNstream End of Link; DN=DNstream Node)
(Trun.= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left & Rt)

Link ID	Type		HYG Vol ac-ft	Trun.	Peak Time hrs	Peak Q cfs	End Points	
D6	ADD	UN	2.452		12.3200	17.28	SUBAREA A13	
		DL	2.452		12.3200	17.28		
		DN	3.876		12.3200	29.60	JUNC 60	
D7	ADD	UN	3.876		12.3200	29.60	JUNC 60	
		DL	3.876		12.3200	29.60		
		DN	19.952		12.1600	150.69	JUNC 40	
ROUTE 2	PONDrt	UN	49.370		12.0400	489.25	POND 2	IN
ROUTE 2			49.413		12.4800	200.74	POND 2	OUT
		DL	49.413		12.4800	200.74		
		DN	49.413		12.4800	200.74	POND 3	
ROUTE 3	PONDrt	UN	49.413		12.4800	200.74	POND 3	IN
ROUTE 3			49.422		12.5200	200.47	POND 3	OUT
		DL	49.422		12.5200	200.47		
		DN	49.422		12.5200	200.47	OUT 20	

NETWORK SUMMARY -- LINKS
(UN=Upstream Node; DL=DNstream End of Link; DN=DNstream Node)
(Trun.= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left & Rt)

DEFAULT Design Storm File,ID = KIF

Storm Tag Name = 100yr

Data Type, File, ID = Synthetic Storm TypeII 24hr
Storm Frequency = 100 yr
Total Rainfall Depth= 6.5000 in
Duration Multiplier = 1
Resulting Duration = 24.0000 hrs
Resulting Start Time= .0000 hrs Step= .1000 hrs End= 24.0000 hrs

---

ICPM CALCULATION TOLERANCES

Target Convergence= .000 cfs +/-
Max. Iterations = 35 loops
ICPM Time Step = .0400 hrs
Output Time Step = .0400 hrs
ICPM Ending Time = 35.0000 hrs

Link ID	Type		HYG Vol ac-ft	Trun.	Peak Time hrs	Peak Q cfs	End Points
D16	ADD	UN	1.050		12.0800	13.57	SUBAREA A11
		DL	1.050		12.0800	13.57	
		DN	3.593		12.0800	45.81	JUNC 10
D16A	ADD	UN	2.542		12.0800	32.24	SUBAREA A5
		DL	2.542		12.0800	32.24	
		DN	3.593		12.0800	45.81	JUNC 10
D17	ADD	UN	3.593		12.0800	45.81	JUNC 10
		DL	3.593		12.0800	45.81	
		DN	62.967		12.0400	624.90	POND 2
D18	ADD	UN	1.022		12.1200	11.34	SUBAREA A2
		DL	1.022		12.1200	11.34	
		DN	38.259		12.1200	339.91	JUNC 30
D19	ADD	UN	4.062		11.9600	65.01	SUBAREA A12
		DL	4.062		11.9600	65.01	
		DN	14.174		12.0000	222.80	JUNC 20

NETWORK SUMMARY -- LINKS
(UN=Upstream Node; DL=DNstream End of Link; DN=DNstream Node)
(Trun.= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left & Rt)

Link ID	Type		HYG Vol ac-ft	Trun.	Peak Time hrs	Peak Q cfs	End Points
D2	ADD	UN	2.687		12.5200	16.85	SUBAREA A7
		DL	2.687		12.5200	16.85	
		DN	25.229		12.1600	190.34	JUNC 40
D20	ADD	UN	14.174		12.0000	222.80	JUNC 20
		DL	14.174		12.0000	222.80	
		DN	62.967		12.0400	624.90	POND 2
D20A	ADD	UN	.570		11.9200	10.62	SUBAREA A6
		DL	.570		11.9200	10.62	
		DN	14.174		12.0000	222.80	JUNC 20
D21	ADD	UN	3.046		12.0800	36.64	SUBAREA A14
		DL	3.046		12.0800	36.64	
		DN	5.591		12.0800	65.00	JUNC 50
D22	ADD	UN	2.545		12.1200	28.76	SUBAREA B1
		DL	2.545		12.1200	28.76	
		DN	5.591		12.0800	65.00	JUNC 50
D23	ADD	UN	5.591		12.0800	65.00	JUNC 50
		DL	5.591		12.0800	65.00	
		DN	25.229		12.1600	190.34	JUNC 40
D24	ADD	UN	38.259		12.1200	339.91	JUNC 30
		DL	38.259		12.1200	339.91	
		DN	62.967		12.0400	624.90	POND 2
D27	ADD	UN	4.371		12.1600	45.61	JUNC 70
		DL	4.371		12.1600	45.61	
		DN	25.229		12.1600	190.34	JUNC 40
D27A	ADD	UN	1.579		12.1200	17.95	SUBAREA 15
		DL	1.579		12.1200	17.95	
		DN	4.371		12.1600	45.61	JUNC 70
D27B	ADD	UN	2.791		12.2000	28.55	SUBAREA 16
		DL	2.791		12.2000	28.55	
		DN	4.371		12.1600	45.61	JUNC 70

NETWORK SUMMARY -- LINKS
(UN=Upstream Node; DL=DNstream End of Link; DN=DNstream Node)
(Trun.= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left & Rt)

Link ID	Type		HYG Vol ac-ft	Trun.	Peak Time hrs	Peak Q cfs	End Points
D3	ADD	UN	25.229		12.1600	190.34	JUNC 40
		DL	25.229		12.1600	190.34	
		DN	38.259		12.1200	339.91	JUNC 30
D30	ADD	UN	5.343		12.0000	80.41	SUBAREA B3
		DL	5.343		12.0000	80.41	
		DN	14.174		12.0000	222.80	JUNC 20
D32	ADD	UN	4.200		12.0000	69.71	SUBAREA B4
		DL	4.200		12.0000	69.71	
		DN	14.174		12.0000	222.80	JUNC 20
D34	ADD	UN	.587		12.0000	9.55	SUBAREA B5
		DL	.587		12.0000	9.55	
		DN	62.967		12.0400	624.90	POND 2
D38	ADD	UN	4.695		12.0800	62.00	SUBAREA B7
		DL	4.695		12.0800	62.00	
		DN	38.259		12.1200	339.91	JUNC 30
D39	ADD	UN	7.313		12.1200	83.57	SUBAREA B2
		DL	7.313		12.1200	83.57	
		DN	38.259		12.1200	339.91	JUNC 30
D3A	ADD	UN	2.937		12.4000	19.96	SUBAREA A3
		DL	2.937		12.4000	19.96	
		DN	25.229		12.1600	190.34	JUNC 40
D4	ADD	UN	4.751		12.4000	33.22	SUBAREA A9
		DL	4.751		12.4000	33.22	
		DN	25.229		12.1600	190.34	JUNC 40
D40	ADD	UN	6.354		12.1600	69.77	SUBAREA B6
		DL	6.354		12.1600	69.77	
		DN	62.967		12.0400	624.90	POND 2
D5A	ADD	UN	1.882		12.2400	17.16	SUBAREA A8
		DL	1.882		12.2400	17.16	
		DN	4.892		12.3200	37.43	JUNC 60

NETWORK SUMMARY -- LINKS
(UN=Upstream Node; DL=DNstream End of Link; DN=DNstream Node)
(Trun.= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left & Rt)

Link ID	Type		HYG Vol ac-ft	Trun.	Peak Time hrs	Peak Q cfs	End Points	
D6	ADD	UN	3.011		12.3200	21.07	SUBAREA A13	
		DL	3.011		12.3200	21.07		
		DN	4.892		12.3200	37.43	JUNC 60	
D7	ADD	UN	4.892		12.3200	37.43	JUNC 60	
		DL	4.892		12.3200	37.43		
		DN	25.229		12.1600	190.34	JUNC 40	
ROUTE 2	PONDrt	UN	62.967		12.0400	624.90	POND 2	IN
ROUTE 2			63.018		12.5200	227.14	POND 2	OUT
		DL	63.018		12.5200	227.14		
		DN	63.018		12.5200	227.14	POND 3	
ROUTE 3	PONDrt	UN	63.018		12.5200	227.14	POND 3	IN
ROUTE 3			63.029		12.6000	226.84	POND 3	OUT
		DL	63.029		12.6000	226.84		
		DN	63.029		12.6000	226.84	OUT 20	

File.... C:\Haestad\PPKW\KIF\
Title... Project Date: 5/3/2004
Project Engineer: Daniel R. Smith
Project Title: KIF Lat Exp Interim Operation w/phase2&3 pond
Project Comments:
This model analyzes the cond of the expan during operation, while Phase 2/3 has a pond. The time of concentration is minimized due to the pond.

