LETTER OF MAP REVISION REQUEST FOR BUCHANAN WASH
(additional data)

City of Phoenix Project No. PW16610002

TECHNICAL DATA NOTEBOOK

June 2003

Prepared for:

City of Phoenix
200 W. Washington Street
Phoenix, Arizona 85003
(602) 262-4026

Prepared by:

Shaw EMCON/OWT, Inc.
305 South Euclid Avenue, Suite 101
Tucson, Arizona 85719

City of Phoenix
STREET TRANSPORTATION DEPARTMENT

June 5, 2003

Andrea L. Ryon, P.E. Director
Engineering Division
Michael Baker Jr., Inc.
3601 Eisenhower Avenue
Suite 600
Alexandria, Virginia 22304-6425

IN REPLY TO:
Case No.: 02-09-290P
Community: City of Phoenix, AZ
Community No.: 0400541

316-AD

Attention: Sacha TOHME, Civil Associate

Dear Ms. Ryon:

This is a response to your request, dated December 6, 2002, requesting additional data to complete the review of the above-mentioned request to issue a revision to the Flood Insurance Rate Map (FIRM) for Maricopa County, Arizona and Incorporated Areas. Pertinent information about the request is listed below.

Identifier:	LOMR Request for Buchanan Wash
Flooding Source:	Buchanan Wash
FIRM Panel(s) Affected:	04013C1185 G

This response is also followed by a subsequent telephone conference call meeting between the City of Phoenix, the FEMA and Michael Baker Jr., Inc., on Tuesday, March 11, 2003.

The following discussions are responses to your review comments in your letter dated December 6, 2003.

ITEM

1. (a) A new Application/Certification form, entitled "Riverine Structures Form", is included in Exhibit 1of this package.

   (b) We have requested the US Army Corps' of Engineers to provide a certification that the above referenced levee was adequately designed and constructed to provide protection from the flood having a 1-percent chance of being equaled or exceeded in any given year in a letter dated May 20, 2003. Subsequent communication with the US Army Corps' of Engineers indicates that the said letter will be available to us within a few weeks. We will forward the certification letter to you as soon as we receive it. The correspondence with the US Army Corps' of Engineers is included in Exhibit 2.

(c) A geotechnical report is included in Exhibit 3 responding to all requested information in ITEM 1(C), of your letter dated December 6, 2002.

(d) There are no pipes crossing the Buchanan Wash channel embankment improvement and the City of Phoenix Levee. Please see as-built plans for both elements for verification, included in Exhibit 4.

(e) A letter from the Flood Control District, the local sponsor of the USACE levee project and the Operation, Maintenance, Repair, Replacement and Rehabilitation Manual, Phoenix, Arizona and Vicinity (including New River), Maricopa County is included in Exhibit 5. This exhibit also includes a letter, a copy of the City of Phoenix Policy and Procedure for maintenance of Drainage Facilities, and a copy of the Phoenix City Code, Article 1, Chapter 32B, Floodplains.

2. A complete set of Skunk Creek Landfill Operations Plan prepared by EMCON (currently EMCON/OWT), in 1994, is included in Exhibit 6, which responds to ITEM 2(a) of your letter dated December 6, 2002.

3. A new HEC-RAS hydraulic modeling effort was performed for the Buchanan Wash for floods having a 10-, 2-, and 0.2 percent chance of being equaled or exceeded in any given year. This includes a new set of flood profiles and topographic map including revised floodplain/floodway delineations (Exhibit 7). The new profile includes the backwater effect from the Skunk Creek due to the 100-yr. event. However, the profile plots do not show the backwater effects from the 10-, 2-, and 0.2 percent chance floods since the modeling effort to revise the Skunk Creek Floodplain Re-delineation is not complete at this time. A separate Letter of Map Revision (LOMR) for the Skunk Creek is under review by the Federal Emergency Management Agency (FEMA) (Case No. 03-09-0661P).

Should you have further questions in this regard, please do not hesitate to contact Mr. Garth Bowers, PE., Shaw EMCON/OWT, Inc., 305 South Euclid Avenue, Suite 101, Tucson, Arizona 85719-6649, telephone (520) 792-2800. If you have any other questions, please contact this office at (602)-262-4960.

Sincerely,

Hasan Mushtaq, PhD, PE, CFM
Floodplain Manager

HM/aff/buchanan6.doc

Attachments

Cc: Garth Bowers, PE
Shaw EMCON/OWT, Inc.

Tim Murphy, PE, CFM
Flood Control District of Maricopa County

Lynn Murphy
KB Homes

Ken Tarr, PE
RBF Consulting

FEDERAL EMERGENCY MANAGEMENT AGENCY

RIVERINE STRUCTURES FORM

O.M.B. No. 3067-0148
Expires September 30, 2005

PAPERWORK BURDEN DISCLOSURE NOTICE

Public reporting burden for this form is estimated to average 7 hours per response. The burden estimate includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the needed data, and completing, reviewing, and submitting the form. You are not required to respond to this collection of information unless a valid OMB control number appears in the upper right corner of this form. Send comments regarding the accuracy of the burden estimate and any suggestions for reducing this burden to: Information Collections Management, Federal Emergency Management Agency, 500 C Street, SW, Washington, DC 20472, Paperwork Reduction Project (3067-0148). Submission of the form is required to obtain or retain benefits under the National Flood Insurance Program. **Please do not send your completed survey to the above address.**

Flooding Source: Buchanan Wash

Note: Fill out one form for each flooding source studied.

A. GENERAL

Complete the appropriate section(s) for each Structure listed below:

Channelization..... complete Section B
Bridge/Culvert..... complete Section C
Dam..... complete Section D
Levee/Floodwall..... complete Section E
Sediment Transport..... complete Section F (if required)

Description Of Structure

1. **Name of Structure:** City of Phoenix Levee

Type (check one): ☐ Channelization ☐ Bridge/Culvert ☒ Levee/Floodwall ☐ Dam

Location of Structure: East Bank of Buchanan Wash at Skunk Creek Confluence

Downstream Limit/Cross Section: 0.043

Upstream Limit/Cross Section: 0.085

2. **Name of Structure:** _____

Type (check one): ☐ Channelization ☐ Bridge/Culvert ☐ Levee/Floodwall ☐ Dam

Location of Structure: _____

Downstream Limit/Cross Section: _____

Upstream Limit/Cross Section: _____

3. **Name of Structure:** _____

Type (check one): ☐ Channelization ☐ Bridge/Culvert ☐ Levee/Floodwall ☐ Dam

Location of Structure: _____

Downstream Limit/Cross Section: _____

Upstream Limit/Cross Section: _____

Note: For more structures, attach additional pages as needed.

B. CHANNELIZATION

Flooding Source: _____

Name of Structure: _____

1. Accessory Structures

The channelization includes (check one):

- ❑ Levees (Attach Levee/Floodwall System Analysis Form - Section E)
- ❑ Superelevated sections
- ❑ Debris basin/detention basin
- ❑ Other (Describe):
- ❑ Drop structures
- ❑ Transitions in cross sectional geometry
- ❑ Energy dissipator

2. Drawing Checklist

Attach the plans of the channelization certified by a registered professional engineer, as described in the instructions.

3. Hydraulic Considerations

The channel was designed to carry ____ (cfs) and/or the _____ -year flood.

The design elevation in the channel is based on (check one):

❑ Subcritical flow ❑ Critical flow ❑ Supercritical flow ❑ Energy grade line

If there is the potential for a hydraulic jump at the following locations, check all that apply and attach an explanation of how the hydraulic jump is controlled without affecting the stability of the channel.

❑ Inlet to channel ❑ Outlet of channel ❑ At Drop Structures ❑ At Transitions
❑ Other locations (specify): _____

4. Sediment Transport Considerations

Was sediment transport considered? ❑ Yes ❑ No If Yes, then fill out Section F (Sediment Transport).
If No, then attach your explanation for why sediment transport was not considered.

C. BRIDGE/CULVERT

Flooding Source: _____

Name of structure: _____

1. This revision reflects (check one):

- ❑ New bridge/culvert not modeled in the FIS
- ❑ Modified bridge/culvert previously modeled in the FIS
- ❑ New analysis of bridge/culvert previously modeled in the FIS

2. Hydraulic model used to analyze the structure (e.g., HEC-2 with special bridge routine, WSPRO, HY8): _____
If different than hydraulic analysis for the flooding source, justify why the hydraulic analysis used for the flooding source could not analyze the structures. Attach justification.

3. Attach plans of the structures certified by a registered professional engineer. The plan detail and information should include the following (check the information that has been provided):

- ❑ Dimensions (height, width, span, radius, length)
- ❑ Shape (culverts only)
- ❑ Material
- ❑ Beveling or Rounding
- ❑ Wing Wall Angle
- ❑ Skew Angle
- ❑ Distances Between Cross Sections
- ❑ Erosion Protection
- ❑ Low Chord Elevations - Upstream and Downstream
- ❑ Top of Road Elevations - Upstream and Downstream
- ❑ Structure Invert Elevations - Upstream and Downstream
- ❑ Stream Invert Elevations - Upstream and Downstream
- ❑ Cross-Section Locations

4. Sediment Transport Considerations

Was sediment transport considered? ❑ Yes ❑ No If Yes, then fill out Section F (Sediment Transport).
If No, then attach your explanation for why transport was not considered.

D. DAM

Flooding Source: _____

Name of Structure: _____

1. This request is for (check one): ❑ Existing dam ❑ New dam ❑ Modification of existing dam

2. The dam was designed by (check one): ❑ Federal agency ❑ State agency ❑ Local government agency

   ❑ Private organization Name of the agency or organization: _____

3. Does the project involve revised hydrology? ❑ Yes ❑ No

   If Yes, complete the Riverine Hydrology & Hydraulics Form (Form 2)

4. Does the submittal include debris/sediment yield analysis? ❑ Yes ❑ No

   If Yes,then fill out Section F (Sediment Transport).
   If No, then attach your explanation for why debris/sediment analysis was not considered.

5. Does the Base Flood Elevation behind the dam or downstream of the dam change?

   ❑ Yes ❑ No If Yes, complete the Riverine Hydrology & Hydraulics Form (Form 2) and complete the table below.

Stillwater Elevation Behind the Dam

FREQUENCY (% annual chance)	FIS	REVISED
10-year (10%)	_____	_____
50-year (2%)	_____	_____
100-year (1%)	_____	_____
500-year (0.2%)	_____	_____
Normal Pool Elevation	_____	_____

Please attach a copy of the formal Operation and Maintenance Plan.

E. LEVEE/FLOODWALL

1. System Elements

a. This Levee/Floodwall analysis is based on (check one):

- ☐ upgrading of an existing levee/floodwall system
- ☐ a newly constructed levee/floodwall system
- ☒ reanalysis of an existing levee/floodwall system

b. Levee elements and locations are (check one):

☐ earthen embankment, dike, berm, etc.	Station _____ to _____
☐ structural floodwall	Station _____ to _____
☒ Other (describe): 8'-Soil-Cement Lined Embankment	Station 0.043 to 0.085

c. Structural Type (check one):

- ☐ monolithic cast-in place reinforced concrete
- ☐ reinforced concrete masonry block
- ☐ sheet piling
- ☐ Other (describe):

d. Has this levee/floodwall system been certified by a Federal agency to provide protection from the base flood?

☐ Yes ☒ No

If Yes, by which agency? _____

e. Attach certified drawings containing the following information (indicate drawing sheet numbers): (see Exhibit 4)

1. Plan of the levee embankment and floodwall structures — Sheet Numbers: 10
2. A profile of the levee/floodwall system showing the Base Flood Elevation (BFE), levee and/or wall crest and foundation, and closure locations for the total levee system. — Sheet Numbers: 10
3. A profile of the BFE, closure opening outlet and inlet invert elevations, type and size of opening, and kind of closure — Sheet Numbers: N/A
4. A layout detail for the embankment protection measures. — Sheet Numbers: 2, 10
5. Location, layout, and size and shape of the levee embankment features, foundation treatment, floodwall structure, closure structures, and pump stations. — Sheet Numbers: 2,10

2. Freeboard

a. The minimum freeboard provided the BFE is:

Riverine

3.0 feet or more at the downstream end and throughout	☒ Yes	☐ No
3.5 feet or more at the upstream end	☒ Yes	☐ No
4.0 feet within 100 feet upstream of all structures and/or constrictions	☐ Yes	☐ No X Not Applicable

Coastal

1.0 foot above the height of the one percent wave associated with the 1%-annual-chance stillwater surge elevation or maximum wave runup (whichever is greater)	☐ Yes	☐ No
2.0 feet above the 1%-annual-chance stillwater surge elevation	☐ Yes	☐ No

2. Freeboard (continued)

Please note, occasionally exceptions are made to the minimum freeboard requirement. If an exception is requested, attach documentation addressing Paragraph 65.10(b)(1)(ii) of the NFIP regulations.

If No is answered to any of the above, please attach an explanation.

b. Is there an indication from historical records that ice-jamming can affect the BFE? ☐ Yes ☒ No

If Yes, provide ice-jam analysis profile and evidence that the minimum freeboard discussed above still exists.

3. Closures

a. Opening through the levee system (check one): ☐ exists ☒ does not exist

If opening exists, list all closures:

Channel Station	Left or Right Bank	Opening Type	Highest Elevation for Opening Invert	Type of Closure Device

(Extend table on an added sheet as needed and reference)

Note: Geotechnical and geologic data

In addition to the required detailed analysis reports, data obtained during field and laboratory investigations and used in the design analysis for the following system features should be submitted in a tabulated summary form. (Reference U.S. Army Corps of Engineers [USACE] EM-1110-2-1906 Form 2086.)

Embankment Protection

a. The maximum levee slope landside is: 2:1

b. The maximum levee slope floodside is: 2:1

c. The range of velocities along the levee during the base flood is: 0.8 ft/s (min.) to 7.1 ft/s (max.)

d. Embankment material is protected by (describe what kind): 8-foot thick soil-cement

e. Riprap Design Parameters (check one): ☐ Velocity ☐ Tractive stress
Attach references

Reach	Sideslope	Flow Depth	Velocity	Curve or Straight	Stone Riprap			Depth of Toedown
					D_{100}	D_{50}	Thickness	
Sta ____ to ____								
Sta ____ to ____								
Sta ____ to ____								
Sta ____ to ____								
Sta ____ to ____								
Sta ____ to ____								

(Extend table on an added sheet as needed and reference each entry)

4. Embankment Protection (continued)

f. Is a bedding/filter analysis and design attached? ☐ Yes ☒ No

g. Describe the analysis used for other kinds of protection used (include copies of the design analysis):

Attach engineering analysis to support construction plans.

5. Embankment and Foundation Stability

a. Identify locations and describe the basis for selection of critical location for analysis:
See Technical Memorandum in Exhibit 3

☐ Overall height: Sta. _____ , height _____ ft.

☐ Limiting foundation soil strength:

Sta. _____ , depth _____ to

strength ϕ = _____ degrees, c = _____ psf

slope: SS = _____ (h) to _____ (v)

(Repeat as needed on an added sheet for additional locations)

b. Specify the embankment stability analysis methodology used (e.g., circular arc, sliding block, infinite slope, etc.):

Circular arc and sliding block

c. Summary of stability analysis results:

See Technical Memorandum in Exhibit 3

Case	Loading Conditions	Critical Safety Factor	Critical (Min.)
I	End of construction	Not Applicable	1.3
II	Sudden drawdown	See Technical Memorandum in Exhibit 3	1.0
III	Critical flood stage	See Technical Memorandum in Exhibit 3	1.4
IV	Steady seepage at flood stage	Not Applicable	1.4
VI	Earthquake (Case I)	Not Applicable	1.0

(Reference: USACE EM-1110-2-1913 Table 6-1)

d. Was a seepage analysis for the embankment performed? ☒ Yes ☐ No

If Yes, describe methodology used: See Technical Memorandum in Exhibit 3

e. Was a seepage analysis for the foundation performed? ☐ Yes ☐ No X Not Applicable

f. Were uplift pressures at the embankment landside toe checked? ☐ Yes ☒ No

g. Were seepage exit gradients checked for piping potential? ☐ Yes ☒ No

h. The duration of the base flood hydrograph against the embankment is 4 hours.

Attach engineering analysis to support construction plans.

6. Floodwall and Foundation Stability (NOT APPLICABLE)

a. Describe analysis submittal based on Code (check one):

☐ UBC (1988) or ☐ Other (specify): _____

b. Stability analysis submitted provides for:

☐ Overturning ☐ Sliding If not, explain: _____

c. Loading included in the analyses were:

☐ Lateral earth @ P_A = _____ psf; P_p = _____ psf

☐ Surchage-Slope @ _____ , ☐ surface _____ psf

☐ Wind @ P_w = _____ psf

☐ Seepage (Uplift); _____ ☐ Earthquake @ P_{eq} = _____ %g

☐ 1%-annual-chance significant wave heightft. _____

☐ 1%-annual-chance significant wave period: _____ sec.

d. Summary of Stability Analysis Results: Factors of Safety.

Itemize for each range in site lay out dimension and loading condition limitation for each respective reach.

Loading Condition	Criteria (Min)		Sta	To	Sta	To
	Overturn	Sliding	Overturn	Sliding	Overturn	Sliding
Dead & Wind	1.5	1.5				
Dead & Soil	1.5	1.5				
Dead, Soil, Flood, & Impact	1.5	1.5				
Dead, Soil, & Seismic	1.3	1.3				

(Ref: FEMA 114 Sept 1986; USACE EM 1110-2-2502)

(Note: Extend table on an added sheet as needed and reference)

e. Foundation bearing strength for each soil type:

Bearing Pressure	Sustained Load (psf)	Short Term Load (psf)
Computed design maximum		
Maximum allowable		

f. Foundation scour protection ☐ is, ☐ is not provided. If provided, attach explanation and supporting documentation.

Attach engineering analysis to support construction plans.

7. Settlement

a. Has anticipated potential settlement been determined and incorporated into the specific construction elevations to maintain the established freeboard margin? ☒ Yes ☐ No See Technical Memorandum in Exhibit 3

b. The computed range of settlement is _____ ft. to _____ ft.

c. Settlement of the levee crest is determined to be primarily from:

☐ Foundation consolidation
☐ Embankment compression
☐ Other (Describe):

d. Differential settlement of floodwalls ☐ has ☐ has not been accommodated in the structural design and construction.

Attach engineering analysis to support construction plans.

8. Interior Drainage (NOT APPLICABLE)

a. Specify size of each interior watershed:

Draining to pressure conduit: _____ acres
Draining to ponding area: _____ acres

b. Relationships Established

Ponding elevation vs. storage	☐ Yes	☐ No
Ponding elevation vs. gravity flow	☐ Yes	☐ No
Differential head vs. gravity flow	☐ Yes	☐ No

c. The river flow duration curve is enclosed: ☐ Yes ☐ No

d. Specify the discharge capacity of the head pressure conduit: _____ cfs

e. Which flooding conditions were analyzed?

Gravity flow (Interior Watershed)	☐ Yes	☐ No
• Common storm (River Watershed)	☐ Yes	☐ No
• Historical ponding probability	☐ Yes	☐ No
• Coastal wave overtopping	☐ Yes	☐ No

•

If No for any of the above, attach explanation.

f. Interior drainage has been analyzed based on joint probability of interior and exterior flooding and the capacities of pumping and outlet facilities to provide the established level of flood protection. ☐ Yes ☐ No

If No, attach explanation.

g. The rate of seepage through the levee system for the base flood is _____ cfs.

h. The length of levee system used to drive this seepage rate in item g: _____ ft.

8. Interior Drainage (continued)

i. Will pumping plants be used for interior drainage? ☐ Yes ☒ No

If Yes, include the number of pumping plants:
For each pumping plant, list:

	Plant #1	Plant #2
The number of pumps		
The ponding storage capacity		
The maximum pumping rate		
The maximum pumping head		
The pumping starting elevation		
The pumping stopping elevation		
Is the discharge facility protected?		
Is there a flood warning plan?		
How much time is available between warning and flooding?		

Will the operation be automatic? ☐ Yes ☐ No

If the pumps are electronic, are there backup power sources? ☐ Yes ☐ No

(Reference: USACE EM-1110-2-3101, 3102, 3103, 3104, and 3105)

ude a copy of supporting documentation of data and analysis. Provide a map showing the flooded area and maximum ponding elevations for all interior watersheds that result in flooding.

9. Other Design Criteria (NOT APPLICABLE)

a. The following items have been addressed as stated:

Liquefaction ☐ is ☐ is not a problem
Hydrocompaction ☐ is ☐ is not a problem
Heave differential movement due to soils of high shrink/swell ☐ is ☐ is not a problem

b. For each of these problems, state the basic facts and corrective action taken:

Attach supporting documentation.

c. If the levee/floodwall is new or enlarged, will the structure adversely impact flood levels and/or flow velocities floodside of the structure? ☐ Yes ☐ No

Attach supporting documentation.

d. Sediment Transport Considerations:

Was sediment transport considered? ☐ Yes ☐ No If Yes, then fill out Section F (Sediment Transport).
If No, then attach your explanation for why sediment transport was not considered.

E. LEVEE/FLOODWALL (CONTINUED)

10. Operational Plan and Criteria

a. Are the planned/installed works in full compliance with Part 65.10 of the NFIP regulations? ☒ Yes ☐ No

b. Does the operation plan incorporate all the provisions for closure devices as required in Paragraph 65.10(c)(1) of the NFIP regulations? ☐ Yes ☐ No (Not Applicable)

c. Does the operation plan incorporate all the provisions for interior drainage as required in Paragraph 65.10(c)(2) of the NFIP regulations? ☐ Yes ☐ No (Not Applicable)

If the answer is No to any of the above, please attach supporting documentation.

11. Maintenance Plan

a. Are the planned/installed works in full compliance with Part 65.10 of the NFIP regulations? ☒ Yes ☐ No
If No, please attach supporting documentation.

12. Operations and Maintenance Plan

Please attach a copy of the formal Operations and Maintenance Plan for the levee/floodwall.

F. SEDIMENT TRANSPORT

Flooding Source: _____

Name of Structure: _____

If there is any indication from historical records that sediment transport (including scour and deposition) can affect the Base Flood Elevation (BFE); and/or based on the stream morphology, vegetative cover, development of the watershed and bank conditions, there is a potential for debris and sediment transport (including scour and deposition) to affect the BFEs, then provide the following information along with the supporting documentation:

Sediment load associated with the base flood discharge: Volume _____ acre-feet

Debris load associated with the base flood discharge: Volume _____ acre-feet

Sediment transport rate _____ (percent concentration by volume)

Method used to estimate sediment transport: _____

Most sediment transport formulas are intended for a range of hydraulic conditions and sediment sizes; attach a detailed explanation for using the selected method.

Method used to estimate scour and/or deposition: _____

Method used to revise hydraulic or hydrologic analysis (model) to account for sediment transport:
Please note that bulked flows are used to evaluate the performance of a structure during the base flood; however, FEMA does not map BFEs based on bulked flows.

_____

If a sediment analysis has not been performed, an explanation as to why sediment transport (including scour and deposition) will not affect the BFEs or structures must be provided.

City of Phoenix
STREET TRANSPORTATION DEPARTMENT

May 20, 2003

U. S. Army Corps of Engineers
P. O. Box 2711
Los Angeles, California 90053

Attention: Ted Masigat

Re: **Request Certification Letter for Skunk Creek Levee at Interstate 17 (I-17), Phoenix, Arizona**

Dear Mr. Masigat:

As part of the Floodplain Management Program, the City of Phoenix has made an application to revise the floodplain/floodway delineation for both Skunk Creek and the Buchanan Wash in the vicinity of the Skunk Creek Levee and Interstate 17 (I-17), to the Federal Emergency Management Agency (FEMA).

One of the review comments from Michael Baker, Jr., Inc., FEMA's contract review consultant, requests a letter from the US Army Corps of Engineers, certifying that the above referenced levee was adequately designed and constructed to provide protection from the flood having a 1-percent chance of being equaled or exceeded in any given year to satisfy Paragraph 65.10(e) of the NFIP regulations. The request for the certification is stated in ITEM 1(b) of the attached letter from FEMA, dated December 6, 2002.

As we are preparing to complete a response back to FEMA on or before June 6, 2003, we would like to seek your assistance in providing us with the requested certification letter for the Skunk Creek Levee at Interstate 17.

Should you have further questions in this regard, please do not hesitate to contact this office at (602)-262-4960.

Sincerely,

Hasan Mushtaq, PhD, PE, CFM
Floodplain Manager

HM/aff/usace.doc.

Attachment

Cc: Tim Murphy, PE, CFM
Flood Control District of Maricopa County

200 West Washington Street, Fifth Floor, Phoenix, Arizona 85003 1611 602-262-6284 FAX: 602-495-2016
Recycled Paper

305 S. Euclid Avenue, Suite 101
Tucson, Arizona 85719-6649
Phone: (520) 792-2800

Shaw™ EMCON/OWT, Inc.

Memorandum

Date: June 3, 2003

To: File 810424

CC:

From: Amy Bonaparte, EIT
Garth Bowers, P.E.

Registered Professional Engineer (Civil) CERTIFICATE NO. 27290 GARTH R. BOWERS Date Signed 6/3/03 ARIZONA U.S.A.

RE: Buchanan Wash LOMR Levee Stability Analyses
Response to FEMA Comment 1c

The following information is provided as a response to Comment 1c of a letter provided by the Federal Emergency Management Agency (FEMA) on December 6, 2002 (Case 02-09-290P), as follows:

"Please provide a slope stability, seepage, and settlement analysis for base flood conditions to demonstrate that seepage into or through the Buchanan Wash channel embankment improvement and the City of Phoenix levee foundations and embankments will not jeopardize embankment or foundation stability, in accordance with Paragraph 65.10(h)(4) of the NFIP regulations. Please note that the USACE manual EM 1110-2-1913 may be used as guidance for this analysis."

Based on the results of discussions at our March 11, 2003 conference call, these analyses were performed on the approximately 700 foot long training berm structure immediately downstream of the USACE levee on the west bank of Skunk Creek. This structure acts as a levee in a 100-year flow event on Buchanan Wash (although the low areas on the "land side" of this levee condition are within the existing Skunk Creek channel and floodplain). It would also function as a levee during a 100-year flow event on Skunk Creek (although the "land side" of this levee condition contains backwater from Skunk Creek at the Buchanan Wash confluence, there is a difference in water surface elevations on opposite sides of the structure, with a maximum water surface elevation differential at the north end of the structure).

Slope Stability:
A slope stability analysis was performed for two scenarios: 1) the water surface in Buchanan Wash is at the 100-year water surface elevation and there is no flow in Skunk Creek, and 2) the water surface in Skunk Creek is at the 100-year water surface elevation and there is backwater behind the levee in the Buchanan Wash confluence area. For both scenarios, three feet were added to the actual 100-year water surface elevations to represent the water surface at the required levee freeboard elevation.

Shaw™ EMCON/OWT, Inc.

305 S. Euclid Avenue, Suite 101
Tucson, Arizona 85719-6649
Phone: (520) 792-2800

PCSTABL5 was used to model the two scenarios mentioned above. Soil properties entered into the models are as follows:

Total unit weight = 140.5 pounds per cubic foot (pcf)
Saturated unit weight = 150.8 pcf
Cohesion intercept = 4120 pounds per square foot (psf)
Friction angle = 35.1 degrees

These soil properties were based on triaxial shear test data from soils sampled near the levee location, as documented in the geotechnical data for the Skunk Creek Landfill Operating Plan (EMCON, 1994) (see attachments). It is assumed that soils used to construct the levee and levee foundation soils have similar geotechnical properties. Although the Skunk Creek side of the levee and the end of the levee at the channel are lined with an 8-foot thick soil-cement lining, the strength properties of this soil cement were ignored to provide conservative results.

In the first scenario, a cross-section of the levee along Skunk Creek near the confluence of Buchanan Wash was modeled. Scenario 1 was modeled for two conditions, the first with the water surface in Buchanan Wash at 1453 feet, and the second was a rapid drawdown situation. Circular and block failures were evaluated on both the Buchanan Wash slope and the Skunk Creek slope.

Several conservative assumptions were made for the analysis. In addition to ignoring the strength properties of soil cement, the properties of the soil were entered as saturated, even though there is insufficient time during the period of the hydrograph during the base flood to fully saturate the levee structure. In addition, water surfaces were modeled at the required freeboard elevation, even though the hydraulic model predicts water surface elevations three feet lower. Although these conservative assumptions were made, the lowest factor of safety modeled was 14.61 (see attachments). Upon evaluation of these results, it was determined that one of the primary reasons for these high factors of safety was the relatively high cohesion exhibited by the tested soils. As a sensitivity analysis of these results, the cohesion value for the model run exhibiting the lowest factor of safety (Run 1E) was reduced to 500 psf. Even with this reduction, the factor of safety (4.8) exceeds the minimum factor of safety recommended in USACE Engineering Manual EM 1110-2-1913.

In the second scenario, a cross-section of the levee along Skunk Creek near cross-section 11.19 was modeled. This cross-section was modeled for two conditions, the first with the water surface in Skunk Creek at 1463 feet and the water surface in the backwater area behind the levee at 1459 feet. The second condition was modeled as a rapid drawdown situation. Circular and block failures were evaluated on both the Skunk Creek slope and the Buchanan Wash slope.

Similar to Scenario 1, conservative assumptions were made in the model. The strength properties of soil cement were ignored, the properties of the soil were entered as saturated, even though there is insufficient time during the period of the hydrograph during the base flood to fully saturate the levee structure. In addition, water surfaces were modeled at the

305 S. Euclid Avenue, Suite 101
Tucson, Arizona 85719-6649
Phone: (520) 792-2800

required freeboard elevation, even though the hydraulic model predicts water surface elevations three feet lower. Despite these conservative assumptions, the lowest factor of safety calculated was 24.03. Similar to Scenario 1, as a sensitivity analysis of these results, the cohesion value for the model run exhibiting the lowest factor of safety (Run 2E) was reduced to 500 psf. Even with this reduction, the factor of safety (6.2) exceeds the minimum factor of safety recommended in USACE Engineering Manual EM 1110-2-1913.

The modeled results exceed the factor of safety requirements listed in USACE Manual EM 1110-2-1913. The probability of an earthquake occurring simultaneously with a 100-year flow event is low. If a levee failure were to occur during a flow event on Buchanan Wash, resulting flooding on the other side of the levee would be contained in the Skunk Creek channel, which within a regulatory floodplain. If a levee failure were to occur during a flow event on Skunk Creek, a rapid expansion would occur and flooding would be primarily within the existing backwater area behind the levee. Therefore, the levee is considered a minor structure with respect to the guidance for seismic analyses under USACE Manual EM 1110-2-1913. In addition, the factors of safety for slope stability under a static analysis are very high. Therefore, no seismic analysis was performed for this levee. In addition, because of the low height and minor nature of the levee, no analysis of failure on an infinite slope length was performed.

Seepage:
As previously discussed with FEMA, a seepage analysis has already been performed and is documented in the Harza Engineering report entitled "Skunk Creek Channel – Hydraulic Analysis of Proposed Channel Improvement (July 1986) which was submitted to FEMA in the City of Phoenix's September 19, 2002 response letter. Relevant pages of this report are attached to this memorandum. Due to the short duration of the hydrograph on Skunk Creek (see attachments), there is insufficient time for the saturation front to progress through the levee section and create steady-state seepage forces. The hydrograph on Buchanan Wash is similar in duration (approximately 4 hours), although the duration of the portion of the hydrograph with sufficient flow rate to maintain the water surface elevation significantly above the toe of the levee is significantly shorter.

Settlement:
The levee in question was constructed more than a decade ago, and therefore post-construction settlement due to drainage of construction water and primary settlement has already occurred. In order to evaluate the long-term settlement potential, recent surveyed elevations of the top of the levee were compared with design elevations. No significant elevation changes were noted. In addition, the levee freeboard ranges from 4.5 feet to more than 8 feet above the modeled 100-year water surface elevation for Skunk Creek and even more above the modeled 100-year water surface elevation for Buchanan Wash, which significantly exceeds required freeboard minima. Therefore, no significant long-term settlement that would reduce freeboard below required minimums is anticipated.

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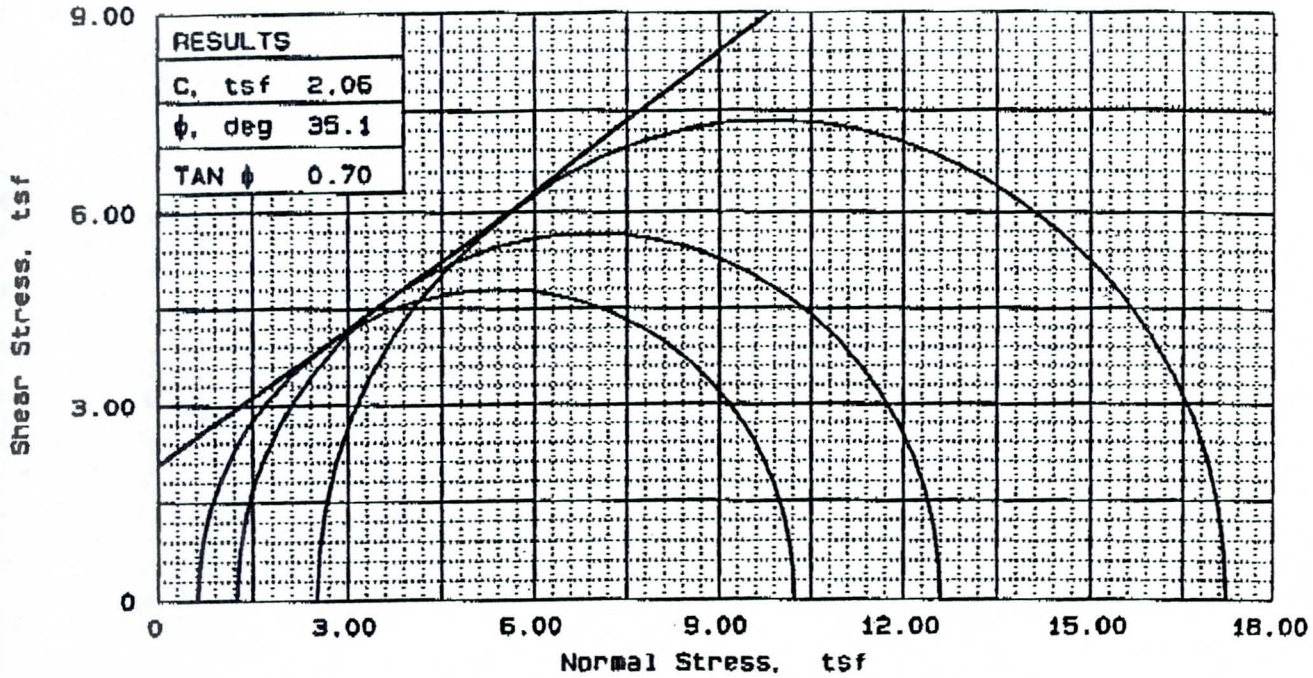
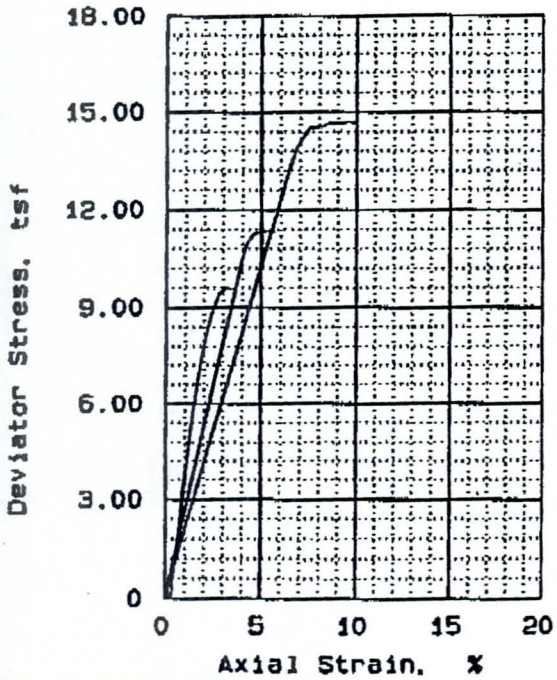
Attachments: Triaxial shear test data (from EMCON, 1994)
Stability analysis calculations
Conceptual diagrams of stability analysis scenarios
Stability analysis output files
Excerpted pages from Harza (1986)
Skunk Creek 100-year flow hydrograph (Tetra-Tech, 2003)

TRIAXIAL SHEAR TEST DATA





SAMPLE NO.		1	2	3
INITIAL	WATER CONTENT, %	5.4	5.4	5.4
	DRY DENSITY, pcf	131.3	131.3	131.3
	SATURATION, %	47.6	47.6	47.6
	VOID RATIO	0.312	0.312	0.312
	DIAMETER, in	2.80	2.80	2.80
	HEIGHT, in	5.60	5.60	5.60
AT TEST	WATER CONTENT, %	5.4	5.4	5.4
	DRY DENSITY, pcf	131.3	131.3	131.3
	SATURATION, %	47.6	47.6	47.6
	VOID RATIO	0.312	0.312	0.312
	DIAMETER, in	2.80	2.80	2.80
	HEIGHT, in	5.60	5.60	5.60
Time to failure, min				
BACK PRESSURE, tsf		0.00	0.00	0.00
CELL PRESSURE, tsf		0.63	1.25	2.51
FAILURE STRESS, tsf		9.60	11.35	14.70
PORE PRESSURE, tsf				
ULTIMATE STRESS, tsf				
PORE PRESSURE, tsf				
σ_1 FAILURE, tsf		10.23	12.60	17.21
σ_3 FAILURE, tsf		0.63	1.25	2.51

TYPE OF TEST:
Unconsolidated undrained
SAMPLE TYPE: Modified Proctor
DESCRIPTION: Brown to drk brown Clayey Sand w/gravel
LL= 34 PL= 17 PI= 17.0
SPECIFIC GRAVITY= 2.76
REMARKS: +3/4" gravel replaced with +#4 to -3/4" gravel. Atterberg Limits performed on -#40 material.
FIG. NO.

CLIENT: Skunk Creek LF - Phoenix, Arizona

PROJECT:

SAMPLE LOCATION: Remold from Proctor SC-2

PROJ. NO.: 1052002002 DATE: July 21, 1993

TRIAXIAL SHEAR TEST REPORT

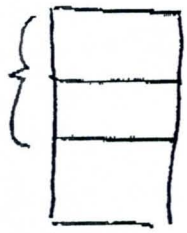
EMCON Baker-Shiflett, Inc.

STABILITY ANALYSIS CALCULATIONS

No. 5505 Engineer's Computation Pad

Volume

$0.312 = V_v$



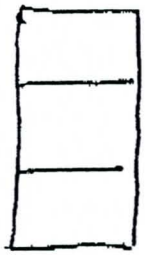
V_A

$V_W = 0.1485\ ft^3$

$V_S = 0.688\ ft^3$

$V_T = 1\ ft^3$

Weight



$W_A = 0$

$W_W = 9.27\ lbs$

$W_S = 131.3\ lbs$

$W_T = 140.57\ lbs$

$\frac{V_v}{V_T} = \text{Void Ratio} = 0.312$

$V_v = V_T(0.312)$

$= 0.312\ cu\ ft$

$\text{sat\%} = 0.476 = \frac{V_W}{V_V}$

$0.476(0.312\ ft^3) = V_W$

$0.1485\ ft^3 = V_W$

$62.4\ lb/ft^3(0.1485) = W_W$

$= 9.27\ lbs$

moist unit weight (sat% = 0.476)

$\text{sat\%} = .476 = \frac{V_W}{V_V}$

$\frac{V_V}{V_T} = .312$

$V_V = (.312)(1)$

$V_V = .312\ ft^3$

$V_W = .476 V_V$

$V_W = (.476)(.312)$

$V_W = .1485\ ft^3$

$w = 5.4 = \frac{M_W}{M_S}$

$M_W = (62.4)(.1485)$

$M_W = 9.27\ lb$

moist unit wt = 9.27 + 131.3

= 140.57 lb

<u>sat unit wt</u>

$\text{sat\%} = 1 = \frac{V_W}{V_V}$

$\frac{V_V}{V_T} = .312$

$V_V = .312\ ft^3$

$V_W = 1 V_V$

$V_W = .312\ ft^3$

$M_W = (.312)(62.4)$

$M_W = 19.469\ lb$

$M_T = 19.469 + 131.3 = 150.8\ lb$

moist unit wt = 140.51 lb/ft³

sat unit wt = 150.8 lb/ft³

CONCEPTUAL DIAGRAMS OF STABILITY ANALYSIS SCENARIOS

COMPUTATION SHEET

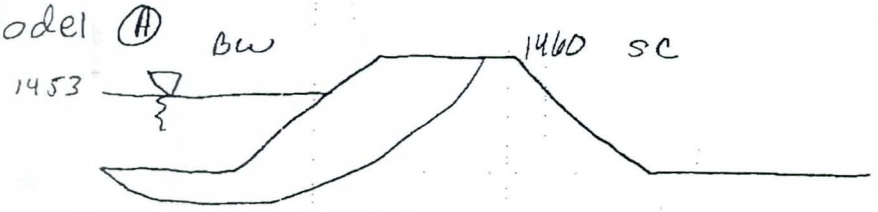
PROJECT TITLE: Skunk Creek Stability Analysis PROJECT NO: 810424
DESCRIPTION: SHEET 1 OF 4
PREP. BY: ACB DATE: 5/7/03 CHKD. BY: DATE:

Alternative I

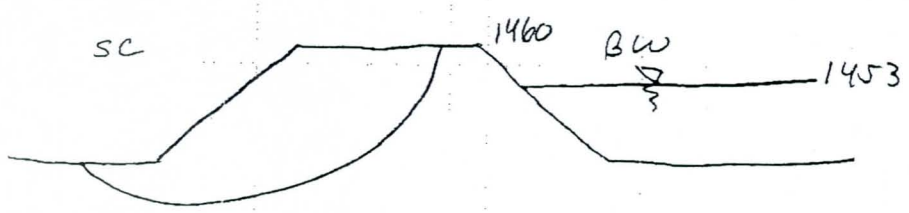
Buchanan Wash @ 100-yr floodplain + 3' freeboard
and
Skunk Creek dry

actual water surface in BW = 1450
model w/ water surface = 1453

model (A)

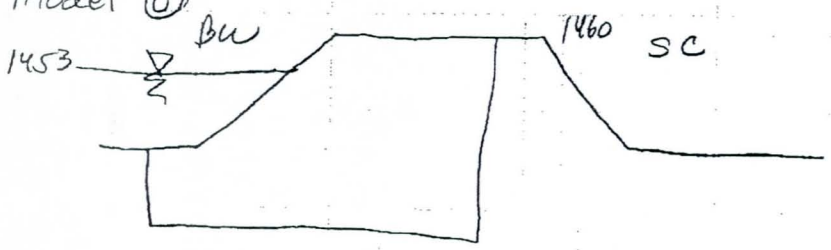


model (B)

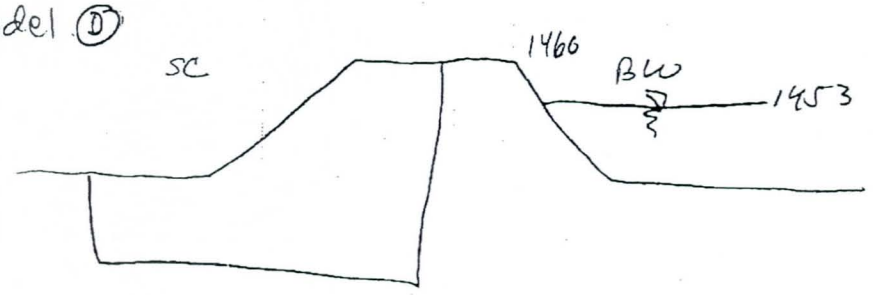


circular failure

model (C)



model (D)



block failure

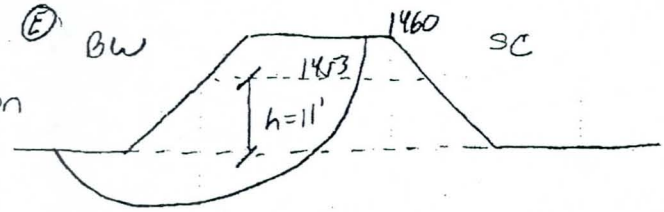
COMPUTATION SHEET

PROJECT TITLE: Skunk Creek Stability Analysis PROJECT NO: 810424

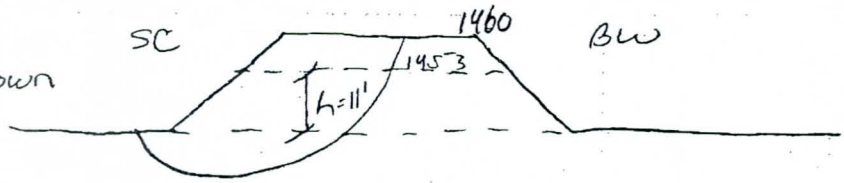
DESCRIPTION: SHEET 2 OF 4

PREP. BY: ACB DATE: 5/7/03 CHKD. BY: DATE:

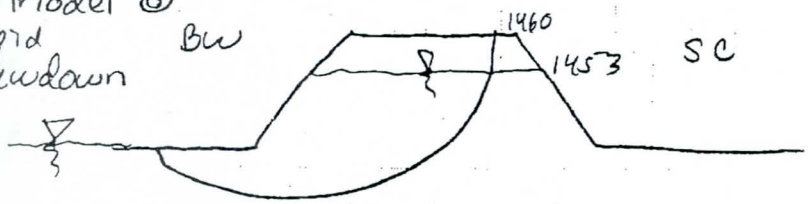
model (E)
rapid drawdown



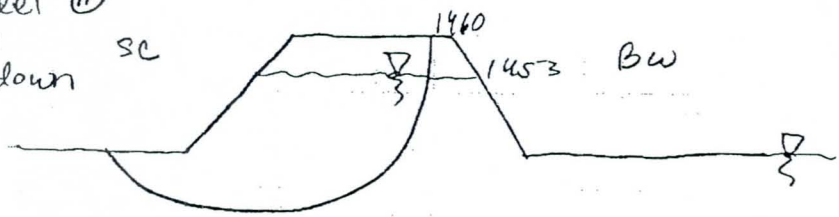
model (F)
rapid drawdown



model (G)
rapid drawdown



model (H)
rapid drawdown



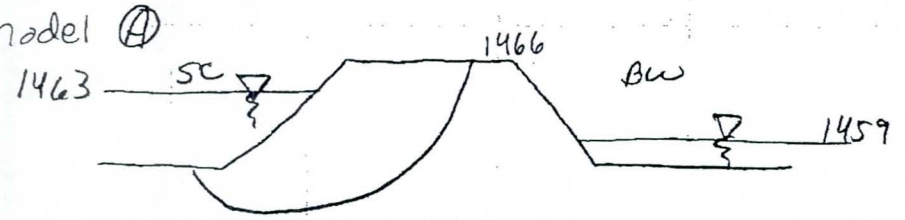
COMPUTATION SHEET

PROJECT TITLE: Skunk Creek Stability Analysis PROJECT NO: 810424
DESCRIPTION: SHEET 3 OF 4
PREP. BY: AEB DATE: 5/7/03 CHKD. BY: DATE:

Alternative II

Skunk Creek @ 100-yr water surface + 3' freeboard
and
Backwater in Buchanan Wash @ 1456 + 3' freeboard
model Skunk Creek @ 1463 (actual water surf = 1460)

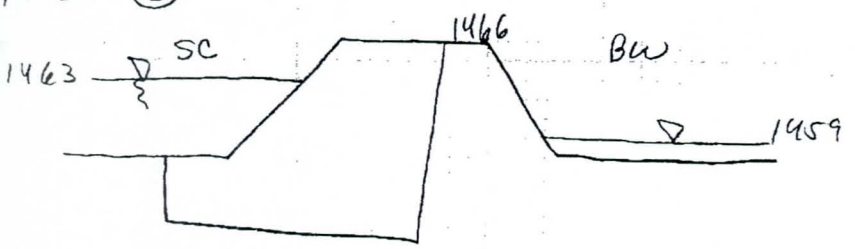
model (A)



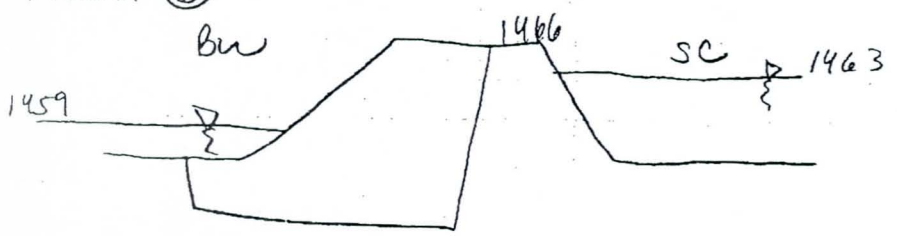
model (B)

circular failure

model (C)



model (D)



Block failure

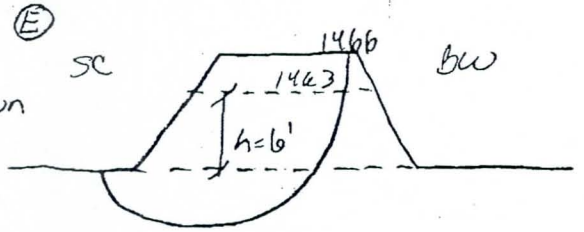
COMPUTATION SHEET

PROJECT TITLE: Skunk Creek Stability Analysis PROJECT NO: 810424

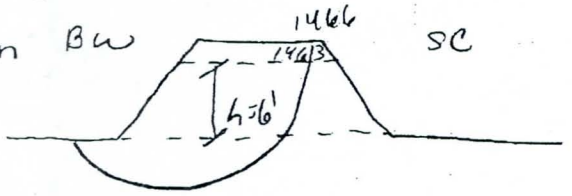
DESCRIPTION: SHEET 4 OF 4

PREP. BY: ACB DATE: 5/7/03 CHKD. BY: DATE:

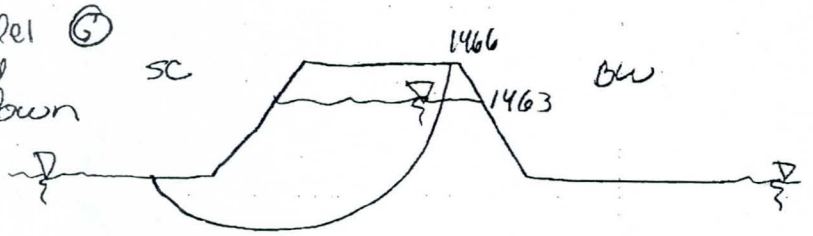
Model (E)
rapid
drawdown



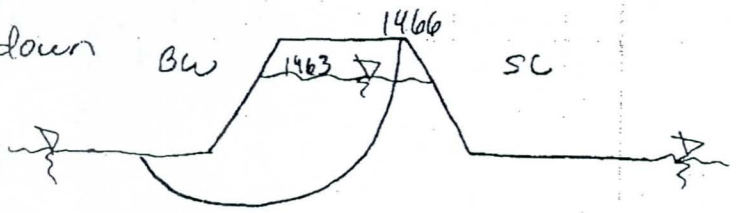
Model (F)
rapid
drawdown



Model (G)
rapid
drawdown



Model (H)
rapid
drawdown



STABILITY ANALYSIS OUTPUT FILES

SKALT1A.OUT
** PCSTABL5 **

by
Purdue University

1

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date:	05-07-03
Time of Run:	2:11pm
Run By:	acb
Input Data Filename:	C:SKALT1A.DAT
Output Filename:	C:SKALT1A.OUT
Plotted Output Filename:	C:SKALT1A.PLT

PROBLEM DESCRIPTION Skunk Creek, circular failure in BW
BW @ 1453, SC dry

BOUNDARY COORDINATES

25 Top Boundaries
25 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	42.00	38.00	42.00	1
2	38.00	42.00	53.00	42.00	1
3	53.00	42.00	73.00	40.00	1
4	73.00	40.00	145.00	40.00	1
5	145.00	40.00	160.00	42.00	1
6	160.00	42.00	168.00	44.00	1
7	168.00	44.00	177.00	46.00	1
8	177.00	46.00	188.00	48.00	1
9	188.00	48.00	197.00	50.00	1
10	197.00	50.00	202.00	52.00	1
11	202.00	52.00	208.00	54.00	1
12	208.00	54.00	211.00	56.00	1
13	211.00	56.00	215.00	58.00	1
14	215.00	58.00	220.00	60.00	1
15	220.00	60.00	238.00	60.00	1
16	238.00	60.00	252.00	58.00	1
17	252.00	58.00	257.00	56.00	1
18	257.00	56.00	262.00	54.00	1
19	262.00	54.00	267.00	52.00	1
20	267.00	52.00	272.00	50.00	1
21	272.00	50.00	278.00	48.00	1
22	278.00	48.00	308.00	46.00	1
23	308.00	46.00	344.00	44.00	1
24	344.00	44.00	369.00	42.00	1
25	369.00	42.00	387.00	42.00	1

1

ISOTROPIC SOIL PARAMETERS

1 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	140.5	150.8	4120.0	35.1	.00	.0	1

1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 62.40

Piezometric Surface No. 1 Specified by 2 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	53.00
2	210.00	53.00

1

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Circular Surfaces, Has Been Specified.

100 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 10 Points Equally Spaced Along The Ground Surface Between X = 120.00 ft.
and X = 215.00 ft.

Each Surface Terminates Between X = 220.00 ft.
and X = 262.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is Y = .00 ft.

5.00 ft. Line Segments Define Each Trial Failure Surface.

The Factor Of Safety For The Trial Failure Surface Defined By The Coordinates Listed Below Is Misleading.

Failure Surface Defined By 10 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	215.00	58.00
2	218.68	54.61
3	222.90	51.94
4	227.53	50.05
5	232.43	49.02
6	237.43	48.88
7	242.37	49.63
8	247.10	51.25
9	251.47	53.69
10	255.18	56.73

Factor Of Safety For The Preceding Specified Surface =*******

1

Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Bishop Method * *

Failure Surface Specified By 28 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	141.11	40.00
2	144.69	36.51
3	148.51	33.28
4	152.55	30.34
5	156.80	27.70
6	161.22	25.37
7	165.80	23.37
8	170.52	21.70
9	175.34	20.38
10	180.24	19.41
11	185.21	18.79
12	190.20	18.54
13	195.20	18.65
14	200.18	19.12
15	205.11	19.95
16	209.97	21.13
17	214.73	22.66
18	219.36	24.53
19	223.85	26.73
20	228.17	29.25
21	232.30	32.07
22	236.21	35.18
23	239.89	38.57
24	243.31	42.22
25	246.46	46.10
26	249.32	50.20

27	251.88	54.50
28	253.36	57.46

Circle Center At X = 191.2 ; Y = 87.7 and Radius, 69.2

*** 16.994 ***

Failure Surface Specified By 30 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	130.56	40.00
2	134.11	36.48
3	137.89	33.21
4	141.88	30.19
5	146.06	27.45
6	150.41	24.99
7	154.92	22.83
8	159.56	20.97
9	164.32	19.43
10	169.17	18.20
11	174.08	17.31
12	179.05	16.74
13	184.05	16.50
14	189.04	16.60
15	194.03	17.02
16	198.97	17.78
17	203.85	18.87
18	208.65	20.28
19	213.34	22.01
20	217.91	24.04
21	222.33	26.38
22	226.58	29.00
23	230.66	31.90
24	234.53	35.07
25	238.18	38.49
26	241.59	42.14
27	244.75	46.01
28	247.65	50.08
29	250.27	54.34
30	252.17	57.93

Circle Center At X = 185.1 ; Y = 91.5 and Radius, 75.0

*** 17.028 ***

1

Failure Surface Specified By 28 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	141.11	40.00
2	144.86	36.69

3	148.82	33.64
4	152.98	30.87
5	157.33	28.39
6	161.83	26.22
7	166.47	24.36
8	171.23	22.83
9	176.08	21.62
10	181.01	20.75
11	185.98	20.22
12	190.97	20.03
13	195.97	20.19
14	200.95	20.69
15	205.88	21.52
16	210.74	22.70
17	215.51	24.20
18	220.16	26.03
19	224.68	28.17
20	229.04	30.62
21	233.22	33.36
22	237.20	36.39
23	240.97	39.67
24	244.50	43.21
25	247.78	46.99
26	250.79	50.98
27	253.53	55.16
28	254.55	56.98

Circle Center At X = 191.2 ; Y = 92.9 and Radius, 72.8

*** 17.084 ***

Failure Surface Specified By 31 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	130.56	40.00
2	134.20	36.57
3	138.05	33.39
4	142.09	30.45
5	146.32	27.77
6	150.70	25.36
7	155.23	23.24
8	159.88	21.40
9	164.63	19.86
10	169.48	18.63
11	174.39	17.70
12	179.36	17.09
13	184.35	16.79
14	189.35	16.81
15	194.34	17.14
16	199.29	17.78
17	204.20	18.74
18	209.04	20.01
19	213.79	21.57
20	218.43	23.44
21	222.94	25.59
22	227.31	28.03
23	231.51	30.73

24	235.54	33.70
25	239.37	36.91
26	242.99	40.36
27	246.38	44.03
28	249.54	47.90
29	252.45	51.97
30	255.09	56.22
31	255.33	56.67

Circle Center At X = 186.6 ; Y = 95.9 and Radius, 79.2

*** 17.180 ***

1

Failure Surface Specified By 28 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	130.56	40.00
2	134.18	36.56
3	138.04	33.38
4	142.13	30.50
5	146.41	27.91
6	150.87	25.65
7	155.48	23.71
8	160.21	22.11
9	165.05	20.86
10	169.97	19.97
11	174.94	19.43
12	179.94	19.25
13	184.94	19.43
14	189.91	19.98
15	194.83	20.88
16	199.66	22.14
17	204.40	23.74
18	209.01	25.69
19	213.46	27.96
20	217.74	30.55
21	221.82	33.44
22	225.68	36.62
23	229.30	40.07
24	232.66	43.77
25	235.74	47.70
26	238.53	51.85
27	241.02	56.19
28	242.53	59.35

Circle Center At X = 179.9 ; Y = 88.3 and Radius, 69.0

*** 17.312 ***

Failure Surface Specified By 33 Coordinate Points

Point	X-Surf	Y-Surf

No.	(ft)	(ft)
1	120.00	40.00
2	123.66	36.60
3	127.52	33.41
4	131.55	30.45
5	135.75	27.73
6	140.09	25.26
7	144.57	23.05
8	149.18	21.09
9	153.88	19.41
10	158.68	18.00
11	163.55	16.87
12	168.48	16.02
13	173.45	15.46
14	178.44	15.19
15	183.44	15.21
16	188.43	15.51
17	193.39	16.11
18	198.32	16.99
19	203.18	18.15
20	207.97	19.59
21	212.66	21.31
22	217.25	23.29
23	221.72	25.54
24	226.05	28.04
25	230.22	30.79
26	234.24	33.78
27	238.07	36.99
28	241.71	40.42
29	245.14	44.05
30	248.36	47.87
31	251.36	51.88
32	254.11	56.05
33	254.63	56.95

Circle Center At X = 180.6 ; Y = 101.6 and Radius, 86.4

*** 17.474 ***

1

Failure Surface Specified By 24 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	151.67	40.89
2	155.84	38.13
3	160.19	35.68
4	164.71	33.54
5	169.37	31.72
6	174.15	30.24
7	179.01	29.10
8	183.95	28.30
9	188.93	27.86
10	193.93	27.77
11	198.92	28.03
12	203.89	28.65
13	208.79	29.61

14	213.62	30.92
15	218.34	32.57
16	222.93	34.55
17	227.37	36.84
18	231.64	39.45
19	235.71	42.35
20	239.57	45.53
21	243.19	48.98
22	246.56	52.67
23	249.66	56.59
24	250.75	58.18

Circle Center At X = 192.7 ; Y = 98.4 and Radius, 70.7

*** 17.561 ***

Failure Surface Specified By 31 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	130.56	40.00
2	134.24	36.62
3	138.12	33.46
4	142.18	30.54
5	146.40	27.87
6	150.79	25.46
7	155.30	23.32
8	159.94	21.46
9	164.68	19.87
10	169.51	18.57
11	174.41	17.57
12	179.36	16.86
13	184.34	16.45
14	189.34	16.34
15	194.34	16.52
16	199.31	17.01
17	204.25	17.80
18	209.13	18.88
19	213.94	20.26
20	218.66	21.91
21	223.27	23.85
22	227.75	26.07
23	232.09	28.55
24	236.28	31.28
25	240.29	34.26
26	244.12	37.48
27	247.75	40.92
28	251.16	44.57
29	254.35	48.42
30	257.31	52.46
31	259.06	55.18

Circle Center At X = 188.7 ; Y = 99.6 and Radius, 83.2

*** 17.648 ***

1

Failure Surface Specified By 30 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	130.56	40.00
2	134.61	37.07
3	138.82	34.38
4	143.17	31.92
5	147.66	29.71
6	152.26	27.75
7	156.96	26.05
8	161.75	24.61
9	166.61	23.45
10	171.53	22.55
11	176.49	21.94
12	181.48	21.60
13	186.48	21.53
14	191.48	21.75
15	196.45	22.24
16	201.39	23.01
17	206.28	24.06
18	211.11	25.37
19	215.85	26.96
20	220.50	28.80
21	225.04	30.90
22	229.45	33.25
23	233.73	35.84
24	237.85	38.67
25	241.81	41.72
26	245.60	44.98
27	249.19	48.46
28	252.59	52.12
29	255.78	55.97
30	256.07	56.37

Circle Center At X = 185.1 ; Y = 111.3 and Radius, 89.7

*** 17.656 ***

Failure Surface Specified By 25 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	141.11	40.00
2	145.42	37.46
3	149.88	35.20
4	154.47	33.21
5	159.17	31.51
6	163.97	30.11
7	168.84	29.01
8	173.78	28.21
9	178.76	27.71
10	183.75	27.53
11	188.75	27.65

12	193.73	28.09
13	198.68	28.83
14	203.57	29.87
15	208.38	31.22
16	213.10	32.86
17	217.72	34.79
18	222.20	37.00
19	226.54	39.49
20	230.72	42.24
21	234.71	45.24
22	238.52	48.48
23	242.12	51.96
24	245.49	55.64
25	247.87	58.59

Circle Center At X = 184.2 ; Y = 108.3 and Radius, 80.8

*** 17.666 ***

1

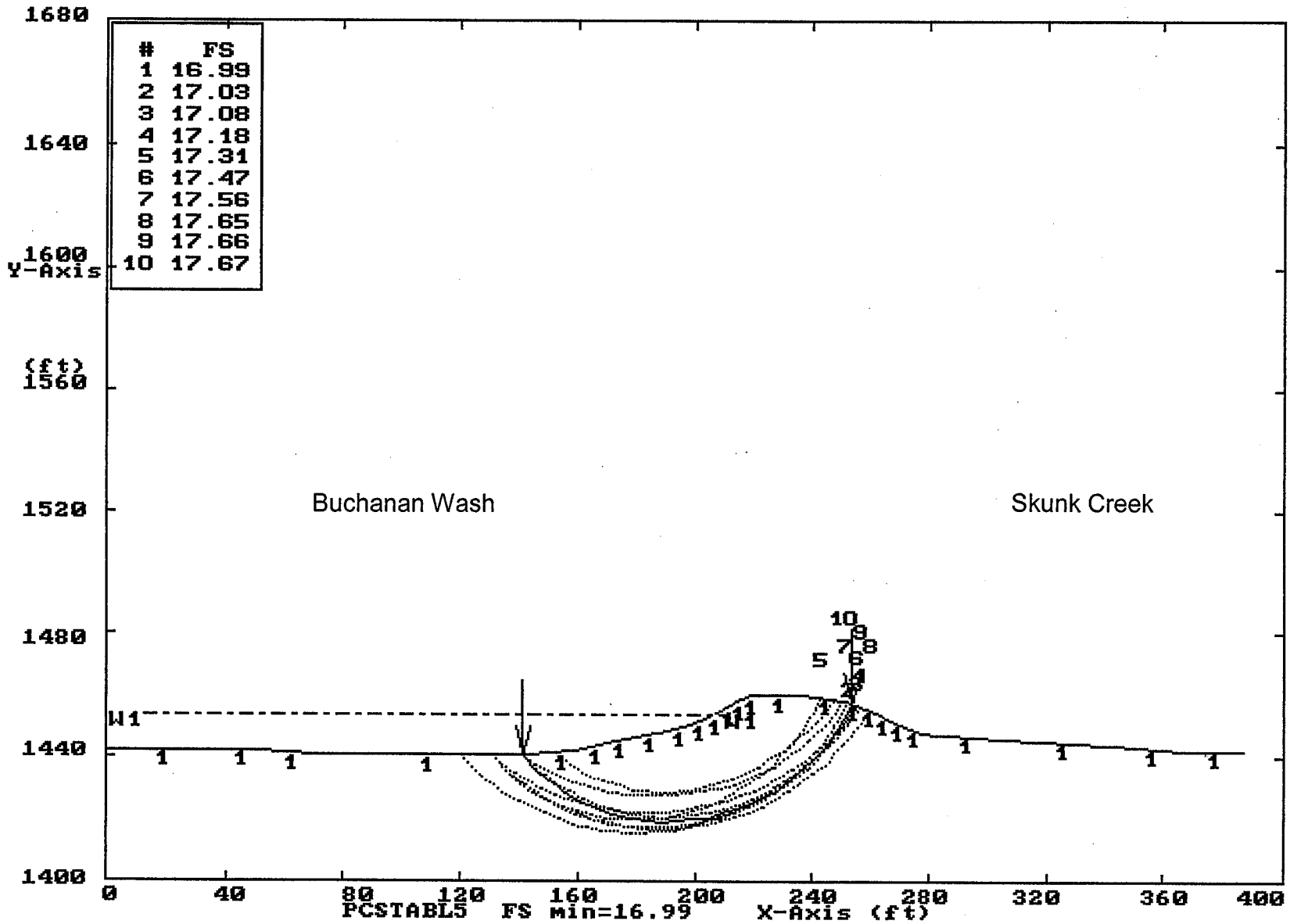
```
            Y            A     X     I     S            F     T

            .00     48.38     96.75    145.13    193.50    241.88

X        .00 +--------*+W--------+---------+---------+---------+
            -
            -
            -
            -
            -        *
      48.38 +
            -        *
            -
            -       *
            -
            -
A      96.75 +
            -
            -
            -       6
            -     662
            -    6622
X    145.13 +   .621*
            -   62107
            -  62137.*
            -  61107.*
            -  2197...*
            -  21.7...*
I    193.50 +  6197...*
            -  .157....*
            -  .1250...**
            -   4157....*
            -   .2155....
            -    .41355..
S    241.88 +     .81125*
            -       8411*
            -        .8**
            -          *
```

```
                  -          *
                  -
        290.25 +
                  -
                  -          *
                  -
                  -
                  -
   F    338.63 +
                  -        *
                  -
                  -
                  -        *
                  -
   T    387.00 +           *
```

Skunk Creek, circular failure in BW BW @ 1453, SC dry
Ten Most Critical. C:SKALT1A.PLT By: acb 05-07-03 2:11pm



SKALT1B.OUT
** PCSTABL5 **

by
Purdue University

1

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 05-07-03
Time of Run: 2:08pm
Run By: acb
Input Data Filename: C:SKALT1B.DAT
Output Filename: C:SKALT1B.OUT
Plotted Output Filename: C:SKALT1B.PLT

PROBLEM DESCRIPTION Skunk Creek, circular failure in SC
BW @ 1453, SC dry

BOUNDARY COORDINATES

25 Top Boundaries
25 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	42.00	18.00	42.00	1
2	18.00	42.00	43.00	44.00	1
3	43.00	44.00	79.00	46.00	1
4	79.00	46.00	109.00	48.00	1
5	109.00	48.00	115.00	50.00	1
6	115.00	50.00	120.00	52.00	1
7	120.00	52.00	125.00	54.00	1
8	125.00	54.00	130.00	56.00	1
9	130.00	56.00	135.00	58.00	1
10	135.00	58.00	149.00	60.00	1
11	149.00	60.00	167.00	60.00	1
12	167.00	60.00	172.00	58.00	1
13	172.00	58.00	176.00	56.00	1
14	176.00	56.00	179.00	54.00	1
15	179.00	54.00	185.00	52.00	1
16	185.00	52.00	190.00	50.00	1
17	190.00	50.00	195.00	48.00	1
18	195.00	48.00	210.00	46.00	1
19	210.00	46.00	219.00	44.00	1
20	219.00	44.00	227.00	42.00	1
21	227.00	42.00	242.00	40.00	1
22	242.00	40.00	314.00	40.00	1
23	314.00	40.00	334.00	42.00	1
24	334.00	42.00	349.00	42.00	1
25	349.00	42.00	387.00	42.00	1

1

ISOTROPIC SOIL PARAMETERS

1 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	140.5	150.8	4120.0	35.1	.00	.0	1

1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 62.40

Piezometric Surface No. 1 Specified by 2 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	182.00	53.00
2	387.00	53.00

1

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Circular Surfaces, Has Been Specified.

100 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 10 Points Equally Spaced Along The Ground Surface Between X = .00 ft.
and X = 115.00 ft.

Each Surface Terminates Between X = 149.00 ft.
and X = 167.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is Y = .00 ft.

10.00 ft. Line Segments Define Each Trial Failure Surface.

1

Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Bishop Method * *

Failure Surface Specified By 10 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	89.44	46.70
2	97.11	40.28
3	106.02	35.74
4	115.72	33.31
5	125.72	33.11
6	135.51	35.16
7	144.59	39.36
8	152.49	45.48
9	158.83	53.21
10	162.20	60.00

Circle Center At X = 121.6 ; Y = 77.3 and Radius, 44.3

*** 20.587 ***

Failure Surface Specified By 12 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	76.67	45.87
2	83.77	38.83
3	92.09	33.29
4	101.33	29.47
5	111.14	27.50
6	121.14	27.47
7	130.96	29.37
8	140.22	33.13
9	148.59	38.61
10	155.73	45.61
11	161.39	53.85
12	164.04	60.00

Circle Center At X = 116.3 ; Y = 78.7 and Radius, 51.5

*** 20.644 ***

1

Failure Surface Specified By 10 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	89.44	46.70
2	96.85	39.97
3	105.64	35.20

4	115.31	32.66
5	125.31	32.49
6	135.06	34.71
7	144.00	39.18
8	151.62	45.65
9	157.49	53.75
10	160.03	60.00

Circle Center At X = 121.0 ; Y = 74.0 and Radius, 41.7

*** 20.733 ***

Failure Surface Specified By 10 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	89.44	46.70
2	96.53	39.64
3	105.12	34.53
4	114.71	31.68
5	124.70	31.26
6	134.49	33.31
7	143.48	37.69
8	151.12	44.13
9	156.96	52.26
10	160.01	60.00

Circle Center At X = 121.4 ; Y = 71.7 and Radius, 40.5

*** 20.833 ***

1

Failure Surface Specified By 10 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	89.44	46.70
2	96.68	39.80
3	105.42	34.93
4	115.10	32.41
5	125.10	32.40
6	134.78	34.89
7	143.54	39.72
8	150.80	46.60
9	156.10	55.07
10	157.66	60.00

Circle Center At X = 120.2 ; Y = 71.7 and Radius, 39.6

*** 21.011 ***

Failure Surface Specified By 10 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	89.44	46.70
2	98.09	41.67
3	107.56	38.45
4	117.47	37.14
5	127.45	37.81
6	137.10	40.43
7	146.05	44.89
8	153.95	51.02
9	160.49	58.58
10	161.29	60.00

Circle Center At X = 119.1 ; Y = 87.8 and Radius, 50.7

*** 21.503 ***

1

Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	102.22	47.55
2	109.62	40.81
3	118.66	36.56
4	128.56	35.15
5	138.44	36.73
6	147.41	41.14
7	154.69	48.00
8	159.62	56.70
9	160.35	60.00

Circle Center At X = 128.3 ; Y = 68.7 and Radius, 33.6

*** 21.583 ***

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	51.11	44.45
2	58.25	37.45
3	66.31	31.53
4	75.13	26.82
5	84.53	23.40
6	94.32	21.36
7	104.30	20.73
8	114.27	21.53

9	124.02	23.73
10	133.37	27.30
11	142.11	32.15
12	150.07	38.20
13	157.09	45.32
14	163.03	53.37
15	166.60	60.00

Circle Center At X = 103.7 ; Y = 90.9 and Radius, 70.2

*** 21.594 ***

1

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	51.11	44.45
2	58.36	37.56
3	66.50	31.75
4	75.38	27.15
5	84.82	23.85
6	94.63	21.90
7	104.61	21.35
8	114.57	22.21
9	124.32	24.47
10	133.64	28.07
11	142.37	32.95
12	150.33	39.00
13	157.36	46.12
14	163.31	54.15
15	166.48	60.00

Circle Center At X = 103.5 ; Y = 92.3 and Radius, 70.9

*** 21.635 ***

Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	102.22	47.55
2	110.48	41.91
3	120.05	39.01
4	130.05	39.14
5	139.55	42.26
6	147.67	48.11
7	153.65	56.12
8	155.00	60.00

Circle Center At X = 124.7 ; Y = 71.5 and Radius, 32.8

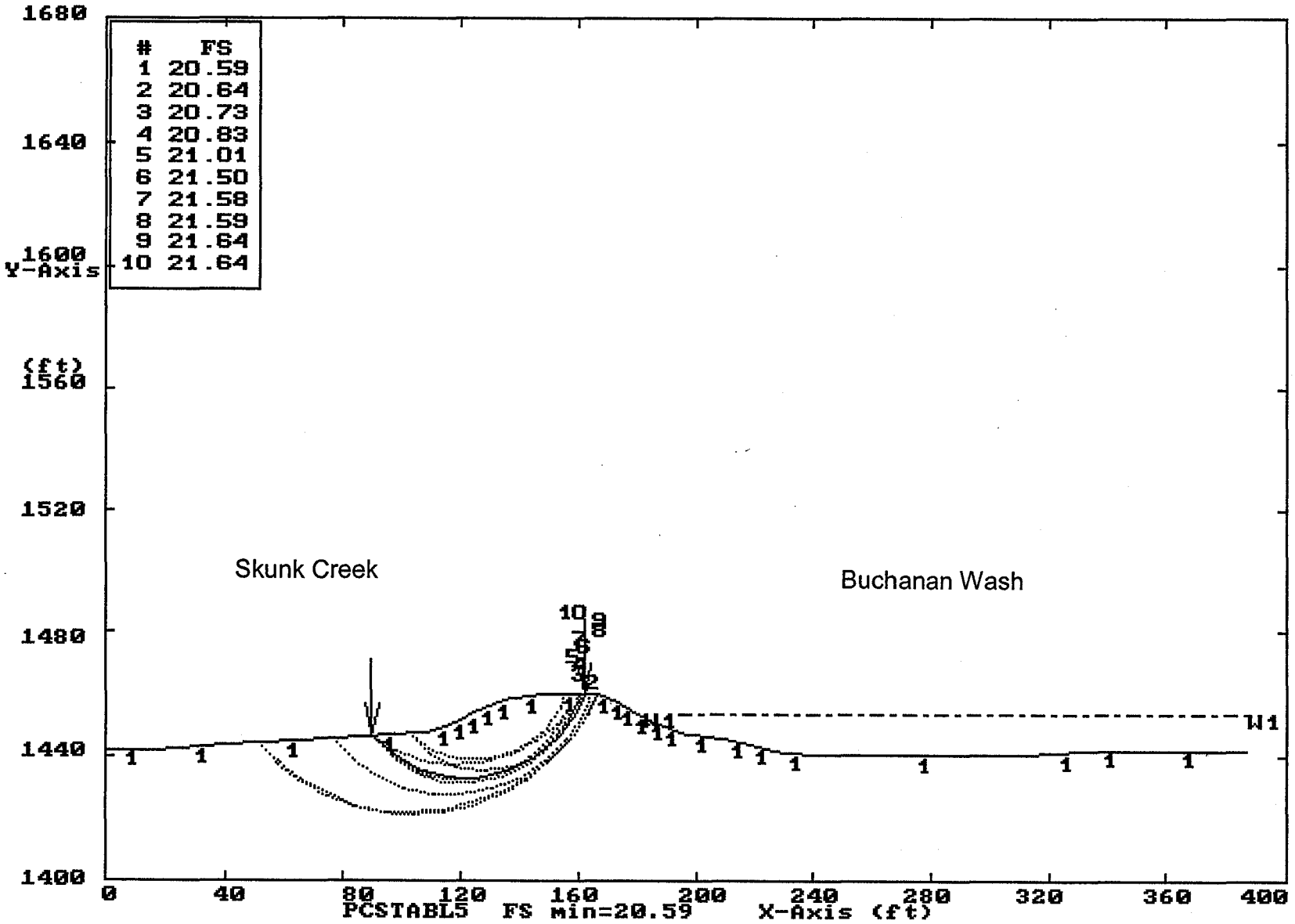
```
***    21.636    ***

1

                Y            A     X     I     S            F     T

                .00      48.38     96.75    145.13    193.50    241.88
X          .00 +--------*+---------+---------+---------+---------+
               -      ..
               -     ...*
               -    .....
               -   .....
               -  ......*
        48.38 + .... ..8
               -  .....8
               - .....8..
               - ....8...
               - ...8..22*
               - ...9.2..1
A       96.75 +  .89..16.
               -  .8.216.7
               -  .892170*
               -   .82.6..*
               -    .216..**
               -     8160..*
X     145.13 +      8160.*
               -      81540
               -        911
               -          *
               -         **
               -         *
I     193.50 +         *
               -
               -        *
               -       *
               -       *
               -
S     241.88 +       *
               -
               -
               -
               -
               -
        290.25 +
               -
               -
               -       *
               -
               -        *
F     338.63 +
               -        *
               -
               -
               -
               -
T     387.00 +        * W
```

Skunk Creek, circular failure in SC BW @ 1453, SC dry
Ten Most Critical. C:SKALT1B.PLT By: acb 05-07-03 2:08pm



SKALT1C.OUT
** PCSTABL5 **

by
Purdue University

1

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date:	05-07-03
Time of Run:	2:10pm
Run By:	acb
Input Data Filename:	C:SKALT1C.DAT
Output Filename:	C:SKALT1C.OUT
Plotted Output Filename:	C:SKALT1C.PLT

PROBLEM DESCRIPTION Skunk Creek, block failure in BW
BW @ 1453, SC dry

BOUNDARY COORDINATES

25 Top Boundaries
25 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	92.00	38.00	92.00	1
2	38.00	92.00	53.00	92.00	1
3	53.00	92.00	73.00	90.00	1
4	73.00	90.00	145.00	90.00	1
5	145.00	90.00	160.00	92.00	1
6	160.00	92.00	168.00	94.00	1
7	168.00	94.00	177.00	96.00	1
8	177.00	96.00	188.00	98.00	1
9	188.00	98.00	197.00	100.00	1
10	197.00	100.00	202.00	102.00	1
11	202.00	102.00	208.00	104.00	1
12	208.00	104.00	211.00	106.00	1
13	211.00	106.00	215.00	108.00	1
14	215.00	108.00	220.00	110.00	1
15	220.00	110.00	238.00	110.00	1
16	238.00	110.00	252.00	108.00	1
17	252.00	108.00	257.00	106.00	1
18	257.00	106.00	262.00	104.00	1
19	262.00	104.00	267.00	102.00	1
20	267.00	102.00	272.00	100.00	1
21	272.00	100.00	278.00	98.00	1
22	278.00	98.00	308.00	96.00	1
23	308.00	96.00	344.00	94.00	1
24	344.00	94.00	369.00	92.00	1
25	369.00	92.00	387.00	92.00	1

1

ISOTROPIC SOIL PARAMETERS

1 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	140.5	150.8	4120.0	35.1	.00	.0	1

1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 62.40

Piezometric Surface No. 1 Specified by 2 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	103.00
2	210.00	103.00

1

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Sliding Block Surfaces, Has Been Specified.

