

DESIGN SUMMARY REPORT

Skye Canyon Detention Basin 1

Las Vegas, NV

Job No.: OLY1401.004

Date: August 2015

Prepared By:

Slater Hanifan Group, Inc.
5740 S. Arville Street, Suite 216
Las Vegas, Nevada 89118
Phone: 702-284-5300 • Fax: 702-284-5399

Prepared For:

Ninety-Five Management, LLC
11411 Southern Highlands Parkway, Suite 300
Las Vegas, NV 89141
Phone: 702-220-6565 • Fax: 702-220-6566



Steve Jones, P.E.
NV Professional Engineer No. 19638

OLY1401.004

August 6, 2015

Nevada State Engineer
Division of Water Resources
901 S. Stewart Street, Suite 2002
Carson City, NV 89701

Subject: Basis of Design for Skye Canyon Detention Basin 1

To whom it may concern:

In pursuant to Nevada Revised Statutes (NRS) 535.010, this application is regarding the construction of the dam identified as Skye Canyon Detention Basin 1. The following standard forms have been included in Appendix A providing the required information to complete review in obtaining a dam safety permit.

- Application for Approval of the Plans and Specification for the Construction of a Dam,
- Notice of Construction of a Dam
- Engineering Review of Dams: Design, Plans and Specifications

Design Scope & Approach

Ninety-Five Management, LLC is proposing to install a regional detention basin on the western edge of the Skye Canyon property (formerly known as Kyle Canyon). The current master plan for the 1,662 acre Skye Canyon property, plans for this detention basin at its western edge to cut-off and reduce offsite flows impacting future development.

DB1 has been planned as a regional detention basin; therefore, requirements of a local Clark County Regional Flood Control District (CCRFCD) regional detention basin have been utilized in the technical design of the facility and its components. Detailed hydrologic and hydraulic analyses have been utilized to design the following significant components of the facility:

- Detention/storage area;
- Collector channel extending from Grand Teton to the detention basin;
- Debris storage;
- Outlet structures;
- PMF overflow spillway;
- Maintenance access.

This summary letter is intended to provide an overview of the Basis of Design for the dam, in accordance with the form "Engineering Review of Dams: Design, Plans and Specifications" and has been structured in a consistent manner.

3.1 Hazard Classification

Hazard classification is defined as a statement of the most realistic adverse impact on human life and downstream developments should a dam fail. Potential dam classifications are 'Low', 'Significant' or 'High'.

After investigation, downstream hazards include the following if dam failure occurs:

- Existing residential development,
- Future residential development is anticipated adjacent to the project within the master planned community,
- U.S. Highway 95.

Therefore, with respect to the appreciable economic loss and human endangerment, it has been determined that if dam failure were to occur that the hazard is classified as 'High'. An inundation drainage map depicting potential hazards has been included in Appendix E for reference.

3.2.1 Hydrology – Tributary Area Described

3.2.1.1 Nature of Tributary Area: A total drainage area of 0.88 square miles of upstream land is anticipated to discharge into the proposed dam, comprised of a majority of undeveloped land typical of southern Nevada encompassed within the Red Rock National Conservation Area (RRCA). The southern 0.50 square miles of tributary area, encompassing 0.03 square miles of future developable land per Clark County Regional Flood Control District's (CCRFCD) Master Plan, is anticipated to be routed to the dam area with a concrete collector channel. Collector channel hydraulic capacity analysis, utilizing WSPG program, has been included in Appendix D. Note that several deeply cut washes do traverse tributary drainage area and the project proposes embankments in these washes with 30-ft to 40-ft cuts of the between areas to obtain the required detention volume for the basin. Sheet C-4 or the watershed map for the project represents the delineation of the tributary area to the basin.

3.2.1.2 Base Flow: No base flow is anticipated to impact the dam, because this detention basin is intended for flood control purposes and will not function as any type of reservoir receiving constant intake flows.

3.2.2 Hydrology – Storm Recurrence Interval

3.2.2.1 Appropriate for Hazard/Size: In accordance with local jurisdictional requirements, the design flood that this detention basin is intended to service is during the 100-year storm event. All downstream properties have been designed to incorporate flood protection up to the 100-year storm event; therefore, the design storm utilized in the basis of design is considered appropriate. The local 6-hour SDN3 storm distribution and 100-year precipitation obtained from NOAA Atlas 2 isopluvials, per CCRFCD requirements, has been utilized in hydrologic modeling. Precipitation data and calculations have been included in Appendix B.

3.2.2.2 Incremental Damage Analysis: No incremental damage analysis has been performed by this design. The detention basin and emergency overflow spillway has been designed to accommodate the entire PMF storm event. The PMP value and storm distribution utilized to obtain the design PMF flow rate storm event has been obtained following procedures outlined

in the NOAA Hydrometeorological Report Number 49. PMP calculations have been included in Appendix B.

3.2.3 Hydrology – Runoff Calculation Method Utilized

3.2.3.1 Appropriate Curve Numbers or Infiltration Rates: The SCS curve number loss rate methodology was utilized to approximate infiltration in the drainage tributary area. A curve number associated with “desert shrub – poor condition” was selected for the area in the RRCA. A curve number associated with “very high density residential” was selected for the 18.0 acres area to be developed in the future. A curve number associated with “newly graded areas” was obtained for the detention basin itself. Note in the undeveloped RRCA areas, due to steep terrain, debris loading impacts on the detention basin were determined utilizing the Modified Universal Soil Loss Equation. Curve numbers and debris calculations have been included in Appendix C.

3.2.4 Hydrology – Flood Routing Method Utilized

The Modified Puls routing method within the HEC-1 program was utilized to obtain the basin’s performance parameters. The HEC-1 models for the design ultimate condition 100-year storm event and the PMF storm event have been included in Appendix D.

The stage-discharge curve for the outlet to the basin has been determined utilizing orifice equation for the primary outlet of a 24-inch orifice on the 60-inch RCP outlet pipe, and a weir equation for the 87-ft crest length on the PMF overflow spillway. Note the bottom approximate 2.5-ft depth of the detention basin is reserved for debris storage, and a dewatering tower is proposed at the bottom of the basin to dewater the debris storage area in less than 7 days as directed by CCRFCD detention basin criteria. The stage-discharge calculations for these 3 structures have also been included in Appendix D.

3.2.5 Hydrology – Freeboard to Crest of Dam

A total of 11-ft of freeboard is present above the design 100-year water surface elevation (3034.96-ft) and the crest of the dam (3046.0-ft).

3.2.6 Hydrology – Freeboard in Spillway

A total of 1.07-ft of freeboard is present above the design PMF water surface elevation (3044.93-ft) in the spillway and the crest of the dam (3046.0-ft). The energy loss over the PMF overflow stepped spillway structure has been determined by a comparison of two methods, Chanson and Christodolou computations, with applicable computation and reference material detailing each method included in Appendix D. The Christodolou method yielded the most conservative approach to estimating energy loss; therefore, a stilling basin and end sill has been proposed at the bottom of the stepped spillway to force a hydraulic jump.

3.2.7 Hydrology – Dam Break Analysis

3.2.7.1 Method Utilized: A formal dam breach analysis is deferred to the Emergency Action Plan (EAP) upon proof of completion for the impoundment. However, in order to ascertain impacts to the downstream hazards, failure of the dam has been evaluated with this

application. The design of the detention basin results in a total of three (3) locations where potential embankment failure can occur. The remainder of the detention basin is below existing ground, and if breach occurs in any of these locations then the released flow will converge into the same three washes where embankment is present. An exhibit displaying the downstream hazards and potential inundation has been provided in Appendix E.

3.2.7.2 Appropriate Constants Applied: A formal dam breach analysis has not been performed at this time. However, in evaluation of the downstream hazards, it is assumed the entire PMF outflow from the detention basin is perpetuated.

3.2.7.3 Inundation Maps: As discussed above, the entire PMF outflow from the detention basin has been routed in each of the 3 washes where proposed embankment is present. Normal depth sections have been prepared to graphically represent the downstream inundation areas as they impact the hazard areas on the exhibit included in Appendix E. Note that the inundation evaluation for each conveyance wash terminates where it can be ascertained that a 'High' hazard classification is merited.

3.2.8 Hydrology – Potential for Seiche due to Landslide into Reservoir

This potential is very minimal due to the anticipation that major debris like a landslide will not impact the basin. Debris impacts from a potential of 5.9 acre-ft (less than 10% total storage volume) of granular sedimentation eroding from the basin's tributary area is likely to cause limited wave action. Note that 1-ft of freeboard above the 100-year water surface elevation is provided to the spillway crest to contain the minimal wave action caused by seiche.

3.2.9 Hydrology – Reservoir Fetch and Wave Run Up Calculations

The amount of surface area provided by the impounded water is considered limited to result in fetch that could cause serious adverse impacts. Additionally, the embankments are lined with soil cement for erosion control from actions like fetch. Therefore, it was not included in the basis for design.

Design Summary

The summary table below provides the project's performance parameters for reference.

Summary of Detention Basin Performance Parameters	
Proposed Supplement Design	
Parameter	Value
100-Yr Inflow	794 cfs
100-Yr Outflow	71 cfs
Outlet Orifice	24-inch
Total Storage Volume	62.9 ac-ft
100-Yr Volume	57 ac-ft
Debris Volume	5.9 ac-ft
100-Yr Water Surface	3034.9-ft
PMF Inflow	6,744 cfs
PMF Outflow	5,989 cfs
PMF Spillway Elevation	3037.0-ft

Summary of Detention Basin Performance Parameters	
Proposed Supplement Design	
Parameter	Value
PMF Spillway Length	87-ft
PMF Water Surface Elevation	3044.93-ft

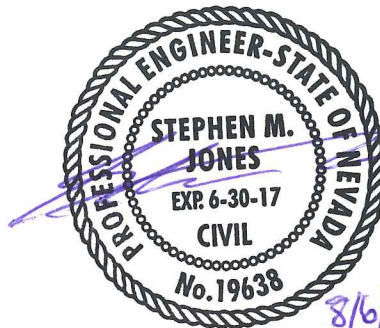
Respectfully Submitted,

SLATER HANIFAN GROUP

Steve Jones, P.E.

Project Manager - Flood Control Division

pc: City of Las Vegas Flood Control Section
Clark County Regional Flood Control District
Ninety-Five Management, LLC
Jerry Slater, P.E. - SHG
Mark Failla, P.E., CFM - SHG



APPENDIX

Appendix A – Standard Forms

- Application for Approval of the Plans and Specification for the Construction of a Dam
- Notice of Construction of a Dam
- Engineering Review of Dams: Design, Plans and Specifications

Appendix B – Precipitation Data & Calculations

- 100-Year Storm Event
- PMF Storm Event

Appendix C – Soils Data & Calculations

- Curve Number Selection
- Debris Loading (MUSLE Equation)

Appendix D – Design Analyses

- 100-year Storm Event HEC-1 Model
- PMF Storm Event HEC-1 Model
- Stage-Discharge Calculations
- Collector Channel Analysis
- PMF Overflow Spillway Structure

Appendix E – Downstream Hazard Evaluation

APPENDIX A

Standard Forms

- Application for Approval of the Plans and Specification for the Construction of a Dam
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STATE OF NEVADA
DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES
DIVISION OF WATER RESOURCES

Filed _____

J- _____

APPLICANT MUST NOT FILL IN ABOVE BLANKS

NV _____

**APPLICATION FOR APPROVAL OF THE PLANS AND SPECIFICATIONS FOR
THE CONSTRUCTION, RECONSTRUCTION OR ALTERATION OF A DAM**

This Application Involves in No Way the Right to Appropriate Water
To secure the right to appropriate water, application should be made to the State Engineer
on forms which will be furnished upon request.

I, Stephen M. Jones, P.E. of 5740 S. Arville Street, #216
Name of applicant Address
Las Vegas, NV 89118, hereby make application for the approval of

Plans and Specifications for the Construction of Skye Canyon Detention Basin 1 dam.
Construction, reconstruction, alteration Name of dam

The owner of the proposed dam is Section 12, LLC c/o Olympia Companies, LLC
Name of owner
of 11411 Southern Highlands Pkwy, Suite 300; Las Vegas State of Nevada 89141
Address

If the owner is a corporation, give name and address of president and secretary:

Garry V. Goett, Manager; Amanda Graham, Office Manager
11411 Southern Highlands Parkway, Suite 300; Las Vegas, NV 89141

The applicant is acting for the owner in the legal capacity of Agent
Agent, Lessee, Trustee, etc.

Location of Dam

1. The source of water to be stored is N/A which is a tributary of N/A,
and the proposed dam to be located within the SW 1/4, SW 1/4, Sec. 12
T. 19S, R. 59E E., M.D.B.&M. in Clark County, Nevada further described as
being at Latitude 36 deg, 18' N. Longitude 115 deg, 20' W. (at a point pursuant to NAC 535.210(6b).

Description and Dimensions of Dam

(If for an alteration, the data given below is for the altered dam)

2. Type of dam Earth 3. Length of crest 1,400 ft.
Concrete arch or gravity, earth, rockfill, etc.
4. Height stream bed to spillway crest 12 ft. 5. Height foundation to spillway crest 14 ft.
6. Freeboard 11 ft. 7. Thickness at top 16 ft. 8. Thickness at bottom 235 ft.
Spillway crest to top
9. Slope upstream* 4% 10. Slope downstream* 3% 11. Upstream facing Soil cement
*This information to be supplied for earth or rockfill dams. Concrete or rock paving, etc.
12. Amount of material in dam 16,780 cu. yds. 13. Estimated Cost \$5,322,805.00
14. Spillway data RCC Stepped Spillway, Design PMF 5,989 cfs
Type, capacity, etc.
15. Outlet data 60-inch RCP with 24-inch orifice plat, Design 100-yr Flow Rate 71 cfs
Type, capacity, etc.

16. Elevation of crest of dam 3046 above NAVD-88 datum
Approximate elevation to be given if true elevation not available

17. Area of reservoir at spillway level 7.46 acres. 18. Capacity of reservoir 72.5 ac. ft.

General Information

19. State the **purpose** of the dam 100-year flood storage, debris storage, flood control
Diversion only; storage only; storage and diversion; debris storage, flood control, etc.

20. State the **use** that is to be made of water none
municipal, domestic, irrigation, power, mining and milling, recreation, stockwatering or none

21. Engineers

Slater Hanifan Group
5740 S. Arville Street, #216
Las Vegas, NV 89118

Name and address of Engineers preparing plans

22. If the proposed dam is to be built under Federal supervision, state what department has jurisdiction.
N/A

23. The maps, plans and specifications accompanying this application are a part thereof.

[Signed]

this 6 day of August, 20 15

APPROVAL OF APPLICATION NO. _____, INCLUDING PLANS AND SPECIFICATIONS

This Is to Certify That Application No. _____, including plans and specifications for the
_____ dam has
been examined and the same is hereby approved, subject to the following conditions:

Witness my hand and seal this _____ day
of _____, 20____

State Engineer

FILE IN TRIPLICATE

NV _____

J - _____

NOTICE OF CONSTRUCTION, RECONSTRUCTION OR ALTERATION OF A DAM

PURSUANT TO NEVADA ADMINISTRATIVE CODE (NAC) 535.200

Name of dam: Skye Canyon Detention Basin 1

Location of dam: Section 12, Township 19S, Range 59E M.D.B.&M. or at a point from which the
SW corner of (said) section 12 M.D.B.&M. bears South 20.49.02 West
a distance of 1699.52-ft feet in the county of Clark.

Name of source of water: N/A

Water right (claim/permit/certificate) under which water will be diverted/stored:

N/A

Date on which work on the dam is to commence (may not be less than 30 days from the submittal date): Jan 6, 2016

Dam length: 1400 ft. Dam height: 27 ft. Dam volume: 16,780 yd³.

Capacity of reservoir to be created at spillway crest 72.5 acre-feet; & at dam crest: 152.7 acre-feet.

Description of proposed work:

A CCRFCD MPU detention basin with embankments that span deep arroyos. A trapezoidal concrete collector channel routes a portion of the watershed to the detention basin. The inflow slopes and embankment slopes inside the detention basin are to be soil-cement lined. The bottom 2.9-ft depth in the basin is reserved for debris storage with a "debris tower" outlet for drainage. A 60-inch RCP outlet pipe with a 24-inch diameter orifice extends through the basin's embankment as the outlet for the design 100-year storm flood. A RCC stepped PMF overflow spillway is proposed. The purpose of the detention basin is to intercept runoff and provide a shadow of protection for the developer's downstream community.

Name, address and telephone number of individual
completing application (*agent / owner*):

Stephen Jones, P.E.

5740 S. Arville Street, #216

Las Vegas, NV 89118

Telephone

(702) 284-5300

Signature of individual
completing application:



Date: 8/6/2015

Additional sheets may be attached for submittal of water right, owner or project information.
Application must be accompanied by plans as described by NAC 535.200(1k).

NV _____

J - _____

Name, address and telephone number of the operator of the dam:

Ninety-Five Management, LLC
11411 Southern Highlands Parkway, Suite 300
Las Vegas, NV 89141
(702) 220-6565

Name, address and telephone number of each owner of the dam:

Section 12, LLC
c/o Olympia Companies
11411 Southern Highlands Parkway, Suite 300
Las Vegas, NV 89141
(702) 220-6565

Name, address and telephone number of each professional engineer in responsible charge of work in connection with the dam:

Stephen M. Jones, P.E.
Slater Hanifan Group
5740 S. Arville Street, #216
Las Vegas, NV 89118
(702) 284-5300

Eric G. Giles, P.E.
G.C. Wallace Companies
1555 S. Rainbow Boulevard
Las Vegas, NV 89146
(702) 804-2000

Additional sheets may be attached for submittal of water right, owner, or project information.

Application must be accompanied by plans as described by NAC 535.200(1k).

NEVADA DIVISION OF WATER RESOURCES
ENGINEERING REVIEW OF DAMS:
DESIGN, PLANS, AND SPECIFICATIONS

Instructions: Note page on which noted information lies. Leave no blanks.
Use check mark if page number is inappropriate.
Note deficiencies and inconsistencies on last page.

1. APPLICATION FORM

- 1.1. ☒ Heading properly completed
- 1.2. ☒ Location properly completed
- 1.3. ☒ Dam information complete
- 1.4. ☒ Engineer listing complete
- 1.5. ☒ Original signature of person listed in heading

2. PLANS

- 2.1. C-1 Owner names on plans and dam name
- 2.2. C-1 Vicinity/location
- 2.3. C-1 Survey tie to found section corner
- 2.4. C-4 Plan view of watershed boundary. Tributary area 0.88 mi²
- 2.5. N/A Downstream hazard
- 2.6. C-3 Reservoir storage capacity curve
 - 2.6.1. C-3 Capacity to spillway invert 72.5 ac-ft at elevation 3037.0 ft
 - 2.6.2. C-3 Capacity to crest of dam 152.7 ac-ft at elevation 3046.0 ft
- 2.7. C-3 Reservoir area curve
 - 2.7.1. C-3 Area at spillway invert 7.46 ac. at elevation 3037.0 ft
 - 2.7.2. C-3 Area at crest of dam 10.7 ac. at elevation 3046.0 ft
- 2.8. C-3 Discharge curves for outlet(s) and spillway(s)
- 2.9. OGD Plan view of dam and reservoir area
- 2.10. ☒ Post-construction topography with elevation contours
- 2.11. OGD Reference point on dam. Latitude 36°18'42" N Longitude 115°19'51" W
- 2.12. ☒ Limits of stripping
- 2.13. N/A Borrow areas
- 2.14. OGD Test pits/boreholes
- 2.15. ☒ Cross section alignments
- 2.16. ☒ Cross sections
 - 2.16.1. ☒ Along axis
 - 2.16.2. ☒ At outlet
 - 2.16.3. ☒ At Spillway

- 2.16.4. ☒ Other
- 2.16.5. ☒ Dam crest elevation 3046.0 ft
- 2.16.6. G-4 Spillway crest elevation 3037.0 ft
- 2.16.7. ☒ Water level elevations
- 2.16.7.1. ☒ At maximum conservation 3037.0 ft
- 2.16.7.2. ☒ At IDF 3034.93 ft
- 2.16.7.3. N/A At minimum pool (if applicable) _____
- 2.16.7.4. ☒ Maximum flow line in spillway and elevation 3044.93 ft
- 2.16.8. D-2,3 Foundation elevation (after stripping and after any improvement)
- 2.16.9. N/A Location and dimensions of core
- 2.16.10. N/A Location and dimensions of filter and drain zones
- 2.16.11. N/A Location and dimensions of shell or random fill zones
- 2.16.12. ☒ Location and dimensions of erosion protection
- 2.16.13. ☒ Dam face slopes
- 2.16.14. N/A Dam crest camber
- 2.17. G-4 Spillway plan view and cross sections
- 2.17.1. G-4 Energy dissipation
- 2.17.2. G-4 Erosion protection
- 2.17.3. G-4 Grade control
- 2.17.4. G-4 Concrete details
- 2.17.5. N/A Reservoir control works details
- 2.18. ☒ Outlet pipe plan view and cross sections
- 2.18.1. S-7, S-9 Detail of inlet. Invert elevation 3025.5 ft
- 2.18.1.1. S-8, S-9 Trash rack
- 2.18.1.2. N/A Gate(s)
- 2.18.1.3. N/A Gate operator(s)
- 2.18.1.4. N/A Vent
- 2.18.1.5. ☒ Protection from ice, vandalism, wave action
- 2.18.1.6. ☒ Structural details
- 2.18.2. ☒ Detail of outfall. Invert elevation 3012.6 ft
- 2.18.2.1. D-5 Structural details
- 2.18.2.2. P-9 Tailwater control
- 2.18.2.3. P-9 Energy dissipater. Type CONCRETE/RIPRAP
- 2.18.3. ☒ Detail of pipe
- 2.18.3.1. D-1 Support
- 2.18.3.2. P-9 Joints

- 2.18.3.3. N/A Cut off collars (NOT ADVISED AS SOLE MEANS OF SEEP CONTROL)
- 2.18.3.4. D-1 Seep control, collection and disposal
- 2.19. N/A Drains
- 2.19.1. N/A Type and location _____
- 2.19.2. N/A Filters
- 2.19.3. N/A Details of construction
- 2.19.4. N/A Access/cleanouts
- 2.20. G-4 Monitoring works
- 2.20.1. ☒ Type, location and details
- 2.21. ☒ Foundation improvement
- 2.21.1. N/A Dental concrete
- 2.21.2. N/A Grouting program
- 2.21.3. N/A Piles
- 2.21.4. ☒ Over excavation
- 2.21.5. N/A Consolidation
- 2.21.6. N/A Relief wells
- 2.21.7. N/A Drains
- 2.22. ☒ Other considerations or details

3. **BASIS OF DESIGN**

3.1. **HAZARD CLASSIFICATION** HIGH

3.2. **HYDROLOGY**

- 3.2.1. 2 Tributary area described
- 3.2.1.1. 2 Nature of tributary area
- 3.2.1.2. 2 Base flow
- 3.2.2. 2 Storm recurrence interval 100-Year & PMF
- 3.2.2.1. 2 Appropriate for hazard/size?
- 3.2.2.2. 2 Incremental damage analysis?
- 3.2.3. 3 Runoff calculation method utilized SCS Curve Number Loss Rate
- 3.2.3.1. 3 Appropriate curve numbers or infiltration rates
- 3.2.4. 3 Flood routing method utilized Modified Puls, HEC-1
- 3.2.5. 3 Freeboard to crest of dam 11 ft.
- 3.2.6. 3 Freeboard in spillway 1.07 ft.
- 3.2.7. 3 Dam break analysis
- 3.2.7.1. 3 Method utilized N/A
- 3.2.7.2. N/A Appropriate constants applied?

- 3.2.7.3. 4 Inundation maps
3.2.8. 4 Potential for seiche due to landslide into reservoir
3.2.9. 4 Reservoir fetch and wave run up calculations

3.3. FOUNDATION

- 3.3.1. ☒ Geotechnical report
3.3.1.1. 2 Surface conditions
3.3.1.2. 3 Possible geological hazards NONE
3.3.1.3. 8 Stripping requirements
3.3.1.4. 9 Borrow area(s)
3.3.1.5. ☒ Shear strength for each zone
3.3.1.6. ☒ Permeability
3.3.1.7. ☒ Grain size distribution and classification
3.3.2. ☒ Boring/test pit logs
3.3.2.1. ☒ Located on plans
3.3.2.2. ☒ Located in report
3.3.2.3. ☒ Total depth
3.3.2.4. ☒ Stratigraphy with location of various formations and depth to groundwater
3.3.3. 7 Seep analysis
3.3.4. 9 Foundation cut-off
3.3.5. ☒ Strength of foundation materials
3.3.6. ☒ Foundation/abutment improvement necessary
3.3.7. 10 Expected settlement
3.3.8. 4 Overall depth to groundwater
3.3.9. 4 Deficiencies or special conditions

3.4. EMBANKMENT

- 3.4.1. 9 Availability of suitable materials
3.4.2. ☒ Soil properties
3.4.2.1. ☒ Shear strength tests. Max. allowable shear stress
3.4.2.1.1. Core N/A psi
3.4.2.1.2. Shell or random fill N/A psi
3.4.2.1.3. Other structural zone N/A psi
3.4.2.2. ☒ Particle size distribution and classification
3.4.2.2.1. N/A Core
3.4.2.2.2. N/A Drain(s)

- 3.4.2.2.3. N/A Filters
- 3.4.2.2.4. N/A Shell or random fill
- 3.4.2.2.5. ☒ Erosion protection
- 3.4.2.2.6. ☒ Erosion protection bedding
- 3.4.2.3. ☒ Density curves. Method ASTMD1557
- 3.4.2.4. N/A Filter compatibility between zones
- 3.4.3. 5 Slope stability
 - 3.4.3.1. 6 Factors of safety
 - 3.4.3.1.1. Post-construction static 2.55
 - 3.4.3.1.2. Steady state seep N/A
 - 3.4.3.1.3. Rapid fill 2.75
 - 3.4.3.1.4. Rapid draw down 1.28
 - 3.4.3.1.5. Seismic 1.69
 - 3.4.3.1.5.1. Method of determining seismic stability BISHOP METHOD
 - 3.4.3.1.5.2. Constants used NONE
 - 3.4.3.1.5.3. Pseudo-static seismic coefficient 0.15
 - 3.4.3.1.5.4. ☒ Assumptions stated?
- 3.4.4. 7 Seep analysis
- 3.4.5. 15 Armoring
 - 3.4.5.1. N/A Riprap calculations including bedding
 - 3.4.5.2. ☒ Soil-cement design
 - 3.4.5.3. ☒ RCC design
 - 3.4.5.4. N/A Other revetment design

4. SPECIFICATIONS

- 4.1. SIG-1 Standard specification cited Uniform Standard Specifications
- 4.2. SP-203-4 Inspection and testing schedules for all facets of work and materials
- 4.3. SP-203-4 Test or inspection failure procedure
- 4.4. ☒ Clearing and grubbing construction area
 - 4.4.1. ☒ Stripping unsuitable material
 - 4.4.2. ☒ Identification of waste dumps
 - 4.4.3. ☒ Identification of areas of over stripping
- 4.5. ☒ Borrow sources
 - 4.5.1. ☒ Material stockpiles
 - 4.5.2. ☒ Material handling
 - 4.5.3. ☒ Rejection of loads

- 4.5.4. ☒ Moisture conditioning
- 4.6. ^{SP-203-3} Foundation preparation and compaction
- 4.6.1. ☒ Relative compaction 90% Mod. Proctor/Proctor
- 4.6.2. ☒ Special requirements
- 4.7. ^{SP-203-1} Placement of embankment materials
- 4.7.1. ^{SP-203-3} Lift thickness
- 4.7.2. ^{SP-203-3} Relative compaction 90% Mod. Proctor/Proctor
- 4.7.3. ²⁰³⁻⁹ Equipment requirements
- 4.7.4. N/A Filter and drain placement
- 4.8. ^{SP-501-1} Concrete
- 4.8.1. ☒ Strengths
- 4.9. ☒ Erosion protection
- 4.9.1. ⁶¹⁰⁻² Riprap
- 4.9.2. ^{SP-310} Soil-cement
- 4.9.3. ^{SP-310} RCC
- 4.9.4. ^{SP-203-4} Other

NOTES ON NEXT PAGE

REVIEW NOTES:

2.5 - Detention Basin is being constructed in a currently undeveloped area, only existing ground present downstream in proximity of detention basin. Downstream hazard is shown more complete on Dam Break Inundation exhibit and 3.1.

2.12 - The entire project is anticipated to be stripped as directed by geotech report & special provisions. Stripping adequately shown in details where necessary.

2.13 - To achieve the required volume of material for soil-cement, it is anticipated to be imported from stockpiles elsewhere on developer's property.

2.16.7.1 - Elevation of spillway crest when design flood spills out of impoundment.

2.16.7.3 - Not reservoir; not applicable.

2.16.7.4 - PMF Water Surface Elevation in spillway.

2.16.9, 2.16.10, 2.16.11 - Seepage considered not an issue, per analysis; therefore, core, filter/drain, shell zones not necessary.

2.16.14 - Settlement to occur during construction, no camber anticipated.

2.17.4 - RCC lined stepped structure.

2.17.5 - Intended as detention basin for flood control purposes, not water storage.

2.18.1 - Flow outlets detention basin at 3025.5-ft elevation; however, pipe invert is 3013.8-ft.

2.18.2.2 - HGL in 60" RCP utilized as TW on 24" orifice.

2.18.1.2, 2.18.1.3, 2.18.1.4 - Not applicable to this detention basin.

2.18.3 - Gasketed joints proposed for control of seepage of water from pipe. Impervious material (i.e. CLSM) proposed in backfill around pipe for seepage control from embankment. Per FEMA L-266 guidelines, compaction of soils around anti-seep collars is problematic; therefore, collars are not proposed by this project.

2.19 - Drains are not needed in embankment to protect against seepage.

2.21, 2.22 - Over-excavation with a cut-off trench have been selected as preferred method for foundation improvement and shown in the details where embankment is proposed.

3.1, 3.2 - See Design Report.

3.3.1.4 - Although borrow not expected, guidelines for imported material provided.

3.3.6 - Over-excavation proposed for foundation.

3.4.2.1.1, 3.4.2.1.2, 3.4.2.1.3, 3.4.2.2.1, 3.4.2.2.2, 3.4.2.2.3, 3.4.2.2.4, 3.4.2.4 - No embankment drainage improvements needed to mitigate for seepage.

3.4.3.1.2 - Basin is filled for short amount of time and seepage expected to not occur; therefore, slope stability for steady-state seep is not required.

4.2, 4.3, 4.5.3 - Special inspection required through City of Las Vegas Building Department for items in Note on Sheet C-2.

4.6.2 - Decrease in excavation due to hard cemented soils.

4.7.4 - No filter required per geotechnical report.

4.8 - Additionally, soil-cement and roller compacted concrete strengths and special provisions provided.

4.9.4 - Soil stabilizer as directed in Special Provisions 203.03.74

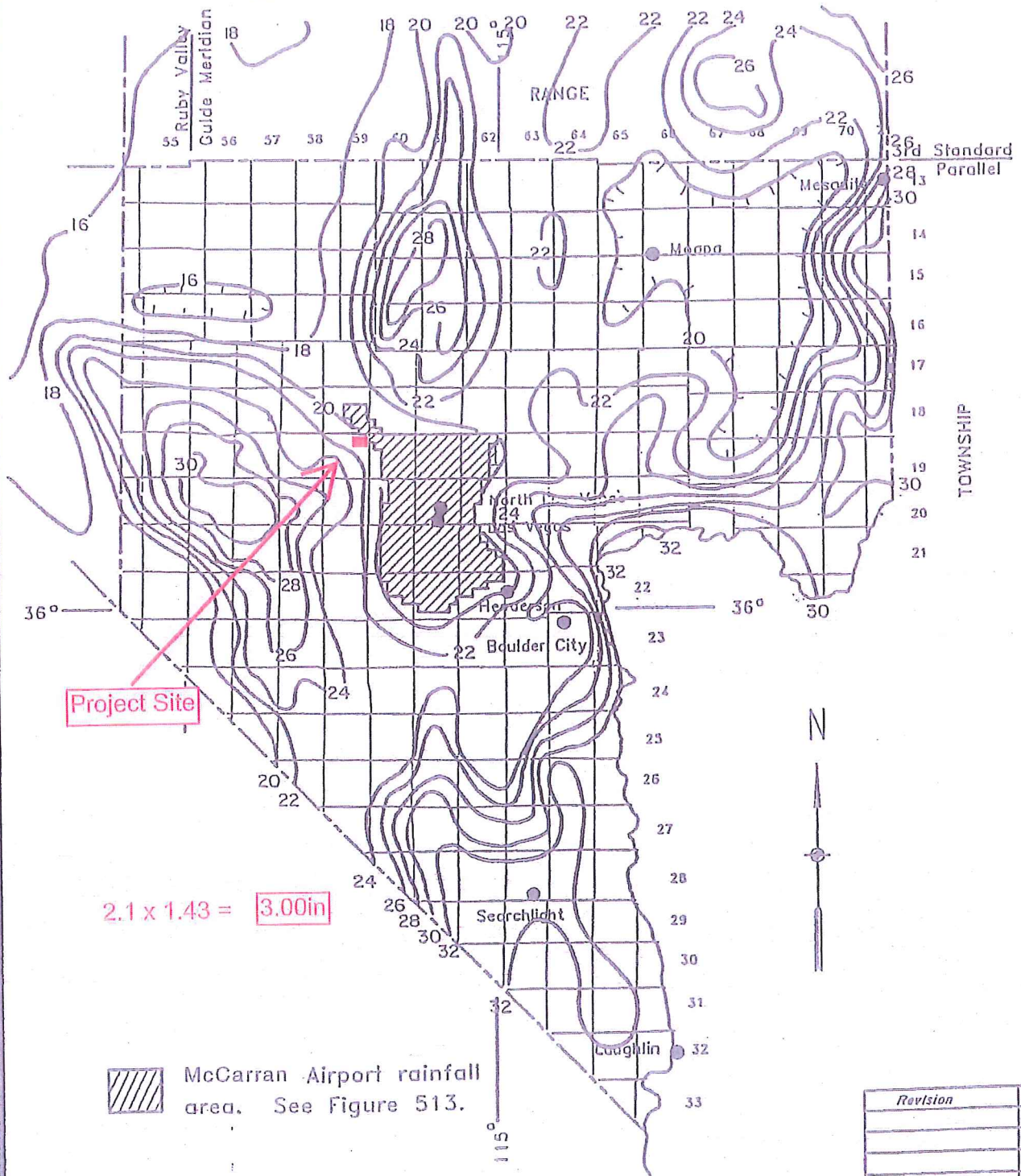
APPENDIX B

Precipitation Data & Calculations

100-Year Storm Event

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

RAINFALL DEPTH-DURATION-FREQUENCY 100-YEAR, 6-HOUR (DEPTHS IN TENTHS OF INCHES)



HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

PRECIPITATION ADJUSTMENT RATIOS

<u>Recurrence Interval</u>	<u>Ratio to NOAA Atlas 2</u>
2-year	1.00
5-year	1.16
10-year	1.24
25-year	1.33
50-year	1.39
100-year	1.43

- NOTE: 1. Multiply the values obtained from the NOAA Atlas 2 by the above ratios to obtain the adjusted precipitation values.
2. NOAA Atlas 2 values for use with TR-55 shall not be adjusted by the above ratios.
3. Tables 505 and 506 require no adjustments.

<i>Revision</i>	<i>Date</i>

WRC
ENGINEERING

REFERENCE:
USACE, Los Angeles District, 1988

TABLE 501

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

SIX-HOUR STORM DISTRIBUTIONS

Percent of Total Storm Depth				Percent of Total Storm Depth			
Storm Time (In Minutes)	SDN3	SDN4	SDN5	Storm Time (In Minutes)	SDN3	SDN4	SDN5
0	0.0	0.0	0.0	185	32.2	37.6	43.0
5	2.0	2.0	2.0	190	35.2	41.5	47.7
10	5.7	5.8	5.9	195	40.9	46.2	51.4
15	7.0	7.5	8.0	200	49.9	53.0	56.1
20	8.7	9.9	11.0	205	59.0	61.0	63.0
25	10.8	12.6	14.4	210	71.0	71.0	71.0
30	12.4	13.7	15.0	215	74.4	73.2	72.0
35	13.0	14.5	16.0	220	78.1	75.6	73.1
40	13.0	14.9	16.8	225	81.2	78.2	75.2
45	13.0	15.1	17.1	230	81.9	79.9	77.9
50	13.0	15.5	18.0	235	83.5	81.3	79.0
55	13.0	15.6	18.2	240	85.1	82.3	79.5
60	13.0	15.9	18.7	245	85.6	83.0	80.4
65	13.3	16.2	19.0	250	86.0	83.5	81.0
70	14.0	16.9	19.7	255	86.8	84.4	82.0
75	14.2	17.2	20.2	260	87.6	85.1	82.6
80	14.8	17.9	21.0	265	88.8	86.4	84.0
85	15.8	18.9	22.0	270	91.0	88.5	85.9
90	17.2	20.1	23.0	275	92.6	90.8	88.9
95	18.1	21.1	24.1	280	93.7	92.4	91.0
100	19.0	22.0	25.0	285	95.0	94.4	93.8
105	19.7	22.8	25.9	290	97.0	96.8	96.6
110	19.9	23.2	26.5	295	97.6	97.3	97.0
115	20.0	24.0	28.0	300	98.2	97.8	97.4
120	20.1	24.6	29.0	305	98.5	98.2	97.9
125	20.4	25.2	30.0	310	98.7	98.4	98.1
130	21.4	26.0	30.5	315	98.9	98.6	98.3
135	22.9	26.9	30.9	320	99.0	98.8	98.5
140	24.1	27.6	31.0	325	99.3	99.1	98.9
145	24.9	28.3	31.7	330	99.3	99.2	99.0
150	25.1	28.6	32.1	335	99.4	99.3	99.2
155	25.6	29.2	32.7	340	99.5	99.4	99.3
160	27.0	30.2	33.3	345	99.8	99.7	99.6
165	27.8	31.2	34.6	350	99.8	99.8	99.7
170	28.1	32.1	36.1	355	99.9	99.9	99.9
175	28.3	33.2	38.1	360	100.0	100.0	100.0
180	29.5	35.2	40.8				

- Notes
1. For drainage areas less than 8 square miles in size, use SDN 3.
 2. For drainage areas greater than or equal to 8 square miles and less than 12 square miles in size, use SDN 4.
 3. For drainage areas greater than or equal to 12 square miles, use SDN 5.
 4. A graphical representation of these values is presented on Figure 515.

Revision	Date

REFERENCE:

TABLE 503

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

SIX HOUR DEPTH-AREA REDUCTION FACTORS

<u>Drainage Area (Square Miles)</u>	<u>Six-Hour Depth-Area Reduction Factor</u>
0.0	1.00
0.5	0.98
1.0	0.97
2.0	0.93
4.0	0.91
6.0	0.90
8.0	0.88
10.0	0.86
20.0	0.79
30.0	0.74
50.0	0.68
100.0	0.60
150.0	0.55
200.0	0.51
300.0	0.46
400.0	0.42
500.0	0.39

- NOTES: 1. A graphical representation of these factors is presented in Figure 514.
2. Consult with the local entity and/or the CCRFCD for guidance in using the Depth-Area Reduction Factors for drainage areas greater than 200 square miles.

<i>Revision</i>	<i>Date</i>

WRC
ENGINEERING

REFERENCE:
USACE, Los Angeles District, 1988

TABLE 502

PMF Storm Event

HYDROMETEOROLOGICAL REPORT NO. 49

Probable Maximum Precipitation Estimates,
Colorado River and Great Basin Drainages

REPRINTED 1984

PROPERTY OF:
NOAA, NATIONAL WEATHER SERVICE

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
U.S. DEPARTMENT OF ARMY
CORPS OF ENGINEERS

Silver Spring, Md.

Table 6.3A.—Local-storm PMP computation, Colorado River, Great Basin and California drainages. For drainage average depth PMP. Go to table 6.3B if areal variation is required.

Drainage INFLOW TO DBI Area 0.9 mi.² (km²)
 Latitude 36°N Longitude 115°W Minimum Elevation 3020 ft (m)

Steps correspond to those in sec. 6.3A.

1. Average 1-hr 1-mi.² (2.6-km²) PMP for 10.6 in. (mm)
 drainage [fig. 4.5].

2. a. Reduction for elevation. [No adjustment
 for elevations up to 5,000 feet (1,524 m):
 5% decrease per 1,000 feet (305 m) above
 5,000 feet (1,524 m)]. 100 %

b. Multiply step 1 by step 2a. 10.6 in. (mm)

3. Average 6/1-hr ratio for drainage [fig. 4.7]. 1.33

4. Durational variation
 for 6/1-hr ratio of
 step 3 [table 4.4].

Duration (hr)									
1/4	1/2	3/4	1	2	3	4	5	6	
69.3	87.2	94.9	100	115.2	126.5	127.1	130.7	133	%

5. 1-mi.² (2.6-km²) PMP for
 indicated durations
 [step 2b X step 4]. 7.3 9.2 10.0 10.6 12.2 13.0 13.5 13.9 14.1 in. (mm)

6. Areal reduction
 [fig. 4.9]. 100 100 100 100 100 100 100 100 100 %

7. Areal reduced PMP
 [steps 5 X 6]. 7.3 9.2 10.0 10.6 12.2 13.0 13.5 13.9 14.1 in. (mm)

8. Incremental PMP
 [successive subtraction
 in step 7]. _____ in. (mm)

} 15-min. increments

9. Time sequence of incre-
 mental PMP according to:

Hourly increments
 [table 4.7]. _____ in. (mm)

Four largest 15-min.
 increments [table 4.8]. _____ in. (mm)

USE IN
 PMF REC-1
 AS PRECIP. VALUE

events. In contrast to figure 4.4, figure 4.5 maintains a maximum between these two locations. There is no known meteorological basis for a different solution. The analysis suggests that in the northern portion of the region maximum PMP occurs between the Sierra Nevada on the west and the Wasatch range on the east.

A discrete maximum (> 10 inches, 254 mm) occurs at the north end of the Sacramento Valley in northern California because the northward-flowing moist air is increasingly channeled and forced upslope. Support for this PMP center comes from the Newton, Kennett, and Red Bluff storms (fig. 4.1). Although the analysis in this region appears to be an extension of the broad maximum through the center of the Southwestern Region, it does not indicate the direction of moist inflow. The pattern has evolved primarily as a result of attempts to tie plotted maxima into a reasonable picture while considering inflow directions, terrain effects, and moisture potential.