DESIGN STORMS SUMMARY

```
Design Storm File,ID =              KIF


Storm Tag Name       = 2yr
----------------------------------------------------------------------
Data Type, File, ID = Synthetic Storm    TypeII  24hr
Storm Frequency      = 2 yr
Total Rainfall Depth= 3.2500 in
Duration Multiplier =  1
Resulting Duration  = 24.0000 hrs
Resulting Start Time= .0000 hrs  Step= .1000 hrs  End= 24.0000 hrs

Storm Tag Name       = 10yr
----------------------------------------------------------------------
Data Type, File, ID = Synthetic Storm    TypeII  24hr
Storm Frequency      = 10 yr
Total Rainfall Depth= 3.6000 in
Duration Multiplier =  1
Resulting Duration  = 24.0000 hrs
Resulting Start Time= .0000 hrs  Step= .1000 hrs  End= 24.0000 hrs

Storm Tag Name       = 25yr
----------------------------------------------------------------------
Data Type, File, ID = Synthetic Storm    TypeII  24hr
Storm Frequency      = 25 yr
Total Rainfall Depth= 5.5000 in
Duration Multiplier =  1
Resulting Duration  = 24.0000 hrs
Resulting Start Time= .0000 hrs  Step= .1000 hrs  End= 24.0000 hrs

Storm Tag Name       = 100yr
----------------------------------------------------------------------
Data Type, File, ID = Synthetic Storm    TypeII  24hr
Storm Frequency      = 100 yr
Total Rainfall Depth= 6.5000 in
Duration Multiplier =  1
Resulting Duration  = 24.0000 hrs
Resulting Start Time= .0000 hrs  Step= .1000 hrs  End= 24.0000 hrs
```

CUMULATIVE RAINFALL FRACTIONS
Output Time increment = .1000 hrs
Time on left represents time for first value in each row.

Time hrs					
.0000	.000	.001	.002	.003	.004
.5000	.005	.006	.007	.008	.009
1.0000	.011	.012	.013	.014	.015
1.5000	.016	.017	.018	.020	.021
2.0000	.022	.023	.024	.026	.027
2.5000	.028	.029	.031	.032	.033
3.0000	.035	.036	.037	.038	.040
3.5000	.041	.042	.044	.045	.047
4.0000	.048	.049	.051	.052	.054
4.5000	.055	.057	.058	.060	.061
5.0000	.063	.065	.066	.068	.070
5.5000	.071	.073	.075	.076	.078
6.0000	.080	.082	.084	.085	.087
6.5000	.089	.091	.093	.095	.097
7.0000	.099	.101	.103	.105	.107
7.5000	.109	.111	.113	.116	.118
8.0000	.120	.122	.125	.127	.130
8.5000	.132	.135	.138	.141	.144
9.0000	.147	.150	.153	.157	.160
9.5000	.163	.166	.170	.173	.177
10.0000	.181	.185	.189	.194	.199
10.5000	.204	.209	.215	.221	.228
11.0000	.235	.243	.251	.261	.271
11.5000	.283	.307	.354	.431	.568
12.0000	.663	.682	.699	.713	.725
12.5000	.735	.743	.751	.759	.766
13.0000	.772	.778	.784	.789	.794
13.5000	.799	.804	.808	.812	.816
14.0000	.820	.824	.827	.831	.834
14.5000	.838	.841	.844	.847	.850
15.0000	.854	.856	.859	.862	.865
15.5000	.868	.870	.873	.875	.878
16.0000	.880	.882	.885	.887	.889
16.5000	.891	.893	.895	.898	.900
17.0000	.902	.904	.906	.908	.910
17.5000	.912	.914	.915	.917	.919
18.0000	.921	.923	.925	.926	.928
18.5000	.930	.931	.933	.935	.936
19.0000	.938	.939	.941	.942	.944
19.5000	.945	.947	.948	.949	.951
20.0000	.952	.953	.955	.956	.957
20.5000	.958	.960	.961	.962	.964
21.0000	.965	.966	.967	.968	.970
21.5000	.971	.972	.973	.975	.976
22.0000	.977	.978	.979	.981	.982
22.5000	.983	.984	.985	.986	.988

CUMULATIVE RAINFALL FRACTIONS
Output Time increment = .1000 hrs
Time on left represents time for first value in each row.

Time hrs					
23.0000	.989	.990	.991	.992	.993
23.5000	.994	.996	.997	.998	.999
24.0000	1.000				

CUMULATIVE RAINFALL FRACTIONS

Output Time increment = .1000 hrs

Time on left represents time for first value in each row.

Time hrs					
.0000	.000	.001	.002	.003	.004
.5000	.005	.006	.007	.008	.009
1.0000	.011	.012	.013	.014	.015
1.5000	.016	.017	.018	.020	.021
2.0000	.022	.023	.024	.026	.027
2.5000	.028	.029	.031	.032	.033
3.0000	.035	.036	.037	.038	.040
3.5000	.041	.042	.044	.045	.047
4.0000	.048	.049	.051	.052	.054
4.5000	.055	.057	.058	.060	.061
5.0000	.063	.065	.066	.068	.070
5.5000	.071	.073	.075	.076	.078
6.0000	.080	.082	.084	.085	.087
6.5000	.089	.091	.093	.095	.097
7.0000	.099	.101	.103	.105	.107
7.5000	.109	.111	.113	.116	.118
8.0000	.120	.122	.125	.127	.130
8.5000	.132	.135	.138	.141	.144
9.0000	.147	.150	.153	.157	.160
9.5000	.163	.166	.170	.173	.177
10.0000	.181	.185	.189	.194	.199
10.5000	.204	.209	.215	.221	.228
11.0000	.235	.243	.251	.261	.271
11.5000	.283	.307	.354	.431	.568
12.0000	.663	.682	.699	.713	.725
12.5000	.735	.743	.751	.759	.766
13.0000	.772	.778	.784	.789	.794
13.5000	.799	.804	.808	.812	.816
14.0000	.820	.824	.827	.831	.834
14.5000	.838	.841	.844	.847	.850
15.0000	.854	.856	.859	.862	.865
15.5000	.868	.870	.873	.875	.878
16.0000	.880	.882	.885	.887	.889
16.5000	.891	.893	.895	.898	.900
17.0000	.902	.904	.906	.908	.910
17.5000	.912	.914	.915	.917	.919
18.0000	.921	.923	.925	.926	.928
18.5000	.930	.931	.933	.935	.936
19.0000	.938	.939	.941	.942	.944
19.5000	.945	.947	.948	.949	.951
20.0000	.952	.953	.955	.956	.957
20.5000	.958	.960	.961	.962	.964
21.0000	.965	.966	.967	.968	.970
21.5000	.971	.972	.973	.975	.976
22.0000	.977	.978	.979	.981	.982
22.5000	.983	.984	.985	.986	.988

CUMULATIVE RAINFALL FRACTIONS

Output Time increment = .1000 hrs

Time on left represents time for first value in each row.