10 Trial Surfaces Have Been Generated.

2 Boxes Specified For Generation Of Central Block Base

Length Of Line Segments For Active And Passive Portions Of Sliding Block Is 5.0

Box No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Height (ft)
1	73.00	69.00	188.00	69.00	15.00
2	197.00	79.00	278.00	79.00	15.00

1

Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Janbu Method * *

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	128.91	90.00
2	129.31	89.86
3	134.08	88.36
4	139.00	87.47
5	143.96	86.84
6	148.40	84.53
7	152.62	81.85
8	157.10	79.64
9	162.05	78.93
10	165.91	75.75
11	169.46	72.23
12	174.40	71.46
13	212.22	83.74
14	214.64	88.12
15	217.82	91.97
16	220.31	96.31
17	223.09	100.46
18	225.03	105.07
19	226.43	109.87
20	226.49	110.00

*** 19.443 ***

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	130.56	90.00
2	132.79	88.14
3	136.33	84.62
4	140.78	82.34
5	145.10	79.82
6	148.70	76.35
7	152.28	72.86
8	206.13	74.23
9	206.93	79.17
10	208.61	83.88
11	212.03	87.53
12	215.55	91.08
13	216.82	95.92
14	220.11	99.68
15	223.30	103.53
16	226.80	107.10
17	229.65	110.00

*** 22.498 ***

1

Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	58.65	91.44
2	61.40	88.69
3	65.09	85.31
4	69.53	83.02
5	73.07	79.49
6	77.85	78.01
7	82.83	77.55
8	87.34	75.40
9	92.18	74.14
10	95.78	70.67
11	99.41	67.23
12	222.21	85.40
13	224.58	89.80
14	227.07	94.14
15	228.25	99.00
16	230.53	103.44
17	233.63	107.37
18	235.99	110.00

*** 30.745 ***

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	83.76	90.00
2	85.24	88.62
3	89.68	86.31
4	93.32	82.88
5	97.00	79.50
6	100.70	76.13
7	104.25	72.62
8	109.21	71.92
9	114.08	70.79
10	118.14	67.87
11	123.09	67.18
12	128.05	66.57
13	203.78	78.06
14	206.94	81.93
15	209.65	86.14
16	212.97	89.87
17	216.48	93.43
18	216.76	98.42
19	218.95	102.92
20	220.47	107.68
21	221.59	110.00

*** 33.457 ***

1

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	125.86	90.00
2	127.96	87.96
3	131.65	84.59
4	136.54	83.55
5	141.53	83.21
6	145.33	79.96
7	148.97	76.54
8	153.74	75.04
9	157.64	71.91
10	161.41	68.63
11	165.87	66.37
12	269.49	80.99
13	272.56	84.94
14	274.96	89.32
15	277.66	93.53
16	280.46	97.67
17	280.57	97.83

*** 37.917 ***

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	135.29	90.00
2	136.67	88.88
3	140.40	85.55
4	144.29	82.41
5	148.22	79.32
6	153.12	78.29
7	157.89	76.81
8	161.46	73.31
9	209.28	84.50
10	210.84	89.25
11	214.12	93.03
12	214.22	98.03
13	217.25	102.00
14	218.87	106.73
15	220.44	110.00

*** 40.590 ***

1

Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)

1	21.21	92.00
2	21.66	91.74
3	26.55	90.69
4	30.22	87.29
5	34.91	85.57
6	39.47	83.52
7	43.92	81.24
8	48.07	78.45
9	51.68	74.99
10	56.67	74.61
11	61.40	73.00
12	64.95	69.47
13	69.27	66.96
14	73.75	64.74
15	212.68	79.09
16	216.20	82.64
17	216.31	87.64
18	219.74	91.27
19	222.80	95.23
20	223.87	100.11
21	226.47	104.39
22	229.57	108.31
23	229.83	110.00

*** 51.339 ***

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	95.90	90.00
2	99.76	87.44
3	104.37	85.50
4	109.23	84.33
5	114.23	84.29
6	117.77	80.75
7	122.67	79.76
8	127.63	79.17
9	132.49	78.00
10	136.19	74.63
11	139.83	71.21
12	143.72	68.07
13	148.71	67.86
14	274.02	78.41
15	277.44	82.06
16	278.47	86.95
17	281.37	91.03
18	284.18	95.16
19	286.32	97.45

*** 56.835 ***

1

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	114.18	90.00
2	115.53	89.20
3	119.07	85.67
4	123.99	84.76
5	128.72	83.15
6	133.23	80.99
7	136.85	77.54
8	141.67	76.19
9	276.81	83.84
10	280.17	87.54
11	282.75	91.82
12	285.95	95.66
13	287.20	97.39

*** 67.973 ***

Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	40.19	92.00
2	43.34	90.54
3	47.55	87.85
4	51.25	84.49
5	55.96	82.79
6	60.10	79.99
7	63.73	76.55
8	67.36	73.11
9	72.05	71.38
10	76.95	70.40
11	262.08	72.63
12	265.23	76.51
13	267.04	81.17
14	268.10	86.06
15	271.58	89.65
16	274.78	93.49
17	277.90	97.39
18	277.98	98.01

*** 79.047 ***

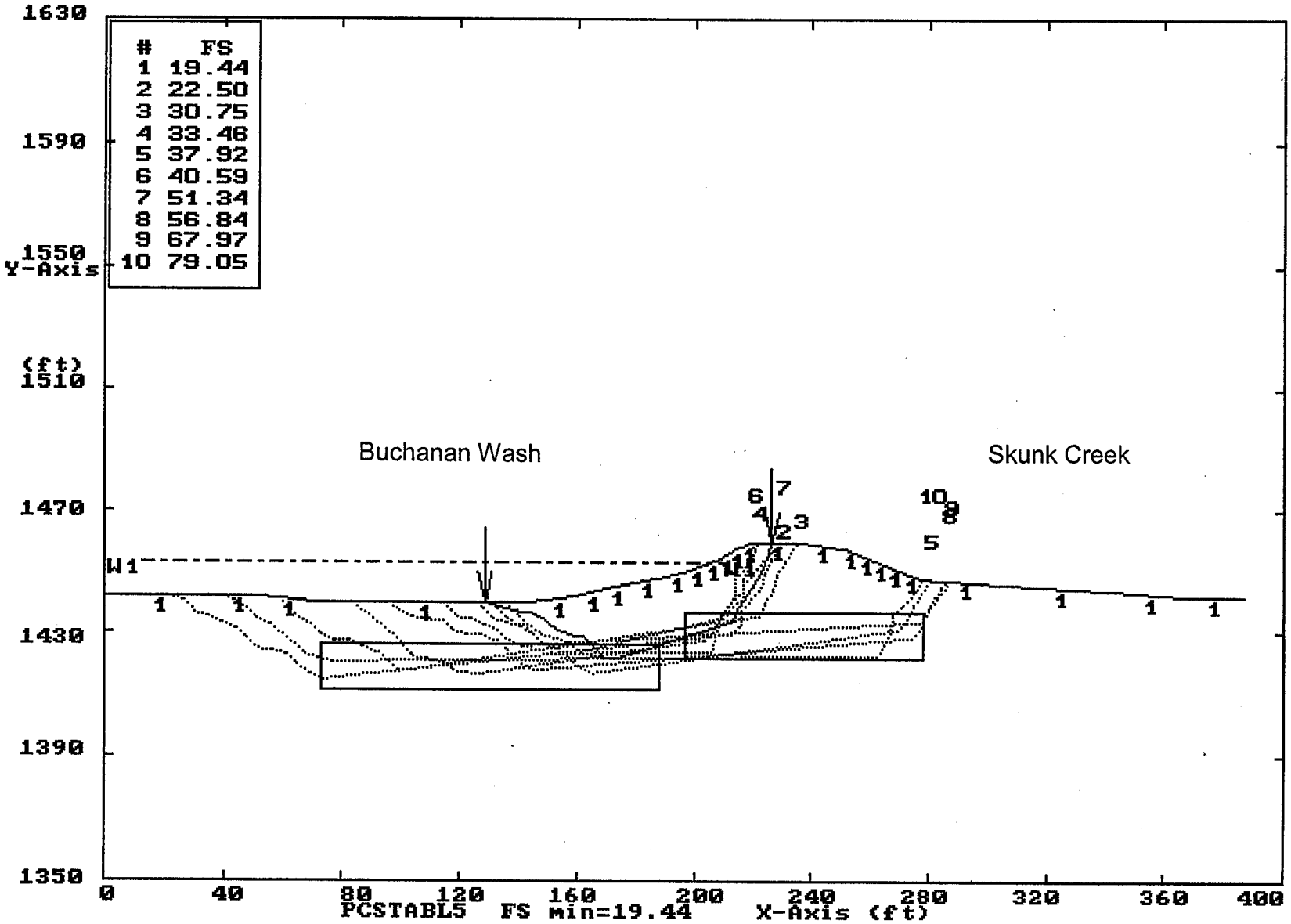
1

```
          Y            A     X     I     S            F     T

           .00      48.38     96.75    145.13    193.50    241.88
X       .00 +---------+--------*+W--------+---------+---------+
            -
            -
```

```
                 -          7
                 -         7
                 -        7 *
       48.38     +       700
                 -      7 0 *
                 -     770 3
                 -    77033 *
                 -     03  4
                 -     33 4
A      96.75     +    334488
                 -     4  8
                 -     4 899
                 -    4 889
                 -    4 8521
                 -     89216
X     145.13     +    8 211*
                 -     211
                 -    551  *
                 -    511  *
                 -     1    *
                 -          *
I     193.50     +           *
                 -     4     *
                 -    22124 **
                 -      71112**
                 -       333111
                 -          333
S     241.88     +            *
                 -            *
                 -           **
                 -    0050   *
                 -     8855**
                 -       885
     290.25      +         8
                 -
                 -         *
                 -
                 -
                 -
F     338.63     +
                 -        *
                 -
                 -
                 -        *
                 -
T     387.00     +        *
```

Skunk Creek, block failure in BW BW @ 1453, SC dry
Ten Most Critical. C:SKALTIC.PLT By: acb 05-07-03 2:10pm



SKALT1D.OUT
** PCSTABL5 **

by
Purdue University

1

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date:	05-07-03
Time of Run:	4:44pm
Run By:	acb
Input Data Filename:	C:SKALT1D.DAT
Output Filename:	C:SKALT1D.OUT
Plotted Output Filename:	C:SKALT1D.PLT

PROBLEM DESCRIPTION Skunk Creek stability anaylsis (block)
Alt1a-BW running, no water in SC (rev)

BOUNDARY COORDINATES

25 Top Boundaries
25 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	42.00	18.00	42.00	1
2	18.00	42.00	43.00	44.00	1
3	43.00	44.00	79.00	46.00	1
4	79.00	46.00	109.00	48.00	1
5	109.00	48.00	115.00	50.00	1
6	115.00	50.00	120.00	52.00	1
7	120.00	52.00	125.00	54.00	1
8	125.00	54.00	130.00	56.00	1
9	130.00	56.00	135.00	58.00	1
10	135.00	58.00	149.00	60.00	1
11	149.00	60.00	167.00	60.00	1
12	167.00	60.00	172.00	58.00	1
13	172.00	58.00	176.00	56.00	1
14	176.00	56.00	179.00	54.00	1
15	179.00	54.00	185.00	52.00	1
16	185.00	52.00	190.00	50.00	1
17	190.00	50.00	195.00	48.00	1
18	195.00	48.00	210.00	46.00	1
19	210.00	46.00	219.00	44.00	1
20	219.00	44.00	227.00	42.00	1
21	227.00	42.00	242.00	40.00	1
22	242.00	40.00	314.00	40.00	1
23	314.00	40.00	334.00	42.00	1
24	334.00	42.00	349.00	42.00	1
25	349.00	42.00	387.00	42.00	1

1

ISOTROPIC SOIL PARAMETERS

1 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	140.5	150.8	4120.0	35.1	.00	.0	1

1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 62.40

Piezometric Surface No. 1 Specified by 2 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	182.00	53.00
2	387.00	53.00

1

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Sliding Block Surfaces, Has Been Specified.

10 Trial Surfaces Have Been Generated.

2 Boxes Specified For Generation Of Central Block Base

Length Of Line Segments For Active And Passive Portions Of Sliding Block Is 5.0

Box No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Height (ft)
1	79.00	25.00	140.00	25.00	20.00
2	149.00	39.00	167.00	39.00	20.00

1

Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Janbu Method * *

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	74.40	45.74
2	74.86	45.32
3	78.56	41.95
4	82.12	38.44
5	87.07	37.74
6	91.94	36.61
7	96.00	33.69
8	100.95	33.00
9	105.91	32.39
10	109.94	29.43
11	113.49	25.91
12	117.33	22.71
13	153.80	38.57
14	157.23	42.21
15	159.54	46.65
16	162.95	50.30
17	166.11	54.17
18	168.82	58.38
19	169.41	59.04

*** 19.370 ***

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	64.31	45.18
2	67.49	42.73
3	71.12	39.30
4	76.12	39.19
5	79.67	35.67
6	84.01	33.18
7	88.89	32.13
8	92.56	28.73
9	97.25	27.01
10	101.81	24.96
11	106.26	22.68
12	110.41	19.89
13	114.02	16.43
14	162.74	48.00
15	163.81	52.88
16	166.40	57.15
17	168.26	59.50

*** 20.561 ***

1

Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	62.69	45.09
2	64.61	43.95
3	68.15	40.42
4	73.07	39.51
5	77.80	37.90
6	82.31	35.74
7	85.93	32.29
8	90.75	30.94
9	95.59	29.68
10	100.58	29.57
11	105.58	29.41
12	109.96	26.98
13	114.52	24.93
14	161.65	44.98
15	165.01	48.68
16	167.59	52.96
17	170.79	56.80
18	171.74	58.11

*** 20.853 ***

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	99.62	47.37
2	101.84	46.62
3	105.82	43.58
4	110.81	43.48
5	114.59	40.20
6	119.34	38.64
7	123.22	35.48
8	126.95	32.15
9	156.00	36.38
10	158.17	40.88
11	160.17	45.47
12	161.82	50.19
13	165.32	53.76
14	168.76	57.38
15	170.10	58.76

*** 23.501 ***

1

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	54.46	44.64

2	55.00	44.10
3	58.69	40.72
4	63.13	38.43
5	66.67	34.90
6	71.45	33.42
7	76.42	32.96
8	80.94	30.81
9	85.78	29.55
10	89.38	26.08
11	93.01	22.65
12	154.60	47.53
13	156.97	51.94
14	159.46	56.27
15	160.37	60.00

*** 26.769 ***

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	57.48	44.80
2	58.90	43.63
3	62.66	40.34
4	67.50	39.07
5	71.05	35.55
6	74.70	32.13
7	79.41	30.45
8	84.34	29.65
9	88.18	26.45
10	160.35	29.94
11	163.85	33.51
12	167.35	37.08
13	170.89	40.61
14	174.29	44.27
15	177.72	47.91
16	180.48	52.08
17	181.09	53.30

*** 29.085 ***

1

Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	51.45	44.47
2	51.70	44.32
3	55.40	40.95
4	60.10	39.25
5	64.24	36.45
6	67.87	33.01
7	71.50	29.58

8	76.19	27.84
9	81.10	26.86
10	163.46	30.50
11	165.57	35.04
12	168.72	38.92
13	170.53	43.58
14	171.59	48.47
15	175.07	52.06
16	177.52	54.99

*** 29.596 ***

Failure Surface Specified By 12 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	60.57	44.98
2	62.29	44.10
3	66.75	41.83
4	71.69	41.05
5	75.50	37.82
6	80.32	36.47
7	84.82	34.30
8	160.69	44.57
9	163.98	48.35
10	167.11	52.24
11	168.60	57.01
12	170.21	58.72

*** 30.597 ***

1

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	81.48	46.17
2	82.07	45.77
3	86.27	43.06
4	90.66	40.66
5	94.61	37.60
6	98.19	34.11
7	164.43	33.84
8	167.35	37.90
9	168.92	42.65
10	170.40	47.42
11	173.87	51.02
12	174.84	55.93
13	175.27	56.37

*** 33.023 ***

Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	101.98	47.53
2	103.01	47.00
3	107.23	44.32
4	111.72	42.11
5	116.66	41.40
6	120.53	38.22
7	124.08	34.70
8	129.02	33.93
9	133.85	32.64
10	160.96	32.76
11	161.59	37.72
12	162.48	42.64
13	163.98	47.41
14	165.63	52.13
15	168.05	56.50
16	169.96	58.82

*** 35.027 ***

1

```
          Y            A     X     I     S            F     T

          .00      48.38     96.75    145.13    193.50    241.88

X       .00 +--------*+---------+---------+---------+---------+
            -
            -        *
            -
            -
            -        *
      48.38 +        7
            -       55
            -      532
            -     7521
            -     5211*
            -    52219
A     96.75 +    5219 4
            -    231 44
            -  2211 44*
            -    1 44  *
            -      4   **
            -      0    *
X    145.13 +           *
            -       1 55
            -     6641125
            -      76771*
            -        66**
            -          *
I    193.50 +         *
            -
```

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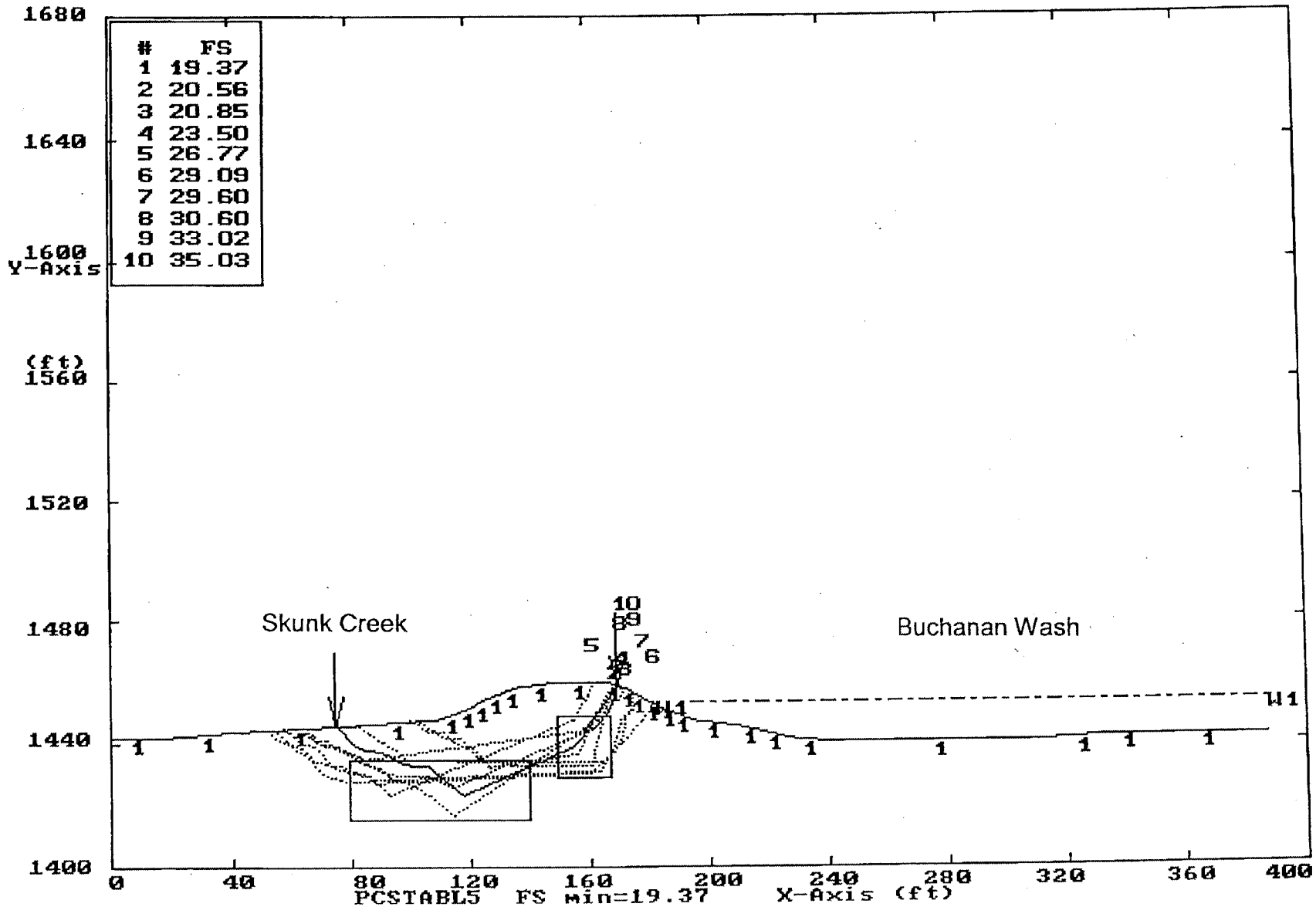
                  -          *
                  -        *
                  -        *
                  -
S     241.88 +        *
                  -
                  -
                  -
                  -
                  -
      290.25 +
                  -
                  -
                  -        *
                  -
                  -        *
F     338.63 +
                  -        *
                  -
                  -
                  -
                  -
T     387.00 +        * W
```

Skunk Creek stability anaylsis (block) Altla-BW running, no water in SC (rev)
Ten Most Critical. C:SKALT1D.PLT By: acb 05-07-03 4:44pm



SKALT1E.OUT
** PCSTABL5 **

by
Purdue University

1

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date:	05-07-03
Time of Run:	2:34pm
Run By:	acb
Input Data Filename:	C:SKALT1E.DAT
Output Filename:	C:SKALT1E.OUT
Plotted Output Filename:	C:SKALT1E.PLT

PROBLEM DESCRIPTION Skunk Creek, circular failure in BW, piezometric head = 11'; rapid drawdown

BOUNDARY COORDINATES

25 Top Boundaries
25 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	42.00	38.00	42.00	1
2	38.00	42.00	53.00	42.00	1
3	53.00	42.00	73.00	40.00	1
4	73.00	40.00	145.00	40.00	1
5	145.00	40.00	160.00	42.00	1
6	160.00	42.00	168.00	44.00	1
7	168.00	44.00	177.00	46.00	1
8	177.00	46.00	188.00	48.00	1
9	188.00	48.00	197.00	50.00	1
10	197.00	50.00	202.00	52.00	1
11	202.00	52.00	208.00	54.00	1
12	208.00	54.00	211.00	56.00	1
13	211.00	56.00	215.00	58.00	1
14	215.00	58.00	220.00	60.00	1
15	220.00	60.00	238.00	60.00	1
16	238.00	60.00	252.00	58.00	1
17	252.00	58.00	257.00	56.00	1
18	257.00	56.00	262.00	54.00	1
19	262.00	54.00	267.00	52.00	1
20	267.00	52.00	272.00	50.00	1
21	272.00	50.00	278.00	48.00	1
22	278.00	48.00	308.00	46.00	1
23	308.00	46.00	344.00	44.00	1
24	344.00	44.00	369.00	42.00	1
25	369.00	42.00	387.00	42.00	1

1

ISOTROPIC SOIL PARAMETERS

1 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	140.5	150.8	4120.0	35.1	.00	11.0	0

1

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Circular Surfaces, Has Been Specified.

100 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 10 Points Equally Spaced Along The Ground Surface Between X = 120.00 ft.
and X = 215.00 ft.

Each Surface Terminates Between X = 220.00 ft.
and X = 262.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is Y = .00 ft.

5.00 ft. Line Segments Define Each Trial Failure Surface.

The Factor Of Safety For The Trial Failure Surface Defined By The Coordinates Listed Below Is Misleading.

Failure Surface Defined By 10 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	215.00	58.00
2	218.68	54.61
3	222.90	51.94
4	227.53	50.05
5	232.43	49.02
6	237.43	48.88
7	242.37	49.63
8	247.10	51.25
9	251.47	53.69
10	255.18	56.73

Factor Of Safety For The Preceding Specified Surface =*******

1

Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Bishop Method * *

Failure Surface Specified By 28 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	130.56	40.00
2	134.18	36.56
3	138.04	33.38
4	142.13	30.50
5	146.41	27.91
6	150.87	25.65
7	155.48	23.71
8	160.21	22.11
9	165.05	20.86
10	169.97	19.97
11	174.94	19.43
12	179.94	19.25
13	184.94	19.43
14	189.91	19.98
15	194.83	20.88
16	199.66	22.14
17	204.40	23.74
18	209.01	25.69
19	213.46	27.96
20	217.74	30.55
21	221.82	33.44
22	225.68	36.62
23	229.30	40.07
24	232.66	43.77
25	235.74	47.70
26	238.53	51.85
27	241.02	56.19
28	242.53	59.35

Circle Center At X = 179.9 ; Y = 88.3 and Radius, 69.0

*** 14.614 ***

Failure Surface Specified By 30 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	130.56	40.00
2	134.11	36.48

3	137.89	33.21
4	141.88	30.19
5	146.06	27.45
6	150.41	24.99
7	154.92	22.83
8	159.56	20.97
9	164.32	19.43
10	169.17	18.20
11	174.08	17.31
12	179.05	16.74
13	184.05	16.50
14	189.04	16.60
15	194.03	17.02
16	198.97	17.78
17	203.85	18.87
18	208.65	20.28
19	213.34	22.01
20	217.91	24.04
21	222.33	26.38
22	226.58	29.00
23	230.66	31.90
24	234.53	35.07
25	238.18	38.49
26	241.59	42.14
27	244.75	46.01
28	247.65	50.08
29	250.27	54.34
30	252.17	57.93

Circle Center At X = 185.1 ; Y = 91.5 and Radius, 75.0

*** 14.623 ***

1

Failure Surface Specified By 28 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	141.11	40.00
2	144.69	36.51
3	148.51	33.28
4	152.55	30.34
5	156.80	27.70
6	161.22	25.37
7	165.80	23.37
8	170.52	21.70
9	175.34	20.38
10	180.24	19.41
11	185.21	18.79
12	190.20	18.54
13	195.20	18.65
14	200.18	19.12
15	205.11	19.95
16	209.97	21.13
17	214.73	22.66
18	219.36	24.53
19	223.85	26.73
20	228.17	29.25

21	232.30	32.07
22	236.21	35.18
23	239.89	38.57
24	243.31	42.22
25	246.46	46.10
26	249.32	50.20
27	251.88	54.50
28	253.36	57.46

Circle Center At X = 191.2 ; Y = 87.7 and Radius, 69.2

*** 14.733 ***

Failure Surface Specified By 31 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	130.56	40.00
2	134.20	36.57
3	138.05	33.39
4	142.09	30.45
5	146.32	27.77
6	150.70	25.36
7	155.23	23.24
8	159.88	21.40
9	164.63	19.86
10	169.48	18.63
11	174.39	17.70
12	179.36	17.09
13	184.35	16.79
14	189.35	16.81
15	194.34	17.14
16	199.29	17.78
17	204.20	18.74
18	209.04	20.01
19	213.79	21.57
20	218.43	23.44
21	222.94	25.59
22	227.31	28.03
23	231.51	30.73
24	235.54	33.70
25	239.37	36.91
26	242.99	40.36
27	246.38	44.03
28	249.54	47.90
29	252.45	51.97
30	255.09	56.22
31	255.33	56.67

Circle Center At X = 186.6 ; Y = 95.9 and Radius, 79.2

*** 14.759 ***

1

Failure Surface Specified By 28 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	141.11	40.00
2	144.86	36.69
3	148.82	33.64
4	152.98	30.87
5	157.33	28.39
6	161.83	26.22
7	166.47	24.36
8	171.23	22.83
9	176.08	21.62
10	181.01	20.75
11	185.98	20.22
12	190.97	20.03
13	195.97	20.19
14	200.95	20.69
15	205.88	21.52
16	210.74	22.70
17	215.51	24.20
18	220.16	26.03
19	224.68	28.17
20	229.04	30.62
21	233.22	33.36
22	237.20	36.39
23	240.97	39.67
24	244.50	43.21
25	247.78	46.99
26	250.79	50.98
27	253.53	55.16
28	254.55	56.98

Circle Center At X = 191.2 ; Y = 92.9 and Radius, 72.8

*** 14.766 ***

Failure Surface Specified By 33 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	120.00	40.00
2	123.66	36.60
3	127.52	33.41
4	131.55	30.45
5	135.75	27.73
6	140.09	25.26
7	144.57	23.05
8	149.18	21.09
9	153.88	19.41
10	158.68	18.00
11	163.55	16.87
12	168.48	16.02
13	173.45	15.46
14	178.44	15.19
15	183.44	15.21
16	188.43	15.51

17	193.39	16.11
18	198.32	16.99
19	203.18	18.15
20	207.97	19.59
21	212.66	21.31
22	217.25	23.29
23	221.72	25.54
24	226.05	28.04
25	230.22	30.79
26	234.24	33.78
27	238.07	36.99
28	241.71	40.42
29	245.14	44.05
30	248.36	47.87
31	251.36	51.88
32	254.11	56.05
33	254.63	56.95

Circle Center At X = 180.6 ; Y = 101.6 and Radius, 86.4

*** 14.931 ***

1

Failure Surface Specified By 25 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	141.11	40.00
2	145.42	37.46
3	149.88	35.20
4	154.47	33.21
5	159.17	31.51
6	163.97	30.11
7	168.84	29.01
8	173.78	28.21
9	178.76	27.71
10	183.75	27.53
11	188.75	27.65
12	193.73	28.09
13	198.68	28.83
14	203.57	29.87
15	208.38	31.22
16	213.10	32.86
17	217.72	34.79
18	222.20	37.00
19	226.54	39.49
20	230.72	42.24
21	234.71	45.24
22	238.52	48.48
23	242.12	51.96
24	245.49	55.64
25	247.87	58.59

Circle Center At X = 184.2 ; Y = 108.3 and Radius, 80.8

*** 14.939 ***

Failure Surface Specified By 30 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	130.56	40.00
2	134.61	37.07
3	138.82	34.38
4	143.17	31.92
5	147.66	29.71
6	152.26	27.75
7	156.96	26.05
8	161.75	24.61
9	166.61	23.45
10	171.53	22.55
11	176.49	21.94
12	181.48	21.60
13	186.48	21.53
14	191.48	21.75
15	196.45	22.24
16	201.39	23.01
17	206.28	24.06
18	211.11	25.37
19	215.85	26.96
20	220.50	28.80
21	225.04	30.90
22	229.45	33.25
23	233.73	35.84
24	237.85	38.67
25	241.81	41.72
26	245.60	44.98
27	249.19	48.46
28	252.59	52.12
29	255.78	55.97
30	256.07	56.37

Circle Center At X = 185.1 ; Y = 111.3 and Radius, 89.7

*** 15.004 ***

1

Failure Surface Specified By 31 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	120.00	40.00
2	123.54	36.46
3	127.30	33.17
4	131.27	30.14
5	135.44	27.37
6	139.78	24.89
7	144.28	22.71
8	148.91	20.83
9	153.66	19.26
10	158.50	18.01

11	163.41	17.08
12	168.38	16.49
13	173.37	16.23
14	178.37	16.29
15	183.35	16.70
16	188.30	17.43
17	193.19	18.49
18	197.99	19.87
19	202.69	21.57
20	207.27	23.58
21	211.71	25.89
22	215.98	28.49
23	220.07	31.37
24	223.96	34.51
25	227.63	37.90
26	231.06	41.54
27	234.25	45.39
28	237.17	49.45
29	239.82	53.69
30	242.18	58.10
31	242.74	59.32

Circle Center At X = 174.8 ; Y = 91.3 and Radius, 75.1

*** 15.049 ***

Failure Surface Specified By 31 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	130.56	40.00
2	134.24	36.62
3	138.12	33.46
4	142.18	30.54
5	146.40	27.87
6	150.79	25.46
7	155.30	23.32
8	159.94	21.46
9	164.68	19.87
10	169.51	18.57
11	174.41	17.57
12	179.36	16.86
13	184.34	16.45
14	189.34	16.34
15	194.34	16.52
16	199.31	17.01
17	204.25	17.80
18	209.13	18.88
19	213.94	20.26
20	218.66	21.91
21	223.27	23.85
22	227.75	26.07
23	232.09	28.55
24	236.28	31.28
25	240.29	34.26
26	244.12	37.48
27	247.75	40.92
28	251.16	44.57

29	254.35	48.42
30	257.31	52.46
31	259.06	55.18

Circle Center At X = 188.7 ; Y = 99.6 and Radius, 83.2

*** 15.137 ***

1

```
              Y            A     X     I     S            F     T

                .00     48.38     96.75    145.13    193.50    241.88
X          .00 +--------*+---------+---------+---------+---------+
               -
               -
               -
               -
               -        *
         48.38 +
               -        *
               -
               -       *
               -
               -
A        96.75 +
               -
               -
               -       6
               -     661
               -    6611
X       145.13 +   9613*
               -   6137.
               -  61157.*
               -  6137..*
               -  2187...*
               -  21.7...*
I       193.50 +  6187...*
               -  .217....*
               -  .2117...**
               -   4217....*
               -   .2211....
               -    .42511..
S       241.88 +     .02221*
               -      0422*
               -       .0**
               -         *
               -        *
               -
        290.25 +
               -
               -        *
               -
               -
               -
F       338.63 +
               -        *
               -
```

```
                    -
                    -        *
                    -
          T    387.00 +       *
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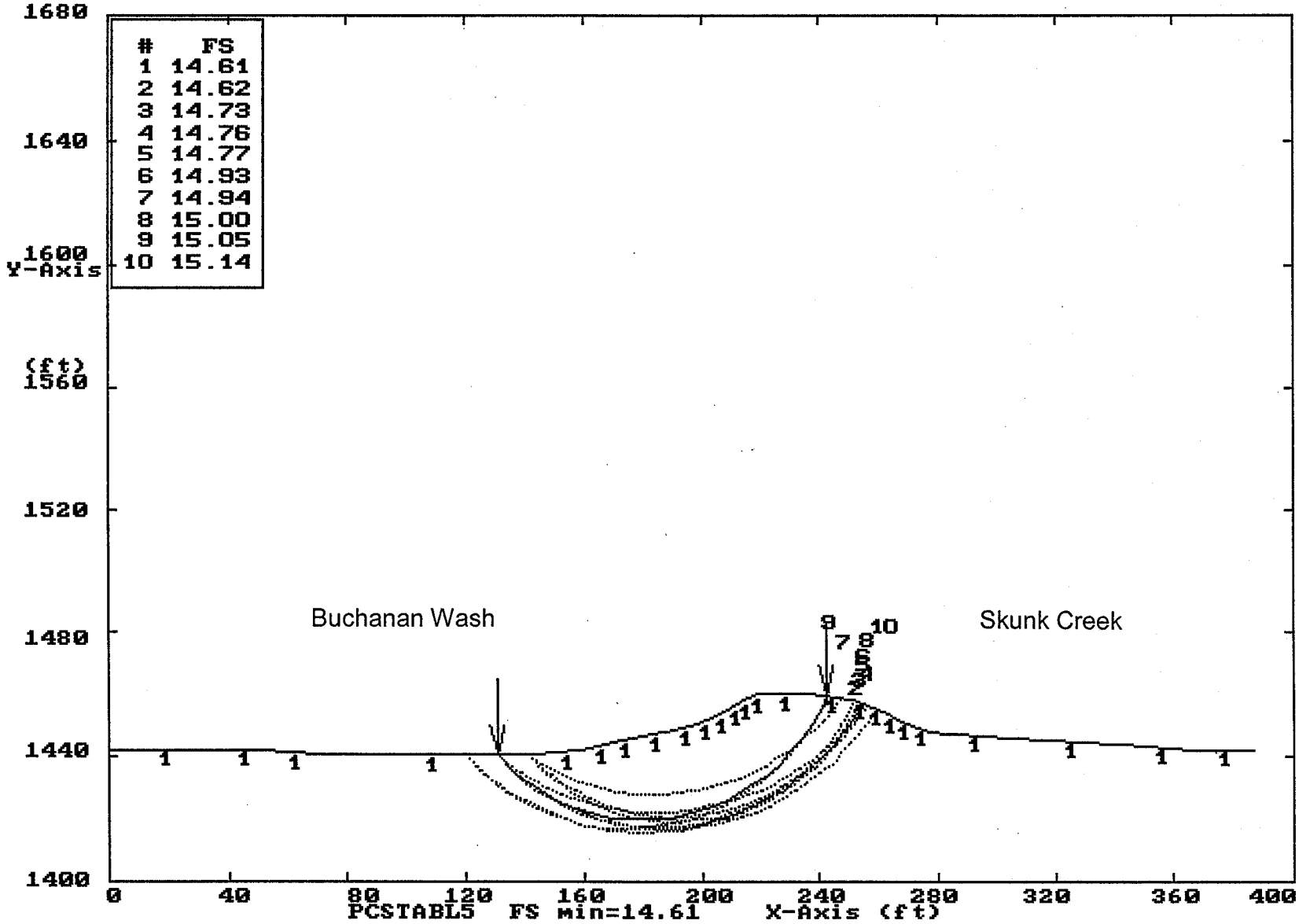
Skunk Creek, circular failure in BW, piezometric head = 11'; rapid drawdown
Ten Most Critical. C:SKALT1E.PLT By: acb 05-07-03 2:34pm



SKALT1F.OUT
** PCSTABL5 **

by
Purdue University

1

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date: 05-07-03
Time of Run: 2:35pm
Run By: acb
Input Data Filename: C:SKALT1F.DAT
Output Filename: C:SKALT1F.OUT
Plotted Output Filename: C:SKALT1F.PLT

PROBLEM DESCRIPTION Skunk Creek, circular failure in SC;
piezometric head = 11'; rapid drawdown

BOUNDARY COORDINATES

25 Top Boundaries
25 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	42.00	18.00	42.00	1
2	18.00	42.00	43.00	44.00	1
3	43.00	44.00	79.00	46.00	1
4	79.00	46.00	109.00	48.00	1
5	109.00	48.00	115.00	50.00	1
6	115.00	50.00	120.00	52.00	1
7	120.00	52.00	125.00	54.00	1
8	125.00	54.00	130.00	56.00	1
9	130.00	56.00	135.00	58.00	1
10	135.00	58.00	149.00	60.00	1
11	149.00	60.00	167.00	60.00	1
12	167.00	60.00	172.00	58.00	1
13	172.00	58.00	176.00	56.00	1
14	176.00	56.00	179.00	54.00	1
15	179.00	54.00	185.00	52.00	1
16	185.00	52.00	190.00	50.00	1
17	190.00	50.00	195.00	48.00	1
18	195.00	48.00	210.00	46.00	1
19	210.00	46.00	219.00	44.00	1
20	219.00	44.00	227.00	42.00	1
21	227.00	42.00	242.00	40.00	1
22	242.00	40.00	314.00	40.00	1
23	314.00	40.00	334.00	42.00	1
24	334.00	42.00	349.00	42.00	1
25	349.00	42.00	387.00	42.00	1

1

ISOTROPIC SOIL PARAMETERS

1 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	140.5	150.8	4120.0	35.1	.00	11.0	0

1

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Circular Surfaces, Has Been Specified.

100 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 10 Points Equally Spaced Along The Ground Surface Between X = .00 ft.
and X = 115.00 ft.

Each Surface Terminates Between X = 149.00 ft.
and X = 167.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is Y = .00 ft.

10.00 ft. Line Segments Define Each Trial Failure Surface.

1

Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Bishop Method * *

Failure Surface Specified By 12 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	76.67	45.87
2	83.77	38.83
3	92.09	33.29
4	101.33	29.47
5	111.14	27.50
6	121.14	27.47
7	130.96	29.37
8	140.22	33.13
9	148.59	38.61

10	155.73	45.61
11	161.39	53.85
12	164.04	60.00

Circle Center At X = 116.3 ; Y = 78.7 and Radius, 51.5

*** 18.663 ***

Failure Surface Specified By 10 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	89.44	46.70
2	97.11	40.28
3	106.02	35.74
4	115.72	33.31
5	125.72	33.11
6	135.51	35.16
7	144.59	39.36
8	152.49	45.48
9	158.83	53.21
10	162.20	60.00

Circle Center At X = 121.6 ; Y = 77.3 and Radius, 44.3

*** 18.744 ***

1

Failure Surface Specified By 10 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	89.44	46.70
2	96.85	39.97
3	105.64	35.20
4	115.31	32.66
5	125.31	32.49
6	135.06	34.71
7	144.00	39.18
8	151.62	45.65
9	157.49	53.75
10	160.03	60.00

Circle Center At X = 121.0 ; Y = 74.0 and Radius, 41.7

*** 18.822 ***

Failure Surface Specified By 10 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	89.44	46.70
2	96.53	39.64
3	105.12	34.53
4	114.71	31.68
5	124.70	31.26
6	134.49	33.31
7	143.48	37.69
8	151.12	44.13
9	156.96	52.26
10	160.01	60.00

Circle Center At X = 121.4 ; Y = 71.7 and Radius, 40.5

*** 18.956 ***

1

Failure Surface Specified By 10 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	89.44	46.70
2	96.68	39.80
3	105.42	34.93
4	115.10	32.41
5	125.10	32.40
6	134.78	34.89
7	143.54	39.72
8	150.80	46.60
9	156.10	55.07
10	157.66	60.00

Circle Center At X = 120.2 ; Y = 71.7 and Radius, 39.6

*** 18.967 ***

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	63.89	45.16
2	71.16	38.29
3	79.48	32.75
4	88.62	28.69
5	98.31	26.23
6	108.28	25.45
7	118.24	26.35
8	127.90	28.93
9	136.99	33.10
10	145.25	38.75
11	152.43	45.70

12	158.33	53.77
13	161.44	60.00

Circle Center At X = 107.9 ; Y = 84.5 and Radius, 59.0

*** 19.220 ***

1

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	51.11	44.45
2	58.25	37.45
3	66.31	31.53
4	75.13	26.82
5	84.53	23.40
6	94.32	21.36
7	104.30	20.73
8	114.27	21.53
9	124.02	23.73
10	133.37	27.30
11	142.11	32.15
12	150.07	38.20
13	157.09	45.32
14	163.03	53.37
15	166.60	60.00

Circle Center At X = 103.7 ; Y = 90.9 and Radius, 70.2

*** 19.286 ***

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	51.11	44.45
2	58.36	37.56
3	66.50	31.75
4	75.38	27.15
5	84.82	23.85
6	94.63	21.90
7	104.61	21.35
8	114.57	22.21
9	124.32	24.47
10	133.64	28.07
11	142.37	32.95
12	150.33	39.00
13	157.36	46.12
14	163.31	54.15
15	166.48	60.00

Circle Center At X = 103.5 ; Y = 92.3 and Radius, 70.9

*** 19.291 ***

1

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	76.67	45.87
2	85.16	40.59
3	94.40	36.76
4	104.13	34.48
5	114.11	33.80
6	124.07	34.74
7	133.74	37.28
8	142.87	41.36
9	151.22	46.85
10	158.57	53.63
11	163.55	60.00

Circle Center At X = 113.3 ; Y = 95.4 and Radius, 61.6

*** 19.332 ***

Failure Surface Specified By 10 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	89.44	46.70
2	98.09	41.67
3	107.56	38.45
4	117.47	37.14
5	127.45	37.81
6	137.10	40.43
7	146.05	44.89
8	153.95	51.02
9	160.49	58.58
10	161.29	60.00

Circle Center At X = 119.1 ; Y = 87.8 and Radius, 50.7

*** 19.340 ***

1

Y	A	X	I	S	F	T
.00	48.38	96.75	145.13	193.50	241.88	

```
X        .00 +--------*+---------+---------+---------+---------+
             -       ..
             -      ...*
             -     .....
             -    .....
             -   ......*
       48.38 + .... ..7
             -   .....7
             - .....7.6
             - ....7.6.
             - ...7.611*
             - ...8619.2
A      96.75 +  .76..20.
             -  .76120..
             -  .7812..*
             -   .6190..*
             -    .120..**
             -     719...*
X    145.13 +      719..*
             -      7154.
             -        811
             -          *
             -         **
             -         *
I    193.50 +        *
             -
             -        *
             -       *
             -       *
             -
S    241.88 +      *
             -
             -
             -
             -
             -
       290.25 +
             -
             -
             -      *
             -
             -       *
F    338.63 +
             -       *
             -
             -
             -
             -
T    387.00 +       *
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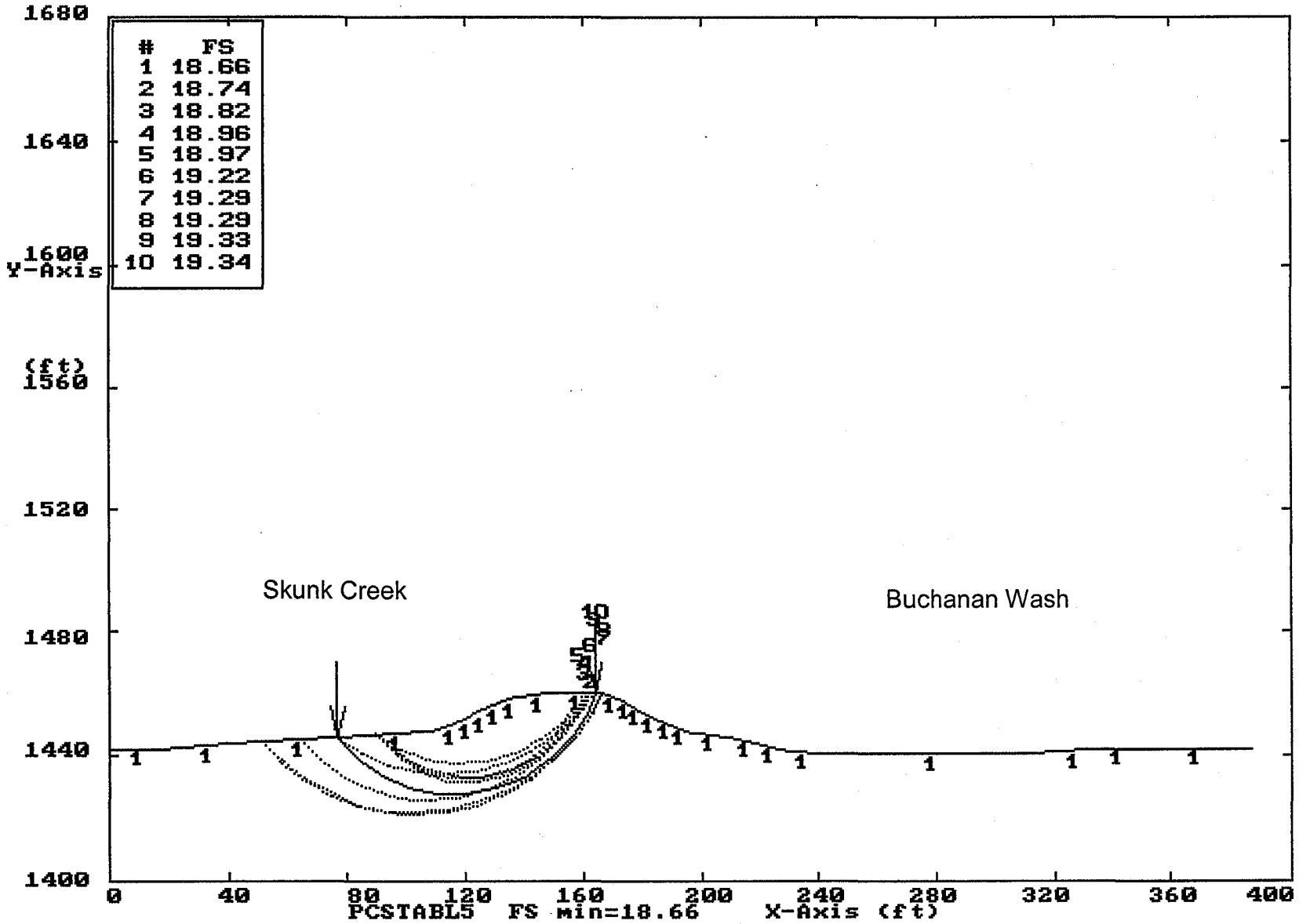
Skunk Creek, circular failure in SC; piezometric head = 11'; rapid drawdown
Ten Most Critical. C:SKALT1F.PLT By: acb 05-07-03 2:35pm



SKALT1G.OUT
** PCSTABL5 **

by
Purdue University

1

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date:	05-07-03
Time of Run:	3:44pm
Run By:	acb
Input Data Filename:	C:SKALT1G.DAT
Output Filename:	C:SKALT1G.OUT
Plotted Output Filename:	C:SKALT1G.PLT

PROBLEM DESCRIPTION Skunk Creek, circular failure in BW, piezometric surface; rapid drawdown

BOUNDARY COORDINATES

25 Top Boundaries
25 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	42.00	38.00	42.00	1
2	38.00	42.00	53.00	42.00	1
3	53.00	42.00	73.00	40.00	1
4	73.00	40.00	145.00	40.00	1
5	145.00	40.00	160.00	42.00	1
6	160.00	42.00	168.00	44.00	1
7	168.00	44.00	177.00	46.00	1
8	177.00	46.00	188.00	48.00	1
9	188.00	48.00	197.00	50.00	1
10	197.00	50.00	202.00	52.00	1
11	202.00	52.00	208.00	54.00	1
12	208.00	54.00	211.00	56.00	1
13	211.00	56.00	215.00	58.00	1
14	215.00	58.00	220.00	60.00	1
15	220.00	60.00	238.00	60.00	1
16	238.00	60.00	252.00	58.00	1
17	252.00	58.00	257.00	56.00	1
18	257.00	56.00	262.00	54.00	1
19	262.00	54.00	267.00	52.00	1
20	267.00	52.00	272.00	50.00	1
21	272.00	50.00	278.00	48.00	1
22	278.00	48.00	308.00	46.00	1
23	308.00	46.00	344.00	44.00	1
24	344.00	44.00	369.00	42.00	1
25	369.00	42.00	387.00	42.00	1

1

ISOTROPIC SOIL PARAMETERS

1 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	140.5	150.8	4120.0	35.1	.00	.0	0

1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 62.40

Piezometric Surface No. 1 Specified by 15 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	38.00	42.00
2	53.00	42.00
3	73.00	40.00
4	145.00	40.00
5	160.00	42.00
6	168.00	44.00
7	177.00	46.00
8	188.00	48.00
9	197.00	50.00
10	202.00	52.00
11	205.00	53.00
12	264.00	53.00
13	267.00	52.00
14	272.00	50.00
15	278.00	48.00

1

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Circular Surfaces, Has Been Specified.

100 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 10 Points Equally Spaced Along The Ground Surface Between X = 120.00 ft.
and X = 215.00 ft.

Each Surface Terminates Between X = 220.00 ft.
and X = 262.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation

At Which A Surface Extends Is Y = .00 ft.

5.00 ft. Line Segments Define Each Trial Failure Surface.

The Factor Of Safety For The Trial Failure Surface Defined By The Coordinates Listed Below Is Misleading.

Failure Surface Defined By 10 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	215.00	58.00
2	218.68	54.61
3	222.90	51.94
4	227.53	50.05
5	232.43	49.02
6	237.43	48.88
7	242.37	49.63
8	247.10	51.25
9	251.47	53.69
10	255.18	56.73

Factor Of Safety For The Preceding Specified Surface =*******

1

Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Bishop Method * *

Failure Surface Specified By 28 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	130.56	40.00
2	134.18	36.56
3	138.04	33.38
4	142.13	30.50
5	146.41	27.91
6	150.87	25.65
7	155.48	23.71
8	160.21	22.11
9	165.05	20.86
10	169.97	19.97
11	174.94	19.43
12	179.94	19.25
13	184.94	19.43

14	189.91	19.98
15	194.83	20.88
16	199.66	22.14
17	204.40	23.74
18	209.01	25.69
19	213.46	27.96
20	217.74	30.55
21	221.82	33.44
22	225.68	36.62
23	229.30	40.07
24	232.66	43.77
25	235.74	47.70
26	238.53	51.85
27	241.02	56.19
28	242.53	59.35

Circle Center At X = 179.9 ; Y = 88.3 and Radius, 69.0

*** 14.633 ***

Failure Surface Specified By 30 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	130.56	40.00
2	134.11	36.48
3	137.89	33.21
4	141.88	30.19
5	146.06	27.45
6	150.41	24.99
7	154.92	22.83
8	159.56	20.97
9	164.32	19.43
10	169.17	18.20
11	174.08	17.31
12	179.05	16.74
13	184.05	16.50
14	189.04	16.60
15	194.03	17.02
16	198.97	17.78
17	203.85	18.87
18	208.65	20.28
19	213.34	22.01
20	217.91	24.04
21	222.33	26.38
22	226.58	29.00
23	230.66	31.90
24	234.53	35.07
25	238.18	38.49
26	241.59	42.14
27	244.75	46.01
28	247.65	50.08
29	250.27	54.34
30	252.17	57.93

Circle Center At X = 185.1 ; Y = 91.5 and Radius, 75.0

*** 14.641 ***

1

Failure Surface Specified By 28 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	141.11	40.00
2	144.69	36.51
3	148.51	33.28
4	152.55	30.34
5	156.80	27.70
6	161.22	25.37
7	165.80	23.37
8	170.52	21.70
9	175.34	20.38
10	180.24	19.41
11	185.21	18.79
12	190.20	18.54
13	195.20	18.65
14	200.18	19.12
15	205.11	19.95
16	209.97	21.13
17	214.73	22.66
18	219.36	24.53
19	223.85	26.73
20	228.17	29.25
21	232.30	32.07
22	236.21	35.18
23	239.89	38.57
24	243.31	42.22
25	246.46	46.10
26	249.32	50.20
27	251.88	54.50
28	253.36	57.46

Circle Center At X = 191.2 ; Y = 87.7 and Radius, 69.2

*** 14.751 ***

Failure Surface Specified By 31 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	130.56	40.00
2	134.20	36.57
3	138.05	33.39
4	142.09	30.45
5	146.32	27.77
6	150.70	25.36
7	155.23	23.24
8	159.88	21.40
9	164.63	19.86
10	169.48	18.63

11	174.39	17.70
12	179.36	17.09
13	184.35	16.79
14	189.35	16.81
15	194.34	17.14
16	199.29	17.78
17	204.20	18.74
18	209.04	20.01
19	213.79	21.57
20	218.43	23.44
21	222.94	25.59
22	227.31	28.03
23	231.51	30.73
24	235.54	33.70
25	239.37	36.91
26	242.99	40.36
27	246.38	44.03
28	249.54	47.90
29	252.45	51.97
30	255.09	56.22
31	255.33	56.67

Circle Center At X = 186.6 ; Y = 95.9 and Radius, 79.2

*** 14.778 ***

1

Failure Surface Specified By 28 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	141.11	40.00
2	144.86	36.69
3	148.82	33.64
4	152.98	30.87
5	157.33	28.39
6	161.83	26.22
7	166.47	24.36
8	171.23	22.83
9	176.08	21.62
10	181.01	20.75
11	185.98	20.22
12	190.97	20.03
13	195.97	20.19
14	200.95	20.69
15	205.88	21.52
16	210.74	22.70
17	215.51	24.20
18	220.16	26.03
19	224.68	28.17
20	229.04	30.62
21	233.22	33.36
22	237.20	36.39
23	240.97	39.67
24	244.50	43.21
25	247.78	46.99
26	250.79	50.98
27	253.53	55.16

28	254.55	56.98

Circle Center At X = 191.2 ; Y = 92.9 and Radius, 72.8

*** 14.784 ***

Failure Surface Specified By 33 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	120.00	40.00
2	123.66	36.60
3	127.52	33.41
4	131.55	30.45
5	135.75	27.73
6	140.09	25.26
7	144.57	23.05
8	149.18	21.09
9	153.88	19.41
10	158.68	18.00
11	163.55	16.87
12	168.48	16.02
13	173.45	15.46
14	178.44	15.19
15	183.44	15.21
16	188.43	15.51
17	193.39	16.11
18	198.32	16.99
19	203.18	18.15
20	207.97	19.59
21	212.66	21.31
22	217.25	23.29
23	221.72	25.54
24	226.05	28.04
25	230.22	30.79
26	234.24	33.78
27	238.07	36.99
28	241.71	40.42
29	245.14	44.05
30	248.36	47.87
31	251.36	51.88
32	254.11	56.05
33	254.63	56.95

Circle Center At X = 180.6 ; Y = 101.6 and Radius, 86.4

*** 14.949 ***

1

Failure Surface Specified By 25 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)

1	141.11	40.00
2	145.42	37.46
3	149.88	35.20
4	154.47	33.21
5	159.17	31.51
6	163.97	30.11
7	168.84	29.01
8	173.78	28.21
9	178.76	27.71
10	183.75	27.53
11	188.75	27.65
12	193.73	28.09
13	198.68	28.83
14	203.57	29.87
15	208.38	31.22
16	213.10	32.86
17	217.72	34.79
18	222.20	37.00
19	226.54	39.49
20	230.72	42.24
21	234.71	45.24
22	238.52	48.48
23	242.12	51.96
24	245.49	55.64
25	247.87	58.59

Circle Center At X = 184.2 ; Y = 108.3 and Radius, 80.8

*** 14.960 ***

Failure Surface Specified By 30 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	130.56	40.00
2	134.61	37.07
3	138.82	34.38
4	143.17	31.92
5	147.66	29.71
6	152.26	27.75
7	156.96	26.05
8	161.75	24.61
9	166.61	23.45
10	171.53	22.55
11	176.49	21.94
12	181.48	21.60
13	186.48	21.53
14	191.48	21.75
15	196.45	22.24
16	201.39	23.01
17	206.28	24.06
18	211.11	25.37
19	215.85	26.96
20	220.50	28.80
21	225.04	30.90
22	229.45	33.25
23	233.73	35.84
24	237.85	38.67

25	241.81	41.72
26	245.60	44.98
27	249.19	48.46
28	252.59	52.12
29	255.78	55.97
30	256.07	56.37

Circle Center At X = 185.1 ; Y = 111.3 and Radius, 89.7

*** 15.023 ***

1

Failure Surface Specified By 31 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	120.00	40.00
2	123.54	36.46
3	127.30	33.17
4	131.27	30.14
5	135.44	27.37
6	139.78	24.89
7	144.28	22.71
8	148.91	20.83
9	153.66	19.26
10	158.50	18.01
11	163.41	17.08
12	168.38	16.49
13	173.37	16.23
14	178.37	16.29
15	183.35	16.70
16	188.30	17.43
17	193.19	18.49
18	197.99	19.87
19	202.69	21.57
20	207.27	23.58
21	211.71	25.89
22	215.98	28.49
23	220.07	31.37
24	223.96	34.51
25	227.63	37.90
26	231.06	41.54
27	234.25	45.39
28	237.17	49.45
29	239.82	53.69
30	242.18	58.10
31	242.74	59.32

Circle Center At X = 174.8 ; Y = 91.3 and Radius, 75.1

*** 15.068 ***

Failure Surface Specified By 31 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	130.56	40.00
2	134.24	36.62
3	138.12	33.46
4	142.18	30.54
5	146.40	27.87
6	150.79	25.46
7	155.30	23.32
8	159.94	21.46
9	164.68	19.87
10	169.51	18.57
11	174.41	17.57
12	179.36	16.86
13	184.34	16.45
14	189.34	16.34
15	194.34	16.52
16	199.31	17.01
17	204.25	17.80
18	209.13	18.88
19	213.94	20.26
20	218.66	21.91
21	223.27	23.85
22	227.75	26.07
23	232.09	28.55
24	236.28	31.28
25	240.29	34.26
26	244.12	37.48
27	247.75	40.92
28	251.16	44.57
29	254.35	48.42
30	257.31	52.46
31	259.06	55.18

Circle Center At X = 188.7 ; Y = 99.6 and Radius, 83.2

*** 15.156 ***

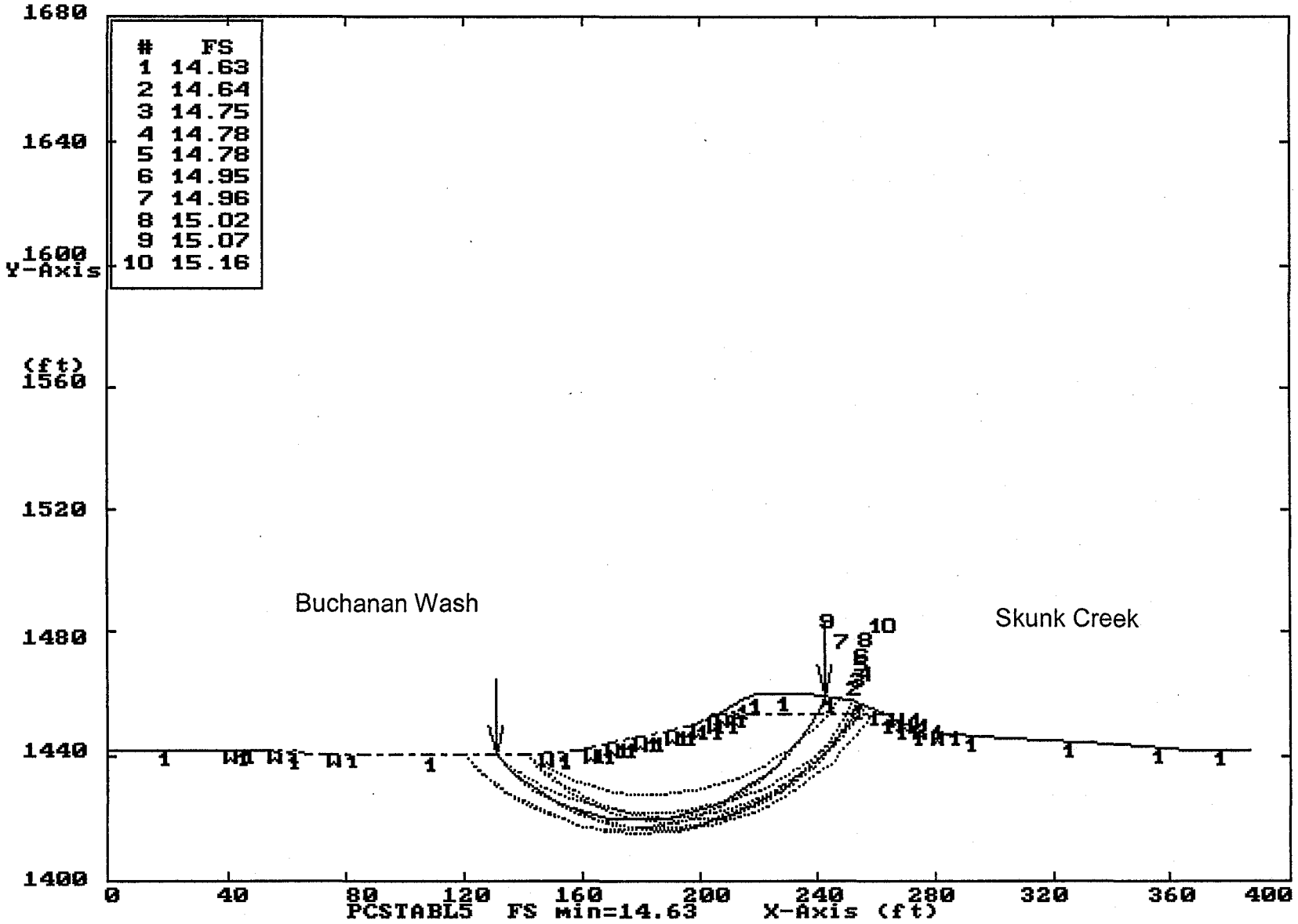
1

```
                Y            A     X     I     S            F     T

                .00     48.38     96.75    145.13    193.50    241.88
X          .00 +--------*+---------+---------+---------+---------+
                -
                -
                -
                -
                -        *
        48.38 +
                -        *
                -
                -       *
                -
                -
A       96.75 +
                -
```

```
                 -
                 -       6
                 -     661
                 -    6611
X     145.13 +   9613*
                 -   6137.
                 -  61157.*
                 -  6137..*
                 -  2187...*
                 -  21.7...*
I     193.50 +  6187...*
                 -  .217....*
                 -  .2117...**
                 -   4217....*
                 -   .2211....
                 -    .42511..
S     241.88 +     .02221*
                 -       0422*
                 -        .0**
                 -          *
                 -         *
                 -
      290.25 +
                 -
                 -         *
                 -
                 -
                 -
F     338.63 +
                 -        *
                 -
                 -
                 -        *
                 -
T     387.00 +        *
```

Skunk Creek, circular failure in BW, piezometric surface; rapid drawdown
Ten Most Critical. C:SKALT1G.PLT By: acb 05-07-03 3:44pm



SKALT1H.OUT
** PCSTABL5 **

by
Purdue University

1

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date:	05-07-03
Time of Run:	3:44pm
Run By:	acb
Input Data Filename:	C:SKALT1H.DAT
Output Filename:	C:SKALT1H.OUT
Plotted Output Filename:	C:SKALT1H.PLT

PROBLEM DESCRIPTION Skunk Creek, circular failure in SC; piezometric surface; rapid drawdown

BOUNDARY COORDINATES

25 Top Boundaries
25 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	42.00	18.00	42.00	1
2	18.00	42.00	43.00	44.00	1
3	43.00	44.00	79.00	46.00	1
4	79.00	46.00	109.00	48.00	1
5	109.00	48.00	115.00	50.00	1
6	115.00	50.00	120.00	52.00	1
7	120.00	52.00	125.00	54.00	1
8	125.00	54.00	130.00	56.00	1
9	130.00	56.00	135.00	58.00	1
10	135.00	58.00	149.00	60.00	1
11	149.00	60.00	167.00	60.00	1
12	167.00	60.00	172.00	58.00	1
13	172.00	58.00	176.00	56.00	1
14	176.00	56.00	179.00	54.00	1
15	179.00	54.00	185.00	52.00	1
16	185.00	52.00	190.00	50.00	1
17	190.00	50.00	195.00	48.00	1
18	195.00	48.00	210.00	46.00	1
19	210.00	46.00	219.00	44.00	1
20	219.00	44.00	227.00	42.00	1
21	227.00	42.00	242.00	40.00	1
22	242.00	40.00	314.00	40.00	1
23	314.00	40.00	334.00	42.00	1
24	334.00	42.00	349.00	42.00	1
25	349.00	42.00	387.00	42.00	1

1

ISOTROPIC SOIL PARAMETERS

1 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	140.5	150.8	4120.0	35.1	.00	.0	0

1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 62.40

Piezometric Surface No. 1 Specified by 13 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	122.00	53.00
2	182.00	53.00
3	185.00	52.00
4	190.00	50.00
5	195.00	48.00
6	210.00	46.00
7	219.00	44.00
8	227.00	42.00
9	242.00	40.00
10	314.00	40.00
11	334.00	42.00
12	349.00	42.00
13	387.00	42.00

1

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Circular Surfaces, Has Been Specified.

100 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 10 Points Equally Spaced Along The Ground Surface Between X = .00 ft.
and X = 115.00 ft.

Each Surface Terminates Between X = 149.00 ft.
and X = 167.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is Y = .00 ft.

10.00 ft. Line Segments Define Each Trial Failure Surface.

1

Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Bishop Method * *

Failure Surface Specified By 12 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	76.67	45.87
2	83.77	38.83
3	92.09	33.29
4	101.33	29.47
5	111.14	27.50
6	121.14	27.47
7	130.96	29.37
8	140.22	33.13
9	148.59	38.61
10	155.73	45.61
11	161.39	53.85
12	164.04	60.00

Circle Center At X = 116.3 ; Y = 78.7 and Radius, 51.5

*** 18.688 ***

Failure Surface Specified By 10 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	89.44	46.70
2	97.11	40.28
3	106.02	35.74
4	115.72	33.31
5	125.72	33.11
6	135.51	35.16
7	144.59	39.36
8	152.49	45.48
9	158.83	53.21
10	162.20	60.00

Circle Center At X = 121.6 ; Y = 77.3 and Radius, 44.3

*** 18.771 ***

1

Failure Surface Specified By 10 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	89.44	46.70
2	96.85	39.97
3	105.64	35.20
4	115.31	32.66
5	125.31	32.49
6	135.06	34.71
7	144.00	39.18
8	151.62	45.65
9	157.49	53.75
10	160.03	60.00

Circle Center At X = 121.0 ; Y = 74.0 and Radius, 41.7

*** 18.849 ***

Failure Surface Specified By 10 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	89.44	46.70
2	96.53	39.64
3	105.12	34.53
4	114.71	31.68
5	124.70	31.26
6	134.49	33.31
7	143.48	37.69
8	151.12	44.13
9	156.96	52.26
10	160.01	60.00

Circle Center At X = 121.4 ; Y = 71.7 and Radius, 40.5

*** 18.983 ***

1

Failure Surface Specified By 10 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	89.44	46.70
2	96.68	39.80
3	105.42	34.93
4	115.10	32.41
5	125.10	32.40
6	134.78	34.89

7	143.54	39.72
8	150.80	46.60
9	156.10	55.07
10	157.66	60.00

Circle Center At X = 120.2 ; Y = 71.7 and Radius, 39.6

*** 18.994 ***

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	63.89	45.16
2	71.16	38.29
3	79.48	32.75
4	88.62	28.69
5	98.31	26.23
6	108.28	25.45
7	118.24	26.35
8	127.90	28.93
9	136.99	33.10
10	145.25	38.75
11	152.43	45.70
12	158.33	53.77
13	161.44	60.00

Circle Center At X = 107.9 ; Y = 84.5 and Radius, 59.0

*** 19.245 ***

1

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	51.11	44.45
2	58.25	37.45
3	66.31	31.53
4	75.13	26.82
5	84.53	23.40
6	94.32	21.36
7	104.30	20.73
8	114.27	21.53
9	124.02	23.73
10	133.37	27.30
11	142.11	32.15
12	150.07	38.20
13	157.09	45.32
14	163.03	53.37
15	166.60	60.00

Circle Center At X = 103.7 ; Y = 90.9 and Radius, 70.2

*** 19.311 ***

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	51.11	44.45
2	58.36	37.56
3	66.50	31.75
4	75.38	27.15
5	84.82	23.85
6	94.63	21.90
7	104.61	21.35
8	114.57	22.21
9	124.32	24.47
10	133.64	28.07
11	142.37	32.95
12	150.33	39.00
13	157.36	46.12
14	163.31	54.15
15	166.48	60.00

Circle Center At X = 103.5 ; Y = 92.3 and Radius, 70.9

*** 19.316 ***

1

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	76.67	45.87
2	85.16	40.59
3	94.40	36.76
4	104.13	34.48
5	114.11	33.80
6	124.07	34.74
7	133.74	37.28
8	142.87	41.36
9	151.22	46.85
10	158.57	53.63
11	163.55	60.00

Circle Center At X = 113.3 ; Y = 95.4 and Radius, 61.6

*** 19.360 ***

Failure Surface Specified By 10 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	89.44	46.70
2	98.09	41.67
3	107.56	38.45
4	117.47	37.14
5	127.45	37.81
6	137.10	40.43
7	146.05	44.89
8	153.95	51.02
9	160.49	58.58
10	161.29	60.00

Circle Center At X = 119.1 ; Y = 87.8 and Radius, 50.7

*** 19.369 ***

1

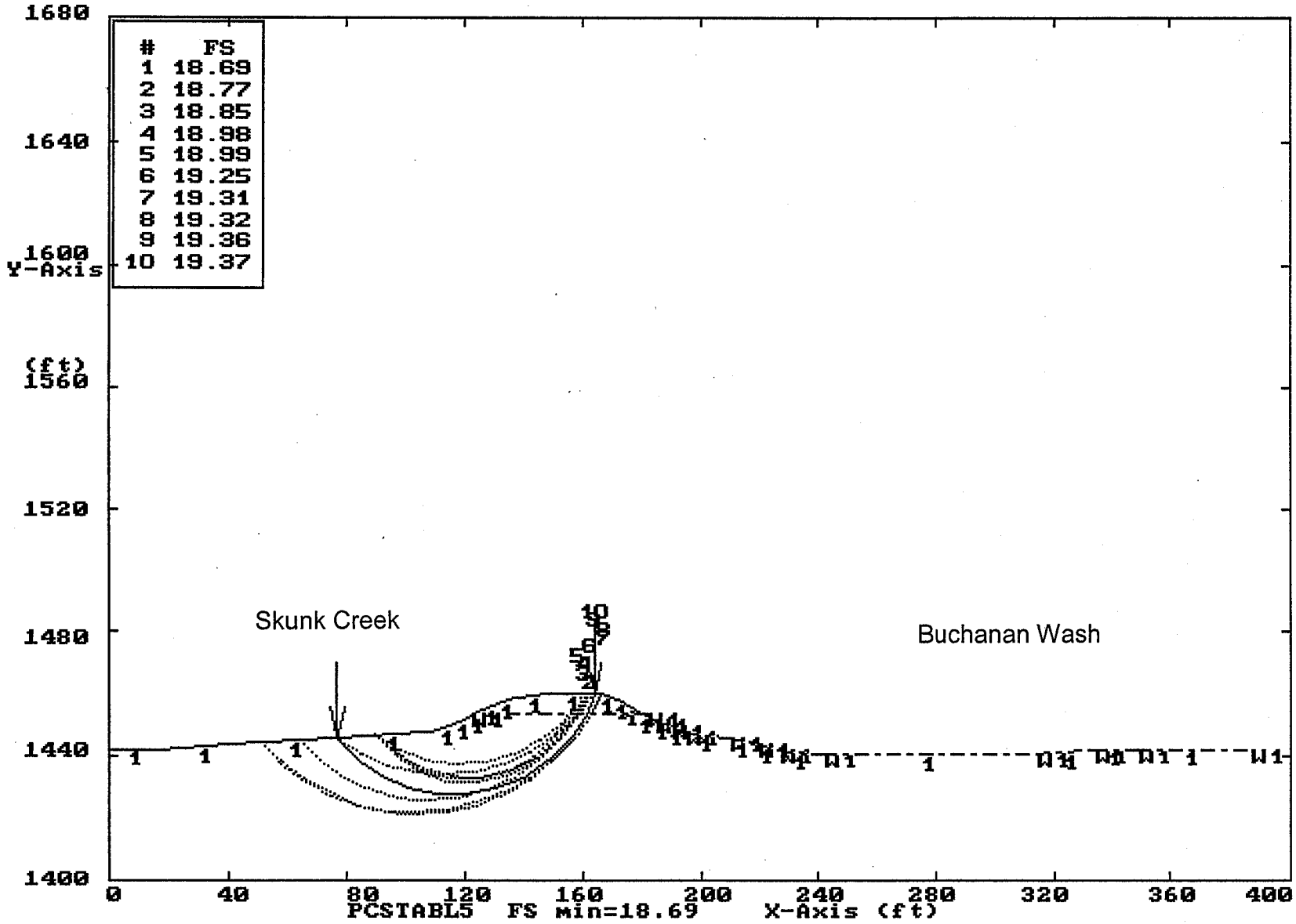
```
            Y            A     X     I     S            F     T