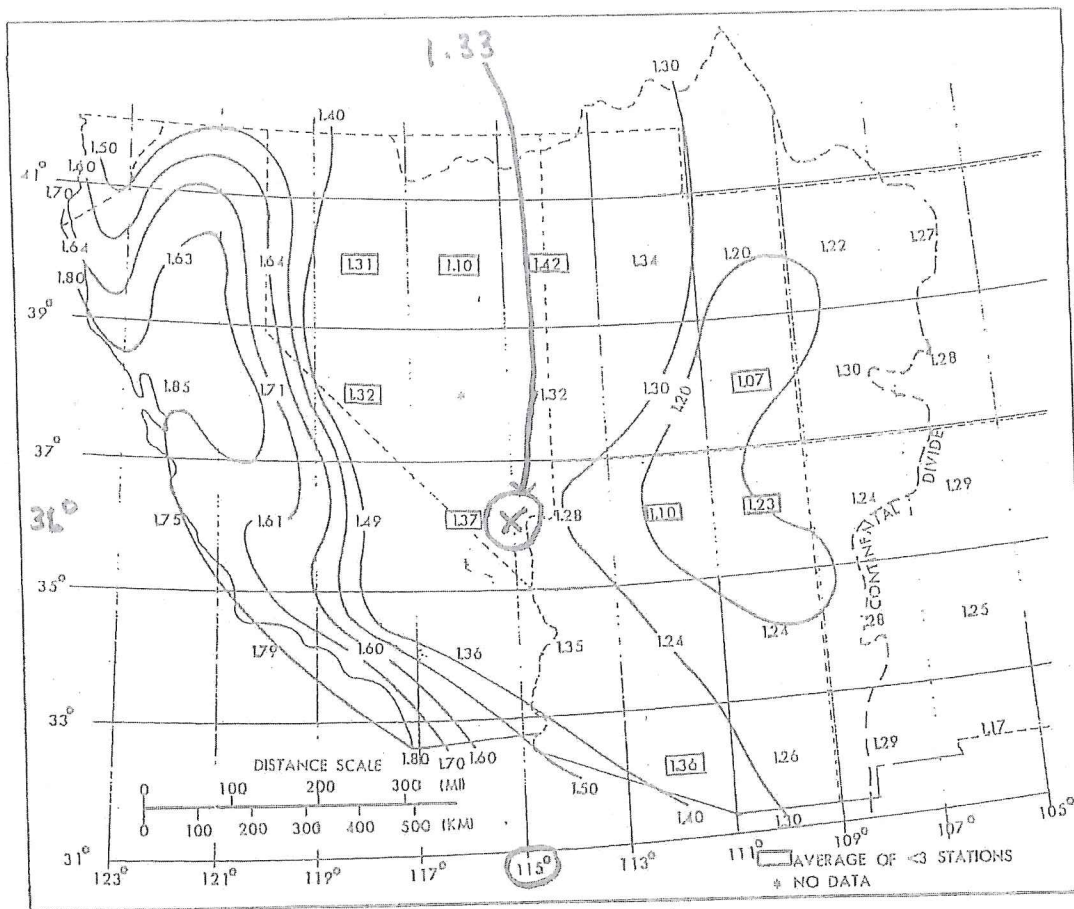


Figure 4.7.--Analysis of 6/1-hr ratios of averaged maximum station data (plotted at midpoints of a 2° latitude-longitude grid).

establish the basic depth-duration curve, then structure a variable set of depth-duration curves to cover the range of 6/1-hr ratios that are needed.

Three sets of data were considered for obtaining a base relation (see table 4.3 for depth-duration data).

a. An average of depth-duration relations from each of 17 greatest 3-hr rains from summer storms (1940-49) in Utah (U. S. Weather Bureau 1951b) and in unpublished tabulations for Nevada and Arizona (1940-63). The 3-hr amounts ranged from 1 to 3 inches (25 to 76 mm) in these events.

b. An average depth-duration relation from 14 of the most extreme short-duration storms listed in Storm Rainfall (U. S. Army, Corps of Engineers 1945-). These storms come from Eastern and Central States and have 3-hr amounts of 5 to 22 inches (127 to 559 mm).

ratios than storms with high 3/1-hr ratios. The geographical distribution of 15-min to 1-hr ratios also were inversely correlated with magnitudes of the 6/1-hr ratios of figure 4.7. For example, Los Angeles and San Diego (high 6/1-hr ratios) have low 15-min to 1-hr ratios (approximately 0.60) whereas the 15-min to 1-hr ratios in Arizona and Utah (low 6/1-hr ratios) were generally higher (approximately 0.75).

Depth-duration relations for durations less than 1 hour were then smoothed to provide a family of curves consistent with the relations determined for 1 to 6 hours, as shown in figure 4.3. Adjustment was necessary to some of the curves to provide smoother relations through the common point at 1 hour.

We believe we were justified in reducing the number of the curves shown in figure 4.3 for durations less than 1 hour, letting one curve apply to a range of 6/1-hr ratios. The corresponding curves have been indicated by letter designators, A-D, on figure 4.3. As an example, for any 6-hr amount between 115% and 135% of 1-hr, 1-mi² (2.6-km²) PMP, the associated values for durations less than 1 hour are obtained from the curve designated as "B".

Table 4.4 lists durational variations in percent of 1-hr PMP for selected 6/1-hr rain ratios. These values were interpolated from figure 4.3.

To determine 6-hr PMP for a basin, use figure 4.3 (or table 4.4) and the geographical distribution of 6/1-hr ratios given in figure 4.7.

Table 4.4.--Durational variation of 1-mi² (2.6-km²) local-storm PMP in percent of 1-hr PMP (see figure 4.3)

6/1-hr ratio	Duration (hr)								
	1/4	1/2	3/4	1	2	3	4	5	6
1.1	86	93	97	100	107	109	110	110	110
1.2	74	89	95	100	110	115	118	119	120
1.3	74	89	95	100	114	121	125	128	130
1.4	63	83	93	100	118	126	132	137	140
1.5	63	83	93	100	121	132	140	145	150
1.6	43	70	87	100	124	138	147	154	160
1.8	43	70	87	100	130	149	161	171	180
2.0	43	70	87	100	137	161	175	188	200

4.5 Depth-Area Relation

We have thus far developed local-storm PMP for an area of 1 mi² (2.6 km²). To apply PMP to a basin, we need to determine how 1-mi² (2.6-km²) PMP should decrease with increasing area. We have adopted depth-area relations based on rainfalls in the Southwest and from consideration of a model thunderstorm.

	1/4	1/2	3/4	1	2	3	4	5	6
@ 1.33	69.3	87.2	94.4	100	115.2	122.5	127.1	130.7	133

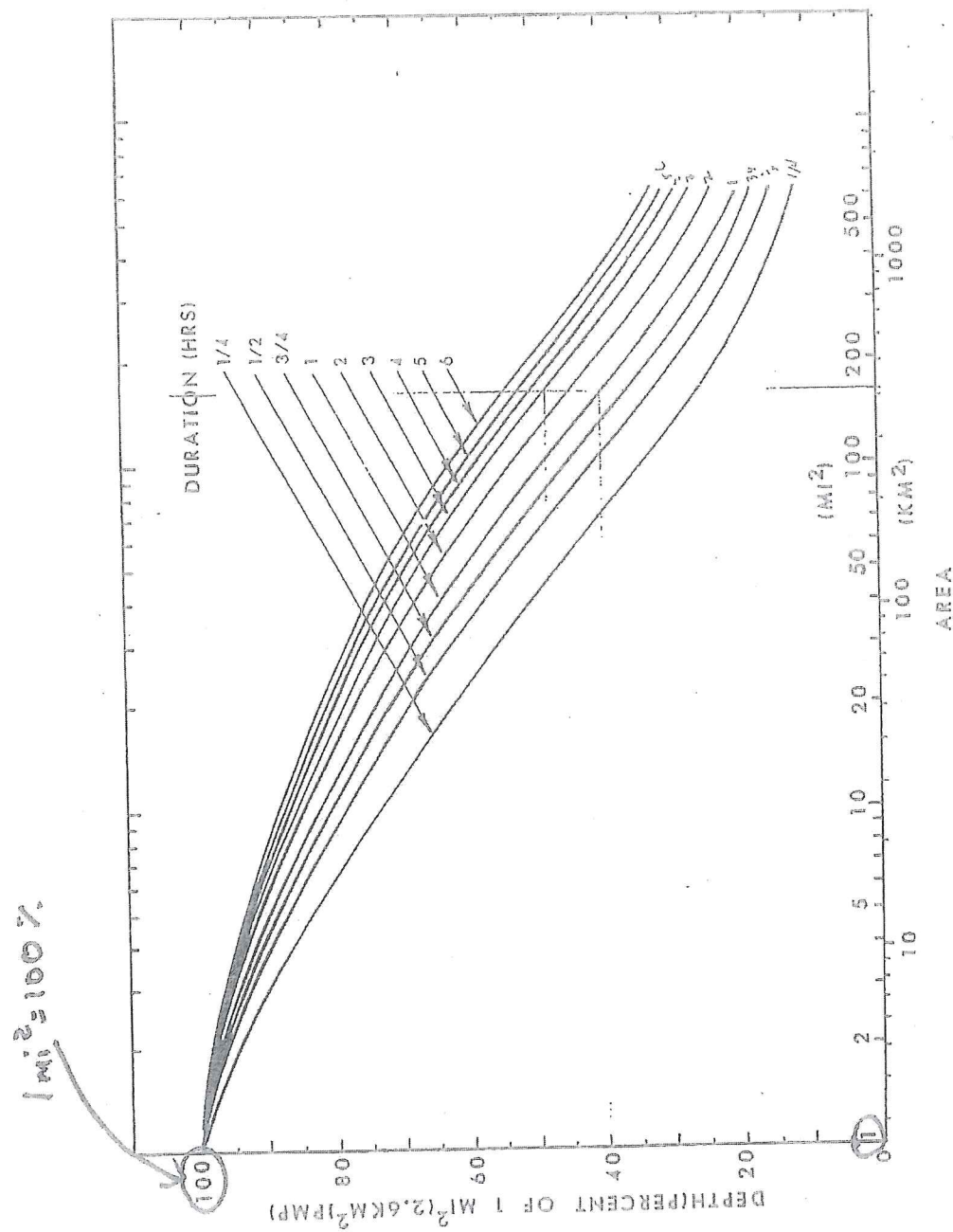
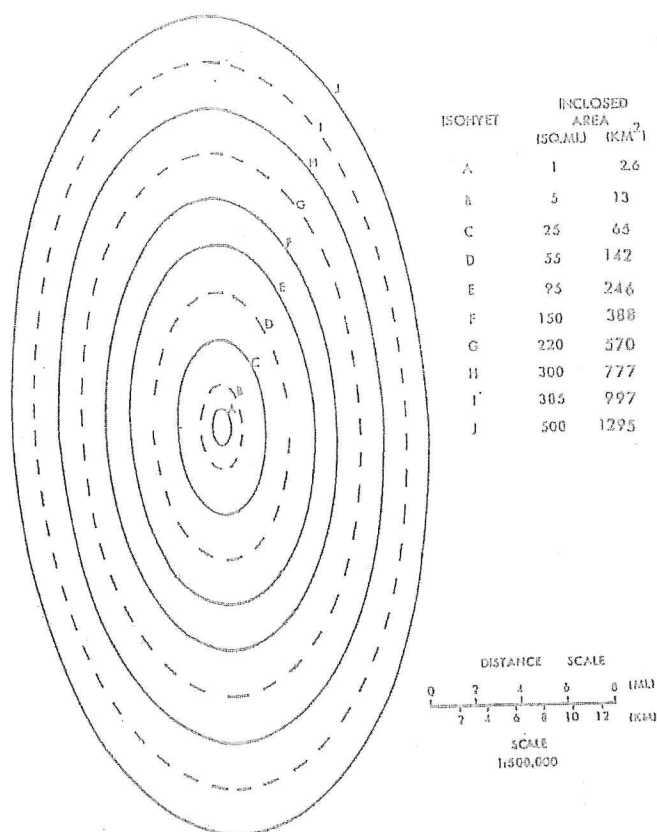


Figure 4.9: --Adopted depth-area relations for local-storm PMP.

Figure 4.10.--Idealized
local-storm isohyetal
pattern.



storm period. The sequence of hourly incremental PMP for the Southwest 6-hr thunderstorm in accord with this study is presented in column 2 of table 4.7. A small variation from this sequence is given in Engineering Manual 1110-2-1411 (U. S. Army, Corps of Engineers 1965). The latter, listed in column 3 of table 4.7, places greater incremental amounts somewhat more toward the end of the 6-hr storm period. In application, the choice of either of these distributions is left to the user since one may prove to be more critical in a specific case than the other.

Table 4.7.--Time sequence for hourly incremental PMP in 6-hr storm

Increment	HMR No. 5 ¹	EM1110-2-1411 ²
	Sequence Position	
Largest hourly amount	Third	Fourth
2nd largest	Fourth	Third
3rd largest	Second	Fifth
4th largest	Fifth	Second
5th largest	First	Last
least	Last	First

¹U. S. Weather Bureau 1947.

²U. S. Corps of Engineers 1952.

Also of importance is the sequence of the four 15-min incremental PMP values. We recommend a time distribution, table 4.8, giving the greatest intensity in the first 15-min interval (U.S. Weather Bureau 1947). This is based on data from a broad geographical region. Additional support for this time distribution is found in the reports of specific storms by Keppell (1963) and Osborn and Renard (1969).

Table 4.8.—Time sequence for 15-min incremental PMP within 1 hr.

Increment	Sequence Position
Largest 15-min amount	First
2nd largest	Second
3rd largest	Third
least	Last

4.8 Seasonal Distribution

The time of the year when local-storm PMP is most likely is of interest. Guidance was obtained from analysis of the distribution of maximum 1-hr thunderstorm events through the warm season at the recording stations in Utah, Arizona, and in southern California (south of 37°N and east of the Sierra Nevada ridgeline). The period of record used was for 1940-72 with an average record length for the stations considered of 27 years. The month with the one greatest thunderstorm rainfall for the period of record at each station was noted. The totals of these events for each month, by States, are shown in table 4.9.

Table 4.9.—Seasonal distribution of thunderstorm rainfalls.

(The maximum event at each of 108 stations, period of record 1940-72.)

	Month						No. of Cases
	M	J	J	A	S	O	
Utah	1	5	9	14	5		34
Arizona		4	16	19	4		43
S. Calif.*		14	10	7			31
No. of cases/mo.	1	23	35	40	9	0	

*South of 37°N and east of Sierra Nevada ridgeline.

HEC-1 PC Card Value Computations

Project Name: Skye Canyon Detention Basin #1 PMF
Date: Apr-15
File Name: OLY1401-004 TDS Add2 PMP Distribution Calc.xlsx
By: SMJ

Table 6.3 A Step 7 Value 14.1 inches

ID	A	B	C	D	E	F	unit
Table 6.3 A Step 9 Values	0.2	0.5	1.6	10.6	0.8	0.4	Inches

ID	G	H	I	J	unit
Table 6.3 A Step 9 Values	7.3	1.9	0.8	0.6	Inches

Equation Computation	Time Percent of Total Storm Event
PMP / 0 = 0.0000	Hour 0 = 0.0000
Equal Increments (1 Hr - 0 Hr) / 4 = 0.0035	15 = 0.0035
	30 = 0.0071
	45 = 0.0106
A / PMP = 0.0142	Hour 1 = 0.0142
	15 = 0.0230
Equal Increments (2 Hr - 1 Hr) / 4 = 0.0089	30 = 0.0319
	45 = 0.0408
(A+B) / PMP = 0.0496	Hour 2 = 0.0496
	15 = 0.0780
Equal Increments (3 Hr - 2 Hr) / 4 = 0.0284	30 = 0.1064
	45 = 0.1348
(A+B+C) / PMP = 0.1631	Hour 3 = 0.1631
(A+B+C+G) / PMP = 0.6809	15 = 0.6809
(A+B+C+G+H) / PMP = 0.8156	30 = 0.8156
(A+B+C+G+H+I) / PMP = 0.8723	45 = 0.8723
(A+B+C+G+H+I+J) / PMP = 0.9149	Hour 4 = 0.9149
	15 = 0.9291
Equal Increments (5 Hr - 4 Hr) / 4 = 0.0142	30 = 0.9433
	45 = 0.9574
(A+B+C+G+H+I+J+E) / PMP = 0.9716	Hour 5 = 0.9716
	15 = 0.9787
Equal Increments (6 Hr - 5 Hr) / 4 = 0.0071	30 = 0.9858
	45 = 0.9929
PMP / PMP = 1.0000	Hour 6 = 1.0000

HEC-1 PC card values in 15 minute intervals

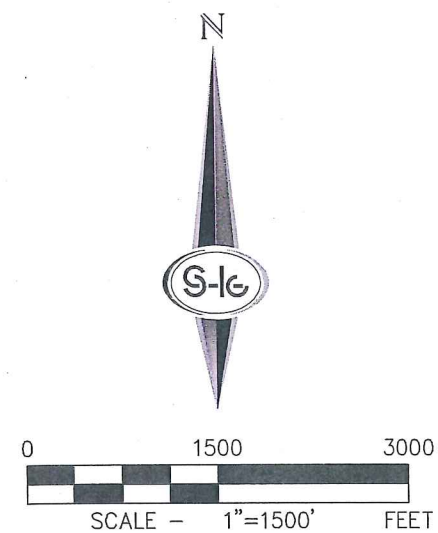
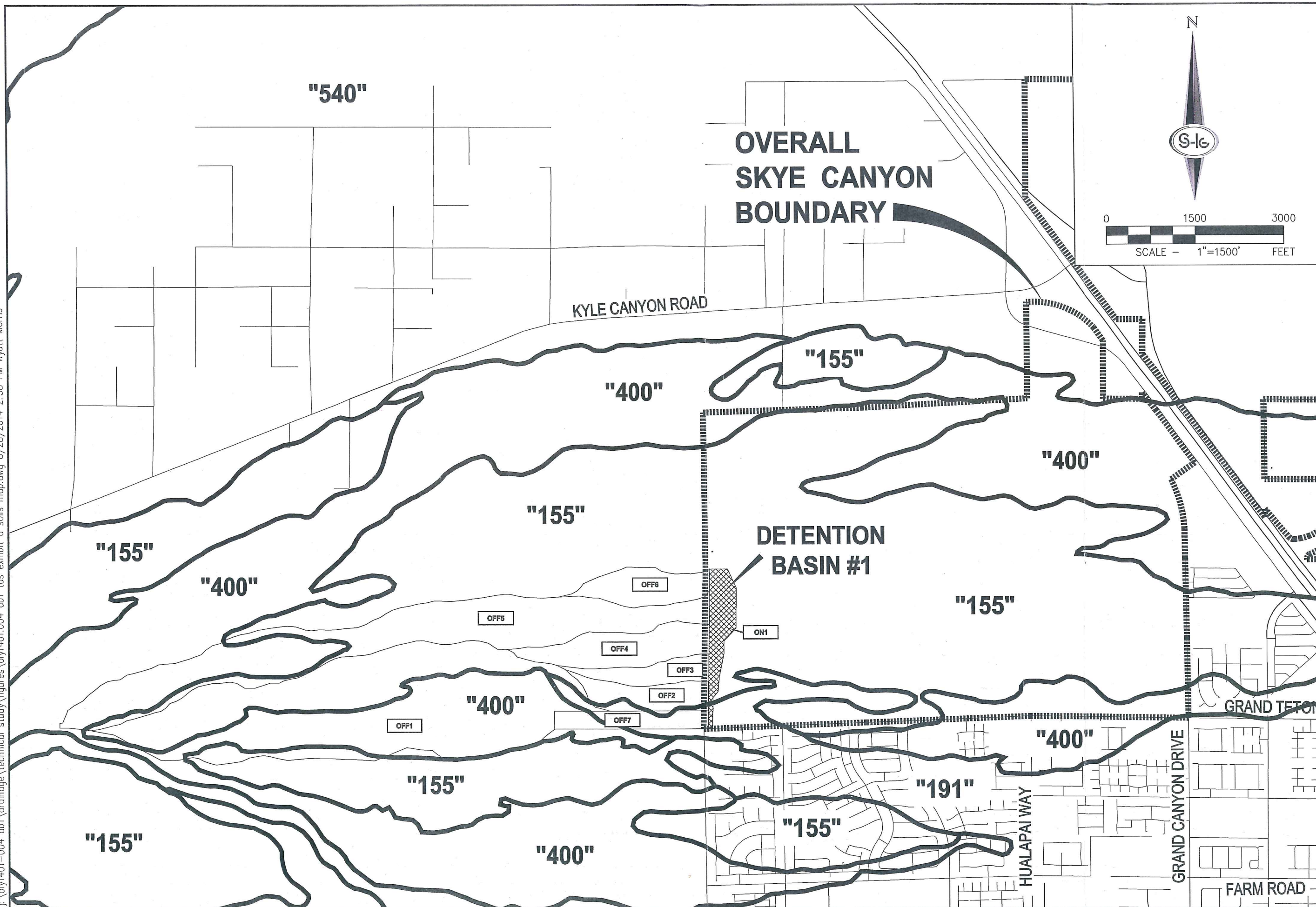
PC	0.000	0.004	0.007	0.011	0.014	0.023	0.032	0.041	0.050	0.078
PC	0.106	0.135	0.163	0.681	0.816	0.872	0.915	0.929	0.943	0.957
PC	0.972	0.979	0.986	0.993	1.000					

APPENDIX C

Soils Data & Calculations

Curve Number Selection

j:\oly1401-004 db1\drainage\technical_study\figures\oly1401.004 db1 tds exhibit d soils map.dwg 8/28/2014 2:58 PM Wyatt Morris



SLATER HANIFAN GROUP
S-HG
CONSULTING ENGINEERS & PLANNERS
5740 S. ARVILLE STREET #216, LAS VEGAS, NV 89118
PHONE (702) 294-5300 FAX (702) 294-5309

NO.	DESCRIPTION	DATE	BY	APP. DATE

NINETY-FIVE MANAGEMENT, LLC.
SKYE CANYON - DETENTION BASIN 1
SOILS MAP

DATE:	SEPT 2014
DRAFTER:	WTM
DESIGNER:	WTM
CHECKED:	SMJ
PROJECT NO.	OLY1401.004
EXHIBIT D	SHEET 1 OF 1

Soil & Curve Number Computation

Project Name: SKYE CANYON - DETENTION BASIN 1

Date: Jul-15

File Name: OLY1401-004 DB1 CNs.xlsx

By: WTM

Data:

Reference:

Soil Type & Description	A	B	C	D
155 Cave gravelly fine sandy loam, 4 to 15 percent slopes	5%	5%	0%	90%
191 Dalian very cobbly fine sandy loam, 2 to 8 percent slopes	5%	85%	0%	10%
400 Tencee very gravelly fine sandy loam, 2 to 8 percent slopes	0%	10%	0%	90%

Soils Exhibit
SCS Soil Data

Land Use	A	B	C	D
Desert Shrub (poor)	63	77	85	88
Newly Graded	77	86	91	94

PROPOSED CONDITION

BASIN ID	SOIL TYPE	SUBAREA PERCENT	LAND USE	HYDROLOGIC SOIL GROUP				LAND USE CN				SUBAREA ACRES	CALCULATED CN
				A	B	C	D	A	B	C	D		
OFF1	400	52.1%	Desert Shrub (poor)	0%	10%	0%	90%	63	77	85	88	135.84	45.3
	155	46.3%	Desert Shrub (poor)	5%	5%	0%	90%	63	77	85	88	120.71	39.9
	191	1.6%	Desert Shrub (poor)	5%	85%	0%	10%	63	77	85	88	4.11	1.2
TOTAL PERCENT		100.0%										TOTAL AREA 260.66	86.4

BASIN ID	SOIL TYPE	SUBAREA PERCENT	LAND USE	HYDROLOGIC SOIL GROUP				LAND USE CN				SUBAREA ACRES	CALCULATED CN
				A	B	C	D	A	B	C	D		
OFF2	155	86.2%	Desert Shrub (poor)	5%	5%	0%	90%	63	77	85	88	19.60	74.3
	191	13.8%	Desert Shrub (poor)	5%	85%	0%	10%	63	77	85	88	3.14	10.7
TOTAL PERCENT		100.0%										TOTAL AREA 22.74	85.0

BASIN ID	SOIL TYPE	SUBAREA PERCENT	LAND USE	HYDROLOGIC SOIL GROUP				LAND USE CN				SUBAREA ACRES	CALCULATED CN
				A	B	C	D	A	B	C	D		
OFF3	155	100.0%	Desert Shrub (poor)	5%	5%	0%	90%	63	77	85	88	16.58	86.2
TOTAL PERCENT		100.0%										TOTAL AREA 16.58	86.2

BASIN ID	SOIL TYPE	SUBAREA PERCENT	LAND USE	HYDROLOGIC SOIL GROUP				LAND USE CN				SUBAREA ACRES	CALCULATED CN
				A	B	C	D	A	B	C	D		
OFF4	155	100.0%	Desert Shrub (poor)	5%	5%	0%	90%	63	77	85	88	37.19	86.2
TOTAL PERCENT		100.0%										TOTAL AREA 37.19	86.2

BASIN ID	SOIL TYPE	SUBAREA PERCENT	LAND USE	HYDROLOGIC SOIL GROUP				LAND USE CN				SUBAREA ACRES	CALCULATED CN
				A	B	C	D	A	B	C	D		
OFF5	155	63.9%	Desert Shrub (poor)	5%	5%	0%	90%	63	77	85	88	105.09	55.1
	400	36.1%	Desert Shrub (poor)	0%	10%	0%	90%	63	77	85	88	59.32	31.4
TOTAL PERCENT		100.0%										TOTAL AREA 164.41	86.5

BASIN ID	SOIL TYPE	SUBAREA PERCENT	LAND USE	HYDROLOGIC SOIL GROUP				LAND USE CN				SUBAREA ACRES	CALCULATED CN
				A	B	C	D	A	B	C	D		
OFF6	155	100.0%	Desert Shrub (poor)	5%	5%	0%	90%	63	77	85	88	25.54	86.2
	262	0.0%	Desert Shrub (poor)	75%	0%	0%	25%	63	77	85	88	0.00	0.0
TOTAL PERCENT		100.0%										TOTAL AREA 25.54	86.2

OFF7 Curve Number referenced from CCRFCD MPU

BASIN ID	SOIL TYPE	SUBAREA PERCENT	LAND USE	HYDROLOGIC SOIL GROUP				LAND USE CN				SUBAREA ACRES	CALCULATED CN
				A	B	C	D	A	B	C	D		
ON1	155	100.0%	Newly Graded	5%	5%	0%	90%	77	86	91	94	16.72	92.8
TOTAL PERCENT		100.0%										TOTAL AREA 16.72	92.8



United States
Department of
Agriculture

Soil
Conservation
Service

In cooperation with
United States Department
of the Interior, Bureau
of Land Management, and
University of Nevada
Agricultural Experiment
Station

Soil Survey of Las Vegas Valley Area Nevada

Part of Clark County



This unit is limited for roads because of the depth to the indurated hardpan. Roads should be designed to minimize cuts.

This map unit is in capability subclass VII_s, nonirrigated, and in horticultural group 6.

152—Cave gravelly fine sandy loam, 0 to 4 percent slopes. This shallow, well drained soil is on erosional fan remnants. It formed in alluvium derived from various kinds of rock.

Typically, about 80 percent of the surface is covered with a desert pavement of pebbles and cobbles. The surface layer is pale brown gravelly fine sandy loam about 12 inches thick. The next layer to a depth of 36 inches is an indurated, lime-cemented hardpan. The underlying material to a depth of 60 inches or more is light brown very gravelly sandy loam. Depth to the hardpan ranges from 4 to 20 inches.

Included in this unit are about 5 percent Arizo soils, flooded, in channels, 5 percent Canutio soils on inset fans, and 5 percent Grapevine soils on side slopes of erosional fan remnants. Included areas make up about 15 percent of the total acreage. The percentage varies from one area to another.

Permeability of the Cave soil is moderate above the hardpan. Available water capacity is very low. Effective rooting depth is 4 to 20 inches. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is high if the surface is disturbed.

This unit is used mainly for urban development. It is also used as habitat for desert wildlife and for recreation.

This unit is poorly suited to urban development. The main limitation is the shallow depth to the hardpan. Excavation for building sites is limited by the hardpan, and heavy equipment is needed. Special design of septic tank absorption fields is needed.

Roads should be designed to minimize cuts because of the limited depth to the hardpan.

It is difficult to establish plants in areas where the pan is exposed. Mulching and fertilizing cut areas help to establish plants. Lawn grasses, shrubs, and trees that are not sensitive to lime-induced chlorosis are well suited to use in landscaping. Annual applications of iron chelates reduce the effects of chlorosis.

Intermittent streams form the drainageways in this unit. These drainageways are subject to rare or occasional periods of high-velocity flooding. Care should be taken during urbanization to accommodate the runoff from the drainageways. If drains become plugged during a major flood, accelerated erosion and damage to roads, buildings, and other structures can occur.

This map unit is in capability subclass VII_s, nonirrigated, and in horticultural group 6.

155—Cave gravelly fine sandy loam, 4 to 15 percent slopes. This shallow, well drained soil is on

erosional fan remnants. It formed in alluvium derived from various kinds of rock.

Typically, about 70 percent of the surface is covered with a desert pavement of rock fragments and pan fragments. The surface layer is light brown gravelly fine sandy loam about 5 inches thick. The underlying material to a depth of 15 inches is light brown gravelly fine sandy loam. The next layer to a depth of 60 inches or more is an indurated, lime-cemented hardpan. Depth to the hardpan ranges from 4 to 20 inches.

Included in this unit are about 5 percent Arizo soils, flooded, in channels and 5 percent Caliza soils on side slopes of erosional fan remnants. Included areas make up about 10 percent of the total acreage. The percentage varies from one area to another.

Permeability of the Cave soil is moderate above the hardpan. Available water capacity is very low. Effective rooting depth is 4 to 20 inches. Runoff is moderate, and the hazard of water erosion is slight. The hazard of soil blowing is high if the surface is disturbed.

This unit is used as habitat for desert wildlife and for recreation.

This unit is limited for roads because of the depth to the indurated hardpan. Roads should be designed to minimize cuts. Cutting and filling can be reduced by building roads in the less sloping areas.

This map unit is in capability subclass VII_s, nonirrigated and in horticultural group 6.

160—Destazo cobbly fine sandy loam, 0 to 2 percent slopes. This very deep, well drained soil is on relict alluvial flats. It formed in alluvium derived dominantly from limestone and dolomite.

Typically, about 60 percent of the surface is covered with a desert pavement of pebbles and cobbles. The surface layer is pink cobbly fine sandy loam about 11 inches thick. The upper 29 inches of the underlying material is light brown very gravelly sandy clay loam, and the lower part to a depth of 60 inches or more is pinkish white gravelly sandy loam containing some crystalline gypsum.

Included in this unit are about 5 percent Bracken very cobbly fine sandy loam, 2 to 8 percent slopes, on side slopes of slightly higher remnants of relict alluvial flats and 10 percent Las Vegas soils on summits of slightly higher remnants of alluvial flats. Included areas make up about 15 percent of the total acreage.

Permeability of this Destazo soil is moderately slow. Available water capacity is moderate. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is moderate.

This unit is used mainly as habitat for desert wildlife and for recreation. It is also used for urban development.

This unit is well suited to the construction of dwellings. The main limitation for septic tank absorption fields is restricted permeability. The operation of septic tank

sandy loam about 4 inches thick. The upper 7 inches of the underlying material is light yellowish brown extremely gravelly fine sandy loam, the next 6 inches is light yellowish brown very gravelly sandy loam, and the lower part to a depth of 61 inches is light yellowish brown extremely gravelly fine sandy loam. Pebbles cover 50 to 75 percent of the surface.

Included in this unit are about 5 percent Tencee soils on erosional fan remnants and 10 percent Arizo soils, flooded, in channels. Included areas make up about 15 percent of the total acreage. The percentage varies from one area to another.

Permeability of this Dalian soil is moderately rapid. Available water capacity is low. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is moderate.

This unit is used mainly as habitat for desert wildlife and for recreation. It is also used for urban development.

This unit is well suited to the construction of dwellings.

Septic tank absorption fields generally function well unless the density of housing is too high.

Roads are easily constructed and maintained.

The main limitation for lawns and landscaping is the pebbles on the surface and throughout the soil. Topsoil is needed for best results when landscaping, particularly in areas used for lawns. Lawn grasses, shrubs, and trees that are not sensitive to lime-induced chlorosis are well suited to use in landscaping. Annual applications of iron chelates reduce the effects of chlorosis.

Intermittent streams form the drainageways in this unit. These drainageways are subject to rare or occasional periods of high-velocity flooding. Care should be taken during urbanization to accommodate the runoff from the drainageways. If drains become plugged during a major flood, accelerated erosion and damage to roads, buildings, and other structures can occur.

This map unit is in capability subclasses IVs, irrigated, and VIIs, nonirrigated. It is in horticultural group 2.

191—^BDalian very cobbly fine sandy loam, 2 to 8 percent slopes. This very deep, well drained soil is on fan skirts. It formed in alluvium derived dominantly from limestone and dolomite.

Typically, about 85 percent of the surface is covered with a desert pavement of rock fragments. The surface layer is light yellowish brown very cobbly fine sandy loam about 5 inches thick. The underlying material to a depth of 60 inches or more is light yellowish brown very gravelly sandy loam to extremely gravelly fine sandy loam.

Included in this unit are about 10 percent Tencee soils on erosional fan remnants and 5 percent Arizo soils, flooded, in channels. Included areas make up about 15 percent of the total acreage. The percentage varies from one area to another.

Permeability of this Dalian soil is moderately rapid. Available water capacity is low. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is moderate if the surface is disturbed. This soil is subject to rare periods of flooding during prolonged, high-intensity storms. Channeling and deposition are common along streambanks.

Most areas of this unit are used as habitat for desert wildlife and for recreation. A few areas are used for urban development.

The main limitation for construction of dwellings is the hazard of flooding. Dikes and channels that have outlets for floodwater can be used to protect buildings from flooding.

Dikes and channels that have outlets for floodwater can be used to protect onsite sewage disposal systems from flooding.

Channeling and deposition can be minimized and maintenance costs reduced by protecting roads from flooding.

The main limitations for lawns and landscaping are the cobbles and pebbles on the surface and throughout the soil. Topsoil is needed for best results when landscaping, particularly in areas used for lawns. Lawn grasses, shrubs, and trees that are not sensitive to lime-induced chlorosis are well suited to use in landscaping. Annual applications of iron chelates reduce the effects of chlorosis.

This map unit is in capability subclass VIIs, nonirrigated, and in horticultural group 2.

192—Dalian-McCullough complex, 0 to 4 percent slopes. This map unit is on fan skirts.

This unit is 55 percent Dalian very gravelly fine sandy loam, 0 to 4 percent slopes, and 35 percent McCullough very gravelly very fine sandy loam, gravelly substratum, 0 to 4 percent slopes. Both the Dalian and McCullough soils are on alluvial fan skirts. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are about 5 percent Las Vegas soils on basin floor remnants and 5 percent Tencee soils on erosional fan remnants. Included areas make up about 10 percent of the total acreage.

The Dalian soil is very deep and well drained. It formed in alluvium derived from various kinds of rock. Typically, about 75 percent of the surface is covered with a desert pavement of pebbles. The surface layer is light yellowish brown very gravelly fine sandy loam about 5 inches thick. The underlying material to a depth of 60 inches or more is light yellowish brown very gravelly sandy loam.

Permeability of the Dalian soil is moderately rapid. Available water capacity is low. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is

Because of the content of gypsum and other salts in the soil, salt-tolerant plants should be selected for lawns and landscaping. Because of the underlying hardpan, deep cuts should be avoided on this soil. Lawn grasses, shrubs, and trees that are not sensitive to lime-induced chlorosis are well suited to use in landscaping. Annual applications of iron chelates reduce the effects of chlorosis.

This map unit is in capability subclasses IIIs, irrigated, and VIIs, nonirrigated. It is in horticultural group 6.

390—Spring clay loam. This very deep, moderately well drained soil is on alluvial flats. It formed in gypsiferous lacustrine sediment. Slope is 0 to 2 percent.

Typically, the surface layer is pale brown clay loam about 5 inches thick. The underlying material to a depth of 60 inches or more is stratified, light brown to pink silt loam to silty clay, averaging silty clay loam, and contains many gypsum crystals.

Included in this unit are about 10 percent Land soils on alluvial flats and 5 percent Las Vegas soils on relict alluvial flats. Included areas make up about 15 percent of the total acreage.

Permeability of the Spring soil is slow. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is high. This soil is subject to rare periods of flooding during prolonged, high-intensity storms. Channeling and deposition are common along streambanks. This soil is strongly affected by salts to a depth of 5 inches, and it is moderately affected below this depth.

This unit is used mainly for urban development. It is also used as habitat for desert wildlife and for recreation.

The main limitation for construction of dwellings is the hazard of flooding. Dikes and channels that have outlets for floodwater can be used to protect buildings from flooding. Gypsum in the soil can induce electrochemical action that corrodes concrete. This limitation can be overcome by using cement that is resistant to sulfate corrosion.

The main limitation for septic tank absorption fields is restricted permeability. Special design of septic tank absorption fields is needed. Using long absorption lines and backfilling the trench with sandy material help to compensate for the restricted permeability.

The Spring soil is limited for roads because of limited ability to support a load. Roads and streets should be designed to compensate for the instability of the soil.

The main limitation for lawns and landscaping is the excess soluble salts in the soil. Intensive management is required to reduce the salinity and maintain soil productivity. Excess salts in the soil can be flushed out by using heavy periodic applications of water. Because of the content of gypsum and other salts in the soil, salt-tolerant plants should be selected.

This map unit is in capability subclasses VI_s, irrigated, and VII_s, nonirrigated. It is in horticultural group 4.

400—Tencee very gravelly fine sandy loam, 2 to 8 percent slopes. This shallow, well drained soil is on erosional fan remnants. It formed in alluvium derived dominantly from limestone and dolomite.

Typically, 75 percent of the surface is covered with a well developed desert pavement of pebbles. There is a dark desert varnish on the exposed surfaces of the rock fragments. The surface layer is light brown very gravelly fine sandy loam about 5 inches thick. The next layer is light brown very gravelly fine sandy loam and very gravelly sandy loam and is weakly cemented with lime to a depth of about 15 inches. An indurated, lime-cemented hardpan is at a depth of about 15 inches. Depth to the hardpan ranges from 7 to 20 inches.

Included in this unit are small areas of Dalian soils on side slopes of fan remnants and on inset fans. Included areas make up about 10 percent of the total acreage. The percentage varies from one area to another.

Permeability of the Tencee soil is moderate above the hardpan. Available water capacity is very low. Effective rooting depth is 7 to 20 inches. Runoff is medium, and the hazard of water erosion is slight. The hazard of soil blowing is moderate if the surface is disturbed.

This unit is used as habitat for desert wildlife and for recreation.

This unit is limited for roads because of the depth to the indurated hardpan. Roads should be designed to minimize cuts. Heavy equipment is needed for excavation.

This map unit is in capability subclass VII_s, nonirrigated, and in horticultural group 6.

415—Aztec very gravelly sandy loam, 2 to 8 percent slopes. This very deep, well drained soil is on erosional fan remnants. It formed in alluvium derived from various kinds of rock.

Typically, 80 percent of the surface is covered with pebbles. The surface layer is light yellowish brown very gravelly sandy loam about 2 inches thick. The underlying material to a depth of 63 inches is stratified, light yellowish brown, light brown, and light reddish brown very gravelly sandy loam to extremely gravelly loamy coarse sand with weak, continuous gypsum cementation in some layers.

Included in this unit are about 5 percent Bracken soils on pediment remnants, 5 percent Rock outcrop on isolated ridges, and 5 percent Caliza soils on erosional fan remnants. Included areas make up about 15 percent of the total acreage. The percentage varies from one area to another.

Permeability of the Aztec soil is moderately slow. Available water capacity is low. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is slight. The hazard of soil blowing is high.

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

RUNOFF CURVE NUMBERS (URBAN AREAS¹)

Cover description		Curve numbers for hydrologic soil group—			
Cover type and hydrologic condition	Average percent impervious area ²	A	B	C	D
<i>Fully developed urban areas (vegetation established)</i>					
Open space (lawns, parks, golf courses, cemeteries, etc.): ³					
Poor condition (grass cover < 50%)		68	79	86	89
Fair condition (grass cover 50% to 75%)		49	69	79	84
Good condition (grass cover > 75%)		39	61	74	80
Impervious areas:					
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)		98	98	98	98
Streets and roads:					
Paved; curbs and storm sewers (excluding right-of-way)		98	98	98	98
Paved; open ditches (including right-of-way)		83	89	92	93
Gravel (including right-of-way)		76	85	89	91
Dirt (including right-of-way)		72	82	87	89
Western desert urban areas:					
Natural desert landscaping (pervious areas only) ⁴ ...		63	77	85	88
Artificial desert landscaping (impervious weed barrier, desert shrub with 1- to 2-inch sand or gravel mulch and basin borders)		96	96	96	96
Urban districts:					
Commercial and business	85	89	92	94	95
Industrial	72	81	88	91	93
Residential districts by average lot size:					

See Table 602A

Developing urban areas

Newly graded areas (pervious areas only, no vegetation) ⁵	77	86	91	94
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1 Average runoff condition, and $I_a = 0.2S$.

2 The average percent impervious area shown was used to develop the composite CN's. Other assumptions are as follows: impervious areas are directly connected to the drainage system. Impervious areas have a CN of 98, and pervious areas are considered equivalent to open space in good hydrologic condition. CN's for other combinations of conditions may be computed using Figure 603.

3 CN's shown are equivalent to those of pasture. Composite CN's may be computed for other combinations of open space cover type.

4 Composite CN's for natural desert landscaping should be computed using Figure 603 based on the impervious area percentage (CN #98) and the pervious area CN. The pervious area CN's are assumed equivalent to desert shrub in poor hydrologic condition.

5 Composite CN's to use for the design of temporary measures during grading and construction should be computed using Figure 603 based on the degree of development (impervious area percentage) and the CN's for the newly graded pervious areas.

Revision	Date

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

RUNOFF CURVE NUMBERS (SEMIARID RANGELANDS¹)

Cover description		Curve numbers for hydrologic soil group—			
Cover type	Hydrologic condition ²	A ³	B	C	D
Herbaceous—mixture of grass, weeds, and low-growing brush, with brush the minor element.	Poor		80	87	93
	Fair		71	81	89
	Good		62	74	85
Oak-aspen—mountain brush mixture of oak brush, aspen, mountain mahogany, bitter brush, maple, and other brush.	Poor		66	74	79
	Fair		48	57	63
	Good		30	41	48
Pinyon-juniper—pinyon, juniper, or both; grass understory.	Poor		75	85	89
	Fair		58	73	80
	Good		41	61	71
Sagebrush with grass understory.	Poor		67	80	85
	Fair		51	63	70
	Good		35	47	55
Desert shrub—major plants include saltbush, greasewood, creosotebush, blackbrush, bursage, palo verde, mesquite, and cactus.	Poor	63	77	85	88
	Fair	55	72	81	86
	Good	49	68	79	84

¹Average runoff condition, and $I_a = 0.2S$.

²Poor: <30% ground cover (litter, grass, and brush overstory).

Fair: 30 to 70% ground cover.

Good: >70% ground cover.

³Curve numbers for group A have been developed only for desert shrub.