Time hrs					
23.0000	.989	.990	.991	.992	.993
23.5000	.994	.996	.997	.998	.999
24.0000	1.000				

File.... C:\Haestad\PPKW\KIF\KIF LAT EXP PHASE2_FINAL COVER_A.PPW

TIME OF CONCENTRATION CALCULATOR

Segment #1: Tc: TR-55 Sheet

Mannings n	.0600	
Hydraulic Length	100.00	ft
2yr, 24hr P	3.2500	in
Slope	.050000	ft/ft
Avg.Velocity	.51	ft/sec

Segment #1 Time: .0540 hrs

Segment #2: Tc: TR-55 Shallow

Hydraulic Length	200.00	ft
Slope	.050000	ft/ft
Unpaved		
Avg.Velocity	3.61	ft/sec

Segment #2 Time: .0154 hrs

Segment #3: Tc: TR-55 Channel

Flow Area	1.7500	sq.ft
Wetted Perimeter	5.16	ft
Hydraulic Radius	.34	ft
Slope	.330000	ft/ft
Mannings n	.0350	
Hydraulic Length	200.00	ft
Avg.Velocity	11.89	ft/sec

Segment #3 Time: .0047 hrs

File.... C:\Haestad\PPKW\KIF\KIF LAT EXP PHASE2_FINAL COVER_A.PPW

Segment #4: Tc: TR-55 Channel

Flow Area	35.3500	sq.ft
Wetted Perimeter	53.00	ft
Hydraulic Radius	.67	ft
Slope	.005000	ft/ft
Mannings n	.0350	
Hydraulic Length	2600.00	ft
Avg.Velocity	2.30	ft/sec

Segment #4 Time: .3143 hrs

Total Tc: .3883 hrs

File.... C:\Haestad\PPKW\KIF\KIF LAT EXP PHASE2_FINAL COVER_A.PPW

Tc Equations used...

==== SCS TR-55 Sheet Flow ====

```
Tc = (.007 * ((n * Lf)**0.8)) / ((P**.5) * (Sf**.4))

Where:  Tc = Time of concentration, hrs
        n  = Mannings n
        Lf = Flow length, ft
        P  = 2yr, 24hr Rain depth, inches
        Sf = Slope, %
```

==== SCS TR-55 Shallow Concentrated Flow ====

```
Unpaved surface:
V  = 16.1345 * (Sf**0.5)

Paved surface:
V  = 20.3282 * (Sf**0.5)

Tc = (Lf / V) / (3600sec/hr)

Where:  V  = Velocity, ft/sec
        Sf = Slope, ft/ft
        Tc = Time of concentration, hrs
        Lf = Flow length, ft
```

File.... C:\Haestad\PPKW\KIF\KIF LAT EXP PHASE2_FINAL COVER_A.PPW

==== SCS Channel Flow ==

```
R  = Aq / Wp
V  = (1.49 * (R**(2/3)) * (Sf**-0.5)) / n

Tc = (Lf / V) / (3600sec/hr)

Where:  R  = Hydraulic radius
        Aq = Flow area, sq.ft.
        Wp = Wetted perimeter, ft
        V  = Velocity, ft/sec
        Sf = Slope, ft/ft
        n  = Mannings n
        Tc = Time of concentration, hrs
        Lf = Flow length, ft
```

File.... C:\Haestad\PPKW\KIF\KIF LAT EXP PHASE2_FINAL COVER_A.PPW

::
TIME OF CONCENTRATION CALCULATOR
::

Segment #1: Tc: TR-55 Sheet

Mannings n	.2400	
Hydraulic Length	100.00	ft
2yr, 24hr P	3.2500	in
Slope	.330000	ft/ft
Avg.Velocity	.36	ft/sec

Segment #1 Time: .0769 hrs

Segment #2: Tc: TR-55 Channel

Flow Area	1.1500	sq.ft
Wetted Perimeter	6.81	ft
Hydraulic Radius	.17	ft
Slope	.005000	ft/ft
Mannings n	.0350	
Hydraulic Length	300.00	ft
Avg.Velocity	.92	ft/sec

Segment #2 Time: .0906 hrs

Segment #3: Tc: TR-55 Channel

Flow Area	1.7500	sq.ft
Wetted Perimeter	5.16	ft
Hydraulic Radius	.34	ft
Slope	.330000	ft/ft
Mannings n	.0350	
Hydraulic Length	300.00	ft
Avg.Velocity	11.89	ft/sec

Segment #3 Time: .0070 hrs

File.... C:\Haestad\PPKW\KIF\KIF LAT EXP PHASE2_FINAL COVER_A.PPW

Segment #4: Tc: TR-55 Channel

Flow Area	35.3500	sq.ft
Wetted Perimeter	53.00	ft
Hydraulic Radius	.67	ft
Slope	.005000	ft/ft
Mannings n	.0350	
Hydraulic Length	2600.00	ft
Avg.Velocity	2.30	ft/sec

Segment #4 Time: .3143 hrs

Total Tc: .4888 hrs

File.... C:\Haestad\PPKW\KIF\KIF LAT EXP PHASE2_FINAL COVER_A.PPW

Tc Equations used...

==== SCS TR-55 Sheet Flow ====

```
Tc = (.007 * ((n * Lf)**0.8)) / ((P**.5) * (Sf**.4))

Where:  Tc = Time of concentration, hrs
        n  = Mannings n
        Lf = Flow length, ft
        P  = 2yr, 24hr Rain depth, inches
        Sf = Slope, %
```

==== SCS Channel Flow ====

```
R  = Aq / Wp
V  = (1.49 * (R**(2/3)) * (Sf**-0.5)) / n

Tc = (Lf / V) / (3600sec/hr)

Where:  R  = Hydraulic radius
        Aq = Flow area, sq.ft.
        Wp = Wetted perimeter, ft
        V  = Velocity, ft/sec
        Sf = Slope, ft/ft
        n  = Mannings n
        Tc = Time of concentration, hrs
        Lf = Flow length, ft
```

File.... C:\Haestad\PPKW\KIF\KIF LAT EXP PHASE2_FINAL COVER_A.PPW

::
TIME OF CONCENTRATION CALCULATOR
::

Segment #1: Tc: TR-55 Sheet

Mannings n	.0600	
Hydraulic Length	100.00	ft
2yr, 24hr P	3.2500	in
Slope	.050000	ft/ft
Avg.Velocity	.51	ft/sec

Segment #1 Time: .0540 hrs

Segment #2: Tc: TR-55 Shallow

Hydraulic Length	300.00	ft
Slope	.050000	ft/ft
Unpaved		
Avg.Velocity	3.61	ft/sec

Segment #2 Time: .0231 hrs

Segment #3: Tc: TR-55 Channel

Flow Area	1.7500	sq.ft
Wetted Perimeter	5.16	ft
Hydraulic Radius	.34	ft
Slope	.330000	ft/ft
Mannings n	.0350	
Hydraulic Length	400.00	ft
Avg.Velocity	11.89	ft/sec

Segment #3 Time: .0093 hrs

File.... C:\Haestad\PPKW\KIF\KIF LAT EXP PHASE2_FINAL COVER_A.PPW

Segment #4: Tc: TR-55 Channel

Flow Area	1.1500	sq.ft
Wetted Perimeter	6.81	ft
Hydraulic Radius	.17	ft
Slope	.005000	ft/ft
Mannings n	.0350	
Hydraulic Length	300.00	ft
Avg.Velocity	.92	ft/sec

Segment #4 Time: .0906 hrs

Segment #5: Tc: TR-55 Channel

Flow Area	1.7500	sq.ft
Wetted Perimeter	5.16	ft
Hydraulic Radius	.34	ft
Slope	.010000	ft/ft
Mannings n	.0350	
Hydraulic Length	1100.00	ft
Avg.Velocity	2.07	ft/sec

Segment #5 Time: .1476 hrs

Total Tc: .3246 hrs

File.... C:\Haestad\PPKW\KIF\KIF LAT EXP PHASE2_FINAL COVER_A.PPW

Tc Equations used...