            .00     48.38     96.75    145.13    193.50    241.88

X        .00 +--------*+---------+---------+---------+---------+
            -       ..
            -      ...*
            -     .....
            -    .....
            -   ......*
      48.38 + .... ..7
            -  .....7
            - .....7.6
            - ....7.6.
            - ...7.611*
            - ...8619.2
A     96.75 +  .76..20.
            -  .76120..
            -  .7812..*
            -   .6190..*
            -    .120..**
            -     719...*
X    145.13 +      719..*
            -       7154.
            -         811
            -           *
            -          **
            -          *
I    193.50 +         *
            -
            -         *
            -        *
            -        *
            -
S    241.88 +       *
            -
            -
            -
```

```
                  -
                  -
        290.25 +
                  -
                  -
                  -        *
                  -
                  -         *
   F    338.63 +
                  -         *
                  -
                  -
                  -
                  -
   T    387.00 +          *
```

Skunk Creek, circular failure in SC; piezometric surface; rapid drawdown
Ten Most Critical. C:SKALTIA.PLT By: acb 05-07-03 3:44pm



SKALT1ES.OUT
** PCSTABL5 **

by
Purdue University

1

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date:	06-02-03
Time of Run:	12:36pm
Run By:	acb
Input Data Filename:	C:SKALT1ES.DAT
Output Filename:	C:SKALT1ES.OUT
Plotted Output Filename:	C:SKALT1ES.PLT

PROBLEM DESCRIPTION Skunk Creek, circular failure in BW, piez head = 11'; rapid dd, sen. analys.

BOUNDARY COORDINATES

25 Top Boundaries
25 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	42.00	38.00	42.00	1
2	38.00	42.00	53.00	42.00	1
3	53.00	42.00	73.00	40.00	1
4	73.00	40.00	145.00	40.00	1
5	145.00	40.00	160.00	42.00	1
6	160.00	42.00	168.00	44.00	1
7	168.00	44.00	177.00	46.00	1
8	177.00	46.00	188.00	48.00	1
9	188.00	48.00	197.00	50.00	1
10	197.00	50.00	202.00	52.00	1
11	202.00	52.00	208.00	54.00	1
12	208.00	54.00	211.00	56.00	1
13	211.00	56.00	215.00	58.00	1
14	215.00	58.00	220.00	60.00	1
15	220.00	60.00	238.00	60.00	1
16	238.00	60.00	252.00	58.00	1
17	252.00	58.00	257.00	56.00	1
18	257.00	56.00	262.00	54.00	1
19	262.00	54.00	267.00	52.00	1
20	267.00	52.00	272.00	50.00	1
21	272.00	50.00	278.00	48.00	1
22	278.00	48.00	308.00	46.00	1
23	308.00	46.00	344.00	44.00	1
24	344.00	44.00	369.00	42.00	1
25	369.00	42.00	387.00	42.00	1

1

ISOTROPIC SOIL PARAMETERS

1 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	140.5	150.8	500.0	35.1	.00	11.0	0

1

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Circular Surfaces, Has Been Specified.

100 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 10 Points Equally Spaced Along The Ground Surface Between X = 120.00 ft.
and X = 215.00 ft.

Each Surface Terminates Between X = 220.00 ft.
and X = 262.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is Y = .00 ft.

5.00 ft. Line Segments Define Each Trial Failure Surface.

The Factor Of Safety For The Trial Failure Surface Defined By The Coordinates Listed Below Is Misleading.

Failure Surface Defined By 10 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	215.00	58.00
2	218.68	54.61
3	222.90	51.94
4	227.53	50.05
5	232.43	49.02
6	237.43	48.88
7	242.37	49.63
8	247.10	51.25
9	251.47	53.69
10	255.18	56.73

Factor Of Safety For The Preceding Specified Surface =-38.872

1

Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Bishop Method * *

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	172.78	45.06
2	177.45	43.29
3	182.28	41.99
4	187.21	41.16
5	192.20	40.83
6	197.20	40.99
7	202.16	41.64
8	207.03	42.77
9	211.76	44.38
10	216.31	46.44
11	220.64	48.95
12	224.71	51.86
13	228.46	55.16
14	231.87	58.82
15	232.78	60.00

Circle Center At X = 193.1 ; Y = 91.6 and Radius, 50.8

*** 4.842 ***

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	151.67	40.89
2	156.22	38.81
3	160.90	37.07
4	165.70	35.66
5	170.58	34.59
6	175.53	33.88
7	180.52	33.52
8	185.52	33.51
9	190.51	33.86
10	195.46	34.56
11	200.35	35.61
12	205.15	37.01
13	209.84	38.75
14	214.39	40.81
15	218.79	43.19

16	223.00	45.88
17	227.02	48.86
18	230.81	52.12
19	234.36	55.64
20	237.65	59.40
21	238.09	59.99

Circle Center At X = 183.1 ; Y = 103.8 and Radius, 70.3

*** 4.847 ***

1

Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	193.89	49.31
2	198.62	47.68
3	203.57	46.98
4	208.56	47.25
5	213.41	48.48
6	217.93	50.61
7	221.96	53.58
8	225.34	57.26
9	227.02	60.00

Circle Center At X = 204.7 ; Y = 72.9 and Radius, 25.9

*** 4.869 ***

Failure Surface Specified By 12 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	183.33	47.15
2	188.18	45.92
3	193.13	45.24
4	198.13	45.09
5	203.11	45.50
6	208.02	46.44
7	212.80	47.92
8	217.39	49.92
9	221.73	52.40
10	225.77	55.34
11	229.47	58.71
12	230.60	60.00

Circle Center At X = 196.9 ; Y = 90.7 and Radius, 45.6

*** 4.911 ***

1

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	151.67	40.89
2	156.45	39.44
3	161.32	38.30
4	166.25	37.48
5	171.23	36.97
6	176.22	36.78
7	181.22	36.92
8	186.20	37.37
9	191.14	38.14
10	196.02	39.23
11	200.82	40.62
12	205.52	42.32
13	210.11	44.32
14	214.55	46.61
15	218.84	49.18
16	222.96	52.02
17	226.89	55.11
18	230.61	58.45
19	232.12	60.00

Circle Center At X = 176.6 ; Y = 114.8 and Radius, 78.0

*** 4.913 ***

Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	193.89	49.31
2	198.73	48.06
3	203.73	47.80
4	208.67	48.54
5	213.37	50.25
6	217.63	52.86
7	221.30	56.27
8	223.97	60.00

Circle Center At X = 202.5 ; Y = 72.8 and Radius, 25.0

*** 4.938 ***

1

Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)

1	141.11	40.00
2	145.52	37.64
3	150.09	35.61
4	154.79	33.91
5	159.60	32.54
6	164.50	31.53
7	169.45	30.87
8	174.44	30.56
9	179.44	30.61
10	184.43	31.02
11	189.37	31.79
12	194.24	32.91
13	199.02	34.37
14	203.69	36.17
15	208.21	38.30
16	212.57	40.75
17	216.74	43.50
18	220.71	46.55
19	224.44	49.87
20	227.93	53.45
21	231.16	57.27
22	233.14	60.00

Circle Center At X = 176.2 ; Y = 100.4 and Radius, 69.8

*** 4.979 ***

Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	141.11	40.00
2	145.53	37.66
3	150.11	35.64
4	154.82	33.97
5	159.64	32.64
6	164.54	31.67
7	169.51	31.06
8	174.50	30.82
9	179.50	30.94
10	184.47	31.42
11	189.40	32.27
12	194.25	33.47
13	199.01	35.03
14	203.63	36.93
15	208.11	39.16
16	212.41	41.71
17	216.51	44.57
18	220.39	47.72
19	224.03	51.15
20	227.41	54.83
21	230.52	58.75
22	231.36	60.00

Circle Center At X = 175.4 ; Y = 99.2 and Radius, 68.4

*** 5.003 ***

1

Failure Surface Specified By 24 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	141.11	40.00
2	145.48	37.58
3	150.01	35.44
4	154.66	33.61
5	159.42	32.07
6	164.27	30.86
7	169.18	29.96
8	174.15	29.38
9	179.14	29.12
10	184.14	29.19
11	189.13	29.59
12	194.08	30.31
13	198.97	31.34
14	203.78	32.70
15	208.50	34.36
16	213.09	36.33
17	217.55	38.59
18	221.86	41.13
19	225.99	43.95
20	229.92	47.03
21	233.65	50.36
22	237.16	53.93
23	240.42	57.72
24	241.74	59.47

Circle Center At X = 180.6 ; Y = 106.0 and Radius, 76.9

*** 5.022 ***

Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	193.89	49.31
2	198.82	48.49
3	203.82	48.44
4	208.77	49.16
5	213.54	50.64
6	218.04	52.84
7	222.13	55.70
8	225.74	59.17
9	226.37	60.00

Circle Center At X = 201.6 ; Y = 80.6 and Radius, 32.2

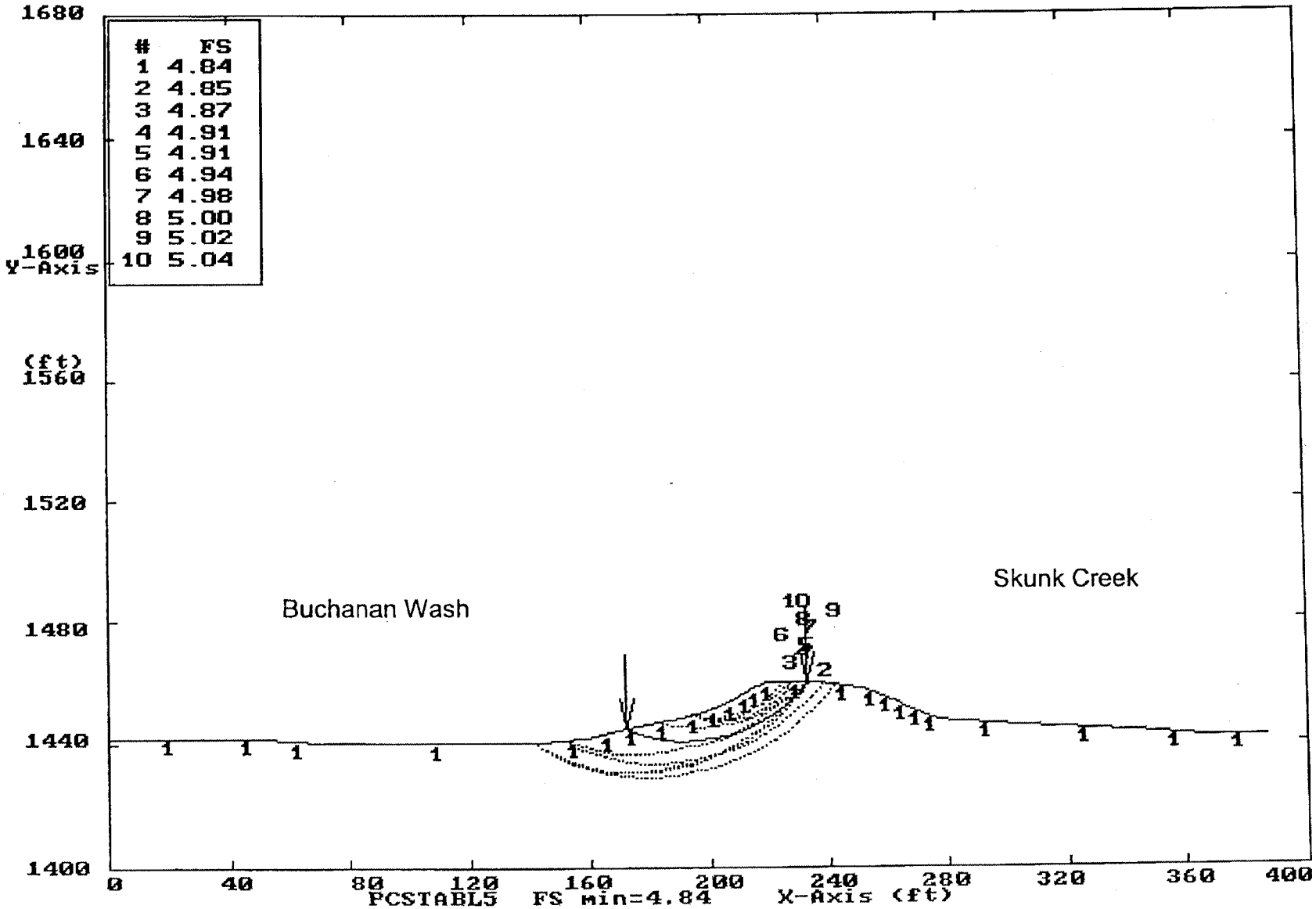
*** 5.043 ***

1

```
                Y           A     X     I     S           F     T

                .00     48.38     96.75    145.13    193.50    241.88
X          .00 +--------*+---------+---------+---------+---------+
               -
               -
               -
               -
               -        *
         48.38 +
               -        *
               -
               -       *
               -
               -
A        96.75 +
               -
               -
               -       .
               -     ...
               -    ....
X      145.13 +   ....*
               -   ...72
               -  ...972*
               -  ...725*
               -  ...7251*
               -  ...7251*
I      193.50 +  ...9214*
               -  ...92213*
               -  ....9213**
               -   ....2216*
               -   .....2213
               -    .....921
S      241.88 +     ......*
               -       ....*
               -        ..**
               -          *
               -         *
               -
         290.25 +
               -
               -         *
               -
               -
               -
F      338.63 +
               -        *
               -
               -
               -        *
               -
T      387.00 +        *
```

Skunk Creek, circular failure in BW, piez head = 11'; rapid dd, sen. analys.
Ten Most Critical. C:SKALTIES.PLT By: acb 06-02-03 12:36pm



SKALT2A
** PCSTABL5 **

by
Purdue University

1

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date:	06-03-03
Time of Run:	1:42pm
Run By:	acb
Input Data Filename:	C:SKALT2A.DAT
Output Filename:	C:SKALT2A.OUT
Plotted Output Filename:	C:SKALT2A.PLT

PROBLEM DESCRIPTION Skunk Creek, circular failure in SC;
BW @ 1459, SC @ 1463

BOUNDARY COORDINATES

16 Top Boundaries
16 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	54.00	329.00	56.00	1
2	329.00	56.00	345.00	58.00	1
3	345.00	58.00	351.00	60.00	1
4	351.00	60.00	357.00	62.00	1
5	357.00	62.00	363.00	64.00	1
6	363.00	64.00	369.00	66.00	1
7	369.00	66.00	401.00	66.00	1
8	401.00	66.00	405.00	64.00	1
9	405.00	64.00	410.00	62.00	1
10	410.00	62.00	416.00	60.00	1
11	416.00	60.00	422.00	58.00	1
12	422.00	58.00	428.00	56.00	1
13	428.00	56.00	434.00	54.00	1
14	434.00	54.00	531.00	52.00	1
15	531.00	52.00	617.00	52.00	1
16	617.00	52.00	703.00	52.00	1

1

ISOTROPIC SOIL PARAMETERS

1 Type(s) of Soil

Soil Type	Total Unit Wt.	Saturated Unit Wt.	Cohesion Intercept	Friction Angle	Pore Pressure	Pressure Constant	Piez. Surface

No.	(pcf)	(pcf)	(psf)	(deg)	Param.	(psf)	No.
1	140.5	150.8	4120.0	35.1	.00	.0	1

1

2 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 62.40

Piezometric Surface No. 1 Specified by 2 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	63.00
2	329.00	63.00

Piezometric Surface No. 2 Specified by 2 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	416.00	59.00
2	703.00	59.00

1

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Circular Surfaces, Has Been Specified.

100 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 10 Points Equally Spaced Along The Ground Surface Between X = 329.00 ft.
and X = 351.00 ft.

Each Surface Terminates Between X = 369.00 ft.
and X = 401.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is Y = .00 ft.

5.00 ft. Line Segments Define Each Trial Failure Surface.

1

Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Bishop Method * *

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	329.00	56.00
2	332.69	52.62
3	336.77	49.73
4	341.18	47.38
5	345.85	45.60
6	350.71	44.43
7	355.68	43.87
8	360.68	43.95
9	365.63	44.65
10	370.45	45.97
11	375.07	47.89
12	379.41	50.37
13	383.41	53.38
14	386.99	56.87
15	390.10	60.78
16	392.70	65.05
17	393.13	66.00

Circle Center At X = 357.6 ; Y = 83.5 and Radius, 39.7

*** 29.716 ***

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	329.00	56.00
2	332.54	52.46
3	336.58	49.52
4	341.03	47.25
5	345.78	45.69
6	350.72	44.90
7	355.72	44.88
8	360.66	45.64
9	365.42	47.16
10	369.89	49.40
11	373.96	52.32
12	377.52	55.83
13	380.49	59.85
14	382.80	64.28
15	383.37	66.00

Circle Center At X = 353.3 ; Y = 76.8 and Radius, 32.0

*** 29.764 ***

1

Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	331.44	56.31
2	335.00	52.79
3	339.01	49.81
4	343.41	47.42
5	348.09	45.67
6	352.97	44.59
7	357.96	44.21
8	362.95	44.53
9	367.84	45.55
10	372.55	47.24
11	376.97	49.58
12	381.02	52.51
13	384.62	55.98
14	387.69	59.92
15	390.19	64.26
16	390.88	66.00

Circle Center At X = 358.2 ; Y = 79.8 and Radius, 35.6

*** 30.120 ***

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	331.44	56.31
2	335.08	52.88
3	339.23	50.08
4	343.77	47.99
5	348.59	46.65
6	353.56	46.11
7	358.55	46.37
8	363.44	47.44
9	368.09	49.28
10	372.38	51.84
11	376.20	55.06
12	379.46	58.85
13	382.06	63.12
14	383.23	66.00

Circle Center At X = 354.4 ; Y = 77.0 and Radius, 30.9

*** 30.153 ***

1

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	329.00	56.00
2	332.94	52.92
3	337.20	50.30
4	341.72	48.16
5	346.45	46.54
6	351.33	45.45
7	356.30	44.91
8	361.30	44.92
9	366.27	45.49
10	371.14	46.60
11	375.86	48.25
12	380.37	50.40
13	384.62	53.05
14	388.54	56.14
15	392.10	59.66
16	395.25	63.54
17	396.82	66.00

Circle Center At X = 358.7 ; Y = 89.9 and Radius, 45.1

*** 30.366 ***

Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	331.44	56.31
2	335.11	52.90
3	339.18	50.00
4	343.59	47.65
5	348.28	45.90
6	353.15	44.77
7	358.12	44.28
8	363.12	44.45
9	368.05	45.26
10	372.84	46.71
11	377.40	48.77
12	381.65	51.40
13	385.52	54.56
14	388.95	58.20
15	391.88	62.25
16	393.90	66.00

Circle Center At X = 359.4 ; Y = 82.7 and Radius, 38.4

*** 30.410 ***

1

Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	329.00	56.00
2	332.63	52.57
3	336.64	49.57
4	340.96	47.05
5	345.54	45.04
6	350.32	43.57
7	355.23	42.66
8	360.22	42.31
9	365.21	42.53
10	370.15	43.33
11	374.96	44.68
12	379.59	46.58
13	383.97	48.99
14	388.05	51.89
15	391.76	55.23
16	395.07	58.98
17	397.94	63.08
18	399.51	66.00

Circle Center At X = 360.8 ; Y = 86.0 and Radius, 43.7

*** 30.432 ***

Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	329.00	56.00
2	332.70	52.63
3	336.74	49.70
4	341.09	47.22
5	345.68	45.24
6	350.46	43.78
7	355.38	42.86
8	360.36	42.48
9	365.36	42.66
10	370.31	43.39
11	375.14	44.66
12	379.81	46.45
13	384.25	48.75
14	388.41	51.52
15	392.24	54.74
16	395.69	58.36
17	398.72	62.34
18	400.91	66.00

Circle Center At X = 361.3 ; Y = 87.7 and Radius, 45.2

*** 30.671 ***

1

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	331.44	56.31
2	335.15	52.95
3	339.24	50.06
4	343.64	47.69
5	348.29	45.87
6	353.13	44.61
7	358.09	43.95
8	363.09	43.89
9	368.06	44.43
10	372.93	45.57
11	377.62	47.28
12	382.08	49.55
13	386.23	52.33
14	390.02	55.60
15	393.39	59.30
16	396.28	63.37
17	397.71	66.00

Circle Center At X = 361.1 ; Y = 85.3 and Radius, 41.5

*** 30.949 ***

Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	333.89	56.61
2	337.47	53.13
3	341.52	50.18
4	345.94	47.85
5	350.65	46.17
6	355.55	45.18
7	360.54	44.89
8	365.52	45.32
9	370.39	46.45
10	375.05	48.26
11	379.40	50.72
12	383.36	53.78
13	386.85	57.36
14	389.79	61.41
15	392.12	65.83
16	392.18	66.00

Circle Center At X = 360.0 ; Y = 79.9 and Radius, 35.0

*** 31.011 ***

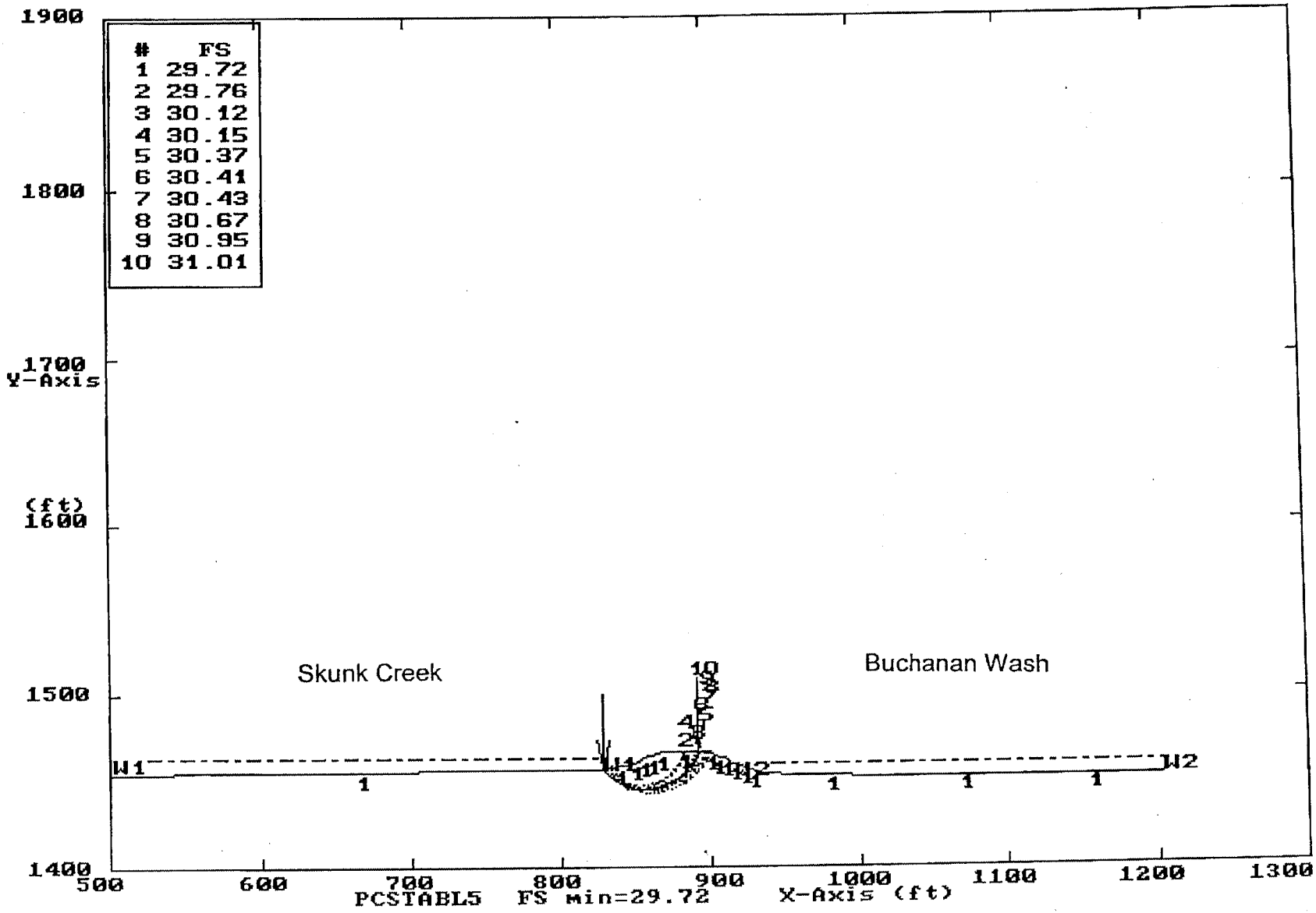
1

```
                                   SKALT2A
                Y            A     X     I     S            F     T

                .00     87.88    175.75    263.63    351.50    439.38

X          .00 +-----*W--+---------+---------+---------+---------+
               -
               -
               -
               -
               -
     87.88 +
               -
               -
               -
               -
               -
A    175.75 +
               -
               -
               -
               -
               -
X    263.63 +
               -
               -
               -
               -      *W
               -     11.
I    351.50 +     1.*
               -     12**
               -     1122
               -      51*
               -       *
               -      **
S    439.38 +      *
               -
               -
               -
               -
               -
     527.25 +      *
               -
               -
               -
               -
               -
F    615.13 +      *
               -
               -
               -
               -
               -
T    703.00 +      *W
```

Skunk Creek, circular failure in SC; BW @ 1459, SC @ 1463
Ten Most Critical. C:SKALT2A.PLT By: acb 06-03-03 1:42pm



SKALT2B
** PCSTABL5 **

by
Purdue University

1

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date:	06-03-03
Time of Run:	1:43pm
Run By:	acb
Input Data Filename:	C:SKALT2B.DAT
Output Filename:	C:SKALT2B.OUT
Plotted Output Filename:	C:SKALT2B.PLT

PROBLEM DESCRIPTION Skunk Creek circular failure in BW;
BW @ 1459, SC @ 1463

BOUNDARY COORDINATES

16 Top Boundaries
16 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	52.00	86.00	52.00	1
2	86.00	52.00	172.00	52.00	1
3	172.00	52.00	269.00	54.00	1
4	269.00	54.00	275.00	56.00	1
5	275.00	56.00	281.00	58.00	1
6	281.00	58.00	287.00	60.00	1
7	287.00	60.00	293.00	62.00	1
8	293.00	62.00	298.00	64.00	1
9	298.00	64.00	302.00	66.00	1
10	302.00	66.00	334.00	66.00	1
11	334.00	66.00	340.00	64.00	1
12	340.00	64.00	346.00	62.00	1
13	346.00	62.00	352.00	60.00	1
14	352.00	60.00	358.00	58.00	1
15	358.00	58.00	374.00	56.00	1
16	374.00	56.00	703.00	54.00	1

1

ISOTROPIC SOIL PARAMETERS

1 Type(s) of Soil

Soil Type	Total Unit Wt.	Saturated Unit Wt.	Cohesion Intercept	Friction Angle	Pore Pressure	Pressure Constant	Piez. Surface

No.	(pcf)	(pcf)	(psf)	(deg)	Param.	(psf)	No.
1	140.5	150.8	4120.0	35.1	.00	.0	1

1

2 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 62.40

Piezometric Surface No. 1 Specified by 2 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	59.00
2	287.00	59.00

Piezometric Surface No. 2 Specified by 2 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	374.00	63.00
2	703.00	63.00

1

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Circular Surfaces, Has Been Specified.

100 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 10 Points Equally Spaced Along The Ground Surface Between X = 100.00 ft.
and X = 172.00 ft.

Each Surface Terminates Between X = 302.00 ft.
and X = 334.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is Y = .00 ft.

5.00 ft. Line Segments Define Each Trial Failure Surface.

1

Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Bishop Method * *

Failure Surface Specified By 37 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	172.00	52.00
2	175.86	48.83
3	179.86	45.83
4	183.99	43.01
5	188.24	40.38
6	192.61	37.93
7	197.08	35.69
8	201.64	33.64
9	206.29	31.80
10	211.01	30.17
11	215.81	28.75
12	220.66	27.55
13	225.56	26.56
14	230.50	25.79
15	235.47	25.23
16	240.46	24.90
17	245.46	24.80
18	250.46	24.91
19	255.45	25.25
20	260.42	25.80
21	265.35	26.58
22	270.25	27.58
23	275.11	28.79
24	279.90	30.22
25	284.62	31.85
26	289.27	33.70
27	293.83	35.75
28	298.29	38.00
29	302.65	40.45
30	306.90	43.09
31	311.03	45.91
32	315.02	48.91
33	318.88	52.09
34	322.60	55.44
35	326.16	58.95
36	329.56	62.61
37	332.44	66.00

Circle Center At X = 245.4 ; Y = 137.4 and Radius, 112.6

*** 28.864 ***

Failure Surface Specified By 37 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	172.00	52.00

2	176.09	49.12
3	180.29	46.41
4	184.60	43.87
5	189.01	41.51
6	193.51	39.34
7	198.10	37.35
8	202.76	35.56
9	207.50	33.95
10	212.30	32.54
11	217.15	31.33
12	222.04	30.32
13	226.98	29.51
14	231.94	28.91
15	236.93	28.51
16	241.92	28.31
17	246.92	28.32
18	251.92	28.53
19	256.90	28.95
20	261.86	29.57
21	266.79	30.40
22	271.68	31.43
23	276.53	32.66
24	281.32	34.08
25	286.05	35.70
26	290.71	37.52
27	295.29	39.52
28	299.79	41.71
29	304.19	44.08
30	308.49	46.64
31	312.68	49.36
32	316.76	52.26
33	320.71	55.32
34	324.54	58.54
35	328.23	61.91
36	331.77	65.44
37	332.30	66.00

Circle Center At X = 244.2 ; Y = 150.1 and Radius, 121.8

*** 30.139 ***

1

Failure Surface Specified By 37 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	172.00	52.00
2	176.12	49.17
3	180.35	46.50
4	184.69	44.01
5	189.12	41.70
6	193.64	39.57
7	198.25	37.62
8	202.93	35.87
9	207.68	34.30
10	212.49	32.92
11	217.35	31.75
12	222.25	30.76

13	227.19	29.98
14	232.15	29.40
15	237.14	29.02
16	242.13	28.84
17	247.13	28.87
18	252.13	29.09
19	257.11	29.52
20	262.07	30.15
21	267.00	30.98
22	271.90	32.01
23	276.74	33.24
24	281.54	34.66
25	286.27	36.27
26	290.93	38.08
27	295.52	40.07
28	300.02	42.24
29	304.43	44.60
30	308.74	47.13
31	312.95	49.84
32	317.04	52.71
33	321.01	55.75
34	324.86	58.94
35	328.57	62.29
36	332.15	65.78
37	332.36	66.00

Circle Center At X = 244.0 ; Y = 152.4 and Radius, 123.5

*** 30.375 ***

Failure Surface Specified By 38 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	164.00	52.00
2	167.81	48.76
3	171.76	45.69
4	175.83	42.80
5	180.03	40.09
6	184.35	37.56
7	188.77	35.23
8	193.29	33.09
9	197.90	31.16
10	202.60	29.43
11	207.36	27.91
12	212.18	26.59
13	217.06	25.50
14	221.98	24.61
15	226.94	23.95
16	231.92	23.50
17	236.91	23.27
18	241.91	23.26
19	246.91	23.48
20	251.89	23.91
21	256.85	24.56
22	261.77	25.42
23	266.65	26.50
24	271.48	27.80

25	276.25	29.31
26	280.95	31.02
27	285.56	32.94
28	290.09	35.06
29	294.52	37.38
30	298.85	39.89
31	303.06	42.58
32	307.14	45.46
33	311.10	48.52
34	314.92	51.75
35	318.59	55.14
36	322.11	58.69
37	325.47	62.39
38	328.47	66.00

Circle Center At X = 239.6 ; Y = 137.0 and Radius, 113.7

*** 30.974 ***

1

Failure Surface Specified By 41 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	156.00	52.00
2	160.00	49.00
3	164.11	46.15
4	168.33	43.47
5	172.64	40.94
6	177.05	38.58
7	181.54	36.38
8	186.11	34.36
9	190.76	32.51
10	195.47	30.84
11	200.24	29.35
12	205.07	28.04
13	209.94	26.91
14	214.85	25.97
15	219.79	25.21
16	224.76	24.64
17	229.75	24.26
18	234.74	24.07
19	239.74	24.07
20	244.74	24.25
21	249.73	24.63
22	254.69	25.19
23	259.64	25.94
24	264.55	26.88
25	269.42	28.00
26	274.25	29.30
27	279.02	30.79
28	283.74	32.46
29	288.38	34.30
30	292.96	36.32
31	297.45	38.50
32	301.86	40.86
33	306.18	43.38
34	310.40	46.07

35	314.51	48.91
36	318.52	51.90
37	322.41	55.05
38	326.17	58.34
39	329.81	61.76
40	333.32	65.33
41	333.93	66.00

Circle Center At X = 237.3 ; Y = 156.3 and Radius, 132.2

*** 31.251 ***

Failure Surface Specified By 38 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	164.00	52.00
2	167.62	48.55
3	171.40	45.27
4	175.32	42.18
5	179.39	39.28
6	183.60	36.57
7	187.93	34.06
8	192.37	31.77
9	196.91	29.69
10	201.55	27.82
11	206.27	26.18
12	211.07	24.76
13	215.93	23.57
14	220.83	22.62
15	225.78	21.89
16	230.76	21.41
17	235.75	21.16
18	240.75	21.14
19	245.75	21.37
20	250.73	21.83
21	255.68	22.52
22	260.59	23.45
23	265.45	24.61
24	270.25	26.01
25	274.99	27.62
26	279.63	29.46
27	284.19	31.52
28	288.64	33.80
29	292.99	36.28
30	297.20	38.96
31	301.29	41.84
32	305.24	44.91
33	309.03	48.17
34	312.67	51.60
35	316.14	55.20
36	319.43	58.96
37	322.54	62.88
38	324.79	66.00

Circle Center At X = 238.5 ; Y = 126.5 and Radius, 105.4

*** 31.771 ***

1

Failure Surface Specified By 43 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	148.00	52.00
2	151.55	48.48
3	155.24	45.11
4	159.08	41.90
5	163.05	38.86
6	167.14	35.98
7	171.35	33.29
8	175.67	30.77
9	180.09	28.44
10	184.61	26.30
11	189.22	24.35
12	193.90	22.60
13	198.65	21.05
14	203.47	19.70
15	208.33	18.56
16	213.25	17.62
17	218.19	16.89
18	223.17	16.38
19	228.16	16.07
20	233.16	15.98
21	238.15	16.10
22	243.14	16.43
23	248.11	16.97
24	253.06	17.72
25	257.96	18.68
26	262.83	19.85
27	267.63	21.22
28	272.38	22.79
29	277.05	24.57
30	281.65	26.54
31	286.16	28.70
32	290.57	31.05
33	294.88	33.59
34	299.08	36.31
35	303.15	39.20
36	307.10	42.26
37	310.92	45.49
38	314.60	48.88
39	318.13	52.42
40	321.51	56.11
41	324.73	59.93
42	327.78	63.89
43	329.27	66.00

Circle Center At X = 232.9 ; Y = 134.0 and Radius, 118.0

*** 32.140 ***

Failure Surface Specified By 47 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	132.00	52.00
2	135.57	48.50
3	139.26	45.13
4	143.08	41.90
5	147.02	38.82
6	151.07	35.89
7	155.23	33.12
8	159.50	30.50
9	163.85	28.05
10	168.30	25.76
11	172.83	23.64
12	177.43	21.70
13	182.11	19.93
14	186.85	18.33
15	191.64	16.92
16	196.49	15.68
17	201.38	14.63
18	206.30	13.77
19	211.25	13.09
20	216.23	12.60
21	221.22	12.29
22	226.22	12.18
23	231.22	12.25
24	236.21	12.51
25	241.19	12.96
26	246.15	13.59
27	251.08	14.41
28	255.98	15.42
29	260.84	16.61
30	265.65	17.98
31	270.40	19.54
32	275.09	21.27
33	279.71	23.17
34	284.26	25.25
35	288.73	27.50
36	293.10	29.92
37	297.39	32.49
38	301.57	35.23
39	305.65	38.12
40	309.61	41.17
41	313.46	44.36
42	317.19	47.70
43	320.79	51.17
44	324.25	54.77
45	327.58	58.51
46	330.76	62.36
47	333.54	66.00

Circle Center At X = 226.8 ; Y = 144.9 and Radius, 132.8

*** 32.974 ***

1

Failure Surface Specified By 47 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	132.00	52.00
2	135.62	48.55
3	139.36	45.23
4	143.22	42.06
5	147.20	39.03
6	151.29	36.15
7	155.48	33.43
8	159.78	30.86
9	164.16	28.46
10	168.63	26.22
11	173.18	24.15
12	177.81	22.25
13	182.50	20.52
14	187.25	18.97
15	192.06	17.59
16	196.91	16.40
17	201.81	15.39
18	206.74	14.56
19	211.70	13.91
20	216.68	13.45
21	221.67	13.18
22	226.67	13.09
23	231.67	13.19
24	236.66	13.47
25	241.64	13.94
26	246.60	14.59
27	251.52	15.43
28	256.42	16.45
29	261.27	17.66
30	266.08	19.04
31	270.83	20.60
32	275.52	22.33
33	280.14	24.24
34	284.69	26.32
35	289.15	28.57
36	293.53	30.98
37	297.82	33.56
38	302.01	36.29
39	306.09	39.17
40	310.06	42.21
41	313.92	45.39
42	317.66	48.71
43	321.27	52.17
44	324.75	55.76
45	328.09	59.48
46	331.29	63.32
47	333.37	66.00

Circle Center At X = 226.5 ; Y = 147.4 and Radius, 134.3

*** 33.159 ***

Failure Surface Specified By 47 Coordinate Points

Point	X-Surf	Y-Surf

SKALT2B

No.	(ft)	(ft)
1	132.00	52.00
2	135.54	48.46
3	139.20	45.07
4	143.00	41.81
5	146.92	38.70
6	150.95	35.75
7	155.09	32.95
8	159.34	30.31
9	163.68	27.83
10	168.12	25.53
11	172.64	23.39
12	177.24	21.43
13	181.91	19.65
14	186.65	18.04
15	191.44	16.62
16	196.28	15.38
17	201.17	14.33
18	206.10	13.46
19	211.05	12.79
20	216.03	12.30
21	221.02	12.00
22	226.02	11.90
23	231.02	11.99
24	236.01	12.26
25	240.99	12.73
26	245.94	13.39
27	250.87	14.23
28	255.76	15.27
29	260.61	16.49
30	265.41	17.89
31	270.15	19.48
32	274.83	21.25
33	279.43	23.19
34	283.96	25.31
35	288.41	27.60
36	292.76	30.06
37	297.02	32.68
38	301.17	35.47
39	305.21	38.41
40	309.14	41.50
41	312.95	44.74
42	316.63	48.13
43	320.18	51.65
44	323.59	55.31
45	326.86	59.09
46	329.98	62.99
47	332.20	66.00

Circle Center At X = 226.3 ; Y = 142.7 and Radius, 130.8

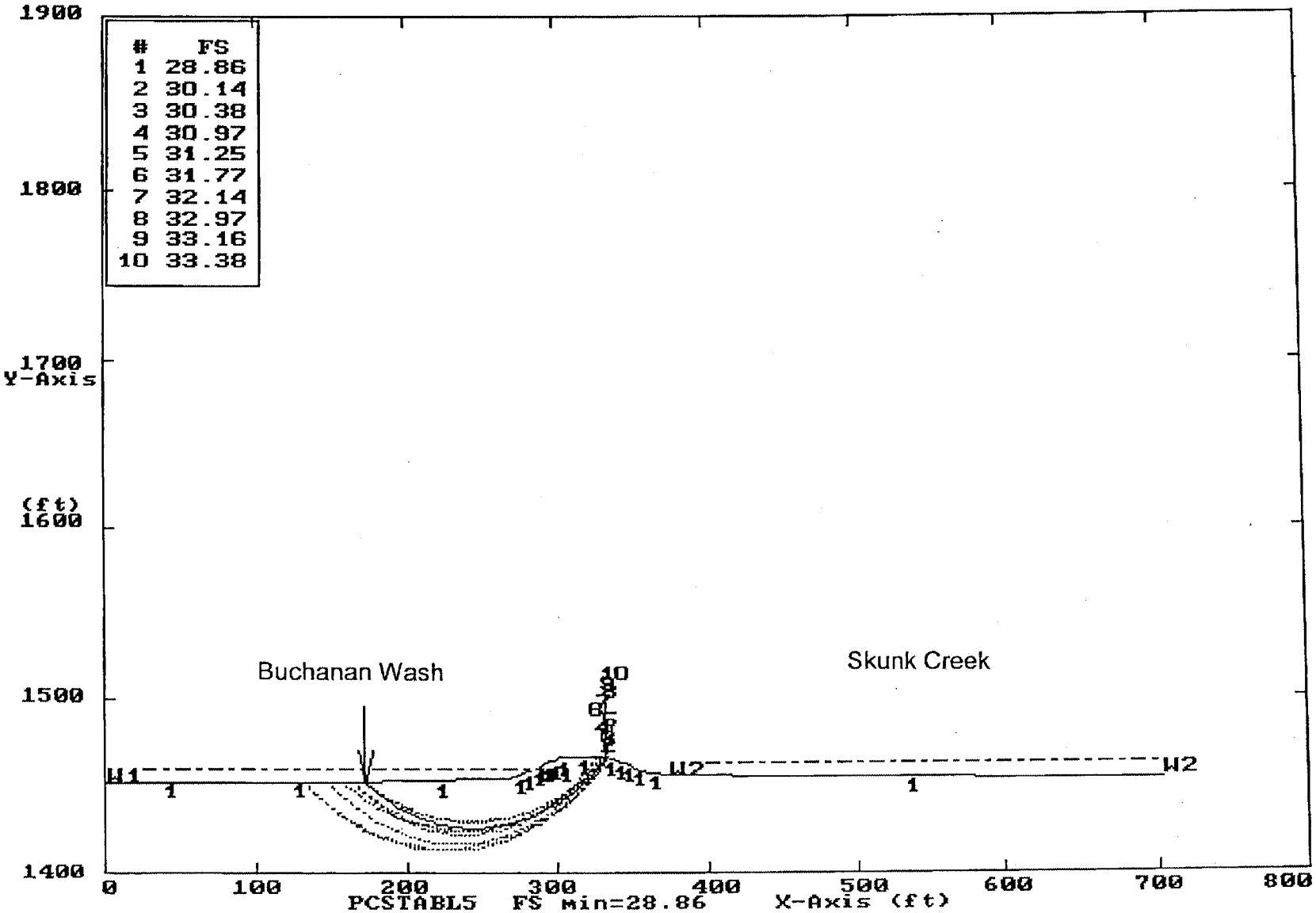
*** 33.375 ***

1

Y	A	X	I	S	F	T
.00	87.88	175.75	263.63	351.50	439.38	

```
X        .00 +-----*W--+---------+---------+---------+---------+
             -
             -
             -
             -
             -
      87.88 +     *
             -    ..
             -   ...
             -  ...8
             - ..887
             -..8754
A    175.75 +.8751*
             -.8611.
             -8711..
             -8612..
             -861...
             -.61...
X    263.63 + 713.*
             - 811.**
             -  712.*
             -   712.*
             -    8114
             -      **
I    351.50 +      *
             -
             -     *W
             -
             -
             -
S    439.38 +
             -
             -
             -
             -
             -
     527.25 +
             -
             -
             -
             -
             -
F    615.13 +
             -
             -
             -
             -
             -
T    703.00 +     *W
```

Skunk Creek circular failure in BW; BW @ 1459, SC @ 1463
Ten Most Critical. C:SKALT2B.PLT By: acb 06-03-03 1:43pm



SKALT2C
** PCSTABL5 **

by
Purdue University

1

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date:	06-03-03
Time of Run:	1:44pm
Run By:	acb
Input Data Filename:	C:SKALT2C.DAT
Output Filename:	C:SKALT2C.OUT
Plotted Output Filename:	C:SKALT2C.PLT

PROBLEM DESCRIPTION Skunk Creek block failure in SC;
BW @ 1459, SC @ 1463

BOUNDARY COORDINATES

16 Top Boundaries
16 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	54.00	329.00	56.00	1
2	329.00	56.00	345.00	58.00	1
3	345.00	58.00	351.00	60.00	1
4	351.00	60.00	357.00	62.00	1
5	357.00	62.00	363.00	64.00	1
6	363.00	64.00	369.00	66.00	1
7	369.00	66.00	401.00	66.00	1
8	401.00	66.00	405.00	64.00	1
9	405.00	64.00	410.00	62.00	1
10	410.00	62.00	416.00	60.00	1
11	416.00	60.00	422.00	58.00	1
12	422.00	58.00	428.00	56.00	1
13	428.00	56.00	434.00	54.00	1
14	434.00	54.00	531.00	52.00	1
15	531.00	52.00	617.00	52.00	1
16	617.00	52.00	703.00	52.00	1

1

ISOTROPIC SOIL PARAMETERS

1 Type(s) of Soil

Soil Type	Total Unit Wt.	Saturated Unit Wt.	Cohesion Intercept	Friction Angle	Pore Pressure	Pressure Constant	Piez. Surface

No.	(pcf)	(pcf)	(psf)	(deg)	Param.	(psf)	No.
1	140.5	150.8	4120.0	35.1	.00	.0	1

1

2 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 62.40

Piezometric Surface No. 1 Specified by 2 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	63.00
2	329.00	63.00

Piezometric Surface No. 2 Specified by 2 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	416.00	59.00
2	703.00	59.00

1

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Sliding Block Surfaces, Has Been Specified.

10 Trial Surfaces Have Been Generated.

2 Boxes Specified For Generation Of Central Block Base

Length Of Line Segments For Active And Passive Portions Of Sliding Block Is 5.0

Box No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Height (ft)
1	300.00	40.00	363.00	40.00	20.00
2	369.00	50.00	401.00	50.00	20.00

1

Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Janbu Method * *

Failure Surface Specified By 12 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	330.53	56.19
2	333.32	55.84
3	337.76	53.53
4	341.98	50.85
5	346.46	48.64
6	351.41	47.93
7	371.35	47.02
8	372.24	51.94
9	373.74	56.71
10	375.39	61.43
11	377.81	65.81
12	377.97	66.00

*** 40.452 ***

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	272.76	55.66
2	275.10	53.72
3	278.87	50.43
4	283.70	49.16
5	287.26	45.64
6	290.90	42.22
7	295.61	40.54
8	300.55	39.74
9	304.39	36.54
10	307.93	33.01
11	387.33	52.61
12	390.83	56.18
13	394.33	59.75
14	397.86	63.29
15	400.39	66.00

*** 45.505 ***

1

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	275.30	55.67
2	278.40	54.71
3	281.97	51.21

4	286.87	50.24
5	290.47	46.77
6	295.25	45.30
7	300.00	43.72
8	304.05	40.80
9	308.19	38.00
10	388.27	50.45
11	389.30	55.34
12	392.39	59.27
13	395.53	63.16
14	398.06	66.00

*** 48.875 ***

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	283.27	55.72
2	286.72	54.17
3	291.16	51.89
4	295.31	49.10
5	298.92	45.64
6	303.91	45.26
7	308.64	43.65
8	312.19	40.13
9	389.55	51.48
10	391.27	56.18
11	394.67	59.84
12	395.72	64.73
13	396.45	66.00

*** 50.126 ***

1

Failure Surface Specified By 10 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	325.00	55.98
2	328.70	52.88
3	332.81	50.04
4	336.54	46.70
5	389.11	47.71
6	392.62	51.26
7	395.59	55.29
8	396.20	60.25
9	396.89	65.20
10	397.46	66.00

*** 51.547 ***

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	323.76	55.97
2	327.54	54.79
3	331.44	51.65
4	335.21	48.37
5	339.67	46.11
6	344.12	43.84
7	349.06	43.06
8	394.84	46.49
9	398.27	50.13
10	401.52	53.93
11	401.86	58.92
12	402.89	63.81
13	403.67	64.66

*** 52.816 ***

1

Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	300.37	55.83
2	304.92	54.24
3	309.50	52.24
4	314.01	50.07
5	318.74	48.46
6	322.71	45.42
7	378.65	59.74
8	382.15	63.32
9	384.69	66.00

*** 54.476 ***

Failure Surface Specified By 12 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	341.06	57.51
2	341.34	57.25
3	345.77	54.94
4	349.41	51.51
5	353.09	48.13
6	371.76	44.92
7	374.93	48.79
8	377.63	52.99

9	380.96	56.73
10	384.47	60.29
11	384.74	65.28
12	385.09	66.00

*** 54.911 ***

1

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	280.19	55.70
2	284.59	53.43
3	288.13	49.90
4	292.90	48.42
5	297.88	47.96
6	302.40	45.81
7	307.24	44.55
8	310.84	41.08
9	314.47	37.65
10	378.96	58.53
11	382.33	62.22
12	385.87	65.76
13	385.99	66.00

*** 54.991 ***

Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	291.35	55.77
2	294.35	53.40
3	298.62	50.80
4	303.50	49.73
5	375.08	48.08
6	375.83	53.02
7	376.69	57.95
8	378.82	62.47
9	382.16	66.00

*** 57.510 ***

1

Y A X I S F T

.00 87.88 175.75 263.63 351.50 439.38

```
X        .00 +-----*W--+---------+---------+---------+---------+
             -
             -
             -
             -
             -
      87.88 +
             -
             -
             -
             -
             -
A    175.75 +
             -
             -
             -
             -
             -
X    263.63 +
             -     2
             -    23
             -   227
             -    7*W
             -    518
I    351.50 +    11*
             -    11**
             -    0111
             -    522*
             -      *
             -     **
S    439.38 +     *
             -
             -
             -
             -
             -
     527.25 +     *
             -
             -
             -
             -
             -
F    615.13 +     *
             -
             -
             -
             -
             -
T    703.00 +     *W
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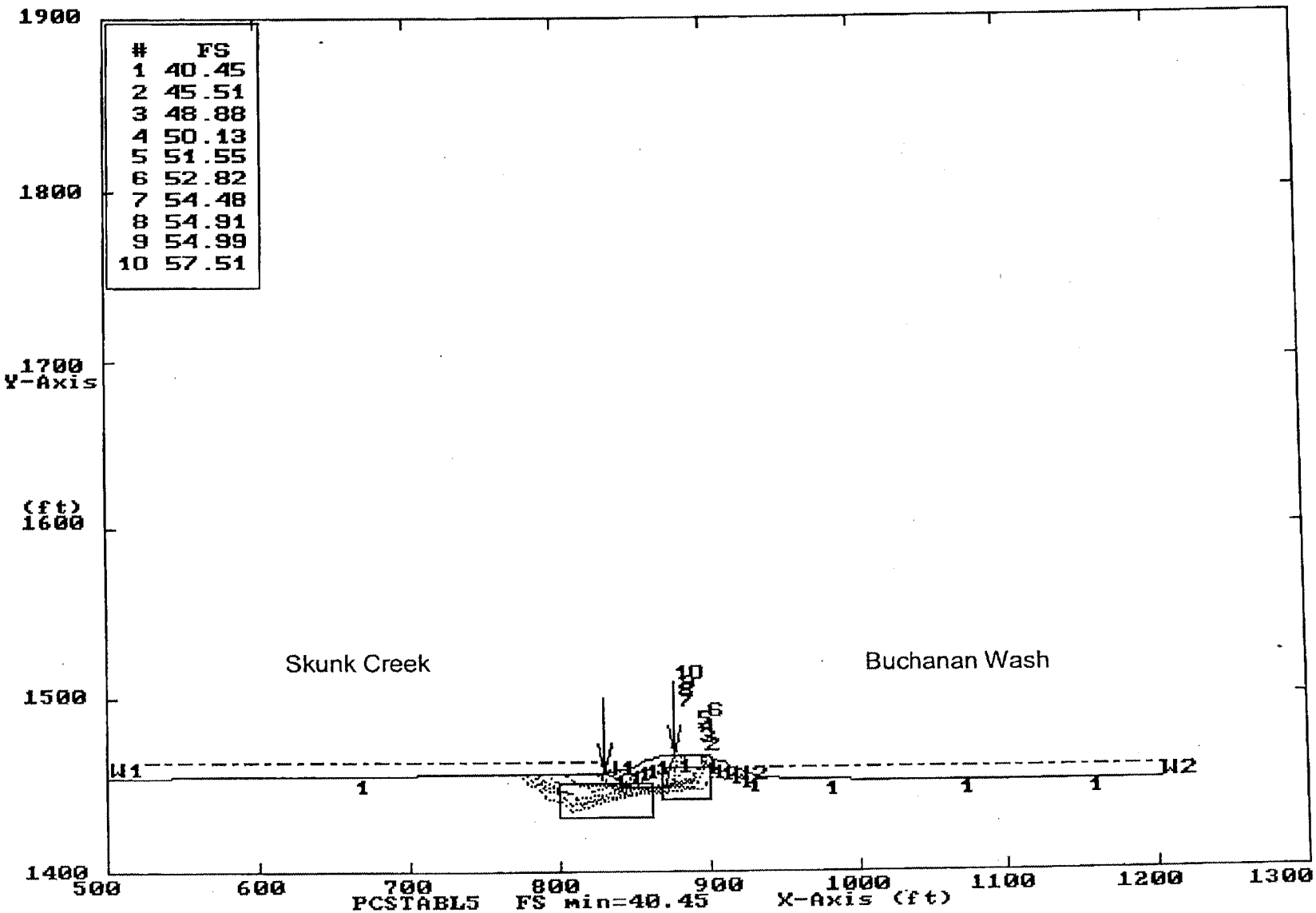
Skunk Creek block failure in SC; BW @ 1459, SC @ 1463
Ten Most Critical. C:SKALT2C.PLT By: acb 06-03-03 1:44pm



SKALT2D
** PCSTABL5 **

by
Purdue University

1

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date:	06-03-03
Time of Run:	1:45pm
Run By:	acb
Input Data Filename:	C:SKALT2D.DAT
Output Filename:	C:SKALT2D.OUT
Plotted Output Filename:	C:SKALT2D.PLT

PROBLEM DESCRIPTION Skunk Creek block failure in BW;
BW @ 1459, SC @ 1463

BOUNDARY COORDINATES

16 Top Boundaries
16 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	52.00	86.00	52.00	1
2	86.00	52.00	172.00	52.00	1
3	172.00	52.00	269.00	54.00	1
4	269.00	54.00	275.00	56.00	1
5	275.00	56.00	281.00	58.00	1
6	281.00	58.00	287.00	60.00	1
7	287.00	60.00	293.00	62.00	1
8	293.00	62.00	298.00	64.00	1
9	298.00	64.00	302.00	66.00	1
10	302.00	66.00	334.00	66.00	1
11	334.00	66.00	340.00	64.00	1
12	340.00	64.00	346.00	62.00	1
13	346.00	62.00	352.00	60.00	1
14	352.00	60.00	358.00	58.00	1
15	358.00	58.00	374.00	56.00	1
16	374.00	56.00	703.00	54.00	1

1

ISOTROPIC SOIL PARAMETERS

1 Type(s) of Soil

Soil Type	Total Unit Wt.	Saturated Unit Wt.	Cohesion Intercept	Friction Angle	Pore Pressure	Pressure Constant	Piez. Surface

No.	(pcf)	(pcf)	(psf)	(deg)	Param.	(psf)	No.
1	140.5	150.8	4120.0	35.1	.00	.0	1

1

2 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 62.40

Piezometric Surface No. 1 Specified by 2 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	59.00
2	287.00	59.00

Piezometric Surface No. 2 Specified by 2 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	374.00	63.00
2	703.00	63.00

1

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Sliding Block Surfaces, Has Been Specified.

10 Trial Surfaces Have Been Generated.

2 Boxes Specified For Generation Of Central Block Base

Length Of Line Segments For Active And Passive Portions Of Sliding Block Is 5.0

Box No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Height (ft)
1	200.00	40.00	293.00	40.00	20.00
2	298.00	50.00	340.00	50.00	20.00

1

Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Janbu Method * *

Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	273.52	55.51
2	276.97	52.37
3	280.53	48.85
4	285.48	48.15
5	317.06	56.85
6	320.44	60.54
7	323.88	64.17
8	324.83	66.00

*** 24.588 ***

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	254.21	53.69
2	256.94	52.10
3	260.53	48.63
4	264.11	45.14
5	302.73	43.65
6	305.01	48.10
7	308.54	51.64
8	311.74	55.48
9	312.54	60.42
10	314.22	65.13
11	315.04	66.00

*** 25.827 ***

1

Failure Surface Specified By 12 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	275.20	56.07
2	276.32	55.31
3	280.52	52.61
4	284.91	50.21
5	288.86	47.14
6	308.17	42.60
7	311.09	46.66
8	312.67	51.40
9	314.14	56.18
10	317.61	59.78
11	318.58	64.69

12	319.87	66.00

*** 32.966 ***

Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	200.98	52.60
2	203.71	49.92
3	207.28	46.41
4	310.29	46.83
5	313.83	50.37
6	317.23	54.03
7	320.66	57.67
8	323.42	61.84
9	325.49	66.00

*** 35.953 ***

1

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	183.47	52.24
2	183.62	52.16
3	188.56	51.38
4	192.37	48.15
5	197.19	46.80
6	201.69	44.62
7	206.45	43.10
8	210.94	40.91
9	215.94	40.64
10	219.50	37.13
11	319.91	45.44
12	322.17	49.90
13	325.45	53.67
14	328.59	57.56
15	330.08	62.34
16	333.51	65.98
17	333.53	66.00

*** 36.014 ***

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)

1	220.82	53.01
2	223.18	50.77
3	227.70	48.65
4	232.63	47.78
5	237.57	47.03
6	321.18	47.68
7	322.48	52.51
8	323.25	57.45
9	326.77	61.00
10	329.94	64.86
11	330.11	66.00

*** 43.618 ***

1

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	216.77	52.92
2	219.04	50.67
3	223.38	48.18
4	228.27	47.13
5	231.93	43.73
6	236.63	42.01
7	241.19	39.96
8	245.64	37.68
9	249.78	34.89
10	253.40	31.43
11	330.05	59.00
12	330.16	64.00
13	332.05	66.00

*** 55.847 ***

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	192.49	52.42
2	195.02	49.90
3	199.79	48.42
4	204.77	47.96
5	209.29	45.81
6	214.13	44.55
7	217.73	41.08
8	221.36	37.65
9	311.07	58.53
10	313.36	62.98
11	316.12	66.00

*** 59.758 ***

1

Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	188.41	52.34
2	190.49	50.90
3	194.21	47.57
4	198.14	44.47
5	202.58	42.18
6	322.36	56.70
7	325.56	60.54
8	329.08	64.10
9	330.48	66.00

*** 59.956 ***

Failure Surface Specified By 10 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	264.67	53.91
2	265.50	53.64
3	269.37	50.48
4	273.10	47.15
5	314.34	47.38
6	317.62	51.16
7	317.72	56.15
8	320.75	60.13
9	322.37	64.86
10	322.92	66.00

*** 67.843 ***

1

```
          Y            A     X     I     S            F     T

          .00     87.88    175.75    263.63    351.50    439.38

X       .00 +-----*W--+---------+---------+---------+---------+
            -
            -
            -
            -
            -
      87.88 +     *
            -
```

```
                  -
                  -
                  -
                  -
A     175.75 +      *
             -    55
             -    44
             -   556
             -    66
             -   7 2
X     263.63 +    2*
             -    1**
             -    3 *
             -    222*
             -    5111
             -      **
I     351.50 +      *
             -
             -     *W
             -
             -
             -
S     439.38 +
             -
             -
             -
             -
             -
      527.25 +
             -
             -
             -
             -
             -
F     615.13 +
             -
             -
             -
             -
             -
T     703.00 +     *W
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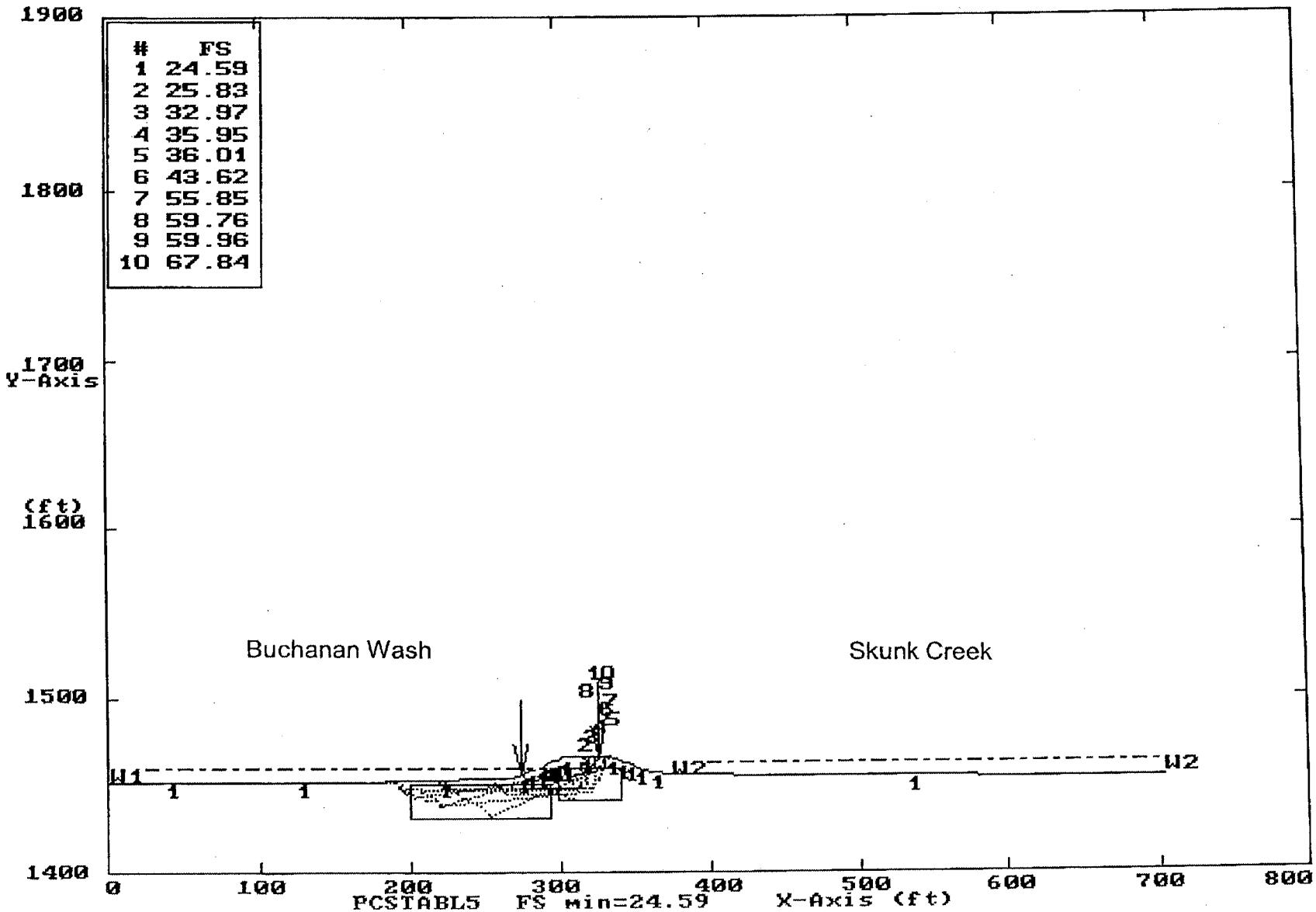
Skunk Creek block failure in BW; BW @ 1459, SC @ 1463
Ten Most Critical. C:SKALI2D.PLT By: acb 06-03-03 1:45pm



SKALT2E.OUT
** PCSTABL5 **

by
Purdue University

1

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date:	05-07-03
Time of Run:	2:31pm
Run By:	acb
Input Data Filename:	C:SKALT2E.DAT
Output Filename:	C:SKALT2E.OUT
Plotted Output Filename:	C:SKALT2E.PLT

PROBLEM DESCRIPTION Skunk Creek circular failure in SC
piezometric head = 6', rapid drawdown

BOUNDARY COORDINATES

16 Top Boundaries
16 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	54.00	329.00	56.00	1
2	329.00	56.00	345.00	58.00	1
3	345.00	58.00	351.00	60.00	1
4	351.00	60.00	357.00	62.00	1
5	357.00	62.00	363.00	64.00	1
6	363.00	64.00	369.00	66.00	1
7	369.00	66.00	401.00	66.00	1
8	401.00	66.00	405.00	64.00	1
9	405.00	64.00	410.00	62.00	1
10	410.00	62.00	416.00	60.00	1
11	416.00	60.00	422.00	58.00	1
12	422.00	58.00	428.00	56.00	1
13	428.00	56.00	434.00	54.00	1
14	434.00	54.00	531.00	52.00	1
15	531.00	52.00	617.00	52.00	1
16	617.00	52.00	703.00	52.00	1

1

ISOTROPIC SOIL PARAMETERS

1 Type(s) of Soil

Soil Type	Total Unit Wt.	Saturated Unit Wt.	Cohesion Intercept	Friction Angle	Pore Pressure	Pressure Constant	Piez. Surface

No.	(pcf)	(pcf)	(psf)	(deg)	Param.	(psf)	No.
1	140.5	150.8	4120.0	35.1	.00	6.0	0

1

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Circular Surfaces, Has Been Specified.

100 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 10 Points Equally Spaced Along The Ground Surface Between X = 329.00 ft.
and X = 351.00 ft.

Each Surface Terminates Between X = 369.00 ft.
and X = 401.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is Y = .00 ft.

5.00 ft. Line Segments Define Each Trial Failure Surface.

1

Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Bishop Method * *

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	329.00	56.00
2	332.54	52.46
3	336.58	49.52
4	341.03	47.25
5	345.78	45.69
6	350.72	44.90
7	355.72	44.88
8	360.66	45.64
9	365.42	47.16
10	369.89	49.40
11	373.96	52.32
12	377.52	55.83
13	380.49	59.85
14	382.80	64.28
15	383.37	66.00

Circle Center At X = 353.3 ; Y = 76.8 and Radius, 32.0

*** 24.034 ***

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	331.44	56.31
2	335.08	52.88
3	339.23	50.08
4	343.77	47.99
5	348.59	46.65
6	353.56	46.11
7	358.55	46.37
8	363.44	47.44
9	368.09	49.28
10	372.38	51.84
11	376.20	55.06
12	379.46	58.85
13	382.06	63.12
14	383.23	66.00

Circle Center At X = 354.4 ; Y = 77.0 and Radius, 30.9

*** 24.453 ***

1

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	329.00	56.00
2	332.69	52.62
3	336.77	49.73
4	341.18	47.38
5	345.85	45.60
6	350.71	44.43
7	355.68	43.87
8	360.68	43.95
9	365.63	44.65
10	370.45	45.97
11	375.07	47.89
12	379.41	50.37
13	383.41	53.38
14	386.99	56.87
15	390.10	60.78
16	392.70	65.05
17	393.13	66.00

Circle Center At X = 357.6 ; Y = 83.5 and Radius, 39.7

*** 24.571 ***

Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	331.44	56.31
2	335.00	52.79
3	339.01	49.81
4	343.41	47.42
5	348.09	45.67
6	352.97	44.59
7	357.96	44.21
8	362.95	44.53
9	367.84	45.55
10	372.55	47.24
11	376.97	49.58
12	381.02	52.51
13	384.62	55.98
14	387.69	59.92
15	390.19	64.26
16	390.88	66.00

Circle Center At X = 358.2 ; Y = 79.8 and Radius, 35.6

*** 25.002 ***

1

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	329.00	56.00
2	332.94	52.92
3	337.20	50.30
4	341.72	48.16
5	346.45	46.54
6	351.33	45.45
7	356.30	44.91
8	361.30	44.92
9	366.27	45.49
10	371.14	46.60
11	375.86	48.25
12	380.37	50.40
13	384.62	53.05
14	388.54	56.14
15	392.10	59.66
16	395.25	63.54
17	396.82	66.00

Circle Center At X = 358.7 ; Y = 89.9 and Radius, 45.1

*** 25.212 ***

Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	331.44	56.31
2	335.11	52.90
3	339.18	50.00
4	343.59	47.65
5	348.28	45.90
6	353.15	44.77
7	358.12	44.28
8	363.12	44.45
9	368.05	45.26
10	372.84	46.71
11	377.40	48.77
12	381.65	51.40
13	385.52	54.56
14	388.95	58.20
15	391.88	62.25
16	393.90	66.00

Circle Center At X = 359.4 ; Y = 82.7 and Radius, 38.4

*** 25.376 ***

1

Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	329.00	56.00
2	332.63	52.57
3	336.64	49.57
4	340.96	47.05
5	345.54	45.04
6	350.32	43.57
7	355.23	42.66
8	360.22	42.31
9	365.21	42.53
10	370.15	43.33
11	374.96	44.68
12	379.59	46.58
13	383.97	48.99
14	388.05	51.89
15	391.76	55.23
16	395.07	58.98
17	397.94	63.08
18	399.51	66.00

Circle Center At X = 360.8 ; Y = 86.0 and Radius, 43.7

*** 25.520 ***

Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	329.00	56.00
2	332.70	52.63
3	336.74	49.70
4	341.09	47.22
5	345.68	45.24
6	350.46	43.78
7	355.38	42.86
8	360.36	42.48
9	365.36	42.66
10	370.31	43.39
11	375.14	44.66
12	379.81	46.45
13	384.25	48.75
14	388.41	51.52
15	392.24	54.74
16	395.69	58.36
17	398.72	62.34
18	400.91	66.00

Circle Center At X = 361.3 ; Y = 87.7 and Radius, 45.2

*** 25.749 ***

1

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	329.00	56.00
2	333.43	53.69
3	338.11	51.91
4	342.95	50.67
5	347.91	50.00
6	352.91	49.91
7	357.88	50.39
8	362.77	51.44
9	367.50	53.05
10	372.02	55.20
11	376.26	57.84
12	380.17	60.96
13	383.69	64.51
14	384.86	66.00

Circle Center At X = 351.2 ; Y = 93.2 and Radius, 43.4

*** 25.845 ***

Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	331.44	56.31
2	335.58	53.50
3	340.01	51.17
4	344.67	49.36
5	349.50	48.09
6	354.45	47.38
7	359.45	47.23
8	364.43	47.64
9	369.34	48.62
10	374.10	50.14
11	378.66	52.20
12	382.95	54.76
13	386.93	57.78
14	390.55	61.24
15	393.74	65.08
16	394.34	66.00

Circle Center At X = 358.3 ; Y = 91.3 and Radius, 44.1

*** 25.895 ***

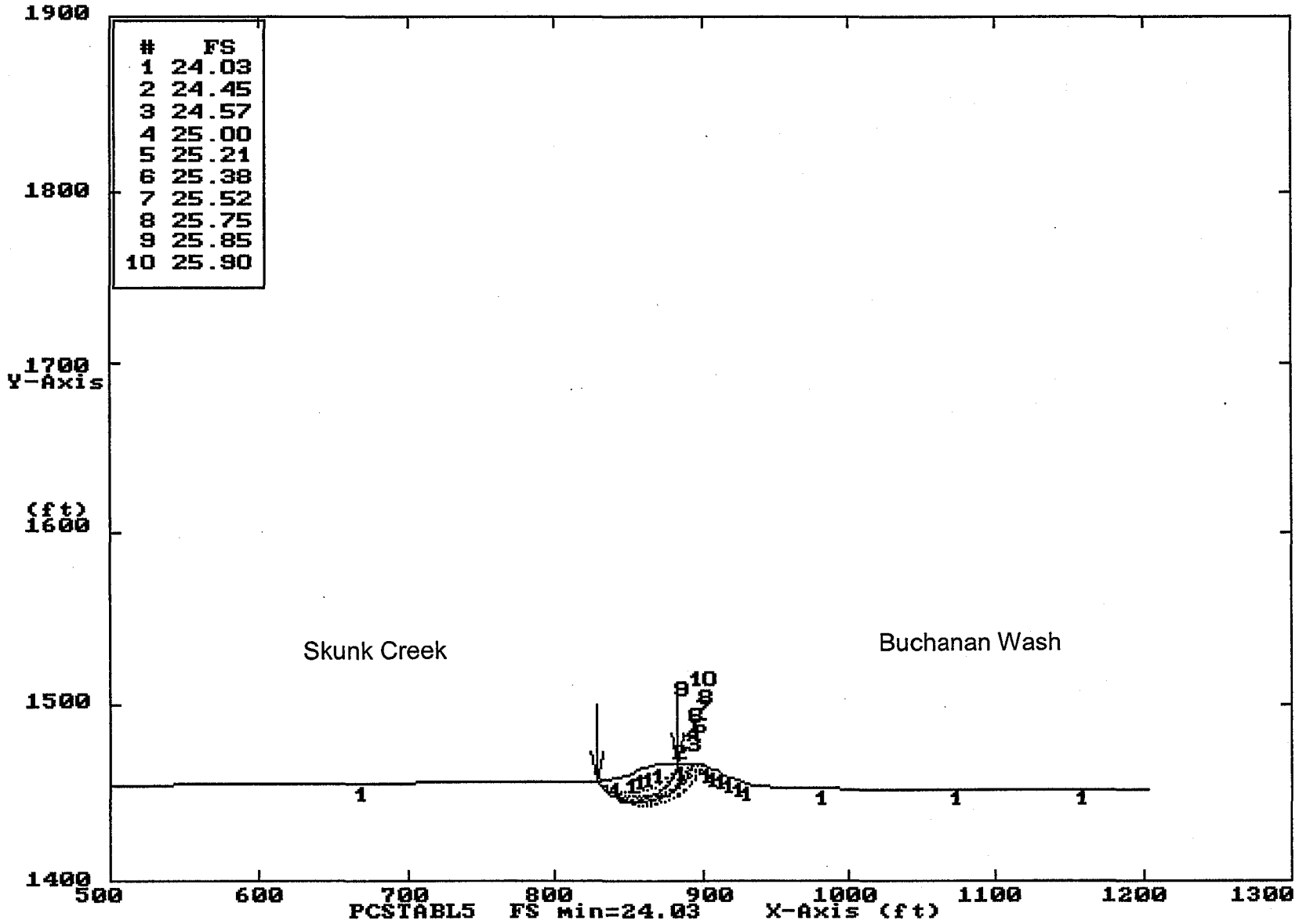
1