Revision	Date

Table 4-2 Land Use Categories

Land Use Index Number	Description - Typical Land Uses	Impervious (%)	Open Landscaped Good Condition (%)	Open Desert Shrub Poor Condition <u>Natural Desert Landscaping</u> (%)
Drought Ordinance Not Applied				
1	Undeveloped Land, Open Desert	0	0	100
2	Parks, Golf Courses	5	85	10
3	Rural, 0.5-1 units per acre (uses 1 unit/acre)	20	20	60
4	Low-Density Residential, 1-2 units per acre (uses 2 units/acre)	25	40	35
5	Medium-Density Residential, 2-4 units per acre (uses 3 units/acre)	29	71	0
6	High-Density Residential, 4-8 units per acre (uses 6 units/acre)	62	38	0
7	Public Facility and Residential, 8- 12 units/acre	72	28	0
8	Very High-Density Residential, 12 units/acre or more	85	15	0
9	Commercial, Retail, Casino, High Rise Condominiums	90	10	0
10	Light Industrial	70	15	15
11	Heavy Industrial	85	8	7
12	Schools	50	50	0
13	Lakes	0	0	0
Drought Ordinance Applied				
14	Low-Density Residential, 1-2 units per acre (uses 2 units/acre)	25	20	55
15	Medium-Density Residential, 2-4 units per acre (uses 3 units/acre)	29	35	36
16	High-Density Residential, 4-8 units per acre (uses 6 units/acre)	62	19	19
17	Public Facility and Residential, 8- 12 units/acre	72	14	14
18	Very High-Density Residential, 12 units/acre or more	85	0	15
19	Commercial, Retail, Casino, High Rise Condominiums	90	0	10
20	Light Industrial	70	0	30
21	Heavy Industrial	85	0	15
22	Schools	50	30	20

The land use data used with the 2008 MPU is shown on the H-Maps of Volume 2. **Figure 4-1** shows the geographic comparison between the 2008 and 2002 MPU land use coverages in terms of percent imperviousness. The increase or decrease in impervious area represents an increase or decrease in the runoff potential for a given area.

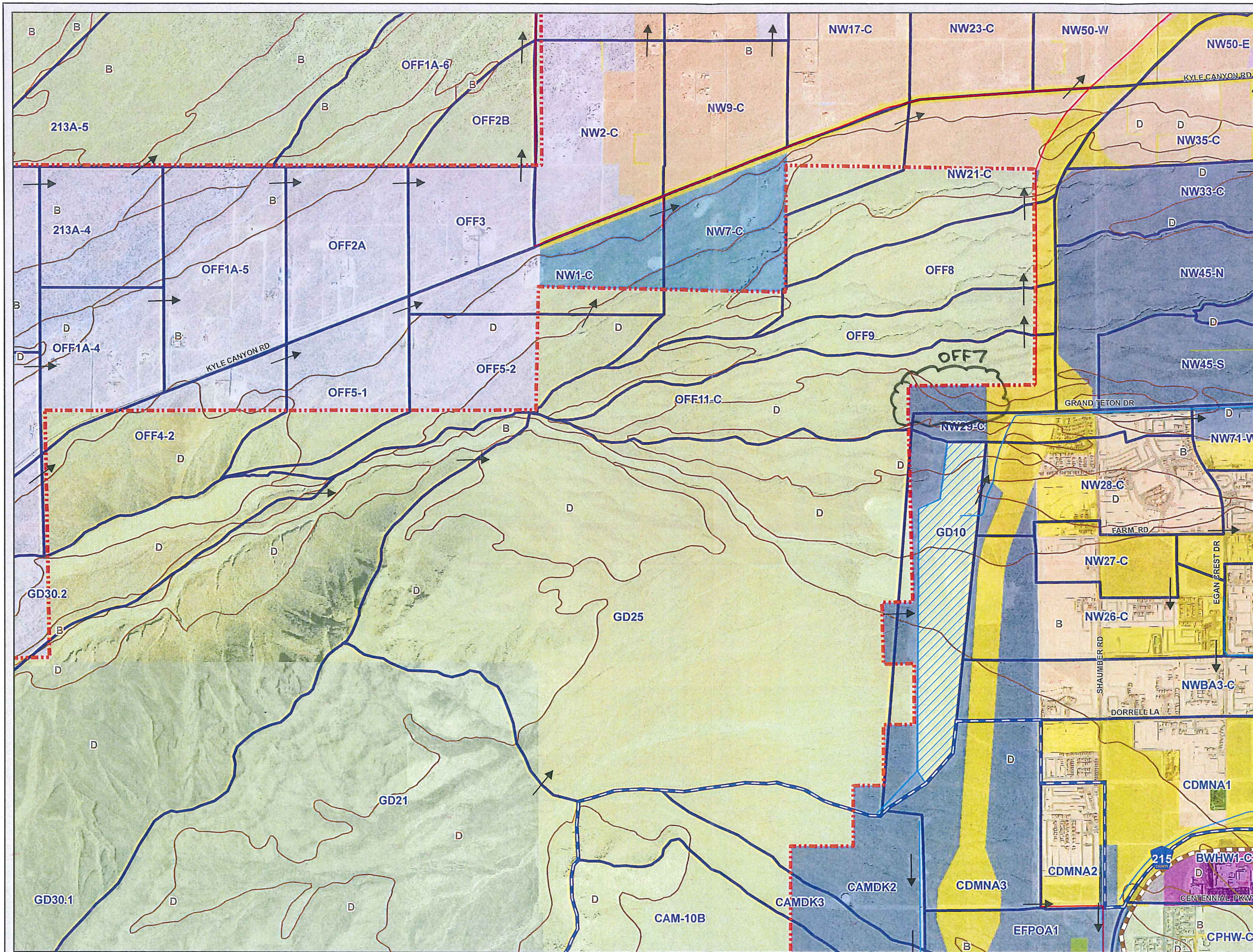
BASIN OFF-7 REPRESENTED BY SOILS 191 & 40D

Table 4-3. Curve Number Matrix

Table 4-3. Curve Number Matrix																									
MAP #	COMPONENTS			LAND USE CLASSIFICATION INDEX NUMBER																					
	OPEN DESERT	OPEN GOOD	% IMP	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
				SOIL TYPE COMPOSITE CN FOR LAND USE TYPE																					
	CN	CN	CN	CN	CN	CN	CN	CN	CN	CN	CN	CN	CN	CN	CN	CN	CN	CN	CN	CN	CN	CN	CN	CN	CN
105	71	51	98	71	55	72	70	65	80	85	91	93	87	92	75	30	74	72	84	88	94	95	90	94	79
107	65	42	98	65	47	67	64	58	77	82	90	92	85	91	70	30	69	67	81	86	93	95	88	93	75
112	66	43	98	66	48	68	65	59	77	83	90	93	85	91	71	30	69	67	81	86	93	95	88	93	75
113	66	43	98	66	48	68	65	59	77	83	90	93	85	91	71	30	69	67	81	86	93	95	88	93	75
117	65	42	98	65	47	67	64	58	77	82	90	92	85	91	70	30	69	67	81	86	93	95	88	93	75
120	64	40	98	64	45	66	63	57	76	82	89	92	84	91	69	30	68	65	81	85	93	95	88	93	74
127	64	41	98	64	46	66	63	58	76	82	89	92	84	91	70	30	68	66	81	85	93	95	88	93	74
128	64	41	98	64	46	66	63	58	76	82	89	92	84	91	70	30	68	66	81	85	93	95	88	93	74
129	66	44	98	66	49	68	65	60	77	83	90	93	85	91	71	30	70	68	82	86	93	95	88	93	75
130	78	63	98	78	66	79	77	73	85	88	93	95	90	94	81	30	80	79	88	90	95	96	92	95	84
132	77	61	98	77	64	78	76	72	84	88	92	94	89	94	80	30	79	77	87	90	95	96	92	95	83
133	79	66	98	79	69	80	79	75	86	89	93	95	90	94	82	30	81	80	88	91	95	96	92	95	83
134	77	61	98	77	64	78	76	72	84	88	92	94	89	94	80	30	79	77	87	90	95	96	92	95	83
140	84	72	98	84	75	84	83	80	88	91	94	95	92	95	85	30	85	84	90	92	96	97	94	96	87
150	86	77	98	86	79	87	85	83	90	92	95	96	93	95	88	30	87	86	92	93	96	97	94	96	89
151	87	78	98	87	80	87	86	84	90	92	95	96	93	95	87	30	88	87	92	94	96	97	95	96	90
152	86	76	98	86	80	86	85	82	90	92	95	96	93	95	87	30	87	86	92	93	96	97	94	96	89
155	86	77	98	86	79	87	85	83	90	92	95	96	93	95	88	30	87	86	92	93	96	97	94	96	89
160	78	63	98	78	66	79	77	73	85	88	93	95	90	94	81	30	80	79	88	90	95	96	92	95	84
181	79	64	98	79	67	80	78	74	85	88	93	95	90	94	81	30	81	79	88	91	95	96	92	95	84
182	77	60	98	77	64	78	75	71	84	87	92	94	89	93	79	30	79	77	87	90	95	96	92	95	82
183	77	61	98	77	64	78	76	72	84	88	92	94	89	94	80	30	79	77	87	90	95	96	92	95	83
184	77	61	98	77	64	78	76	72	84	88	92	94	89	94	80	30	79	77	87	90	95	96	92	95	83
187	77	61	98	77	64	78	76	72	84	88	92	94	89	94	80	30	79	77	87	90	95	96	92	95	83
190	76	60	98	76	64	77	75	71	84	87	92	94	89	93	79	30	78	77	87	90	95	96	91	95	82
191	77	62	98	77	65	78	76	72	84	88	93	94	89	94	80	30	79	78	87	90	95	96	92	95	83
192	78	63	98	78	66	79	77	73	85	88	93	95	90	94	81	30	80	79	88	90	95	96	92	95	84
200	77	62	98	77	65	78	76	72	84	88	93	94	89	94	80	30	79	78	87	90	95	96	92	95	83
206	77	62	98	77	65	78	76	72	84	88	93	94	89	94	80	30	79	78	87	90	95	96	92	95	83
222	77	61	98	77	64	78	76	72	84	88	92	94	89	94	80	30	79	77	87	90	95	96	92	95	83
236	78	62	98	78	65	79	77	72	84	88	93	94	90	94	80	30	80	78	87	90	95	96	92	95	83
237	77	61	98	77	64	78	76	72	84	88	92	94	89	94	80	30	79	77	87	90	95	96	92	95	83
240	87	78	98	87	80	87	86	84	90	92	95	96	93	96	88	30	88	87	92	94	96	97	95	96	90
252	78	62	98	78	65	79	77	72	84	88	93	94	90	94	80	30	80	78	87	90	95	96	92	95	83
255	78	62	98	78	65	79	77	72	84	88	93	94	90	94	80	30	80	78	87	90	95	96	92	95	83
260	64	41	98	64	46	66	63	58	76	82	89	92	84	91	70	30	68	66	81	85	93	95	88	93	74
262	69	49	98	69	53	71	68	63	79	84	91	93	86	92	74	30	72	70	83	87	94	95	89	94	78
263	64	41	98	64	46	66	63	58	76	82	89	92	84	91	70	30	68	66	81	85	93	95	88	93	74
264	63	39	98	63	44	65	62	56	76	81	89	92	84	91	69	30	67	65	80	85	93	95	88	93	73
270	77	61	98	77	64	78	76	72	84	88	92	94	89	94	80	30	79	77	87	90	95	96	92	95	83
278	77	61	98	77	64	78	76	72	84	88	92	94	89	94	80	30	79	77	87	90	95	96	92	95	83
282	84	73	98	84	75	85	83	80	89	91	94	96	92	95	86	30	85	84	91	93	96	97	94	96	88
300	87	78	98	87	80	87	86	84	90	92	95	96	93	96	88	30	88	87	92	94	96	97	95	96	90
301	87	79	98	87	81	88	87	85	91	93	95	96	94	96	89	30	88	87	92	94	96	97	95	96	90
302	81	68	98	81	71	82	80	77	87	90	94	95	91	94	83	30	83	81	89	91	95	96	93	95	86
305	83	72	98	83	74	84	82	80	88	91	94	95	92	95	85	30	85	84	90	92	96	97	94	96	89
306	86	76	98	86	78	86	85	82	90	92	95	96	93	95	87	30	87	86	92	93	96	97	94	96	89
325	77	61	98	77	64	78	76	72	84	88	92	94	89	94	80	30	79	77	87	90	95	96	92	95	83
326	77	61	98	77	64	78	76	72	84	88	92	94	89	94	80	30	79	77	87	90	95	96	92	95	83

Table 4-3. Curve Number Matrix (Continued)

Table 4-3. Curve Number Matrix (Continued)																											
MAP #	COMPONENTS			LAND USE CLASSIFICATION INDEX NUMBER																							
	OPEN	DESERT	% IMP	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22		
	GOOD	POOR		100	10	60	35	0	0	0	0	0	15	7	0	0	55	36	19	14	15	10	30	15	20		
	% --->			0	85	20	40	71	38	28	15	10	15	8	50	0	20	35	19	14	0	0	0	0	30		
	% --->			0	5	20	25	29	62	72	85	90	70	85	50	0	25	29	62	72	85	90	70	85	50		
			SOIL TYPE COMPOSITE CN FOR LAND USE TYPE																								
CN	CN	CN	85	74	98	85.0	76.0	85.0	84.0	81.0	89.0	91.0	94.0	96.0	92.0	95.0	86.0	30.0	86.0	85.0	91.0	93.0	96.0	97.0	94.0	96.0	88.0
341	85	74	98	85.0	76.0	85.0	84.0	81.0	89.0	91.0	94.0	96.0	92.0	95.0	86.0	30.0	86.0	85.0	91.0	93.0	94.0	96.0	97.0	95.0	96.0	91.0	88.0
360	87	82	98	87.0	83.0	88.0	88.0	87.0	92.0	94.0	96.0	96.0	94.0	96.0	90.0	30.0	89.0	88.0	93.0	94.0	96.0	97.0	95.0	96.0	91.0	88.0	
380	84	73	98	84.0	75.0	85.0	83.0	80.0	89.0	91.0	94.0	96.0	92.0	95.0	86.0	30.0	85.0	84.0	91.0	93.0	96.0	97.0	94.0	96.0	88.0	88.0	
390	85	74	98	85.0	76.0	85.0	84.0	81.0	89.0	91.0	94.0	96.0	92.0	95.0	86.0	30.0	86.0	85.0	91.0	93.0	96.0	97.0	94.0	96.0	88.0	88.0	
400	87	78	98	87.0	80.0	87.0	86.0	84.0	90.0	92.0	95.0	96.0	93.0	96.0	88.0	30.0	88.0	87.0	92.0	94.0	96.0	97.0	95.0	96.0	90.0	90.0	
415	78	62	98	78.0	65.0	79.0	77.0	72.0	84.0	88.0	93.0	94.0	90.0	94.0	80.0	30.0	80.0	78.0	87.0	90.0	95.0	96.0	92.0	95.0	83.0	83.0	
417	82	72	98	82.0	74.0	83.0	82.0	80.0	88.0	91.0	94.0	95.0	92.0	95.0	85.0	30.0	84.0	83.0	90.0	92.0	96.0	96.0	93.0	96.0	87.0	87.0	
418	78	62	98	78.0	65.0	79.0	77.0	72.0	84.0	88.0	93.0	94.0	90.0	94.0	80.0	30.0	80.0	78.0	87.0	90.0	95.0	96.0	92.0	95.0	83.0	83.0	
419	77	62	98	77.0	65.0	78.0	76.0	72.0	84.0	88.0	92.0	94.0	89.0	94.0	80.0	30.0	79.0	77.0	87.0	90.0	95.0	96.0	92.0	95.0	83.0	83.0	
430	77	61	98	77.0	64.0	78.0	76.0	72.0	84.0	88.0	92.0	94.0	89.0	94.0	80.0	30.0	79.0	77.0	87.0	90.0	95.0	96.0	92.0	95.0	82.0	82.0	
440	76	60	98	76.0	64.0	77.0	75.0	71.0	84.0	87.0	92.0	94.0	89.0	93.0	79.0	30.0	89.0	88.0	93.0	94.0	97.0	97.0	95.0	97.0	91.0	91.0	
450	88	80	98	88.0	82.0	88.0	87.0	85.0	91.0	93.0	95.0	96.0	94.0	96.0	89.0	30.0	89.0	88.0	93.0	94.0	97.0	97.0	95.0	96.0	89.0	89.0	
481	86	77	98	86.0	79.0	87.0	85.0	83.0	90.0	92.0	95.0	96.0	93.0	95.0	88.0	30.0	87.0	86.0	92.0	93.0	96.0	97.0	94.0	96.0	89.0	89.0	
484	87	79	98	87.0	81.0	88.0	87.0	85.0	91.0	93.0	95.0	96.0	94.0	96.0	89.0	30.0	88.0	87.0	92.0	93.0	96.0	97.0	94.0	96.0	89.0	89.0	
500	82	69	98	82.0	72.0	83.0	81.0	77.0	87.0	90.0	94.0	95.0	91.0	95.0	84.0	30.0	83.0	82.0	89.0	91.0	95.0	96.0	93.0	95.0	86.0	86.0	
501	77	61	98	77.0	64.0	78.0	76.0	72.0	84.0	88.0	92.0	94.0	89.0	94.0	80.0	30.0	79.0	77.0	87.0	90.0	95.0	96.0	92.0	95.0	83.0	83.0	
502	81	68	98	81.0	71.0	82.0	80.0	77.0	87.0	90.0	94.0	95.0	91.0	94.0	83.0	30.0	83.0	81.0	89.0	91.0	95.0	96.0	93.0	95.0	86.0	86.0	
505	82	70	98	82.0	73.0	83.0	81.0	78.0	87.0	90.0	94.0	95.0	91.0	95.0	84.0	30.0	84.0	82.0	90.0	92.0	96.0	96.0	93.0	96.0	86.0	86.0	
510	88	82	98	88.0	83.0	89.0	88.0	87.0	92.0	94.0	96.0	96.0	94.0	96.0	90.0	30.0	89.0	89.0	93.0	94.0	97.0	97.0	95.0	97.0	91.0	91.0	
540	77	62	98	77.0	65.0	78.0	76.0	72.0	84.0	88.0	93.0	94.0	89.0	94.0	80.0	30.0	79.0	78.0	87.0	90.0	95.0	96.0	92.0	95.0	83.0	83.0	
542	77	62	98	77.0	65.0	78.0	76.0	72.0	84.0	88.0	93.0	94.0	89.0	94.0	80.0	30.0	79.0	78.0	87.0	90.0	95.0	96.0	92.0	95.0	83.0	83.0	
545	81	68	98	81.0	71.0	82.0	80.0	77.0	87.0	90.0	94.0	95.0	91.0	94.0	83.0	30.0	83.0	81.0	89.0	91.0	95.0	96.0	93.0	95.0	86.0	86.0	
600	85	74	98	85.0	76.0	85.0	84.0	81.0	89.0	91.0	94.0	96.0	92.0	95.0	86.0	30.0	86.0	85.0	91.0	93.0	96.0	97.0	94.0	96.0	88.0	88.0	
605	85	74	98	85.0	76.0	85.0	84.0	81.0	89.0	91.0	94.0	96.0	92.0	95.0	86.0	30.0	86.0	85.0	91.0	93.0	96.0	97.0	94.0	96.0	88.0	88.0	
610	85	74	98	85.0	76.0	85.0	84.0	81.0	89.0	91.0	94.0	96.0	92.0	95.0	86.0	30.0	86.0	85.0	91.0	93.0	96.0	97.0	94.0	96.0	88.0	88.0	
615	85	74	98	85.0	76.0	85.0	84.0	81.0	89.0	91.0	94.0	96.0	92.0	95.0	86.0	30.0	86.0	85.0	91.0	93.0	96.0	97.0	94.0	96.0	88.0	88.0	
630	88	80	98	88.0	82.0	88.0	87.0	85.0	91.0	93.0	95.0	96.0	94.0	96.0	89.0	30.0	89.0	88.0	93.0	94.0	97.0	97.0	95.0	97.0	91.0	91.0	
635	90	90	98	90.0	90.0	92.0	92.0	92.0	95.0	96.0	97.0	97.0	96.0	97.0	94.0	30.0	92.0	92.0	95.0	96.0	97.0	97.0	96.0	97.0	94.0	94.0	
640	90	90	98	90.0	90.0	92.0	92.0	92.0	95.0	96.0	97.0	97.0	96.0	97.0	94.0	30.0	92.0	92.0	95.0	96.0	97.0	97.0	96.0	97.0	94.0	94.0	
645	85	74	98	85.0	76.0	85.0	84.0	81.0	89.0	91.0	94.0	96.0	92.0	95.0	86.0	30.0	86.0	85.0	91.0	93.0	96.0	97.0	94.0	96.0	88.0	88.0	
999	63	39	30	63.0	41.0	52.0	45.0	36.0	33.0	33.0	31.0	31.0	36.0	33.0	35.0	30.0	50.0	45.0	38.0	36.0	35.0	33.0	40.0	35.0	39.0	39.0	
1141	86	79	98	86.0	81.0	87.0	86.0	85.0	91.0	93.0	95.0	96.0	93.0	96.0	89.0	30.0	88.0	87.0	92.0	94.0	96.0	97.0	94.0	96.0	90.0	90.0	
1150	63	39	98	63.0	44.0	55.0	48.0	39.0	36.0	36.0	34.0	34.0	41.0	38.0	40.0	35.0	40.0	35.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	
1191	67	45	98	67.0	50.0	60.0	55.0	45.0	40.0	40.0	38.0	38.0	45.0	42.0	45.0	40.0	40.0	35.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	
1200	76	60	98	76.0	64.0	77.0	75.0	71.0	84.0	87.0	92.0	94.0	89.0	94.0	79.0	30.0	78.0	77.0	87.0	90.0	95.0	96.0	91.0	95.0	82.0	82.0	
1221	78	63	98	78.0	66.0	79.0	77.0	73.0	85.0	88.0	93.0	95.0	90.0	94.0	81.0	30.0	80.0	79.0	88.0	90.0	95.0	96.0	92.0	95.0	84.0	84.0	
1292	89	86	98	89.0	87.0	90.0	90.0	89.0	93.0	95.0	96.0	97.0	95.0	96.0	92.0	30.0	91.0	91.0	94.0	95.0	97.0	97.0	95.0	97.0	93.0	93.0	
1294	90	89	98	90.0	90.0	91.0	92.0	92.0	95.0	96.0	97.0	97.0	96.0	97.0	94.0	30.0	92.0	92.0	95.0	96.0	97.0	97.0	96.0	97.0	94.0	94.0	
1311	78	63	98	78.0	66.0	79.0	77.0	73.0	85.0	88.0	93.0	95.0	90.0	94.0	81.0	30.0	80.0	79.0	88.0	90.0	95.0	96.0	92.0	95.0	84.0	84.0	
1314	79	64	98	79.0	67.0	80.0	78.0	74.0	85.0	88.0	93.0	95.0	90.0	94.0													



2008
LAS VEGAS VALLEY
FLOOD CONTROL
MASTER PLAN UPDATE
FIGURE H-12
HYDROLOGIC SUMMARY

LEGEND

- Ultimate Development Boundary
- Watershed Boundary
- Subbasin Boundary
- Drought Ordinance Boundary
- Flow Arrows

Flood Control Facilities

- Existing Facilities
- Category A Proposed Facilities
- Category B Proposed Facilities
- Category A Remove & Replace/Parallel Facilities
- Category B Remove & Replace/Parallel Facilities

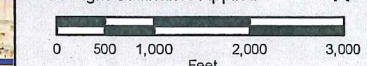
Type Hydrologic Soil Groups

- A Low Runoff Potential
- B Moderately Low Runoff Potential
- C Moderately High Runoff Potential
- D High Runoff Potential/Rock Outcrops

Typical Land Use

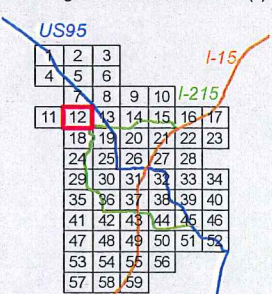
- 1 Undeveloped Land, Open Desert
- 2 Parks, Golf Courses
- 3 Rural
- 4 / 14* Low Density Residential
- 5 / 15* Medium Density Residential
- 6 / 16* High Density Residential
- 7 / 17* Public Facility, Residential
- 8 / 18* **Very High Density Residential**
- 9 / 19* Commercial, Retail, Casino, High Rise Condominiums
- 10 / 20* Light Industrial
- 11 / 21* Heavy Industrial
- 12 / 22* Schools
- 13 Lakes

* Drought Ordinance Applied



Scale: 1 inch = 2,000 feet

Refer to Figure G-2 for Aerial Source(s)



Debris Loading (MUSLE Equation)

Debris Volume Summary		
Tributary	Debris Volume (ac-ft)	Cumulative Volume (ac-ft)
OFF1	2.05	2.05
OFF2	0.10	2.15
OFF3	0.09	2.24
OFF4	0.27	2.51
OFF5	1.40	3.92
OFF6	0.14	4.06

TABLE 14.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS--Continued

Soil name and map symbol	Depth	Clay	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors		Wind erodibility group
								K	T	
	In	Pct	In/hr	In/in	pH	Mmhos/cm				
140----- Casaga	0-1 1-21 21-41 41-60	20-30 27-35 27-35 8-18	0.2-0.6 0.06-0.2 0.2-0.6 2.0-6.0	0.08-0.10 0.19-0.21 0.08-0.11 0.06-0.10	>8.4 >8.4 >8.4 7.4-9.0	8-16 4-8 4-8 8-16	Moderate----- Moderate----- Moderate----- Low-----	0.10 0.32 0.17 0.10	5	7
150----- Cave	0-6 6-60	10-20 ---	0.6-2.0 ---	0.06-0.10 ---	7.4-8.4 ---	<2 ---	Low----- ---	0.10 ---	1	5
151----- Cave	0-5 5-11 11-60	3-8 10-20 ---	6.0-20 0.6-2.0 ---	0.09-0.11 0.07-0.12 ---	7.9-8.4 7.9-8.4 ---	2-4 2-4 ---	Low----- Low----- ---	0.17 0.24 ---	1	2
152----- Cave	0-12 12-36 36-60	10-20 --- 2-5	0.6-2.0 --- 2.0-6.0	0.07-0.12 --- 0.04-0.06	7.9-8.4 --- 7.9-8.4	2-4 --- <4	Low----- --- Low-----	0.20 --- 0.10	1	4L
155----- Cave	0-15 15-60	10-20 ---	0.6-2.0 ---	0.07-0.12 ---	7.9-8.4 ---	2-4 ---	Low----- ---	0.20 ---	1	4L
160----- Destazo	0-11 11-40 40-60	8-18 20-35 15-20	2.0-6.0 0.2-0.6 2.0-6.0	0.10-0.12 0.05-0.10 0.09-0.11	7.9-8.4 7.9-8.4 7.9-8.4	<4 <4 <4	Low----- Low----- Low-----	0.17 0.10 0.17	5	8
181*: Caliza-----	0-2 2-14 14-60	4-10 3-8 2-8	2.0-6.0 2.0-6.0 6.0-20	0.05-0.08 0.05-0.09 0.03-0.07	7.9-8.4 7.9-8.4 7.9-8.4	<2 <2 <2	Low----- Low----- Low-----	0.05 0.10 0.05	5	6
Pittman-----	0-2 2-23 23-32 32-50 50-60	5-15 2-12 --- --- 0-5	6.0-20 6.0-20 --- --- 6.0-20	0.04-0.08 0.04-0.08 --- --- 0.03-0.06	7.4-8.4 7.9-8.4 --- --- 7.4-8.4	<2 <2 --- --- <8	Low----- Low----- --- --- Low-----	0.10 0.17 --- --- 0.05	2	8
182*: Caliza-----	0-2 2-14 14-60	4-10 3-8 2-8	2.0-6.0 2.0-6.0 6.0-20	0.05-0.08 0.05-0.09 0.03-0.07	7.9-8.4 7.9-8.4 7.9-8.4	<2 <2 <2	Low----- Low----- Low-----	0.05 0.10 0.05	5	6
Pittman-----	0-2 2-23 23-32 32-50 50-60	5-15 2-12 --- --- 0-5	6.0-20 6.0-20 --- --- 6.0-20	0.04-0.06 0.04-0.08 --- --- 0.03-0.06	7.4-8.4 7.9-8.4 --- --- 7.4-8.4	<2 <2 --- --- <8	Low----- Low----- --- --- Low-----	0.10 0.17 --- --- 0.05	2	8
Arizo-----	0-8 8-60	2-8 0-5	6.0-20 >20	0.04-0.06 0.04-0.06	7.4-9.0 7.4-9.0	<2 <2	Low----- Low-----	0.15 0.10	5	4
183----- Caliza	0-3 3-60	2-6 2-8	6.0-20 2.0-6.0	0.04-0.07 0.03-0.07	7.9-8.4 7.9-8.4	<2 <2	Low----- Low-----	0.05 0.05	5	5
184----- Caliza	0-3 3-16 16-60	5-10 5-10 3-8	2.0-6.0 2.0-6.0 6.0-20	0.05-0.07 0.05-0.08 0.03-0.06	7.9-8.4 7.9-8.4 7.9-8.4	<2 <2 <2	Low----- Low----- Low-----	0.10 0.05 0.10	5	5
187----- Caliza	0-2 2-14 14-60	4-10 3-8 2-8	2.0-6.0 2.0-6.0 6.0-20	0.05-0.08 0.05-0.09 0.03-0.07	7.9-8.4 7.9-8.4 7.9-8.4	<2 <2 <2	Low----- Low----- Low-----	0.05 0.10 0.05	5	6
190----- Dalian	0-4 4-61	5-10 3-12	2.0-6.0 2.0-6.0	0.05-0.09 0.05-0.09	7.9-8.4 7.9-8.4	<2 <2	Low----- Low-----	0.15 0.15	5	5
191----- Dalian	0-5 5-60	5-10 3-12	2.0-6.0 2.0-6.0	0.05-0.09 0.05-0.09	7.9-8.4 7.9-8.4	<2 <2	Low----- Low-----	0.15 0.15	5	8
192*: Dalian-----	0-5 5-60	5-10 3-12	2.0-6.0 2.0-6.0	0.05-0.09 0.05-0.09	7.9-8.4 7.9-8.4	<2 <2	Low----- Low-----	0.15 0.15	5	5

See footnote at end of table.

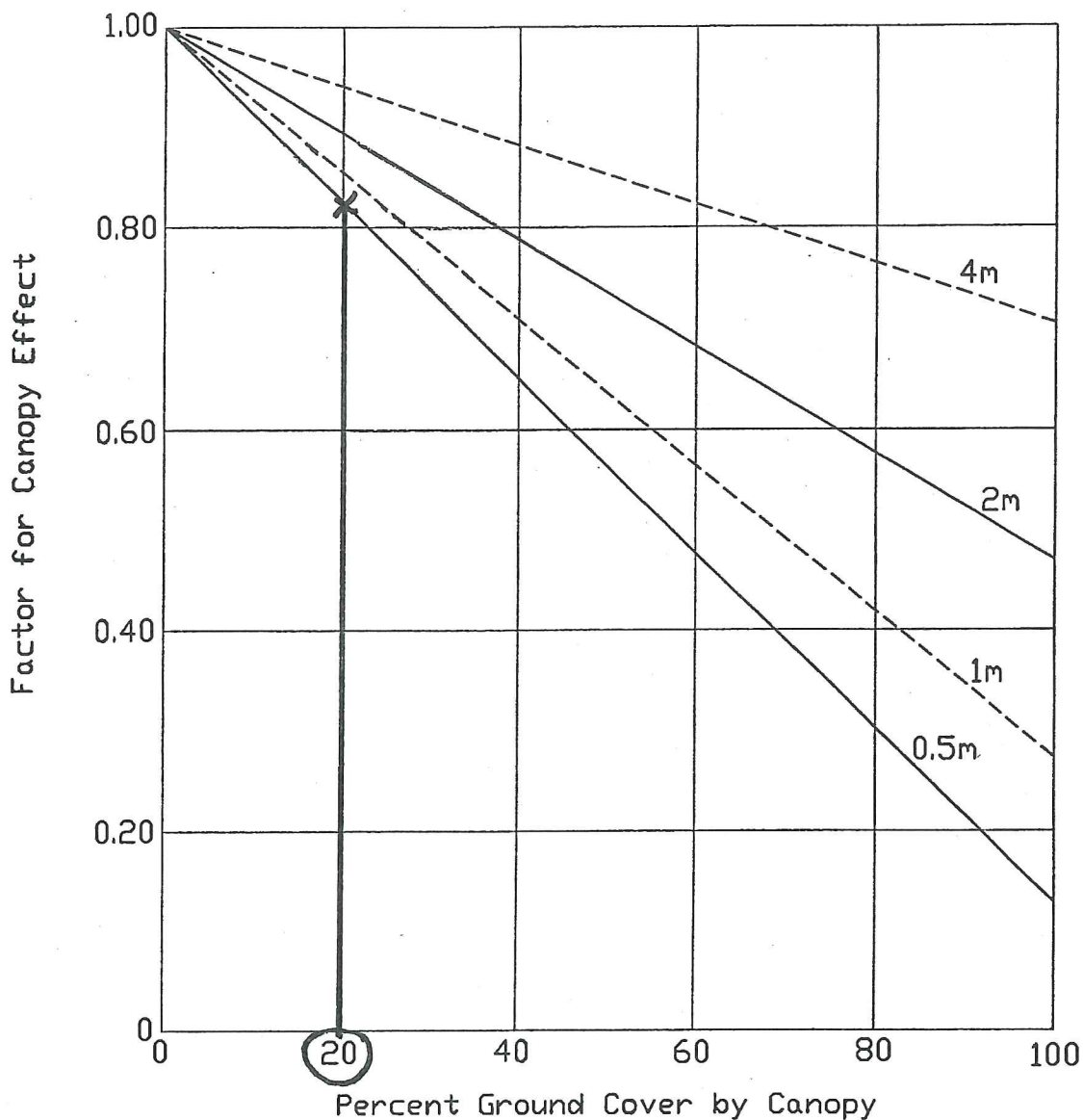
TABLE 14.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS--Continued

Soil name and map symbol	Depth	Clay	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors		Wind erodibility group
								K	T	
	In	Pct	In/hr	In/in	pH	Mmhos/cm				
400----- Tencee	0-5 5-15 15-60	10-20 10-20 ---	2.0-6.0 0.6-2.0 ---	0.05-0.07 0.05-0.08 ---	7.9-8.4 7.9-8.4 ---	<2 <2 ---	Low----- Low----- ---	0.15 0.15 ---	1	8
415----- Aztec	0-2 2-30 30-60	6-12 3-15 ---	2.0-6.0 0.2-0.6 ---	0.06-0.08 0.06-0.08 ---	7.4-9.0 7.4-9.0 ---	<2 4-8 ---	Low----- Low----- ---	0.10 0.15 ---	5	6
417*: Aztec-----	0-4 4-30 30-60	6-12 3-15 ---	2.0-6.0 0.2-0.6 ---	0.06-0.08 0.06-0.08 ---	7.4-9.0 7.4-9.0 ---	<2 4-8 ---	Low----- Low----- ---	0.10 0.15 ---	5	6
Rock outcrop.										
418*: Aztec-----	0-4 4-30 30-60	3-12 3-15 ---	2.0-20 0.2-0.6 ---	0.06-0.10 0.06-0.08 ---	7.4-9.0 7.4-9.0 ---	<2 4-8 ---	Low----- Low----- ---	0.17 0.15 ---	5	3
Nickel-----	0-9 9-23 23-45 45	4-12 6-15 2-10 ---	2.0-6.0 2.0-0.6 2.0-6.0 ---	0.06-0.10 0.04-0.07 0.04-0.08 ---	7.9-9.0 7.9-9.0 7.9-9.0 ---	<2 <2 <2 ---	Low----- Low----- Low----- ---	0.15 0.05 0.05 ---	5	4
Knob Hill-----	0-7 7-23 23-37 37-60	3-8 3-10 3-10 3-8	6.0-20 2.0-6.0 2.0-6.0 6.0-20	0.06-0.08 0.06-0.08 0.06-0.08 0.05-0.07	7.9-8.4 7.9-8.4 7.9-9.0 7.9-9.0	<2 <2 <4 <4	Low----- Low----- Low----- Low-----	0.17 0.17 0.17 0.17	5	2
419*: Aztec-----	0-4 4-60	3-12 3-15	2.0-20 0.2-0.6	0.06-0.10 0.06-0.08	7.4-9.0 7.4-9.0	<2 4-8	Low----- Low-----	0.17 0.15	5	3
Bracken-----	0-1 1-60	4-10 ---	2.0-6.0 ---	0.06-0.11 ---	7.4-8.4 ---	<2 ---	Low----- ---	0.10 ---	4	6
430----- Knob Hill	0-7 7-23 23-37 37-60	3-8 3-10 3-10 3-8	6.0-20 2.0-6.0 2.0-6.0 6.0-20	0.06-0.08 0.06-0.08 0.06-0.08 0.05-0.07	7.9-8.4 7.9-8.4 7.9-9.0 7.9-9.0	<2 <2 <4 <4	Low----- Low----- Low----- Low-----	0.17 0.17 0.17 0.17	5	2
440----- Nickel	0-9 9-23 23-45 45	4-12 6-15 2-10 ---	2.0-6.0 2.0-0.6 2.0-6.0 ---	0.04-0.08 0.04-0.07 0.04-0.08 ---	7.9-9.0 7.9-9.0 7.9-9.0 ---	<2 <2 <2 ---	Low----- Low----- Low----- ---	0.10 0.05 0.05 ---	5	5
450----- Cave Variant	0-2 2-11 11-29 29-40 40-60	7-15 7-18 --- 12-30 5-10	2.0-6.0 2.0-6.0 --- 0.6-2.0 2.0-6.0	0.06-0.09 0.04-0.08 --- 0.10-0.14 0.05-0.09	7.9-8.4 7.9-8.4 --- 7.9-8.4 7.4-7.8	<2 <2 --- 8-16 8-16	Low----- Low----- --- Moderate--- Low-----	0.17 0.17 --- 0.24 0.15	1	5
481----- Hobog	0-4 4-13 13	1-5 12-25 ---	6.0-20 0.6-2.0 ---	0.08-0.10 0.04-0.06 ---	7.4-8.4 7.4-9.0 ---	<2 <2 ---	Low----- Low----- ---	0.17 0.20 ---	1	2
484----- Hobog	0-9 9-15 15	9-21 9-21 ---	0.6-2.0 0.6-2.0 ---	0.04-0.06 0.04-0.06 ---	7.4-9.0 7.4-9.0 ---	<2 <2 ---	Low----- Low----- ---	0.10 0.17 ---	1	8
500*: Canutio-----	0-4 4-43 43	5-12 5-10 ---	2.0-6.0 2.0-6.0 ---	0.05-0.08 0.04-0.08 ---	7.4-8.4 7.4-8.4 ---	<2 <2 ---	Low----- Low----- ---	0.10 0.10 ---	3	8
Akela-----	0-3 3-11 11-60	5-12 6-10 ---	0.6-2.0 0.6-2.0 ---	0.04-0.09 0.04-0.09 ---	7.4-8.4 7.4-8.4 ---	<2 <2 ---	Low----- Low----- ---	0.17 0.17 ---	1	5

See footnote at end of table.