==== SCS TR-55 Sheet Flow ====

```
Tc = (.007 * ((n * Lf)**0.8)) / ((P**.5) * (Sf**.4))

Where:  Tc = Time of concentration, hrs
        n  = Mannings n
        Lf = Flow length, ft
        P  = 2yr, 24hr Rain depth, inches
        Sf = Slope, %
```

==== SCS TR-55 Shallow Concentrated Flow ====

```
Unpaved surface:
V  = 16.1345 * (Sf**0.5)

Paved surface:
V  = 20.3282 * (Sf**0.5)

Tc = (Lf / V) / (3600sec/hr)

Where:  V  = Velocity, ft/sec
        Sf = Slope, ft/ft
        Tc = Time of concentration, hrs
        Lf = Flow length, ft
```

File.... C:\Haestad\PPKW\KIF\KIF LAT EXP PHASE2_FINAL COVER_A.PPW

==== SCS Channel Flow ==

```
R  = Aq / Wp
V  = (1.49 * (R**(2/3)) * (Sf**-0.5)) / n

Tc = (Lf / V) / (3600sec/hr)

Where:  R  = Hydraulic radius
        Aq = Flow area, sq.ft.
        Wp = Wetted perimeter, ft
        V  = Velocity, ft/sec
        Sf = Slope, ft/ft
        n  = Mannings n
        Tc = Time of concentration, hrs
        Lf = Flow length, ft
```

File.... C:\Haestad\PPKW\KIF\KIF LAT EXP PHASE2_FINAL COVER_A.PPW

TIME OF CONCENTRATION CALCULATOR

Segment #1: Tc: TR-55 Sheet

Mannings n	.0600
Hydraulic Length	100.00 ft
2yr, 24hr P	3.2500 in
Slope	.050000 ft/ft
Avg.Velocity	.51 ft/sec

Segment #1 Time: .0540 hrs

Segment #2: Tc: TR-55 Shallow

Hydraulic Length	100.00 ft
Slope	.050000 ft/ft
Unpaved	
Avg.Velocity	3.61 ft/sec

Segment #2 Time: .0077 hrs

Segment #3: Tc: TR-55 Channel

Flow Area	1.1500 sq.ft
Wetted Perimeter	6.81 ft
Hydraulic Radius	.17 ft
Slope	.025000 ft/ft
Mannings n	.0200
Hydraulic Length	400.00 ft
Avg.Velocity	3.60 ft/sec

Segment #3 Time: .0309 hrs

File.... C:\Haestad\PPKW\KIF\KIF LAT EXP PHASE2_FINAL COVER_A.PPW

Segment #4: Tc: TR-55 Channel

Flow Area	8.4000 sq.ft
Wetted Perimeter	22.56 ft
Hydraulic Radius	.37 ft
Slope	.090000 ft/ft
Mannings n	.0350
Hydraulic Length	800.00 ft
Avg.Velocity	6.61 ft/sec

Segment #4 Time: .0336 hrs

Segment #5: Tc: TR-55 Channel

Flow Area	1.3300 sq.ft
Wetted Perimeter	4.29 ft
Hydraulic Radius	.31 ft
Slope	.010000 ft/ft
Mannings n	.0350
Hydraulic Length	200.00 ft
Avg.Velocity	1.95 ft/sec

Segment #5 Time: .0285 hrs

Total Tc: .1546 hrs

File.... C:\Haestad\PPKW\KIF\KIF LAT EXP PHASE2_FINAL COVER_A.PPW

Tc Equations used...

==== SCS TR-55 Sheet Flow ====

```
Tc = (.007 * ((n * Lf)**0.8)) / ((P**.5) * (Sf**.4))

Where:  Tc = Time of concentration, hrs
        n  = Mannings n
        Lf = Flow length, ft
        P  = 2yr, 24hr Rain depth, inches
        Sf = Slope, %
```

==== SCS TR-55 Shallow Concentrated Flow ====

```
Unpaved surface:
V  = 16.1345 * (Sf**0.5)

Paved surface:
V  = 20.3282 * (Sf**0.5)

Tc = (Lf / V) / (3600sec/hr)

Where:  V  = Velocity, ft/sec
        Sf = Slope, ft/ft
        Tc = Time of concentration, hrs
        Lf = Flow length, ft
```

File.... C:\Haestad\PPKW\KIF\KIF LAT EXP PHASE2_FINAL COVER_A.PPW

==== SCS Channel Flow ==

```
R  = Aq / Wp
V  = (1.49 * (R**(2/3)) * (Sf**-0.5)) / n

Tc = (Lf / V) / (3600sec/hr)

Where:  R  = Hydraulic radius
        Aq = Flow area, sq.ft.
        Wp = Wetted perimeter, ft
        V  = Velocity, ft/sec
        Sf = Slope, ft/ft
        n  = Mannings n
        Tc = Time of concentration, hrs
        Lf = Flow length, ft
```

File.... C:\Haestad\PPKW\KIF\KIF LAT EXP PHASE2_FINAL COVER_A.PPW

TIME OF CONCENTRATION CALCULATOR

Segment #1: Tc: User Defined

Segment #1 Time: .8400 hrs

Total Tc: .8400 hrs

File.... C:\Haestad\PPKW\KIF\KIF LAT EXP PHASE2_FINAL COVER_A.PPW

Tc Equations used...

==== User Defined ====

Tc = Value entered by user

Where: Tc = Time of concentration

File.... C:\Haestad\PPKW\KIF\KIF LAT EXP PHASE2_FINAL COVER_A.PPW

TIME OF CONCENTRATION CALCULATOR

Segment #1: Tc: User Defined

Segment #1 Time: .1550 hrs

Segment #2: Tc: TR-55 Channel

Flow Area	35.3500	sq.ft
Wetted Perimeter	53.00	ft
Hydraulic Radius	.67	ft
Slope	.005000	ft/ft
Mannings n	.0350	
Hydraulic Length	1600.00	ft

Avg.Velocity 2.30 ft/sec

Segment #2 Time: .1934 hrs

Total Tc: .3484 hrs

File.... C:\Haestad\PPKW\KIF\KIF LAT EXP PHASE2_FINAL COVER_A.PPW

Tc Equations used...

==== User Defined ====

Tc = Value entered by user

Where: Tc = Time of concentration

==== SCS Channel Flow ====

```
R  = Aq / Wp
V  = (1.49 * (R**(2/3)) * (Sf**-0.5)) / n

Tc = (Lf / V) / (3600sec/hr)

Where:  R  = Hydraulic radius
        Aq = Flow area, sq.ft.
        Wp = Wetted perimeter, ft
        V  = Velocity, ft/sec
        Sf = Slope, ft/ft
        n  = Mannings n
        Tc = Time of concentration, hrs
        Lf = Flow length, ft
```

File.... C:\Haestad\PPKW\KIF\KIF LAT EXP PHASE2_FINAL COVER_A.PPW

TIME OF CONCENTRATION CALCULATOR

Segment #1: Tc: TR-55 Sheet

Mannings n	.0240	
Hydraulic Length	100.00	ft
2yr, 24hr P	3.2500	in
Slope	.330000	ft/ft
Avg.Velocity	2.28	ft/sec

Segment #1 Time: .0122 hrs

Segment #2: Tc: TR-55 Channel

Flow Area	35.3500	sq.ft
Wetted Perimeter	53.00	ft
Hydraulic Radius	.67	ft
Slope	.005000	ft/ft
Mannings n	.0350	
Hydraulic Length	1800.00	ft
Avg.Velocity	2.30	ft/sec

Segment #2 Time: .2176 hrs

Segment #3: Tc: TR-55 Channel

Flow Area	35.3500	sq.ft
Wetted Perimeter	53.00	ft
Hydraulic Radius	.67	ft
Slope	.005000	ft/ft
Mannings n	.0350	
Hydraulic Length	1600.00	ft
Avg.Velocity	2.30	ft/sec

Segment #3 Time: .1934 hrs

Total Tc: .4232 hrs

File.... C:\Haestad\PPKW\KIF\KIF LAT EXP PHASE2_FINAL COVER_A.PPW

Tc Equations used...