```
            Y            A     X     I     S            F     T

            .00     87.88    175.75    263.63    351.50    439.38
X        .00 +-----*---+---------+---------+---------+---------+
            -
            -
            -
            -
            -
      87.88 +
            -
            -
            -
            -
            -
A    175.75 +
            -
            -
            -
            -
            -
X    263.63 +
            -
            -
            -
            -     *
            -    11.
I    351.50 +    19*
            -    11**
            -    3111
```

```
                  -      53*
                  -       *
                  -      **
S     439.38 +            *
                  -
                  -
                  -
                  -
                  -
      527.25 +            *
                  -
                  -
                  -
                  -
                  -
F     615.13 +            *
                  -
                  -
                  -
                  -
                  -
T     703.00 +            *
```

Skunk Creek circular failure in SC piezometric head = 6', rapid drawdown
Ten Most Critical. C:SKALT2E.PLT By: acb 05-07-03 2:31pm



SKALT2F.OUT
** PCSTABL5 **

by
Purdue University

1

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date:	05-07-03
Time of Run:	2:32pm
Run By:	acb
Input Data Filename:	C:SKALT2F.DAT
Output Filename:	C:SKALT2F.OUT
Plotted Output Filename:	C:SKALT2F.PLT

PROBLEM DESCRIPTION Skunk Creek circular failure in BW;
piezometric head = 6'; rapid drawdown

BOUNDARY COORDINATES

16 Top Boundaries
16 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	52.00	86.00	52.00	1
2	86.00	52.00	172.00	52.00	1
3	172.00	52.00	269.00	54.00	1
4	269.00	54.00	275.00	56.00	1
5	275.00	56.00	281.00	58.00	1
6	281.00	58.00	287.00	60.00	1
7	287.00	60.00	293.00	62.00	1
8	293.00	62.00	298.00	64.00	1
9	298.00	64.00	302.00	66.00	1
10	302.00	66.00	334.00	66.00	1
11	334.00	66.00	340.00	64.00	1
12	340.00	64.00	346.00	62.00	1
13	346.00	62.00	352.00	60.00	1
14	352.00	60.00	358.00	58.00	1
15	358.00	58.00	374.00	56.00	1
16	374.00	56.00	703.00	54.00	1

1

ISOTROPIC SOIL PARAMETERS

1 Type(s) of Soil

Soil Type	Total Unit Wt.	Saturated Unit Wt.	Cohesion Intercept	Friction Angle	Pore Pressure	Pressure Constant	Piez. Surface

No.	(pcf)	(pcf)	(psf)	(deg)	Param.	(psf)	No.
1	140.5	150.8	4120.0	35.1	.00	6.0	0

1

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Circular Surfaces, Has Been Specified.

100 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 10 Points Equally Spaced Along The Ground Surface Between X = 100.00 ft.
and X = 172.00 ft.

Each Surface Terminates Between X = 302.00 ft.
and X = 334.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is Y = .00 ft.

5.00 ft. Line Segments Define Each Trial Failure Surface.

1

Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Bishop Method * *

Failure Surface Specified By 37 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	172.00	52.00
2	175.86	48.83
3	179.86	45.83
4	183.99	43.01
5	188.24	40.38
6	192.61	37.93
7	197.08	35.69
8	201.64	33.64
9	206.29	31.80
10	211.01	30.17
11	215.81	28.75
12	220.66	27.55
13	225.56	26.56
14	230.50	25.79
15	235.47	25.23
16	240.46	24.90
17	245.46	24.80
18	250.46	24.91

19	255.45	25.25
20	260.42	25.80
21	265.35	26.58
22	270.25	27.58
23	275.11	28.79
24	279.90	30.22
25	284.62	31.85
26	289.27	33.70
27	293.83	35.75
28	298.29	38.00
29	302.65	40.45
30	306.90	43.09
31	311.03	45.91
32	315.02	48.91
33	318.88	52.09
34	322.60	55.44
35	326.16	58.95
36	329.56	62.61
37	332.44	66.00

Circle Center At X = 245.4 ; Y = 137.4 and Radius, 112.6

*** 26.340 ***

Failure Surface Specified By 37 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	172.00	52.00
2	176.09	49.12
3	180.29	46.41
4	184.60	43.87
5	189.01	41.51
6	193.51	39.34
7	198.10	37.35
8	202.76	35.56
9	207.50	33.95
10	212.30	32.54
11	217.15	31.33
12	222.04	30.32
13	226.98	29.51
14	231.94	28.91
15	236.93	28.51
16	241.92	28.31
17	246.92	28.32
18	251.92	28.53
19	256.90	28.95
20	261.86	29.57
21	266.79	30.40
22	271.68	31.43
23	276.53	32.66
24	281.32	34.08
25	286.05	35.70
26	290.71	37.52
27	295.29	39.52
28	299.79	41.71
29	304.19	44.08
30	308.49	46.64

31	312.68	49.36
32	316.76	52.26
33	320.71	55.32
34	324.54	58.54
35	328.23	61.91
36	331.77	65.44
37	332.30	66.00

Circle Center At X = 244.2 ; Y = 150.1 and Radius, 121.8

*** 27.264 ***

1

Failure Surface Specified By 37 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	172.00	52.00
2	176.12	49.17
3	180.35	46.50
4	184.69	44.01
5	189.12	41.70
6	193.64	39.57
7	198.25	37.62
8	202.93	35.87
9	207.68	34.30
10	212.49	32.92
11	217.35	31.75
12	222.25	30.76
13	227.19	29.98
14	232.15	29.40
15	237.14	29.02
16	242.13	28.84
17	247.13	28.87
18	252.13	29.09
19	257.11	29.52
20	262.07	30.15
21	267.00	30.98
22	271.90	32.01
23	276.74	33.24
24	281.54	34.66
25	286.27	36.27
26	290.93	38.08
27	295.52	40.07
28	300.02	42.24
29	304.43	44.60
30	308.74	47.13
31	312.95	49.84
32	317.04	52.71
33	321.01	55.75
34	324.86	58.94
35	328.57	62.29
36	332.15	65.78
37	332.36	66.00

Circle Center At X = 244.0 ; Y = 152.4 and Radius, 123.5

*** 27.444 ***

Failure Surface Specified By 38 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	164.00	52.00
2	167.81	48.76
3	171.76	45.69
4	175.83	42.80
5	180.03	40.09
6	184.35	37.56
7	188.77	35.23
8	193.29	33.09
9	197.90	31.16
10	202.60	29.43
11	207.36	27.91
12	212.18	26.59
13	217.06	25.50
14	221.98	24.61
15	226.94	23.95
16	231.92	23.50
17	236.91	23.27
18	241.91	23.26
19	246.91	23.48
20	251.89	23.91
21	256.85	24.56
22	261.77	25.42
23	266.65	26.50
24	271.48	27.80
25	276.25	29.31
26	280.95	31.02
27	285.56	32.94
28	290.09	35.06
29	294.52	37.38
30	298.85	39.89
31	303.06	42.58
32	307.14	45.46
33	311.10	48.52
34	314.92	51.75
35	318.59	55.14
36	322.11	58.69
37	325.47	62.39
38	328.47	66.00

Circle Center At X = 239.6 ; Y = 137.0 and Radius, 113.7

*** 28.107 ***

1

Failure Surface Specified By 41 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)

1	156.00	52.00
2	160.00	49.00
3	164.11	46.15
4	168.33	43.47
5	172.64	40.94
6	177.05	38.58
7	181.54	36.38
8	186.11	34.36
9	190.76	32.51
10	195.47	30.84
11	200.24	29.35
12	205.07	28.04
13	209.94	26.91
14	214.85	25.97
15	219.79	25.21
16	224.76	24.64
17	229.75	24.26
18	234.74	24.07
19	239.74	24.07
20	244.74	24.25
21	249.73	24.63
22	254.69	25.19
23	259.64	25.94
24	264.55	26.88
25	269.42	28.00
26	274.25	29.30
27	279.02	30.79
28	283.74	32.46
29	288.38	34.30
30	292.96	36.32
31	297.45	38.50
32	301.86	40.86
33	306.18	43.38
34	310.40	46.07
35	314.51	48.91
36	318.52	51.90
37	322.41	55.05
38	326.17	58.34
39	329.81	61.76
40	333.32	65.33
41	333.93	66.00

Circle Center At X = 237.3 ; Y = 156.3 and Radius, 132.2

*** 28.425 ***

Failure Surface Specified By 38 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	164.00	52.00
2	167.62	48.55
3	171.40	45.27
4	175.32	42.18
5	179.39	39.28
6	183.60	36.57
7	187.93	34.06
8	192.37	31.77

9	196.91	29.69
10	201.55	27.82
11	206.27	26.18
12	211.07	24.76
13	215.93	23.57
14	220.83	22.62
15	225.78	21.89
16	230.76	21.41
17	235.75	21.16
18	240.75	21.14
19	245.75	21.37
20	250.73	21.83
21	255.68	22.52
22	260.59	23.45
23	265.45	24.61
24	270.25	26.01
25	274.99	27.62
26	279.63	29.46
27	284.19	31.52
28	288.64	33.80
29	292.99	36.28
30	297.20	38.96
31	301.29	41.84
32	305.24	44.91
33	309.03	48.17
34	312.67	51.60
35	316.14	55.20
36	319.43	58.96
37	322.54	62.88
38	324.79	66.00

Circle Center At X = 238.5 ; Y = 126.5 and Radius, 105.4

*** 28.800 ***

1

Failure Surface Specified By 43 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	148.00	52.00
2	151.55	48.48
3	155.24	45.11
4	159.08	41.90
5	163.05	38.86
6	167.14	35.98
7	171.35	33.29
8	175.67	30.77
9	180.09	28.44
10	184.61	26.30
11	189.22	24.35
12	193.90	22.60
13	198.65	21.05
14	203.47	19.70
15	208.33	18.56
16	213.25	17.62
17	218.19	16.89
18	223.17	16.38

19	228.16	16.07
20	233.16	15.98
21	238.15	16.10
22	243.14	16.43
23	248.11	16.97
24	253.06	17.72
25	257.96	18.68
26	262.83	19.85
27	267.63	21.22
28	272.38	22.79
29	277.05	24.57
30	281.65	26.54
31	286.16	28.70
32	290.57	31.05
33	294.88	33.59
34	299.08	36.31
35	303.15	39.20
36	307.10	42.26
37	310.92	45.49
38	314.60	48.88
39	318.13	52.42
40	321.51	56.11
41	324.73	59.93
42	327.78	63.89
43	329.27	66.00

Circle Center At X = 232.9 ; Y = 134.0 and Radius, 118.0

*** 29.508 ***

Failure Surface Specified By 39 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	156.00	52.00
2	160.22	49.32
3	164.54	46.79
4	168.93	44.41
5	173.41	42.19
6	177.97	40.13
7	182.59	38.22
8	187.28	36.48
9	192.02	34.91
10	196.82	33.50
11	201.66	32.25
12	206.55	31.18
13	211.46	30.28
14	216.41	29.55
15	221.38	29.00
16	226.37	28.62
17	231.36	28.41
18	236.36	28.38
19	241.36	28.52
20	246.35	28.83
21	251.33	29.32
22	256.28	29.99
23	261.21	30.82
24	266.11	31.83

25	270.97	33.01
26	275.78	34.36
27	280.55	35.87
28	285.26	37.55
29	289.90	39.40
30	294.48	41.40
31	298.99	43.57
32	303.42	45.89
33	307.77	48.36
34	312.02	50.98
35	316.19	53.75
36	320.25	56.66
37	324.21	59.72
38	328.06	62.91
39	331.53	66.00

Circle Center At X = 234.8 ; Y = 171.5 and Radius, 143.2

*** 30.481 ***

1

Failure Surface Specified By 47 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	132.00	52.00
2	135.57	48.50
3	139.26	45.13
4	143.08	41.90
5	147.02	38.82
6	151.07	35.89
7	155.23	33.12
8	159.50	30.50
9	163.85	28.05
10	168.30	25.76
11	172.83	23.64
12	177.43	21.70
13	182.11	19.93
14	186.85	18.33
15	191.64	16.92
16	196.49	15.68
17	201.38	14.63
18	206.30	13.77
19	211.25	13.09
20	216.23	12.60
21	221.22	12.29
22	226.22	12.18
23	231.22	12.25
24	236.21	12.51
25	241.19	12.96
26	246.15	13.59
27	251.08	14.41
28	255.98	15.42
29	260.84	16.61
30	265.65	17.98
31	270.40	19.54
32	275.09	21.27
33	279.71	23.17

34	284.26	25.25
35	288.73	27.50
36	293.10	29.92
37	297.39	32.49
38	301.57	35.23
39	305.65	38.12
40	309.61	41.17
41	313.46	44.36
42	317.19	47.70
43	320.79	51.17
44	324.25	54.77
45	327.58	58.51
46	330.76	62.36
47	333.54	66.00

Circle Center At X = 226.8 ; Y = 144.9 and Radius, 132.8

*** 30.575 ***

Failure Surface Specified By 47 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	132.00	52.00
2	135.62	48.55
3	139.36	45.23
4	143.22	42.06
5	147.20	39.03
6	151.29	36.15
7	155.48	33.43
8	159.78	30.86
9	164.16	28.46
10	168.63	26.22
11	173.18	24.15
12	177.81	22.25
13	182.50	20.52
14	187.25	18.97
15	192.06	17.59
16	196.91	16.40
17	201.81	15.39
18	206.74	14.56
19	211.70	13.91
20	216.68	13.45
21	221.67	13.18
22	226.67	13.09
23	231.67	13.19
24	236.66	13.47
25	241.64	13.94
26	246.60	14.59
27	251.52	15.43
28	256.42	16.45
29	261.27	17.66
30	266.08	19.04
31	270.83	20.60
32	275.52	22.33
33	280.14	24.24
34	284.69	26.32
35	289.15	28.57

36	293.53	30.98
37	297.82	33.56
38	302.01	36.29
39	306.09	39.17
40	310.06	42.21
41	313.92	45.39
42	317.66	48.71
43	321.27	52.17
44	324.75	55.76
45	328.09	59.48
46	331.29	63.32
47	333.37	66.00

Circle Center At X = 226.5 ; Y = 147.4 and Radius, 134.3

*** 30.682 ***

1

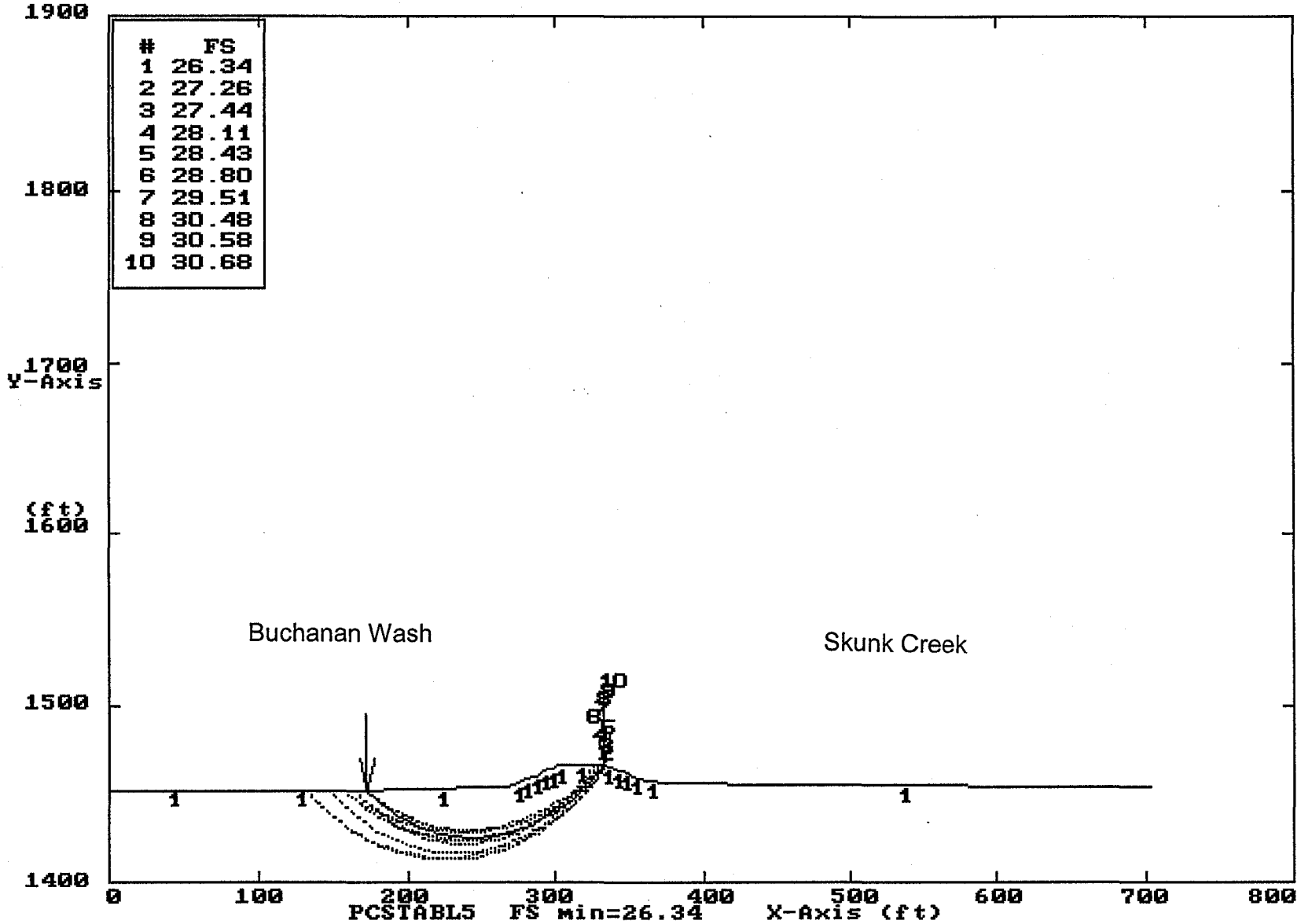
```
            Y            A     X     I     S            F     T

                .00     87.88    175.75    263.63    351.50    439.38

X          .00 +-----*---+---------+---------+---------+---------+
               -
               -
               -
               -
               -
        87.88 +     *
               -    ..
               -   ...
               -  ...9
               - ..997
               -..9754
A      175.75 +.9751*
               -.9611.
               -9711..
               -9612..
               -961...
               -.61...
X      263.63 + 713.*
               - 911.**
               -  712.*
               -   712.*
               -    9114
               -      **
I      351.50 +      *
               -
               -     *
               -
               -
               -
S      439.38 +
               -
               -
               -
               -
               -
```

```
          527.25 +
                 -
                 -
                 -
                 -
                 -
F         615.13 +
                 -
                 -
                 -
                 -
                 -
T         703.00 +      *
```

Skunk Creek circular failure in BW; piezometric head = 6'; rapid drawdown
Ten Most Critical. C:SKALT2F.PLT By: acb 05-07-03 2:32pm



#	FS
1	26.34
2	27.26
3	27.44
4	28.11
5	28.43
6	28.80
7	29.51
8	30.48
9	30.58
10	30.68

SKALT2G.OUT
** PCSTABL5 **

by
Purdue University

1

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date:	05-07-03
Time of Run:	3:43pm
Run By:	acb
Input Data Filename:	C:SKALT2G.DAT
Output Filename:	C:SKALT2G.OUT
Plotted Output Filename:	C:SKALT2G.PLT

PROBLEM DESCRIPTION Skunk Creek circular failure in SC;
piezometric surface, rapid drawdown

BOUNDARY COORDINATES

16 Top Boundaries
16 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	54.00	329.00	56.00	1
2	329.00	56.00	345.00	58.00	1
3	345.00	58.00	351.00	60.00	1
4	351.00	60.00	357.00	62.00	1
5	357.00	62.00	363.00	64.00	1
6	363.00	64.00	369.00	66.00	1
7	369.00	66.00	401.00	66.00	1
8	401.00	66.00	405.00	64.00	1
9	405.00	64.00	410.00	62.00	1
10	410.00	62.00	416.00	60.00	1
11	416.00	60.00	422.00	58.00	1
12	422.00	58.00	428.00	56.00	1
13	428.00	56.00	434.00	54.00	1
14	434.00	54.00	531.00	52.00	1
15	531.00	52.00	617.00	52.00	1
16	617.00	52.00	703.00	52.00	1

1

ISOTROPIC SOIL PARAMETERS

1 Type(s) of Soil

Soil Type	Total Unit Wt.	Saturated Unit Wt.	Cohesion Intercept	Friction Angle	Pore Pressure	Pressure Constant	Piez. Surface

No.	(pcf)	(pcf)	(psf)	(deg)	Param.	(psf)	No.
1	140.5	150.8	4120.0	35.1	.00	.0	0

1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 62.40

Piezometric Surface No. 1 Specified by 15 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	54.00
2	329.00	56.00
3	345.00	58.00
4	351.00	60.00
5	357.00	62.00
6	360.00	63.00
7	407.00	63.00
8	410.00	62.00
9	416.00	60.00
10	422.00	58.00
11	428.00	56.00
12	434.00	54.00
13	531.00	52.00
14	617.00	52.00
15	703.00	52.00

1

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Circular Surfaces, Has Been Specified.

100 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 10 Points Equally Spaced Along The Ground Surface Between X = 329.00 ft.
and X = 351.00 ft.

Each Surface Terminates Between X = 369.00 ft.
and X = 401.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is Y = .00 ft.

5.00 ft. Line Segments Define Each Trial Failure Surface.

1

Following Are Displayed The Ten Most Critical Of The Trial

Failure Surfaces Examined. They Are Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Bishop Method * *

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	329.00	56.00
2	332.54	52.46
3	336.58	49.52
4	341.03	47.25
5	345.78	45.69
6	350.72	44.90
7	355.72	44.88
8	360.66	45.64
9	365.42	47.16
10	369.89	49.40
11	373.96	52.32
12	377.52	55.83
13	380.49	59.85
14	382.80	64.28
15	383.37	66.00

Circle Center At X = 353.3 ; Y = 76.8 and Radius, 32.0

*** 24.053 ***

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	331.44	56.31
2	335.08	52.88
3	339.23	50.08
4	343.77	47.99
5	348.59	46.65
6	353.56	46.11
7	358.55	46.37
8	363.44	47.44
9	368.09	49.28
10	372.38	51.84
11	376.20	55.06
12	379.46	58.85
13	382.06	63.12
14	383.23	66.00

Circle Center At X = 354.4 ; Y = 77.0 and Radius, 30.9

*** 24.473 ***

1

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	329.00	56.00
2	332.69	52.62
3	336.77	49.73
4	341.18	47.38
5	345.85	45.60
6	350.71	44.43
7	355.68	43.87
8	360.68	43.95
9	365.63	44.65
10	370.45	45.97
11	375.07	47.89
12	379.41	50.37
13	383.41	53.38
14	386.99	56.87
15	390.10	60.78
16	392.70	65.05
17	393.13	66.00

Circle Center At X = 357.6 ; Y = 83.5 and Radius, 39.7

*** 24.590 ***

Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	331.44	56.31
2	335.00	52.79
3	339.01	49.81
4	343.41	47.42
5	348.09	45.67
6	352.97	44.59
7	357.96	44.21
8	362.95	44.53
9	367.84	45.55
10	372.55	47.24
11	376.97	49.58
12	381.02	52.51
13	384.62	55.98
14	387.69	59.92
15	390.19	64.26
16	390.88	66.00

Circle Center At X = 358.2 ; Y = 79.8 and Radius, 35.6

*** 25.022 ***

1

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	329.00	56.00
2	332.94	52.92
3	337.20	50.30
4	341.72	48.16
5	346.45	46.54
6	351.33	45.45
7	356.30	44.91
8	361.30	44.92
9	366.27	45.49
10	371.14	46.60
11	375.86	48.25
12	380.37	50.40
13	384.62	53.05
14	388.54	56.14
15	392.10	59.66
16	395.25	63.54
17	396.82	66.00

Circle Center At X = 358.7 ; Y = 89.9 and Radius, 45.1

*** 25.233 ***

Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	331.44	56.31
2	335.11	52.90
3	339.18	50.00
4	343.59	47.65
5	348.28	45.90
6	353.15	44.77
7	358.12	44.28
8	363.12	44.45
9	368.05	45.26
10	372.84	46.71
11	377.40	48.77
12	381.65	51.40
13	385.52	54.56
14	388.95	58.20
15	391.88	62.25
16	393.90	66.00

Circle Center At X = 359.4 ; Y = 82.7 and Radius, 38.4

*** 25.397 ***

1

Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	329.00	56.00
2	332.63	52.57
3	336.64	49.57
4	340.96	47.05
5	345.54	45.04
6	350.32	43.57
7	355.23	42.66
8	360.22	42.31
9	365.21	42.53
10	370.15	43.33
11	374.96	44.68
12	379.59	46.58
13	383.97	48.99
14	388.05	51.89
15	391.76	55.23
16	395.07	58.98
17	397.94	63.08
18	399.51	66.00

Circle Center At X = 360.8 ; Y = 86.0 and Radius, 43.7

*** 25.540 ***

Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	329.00	56.00
2	332.70	52.63
3	336.74	49.70
4	341.09	47.22
5	345.68	45.24
6	350.46	43.78
7	355.38	42.86
8	360.36	42.48
9	365.36	42.66
10	370.31	43.39
11	375.14	44.66
12	379.81	46.45
13	384.25	48.75
14	388.41	51.52
15	392.24	54.74
16	395.69	58.36
17	398.72	62.34
18	400.91	66.00

Circle Center At X = 361.3 ; Y = 87.7 and Radius, 45.2

*** 25.769 ***

1

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	329.00	56.00
2	333.43	53.69
3	338.11	51.91
4	342.95	50.67
5	347.91	50.00
6	352.91	49.91
7	357.88	50.39
8	362.77	51.44
9	367.50	53.05
10	372.02	55.20
11	376.26	57.84
12	380.17	60.96
13	383.69	64.51
14	384.86	66.00

Circle Center At X = 351.2 ; Y = 93.2 and Radius, 43.4

*** 25.868 ***

Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	331.44	56.31
2	335.58	53.50
3	340.01	51.17
4	344.67	49.36
5	349.50	48.09
6	354.45	47.38
7	359.45	47.23
8	364.43	47.64
9	369.34	48.62
10	374.10	50.14
11	378.66	52.20
12	382.95	54.76
13	386.93	57.78
14	390.55	61.24
15	393.74	65.08
16	394.34	66.00

Circle Center At X = 358.3 ; Y = 91.3 and Radius, 44.1

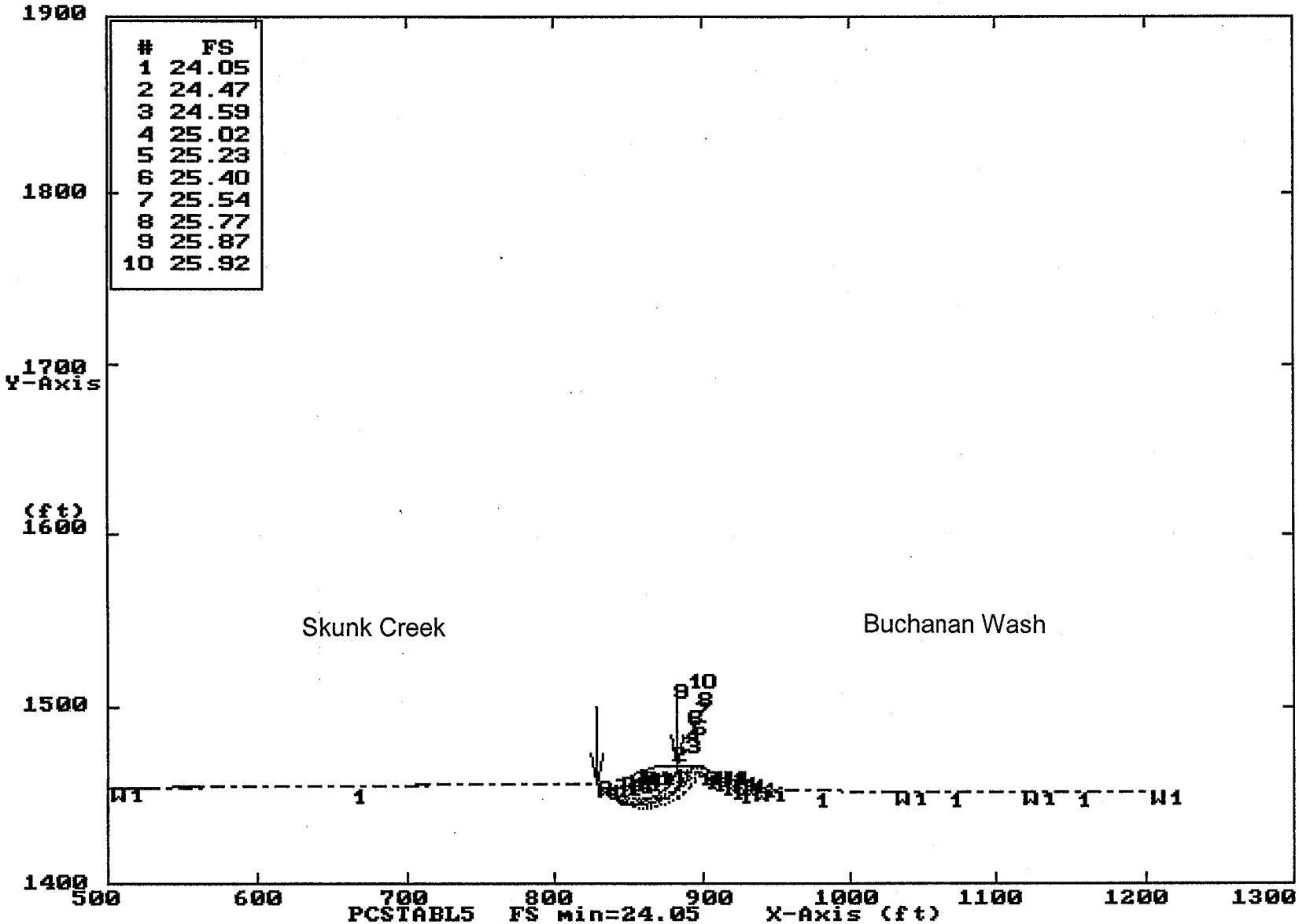
*** 25.916 ***

1

Y A X I S F T

```
                .00     87.88    175.75    263.63    351.50    439.38
X          .00 +-----*---+---------+---------+---------+---------+
               -
               -
               -
               -
               -
       87.88 +
               -
               -
               -
               -
               -
A     175.75 +
               -
               -
               -
               -
               -
X     263.63 +
               -
               -
               -
               -     *
               -    11.
I     351.50 +    19*
               -    11**
               -    3111
               -     53*
               -      *
               -     **
S     439.38 +     *
               -
               -
               -
               -
               -
       527.25 +     *
               -
               -
               -
               -
               -
F     615.13 +     *
               -
               -
               -
               -
               -
T     703.00 +     *
```

Skunk Creek circular failure in SC; piezometric surface, rapid drawdown
Ten Most Critical. C:SKALT2G.PLT By: acb 05-07-03 3:43pm



SKALT2H.OUT
** PCSTABL5 **

by
Purdue University

1

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date:	05-07-03
Time of Run:	3:42pm
Run By:	acb
Input Data Filename:	C:SKALT2H.DAT
Output Filename:	C:SKALT2H.OUT
Plotted Output Filename:	C:SKALT2H.PLT

PROBLEM DESCRIPTION Skunk Creek circular failure in BW; piezometric surface; rapid drawdown

BOUNDARY COORDINATES

16 Top Boundaries
16 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	52.00	86.00	52.00	1
2	86.00	52.00	172.00	52.00	1
3	172.00	52.00	269.00	54.00	1
4	269.00	54.00	275.00	56.00	1
5	275.00	56.00	281.00	58.00	1
6	281.00	58.00	287.00	60.00	1
7	287.00	60.00	293.00	62.00	1
8	293.00	62.00	298.00	64.00	1
9	298.00	64.00	302.00	66.00	1
10	302.00	66.00	334.00	66.00	1
11	334.00	66.00	340.00	64.00	1
12	340.00	64.00	346.00	62.00	1
13	346.00	62.00	352.00	60.00	1
14	352.00	60.00	358.00	58.00	1
15	358.00	58.00	374.00	56.00	1
16	374.00	56.00	703.00	54.00	1

1

ISOTROPIC SOIL PARAMETERS

1 Type(s) of Soil

Soil Type	Total Unit Wt.	Saturated Unit Wt.	Cohesion Intercept	Friction Angle	Pore Pressure	Pressure Constant	Piez. Surface

No.	(pcf)	(pcf)	(psf)	(deg)	Param.	(psf)	No.
1	140.5	150.8	4120.0	35.1	.00	.0	0

1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 62.40

Piezometric Surface No. 1 Specified by 15 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	.00	52.00
2	86.00	52.00
3	172.00	52.00
4	269.00	54.00
5	275.00	56.00
6	281.00	58.00
7	287.00	60.00
8	293.00	62.00
9	296.00	63.00
10	343.00	63.00
11	346.00	62.00
12	352.00	60.00
13	358.00	58.00
14	374.00	56.00
15	703.00	54.00

1

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.

100 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 10 Points Equally Spaced
Along The Ground Surface Between X = 100.00 ft.
and X = 172.00 ft.

Each Surface Terminates Between X = 302.00 ft.
and X = 334.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = .00 ft.

5.00 ft. Line Segments Define Each Trial Failure Surface.

1

Following Are Displayed The Ten Most Critical Of The Trial

Failure Surfaces Examined. They Are Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Bishop Method * *

Failure Surface Specified By 37 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	172.00	52.00
2	175.86	48.83
3	179.86	45.83
4	183.99	43.01
5	188.24	40.38
6	192.61	37.93
7	197.08	35.69
8	201.64	33.64
9	206.29	31.80
10	211.01	30.17
11	215.81	28.75
12	220.66	27.55
13	225.56	26.56
14	230.50	25.79
15	235.47	25.23
16	240.46	24.90
17	245.46	24.80
18	250.46	24.91
19	255.45	25.25
20	260.42	25.80
21	265.35	26.58
22	270.25	27.58
23	275.11	28.79
24	279.90	30.22
25	284.62	31.85
26	289.27	33.70
27	293.83	35.75
28	298.29	38.00
29	302.65	40.45
30	306.90	43.09
31	311.03	45.91
32	315.02	48.91
33	318.88	52.09
34	322.60	55.44
35	326.16	58.95
36	329.56	62.61
37	332.44	66.00

Circle Center At X = 245.4 ; Y = 137.4 and Radius, 112.6

*** 26.358 ***

Failure Surface Specified By 37 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)

1	172.00	52.00
2	176.09	49.12
3	180.29	46.41
4	184.60	43.87
5	189.01	41.51
6	193.51	39.34
7	198.10	37.35
8	202.76	35.56
9	207.50	33.95
10	212.30	32.54
11	217.15	31.33
12	222.04	30.32
13	226.98	29.51
14	231.94	28.91
15	236.93	28.51
16	241.92	28.31
17	246.92	28.32
18	251.92	28.53
19	256.90	28.95
20	261.86	29.57
21	266.79	30.40
22	271.68	31.43
23	276.53	32.66
24	281.32	34.08
25	286.05	35.70
26	290.71	37.52
27	295.29	39.52
28	299.79	41.71
29	304.19	44.08
30	308.49	46.64
31	312.68	49.36
32	316.76	52.26
33	320.71	55.32
34	324.54	58.54
35	328.23	61.91
36	331.77	65.44
37	332.30	66.00

Circle Center At X = 244.2 ; Y = 150.1 and Radius, 121.8

*** 27.284 ***

1

Failure Surface Specified By 37 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	172.00	52.00
2	176.12	49.17
3	180.35	46.50
4	184.69	44.01
5	189.12	41.70
6	193.64	39.57
7	198.25	37.62
8	202.93	35.87
9	207.68	34.30
10	212.49	32.92

11	217.35	31.75
12	222.25	30.76
13	227.19	29.98
14	232.15	29.40
15	237.14	29.02
16	242.13	28.84
17	247.13	28.87
18	252.13	29.09
19	257.11	29.52
20	262.07	30.15
21	267.00	30.98
22	271.90	32.01
23	276.74	33.24
24	281.54	34.66
25	286.27	36.27
26	290.93	38.08
27	295.52	40.07
28	300.02	42.24
29	304.43	44.60
30	308.74	47.13
31	312.95	49.84
32	317.04	52.71
33	321.01	55.75
34	324.86	58.94
35	328.57	62.29
36	332.15	65.78
37	332.36	66.00

Circle Center At X = 244.0 ; Y = 152.4 and Radius, 123.5

*** 27.463 ***

Failure Surface Specified By 38 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	164.00	52.00
2	167.81	48.76
3	171.76	45.69
4	175.83	42.80
5	180.03	40.09
6	184.35	37.56
7	188.77	35.23
8	193.29	33.09
9	197.90	31.16
10	202.60	29.43
11	207.36	27.91
12	212.18	26.59
13	217.06	25.50
14	221.98	24.61
15	226.94	23.95
16	231.92	23.50
17	236.91	23.27
18	241.91	23.26
19	246.91	23.48
20	251.89	23.91
21	256.85	24.56
22	261.77	25.42

23	266.65	26.50
24	271.48	27.80
25	276.25	29.31
26	280.95	31.02
27	285.56	32.94
28	290.09	35.06
29	294.52	37.38
30	298.85	39.89
31	303.06	42.58
32	307.14	45.46
33	311.10	48.52
34	314.92	51.75
35	318.59	55.14
36	322.11	58.69
37	325.47	62.39
38	328.47	66.00

Circle Center At X = 239.6 ; Y = 137.0 and Radius, 113.7

*** 28.126 ***

1

Failure Surface Specified By 41 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	156.00	52.00
2	160.00	49.00
3	164.11	46.15
4	168.33	43.47
5	172.64	40.94
6	177.05	38.58
7	181.54	36.38
8	186.11	34.36
9	190.76	32.51
10	195.47	30.84
11	200.24	29.35
12	205.07	28.04
13	209.94	26.91
14	214.85	25.97
15	219.79	25.21
16	224.76	24.64
17	229.75	24.26
18	234.74	24.07
19	239.74	24.07
20	244.74	24.25
21	249.73	24.63
22	254.69	25.19
23	259.64	25.94
24	264.55	26.88
25	269.42	28.00
26	274.25	29.30
27	279.02	30.79
28	283.74	32.46
29	288.38	34.30
30	292.96	36.32
31	297.45	38.50
32	301.86	40.86

33	306.18	43.38
34	310.40	46.07
35	314.51	48.91
36	318.52	51.90
37	322.41	55.05
38	326.17	58.34
39	329.81	61.76
40	333.32	65.33
41	333.93	66.00

Circle Center At X = 237.3 ; Y = 156.3 and Radius, 132.2

*** 28.444 ***

Failure Surface Specified By 38 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	164.00	52.00
2	167.62	48.55
3	171.40	45.27
4	175.32	42.18
5	179.39	39.28
6	183.60	36.57
7	187.93	34.06
8	192.37	31.77
9	196.91	29.69
10	201.55	27.82
11	206.27	26.18
12	211.07	24.76
13	215.93	23.57
14	220.83	22.62
15	225.78	21.89
16	230.76	21.41
17	235.75	21.16
18	240.75	21.14
19	245.75	21.37
20	250.73	21.83
21	255.68	22.52
22	260.59	23.45
23	265.45	24.61
24	270.25	26.01
25	274.99	27.62
26	279.63	29.46
27	284.19	31.52
28	288.64	33.80
29	292.99	36.28
30	297.20	38.96
31	301.29	41.84
32	305.24	44.91
33	309.03	48.17
34	312.67	51.60
35	316.14	55.20
36	319.43	58.96
37	322.54	62.88
38	324.79	66.00

Circle Center At X = 238.5 ; Y = 126.5 and Radius, 105.4

*** 28.820 ***

1

Failure Surface Specified By 43 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	148.00	52.00
2	151.55	48.48
3	155.24	45.11
4	159.08	41.90
5	163.05	38.86
6	167.14	35.98
7	171.35	33.29
8	175.67	30.77
9	180.09	28.44
10	184.61	26.30
11	189.22	24.35
12	193.90	22.60
13	198.65	21.05
14	203.47	19.70
15	208.33	18.56
16	213.25	17.62
17	218.19	16.89
18	223.17	16.38
19	228.16	16.07
20	233.16	15.98
21	238.15	16.10
22	243.14	16.43
23	248.11	16.97
24	253.06	17.72
25	257.96	18.68
26	262.83	19.85
27	267.63	21.22
28	272.38	22.79
29	277.05	24.57
30	281.65	26.54
31	286.16	28.70
32	290.57	31.05
33	294.88	33.59
34	299.08	36.31
35	303.15	39.20
36	307.10	42.26
37	310.92	45.49
38	314.60	48.88
39	318.13	52.42
40	321.51	56.11
41	324.73	59.93
42	327.78	63.89
43	329.27	66.00

Circle Center At X = 232.9 ; Y = 134.0 and Radius, 118.0

*** 29.527 ***

Failure Surface Specified By 39 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	156.00	52.00
2	160.22	49.32
3	164.54	46.79
4	168.93	44.41
5	173.41	42.19
6	177.97	40.13
7	182.59	38.22
8	187.28	36.48
9	192.02	34.91
10	196.82	33.50
11	201.66	32.25
12	206.55	31.18
13	211.46	30.28
14	216.41	29.55
15	221.38	29.00
16	226.37	28.62
17	231.36	28.41
18	236.36	28.38
19	241.36	28.52
20	246.35	28.83
21	251.33	29.32
22	256.28	29.99
23	261.21	30.82
24	266.11	31.83
25	270.97	33.01
26	275.78	34.36
27	280.55	35.87
28	285.26	37.55
29	289.90	39.40
30	294.48	41.40
31	298.99	43.57
32	303.42	45.89
33	307.77	48.36
34	312.02	50.98
35	316.19	53.75
36	320.25	56.66
37	324.21	59.72
38	328.06	62.91
39	331.53	66.00

Circle Center At X = 234.8 ; Y = 171.5 and Radius, 143.2

*** 30.503 ***

1

Failure Surface Specified By 47 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	132.00	52.00
2	135.57	48.50

3	139.26	45.13
4	143.08	41.90
5	147.02	38.82
6	151.07	35.89
7	155.23	33.12
8	159.50	30.50
9	163.85	28.05
10	168.30	25.76
11	172.83	23.64
12	177.43	21.70
13	182.11	19.93
14	186.85	18.33
15	191.64	16.92
16	196.49	15.68
17	201.38	14.63
18	206.30	13.77
19	211.25	13.09
20	216.23	12.60
21	221.22	12.29
22	226.22	12.18
23	231.22	12.25
24	236.21	12.51
25	241.19	12.96
26	246.15	13.59
27	251.08	14.41
28	255.98	15.42
29	260.84	16.61
30	265.65	17.98
31	270.40	19.54
32	275.09	21.27
33	279.71	23.17
34	284.26	25.25
35	288.73	27.50
36	293.10	29.92
37	297.39	32.49
38	301.57	35.23
39	305.65	38.12
40	309.61	41.17
41	313.46	44.36
42	317.19	47.70
43	320.79	51.17
44	324.25	54.77
45	327.58	58.51
46	330.76	62.36
47	333.54	66.00

Circle Center At X = 226.8 ; Y = 144.9 and Radius, 132.8

*** 30.594 ***

Failure Surface Specified By 47 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	132.00	52.00
2	135.62	48.55
3	139.36	45.23
4	143.22	42.06

5	147.20	39.03
6	151.29	36.15
7	155.48	33.43
8	159.78	30.86
9	164.16	28.46
10	168.63	26.22
11	173.18	24.15
12	177.81	22.25
13	182.50	20.52
14	187.25	18.97
15	192.06	17.59
16	196.91	16.40
17	201.81	15.39
18	206.74	14.56
19	211.70	13.91
20	216.68	13.45
21	221.67	13.18
22	226.67	13.09
23	231.67	13.19
24	236.66	13.47
25	241.64	13.94
26	246.60	14.59
27	251.52	15.43
28	256.42	16.45
29	261.27	17.66
30	266.08	19.04
31	270.83	20.60
32	275.52	22.33
33	280.14	24.24
34	284.69	26.32
35	289.15	28.57
36	293.53	30.98
37	297.82	33.56
38	302.01	36.29
39	306.09	39.17
40	310.06	42.21
41	313.92	45.39
42	317.66	48.71
43	321.27	52.17
44	324.75	55.76
45	328.09	59.48
46	331.29	63.32
47	333.37	66.00

Circle Center At X = 226.5 ; Y = 147.4 and Radius, 134.3

*** 30.701 ***

1

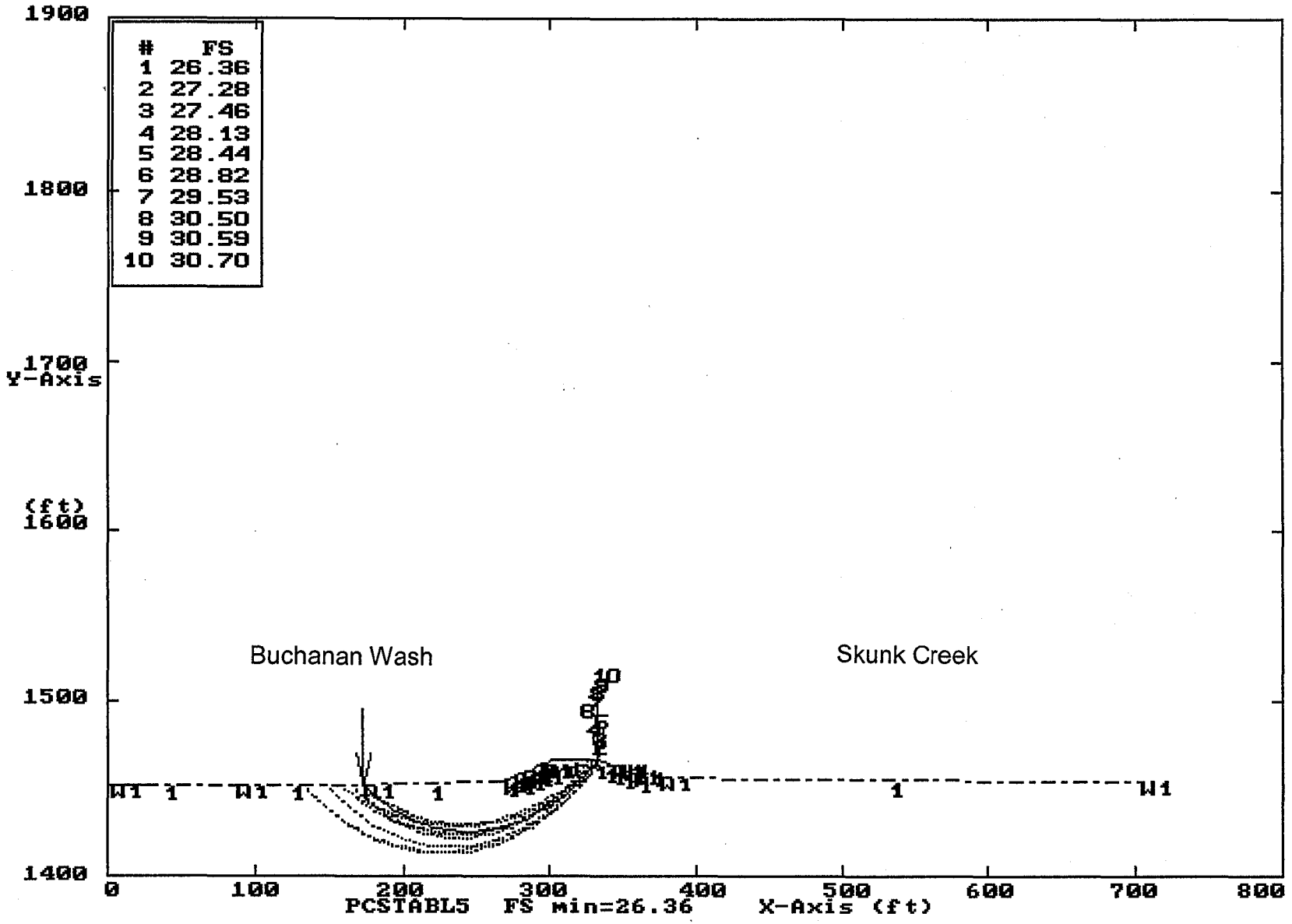
```
            Y            A     X     I     S            F     T

            .00     87.88    175.75    263.63    351.50    439.38

X        .00 +-----*---+---------+---------+---------+---------+
            -
            -
            -
            -
```

```
                 -
        87.88 +     *
              -    ..
              -   ...
              -  ...9
              - ..997
              -..9754
A     175.75 +.9751*
              -.9611.
              -9711..
              -9612..
              -961...
              -.61...
X     263.63 + 713.*
              - 911.**
              -  712.*
              -   712.*
              -    9114
              -      **
I     351.50 +      *
              -
              -     *
              -
              -
              -
S     439.38 +
              -
              -
              -
              -
              -
      527.25 +
              -
              -
              -
              -
              -
F     615.13 +
              -
              -
              -
              -
              -
T     703.00 +     *
```

Skunk Creek circular failure in BW; piezometric surface; rapid drawdown
Ten Most Critical. C:SKALT2H.PLT By: acb 05-07-03 3:42pm



SKALT2ES.OUT
** PCSTABL5 **

by
Purdue University

1

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date:	06-02-03
Time of Run:	12:37pm
Run By:	acb
Input Data Filename:	C:SKALT2ES.DAT
Output Filename:	C:SKALT2ES.OUT
Plotted Output Filename:	C:SKALT2ES.PLT

PROBLEM DESCRIPTION Skunk Creek circular failure in SC
piez head = 6', rapid dd, sens. analys.

BOUNDARY COORDINATES

16 Top Boundaries
16 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	.00	54.00	329.00	56.00	1
2	329.00	56.00	345.00	58.00	1
3	345.00	58.00	351.00	60.00	1
4	351.00	60.00	357.00	62.00	1
5	357.00	62.00	363.00	64.00	1
6	363.00	64.00	369.00	66.00	1
7	369.00	66.00	401.00	66.00	1
8	401.00	66.00	405.00	64.00	1
9	405.00	64.00	410.00	62.00	1
10	410.00	62.00	416.00	60.00	1
11	416.00	60.00	422.00	58.00	1
12	422.00	58.00	428.00	56.00	1
13	428.00	56.00	434.00	54.00	1
14	434.00	54.00	531.00	52.00	1
15	531.00	52.00	617.00	52.00	1
16	617.00	52.00	703.00	52.00	1

1

ISOTROPIC SOIL PARAMETERS

1 Type(s) of Soil

Soil Type	Total Unit Wt.	Saturated Unit Wt.	Cohesion Intercept	Friction Angle	Pore Pressure	Pressure Constant	Piez. Surface

No.	(pcf)	(pcf)	(psf)	(deg)	Param.	(psf)	No.
1	140.5	150.8	500.0	35.1	.00	6.0	0

1

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Circular Surfaces, Has Been Specified.

100 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 10 Points Equally Spaced Along The Ground Surface Between X = 329.00 ft.
and X = 351.00 ft.

Each Surface Terminates Between X = 369.00 ft.
and X = 401.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is Y = .00 ft.

5.00 ft. Line Segments Define Each Trial Failure Surface.

1

Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Bishop Method * *

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	333.89	56.61
2	338.42	54.49
3	343.22	53.08
4	348.17	52.43
5	353.17	52.54
6	358.09	53.41
7	362.83	55.03
8	367.26	57.35
9	371.28	60.32
10	374.80	63.87
11	376.35	66.00

Circle Center At X = 350.0 ; Y = 85.0 and Radius, 32.6

*** 6.288 ***

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	333.89	56.61
2	338.42	54.51
3	343.23	53.14
4	348.20	52.55
5	353.20	52.74
6	358.10	53.72
7	362.79	55.46
8	367.14	57.91
9	371.06	61.02
10	374.44	64.70
11	375.30	66.00

Circle Center At X = 349.5 ; Y = 84.2 and Radius, 31.7

*** 6.294 ***

1

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	336.33	56.92
2	340.88	54.83
3	345.68	53.43
4	350.63	52.75
5	355.63	52.82
6	360.57	53.62
7	365.33	55.14
8	369.82	57.34
9	373.93	60.19
10	377.58	63.61
11	379.47	66.00

Circle Center At X = 352.7 ; Y = 86.5 and Radius, 33.8

*** 6.378 ***

Failure Surface Specified By 10 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	341.22	57.53
2	345.82	55.55
3	350.69	54.45
4	355.69	54.24
5	360.64	54.94

6	365.38	56.53
7	369.75	58.95
8	373.62	62.13
9	376.84	65.95
10	376.87	66.00

Circle Center At X = 354.3 ; Y = 81.7 and Radius, 27.5

*** 6.380 ***

1

Failure Surface Specified By 12 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	333.89	56.61
2	338.38	54.41
3	343.12	52.82
4	348.03	51.88
5	353.02	51.61
6	358.01	52.00
7	362.90	53.05
8	367.60	54.74
9	372.04	57.05
10	376.13	59.92
11	379.80	63.32
12	382.02	66.00

Circle Center At X = 352.6 ; Y = 89.0 and Radius, 37.4

*** 6.478 ***

Failure Surface Specified By 10 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	336.33	56.92
2	341.11	55.45
3	346.05	54.65
4	351.05	54.54
5	356.01	55.13
6	360.85	56.40
7	365.46	58.32
8	369.77	60.87
9	373.68	63.99
10	375.59	66.00

Circle Center At X = 349.3 ; Y = 90.6 and Radius, 36.1

*** 6.486 ***

1

Failure Surface Specified By 12 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	331.44	56.31
2	335.53	53.42
3	340.06	51.31
4	344.90	50.06
5	349.89	49.71
6	354.86	50.26
7	359.65	51.70
8	364.10	53.98
9	368.06	57.03
10	371.41	60.75
11	374.03	65.01
12	374.41	66.00

Circle Center At X = 349.3 ; Y = 77.3 and Radius, 27.6

*** 6.489 ***

Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	343.67	57.83
2	348.47	56.44
3	353.44	55.91
4	358.43	56.24
5	363.29	57.43
6	367.86	59.45
7	372.01	62.23
8	375.62	65.69
9	375.85	66.00

Circle Center At X = 354.0 ; Y = 84.6 and Radius, 28.7

*** 6.564 ***

1

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	336.33	56.92
2	340.32	53.90
3	344.83	51.73
4	349.67	50.47
5	354.66	50.19

6	359.61	50.88
7	364.33	52.53
8	368.63	55.08
9	372.36	58.41
10	375.37	62.41
11	377.09	66.00

Circle Center At X = 353.6 ; Y = 75.6 and Radius, 25.5

*** 6.565 ***

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	329.00	56.00
2	333.43	53.69
3	338.11	51.91
4	342.95	50.67
5	347.91	50.00
6	352.91	49.91
7	357.88	50.39
8	362.77	51.44
9	367.50	53.05
10	372.02	55.20
11	376.26	57.84
12	380.17	60.96
13	383.69	64.51
14	384.86	66.00

Circle Center At X = 351.2 ; Y = 93.2 and Radius, 43.4

*** 6.592 ***

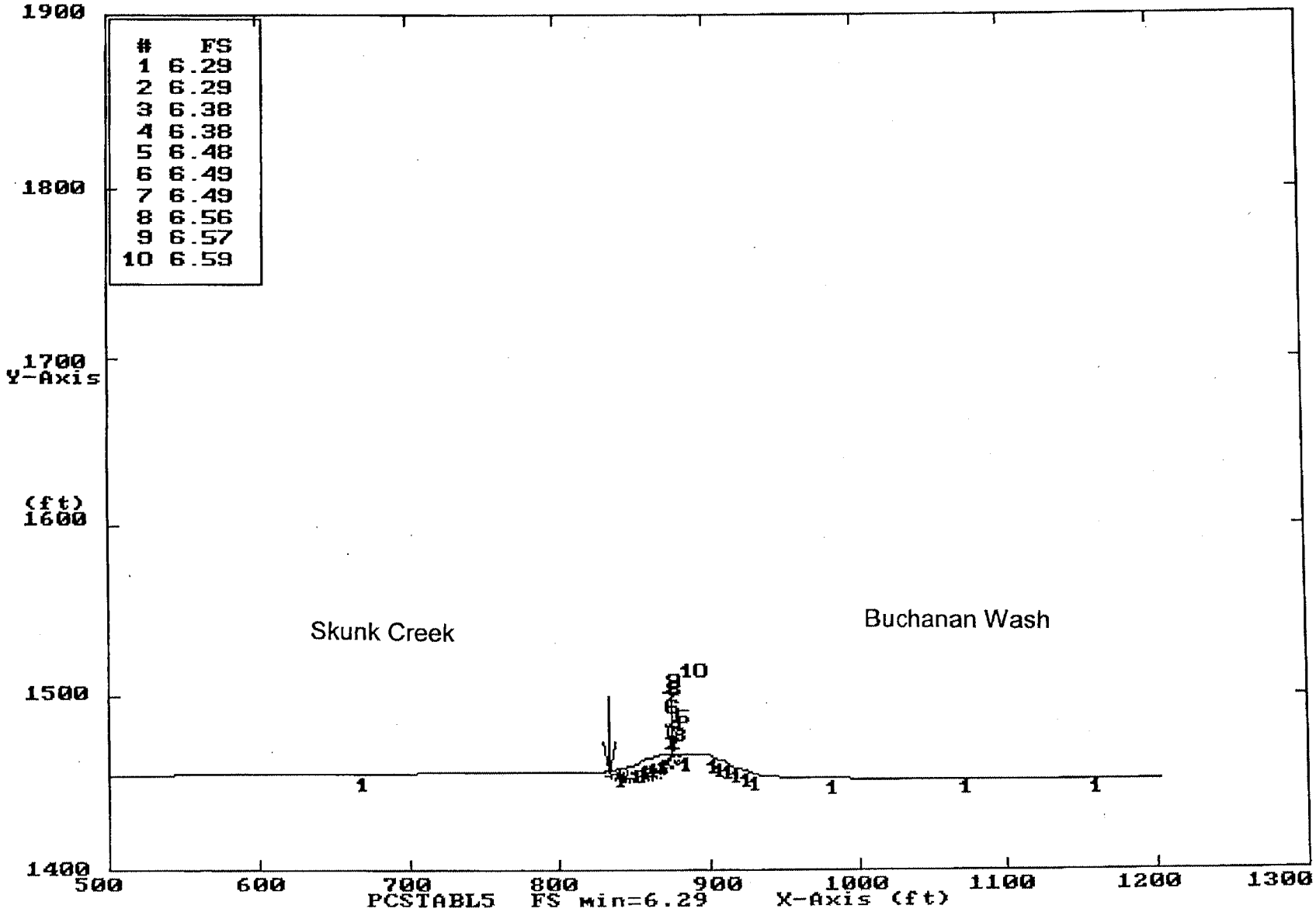
1

```
          Y            A     X     I     S            F     T

             .00     87.88    175.75    263.63    351.50    439.38
X        .00 +-----*---+---------+---------+---------+---------+
             -
             -
             -
             -
             -
      87.88 +
             -
             -
             -
             -
             -
A    175.75 +
             -
```