INFLUENCE OF VEGETAL CANOPY (C_v)

$$C_v = 0.82$$



ESTIMATED 20% GROUND COVER @ 0.5m HIGH CANOPY
 PER TABLE 602 4 OF 4 DESERT SHRUB - POOR CONDITION
 (< 30% GROUND COVER)

Revision	Date

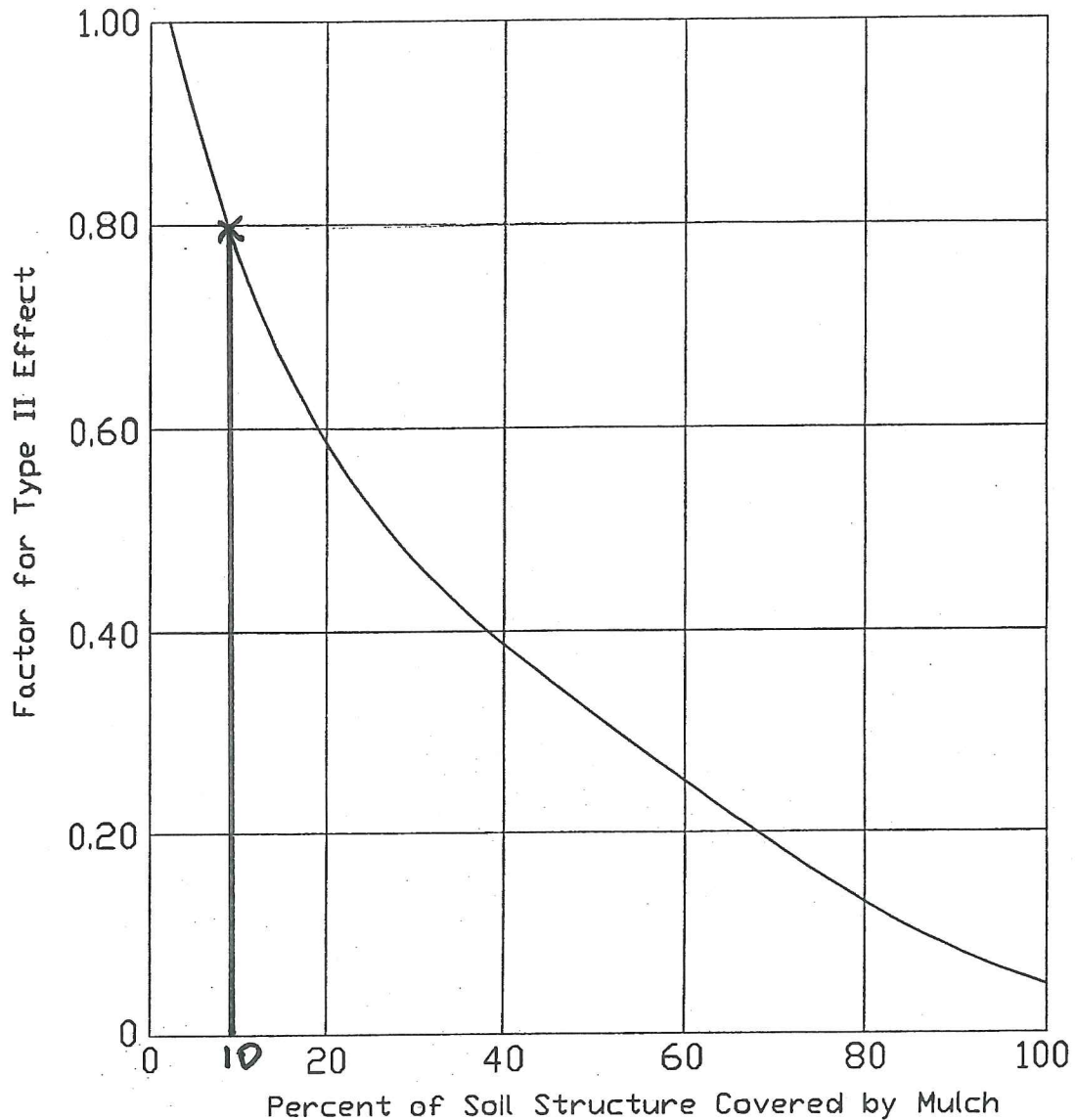
REFERENCE: A Soil-Erodibility Nomograph
 for Farmland and Construction Sites, 1971

FIGURE 1303b

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

EFFECT OF PLANT RESIDUES OR CLOSE-GROWING STEMS AT THE SOIL SURFACE (C_{11})

$$C_{11} = 0.80$$



ESTIMATED 10% MULCH

Revision	Date

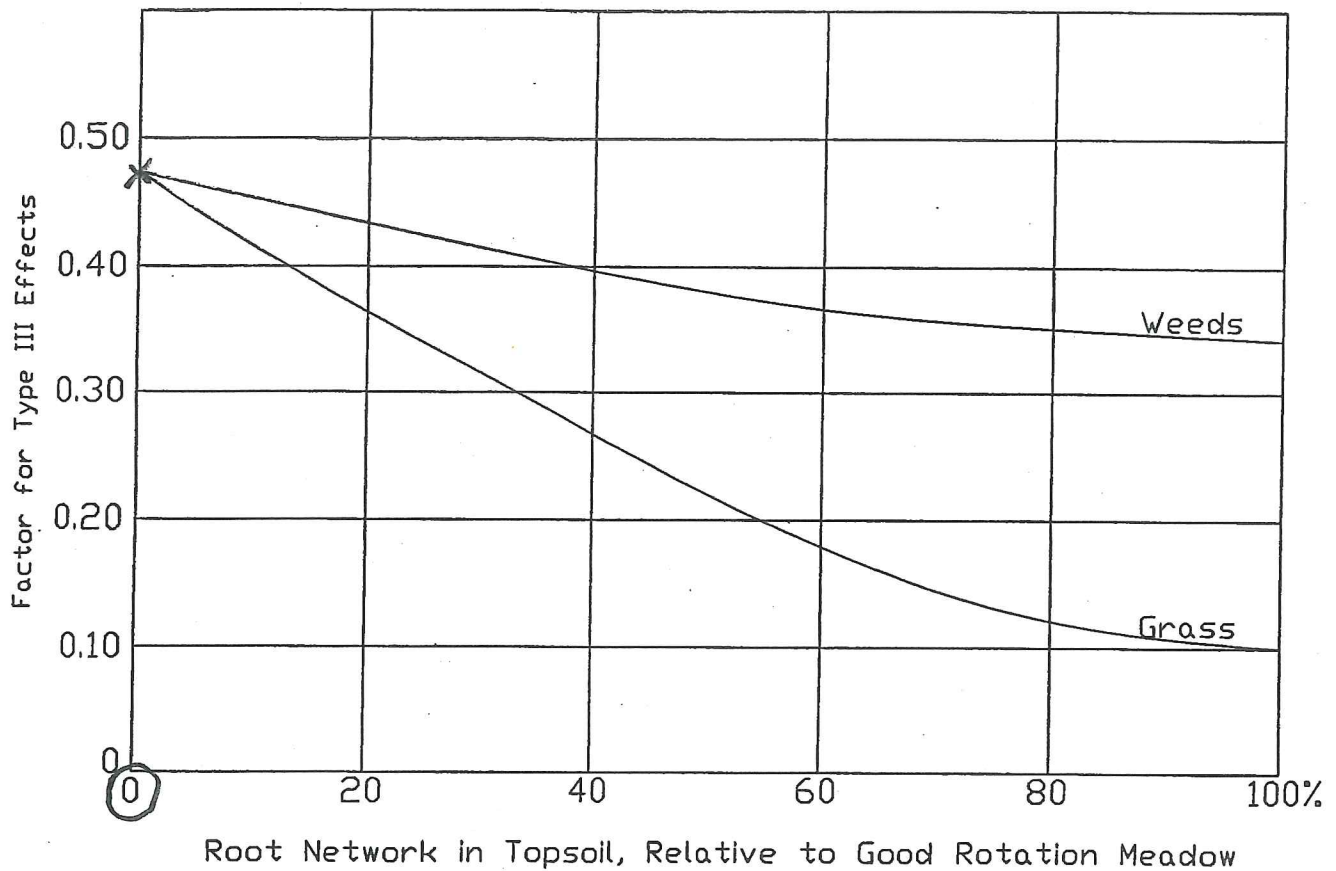
REFERENCE: Estimating the Cover and Management Factor for Undisturbed Areas, 1972

FIGURE 1303c

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

TYPE III EFFECTS ON UNDISTURBED LAND AREAS (C_{III})

$$C_{III} = 0.48$$



0% ROOTS IN TOP SOIL, NO TREES

Revision	Date

REFERENCE: Estimating the Cover and Management Factor for Undisturbed Areas, 1972

FIGURE 1303d

BY: SMJ
DATE: 8/7/2014

$$Y_s = 95(VQ_p)^{0.56} K(LS) CP$$

Eqn. 1307

Basin/Concentration Point =

OFF1

Runoff Volume (V) =

37 ac-ft

(From HEC-1)

Peak Flow (Q_p) =

403 cfs

(From HEC-1)

Soil Erodibility Factor (K) =

0.173

(See Composite K Calcs)

Topographic Factor (LS) =

3.65

$$LS = (X_r)^{0.5} (0.0076 + 0.53S_0 + 7.6S_0^2)$$

Eqn. 1303

Runoff Length (X_r) =

9751 ft

(From Standard Form 4)

Runoff Slope (S₀) =

0.0364 ft/ft

(From Standard Form 4)

Cropping Management Factor (C) =

0.31

$$C = C_I C_{II} C_{III}$$

Eqn. 1304

Canopy Cover (C_I) =

0.82

Fig. 1303b

Mulch/Vegetation on Soil Surface (C_{II}) =

0.80

Fig. 1303c

Tillage and Land Use (C_{III}) =

0.48

Fig. 1303d

Conservation Practice Factor (P) =

1.0

Sediment Yield (Y_s) =

4108.9555 tons

Sediment Volume =

2.05 ac-ft

Soil Erodibility Factor Calculations

BY: SMJ
DATE: 8/7/2014

Basin/Concentration Point = OFF1

Soil Type 1 Breakdown = 46.3% %
Soil Type 2 Breakdown = 1.6% %
Soil Type 3 Breakdown = 52.1% %

Soil Type 1 Erosion Factor (K_w) = 0.20
Soil Type 2 Erosion Factor (K_w) = 0.15
Soil Type 3 Erosion Factor (K_w) = 0.15

Soil Type 155 (From Soils Exhibit)
Soil Type 191 (From Soils Exhibit)
Soil Type 400 (From Soils Exhibit)

Soil Type 155 (From Soil Properties)
Soil Type 191 (From Soil Properties)
Soil Type 400 (From Soil Properties)

Composite Soil Erodibility Factor (K) = 0.173

Modified Universal Soil Loss Equation

BY: SMJ
DATE: 8/7/2014

Basin/Concentration Point =	<u>OFF2</u>	$Y_s = 95(VQ_p)^{0.56} K(LS)CP$	Eqn. 1307
Runoff Volume (V) =	<u>3</u> ac-ft		(From HEC-1)
Peak Flow (Q _p) =	<u>48</u> cfs		(From HEC-1)
Soil Erodibility Factor (K) =	<u>0.193</u>		(See Composite K Calcs)
Topographic Factor (LS) =	<u>2.06</u>	$LS = (X_r)^{0.5} (0.0076 + 0.53S_0 + 7.6S_0^2)$	Eqn. 1303
Runoff Length (X _r) =	<u>2754</u> ft		(From Standard Form 4)
Runoff Slope (S ₀) =	<u>0.0385</u> ft/ft		(From Standard Form 4)
Cropping Management Factor (C) =	<u>0.31</u>	$C = C_I C_{II} C_{III}$	Eqn. 1304
Canopy Cover (C _I) =	<u>0.82</u>		Fig. 1303b
Mulch/Vegetation on Soil Surface (C _{II}) =	<u>0.80</u>		Fig. 1303c
Tillage and Land Use (C _{III}) =	<u>0.48</u>		Fig. 1303d
Conservation Practice Factor (P) =	<u>1.0</u>		

Sediment Yield (Y_s) = 192.476595 tons

Sediment Volume = 0.10 ac-ft

Soil Erodibility Factor Calculations

BY: SMJ
DATE: 8/7/2014

Basin/Concentration Point = OFF2

Soil Type 1 Breakdown = 86.2% %
Soil Type 2 Breakdown = 13.8% %

Soil Type 1 Erosion Factor (K_w) = 0.20
Soil Type 2 Erosion Factor (K_w) = 0.15

Soil Type 155 (From Soils Exhibit)
Soil Type 191 (From Soils Exhibit)

Soil Type 155 (From Soil Properties)
Soil Type 191 (From Soil Properties)

Composite Soil Erodibility Factor (K) = 0.193

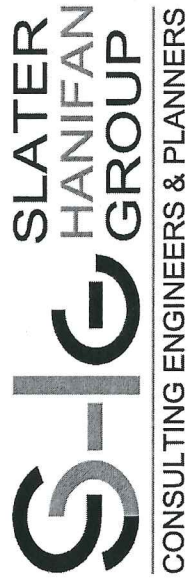
Modified Universal Soil Loss Equation

BY: SMJ
DATE: 8/7/2014

Basin/Concentration Point =	<u>OFF3</u>	$Y_s = 95(VQ_P)^{0.56} K(LS)CP$	Eqn. 1307
Runoff Volume (V) =	<u>2</u> ac-ft		(From HEC-1)
Peak Flow (Q _P) =	<u>38</u> cfs		(From HEC-1)
Soil Erodibility Factor (K) =	<u>0.200</u>		(See Composite K Calcs)
Topographic Factor (LS) =	<u>2.70</u>	$LS = (X_r)^{0.5} (0.0076 + 0.53S_0 + 7.6S_0^2)$	Eqn. 1303
Runoff Length (X _r) =	<u>2647</u> ft		(From Standard Form 4)
Runoff Slope (S ₀) =	<u>0.0495</u> ft/ft		(From Standard Form 4)
Cropping Management Factor (C) =	<u>0.31</u>	$C = C_I C_{II} C_{III}$	Eqn. 1304
Canopy Cover (C _I) =	<u>0.82</u>		Fig. 1303b
Mulch/Vegetation on Soil Surface (C _{II}) =	<u>0.80</u>		Fig. 1303c
Tillage and Land Use (C _{III}) =	<u>0.48</u>		Fig. 1303d
Conservation Practice Factor (P) =	<u>1.0</u>		

Sediment Yield (Y_s) = 182.529844 **tons**

Sediment Volume = 0.09 **ac-ft**



Soil Erodibility Factor Calculations

BY: SMJ
DATE: 8/7/2014

Basin/Concentration Point = OFF3
Soil Type 1 Breakdown = 100.0% %
Soil Type 1 Erosion Factor (K_w) = 0.20

Soil Type 155 (From Soils Exhibit)
Soil Type 155 (From Soil Properties)

Composite Soil Erodibility Factor (K) = 0.200

BY: SMJ
DATE: 8/7/2014

$$Y_s = 95(VQ_p)^{0.56} K(LS)CP$$

Eqn. 1307

Basin/Concentration Point =

OFF4

Runoff Volume (V) =

5 ac-ft

(From HEC-1)

Peak Flow (Q_p) =

84 cfs

(From HEC-1)

Soil Erodibility Factor (K) =

0.200

(See Composite K Calcs)

Topographic Factor (LS) =

3.08

Eqn. 1303

Runoff Length (X_r) =

3522 ft

(From Standard Form 4)

Runoff Slope (S₀) =

0.0491 ft/ft

(From Standard Form 4)

$$LS = (X_r)^{0.5} (0.0076 + 0.53S_0 + 7.6S_0^2)$$

Cropping Management Factor (C) =

0.31

Eqn. 1304

Canopy Cover (C_i) =

0.82

Fig. 1303b

Mulch/Vegetation on Soil Surface (C_{ii}) =

0.80

Fig. 1303c

Tillage and Land Use (C_{iii}) =

0.48

Fig. 1303d

$$C = C_i C_{ii} C_{iii}$$

Conservation Practice Factor (P) =

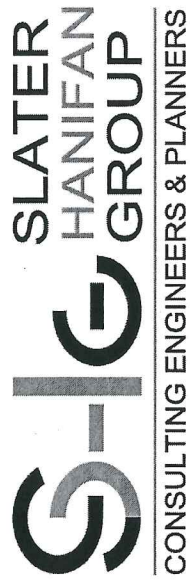
1.0

Sediment Yield (Y_s) =

543.072749 tons

Sediment Volume =

0.27 ac-ft



Soil Erodibility Factor Calculations

BY: SMJ
DATE: 8/7/2014

Basin/Concentration Point = OFF4

Soil Type 1 Breakdown = 100.0% %

Soil Type 1 Erosion Factor (K_w) = 0.20

Soil Type 155 (From Soils Exhibit)

Soil Type 155 (From Soil Properties)

Composite Soil Erodibility Factor (K) = 0.200



BY: SMJ
DATE: 8/7/2014

Eqn. 1307

OFF5

23 ac-ft

236 cfs

0.182

4.18

12337 ft

0.037 ft/ft

Eqn. 1303

(From Standard Form 4)

Eqn. 1304

0.82

0.80

0.48

1.0

2806.58353 tons

1.40 ac-ft

S-I-G SLATER
HANIFAN
GROUP
CONSULTING ENGINEERS & PLANNERS

Soil Erodibility Factor Calculations

BY: SMJ
DATE: 8/7/2014

Basin/Concentration Point = OFF5

Soil Type 1 Breakdown = 63.9% %
Soil Type 2 Breakdown = 36.1% %

Soil Type 1 Erosion Factor (K_w) = 0.20
Soil Type 2 Erosion Factor (K_w) = 0.15

Soil Type 155 (From Soils Exhibit)
Soil Type 400 (From Soils Exhibit)

Soil Type 155 (From Soil Properties)
Soil Type 400 (From Soil Properties)

Composite Soil Erodibility Factor (K) = 0.182

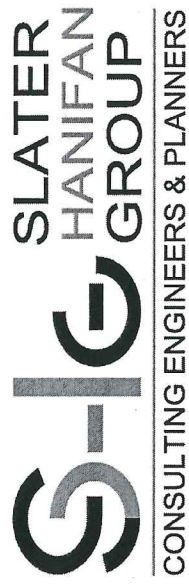
Modified Universal Soil Loss Equation

BY: SMJ
 DATE: 8/7/2014

Basin/Concentration Point =	<u>OFF6</u>	$Y_s = 95(VQ_p)^{0.56} K(LS)CP$	Eqn. 1307
Runoff Volume (V) =	<u>4</u> ac-ft		(From HEC-1)
Peak Flow (Q _p) =	<u>59</u> cfs		(From HEC-1)
Soil Erodibility Factor (K) =	<u>0.200</u>		(See Composite K Calcs)
Topographic Factor (LS) =	<u>2.23</u>	$LS = (X_r)^{0.5} (0.0076 + 0.53S_0 + 7.6S_0^2)$	Eqn. 1303
Runoff Length (X _r) =	<u>2341</u> ft		(From Standard Form 4)
Runoff Slope (S ₀) =	<u>0.0444</u> ft/ft		(From Standard Form 4)
Cropping Management Factor (C) =	<u>0.31</u>	$C = C_I C_{II} C_{III}$	Eqn. 1304
Canopy Cover (C _I) =	<u>0.82</u>		Fig. 1303b
Mulch/Vegetation on Soil Surface (C _{II}) =	<u>0.80</u>		Fig. 1303c
Tillage and Land Use (C _{III}) =	<u>0.48</u>		Fig. 1303d
Conservation Practice Factor (P) =	<u>1.0</u>		

Sediment Yield (Y_s) = 284.620427 tons

Sediment Volume = 0.14 ac-ft



Soil Erodibility Factor Calculations

BY: SMJ
DATE: 8/7/2014

Basin/Concentration Point = OFF6

Soil Type 1 Breakdown = 100.0% %

Soil Type 1 Erosion Factor (K_w) = 0.20

Soil Type 155 (From Soils Exhibit)

Soil Type 155 (From Soil Properties)

Composite Soil Erodibility Factor (K) = 0.200

APPENDIX D

Design Analyses

100-Year Storm Event HEC-1 Model



Project Name:	SKYE CANYON - DETENTION BASIN 1
Description:	Hydrologic Data
File Name:	OLY1401-004 DB1 SF4.xls
By:	WTM
Date:	Aug-14

SUB-BASIN DATA						INITIAL / OVERLAND TIME (Ti)			TRAVEL TIME (Tt)					Tc		Tc Check		Trail	
DESIG:	DEV./EX. (D or E)	CN	K	AREA Ac	AREA Mi^2	INITIAL LENGTH Feet	SLOPE %	Ti Min	TRAVEL LENGTH Feet	SLOPE %	VELOCITY FPS	V1	VELOCITY FPS	V2	Tt Min	Tc Calc.	Total Length Feet	Tc Check	Trail
			[1]		[2]			[3]				[4]		[5]	[6]	[7]	[8]	[9]	[10]
OFF1	E	86.4	0.750	260.66	0.4073	261.6	7.60	5.18	9751	3.64	5.61	2.82	5.61	5.61	30.44	35.61			0.356
OFF2	E	85.0	0.732	22.74	0.0355	171.3	4.10	5.42	2754	3.85	5.77	2.90	5.77	5.77	9.38	14.80			0.148
OFF3	E	86.2	0.748	16.58	0.0259	150.9	13.90	3.24	2647	4.95	6.54	3.29	6.54	6.54	8.00	11.24			0.112
OFF4	E	86.2	0.748	37.19	0.0581	155.9	13.50	3.32	3522	4.91	6.52	3.28	6.52	6.52	10.27	13.59			0.136
OFF5	E	86.5	0.751	164.41	0.2569	199.1	10.50	4.05	12337	3.70	5.65	2.85	5.65	5.65	37.82	41.87			0.419
OFF6	E	86.2	0.748	25.54	0.0399	141.6	4.94	4.43	2341	4.44	6.19	3.12	6.19	6.19	7.63	12.05			0.121
OFF7	D	96.0	0.877	17.98	0.0281	100	1.00	4.01	2600	4.00	6.12	4.04	6.12	6.12	7.78	11.79	2700	25.000	0.118
ON1	D	92.8	0.834	16.72	0.0261	124.0	36.00	1.61	2233	1.83	4.14	2.73	4.14	4.14	10.03	11.64	2357	23.094	0.116
[1]	K = 0.0132 (CN) - 0.39					[5]	For Existing Conditions: V2 = 29.4 * (S/100)^0.5					[9]	Tc = (L/180) + 10						
[2]	A = Area/640					[6]	For Developed Conditions: V2 = 30.6 * (S/100)^0.5					[10]	Trail = (0.6*Tc)/60						
[3]	Ti = (1.8 (1.1-K) L^0.5)/S^0.33					[7]	Tt = L/(60*V)					[11]	Min Trail = 0.05						
[4]	For Existing Conditions: V1 = 14.8 * (S/100)^0.5					[8]	Tc = Ti + Tt					Note: For Travel Time Calcs: V1 applies to first 500 feet and V2 applies to remaining distance.							
	For Developed Conditions: V1 = 20.2 * (S/100)^0.5						Total L = Initial L + Travel L												
REFERENCE :																			
STANDARD FORM 4																			


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*****
* FLOOD HYDROGRAPH PACKAGE (HEC-1)
* JUN 1998
* VERSION 4.1
* RUN DATE 27JUL15 TIME 10:50:57
*****

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ULT1.OUT

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*****
* U.S. ARMY CORPS OF ENGINEERS
* HYDROLOGIC ENGINEERING CENTER
* 609 SECOND STREET
* DAVIS, CALIFORNIA 95616
* (916) 756-1104
*****

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THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HECIGS, HECIDB, AND HECIKW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE. THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE, SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY, DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1 HEC-1 INPUT PAGE 1

LINE ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

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*DIAGRAM
ID SLATER HANIFAN GROUP
ID NINETY-FIVE MANAGEMENT, LLC.
ID SKYE CANYON - DETENTION BASIN #1
ID TECHNICAL DRAINAGE STUDY - CLV SUPPLEMENT
ID ULTIMATE DRAINAGE CONDITION
ID
ID RETURN PERIOD ----- 100-YEAR
ID DISTRIBUTION ----- 6-HOUR SDN3
ID PROJECT NO. ----- OLY1401.004
ID FILENAME ----- ULT1.H1
ID DATE ----- 7/16/2015
ID MODELED BY ----- SMJ
ID
ID SIX HOUR DEPTH-AREA REDUCTION FACTORS
ID DRAINAGE AREA (MI^2) RATIO
ID 0.0-0.49 1.00
ID 0.5-0.99 0.98
ID
ID IT 5 0 0 500
ID IO 5 0 0
ID IN 5 0 0
ID JR PREC 1.00 0.98
*
KK OFF1
KO 3
KM EXISTING OFFSITE DRAINAGE BASIN
KM DISCHARGES INTO DETENTION BASIN "DB1"
PB 3.00
PC 0 0.020 0.057 0.070 0.087 0.108 0.124 0.130 0.130 0.130
PC 0.130 0.130 0.130 0.133 0.140 0.142 0.148 0.158 0.172 0.181
PC 0.190 0.197 0.199 0.200 0.201 0.204 0.214 0.229 0.241 0.249
PC 0.251 0.256 0.270 0.278 0.281 0.283 0.295 0.322 0.352 0.409
PC 0.499 0.590 0.710 0.744 0.781 0.812 0.819 0.835 0.851 0.856
PC 0.860 0.868 0.876 0.888 0.910 0.926 0.937 0.950 0.970 0.976
PC 0.982 0.985 0.987 0.989 0.990 0.993 0.993 0.994 0.995 0.998
PC 0.998 0.999 1
BA .4073
LS 0 86.4
UD 0.356
*
KK OFF7
KO 3
KM FUTURE DEVELOPED OFFSITE DRAINAGE BASIN
KM DISCHARGES INTO DETENTION BASIN "DB1"
BA .0281
LS 0 96.0
UD 0.118
*

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1 HEC-1 INPUT PAGE 2

LINE ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

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KK CP2
KM COMBINE OFF1, OFF7
HC 2
*
KK OFF2
KO 3
KM EXISTING OFFSITE DRAINAGE BASIN
KM DISCHARGES INTO DETENTION BASIN "DB1"
BA .0355
LS 0 85.0
UD 0.148
*
KK OFF3
KO 3
KM EXISTING OFFSITE DRAINAGE BASIN
KM DISCHARGES INTO DETENTION BASIN "DB1"
BA .0259
LS 0 86.2
UD 0.112
*
KK CP1
KM COMBINE CP2, OFF2, AND OFF3
HC 3
*
KK OFF4
KO 3
KM EXISTING OFFSITE DRAINAGE BASIN
KM DISCHARGES INTO DETENTION BASIN "DB1"
BA .0581
LS 0 86.2
UD 0.136

```

ULT1.OUT

```

*
73 KK OFF5
74 KO 3
75 KM EXISTING OFFSITE DRAINAGE BASIN
76 KM DISCHARGES INTO DETENTION BASIN "DB1"
77 BA .2569
78 LS 0 86.5
79 UD 0.419
*
80 KK OFF6
81 KO 3
82 KM EXISTING OFFSITE DRAINAGE BASIN
83 KM DISCHARGES INTO DETENTION BASIN "DB1"
84 BA .0399
85 LS 0 86.2
86 UD 0.121
*

```

1 HEC-1 INPUT PAGE 3

LINE ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

```

87 KK ON1
88 KM PROPOSED ONSITE DRAINAGE BASIN
89 BA .0261
90 LS 0 92.8
91 UD 0.116
*
92 KK DB1
93 KM COMBINE CP1, OFF4, OFF5, OFF6 AND ON1
94 KO 1
95 HC 5
*
96 KK RDB1
97 KM OUTLET = 24" ORIFICE @ INVERT ELEVATION = 3013.8-FT
98 KO 1
99 RS 1 ELEV 3025.5
100 SA 4.68 5.56 5.74 5.92 6.10 7.01 7.46 8.36 9.32 10.68
101 SE 3025.5 3027 3028 3029 3030 3035 3037 3040 3043 3046
102 SQ 49.7 60.6 70.8 74.5 1436.0 3920.5 7136.3
103 SE 3025.5 3030 3035 3037 3040 3043 3046
104 ZZ

```

1 SCHEMATIC DIAGRAM OF STREAM NETWORK

```

INPUT LINE (V) ROUTING (--->) DIVERSION OR PUMP FLOW
NO. (.) CONNECTOR (<---) RETURN OF DIVERTED OR PUMPED FLOW
23 OFF1
.
.
39 OFF7
.
.
46 CP2.....
.
.
49 OFF2
.
.
56 OFF3
.
.
63 CP1.....
.
.
66 OFF4
.
.
73 OFF5
.
.
80 OFF6
.
.
87 ON1
.
.
92 DB1.....
V
V
96 RDB1

```

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```

*****
* FLOOD HYDROGRAPH PACKAGE (HEC-1)
* JUN 1998
* VERSION 4.1
* RUN DATE 27JUL15 TIME 10:50:57
*
*****

```

```

*****
* U.S. ARMY CORPS OF ENGINEERS
* HYDROLOGIC ENGINEERING CENTER
* 609 SECOND STREET
* DAVIS, CALIFORNIA 95616
* (916) 756-1104
*
*****

```

SLATER HANIFAN GROUP
NINETY-FIVE MANAGEMENT, LLC.
SKYE CANYON - DETENTION BASIN #1
TECHNICAL DRAINAGE STUDY - CLV SUPPLEMENT
ULTIMATE DRAINAGE CONDITION

RETURN PERIOD ----- 100-YEAR
DISTRIBUTION ----- 6-HOUR SDN3
PROJECT NO. ----- OLY1401.004
FILENAME ----- ULT1.H1
DATE ----- 7/16/2015
MODELED BY ----- SMJ

SIX HOUR DEPTH-AREA REDUCTION FACTORS
DRAINAGE AREA (MI^2) RATIO
0.0-0.49 1.00
0.5-0.99 0.98

20 IO OUTPUT CONTROL VARIABLES
IPRNT 5 PRINT CONTROL
IPLOT 0 PLOT CONTROL
QSCAL 0. HYDROGRAPH PLOT SCALE

IT HYDROGRAPH TIME DATA

NMIN 5 MINUTES IN COMPUTATION INTERVAL
 IDATE 1 0 STARTING DATE
 ITIME 0000 STARTING TIME
 NQ 500 NUMBER OF HYDROGRAPH ORDINATES
 NDDATE 2 0 ENDING DATE
 NDTIME 1735 ENDING TIME
 ICENT 19 CENTURY MARK
 COMPUTATION INTERVAL .08 HOURS
 TOTAL TIME BASE 41.58 HOURS

ENGLISH UNITS
 DRAINAGE AREA SQUARE MILES
 PRECIPITATION DEPTH INCHES
 LENGTH, ELEVATION FEET
 FLOW CUBIC FEET PER SECOND
 STORAGE VOLUME ACRE-Feet
 SURFACE AREA ACRES
 TEMPERATURE DEGREES FAHRENHEIT

JP MULTI-PLAN OPTION
 NPLAN 1 NUMBER OF PLANS
 JR MULTI-RATIO OPTION
 RATIOS OF PRECIPITATION
 1.00 .98

23 KK *****
 * OFF1 *
 * *

24 KO OUTPUT CONTROL VARIABLES
 IPRNT 3 PRINT CONTROL
 IPLOT 0 PLOT CONTROL
 QSCAL 0. HYDROGRAPH PLOT SCALE
 EXISTING OFFSITE DRAINAGE BASIN
 DISCHARGES INTO DETENTION BASIN "DB1"

21 IN TIME DATA FOR INPUT TIME SERIES
 JXMIN 5 TIME INTERVAL IN MINUTES
 JXDATE 1 0 STARTING DATE
 JXTIME 0 STARTING TIME

SUBBASIN RUNOFF DATA

36 BA SUBBASIN CHARACTERISTICS
 TAREA .41 SUBBASIN AREA

PRECIPITATION DATA

27 PB STORM 3.00 BASIN TOTAL PRECIPITATION

28 PI INCREMENTAL PRECIPITATION PATTERN
 .02 .04 .01 .02 .02 .02 .01 .00 .00 .00
 .00 .00 .00 .01 .00 .01 .01 .01 .01 .01
 .01 .00 .00 .00 .00 .01 .02 .01 .01 .00
 .01 .01 .01 .00 .00 .01 .03 .03 .06 .09
 .09 .12 .03 .04 .03 .01 .02 .02 .00 .00
 .01 .01 .01 .02 .02 .01 .01 .02 .01 .01
 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00
 .00 .00

37 LS SCS LOSS RATE
 STRTL .31 INITIAL ABSTRACTION
 CRVNB 86.40 CURVE NUMBER
 RTIMP .00 PERCENT IMPERVIOUS AREA

38 UD SCS DIMENSIONLESS UNITGRAPH
 TLAG .36 LAG

UNIT HYDROGRAPH
 23 END-OF-PERIOD ORDINATES
 54. 169. 350. 472. 493. 441. 353. 239. 168. 121.
 87. 61. 44. 31. 22. 16. 11. 8. 6. 4.
 3. 2. 1.

TOTAL RAINFALL = 3.00, TOTAL LOSS = 1.31, TOTAL EXCESS = 1.69

PEAK FLOW	TIME	6-HR	24-HR	72-HR	41.58-HR
(CFS)	(HR)	(CFS)	(CFS)	(CFS)	(CFS)
403.	3.75	74.	19.	11.	11.
		(INCHES)	(INCHES)	(INCHES)	(INCHES)
		1.691	1.693	1.693	1.693
		(AC-FT)	(AC-FT)	(AC-FT)	(AC-FT)
		37.	37.	37.	37.
CUMULATIVE AREA =		.41 SQ MI			

 HYDROGRAPH AT STATION OFF1
 FOR PLAN 1, RATIO = 1.00

TOTAL RAINFALL = 3.00, TOTAL LOSS = 1.31, TOTAL EXCESS = 1.69

PEAK FLOW	TIME	6-HR	24-HR	72-HR	41.58-HR
(CFS)	(HR)	(CFS)	(CFS)	(CFS)	(CFS)
403.	3.75	74.	19.	11.	11.
		(INCHES)	(INCHES)	(INCHES)	(INCHES)
		1.691	1.693	1.693	1.693
		(AC-FT)	(AC-FT)	(AC-FT)	(AC-FT)
		37.	37.	37.	37.
CUMULATIVE AREA =		.41 SQ MI			

 HYDROGRAPH AT STATION OFF1
 FOR PLAN 1, RATIO = .98

TOTAL RAINFALL = 2.94, TOTAL LOSS = 1.30, TOTAL EXCESS = 1.64

PEAK FLOW	TIME	6-HR	24-HR	72-HR	41.58-HR
(CFS)	(HR)	(CFS)	(CFS)	(CFS)	(CFS)
391.	3.75	72.	18.	10.	10.
		(INCHES)	(INCHES)	(INCHES)	(INCHES)
		1.640	1.641	1.641	1.641

(AC-FT) 36. 36. 36. 36. ULT1.OUT
CUMULATIVE AREA = .41 SQ MI

*** **

*
* OFF7 *
*

40 KO OUTPUT CONTROL VARIABLES
IPRNT 3 PRINT CONTROL
IPLOT 0 PLOT CONTROL
QSCAL 0. HYDROGRAPH PLOT SCALE
FUTURE DEVELOPED OFFSITE DRAINAGE BASIN
DISCHARGES INTO DETENTION BASIN "DB1"

SUBBASIN RUNOFF DATA

43 BA SUBBASIN CHARACTERISTICS
TAREA .03 SUBBASIN AREA

PRECIPITATION DATA

27 PB STORM 3.00 BASIN TOTAL PRECIPITATION

28 PI INCREMENTAL PRECIPITATION PATTERN
.02 .04 .01 .02 .02 .02 .01 .00 .00 .00
.00 .00 .00 .01 .00 .01 .01 .01 .01 .01
.01 .00 .00 .00 .00 .01 .02 .01 .01 .00
.01 .01 .01 .00 .00 .03 .03 .06 .06 .09
.09 .12 .03 .04 .03 .01 .02 .02 .00 .00
.01 .01 .01 .02 .02 .01 .01 .02 .01 .01
.00 .00 .00 .00 .00 .00 .00 .00 .00 .00
.00 .00

44 LS SCS LOSS RATE
STRTL .08 INITIAL ABSTRACTION
CRVNB 96.00 CURVE NUMBER
RTIMP .00 PERCENT IMPERVIOUS AREA

45 UD SCS DIMENSIONLESS UNITGRAPH
FLAG .12 LAG

UNIT HYDROGRAPH
9 END-OF-PERIOD ORDINATES
44. 85. 52. 21. 9. 4. 1. 0.
TOTAL RAINFALL = 3.00, TOTAL LOSS = .45, TOTAL EXCESS = 2.55
PEAK FLOW TIME 6-HR MAXIMUM AVERAGE FLOW 72-HR 41.58-HR
+ (CFS) (HR) (CFS)
+ 55. 3.50 8. 2. 1. 1.
(INCHES) 2.549 2.552 2.552 2.552
(AC-FT) 4. 4. 4. 4.
CUMULATIVE AREA = .03 SQ MI

HYDROGRAPH AT STATION OFF7
FOR PLAN 1, RATIO = 1.00
TOTAL RAINFALL = 3.00, TOTAL LOSS = .45, TOTAL EXCESS = 2.55
PEAK FLOW TIME 6-HR MAXIMUM AVERAGE FLOW 72-HR 41.58-HR
+ (CFS) (HR) (CFS)
+ 55. 3.50 8. 2. 1. 1.
(INCHES) 2.549 2.552 2.552 2.552
(AC-FT) 4. 4. 4. 4.
CUMULATIVE AREA = .03 SQ MI

HYDROGRAPH AT STATION OFF7
FOR PLAN 1, RATIO = .98
TOTAL RAINFALL = 2.94, TOTAL LOSS = .45, TOTAL EXCESS = 2.49
PEAK FLOW TIME 6-HR MAXIMUM AVERAGE FLOW 72-HR 41.58-HR
+ (CFS) (HR) (CFS)
+ 54. 3.50 8. 2. 1. 1.
(INCHES) 2.490 2.493 2.493 2.493
(AC-FT) 4. 4. 4. 4.
CUMULATIVE AREA = .03 SQ MI

*** **

*
* OFF2 *
*

50 KO OUTPUT CONTROL VARIABLES
IPRNT 3 PRINT CONTROL
IPLOT 0 PLOT CONTROL
QSCAL 0. HYDROGRAPH PLOT SCALE
EXISTING OFFSITE DRAINAGE BASIN
DISCHARGES INTO DETENTION BASIN "DB1"

SUBBASIN RUNOFF DATA

53 BA SUBBASIN CHARACTERISTICS
TAREA .04 SUBBASIN AREA

PRECIPITATION DATA

ULT1.0UT

27 PB STORM 3.00 BASIN TOTAL PRECIPITATION
 28 PI INCREMENTAL PRECIPITATION PATTERN
 .02 .04 .01 .02 .02 .02 .01 .00 .00 .00
 .00 .00 .00 .01 .00 .01 .01 .01 .01 .01
 .01 .00 .00 .00 .00 .01 .02 .01 .01 .00
 .01 .01 .01 .00 .00 .01 .03 .03 .06 .09
 .09 .12 .03 .04 .03 .01 .02 .02 .00 .00
 .01 .01 .01 .02 .02 .01 .01 .02 .01 .01
 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00
 .00 .00

54 LS SCS LOSS RATE
 STRTL .35 INITIAL ABSTRACTION
 CRVNB 85.00 CURVE NUMBER
 RTIMP .00 PERCENT IMPERVIOUS AREA

55 UD SCS DIMENSIONLESS UNITGRAPH
 TLAG .15 LAG

UNIT HYDROGRAPH
 11 END-OF-PERIOD ORDINATES
 34. 89. 77. 38. 19. 9. 4. 2. 1. 1.
 0.
 TOTAL RAINFALL = 3.00, TOTAL LOSS = 1.41, TOTAL EXCESS = 1.59
 PEAK FLOW TIME
 + (CFS) (HR) 6-HR MAXIMUM AVERAGE FLOW 41.58-HR
 + 48. 3.58 (CFS) 6. 2. 1. 1.
 (INCHES) 1.588 1.588 1.588 1.588
 (AC-FT) 3. 3. 3. 3.
 CUMULATIVE AREA = .04 SQ MI

HYDROGRAPH AT STATION OFF2
 FOR PLAN 1, RATIO = 1.00

TOTAL RAINFALL = 3.00, TOTAL LOSS = 1.41, TOTAL EXCESS = 1.59
 PEAK FLOW TIME
 + (CFS) (HR) 6-HR MAXIMUM AVERAGE FLOW 41.58-HR
 + 48. 3.58 (CFS) 6. 2. 1. 1.
 (INCHES) 1.588 1.588 1.588 1.588
 (AC-FT) 3. 3. 3. 3.
 CUMULATIVE AREA = .04 SQ MI

HYDROGRAPH AT STATION OFF2
 FOR PLAN 1, RATIO = .98

TOTAL RAINFALL = 2.94, TOTAL LOSS = 1.40, TOTAL EXCESS = 1.54
 PEAK FLOW TIME
 + (CFS) (HR) 6-HR MAXIMUM AVERAGE FLOW 41.58-HR
 + 47. 3.58 (CFS) 6. 1. 1. 1.
 (INCHES) 1.538 1.538 1.538 1.538
 (AC-FT) 3. 3. 3. 3.
 CUMULATIVE AREA = .04 SQ MI

*** **

 * OFF3 *

57 KO OUTPUT CONTROL VARIABLES
 IPRNT 3 PRINT CONTROL
 IPLOT 0 PLOT CONTROL
 QSCAL 0. HYDROGRAPH PLOT SCALE
 EXISTING OFFSITE DRAINAGE BASIN
 DISCHARGES INTO DETENTION BASIN "D81"

SUBBASIN RUNOFF DATA

60 BA SUBBASIN CHARACTERISTICS
 TAREA .03 SUBBASIN AREA

PRECIPITATION DATA

27 PB STORM 3.00 BASIN TOTAL PRECIPITATION

28 PI INCREMENTAL PRECIPITATION PATTERN
 .02 .04 .01 .02 .02 .02 .01 .00 .00 .00
 .00 .00 .00 .01 .00 .01 .01 .01 .01 .01
 .01 .00 .00 .00 .00 .01 .02 .01 .01 .00
 .01 .01 .01 .00 .00 .01 .03 .03 .06 .09
 .09 .12 .03 .04 .03 .01 .02 .02 .00 .00
 .01 .01 .01 .02 .02 .01 .01 .02 .01 .01
 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00
 .00 .00

61 LS SCS LOSS RATE
 STRTL .32 INITIAL ABSTRACTION
 CRVNB 86.20 CURVE NUMBER
 RTIMP .00 PERCENT IMPERVIOUS AREA

62 UD SCS DIMENSIONLESS UNITGRAPH
 TLAG .11 LAG

UNIT HYDROGRAPH
 9 END-OF-PERIOD ORDINATES
 45. 81. 44. 18. 7. 3. 1. 1. 0.
 TOTAL RAINFALL = 3.00, TOTAL LOSS = 1.32, TOTAL EXCESS = 1.68

PEAK FLOW + (CFS)	TIME (HR)	6-HR (CFS)	MAXIMUM AVERAGE FLOW 24-HR	72-HR	41.58-HR
38.	3.58	5. (INCHES) (AC-FT)	1.678 2.	1. 1.678 2.	1. 1.678 2.
		CUMULATIVE AREA = .03 SQ MI			

*** *** *** *** ***

HYDROGRAPH AT STATION OFF3
FOR PLAN 1, RATIO = 1.00

TOTAL RAINFALL = 3.00, TOTAL LOSS = 1.32, TOTAL EXCESS = 1.68

PEAK FLOW + (CFS)	TIME (HR)	6-HR (CFS)	MAXIMUM AVERAGE FLOW 24-HR	72-HR	41.58-HR
38.	3.58	5. (INCHES) (AC-FT)	1.678 2.	1. 1.678 2.	1. 1.678 2.
		CUMULATIVE AREA = .03 SQ MI			

*** *** *** *** ***

HYDROGRAPH AT STATION OFF3
FOR PLAN 1, RATIO = .98

TOTAL RAINFALL = 2.94, TOTAL LOSS = 1.31, TOTAL EXCESS = 1.63

PEAK FLOW + (CFS)	TIME (HR)	6-HR (CFS)	MAXIMUM AVERAGE FLOW 24-HR	72-HR	41.58-HR
37.	3.58	5. (INCHES) (AC-FT)	1.626 2.	1. 1.626 2.	1. 1.626 2.
		CUMULATIVE AREA = .03 SQ MI			

*** **

*
66 KK * OFF4 *
*

67 KO OUTPUT CONTROL VARIABLES
 IPRNT 3 PRINT CONTROL
 IPLOT 0 PLOT CONTROL
 QSCAL 0. HYDROGRAPH PLOT SCALE
 EXISTING OFFSITE DRAINAGE BASIN
 DISCHARGES INTO DETENTION BASIN "DB1"

SUBBASIN RUNOFF DATA
70 BA SUBBASIN CHARACTERISTICS
 TAREA .06 SUBBASIN AREA

PRECIPITATION DATA
27 PB STORM 3.00 BASIN TOTAL PRECIPITATION

28 PI INCREMENTAL PRECIPITATION PATTERN
 .02 .04 .01 .02 .02 .02 .01 .00 .00 .00
 .00 .00 .00 .01 .00 .01 .01 .01 .01 .01
 .01 .00 .00 .00 .00 .01 .02 .01 .01 .00
 .01 .01 .01 .00 .00 .01 .03 .03 .06 .09
 .09 .12 .03 .04 .03 .01 .02 .02 .00 .00
 .01 .01 .01 .02 .02 .01 .01 .02 .01 .01
 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00
 .00 .00

71 LS SCS LOSS RATE
 STRTL .32 INITIAL ABSTRACTION
 CRVNER 86.20 CURVE NUMBER
 RTIMP .00 PERCENT IMPERVIOUS AREA

72 UD SCS DIMENSIONLESS UNITGRAPH
 TLAG .14 LAG

UNIT HYDROGRAPH
10 END-OF-PERIOD ORDINATES
26. 12. 6.

67. 158. 123. 55. 3. 1. 0.