==== SCS TR-55 Sheet Flow ====

```
Tc = (.007 * ((n * Lf)**0.8)) / ((P**.5) * (Sf**.4))

Where:  Tc = Time of concentration, hrs
        n  = Mannings n
        Lf = Flow length, ft
        P  = 2yr, 24hr Rain depth, inches
        Sf = Slope, %
```

==== SCS Channel Flow ====

```
R  = Aq / Wp
V  = (1.49 * (R**(2/3)) * (Sf**-0.5)) / n

Tc = (Lf / V) / (3600sec/hr)

Where:  R  = Hydraulic radius
        Aq = Flow area, sq.ft.
        Wp = Wetted perimeter, ft
        V  = Velocity, ft/sec
        Sf = Slope, ft/ft
        n  = Mannings n
        Tc = Time of concentration, hrs
        Lf = Flow length, ft
```

File.... C:\Haestad\PPKW\KIF\KIF LAT EXP PHASE2_FINAL COVER_A.PPW

::

TIME OF CONCENTRATION CALCULATOR

::

Segment #1: Tc: TR-55 Sheet

Mannings n	.2400	
Hydraulic Length	100.00	ft
2yr, 24hr P	3.2500	in
Slope	.005000	ft/ft
Avg.Velocity	.07	ft/sec

Segment #1 Time: .4109 hrs

Segment #2: Tc: TR-55 Shallow

Hydraulic Length	300.00	ft
Slope	.005000	ft/ft
Unpaved		
Avg.Velocity	1.14	ft/sec

Segment #2 Time: .0730 hrs

Segment #3: Tc: TR-55 Channel

Flow Area	35.3500	sq.ft
Wetted Perimeter	53.00	ft
Hydraulic Radius	.67	ft
Slope	.005000	ft/ft
Mannings n	.0350	
Hydraulic Length	1600.00	ft
Avg.Velocity	2.30	ft/sec

Segment #3 Time: .1934 hrs

File.... C:\Haestad\PPKW\KIF\KIF LAT EXP PHASE2_FINAL COVER_A.PPW

Segment #4: Tc: TR-55 Channel

Flow Area	35.3500	sq.ft
Wetted Perimeter	53.00	ft
Hydraulic Radius	.67	ft
Slope	.005000	ft/ft
Mannings n	.0350	
Hydraulic Length	1800.00	ft

Avg.Velocity 2.30 ft/sec

Segment #4 Time: .2176 hrs

Total Tc: .8949 hrs

```
------------------------------------------------------------------------
 Tc Equations used...
------------------------------------------------------------------------


==== SCS TR-55 Sheet Flow ==============================================

     Tc = (.007 * ((n * Lf)**0.8)) / ((P**.5) * (Sf**.4))

     Where:  Tc = Time of concentration, hrs
             n  = Mannings n
             Lf = Flow length, ft
             P  = 2yr, 24hr Rain depth, inches
             Sf = Slope, %


==== SCS TR-55 Shallow Concentrated Flow ===============================

     Unpaved surface:
     V  = 16.1345 * (Sf**0.5)

     Paved surface:
     V  = 20.3282 * (Sf**0.5)

     Tc = (Lf / V) / (3600sec/hr)

     Where:  V  = Velocity, ft/sec
             Sf = Slope, ft/ft
             Tc = Time of concentration, hrs
             Lf = Flow length, ft
```

File.... C:\Haestad\PPKW\KIF\KIF LAT EXP PHASE2_FINAL COVER_A.PPW

==== SCS Channel Flow ==

R = Aq / Wp
V = (1.49 * (R**(2/3)) * (Sf**-0.5)) / n

Tc = (Lf / V) / (3600sec/hr)

Where: R = Hydraulic radius
Aq = Flow area, sq.ft.
Wp = Wetted perimeter, ft
V = Velocity, ft/sec
Sf = Slope, ft/ft
n = Mannings n
Tc = Time of concentration, hrs
Lf = Flow length, ft

File.... C:\Haestad\PPKW\KIF\KIF LAT EXP PHASE2_FINAL COVER_A.PPW

::
TIME OF CONCENTRATION CALCULATOR
::

Segment #1: Tc: TR-55 Sheet

Mannings n	.2400	
Hydraulic Length	100.00	ft
2yr, 24hr P	3.2500	in
Slope	.330000	ft/ft
Avg.Velocity	.36	ft/sec

Segment #1 Time: .0769 hrs

Segment #2: Tc: TR-55 Channel

Flow Area	1.1500	sq.ft
Wetted Perimeter	6.81	ft
Hydraulic Radius	.17	ft
Slope	.005000	ft/ft
Mannings n	.0350	
Hydraulic Length	300.00	ft
Avg.Velocity	.92	ft/sec

Segment #2 Time: .0906 hrs

Segment #3: Tc: TR-55 Channel

Flow Area	1.7500	sq.ft
Wetted Perimeter	5.16	ft
Hydraulic Radius	.34	ft
Slope	.330000	ft/ft
Mannings n	.0350	
Hydraulic Length	400.00	ft
Avg.Velocity	11.89	ft/sec

Segment #3 Time: .0093 hrs

File.... C:\Haestad\PPKW\KIF\KIF LAT EXP PHASE2_FINAL COVER_A.PPW

Segment #4: Tc: TR-55 Channel

Flow Area	1.3300	sq.ft
Wetted Perimeter	4.29	ft
Hydraulic Radius	.31	ft
Slope	.010000	ft/ft
Mannings n	.0350	
Hydraulic Length	1100.00	ft
Avg.Velocity	1.95	ft/sec

Segment #4 Time: .1567 hrs

Total Tc: .3335 hrs

File.... C:\Haestad\PPKW\KIF\KIF LAT EXP PHASE2_FINAL COVER_A.PPW

Tc Equations used...

==== SCS TR-55 Sheet Flow ====

```
Tc = (.007 * ((n * Lf)**0.8)) / ((P**.5) * (Sf**.4))

Where:  Tc = Time of concentration, hrs
        n  = Mannings n
        Lf = Flow length, ft
        P  = 2yr, 24hr Rain depth, inches
        Sf = Slope, %
```

==== SCS Channel Flow ====

```
R  = Aq / Wp
V  = (1.49 * (R**(2/3)) * (Sf**-0.5)) / n

Tc = (Lf / V) / (3600sec/hr)

Where:  R  = Hydraulic radius
        Aq = Flow area, sq.ft.
        Wp = Wetted perimeter, ft
        V  = Velocity, ft/sec
        Sf = Slope, ft/ft
        n  = Mannings n
        Tc = Time of concentration, hrs
        Lf = Flow length, ft
```

File.... C:\Haestad\PPKW\KIF\KIF LAT EXP PHASE2_FINAL COVER_A.PPW

::

TIME OF CONCENTRATION CALCULATOR

::

Segment #1: Tc: TR-55 Sheet

Mannings n	.0600	
Hydraulic Length	100.00	ft
2yr, 24hr P	3.2500	in
Slope	.330000	ft/ft
Avg.Velocity	1.10	ft/sec

Segment #1 Time: .0254 hrs

Segment #2: Tc: TR-55 Shallow

Hydraulic Length	300.00	ft
Slope	.330000	ft/ft
Unpaved		
Avg.Velocity	9.27	ft/sec

Segment #2 Time: .0090 hrs

Segment #3: Tc: TR-55 Channel

Flow Area	1.7500	sq.ft
Wetted Perimeter	5.16	ft
Hydraulic Radius	.34	ft
Slope	.010000	ft/ft
Mannings n	.0350	
Hydraulic Length	400.00	ft
Avg.Velocity	2.07	ft/sec