```
                  -
                  -
                  -
                  -
X     263.63 +
                  -
                  -
                  -
                  -      *
                  -     .14
I     351.50 +     .1*
                  -     .1**
                  -     ..11
                  -      ..*
                  -       *
                  -      **
S     439.38 +      *
                  -
                  -
                  -
                  -
                  -
      527.25 +      *
                  -
                  -
                  -
                  -
                  -
F     615.13 +      *
                  -
                  -
                  -
                  -
T     703.00 +      *
```

Skunk Creek circular failure in SC piez head = 6', rapid dd, sens. analys.
Ten Most Critical. C:SKALT2ES.PLT By: acb 06-02-03 12:37pm



EXCERPTED PAGES FROM
HARZA (1986)

SKUNK CREEK CHANNEL

HYDRAULIC ANALYSIS OF
PROPOSED CHANNEL IMPROVEMENT
Phoenix, Arizona

HARZA ENGINEERING COMPANY
July 1986

SA-855130

HARZA
ENGINEERING COMPANY

Velocities in the channel during peak discharge will vary slightly with the recommended modifications. These changes should not have a significant effect on changing the existing potential for aggradation/degradation of the channel bottom. In the vicinity of Happy Valley Road which crosses the bottom of Skunk Creek near Station 10.40 the velocity during the peak discharge of the 100 year flood would increase less than 10%, from 8.7 feet per second (fps) to 9.4 fps. In the vicinity of the pwer line crossing (Station 10.04) the velocity during the peak discharge of the 100 year flood would increase about 15%, from 11.9 fps to 14.1 fps.

The largest velocity increase as a result of the recommended actions will occur near the north end of the landfill site where the previous COE project terminates 190' upstream of the property boundary. The proposed confinement of the channel in this area will result in the velocity increasing from 9.2 fps to 12.0 fps for the peak discharge of the 100 year flood.

Leachate Generation

The presence of a water filled channel under flood conditions next to a landfill raises concerns on the possibility of leachate generation. Analysis of the potential for water in Skunk Creek to travel through the proposed embankment and into the fill indicates this concern is unwarranted. The two factors which lead to this conclusion are the relatively short duration of a flood and the rate which water can move horizontally toward the fill.

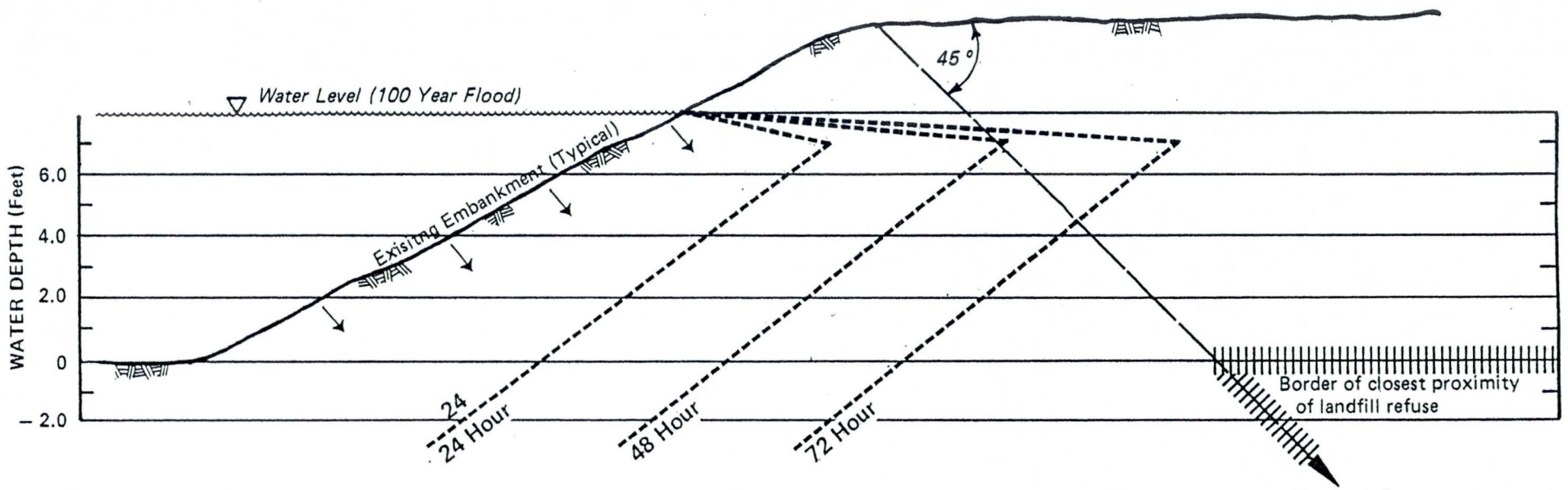
The rate of horizontal movement of Skunk Creek flood water toward the fill areas was calculated with a form of the Green-Ampt equation which calculates the time required for the advancement of a wetting front through a porous medium.[1/] Water in the channel must permeate the embankment and move horizontally as well as vertically to reach the refuse in the landfill.

[1/] Calculations are presented after the figures.

The calculated advancement of a wetting front for a typical embankment cross section is shown for periods of 24, 48, and 72 hours. As indicated on Figure 23, the wetting front would take in excess of 72 hours to advance 25' horizontally toward the fill under existing conditions. Existing conditions were characterized as follows:

Permeability of embankment	-	10^{-5} feet/sec
Maximum WSEL in Skunk Creek	-	8' above channel bottom
Location of refuse	-	Outside of 45° angle drawn from inside top of embankment toward fill
Duration of Maximum WSEL $\pm$ 1'	-	less than 72 hours.

The recommended soil cement lining will decrease the permeability of the channel sides by at least 3 orders of magnitude. Consequently, the rate of horizontal movement will be reduced by at least 3 orders of magnitude and essentially eliminate the potential for leachate generation from flood flows seeping into the channel sides.



LEGEND

- - - - - - - Location to which Wetting Front has Advanced

48 Hour Time Required for Advancement of Wetting Front

Figure 23

CALCULATED MOVEMENT OF FLOOD WATER THROUGH EXISTING EMBANKMENT

HYDRAULIC ANALYSIS OF PROPOSED CHANNEL IMPROVEMENT

FLOOD PROTECTION OF SKUNK CREEK LANDFILL

Phoenix, Arizona

HARZA ENGINEERING COMPANY

July 1986

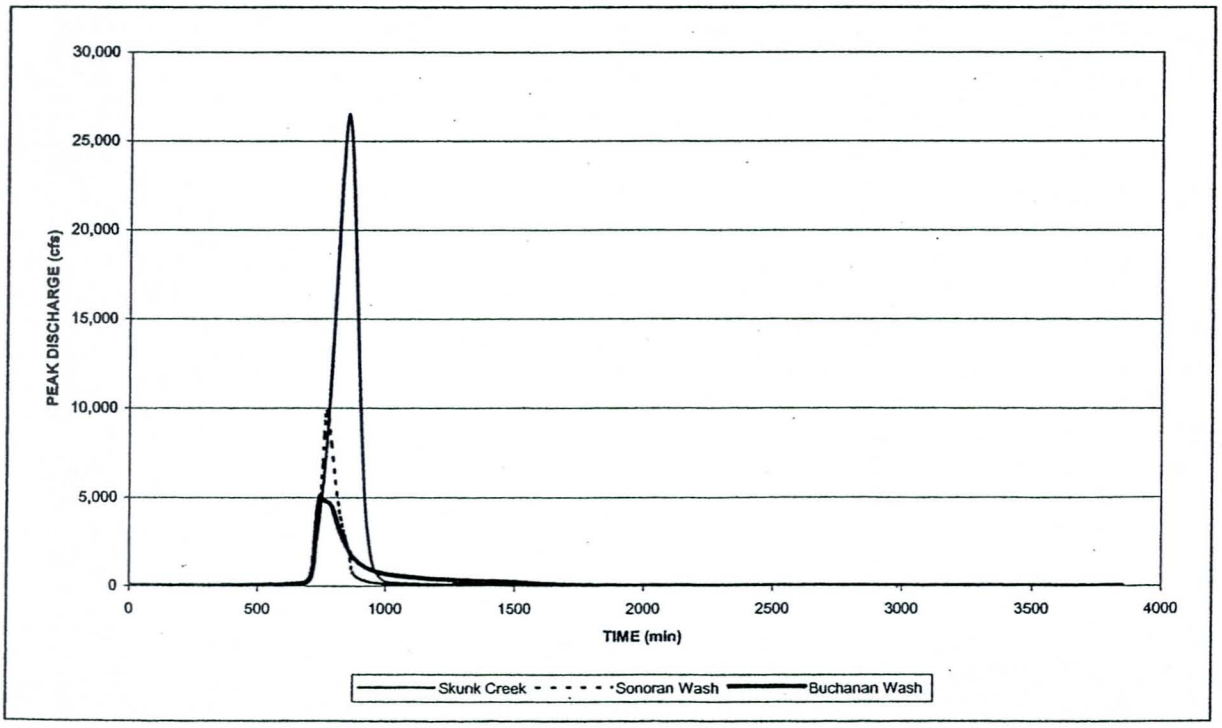
SKUNK CREEK 100-YEAR FLOW HYDROGRAPH

SECTION 3: HYDROLOGY

3.1 METHOD DESCRIPTION

Each floodplain condition or alternative that was analyzed for this study was modeled for both the 100-year and SPF events. For the 100-year event, the effective Flood Insurance Study (FIS) hydrology was provided by the Flood Control District of Maricopa County. Inflow hydrographs for Skunk Creek and Sonoran Wash were obtained from the *Skunk Creek Watercourse Master Plan* (WCMP), a study prepared by Tetra Tech Inc. These hydrographs are based on the 100-year, 24-hour rainfall event. The 100-year inflow hydrograph for Buchanan Wash was prepared using the HEC-1 model for *Hydrologic Analyses for Buchanan Wash, Maricopa County, Arizona*, prepared by AGK Engineers. The AGK study was based upon the 100-year, 6-hour rainfall event. The AGK HEC-1 model was run with a 100-year, 24-hour rainfall distribution to obtain the inflow hydrograph used for this study. The FLO-2D 100-year inflow hydrographs are presented below in Figure 3-1. The peak discharge for each hydrograph is as follows: Skunk Creek – 26,513 cfs; Sonoran Wash – 9,825 cfs; Buchanan Wash – 5,063 cfs. The hydrograph point data is included in Appendix N.

FIGURE 3-1: 100-Year Event Hydrographs

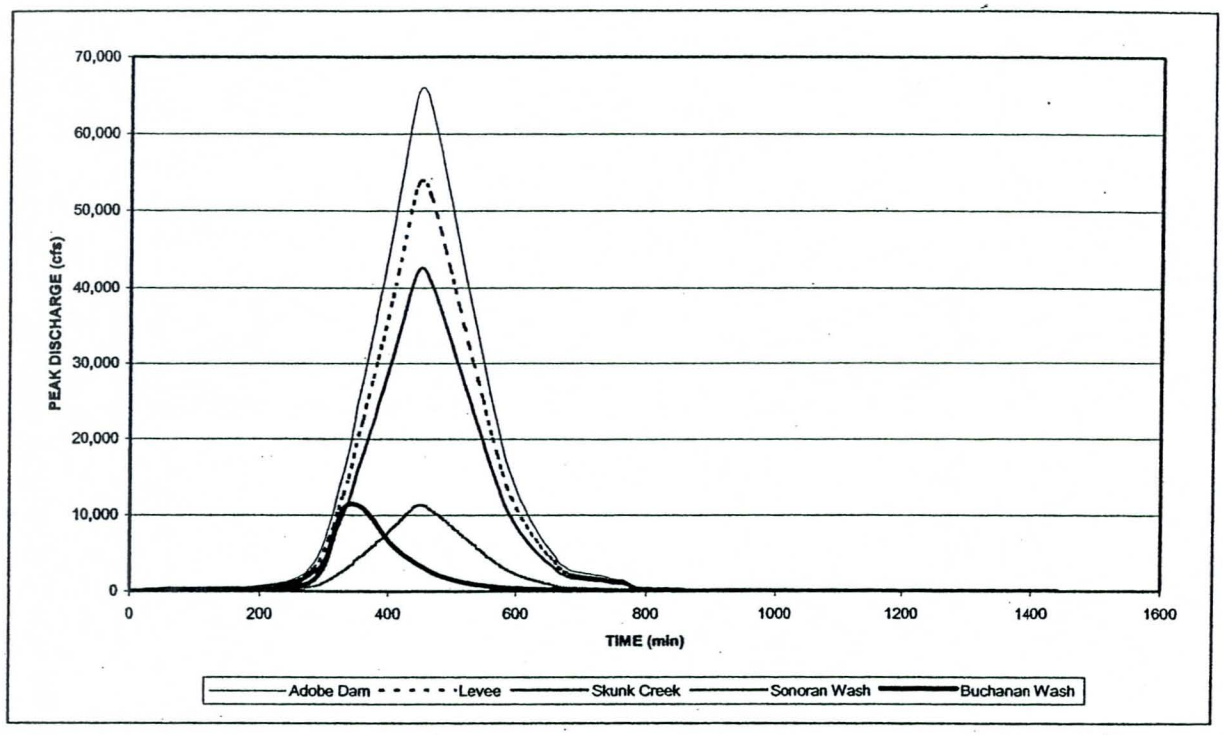


3.2 SPF HYDROGRAPH DEVELOPMENT

Inflow hydrographs for the SPF event were based on hydrology prepared by the U.S. Army Corps of Engineers during the design of Adobe Dam. The SPF hydrograph for Adobe Dam was obtained from Adobe Dam (including Skunk Creek to the Arizona Canal), Design Memorandum No. 3, General Design Memorandum – Phase II, Project Design – Part 2, dated April 1979. The SPF peak flow at Adobe Dam is 66,000 cfs. Further upstream, at the Skunk Creek levees, the peak flow is 54,000 cfs. The Adobe Dam hydrograph was scaled down to a peak of 54,000 cfs to represent the SPF hydrograph at the levees. Then, hydrographs for Skunk Creek and Sonoran Wash were derived by obtaining a peak flow ratio based upon watershed area. The levee hydrograph was divided into two additive hydrographs based upon this ratio. The resultant Skunk Creek SPF hydrograph peaks at 42,655 cfs. The Sonoran Wash SPF hydrograph peaks at 11,345 cfs.

To obtain an SPF hydrograph for Buchanan Wash, the AGK HEC-1 model was run using the rainfall hyetograph from the Adobe Dam hydrology. The timing of the resultant hydrograph was then adjusted so that the peak flow in Buchanan Wash coincided with the peak flow from Skunk Creek and Sonoran Wash. The FLO-2D SPF hydrographs are presented below in Figure 3-2. Supporting hydrologic calculations and documentation are included in Appendix N.

FIGURE 3-2: SPF Event Hydrographs

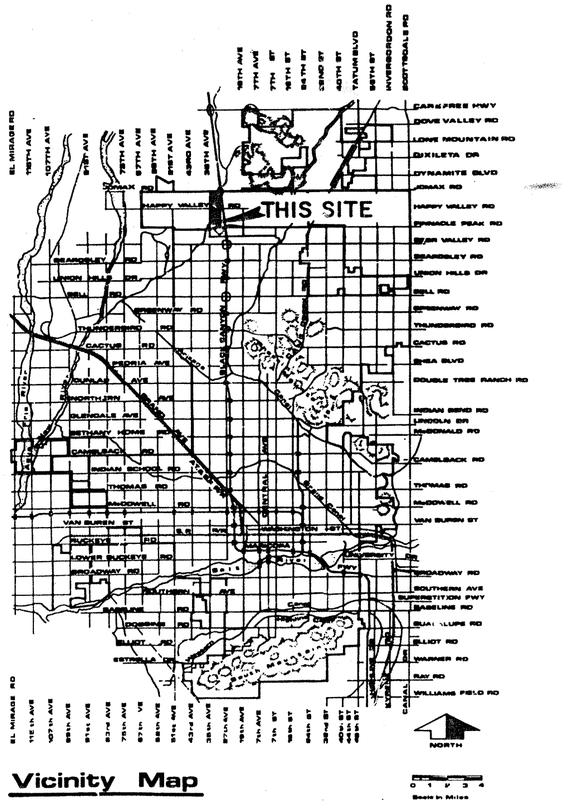


CITY OF PHOENIX

ENGINEERING & ARCHITECTURAL SERVICES
PROJECT MANAGEMENT

SKUNK CREEK CHANNEL IMPROVEMENTS
INDEX NUMBER SA-884080

1992



Vicinity Map

MAYOR

PAUL JOHNSON

CITY COUNCIL

DISTRICT NO. 1 THELDA WILLIAMS
DISTRICT NO. 2 FRANCES BARWOOD
DISTRICT NO. 3 SKIP RIMSZA
DISTRICT NO. 4 CRAIG TRIBKEN
DISTRICT NO. 5 JOHN NELSON
DISTRICT NO. 6 KATHY DUBS
DISTRICT NO. 7 MARY ROSE WILCOX
DISTRICT NO. 8 CALVIN C. GOODE

CITY MANAGER - FRANK FAIRBANKS

CITY ENGINEER - KENNY HARRIS, P.E.

APPROVALS

ENGINEERING SUPERVISOR — DATE 4/21/92

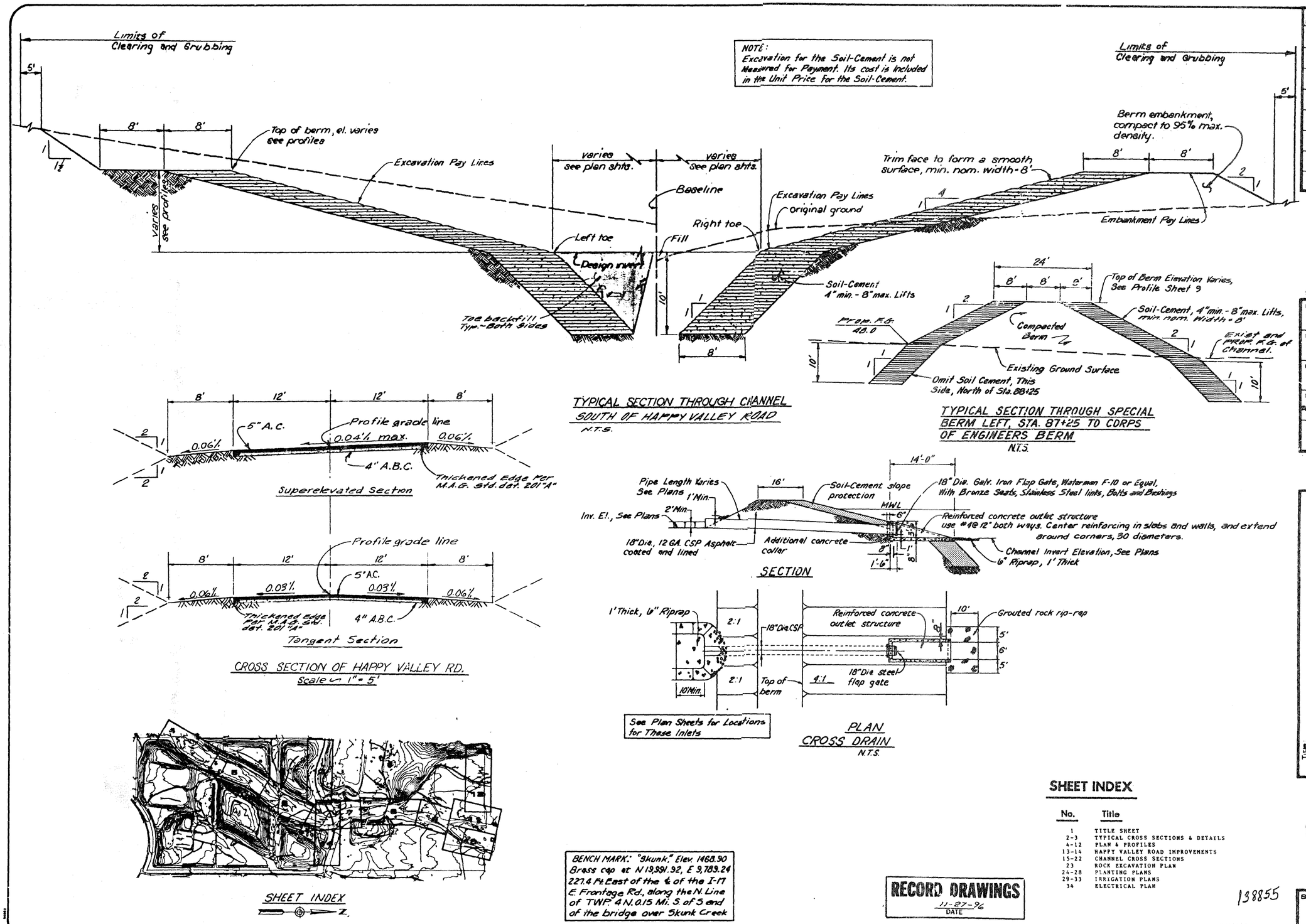
PUBLIC WORKS DIRECTOR — DATE

RECORD DRAWINGS
11-27-96
DATE

138154

MH001363

MOREA-HALL engineering, inc.
1820 W. Maricopa Freeway
Phoenix, Arizona 85007
Phone: 602-258-4428
CIVIL • SANITARY • STRUCTURAL • SURVEY



SHEET INDEX

BENCH MARK: "Skunk," Elev. 1468.90 Brass cap at N 19,391.92, E 9,789.24 227.4 Ft. East of the ℄ of the I-17 E. Frontage Rd., along the N. Line of TWP. 4 N. 0.15 Mi. S. of S end of the bridge over Skunk Creek

RECORD DRAWINGS
11-27-96
DATE

SHEET INDEX

No.	Title
1	TITLE SHEET
2-3	TYPICAL CROSS SECTIONS & DETAILS
4-12	PLAN & PROFILES
13-14	HAPPY VALLEY ROAD IMPROVEMENTS
15-22	CHANNEL CROSS SECTIONS
23	ROCK EXCAVATION PLAN
24-28	PLANTING PLANS
29-33	IRRIGATION PLANS
34	ELECTRICAL PLAN

138855

Revisions	Date

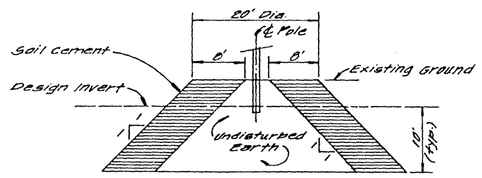
Seal

Designed By: C. MOREA
Drawn By: M. CROSS
Checked By: C. MOREA
Date: APR. 24, 1995

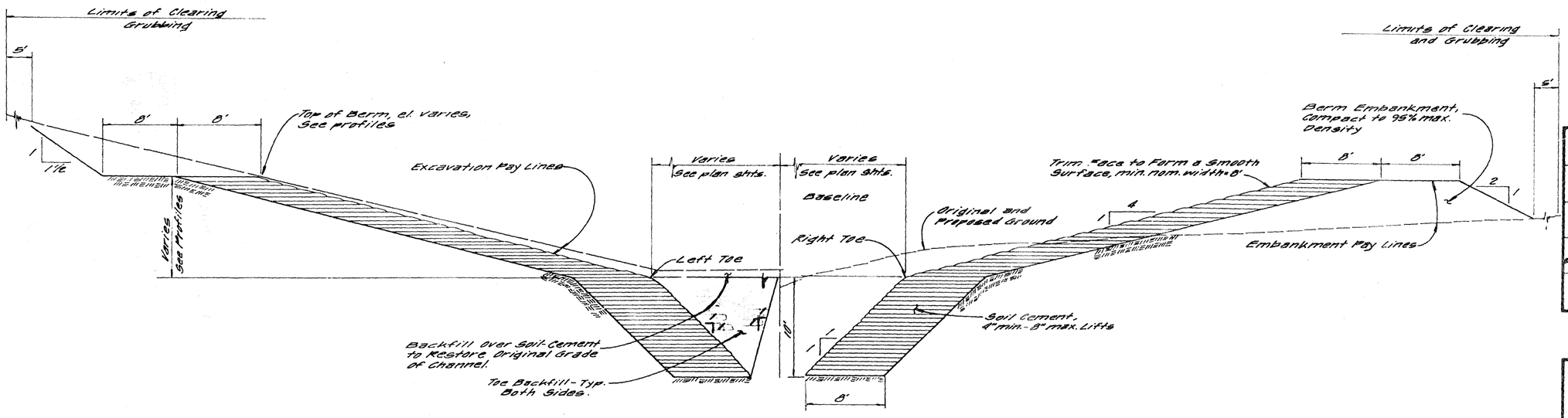
Title: SKUNK CREEK CHANNEL IMPROVEMENTS INDEX NO. SA-884080

Sheet 2 of 34

CITY OF PHOENIX • ENGINEERING DEPARTMENT • DESIGN DIVISION



SOIL CEMENT AROUND POLE



TYPICAL SECTION THROUGH CHANNEL
NORTH OF HAMMY VALLEY ROAD
N.T.S.

Revisions	Date

Seal

Designed By: C. MOREA

Drawn By: M. CROSS

Checked By: C. MOREA

Date: APR. 24, 1992

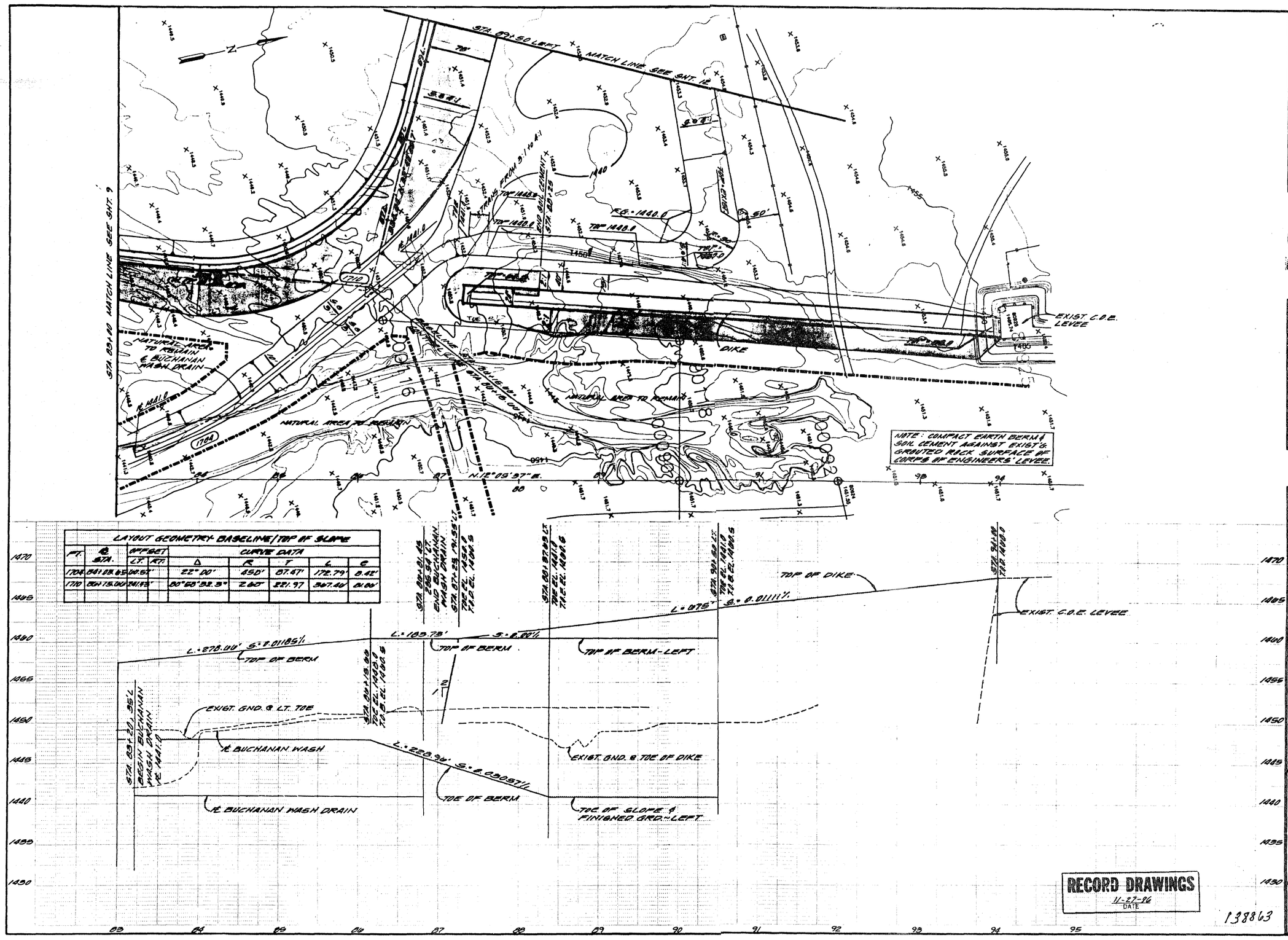
SKUNK CREEK CHANNEL
IMPROVEMENTS
INDEX NO. SA-384080

RECORD DRAWINGS
11-27-96
DATE

138856

Sheet 3 of 34

CITY OF PHOENIX • ENGINEERING DEPARTMENT • DESIGN DIVISION



RECORD DRAWINGS
11-27-86
DATE

138863

Revisions	Date

Seal

Designed By: C. MOREA

Drawn By: M. CROSS

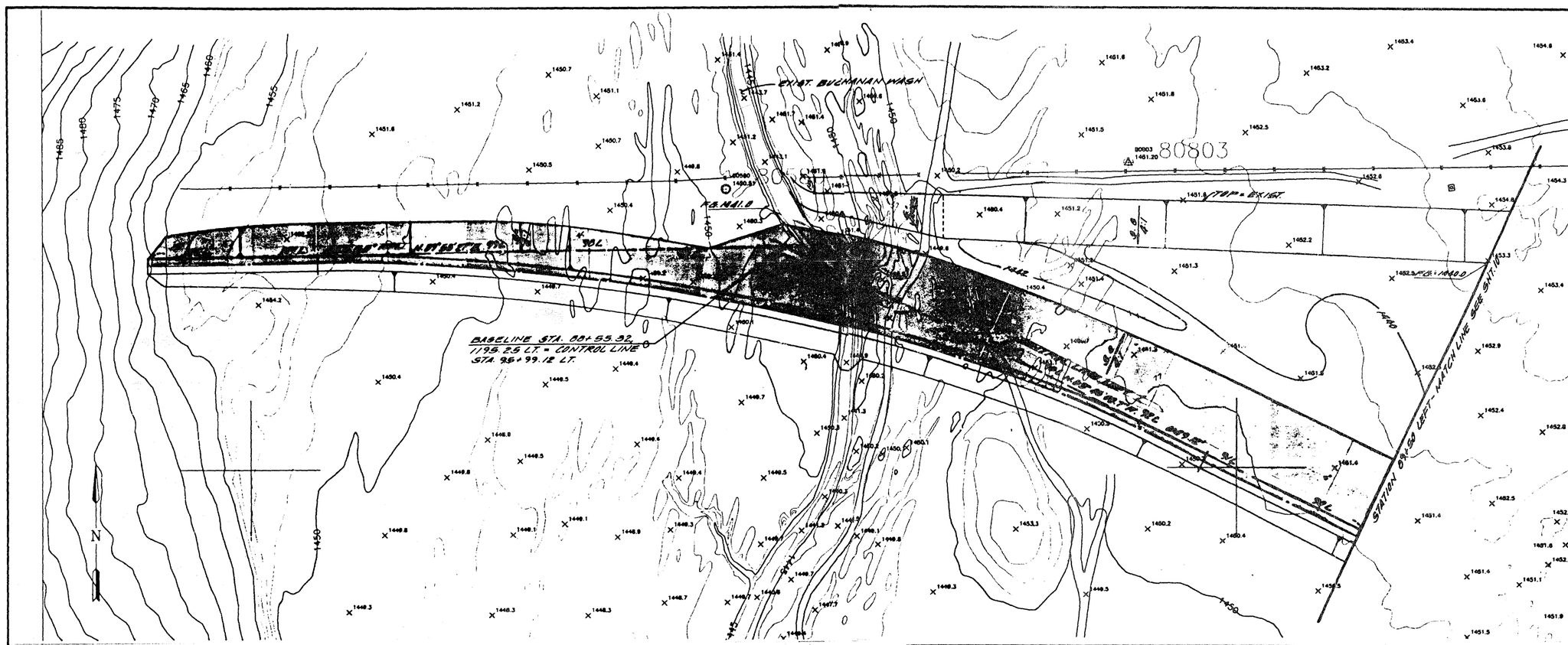
Checked By: C. MOREA

Date: APR. 24, 1985

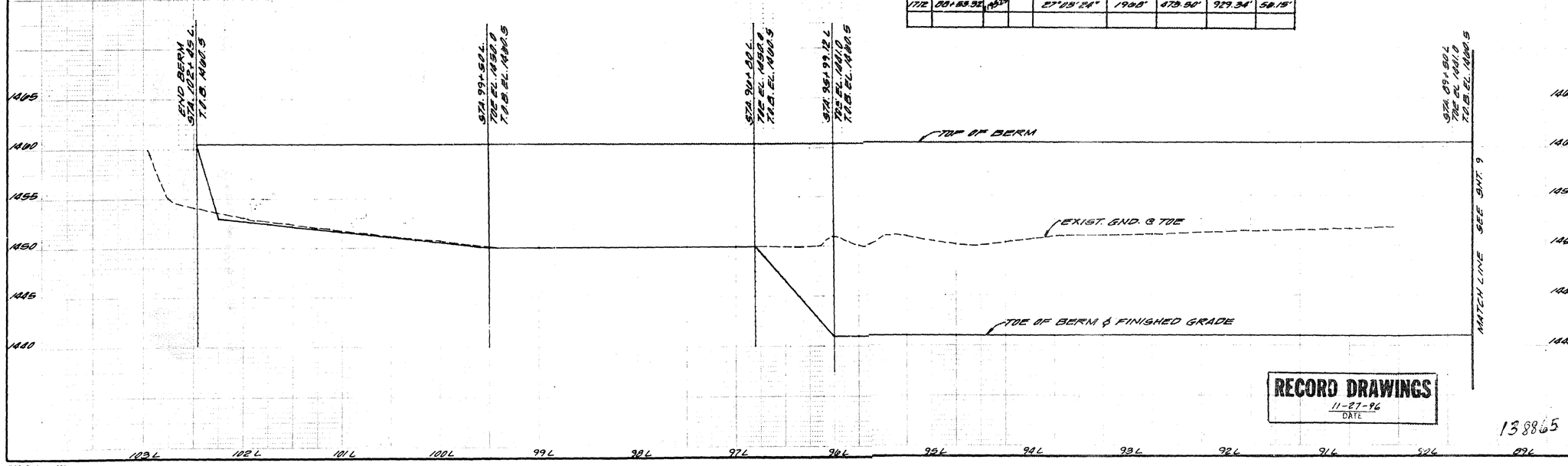
Title: SKUNK CREEK CHANNEL IMPROVEMENTS
INDEX NO. SA-884080

Sheet 10 of 34

CITY OF PHOENIX • ENGINEERING DEPARTMENT • DESIGN DIVISION



LAYOUT GEOMETRY - BASELINE/TOP OF SLOPE								
PT.	@ STA.	OFFSET LT.	OFFSET RT.	CURVE DATA Δ	R	T	L	E
1712	88+55.32	1195.25		27°09'24"	1908'	473.90'	929.34'	58.15'



RECORD DRAWINGS
11-27-96
DATE

138865

Revisions	Date

Seal

Designed By: C. MOREA

Drawn By: M. CROSS

Checked By: C. MOREA

Date: APR. 24, 1996

Title: SKUNK CREEK CHANNEL IMPROVEMENTS
INDEX NO. SA-884080

Sheet 12 of 34

CITY OF PHOENIX • ENGINEERING DEPARTMENT • DESIGN DIVISION

City of Phoenix
STREET TRANSPORTATION DEPARTMENT

May 20, 2003

Tim Murphy, PE, CFM
Floodplain Delineation Branch
Flood Control District of Maricopa County
2801 West Durango Street
Phoenix, Arizona 85009

Re: **Operation and Maintenance Plan for Skunk Creek Levee at Interstate 17 (I-17), Phoenix, Arizona**

Dear Mr. Murphy:

As part of the Floodplain Management Program, the City of Phoenix has made an application to revise the floodplain/floodway delineation for both Skunk Creek and the Buchanan Wash in the vicinity of the Skunk Creek Levee and Interstate 17 (I-17), to the Federal Emergency Management Agency (FEMA).

One of the review comments from Michael Baker, Jr., Inc., FEMA's contract review consultant, requests to submit an operation and maintenance plan for all levees that addresses the requirements listed in Paragraphs 65.10(c) and (d) of the NFIP regulations, according to a letter, dated December 6, 2002. The ITEM 1(e) of the attached letter also requests that the plan should include guidance for vegetation management and future crossings by utility conduits and pipes.

As we are preparing to complete a response back to FEMA on or before June 6, 2003, we would like to seek your assistance in providing us with the requested Operation and Maintenance Plan for the Skunk Creek Levee at Interstate 17 (I-17).

Should you have further questions in this regard, please do not hesitate to contact this office at (602)-262-4960.

Sincerely,

Hasan Mushtaq, PhD, PE, CFM
Floodplain Manager

Attachment

200 West Washington Street, Fifth Floor, Phoenix, Arizona 85003 1611 602-262-6284 FAX: 602-495-2016
Recycled Paper

FLOOD CONTROL DISTRICT
of
Maricopa County

2801 West Durango Street • Phoenix, Arizona 85009-6399
Telephone (602) 506-1501
Fax (602) 506-4601
TT (602) 506-5897

BOARD OF DIRECTORS
Fulton Brock
Andrew Kunasek
Don Stapley
Mary Rose Garrido Wilcox
Max W. Wilson

May 29, 2003

Hasan Mushtaq, Ph.D., P.E., CFM
Floodplain Manager
City of Phoenix
200 West Washington Street, 5th Floor
Phoenix, Arizona 85003-1611

Subject: Operation and Maintenance Plan for Skunk Creek Levees at I-17

Dear Hasan:

Enclosed is a copy of a manual entitled "OPERATION MAINTENANCE, REPAIR, REPLACEMENT, AND REHABILITION MANUAL, PHOENIX, ARIZONA AND VICINITY (INCLUDING NEW RIVER)." This manual was developed by the Los Angeles District of the US Army Corps of Engineers for the Phoenix, Arizona and Vicinity (Including New River) Flood Control Project, which is also known as the New River and Phoenix city Streams Flood Control Project. The enclosed manual covers all the parts of the US Army Corps of Engineers project, and the Skunk Creek Levees were constructed as part of that project. The US Army Corps of Engineers requires that the Flood Control District of Maricopa County (District) follow the operation and maintenance procedures in the enclosed manual.

The District uses the enclosed manual as the operation and maintenance plan for the Skunk Creek Levees at I-17. I have enclosed two copies of recent inspection reports, one inspection was done on May 1, 2002, and the other inspection was done on April 9, 2003. I have also enclosed a copy of the District's Annual Inspection Schedule for 2003, which shows when scheduled inspections will be done for each of the District's structures.

If more information is needed on the District's operation and maintenance procedures please contact Charles Klenner, the District's Operation & Maintenance Division Manager, at 602-506-4714.

If additional information is required, please contact me at 602-506-4605.

Sincerely,

Tim Murphy

Tim Murphy, P.E.
Delineation Branch Manager

Flood Control District of Maricopa County
Annual Inspection Schedule For 2003:

JANUARY:

Saddleback FRS
Harquahala FRS
Harquahala Floodway
Saddleback Floodway
Centennial Levee

February:

Powerline FRS
Rittenhouse FRS
Vineyard FRS
Powerline Floodway
McMicken Dam
McMicken Floodway

MARCH:

Buckeye FRS #1
Buckeye FRS #2
Buckeye FRS #3

APRIL:

Adobe Dam
Dreamy Draw Dam
Cave Buttes/Cave Creek Dams
New River Dam
A.C.D.C. & The Cave Creek Arm
Skunk Creek @ I-17
New River Floodway

MAY:

Holly Acres
Perryville Rip Rap
Salt/Gila Low Flow
Colter Channel
Rio Salado
Sossaman Rd. Drain
Guadalupe Channel Box

JUNE:

Alma School Drain
Agua Fria Floodway
Indian School Drain
48th St. Drain
Dysart Drain
El Mirage Drain

JULY:

Indian Bend Wash
Scatter Wash
East Fork - Cave Creek
Old Cross Cut Canal
10th St. Basins #1 & 2

AUGUST:

Sun City Drains
Sun City West Drains
Paradise Valley Retention Basin
Rittenhouse Rd. Channel
R.I.D. Overchute
Camelback Ranch Levee's

SEPTEMBER:

Spook Hill Floodway & Basin
East Maricopa Floodway
Signal Butte Floodway
Bulldog Floodway
Pass Mountain Floodway

OCTOBER: Semi-Annual Inspection

Adobe Dam
Dreamy Draw Dam
Cave Buttes/Cave Creek Dams
New River Dam
A.C.D.C. & Cave Creek Arm
Skunk Creek @ I-17
New River Channel

NOVEMBER:

Sunnycove FRS
Sunset FRS
White Tanks FRS #3
White Tanks FRS #4
Casandro Wash Dam

DECEMBER:

Guadalupe FRS
Spook Hill FRS
Signal Butte FRS
Apache Jct. FRS

rev. 12/6/00 cfr

2003 MAINTENANCE INSPECTION SKUNK CREEK @ I-17

O&M Division Mgr ____
Maint. Mgr. ____

Structure: Skunk Creek @ I-17

Inspection Date: 4/9/03

Date of Last Inspection: 5/1/02

Inspectors: C. F. Rivera

Existing Weather Conditions: Clear and warm

Recent Rainfall: Yes ☑ No ☐

Yes	No	**Both levees of the floodway**
☐	☑	Erosion concerns
☑	☐	Slope protection adequate
☐	☑	Adverse vegetation
☐	☑	Animal burrows or rodent activity
☐	☑	Settlements, slides, depressions, bulges
☑	☐	Other
		See Comments: #4 & *Additional comments

		Condition of the crest of both levees
☐	☑	Erosion concerns
☐	☑	Adverse vegetation
☐	☑	Animal burrows or rodent activity
☐	☑	Road condition concerns (plating, ruts, re-grading, etc.)
☑	☐	Other
		See Comments: #4, 5

		Floodway Channel Invert
☐	☑	Erosion concerns
☐	☑	Sediment accumulation
☑	☐	Adverse vegetation
☐	☑	Animal burrows or rodent activity
☐	☑	Trash/debris
☑	☐	Other
		See Comments: #6

2003 MAINTENANCE INSPECTION SKUNK CREEK @ I-17

Yes	No	**Project Stationing & Signs**
☐	☑	Vandalism
☐	☑	Placards need re-furbished
☐	☑	Need of additional signs
☑	☐	Accuracy concerns
☑	☐	Other concerns
		See Comments: #5 & Additional comments

		Perimeter fencing & gates
☑	☐	Vandalism
☐	☑	Need of additional fencing
☑	☐	Other concerns
		See Comments: #1, 5, & Additional Comments

		Maintenance Access Roads and Down Ramps
☐	☑	Erosion, ruts, or deep rilling concerns
☐	☑	Additional plating needed
☐	☑	Adverse vegetation
☐	☑	Road needs re-graded
☑	☐	Other concerns
		See Comments: *Additional comments

***Additional comments or concerns not listed:**
The Skunk Creek @ I-17 project is just starting to feel the affects of urbanization with all the new on-going development in the vicinity. More vandalism is starting to become evident with cut fencing, damaged gates, illegal dumping, and unauthorized access.

2003 MAINTENANCE INSPECTION SKUNK CREEK @ I-17

Skunk Creek @ I-17
Maintenance Inspection Comments
4/9/03

Comment #1: Check all the project applicable wire and chain link fencing and access gates. Refurbish or repair as needed. During the inspection most of the damaged fencing was located upstream of I-17 along the south levee.

Comment #2: It was noted during the inspection that there were several trees growing along the upstream and downstream slopes of the north levee. Cut and stump treat as needed.

Comment#3: At sta. #103+00 located on the downstream side of the north levee, remove blockage from inlet.

Comment #4: Continue to monitor the surface cracking that is occurring on the concrete vertical walls of the concrete transition. Re-install any displaced joint material as needed.

Comment #5: Check all project signs, stationing, and staff gages for wear or deterioration; refurbish or replace as needed.

Comment#6: In the Skunk Creek Channel bottom area downstream of I-17, schedule the mower to cut down high vegetation and tall grasses.

Comment #7: At sta. #90+00 along the downstream toe of the north levee chain link fence line, cut down the high grasses.

O&M Div Mgr _____
PWS_____
Ops Supv_____

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
Inspection Report

SKUNK CREEK CHANNEL AT I-17

Inspection Date: 5/1/02

Date of Last Inspection: 5/1/01

Inspectors: C. Kleener -C. Rivera-S. Rubin

Existing Weather Conditions: Clear and warm

Recent Rainfall: Yes ☐ No ☑

Yes	No	**Skunk Creek east of I-17:**
☑	☐	Project perimeter fencing, access gates, and guardrails. Any maintenance concerns? See Comments: #1
☑	☐	South Levee including black top access road and upstream armor plating. Any maintenance concerns? See Comments: #1, 2, 3, 5, 8
☑	☐	North Levee including black top access road and upstream armor plating. Any maintenance concerns? See Comments: #1, 2, 3, 5, 8
☑	☐	Box culvert (sta. #105+22) located on the north dike and associated concrete lined channel. Any maintenance concerns? See Comments: #4
☑	☐	Transition-Concrete Control Works at I-17. Any maintenance concerns? See Comments: #1, 2, 3

Yes	No	**Skunk Creek east of I-17:**
☐	☑	Concrete walls and bridge crossings at the Concrete Control Works. Any maintenance concerns? See Comments: #10

Yes	No	**Skunk Creek west of I-17:**
☑	☐	North Levee on both slopes, including black top access roads. Any maintenance concerns? See Comments: #1, 2, 3, 5, 8
☐	☑	24" side inlet drain, sta. # 96+25. Any maintenance concerns? See Comments: #7
☑	☐	Project perimeter fencing, access gates, and guardrails. Any maintenance concerns? See Comments: #1
☐	☑	Grouted riprap channel bottom section. Any maintenance concerns? See Comments: #2
☐	☑	Turnaround areas – any maintenance concerns? See Comments: #1, 2
☐	☑	All FCD signs and stationing. See Comments: #3
☑	☐	Earthen channel bottom transition maintenance concerns. See Comments: #6

Skunk Creek Channel I-17
Operational Inspection Comments
5/1/02

Comment #1: Check all project fencing and access gates; repair or refurbish as needed. The area with the highest concentration of damaged fencing is located east of I-17 along the downstream side of the south levee.

Comment #2: Pick up and dispose of all trash and organic debris throughout the project right-of-way. Most of the concern is located east of I-17 between the toe of the south downstream levee and the project right-of-way fence line. In addition, at sta. #94+17 along the north levee, west of I-17, cut up and haul away discarded utility pole that is lying in FCD right-of-way.

Comment #3: Check all project signs and stationing. Refurbish or replace as needed. Ensure all pertinent structures are stationed accordingly.

Comment #4: East of I-17, on the north levee, the box culvert located at sta. #105+22 needs the high grasses growing at the invert cut down and removed. In addition, cut and remove the two small trees growing near the head wall.

Comment #5: Cut and stump treat all deep-rooted vegetation that is growing on the slopes of the levees. Along the toe of the north levee, west of I-17 between sta. #81+19 to 83+70, clear the toe area of the levee and 10' ft. out. Most of the deep-rooted vegetation concern is located on the north levee, east of I-17.

Comment #6: West of I-17, utilize mower equipment to cut high grasses and unwanted vegetation along the channel bottom.

Comment #7: Check and service the outlet end 24" inch flap gate located at sta. #96+25.

Comment #8: Numerous transverse cracks were discovered along the asphalt roadways on the crest of the levees. The Dam Safety Section should conduct an investigation to determine if these cracks are anything significant or determine if they are just just surface cracks that need to be re-sealed.

Comment #9: Spray the scattered small desert broom that is growing in the channel bottom east of I-17.

Comment #10: The inspection team also noted that there is scattered minor surface cracking on the vertical walls of the concrete works transition.

OPERATION, MAINTENANCE, REPAIR, REPLACEMENT, AND REHABILITATION MANUAL

not included in this package

City of Phoenix
STREET TRANSPORTATION DEPARTMENT

June 5, 2003

Andrea L. Ryon, P E., Director
Engineering Division
Michael Baker Jr., Inc.
3601 Eisenhower Avenue, Suite 600
Alexandria, VA 22304-6425

Dear Ms. Ryon:

RE: REQUEST FOR A LETTER OF MAP REVISION FOR BUCHANAN WASH (CASE NO. 02-09-290P)

The City of Phoenix will adopt and enforce the modified regulatory floodway, according to the Phoenix City Code, Article 1, Chapter 32B, Floodplains. A copy of the stated regulation is included with this submittal. The City of Phoenix understands the responsibility and the liability for the inspections and ensures the flow carrying capacities within the altered or relocated portions of any watercourse/drainage channels associated with the Buchanan Wash. Attached is a copy of the City of Phoenix Policy and Procedure for maintenance of Drainage Facilities.

If you have any technical questions, please contact Mr. Garth Bowers, P E, Shaw Emcon/Owt, Inc., 305 South Euclid Avenue, Suite 101, Tucson, Arizona 85719-6649, telephone (520) 792-2800. If you have any other questions, please contact this office at (602)-262-4960.

Sincerely,

Hasan Mushtaq, PhD, PE, CFM
Floodplain Manager

HM/DW/Buchanan Wash.doc

Attachments

200 West Washington Street, Fifth Floor, Phoenix, Arizona 85003 1611 602-262-6284 FAX: 602-495-2016
Recycled Paper

CITY OF PHOENIX

STREET MAINTENANCE DIVISION POLICY AND PROCEDURE

NUMBER

MAINTENANCE OF DRAINAGE FACILITIES

SUBJECT

12-02-92

ISSUE DATE

PURPOSE:

To insure all drainage facilities are maintained and kept clear from objects that may impede the flow of storm runoff.

POLICY:

All drainage facilities shall be inspected and cleaned on a maintenance schedule.

PROCEDURE:

1. The Street Maintenance Drainage Foreman shall visually inspect each drainage facility in his/her section once a month.

2. The Drainage Foreman shall schedule the cleaning as needed, but no more than the established service levels, unless it is determined that if allowed to exist could become an obstruction to drainage.

3. The following is the established service levels.

   a) Man-made Drainage Easements: Inspected and cleaned, if needed, once a month.

   b) Dedicated Natural Washes: Inspected monthly and cleaned of debris twice annually.

   c) Un-dedicated Natural Washes: Inspect twice annually and notify adjacent property owner to clean as needed. If the property owner does not remove the debris from the wash, the Foreman shall advise the area Street Maintenance Field Inspector who shall follow through by notifying NIH - Zoning Enforcement.

   d) Man-made Detention Basins: Inspect monthly and clean as needed.

   e) Storm Drainage Inlets: Inspect monthly and clean as needed.

The Street Maintenance Section shall respond to any complaints regarding the clogging of drainage facilities and correct the problem within five days of notification. The above service levels shall be followed for routine maintenance. Extenuating circumstances may require deviation.

DTM:ve

Chapter 32B

FLOODPLAINS*

---

* **Cross References:** Engineering and Architectural Services Department, § 2-27; Development Advisory Board, § 2-164 et seq.; building regulations, ch. 9; subdivisions, ch. 32; grading and drainage, ch. 32A.

State Law References: Floodplain management, A.R.S. § 48-3601 et seq.; municipal floodplain management programs, A.R.S. § 48-3610.

Article I. General

Sec. 32B-1. Implementation.
Sec. 32B-2. Definitions.

Article II. Regulations

Sec. 32B-3. Maps.
Sec. 32B-4. Classification of floodplains.
Sec. 32B-5. Regulation.
Sec. 32B-6. Interim elevations.
Sec. 32B-7. Coordination in floodplain management.
Sec. 32B-8. Non-prohibited construction.
Sec. 32B-9. Reserved.
Sec. 32B-9.1. Manufactured homes.
Sec. 32B-9.2. Mechanical and utility equipment.
Sec. 32B-9.3. Federal and State permits.
Sec. 32B-9.4. Openings in enclosures below a structure's lowest floor.
Sec. 32B-10. Sand and gravel operations.
Sec. 32B-11. Variance provisions.
Sec. 32B-12. Appeals.
Sec. 32B-13. Structures in violation of regulations.
Sec. 32B-14. Diversion of water flow.
Sec. 32B-15. Violation as separate offense.
Sec. 32B-16. Severability.
Sec. 32B-17. Floodplain plan review fees.

ARTICLE I.

GENERAL

Sec. 32B-1. Implementation.

To implement the regulation of the floodplain areas in the City of Phoenix, the City Council is designated as the Floodplain Board and the City Engineer is designated as the administrative agent for these regulations.
(Ord. No. G-2027, § 2)

Sec. 32B-2. Definitions.

Area of shallow flooding means a designated zone in which the base flood depths range from one to three feet; a clearly defined channel does not exist; the path of flooding is unpredictable and indeterminate; and high velocity flow may be evident.

Area of special flood hazard means the land within a floodplain which is subject to inundation by the base flood.

Base flood means the flood having a one percent chance of being equalled or exceeded in any given year, i.e., the one-hundred-year flood.

Development means any manmade change to improved or unimproved real estate, including, but not limited to, buildings and other structures, utilities, pipelines, mining, dredging, filling, grading, paving, or excavation located within the area of special flood hazard.

Dwelling unit means any structure usable for residential purposes and which may be located in a single- or multiple-dwelling building, which includes working, sleeping, eating, cooking, recreation facilities, or a combination thereof, except a structure used only for storage purposes.

Flood or *floodwaters* means a temporary overflow of water on land not normally covered by water.

Flood boundary and floodway maps (FBFM) means the official map for the community on which the Federal Insurance Administration has delineated the area of special flood hazard and the selected floodway.

Flood insurance rate maps (FIRM) means the official maps on which the Federal Insurance Administration has delineated both the areas of special flood hazard and the risk premium insurance rates applicable to the community.

Flood insurance study means the official report provided by the Federal Insurance Administration that includes flood profiles, the flood boundary and floodway maps, and the water surface elevations of the base flood.

Floodplain means the relatively flat area adjoining the channel of a watercourse, or areas where drainage is or may be restricted by natural or manmade structures which may have been or may be covered partially or wholly by floodwater from a base flood.

Floodplain Board or *Board* means the City Council acting as the "Floodplain Board."

Floodway fringe area means that portion of the area of special flood hazard that is not included in the selected floodway.

Lowest floor means the lowest floor of the lowest enclosed area (including basement). An unfinished or flood resistant enclosure, usable solely for parking of vehicles, building access or storage, in an area other than a basement area, is not considered a building's lowest floor, provided that such enclosure is not built so as to render the structure in violation of the applicable non-elevation design requirements of this ordinance.

Manufactured home means a structure, transportable in one or more sections, which is built on a permanent chassis and is designed for use with or without a permanent foundation when connected to the required utilities. For floodplain management purposes the term "manufactured home" also includes park trailers, travel trailers, and other similar vehicles placed on a site for greater than one hundred eighty consecutive days. For insurance purposes the term "manufactured home" does not include park trailers, travel trailers, and other similar vehicles.

Manufactured home park or subdivision means a parcel (or contiguous parcels) of land divided into two or more manufactured home lots for rent or sale.

Mean sea level means, for purposes of the National Flood Insurance Program, the National Geodetic Vertical Datum (NGVD of 1929) or other datum, to which base flood elevations shown on a community's flood insurance rate map are referenced.

Person means any individual or his agent, firm, partnership, association, corporation, or any agent of the aforementioned groups, or a federal, State, County or municipal government agency or political subdivision thereof.

Reasonable alteration or repair means any modification or improvement to existing facilities in which the total cost does not exceed fifty percent of the real cash value assessed at the commencement of construction. A reasonable alteration, however, should not be construed to mean any improvement which would increase the flood hazard to that property or the properties of surrounding homes.

Regulatory flood elevation means the elevation which is one foot above the "base flood" elevation for a "watercourse" for which the "base flood" elevation has been determined and shall be as determined by the criteria developed by the City Engineer for all other watercourses.

Selected floodway means the limits, as determined by the City Engineer, where the permitted encroachment in the floodplain will allow passage of the one-hundred-year flood without increasing the flood heights more than one foot. Additional hydraulic criteria such as maximum flow velocities of five feet per second at the limits of the selected floodway, smooth transitions around developments, and equal conveyance removal from each side will be used in computing the lines of the selected floodway.

Start of construction includes substantial improvement, and means the date the

building permit was issued, provided the actual start of construction, repair, reconstruction, placement, or other improvement was within one hundred eighty days of the permit date. The actual start means either the first placement of permanent construction of a structure on a site, such as the pouring of slab or footings, the installation of piles, the construction of columns, or any work beyond the state of excavation; or the placement of a manufactured home on a foundation. Permanent construction does not include land preparation, such as clearing, grading and filling; nor does it include the installation of streets and/or walkways; nor does it include excavation for a basement, footings, piers, or foundations or the erection of temporary forms; nor does it include the installation on the property of accessory buildings, such as garages or sheds not occupied as dwelling units or not part of the main structure.

Structure means a walled and roofed building or "manufactured home" that may or may not be habitable, may or may not be constructed on a permanent foundation, and was manmade.

Substantial improvement means any repair, reconstruction or improvement of a structure, the cost of which equals or exceeds fifty percent of the market value of the structure either before the improvement or if the structure was damaged and is being restored, before the damage occurred. A substantial improvement will not be permitted nor should it be construed to mean any modification which will increase flood hazard risk.

Violation means the failure of a structure or other development to be fully compliant with the community's floodplain management regulations. A structure or other development without the elevation certificate, other certifications, or other evidence of compliance required by this chapter is presumed to be in violation until such time as that documentation is provided.

Watercourse means any lake, river, creek, stream, wash, arroyo, channel, or other body of water having banks and bed through which waters flow at least periodically. The term may include specifically designated areas in which flood damage may occur. (Ord. No. G-2027, § 2; Ord. No. G-3092, § 2)

Cross References: Definitions and rules of construction generally, § 1-2.

ARTICLE II.

REGULATIONS

Sec. 32B-3. Maps.

The areas of special flood hazard and the selected floodway for designated floodplains are shown on the current maps labeled "FIRM" and "Floodway," or as they may subsequently be amended, on file with the City Engineer, which maps are incorporated herein by reference. The maps are consistent with the criteria established by

the Arizona Department of Water Resources and Federal Emergency Management Agency. New or additional engineering data may be considered for re-evaluation of floodplain and floodway delineations if circumstances indicate such action is in the public interest. Any such scientific or technical data will be submitted to the office of the City Engineer for review and conformance with established policy.
(Ord. No. G-2027, § 2; Ord. No. G-2641, § 1; Ord. No. G-3092, § 3)

Sec. 32B-4. Classification of floodplains.

To encourage the safe and orderly development of floodplain land, the Board recognizes that the floodplains consist of two distinct areas: the floodway fringe area having lower water velocities and shallower depths of flow and, the selected floodway which contains greater flow depths and damaging velocities. The Board also recognizes that encroachment into the floodway fringe area will not substantially increase the flood hazard to adjoining properties. It is also recognized that development and construction within the selected floodway will require higher standards of engineering and construction than development within the floodway fringe area in order to insure that there is no substantial hazard to such development or construction and that it does not create a substantial hazard to other property within the floodplain.
(Ord. No. G-2027, § 2)

Sec. 32B-5. Regulation.

In order to promote the public health, safety and general welfare, the Floodplain Board will enforce the following regulations:

1. No person may either obstruct, divert, or reduce the capacity within the area of special flood hazard by constructing any development or altering the width or course of said floodways except as provided in these regulations.

2. Construction and development may occur within the floodway fringe and the areas of shallow flooding provided that the City Engineer review and approve all such requests for building permits prior to issuance by the Building Official. The City Engineer will ascertain that the proposed construction will incorporate appropriate floodproofing measures to the "regulatory flood elevation," or that the "lowest floor" is above the "regulatory flood elevation." A "dwelling unit" shall be so constructed so as to place the "lowest floor" elevation of the "dwelling unit" above the "regulatory flood elevation." Appropriate floodproofing measures may include, but not be limited to: providing access during flood events, maintaining electrical, water, and sewer services, designing foundations and structures to withstand hydraulic loadings expected during the base flood and designing windows, doorways and other openings located below the level of the base flood to prevent the entrance of floodwaters. Any

applicant for a building permit has the burden of furnishing the Development Services Director satisfactory evidence to enable him to either determine that the applicant's property does not fall within the area of special flood hazard or that there is no substantial hazard, either to the proposed development or to the property.

3. Construction and development may be permitted within the selected floodway subject to review and approval by the City Engineer, on an individual permit basis; however, no development in the selected floodway will be allowed which will increase the water surface elevation of the base flood.

4. These regulations do not affect the existing use of property in the areas of special flood hazard or the right to the continuation of that use, nor do they affect the reasonable repair or alteration of property for the purpose for which such property was lawfully used on February 12, 1974.

5. Any substantial improvements to existing structures must conform to the requirements of this chapter.

6. New developments which provide on-site waste disposal systems must locate them outside the boundary of the base flood.

7. Within one hundred twenty days after completion of any flood control project, the areas of special flood hazard and the selected floodway in the area benefited by such works will be redefined.

8. Any new building or development located or maintained within the area of special flood hazard must have prior written authorization from the City Engineer, except as specified in 32B-8 and 32B-10 of these regulations.

9. The owner must have a registered professional engineer, or registered land surveyor, certify to the Development Services Director the actual elevation of the minimum finished floor of any new or substantially improved structure located within the area of special flood hazard. A record of these certifications shall be maintained with the Development Services Director. In addition, where a nonresidential structure is intended to be made watertight below the base flood level, a registered professional engineer or registered architect shall develop and/or review structural design, specifications, and plans for the construction, and shall certify that the design and methods of construction are in accordance with accepted standards of practice for meeting the applicable provisions of this section. A record of such certification which includes the specific elevation (in relation to mean sea level) to which such structures are floodproofed shall be maintained with the Development Services Director.

10. The City Engineer and the Development Services Director will obtain and maintain for public inspection, all records pertaining to the provisions of this ordinance.

11. No development shall increase the one-hundred-year twenty-four-hour peak or the one-hundred-year two-hour peak whichever is higher. Nor shall the time of the peak change or the total runoff exceed the pre-development total runoff.

12. In areas of special flood hazard without a selected floodway or its flood insurance rate map (FIRM) [or] flood insurance flood boundary and floodway maps (FBFM): No new flood boundary and floodway maps, construction, substantial improvements, or other development (including fill) shall be permitted unless it is demonstrated that the cumulative effect of the proposed developments, when combined with all other existing and proposed developments will not increase the water surface elevation of the base flood more than one foot at a point within the community.

(Ord. No. G-2027, § 2; Ord. No. G-3092, § 4; Ord. No. G-3313, § 1)

Sec. 32B-6. Interim elevations.

When base flood elevations and delineations are not available due to recent annexation or other causes, the City Engineer may obtain, review, and reasonably utilize any base flood elevation data available from a federal, State, County or other political subdivision for the purpose of securing a base flood determination, until such time as the Federal Emergency Management Agency has published the final FIRM (flood insurance rate maps) and FBFW (flood boundary and floodway maps).
(Ord. No. G-2027, § 2; Ord. No. G-3313, § 1)

Sec. 32B-7. Coordination in floodplain management.

The Floodplain Board may adopt other regulations which provide for coordination with all other interested and affected political subdivisions and State agencies and may enter into agreements for cooperative regulations, planning, designs, and construction. The Development Services Director shall advise the Flood Control District of Maricopa County and any other adjacent jurisdiction having responsibility for floodplain management, in writing, and provide a copy of any development plan of all applications for floodplain use permits or variances to develop land in a floodplain or floodway within one mile of the boundary between the City's area of jurisdiction and the area of jurisdiction of the District. The Development Services Director shall also advise the District and any adjacent jurisdiction having responsibility for floodplain management in writing and provide a copy of any development plan of any major development proposed within a floodplain or floodway which could affect floodplains, floodways or watercourses outside the City's area of jurisdiction. Written notice and a copy of the plan of development shall be sent to any adjacent jurisdiction no later than

three working days after having been received.
(Ord. No. G-2027, § 2; Ord. No. G-3092, § 5; Ord. No. G-3313, § 1)

Sec. 32B-8. Non-prohibited construction.

Written authorization shall not be required nor shall the Floodplain Board prohibit:

1. The construction of bridges, culverts, dikes, and other structures necessary to the construction of public highways, roads, and streets intersecting or crossing a watercourse.

2. The construction of storage dams for watering livestock or wildlife structures on banks of a creek, stream, river, wash, arroyo or other watercourses to prevent erosion of or damage to adjoining land, or dams for the conservation of floodwaters as permitted by A.R.S. tit. 45, ch. 3.1 (A.R.S. § 45-801.01 et seq.).

3. Construction of tailing dams and waste disposal areas for use in connection with mining and metallurgical operations.