TOTAL RAINFALL = 3.00, TOTAL LOSS = 1.32, TOTAL EXCESS = 1.68

PEAK FLOW + (CFS)	TIME (HR)	6-HR (CFS)	MAXIMUM AVERAGE FLOW 24-HR	72-HR	41.58-HR
84.	3.58	10. (INCHES) (AC-FT)	1.677 5.	3. 1.678 5.	2. 1.678 5.
		CUMULATIVE AREA = .06 SQ MI			

*** *** *** *** ***

HYDROGRAPH AT STATION OFF4
FOR PLAN 1, RATIO = 1.00

TOTAL RAINFALL = 3.00, TOTAL LOSS = 1.32, TOTAL EXCESS = 1.68

PEAK FLOW + (CFS)	TIME (HR)	6-HR (CFS)	MAXIMUM AVERAGE FLOW 24-HR	72-HR	41.58-HR
84.	3.58	10. (INCHES) (AC-FT)	1.677 5.	3. 1.678 5.	2. 1.678 5.
		CUMULATIVE AREA = .06 SQ MI			


```

***          ***          ***          ***          ***
HYDROGRAPH AT STATION OFF4
FOR PLAN 1, RATIO = .98
TOTAL RAINFALL = 2.94, TOTAL LOSS = 1.31, TOTAL EXCESS = 1.63
PEAK FLOW      TIME      6-HR      MAXIMUM AVERAGE FLOW      41.58-HR
+ (CFS)      (HR)
+ 82.      3.58      (CFS)      10.      3.      1.      1.
      (INCHES) 1.626      1.626      1.626      1.626
      (AC-FT) 5.      5.      5.      5.
CUMULATIVE AREA = .06 SQ MI

***          ***          ***          ***          ***
*****
*
73 KK * OFF5 *
*
*****

74 KO OUTPUT CONTROL VARIABLES
      IPRNT 3 PRINT CONTROL
      IPLOT 0 PLOT CONTROL
      QSCAL 0. HYDROGRAPH PLOT SCALE
      EXISTING OFFSITE DRAINAGE BASIN
      DISCHARGES INTO DETENTION BASIN "DB1"

SUBBASIN RUNOFF DATA

77 BA SUBBASIN CHARACTERISTICS
      TAREA .26 SUBBASIN AREA

PRECIPITATION DATA

27 PB STORM 3.00 BASIN TOTAL PRECIPITATION

28 PI INCREMENTAL PRECIPITATION PATTERN
      .02 .04 .01 .02 .02 .01 .00 .00 .00
      .00 .00 .00 .01 .00 .01 .01 .01 .01
      .01 .00 .00 .00 .00 .01 .02 .01 .01
      .01 .01 .01 .00 .00 .01 .03 .03 .06
      .09 .12 .03 .04 .03 .01 .02 .02 .00
      .01 .01 .01 .02 .02 .01 .02 .01 .01
      .00 .00 .00 .00 .00 .00 .00 .00 .00
      .00 .00 .00 .00 .00 .00 .00 .00 .00

78 LS SCS LOSS RATE
      STRTL .31 INITIAL ABSTRACTION
      CRVNR 86.50 CURVE NUMBER
      RTIMP .00 PERCENT IMPERVIOUS AREA

79 UD SCS DIMENSIONLESS UNITGRAPH
      TLAG .42 LAG

***
UNIT HYDROGRAPH
27 END-OF-PERIOD ORDINATES
23. 71. 148. 228. 267. 267. 238. 197. 143. 104.
77. 59. 43. 32. 24. 18. 13. 10. 7. 6.
4. 3. 2. 2. 1. 1. 0.
TOTAL RAINFALL = 3.00, TOTAL LOSS = 1.30, TOTAL EXCESS = 1.70
PEAK FLOW      TIME      6-HR      MAXIMUM AVERAGE FLOW      41.58-HR
+ (CFS)      (HR)
+ 236.      3.83      (CFS)      47.      12.      7.      7.
      (INCHES) 1.698      1.700      1.700      1.700
      (AC-FT) 23.      23.      23.      23.
CUMULATIVE AREA = .26 SQ MI

***          ***          ***          ***          ***
HYDROGRAPH AT STATION OFF5
FOR PLAN 1, RATIO = 1.00
TOTAL RAINFALL = 3.00, TOTAL LOSS = 1.30, TOTAL EXCESS = 1.70
PEAK FLOW      TIME      6-HR      MAXIMUM AVERAGE FLOW      41.58-HR
+ (CFS)      (HR)
+ 236.      3.83      (CFS)      47.      12.      7.      7.
      (INCHES) 1.698      1.700      1.700      1.700
      (AC-FT) 23.      23.      23.      23.
CUMULATIVE AREA = .26 SQ MI

***          ***          ***          ***          ***
HYDROGRAPH AT STATION OFF5
FOR PLAN 1, RATIO = .98
TOTAL RAINFALL = 2.94, TOTAL LOSS = 1.29, TOTAL EXCESS = 1.65
PEAK FLOW      TIME      6-HR      MAXIMUM AVERAGE FLOW      41.58-HR
+ (CFS)      (HR)
+ 229.      3.83      (CFS)      45.      11.      7.      7.
      (INCHES) 1.646      1.649      1.649      1.649
      (AC-FT) 23.      23.      23.      23.
CUMULATIVE AREA = .26 SQ MI

***          ***          ***          ***          ***
*****
*
80 KK * OFF6 *
*
*****

```

81 KO OUTPUT CONTROL VARIABLES
 IPRNT 3 PRINT CONTROL
 IPLOT 0 PLOT CONTROL
 QSCAL 0. HYDROGRAPH PLOT SCALE
 EXISTING OFFSITE DRAINAGE BASIN
 DISCHARGES INTO DETENTION BASIN "DB1"

SUBBASIN RUNOFF DATA

84 BA SUBBASIN CHARACTERISTICS
 TAREA .04 SUBBASIN AREA

PRECIPITATION DATA

27 PB STORM 3.00 BASIN TOTAL PRECIPITATION

28 PI INCREMENTAL PRECIPITATION PATTERN
 .02 .04 .02 .02 .02 .01 .00 .00 .00
 .00 .00 .00 .01 .00 .01 .01 .01 .01
 .01 .00 .00 .00 .00 .01 .02 .01 .01
 .01 .01 .01 .00 .00 .01 .03 .03 .06
 .09 .12 .03 .04 .03 .01 .02 .02 .00
 .01 .01 .01 .02 .02 .01 .01 .02 .01
 .00 .00 .00 .00 .00 .00 .00 .00 .00

85 LS SCS LOSS RATE
 STRTL .32 INITIAL ABSTRACTION
 CRVNB 86.20 CURVE NUMBER
 RTIMP .00 PERCENT IMPERVIOUS AREA

86 UD SCS DIMENSIONLESS UNITGRAPH
 TLAG .12 LAG

UNIT HYDROGRAPH
 9 END-OF-PERIOD ORDINATES

59. 119. 76. 31. 14. 6. 3. 1. 0.

TOTAL RAINFALL = 3.00, TOTAL LOSS = 1.32, TOTAL EXCESS = 1.68

PEAK FLOW TIME 6-HR MAXIMUM AVERAGE FLOW 41.58-HR
 + (CFS) (HR) 24-HR 72-HR
 + 59. 3.58 (CFS) 7. 2. 1. 1.
 (INCHES) 1.678 1.678 1.678 1.678
 (AC-FT) 4. 4. 4. 4.

CUMULATIVE AREA = .04 SQ MI

HYDROGRAPH AT STATION OFF6
 FOR PLAN 1, RATIO = 1.00

TOTAL RAINFALL = 3.00, TOTAL LOSS = 1.32, TOTAL EXCESS = 1.68

PEAK FLOW TIME 6-HR MAXIMUM AVERAGE FLOW 41.58-HR
 + (CFS) (HR) 24-HR 72-HR
 + 59. 3.58 (CFS) 7. 2. 1. 1.
 (INCHES) 1.678 1.678 1.678 1.678
 (AC-FT) 4. 4. 4. 4.

CUMULATIVE AREA = .04 SQ MI

HYDROGRAPH AT STATION OFF6
 FOR PLAN 1, RATIO = .98

TOTAL RAINFALL = 2.94, TOTAL LOSS = 1.31, TOTAL EXCESS = 1.63

PEAK FLOW TIME 6-HR MAXIMUM AVERAGE FLOW 41.58-HR
 + (CFS) (HR) 24-HR 72-HR
 + 57. 3.58 (CFS) 7. 2. 1. 1.
 (INCHES) 1.626 1.626 1.626 1.626
 (AC-FT) 3. 3. 3. 3.

CUMULATIVE AREA = .04 SQ MI

 *
 92 KK * DB1 *
 *

94 KO OUTPUT CONTROL VARIABLES
 IPRNT 1 PRINT CONTROL
 IPLOT 0 PLOT CONTROL
 QSCAL 0. HYDROGRAPH PLOT SCALE

95 HC HYDROGRAPH COMBINATION
 ICOMP 5 NUMBER OF HYDROGRAPHS TO COMBINE

HYDROGRAPH AT STATION DB1
 SUM OF 5 HYDROGRAPHS
 PLAN 1, RATIO = 1.00

DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW
1	0000	1	0.	*	1	1025	126	0.	*	1	2050	251	0.	*	2	0715	376	0.	
1	0005	2	0.	*	1	1030	127	0.	*	1	2055	252	0.	*	2	0720	377	0.	
1	0010	3	1.	*	1	1035	128	0.	*	1	2100	253	0.	*	2	0725	378	0.	
1	0015	4	2.	*	1	1040	129	0.	*	1	2105	254	0.	*	2	0730	379	0.	
1	0020	5	4.	*	1	1045	130	0.	*	1	2110	255	0.	*	2	0735	380	0.	
1	0025	6	6.	*	1	1050	131	0.	*	1	2115	256	0.	*	2	0740	381	0.	

										ULT1.OUT									
1	0030	7	9.	*	1	1055	132	0.	*	1	2120	257	0.	*	2	0745	382	0.	*
1	0035	8	10.	*	1	1100	133	0.	*	1	2125	258	0.	*	2	0750	383	0.	*
1	0040	9	8.	*	1	1105	134	0.	*	1	2130	259	0.	*	2	0755	384	0.	*
1	0045	10	5.	*	1	1110	135	0.	*	1	2135	260	0.	*	2	0800	385	0.	*
1	0050	11	4.	*	1	1115	136	0.	*	1	2140	261	0.	*	2	0805	386	0.	*
1	0055	12	3.	*	1	1120	137	0.	*	1	2145	262	0.	*	2	0810	387	0.	*
1	0100	13	2.	*	1	1125	138	0.	*	1	2150	263	0.	*	2	0815	388	0.	*
1	0105	14	3.	*	1	1130	139	0.	*	1	2155	264	0.	*	2	0820	389	0.	*
1	0110	15	4.	*	1	1135	140	0.	*	1	2200	265	0.	*	2	0825	390	0.	*
1	0115	16	5.	*	1	1140	141	0.	*	1	2205	266	0.	*	2	0830	391	0.	*
1	0120	17	6.	*	1	1145	142	0.	*	1	2210	267	0.	*	2	0835	392	0.	*
1	0125	18	7.	*	1	1150	143	0.	*	1	2215	268	0.	*	2	0840	393	0.	*
1	0130	19	8.	*	1	1155	144	0.	*	1	2220	269	0.	*	2	0845	394	0.	*
1	0135	20	9.	*	1	1200	145	0.	*	1	2225	270	0.	*	2	0850	395	0.	*
1	0140	21	10.	*	1	1205	146	0.	*	1	2230	271	0.	*	2	0855	396	0.	*
1	0145	22	11.	*	1	1210	147	0.	*	1	2235	272	0.	*	2	0900	397	0.	*
1	0150	23	12.	*	1	1215	148	0.	*	1	2240	273	0.	*	2	0905	398	0.	*
1	0155	24	13.	*	1	1220	149	0.	*	1	2245	274	0.	*	2	0910	399	0.	*
1	0200	25	14.	*	1	1225	150	0.	*	1	2250	275	0.	*	2	0915	400	0.	*
1	0205	26	15.	*	1	1230	151	0.	*	1	2255	276	0.	*	2	0920	401	0.	*
1	0210	27	16.	*	1	1235	152	0.	*	1	2300	277	0.	*	2	0925	402	0.	*
1	0215	28	17.	*	1	1240	153	0.	*	1	2305	278	0.	*	2	0930	403	0.	*
1	0220	29	18.	*	1	1245	154	0.	*	1	2310	279	0.	*	2	0935	404	0.	*
1	0225	30	19.	*	1	1250	155	0.	*	1	2315	280	0.	*	2	0940	405	0.	*
1	0230	31	20.	*	1	1255	156	0.	*	1	2320	281	0.	*	2	0945	406	0.	*
1	0235	32	21.	*	1	1300	157	0.	*	1	2325	282	0.	*	2	0950	407	0.	*
1	0240	33	22.	*	1	1305	158	0.	*	1	2330	283	0.	*	2	0955	408	0.	*
1	0245	34	23.	*	1	1310	159	0.	*	1	2335	284	0.	*	2	1000	409	0.	*
1	0250	35	24.	*	1	1315	160	0.	*	1	2340	285	0.	*	2	1005	410	0.	*
1	0255	36	25.	*	1	1320	161	0.	*	1	2345	286	0.	*	2	1010	411	0.	*
1	0300	37	26.	*	1	1325	162	0.	*	1	2350	287	0.	*	2	1015	412	0.	*
1	0305	38	27.	*	1	1330	163	0.	*	1	2355	288	0.	*	2	1020	413	0.	*
1	0310	39	28.	*	1	1335	164	0.	*	1	0000	289	0.	*	2	1025	414	0.	*
1	0315	40	29.	*	1	1340	165	0.	*	1	0005	290	0.	*	2	1030	415	0.	*
1	0320	41	30.	*	1	1345	166	0.	*	1	0010	291	0.	*	2	1035	416	0.	*
1	0325	42	31.	*	1	1350	167	0.	*	1	0015	292	0.	*	2	1040	417	0.	*
1	0330	43	32.	*	1	1355	168	0.	*	1	0020	293	0.	*	2	1045	418	0.	*
1	0335	44	33.	*	1	1400	169	0.	*	1	0025	294	0.	*	2	1050	419	0.	*
1	0340	45	34.	*	1	1405	170	0.	*	1	0030	295	0.	*	2	1055	420	0.	*
1	0345	46	35.	*	1	1410	171	0.	*	1	0035	296	0.	*	2	1100	421	0.	*
1	0350	47	36.	*	1	1415	172	0.	*	1	0040	297	0.	*	2	1105	422	0.	*
1	0355	48	37.	*	1	1420	173	0.	*	1	0045	298	0.	*	2	1110	423	0.	*
1	0400	49	38.	*	1	1425	174	0.	*	1	0050	299	0.	*	2	1115	424	0.	*
1	0405	50	39.	*	1	1430	175	0.	*	1	0055	300	0.	*	2	1120	425	0.	*
1	0410	51	40.	*	1	1435	176	0.	*	1	0100	301	0.	*	2	1125	426	0.	*
1	0415	52	41.	*	1	1440	177	0.	*	1	0105	302	0.	*	2	1130	427	0.	*
1	0420	53	42.	*	1	1445	178	0.	*	1	0110	303	0.	*	2	1135	428	0.	*
1	0425	54	43.	*	1	1450	179	0.	*	1	0115	304	0.	*	2	1140	429	0.	*
1	0430	55	44.	*	1	1455	180	0.	*	1	0120	305	0.	*	2	1145	430	0.	*
1	0435	56	45.	*	1	1500	181	0.	*	1	0125	306	0.	*	2	1150	431	0.	*
1	0440	57	46.	*	1	1505	182	0.	*	1	0130	307	0.	*	2	1155	432	0.	*
1	0445	58	47.	*	1	1510	183	0.	*	1	0135	308	0.	*	2	1200	433	0.	*
1	0450	59	48.	*	1	1515	184	0.	*	1	0140	309	0.	*	2	1205	434	0.	*
1	0455	60	49.	*	1	1520	185	0.	*	1	0145	310	0.	*	2	1210	435	0.	*
1	0500	61	50.	*	1	1525	186	0.	*	1	0150	311	0.	*	2	1215	436	0.	*
1	0505	62	51.	*	1	1530	187	0.	*	1	0155	312	0.	*	2	1220	437	0.	*
1	0510	63	52.	*	1	1535	188	0.	*	1	0200	313	0.	*	2	1225	438	0.	*
1	0515	64	53.	*	1	1540	189	0.	*	1	0205	314	0.	*	2	1230	439	0.	*
1	0520	65	54.	*	1	1545	190	0.	*	1	0210	315	0.	*	2	1235	440	0.	*
1	0525	66	55.	*	1	1550	191	0.	*	1	0215	316	0.	*	2	1240	441	0.	*
1	0530	67	56.	*	1	1555	192	0.	*	1	0220	317	0.	*	2	1245	442	0.	*
1	0535	68	57.	*	1	1600	193	0.	*	1	0225	318	0.	*	2	1250	443	0.	*
1	0540	69	58.	*	1	1605	194	0.	*	1	0230	319	0.	*	2	1255	444	0.	*
1	0545	70	59.	*	1	1610	195	0.	*	1	0235	320	0.	*	2	1300	445	0.	*
1	0550	71	60.	*	1	1615	196	0.	*	1	0240	321	0.	*	2	1305	446	0.	*
1	0555	72	61.	*	1	1620	197	0.	*	1	0245	322	0.	*	2	1310	447	0.	*
1	0600	73	62.	*	1	1625	198	0.	*	1	0250	323	0.	*	2	1315	448	0.	*
1	0605	74	63.	*	1	1630	199	0.	*	1	0255	324	0.	*	2	1320	449	0.	*
1	0610	75	64.	*	1	1635	200	0.	*	1	0300	325	0.	*	2	1325	450	0.	*
1	0615	76	65.	*	1	1640	201	0.	*	1	0305	326	0.	*	2	1330	451	0.	*
1	0620	77	66.	*	1	1645	202	0.	*	1	0310	327	0.	*	2	1335	452	0.	*
1	0625	78	67.	*	1	1650	203	0.	*	1	0315	328	0.	*	2	1340	453	0.	*
1	0630	79	68.	*	1	1655	204	0.	*	1	0320	329	0.	*	2	1345	454	0.	*
1	0635	80	69.	*	1	1700	205	0.	*	1	0325	330	0.	*	2	1350	455	0.	*
1	0640	81	70.	*	1	1705	206	0.	*	1	0330	331	0.	*	2	1355	456	0.	*
1	0645	82	71.	*	1	1710	207	0.	*	1	0335	332	0.	*	2	1400	457	0.	*
1	0650	83	72.	*	1	1715	208	0.	*	1	0340	333	0.	*	2	1405	458	0.	*
1	0655	84	73.	*	1	1720	209	0.	*	1	0345	334	0.	*	2	1410	459	0.	*
1	0700	85	74.	*	1	1725	210	0.	*	1	0350	335	0.	*	2	1415	460	0.	*
1	0705	86	75.	*	1	1730	211	0.	*	1	0355	336	0.	*	2	1420	461	0.	*
1	0710	87	76.	*	1	1735	212	0.	*	1	0400	337	0.	*	2	1425	462	0.	*
1	0715	88	77.	*	1	1740	213	0.	*	1	0405	338	0.	*	2	1430	463	0.	*
1	0720	89	78.	*	1	1745	214	0.	*	1	0410	339	0.	*	2	1435	464	0.	*
1	0725	90	79.	*	1	1750	215	0.	*	1	0415	340	0.	*	2	1440	465	0.	*
1	0730	91	80.	*	1	1755	216	0.	*	1	0420	341	0.	*	2	1445	466	0.	*
1	0735	92	81.	*	1	1800	217	0.	*	1	0425	342	0.	*	2	1450	467	0.	*
1	0740	93	82.	*	1	1805	218	0.	*	1	0430	343	0.	*	2	1455	468	0.	*
1	0745	94	83.	*	1	1810	219	0.	*	1	0435	344	0.	*	2	1500	469	0.	*
1	0750	95	84.	*	1	1815	220	0.	*	1	0440	345	0.	*	2	1505	470	0.	

ULT1.OUT

CUMULATIVE AREA = .88 SQ MI

HYDROGRAPH AT STATION DB1
SUM OF 5 HYDROGRAPHS
PLAN 1, RATIO = .98

DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW
1	0000	1	0.	1	1025	126	0.	1	2050	251	0.	2	0715	376	0.				
1	0005	2	0.	1	1030	127	0.	1	2055	252	0.	2	0720	377	0.				
1	0010	3	1.	1	1035	128	0.	1	2100	253	0.	2	0725	378	0.				
1	0015	4	2.	1	1040	129	0.	1	2105	254	0.	2	0730	379	0.				
1	0020	5	3.	1	1045	130	0.	1	2110	255	0.	2	0735	380	0.				
1	0025	6	6.	1	1050	131	0.	1	2115	256	0.	2	0740	381	0.				
1	0030	7	9.	1	1055	132	0.	1	2120	257	0.	2	0745	382	0.				
1	0035	8	9.	1	1100	133	0.	1	2125	258	0.	2	0750	383	0.				
1	0040	9	7.	1	1105	134	0.	1	2130	259	0.	2	0755	384	0.				
1	0045	10	5.	1	1110	135	0.	1	2135	260	0.	2	0800	385	0.				
1	0050	11	3.	1	1115	136	0.	1	2140	261	0.	2	0805	386	0.				
1	0055	12	3.	1	1120	137	0.	1	2145	262	0.	2	0810	387	0.				
1	0100	13	2.	1	1125	138	0.	1	2150	263	0.	2	0815	388	0.				
1	0105	14	2.	1	1130	139	0.	1	2155	264	0.	2	0820	389	0.				
1	0110	15	4.	1	1135	140	0.	1	2200	265	0.	2	0825	390	0.				
1	0115	16	5.	1	1140	141	0.	1	2205	266	0.	2	0830	391	0.				
1	0120	17	7.	1	1145	142	0.	1	2210	267	0.	2	0835	392	0.				
1	0125	18	10.	1	1150	143	0.	1	2215	268	0.	2	0840	393	0.				
1	0130	19	16.	1	1155	144	0.	1	2220	269	0.	2	0845	394	0.				
1	0135	20	23.	1	1200	145	0.	1	2225	270	0.	2	0850	395	0.				
1	0140	21	27.	1	1205	146	0.	1	2230	271	0.	2	0855	396	0.				
1	0145	22	31.	1	1210	147	0.	1	2235	272	0.	2	0900	397	0.				
1	0150	23	32.	1	1215	148	0.	1	2240	273	0.	2	0905	398	0.				
1	0155	24	29.	1	1220	149	0.	1	2245	274	0.	2	0910	399	0.				
1	0200	25	26.	1	1225	150	0.	1	2250	275	0.	2	0915	400	0.				
1	0205	26	23.	1	1230	151	0.	1	2255	276	0.	2	0920	401	0.				
1	0210	27	24.	1	1235	152	0.	1	2300	277	0.	2	0925	402	0.				
1	0215	28	32.	1	1240	153	0.	1	2305	278	0.	2	0930	403	0.				
1	0220	29	47.	1	1245	154	0.	1	2310	279	0.	2	0935	404	0.				
1	0225	30	49.	1	1250	155	0.	1	2315	280	0.	2	0940	405	0.				
1	0230	31	50.	1	1255	156	0.	1	2320	281	0.	2	0945	406	0.				
1	0235	32	49.	1	1300	157	0.	1	2325	282	0.	2	0950	407	0.				
1	0240	33	54.	1	1305	158	0.	1	2330	283	0.	2	0955	408	0.				
1	0245	34	60.	1	1310	159	0.	1	2335	284	0.	2	1000	409	0.				
1	0250	35	60.	1	1315	160	0.	1	2340	285	0.	2	1005	410	0.				
1	0255	36	55.	1	1320	161	0.	1	2345	286	0.	2	1010	411	0.				
1	0300	37	55.	1	1325	162	0.	1	2350	287	0.	2	1015	412	0.				
1	0305	38	72.	1	1330	163	0.	1	2355	288	0.	2	1020	413	0.				
1	0310	39	103.	1	1335	164	0.	2	0000	289	0.	2	1025	414	0.				
1	0315	40	158.	1	1340	165	0.	2	0005	290	0.	2	1030	415	0.				
1	0320	41	264.	1	1345	166	0.	2	0010	291	0.	2	1035	416	0.				
1	0325	42	414.	1	1350	167	0.	2	0015	292	0.	2	1040	417	0.				
1	0330	43	599.	1	1355	168	0.	2	0020	293	0.	2	1045	418	0.				
1	0335	44	741.	1	1400	169	0.	2	0025	294	0.	2	1050	419	0.				
1	0340	45	784.	1	1405	170	0.	2	0030	295	0.	2	1055	420	0.				
1	0345	46	794.	1	1410	171	0.	2	0035	296	0.	2	1100	421	0.				
1	0350	47	758.	1	1415	172	0.	2	0040	297	0.	2	1105	422	0.				
1	0355	48	678.	1	1420	173	0.	2	0045	298	0.	2	1110	423	0.				
1	0400	49	595.	1	1425	174	0.	2	0050	299	0.	2	1115	424	0.				
1	0405	50	505.	1	1430	175	0.	2	0055	300	0.	2	1120	425	0.				
1	0410	51	414.	1	1435	176	0.	2	0100	301	0.	2	1125	426	0.				
1	0415	52	339.	1	1440	177	0.	2	0105	302	0.	2	1130	427	0.				
1	0420	53	284.	1	1445	178	0.	2	0110	303	0.	2	1135	428	0.				
1	0425	54	247.	1	1450	179	0.	2	0115	304	0.	2	1140	429	0.				
1	0430	55	233.	1	1455	180	0.	2	0120	305	0.	2	1145	430	0.				
1	0435	56	235.	1	1500	181	0.	2	0125	306	0.	2	1150	431	0.				
1	0440	57	234.	1	1505	182	0.	2	0130	307	0.	2	1155	432	0.				
1	0445	58	231.	1	1510	183	0.	2	0135	308	0.	2	1200	433	0.				
1	0450	59	239.	1	1515	184	0.	2	0140	309	0.	2	1205	434	0.				
1	0455	60	242.	1	1520	185	0.	2	0145	310	0.	2	1210	435	0.				
1	0500	61	226.	1	1525	186	0.	2	0150	311	0.	2	1215	436	0.				
1	0505	62	204.	1	1530	187	0.	2	0155	312	0.	2	1220	437	0.				
1	0510	63	178.	1	1535	188	0.	2	0200	313	0.	2	1225	438	0.				
1	0515	64	151.	1	1540	189	0.	2	0205	314	0.	2	1230	439	0.				
1	0520	65	124.	1	1545	190	0.	2	0210	315	0.	2	1235	440	0.				
1	0525	66	101.	1	1550	191	0.	2	0215	316	0.	2	1240	441	0.				
1	0530	67	82.	1	1555	192	0.	2	0220	317	0.	2	1245	442	0.				
1	0535	68	65.	1	1600	193	0.	2	0225	318	0.	2	1250	443	0.				
1	0540	69	53.	1	1605	194	0.	2	0230	319	0.	2	1255	444	0.				
1	0545	70	45.	1	1610	195	0.	2	0235	320	0.	2	1300	445	0.				
1	0550	71	40.	1	1615	196	0.	2	0240	321	0.	2	1305	446	0.				
1	0555	72	34.	1	1620	197	0.	2	0245	322	0.	2	1310	447	0.				
1	0600	73	29.	1	1625	198	0.	2	0250	323	0.	2	1315	448	0.				
1	0605	74	21.	1	1630	199	0.	2	0255	324	0.	2	1320	449	0.				
1	0610	75	21.	1	1635	200	0.	2	0300	325	0.	2	1325	450	0.				
1	0615	76	17.	1	1640	201	0.	2	0305	326	0.	2	1330	451	0.				
1	0620	77	13.	1	1645	202	0.	2	0310	327	0.	2	1335	452	0.				
1	0625	78	10.	1	1650	203	0.	2	0315	328	0.	2	1340	453	0.				
1	0630	79	7.	1	1655	204	0.	2	0320	329	0.	2	1345	454	0.				
1	0635	80	5.	1	1700	205	0.	2	0325	330	0.	2	1350	455	0.				
1	0640	81	4.	1	1705	206	0.	2	0330	331	0.	2	1355	456	0.				
1	0645	82	3.	1	1710	207	0.	2	0335	332	0.	2	1400	457	0.				
1	0650	83	2.	1	1715	208	0.	2	0340	333	0.	2	1405	458	0.				
1	0655	84	1.	1	1720	209	0.	2	0345	334	0.	2	1410	459	0.				
1	0700	85	1.	1	1725	210	0.	2	0350	335	0.	2	1415	460	0.				
1	0705	86	1.	1	1730	211	0.	2	0355	336	0.	2	1420	461	0.				
1	0710	87	0.	1	1735	212	0.	2	0400	337	0.	2	1425	462	0.				
1	0715	88	0.	1	1740	213	0.	2	0405	338	0.	2	1430	463	0.				
1	0720	89																	

	1	0935	116	0.	*	1	2000	241	0.	*	2	0625	366	0.	*	2	1650	491	0.
	1	0940	117	0.	*	1	2005	242	0.	*	2	0630	367	0.	*	2	1655	492	0.
	1	0945	118	0.	*	1	2010	243	0.	*	2	0635	368	0.	*	2	1700	493	0.
	1	0950	119	0.	*	1	2015	244	0.	*	2	0640	369	0.	*	2	1705	494	0.
	1	0955	120	0.	*	1	2020	245	0.	*	2	0645	370	0.	*	2	1710	495	0.
	1	1000	121	0.	*	1	2025	246	0.	*	2	0650	371	0.	*	2	1715	496	0.
	1	1005	122	0.	*	1	2030	247	0.	*	2	0655	372	0.	*	2	1720	497	0.
	1	1010	123	0.	*	1	2035	248	0.	*	2	0700	373	0.	*	2	1725	498	0.
	1	1015	124	0.	*	1	2040	249	0.	*	2	0705	374	0.	*	2	1730	499	0.
	1	1020	125	0.	*	1	2045	250	0.	*	2	0710	375	0.	*	2	1735	500	0.

PEAK FLOW	TIME	6-HR	24-HR	72-HR	41.58-HR
+	(CFS)				
+	794.	3.75			
		(CFS)			
		158.	40.	23.	23.
		(INCHES)	1.675	1.680	1.680
		(AC-FT)	78.	79.	79.
		CUMULATIVE AREA =	.88	SQ MI	

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96 KK

* RDB1 *

98 KO OUTPUT CONTROL VARIABLES
IPRNT 1 PRINT CONTROL
IPLOT 0 PLOT CONTROL
QSCAL 0. HYDROGRAPH PLOT SCALE

HYDROGRAPH ROUTING DATA

99 RS STORAGE ROUTING
NSTPS 1 NUMBER OF SUBREACHES
ITYP ELEV TYPE OF INITIAL CONDITION
RSVRIC 3025.50 INITIAL CONDITION
X .00 WORKING R AND D COEFFICIENT

100 SA	AREA	4.7	5.6	5.7	5.9	6.1	7.0	7.5	8.4	9.3	10.7
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101 SE	ELEVATION	3025.50	3027.00	3028.00	3029.00	3030.00	3035.00	3037.00	3040.00	3043.00	3046.00
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102 SQ	DISCHARGE	50.	61.	71.	75.	1436.	3921.	7136.
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103 SE	ELEVATION	3025.50	3030.00	3035.00	3037.00	3040.00	3043.00	3046.00
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COMPUTED STORAGE-ELEVATION DATA

STORAGE	.00	7.67	13.32	19.15	25.16	57.91	72.38	96.09	122.60	152.58
ELEVATION	3025.50	3027.00	3028.00	3029.00	3030.00	3035.00	3037.00	3040.00	3043.00	3046.00

COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

STORAGE	.00	7.67	13.32	19.15	25.16	57.91	72.38	96.09	122.60	152.58
OUTFLOW	49.70	53.33	55.76	58.18	60.60	70.80	74.50	1436.00	3920.50	7136.30
ELEVATION	3025.50	3027.00	3028.00	3029.00	3030.00	3035.00	3037.00	3040.00	3043.00	3046.00

HYDROGRAPH AT STATION RDB1
PLAN 1, RATIO = 1.00

DA	MON	HR	MIN	ORD	OUTFLOW	STORAGE	STAGE	DA	MON	HR	MIN	ORD	OUTFLOW	STORAGE	STAGE	DA	MON	HR	MIN	ORD	OUTFLOW	STORAGE	STAGE
1	0000	1	50.	.0	3025.5	*	1	1355	168	57.	17.4	3028.7	*	2	0350	335	50.	-.2	3025.5				
1	0005	2	50.	-.2	3025.5	*	1	1400	169	57.	17.0	3028.6	*	2	0355	336	50.	-.2	3025.5				
1	0010	3	50.	-.2	3025.5	*	1	1405	170	57.	16.6	3028.6	*	2	0400	337	50.	-.2	3025.5				
1	0015	4	50.	-.2	3025.5	*	1	1410	171	57.	16.2	3028.5	*	2	0405	338	50.	-.2	3025.5				
1	0020	5	50.	-.2	3025.5	*	1	1415	172	57.	15.8	3028.4	*	2	0410	339	50.	-.2	3025.5				
1	0025	6	50.	-.2	3025.5	*	1	1420	173	57.	15.4	3028.4	*	2	0415	340	50.	-.2	3025.5				
1	0030	7	50.	-.2	3025.5	*	1	1425	174	56.	15.0	3028.3	*	2	0420	341	50.	-.2	3025.5				
1	0035	8	50.	-.2	3025.5	*	1	1430	175	56.	14.6	3028.2	*	2	0425	342	50.	-.2	3025.5				
1	0040	9	50.	-.2	3025.5	*	1	1435	176	56.	14.3	3028.2	*	2	0430	343	50.	-.2	3025.5				
1	0045	10	50.	-.2	3025.5	*	1	1440	177	56.	13.9	3028.1	*	2	0435	344	50.	-.2	3025.5				
1	0050	11	50.	-.2	3025.5	*	1	1445	178	56.	13.5	3028.0	*	2	0440	345	50.	-.2	3025.5				
1	0055	12	50.	-.2	3025.5	*	1	1450	179	56.	13.1	3028.0	*	2	0445	346	50.	-.2	3025.5				
1	0100	13	50.	-.2	3025.5	*	1	1455	180	55.	12.7	3027.9	*	2	0450	347	50.	-.2	3025.5				
1	0105	14	50.	-.2	3025.5	*	1	1500	181	55.	12.3	3027.8	*	2	0455	348	50.	-.2	3025.5				
1	0110	15	50.	-.2	3025.5	*	1	1505	182	55.	12.0	3027.8	*	2	0500	349	50.	-.2	3025.5				
1	0115	16	50.	-.2	3025.5	*	1	1510	183	55.	11.6	3027.7	*	2	0505	350	50.	-.2	3025.5				
1	0120	17	50.	-.2	3025.5	*	1	1515	184	55.	11.2	3027.6	*	2	0510	351	50.	-.2	3025.5				
1	0125	18	50.	-.2	3025.5	*	1	1520	185	55.	10.8	3027.6	*	2	0515	352	50.	-.2	3025.5				
1	0130	19	50.	-.2	3025.5	*	1	1525	186	55.	10.4	3027.5	*	2	0520	353	50.	-.2	3025.5				
1	0135	20	50.	-.2	3025.5	*	1	1530	187	54.	10.1	3027.4	*	2	0525	354	50.	-.2	3025.5				
1	0140	21	50.	-.2	3025.5	*	1	1535	188	54.	9.7	3027.4	*	2	0530	355	50.	-.2	3025.5				
1	0145	22	50.	-.2	3025.5	*	1	1540	189	54.	9.3	3027.3	*	2	0535	356	50.	-.2	3025.5				
1	0150	23	50.	-.2	3025.5	*	1	1545	190	54.	9.0	3027.2	*	2	0540	357	50.	-.2	3025.5				
1	0155	24	50.	-.2	3025.5	*	1	1550	191	54.	8.6	3027.2	*	2	0545	358	50.	-.2	3025.5				
1	0200	25	50.	-.2	3025.5	*	1	1555	192	54.	8.2	3027.1	*	2	0550	359	50.	-.2	3025.5				
1	0205	26	50.	-.2	3025.5	*	1	1600	193	53.	7.8	3027.0	*	2	0555	360	50.	-.2	3025.5				
1	0210	27	50.	-.2	3025.5	*	1	1605	194	53.	7.5	3027.0	*	2	0600	361	50.	-.2	3025.5				
1	0215	28	50.	-.2	3025.5	*	1	1610	195	53.	7.1	3026.9	*	2	0605	362	50.	-.2	3025.5				
1	0220	29	50.	-.2	3025.5	*	1	1615	196	53.	6.7	3026.8	*	2	0610	363	50.	-.2	3025.5				
1	0225	30	50.	-.2	3025.5	*	1	1620	197	53.	6.4	3026.7	*	2	0615	364	50.	-.2	3025.5				
1	0230	31	50.	-.2	3025.5	*	1	1625	198	53.	6.0	3026.7	*	2	0620	365	50.	-.2	3025.5				
1	0235	32	50.	-.1	3025.5	*	1	1630	199	52.	5.7	3026.6	*	2	0625	366	50.	-.2	3025.5				
1	0240	33	50.	-.1	3025.5	*	1	1635	200	52.	5.3	3026.5	*	2	0630	367	50.	-.2	3025.5				
1	0245	34	50.	.0	3025.5	*	1	1640	201	52.	4.9	3026.5	*	2	0635	368	50.	-.2	3025.5				
1	0250	35	50.	.0	3025.5	*	1	1645	202	52.	4.6	3026.4	*	2	0640	369	50.	-.2	3025.5				
1	0255	36	50.	.1	3025.5	*	1	1650	203	52.	4.2	3026.3	*	2	0645	370	50.	-.2	3025.5				
1	0300	37	50.	.2	3025.5	*	1	1655	204	52.	3.9	3026.3	*	2	0650	371	50.	-.2	3025.5				
1	0305	38	50.	.3	3025.6	*	1	1700	205	51.	3.5	3026.2	*	2	0655	372	50.	-.2	3025.5				
1	0310	39	50.	.6	3025.6	*	1	1705	206	51.	3.2	3026.1	*	2	0700	373	50.	-.2	3025.5				
1	0315	40	50.	1.2	3025.7	*	1	1710	207	51.	2.8	3026.0	*	2	0705	374	50.	-.2	3025.5				
1	0320	41	51.	2.3	3026.0	*	1	1715	208	51.	2.5	3026.0	*	2	0710	375	50.	-.2	3025.5				
1	0325	42	52.	4.4	3026.4	*	1	1720	209	51.	2.1	3025.9	*	2	0715	376	50.	-.2	3025.5				
1	0330	43	53.	7.6	3027.0	*	1	1725	210	51.	1.8	3025.8	*	2	0720	377	50.	-.2	3025.5				
1	0335	44	55.	12.0	3027.8	*	1	1730	211	50.	1.4	3025.8	*	2	0725	378	50.	-.2	3025.5				
1	0340	45	57.	17.0	3028.6	*	1	1735	212	50.	1.1	3025.7	*	2	0730	379	50.	-.2	3025.5				
1	0345	46	59.	22.2	3029.5	*	1	1740	213	50.	.7	3025.6	*	2	0735	380	50.	-.2	3025.5				
1	0350	47	61.	27.3	3030.3	*	1	1745	214	50.	.4	3025.6	*	2	0740	381	50.	-.2	3025.5				

1	0355	48	63.	32.0	3031.0	*	1	1750	215	50.	0	0745	382	50.	-2	3025.5
1	0400	49	64.	36.0	3031.7	*	1	1755	216	50.	-2	0750	383	50.	-2	3025.5
1	0405	50	65.	39.5	3032.2	*	1	1800	217	50.	-2	0755	384	50.	-2	3025.5
1	0410	51	66.	42.3	3032.6	*	1	1805	218	50.	-2	0800	385	50.	-2	3025.5
1	0415	52	67.	44.5	3033.0	*	1	1810	219	50.	-2	0805	386	50.	-2	3025.5
1	0420	53	67.	46.2	3033.2	*	1	1815	220	50.	-2	0810	387	50.	-2	3025.5
1	0425	54	68.	47.7	3033.4	*	1	1820	221	50.	-2	0815	388	50.	-2	3025.5
1	0430	55	68.	48.9	3033.6	*	1	1825	222	50.	-2	0820	389	50.	-2	3025.5
1	0435	56	68.	50.1	3033.8	*	1	1830	223	50.	-2	0825	390	50.	-2	3025.5
1	0440	57	69.	51.3	3034.0	*	1	1835	224	50.	-2	0830	391	50.	-2	3025.5
1	0445	58	69.	52.4	3034.2	*	1	1840	225	50.	-2	0835	392	50.	-2	3025.5
1	0450	59	69.	53.6	3034.3	*	1	1845	226	50.	-2	0840	393	50.	-2	3025.5
1	0455	60	70.	54.8	3034.5	*	1	1850	227	50.	-2	0845	394	50.	-2	3025.5
1	0500	61	70.	56.0	3034.7	*	1	1855	228	50.	-2	0850	395	50.	-2	3025.5
1	0505	62	71.	57.0	3034.9	*	1	1900	229	50.	-2	0855	396	50.	-2	3025.5
1	0510	63	71.	57.9	3035.0	*	1	1905	230	50.	-2	0900	397	50.	-2	3025.5
1	0515	64	71.	58.6	3035.1	*	1	1910	231	50.	-2	0905	398	50.	-2	3025.5
1	0520	65	71.	59.1	3035.2	*	1	1915	232	50.	-2	0910	399	50.	-2	3025.5
1	0525	66	71.	59.4	3035.2	*	1	1920	233	50.	-2	0915	400	50.	-2	3025.5
1	0530	67	71.	59.5	3035.2	*	1	1925	234	50.	-2	0920	401	50.	-2	3025.5
1	0535	68	71.	59.6	3035.2	*	1	1930	235	50.	-2	0925	402	50.	-2	3025.5
1	0540	69	71.	59.5	3035.2	*	1	1935	236	50.	-2	0930	403	50.	-2	3025.5
1	0545	70	71.	59.3	3035.2	*	1	1940	237	50.	-2	0935	404	50.	-2	3025.5
1	0550	71	71.	59.2	3035.2	*	1	1945	238	50.	-2	0940	405	50.	-2	3025.5
1	0555	72	71.	58.9	3035.1	*	1	1950	239	50.	-2	0945	406	50.	-2	3025.5
1	0600	73	71.	58.7	3035.1	*	1	1955	240	50.	-2	0950	407	50.	-2	3025.5
1	0605	74	71.	58.4	3035.1	*	1	2000	241	50.	-2	0955	408	50.	-2	3025.5
1	0610	75	71.	58.0	3035.0	*	1	2005	242	50.	-2	1000	409	50.	-2	3025.5
1	0615	76	71.	57.7	3035.0	*	1	2010	243	50.	-2	1005	410	50.	-2	3025.5
1	0620	77	71.	57.3	3034.9	*	1	2015	244	50.	-2	1010	411	50.	-2	3025.5
1	0625	78	70.	56.9	3034.8	*	1	2020	245	50.	-2	1015	412	50.	-2	3025.5
1	0630	79	70.	56.5	3034.7	*	1	2025	246	50.	-2	1020	413	50.	-2	3025.5
1	0635	80	70.	56.0	3034.7	*	1	2030	247	50.	-2	1025	414	50.	-2	3025.5
1	0640	81	70.	55.6	3034.6	*	1	2035	248	50.	-2	1030	415	50.	-2	3025.5
1	0645	82	70.	55.1	3034.6	*	1	2040	249	50.	-2	1035	416	50.	-2	3025.5
1	0650	83	70.	54.7	3034.5	*	1	2045	250	50.	-2	1040	417	50.	-2	3025.5
1	0655	84	70.	54.2	3034.4	*	1	2050	251	50.	-2	1045	418	50.	-2	3025.5
1	0700	85	69.	53.7	3034.4	*	1	2055	252	50.	-2	1050	419	50.	-2	3025.5
1	0705	86	69.	53.2	3034.3	*	1	2100	253	50.	-2	1055	420	50.	-2	3025.5
1	0710	87	69.	52.8	3034.2	*	1	2105	254	50.	-2	1100	421	50.	-2	3025.5
1	0715	88	69.	52.3	3034.1	*	1	2110	255	50.	-2	1105	422	50.	-2	3025.5
1	0720	89	69.	51.8	3034.1	*	1	2115	256	50.	-2	1110	423	50.	-2	3025.5
1	0725	90	69.	51.3	3034.0	*	1	2120	257	50.	-2	1115	424	50.	-2	3025.5
1	0730	91	69.	50.9	3033.9	*	1	2125	258	50.	-2	1120	425	50.	-2	3025.5
1	0735	92	68.	50.4	3033.9	*	1	2130	259	50.	-2	1125	426	50.	-2	3025.5
1	0740	93	68.	49.9	3033.8	*	1	2135	260	50.	-2	1130	427	50.	-2	3025.5
1	0745	94	68.	49.5	3033.7	*	1	2140	261	50.	-2	1135	428	50.	-2	3025.5
1	0750	95	68.	49.0	3033.6	*	1	2145	262	50.	-2	1140	429	50.	-2	3025.5
1	0755	96	68.	48.5	3033.6	*	1	2150	263	50.	-2	1145	430	50.	-2	3025.5
1	0800	97	68.	48.1	3033.5	*	1	2155	264	50.	-2	1150	431	50.	-2	3025.5
1	0805	98	68.	47.6	3033.4	*	1	2200	265	50.	-2	1155	432	50.	-2	3025.5
1	0810	99	67.	47.1	3033.4	*	1	2205	266	50.	-2	1200	433	50.	-2	3025.5
1	0815	100	67.	46.7	3033.3	*	1	2210	267	50.	-2	1205	434	50.	-2	3025.5
1	0820	101	67.	46.2	3033.2	*	1	2215	268	50.	-2	1210	435	50.	-2	3025.5
1	0825	102	67.	45.7	3033.1	*	1	2220	269	50.	-2	1215	436	50.	-2	3025.5
1	0830	103	67.	45.3	3033.1	*	1	2225	270	50.	-2	1220	437	50.	-2	3025.5
1	0835	104	67.	44.8	3033.0	*	1	2230	271	50.	-2	1225	438	50.	-2	3025.5
1	0840	105	67.	44.4	3032.9	*	1	2235	272	50.	-2	1230	439	50.	-2	3025.5
1	0845	106	66.	43.9	3032.9	*	1	2240	273	50.	-2	1235	440	50.	-2	3025.5
1	0850	107	66.	43.4	3032.8	*	1	2245	274	50.	-2	1240	441	50.	-2	3025.5
1	0855	108	66.	43.0	3032.7	*	1	2250	275	50.	-2	1245	442	50.	-2	3025.5
1	0900	109	66.	42.5	3032.7	*	1	2255	276	50.	-2	1250	443	50.	-2	3025.5
1	0905	110	66.	42.1	3032.6	*	1	2300	277	50.	-2	1255	444	50.	-2	3025.5
1	0910	111	66.	41.6	3032.5	*	1	2305	278	50.	-2	1255	445	50.	-2	3025.5
1	0915	112	66.	41.2	3032.4	*	1	2310	279	50.	-2	1300	446	50.	-2	3025.5
1	0920	113	65.	40.7	3032.4	*	1	2315	280	50.	-2	1310	447	50.	-2	3025.5
1	0925	114	65.	40.3	3032.3	*	1	2320	281	50.	-2	1315	448	50.	-2	3025.5
1	0930	115	65.	39.8	3032.2	*	1	2325	282	50.	-2	1320	449	50.	-2	3025.5
1	0935	116	65.	39.4	3032.2	*	1	2330	283	50.	-2	1325	450	50.	-2	3025.5
1	0940	117	65.	38.9	3032.1	*	1	2335	284	50.	-2	1330	451	50.	-2	3025.5
1	0945	118	65.	38.5	3032.0	*	1	2340	285	50.	-2	1335	452	50.	-2	3025.5
1	0950	119	65.	38.0	3032.0	*	1	2345	286	50.	-2	1340	453	50.	-2	3025.5
1	0955	120	64.	37.6	3031.9	*	1	2350	287	50.	-2	1345	454	50.	-2	3025.5
1	1000	121	64.	37.1	3031.8	*	1	2355	288	50.	-2	1350	455	50.	-2	3025.5
1	1005	122	64.	36.7	3031.8	*	2	0000	289	50.	-2	1355	456	50.	-2	3025.5
1	1010	123	64.	36.3	3031.7	*	2	0005	290	50.	-2	1400	457	50.	-2	3025.5
1	1015	124	64.	35.8	3031.6	*	2	0010	291	50.	-2	1405	458	50.	-2	3025.5
1	1020	125	64.	35.4	3031.6	*	2	0015	292	50.	-2	1410	459	50.	-2	3025.5
1	1025	126	64.	34.9	3031.5	*	2	0020	293	50.	-2	1415	460	50.	-2	3025.5
1	1030	127	64.	34.5	3031.4	*	2	0025	294	50.	-2	1420	461	50.	-2	3025.5
1	1035	128	63.	34.1	3031.4	*	2	0030	295	50.	-2	1425	462	50.	-2	3025.5
1	1040	129	63.	33.6	3031.3	*	2	0035	296	50.	-2	1430	463	50.	-2	3025.5
1	1045	130	63.	33.2	3031.2	*	2	0040	297	50.	-2	1435	464	50.	-2	3025.5
1	1050	131	63.	32.8	3031.2	*	2	0045	298	50.	-2	1440	465	50.	-2	3025.5
1	1055	132	63.	32.3	3031.1	*	2	0050	299	50.	-2	1445	466	50.	-2	3025.5
1	1100	133	63.	31.9	3031.0	*	2	0055	300	50.	-2	1450	467	50.	-2	3025.5
1	1105	134	63.	31.5	3031.0	*	2	0100	301	50.	-2	1455	468	50.	-2	3025.5
1	1110	135	62.	31.0	3030.9	*	2	0105	302	50.	-2	1500	469	50.	-2	3025.5
1	1115	136	62.	30.6	3030.8	*	2	0110	303	50.	-2	1505	470	50.	-2	3025.5
1	1120	137	62.	30.2	3030.8	*	2	0115	304	50.	-2	1510	471	50.	-2	3025.5
1	1125	138	62.	29.8	3030.7	*	2	0120	305</							

(AC-FT) 34. 113. 185. 185. ULT1.OUT

PEAK STORAGE TIME 6-HR MAXIMUM AVERAGE STORAGE 41.58-HR

+ (AC-FT) (HR) 5.58 50. 19. 11. 11.