Segment #3 Time: .0537 hrs

========================

Total Tc: .0880 hrs

========================

File.... C:\Haestad\PPKW\KIF\KIF LAT EXP PHASE2_FINAL COVER_A.PPW

```
-----------------------------------------------------------------------
Tc Equations used...
-----------------------------------------------------------------------


==== SCS TR-55 Sheet Flow =============================================

     Tc = (.007 * ((n * Lf)**0.8)) / ((P**.5) * (Sf**.4))

     Where:  Tc = Time of concentration, hrs
             n  = Mannings n
             Lf = Flow length, ft
             P  = 2yr, 24hr Rain depth, inches
             Sf = Slope, %


==== SCS TR-55 Shallow Concentrated Flow ==============================

     Unpaved surface:
     V  = 16.1345 * (Sf**0.5)

     Paved surface:
     V  = 20.3282 * (Sf**0.5)

     Tc = (Lf / V) / (3600sec/hr)

     Where:  V  = Velocity, ft/sec
             Sf = Slope, ft/ft
             Tc = Time of concentration, hrs
             Lf = Flow length, ft
```

File.... C:\Haestad\PPKW\KIF\KIF LAT EXP PHASE2_FINAL COVER_A.PPW

==== SCS Channel Flow ==

R = Aq / Wp
V = (1.49 * (R**(2/3)) * (Sf**-0.5)) / n

Tc = (Lf / V) / (3600sec/hr)

Where: R = Hydraulic radius
Aq = Flow area, sq.ft.
Wp = Wetted perimeter, ft
V = Velocity, ft/sec
Sf = Slope, ft/ft
n = Mannings n
Tc = Time of concentration, hrs
Lf = Flow length, ft

File.... C:\Haestad\PPKW\KIF\KIF LAT EXP PHASE2_FINAL COVER_A.PPW

TIME OF CONCENTRATION CALCULATOR

Segment #1: Tc: TR-55 Sheet

Mannings n	.2400	
Hydraulic Length	100.00	ft
2yr, 24hr P	3.2500	in
Slope	.330000	ft/ft
Avg.Velocity	.36	ft/sec

Segment #1 Time: .0769 hrs

Segment #2: Tc: TR-55 Channel

Flow Area	1.1500	sq.ft
Wetted Perimeter	6.81	ft
Hydraulic Radius	.17	ft
Slope	.005000	ft/ft
Mannings n	.0350	
Hydraulic Length	300.00	ft
Avg.Velocity	.92	ft/sec

Segment #2 Time: .0906 hrs

Segment #3: Tc: TR-55 Channel

Flow Area	1.7500	sq.ft
Wetted Perimeter	5.16	ft
Hydraulic Radius	.34	ft
Slope	.330000	ft/ft
Mannings n	.0350	
Hydraulic Length	350.00	ft
Avg.Velocity	11.89	ft/sec

Segment #3 Time: .0082 hrs

File.... C:\Haestad\PPKW\KIF\KIF LAT EXP PHASE2_FINAL COVER_A.PPW

Segment #4: Tc: TR-55 Channel

Flow Area	1.1500	sq.ft
Wetted Perimeter	6.81	ft
Hydraulic Radius	.17	ft
Slope	.005000	ft/ft
Mannings n	.0350	
Hydraulic Length	1400.00	ft
Avg.Velocity	.92	ft/sec

Segment #4 Time: .4229 hrs

Segment #5: Tc: TR-55 Channel

Flow Area	35.3500	sq.ft
Wetted Perimeter	53.00	ft
Hydraulic Radius	.67	ft
Slope	.005000	ft/ft
Mannings n	.0350	
Hydraulic Length	3400.00	ft
Avg.Velocity	2.30	ft/sec

Segment #5 Time: .4110 hrs

Total Tc: 1.0095 hrs

File.... C:\Haestad\PPKW\KIF\KIF LAT EXP PHASE2_FINAL COVER_A.PPW

Tc Equations used...

==== SCS TR-55 Sheet Flow ====

```
Tc = (.007 * ((n * Lf)**0.8)) / ((P**.5) * (Sf**.4))

Where:  Tc = Time of concentration, hrs
        n  = Mannings n
        Lf = Flow length, ft
        P  = 2yr, 24hr Rain depth, inches
        Sf = Slope, %
```

==== SCS Channel Flow ====

```
R  = Aq / Wp
V  = (1.49 * (R**(2/3)) * (Sf**-0.5)) / n

Tc = (Lf / V) / (3600sec/hr)

Where:  R  = Hydraulic radius
        Aq = Flow area, sq.ft.
        Wp = Wetted perimeter, ft
        V  = Velocity, ft/sec
        Sf = Slope, ft/ft
        n  = Mannings n
        Tc = Time of concentration, hrs
        Lf = Flow length, ft
```

File.... C:\Haestad\PPKW\KIF\KIF LAT EXP PHASE2_FINAL COVER_A.PPW

::

TIME OF CONCENTRATION CALCULATOR

::

Segment #1: Tc: TR-55 Sheet

Mannings n	.2400	
Hydraulic Length	100.00	ft
2yr, 24hr P	3.2500	in
Slope	.330000	ft/ft
Avg.Velocity	.36	ft/sec

Segment #1 Time: .0769 hrs

Segment #2: Tc: TR-55 Channel

Flow Area	1.1500	sq.ft
Wetted Perimeter	6.81	ft
Hydraulic Radius	.17	ft
Slope	.005000	ft/ft
Mannings n	.0350	
Hydraulic Length	300.00	ft
Avg.Velocity	.92	ft/sec

Segment #2 Time: .0906 hrs

Segment #3: Tc: TR-55 Channel

Flow Area	1.7500	sq.ft
Wetted Perimeter	5.16	ft
Hydraulic Radius	.34	ft
Slope	.330000	ft/ft
Mannings n	.0350	
Hydraulic Length	300.00	ft
Avg.Velocity	11.89	ft/sec

Segment #3 Time: .0070 hrs

File.... C:\Haestad\PPKW\KIF\KIF LAT EXP PHASE2_FINAL COVER_A.PPW

Segment #4: Tc: TR-55 Channel

Flow Area	35.3500	sq.ft
Wetted Perimeter	53.00	ft
Hydraulic Radius	.67	ft
Slope	.005000	ft/ft
Mannings n	.0350	
Hydraulic Length	3400.00	ft

Avg.Velocity 2.30 ft/sec

Segment #4 Time: .4110 hrs

Total Tc: .5855 hrs

File.... C:\Haestad\PPKW\KIF\KIF LAT EXP PHASE2_FINAL COVER_A.PPW

Tc Equations used...

```
==== SCS TR-55 Sheet Flow ============================================

     Tc = (.007 * ((n * Lf)**0.8)) / ((P**.5) * (Sf**.4))

     Where:  Tc = Time of concentration, hrs
             n  = Mannings n
             Lf = Flow length, ft
             P  = 2yr, 24hr Rain depth, inches
             Sf = Slope, %


==== SCS Channel Flow ================================================

     R  = Aq / Wp
     V  = (1.49 * (R**(2/3)) * (Sf**-0.5)) / n

     Tc = (Lf / V) / (3600sec/hr)

     Where:  R  = Hydraulic radius
             Aq = Flow area, sq.ft.
             Wp = Wetted perimeter, ft
             V  = Velocity, ft/sec
             Sf = Slope, ft/ft
             n  = Mannings n
             Tc = Time of concentration, hrs
             Lf = Flow length, ft
```

File.... C:\Haestad\PPKW\KIF\KIF LAT EXP PHASE2_FINAL COVER_A.PPW

::
TIME OF CONCENTRATION CALCULATOR
::

Segment #1: Tc: TR-55 Sheet

Mannings n	.0600	
Hydraulic Length	100.00	ft
2yr, 24hr P	3.2500	in
Slope	.050000	ft/ft
Avg.Velocity	.51	ft/sec

Segment #1 Time: .0540 hrs

Segment #2: Tc: TR-55 Channel

Flow Area	1.1500	sq.ft
Wetted Perimeter	6.81	ft
Hydraulic Radius	.17	ft
Slope	.005000	ft/ft
Mannings n	.0350	
Hydraulic Length	1100.00	ft
Avg.Velocity	.92	ft/sec

Segment #2 Time: .3322 hrs

Segment #3: Tc: TR-55 Channel

Flow Area	1.1500	sq.ft
Wetted Perimeter	6.81	ft
Hydraulic Radius	.17	ft
Slope	.100000	ft/ft
Mannings n	.0350	
Hydraulic Length	700.00	ft
Avg.Velocity	4.11	ft/sec

Segment #3 Time: .0473 hrs

File.... C:\Haestad\PPKW\KIF\KIF LAT EXP PHASE2_FINAL COVER_A.PPW

Segment #4: Tc: TR-55 Channel

Flow Area	35.3500 sq.ft
Wetted Perimeter	53.00 ft
Hydraulic Radius	.67 ft
Slope	.005000 ft/ft
Mannings n	.0350
Hydraulic Length	3400.00 ft

Avg.Velocity 2.30 ft/sec

Segment #4 Time: .4110 hrs

Total Tc: .8445 hrs

File.... C:\Haestad\PPKW\KIF\KIF LAT EXP PHASE2_FINAL COVER_A.PPW

Tc Equations used...