(Ord. No. G-2027, § 2)

Sec. 32B-9. Reserved.

Editors Note: Section 32B-9 was repealed; see Ord. No. G-3092, § 6.

Sec. 32B-9.1. Manufactured homes.

Any manufactured homes to be placed within the area of special flood hazard shall be installed using methods and practices which minimize flood damage. For the purposes of this requirement, manufactured homes must be elevated so that the bottom of the structural frame or the lowest point of any attached appliances, whichever is lower, is at or above the regulatory flood elevation and anchored to resist flotation, collapse, or lateral movement. Methods of anchoring may include, but are not limited to, use of over-the-top or frame ties to ground anchors. This requirement is in addition to applicable State requirements.
(Ord. No. G-3092, § 6)

Sec. 32B-9.2. Mechanical and utility equipment.

Electrical, heating, ventilation, plumbing, and air conditioning equipment and other service facilities shall be designed and/or located so as to prevent water from entering or accumulating within the components during conditions of flooding.
(Ord. No. G-3092, § 6)

Sec. 32B-9.3. Federal and State permits.

All development located within an area of special flood hazard shall obtain all permits required by State and federal law, specifically that required by section 404 of the Federal Water Pollution Control Amendments of 1972.
(Ord. No. G-3092, § 6)

Sec. 32B-9.4. Openings in enclosures below a structure's lowest floor.

For all new construction and substantial improvements, fully enclosed areas below the lowest floor that are subject to flooding shall be designed to automatically equalize hydrostatic flood forces on exterior walls by allowing for the entry and exit of floodwaters. Designs for meeting this requirement must either be certified by a registered professional engineer or architect or must meet or exceed the following minimum criteria:

A minimum of two openings having a total net area of not less than one square inch for every square foot of enclosed area subject to flooding shall be provided. The bottom of all openings shall be no higher than one foot above grade. Openings may be equipped with screens, louvers, or other coverings or devices provided that they permit the automatic entry and exit of floodwaters.
(Ord. No. G-3092, § 6)

Sec. 32B-10. Sand and gravel operations.

Sand and gravel operations are allowed within the floodplain subject to the following conditions:

1. Within the selected floodway, sand and gravel operations may be conducted without permit provided that:

   (a) The operations are restricted to [the] extraction of sand and gravel for commercial purposes; and

   (b) Excavations are not so located nor of such depth as to present a hazard to other development, including, but not limited to, roads, bridges, culverts, and utilities.

2. No stockpiling, within the selected floodway, of material or tailings that may obstruct, divert, or retard the flow of floodwaters will be permitted except as reviewed and approved by the City Engineer, on an individual permit basis.

3. Stockpiling of sand and gravel products within the floodway fringe area may be done without permit provided that the operator furnishes the City Engineer satisfactory evidence that such stockpiling is within the floodway fringe area rather than in the selected floodway.

4. Excavations for sand and gravel for commercial purposes within the floodway fringe area which exceed the definitions contained in section 32A-6, paragraph (b)(1) [sic] (Grading and Drainage) of the City Code will be permitted subject to review and approval by the City Engineer, on an individual permit basis.

(Ord. No. G-2027, § 2)

Sec. 32B-11. Variance provisions.

A. The City Engineer may authorize variances from the terms of this chapter when a literal enforcement of any provisions of this ordinance would result in an unnecessary property hardship and when evidence is presented demonstrating to the satisfaction of the City Engineer that all of the following conditions are fulfilled:

1. That special conditions and circumstances exist which are peculiar to the land or structure involved and which are not applicable to other lands or structures within the same general area such as a new structure to be erected on a lot of one-half acre or less, contiguous to and surrounded by lots with existing structures built below the level of the base flood; and

2. That the alleged hardships caused by literal interpretation of the provisions of this chapter are property hardships which include more than personal inconvenience and financial hardships, and do not result from the action of the owner or the applicant; and

3. That the variances will not be detrimental to persons residing or working in the vicinity and to adjacent property, to the neighborhood and to the public welfare in general; and

4. That the variance is the minimum variance that will make possible the reasonable use of the land or structure; and

5. That appropriate and specific conditions have been stipulated by the City Engineer in connection with the variances as may be deemed necessary in order to fully carry out the intent of the Floodplain Ordinance. The stipulation may include, among other things, a requirement that the applicant insert a note on any future deed or other conveyance of the property stating that the property is located in a floodprone area. The notice will include the number of feet that the lowest non-floodproofed floor of the proposed structure is below the base flood level and a statement that the actuarial flood insurance rates increase as the first floor elevation decreases. A violation of any condition shall be considered a violation of the Floodplain Ordinance and such violation shall render the variance null and void; and

6. That the burden of proof in all matters heard by the City Engineer shall rest with the applicant. The granting of a variance is a matter of grace, resting on the discretion of the City Engineer, and a refusal is not a denial of a right, conditional or otherwise.

B. A variance will be issued for the reconstruction, rehabilitation, or restoration of all structures listed on the National or State Register of Historic Places or the State inventory of historic places, without regard to conflicting procedures and provisions set forth in this section.
(Ord. No. G-2027, § 2)

Sec. 32B-12. Appeals.

Appeals from decisions of the City Engineer in application of these regulations may be taken to the Development Advisory Board acting as the Floodplain Appeal Board. Any person aggrieved by a decision of the Floodplain Appeal Board may bring special action in a court of competent jurisdiction. The Floodplain Appeal Board, when reviewing an appeal from a decision of the City Engineer, shall follow the rules and standards set forth in this ordinance.
(Ord. No. G-2027, § 2; Ord. No. G-3313, § 1; Ord. No. G-4176, § 13, passed 5-19-1999, eff. 6-18-1999)

Sec. 32B-13. Structures in violation of regulations.

Except as provided in paragraphs 32B-8 and 32B-10, all new development located or maintained within any area of special flood hazard in violation of the regulations of this chapter and without written authorization from the Floodplain Board or the City Engineer as administrative agent of the Floodplain Board is hereby declared to be a public nuisance per se and may be abated, prevented or restrained by action of the City.
(Ord. No. G-2027, § 2)

Sec. 32B-14. Diversion of water flow.

A. It is unlawful for any person to divert, retard, or obstruct any watercourse in the City of Phoenix whenever such action creates a hazard to life or property without securing the written authorization required by the preceding regulations.

B. Any person violating the provisions of this section shall be guilty of a misdemeanor.
(Ord. No. G-2027, § 2)

Sec. 32B-15. Violation as separate offense.

Each day of violation of these regulations shall constitute a separate offense.

(Ord. No. G-2027, § 2)

Sec. 32B-16. Severability.

If any provision of this ordinance is held invalid, such invalidity shall not affect other provisions which can be given effect without the invalid provision, and to this end the provisions of this ordinance are declared to be severable.
(Ord. No. G-2027, § 2)

Sec. 32B-17. Floodplain plan review fees.

The Development Services Director shall collect the fees set forth in this section before providing floodplain plan review services:

FLOODPLAIN PLAN REVIEW
FEE SCHEDULE
Effective September 1, 1987

1. Generated through grading and drainage review:

   $240.00/plan sheet for office review.

   $170.00/plan sheet for third review and each thereafter.

   $240.00/plan sheet for revisions to approved plans.

   $125.00/plan sheet for updates to approved plans.

2. Generated through building safety check:

   $17.00/form, finished floor requirement. (Form 126-225D Rev.)

   $240.00/plan sheet for office review.

(Ord. No. G-2217, § 1; Ord. No. G-2226, § 2; Ord. No. G-2512, § 1; Ord. No. G-2629, § 1; Ord. No. G-2787, § 1; Ord. No. G-3011, § 1; Ord. No. G-3127, § 3)

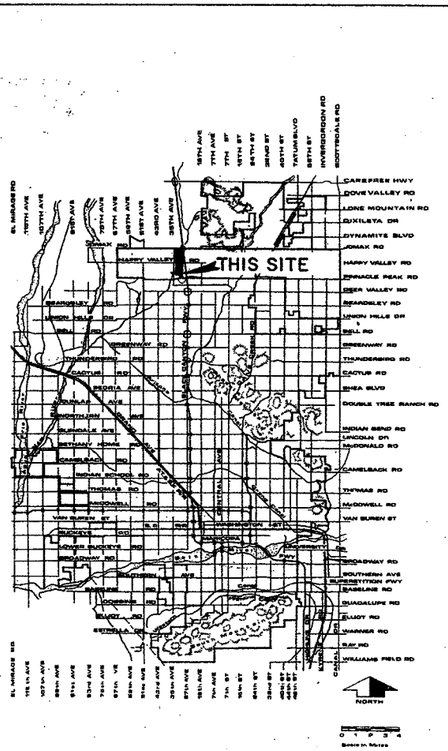
Cross References: Development Services Department fee schedule, app. A.2.

CITY OF PHOENIX

ENGINEERING & ARCHITECTURAL SERVICES
PROJECT MANAGEMENT DIVISION

SKUNK CREEK LANDFILL
INDEX NUMBER SA-930222

1994



VICINITY MAP

MAYOR

PAUL JOHNSON

CITY COUNCIL

DISTRICT NO. 1	THELDA WILLIAMS	DISTRICT NO. 5	JOHN NELSON
DISTRICT NO. 2	FRANCES BARWOOD	DISTRICT NO. 6	SAL DICICCIO
DISTRICT NO. 3	SKIP RIMSZA	DISTRICT NO. 7	SALOMON LEIJA
DISTRICT NO. 4	CRAIG TRIBKEN	DISTRICT NO. 8	CODY WILLIAMS

CITY MANAGER - FRANK FAIRBANKS

CITY ENGINEER - KENNY W. HARRIS, P.E.

APPROVALS

ENGINEERING SUPERVISOR _____ DATE _____

PUBLIC WORKS DIRECTOR _____ DATE _____

INDEX OF DRAWINGS

SHEET	DESCRIPTION
1	COVER SHEET
2	EXISTING TOPOGRAPHY
3	FINAL GRADING PLAN
4	FINAL FILL SEQUENCE
5	TYPICAL SECTIONS – CELL 4 & CELL 5
6	TYPICAL SECTIONS – CELL 6
7	FINAL GRADING AND DRAINAGE PLAN – CELL 1
8	FINAL GRADING AND DRAINAGE PLAN – CELL 2
9	FINAL GRADING AND DRAINAGE PLAN – CELL 3
10	LINER PLAN – CELL 4
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16	LEACHATE EVAPORATING/HOLDING POND – PLAN & DETAILS
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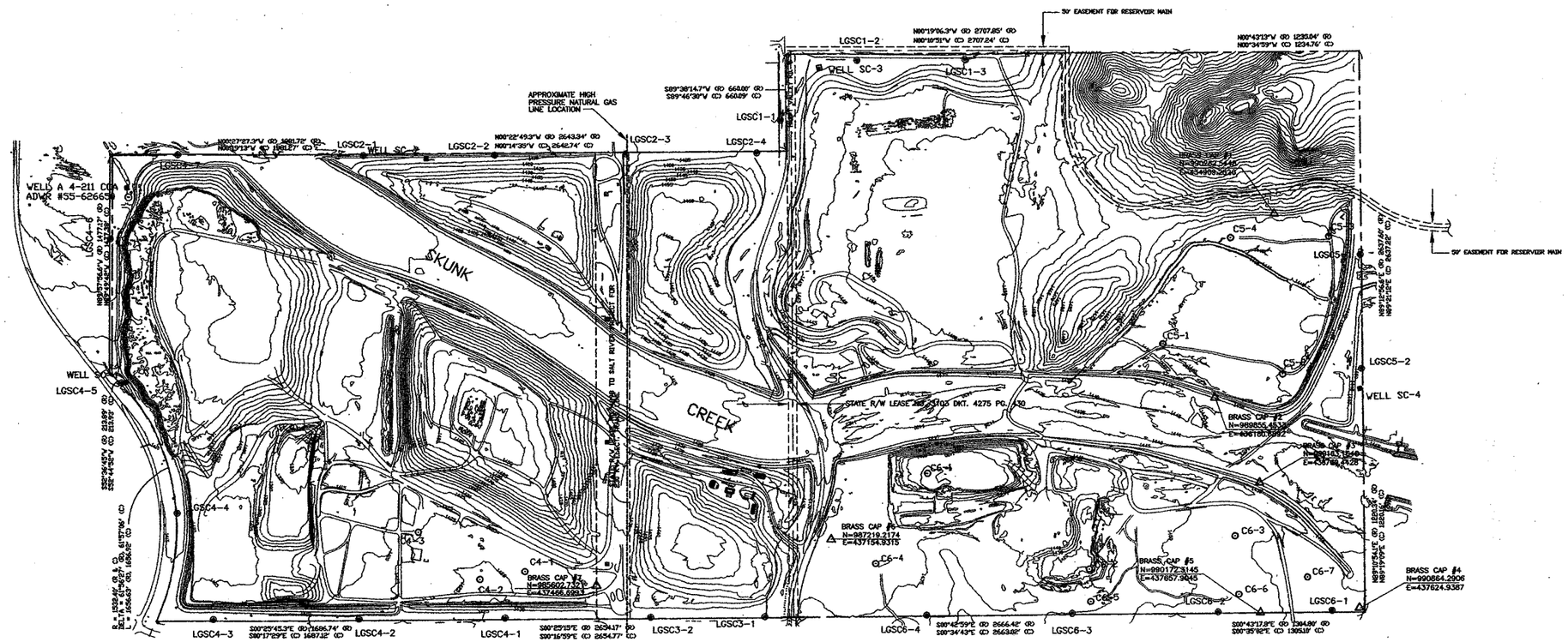
19	DRAINAGE AND MISCELLANEOUS DETAILS
20	CONCEPTUAL ANCILLARY FACILITY
21	CONCEPTUAL PARK MASTER PLAN
22	GAS PROBE LOCATIONS AND DETAILS

ISSUED FOR PERMITTING ONLY

Registered Professional Engineer (Civil) CERTIFICATE NO. 20008 RICHARD G. REEVES Date Signed 4-8-94

EMCON Associates
Consultants in Wastes Management
3922 East University Drive, Suite 7
Phoenix, Arizona 85034
(602) 470-0444

Fri Mar 4 10:02:00 1994 DATE LAST REVISED: 2-10-94 CADD FILE: 73330101\SHEET1



LEGEND

- Gas Probe Location
- Geotechnical Boring Location
- Groundwater Monitoring Well
- Transmission Towers
- Property boundary
- Easements
- Permanent Monuments

Base map prepared by Aerial Mapping Company Inc.
Field control provided by Morea-Hall Engineering, Inc.
Date of photography 6-25-93

ISSUED FOR PERMITTING ONLY

EMCON Associates
Consultants in Wastes Management
3922 East University Drive, Suite 7
Phoenix, Arizona 85034
(602) 470-0444

Revisions	Date

Arizona Professional Engineer (Civil)
CERTIFICATE NO. 20006
RICHARD G. REEVES
Date Signed 2/16/94

Designed By:	PJK
Drawn By:	PJK
Checked By:	RGR
Date:	FEBRUARY 1994

Title: EXISTING TOPOGRAPHY
FACILITY DEVELOPMENT PLAN
SKUNK CREEK LANDFILL
INDEX NO. SA-930222

Sheet: 2 of 22

CITY OF PHOENIX ■ EAS DEPARTMENT ■ PROJECT MANAGEMENT DIVISION

DATE LAST REVISED: 2/16/94 CADD FILE: \73330101\SHEET2

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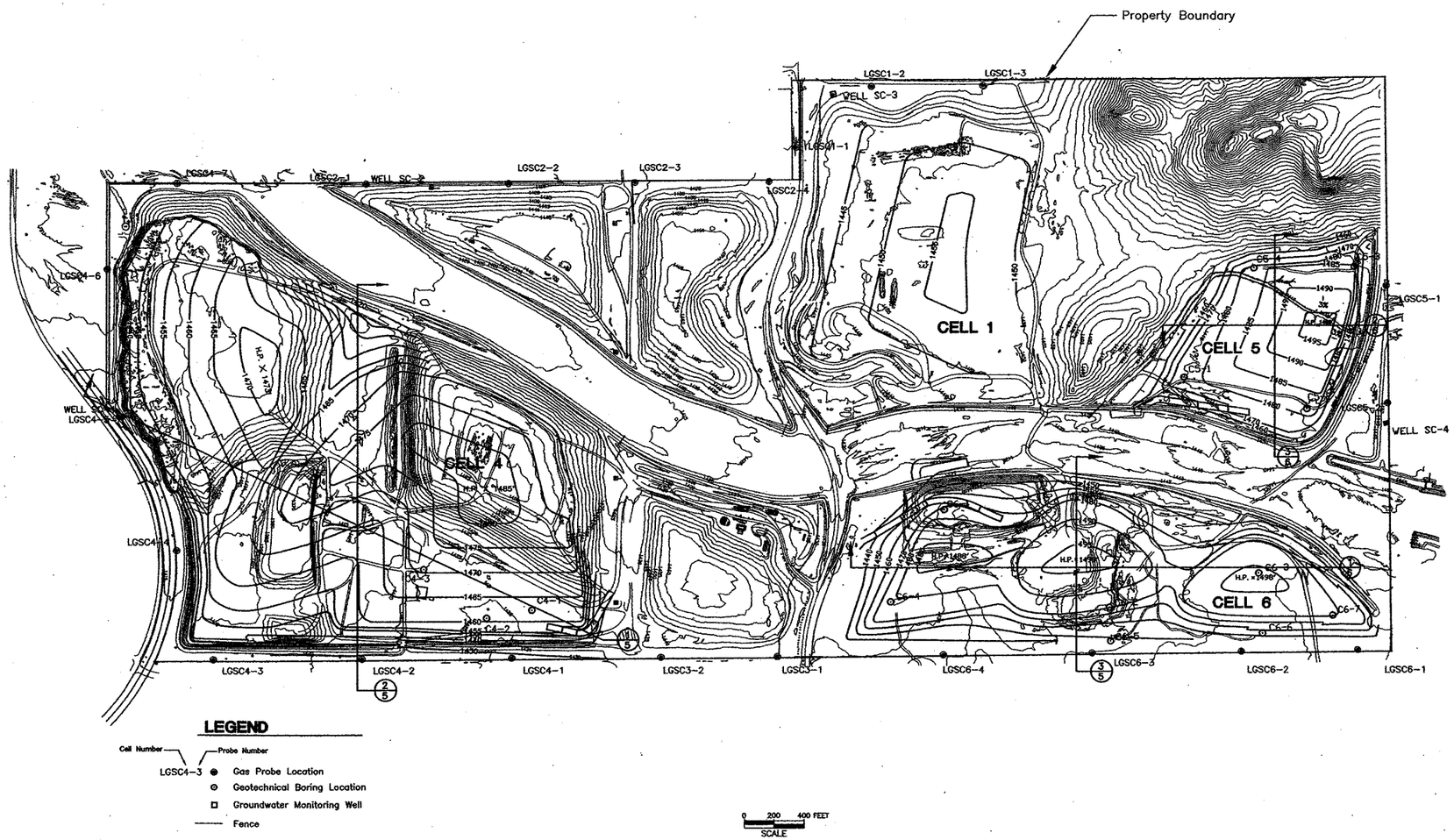

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Revisions	Date

Arizona Professional Engineer (Civil)
CERTIFICATE NO. 20008
RICHARD G. REEVES
Date Signed 2-22-94

Designed By: PJK
Drawn By: PJK
Checked By: RGR
Date: FEBRUARY 1994

Title:
FINAL GRADING PLAN
FACILITY DEVELOPMENT PLAN
SKUNK CREEK LANDFILL
INDEX NO. SA-930222

EMCON Associates
Consultants in Wastes Management
3922 East University Drive, Suite 7
Phoenix, Arizona 85034
(602) 470-0444

Sheet: 3 of 22

CITY OF PHOENIX ■ EAS DEPARTMENT ■ PROJECT MANAGEMENT DIVISION

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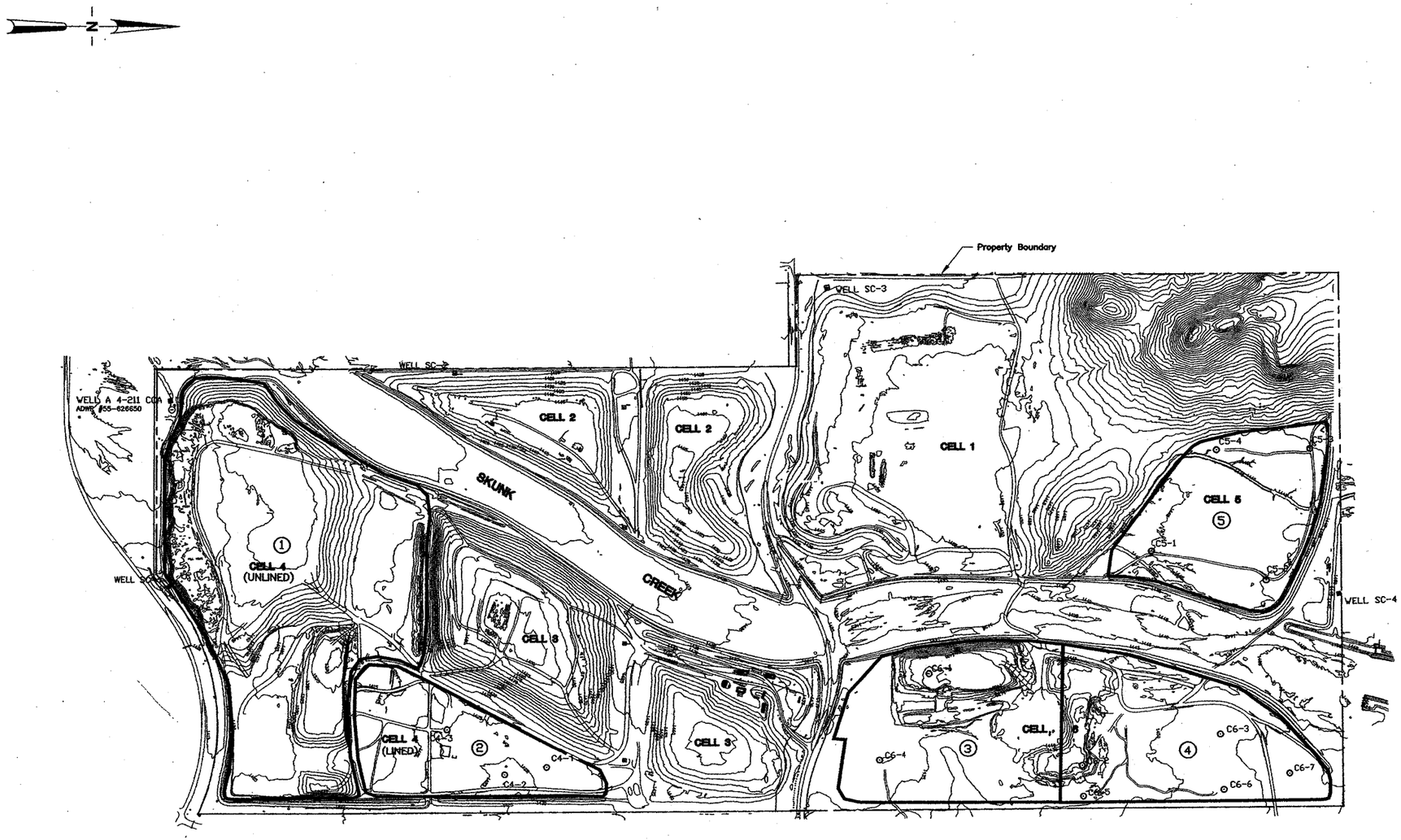

LEGEND

- Groundwater Monitoring Well
- Fence Line
- Goetechnical Boring Location
- (1) Fill Progression
- Transmission Towers

0 200 400 FEET
SCALE

ISSUED FOR PERMITTING ONLY

EMCON Associates
Consultants in Wastes Management
3922 East University Drive, Suite 7
Phoenix, Arizona 85034
(602) 470-0444

Revisions	Date

Registered Professional Engineer (Civil)
CERTIFICATE NO. 20008
RICHARD G. REEVES
Date Signed 2/17/94
ARIZONA U.S.A.

Designed By: PJK
Drawn By: PJK
Checked By: RGR
Date: FEBRUARY 1994

Title: PROPOSED FILL SEQUENCE
FACILITY DEVELOPMENT PLAN
SKUNK CREEK LANDFILL
INDEX NO. SA-930222

Sheet: 4 of 22

CITY OF PHOENIX ■ EAS DEPARTMENT ■ PROJECT MANAGEMENT DIVISION

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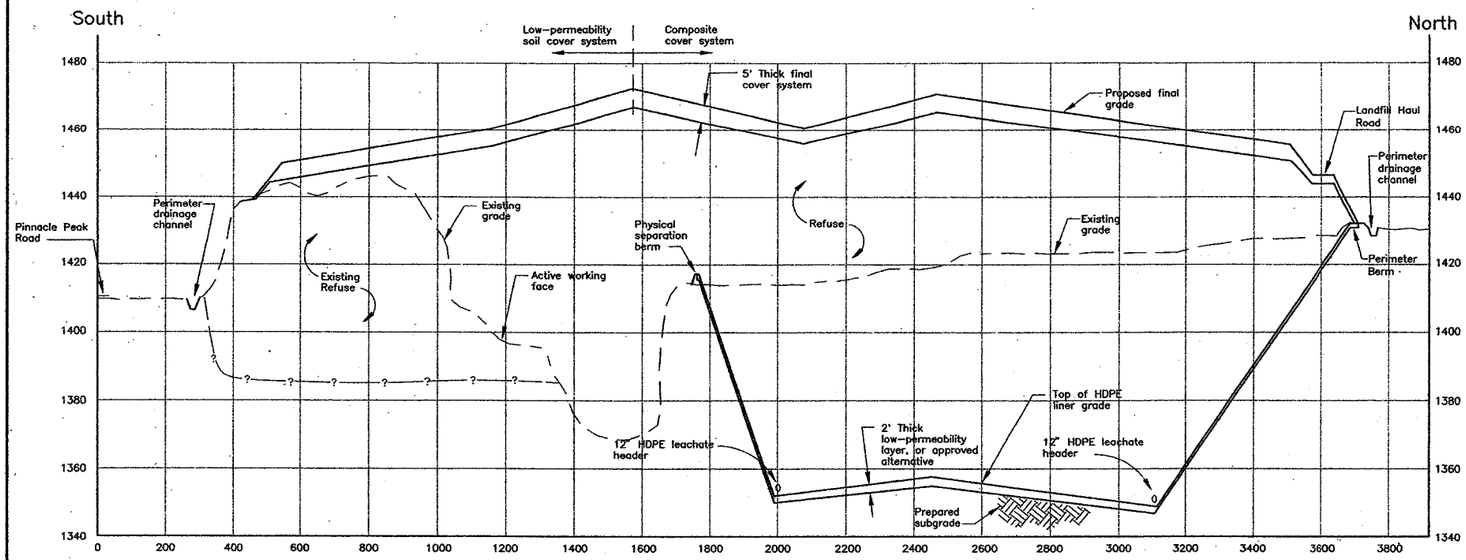

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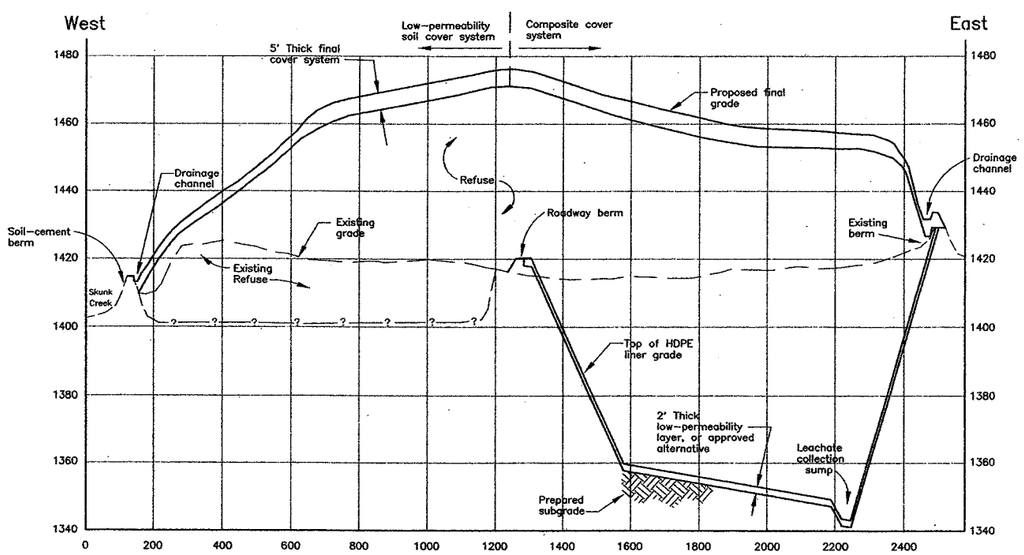

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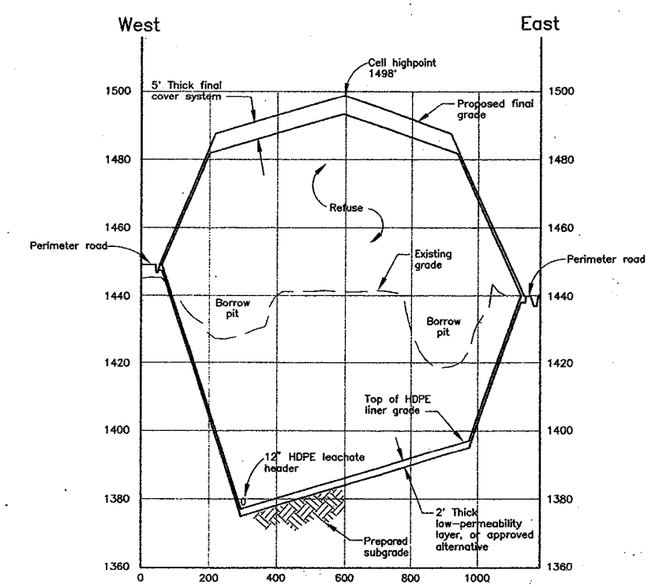

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ISSUED FOR PERMITTING ONLY

Revisions	Date
Revised Base Grades	4/96

Registered Professional Engineer (Civil) CERTIFICATE NO. 30509 PETER J. KELLER Date Signed 10-24-94 Arizona U.S.A.

Designed By: PJK
Drawn By: TJT
Checked By: RGR
Date: FEBRUARY 1994

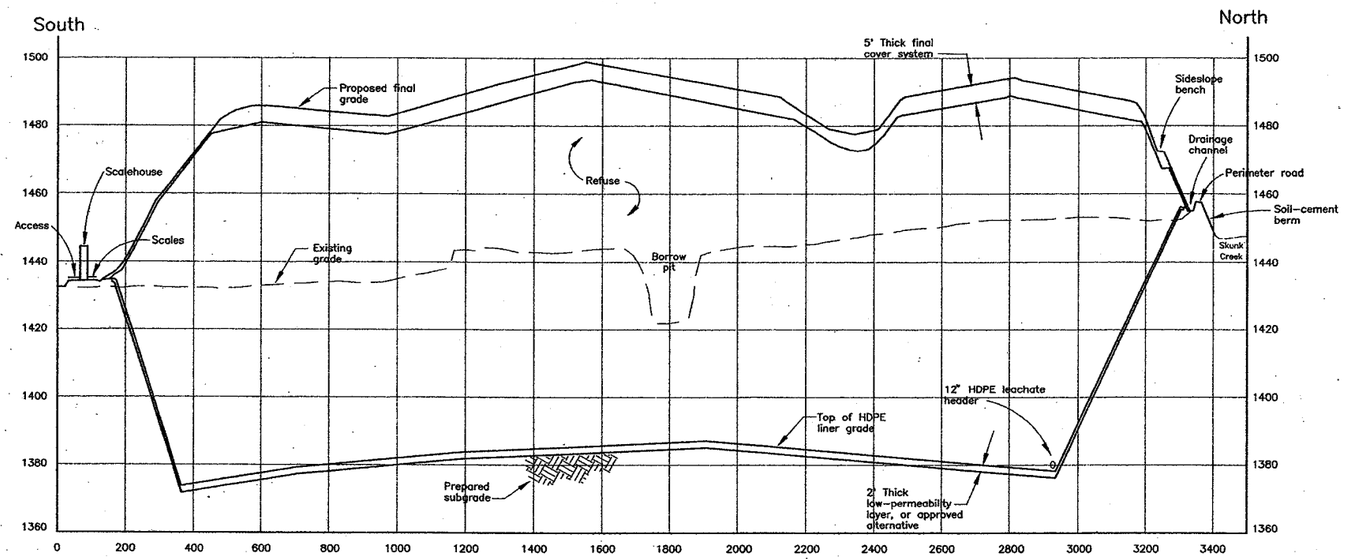
Title: TYPICAL SECTIONS - CELL 4 & CELL 6
FACILITY DEVELOPMENT PLAN
SKUNK CREEK LANDFILL
INDEX NO. SA-930222

EMCON Associates
Consultants in Wastes Management
3922 East University Drive, Suite 7
Phoenix, Arizona 85034
(602) 470-0444

Sheet: 5 of 22

CITY OF PHOENIX ■ EAS DEPARTMENT ■ PROJECT MANAGEMENT DIVISION

CADD FILE: 7330101\SHEET5
DATE LAST REVISED: 2/23/94



SECTION 1/3

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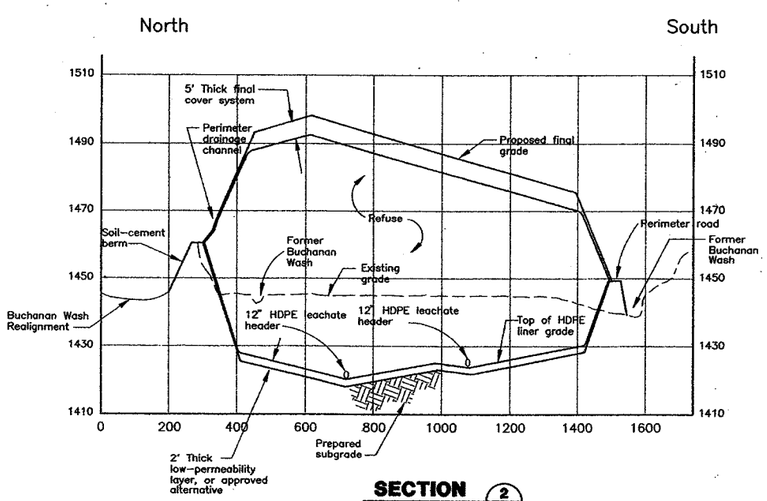

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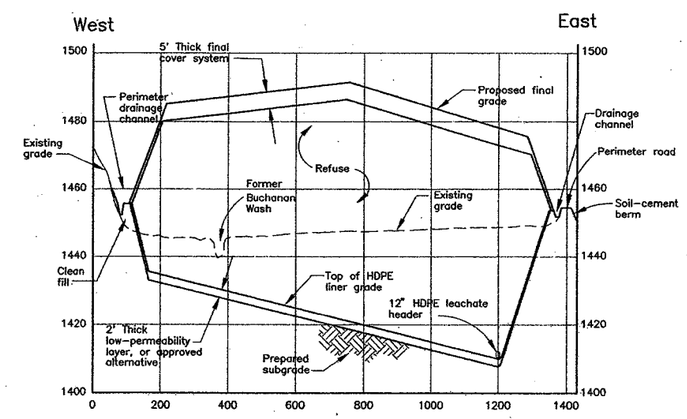

SECTION 3/3

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Revisions	Date
Revised Base Grades	4/96

Registered Professional Engineer (Civil)
CERTIFICATE NO. 30609
PETER J. KELLER
Date Signed 2-18-94
ARIZONA U.S.A.

Designed By: PJK
Drawn By: TJT
Checked By: RGR
Date: FEBRUARY 1994

Title: TYPICAL SECTIONS - CELL 5 & CELL 6
FACILITY DEVELOPMENT PLAN
SKUNK CREEK LANDFILL
INDEX NO. SA-930222

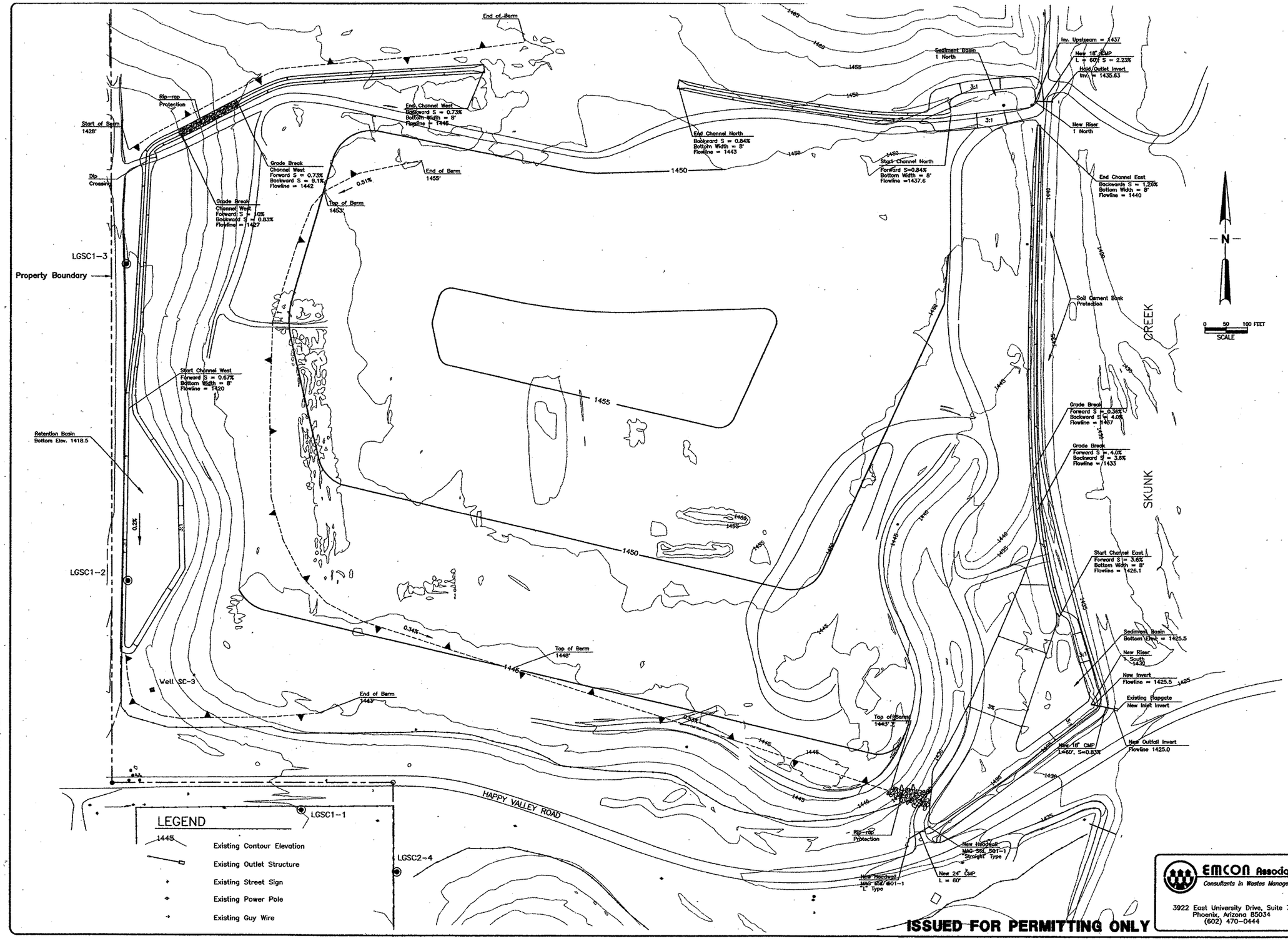
EMCON Associates
Consultants in Wastes Management
3922 East University Drive, Suite 7
Phoenix, Arizona 85034
(602) 470-0444

Sheet: 6 of 22

CITY OF PHOENIX ■ EAS DEPARTMENT ■ PROJECT MANAGEMENT DIVISION

CADD FILE: 7333010\SHEET6

DATE LAST REVISED: 2-23-94



ISSUED FOR PERMITTING ONLY

Revisions	Date

Registered Professional Engineer (Civil) CERTIFICATE NO. 20006 RICHARD G. REEVES Date Signed 3-29-94 Arizona U.S.A.

Designed By:	PJK
Drawn By:	TJT
Checked By:	RGR
Date:	FEBRUARY 1994

Title: FINAL GRADING AND DRAINAGE PLAN - CELL 1
FACILITY DEVELOPMENT PLAN
SKUNK CREEK LANDFILL
INDEX NO. SA-930222

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Sheet: 7 of 22

CITY OF PHOENIX ■ EAS DEPARTMENT ■ PROJECT MANAGEMENT DIVISION

DATE LAST REVISED:3-29-94 CADD FILE: 73330101\SHEET7

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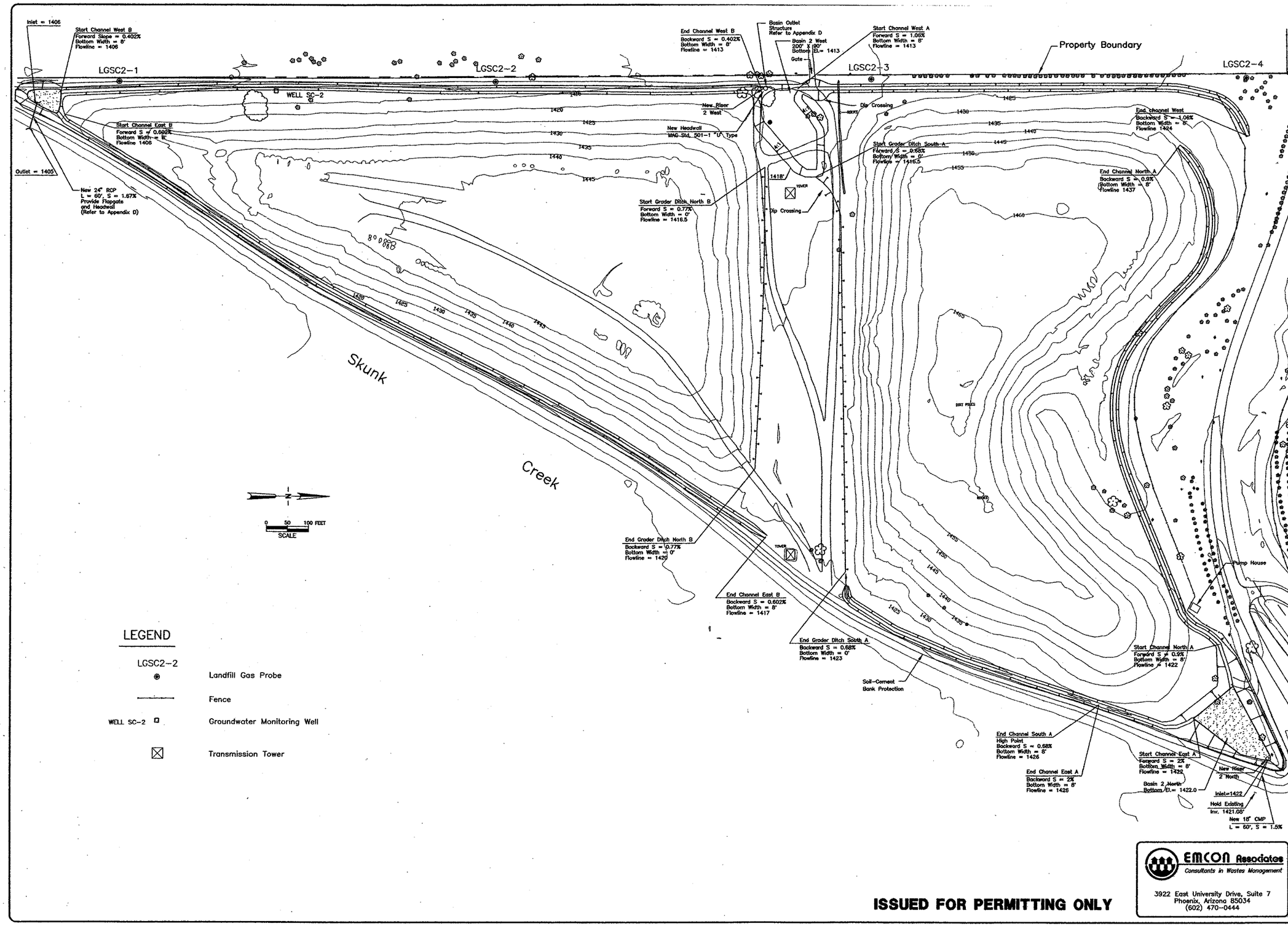

LEGEND

LGSC2-2 ●	Landfill Gas Probe
———	Fence
WELL SC-2 ◻	Groundwater Monitoring Well
⊠	Transmission Tower

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3922 East University Drive, Suite 7
Phoenix, Arizona 85034
(602) 470-0444

Revisions	Date

Arizona Professional Engineer (Civil)
CERTIFICATE NO. 20008
RICHARD G. REEVES
DATE SIGNED 4/4/94

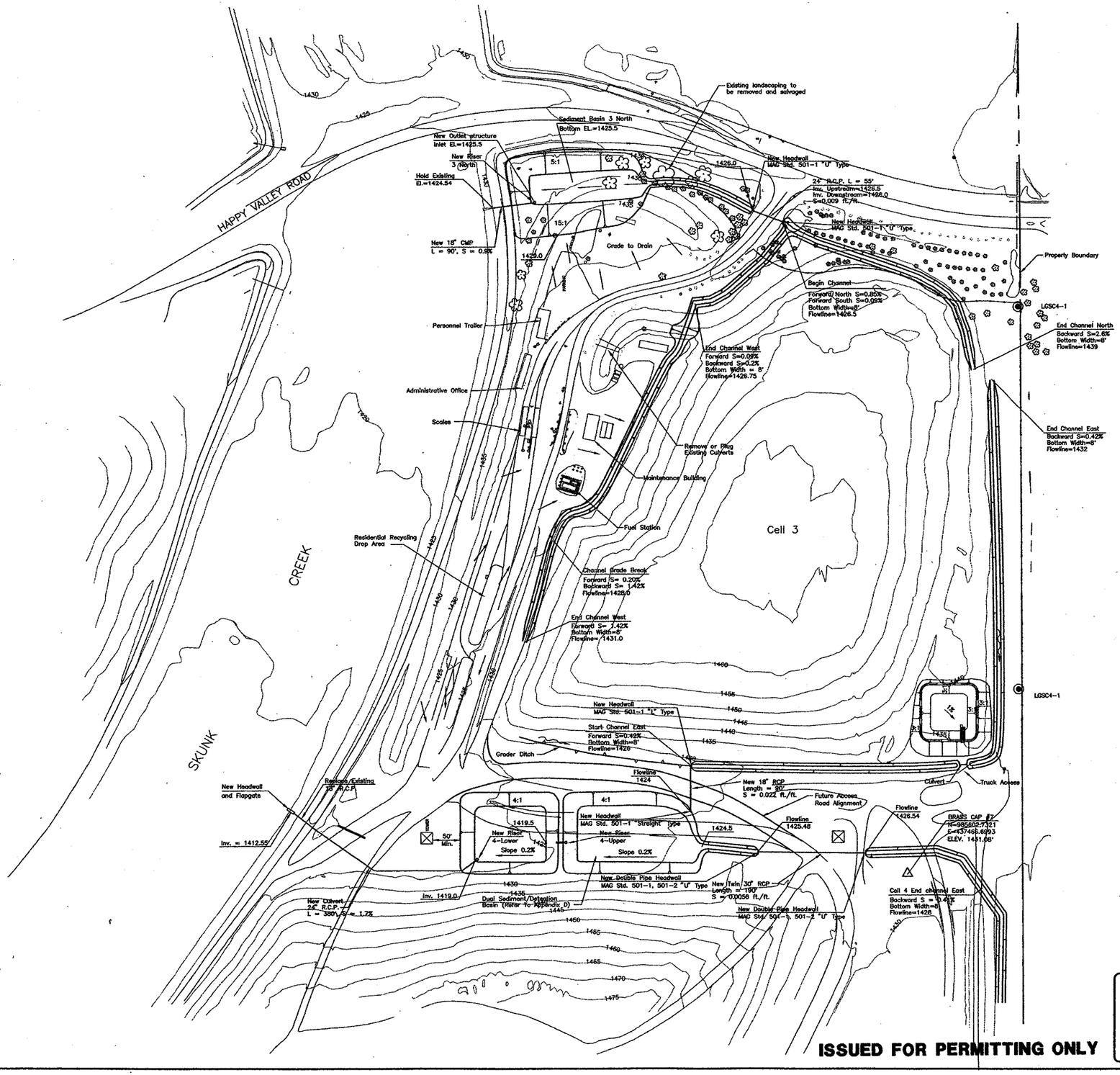
Designed By:	PJK
Drawn By:	TJT
Checked By:	RGR
Date:	FEBRUARY 1994

Title:
FINAL GRADING AND DRAINAGE PLAN - CELL 2
FACILITY DEVELOPMENT PLAN
SKUNK CREEK LANDFILL
INDEX NO. SA-930222

Sheet: 8 OF 22

CITY OF PHOENIX ■ EAS DEPARTMENT ■ PROJECT MANAGEMENT DIVISION

CADD FILE: 73330101\SHEET8
DATE LAST REVISED: 3/30/94
Wed Mar 30 15:18:28 1994



ISSUED FOR PERMITTING ONLY

Revisions	Date

Registered Professional Engineer (Civil)
CERTIFICATE NO.
20008
RICHARD G. REEVES
Date Signed 3-30-94

Designed By:	PJK
Drawn By:	TJT
Checked By:	RGR
Date:	FEBRUARY 1994

Title:
FINAL GRADING PLAN - CELL 3
FACILITY DEVELOPMENT PLAN
SKUNK CREEK LANDFILL
INDEX NO. SA-930222

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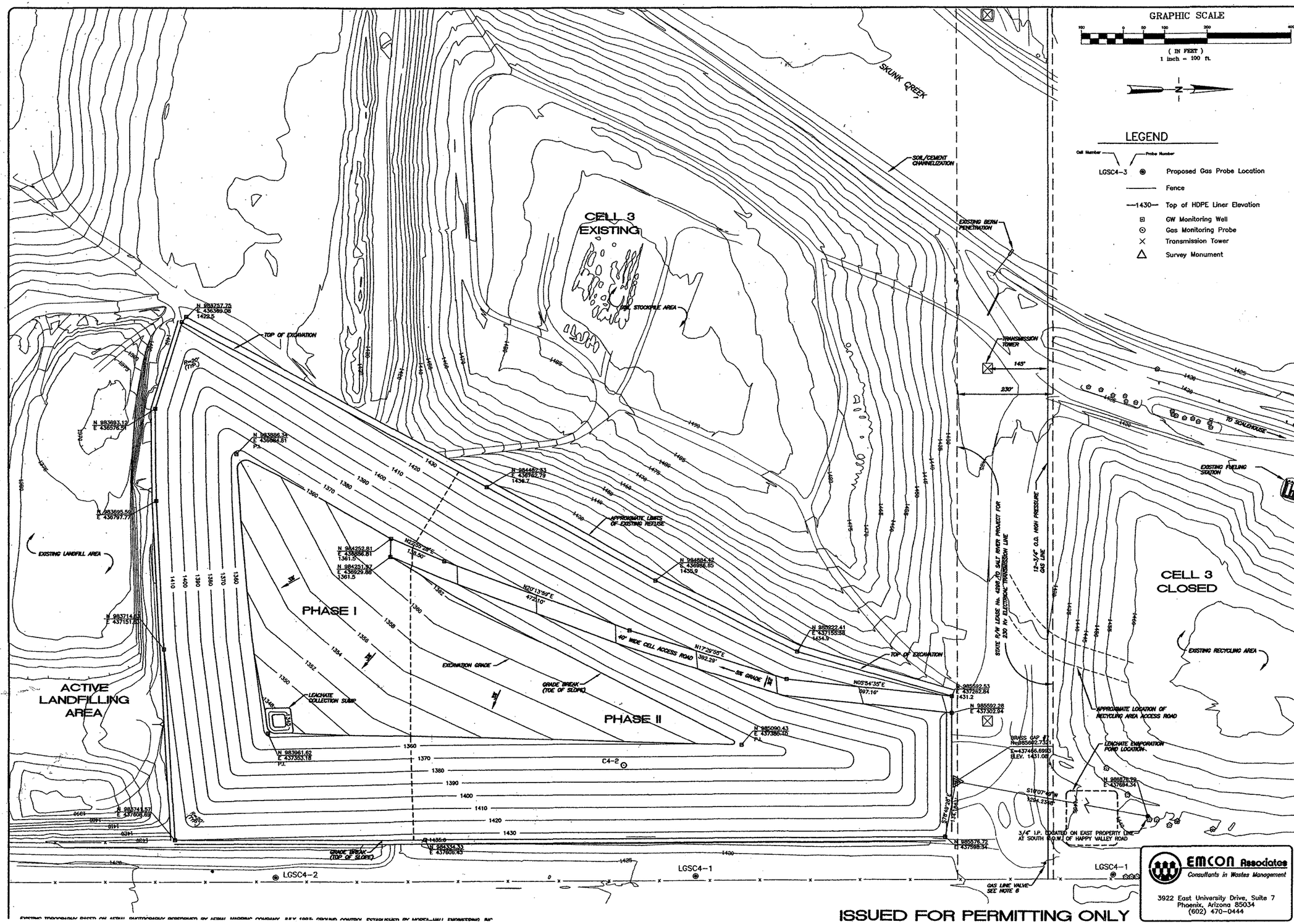
Sheet:
9 OF 22

CITY OF PHOENIX ■ EAS DEPARTMENT ■ PROJECT MANAGEMENT DIVISION

CADD FILE: 7330101\SHEET9

DATE LAST REVISED: 3-30-94

Thu Mar 31 07:56:38 1994



Revisions	Date
Revised Base Grade and Line	4/96

Registered Professional Engineer (Civil)
CERTIFICATE NO.
30509
PETER J. KELLER
ARIZONA U.S.A.

Designed By:	PJK
Drawn By:	PJK
Checked By:	WDS
Date:	FEBRUARY 1994

Title:

LINER PLAN - CELL 4
FACILITY DEVELOPMENT PLAN
SKUNK CREEK LANDFILL
INDEX NO. SA-930222

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Phoenix, Arizona 85034
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Sheet: 10 OF 22

CITY OF PHOENIX ■ EAS DEPARTMENT ■ PROJECT MANAGEMENT DIVISION

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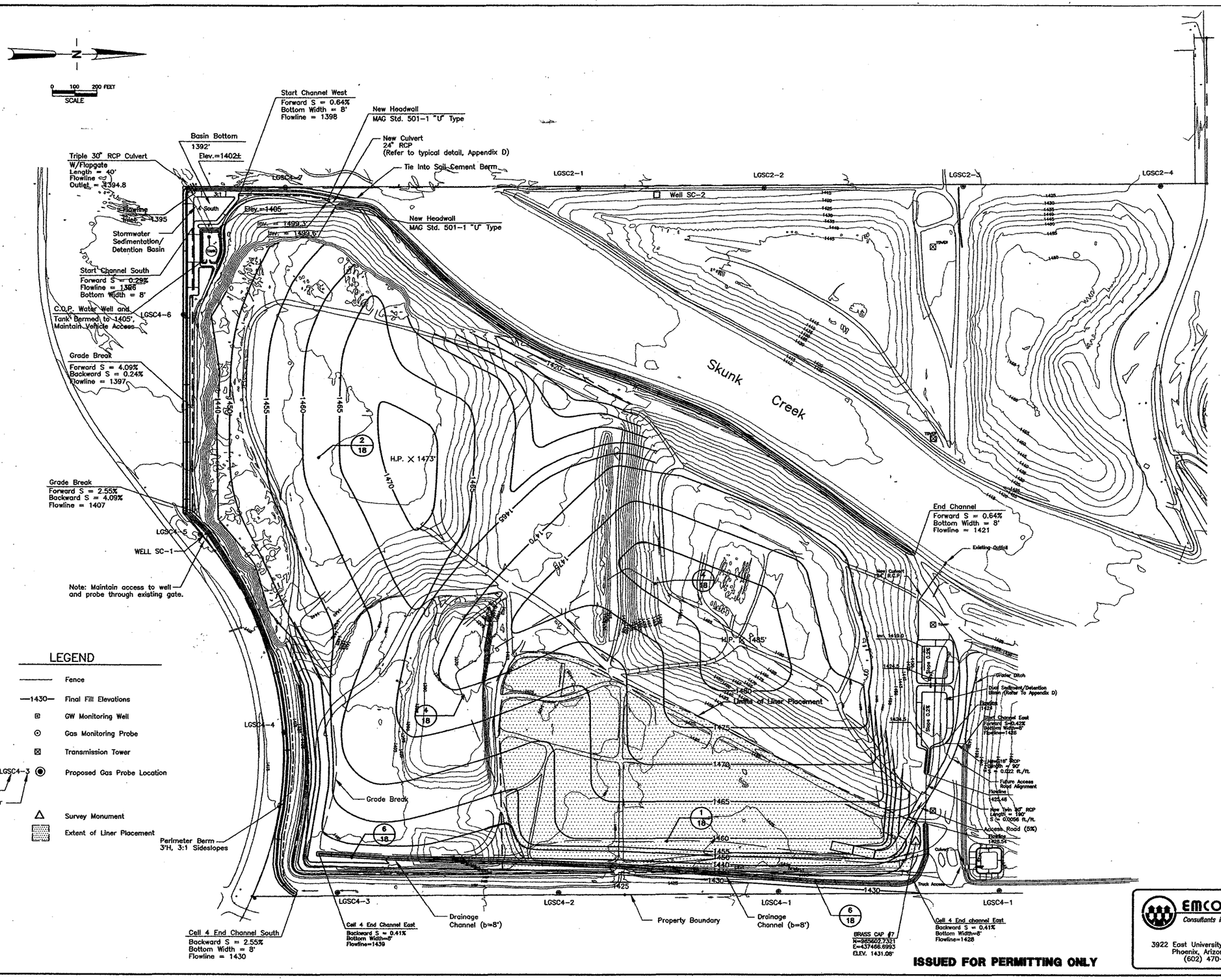
DATE LAST REVISED: 7/1/96



ISSUED FOR PERMITTING ONLY

Revisions	Date

Registered Professional Engineer (Civil) CERTIFICATE NO. 20009 RICHARD G. REEVES ARIZONA U.S.A.

Designed By:	PJK
Drawn By:	PJK
Checked By:	RGR
Date:	FEBRUARY 1994

Title: FINAL GRADING AND DRAINAGE PLAN-CELL 4
FACILITY DEVELOPMENT PLAN
SKUNK CREEK LANDFILL
INDEX NO. SA-930222

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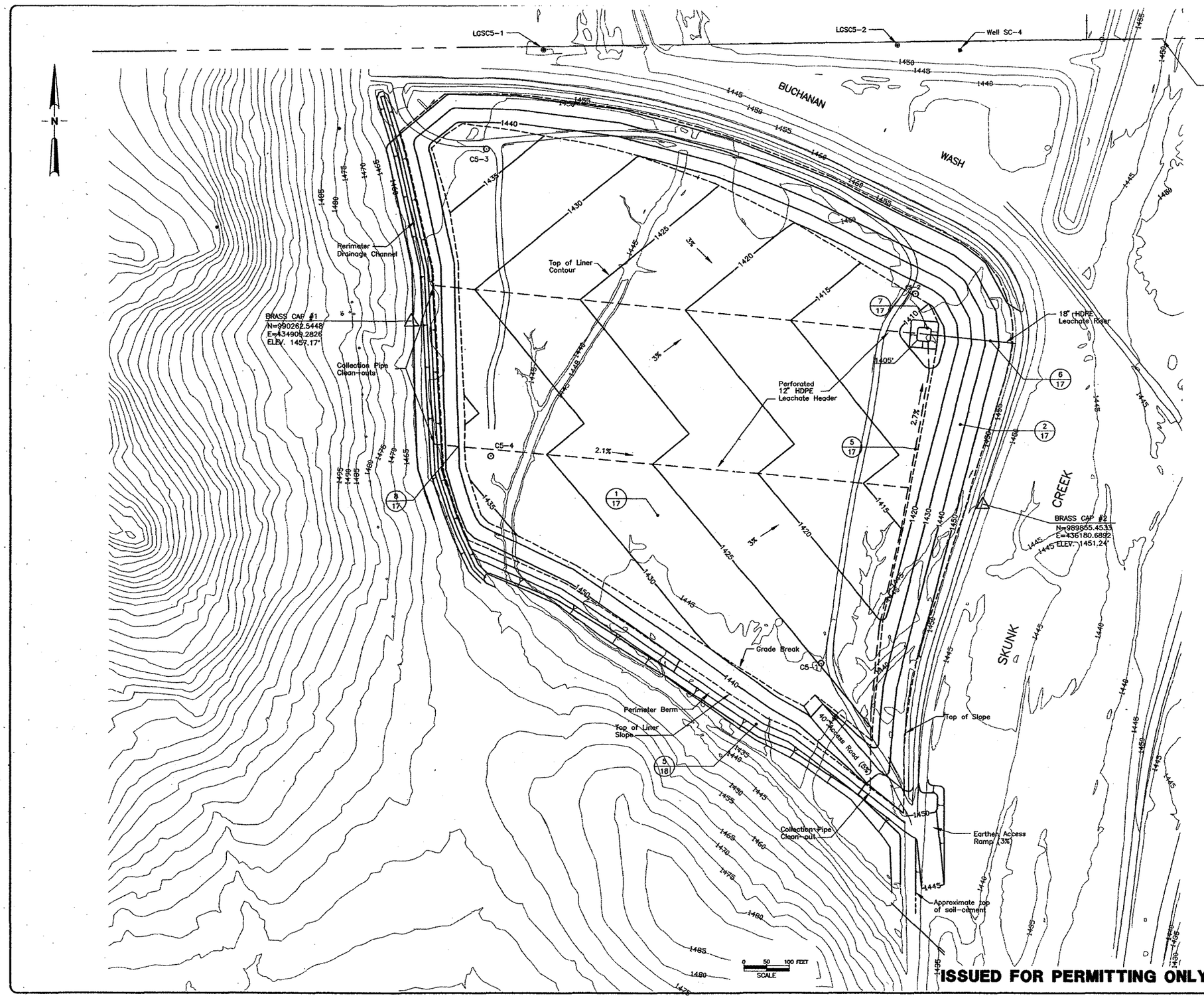
Sheet: 11 of 22

CITY OF PHOENIX ■ EAS DEPARTMENT ■ PROJECT MANAGEMENT DIVISION

CADD FILE: 7333010\1\SHEET11
DATE LAST REVISED: 3-28-94
Wed Mar 30 15:51:02 1994



LEGEND

- Fence
- 1425 Top of HDPE liner elevation
- Groundwater monitoring well
- Landfill gas probe
- Geotechnical boring
- Survey Monument

Revisions	Date

Registered Professional Engineer (Civil) CERTIFICATE NO. 20008 RICHARD G. REEVES

Designed By:	PJK
Drawn By:	PJK
Checked By:	RGR
Date:	FEBRUARY 1994

Title: LINER PLAN - CELL 5
FACILITY DEVELOPMENT PLAN
SKUNK CREEK LANDFILL
INDEX NO. SA-930222

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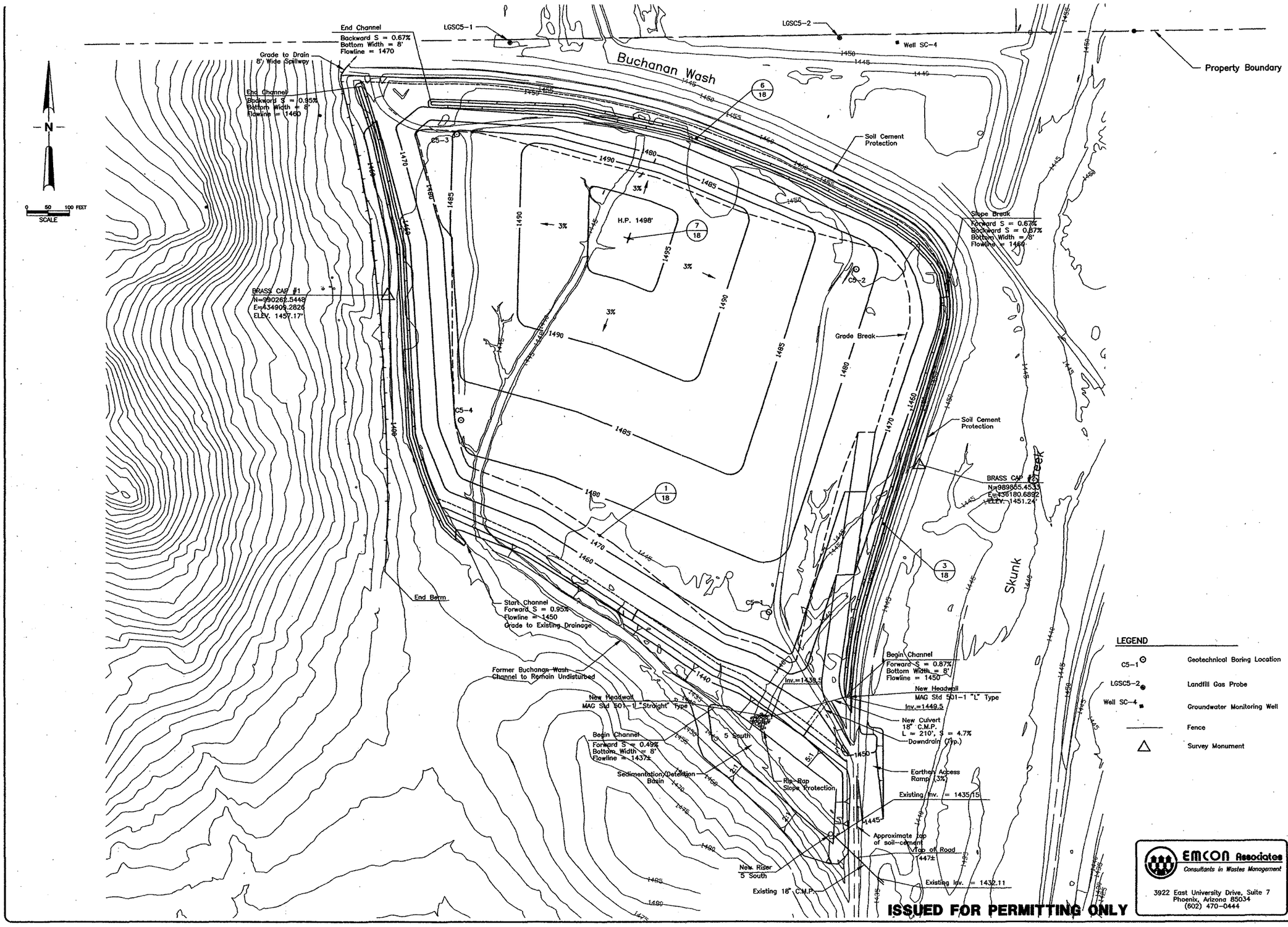
CITY OF PHOENIX ■ EAS DEPARTMENT ■ PROJECT MANAGEMENT DIVISION

DATE LAST REVISED: 3/30/94 CADD FILE: 7333010\1\SHEET12

Thu Mar 31 08:34:21 1994



Revisions	Date

Registered Professional Engineer (Civil)
CERTIFICATE NO. 20008
RICHARD G. REEVES
Date Signed 3/30/94

Designed By:	PJK
Drawn By:	PJK
Checked By:	RGR
Date:	FEBRUARY 1994

Title:
FINAL GRADING AND DRAINAGE PLAN - CELL 6
FACILITY DEVELOPMENT PLAN
SKUNK CREEK LANDFILL
INDEX NO. SA-930222

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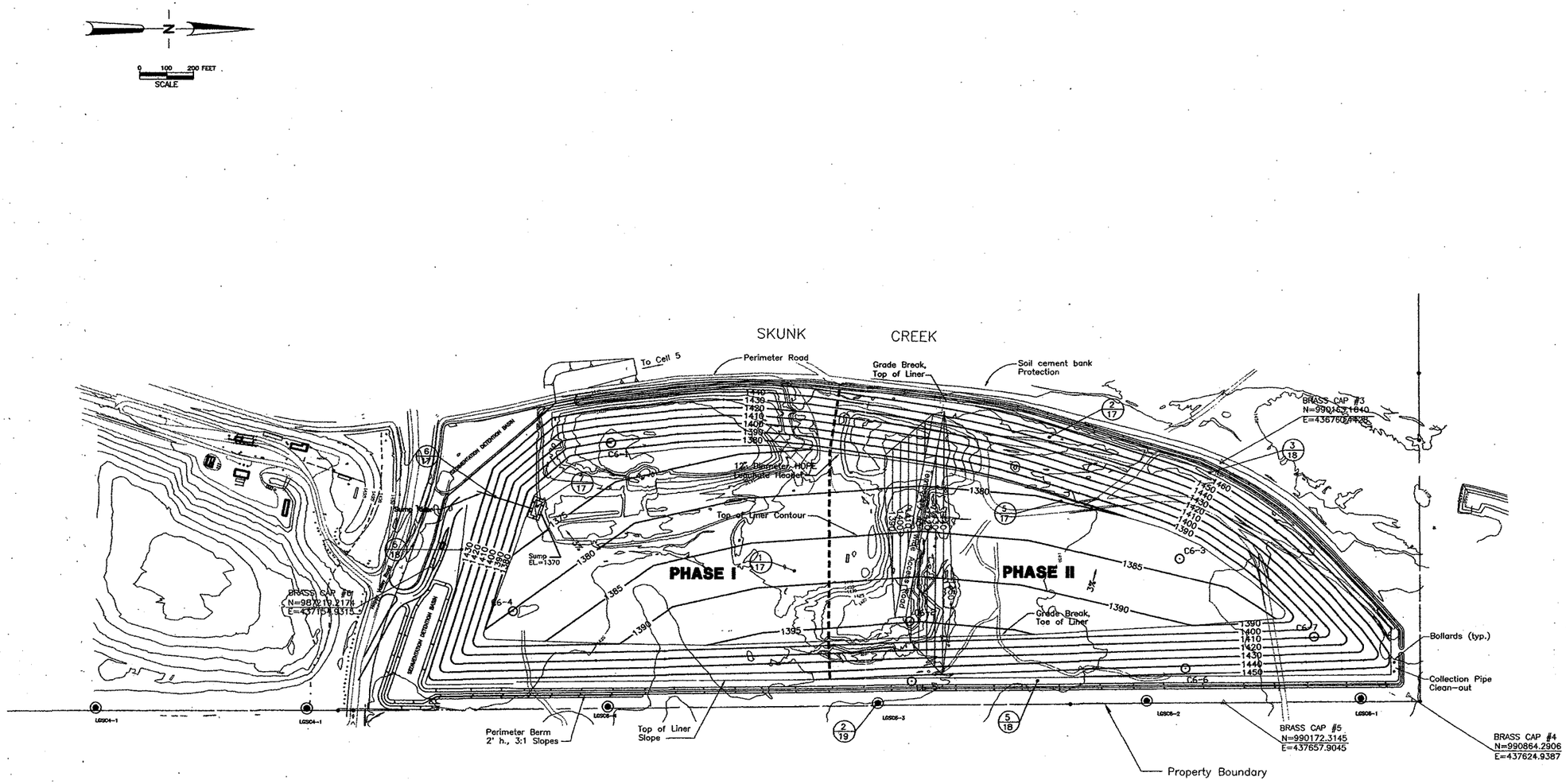
13 OF 22

CITY OF PHOENIX ■ EAS DEPARTMENT ■ PROJECT MANAGEMENT DIVISION

DATE LAST REVISED:3/30/94 CADD FILE: SHEET13

Thu Mar 31 09:27:09 1994



LEGEND

—— 1415 ——	Top of HDPE Liner Elevation
LGSC6-2 ◉	Proposed Gas Probe Location
C6-3 ⊙	Geotechnical Boring Location
—— ——	Existing Fence
△	Survey Monument

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Revisions	Date
Revised Base Grades	4/95

Registered Professional Engineer (Civil) CERTIFICATE NO. 30509 PETER J. KELLER STATE OF ARIZONA

Designed By:	PJK
Drawn By:	PJK
Checked By:	RGR
Date:	FEBRUARY 1994

Title:

LINER PLAN - CELL 6
FACILITY DEVELOPMENT PLAN
SKUNK CREEK LANDFILL
INDEX NO. SA-930222

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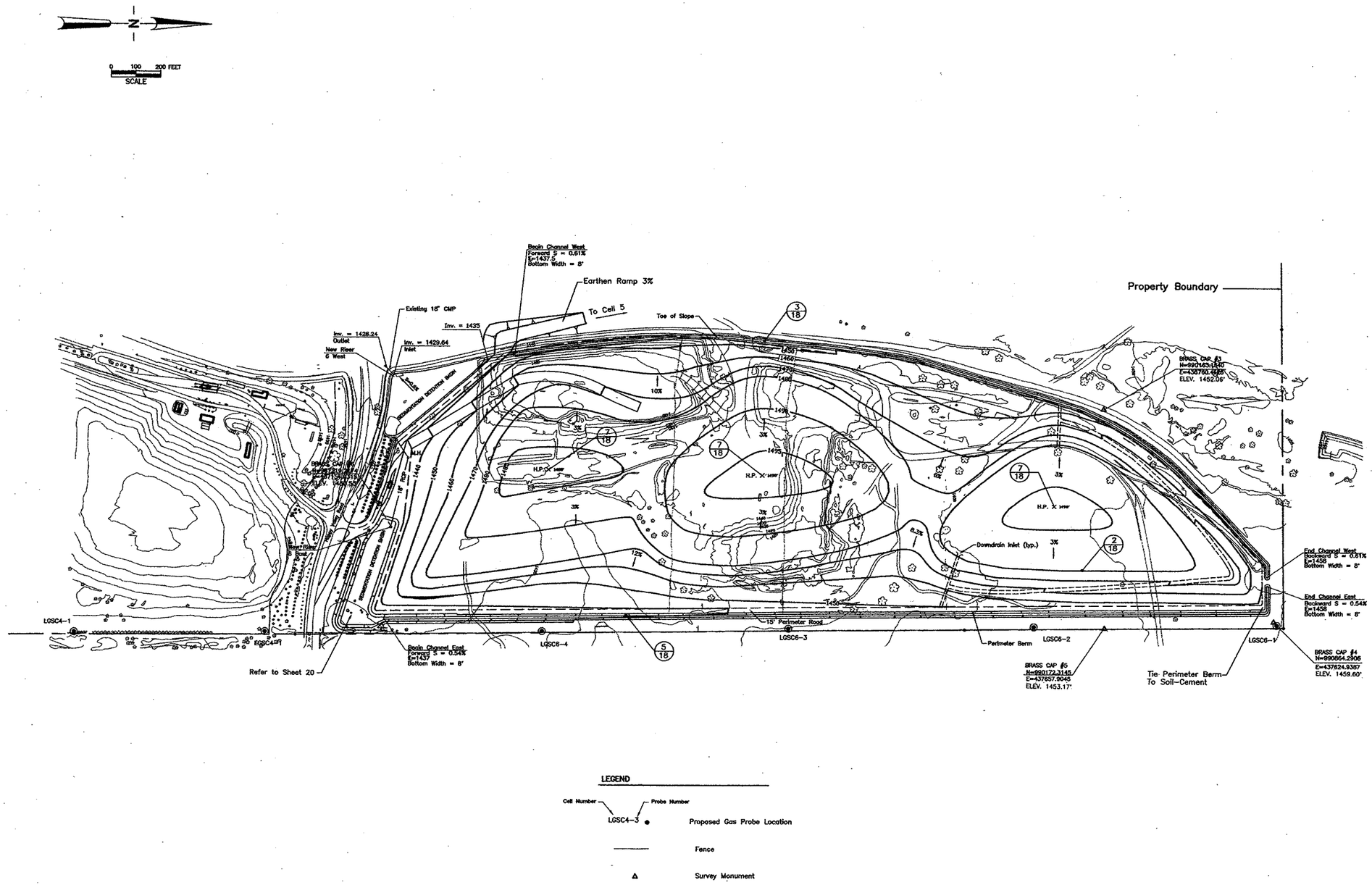
CITY OF PHOENIX ■ EAS DEPARTMENT ■ PROJECT MANAGEMENT DIVISION

DATE LAST REVISED:3/29/94 CADD FILE: 7333010\SHEET14



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Revisions	Date

Registered Professional Engineer (Civil)
CERTIFICATE NO.
20003
RICHARD G.
REEVES
Date Signed 3/29/94

Designed By:	PJK
Drawn By:	PJK
Checked By:	RGR
Date:	FEBRUARY 1994

Title: FINAL GRADING & DRAINAGE PLAN - CELL 6
FACILITY DEVELOPMENT PLAN
SKUNK CREEK LANDFILL
INDEX NO. SA-930222

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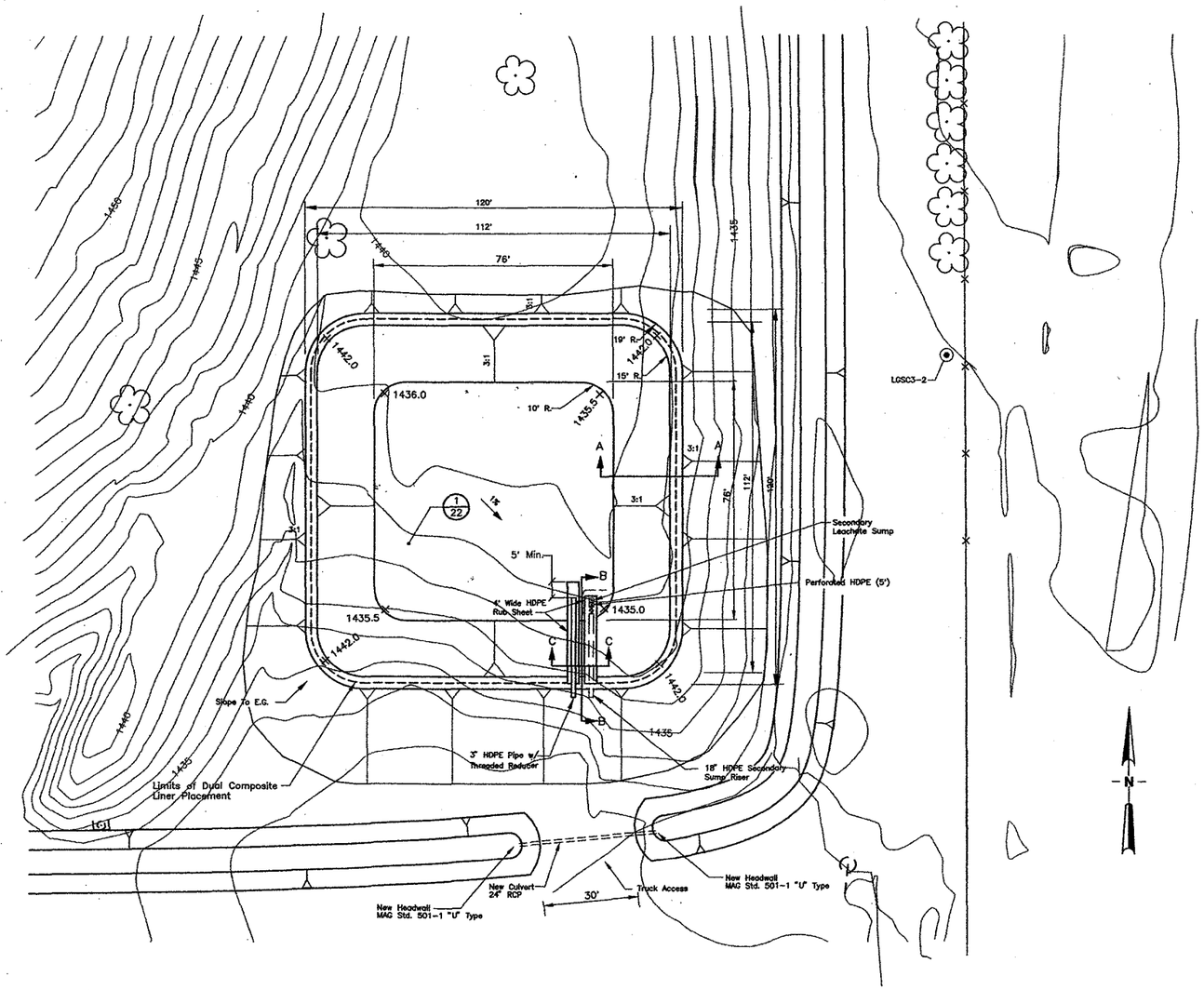
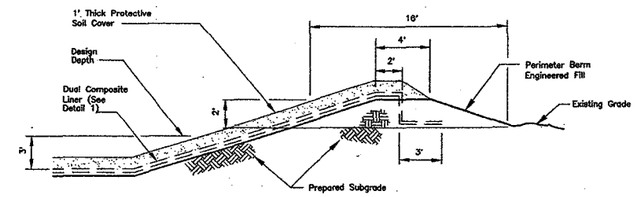
CITY OF PHOENIX ■ EAS DEPARTMENT ■ PROJECT MANAGEMENT DIVISION

CADD FILE: 73330101\SHEET15
DATE LAST REVISED:3/29/94
Tue Mar 29 12:22:04 1994



PLAN VIEW (1/—)

0 10 20 FEET
SCALE



SECTION A-A' (A/—)

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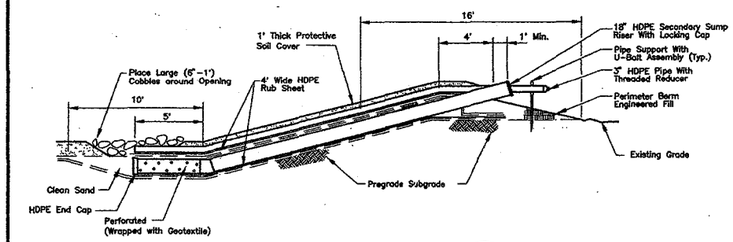

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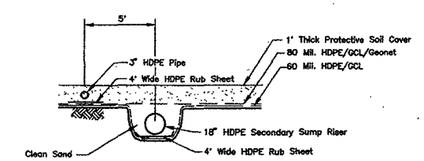

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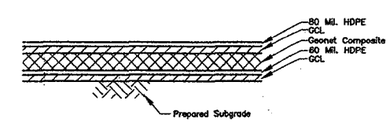

(Geosynthetic Clay Liner = GCL)

LEACHATE/CONDENSATE EVAPORATION POND LINER SYSTEM (1/22)

N.T.S.

ISSUED FOR PERMITTING ONLY

Revisions	Date

Registered Professional Engineer (Civil) CERTIFICATE NO. 20008 RICHARD G. REEVES Date Signed 3-29-94 Arizona U.S.A.

Designed By:	PJK
Drawn By:	TJT
Checked By:	RGR
Date:	FEBRUARY 1994

Title: **LEACHATE EVAPORATION/HOLDING POND - PLAN & DETAILS**
FACILITY DEVELOPMENT PLAN
SKUNK CREEK LANDFILL
INDEX NO. SA-930222

EMCON Associates
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Phoenix, Arizona 85034
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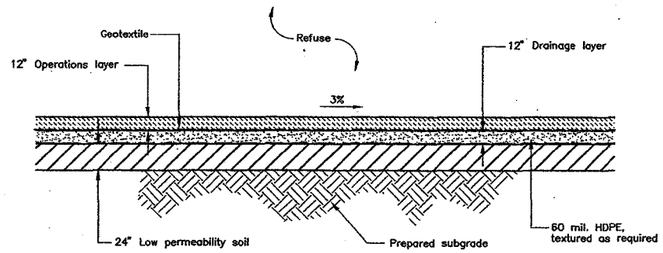
Sheet: 16 of 22

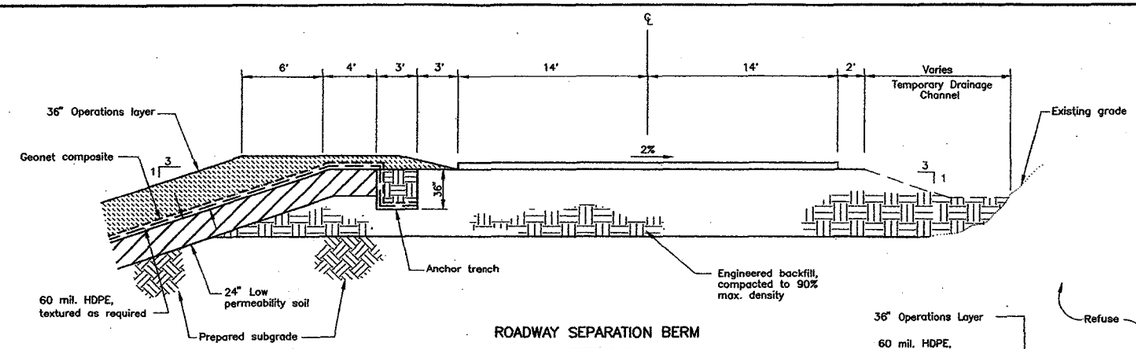
CITY OF PHOENIX ■ EAS DEPARTMENT ■ PROJECT MANAGEMENT DIVISION

CADD FILE: 7233010T\SHEET16

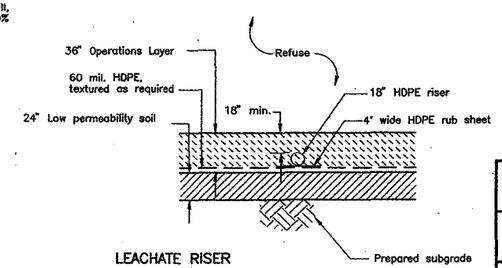
DATE LAST REVISED: 3-29-94



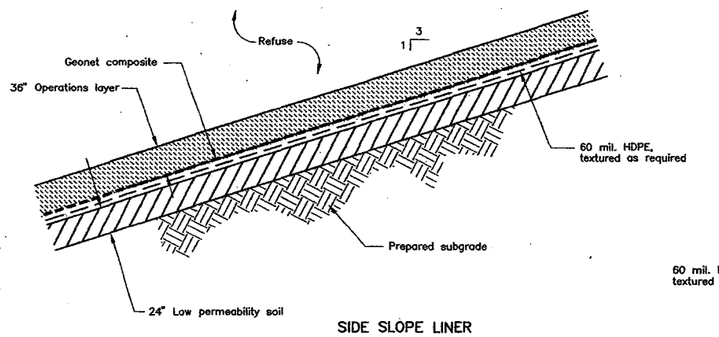
BASE LINER
DETAIL 1



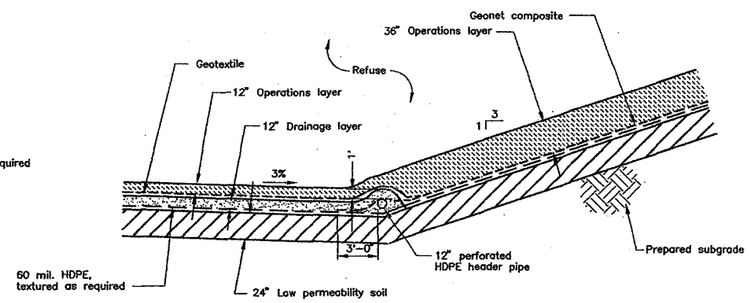
ROADWAY SEPARATION BERM
DETAIL 4/10



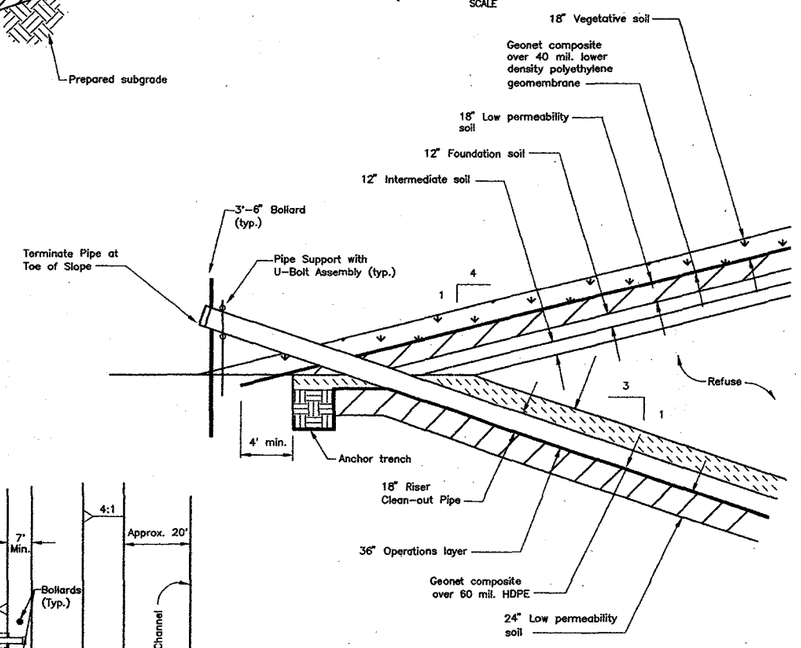
LEACHATE RISER
DETAIL 6



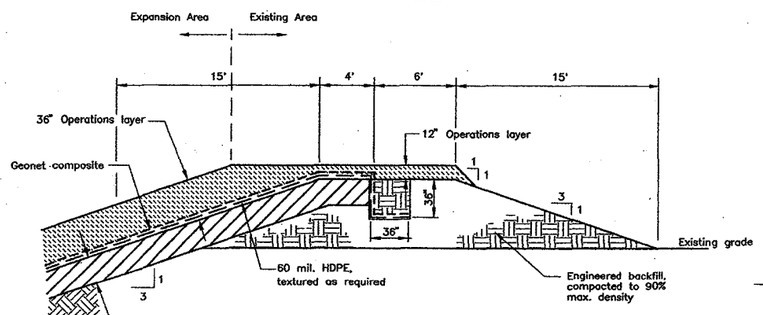
SIDE SLOPE LINER
DETAIL 2



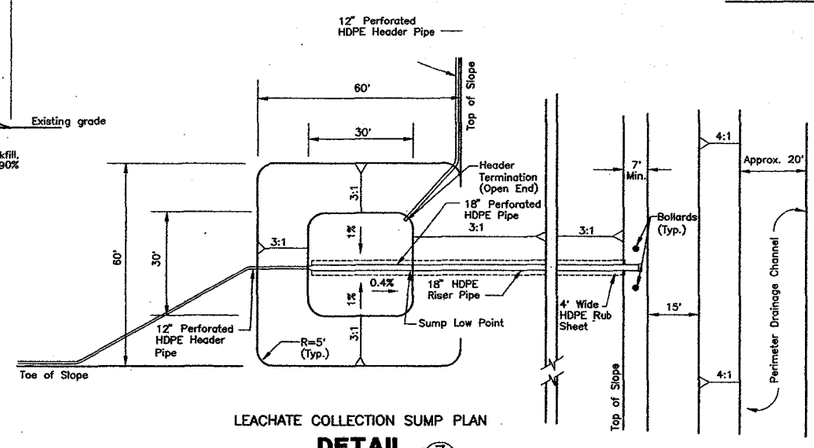
LEACHATE COLLECTION HEADER PIPE
DETAIL 5



TYPICAL RISER/CLEAN-OUT PIPE PENETRATION
DETAIL 8



PHYSICAL SEPARATION BERM
DETAIL 3/10



LEACHATE COLLECTION SUMP PLAN
DETAIL 7

ISSUED FOR PERMITTING ONLY

Revisions	Date

Designed By: PJK
Drawn By: TJT
Checked By: RGR
Date: FEBRUARY 1994

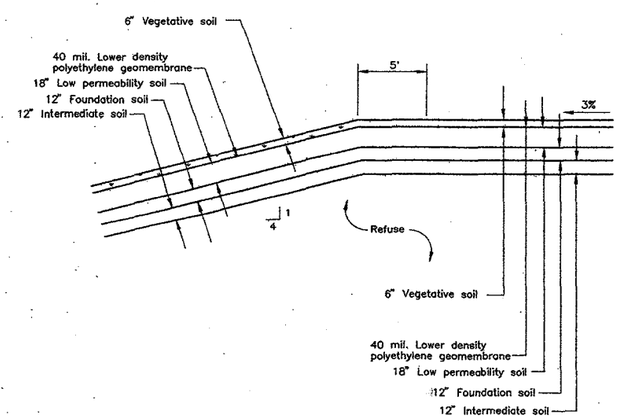
Title: LINER DETAILS
FACILITY DEVELOPMENT PLAN
SKUNK CREEK LANDFILL
INDEX NO. SA-930222

EMCON Associates
Consultants in Wastes Management
3922 East University Drive, Suite 7
Phoenix, Arizona 85034
(602) 470-0444

Sheet: 17 of 22

CITY OF PHOENIX ■ EAS DEPARTMENT ■ PROJECT MANAGEMENT DIVISION

CADD FILE: 7333010\SHEET17
DATE LAST REVISED: 2/14/94
Fri Feb 18 17:32:40 1994



FINAL COVER SYSTEM–LINED AREAS

DETAIL 1

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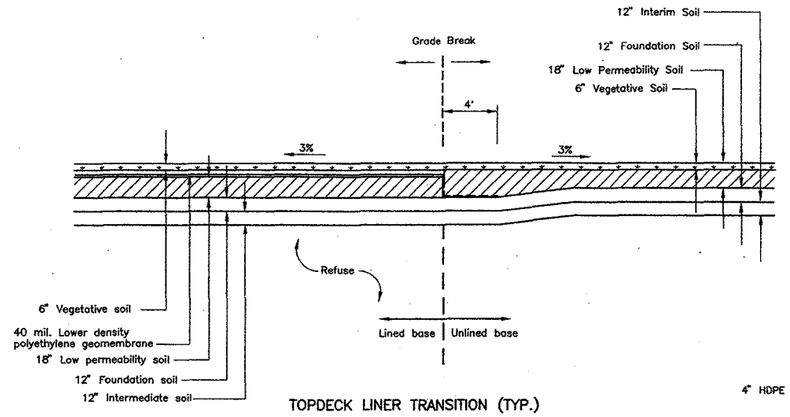

TOPDECK LINER TRANSITION (TYP.)

DETAIL 4/11

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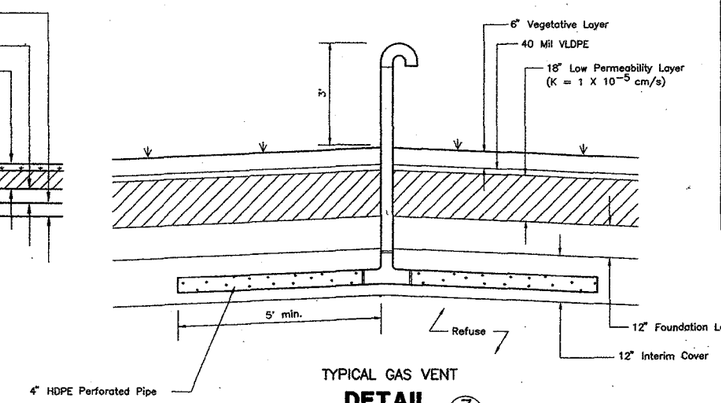

TYPICAL GAS VENT

DETAIL 7

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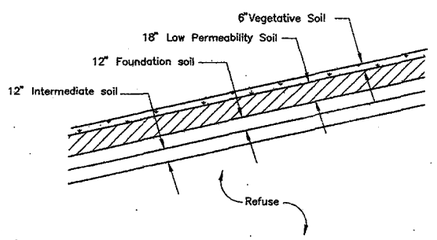

FINAL COVER SYSTEM–UNLINED AREAS

DETAIL 2

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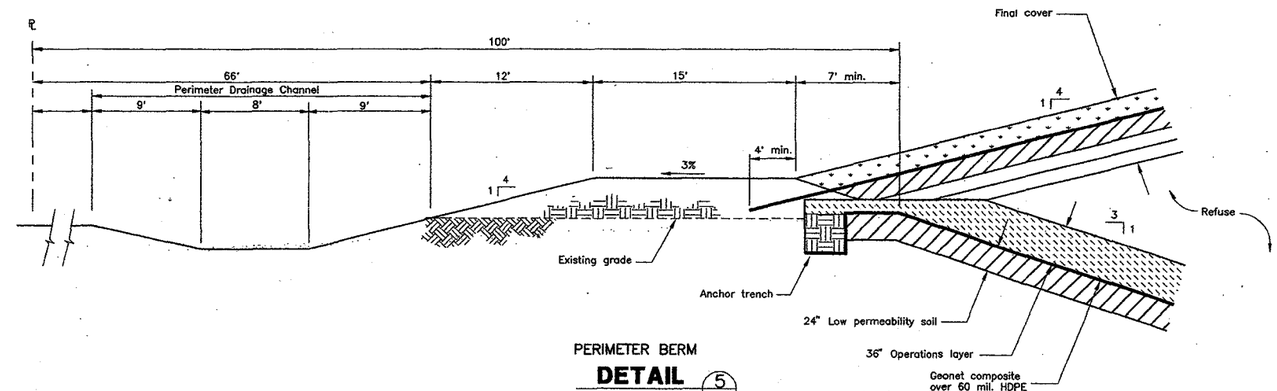

PERIMETER BERM

DETAIL 5

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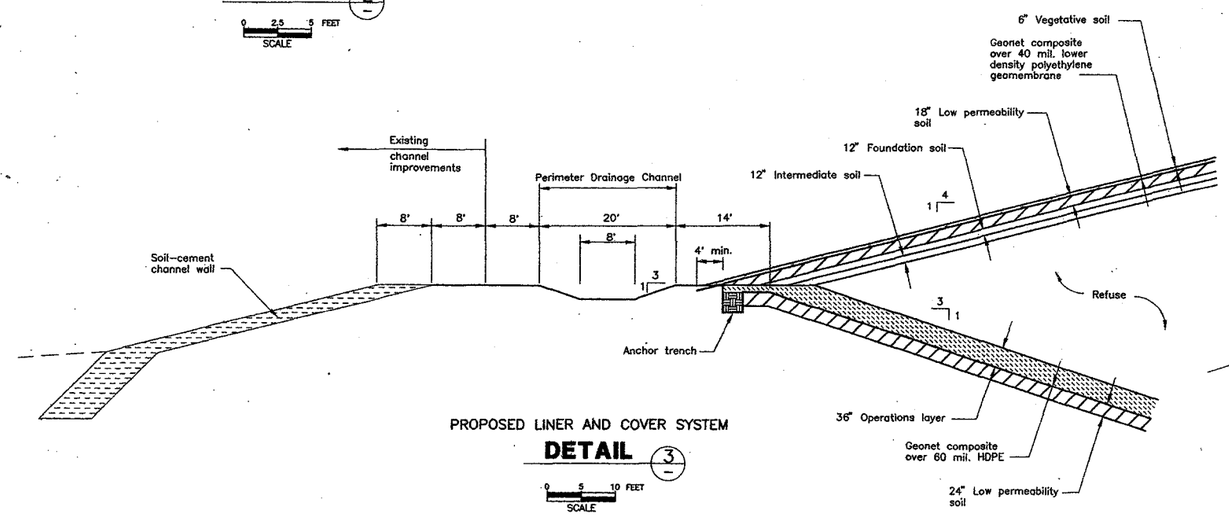

PROPOSED LINER AND COVER SYSTEM

DETAIL 3

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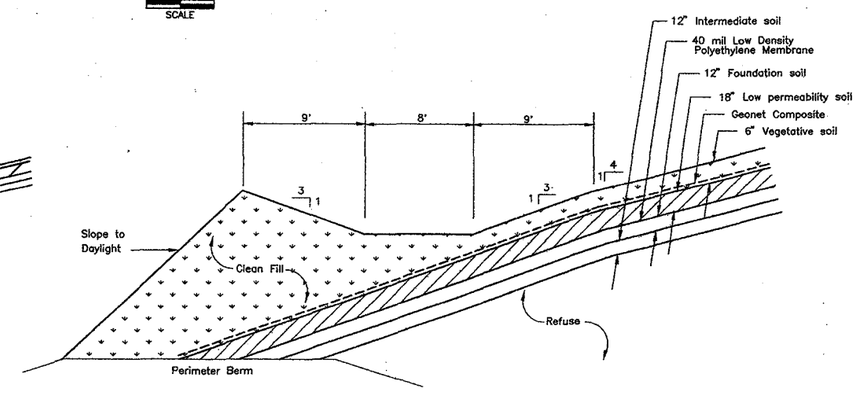

LANDFILL SLOPE DRAINAGE CHANNEL

DETAIL 6

0 2.5 5 FEET SCALE

ISSUED FOR PERMITTING ONLY

Revisions	Date
Revised cover details	8/96

Designed By: PJK

Drawn By: TJT

Checked By: RGR

Date: FEBRUARY 1994

Title: FINAL GRADING DETAILS FACILITY DEVELOPMENT PLAN SKUNK CREEK LANDFILL INDEX NO. SA-930222

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Consultants in Wastes Management
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Phoenix, Arizona 85034
(602) 470-0444

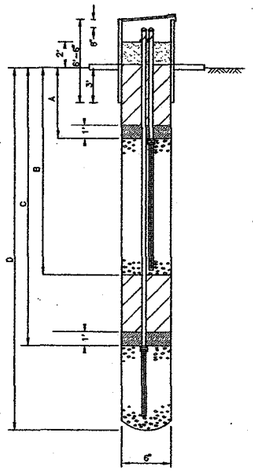
Sheet: 18 of 22

CITY OF PHOENIX ■ EAS DEPARTMENT ■ PROJECT MANAGEMENT DIVISION

CADD FILE: 7333010\SHEET18

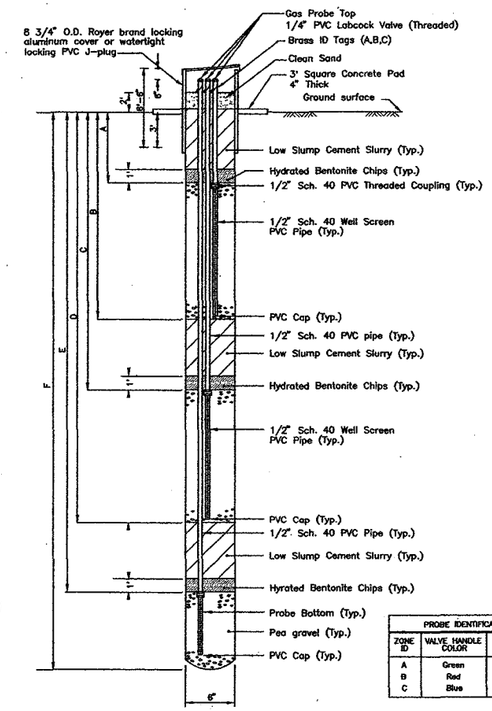
DATE LAST REVISED: 2/14/94

Probe	Probe Dimensions (ft)					
	Green		Red		Blue	
	A	B	C	D	E	F
LGSC1-1	4.1	14.1	19	29	–	–
LGSC1-2	4	14	18.9	28.9	–	–
LGSC1-3	3.7	13.7	18.5	28.5	–	–
LGSC2-1	4.1	11.1	–	–	–	–
LGSC2-2	4.3	9.3	14.3	21.3	–	–
LGSC2-3	4.1	14.1	18.9	28.9	–	–
LGSC2-4	3.8	13.8	18.7	28.7	–	–
LGSC3-1	9.3	14.3	19.6	29.5	–	–
LGSC3-2	3.8	8.8	14.3	19.3	–	–
LGSC4-1	4.3	14.3	19.4	29.4	–	–
LGSC4-2	9.2	14.2	19.3	29.3	–	–
LGSC4-3	4.3	14.3	19.3	29.3	–	–
LGSC4-4	4.3	14.3	19	29	–	–
LGSC4-5	4.5	14.5	19.3	29.3	–	–
LGSC4-6	4.3	9.3	–	–	–	–
LGSC4-7	4.3	11.3	–	–	–	–
LGSC5-1	3.8	13.8	18.8	28.8	33.7	43.7
LGSC5-2	4	14	19	29	34.1	44.1
LGSC6-1	4.7	14.7	18.8	28.8	34	44
LGSC6-2	3.8	13.8	–	–	–	–
LGSC6-3	3.8	13.8	19.4	29.4	33.7	43.7
LGSC6-4	4.2	14.2	19.3	29.3	34.3	44.3



TYPICAL LANDFILL GAS
DUAL-LEVEL PROBE INSTALLATION

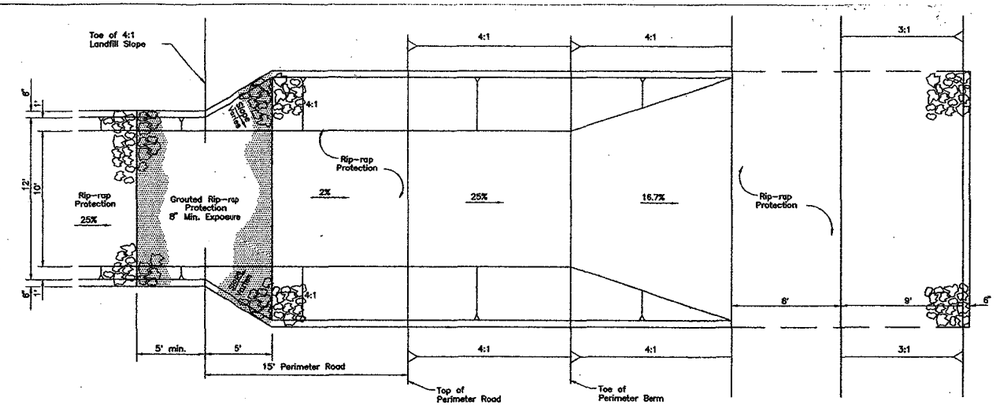
DETAIL 1/–
NOT TO SCALE



PROBE IDENTIFICATION		
ZONE ID	VALVE HANDLE COLOR	SAMPLE ZONE
A	Green	Shallow
B	Red	Mid-depth
C	Blue	Deep

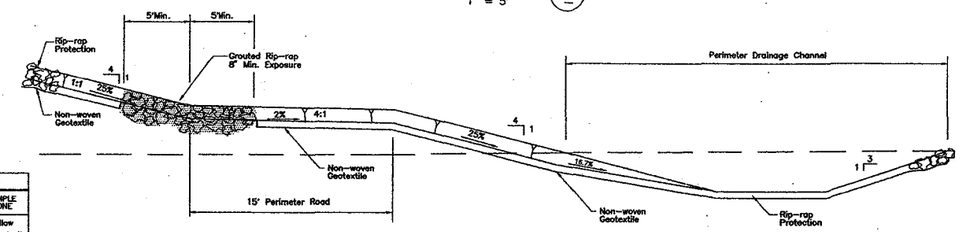
TYPICAL LANDFILL GAS
TRI-LEVEL PROBE INSTALLATION

DETAIL 2/–
NOT TO SCALE



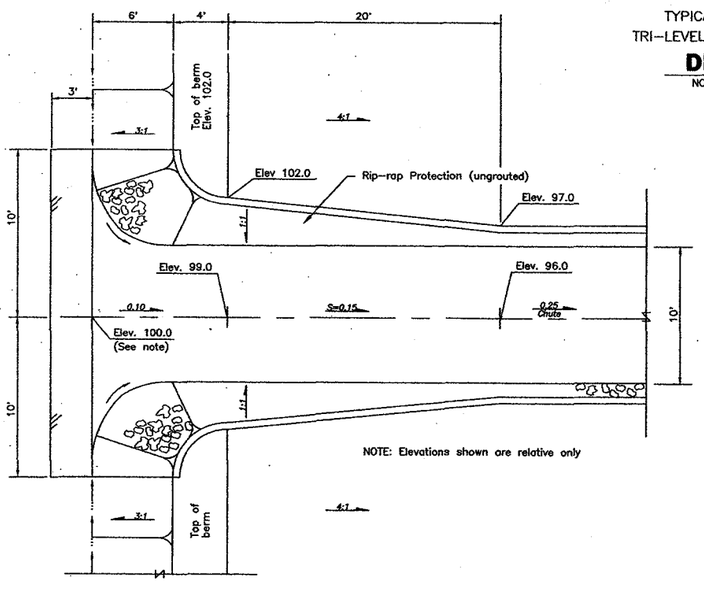
TYPICAL DOWNDRAIN ROAD CROSSING

DETAIL 5/–
1" = 5'



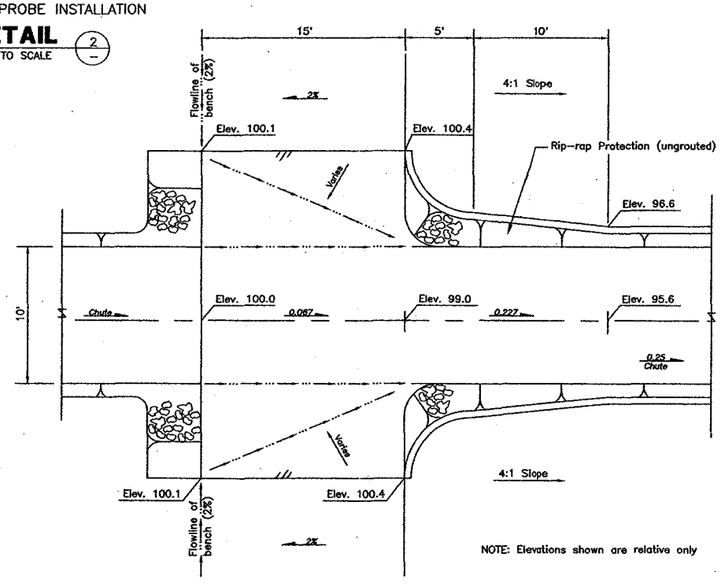
TYPICAL DOWNDRAIN ROAD CROSSING

SECTION 1/–
1" = 5'



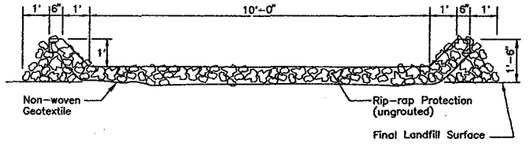
DECK INLET FOR CHUTE DOWNDRAIN

DETAIL 3/–
SCALE: 1"=5'



TYPICAL DOWNDRAIN/BENCH CROSSING

DETAIL 4/–
SCALE: 1"=5'



TYPICAL SECTION – DOWNDRAIN CHUTE

DETAIL 6/–
SCALE: 1"=2'

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EMCON Associates
Consultants in Wastes Management
3922 East University Drive, Suite 7
Phoenix, Arizona 85034
(602) 470-0444

Revisions	Date

Registered Professional Engineer (Civil)
CERTIFICATE NO. 20008
RICHARD G. REEVES
Date Signed 2/14/94

Designed By:	PJK
Drawn By:	TJT
Checked By:	RGR
Date:	FEBRUARY 1994

Title: **DRAINAGE AND MISCELLANEOUS DETAILS**
FACILITY DEVELOPMENT PLAN
SKUNK CREEK LANDFILL
INDEX NO. SA-930222

Sheet: 19 of 22

CITY OF PHOENIX ■ EAS DEPARTMENT ■ PROJECT MANAGEMENT DIVISION

CADD FILE: 73330101\SHEET19
DATE LAST REVISED: 2/14/94

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Revisions	Date

Designed By: PJK

Drawn By: PJK

Checked By: RGR

Date: FEBRUARY 1994

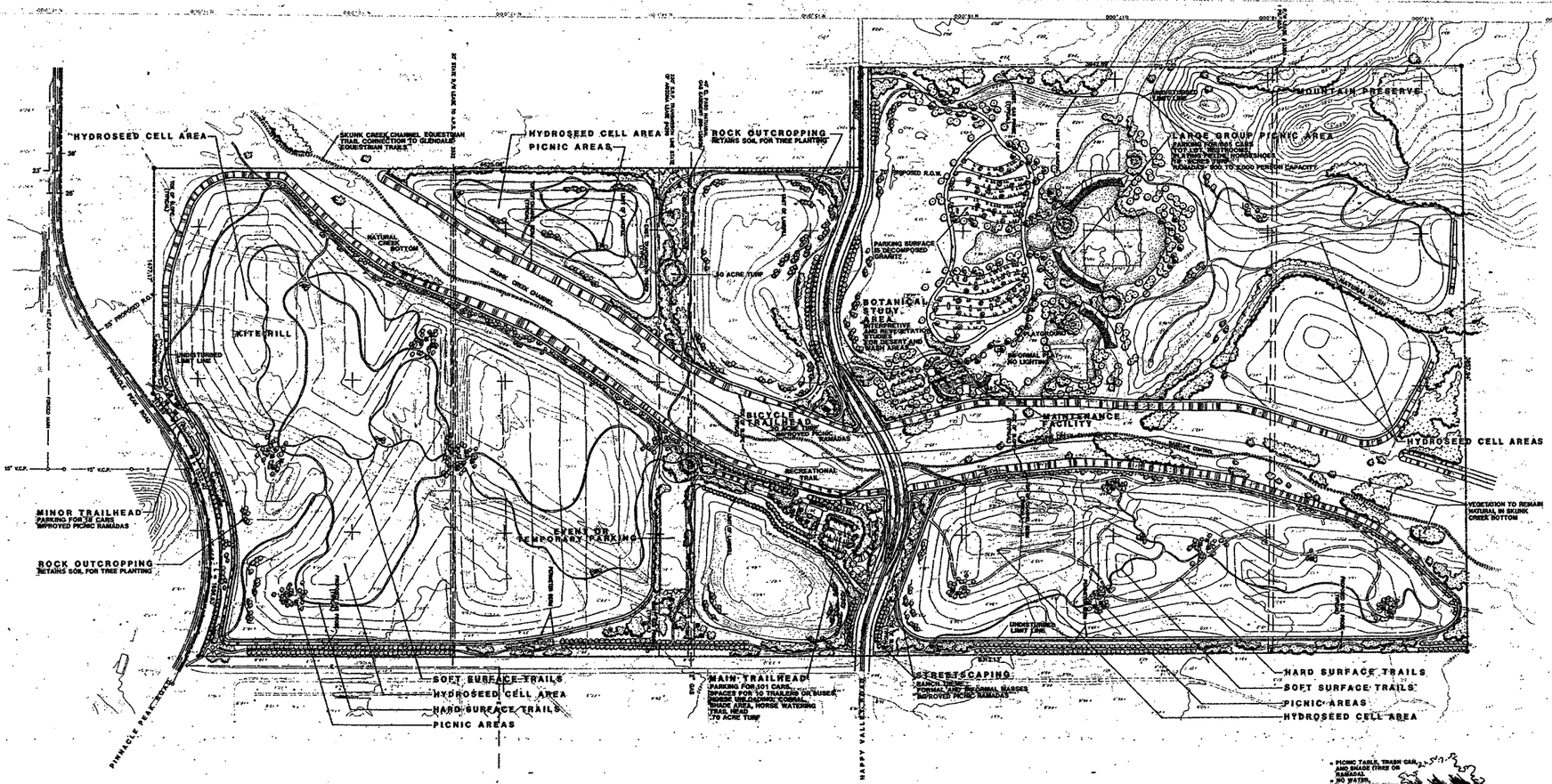
Title: CONCEPTUAL ANCILLARY FACILITY FACILITY DEVELOPMENT PLAN SKUNK CREEK LANDFILL INDEX NO. SA-930222

EMCON Associates
Consultants in Wastes Management
3922 East University Drive, Suite 7
Phoenix, Arizona 85034
(602) 470-0444

Sheet: 20 of 22

CITY OF PHOENIX ■ EAS DEPARTMENT ■ PROJECT MANAGEMENT DIVISIO

DATE LAST REVISED:3/1/94 · CADD FILE: 73330101\SHEET20



City of Phoenix

SKUNK CREEK LANDFILL MASTER PLAN

EDAW

CONCEPT:

- Steep landfill bowl surrounding natural hills, with regular landforms, desert vegetation, rock outcroppings. Selection for site protection and Happy Valley Road.

RECOMMENDATIONS:

- Erosion control: Use contour grading on side slopes at 4:1 or less, irregularities and a natural shape. Tops of cells should be properly compacted. Use hydroseeds fabric or collection ponds.
- Grading: Minimum maximum side slope of 4:1. Minimum minimum 2' cover over landfill. Provide collection points rather than sheet drainage for tops of cells.
- Paving: Limited to access large and small areas in a dense or compacted. Compact soil, discourage depositing from those areas.
- Soil amendment: To restore high pH and low fertility apply Gro-Power (2-7-1) at 1000 lbs. per acre.
- Planting: Revegetated surf should be Sonoran. Selection should be based on the natural vegetation and surrounding of the site. Landfill area from natural plant from adjacent to the plot where, with some contour planting. Consider planting; will need to have additional soil, provided by such contractors or site.
- Water supply: Provide additional water from potable to enclosed spaces areas. Will need approximately 20,000 gallons per day what entire planting have been established the the irrigation system. (Assume temporary system elimination.)
- Irrigation System: Permanent pop-up irrigation every quadrant for turf grass. Possess corresponding drip emitters and weights for necessary and permanent plantings, and consider planting on trellis. Temporary drip irrigation for native and plant materials (replacement), expected life ten years.

Designed By: EDAW

Drawn By: EDAW

Checked By: RGR

Date: FEBRUARY 1994

Revisions | Date

Registered Professional Engineer (Civil) CERTIFICATE NO. 20008 RICHARD G. REEVES DATE SIGNED 4-8-94 ARIZONA U.S.A.

Richard G. Reeves

Title: CONCEPTUAL PARK MASTER PLAN
FACILITY DEVELOPMENT PLAN
SKUNK CREEK LANDFILL
INDEX NO. SA-930222

JOB# 9P015.01

DATE: 3-31-94
CKD BY: J.J.H.
DRN BY: J.P.G. P.L.R.
REVISIONS:

EMCON Associates
Consultants in Wastes Management
3922 East University Drive, Suite 7
Phoenix, Arizona 85034
(602) 470-0444

Sheet: 21 of 22

CITY OF PHOENIX ■ EAS DEPARTMENT ■ PROJECT MANAGEMENT DIVISIO

Prepared by others, included for reference only

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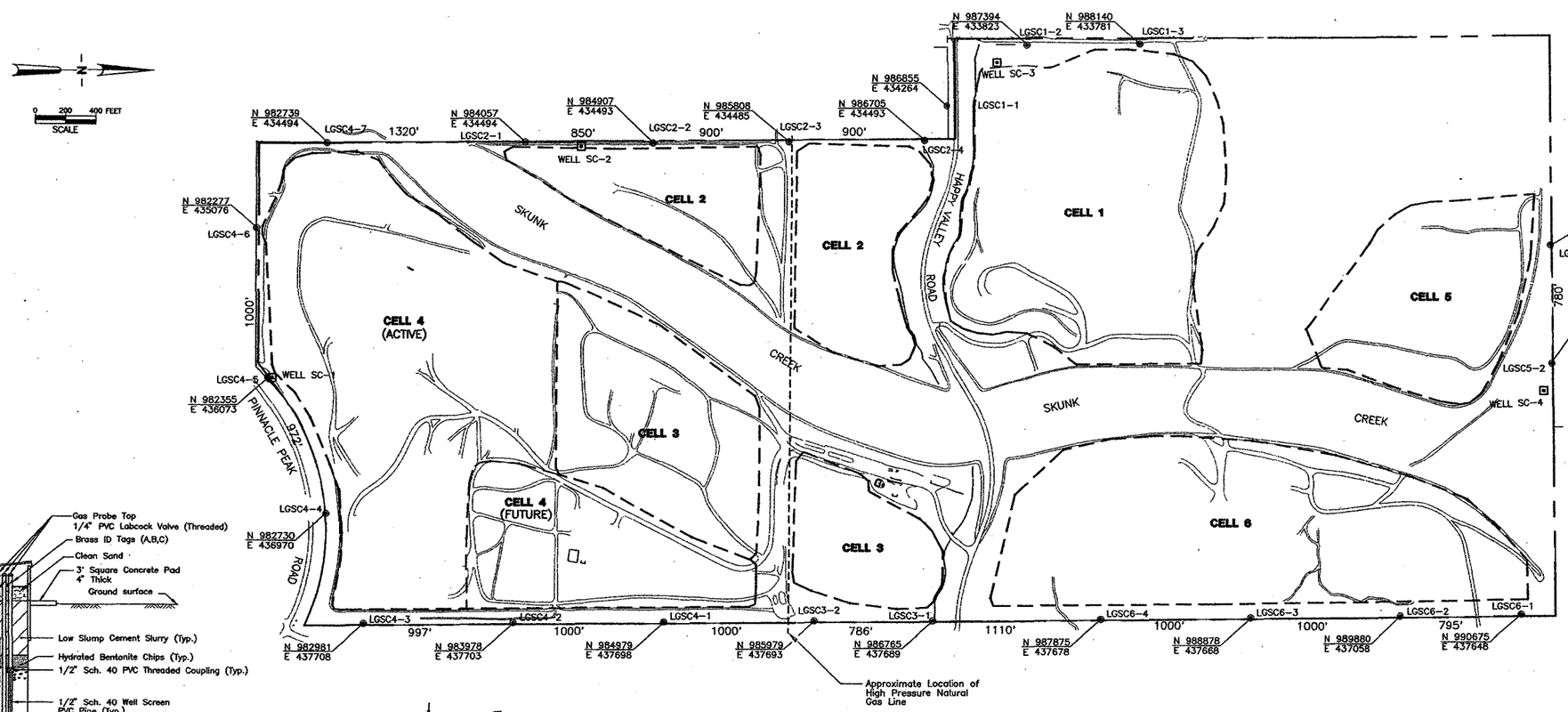
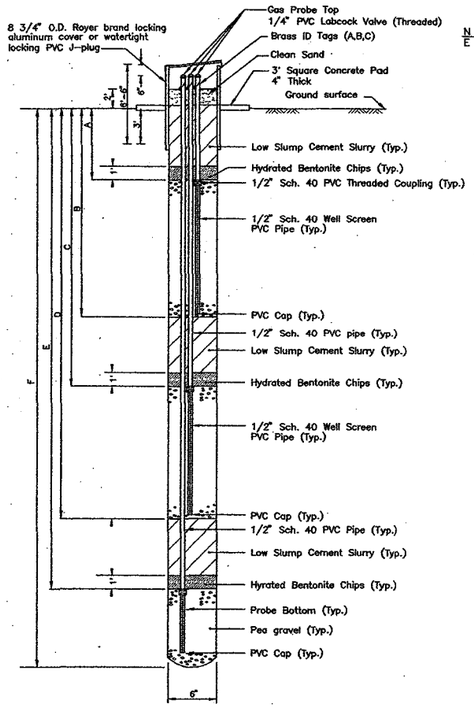
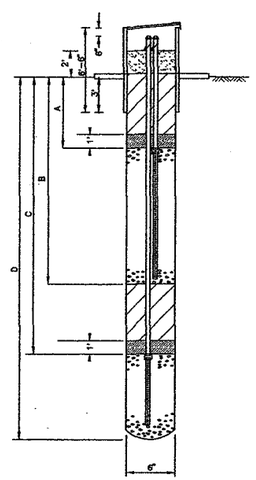
DATE LAST REVISED: 3-4-94

Fri Mar 4 09:56:55 1994





TYPICAL LANDFILL GAS
TRI-LEVEL PROBE INSTALLATION
(NTS)



TYPICAL LANDFILL GAS
DUAL-LEVEL PROBE INSTALLATION
(NTS)

PROBE IDENTIFICATION		
ZONE ID	VALVE HANDLE COLOR	SAMPLE ZONE
A	Green	Shallow
B	Red	Mid-depth
C	Blue	Deep

Probe	Probe Dimensions (ft)					
	Green		Red		Blue	
	A	B	C	D	E	F
LGSC1-1	4.1	14.1	19	29	–	–
LGSC1-2	4	14	18.9	28.9	–	–
LGSC1-3	3.7	13.7	18.5	28.5	–	–
LGSC2-1	4.1	11.1	–	–	–	–
LGSC2-2	4.3	9.3	14.3	21.3	–	–
LGSC2-3	4.1	14.1	18.9	28.9	–	–
LGSC2-4	3.8	13.8	18.7	28.7	–	–
LGSC3-1	9.3	14.3	19.6	29.5	–	–
LGSC3-2	3.8	8.8	14.3	19.3	–	–
LGSC4-1	4.3	14.3	19.4	29.4	–	–
LGSC4-2	9.2	14.2	19.3	29.3	–	–
LGSC4-3	4.3	14.3	19.3	29.3	–	–
LGSC4-4	4.3	14.3	19	29	–	–
LGSC4-5	4.5	14.5	19.3	29.3	–	–
LGSC4-6	4.3	9.3	–	–	–	–
LGSC4-7	4.3	11.3	–	–	–	–
LGSC5-1	3.8	13.8	18.8	28.8	33.7	43.7
LGSC5-2	4	14	19	29	34.1	44.1
LGSC6-1	4.7	14.7	18.8	28.8	34	44
LGSC6-2	3.8	13.8	–	–	–	–
LGSC6-3	3.8	13.8	19.4	29.4	33.7	43.7
LGSC6-4	4.2	14.2	19.3	29.3	34.3	44.3

LEGEND

WELL SC-1 ⊡ Groundwater Monitoring Well Location

Cell Number — Probe Number
LGSC4-3 ● Proposed Gas Probe Location

NOTE: Gas probe locations field surveyed 3 foot inside property boundaries

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EMCON Associates
Consultants in Wastes Management
3922 East University Drive, Suite 7
Phoenix, Arizona 85034
(602) 470-0444

Revisions	Date

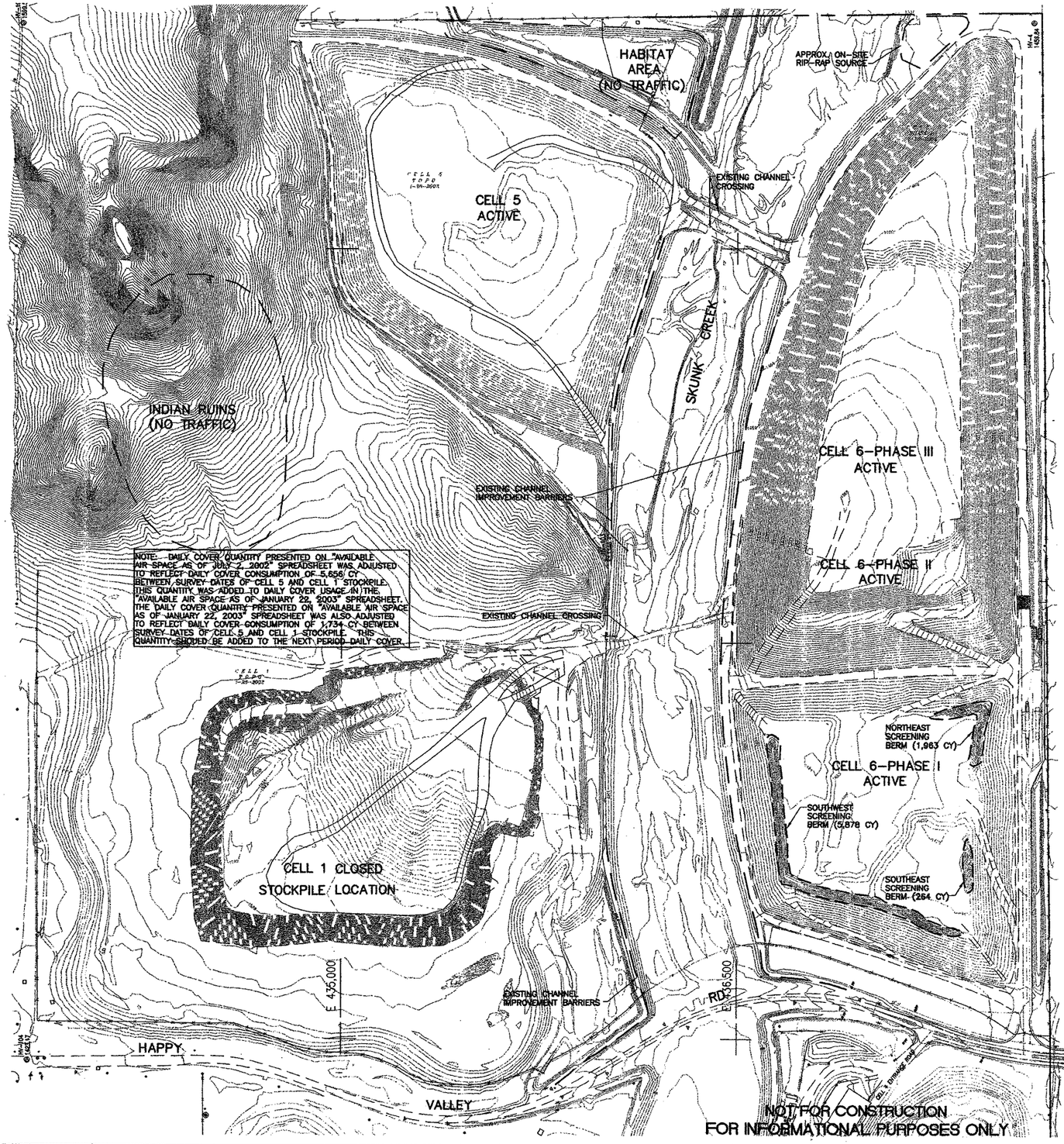
Registered Professional Engineer (Civil)
CERTIFICATE NO. 20008
RICHARD G. BEEVER
STATE OF ARIZONA

Designed By:	PJK
Drawn By:	JHK
Checked By:	RGR
Date:	FEBRUARY 1994

Title: GAS PROBE LOCATIONS AND DETAILS
FACILITY DEVELOPMENT PLAN
SKUNK CREEK LANDFILL
INDEX NO. SA-930222

Sheet: 22 OF 22

CITY OF PHOENIX ■ EAS DEPARTMENT ■ PROJECT MANAGEMENT DIVISION



TOPOGRAPHY PREPARED BY M&B AERIAL; JANUARY 13, 1998.
EXCEPT IN THE AREAS OF:

CELL 1 AS-BUILT STOCKPILE TOPOGRAPHY (CELL 6-III STOCKPILE)
PREPARED BY MORRISON-MAIERLE, INC; JANUARY 28, 2003

CELL 3/4 AS-BUILT PERIMETER ROAD TOPOGRAPHY
PREPARED BY MORRISON-MAIERLE, INC; APRIL 28, 2000

CELL 3/4 AS-BUILT WASTE FILL TOPOGRAPHY
PREPARED BY MORRISON-MAIERLE, INC; DECEMBER 21, 2000

CELL 3/4 AS-BUILT STOCKPILE TOPOGRAPHY (CELL 6-II STOCKPILE)
PREPARED BY MORRISON-MAIERLE, INC; JANUARY 9, 2001

CELL 5 ACTIVE WASTE FILL TOPOGRAPHY
PREPARED BY MORRISON-MAIERLE, INC; JANUARY 28, 2003

CELL 6-I ACTIVE WASTE FILL TOPOGRAPHY
PREPARED BY MORRISON-MAIERLE, INC; JULY 10, 2002

CELL 6-II ACTIVE WASTE FILL TOPOGRAPHY
PREPARED BY MORRISON-MAIERLE, INC; JULY 10, 2002

CELL 6-III AS-BUILT EXCAVATION TOPOGRAPHY
PREPARED BY MORRISON-MAIERLE, INC; APRIL 3, 2002

CELL 6-III ACTIVE WASTE FILL TOPOGRAPHY SPLICE INTO EXCAVATION CONTOURS
PREPARED BY MORRISON-MAIERLE, INC; JANUARY 28, 2003

Revisions	Date

REGISTERED PROFESSIONAL ENGINEER (CIVIL) 27290 GARTH R. BOWERS ARIZONA U.S.A.

Designed By:	MDC
Drawn By:	MDC
Checked By:	GRB
Approved By:	GRB
Date:	JANUARY 2003

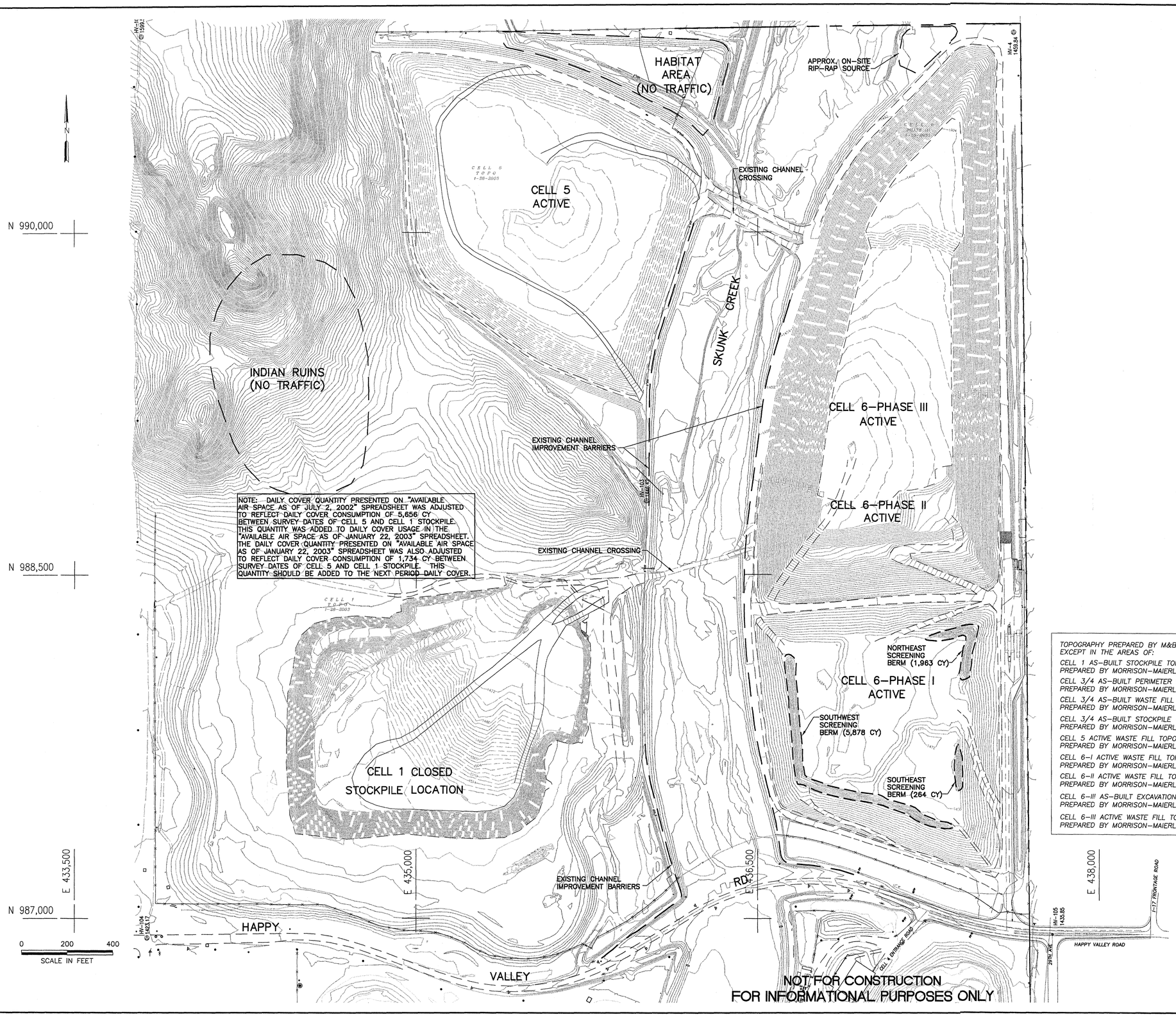
Title: NORTH AREA TOPOGRAPHY JANUARY 2003
SKUNK CREEK LANDFILL

EMCON/OWT, INC. A Shaw Group Company

Sheet: 1 OF 1

CITY OF PHOENIX ■ EAS DEPARTMENT ■ PROJECT MANAGEMENT DIVISION

DATE LAST REVISED: 4/22/03 mcarse CADD FILE: CGP\NORTH_TOPO_2003\PropSP11_NORTH.dwg xref: XCOPBM11



NOTE: DAILY COVER QUANTITY PRESENTED ON "AVAILABLE AIR SPACE AS OF JULY 2, 2002" SPREADSHEET WAS ADJUSTED TO REFLECT DAILY COVER CONSUMPTION OF 5,656 CY BETWEEN SURVEY DATES OF CELL 5 AND CELL 1 STOCKPILE. THIS QUANTITY WAS ADDED TO DAILY COVER USAGE IN THE "AVAILABLE AIR SPACE AS OF JANUARY 22, 2003" SPREADSHEET. THE DAILY COVER QUANTITY PRESENTED ON "AVAILABLE AIR SPACE AS OF JANUARY 22, 2003" SPREADSHEET WAS ALSO ADJUSTED TO REFLECT DAILY COVER CONSUMPTION OF 1,734 CY BETWEEN SURVEY DATES OF CELL 5 AND CELL 1 STOCKPILE. THIS QUANTITY SHOULD BE ADDED TO THE NEXT PERIOD DAILY COVER.

TOPOGRAPHY PREPARED BY M&B AERIAL; JANUARY 13, 1998.
EXCEPT IN THE AREAS OF:

CELL 1 AS-BUILT STOCKPILE TOPOGRAPHY (CELL 6-III STOCKPILE)
PREPARED BY MORRISON-MAIERLE, INC; JANUARY 28, 2003

CELL 3/4 AS-BUILT PERIMETER ROAD TOPOGRAPHY
PREPARED BY MORRISON-MAIERLE, INC; APRIL 28, 2000

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PREPARED BY MORRISON-MAIERLE, INC; DECEMBER 21, 2000

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PREPARED BY MORRISON-MAIERLE, INC; JANUARY 28, 2003

CELL 6-I ACTIVE WASTE FILL TOPOGRAPHY
PREPARED BY MORRISON-MAIERLE, INC; JULY 10, 2002

CELL 6-II ACTIVE WASTE FILL TOPOGRAPHY
PREPARED BY MORRISON-MAIERLE, INC; JULY 10, 2002

CELL 6-III AS-BUILT EXCAVATION TOPOGRAPHY
PREPARED BY MORRISON-MAIERLE, INC; APRIL 3, 2002

CELL 6-III ACTIVE WASTE FILL TOPOGRAPHY SPLICE INTO EXCAVATION CONTOURS
PREPARED BY MORRISON-MAIERLE, INC; JANUARY 28, 2003

Revisions	Date

Registered Professional Engineer (Civil) CERTIFICATE NO. 27290 GARTH R. BOWERS Date Signed 4/22/03 ARIZONA U.S.A.

Designed By:	MDC
Drawn By:	MDC
Checked By:	GRB
Approved By:	GRB
Date:	JANUARY 2003

Title: NORTH AREA TOPOGRAPHY JANUARY 2003
SKUNK CREEK LANDFILL

CITY OF PHOENIX ■ EAS DEPARTMENT ■ PROJECT MANAGEMENT DIVISION

EMCON/OWT, INC.
A Shaw Group Company

Sheet: 1 OF 1

DATE LAST REVISED: 4/22/03 mcase CADD FILE: COP:\NORTH_TOPO_2003\PcopSP11_NORTH.dwg xref: XCOPBM11

305 S. Euclid Avenue, Suite 101
Tucson, Arizona 85719-6649
Phone: (520) 792-2800

Shaw™ EMCON/OWT, Inc.

Memorandum

Date: June 3, 2003

To: File 844905

CC:

From: Amy Bonaparte, EIT
Garth Bowers, P.E.

RE: Buchanan Wash LOMR Additional Hydraulic Analyses
Response to FEMA Comment 3

Registered Professional Engineer (Civil) CERTIFICATE NO. 27290 GARTH R. BOWERS Date Signed 6/3/03 ARIZONA U.S.A.

The following information is provided as a response to Comment 3 of a letter provided by the Federal Emergency Management Agency (FEMA) on December 6, 2002 (Case 02-09-290P), as follows:

"Our detailed review of the HEC-RAS hydraulic model for Buchanan Wash revealed that only the base flood was restudied based on existing conditions. In addition to the base flood, the effective hydraulic model for Buchanan Wash and Skunk Creek includes floods having a 10-, 2-, and 0.2-percent chance of being equaled or exceeded in any given year. Please submit a revised hydraulic model for each of Buchanan Wash and Skunk Creek of the 10-, 2-, and 0.2-percent-annual-chance floods, along with a new set of flood profiles. Please also submit a topographic work map, certified by a registered professional engineer, that shows the boundary delineations along Buchanan Wash of the Special Flood Hazard Area, the area that would be inundated by the base flood, and of the area that would be inundated by the 0.2-percent-annual-chance flood."

In order to perform the additional hydraulic analyses requested by FEMA, the HEC-RAS input data files prepared by Tetra-Tech (2001) for the original Buchanan Wash LOMR request were modified to perform a multiple profile analysis. Flowrates for the 10-, 50-, and 500-year return interval events on Buchanan Wash were obtained from the effective Flood Insurance Study (AGK, 1987). Relevant pages of this FIS study report are attached. As in the 100-year event model prepared by Tetra-Tech, the slope area method was used as the downstream boundary condition for modeling the additional return interval flows. No changes were made to the geometry data from the Tetra-Tech model. A copy of the data report, profile output, and summary output table from the multiple profile analysis model and a disk containing the input and output files are attached.

Based on the results of the multiple profile analysis model, figures 2 and 5 from the Tetra-Tech Buchanan Wash LOMR request were modified. Figure 2 (Work Study Map) was modified to add the 500-year floodplain delineation and shade the area between the 100-year and 500-year floodplains. A small portion of the 500-year floodplain on the east

Shaw™ EMCON/OWT, Inc.

305 S. Euclid Avenue, Suite 101
Tucson, Arizona 85719-6649
Phone: (520) 792-2800

overbank of Buchanan Wash in the vicinity of cross-section 1.197 exceeds the limit of available topographic information. The 500-year floodplain delineation and shading is truncated at this location. However, as discussed on a March 11, 2003 conference call with representatives of FEMA, the City of Phoenix, and EMCON/OWT, Inc., the effective FIRM panel for this area depicts Zone X beyond the 500-year floodplain for Buchanan Wash due to flooding from other sources.

The Buchanan Wash LOMR request Figure 5 (Flood Profiles) was modified to depict the modeled water surface profiles for the 10-, 50-, and 500-year return interval events in addition to the 100-year water surface profile depicted in the original application. In addition, the downstream end of the 100-year water surface profile was modified to depict the backwater from the 100-year flow event on Skunk Creek at the Skunk Creek/Buchanan Wash confluence, based on the modeled water surface elevation predicted in the Skunk Creek LOMR application (Tetra-Tech, 2002). This LOMR request was submitted to FEMA earlier this year and response to FEMA comments is in progress. Water surface profiles for the 10-, 50-, and 500-year events on Skunk Creek have not yet been developed.

Attachments: Hydrologic Data (AGK, 1987)
HEC-RAS Multiple Profile Analysis Model Output
Figure 2 (Work Study Map)(Revised from Tetra-Tech, 2001)
Figure 5 (Flood Profiles)(Revised from Tetra-Tech, 2001)

FLOOD CONTROL DISTRIC

OF MARICOPA COUNTY

FLOOD INSURANCE STUDY R

BUCHANAN WASH

FROM SKUNK CREEK TO C.A.P ANAL

MARICOPA COUNTY, ARIZ

CONTRACT FCD 86-26

Registered Professional Engineer (Civil)
CERTIFICATE NO.
10283
SAMUEL E.
KAO
Date Signed 11-30-87
ARIZONA, U.S.A.

NOVEMBER 1987

AGK ENGIN ERS, INC.

2255 North th Street
Suit 20
Phoenix, A ona 85008

AGK Projec o. 310.40

periods greater than one year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (1 percent chance of annual exceedence) in any 50-year period is approximately 40 percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the study area at the time of this study's completion. The analyses reported herein reflect current conditions in the watersheds of the flooding sources. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for Buchanan Wash and its tributaries. Since no gaging station is available in the watershed, there is no means to develop discharge-frequency relationships from historical flood records. As a result, the HEC-1 computer model as developed by the U. S. Army Corps of Engineers (Reference 8) was used for generating flood peaks at various concentration points in the watershed.

The watershed was subdivided into a number of subwatersheds to form an interconnected system of stream network components. The boundaries of the subwatersheds were determined based on the USGS quadrangle maps (Reference 5) and the 1 inch=1000 feet aerial photographs obtained from Cooper Aerial Survey Company (Reference 7). The drainage boundaries near the Carefree Highway interchange were determined with the aid of the as-built highway plans for Interstate 17, obtained from Arizona Department of Transportation (Reference 11). Field verification supplemented the mapping inadequacies in determination of drainage boundaries.

The precipitation frequencies for the study area were obtained from isopluvial charts as shown on NOAA Atlas 2, prepared by the U. S. Department of Commerce (Reference 4). The SCS Type II dimensionless distribution of cumulative rainfall table (revised in May 1982) was used for generating the rainfall hyetographs.

The SCS curve number was used for the determination of rainfall losses due to interception and infiltration. The curve numbers were estimated from the tables in the SCS National Engineering Handbook Section 4, Hydrology, 1972 (Reference 3), according to the soil information obtained

from the General Soil Map for Maricopa County, as prepared by SCS in 1973 (Reference 2).

The kinematic wave overland-flow option of the HEC-1 computer model was used in this study. The effective roughness parameters were based on the category of sparse vegetation, per Table 3.5 of the HEC-1 Users Manual.

The kinematic wave method was used for flood routing from upstream to downstream. The cross-sectional geometry was approximated by a trapezoidal shape. The level-pool reservoir routing was used for flows through culverts, such as at the C.A.P. Canal. The relationship between the volume of storage and the elevation was established based on the aerial photographs with 2-foot contour intervals.

Because the runoff peak may occur from storm ranging in duration from one hour to 24 hours, the peak rates were computed for storm durations of one-hour, two-hours, three-hours, six-hours, and 24-hours, and the greatest peak was selected as the input for hydraulic analyses. Peak discharge-drainage area relationships for Buchanan Wash and its tributary are shown in Table 1.

TABLE 1 SUMMARY OF DISCHARGES

Flood Source and Location	Drainage Area Sq. Miles	Peak Discharges (cfs) 10-Yr	50-Yr	100 Yr	500-Yr
Main Channel					
At 800 feet downstream of C.A.P. Canal	9.17	1065	1253	1308	1407
At 4300 feet downstream of C.A.P. Canal	9.99	1175	1467	1609	1958
At Confluence of Skunk Creek	11.29	1422	2005	2304	3067
Initial Water Surface Elevation		1456.50	1458.93	1460.42	1465.95
Tributary					
At Cross Section 2.045 of Main Channel	0.43	100	231	301	467
Initial Water Surface Elevation		1491.37	1491.72	1491.87	1492.24

BuchananWashRev1.rep

HEC-RAS Version 3.0.1 Mar 2001
U.S. Army Corp of Engineers
Hydrologic Engineering Center
609 Second Street, Suite D
Davis, California 95616-4687
(916) 756-1104