PEAK STAGE TIME 6-HR MAXIMUM AVERAGE STAGE 41.58-HR

+ (FEET) (HR) 5.58 3033.77 3028.70 3027.35 3027.35

CUMULATIVE AREA = .88 SQ MI

HYDROGRAPH AT STATION RDB1
PLAN 1, RATIO = .98

DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	*	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	*	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	*
1	0000	1	50.		.0	3025.5	*	1	1355	168	57.	15.7	3028.4	*	2	0350	335	50.		-2	3025.5		
1	0005	2	50.		-.2	3025.5	*	1	1400	169	57.	15.3	3028.3	*	2	0355	336	50.		-2	3025.5		
1	0010	3	50.		-.2	3025.5	*	1	1405	170	56.	14.9	3028.3	*	2	0400	337	50.		-2	3025.5		
1	0015	4	50.		-.2	3025.5	*	1	1410	171	56.	14.5	3028.2	*	2	0405	338	50.		-2	3025.5		
1	0020	5	50.		-.2	3025.5	*	1	1415	172	56.	14.1	3028.1	*	2	0410	339	50.		-2	3025.5		
1	0025	6	50.		-.2	3025.5	*	1	1420	173	56.	13.7	3028.1	*	2	0415	340	50.		-2	3025.5		
1	0030	7	50.		-.2	3025.5	*	1	1425	174	56.	13.3	3028.0	*	2	0420	341	50.		-2	3025.5		
1	0035	8	50.		-.2	3025.5	*	1	1430	175	56.	13.0	3027.9	*	2	0425	342	50.		-2	3025.5		
1	0040	9	50.		-.2	3025.5	*	1	1435	176	55.	12.6	3027.9	*	2	0430	343	50.		-2	3025.5		
1	0045	10	50.		-.2	3025.5	*	1	1440	177	55.	12.2	3027.8	*	2	0435	344	50.		-2	3025.5		
1	0050	11	50.		-.2	3025.5	*	1	1445	178	55.	11.8	3027.8	*	2	0440	345	50.		-2	3025.5		
1	0055	12	50.		-.2	3025.5	*	1	1450	179	55.	11.4	3027.7	*	2	0445	346	50.		-2	3025.5		
1	0100	13	50.		-.2	3025.5	*	1	1455	180	55.	11.1	3027.6	*	2	0450	347	50.		-2	3025.5		
1	0105	14	50.		-.2	3025.5	*	1	1500	181	55.	10.7	3027.5	*	2	0455	348	50.		-2	3025.5		
1	0110	15	50.		-.2	3025.5	*	1	1505	182	54.	10.3	3027.5	*	2	0500	349	50.		-2	3025.5		
1	0115	16	50.		-.2	3025.5	*	1	1510	183	54.	9.9	3027.4	*	2	0505	350	50.		-2	3025.5		
1	0120	17	50.		-.2	3025.5	*	1	1515	184	54.	9.6	3027.3	*	2	0510	351	50.		-2	3025.5		
1	0125	18	50.		-.2	3025.5	*	1	1520	185	54.	9.2	3027.3	*	2	0515	352	50.		-2	3025.5		
1	0130	19	50.		-.2	3025.5	*	1	1525	186	54.	8.8	3027.2	*	2	0520	353	50.		-2	3025.5		
1	0135	20	50.		-.2	3025.5	*	1	1530	187	54.	8.4	3027.1	*	2	0525	354	50.		-2	3025.5		
1	0140	21	50.		-.2	3025.5	*	1	1535	188	54.	8.1	3027.1	*	2	0530	355	50.		-2	3025.5		
1	0145	22	50.		-.2	3025.5	*	1	1540	189	53.	7.7	3027.0	*	2	0535	356	50.		-2	3025.5		
1	0150	23	50.		-.2	3025.5	*	1	1545	190	53.	7.3	3026.9	*	2	0540	357	50.		-2	3025.5		
1	0155	24	50.		-.2	3025.5	*	1	1550	191	53.	7.0	3026.9	*	2	0545	358	50.		-2	3025.5		
1	0200	25	50.		-.2	3025.5	*	1	1555	192	53.	6.6	3026.8	*	2	0550	359	50.		-2	3025.5		
1	0205	26	50.		-.2	3025.5	*	1	1600	193	53.	6.2	3026.7	*	2	0555	360	50.		-2	3025.5		
1	0210	27	50.		-.2	3025.5	*	1	1605	194	52.	5.9	3026.7	*	2	0600	361	50.		-2	3025.5		
1	0215	28	50.		-.2	3025.5	*	1	1610	195	52.	5.5	3026.6	*	2	0605	362	50.		-2	3025.5		
1	0220	29	50.		-.2	3025.5	*	1	1615	196	52.	5.2	3026.6	*	2	0610	363	50.		-2	3025.5		
1	0225	30	50.		-.2	3025.5	*	1	1620	197	52.	4.8	3026.4	*	2	0615	364	50.		-2	3025.5		
1	0230	31	50.		-.2	3025.5	*	1	1625	198	52.	4.4	3026.4	*	2	0620	365	50.		-2	3025.5		
1	0235	32	50.		-.2	3025.5	*	1	1630	199	52.	4.1	3026.3	*	2	0625	366	50.		-2	3025.5		
1	0240	33	50.		-.2	3025.5	*	1	1635	200	51.	3.7	3026.2	*	2	0630	367	50.		-2	3025.5		
1	0245	34	50.		-.1	3025.5	*	1	1640	201	51.	3.4	3026.2	*	2	0635	368	50.		-2	3025.5		
1	0250	35	50.		0	3025.5	*	1	1645	202	51.	3.0	3026.1	*	2	0640	369	50.		-2	3025.5		
1	0255	36	50.		0	3025.5	*	1	1650	203	51.	2.7	3026.0	*	2	0645	370	50.		-2	3025.5		
1	0300	37	50.		.1	3025.5	*	1	1655	204	51.	2.3	3026.0	*	2	0650	371	50.		-2	3025.5		
1	0305	38	50.		.1	3025.5	*	1	1700	205	51.	2.0	3025.9	*	2	0655	372	50.		-2	3025.5		
1	0310	39	50.		.4	3025.6	*	1	1705	206	50.	1.6	3025.8	*	2	0700	373	50.		-2	3025.5		
1	0315	40	50.		1.0	3025.7	*	1	1710	207	50.	1.2	3025.8	*	2	0705	374	50.		-2	3025.5		
1	0320	41	51.		2.1	3025.9	*	1	1715	208	50.	.9	3025.7	*	2	0710	375	50.		-2	3025.5		
1	0325	42	52.		4.1	3026.3	*	1	1720	209	50.	.6	3025.6	*	2	0715	376	50.		-2	3025.5		
1	0330	43	53.		7.2	3026.9	*	1	1725	210	50.	.2	3025.5	*	2	0720	377	50.		-2	3025.5		
1	0335	44	55.		11.4	3027.7	*	1	1730	211	50.	-.1	3025.5	*	2	0725	378	50.		-2	3025.5		
1	0340	45	57.		16.3	3028.5	*	1	1735	212	50.	-.2	3025.5	*	2	0730	379	50.		-2	3025.5		
1	0345	46	59.		21.3	3029.4	*	1	1740	213	50.	-.2	3025.5	*	2	0735	380	50.		-2	3025.5		
1	0350	47	61.		26.3	3030.2	*	1	1745	214	50.	-.2	3025.5	*	2	0740	381	50.		-2	3025.5		
1	0355	48	62.		30.8	3030.9	*	1	1750	215	50.	-.2	3025.5	*	2	0745	382	50.		-2	3025.5		
1	0400	49	64.		34.7	3031.5	*	1	1755	216	50.	-.2	3025.5	*	2	0750	383	50.		-2	3025.5		
1	0405	50	65.		38.1	3032.0	*	1	1800	217	50.	-.2	3025.5	*	2	0755	384	50.		-2	3025.5		
1	0410	51	65.		40.8	3032.4	*	1	1805	218	50.	-.2	3025.5	*	2	0800	385	50.		-2	3025.5		
1	0415	52	66.		42.9	3032.7	*	1	1810	219	50.	-.2	3025.5	*	2	0805	386	50.		-2	3025.5		
1	0420	53	67.		44.6	3033.0	*	1	1815	220	50.	-.2	3025.5	*	2	0810	387	50.		-2	3025.5		
1	0425	54	67.		46.0	3033.2	*	1	1820	221	50.	-.2	3025.5	*	2	0815	388	50.		-2	3025.5		
1	0430	55	67.		47.2	3033.4	*	1	1825	222	50.	-.2	3025.5	*	2	0820	389	50.		-2	3025.5		
1	0435	56	68.		48.3	3033.5	*	1	1830	223	50.	-.2	3025.5	*	2	0825	390	50.		-2	3025.5		
1	0440	57	68.		49.5	3033.7	*	1	1835	224	50.	-.2	3025.5	*	2	0830	391	50.		-2	3025.5		
1	0445	58	69.		50.6	3033.9	*	1	1840	225	50.	-.2	3025.5	*	2	0835	392	50.		-2	3025.5		
1	0450	59	69.		51.7	3034.1	*	1	1845	226	50.	-.2	3025.5	*	2	0840	393	50.		-2	3025.5		
1	0455	60	69.		52.9	3034.2	*	1	1850	227	50.	-.2	3025.5	*	2	0845	394	50.		-2	3025.5		
1	0500	61	70.		54.1	3034.4	*	1	1855	228	50.	-.2	3025.5	*	2	0850	395	50.		-2	3025.5		
1	0505	62	70.		55.1	3034.6	*	1	1900	229	50.	-.2	3025.5	*	2	0855	396	50.		-2	3025.5		
1	0510	63	70.		55.9	3034.7	*	1	1905	230	50.	-.2	3025.5	*	2	0900	397	50.		-2	3025.5		
1	0515	64	70.		56.5</																		

1	0845 106	66.	41.9	3032.6	* 1	2240 273	50.	ULT1.OUT	-2	3025.5	* 2	1235 440	50.	-2	3025.5
1	0850 107	66.	41.5	3032.5	* 1	2245 274	50.		-2	3025.5	* 2	1240 441	50.	-2	3025.5
1	0855 108	66.	41.0	3032.4	* 1	2250 275	50.		-2	3025.5	* 2	1245 442	50.	-2	3025.5
1	0900 109	65.	40.6	3032.4	* 1	2255 276	50.		-2	3025.5	* 2	1250 443	50.	-2	3025.5
1	0905 110	65.	40.1	3032.3	* 1	2300 277	50.		-2	3025.5	* 2	1255 444	50.	-2	3025.5
1	0910 111	65.	39.7	3032.2	* 1	2305 278	50.		-2	3025.5	* 2	1300 445	50.	-2	3025.5
1	0915 112	65.	39.2	3032.1	* 1	2310 279	50.		-2	3025.5	* 2	1305 446	50.	-2	3025.5
1	0920 113	65.	38.8	3032.1	* 1	2315 280	50.		-2	3025.5	* 2	1310 447	50.	-2	3025.5
1	0925 114	65.	38.3	3032.0	* 1	2320 281	50.		-2	3025.5	* 2	1315 448	50.	-2	3025.5
1	0930 115	65.	37.9	3031.9	* 1	2325 282	50.		-2	3025.5	* 2	1320 449	50.	-2	3025.5
1	0935 116	64.	37.4	3031.9	* 1	2330 283	50.		-2	3025.5	* 2	1325 450	50.	-2	3025.5
1	0940 117	64.	37.0	3031.8	* 1	2335 284	50.		-2	3025.5	* 2	1330 451	50.	-2	3025.5
1	0945 118	64.	36.5	3031.7	* 1	2340 285	50.		-2	3025.5	* 2	1335 452	50.	-2	3025.5
1	0950 119	64.	36.1	3031.7	* 1	2345 286	50.		-2	3025.5	* 2	1340 453	50.	-2	3025.5
1	0955 120	64.	35.7	3031.6	* 1	2350 287	50.		-2	3025.5	* 2	1345 454	50.	-2	3025.5
1	1000 121	64.	35.2	3031.5	* 1	2355 288	50.		-2	3025.5	* 2	1350 455	50.	-2	3025.5
1	1005 122	64.	34.8	3031.5	* 2	0000 289	50.		-2	3025.5	* 2	1355 456	50.	-2	3025.5
1	1010 123	63.	34.3	3031.4	* 2	0005 290	50.		-2	3025.5	* 2	1400 457	50.	-2	3025.5
1	1015 124	63.	33.9	3031.3	* 2	0010 291	50.		-2	3025.5	* 2	1405 458	50.	-2	3025.5
1	1020 125	63.	33.5	3031.3	* 2	0015 292	50.		-2	3025.5	* 2	1410 459	50.	-2	3025.5
1	1025 126	63.	33.0	3031.2	* 2	0020 293	50.		-2	3025.5	* 2	1415 460	50.	-2	3025.5
1	1030 127	63.	32.6	3031.1	* 2	0025 294	50.		-2	3025.5	* 2	1420 461	50.	-2	3025.5
1	1035 128	63.	32.2	3031.1	* 2	0030 295	50.		-2	3025.5	* 2	1425 462	50.	-2	3025.5
1	1040 129	63.	31.7	3031.0	* 2	0035 296	50.		-2	3025.5	* 2	1430 463	50.	-2	3025.5
1	1045 130	62.	31.3	3030.9	* 2	0040 297	50.		-2	3025.5	* 2	1435 464	50.	-2	3025.5
1	1050 131	62.	30.9	3030.9	* 2	0045 298	50.		-2	3025.5	* 2	1440 465	50.	-2	3025.5
1	1055 132	62.	30.4	3030.8	* 2	0050 299	50.		-2	3025.5	* 2	1445 466	50.	-2	3025.5
1	1100 133	62.	30.0	3030.7	* 2	0055 300	50.		-2	3025.5	* 2	1450 467	50.	-2	3025.5
1	1105 134	62.	29.6	3030.7	* 2	0100 301	50.		-2	3025.5	* 2	1455 468	50.	-2	3025.5
1	1110 135	62.	29.2	3030.6	* 2	0105 302	50.		-2	3025.5	* 2	1500 469	50.	-2	3025.5
1	1115 136	62.	28.7	3030.5	* 2	0110 303	50.		-2	3025.5	* 2	1505 470	50.	-2	3025.5
1	1120 137	62.	28.3	3030.5	* 2	0115 304	50.		-2	3025.5	* 2	1510 471	50.	-2	3025.5
1	1125 138	61.	27.9	3030.4	* 2	0120 305	50.		-2	3025.5	* 2	1515 472	50.	-2	3025.5
1	1130 139	61.	27.5	3030.4	* 2	0125 306	50.		-2	3025.5	* 2	1520 473	50.	-2	3025.5
1	1135 140	61.	27.0	3030.3	* 2	0130 307	50.		-2	3025.5	* 2	1525 474	50.	-2	3025.5
1	1140 141	61.	26.6	3030.2	* 2	0135 308	50.		-2	3025.5	* 2	1530 475	50.	-2	3025.5
1	1145 142	61.	26.2	3030.2	* 2	0140 309	50.		-2	3025.5	* 2	1535 476	50.	-2	3025.5
1	1150 143	61.	25.8	3030.1	* 2	0145 310	50.		-2	3025.5	* 2	1540 477	50.	-2	3025.5
1	1155 144	61.	25.4	3030.0	* 2	0150 311	50.		-2	3025.5	* 2	1545 478	50.	-2	3025.5
1	1200 145	61.	25.0	3030.0	* 2	0155 312	50.		-2	3025.5	* 2	1550 479	50.	-2	3025.5
1	1205 146	60.	24.5	3029.9	* 2	0200 313	50.		-2	3025.5	* 2	1555 480	50.	-2	3025.5
1	1210 147	60.	24.1	3029.8	* 2	0205 314	50.		-2	3025.5	* 2	1600 481	50.	-2	3025.5
1	1215 148	60.	23.7	3029.8	* 2	0210 315	50.		-2	3025.5	* 2	1605 482	50.	-2	3025.5
1	1220 149	60.	23.3	3029.7	* 2	0215 316	50.		-2	3025.5	* 2	1610 483	50.	-2	3025.5
1	1225 150	60.	22.9	3029.6	* 2	0220 317	50.		-2	3025.5	* 2	1615 484	50.	-2	3025.5
1	1230 151	60.	22.5	3029.6	* 2	0225 318	50.		-2	3025.5	* 2	1620 485	50.	-2	3025.5
1	1235 152	59.	22.1	3029.5	* 2	0230 319	50.		-2	3025.5	* 2	1625 486	50.	-2	3025.5
1	1240 153	59.	21.7	3029.4	* 2	0235 320	50.		-2	3025.5	* 2	1630 487	50.	-2	3025.5
1	1245 154	59.	21.2	3029.3	* 2	0240 321	50.		-2	3025.5	* 2	1635 488	50.	-2	3025.5
1	1250 155	59.	20.8	3029.3	* 2	0245 322	50.		-2	3025.5	* 2	1640 489	50.	-2	3025.5
1	1255 156	59.	20.4	3029.2	* 2	0250 323	50.		-2	3025.5	* 2	1645 490	50.	-2	3025.5
1	1300 157	59.	20.0	3029.1	* 2	0255 324	50.		-2	3025.5	* 2	1650 491	50.	-2	3025.5
1	1305 158	58.	19.6	3029.1	* 2	0300 325	50.		-2	3025.5	* 2	1655 492	50.	-2	3025.5
1	1310 159	58.	19.2	3029.0	* 2	0305 326	50.		-2	3025.5	* 2	1700 493	50.	-2	3025.5
1	1315 160	58.	18.8	3028.9	* 2	0310 327	50.		-2	3025.5	* 2	1705 494	50.	-2	3025.5
1	1320 161	58.	18.4	3028.9	* 2	0315 328	50.		-2	3025.5	* 2	1710 495	50.	-2	3025.5
1	1325 162	58.	18.0	3028.8	* 2	0320 329	50.		-2	3025.5	* 2	1715 496	50.	-2	3025.5
1	1330 163	58.	17.6	3028.7	* 2	0325 330	50.		-2	3025.5	* 2	1720 497	50.	-2	3025.5
1	1335 164	57.	17.2	3028.7	* 2	0330 331	50.		-2	3025.5	* 2	1725 498	50.	-2	3025.5
1	1340 165	57.	16.8	3028.6	* 2	0335 332	50.		-2	3025.5	* 2	1730 499	50.	-2	3025.5
1	1345 166	57.	16.5	3028.5	* 2	0340 333	50.		-2	3025.5	* 2	1735 500	50.	-2	3025.5
1	1350 167	57.	16.1	3028.5	* 2	0345 334	50.		-2	3025.5	* 2				

PEAK FLOW	TIME	6-HR	MAXIMUM AVERAGE FLOW	72-HR	41.58-HR
+	(CFS)	(HR)	(CFS)		
+	71.	5.58	68.	57.	54.
			(INCHES)	2.401	3.944
			(AC-FT)	112.	185.
PEAK STORAGE	TIME	6-HR	MAXIMUM AVERAGE STORAGE	72-HR	41.58-HR
+	(AC-FT)	(HR)			
+	57.	5.58	48.	18.	10.
PEAK STAGE	TIME	6-HR	MAXIMUM AVERAGE STAGE	72-HR	41.58-HR
+	(FEET)	(HR)			
+	3034.93	5.58	3033.47	3028.53	3027.25
			CUMULATIVE AREA =	.88 SQ MI	

1

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
TIME TO PEAK IN HOURS

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO PRECIPITATION
				RATIO 1 1.00
				RATIO 2 .98
HYDROGRAPH AT	OFF1	.41	1 FLOW TIME	403. 3.75
HYDROGRAPH AT	OFF7	.03	1 FLOW TIME	55. 3.50
2 COMBINED AT	CP2	.44	1 FLOW TIME	432. 3.75
HYDROGRAPH AT	OFF2	.04	1 FLOW TIME	48. 3.58
HYDROGRAPH AT	OFF3	.03	1 FLOW TIME	38. 3.58
3 COMBINED AT	CP1	.50	1 FLOW TIME	485. 3.75
HYDROGRAPH AT	OFF4	.06	1 FLOW TIME	84. 3.58
HYDROGRAPH AT	OFF5	.26	1 FLOW TIME	236. 3.83
HYDROGRAPH AT				

							ULT1.OUT
+	OFF6	.04	1	FLOW	59.	57.	
				TIME	3.58	3.58	
HYDROGRAPH AT							
+	ON1	.03	1	FLOW	47.	46.	
				TIME	3.58	3.58	
5 COMBINED AT							
+	DB1	.88	1	FLOW	817.	794.	
				TIME	3.75	3.75	
ROUTED TO							
+	RD81	.88	1	FLOW	71.	71.	
				TIME	5.58	5.58	
				** PEAK STAGES IN FEET **			
			1	STAGE	3035.23	3034.93	
				TIME	5.58	5.58	

*** NORMAL END OF HEC-1 ***

PMF Storm Event HEC-1 Model

```

*****
* FLOOD HYDROGRAPH PACKAGE (HEC-1)
* JUN 1998
* VERSION 4.1
* RUN DATE 22JUL15 TIME 16:22:39
*****

```

PMF.OUT

```

*****
* U.S. ARMY CORPS OF ENGINEERS
* HYDROLOGIC ENGINEERING CENTER
* 609 SECOND STREET
* DAVIS, CALIFORNIA 95616
* (916) 756-1104
*****

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```

X X XXXXXX XXXXX X
X X X X XX
X X X X X
XXXXXX XXXX X XXXX
X X X X X
X X X X X
X X XXXXXX XXXXX XXX

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THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HECIGS, HECIDB, AND HECIKW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.

THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION

NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE, SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY, DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION

KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1 HEC-1 INPUT PAGE 1

```

LINE ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10
*DIAGRAM
1 ID SLATER HANIFAN GROUP
2 ID NINETY-FIVE MANAGEMENT, LLC.
3 ID SKYE CANYON - DETENTION BASIN 1
4 ID TECHNICAL DRAINAGE STUDY - SUPPLEMENT
5 ID PMF DRAINAGE CONDITION
6 ID
7 ID RETURN PERIOD ----- 100-YEAR
8 ID DISTRIBUTION ----- 6-HOUR SDN3
9 ID PROJECT NO. ----- OLY1401.004
10 ID FILENAME ----- PMF.H1
11 ID DATE ----- 7/17/2015
12 ID MODELED BY ----- EM
13 ID
14 ID SIX HOUR DEPTH-AREA REDUCTION FACTORS
15 ID DRAINAGE AREA (MI^2) RATIO
16 ID 0.0-0.49 1.00
17 ID 0.5-0.99 0.98
18 ID
19 IT 15 0 0 500
20 IO 5 0 0
21 IN 15 0 0
22 JR PREC 1.00
*
23 KK OFF1
24 KM EXISTING OFFSITE DRAINAGE BASIN
25 KM DISCHARGES INTO DETENTION BASIN "DB1"
26 PB 14.1
27 PC 0.000 0.004 0.007 0.011 0.014 0.023 0.032 0.041 0.050 0.078
28 PC 0.106 0.135 0.163 0.681 0.816 0.872 0.915 0.929 0.943 0.957
29 PC 0.972 0.979 0.986 0.993 1.000
30 BA .4073
31 LS 0 86.4
32 UD 0.356
*
33 KK OFF7
34 KM FUTURE DEVELOPED OFFSITE DRAINAGE BASIN
35 KM DISCHARGES INTO DETENTION BASIN "DB1"
36 BA .0281
37 LS 0 96.0
38 UD 0.118
*
39 KK CP2
40 KM COMBINE OFF1, OFF7
41 HC 2
*

```

1 HEC-1 INPUT PAGE 2

```

LINE ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10
42 KK OFF2
43 KM EXISTING OFFSITE DRAINAGE BASIN
44 KM DISCHARGES INTO DETENTION BASIN "DB1"
45 BA .0355
46 LS 0 85.0
47 UD 0.148
*
48 KK OFF3
49 KM EXISTING OFFSITE DRAINAGE BASIN
50 KM DISCHARGES INTO DETENTION BASIN "DB1"
51 BA .0259
52 LS 0 86.2
53 UD 0.112
*
54 KK CP1
55 KM COMBINE CP2, OFF2, AND OFF3
56 HC 3
*
57 KK OFF4
58 KM EXISTING OFFSITE DRAINAGE BASIN
59 KM DISCHARGES INTO DETENTION BASIN "DB1"
60 BA .0581
61 LS 0 86.2
62 UD 0.136
*
63 KK OFF5
64 KM EXISTING OFFSITE DRAINAGE BASIN
65 KM DISCHARGES INTO DETENTION BASIN "DB1"
66 BA .2569
67 LS 0 86.5
68 UD 0.419
*

```

```

69      KK      OFF6
70      KM      EXISTING OFFSITE DRAINAGE BASIN
71      KM      DISCHARGES INTO DETENTION BASIN "DB1"
72      BA      .0398
73      LS      0      86.2
74      UD      0.121
      *

75      KK      ON1
76      KM      PROPOSED ONSITE DRAINAGE BASIN
77      BA      .0261
78      LS      0      92.8
79      UD      0.116
      *

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1

HEC-1 INPUT

PAGE 3

```

LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

80      KK      DB1
81      KM      COMBINE CP1, OFF4, OFF5, OFF6 AND ON1
82      KO      1
83      HC      5
      *

84      KK      RDB1
85      KM      OUTLET = 24" ORIFICE @ INVERT ELEVATION = 3013.8-FT
86      KM      87-FT WIDE SPILLWAY @ CREST ELEVATION = 3037.0-FT
87      KO      1
88      RS      1      ELEV 3025.5
89      SA      4.68      5.56      5.74      5.92      6.10      7.01      7.46      8.36      9.32      10.68
90      SE      3025.5      3027      3028      3029      3030      3035      3037      3040      3043      3046
91      SQ      49.7      60.6      70.8      74.5      1436.0      3920.5      7136.3
92      SE      3025.5      3030      3035      3037      3040      3043      3046
      *

93      ZZ

```

1

SCHEMATIC DIAGRAM OF STREAM NETWORK

```

INPUT LINE      (V) ROUTING      (--->) DIVERSION OR PUMP FLOW
NO.      (.) CONNECTOR      (<---) RETURN OF DIVERTED OR PUMPED FLOW

23      OFF1
      .
      .
33      .      OFF7
      .
      .
39      CP2.....
      .
      .
42      .      OFF2
      .
      .
48      .      OFF3
      .
      .
54      CP1.....
      .
      .
57      .      OFF4
      .
      .
63      .      OFF5
      .
      .
69      .      OFF6
      .
      .
75      .      ON1
      .
      .
80      DB1.....
      V
      V
84      RDB1

```

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```

*****
* FLOOD HYDROGRAPH PACKAGE (HEC-1) *
* JUN 1998 *
* VERSION 4.1 *
* RUN DATE 22JUL15 TIME 16:22:39 *
*****

```

```

*****
* U.S. ARMY CORPS OF ENGINEERS *
* HYDROLOGIC ENGINEERING CENTER *
* 609 SECOND STREET *
* DAVIS, CALIFORNIA 95616 *
* (916) 756-1104 *
*****

```

SLATER HANIFAN GROUP
NINETY-FIVE MANAGEMENT, LLC.
SKYE CANYON - DETENTION BASIN 1
TECHNICAL DRAINAGE STUDY - SUPPLEMENT
PMF DRAINAGE CONDITION

RETURN PERIOD ----- 100-YEAR
DISTRIBUTION ----- 6-HOUR SDN3
PROJECT NO. ----- OLY1401.004
FILENAME ----- PMF.H1
DATE ----- 7/17/2015
MODELED BY ----- EM

SIX HOUR DEPTH-AREA REDUCTION FACTORS
DRAINAGE AREA (MI^2) RATIO
0.0-0.49 1.00
0.5-0.99 0.98

20 IO

OUTPUT CONTROL VARIABLES