==== SCS TR-55 Sheet Flow ====

```
Tc = (.007 * ((n * Lf)**0.8)) / ((P**.5) * (Sf**.4))

Where:  Tc = Time of concentration, hrs
        n  = Mannings n
        Lf = Flow length, ft
        P  = 2yr, 24hr Rain depth, inches
        Sf = Slope, %
```

==== SCS Channel Flow ====

```
R  = Aq / Wp
V  = (1.49 * (R**(2/3)) * (Sf**-0.5)) / n

Tc = (Lf / V) / (3600sec/hr)

Where:  R  = Hydraulic radius
        Aq = Flow area, sq.ft.
        Wp = Wetted perimeter, ft
        V  = Velocity, ft/sec
        Sf = Slope, ft/ft
        n  = Mannings n
        Tc = Time of concentration, hrs
        Lf = Flow length, ft
```

File.... C:\Haestad\PPKW\KIF\KIF LAT EXP PHASE2_FINAL COVER_A.PPW

TIME OF CONCENTRATION CALCULATOR

Segment #1: Tc: User Defined

Segment #1 Time: .1980 hrs

Segment #2: Tc: TR-55 Channel

Flow Area	35.3500	sq.ft
Wetted Perimeter	53.00	ft
Hydraulic Radius	.67	ft
Slope	.005000	ft/ft
Mannings n	.0350	
Hydraulic Length	1600.00	ft

Avg.Velocity 2.30 ft/sec

Segment #2 Time: .1934 hrs

Total Tc: .3914 hrs

File.... C:\Haestad\PPKW\KIF\KIF LAT EXP PHASE2_FINAL COVER_A.PPW

```
------------------------------------------------------------------------
Tc Equations used...
------------------------------------------------------------------------


==== User Defined =======================================================

     Tc = Value entered by user

     Where:  Tc = Time of concentration


==== SCS Channel Flow ===================================================

     R  = Aq / Wp
     V  = (1.49 * (R**(2/3)) * (Sf**-0.5)) / n

     Tc = (Lf / V) / (3600sec/hr)

     Where:  R  = Hydraulic radius
             Aq = Flow area, sq.ft.
             Wp = Wetted perimeter, ft
             V  = Velocity, ft/sec
             Sf = Slope, ft/ft
             n  = Mannings n
             Tc = Time of concentration, hrs
             Lf = Flow length, ft
```

File.... C:\Haestad\PPKW\KIF\KIF LAT EXP PHASE2_FINAL COVER_A.PPW

TIME OF CONCENTRATION CALCULATOR

Segment #1: Tc: User Defined

Segment #1 Time: .1980 hrs

Segment #2: Tc: TR-55 Channel

Flow Area	35.3500	sq.ft
Wetted Perimeter	53.00	ft
Hydraulic Radius	.67	ft
Slope	.005000	ft/ft
Mannings n	.0350	
Hydraulic Length	1600.00	ft
Avg.Velocity	2.30	ft/sec

Segment #2 Time: .1934 hrs

Total Tc: .3914 hrs

File.... C:\Haestad\PPKW\KIF\KIF LAT EXP PHASE2_FINAL COVER_A.PPW

```
--------------------------------------------------------------------------
Tc Equations used...
--------------------------------------------------------------------------


==== User Defined ========================================================

     Tc = Value entered by user

     Where:  Tc = Time of concentration


==== SCS Channel Flow ====================================================

     R  = Aq / Wp
     V  = (1.49 * (R**(2/3)) * (Sf**-0.5)) / n

     Tc = (Lf / V) / (3600sec/hr)

     Where:  R  = Hydraulic radius
             Aq = Flow area, sq.ft.
             Wp = Wetted perimeter, ft
             V  = Velocity, ft/sec
             Sf = Slope, ft/ft
             n  = Mannings n
             Tc = Time of concentration, hrs
             Lf = Flow length, ft
```

File.... C:\Haestad\PPKW\KIF\KIF LAT EXP PHASE2_FINAL COVER_A.PPW

::

TIME OF CONCENTRATION CALCULATOR

::

Segment #1: Tc: TR-55 Sheet

Mannings n	.0600	
Hydraulic Length	100.00	ft
2yr, 24hr P	3.2500	in
Slope	.010000	ft/ft
Avg.Velocity	.27	ft/sec

Segment #1 Time: .1027 hrs

Segment #2: Tc: TR-55 Channel

Flow Area	1.1500	sq.ft
Wetted Perimeter	6.81	ft
Hydraulic Radius	.17	ft
Slope	.025000	ft/ft
Mannings n	.0200	
Hydraulic Length	400.00	ft
Avg.Velocity	3.60	ft/sec

Segment #2 Time: .0309 hrs

Segment #3: Tc: TR-55 Channel

Flow Area	1.7500	sq.ft
Wetted Perimeter	5.16	ft
Hydraulic Radius	.34	ft
Slope	.330000	ft/ft
Mannings n	.0350	
Hydraulic Length	800.00	ft
Avg.Velocity	11.89	ft/sec

Segment #3 Time: .0187 hrs

File.... C:\Haestad\PPKW\KIF\KIF LAT EXP PHASE2_FINAL COVER_A.PPW

Segment #4: Tc: TR-55 Channel

Flow Area	1.3300 sq.ft
Wetted Perimeter	4.29 ft
Hydraulic Radius	.31 ft
Slope	.010000 ft/ft
Mannings n	.0350
Hydraulic Length	200.00 ft

Avg.Velocity 1.95 ft/sec

Segment #4 Time: .0285 hrs

Segment #5: Tc: TR-55 Shallow

Hydraulic Length	100.00 ft
Slope	.010000 ft/ft
Unpaved	

Avg.Velocity 1.61 ft/sec

Segment #5 Time: .0172 hrs

Total Tc: .1980 hrs

File.... C:\Haestad\PPKW\KIF\KIF LAT EXP PHASE2_FINAL COVER_A.PPW

Tc Equations used...