```
X     X  XXXXXX    XXXX        XXXX       XX      XXXX
X     X  X        X    X       X   X     X  X    X
X     X  X        X            X   X    X    X   X
XXXXXXX  XXXX     X       XXX  XXXX     XXXXXX    XXXX
X     X  X        X            X  X     X    X        X
X     X  X        X    X       X   X    X    X        X
X     X  XXXXXX    XXXX        X    X   X    X   XXXXX
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PROJECT DATA
Project Title: Buchanan Wash
Project File : BuchananWashRev1.prj
Run Date and Time: 6/3/2003 1:01:03 PM

Project in English units

Project Description:
Buchanan Wash LOMR
Flow data revised from Tetra-Tech, 2001 by EMCON/OWT, Inc. to perform multiple profile analysis

As a result of the
construction of the Skunk Creek Landfill, the natural drainage pattern for Buchanan Wash was altered significantly. Several new cross-sections below the current effective FIS were input to more accurately model the confluence of Buchanan and Skunk Creek. With the new mapping, the effective FIS cross-sections were recut with new topographic mapping in their former locations and renumbered. Additional cross-sectios were added in locations of interest as necessary.

Starting WSEL
The initial boundary condition is the
normal slope area method.

Encroachments
Method 4 was used to initially
place the encroachments. From this point, the existing FIS encroachments were matched using Method 1. Then further Method 1 adjustments were made to model the changes along the watercourse and smooth the floodway.

PLAN DATA

Plan Title: BuchananWash-multiprof
Plan File : C:\HEC\RAS\projects\BuchananWashRev1.p02

Geometry Title: Buchanan Wash Geometry
Geometry File : C:\HEC\RAS\projects\BuchananWashRev1.g01

Flow Title : Buchanan Discharge
Flow File : C:\HEC\RAS\projects\BuchananWashRev1.f02

Plan Summary Information:
Number of: Cross Sections = 27 Mulitple Openings = 0
Culverts = 1 Inline Weirs = 0
Bridges = 0

Computational Information
Water surface calculation tolerance = 0.01
Critical depth calculaton tolerance = 0.01
Maximum number of interations = 20
Maximum difference tolerance = 0.3
Flow tolerance factor = 0.001

Computation Options
Critical depth computed only where necessary
Conveyance Calculation Method: At breaks in n values only
Friction Slope Method: Average Conveyance
Computational Flow Regime: Subcritical Flow

FLOW DATA

Flow Title: Buchanan Discharge
Flow File : C:\HEC\RAS\projects\BuchananWashRev1.f02

Flow Data (cfs)

River	Reach	RS	10-yr	50-yr	100-yr	500-yr
Buchanan Wash	Buchanan Wash	1.935	1065	1253	1308	1407
Buchanan Wash	Buchanan Wash	1.766	1175	1467	1609	1958
Buchanan Wash	Buchanan Wash	1.098	1422	2005	2304	3067

Boundary Conditions

River	Reach	Profile	Upstream	Downstream
Buchanan Wash	Buchanan Wash	10-yr		
Normal S = .003				
Buchanan Wash	Buchanan Wash	50-yr		
Normal S = .003				

GEOMETRY DATA

Geometry Title: Buchanan Wash Geometry
Geometry File : C:\HEC\RAS\projects\BuchananWashRev1.g01

```
CROSS SECTION          RIVER: Buchanan Wash
REACH: Buchanan Wash      RS: 1.935

INPUT
Description: 1.935  Adjacent to CAP bank
Station Elevation Data    num=     146
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
 9703.081497.0179705.6321496.9269705.8391496.9199717.2991496.8229724.5131496.761
9724.7931496.7589725.8181496.7469734.4291496.9369741.2351497.0869742.7321497.087
9751.9591497.2929755.2751497.3729763.835    14969776.2031495.8449778.1011495.781
9778.4891495.7829790.404    14969795.1221496.6039798.0381496.5529806.4871496.404
9807.977    14969818.5471495.6599830.241 1495.599838.0841495.6089848.1361495.841
9848.4161495.8479848.6431495.8539849.5071495.892 9863.451495.8289864.1211495.843
9865.3651495.8459874.8531495.8149875.4261495.817 9891.691495.7949891.8991495.796
9903.736    14969905.305    1496 9909.281496.4749909.8151496.4719914.4871496.576
9920.7971496.9679926.5981497.1489937.2491497.1649939.6791497.3119941.2561497.419
9941.7731497.4199947.0661497.6299955.1711497.2819957.476 1497.129964.1051496.954
9966.5851496.9729973.076    14969977.3741495.0379981.998    14949987.3071493.448
10001.74    149210002.83    149210015.761493.54910020.09    149410020.891494.174
10029.51    149610036.331496.70110048.731497.173 10049.81497.17810057.911497.168
10071.38    149610074.281495.49210077.651495.52810079.291495.54610080.131495.529
10092.041495.42710100.631495.45110101.011495.45410116.67    149610116.79    1496
10116.92    149610135.23    149610146.83    149610146.92    149610147.06    1496
10151.34    149610155.94    149610174.491497.28110176.041496.79710180.451496.865
10183.57    149610187.15    149610188.68    149610190.35    149610193.211496.488
10193.521496.48810205.761497.52310225.331497.28410227.321497.34310232.471497.446
10232.941497.44710262.291497.70510263.391497.723 10264.71497.77110283.091497.764
10292.81    149810311.78    149810312.41    1498 10324.8    149810326.85    1498
10339.86    149810340.33    149810354.27    149810365.62    149810365.92    1498
10367.41    149810372.77    149810377.251498.265 10380.91498.03610390.361498.222
10391.971498.20110396.471498.693 10399.91498.61310401.58 1498.5510401.911498.549
 10409.71499.21110414.631499.41810425.231499.28410433.511499.264   10445 1499.35
10459.63    150010463.83    150010464.36    150010473.74    150010484.66    1500
10485.61    150010490.77    1500 10496.1    150010499.35    150010500.66    1500
10502.47    150010503.11    1500 10504.5 1500.0510512.571500.18210513.131500.198
10514.531500.26210520.471500.46710524.921500.80610534.36    150210536.08    1502
10538.13    1502

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
 9703.08    .0559966.585    .05510048.73    .055

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
      9966.58510048.73                70  100.93     100             .1       .3
Blocked Obstructions     num=       2
   Sta L   Sta R    Elev   Sta L   Sta R    Elev
 9703.089947.0661497.629 10049.810538.13 1497.17

CROSS SECTION          RIVER: Buchanan Wash
REACH: Buchanan Wash      RS: 1.916

INPUT
Description: 2.200
Station Elevation Data    num=     117
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
 9599.361502.6099603.768    15029604.5731501.8899605.8131501.7179606.8891501.376
9610.5471500.2159614.986    15009617.171    15009622.569 1499.859622.6141499.848
9633.184 1499.549638.4451499.3649646.8371499.2419658.322    14989666.1691497.487
9667.401 1497.37    96681497.3299673.3531496.9789674.1671496.925  9682.91496.615
9683.9991496.6159684.3051496.6079688.833    14969688.908    14969725.9371494.901
9735.8721494.7669736.0661494.7639742.2221494.6989749.4161494.5569753.0671494.516
 9785.811494.2289788.5461494.167 9792.57    14949796.213    14949798.313    1494
```

```
9801.201    14949835.584    14949837.106    14949840.883    14949842.035    1494
9843.942    14949846.086    14949857.892    14949862.302    1494 9863.56    1494
9875.441    1494 9875.93    1494 9876.15    1494 9876.99    14949877.374    1494
9907.028    14949918.926    14949921.588    1494 9935.35    14949963.935    1494
9964.791    14949965.117    14949979.543    14949986.288    14949990.9931493.123
 9993.53 1492.659994.8861492.3459996.425    1492   10000    149210001.88    1492
10027.37    149210031.331493.31710033.39    1494 10039.21495.92910039.41    1496
10039.791496.06310050.371497.39810052.99    149810062.21    149810063.24    1498
10066.33    149810072.481496.07810072.73    149610078.98    149610127.75    1496
10128.88    149610135.37    1496 10137.9    149610140.67    149610152.11    1496
10158.65    149610167.29    149610169.72    149610193.56    149610195.42    1496
10199.61    149610204.44    149610214.96    1496 10225.5    149610246.971496.938
10251.59 1496.9910267.741497.45810268.361497.47910284.62    1498 10285.2    1498
10288.631498.26210292.791498.62710303.281499.53310309.95    150010316.081500.542
10321.25 1501.0510330.93    150210337.381502.68810359.831505.07210367.99    1506
10371.461506.40710371.711506.43610372.071506.47210372.581506.52910384.84    1508
10396.431509.39110398.52 1509.66
```

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
9599.36	.055	9986.288	.055	10033.39	.055

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
9986.28	10033.39	230	389.3	380	.1	.3

CROSS SECTION RIVER: Buchanan Wash
REACH: Buchanan Wash RS: 1.842

INPUT
Description: 2.121
Station Elevation Data num= 85

```
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
 9611.041508.1519612.8981507.5929614.7111507.0489618.199    15069619.9251505.482
9621.5721504.9879624.805    15049638.5021503.2199650.949    15029653.1731501.975
9660.0491501.8859762.8971500.6289773.102 1500.529800.527    15009832.4421499.101
9847.3021498.735 9865.331498.4419887.345    1498 9893.711497.6749896.9991497.511
 9910.361496.8039916.7491496.4669919.0091496.3399925.591    14969930.7591495.405
9939.2321494.3999942.511    14949946.1051493.8069982.894    1492 9986.17    1492
9989.8891491.6499991.8731491.435   10000 1490.5110004.37    149010007.07    1490
10012.54    149010024.33    149010028.851490.79710030.891491.15810031.56 1491.29
10035.16    149210035.54    149210042.061492.298   100611493.09810090.47    1494
 10114.21495.48310123.35    149610126.79    149610145.18    149610147.391495.969
10166.79 1495.7210199.971495.28410254.75    149410261.98    149410265.11    1494
10266.57    149410268.64    1494 10270.71493.95910396.38 1493.8710404.23    1494
10405.19    149410407.221494.18410408.551494.30510411.431494.58210421.521495.579
10423.07 1495.69 10427.2    1496 10442.51496.56710457.461497.08310462.461497.279
10466.47 1497.4210467.151497.44510480.33    149810488.511499.25110493.31    1500
10509.831501.71710512.98    150210525.321503.264 10531.9    150410538.411505.213
10540.251505.54310542.381505.92610543.311506.082 10545.1 1506.3310553.761507.614
```

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
9611.04	.055	9986.17	.055	10035.16	.055

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
9986.17	10035.16	400	401.78	430	.1	.3

CROSS SECTION RIVER: Buchanan Wash
REACH: Buchanan Wash RS: 1.766

INPUT
Description: 2.045
Station Elevation Data num= 84

```
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
 9461.51 1499.259543.418     1498 9548.48     14989567.832     14989581.578     1498
9584.415     1498  9587.5     14989589.731     14989597.626     14989600.765     1498
9610.142     14989634.549     14989713.1521496.9699764.797     14969765.388     1496
9827.4271494.1429832.273     14949832.9961493.9299851.416     14929871.1671490.594
9880.905     14909885.271     14909898.368     1490 9949.75     14909957.941     1490
9965.181     14909968.293     1490 9971.08     14909972.279     14909974.012     1490
9977.142     14909979.177     1490 9987.15     14909988.2641489.4779991.744     1488
   10000     148810009.23     148810011.77     148810012.831488.40510013.811488.778
10015.891489.50610017.31     1490 10021.6     149010029.44     149010033.91     1490
10036.64     149010039.65     149010040.94     149010044.471489.39210057.95 1488.15
10058.711488.08510059.53     148810062.49     148810063.51     148810066.461488.627
10071.871489.74810075.85     149010086.13     149010087.29     149010089.82     1490
10093.09     149010149.571490.85110177.341491.23110178.68 1491.2510225.051491.959
10225.431491.96510227.52     149210314.731493.07410372.221493.61110384.971493.958
10386.57     1494   103911494.54710401.68     149610408.931497.452 10411.5     1498
10415.161498.78310420.85     1500 10423.51500.56710430.19     150210432.351502.461
10439.54     150410445.021505.17310451.771506.61810454.461507.194

Manning's n Values          num=        3
     Sta   n Val      Sta   n Val      Sta   n Val
 9461.51    .055 9987.15    .05510017.31    .055

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
       9987.1510017.31               500  508.03     555              .1       .3

CROSS SECTION          RIVER: Buchanan Wash
REACH: Buchanan Wash      RS: 1.670

INPUT
Description: 1.951
Station Elevation Data    num=      72
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
  9429.61496.7869467.767 1496.719503.5921496.4869576.888     14969598.438     1496
9602.473     14969605.481     14969633.8241495.7419663.2241495.5589685.1141495.372
9816.504     14949833.324     14949835.127     14949835.583     14949866.865 1492.93
9892.538     14929892.584     14929901.8351490.9139909.386     14909918.9391488.931
9924.8551488.3099927.282     14889942.1051487.0719944.9911486.9129962.916     1486
9965.668     14869972.966     14869976.019     14869979.006     14869987.351     1486
9991.6711484.6729993.656     14849998.969     1484   10000     148410001.11     1484
10010.07     148410013.581485.06210016.35     148610018.991486.61810024.12     1488
10034.621489.17710042.39     149010042.79     149010043.76     149010053.07     1490
10060.11     149010063.49     149010065.28     149010072.42     1490 10117.2     1490
10159.55     1490   10249 1491.4410254.171491.452 10281.41491.84310283.541491.853
10290.19     149210316.091492.51410352.721493.14310378.741493.56510383.721493.645
10389.421493.72210402.841493.87910409.53     149410443.271495.351 10457.9     1496
 10472.41497.91410472.87     149810479.531499.21410483.81     150010490.571501.126
10495.76     150210509.341503.506

Manning's n Values          num=        3
     Sta   n Val      Sta   n Val      Sta   n Val
  9429.6    .0559987.351    .05510042.39    .055

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
       9987.35110042.39              510  500.86     490              .1       .3

CROSS SECTION          RIVER: Buchanan Wash
REACH: Buchanan Wash      RS: 1.575

INPUT
Description: 1.856
Station Elevation Data    num=      82
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
```

```
 9486.56    14929486.838    14929494.261    14929513.417 1491.929532.5891491.946
9582.936    14929583.304    14929583.318    14929583.321    14929584.706    1492
9594.8841491.9989597.763    14929608.3281492.0089608.3861492.0089656.4951492.129
9679.7971492.0699692.451    14929703.992    14929715.933    14929718.365    1492
9777.8571491.0419791.4151490.7829802.1971490.5579827.477    14909832.851    1490
9859.6771488.5339861.8321488.4039867.103    14889867.852    14889880.3911487.629
9916.5041486.6699941.263    14869965.8071484.2519967.0821484.1669969.577    1484
9970.6291483.6879977.811    14829989.617    14829998.541    1482   10000  1482.5
10001.871483.25310003.86    148410004.331484.02410043.35    148610055.311486.991
10067.27    148810083.361488.71910087.521488.81710095.541489.12310098.891489.255
10104.141489.30210128.271489.51110129.321489.48710138.421489.172 10144.9 1488.95
10153.391488.76410163.361488.31210169.39    148810173.81    1488 10175.3    1488
10223.06    148810228.24    148810233.97    148810242.741487.92810252.74    1488
10274.751488.19310297.321488.46110330.011488.50510342.931488.61210346.361488.664
10385.921489.64110398.13    149010399.01    1490 10399.81490.12310411.83    1492
10421.211493.46310424.65    149410426.471494.28510454.041498.54810458.871499.314
10463.03    150010466.551500.599

Manning's n Values          num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
 9486.56    .0559969.577    .05510003.86    .055

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
      9969.57710003.86              505   505.7     540             .1       .3

CROSS SECTION          RIVER: Buchanan Wash
REACH: Buchanan Wash      RS: 1.479

INPUT
Description: 1.761
Station Elevation Data    num=      74
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
 9486.18    14889532.129    14889587.464    14889601.325    14889601.809    1488
 9601.88    14889602.6081487.9879648.2261487.2299691.5221486.7489699.7231486.647
9702.1731486.6049703.4381486.5819737.7681486.1299741.2251486.127 9743.191486.127
9743.4521486.1269762.758    14869769.997    14869772.618    14869776.918    1486
9840.026    14869843.143    14869854.567    14869894.082    1486 9914.97    1486
9915.241    14869923.008 1485.259935.777    14849948.907 1482.97 9961.84    1482
9964.531    14829971.744    14829979.602    14829984.1031480.3289985.138    1480
9988.286    1480   10000    1480 10008.2    148010012.121481.303 10014.1    1482
10021.041482.15610023.151482.17710044.06 1482.6110079.841483.17110087.971483.272
10118.461483.46310122.041483.45810198.751483.56510241.951483.94710243.751483.962
 10245.7    148410248.57    148410271.351484.60410274.791484.67610285.941484.802
10290.661484.84610311.961485.17810316.111485.16410323.051485.05810330.421484.838
10334.791484.70210341.611484.59910344.721484.57110356.231484.24910360.38 1484.17
10360.931484.15810367.87    148410370.28    148410371.16    1484 10373.5    1484
10384.83    148410387.83    148410390.451484.06510430.431485.469

Manning's n Values          num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
 9486.18    .0559979.602    .055 10014.1    .055

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
      9979.602 10014.1              355  351.78     335             .1       .3
Ineffective Flow     num=       1
   Sta L   Sta R    Elev  Permanent
888       F

CROSS SECTION          RIVER: Buchanan Wash
REACH: Buchanan Wash      RS: 1.412

INPUT
Description: 1.695
```

```
Station Elevation Data    num=      81
     Sta     Elev     Sta     Elev     Sta     Elev     Sta     Elev     Sta     Elev
 9489.44    14849497.438    14849512.968    14849518.285    14849522.267    1484
 9523.68    14849539.023    14849540.713    1484  9564.2    14849567.169    1484
9594.619    14849604.671    14849621.753    14849704.446    14849713.941    1484
9726.539    14849744.536    14849748.402    14849789.392    14849791.9731483.971
9792.1571483.9689797.308    14849799.985    14849804.081    1484 9814.48    1484
9819.818    14849821.591    14849837.558    1484 9838.44    14849851.588    1484
9855.874    14849863.081    14849864.931    14849886.9741482.7339896.056 1482.68
9903.299    14829903.553    1482 9911.081481.6259913.147 1481.529920.1951481.226
9923.9391481.1149930.2931480.983 9974.97    14809989.316    14809990.174    1480
9990.5621479.7659994.023    1478   10000    147810011.15    147810014.43    1478
10015.131478.28410019.36    148010019.49    148010043.29    148010073.92    1480
10094.75    148010100.53    148010104.65    148010107.06    148010118.871480.891
10121.66 1481.1210125.081481.37910132.781481.98810132.831481.99110132.891481.996
10132.94    148210193.791483.37710220.37    148410225.23    148410233.711484.315
10235.231484.35710243.181484.51810250.011484.79610258.871485.13910284.161485.957
10284.761485.98210285.33    148610285.44    148610285.54    148610315.95    1486
10369.561487.386

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
 9489.44    .0559990.174    .05510019.36    .055

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
      9990.17410019.36              300  296.39     305             .1       .3

CROSS SECTION          RIVER: Buchanan Wash
REACH: Buchanan Wash      RS: 1.356

INPUT
Description: 1.638
Station Elevation Data    num=      92
     Sta     Elev     Sta     Elev     Sta     Elev     Sta     Elev     Sta     Elev
 9303.28 1482.979327.506    14829328.545    14829329.839    14829330.789    1482
9331.965    14829347.742    14829375.766    14829396.419    14829401.532    1482
9474.152    14829485.166    14829485.476    14829489.638    14829490.418    1482
9520.2911482.4069533.0781482.5739541.0831482.6939547.4911482.7849695.671    1484
9696.091    14849696.175    14849697.436    14849697.602    14849709.9061483.625
9718.5051483.3619725.3031483.1619743.6521482.7549743.7061482.7519766.101    1482
  9774.1    14829783.766    14829787.888    14829839.961    14829844.902    1482
9897.6571481.1959898.701 1481.189904.3031481.2019923.9411480.7289924.259 1480.73
9933.736    14809938.099    14809961.297    14809978.7151479.392 9980.191479.238
9981.9671479.0049985.7541478.5919990.356    14789992.2731476.9939994.111    1476
   10000    147610002.12    147610009.18    147610013.281477.19310016.05    1478
 10026.51478.85210036.161479.64510042.58    148010045.461480.63210046.491480.859
10049.581481.20310050.981481.35910053.041481.32510058.651481.24710058.831481.269
10064.87    148210065.46    148210066.48    148210073.79    1482 10076.71481.314
10079.061480.82610079.061480.82510080.371480.44910081.92    148010083.76    1480
10086.92    148010112.881480.87910142.55    148210148.651482.53210167.51    1484
10184.431485.67710187.68    148610190.931486.34310205.751487.50310208.191487.698
10211.74    148810211.92    148810211.98    148810214.671488.27810230.67    1490
 10233.51490.24710241.311490.925

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
 9303.28    .0559961.297    .05510050.98    .055

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
      9961.29710050.98              205  129.16      75             .1       .3
Ineffective Flow     num=       1
   Sta L   Sta R    Elev  Permanent
888        F
```

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CROSS SECTION          RIVER: Buchanan Wash
REACH: Buchanan Wash      RS: 1.332

INPUT
Description: 1.332 Near Culvert
Station Elevation Data    num=      83
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
8955.4651481.9978955.553    14828956.051    14828958.859    1482 8971.09    1482
 8978.62    14828992.3191481.9488994.1131481.9348996.1791481.904 8996.851481.892
9000.4781481.8659028.2321481.2579045.9981480.8759059.3511480.5949067.4611480.422
9078.7361480.2369082.6111480.2169083.8341480.2089090.0811480.1789106.4121480.068
9106.6311480.0659108.0071480.0579108.2691480.0579130.4731480.0429130.8551480.043
9134.167    14809137.825    14809145.106    14809146.659    14809146.989    1480
9147.039    14809151.566    14809157.235    14809159.582    14809162.787    1480
9163.074    14809164.935    14809170.856    14809176.616    14809182.808    1480
9186.047    14809188.448    14809213.4941478.6979218.0841478.6019237.1721478.296
9238.539 1478.269253.909    14789254.297    14789257.611 1477.359263.3681476.369
9264.9251476.1049265.263    14769276.206    14769284.216    14769286.5161476.421
9287.1921476.5449293.767    14789302.0931478.402  9331.8    14809332.875    1480
 9338.04    14809340.812    14809341.017    14809347.581    14809349.444    1480
9353.356    14809359.263    14809360.589    14809365.243    14809366.504 1480.08
9366.6151480.0829367.3851480.1069374.7381480.4519383.5931480.8479384.3531480.879
9389.4251480.9449396.8131481.154 9398.131481.2149420.9671481.8939422.219    1482
9422.8031481.9579424.389    14829434.1611483.003

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
8955.465    .0559253.909    .0559293.767    .055

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
      9253.9099293.767               65   71.81      75             .1       .3
Skew Angle = 22

CULVERT                RIVER: Buchanan Wash
REACH: Buchanan Wash      RS: 1.326

INPUT
Description:
Distance from Upstream XS =      13
Deck/Roadway Width        =      30
Weir Coefficient          =     2.6
Bridge Deck/Roadway Skew  =      22
Upstream  Deck/Roadway Coordinates
    num=       5
     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord
    8470  1480.5            9960  1480.5           10070  1480.5
   10124    1482           10250    1490

Upstream Bridge Cross Section Data
Station Elevation Data    num=      83
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
8955.4651481.9978955.553    14828956.051    14828958.859    1482 8971.09    1482
 8978.62    14828992.3191481.9488994.1131481.9348996.1791481.904 8996.851481.892
9000.4781481.8659028.2321481.2579045.9981480.8759059.3511480.5949067.4611480.422
9078.7361480.2369082.6111480.2169083.8341480.2089090.0811480.1789106.4121480.068
9106.6311480.0659108.0071480.0579108.2691480.0579130.4731480.0429130.8551480.043
9134.167    14809137.825    14809145.106    14809146.659    14809146.989    1480
9147.039    14809151.566    14809157.235    14809159.582    14809162.787    1480
9163.074    14809164.935    14809170.856    14809176.616    14809182.808    1480
9186.047    14809188.448    14809213.4941478.6979218.0841478.6019237.1721478.296
9238.539 1478.269253.909    14789254.297    14789257.611 1477.359263.3681476.369
9264.9251476.1049265.263    14769276.206    14769284.216    14769286.5161476.421
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9287.1921476.5449293.767    14789302.0931478.402  9331.8    14809332.875    1480
 9338.04    14809340.812    14809341.017    14809347.581    14809349.444    1480
9353.356    14809359.263    14809360.589    14809365.243    14809366.504 1480.08
9366.6151480.0829367.3851480.1069374.7381480.4519383.5931480.8479384.3531480.879
9389.4251480.9449396.8131481.154 9398.131481.2149420.9671481.8939422.219    1482
9422.8031481.9579424.389    14829434.1611483.003

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
8955.465    .0559253.909    .0559293.767    .055

Bank Sta: Left   Right    Coeff Contr.   Expan.
      9253.9099293.767             .1       .3
Skew Angle = 22

Downstream  Deck/Roadway Coordinates
    num=       5
     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord
    8470  1480.5            9960  1480.5           10070  1480.5
   10124    1482           10250    1490

Downstream Bridge Cross Section Data
Station Elevation Data    num=      72
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
8981.0831481.6249011.0611481.7849031.6651481.7069059.025  1481.59090.5241481.034
 9100.751480.8489101.4241480.8439117.075    14809118.084    14809120.042    1480
9132.105    14809132.137    14809132.153    14809132.2891479.9969159.5511479.705
9161.6451479.6419178.1471479.5669183.7811479.5439187.3351479.4249187.426 1479.42
 9188.791479.3689210.585 1479.329210.7031479.3189221.0831479.1319223.3451479.119
9227.6561479.1389228.8521479.1199235.4081479.1689236.1911479.1629240.8271478.965
  9241.81478.9959253.7411478.0169253.7821478.0149253.8011478.0139253.895    1478
9256.0111477.416 9258.521476.6739261.139    14769261.522    14769274.119    1476
9276.289    14769292.534    14769293.655    14769293.804    14769294.8791476.259
9300.257    14789305.467    14789305.478    14789305.765    14789306.1821478.015
9306.3021478.0199352.772    14809355.118    1480 9358.53    14809362.879    1480
9365.781    14809366.458    14809376.0551480.7669379.9381481.0179392.169    1482
9397.212    14829410.1461483.0299411.2311483.0849419.891    14849426.1321484.557
 9431.871484.9039442.209    14869444.138    14869449.5231486.5119459.4821487.498
 9463.19 1487.819464.4521487.907

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
8981.083    .0559253.741    .0559300.257    .055

Bank Sta: Left   Right    Coeff Contr.   Expan.
      9253.7419300.257             .1       .3
Skew Angle = 22

Upstream Embankment side slope                =       0 horiz. to 1.0 vertical
Downstream Embankment side slope              =       0 horiz. to 1.0 vertical
Maximum allowable submergence for weir flow =     .95
Elevation at which weir flow begins           =
Energy head used in spillway design           =
Spillway height used in design                =
Weir crest shape                              = Broad Crested

Number of Culverts =  1

Culvert Name     Shape      Rise    Span
Culvert #1           Box       4       7
FHWA Chart # 8 - flared wingwalls
FHWA Scale # 3 - Wingwall flared 0 deg. (sides extended straight)
Solution Criteria = Highest U.S. EG
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Culvert Upstrm Dist  Length    n Value   Entrance Loss Coef   Exit Loss Coef
                 13      30       .013                   .4                1
Number of Barrels =  4
Upstream   Elevation =  1476
Centerline Stations
    Sta.    Sta.    Sta.    Sta.
    9263    9271    9279    9287
Downstream Elevation =  1476
Centerline Stations
    Sta.    Sta.    Sta.    Sta.
    9265    9273    9281    9289

CROSS SECTION          RIVER: Buchanan Wash
REACH: Buchanan Wash      RS: 1.318

INPUT
Description:
Station Elevation Data    num=      72
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
8981.0831481.6249011.0611481.7849031.6651481.7069059.025  1481.59090.5241481.034
 9100.751480.8489101.4241480.8439117.075    14809118.084    14809120.042    1480
9132.105    14809132.137    14809132.153    14809132.2891479.9969159.5511479.705
9161.6451479.6419178.1471479.5669183.7811479.5439187.3351479.4249187.426 1479.42
 9188.791479.3689210.585 1479.329210.7031479.3189221.0831479.1319223.3451479.119
9227.6561479.1389228.8521479.1199235.4081479.1689236.1911479.1629240.8271478.965
  9241.81478.9959253.7411478.0169253.7821478.0149253.8011478.0139253.895    1478
9256.0111477.416 9258.521476.6739261.139    14769261.522    14769274.119    1476
9276.289    14769292.534    14769293.655    14769293.804    14769294.8791476.259
9300.257    14789305.467    14789305.478    14789305.765    14789306.1821478.015
9306.3021478.0199352.772    14809355.118    1480 9358.53    14809362.879    1480
9365.781    14809366.458    14809376.0551480.7669379.9381481.0179392.169    1482
9397.212    14829410.1461483.0299411.2311483.0849419.891    14849426.1321484.557
 9431.871484.9039442.209    14869444.138    14869449.5231486.5119459.4821487.498
 9463.19 1487.819464.4521487.907

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
8981.083    .0559253.741    .0559300.257    .055

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
      9253.7419300.257               105   150.9     190              .1       .3
Skew Angle = 22

CROSS SECTION          RIVER: Buchanan Wash
REACH: Buchanan Wash      RS: 1.290

INPUT
Description: 1.572
Station Elevation Data    num=     114
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
 9246.011480.141 9270.34    14809283.836    14809290.475    14809300.665    1480
9319.967    14809327.5381479.9269327.8591479.9249428.0161479.9769429.3491479.964
9437.1781479.9369452.6761479.8219454.0481479.8099464.0811479.7449473.1091479.674
9484.0661479.6229536.9171479.9889537.1441479.9879537.1591479.9879546.5571479.946
9550.8781479.8999550.912  1479.99559.4981479.7489607.732    14809639.136    1480
9639.495    14809642.892    14809643.074    14809644.811    14809645.202    1480
  9647.7    14809653.512    14809653.839    14809659.879    1480 9663.41    1480
9683.9751480.5639685.0931480.5449706.5141480.9619771.6131480.8449789.6861480.702
9855.473    14809856.184    14809859.263    14809859.841    14809862.603    1480
9907.3861478.2869913.437    14789914.932    14789916.036    14789916.615    1478
9933.875    14789991.275    14789993.359    14789993.391    14789995.508    1478
 9995.58    1478   10000  1476.510001.431476.07810001.62    147610002.03    1476
10002.51    147610023.55    147610023.71    147610030.75    147610037.75    1476
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10038.23    147610038.93    147610045.391476.20210056.96 1476.5410089.59    1478
 10089.8    147810095.34    147810100.22    147810102.27    147810111.65    1478
10114.37    147810114.79    147810162.951479.38910185.28    148010189.67    1480
10192.63    148010195.29    148010199.58    148010202.77    1480 10205.5    1480
10227.011481.65310230.89    148210240.241483.99710240.241483.99910240.25    1484
10247.99 1485.54 10250.3    148610251.941486.32710260.34    148810264.431488.754
 10272.5    149010274.171490.29910283.64    149210291.171493.35110294.78    1494
10296.481494.27410308.21    149610317.041497.03710325.46    149810335.311499.125
10342.96    150010359.791501.92510360.45    150210364.641502.513 10376.11503.924
10376.72    150410378.99 1504.2810398.631506.69610401.611507.063