```

IPRNT 5 PRINT CONTROL
IPLOT 0 PLOT CONTROL
QSCAL 0. HYDROGRAPH PLOT SCALE

```

IT

HYDROGRAPH TIME DATA

```

NMIN 15 MINUTES IN COMPUTATION INTERVAL
IDATE 1 0 STARTING DATE
ITIME 0000 STARTING TIME
NQ 500 NUMBER OF HYDROGRAPH ORDINATES
NDDATE 6 0 ENDING DATE
NDTIME 0445 ENDING TIME
ICENT 19 CENTURY MARK

```

COMPUTATION INTERVAL .25 HOURS
TOTAL TIME BASE 124.75 HOURS

ENGLISH UNITS
DRAINAGE AREA
PRECIPITATION DEPTH
LENGTH, ELEVATION
FLOW
STORAGE VOLUME
SURFACE AREA
TEMPERATURE

SQUARE MILES
INCHES
FEET
CUBIC FEET PER SECOND
ACRE-Feet
ACRES
DEGREES FAHRENHEIT

PMF.OUT

JP MULTI-PLAN OPTION
NPLAN 1 NUMBER OF PLANS

JR MULTI-RATIO OPTION
RATIOS OF PRECIPITATION
1.00

*
* DB1 *
*

82 KO OUTPUT CONTROL VARIABLES
IPRNT 1 PRINT CONTROL
IPLOT 0 PLOT CONTROL
QSCAL 0. HYDROGRAPH PLOT SCALE

83 HC HYDROGRAPH COMBINATION
ICOMP 5 NUMBER OF HYDROGRAPHS TO COMBINE

HYDROGRAPH AT STATION DB1
SUM OF 5 HYDROGRAPHS
PLAN 1, RATIO = 1.00

DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW
1	0000	1	0.	2	0715	126	0.	3	1430	251	0.	4	2145	376	0.				
1	0015	2	0.	2	0730	127	0.	3	1445	252	0.	4	2200	377	0.				
1	0030	3	0.	2	0745	128	0.	3	1500	253	0.	4	2215	378	0.				
1	0045	4	1.	2	0800	129	0.	3	1515	254	0.	4	2230	379	0.				
1	0100	5	1.	2	0815	130	0.	3	1530	255	0.	4	2245	380	0.				
1	0115	6	5.	2	0830	131	0.	3	1545	256	0.	4	2300	381	0.				
1	0130	7	12.	2	0845	132	0.	3	1600	257	0.	4	2315	382	0.				
1	0145	8	34.	2	0900	133	0.	3	1615	258	0.	4	2330	383	0.				
1	0200	9	60.	2	0915	134	0.	3	1630	259	0.	4	2345	384	0.				
1	0215	10	188.	2	0930	135	0.	3	1645	260	0.	5	0000	385	0.				
1	0230	11	349.	2	0945	136	0.	3	1700	261	0.	5	0015	386	0.				
1	0245	12	497.	2	1000	137	0.	3	1715	262	0.	5	0030	387	0.				
1	0300	13	599.	2	1015	138	0.	3	1730	263	0.	5	0045	388	0.				
1	0315	14	5255.	2	1030	139	0.	3	1745	264	0.	5	0100	389	0.				
1	0330	15	6744.	2	1045	140	0.	3	1800	265	0.	5	0115	390	0.				
1	0345	16	5206.	2	1100	141	0.	3	1815	266	0.	5	0130	391	0.				
1	0400	17	3233.	2	1115	142	0.	3	1830	267	0.	5	0145	392	0.				
1	0415	18	1914.	2	1130	143	0.	3	1845	268	0.	5	0200	393	0.				
1	0430	19	1139.	2	1145	144	0.	3	1900	269	0.	5	0215	394	0.				
1	0445	20	749.	2	1200	145	0.	3	1915	270	0.	5	0230	395	0.				
1	0500	21	591.	2	1215	146	0.	3	1930	271	0.	5	0245	396	0.				
1	0515	22	447.	2	1230	147	0.	3	1945	272	0.	5	0300	397	0.				
1	0530	23	330.	2	1245	148	0.	3	2000	273	0.	5	0315	398	0.				
1	0545	24	265.	2	1300	149	0.	3	2015	274	0.	5	0330	399	0.				
1	0600	25	239.	2	1315	150	0.	3	2030	275	0.	5	0345	400	0.				
1	0615	26	160.	2	1330	151	0.	3	2045	276	0.	5	0400	401	0.				
1	0630	27	82.	2	1345	152	0.	3	2100	277	0.	5	0415	402	0.				
1	0645	28	35.	2	1400	153	0.	3	2115	278	0.	5	0430	403	0.				
1	0700	29	15.	2	1415	154	0.	3	2130	279	0.	5	0445	404	0.				
1	0715	30	7.	2	1430	155	0.	3	2145	280	0.	5	0500	405	0.				
1	0730	31	3.	2	1445	156	0.	3	2200	281	0.	5	0515	406	0.				
1	0745	32	1.	2	1500	157	0.	3	2215	282	0.	5	0530	407	0.				
1	0800	33	0.	2	1515	158	0.	3	2230	283	0.	5	0545	408	0.				
1	0815	34	0.	2	1530	159	0.	3	2245	284	0.	5	0600	409	0.				
1	0830	35	0.	2	1545	160	0.	3	2300	285	0.	5	0615	410	0.				
1	0845	36	0.	2	1600	161	0.	3	2315	286	0.	5	0630	411	0.				
1	0900	37	0.	2	1615	162	0.	3	2330	287	0.	5	0645	412	0.				
1	0915	38	0.	2	1630	163	0.	3	2345	288	0.	5	0700	413	0.				
1	0930	39	0.	2	1645	164	0.	4	0000	289	0.	5	0715	414	0.				
1	0945	40	0.	2	1700	165	0.	4	0015	290	0.	5	0730	415	0.				
1	1000	41	0.	2	1715	166	0.	4	0030	291	0.	5	0745	416	0.				
1	1015	42	0.	2	1730	167	0.	4	0045	292	0.	5	0800	417	0.				
1	1030	43	0.	2	1745	168	0.	4	0100	293	0.	5	0815	418	0.				
1	1045	44	0.	2	1800	169	0.	4	0115	294	0.	5	0830	419	0.				
1	1100	45	0.	2	1815	170	0.	4	0130	295	0.	5	0845	420	0.				
1	1115	46	0.	2	1830	171	0.	4	0145	296	0.	5	0900	421	0.				
1	1130	47	0.	2	1845	172	0.	4	0200	297	0.	5	0915	422	0.				
1	1145	48	0.	2	1900	173	0.	4	0215	298	0.	5	0930	423	0.				
1	1200	49	0.	2	1915	174	0.	4	0230	299	0.	5	0945	424	0.				
1	1215	50	0.	2	1930	175	0.	4	0245	300	0.	5	1000	425	0.				
1	1230	51	0.	2	1945	176	0.	4	0300	301	0.	5	1015	426	0.				
1	1245	52	0.	2	2000	177	0.	4	0315	302	0.	5	1030	427	0.				
1	1300	53	0.	2	2015	178	0.	4	0330	303	0.	5	1045	428	0.				
1	1315	54	0.	2	2030	179	0.	4	0345	304	0.	5	1100	429	0.				
1	1330	55	0.	2	2045	180	0.	4	0400	305	0.	5	1115	430	0.				
1	1345	56	0.	2	2100	181	0.	4	0415	306	0.	5	1130	431	0.				
1	1400	57	0.	2	2115	182	0.	4	0430	307	0.	5	1145	432	0.				
1	1415	58	0.	2	2130	183	0.	4	0445	308	0.	5	1200	433	0.				
1	1430	59	0.	2	2145	184	0.	4	0500	309	0.	5	1215	434	0.				
1	1445	60	0.	2	2200	185	0.	4	0515	310	0.	5	1230	435	0.				
1	1500	61	0.	2	2215	186	0.	4	0530	311	0.	5	1245	436	0.				
1	1515	62	0.	2	2230	187	0.	4	0545	312	0.	5	1300	437	0.				
1	1530	63	0.	2	2245	188	0.	4	0600	313	0.	5	1315	438	0.				
1	1545	64	0.	2	2300	189	0.	4	0615	314	0.	5	1330	439	0.				
1	1600	65	0.	2	2315	190	0.	4	0630	315	0.	5	1345	440	0.				
1	1615	66	0.	2	2330	191	0.	4	0645	316	0.	5	1400	441	0.				
1	1630	67	0.	2	2345	192	0.	4	0700	317	0.	5	1415	442	0.				
1	1645	68	0.	3	0000	193	0.	4	0715	318	0.	5	1430	443	0.				
1	1700	69	0.	3	0015	194	0.	4	0730	319	0.	5	1445	444	0.				
1	1715	70	0.	3	0030	195	0.	4	0745	320	0.	5	1500	445	0.				
1	1730	71	0.	3	0045	196	0.	4	0800	321	0.	5	1515	446	0.				
1	1745	72	0.	3	0100	197	0.	4	0815	322	0.	5	1530	447	0.				
1	1800	73	0.	3	0115	198	0.	4	0830	323	0.	5	1545	448	0.				
1	1815	74	0.	3	0130	199	0.	4	0845	324	0.	5	1600	449	0.				
1	1830	75	0.	3	0145	200	0.	4	0900	325	0.	5	1615	450	0.				
1	1845	76	0.	3	0200	201	0.	4	0915	326	0.	5	1630	451	0.				
1	1900	77	0.	3	0215	202	0.	4	0930	327	0.	5	1645	452	0.				
1	1915	78	0.	3	0230	203	0.	4	0945	328	0.	5	1700	453	0.				
1	1930	79	0.	3	0245	204	0.	4	1000	329	0.	5	1715	454	0.				
1	1945	80	0.	3	0300	205	0.	4	1015	330	0.	5	1730	455	0.				
1	2000	81	0.	3	0315	206	0.	4	1030	331	0.	5	1745	456	0.				
1	2015	82	0.	3	0330	207	0.	4	1045	332	0.	5	1800	457	0.				

PMF.OUT																		
1	2030	83	0.	*	3	0345	208	0.	*	4	1100	333	0.	*	5	1815	458	0.
1	2045	84	0.	*	3	0400	209	0.	*	4	1115	334	0.	*	5	1830	459	0.
1	2100	85	0.	*	3	0415	210	0.	*	4	1130	335	0.	*	5	1845	460	0.
1	2115	86	0.	*	3	0430	211	0.	*	4	1145	336	0.	*	5	1900	461	0.
1	2130	87	0.	*	3	0445	212	0.	*	4	1200	337	0.	*	5	1915	462	0.
1	2145	88	0.	*	3	0500	213	0.	*	4	1215	338	0.	*	5	1930	463	0.
1	2200	89	0.	*	3	0515	214	0.	*	4	1230	339	0.	*	5	1945	464	0.
1	2215	90	0.	*	3	0530	215	0.	*	4	1245	340	0.	*	5	2000	465	0.
1	2230	91	0.	*	3	0545	216	0.	*	4	1300	341	0.	*	5	2015	466	0.
1	2245	92	0.	*	3	0600	217	0.	*	4	1315	342	0.	*	5	2030	467	0.
1	2300	93	0.	*	3	0615	218	0.	*	4	1330	343	0.	*	5	2045	468	0.
1	2315	94	0.	*	3	0630	219	0.	*	4	1345	344	0.	*	5	2100	469	0.
1	2330	95	0.	*	3	0645	220	0.	*	4	1400	345	0.	*	5	2115	470	0.
1	2345	96	0.	*	3	0700	221	0.	*	4	1415	346	0.	*	5	2130	471	0.
2	0000	97	0.	*	3	0715	222	0.	*	4	1430	347	0.	*	5	2145	472	0.
2	0015	98	0.	*	3	0730	223	0.	*	4	1445	348	0.	*	5	2200	473	0.
2	0030	99	0.	*	3	0745	224	0.	*	4	1500	349	0.	*	5	2215	474	0.
2	0045	100	0.	*	3	0800	225	0.	*	4	1515	350	0.	*	5	2230	475	0.
2	0100	101	0.	*	3	0815	226	0.	*	4	1530	351	0.	*	5	2245	476	0.
2	0115	102	0.	*	3	0830	227	0.	*	4	1545	352	0.	*	5	2300	477	0.
2	0130	103	0.	*	3	0845	228	0.	*	4	1600	353	0.	*	5	2315	478	0.
2	0145	104	0.	*	3	0900	229	0.	*	4	1615	354	0.	*	5	2330	479	0.
2	0200	105	0.	*	3	0915	230	0.	*	4	1630	355	0.	*	5	2345	480	0.
2	0215	106	0.	*	3	0930	231	0.	*	4	1645	356	0.	*	6	0000	481	0.
2	0230	107	0.	*	3	0945	232	0.	*	4	1700	357	0.	*	6	0015	482	0.
2	0245	108	0.	*	3	1000	233	0.	*	4	1715	358	0.	*	6	0030	483	0.
2	0300	109	0.	*	3	1015	234	0.	*	4	1730	359	0.	*	6	0045	484	0.
2	0315	110	0.	*	3	1030	235	0.	*	4	1745	360	0.	*	6	0100	485	0.
2	0330	111	0.	*	3	1045	236	0.	*	4	1800	361	0.	*	6	0115	486	0.
2	0345	112	0.	*	3	1100	237	0.	*	4	1815	362	0.	*	6	0130	487	0.
2	0400	113	0.	*	3	1115	238	0.	*	4	1830	363	0.	*	6	0145	488	0.
2	0415	114	0.	*	3	1130	239	0.	*	4	1845	364	0.	*	6	0200	489	0.
2	0430	115	0.	*	3	1145	240	0.	*	4	1900	365	0.	*	6	0215	490	0.
2	0445	116	0.	*	3	1200	241	0.	*	4	1915	366	0.	*	6	0230	491	0.
2	0500	117	0.	*	3	1215	242	0.	*	4	1930	367	0.	*	6	0245	492	0.
2	0515	118	0.	*	3	1230	243	0.	*	4	1945	368	0.	*	6	0300	493	0.
2	0530	119	0.	*	3	1245	244	0.	*	4	2000	369	0.	*	6	0315	494	0.
2	0545	120	0.	*	3	1300	245	0.	*	4	2015	370	0.	*	6	0330	495	0.
2	0600	121	0.	*	3	1315	246	0.	*	4	2030	371	0.	*	6	0345	496	0.
2	0615	122	0.	*	3	1330	247	0.	*	4	2045	372	0.	*	6	0400	497	0.
2	0630	123	0.	*	3	1345	248	0.	*	4	2100	373	0.	*	6	0415	498	0.
2	0645	124	0.	*	3	1400	249	0.	*	4	2115	374	0.	*	6	0430	499	0.
2	0700	125	0.	*	3	1415	250	0.	*	4	2130	375	0.	*	6	0445	500	0.

PEAK FLOW TIME
 + (CFS) (HR)
 + 6744. 3.50
 (CFS) 1173. 293. 98. 56.
 (INCHES) 12.424 12.429 12.429 12.429
 (AC-FT) 582. 582. 582. 582.
 CUMULATIVE AREA = .88 SQ MI

 84 KK RDB1

87 KO OUTPUT CONTROL VARIABLES
 IPRNT 1 PRINT CONTROL
 IPILOT 0 PLOT CONTROL
 QSCAL 0. HYDROGRAPH PLOT SCALE

HYDROGRAPH ROUTING DATA

88 RS STORAGE ROUTING
 NSTPS 1 NUMBER OF SUBREACHES
 ITYP ELEV TYPE OF INITIAL CONDITION
 RSVRIC 3025.50 INITIAL CONDITION
 X .00 WORKING R AND D COEFFICIENT

89 SA	AREA	4.7	5.6	5.7	5.9	6.1	7.0	7.5	8.4	9.3	10.7
90 SE	ELEVATION	3025.50	3027.00	3028.00	3029.00	3030.00	3035.00	3037.00	3040.00	3043.00	3046.00
91 SQ	DISCHARGE	50.	61.	71.	75.	1436.	3921.	7136.			
92 SE	ELEVATION	3025.50	3030.00	3035.00	3037.00	3040.00	3043.00	3046.00			

COMPUTED STORAGE-ELEVATION DATA

STORAGE	.00	7.67	13.32	19.15	25.16	57.91	72.38	96.09	122.60	152.58
ELEVATION	3025.50	3027.00	3028.00	3029.00	3030.00	3035.00	3037.00	3040.00	3043.00	3046.00

COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

STORAGE	.00	7.67	13.32	19.15	25.16	57.91	72.38	96.09	122.60	152.58
OUTFLOW	49.70	53.33	55.76	58.18	60.60	70.80	74.50	1436.00	3920.50	7136.30
ELEVATION	3025.50	3027.00	3028.00	3029.00	3030.00	3035.00	3037.00	3040.00	3043.00	3046.00

*** WARNING *** MODIFIED PULS ROUTING MAY BE NUMERICALLY UNSTABLE FOR OUTFLOWS BETWEEN 3921. TO 7136.
 THE ROUTED HYDROGRAPH SHOULD BE EXAMINED FOR OSCILLATIONS OR OUTFLOWS GREATER THAN PEAK INFLOWS.
 THIS CAN BE CORRECTED BY DECREASING THE TIME INTERVAL OR INCREASING STORAGE (USE A LONGER REACH.)

HYDROGRAPH AT STATION RDB1
 PLAN 1, RATIO = 1.00

DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	*	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	*	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE
1	0000	1	50.	.0	3025.5	*	2	1745	168	50.	-.5	3025.5	*	4	1130	335	50.	-.5	3025.5			
1	0015	2	50.	-.5	3025.5	*	2	1800	169	50.	-.5	3025.5	*	4	1145	336	50.	-.5	3025.5			
1	0030	3	50.	-.5	3025.5	*	2	1815	170	50.	-.5	3025.5	*	4	1200	337	50.	-.5	3025.5			
1	0045	4	50.	-.5	3025.5	*	2	1830	171	50.	-.5	3025.5	*	4	1215	338	50.	-.5	3025.5			
1	0100	5	50.	-.5	3025.5	*	2	1845	172	50.	-.5	3025.5	*	4	1230	339	50.	-.5	3025.5			
1	0115	6	50.	-.5	3025.5	*	2	1900	173	50.	-.5	3025.5	*	4	1245	340	50.	-.5	3025.5			
1	0130	7	50.	-.5	3025.5	*	2	1915	174	50.	-.5	3025.5	*	4	1300	341	50.	-.5	3025.5			
1	0145	8	50.	-.5	3025.5	*	2	1930	175	50.	-.5	3025.5	*	4	1315	342	50.	-.5	3025.5			
1	0200	9	50.	-.5	3025.5	*	2	1945	176	50.	-.5	3025.5	*	4	1330	343	50.	-.5	3025.5			
1	0215	10	50.	1.0	3025.7	*	2	2000	177	50.	-.5	3025.5	*	4	1345	344	50.	-.5	3025.5			

1	0230	11	52.	5.5	3026.6	*	2	2015	178	50.	-5	3025.5	*	4	1400	345	50.	-5	3025.5
1	0245	12	56.	13.1	3028.0	*	2	2030	179	50.	-5	3025.5	*	4	1415	346	50.	-5	3025.5
1	0300	13	60.	23.2	3029.7	*	2	2045	180	50.	-5	3025.5	*	4	1430	347	50.	-5	3025.5
1	0315	17	43.	78.6	3037.8	*	2	2100	181	50.	-5	3025.5	*	4	1445	348	50.	-5	3025.5
1	0330	15	5702.	139.2	3044.7	*	2	2115	182	50.	-5	3025.5	*	4	1500	349	50.	-5	3025.5
1	0345	16	5989.	141.9	3044.9	*	2	2130	183	50.	-5	3025.5	*	4	1515	350	50.	-5	3025.5
1	0400	17	4129.	124.5	3043.2	*	2	2145	184	50.	-5	3025.5	*	4	1530	351	50.	-5	3025.5
1	0415	18	2585.	108.4	3041.4	*	2	2200	185	50.	-5	3025.5	*	4	1545	352	50.	-5	3025.5
1	0430	19	1544.	97.2	3040.1	*	2	2215	186	50.	-5	3025.5	*	4	1600	353	50.	-5	3025.5
1	0445	20	1071.	89.7	3039.2	*	2	2230	187	50.	-5	3025.5	*	4	1615	354	50.	-5	3025.5
1	0500	21	773.	84.5	3038.5	*	2	2245	188	50.	-5	3025.5	*	4	1630	355	50.	-5	3025.5
1	0515	22	584.	81.2	3038.1	*	2	2300	189	50.	-5	3025.5	*	4	1645	356	50.	-5	3025.5
1	0530	23	438.	78.7	3037.8	*	2	2315	190	50.	-5	3025.5	*	4	1700	357	50.	-5	3025.5
1	0545	24	333.	76.9	3037.6	*	2	2330	191	50.	-5	3025.5	*	4	1715	358	50.	-5	3025.5
1	0600	25	273.	75.8	3037.4	*	2	2350	192	50.	-5	3025.5	*	4	1730	359	50.	-5	3025.5
1	0615	26	219.	74.9	3037.3	*	3	0000	193	50.	-5	3025.5	*	4	1745	360	50.	-5	3025.5
1	0630	27	146.	73.6	3037.2	*	3	0015	194	50.	-5	3025.5	*	4	1800	361	50.	-5	3025.5
1	0645	28	81.	72.5	3037.0	*	3	0030	195	50.	-5	3025.5	*	4	1815	362	50.	-5	3025.5
1	0700	29	74.	71.4	3036.9	*	3	0045	196	50.	-5	3025.5	*	4	1830	363	50.	-5	3025.5
1	0715	30	74.	70.1	3036.7	*	3	0100	197	50.	-5	3025.5	*	4	1845	364	50.	-5	3025.5
1	0730	31	74.	68.7	3036.5	*	3	0115	198	50.	-5	3025.5	*	4	1900	365	50.	-5	3025.5
1	0745	32	73.	67.2	3036.3	*	3	0130	199	50.	-5	3025.5	*	4	1915	366	50.	-5	3025.5
1	0800	33	73.	65.7	3036.1	*	3	0145	200	50.	-5	3025.5	*	4	1930	367	50.	-5	3025.5
1	0815	34	72.	64.2	3035.9	*	3	0200	201	50.	-5	3025.5	*	4	1945	368	50.	-5	3025.5
1	0830	35	72.	62.7	3035.7	*	3	0215	202	50.	-5	3025.5	*	4	2000	369	50.	-5	3025.5
1	0845	36	72.	61.2	3035.5	*	3	0230	203	50.	-5	3025.5	*	4	2015	370	50.	-5	3025.5
1	0900	37	71.	59.8	3035.3	*	3	0245	204	50.	-5	3025.5	*	4	2030	371	50.	-5	3025.5
1	0915	38	71.	58.3	3035.1	*	3	0300	205	50.	-5	3025.5	*	4	2045	372	50.	-5	3025.5
1	0930	39	70.	56.8	3034.8	*	3	0315	206	50.	-5	3025.5	*	4	2100	373	50.	-5	3025.5
1	0945	40	70.	55.4	3034.6	*	3	0330	207	50.	-5	3025.5	*	4	2115	374	50.	-5	3025.5
1	1000	41	70.	53.9	3034.4	*	3	0345	208	50.	-5	3025.5	*	4	2130	375	50.	-5	3025.5
1	1015	42	69.	52.5	3034.2	*	3	0400	209	50.	-5	3025.5	*	4	2145	376	50.	-5	3025.5
1	1030	43	69.	51.1	3034.0	*	3	0415	210	50.	-5	3025.5	*	4	2200	377	50.	-5	3025.5
1	1045	44	68.	49.7	3033.7	*	3	0430	211	50.	-5	3025.5	*	4	2215	378	50.	-5	3025.5
1	1100	45	68.	48.3	3033.5	*	3	0445	212	50.	-5	3025.5	*	4	2230	379	50.	-5	3025.5
1	1115	46	67.	46.9	3033.3	*	3	0500	213	50.	-5	3025.5	*	4	2245	380	50.	-5	3025.5
1	1130	47	67.	45.5	3033.1	*	3	0515	214	50.	-5	3025.5	*	4	2300	381	50.	-5	3025.5
1	1145	48	67.	44.1	3032.9	*	3	0530	215	50.	-5	3025.5	*	4	2315	382	50.	-5	3025.5
1	1200	49	66.	42.7	3032.7	*	3	0545	216	50.	-5	3025.5	*	4	2330	383	50.	-5	3025.5
1	1215	50	66.	41.4	3032.5	*	3	0600	217	50.	-5	3025.5	*	4	2345	384	50.	-5	3025.5
1	1230	51	65.	40.0	3032.3	*	3	0615	218	50.	-5	3025.5	*	5	0000	385	50.	-5	3025.5
1	1245	52	65.	38.7	3032.1	*	3	0630	219	50.	-5	3025.5	*	5	0015	386	50.	-5	3025.5
1	1300	53	64.	37.3	3031.9	*	3	0645	220	50.	-5	3025.5	*	5	0030	387	50.	-5	3025.5
1	1315	54	64.	36.0	3031.7	*	3	0700	221	50.	-5	3025.5	*	5	0045	388	50.	-5	3025.5
1	1330	55	64.	34.7	3031.5	*	3	0715	222	50.	-5	3025.5	*	5	0100	389	50.	-5	3025.5
1	1345	56	63.	33.4	3031.3	*	3	0730	223	50.	-5	3025.5	*	5	0115	390	50.	-5	3025.5
1	1400	57	63.	32.1	3031.1	*	3	0745	224	50.	-5	3025.5	*	5	0130	391	50.	-5	3025.5
1	1415	58	62.	30.8	3030.9	*	3	0800	225	50.	-5	3025.5	*	5	0145	392	50.	-5	3025.5
1	1430	59	62.	29.5	3030.7	*	3	0815	226	50.	-5	3025.5	*	5	0200	393	50.	-5	3025.5
1	1445	60	62.	28.2	3030.5	*	3	0830	227	50.	-5	3025.5	*	5	0215	394	50.	-5	3025.5
1	1500	61	61.	27.0	3030.3	*	3	0845	228	50.	-5	3025.5	*	5	0230	395	50.	-5	3025.5
1	1515	62	61.	25.7	3030.1	*	3	0900	229	50.	-5	3025.5	*	5	0245	396	50.	-5	3025.5
1	1530	63	60.	24.5	3029.9	*	3	0915	230	50.	-5	3025.5	*	5	0300	397	50.	-5	3025.5
1	1545	64	60.	23.2	3029.7	*	3	0930	231	50.	-5	3025.5	*	5	0315	398	50.	-5	3025.5
1	1600	65	59.	22.0	3029.5	*	3	0945	232	50.	-5	3025.5	*	5	0330	399	50.	-5	3025.5
1	1615	66	59.	20.8	3029.3	*	3	1000	233	50.	-5	3025.5	*	5	0345	400	50.	-5	3025.5
1	1630	67	58.	19.6	3029.1	*	3	1015	234	50.	-5	3025.5	*	5	0400	401	50.	-5	3025.5
1	1645	68	58.	18.4	3028.9	*	3	1030	235	50.	-5	3025.5	*	5	0415	402	50.	-5	3025.5
1	1700	69	57.	17.2	3028.7	*	3	1045	236	50.	-5	3025.5	*	5	0430	403	50.	-5	3025.5
1	1715	70	57.	16.0	3028.5	*	3	1100	237	50.	-5	3025.5	*	5	0445	404	50.	-5	3025.5
1	1730	71	56.	14.8	3028.3	*	3	1115	238	50.	-5	3025.5	*	5	0500	405	50.	-5	3025.5
1	1745	72	56.	13.7	3028.1	*	3	1130	239	50.	-5	3025.5	*	5	0515	406	50.	-5	3025.5
1	1800	73	55.	12.5	3027.9	*	3	1145	240	50.	-5	3025.5	*	5	0530	407	50.	-5	3025.5
1	1815	74	55.	11.4	3027.7	*	3	1200	241	50.	-5	3025.5	*	5	0545	408	50.	-5	3025.5
1	1830	75	54.	10.2	3027.5	*	3	1215	242	50.	-5	3025.5	*	5	0600	409	50.	-5	3025.5
1	1845	76	54.	9.1	3027.3	*	3	1230	243	50.	-5	3025.5	*	5	0615	410	50.	-5	3025.5
1	1900	77	53.	8.0	3027.1	*	3	1245	244	50.	-5	3025.5	*	5	0630	411	50.	-5	3025.5
1	1915	78	53.	6.9	3026.9	*	3	1300	245	50.	-5	3025.5	*	5	0645	412	50.	-5	3025.5
1	1930	79	52.	5.8	3026.6	*	3	1315	246	50.	-5	3025.5	*	5	0700	413	50.	-5	3025.5
1	1945	80	52.	4.7	3026.4	*	3	1330	247	50.	-5	3025.5	*	5	0715	414	50.	-5	3025.5
1	2000	81	51.	3.7	3026.2	*	3	1345	248	50.	-5	3025.5	*	5	0730	415	50.	-5	3025.5
1	2015	82	51.	2.6	3026.0	*	3	1400	249	50.	-5	3025.5	*	5	0745	416	50.	-5	3025.5
1	2030	83	50.	1.6	3025.8	*	3	1415	250	50.	-5	3025.5	*	5	0800	417	50.	-5	3025.5
1	2045	84	50.	.5	3025.6	*	3	1430	251	50.	-5	3025.5	*	5	0815	418	50.	-5	3025.5
1	2100	85	50.	-5	3025.5	*	3	1445	252	50.	-5	3025.5	*	5	0830	419	50.	-5	3025.5
1	2115	86	50.	-5	3025.5	*	3	1500	253	50.	-5	3025.5	*	5	0845	420	50.	-5	3025.5
1	2130	87	50.	-5	3025.5	*	3	1515	254	50.	-5	3025.5	*	5	0900	421	50.	-5	3025.5
1	2145	88	50.	-5	3025.5	*	3	1530	255	50.	-5	3025.5	*	5	0915	422	50.	-5	3025.5
1	2200	89	50.	-5	3025.5	*	3	1545	256	50.	-5	3025.5	*	5	0930	423	50.	-5	3025.5
1	2215	90	50.	-5															

2	1045	140	50.	-.5	3025.5	*	4	0430	307	50.	-.5	3025.5	*	5	2215	474	50.	-.5	3025.5	*	5
2	1100	141	50.	-.5	3025.5	*	4	0445	308	50.	-.5	3025.5	*	5	2230	475	50.	-.5	3025.5	*	5
2	1115	142	50.	-.5	3025.5	*	4	0500	309	50.	-.5	3025.5	*	5	2245	476	50.	-.5	3025.5	*	5
2	1130	143	50.	-.5	3025.5	*	4	0515	310	50.	-.5	3025.5	*	5	2300	477	50.	-.5	3025.5	*	5
2	1145	144	50.	-.5	3025.5	*	4	0530	311	50.	-.5	3025.5	*	5	2315	478	50.	-.5	3025.5	*	5
2	1200	145	50.	-.5	3025.5	*	4	0545	312	50.	-.5	3025.5	*	5	2330	479	50.	-.5	3025.5	*	5
2	1215	146	50.	-.5	3025.5	*	4	0600	313	50.	-.5	3025.5	*	5	2345	480	50.	-.5	3025.5	*	5
2	1230	147	50.	-.5	3025.5	*	4	0615	314	50.	-.5	3025.5	*	6	0000	481	50.	-.5	3025.5	*	6
2	1245	148	50.	-.5	3025.5	*	4	0630	315	50.	-.5	3025.5	*	6	0015	482	50.	-.5	3025.5	*	6
2	1300	149	50.	-.5	3025.5	*	4	0645	316	50.	-.5	3025.5	*	6	0030	483	50.	-.5	3025.5	*	6
2	1315	150	50.	-.5	3025.5	*	4	0700	317	50.	-.5	3025.5	*	6	0045	484	50.	-.5	3025.5	*	6
2	1330	151	50.	-.5	3025.5	*	4	0715	318	50.	-.5	3025.5	*	6	0100	485	50.	-.5	3025.5	*	6
2	1345	152	50.	-.5	3025.5	*	4	0730	319	50.	-.5	3025.5	*	6	0115	486	50.	-.5	3025.5	*	6
2	1400	153	50.	-.5	3025.5	*	4	0745	320	50.	-.5	3025.5	*	6	0130	487	50.	-.5	3025.5	*	6
2	1415	154	50.	-.5	3025.5	*	4	0800	321	50.	-.5	3025.5	*	6	0145	488	50.	-.5	3025.5	*	6
2	1430	155	50.	-.5	3025.5	*	4	0815	322	50.	-.5	3025.5	*	6	0200	489	50.	-.5	3025.5	*	6
2	1445	156	50.	-.5	3025.5	*	4	0830	323	50.	-.5	3025.5	*	6	0215	490	50.	-.5	3025.5	*	6
2	1500	157	50.	-.5	3025.5	*	4	0845	324	50.	-.5	3025.5	*	6	0230	491	50.	-.5	3025.5	*	6
2	1515	158	50.	-.5	3025.5	*	4	0900	325	50.	-.5	3025.5	*	6	0245	492	50.	-.5	3025.5	*	6
2	1530	159	50.	-.5	3025.5	*	4	0915	326	50.	-.5	3025.5	*	6	0300	493	50.	-.5	3025.5	*	6
2	1545	160	50.	-.5	3025.5	*	4	0930	327	50.	-.5	3025.5	*	6	0315	494	50.	-.5	3025.5	*	6
2	1600	161	50.	-.5	3025.5	*	4	0945	328	50.	-.5	3025.5	*	6	0330	495	50.	-.5	3025.5	*	6
2	1615	162	50.	-.5	3025.5	*	4	1000	329	50.	-.5	3025.5	*	6	0345	496	50.	-.5	3025.5	*	6
2	1630	163	50.	-.5	3025.5	*	4	1015	330	50.	-.5	3025.5	*	6	0400	497	50.	-.5	3025.5	*	6
2	1645	164	50.	-.5	3025.5	*	4	1030	331	50.	-.5	3025.5	*	6	0415	498	50.	-.5	3025.5	*	6
2	1700	165	50.	-.5	3025.5	*	4	1045	332	50.	-.5	3025.5	*	6	0430	499	50.	-.5	3025.5	*	6
2	1715	166	50.	-.5	3025.5	*	4	1100	333	50.	-.5	3025.5	*	6	0445	500	50.	-.5	3025.5	*	6
2	1730	167	50.	-.5	3025.5	*	4	1115	334	50.	-.5	3025.5	*	6							

PEAK FLOW	TIME		6-HR	MAXIMUM AVERAGE FLOW	
+	(CFS)	(HR)		24-HR	72-HR
+	5989.	3.75		124.75-HR	
		(CFS)	1039.	303.	134.
		(INCHES)	11.010	12.830	17.041
		(AC-FT)	515.	601.	798.
					98.
					21.669
					1014.
PEAK STORAGE	TIME		6-HR	MAXIMUM AVERAGE STORAGE	
+	(AC-FT)	(HR)		24-HR	72-HR
+	142.	3.75		124.75-HR	
			82.	35.	12.
					6.
PEAK STAGE	TIME		6-HR	MAXIMUM AVERAGE STAGE	
+	(FEET)	(HR)		24-HR	72-HR
+	3044.93	3.75		124.75-HR	
			3038.15	3031.10	3027.37
					3026.58
			CUMULATIVE AREA =	.88 SQ MI	

1

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
TIME TO PEAK IN HOURS

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO PRECIPITATION
				RATIO 1.00
HYDROGRAPH AT	OFF1	.41	1	FLOW
+				TIME 3322.
				3.50
HYDROGRAPH AT	OFF7	.03	1	FLOW
+				TIME 398.
				3.25
2 COMBINED AT	CP2	.44	1	FLOW
+				TIME 3535.
				3.50
HYDROGRAPH AT	OFF2	.04	1	FLOW
+				TIME 425.
				3.25
HYDROGRAPH AT	OFF3	.03	1	FLOW
+				TIME 344.
				3.25
3 COMBINED AT	CP1	.50	1	FLOW
+				TIME 3997.
				3.50
HYDROGRAPH AT	OFF4	.06	1	FLOW
+				TIME 739.
				3.25
HYDROGRAPH AT	OFF5	.26	1	FLOW
+				TIME 1824.
				3.50
HYDROGRAPH AT	OFF6	.04	1	FLOW
+				TIME 530.
				3.25
HYDROGRAPH AT	ON1	.03	1	FLOW
+				TIME 364.
				3.25
5 COMBINED AT	DB1	.88	1	FLOW
+				TIME 6744.
				3.50
ROUTED TO	RDB1	.88	1	FLOW
+				TIME 5989.
				3.75
			** PEAK STAGES IN FEET **	
			1	STAGE
				3044.93
				3.75

*** NORMAL END OF HEC-1 ***

Stage-Discharge Calculations

DB1 - Stage-Discharge Summary

Stage (elevation)	24" Orifice Outlet Pipe Flow (cfs)	Spillway Flow (cfs)	Total Flow (cfs)
3013.8	0.00	0.00	0
3014	0.00	0.00	0
3015	0.00	0.00	0
3016	0.00	0.00	0
3017	13.71	0.00	13.7
3018	21.36	0.00	21.4
3019	26.92	0.00	26.9
3020	31.51	0.00	31.5
3021	35.51	0.00	35.5
3022	39.11	0.00	39.1
3023	42.40	0.00	42.4
3024	45.45	0.00	45.5
3025	48.32	0.00	48.3
3026	51.02	0.00	51.0
3027	53.58	0.00	53.6
3028	56.03	0.00	56.0
3029	58.38	0.00	58.4
3030	60.63	0.00	60.6
3031	62.80	0.00	62.8
3032	64.91	0.00	64.9
3033	66.94	0.00	66.9
3034	68.92	0.00	68.9
3035	70.84	0.00	70.8
3036	72.70	0.00	72.7
3037	74.53	0.00	74.5
3038	76.31	261.00	337.3
3039	78.04	738.22	816.3
3040	79.75	1356.20	1436.0
3041	81.41	2088.00	2169.4
3042	83.04	2918.07	3001.1
3043	84.64	3835.90	3920.5
3044	86.21	4833.79	4920.0
3045	87.75	5905.76	5993.5
3046	89.27	7047.00	7136.3

24-inch Orifice Discharge Curve Rating Table for Circular Orifice

Project Description	
Worksheet	Outfall
Type	Circular Orifice
Solve For	Discharge

Input Data	
Centroid Elevation	3,014.80 ft
Tailwater Elevation	3,016.30 ft
Discharge Coefficient	0.65
Diameter	24.0 in

→ CONSIDERS 2.5' DEPTH IN 60" RCP OUTLET

Attribute	Minimum	Maximum	Increment
Headwater Elevation (ft)	3,014.00	3,046.00	1.00

Headwater Elevation (ft)	Discharge (cfs)	Velocity (ft/s)
3,014.00	N/A	N/A
3,015.00	N/A	N/A
3,016.00	N/A	N/A
3,017.00	13.71	4.36
3,018.00	21.36	6.80
3,019.00	26.92	8.57
3,020.00	31.51	10.03
3,021.00	35.51	11.30
3,022.00	39.11	12.45
3,023.00	42.40	13.50
3,024.00	45.45	14.47
3,025.00	48.32	15.38
3,026.00	51.02	16.24
3,027.00	53.58	17.06
3,028.00	56.03	17.84
3,029.00	58.38	18.58
3,030.00	60.63	19.30
3,031.00	62.80	19.99
3,032.00	64.91	20.66
3,033.00	66.94	21.31
3,034.00	68.92	21.94
3,035.00	70.84	22.55
3,036.00	72.70	23.14
3,037.00	74.53	23.72
3,038.00	76.31	24.29
3,039.00	78.04	24.84
3,040.00	79.75	25.38
3,041.00	81.41	25.91
3,042.00	83.04	26.43
3,043.00	84.64	26.94
3,044.00	86.21	27.44
3,045.00	87.75	27.93
3,046.00	89.27	28.42

60-inch RCP "Free-Flow" Outflow Pipe Worksheet for Circular Channel

Project Description	
Worksheet	Outflow Pipe
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data	
Mannings Coefficient	0.013
Channel Slope	0.30 %
Diameter	60.0 in
Discharge	71.00 cfs

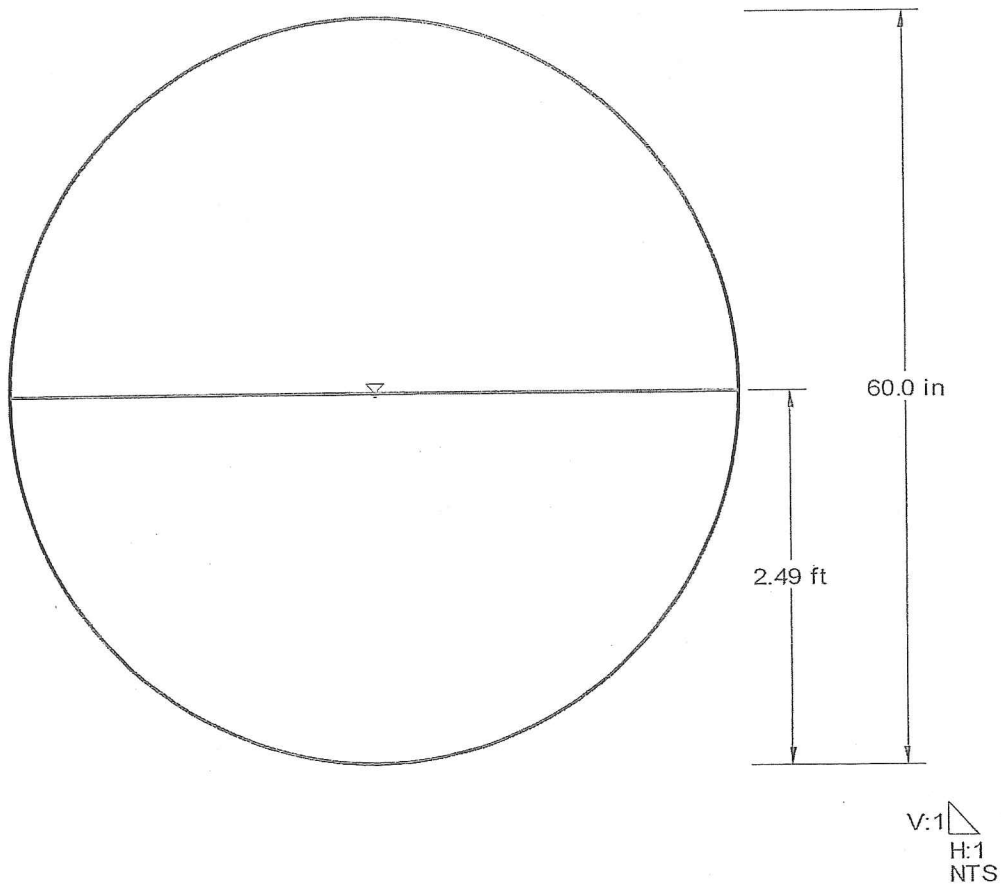
Results	
Depth	2.49 ft
Flow Area	9.8 ft ²
Wetted Perimeter	7.84 ft
Top Width	0.00 ft
Critical Depth	2.38 ft
Percent Full	49.9 %
Critical Slope	0.35 %
Velocity	7.26 ft/s
Velocity Head	0.82 ft
Specific Energy	3.31 ft
Froude Number	0.91
Maximum Discharge	153.44 cfs
Discharge Full	142.64 cfs
Slope Full	0.07 %
Flow Type	Subcritical

→ > 3 FT/S; MEETS MIN. CLEANOUT VELOCITY REQUIREMENTS

60-inch RCP "Free-Flow" Outflow Pipe
Cross Section for Circular Channel

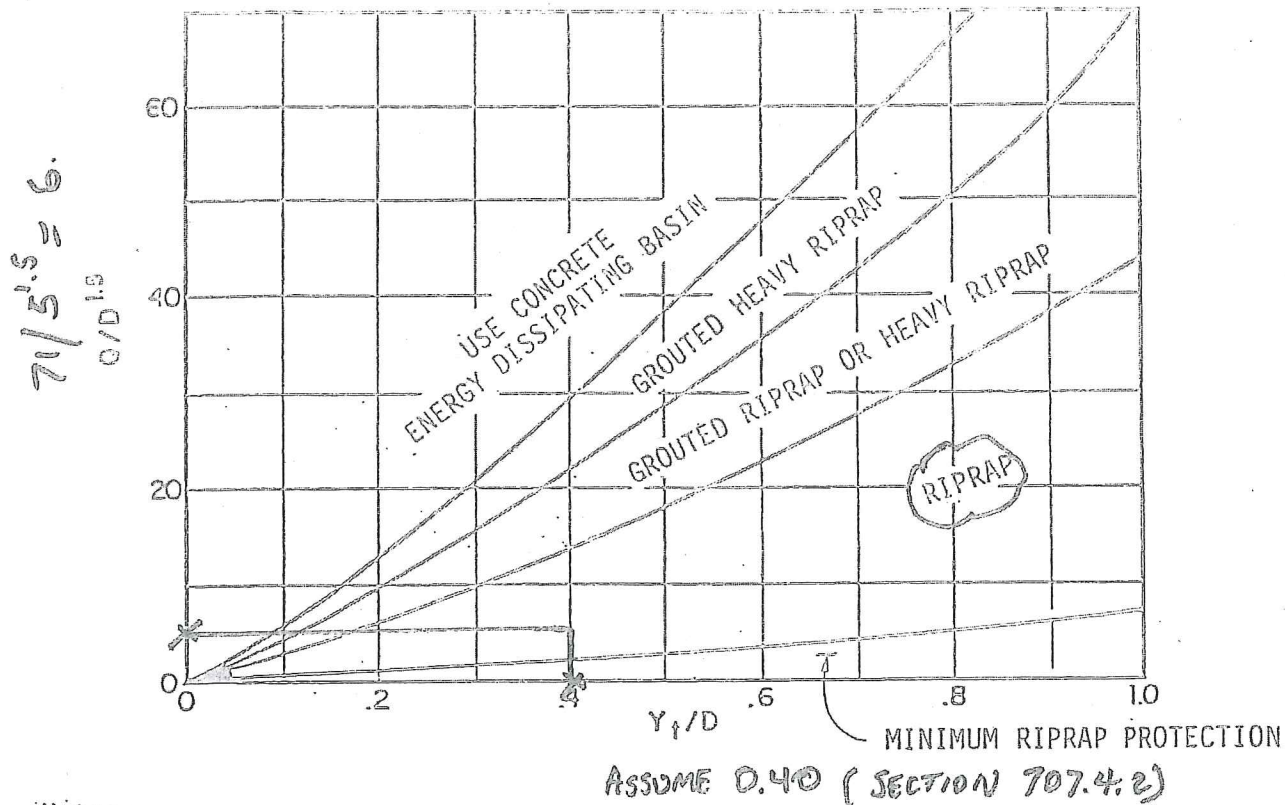
Project Description	
Worksheet	Outflow Pipe
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data	
Mannings Coefficient	0.013
Channel Slope	0.30 %
Depth	2.49 ft
Diameter	60.0 in
Discharge	71.00 cfs



RIPRAP EROSION PROTECTION AT CIRCULAR CONDUIT OUTLET

60" RCP OUTLET PIPE



Notes:

1. Use H_a instead of H whenever culvert has supercritical flow in the barrel.
2. Minimum Riprap Protection: Use Riprap for a distance of $3H$ downstream for 18" to 36" equivalent round pipe size and $4D$ downstream for 42" and larger equivalent round pipe size.

* CONCRETE PROPOSED *

Revision	Date

PMF Overflow Spillway Discharge Curve

Rating Table for Generic Weir

Project Description	
Worksheet	PMF Spillway - Weir
Type	Generic Weir
Solve For	Discharge

Input Data	
Crest Elevation	3,037.00 ft
Discharge Coefficient	3.00 US
Crest Length	87.00 ft

Attribute	Minimum	Maximum	Increment
Headwater Elevation (ft)	3,037.00	3,046.00	1.00

Headwater Elevation (ft)	Discharge (cfs)	Velocity (ft/s)
3,037.00	N/A	N/A
3,038.00	261.00	3.00
3,039.00	738.22	4.24
3,040.00	1,356.20	5.20
3,041.00	2,088.00	6.00
3,042.00	2,918.07	6.71
3,043.00	3,835.90	7.35
3,044.00	4,833.79	7.94
3,045.00	5,905.76	8.49
3,046.00	7,047.00	9.00

Debris Tower Orifice Calculator

Rating Table for Circular Orifice

Project Description	
Worksheet	Debris Tower
Type	Circular Orifice
Solve For	Discharge

Input Data	
Centroid Elevation	3,023.12 ft
Tailwater Elevation	3,023.00 ft
Discharge Coefficient	0.65
Diameter	3.0 in

Attribute	Minimum	Maximum	Increment
Headwater Elevation (ft)	3,023.00	3,025.50	0.50

Headwater Elevation (ft)	Discharge (cfs)	Velocity (ft/s)
3,023.00	N/A	N/A
3,023.50	0.16	3.21
3,024.00	0.24	4.89
3,024.50	0.30	6.13
3,025.00	0.35	7.15
3,025.50	0.39	8.04

MULTIPLY Q BY 4 PERFORATIONS @ EACH STAGE (6").

Elevation vs. Discharge Calculation