==== SCS TR-55 Sheet Flow ====

```
Tc = (.007 * ((n * Lf)**0.8)) / ((P**.5) * (Sf**.4))

Where:  Tc = Time of concentration, hrs
        n  = Mannings n
        Lf = Flow length, ft
        P  = 2yr, 24hr Rain depth, inches
        Sf = Slope, %
```

==== SCS TR-55 Shallow Concentrated Flow ====

```
Unpaved surface:
V  = 16.1345 * (Sf**0.5)

Paved surface:
V  = 20.3282 * (Sf**0.5)

Tc = (Lf / V) / (3600sec/hr)

Where:  V  = Velocity, ft/sec
        Sf = Slope, ft/ft
        Tc = Time of concentration, hrs
        Lf = Flow length, ft
```

File.... C:\Haestad\PPKW\KIF\KIF LAT EXP PHASE2_FINAL COVER_A.PPW

==== SCS Channel Flow ==

```
R  = Aq / Wp
V  = (1.49 * (R**(2/3)) * (Sf**-0.5)) / n

Tc = (Lf / V) / (3600sec/hr)

Where:  R  = Hydraulic radius
        Aq = Flow area, sq.ft.
        Wp = Wetted perimeter, ft
        V  = Velocity, ft/sec
        Sf = Slope, ft/ft
        n  = Mannings n
        Tc = Time of concentration, hrs
        Lf = Flow length, ft
```

File.... C:\Haestad\PPKW\KIF\KIF LAT EXP PHASE2_FINAL COVER_A.PPW

::
TIME OF CONCENTRATION CALCULATOR
::

Segment #1: Tc: TR-55 Sheet

Mannings n	.0600	
Hydraulic Length	100.00	ft
2yr, 24hr P	3.2500	in
Slope	.330000	ft/ft
Avg.Velocity	1.10	ft/sec

Segment #1 Time: .0254 hrs

Segment #2: Tc: TR-55 Channel

Flow Area	1.1500	sq.ft
Wetted Perimeter	6.81	ft
Hydraulic Radius	.17	ft
Slope	.005000	ft/ft
Mannings n	.0350	
Hydraulic Length	300.00	ft
Avg.Velocity	.92	ft/sec

Segment #2 Time: .0906 hrs

Segment #3: Tc: TR-55 Channel

Flow Area	1.7500	sq.ft
Wetted Perimeter	5.16	ft
Hydraulic Radius	.34	ft
Slope	.330000	ft/ft
Mannings n	.0350	
Hydraulic Length	400.00	ft
Avg.Velocity	11.89	ft/sec

Segment #3 Time: .0093 hrs

File.... C:\Haestad\PPKW\KIF\KIF LAT EXP PHASE2_FINAL COVER_A.PPW

Segment #4: Tc: TR-55 Channel

Flow Area	1.3300	sq.ft
Wetted Perimeter	4.29	ft
Hydraulic Radius	.31	ft
Slope	.010000	ft/ft
Mannings n	.0350	
Hydraulic Length	200.00	ft

Avg.Velocity 1.95 ft/sec

Segment #4 Time: .0285 hrs

Total Tc: .1538 hrs

File.... C:\Haestad\PPKW\KIF\KIF LAT EXP PHASE2_FINAL COVER_A.PPW

Tc Equations used...

==== SCS TR-55 Sheet Flow ====

```
Tc = (.007 * ((n * Lf)**0.8)) / ((P**.5) * (Sf**.4))

Where:  Tc = Time of concentration, hrs
        n  = Mannings n
        Lf = Flow length, ft
        P  = 2yr, 24hr Rain depth, inches
        Sf = Slope, %
```

==== SCS Channel Flow ====

```
R  = Aq / Wp
V  = (1.49 * (R**(2/3)) * (Sf**-0.5)) / n

Tc = (Lf / V) / (3600sec/hr)

Where:  R  = Hydraulic radius
        Aq = Flow area, sq.ft.
        Wp = Wetted perimeter, ft
        V  = Velocity, ft/sec
        Sf = Slope, ft/ft
        n  = Mannings n
        Tc = Time of concentration, hrs
        Lf = Flow length, ft
```

File.... C:\Haestad\PPKW\KIF\KIF LAT EXP PHASE2_FINAL COVER_A.PPW

TIME OF CONCENTRATION CALCULATOR

Segment #1: Tc: TR-55 Sheet

Mannings n	.2400
Hydraulic Length	100.00 ft
2yr, 24hr P	3.2500 in
Slope	.330000 ft/ft
Avg.Velocity	.36 ft/sec

Segment #1 Time: .0769 hrs

Segment #2: Tc: TR-55 Channel

Flow Area	1.1500 sq.ft
Wetted Perimeter	6.81 ft
Hydraulic Radius	.17 ft
Slope	.005000 ft/ft
Mannings n	.0350
Hydraulic Length	300.00 ft
Avg.Velocity	.92 ft/sec

Segment #2 Time: .0906 hrs

Segment #3: Tc: TR-55 Channel

Flow Area	1.7500 sq.ft
Wetted Perimeter	5.16 ft
Hydraulic Radius	.34 ft
Slope	.330000 ft/ft
Mannings n	.0350
Hydraulic Length	250.00 ft
Avg.Velocity	11.89 ft/sec

Segment #3 Time: .0058 hrs

Total Tc: .1733 hrs

File.... C:\Haestad\PPKW\KIF\KIF LAT EXP PHASE2_FINAL COVER_A.PPW

Tc Equations used...

==== SCS TR-55 Sheet Flow ====

```
Tc = (.007 * ((n * Lf)**0.8)) / ((P**.5) * (Sf**.4))

Where:  Tc = Time of concentration, hrs
        n  = Mannings n
        Lf = Flow length, ft
        P  = 2yr, 24hr Rain depth, inches
        Sf = Slope, %
```

==== SCS Channel Flow ====

```
R  = Aq / Wp
V  = (1.49 * (R**(2/3)) * (Sf**-0.5)) / n

Tc = (Lf / V) / (3600sec/hr)

Where:  R  = Hydraulic radius
        Aq = Flow area, sq.ft.
        Wp = Wetted perimeter, ft
        V  = Velocity, ft/sec
        Sf = Slope, ft/ft
        n  = Mannings n
        Tc = Time of concentration, hrs
        Lf = Flow length, ft
```

File.... C:\Haestad\PPKW\KIF\KIF LAT EXP PHASE2_FINAL COVER_A.PPW

TIME OF CONCENTRATION CALCULATOR

Segment #1: Tc: TR-55 Sheet

Mannings n	.2400	
Hydraulic Length	100.00	ft
2yr, 24hr P	3.2500	in
Slope	.010000	ft/ft
Avg.Velocity	.09	ft/sec

Segment #1 Time: .3114 hrs

Segment #2: Tc: TR-55 Shallow

Hydraulic Length	100.00	ft
Slope	.010000	ft/ft
Unpaved		
Avg.Velocity	1.61	ft/sec

Segment #2 Time: .0172 hrs

Segment #3: Tc: TR-55 Channel

Flow Area	1.1500	sq.ft
Wetted Perimeter	6.81	ft
Hydraulic Radius	.17	ft
Slope	.005000	ft/ft
Mannings n	.0350	
Hydraulic Length	300.00	ft
Avg.Velocity	.92	ft/sec

Segment #3 Time: .0906 hrs

File.... C:\Haestad\PPKW\KIF\KIF LAT EXP PHASE2_FINAL COVER_A.PPW

Segment #4: Tc: TR-55 Channel

Flow Area	1.7500	sq.ft
Wetted Perimeter	6.81	ft
Hydraulic Radius	.26	ft
Slope	.330000	ft/ft
Mannings n	.0350	
Hydraulic Length	600.00	ft

Avg.Velocity 9.88 ft/sec

Segment #4 Time: .0169 hrs

Total Tc: .4361 hrs

File.... C:\Haestad\PPKW\KIF\KIF LAT EXP PHASE2_FINAL COVER_A.PPW

Tc Equations used...

==== SCS TR-55 Sheet Flow ====

```
Tc = (.007 * ((n * Lf)**0.8)) / ((P**.5) * (Sf**.4))

Where:  Tc = Time of concentration, hrs
        n  = Mannings n
        Lf = Flow length, ft
        P  = 2yr, 24hr Rain depth, inches
        Sf = Slope, %
```

==== SCS TR-55 Shallow Concentrated Flow ====

```
Unpaved surface:
V  = 16.1345 * (Sf**0.5)

Paved surface:
V  = 20.3282 * (Sf**0.5)

Tc = (Lf / V) / (3600sec/hr)

Where:  V  = Velocity, ft/sec
        Sf = Slope, ft/ft
        Tc = Time of concentration, hrs
        Lf = Flow length, ft
```