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
 9246.01    .055 9995.58    .05510089.59    .055

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
       9995.5810089.59              445  486.94     505             .1       .3
Ineffective Flow     num=       1
   Sta L   Sta R    Elev  Permanent
888       T

CROSS SECTION          RIVER: Buchanan Wash
REACH: Buchanan Wash      RS: 1.197

INPUT
Description: 1.483
Station Elevation Data    num=      84
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
 9305.86    14789318.424    14789328.717    14789341.049    14789354.207    1478
9362.335    14789365.869    14789428.139    14789428.737    14789447.901    1478
9452.074    14789467.659    14789480.071    14789488.574    14789488.894    1478
9491.178    14789536.917    14789560.454    14789560.901    1478 9561.32    1478
9570.947    14789589.844    14789614.2561477.5429622.2011477.3859680.701    1476
9692.249    14769692.823    14769693.397    14769694.533    14769694.915    1476
9695.543    14769713.3761476.7449715.8661476.8139726.0471477.3279727.1991477.387
9729.8881477.5119737.942    14789747.092    14789750.879    14789759.531    1478
9766.096    14789777.726    14789794.738    14789799.896    14789804.448    1478
9829.112    14789830.179    14789830.575    14789833.084    1478 9839.42    1478
9840.745    14789840.974    14789908.0031476.7529941.7271476.1989949.329    1476
9951.408    14769951.997    14769967.4471474.7969977.867    14749981.294 1472.77
9983.396    14729989.937    1472   10000    147210005.48    1472 10009.31473.913
10009.48    147410010.871474.05110065.66    147610081.431477.92710081.481477.931
10082.02    147810085.921478.48910096.581479.81610097.95    148010098.891480.151
10100.671480.55610117.541484.39110124.61    148610124.671486.01210124.821486.047
10131.47 1487.5210133.63    148810139.321489.26110151.611491.984

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
 9305.86    .0559977.867    .05510009.48    .055

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
      9977.86710009.48              615  523.26     520             .1       .3
Ineffective Flow     num=       1
   Sta L   Sta R    Elev  Permanent
888       F

CROSS SECTION          RIVER: Buchanan Wash
REACH: Buchanan Wash      RS: 1.098

INPUT
Description: 1.383
Station Elevation Data    num=      91
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
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 9385.871479.2389395.5821479.1159430.2551478.3559444.843    14789458.1841476.651
9465.536    14769484.7921474.7949499.156    14749508.154    14749517.292    1474
 9518.08    14749520.428    14749525.639    14749527.845    14749542.529    1474
 9545.04    14749590.5321474.3919634.4921474.686 9637.341474.6979669.7941474.868
9672.6121474.8699800.2231474.2129805.8021474.2279806.4041474.233 9824.61    1474
9826.366    14749826.937    14749826.988    14749833.034    14749839.214    1474
9842.727    1474 9885.73    14749887.114    14749897.541    14749899.293    1474
9901.5211473.9169905.9321473.7669936.8291472.6839957.877    14729960.458    1472
9972.745    1472 9972.93    14729973.656    14729978.923    14729983.206    1472
9983.331    14729983.3541471.9899987.698    14709993.659 1469.04   10000    1468
10006.78    146810007.65    146810009.731468.49110010.511468.66810015.47    1470
 10019.11470.99610020.251471.31210022.64    147210030.181472.63610033.791472.945
10047.55    147410053.131475.11810062.651477.02510067.51    147810075.461479.591
10076.861479.89810078.581480.27110108.661486.82410113.541487.88710113.811487.946
 10114.1    148810114.281488.03410124.61    149010128.931490.82210135.12    1492
10144.811493.84410145.77    149410149.361494.58210158.09    149610166.251497.758
10168.221498.20710170.971498.955 10178.31500.94610182.18    150210186.461503.163
10192.061504.77910207.741509.58510213.411511.43310217.071512.42210225.481514.696
10226.861515.068

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
 9385.87    .0559983.331    .05510022.64    .055

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
      9983.33110022.64              465  491.72     505             .1       .3

CROSS SECTION          RIVER: Buchanan Wash
REACH: Buchanan Wash      RS: 1.005

INPUT
Description: 1.288
Station Elevation Data    num=      98
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
 9349.31    14789349.344    14789352.223    1478 9352.28    14789352.9041477.982
9368.6871477.494 9368.99 1477.48 9369.331477.4689377.5361477.1399399.6861476.588
9405.4941476.3829415.802    14769422.5391475.8589448.5721475.4429528.805    1474
9531.292    14749531.433    14749531.535    14749544.073    14749574.3491472.717
9578.2881472.6999585.754 1472.52 9596.481472.1389599.652    14729599.866    1472
9608.012 1471.739618.5621471.3939636.1221470.8119660.712    14709667.565    1470
9669.681    14709671.712    1470 9672.03    1470 9677.92    14709718.0331470.168
9718.3391470.1669722.9011470.1479727.135 1470.229727.564 1470.239737.7181470.449
9745.8671470.5989842.5411470.3049862.506    14709865.334    14709870.884    1470
9881.122    14709900.788    1470 9903.56    14709904.807    14709933.8281469.237
  9982.1    14689983.1611467.6149987.382    1466   10000    146610001.38    1466
10005.54    146610009.861467.583   10011    146810012.62    146810026.071468.998
10033.171469.40510038.041469.57810040.951469.64810049.68    147010051.58    1470
10051.73    147010054.08    147010054.53    147010059.441470.41810064.761470.767
10082.47    147210104.371473.773   101061473.90710107.21    1474 10125.11475.392
10133.03    147610134.18    147610158.871477.48710162.611477.62810166.47    1478
10167.04    147810175.39    147810182.19    147810184.09    147810197.74 1479.05
10209.17    148010214.04    148010218.48    148010218.76    1480 10222.7    1480
10224.121480.16110238.73    148210239.131482.049 10239.51482.087 10253.5    1484
10253.781484.03910254.571484.12710259.181484.659

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
 9349.31    .055  9982.1    .05510012.62    .055

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
        9982.110012.62              360  408.16     420             .1       .3

CROSS SECTION          RIVER: Buchanan Wash
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REACH: Buchanan Wash      RS: 0.928

INPUT
Description: 1.207
Station Elevation Data    num=      75
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
9480.0551470.7619487.2291470.6069496.4981470.4129498.8821470.3759500.7241470.354
9502.9021470.2889504.2681470.2629507.3531470.1869511.609 1470.219512.0621470.199
9520.8981470.1899565.122 1470.489578.0261470.4269581.7541470.4769583.7141470.494
9597.873  1470.79647.6241470.2649649.3581470.2579662.8921470.1219670.117    1470
 9671.77    14709675.661    14709679.786    14709694.392    14709707.909    1470
9708.742    14709741.312    14709765.553    14709790.362    14709790.845    1470
9791.4191469.9029802.417    14689803.963    14689828.0171466.5489829.5241466.403
9831.5411466.2299837.5691466.0899838.6961466.0939905.9431466.5729959.977    1466
9973.427    1466 9982.71    14669987.4621464.4299988.682    14649994.963    1464
   10000    146410010.17    146410015.721465.08410020.33    146610030.341467.114
10039.08    146810041.671468.70810046.38    147010049.38 1470.8210054.881472.327
10060.871473.96410077.741477.46910086.131478.88110092.17    1480   100961480.711
10101.221481.67710123.051485.52210125.97    148610133.451487.09710139.69    1488
10148.631489.32310152.741489.89910154.361490.12510167.75    149210183.97 1493.83
10185.61    149410187.85    149410192.491494.36510210.44    149610217.881496.461

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
9480.055    .055 9982.71    .05510020.33    .055

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
       9982.7110020.33               480  471.49     465             .1       .3

CROSS SECTION          RIVER: Buchanan Wash
REACH: Buchanan Wash      RS: 0.839

INPUT
Description: 1.120
Station Elevation Data    num=     109
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
 9375.97    14709377.121    14709385.403    14709389.406    14709394.296    1470
9405.452    14709418.768    14709418.848    14709418.852    14709420.531    1470
9422.435    14709422.466    14709435.2791469.9149435.6711469.9169438.6711469.905
9447.4121469.8459465.0941469.7329470.7021469.685 9485.131469.5589492.6841469.503
9579.692    14689598.238    14689603.504    14689603.773    14689605.106    1468
9610.183    14689613.244    14689621.859    14689623.491    14689634.965    1468
9635.094    14689642.019    14689642.558    14689651.053    14689660.779    1468
9661.446    14689823.7351466.4829825.7251466.4779835.0011466.3749862.5281466.022
9862.5851466.0229862.858 1466.029864.388    14669866.648    1466 9915.631464.725
9929.5341464.3919936.1251464.2099944.003    14649945.674    14649950.512    1464
9963.476    14649975.423    14649980.2041463.3739990.558    14629999.652    1462
   10006    1462 10011.9    146210018.561463.42710021.24    146410035.73    1464
10038.27    146410040.65    146410041.71    1464 10050.41464.30210051.321464.353
10054.711464.60110056.081464.69410074.17    146610093.121467.43410100.73    1468
10107.671468.51410110.181468.68310123.561469.57810129.49    147010135.41    1470
10138.06    147010139.61    147010139.78    1470 10177.9    147010195.29    1470
10222.011470.80210240.031470.40910242.951470.43910245.311470.49510245.931470.516
10248.181470.60310252.64 1470.8310257.181470.79510262.971471.10310266.391471.254
10267.141471.27510269.321471.36810281.461471.721 10284.21471.82710284.531471.832
10284.881471.83810297.18 1471.9710297.381471.97210298.92    147210299.46    1472
10305.24    147210310.441472.50210312.59 1472.69 10317.11472.90610318.681472.981
10319.23 1473.0310324.351473.48310327.241473.66910332.37    1474

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
 9375.97    .0559975.423    .05510021.24    .055
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Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
      9975.42310021.24              715   752.2     765              .1       .3
Ineffective Flow     num=       1
   Sta L   Sta R    Elev  Permanent
888       T

CROSS SECTION          RIVER: Buchanan Wash
REACH: Buchanan Wash      RS: 0.696

INPUT
Description: Former 0.985
Station Elevation Data    num=     144
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
 9040.821476.5119042.3371476.4699054.879    14769062.599    14769067.4391475.795
9078.3471475.2879098.818    1474 9114.851472.9079128.162    14729139.6051470.602
9146.093    14709161.9041468.0979162.711    14689165.1741467.7049172.292 1466.99
9182.289    14669183.3381465.8179191.3051464.3129193.022    14649193.431    1464
9200.985    1464 9211.63    14649217.332    14649222.717    14649223.176    1464
9223.487    14649224.528    14649229.813    1464 9232.48    14649234.082    1464
9235.984    14649236.082    14649237.756    14649241.378    14649243.263    1464
9274.926    1464 9278.44    14649281.511    1464 9281.58    14649327.692    1464
9332.682    14649335.958    14649336.408    14649337.291    14649392.4851463.115
9417.2741463.1319523.7251462.176 9529.31 1462.13 9531.921462.1119546.141    1462
9547.931    14629548.889    14629552.756    14629553.363    14629556.322    1462
9556.983    14629568.451    14629588.322    14629600.057    14629601.482    1462
9604.415    14629607.399    14629610.587    14629619.997    14629620.065    1462
 9622.08    14629631.213    14629635.915    1462 9636.55    14629637.299    1462
9640.639    14629642.107    14629654.129    14629658.336    14629664.389    1462
9669.983    14629672.263    14629705.198    14629705.449    14629706.476    1462
9713.721    14629715.769    14629723.987    1462 9725.68    14629725.8751462.017
9726.778    14629727.321    14629727.383    14629728.3261462.057 9728.461462.059
 9728.751462.0749729.0011462.0929732.0191462.3599733.1531462.5199735.3521462.966
 9752.47    14649821.8291462.6429832.8671462.4039852.886    14629854.803    1462
9854.908    14629856.5861461.8839868.0721461.1729893.795    14609897.817    1460
9903.094    14609904.901    14609905.022    14609922.332    14609928.807    1460
9933.612    14609939.881    14609943.167    14609944.247    1460 9948.92    1460
9949.483    1460 9950.35    14609950.839    14609953.397    14609953.975    1460
9981.216    14609991.525    1460 9995.71    1460   10000  1458.910003.021458.245
10004.08    145810006.04    1458   10014    145810018.591459.458 10020.3    1460
10020.57    146010049.631460.92610082.65    146210082.89    146210083.07    1462
10107.031463.47910114.461463.935 10115.5    146410115.75 1464.0210144.26    1466
10149.05 1466.26   10182    146810187.24 1468.3310188.151468.381

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
 9040.82    .055 9995.71    .055 10020.3    .055

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
       9995.71 10020.3              645  533.49     500              .1       .3

CROSS SECTION          RIVER: Buchanan Wash
REACH: Buchanan Wash      RS: 0.595

INPUT
Description: Former 0.890
Station Elevation Data    num=     140
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
 8732.541470.8788734.5851470.7838735.3061470.8038738.7351470.8748742.7241470.726
8749.3481470.8318751.459 1470.778817.5461470.2688824.6471470.156 8834.14    1470
8843.0981469.852 8862.651469.529 8865.721469.4788916.9661468.9468921.3021468.972
8927.9291468.7738930.1781468.7048941.5881469.0898946.9931468.6028947.9921468.528
8956.695    1468  8957.4    14688958.135    14688960.826    14688979.8681467.768
9008.367 1466.949022.4061466.6589035.912    14669045.6071465.4449047.2191465.363
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9049.508 1465.289058.3421464.8049069.896    14649071.442    14649115.4021462.848
9141.4771462.1649145.0041462.091 9152.96    14629153.717    14629156.192    1462
9159.557    14629163.955    14629164.251    14629164.315    14629177.088    1462
9187.531 1461.64 9216.731461.2289263.4721461.115 9266.391461.1219269.4621461.128
9280.1231461.0829285.3561461.1029308.2951461.0759324.267 1460.959383.0881460.044
9385.745    14609385.965    14609387.599    14609412.872    14609415.444    1460
9441.917    14609443.356    14609443.933    14609445.773    14609462.5821459.766
9566.2171459.5329599.3181459.4359610.689 1459.389624.5361459.346 9696.571459.049
9851.312    14609859.738    14609868.789    14609870.247    14609871.576    1460
9874.212    14609875.725    1460 9879.261459.9579884.5981459.6849886.1511459.702
9889.4011459.6659895.4121459.2149898.0741459.1319909.968    14589911.349    1458
9927.466    14589930.652    14589930.772    14589932.464    14589937.123    1458
 9962.22    14589962.952    14589963.221    14589967.909    14589981.882    1458
9991.042    14589992.4141457.347 9994.181456.5069997.3881454.987   100001453.788
10002.111452.72610010.911452.853 10019.4    145410022.931455.642 10023.7    1456
10026.891457.48510028.12    145810028.22    145810029.77    1458 10035.1    1458
10049.17    145810078.81    145810085.63    145810109.51    145810116.33    1458
10118.41    145810121.91    145810122.59    145810127.63    145810129.541458.054
10129.961458.068 10133.8 1458.1910190.42    146010193.81    1460 10206.9    1460
 10210.7    146010211.25    146010211.46    146010211.68    146010213.951460.073
10214.871460.10710216.33 1460.1610263.92    146210278.751463.52910282.25    1464
10284.981464.36710287.091464.57610299.51    146610301.161466.18510302.411466.333

Manning's n Values          num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
 8732.54    .0559991.042    .05510028.12    .055

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
      9991.04210028.12              635  497.19     360             .1       .3

CROSS SECTION          RIVER: Buchanan Wash
REACH: Buchanan Wash      RS: 0.501

INPUT
Description: Section 0.782 in old study

Ineffective Flow Areas reflect the
             retention basin for the Arizona Hillcrest Subdivision.  It is
             assumed the full depth of the retention basin will not act as
             conveyance area.
Station Elevation Data    num=     279
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
 8635.48    14688642.139    14688647.536    14688649.667    14688650.937    1468
  8675.91467.3768689.1091466.9798721.194    14668726.3651465.0898729.7611464.512
8739.2151464.3258740.4871464.3868752.8941464.6368760.8231465.1498763.3561465.252
8766.1081465.3138768.8931465.5538770.1831465.5968770.9451465.6068774.013    1466
8800.406    14668806.774    14668815.609    14668826.128    14668827.613    1466
8829.278    14668831.712    14668833.399    14668839.277    14668845.919    1466
8850.093    14668865.729    14668895.104    14668900.608    14668904.611    1466
8905.998    14668908.321    14668935.362    14668939.827    14668962.998    1466
8965.164    14668966.265    14668968.021    14668969.869    14668971.068    1466
9021.9451464.5339024.9141464.5149032.4041464.4649041.7141464.4059043.987 1464.39
9045.8091464.3799053.3441464.3289064.1811464.2599065.8981464.2489073.5851464.197
9074.3221464.192 9086.761464.113 9087.641464.1079095.2181464.0579095.3621464.057
9104.262    14649108.899    1464  9109.5    14649120.653    14649121.355    1464
9129.919    14649132.824    14649136.192    14649139.237    14649149.705    1464
9153.155    1464 9156.17    14649182.531 1462.419187.0561462.3219192.3881462.008
9192.4191462.0079192.566    14629195.007    14629195.936    14629203.053    1462
9204.655    14629206.078    14629208.154    14629215.4181462.249 9217.13  1462.3
9225.4251462.6339226.5741462.6549226.6321462.6569227.2621462.681 9232.081462.739
 9244.091463.1199245.6581463.1599245.7051463.1619249.6881463.2789259.6421462.758
9265.6851462.8399267.7231462.8659274.0161462.9279278.864 1462.999327.0151462.623
9339.8931462.6839346.6071462.7179354.705 1462.759358.9151462.7739359.8571462.775
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9368.0161462.8159371.3651462.8359372.325 1462.849374.5451462.8369377.6041462.854
9377.7011462.8549384.8091462.8899387.454    14629406.373    14629407.028    1462
9424.172    14629434.321    14629459.1231463.2719461.0851463.2959468.0521463.331
9469.2081463.3379470.921 1463.359476.3391463.3789476.4881463.378 9477.821463.385
9481.9521463.4079483.5841463.4139502.201    14629505.967    14629508.469    1462
 9556.97    14629558.603    1462 9561.86    14629569.589    14629572.453    1462
9574.869    14629580.071    1462  9592.2    14629595.901    14629597.072    1462
9597.224    14629600.426    14629601.129    14629605.171    14629617.998    1462
 9618.84    14629622.355    14629622.596    14629626.398    14629632.071    1462
9634.653    14629637.311    14629638.515    1462 9647.351461.7529649.9541461.701
9655.9771461.578 9665.391461.3949675.0821461.1839678.3621461.1149702.2791460.593
9729.325    14609750.678    1460  9760.7    1460 9760.87    14609761.161    1460
9761.793    14609773.737    14609807.2051461.0019809.5581461.0799828.0411461.302
9831.0431461.3889832.8871461.3529834.4331461.3259838.4061461.2549840.829 1461.26
9844.9941461.1769845.2551461.1699848.3721461.1129855.6361460.9269856.0111460.914
9857.8341460.8579858.2371460.8419865.4271460.6769877.6451460.374 9879.141460.337
9879.268 1460.339882.2341460.2019887.777    14609887.925    14609888.506    1460
9895.839    1460 9896.29    14609898.931    14609902.8691459.4819904.4461459.273
 9904.61 1459.26 9905.051459.2269908.2751458.8419911.751 1458.389914.471    1458
9915.7271457.8259915.8981457.8019917.2351457.5559920.7991456.8999922.4091456.416
9923.797    14569930.1181454.9829936.8021454.642 9942.14    14549949.848    1454
9950.184    14549950.454    14549951.941    14549967.0521454.9099971.3981454.484
9972.1661454.4279976.579    1454   10000    1454 10002.2    145410021.79    1454
10022.96    145410023.03    145410023.341454.03610023.621454.055 10032.91454.956
10033.381454.97510043.99    1456 10045.5    145610058.33    145610067.44    1456
10072.07    145610073.31    145610075.01    145610076.57    145610084.61    1456
10088.93    145610095.68    145610095.91    145610098.55    1456 10116.4    1456
10120.46    145610121.52    145610142.27    145610148.08    145610183.91    1456
10187.68    145610258.37    145610272.53    145610277.22    145610287.14    1456
10312.88    145610349.42    145610356.01    145610362.06    1456 10388.7    1456
10392.75    145610393.88    145610394.12    145610454.941457.02110513.73    1458
10532.071459.92410532.441459.95210532.78    146010532.82    146010548.261460.735
10574.67    146210574.78    146210575.181462.446 10576.6    1464 10577.21464.656
10578.42    1466 10579.11466.74510580.25    1468 10580.5    146810592.121468.428
 10607.71468.98610628.591469.56410633.361469.71610640.561469.932

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
 8635.48    .0559967.052    .05510043.99    .055

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
      9967.05210043.99              260  235.61     225              .1       .3
Ineffective Flow     num=       1
   Sta L   Sta R    Elev  Permanent
888       T

CROSS SECTION          RIVER: Buchanan Wash
REACH: Buchanan Wash      RS: 0.456

INPUT
Description: Section 0.456 placed to reflect retention basin and property
             boundary of Arizona Hillcrest property.

Ineffective Flow Areas
             reflect the retention basin for the Arizona Hillcrest Subdivision.
             It is assumed the full depth of the retention basin will not act
             as conveyance area.
Station Elevation Data    num=     277
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
 8629.371466.6468640.0911466.3568653.045    14668667.635    14668678.398    1466
8685.581    14668693.535    14668766.081    14668769.063    14668769.192    1466
  8772.8    14668774.245    14668776.499    14668782.608    14668790.616    1466
 8791.52    14668799.382    14668799.419    14668800.4151465.858 8802.171465.644
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8814.088    14648828.103    14648838.877    14648841.857    14648847.187    1464
8848.731    1464 8848.86    14648850.1551464.053 8855.981464.3578859.1641464.503
8913.084    14668917.431    14668920.275    14668923.665    14668946.138    1466
  8949.51465.9268949.9851465.9298959.4831465.9968960.173    14668960.203    1466
8962.547    14668962.798    14668963.372    14668972.974    14668973.016    1466
8973.104    14668991.538    14669005.479    14669007.818    14669009.094    1466
9021.266    14669021.881    14669024.489    14669025.761    14669084.1681465.231
9112.981    14669127.913    14669128.393    1466 9131.57    14669132.596    1466
9133.818    14669134.178    14669134.557    14669139.692    14669141.932    1466
9142.593    14669143.787    1466 9143.83    14669143.883    14669144.447    1466
 9144.58    14669145.212    14669147.017    14669152.485    14669152.628    1466
 9157.85    14669159.592    14669160.228    14669160.6691465.786 9162.541464.914
9164.201    14649164.307    14649164.602    14649171.877    14649172.101    1464
9180.519    14649187.673    14649234.019    1464 9253.71    14649262.575    1464
9267.764    14649268.228    14649271.305    14649282.9291462.933 9289.471462.798
9299.0761462.6529311.743 1462.389328.998    14629329.974    14629331.755    1462
9331.792    14629343.0451461.7659350.2141461.6289350.2651461.6279360.8991461.489
9364.3421461.4639373.2771461.3429376.6061461.2979377.023 1461.299378.1731461.273
9379.016 1461.269385.5871461.1989393.8471461.0699394.2771461.0619398.1541460.982
9398.6041460.9729407.2141460.8069419.5131460.5179424.178 1460.499430.9261460.414
9443.3541460.185  9447.3    14609456.409    14609456.955    14609462.899    1460
9464.179    14609466.1151459.8699468.649    14609475.965    14609476.535    1460
9478.299    14609480.488    14609481.9511459.7979503.1291459.0169511.3351459.158
9538.227    14609538.274    14609538.4091460.0439538.4191460.0469544.042    1462
9548.841    1462 9554.87    14629567.068 1461.399569.8031461.4189571.4551461.437
9572.5261461.4559575.9521461.4929581.2081461.3249623.135    14609628.683    1460
9635.511    14609643.894    14609653.433    14609657.678    14609668.081    1460
9669.247    14609670.475    14609678.805    14609683.926    14609689.147    1460
9695.397    14609709.986    14609717.548    14609720.999    14609725.183    1460
9729.608    14609737.068    14609743.464    14609746.047    14609758.213    1460
9760.548    14609762.555    14609770.375    14609772.369    14609788.847    1460
9795.627    14609795.724    14609802.096    14609804.062    14609812.851    1460
9814.894    14609818.051    14609818.795    14609825.236    14609827.0861459.813
9830.2591459.4949836.1821458.732 9836.381458.7179838.8971458.5089842.311    1458
9843.134    14589847.8761457.0049853.7621455.4549854.8971455.255 9855.451455.158
9858.2081454.5679858.5751454.4889860.673    1454 9863.881453.2549869.271    1452
9877.0561450.1899877.869    14509883.252    14509890.985    14509894.505    1450
9902.334    14509903.475    14509905.127    14509907.0381450.4879912.906    1452
9916.2031452.8369920.828    14549921.353    14549938.929    14549947.152    1454
9959.914    1454 9963.65    14549964.843    14549965.718    14549971.563    1454
9977.948    14549981.7661454.434 9983.05    1454 9983.59    14549984.6861453.724
9985.3031453.568  9986.61453.1069989.704    14529990.0951451.8619991.2051451.465
9994.6371450.4239995.6191450.1259995.7991450.0439995.893    1450   10000    1450
10008.99    145010009.42    145010014.28    145010015.54    145010015.58    1450
 10020.21451.915 10020.4    145210024.681453.77710025.22    145410028.76 1455.47
10030.04    145610030.21    145610030.35    145610034.58    145610036.34    1456
10036.57    145610041.08    145610125.051455.01110130.131454.97210131.43 1454.97
10159.771454.96510192.731454.83910262.851454.50210460.39    145610464.49    1456
10468.59    1456 10478.7    145610479.13    145610481.62    145610482.05    1456
10483.48    145610508.691456.64810562.81    1458 10573.71458.81610589.17    1460
10595.931461.04410602.13    146210607.321462.73510616.59    146410625.941465.209
10634.22    146610634.451466.023

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
 8629.37    .0559981.766    .05510030.04    .055

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
      9981.76610030.04              210  210.92     200              .1       .5
Ineffective Flow     num=       1
   Sta L   Sta R    Elev  Permanent
888        T
```

CROSS SECTION RIVER: Buchanan Wash
REACH: Buchanan Wash RS: 0.416

INPUT
Description: Section 0.710 in old study

Ineffective Flow Areas reflect the
retention basin for the Arizona Hillcrest Subdivision. It is
assumed the full depth of the retention basin will not act as
conveyance area.

Station Elevation Data num= 190

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
8579.83	14648	586.223	14648	592.832	14648	593.379	14648	598.017	1464
8598.625	14648	600.713	14648	632.067	1464	237 8632.291	1464	2388632.627	1464.228
8665.942	1464	.0438666.255	1464	.0348667.297	1464	.0358667.543	1464	.0428667.589	1464.044
8673.869	1464	.1488673.926	1464	.1498673.998	1464	.1498688.736	1464	.5068688.887	1464.506
8735.783	1464	.3858744.534	1464	.4168744.998	1464	.4318752.962	1464	.3448757.155	1464.274
8766.562	1464	.1498768.143	1464	.1288769.247	1464	.1218770.908	1464	.1118778.607	1464
8785.054	1464	.6368785.952	1464	.3138787.354	14648	789.476	14648	792.384	1464
8794.682	14648	794.959	14648	795.835	14648	799.048	14648	800.717	1464
8806.81	14648	809.723	14648	814.045	14648	818.168	14648	829.564	1464
8833.584	14648	861.581	14648	892.718	14648	897.862	1464	8904.43	1464
8910.633	14648	917.225	14648	929.348	14648	938.972	14648	943.191	1464
8948.451	14648	950.631	14648	954.894	14648	960.915	14648	998.163	1462.875
9007.259	1462	.8459054.108	14629	061.363	14629	095.638	14629	100.513	1462
9101.764	14629	105.377	14629	124.169	14629	136.647	14629	161.174	1462
9189.141	1461	.3039219.494	1460	.845 9245.831	1460	.5469251.015	1460	.5269279.638	1460
9280.698	1460	9282.19	14609	283.126	14609	290.461	14609	292.982	1460
9294.839	14609	304.056	14609	335.992	14609	344.013	14609	363.677	1459.676
9393.355	1459	.5219405.152	1459	.2879426.999	1458	.888 9471.46	1458	9531.11	1456.524
9552.387	14569	555.137	1455	.7059558.782	1455	.3669573.947	14549	580.945	1452.3
9582.116	14529	583.001	1451	.7739589.909	14509	589.972	14509	594.231	1450
9595.339	14509	602.213	14509	603.154	14509	613.337	14509	788.536	1448.279
9795.252	1448	.2219800.594	1448	.1759819.058	1448	.2539819.692	1448	.4049820.367	1448.633
9820.932	1448	.4739821.355	1448	.5749821.768	1448	.6969827.269	14509	828.615	1450.312
9831.029	1450	.8719833.909	1451	.619835.429	14529	837.784	1452	.622 9843.1	1454
9847.304	14549	847.306	14549	857.489	14549	860.769	14549	887.096	1454
9891.678	14549	943.257	14549	965.172	14549	965.969	14549	977.895	1454
9977.976	1454	9978.35	14549	978.712	1454	9978.76	14549	985.359	1454
9986.006	1454	9988.61	1452	.7269991.222	1451	.4239994.114	14509	995.437	1449.365
9998.516	1448	10000	144810	003.91	144810	006.74	144810	007.651	1448.479
10013.73	1450	10016.21	1451	.921 10016.3	1452	10016.4	1452	.110016.821	1452.147
10023.48	145410	024.93	145410	043.881	1453	.40910048.041	1453	.61610050.57	1454
10090.61	145410	128.931	1453	.69510138.55	1453	.6910142.841	1453	.68610182.031	1453.473
10204.86	1453	.4110299.641	1453	.60110348.321	1453	.91810351.05	1453	.9310352.751	1453.932
10353.331	1453	.93210363.21	145410	370.17	145410	378.05	145410	399.55	1454.26
10424.351	1454	.805 10462.21	1455	.454 10475.2	145610	479.121	1456	.733 10485.9	1458
10493.951	1459	.505 10496.6	146010	500.431	1460	.71610507.69	146210	511.561	1462.743
10517.721	1463	.94110518.08	146410	518.551	1464	.078 10530.1	146610	530.591	1466.061
10548.74	146810	550.151	1468	.14410561.511	1469	.228 10569.6	147010	584.911	1471.159

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
8579.83	.055	9986.006	.055	10023.48	.055

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
9986.006	10023.48	670	601.53	500	.1	.3

Ineffective Flow num= 1

Sta L	Sta R	Elev	Permanent
888			T

CROSS SECTION RIVER: Buchanan Wash
REACH: Buchanan Wash RS: 0.302

```
INPUT
Description: 0.302
Station Elevation Data    num=      79
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
 9649.66    1456 9664.57    1456 9670.01    1456 9673.15    1456  9673.5    1456
 9675.57    1456 9675.87    1456 9675.94    1456 9695.31 1454.39 9699.21    1454
 9723.42 1452.32 9728.47    1452 9728.84    1452 9729.17    1452 9730.56    1452
 9731.19    1452 9762.67 1451.41 9807.48 1450.59 9821.35    1450 9825.97    1450
 9827.35    1450 9828.05    1450  9838.4    1450 9847.28    1450  9853.7 1450.22
 9856.75 1450.27 9871.57 1450.46 9874.77 1450.51 9883.31 1450.62 9886.85 1450.67
 9902.26 1450.89 9912.54    1450 9914.07    1450 9968.34    1450 9970.34    1450
 9973.33    1450 9977.57    1450 9978.18    1450 9981.03    1450 9983.12    1450
 9983.38    1450 9987.82 1448.09 9988.02    1448 9988.15 1447.95 9988.48  1447.8
 9991.74    1446 9996.51 1445.19 9996.55 1445.1810002.47    144410004.08    1444
10004.57    144410007.25 1445.1110009.65    1446 10011.2 1447.1610012.33    1448
10014.65 1449.7310015.03 1449.9410015.15    145010015.53    145010064.58    1450
 10072.2    145010072.32    145010076.29    145010077.11    145010083.81    1450
10083.87    1450 10084.4 1450.0210165.23 1450.75 10209.1 1450.82 10226.9 1450.98
10237.43 1451.0610240.22 1451.0910253.92 1451.2510272.83 1451.3510337.64 1451.91
10344.95    145210375.52 1453.7310380.45    145410386.41 1454.66

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
 9649.66    .055 9983.38    .05510015.15    .055

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
       9983.3810015.15               180     193     230             .1       .3

CROSS SECTION          RIVER: Buchanan Wash
REACH: Buchanan Wash      RS: 0.266

INPUT
Description: Cross-Section 0.266
Station Elevation Data    num=      84
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
 9677.35    14569686.064    14569687.1281455.9659688.9881455.9139756.171    1454
9762.9951453.7799815.152    14529815.674    14529825.187 1451.359846.129    1450
9847.472    14509849.528    14509860.794    1450 9867.46    14509875.183    1450
9939.197    14509945.714    14509954.301    14509962.389    14509962.606    1450
9966.592    14509966.684    14509972.453    14509976.293    14509977.096    1450
9984.769    14509986.5941448.5199989.107 1446.489989.3361446.2959989.699    1446
9991.2691444.7279992.355    14449993.222    14449993.631    14449997.361    1444
9999.153    144410003.77    144410007.53    144410008.951445.43710009.51    1446
10010.881447.38910011.48    144810012.711449.24910013.131449.67410013.41    1450
10030.27    145010030.42    1450 10040.5    145010053.12    145010054.75    1450
10080.79    145010082.05    1450 10097.5    145010119.92    145010119.97    1450
10126.63    145010135.92    145010140.01    145010148.42    1450 10150.9    1450
10184.56    145010202.99    145010223.62    145010228.57    145010293.371450.715
10302.77  1450.810427.33    145210427.46    1452 10427.7    145210431.471452.208
10449.221453.00810452.311453.11910468.121453.90410468.521453.925 10469.11453.952
10470.03    145410487.461454.727   104971454.966 10504.1  1455.210511.321455.339
 10514.51455.35610524.581455.731 10525.61455.75910527.351455.828

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
 9677.35    .0559984.769    .05510013.41    .055

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
      9984.76910013.41               380  467.87     590             .5       .3

CROSS SECTION          RIVER: Buchanan Wash
REACH: Buchanan Wash      RS: 0.177
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INPUT
Description: 0.177
Station Elevation Data    num=      69
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
 9674.62    14529678.067    14529700.544    14529729.273    14529729.811    1452
9739.118    14529743.646    14529754.261    14529760.141    14529774.887    1452
9828.6131450.7089839.2081450.5969869.0641450.2559878.0851450.1489882.4611450.132
9890.542    14509891.9811449.6799900.362    14489906.1951446.8319909.876    1446
9913.1381445.2639918.732    14449922.8821443.0639927.588    14429933.501    1442
9944.819    14429949.677    14429957.674    14429960.466 1442.299972.593    1444
9976.378    14449979.425    14449998.891    144410006.83    144410013.541445.556
10015.51    144610023.511447.86310024.09    144810029.571449.27610032.69    1450
10033.061450.08710041.29    1452 10042.71452.32810049.89    145410052.331454.569
10058.48    145610065.271457.59610066.95    145810067.931458.31310073.21    1460
10081.71    146010091.64    146010094.96 1458.7310098.281457.45310104.391455.125
10106.26 1454.4110107.33    145410112.351452.08210112.56    1452 10113.9 1451.73
 10120.11450.46910124.19    145010126.31    145010131.82    145010135.48    1450
10150.171449.519 10160.31449.51310165.59 1449.5110168.961449.524

Manning's n Values        num=       4
     Sta   n Val     Sta   n Val     Sta   n Val     Sta   n Val
 9674.62    .0559913.138    .0559972.593    .05510006.83    .025

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
      9913.1389972.593               515  487.43  487.43             .1       .3
Blocked Obstructions      num=       1
   Sta L   Sta R    Elev
   1008010168.96

CROSS SECTION          RIVER: Buchanan Wash
REACH: Buchanan Wash      RS: 0.085

INPUT
Description: 0.085
Station Elevation Data    num=     126
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
 9361.87     1466 9365.14     1466 9367.83 1465.56 9369.51 1465.29 9370.65  1465.1
 9373.66 1465.25 9391.92 1465.91  9392.1 1465.94  9393.3 1465.99 9393.58    1466
 9393.84 1465.95 9403.44     1464 9413.27 1462.01  9413.3    1462 9416.53 1461.42
 9418.86     1461 9424.88 1460.04 9425.02 1460.02 9425.06 1460.01 9428.68 1459.39
 9431.63 1458.88 9436.84     1458 9437.01 1457.97 9437.31 1457.92 9442.39 1457.03
 9448.31     1456 9448.99 1455.94 9449.15 1455.93 9449.35 1455.91 9459.85 1455.14
 9461.39 1455.18 9462.16 1455.13 9465.02 1454.84 9467.77 1454.62 9469.81 1454.47
 9471.13 1454.34 9477.55 1455.08 9480.53 1454.98 9500.12     1454 9521.99    1454
 9544.34     1454 9550.75     1454 9562.74     1454 9568.49     1454  9569.5    1454
 9574.92     1454 9576.06     1454 9578.23     1454 9585.09     1454 9658.46    1454
 9660.55     1454 9661.41     1454  9664.1     1454 9667.28 1453.62 9674.48    1452
 9678.66 1450.98 9682.67     1450 9688.09 1448.68 9690.86     1448 9697.51 1446.38
 9699.04     1446 9706.36 1444.22 9707.23     1444 9715.34 1442.78 9720.43    1442
 9721.28     1442  9745.4 1440.21  9747.7     1440 9813.98     1440 9827.74    1440
 9839.93     1440 9845.24     1440 9845.78     1440 9855.04 1441.05 9862.39 1441.56
 9866.01     1442 9866.71     1442  9870.8     1442 9877.62     1442 9883.92    1442
 9886.02     1442 9887.35     1442 9887.89     1442 9898.24     1442 9900.37    1442
 9908.53     1442 9913.91     1442 9943.81     1442  9974.8     1442    9975    1442
 9975.23 1442.11 9979.15     1444 9982.32     1444 9985.95     1444 9987.52 1443.41
 9991.26     1442 9996.24     1442 9997.72     1442   10000 1442.1610020.49 1443.68
10022.09     144410024.48 1444.5210037.54 1447.5810039.37     144810039.47 1448.03
10039.73 1448.0910047.76     145010050.28  1450.610055.69     145210058.78  1452.8
10063.41     145410068.35 1455.2810071.13     1456   10076 1457.2610078.85    1458
10079.95  1458.310086.43 1459.9710086.57     146010086.68     1460 10109.7    1460
10112.25 1458.9610118.66 1456.3510120.56 1455.5710126.94 1452.9810129.23    1452
10135.49 1451.89
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Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
 9361.87    .055  9664.1    .055 9997.72    .025

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
        9664.110086.57               245  224.46  224.46             .3       .3

CROSS SECTION          RIVER: Buchanan Wash
REACH: Buchanan Wash      RS: 0.043

INPUT
Description: 0.043
Station Elevation Data    num=      54
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
 9921.66    1460 9923.24    1460 9930.85    1460 9936.35    1460 9938.28  1459.5
 9942.85    1458 9944.38 1457.49 9948.17    1456 9950.25  1455.2 9953.09    1454
 9954.38 1453.54 9958.66    1452 9959.52 1451.69 9961.31 1451.05 9964.05    1450
 9966.52 1449.73 9980.52    1448 9983.33 1447.05 9986.43    1446 9990.28  1444.7
 9992.43    1444 9994.96 1443.16 9998.36    1442   10000    144210006.02    1442
10016.11    144210020.05  1443.310022.18    144410027.52 1445.7510028.31    1446
 10035.4 1446.8510045.48    144810049.85  1448.910055.17    145010060.69 1451.17
10064.67    145210072.33 1453.6710075.18 1454.2910082.12    145610087.99 1457.69
10089.23    145810090.21 1458.2410097.28    146010115.21    146010120.93    1460
10123.95 1458.7910125.91    1458 10129.1 1456.72 10130.9    145610135.46 1454.17
10135.88    145410136.16 1453.8910142.79    1452 10143.6    1452

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
 9921.66    .025 9998.36    .05510016.11    .025

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
       9980.5210028.31                 0       0       0             .1       .5
Ineffective Flow     num=       1
   Sta L   Sta R    Elev  Permanent
888       T


SUMMARY OF MANNING'S N VALUES

River:Buchanan Wash
```

Reach	River Sta.	n1	n2	n3	n4
Buchanan Wash	1.935	.055	.055	.055	
Buchanan Wash	1.916	.055	.055	.055	
Buchanan Wash	1.842	.055	.055	.055	
Buchanan Wash	1.766	.055	.055	.055	
Buchanan Wash	1.670	.055	.055	.055	
Buchanan Wash	1.575	.055	.055	.055	
Buchanan Wash	1.479	.055	.055	.055	
Buchanan Wash	1.412	.055	.055	.055	
Buchanan Wash	1.356	.055	.055	.055	
Buchanan Wash	1.332	.055	.055	.055	
Buchanan Wash	1.326	Culvert			
Buchanan Wash	1.318	.055	.055	.055	
Buchanan Wash	1.290	.055	.055	.055	
Buchanan Wash	1.197	.055	.055	.055	
Buchanan Wash	1.098	.055	.055	.055	
Buchanan Wash	1.005	.055	.055	.055	
Buchanan Wash	0.928	.055	.055	.055	
Buchanan Wash	0.839	.055	.055	.055	

Buchanan Wash	0.696	.055	.055	.055	
Buchanan Wash	0.595	.055	.055	.055	
Buchanan Wash	0.501	.055	.055	.055	
Buchanan Wash	0.456	.055	.055	.055	
Buchanan Wash	0.416	.055	.055	.055	
Buchanan Wash	0.302	.055	.055	.055	
Buchanan Wash	0.266	.055	.055	.055	
Buchanan Wash	0.177	.055	.055	.055	.025
Buchanan Wash	0.085	.055	.055	.025	
Buchanan Wash	0.043	.025	.055	.025	

SUMMARY OF REACH LENGTHS

River: Buchanan Wash

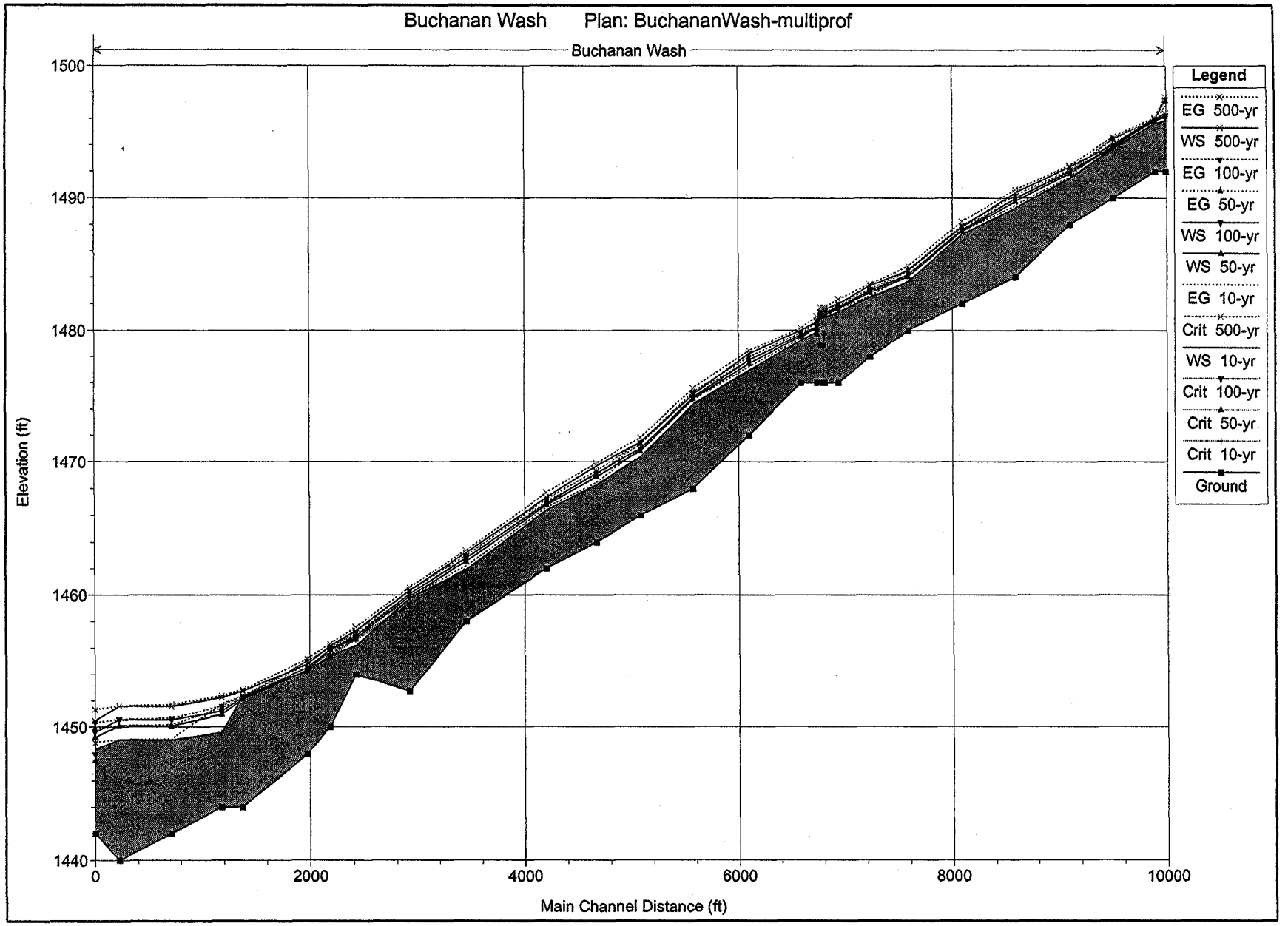
Reach	River Sta.	Left	Channel	Right
Buchanan Wash	1.935	70	100.93	100
Buchanan Wash	1.916	230	389.3	380
Buchanan Wash	1.842	400	401.78	430
Buchanan Wash	1.766	500	508.03	555
Buchanan Wash	1.670	510	500.86	490
Buchanan Wash	1.575	505	505.7	540
Buchanan Wash	1.479	355	351.78	335
Buchanan Wash	1.412	300	296.39	305
Buchanan Wash	1.356	205	129.16	75
Buchanan Wash	1.332	65	71.81	75
Buchanan Wash	1.326	Culvert		
Buchanan Wash	1.318	105	150.9	190
Buchanan Wash	1.290	445	486.94	505
Buchanan Wash	1.197	615	523.26	520
Buchanan Wash	1.098	465	491.72	505
Buchanan Wash	1.005	360	408.16	420
Buchanan Wash	0.928	480	471.49	465
Buchanan Wash	0.839	715	752.2	765
Buchanan Wash	0.696	645	533.49	500
Buchanan Wash	0.595	635	497.19	360
Buchanan Wash	0.501	260	235.61	225
Buchanan Wash	0.456	210	210.92	200
Buchanan Wash	0.416	670	601.53	500
Buchanan Wash	0.302	180	193	230
Buchanan Wash	0.266	380	467.87	590
Buchanan Wash	0.177	515	487.43	487.43
Buchanan Wash	0.085	245	224.46	224.46
Buchanan Wash	0.043	0	0	0

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS
River: Buchanan Wash

Reach	River Sta.	Contr.	Expan.
Buchanan Wash	1.935	.1	.3
Buchanan Wash	1.916	.1	.3
Buchanan Wash	1.842	.1	.3
Buchanan Wash	1.766	.1	.3
Buchanan Wash	1.670	.1	.3

BuchananWashRev1

Buchanan Wash	1.575	.1	.3
Buchanan Wash	1.479	.1	.3
Buchanan Wash	1.412	.1	.3
Buchanan Wash	1.356	.1	.3
Buchanan Wash	1.332	.1	.3
Buchanan Wash	1.326	Culvert	
Buchanan Wash	1.318	.1	.3
Buchanan Wash	1.290	.1	.3
Buchanan Wash	1.197	.1	.3
Buchanan Wash	1.098	.1	.3
Buchanan Wash	1.005	.1	.3
Buchanan Wash	0.928	.1	.3
Buchanan Wash	0.839	.1	.3
Buchanan Wash	0.696	.1	.3
Buchanan Wash	0.595	.1	.3
Buchanan Wash	0.501	.1	.3
Buchanan Wash	0.456	.1	.5
Buchanan Wash	0.416	.1	.3
Buchanan Wash	0.302	.1	.3
Buchanan Wash	0.266	.5	.3
Buchanan Wash	0.177	.1	.3
Buchanan Wash	0.085	.3	.3
Buchanan Wash	0.043	.1	.5


Buchanan Wash Plan: BuchananWash-multiprof
Buchanan Wash
Elevation (ft)
1500
1490
1480
1470
1460
1450
1440
0
2000
4000
6000
8000
10000
Main Channel Distance (ft)
Legend
EG 500-yr
WS 500-yr
EG 100-yr
EG 50-yr
WS 100-yr
WS 50-yr
EG 10-yr
Crit 500-yr
WS 10-yr
Crit 100-yr
Crit 50-yr
Crit 10-yr
Ground

HEC-RAS Plan: mulitprof River: Buchanan Wash Reach: Buchanan Wash

Reach	River Sta	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
		(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Buchanan Wash	1.935	1065.00	1492.00	1495.82	1495.82	1496.98	0.035095	8.63	123.38	54.78	1.01
Buchanan Wash	1.935	1253.00	1492.00	1496.14	1496.14	1497.36	0.033896	8.87	141.29	58.69	1.01
Buchanan Wash	1.935	1308.00	1492.00	1496.25	1496.25	1497.46	0.033121	8.85	147.74	60.46	1.00
Buchanan Wash	1.935	1407.00	1492.00	1496.39	1496.39	1497.64	0.033077	8.97	156.85	62.88	1.00
Buchanan Wash	1.916	1065.00	1492.00	1495.58		1495.66	0.002368	2.85	543.18	335.16	0.28
Buchanan Wash	1.916	1253.00	1492.00	1495.81		1495.89	0.002234	2.90	620.18	343.49	0.27
Buchanan Wash	1.916	1308.00	1492.00	1495.87		1495.95	0.002200	2.91	642.18	345.84	0.27
Buchanan Wash	1.916	1407.00	1492.00	1495.98		1496.06	0.002172	2.95	678.18	349.63	0.27
Buchanan Wash	1.842	1065.00	1490.00	1493.70		1494.16	0.010423	5.85	223.05	132.61	0.58
Buchanan Wash	1.842	1253.00	1490.00	1493.82		1494.38	0.012278	6.50	238.80	138.75	0.64
Buchanan Wash	1.842	1308.00	1490.00	1493.85		1494.44	0.012853	6.69	242.87	140.24	0.65
Buchanan Wash	1.842	1407.00	1490.00	1493.97	1493.59	1494.56	0.012625	6.79	266.64	278.22	0.65
Buchanan Wash	1.766	1175.00	1488.00	1491.49		1491.59	0.004078	3.65	495.78	335.53	0.36
Buchanan Wash	1.766	1467.00	1488.00	1491.84		1491.94	0.003470	3.61	617.36	363.18	0.34
Buchanan Wash	1.766	1609.00	1488.00	1491.99		1492.10	0.003246	3.59	676.13	375.64	0.33
Buchanan Wash	1.766	1958.00	1488.00	1492.33		1492.43	0.002983	3.65	805.82	405.67	0.32
Buchanan Wash	1.670	1175.00	1484.00	1489.25		1489.45	0.004259	3.96	332.49	119.19	0.38
Buchanan Wash	1.670	1467.00	1484.00	1489.74		1489.96	0.004237	4.08	393.43	128.25	0.38
Buchanan Wash	1.670	1609.00	1484.00	1489.95		1490.18	0.004255	4.14	420.84	132.12	0.38
Buchanan Wash	1.670	1958.00	1484.00	1490.38		1490.63	0.004110	4.36	526.38	276.66	0.38
Buchanan Wash	1.575	1175.00	1482.00	1487.26	1485.78	1487.50	0.003568	4.58	359.00	164.05	0.37
Buchanan Wash	1.575	1467.00	1482.00	1487.49		1487.79	0.004360	5.23	398.70	175.61	0.41
Buchanan Wash	1.575	1609.00	1482.00	1487.60		1487.93	0.004713	5.51	417.43	180.81	0.43
Buchanan Wash	1.575	1958.00	1482.00	1487.84	1486.72	1488.24	0.005474	6.12	462.66	192.01	0.46
Buchanan Wash	1.479	1175.00	1480.00	1483.67		1484.24	0.013900	7.03	259.27	270.91	0.68
Buchanan Wash	1.479	1467.00	1480.00	1484.05		1484.48	0.010386	6.53	369.92	339.11	0.60
Buchanan Wash	1.479	1609.00	1480.00	1484.20		1484.59	0.009403	6.37	416.82	357.26	0.57
Buchanan Wash	1.479	1958.00	1480.00	1484.52		1484.85	0.007882	6.15	522.68	394.16	0.53
Buchanan Wash	1.412	1175.00	1478.00	1482.49		1482.57	0.002129	3.17	541.22	256.27	0.27

HEC-RAS Plan: mulitprof River: Buchanan Wash Reach: Buchanan Wash (Continued)

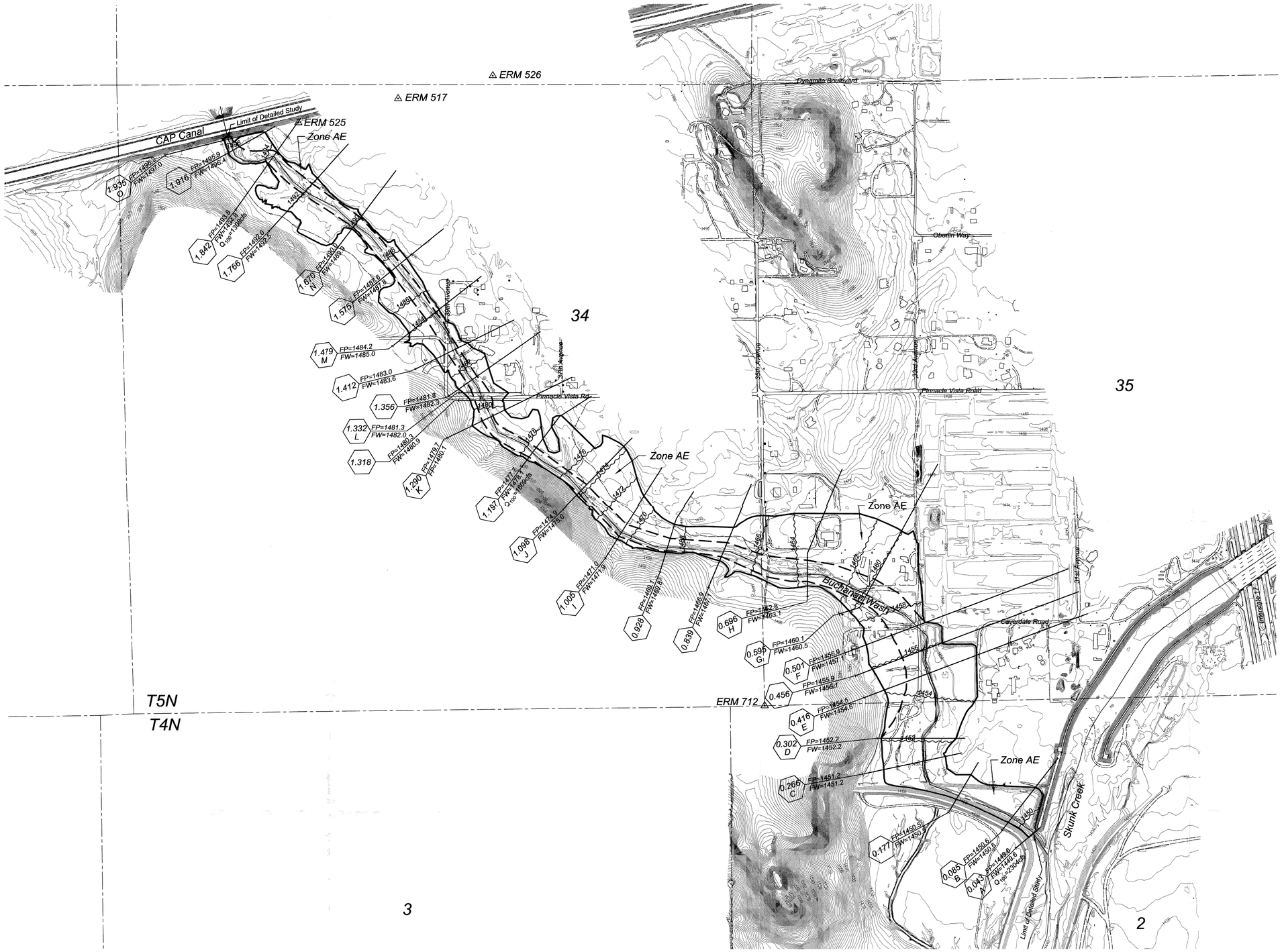
Reach	River Sta	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
		(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Buchanan Wash	1.412	1467.00	1478.00	1482.83		1482.93	0.002244	3.44	634.91	284.57	0.28
Buchanan Wash	1.412	1609.00	1478.00	1482.98		1483.09	0.002282	3.54	677.33	293.61	0.29
Buchanan Wash	1.412	1958.00	1478.00	1483.35		1483.47	0.002256	3.70	790.45	316.45	0.29
Buchanan Wash	1.356	1175.00	1476.00	1481.37		1481.59	0.005605	4.01	348.60	222.54	0.42
Buchanan Wash	1.356	1467.00	1476.00	1481.63		1481.89	0.005942	4.38	411.49	250.34	0.44
Buchanan Wash	1.356	1609.00	1476.00	1481.75		1482.02	0.006049	4.53	442.06	262.79	0.45
Buchanan Wash	1.356	1958.00	1476.00	1482.01		1482.35	0.006914	5.10	514.54	540.86	0.48
Buchanan Wash	1.332	1175.00	1476.00	1480.97	1479.46	1481.08	0.002277	3.46	556.75	348.61	0.29
Buchanan Wash	1.332	1467.00	1476.00	1481.20	1479.80	1481.33	0.002506	3.76	641.31	367.23	0.31
Buchanan Wash	1.332	1609.00	1476.00	1481.31	1479.88	1481.45	0.002584	3.88	682.03	375.85	0.31
Buchanan Wash	1.332	1958.00	1476.00	1481.56	1479.93	1481.71	0.002753	4.14	777.02	395.38	0.32
Buchanan Wash	1.326	Culvert									
Buchanan Wash	1.318	1175.00	1476.00	1479.90	1479.13	1480.31	0.007866	5.59	284.69	209.41	0.52
Buchanan Wash	1.318	1467.00	1476.00	1480.18	1479.73	1480.62	0.008409	6.07	349.76	254.81	0.54
Buchanan Wash	1.318	1609.00	1476.00	1480.30	1479.88	1480.74	0.008342	6.17	381.03	258.60	0.54
Buchanan Wash	1.318	1958.00	1476.00	1480.61	1480.28	1481.04	0.007719	6.24	464.02	268.40	0.53
Buchanan Wash	1.290	1175.00	1476.00	1479.24		1479.39	0.004300	3.41	430.55	275.32	0.37
Buchanan Wash	1.290	1467.00	1476.00	1479.54		1479.69	0.004165	3.60	514.62	293.57	0.37
Buchanan Wash	1.290	1609.00	1476.00	1479.67		1479.83	0.004109	3.68	554.17	318.41	0.37
Buchanan Wash	1.290	1958.00	1476.00	1480.01		1480.19	0.003950	3.87	662.67	747.57	0.37
Buchanan Wash	1.197	1175.00	1472.00	1476.95		1477.23	0.004571	5.00	337.43	254.54	0.41
Buchanan Wash	1.197	1467.00	1472.00	1477.47		1477.72	0.003958	4.99	435.75	318.74	0.39
Buchanan Wash	1.197	1609.00	1472.00	1477.73		1477.97	0.003578	4.91	492.63	353.42	0.37
Buchanan Wash	1.197	1958.00	1472.00	1478.23		1478.47	0.003252	4.96	620.66	777.99	0.36
Buchanan Wash	1.098	1422.00	1468.00	1474.35	1473.10	1474.69	0.004815	5.35	426.28	369.25	0.42
Buchanan Wash	1.098	2005.00	1468.00	1474.76	1473.76	1475.13	0.005453	6.00	605.34	519.80	0.46
Buchanan Wash	1.098	2304.00	1468.00	1474.88	1473.83	1475.31	0.006154	6.48	674.61	568.59	0.49
Buchanan Wash	1.098	3067.00	1468.00	1475.11	1473.71	1475.59	0.007346	7.27	803.33	573.31	0.54

HEC-RAS Plan: mulitprof River: Buchanan Wash Reach: Buchanan Wash (Continued)

Reach	River Sta	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
		(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Buchanan Wash	1.005	1422.00	1466.00	1470.35		1470.98	0.013576	7.67	310.61	315.58	0.69
Buchanan Wash	1.005	2005.00	1466.00	1470.80		1471.34	0.012050	7.76	484.10	428.56	0.66
Buchanan Wash	1.005	2304.00	1466.00	1470.99		1471.47	0.010641	7.52	570.10	437.40	0.62
Buchanan Wash	1.005	3067.00	1466.00	1471.47		1471.84	0.008176	7.04	781.93	458.55	0.55
Buchanan Wash	0.928	1422.00	1464.00	1468.28		1468.43	0.003506	3.89	506.17	239.32	0.35
Buchanan Wash	0.928	2005.00	1464.00	1468.86		1469.03	0.003301	4.15	647.12	244.81	0.35
Buchanan Wash	0.928	2304.00	1464.00	1469.12		1469.31	0.003263	4.29	711.12	247.26	0.35
Buchanan Wash	0.928	3067.00	1464.00	1469.67		1469.89	0.003359	4.68	848.19	252.44	0.36
Buchanan Wash	0.839	1422.00	1462.00	1466.39		1466.59	0.004293	4.33	465.27	245.79	0.39
Buchanan Wash	0.839	2005.00	1462.00	1466.77		1467.04	0.005468	5.20	566.38	291.06	0.45
Buchanan Wash	0.839	2304.00	1462.00	1466.89		1467.21	0.006230	5.66	604.04	306.21	0.48
Buchanan Wash	0.839	3067.00	1462.00	1467.34		1467.70	0.006656	6.24	751.43	359.41	0.50
Buchanan Wash	0.696	1422.00	1458.00	1461.91		1462.18	0.008787	5.55	371.27	223.47	0.54
Buchanan Wash	0.696	2005.00	1458.00	1462.53		1462.73	0.006202	5.24	639.52	513.91	0.46
Buchanan Wash	0.696	2304.00	1458.00	1462.81	1461.81	1462.98	0.005204	5.02	787.20	563.72	0.43
Buchanan Wash	0.696	3067.00	1458.00	1463.20		1463.38	0.005093	5.27	1025.21	661.09	0.43
Buchanan Wash	0.595	1422.00	1452.73	1459.75	1458.71	1459.88	0.002233	3.73	686.58	640.50	0.29
Buchanan Wash	0.595	2005.00	1452.73	1459.89	1459.10	1460.09	0.003525	4.77	779.58	686.15	0.36
Buchanan Wash	0.595	2304.00	1452.73	1460.06	1459.31	1460.30	0.004153	5.29	909.64	831.86	0.39
Buchanan Wash	0.595	3067.00	1452.73	1460.31	1459.66	1460.56	0.004603	5.72	1114.01	854.04	0.42
Buchanan Wash	0.501	1422.00	1454.00	1456.16	1455.09	1456.94	0.035882	7.66	246.24	480.58	1.00
Buchanan Wash	0.501	2005.00	1454.00	1456.72	1456.63	1457.05	0.013730	5.65	523.81	515.64	0.64
Buchanan Wash	0.501	2304.00	1454.00	1456.92	1456.73	1457.21	0.011270	5.40	625.91	527.98	0.59
Buchanan Wash	0.501	3067.00	1454.00	1457.30	1456.92	1457.57	0.008935	5.28	835.58	553.33	0.54
Buchanan Wash	0.456	1422.00	1450.00	1455.39	1454.88	1455.48	0.001907	2.87	669.73	461.14	0.25
Buchanan Wash	0.456	2005.00	1450.00	1455.88	1455.30	1455.98	0.001973	3.11	921.54	570.14	0.26
Buchanan Wash	0.456	2304.00	1450.00	1455.88	1455.43	1456.02	0.002602	3.57	922.16	570.39	0.30
Buchanan Wash	0.456	3067.00	1450.00	1456.13	1455.70	1456.32	0.003312	4.17	1078.66	637.52	0.34
Buchanan Wash	0.416	1422.00	1448.00	1454.28	1454.28	1454.69	0.009562	6.28	469.87	829.46	0.56

HEC-RAS Plan: mulitprof River: Buchanan Wash Reach: Buchanan Wash (Continued)

Reach	River Sta	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
		(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Buchanan Wash	0.416	2005.00	1448.00	1454.33	1454.28	1455.01	0.016349	8.28	509.62	832.17	0.73
Buchanan Wash	0.416	2304.00	1448.00	1454.52	1454.28	1454.98	0.012044	7.33	671.38	843.10	0.63
Buchanan Wash	0.416	3067.00	1448.00	1454.77	1454.28	1455.15	0.010948	7.27	881.00	857.05	0.61
Buchanan Wash	0.302	1422.00	1444.00	1452.36	1450.91	1452.39	0.000705	2.25	1176.89	628.38	0.16
Buchanan Wash	0.302	2005.00	1444.00	1452.12		1452.22	0.002038	3.73	1029.69	620.55	0.27
Buchanan Wash	0.302	2304.00	1444.00	1452.25		1452.36	0.002188	3.92	1109.12	624.82	0.28
Buchanan Wash	0.302	3067.00	1444.00	1452.73		1452.83	0.001942	3.89	1411.35	640.24	0.27
Buchanan Wash	0.266	1422.00	1444.00	1449.56	1449.56	1451.75	0.033202	11.87	119.77	27.71	1.01
Buchanan Wash	0.266	2005.00	1444.00	1450.95	1450.95	1451.44	0.008670	7.15	544.94	487.23	0.53
Buchanan Wash	0.266	2304.00	1444.00	1451.19	1451.03	1451.59	0.007364	6.78	664.99	515.79	0.50
Buchanan Wash	0.266	3067.00	1444.00	1452.23		1452.37	0.002633	4.52	1260.65	623.37	0.30
Buchanan Wash	0.177	1422.00	1442.00	1449.01		1449.09	0.000652	2.36	636.87	133.09	0.16
Buchanan Wash	0.177	2005.00	1442.00	1450.07		1450.18	0.000698	2.70	783.02	146.53	0.17
Buchanan Wash	0.177	2304.00	1442.00	1450.53		1450.66	0.000731	2.88	861.67	190.29	0.18
Buchanan Wash	0.177	3067.00	1442.00	1451.56		1451.71	0.000750	3.17	1090.39	246.38	0.19
Buchanan Wash	0.085	1422.00	1440.00	1449.02		1449.03	0.000029	0.57	2500.40	356.96	0.04
Buchanan Wash	0.085	2005.00	1440.00	1450.09		1450.10	0.000037	0.69	2886.37	365.83	0.04
Buchanan Wash	0.085	2304.00	1440.00	1450.56		1450.57	0.000041	0.75	3059.58	369.74	0.05
Buchanan Wash	0.085	3067.00	1440.00	1451.60		1451.61	0.000050	0.89	3446.64	377.99	0.05
Buchanan Wash	0.043	1422.00	1442.00	1448.31	1446.52	1448.85	0.003001	5.99	246.42	68.96	0.49
Buchanan Wash	0.043	2005.00	1442.00	1449.21	1447.50	1449.87	0.003001	6.73	313.61	80.59	0.50
Buchanan Wash	0.043	2304.00	1442.00	1449.60	1447.92	1450.33	0.003001	7.05	346.50	85.70	0.51
Buchanan Wash	0.043	3067.00	1442.00	1450.47	1448.79	1451.32	0.003004	7.72	425.25	94.57	0.52



THE BASE TOPOGRAPHIC MAPPING USED TO CONDUCT THIS FLOODPLAIN DELINEATION STUDY WAS PREPARED BY M & B AERIAL MAPPING COMPANY, INC. THIS MAPPING IS BASED ON AERIAL PHOTOGRAPHY TAKEN FEB 11, 2000 AND JAN 24, 2001. PROJECT CONTROL WAS PROVIDED BY MORRISON–MAIERLE, INC. TETRA TECH, INC. ASSUMES NO RESPONSIBILITY FOR THE ACCURACY OF THE CONTROL SURVEY OR THE BASE TOPOGRAPHIC MAPPING.

LEGEND

100–YR FLOODPLAIN BOUNDARY
FLOODWAY BOUNDARY
HYDRAULIC BASE LINE

CROSS SECTION — 0.10 A (CROSS SECTION RIVER MILE; INDEX CROSS SECTION) — FP= 1483.6 (FLOODPLAIN WATER SURFACE ELEVATION); FW= 1483.0 (FLOODWAY WATER SURFACE ELEVATION)

ELEVATION REFERENCE MARK — △ ERM XXX
BASE FLOOD ELEVATION — 1462
SFH ZONE DESIGNATION — ZONE AE

ELEVATION REFERENCE MARKS

NOTE: ALL ELEVATIONS ARE BASED ON NATIONAL GEODETIC VERTICAL DATUM OF 1929. CONVERSION FACTOR: NGVD 1929 +1.95' = NAVD 1988

I.D. NUMBER	ELEVATION (FT)	DESCRIPTION/LOCATION
517	1500.60	FOUND U.S. DEPARTMENT OF INTERIOR BRASS CAP ALONG C.A.P. CANAL. STAMPED POINT #44, STATION 373+41.83 150' RIGHT N: 996,684.42 E: 430,995.55
525	1502.21	FOUND U.S. DEPARTMENT OF INTERIOR BRASS CAP ALONG C.A.P. CANAL. POINT #43 STATION 386+00, 125' RIGHT N: 996,480.99 E: 430,163.65
526	1500.11	FOUND U.S. DEPARTMENT OF INTERIOR BRASS CAP ALONG C.A.P. CANAL. STAMPED POINT #44, STATION 402+67.37 125' RIGHT N: 996,877.09 E: 431,783.43
712	1555.08	FOUND STONE AT THE SOUTHEAST CORNER OF OF SECTION 34 T5N R2E N: 991,520.42 E: 434,056.21

NOTES

NO.	REVISION	BY	DATE
2			
1			

CITY OF PHOENIX
MARICOPA COUNTY, ARIZONA

BUCHANAN WASH
WORK STUDY MAP
LETTER OF MAP REVISION

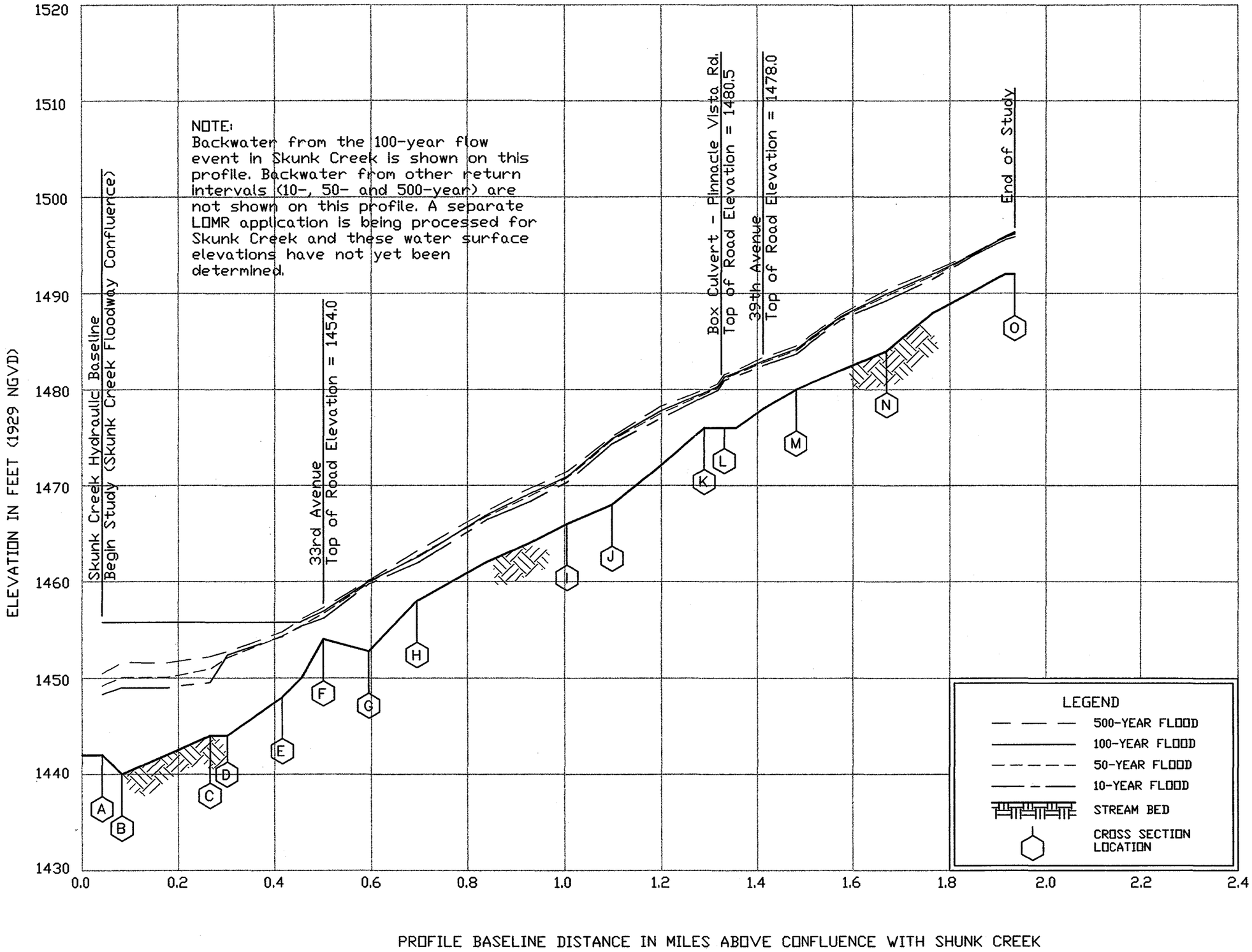
REGISTERED PROFESSIONAL ENGINEER (Civil) CERTIFICATE NO. 28660 BART S. BERGENDAHL Date Signed 11-1-01 ARIZONA, U.S.A.

TETRA TECH, INC.
INFRASTRUCTURE SOUTHWEST GROUP
4801 East Washington Street, Suite 360, Phoenix, AZ 85034
(602) 682-3300 FAX (602) 244-1164

	BY	DATE
DESIGN	DEJ	10/2001
DESIGN CHK.	BSB	10/2001
PLANS	CBC	10/2001
PLANS CHK.	BSB	10/2001

SHEET 01 OF 01

Figure 2



FLOOD PROFILES

BUCHANAN WASH

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF PHOENIX

FIGURE 5