Project: Skye Canyon Detention Basin No. 1
Date: 8/26/2014

(1) Elevation (Feet)	Row 1 4- 3" Dia. (cfs)	Row 2 4- 3" Dia. (cfs)	Row 3 4- 3" Dia. (cfs)	Row 4 4- 3" Dia. (cfs)	Row 5 Beehive Grate (cfs)	Q Total (cfs)
3023.0	0.00	0.00	0.00	0.00	0.00	0.00
3023.5	0.64	0.00	0.00	0.00	0.00	0.64
3024.0	0.96	0.64	0.00	0.00	0.00	1.60
3024.5	1.20	0.96	0.64	0.00	0.00	2.80
3025.0	1.40	1.20	0.96	0.64	0.00	4.20
3025.5	1.56	1.40	1.20	0.96	4.10	9.22

Dewatering Time Calculation

Project: Skye Canyon Detention Basin No. 1

Date: 8/26/2014

(1) Elevation (Feet)	Storage Volume (Cu. Ft.)	Difference in Storage Volumes	(4) Discharge (cfs)	Average Discharge (cfs)	(6) Time (Hrs.)	(7) Accumulated Time (Hrs.)
3025.5	162159	0	9.22	0.00	0.00	0.00
3025.0	120608	41551	4.20	4.20	2.75	2.75
3024.5	76670	43938	2.80	3.50	3.49	6.24
3024.0	32731	43939	1.60	2.20	5.55	11.78
3023.5	16366	16365	0.64	1.12	4.06	15.84
3023.0	0	16366	0.00	0.32	14.21	30.05

Debris storage area drains in 30 hours which is less than maximum allowed 7 days.

Debris Tower Acceptable.

Collector Channel Analysis

Summary of Collector Channel Hydraulic Characteristics

Station	Q₁₀₀ (cfs)	Flow Depth (ft)	Flow Velocity (ft/s)	Hydraulic Freeboard (ft)¹	Sedimentation Freeboard (ft)	Required Channel Depth (ft)	Proposed Channel Depth (ft)
2494.58	471	0.69	27.51	1.61	1.0	3.30	4.5
2460.28	471	1.51	12.44	1.36	1.0	3.87	4.0
2450.28	471	1.20	13.68	1.36	1.0	3.56	4.0
2437.78	471	2.18	11.66	1.38	1.0	4.56	5.0
2041.13	471	1.14	26.69	1.70	1.0	3.84	5.0
1874.19	471	2.43	10.03	1.34	1.0	4.77	5.0
1102.17	471	2.85	8.05	1.29	0.9	5.00	5.0

1 – Hydraulic Freeboard obtained from CCRFCD Manual Equation 747.

chn7.wsp

[illegible]

DATE: 12/18/2014
TIME: 18: 6

CHNL.OUT

WATER SURFACE PROFILE - CHANNEL DEFINITION LISTING.

PAGE 1

CARD NO	SECT NO	CHN TYPE	NO OF PIERS	AVE WIDTH	PIER WIDTH	HEIGHT 1 DIAMETER	BASE WIDTH	ZL	ZR	INV DROP	Y(1)	Y(2)	Y(3)	Y(4)	Y(5)	Y(6)	Y(7)	Y(8)	Y(9)	Y(10)
CD 1	1	1	0	0.00	0.00	5.00	12.00	3.00	3.00	0.00										
CD 2	2	0	0	0.00	0.00	5.00	25.00			0.00										
CD 3	1	0	0	0.00	0.00	5.00	25.00	3.00	3.00	0.00										

F 0 5 1 5 P

PAGE NO 3

WATER SURFACE PROFILE - TITLE CARD LISTING

HEADING LINE NO 1 IS -

SKYE CANYON DETENTION BASIN, OLY1401.004

HEADING LINE NO 2 IS -

TECHNICAL DRAINAGE STUDY - ADDENDUM #1

HEADING LINE NO 3 IS -

COLLECTOR CHANNEL

F 0 5 1 5 P

PAGE NO 2

WATER SURFACE PROFILE - ELEMENT CARD LISTING

ELEMENT NO	1 IS A SYSTEM OUTLET U/S DATA	STATION	INVERT	SECT	2	W S ELEV
		-2494.58	3025.90			3030.30
ELEMENT NO	2 IS A REACH U/S DATA	STATION	INVERT	SECT	2	RADIUS
		-2460.28	3036.90			0.00
ELEMENT NO	3 IS A TRANSITION U/S DATA	STATION	INVERT	SECT	3	ANG PT
		-2450.28	3036.95			0.00
ELEMENT NO	4 IS A TRANSITION U/S DATA	STATION	INVERT	SECT	1	MAN H
		-2437.78	3037.01			0
ELEMENT NO	5 IS A REACH U/S DATA	STATION	INVERT	SECT	1	RADIUS
		-2041.13	3039.00			0.00
ELEMENT NO	6 IS A REACH U/S DATA	STATION	INVERT	SECT	1	ANG PT
		-1874.19	3055.69			0.00
ELEMENT NO	7 IS A REACH U/S DATA	STATION	INVERT	SECT		MAN H
						0

Page 1

CHNL.OUT 0.015

-1102.17 3059.55 1.

0.00 0.00 0.00 0

ELEMENT NO 8 IS A SYSTEM HEADWORKS
U/S DATA STATION INVERT SECT
-1102.17 3059.55 1
NO EDIT ERRORS ENCOUNTERED-COMPUTATION IS NOW BEGINNING
** WARNING NO. 2 ** - WATER SURFACE ELEVATION GIVEN IS LESS THAN OR EQUALS INVERT ELEVATION IN HDWKDS, W.S.ELEV = INV + DC
LICENSEE: SLATER HANIFAN GROUP F0511SP
W S ELEV 0.00
PAGE 1

WATER SURFACE PROFILE LISTING
SKYE CANYON DETENTION BASIN, OLY1401.004
TECHNICAL DRAINAGE STUDY - ADDENDUM #1
COLLECTOR CHANNEL

STATION	INVERT ELEV	DEPTH OF FLOW	W.S. ELEV	Q	VEL	VEL HEAD	ENERGY GRD.EL.	SUPER ELEV	CRITICAL DEPTH	HGT/ DIA	BASE/ ID NO.	ZL	NO PIER	AVBPR
L/ELEM	SO					SF AVE	HF							
-2494.58	3025.90	0.685	3026.585	471.0	27.51	11.748	3038.333	0.00	2.226	5.00	25.00	0.00	0	0.00
3.59	0.32070					.130522	0.47					0.00		
-2490.99	3027.05	0.706	3027.756	471.0	26.67	11.045	3038.801	0.00	2.226	5.00	25.00	0.00	0	0.00
4.71	0.32070					.115055	0.54					0.00		
-2486.28	3028.56	0.741	3029.303	471.0	25.43	10.041	3039.344	0.00	2.226	5.00	25.00	0.00	0	0.00
3.95	0.32070					.098504	0.39					0.00		
-2482.33	3029.83	0.777	3030.605	471.0	24.25	9.128	3039.733	0.00	2.226	5.00	25.00	0.00	0	0.00
3.35	0.32070					.084349	0.28					0.00		
-2478.98	3030.90	0.815	3031.717	471.0	23.12	8.299	3040.016	0.00	2.226	5.00	25.00	0.00	0	0.00
2.87	0.32070					.072240	0.21					0.00		
-2476.11	3031.82	0.855	3032.680	471.0	22.04	7.544	3040.224	0.00	2.226	5.00	25.00	0.00	0	0.00
2.49	0.32070					.061881	0.15					0.00		
-2473.62	3032.62	0.896	3033.519	471.0	21.02	6.859	3040.378	0.00	2.226	5.00	25.00	0.00	0	0.00
2.17	0.32070					.053017	0.12					0.00		
-2471.45	3033.32	0.940	3034.257	471.0	20.04	6.235	3040.492	0.00	2.226	5.00	25.00	0.00	0	0.00
1.89	0.32070					.045431	0.09					0.00		
-2469.56	3033.92	0.986	3034.910	471.0	19.11	5.668	3040.578	0.00	2.226	5.00	25.00	0.00	0	0.00
1.66	0.32070					.038939	0.06					0.00		
-2467.90	3034.46	1.034	3035.490	471.0	18.22	5.153	3040.643	0.00	2.226	5.00	25.00	0.00	0	0.00

1.45 0.32070 .033381 .05 0.528 0.00 0.00
 -2466.45 3034.92 1.085 3036.007 471.0 17.37 4.685 3040.692 0.00 2.226 5.00 25.00 0.00 0 0.00
 1.28 0.32070 .028623 0.04 0.528 0.00 0.00
 F0515P
 WATER SURFACE PROFILE LISTING
 SKYE CANYON DETENTION BASIN, OLY1401.004
 TECHNICAL DRAINAGE STUDY - ADDENDUM #1
 COLLECTOR CHANNEL

STATION	INVERT ELEV	DEPTH OF FLOW	W.S. ELEV	Q	VEL	VEL HEAD	ENERGY GRD.ELEV	SUPER ELEV	CRITICAL DEPTH	HGT/ DIA	BASE/ ID NO.	ZL	NO PIER	AVBPR
L/ELEM	SO					SF AVE	HF							
*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****
-2465.17	3035.33	1.138	3036.470	471.0	16.56	4.259	3040.729	0.00	2.226	5.00	25.00	0.00	0	0.00
1.12	0.32070					.024549	0.03					0.00		
-2464.05	3035.69	1.193	3036.884	471.0	15.79	3.871	3040.755	0.00	2.226	5.00	25.00	0.00	0	0.00
0.98	0.32070					.021059	0.02					0.00		
-2463.07	3036.01	1.251	3037.256	471.0	15.06	3.520	3040.776	0.00	2.226	5.00	25.00	0.00	0	0.00
0.86	0.32070					.018070	0.02					0.00		
-2462.21	3036.28	1.312	3037.592	471.0	14.35	3.200	3040.792	0.00	2.226	5.00	25.00	0.00	0	0.00
0.74	0.32070					.015509	0.01					0.00		
-2461.47	3036.52	1.377	3037.895	471.0	13.69	2.909	3040.804	0.00	2.226	5.00	25.00	0.00	0	0.00
0.64	0.32070					.013314	0.01					0.00		
-2460.83	3036.72	1.444	3038.168	471.0	13.05	2.644	3040.812	0.00	2.226	5.00	25.00	0.00	0	0.00
0.55	0.32070					.011434	0.01					0.00		
-2460.28	3036.90	1.514	3038.414	471.0	12.44	2.404	3040.818	0.00	2.226	5.00	25.00	0.00	0	0.00
TRANS STR	0.00500					.014158	0.14					0.00		
-2450.28	3036.95	1.203	3038.153	471.0	13.68	2.907	3041.060	0.00	2.042	5.00	25.00	3.00	0	0.00
TRANS STR	0.00480					.012682	0.16					3.00		
-2437.78	3037.01	2.179	3039.189	471.0	11.66	2.111	3041.300	0.00	2.849	5.00	12.00	3.00	0	0.00
17.10	0.00502					.007809	0.13					2.430		
-2420.68	3037.10	2.150	3039.246	471.0	11.87	2.188	3041.434	0.00	2.849	5.00	12.00	3.00	0	0.00
40.43	0.00502					.008578	0.35					2.430		

-2380.25 3037.30 2.076 3039.375 471.0 12.45 2.407 3041.782 0.00 2.849 5.00 12.00 3.00 0 0.00
35.06 0.00502
LICENSEE: SLATER HANIFAN GROUP

WATER SURFACE PROFILE LISTING
SKYE CANYON DETENTION BASIN, OLY1401.004
TECHNICAL DRAINAGE STUDY - ADDENDUM #1
COLLECTOR CHANNEL

STATION	INVERT ELEV	DEPTH OF FLOW	W.S. ELEV	Q	VEL	VEL HEAD	ENERGY GRD.EL.	SUPER ELEV	CRITICAL DEPTH	HGT/ DIA	BASE/ ID NO.	ZL	NO PIER	AVBPR
L/ELEM	SO					SF AVE	HF							
-2345.19	3037.47	2.003	3039.478	471.0	13.06	2.647	3042.125	0.00	2.849	5.00	12.00	3.00	0	0.00
31.31	0.00502					.011220	0.35					3.00		
-2313.88	3037.63	1.933	3039.565	471.0	13.69	2.912	3042.477	0.00	2.849	5.00	12.00	3.00	0	0.00
28.49	0.00502					.012837	0.37					3.00		
-2285.39	3037.78	1.864	3039.639	471.0	14.36	3.203	3042.842	0.00	2.849	5.00	12.00	3.00	0	0.00
26.25	0.00502					.014692	0.39					3.00		
-2259.14	3037.91	1.798	3039.704	471.0	15.06	3.524	3043.228	0.00	2.849	5.00	12.00	3.00	0	0.00
24.39	0.00502					.016820	0.41					3.00		
-2234.75	3038.03	1.733	3039.762	471.0	15.80	3.876	3043.638	0.00	2.849	5.00	12.00	3.00	0	0.00
22.83	0.00502					.019262	0.44					3.00		
-2211.92	3038.14	1.671	3039.814	471.0	16.57	4.263	3044.077	0.00	2.849	5.00	12.00	3.00	0	0.00
21.45	0.00502					.022066	0.47					3.00		
-2190.47	3038.25	1.610	3039.861	471.0	17.38	4.690	3044.551	0.00	2.849	5.00	12.00	3.00	0	0.00
20.25	0.00502					.025285	0.51					3.00		
-2170.22	3038.35	1.552	3039.904	471.0	18.23	5.159	3045.063	0.00	2.849	5.00	12.00	3.00	0	0.00
19.15	0.00502					.028983	0.56					3.00		
-2151.07	3038.45	1.495	3039.943	471.0	19.12	5.675	3045.618	0.00	2.849	5.00	12.00	3.00	0	0.00
18.16	0.00502					.033234	0.60					3.00		
-2132.91	3038.54	1.440	3039.980	471.0	20.05	6.242	3046.222	0.00	2.849	5.00	12.00	3.00	0	0.00
17.24	0.00502					.038121	0.66					3.00		
-2115.67	3038.63	1.386	3040.012	471.0	21.03	6.867	3046.879	0.00	2.849	5.00	12.00	3.00	0	0.00

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SKYE CANYON DETENTION BASIN, OLY1401.004
TECHNICAL DRAINAGE STUDY - ADDENDUM #1
COLLECTOR CHANNEL

STATION	INVERT ELEV	DEPTH OF FLOW	W.S. ELEV	Q	VEL	VEL HEAD	ENERGY GRD.EL.	SUPER ELEV	CRITICAL DEPTH	HGT/ DIA	BASE/ ID NO.	ZL	NO PIER	AVBPR
L/ELEM	SO					SF AVE	HF							
***** NORM DEPTH *****														
-2099.27	3038.71	1.334	3040.042	471.0	22.05	7.553	3047.595	0.00	2.849	5.00	12.00	3.00	0	0.00
15.60	0.00502					.050208	0.78					3.00		
-2083.67	3038.79	1.284	3040.071	471.0	23.13	8.308	3048.379	0.00	2.849	5.00	12.00	3.00	0	0.00
14.87	0.00502					.057651	0.86					3.00		
-2068.80	3038.86	1.236	3040.097	471.0	24.26	9.140	3049.237	0.00	2.849	5.00	12.00	3.00	0	0.00
14.16	0.00502					.066221	0.94					3.00		
-2054.64	3038.93	1.189	3040.121	471.0	25.44	10.053	3050.174	0.00	2.849	5.00	12.00	3.00	0	0.00
13.51	0.00502					.076092	1.03					3.00		
-2041.13	3039.00	1.144	3040.144	471.0	26.69	11.058	3051.202	0.00	2.849	5.00	12.00	3.00	0	0.00
25.25	0.09998					.078470	1.98					3.00		
-2015.88	3041.52	1.168	3042.692	471.0	26.02	10.511	3053.203	0.00	2.849	5.00	12.00	3.00	0	0.00
31.02	0.09998					.070664	2.19					3.00		
-1984.86	3044.63	1.214	3045.840	471.0	24.81	9.555	3055.395	0.00	2.849	5.00	12.00	3.00	0	0.00
21.35	0.09998					.061509	1.31					3.00		
-1963.51	3046.76	1.262	3048.022	471.0	23.65	8.687	3056.709	0.00	2.849	5.00	12.00	3.00	0	0.00
15.95	0.09998					.053558	0.85					3.00		
-1947.56	3048.35	1.311	3049.665	471.0	22.55	7.897	3057.562	0.00	2.849	5.00	12.00	3.00	0	0.00
12.51	0.09998					.046652	0.58					3.00		
-1935.05	3049.61	1.362	3050.967	471.0	21.50	7.179	3058.146	0.00	2.849	5.00	12.00	3.00	0	0.00
10.11	0.09998					.040652	0.41					3.00		
-1924.94	3050.62	1.414	3052.030	471.0	20.50	6.527	3058.557	0.00	2.849	5.00	12.00	3.00	0	0.00
8.35	0.09998					.035435	0.30					3.00		

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WATER SURFACE PROFILE LISTING
SKYE CANYON DETENTION BASIN, OLY1401.004
TECHNICAL DRAINAGE STUDY - ADDENDUM #1
COLLECTOR CHANNEL

STATION	INVERT ELEV	DEPTH OF FLOW	W.S. ELEV	Q	VEL	VEL HEAD	SF AVE	ENERGY GRD.EL.	SUPER ELEV	CRITICAL DEPTH	HGT/ DIA	BASE/ ID NO.	ZL	NO PIER	AVBPR
L/ELEM	SO							HF							
-1916.59	3051.45	1.469	3052.920	471.0	19.55	5.933	3058.853	0.22	0.00	2.849	5.00	12.00	3.00	0	0.00
7.00	0.09998					.030898							3.00		
-1909.59	3052.15	1.525	3053.676	471.0	18.64	5.394	3059.070	0.16	0.00	2.849	5.00	12.00	3.00	0	0.00
5.92	0.09998					.026951							3.00		
-1903.67	3052.74	1.583	3054.326	471.0	17.77	4.903	3059.229	0.12	0.00	2.849	5.00	12.00	3.00	0	0.00
5.05	0.09998					.023516							3.00		
-1898.62	3053.25	1.642	3054.890	471.0	16.94	4.458	3059.348	0.09	0.00	2.849	5.00	12.00	3.00	0	0.00
4.33	0.09998					.020525							3.00		
-1894.29	3053.68	1.704	3055.384	471.0	16.16	4.053	3059.437	0.07	0.00	2.849	5.00	12.00	3.00	0	0.00
3.71	0.09998					.017920							3.00		
-1890.58	3054.05	1.767	3055.819	471.0	15.40	3.684	3059.503	0.05	0.00	2.849	5.00	12.00	3.00	0	0.00
3.20	0.09998					.015650							3.00		
-1887.38	3054.37	1.833	3056.204	471.0	14.69	3.349	3059.553	0.04	0.00	2.849	5.00	12.00	3.00	0	0.00
2.75	0.09998					.013673							3.00		
-1884.63	3054.65	1.900	3056.546	471.0	14.00	3.045	3059.591	0.03	0.00	2.849	5.00	12.00	3.00	0	0.00
2.35	0.09998					.011949							3.00		
-1882.28	3054.88	1.970	3056.851	471.0	13.35	2.768	3059.619	0.02	0.00	2.849	5.00	12.00	3.00	0	0.00
2.01	0.09998					.010444							3.00		
-1880.27	3055.08	2.041	3057.123	471.0	12.73	2.516	3059.639	0.02	0.00	2.849	5.00	12.00	3.00	0	0.00
1.71	0.09998					.009132							3.00		
-1878.56	3055.25	2.115	3057.368	471.0	12.14	2.288	3059.656	0.01	0.00	2.849	5.00	12.00	3.00	0	0.00
1.43	0.09998					.007987							3.00		

TECHNICAL DRAINAGE STUDY - ADDENDUM #1
COLLECTOR CHANNEL

STATION	INVERT ELEV	DEPTH OF FLOW	W.S. ELEV	Q	VEL	VEL HEAD	ENERGY GRD.ELEV.	SUPER ELEV	CRITICAL DEPTH	NORM DEPTH	HGT/DIA	BASE/ID NO.	ZL	NO PIER	AVBPR
L/ELEM	SO					SF AVE	HF						ZR		
-1877.13	3055.40	2.191	3057.587	471.0	11.57	2.080	3059.667	0.00	2.849		5.00	12.00	3.00	0	0.00
1.19	0.09998					.006988	0.01			1.079			3.00		
-1875.94	3055.51	2.269	3057.784	471.0	11.03	1.891	3059.675	0.00	2.849		5.00	12.00	3.00	0	0.00
0.98	0.09998					.006115	0.01			1.079			3.00		
-1874.96	3055.61	2.350	3057.963	471.0	10.52	1.719	3059.682	0.00	2.849		5.00	12.00	3.00	0	0.00
0.77	0.09998					.005352	0.00			1.079			3.00		
-1874.19	3055.69	2.433	3058.123	471.0	10.03	1.562	3059.685	0.00	2.849		5.00	12.00	3.00	0	0.00
478.20	0.00500					.004997	2.39			2.433			3.00		
-1395.99	3058.08	2.433	3060.514	471.0	10.03	1.562	3062.076	0.00	2.849		5.00	12.00	3.00	0	0.00
184.23	0.00500					.004800	0.88			2.433			3.00		
-1211.76	3059.00	2.485	3061.487	471.0	9.74	1.473	3062.960	0.00	2.849		5.00	12.00	3.00	0	0.00
68.97	0.00500					.004317	0.30			2.433			3.00		
-1142.79	3059.35	2.572	3061.919	471.0	9.29	1.339	3063.258	0.00	2.849		5.00	12.00	3.00	0	0.00
26.59	0.00500					.003781	0.10			2.433			3.00		
-1116.20	3059.48	2.662	3062.142	471.0	8.86	1.218	3063.360	0.00	2.849		5.00	12.00	3.00	0	0.00
11.12	0.00500					.003312	0.04			2.433			3.00		
-1105.08	3059.53	2.753	3062.288	471.0	8.44	1.107	3063.395	0.00	2.849		5.00	12.00	3.00	0	0.00
2.91	0.00500					.002901	0.01			2.433			3.00		
-1102.17	3059.55	2.849	3062.399	471.0	8.05	1.005	3063.404	0.00	2.849		5.00	12.00	3.00	0	0.00

SKYE CANYON DETENTION BASIN, OLY1401.004
TECHNICAL DRAINAGE STUDY - ADDENDUM #1
COLLECTOR CHANNEL

-2494.58
-2483.79
-2472.99
-2462.20

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-1836.15
-1825.36
-1814.57
-1803.77
-1792.98
-1782.18
-1771.39
-1760.60
-1749.80
-1739.01
-1728.21
-1717.42
-1706.63
-1695.83
-1685.04
-1674.25
-1663.45
-1652.66
-1641.86
-1631.07
-1620.28
-1609.48
-1598.69
-1587.89
-1577.10
-1566.31
-1555.51
-1544.72
-1533.93
-1523.13
-1512.34
-1501.54
-1490.75
-1479.96
-1469.16
-1458.37
-1447.57
-1436.78
-1425.99
-1415.19
-1404.40
-1393.60
-1382.81
-1372.02
-1361.22
-1350.43
-1339.64
-1328.84
-1318.05
-1307.25
-1296.46
-1285.67
-1274.87
-1264.08
-1253.28
-1242.49
-1231.70

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I WC E H

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1. GLOSSARY

- I = INVERT ELEVATION
C = CRITICAL DEPTH
W = WATER SURFACE ELEVATION
H = HEIGHT OF CHANNEL
E = ENERGY GRADE LINE
X = CURVES CROSSING OVER
B = BRIDGE ENTRANCE OR EXIT
Y = WALL ENTRANCE OR EXIT

2. STATIONS FOR POINTS AT A JUMP MAY NOT BE PLOTTED EXACTLY 7'

PMF Overflow Spillway Structure

Chanson - Energy Reduction Step Computation

Project Name: Skye Canyon Detention Basin No. 1 - CLV Supplement

Date: 7/22/2015

File Name: OLY1401-004 TDS Supp RCC Spillway Energy Calc.xlsx

By: SMJ

1. Using the energy reduction equation in Sturm - Open Channel Hydraulics (Section 6.4 Stepped Spillways, pages 213-215)

$$\Delta H/H = 1 - [(C_f^{1/3} \cos \theta + 0.5 C_f^{-2/3}) / (1.5 + H_{\text{dam}} / y_c)]$$

ΔH = Energy head dissipated, ft

H = Total Head, ft

H_{dam} = Height from the toe of the spillway to the crest, ft

$$C_f = f / (8 \sin \theta)$$

f = friction factor

$$\theta = \tan^{-1} (h/l)$$

h = height of the step, ft

l = length of the step, ft

2. Using the critical depth (rectangular) equation in Lindeburg (page 19-17)

$$y_c = [(Q^2) / (gw^2)]^{1/3}$$

Q = Flow rate, cfs

g = gravity, ft/sec²

w = width, ft

3. Applying Steps 1 and 2

Known: $Q = 5,989$ cfs
 $g = 32.2$ ft/sec²
 $w = 87$ ft
 $H_{\text{dam}} = 16$ ft
 $f = 1$

Solve for: $y_c = 5.28$ ft

Solve for:

h/l (assumed)	θ (rads)	θ (deg)	C_f	$C_f^{1/3}$	$\cos \theta$ (rads)	$C_f^{-2/3}$	$\Delta H/H$
0.01	0.010	0.573	12.501	2.321	1.000	0.186	0.467
0.02	0.020	1.146	6.251	1.842	1.000	0.295	0.561
0.03	0.030	1.719	4.169	1.609	1.000	0.386	0.602
0.05	0.050	2.864	2.503	1.358	0.999	0.542	0.641
0.10	0.100	5.713	1.256	1.079	0.995	0.859	0.668
0.15	0.149	8.535	0.843	0.945	0.989	1.121	0.670
0.20	0.197	11.316	0.637	0.861	0.981	1.350	0.665
0.25	0.245	14.043	0.515	0.802	0.970	1.556	0.657
0.30	0.291	16.708	0.435	0.758	0.958	1.742	0.648
0.35	0.337	19.300	0.378	0.723	0.944	1.912	0.638
0.40	0.381	21.812	0.337	0.696	0.928	2.067	0.629
0.45	0.423	24.240	0.305	0.673	0.912	2.209	0.621
0.50	0.464	26.579	0.280	0.654	0.894	2.339	0.613
0.55	0.503	28.825	0.259	0.638	0.876	2.459	0.605
0.60	0.540	30.979	0.243	0.624	0.857	2.568	0.598
0.65	0.576	33.041	0.229	0.612	0.838	2.669	0.592
0.70	0.611	35.010	0.218	0.602	0.819	2.761	0.586
0.75	0.644	36.889	0.208	0.593	0.800	2.846	0.581
0.80	0.675	38.679	0.200	0.585	0.781	2.923	0.577
0.85	0.704	40.385	0.193	0.578	0.762	2.994	0.572

0.90	0.733	42.009	0.187	0.572	0.743	3.060	0.569
0.95	0.760	43.553	0.181	0.566	0.725	3.120	0.565
1.00	0.785	45.023	0.177	0.561	0.707	3.175	0.562
1.25	0.896	51.366	0.160	0.543	0.625	3.392	0.551
1.50	0.983	56.338	0.150	0.532	0.555	3.539	0.544
1.75	1.052	60.286	0.144	0.524	0.496	3.640	0.541
2.00	1.107	63.467	0.140	0.519	0.447	3.713	0.539
2.25	1.153	66.071	0.137	0.515	0.406	3.767	0.538
2.50	1.190	68.233	0.135	0.513	0.371	3.807	0.538
2.75	1.222	70.052	0.133	0.510	0.342	3.838	0.538
3.00	1.249	71.601	0.132	0.509	0.316	3.862	0.538
3.25	1.272	72.934	0.131	0.508	0.294	3.881	0.539
3.50	1.292	74.092	0.130	0.507	0.275	3.897	0.539
3.75	1.310	75.107	0.129	0.506	0.258	3.909	0.540
4.00	1.326	76.002	0.129	0.505	0.243	3.920	0.540
4.25	1.340	76.798	0.128	0.505	0.229	3.929	0.541
4.50	1.352	77.510	0.128	0.504	0.217	3.936	0.541
4.75	1.363	78.151	0.128	0.504	0.206	3.943	0.542
5.00	1.373	78.730	0.127	0.503	0.196	3.948	0.542
5.25	1.383	79.256	0.127	0.503	0.187	3.953	0.543
5.50	1.391	79.736	0.127	0.503	0.179	3.957	0.543
5.75	1.399	80.175	0.127	0.502	0.171	3.960	0.544
6.00	1.406	80.579	0.127	0.502	0.164	3.964	0.544
6.25	1.412	80.951	0.127	0.502	0.158	3.966	0.545
6.50	1.418	81.295	0.126	0.502	0.152	3.969	0.545
6.75	1.424	81.614	0.126	0.502	0.147	3.971	0.545
7.00	1.429	81.911	0.126	0.502	0.141	3.973	0.546
7.25	1.434	82.188	0.126	0.502	0.137	3.975	0.546
7.50	1.438	82.447	0.126	0.501	0.132	3.977	0.547
7.75	1.442	82.690	0.126	0.501	0.128	3.978	0.547
8.00	1.446	82.917	0.126	0.501	0.124	3.979	0.547
8.25	1.450	83.131	0.126	0.501	0.120	3.981	0.547
8.50	1.454	83.332	0.126	0.501	0.117	3.982	0.548
8.75	1.457	83.523	0.126	0.501	0.114	3.983	0.548
9.00	1.460	83.702	0.126	0.501	0.110	3.984	0.548
9.25	1.463	83.872	0.126	0.501	0.107	3.985	0.548
9.50	1.466	84.034	0.126	0.501	0.105	3.985	0.549
9.75	1.469	84.187	0.126	0.501	0.102	3.986	0.549
10.00	1.471	84.332	0.126	0.501	0.100	3.987	0.549

4. Findings of Step 3 and Results

From the computations of Step 3, the maximum reduction we can obtain is approximately 67.0%
The corresponding h/l ratio is 0.15

Per CCRFCD, the preferred height of a step is 2.0 ft
Per CCRFCD, the preferred slope is 2:1; therefore, the length of the step is 4.0 ft

The resulting h/l ratio is 0.50

Number of steps, $N = H_{\text{dam}}/h$ 8

From the table and chart, the corresponding energy reduction is 61.3%

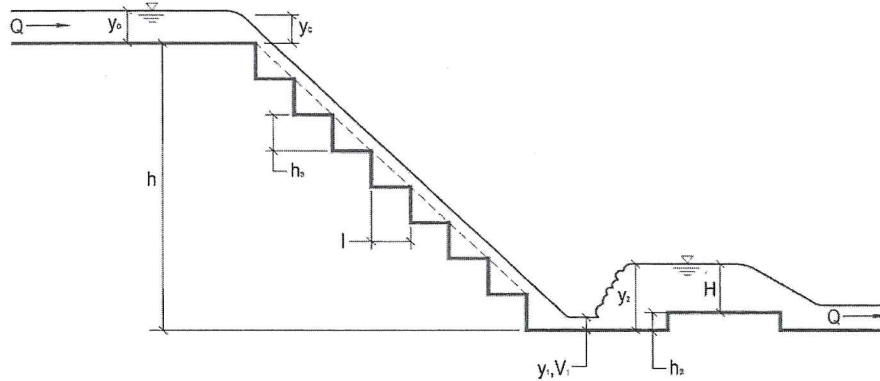
Christodolou - Stepped Spillway & Stilling Basin Computation

Project Name: Skye Canyon Detention Basin No. 1 - CLV Supplement

Date: 7/22/2015

File Name: OLY1401-004 TDS Supp RCC Spillway Chirstodolou Calc.xlsx

By: SMJ



1. Identify known parameters

Known:

Flow rate, Q =	5,989	cfs
Gravity, g =	32.2	ft/s ²
Width of spillway, w =	87	ft
Height of spillway, h =	16	ft
Number of Steps, N =	8	
Height of step, h _s =	2	ft
Length of step, l =	4	ft

2. Using the critical depth (rectangular) equation in Lindeburg (page 19-17)

$$y_c = [(Q^2) / (gw^2)]^{1/3}$$

Q = Flow rate, cfs
g = gravity, ft/sec²
w = width of spillway, ft

Solve for: $y_c = 5.28$ ft

3. Determining the energy at the top of stepped structure

$$H_0 = h + y_o + (V_o^2 / 2g)$$

$$= h + y_c + (V_c^2 / 2g)$$

$$= h + y_c + (Q^2 / 2gw^2y_c^2)$$

Q = Flow rate, cfs
g = gravity, ft/sec²
w = width, ft
h = height of spillway, ft
y_c = critical flow depth, ft

Solve for: $H_0 = 23.92$ ft

4. Determining the energy at the toe of stepped structure

$$H_1 = H_0 - \Delta H$$

$$= y_1 + (V_1^2 / 2g)$$

$$= y_1 + (Q^2 / 2gw^2y_1^2)$$

Q = Flow rate, cfs
g = gravity, ft/sec²
w = width, ft
y₁ = flow depth at the toe of stepped structure

Use the percentages from both the Energy Reduction and Christodoulou Methods to see which controls.

(See Energy Reduction)	(Use Christodoulou, Fig 4)
	l/h _s = 2.0
	y _c /h _s = 2.6
	If y _c /(Nh _s) = 0.33
	Check 1, is l/h _s ≥ 0.7 yes
	Check 2, is l/h _s ≤ 2.5 yes
	Check 3, is y _c /h _s ≤ 4.5 yes
	Check 4, is y _c /Nh _s ≤ 0.5 yes
	Is the Christodoulou Method, Fig 4 valid?: yes
ΔH = 61.3%	ΔH = 20.0%
Then H ₁ = 9.257	Then H ₁ = 19.136
Solve for: y ₁ = 8.15 ft	Solve for: y ₁ = 2.08 ft

$$V_1 = Q / (wy_1)$$

V₁ = velocity at the toe of stepped structure
y₁ = flow depth at the toe of stepped structure
w = width of spillway, ft
Q = Flow rate, cfs

(Energy Reduction)	(Christodoulou)
Solve for: V ₁ = 8.45	Solve for: V ₁ = 33.10

$$F_{r1} = V_1 / (gy_1)^{0.5}$$

F_{r1} = Froude Number at the toe of stepped structure
g = gravity, ft/sec²
y₁ = flow depth at the toe of stepped structure

(Energy Reduction)	(Christodoulou)
Solve for: F _{r1} = 0.52	Solve for: F _{r1} = 4.04

5. Determining the height of block to force a hydraulic jump

Broad-crested weir

$$Q = CLH^{3/2}$$

Q = Flow rate, cfs
C = Weir coefficient
L = width of spillway, ft
H = Weir depth, ft

C = 3.30
L = w = 87 ft

Solve for: H = 7.58 ft

Conjugate depth for a hydraulic jump

$$y_2 = (y_1 / 2) \left((1 + 8F_{r1}^{2/3})^{0.5} - 1 \right)$$

y_2 = flow depth at the hydraulic jump
 y_1 = flow depth at the toe of stepped structure
 F_{r1} = Froude Number at the toe of stepped structure

(Energy Reduction)

Solve for: $y_2 = 3.19$ ft

(Christodoulou)

Solve for: $y_2 = 10.90$ ft

Required tailwater depth to force a hydraulic jump

$$h_B = y_2 - H$$

y_2 = flow depth at the hydraulic jump
 h_B = Height of block, ft
 H = Weir depth, ft

(Energy Reduction)

If $\Delta H = 61.3\%$
 Solve for: $h_B = 4.4$ ft

(Christodoulou)

If $\Delta H = 20.0\%$
 Solve for: $h_B = 3.32$ ft

Conclusion:

Use Christodoulou Equation. End Sill Height is 3.5-ft (h_B). 11-ft (y_2) depth provided in stilling basin for hydraulic jump depth.

Use: $h_B = 3.5$ ft

6. Determining the length of the stilling basin

Length of Free Jump can be obtained from USBR EM25 Figure 12 (1983)

Controlling Method = Christodoulou

$F_{r1} = 4.04$

$y_2 = 10.90$

Then $L_B/y_2 = 5.800$

Solve for: Length of stilling basin, $L_B = 63.23$ ft

Conclusion:

The design length of the stilling basin is 65-ft.

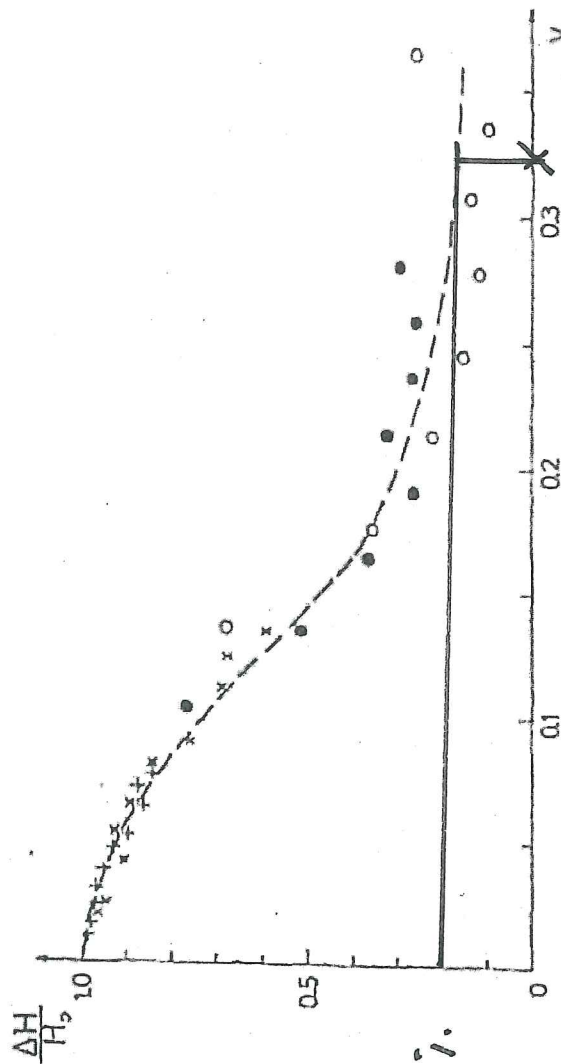


FIG. 4. Dependence of $\Delta H/H_0$ on y_c/Nh

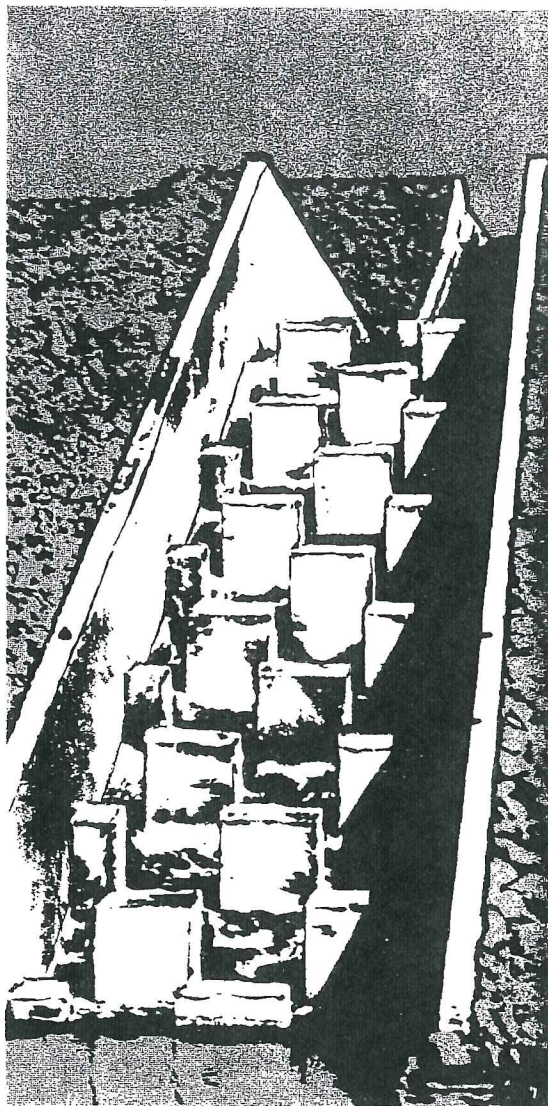
$$\frac{y_c}{Nh} = \frac{5.28}{(8)(2)} = 0.33$$

$$y_c = 5.28$$

$$N = 8 \text{ steps}$$

$$h = 2\text{-FT HIGH STEP}$$

A WATER RESOURCES TECHNICAL PUBLICATION
ENGINEERING MONOGRAPH No. 25



Hydraulic Design of Stilling Basins and Energy Dissipators

UNITED STATES DEPARTMENT
OF THE INTERIOR
BUREAU OF RECLAMATION

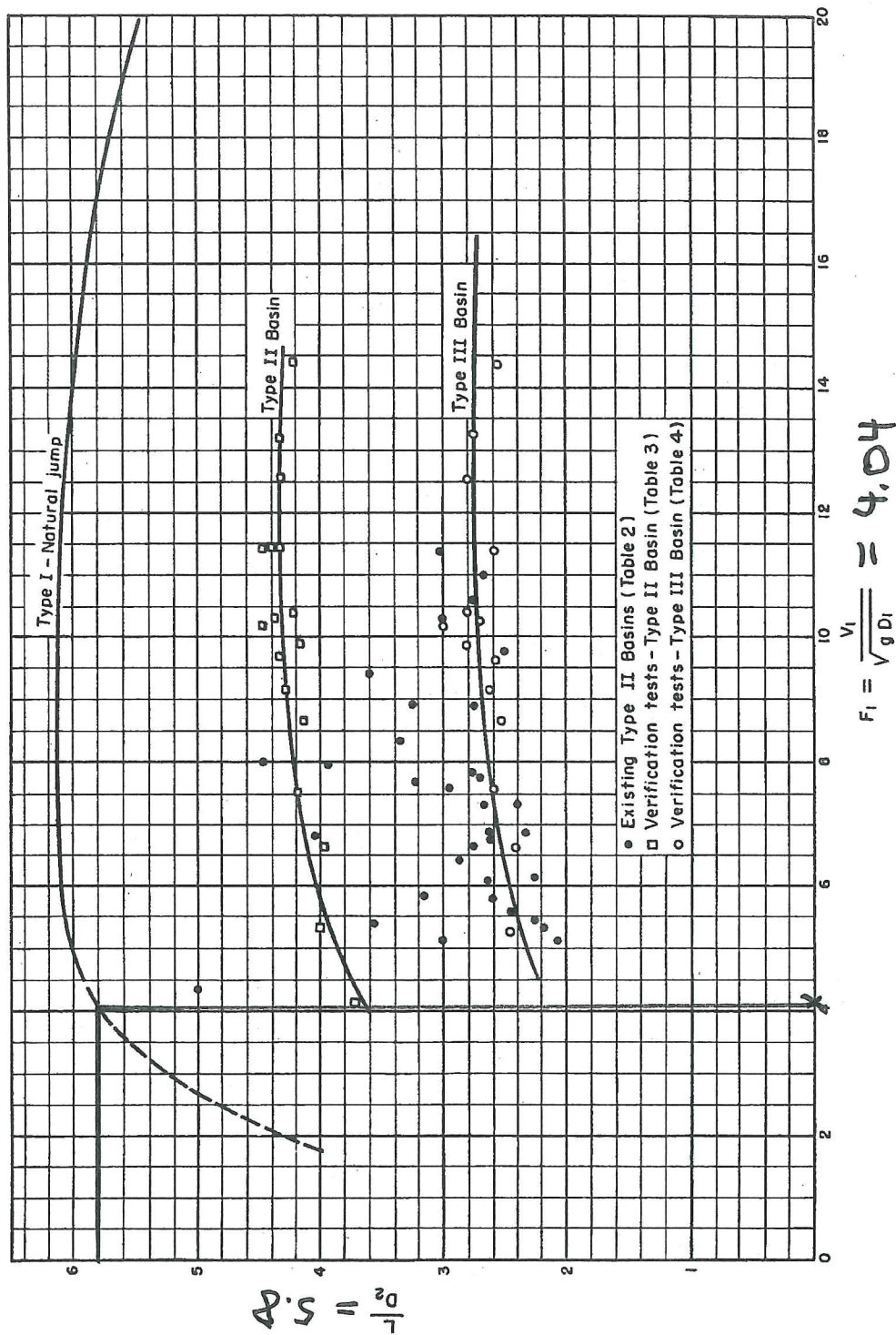


FIGURE 12.—Length of jump on horizontal floor (Basins I, II, and III).

known from prototype experience, the required value of L/h can be determined from Equation 6.8 for the desired air concentration. Then, from the relationship given by Equation 6.7 from physical model studies or numerical analysis of the jet trajectory for a given ramp geometry, the required underpressure Δp_a can be determined for the specified value of L/h and the known value of the Froude number. Finally, the air delivery system can be designed to provide the air flow rate with the specified pressure drop.

The value of k in Equation 6.8 has been determined to be 0.033 from the Foz do Areia prototype spillway tests (de S. Pinto 1988), but it can vary for different flow conditions and different ramp geometries. What is required is a model study with a relatively large scale (1:10 to 1:15) to eliminate Reynolds number and Weber number effects and so determine specific design values of k .

6.4

STEPPED SPILLWAYS

Stepped spillways have been used extensively around the world since antiquity, but they became very popular in the past few decades with the advent of roller-compacted concrete (RCC) and gabion construction of dams (Chanson 1994a). They provide good surface aeration but also increase the energy dissipation in the flow down the spillway in comparison to a smooth spillway. This latter feature of stepped spillways may reduce the cost of the downstream stilling basin.

Stepped spillways can operate either in a nappe flow regime or a skimming flow regime. In nappe flow, which tends to occur at lower discharges on flatter spillways, the flow consists of a series of jets that strike the floor of the succeeding steps. Each jet usually is followed by a partial hydraulic jump. In skimming flow, the jets move smoothly without breakup across the steps, which act as a series of roughness elements. A recirculating vortex forms on each step in which energy dissipates. The skimming flow regime is shown in Figure 6.8. Rajaratnam (1990) suggested that the onset of skimming flow occurs for values of y_c/h exceeding 0.8,

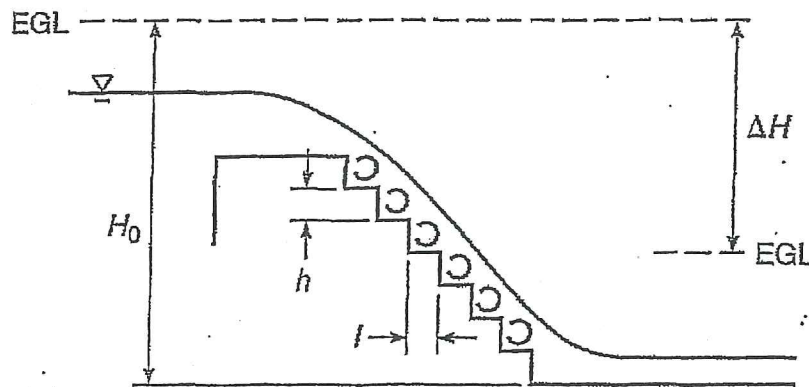


FIGURE 6.8

Definition sketch of a stepped spillway.

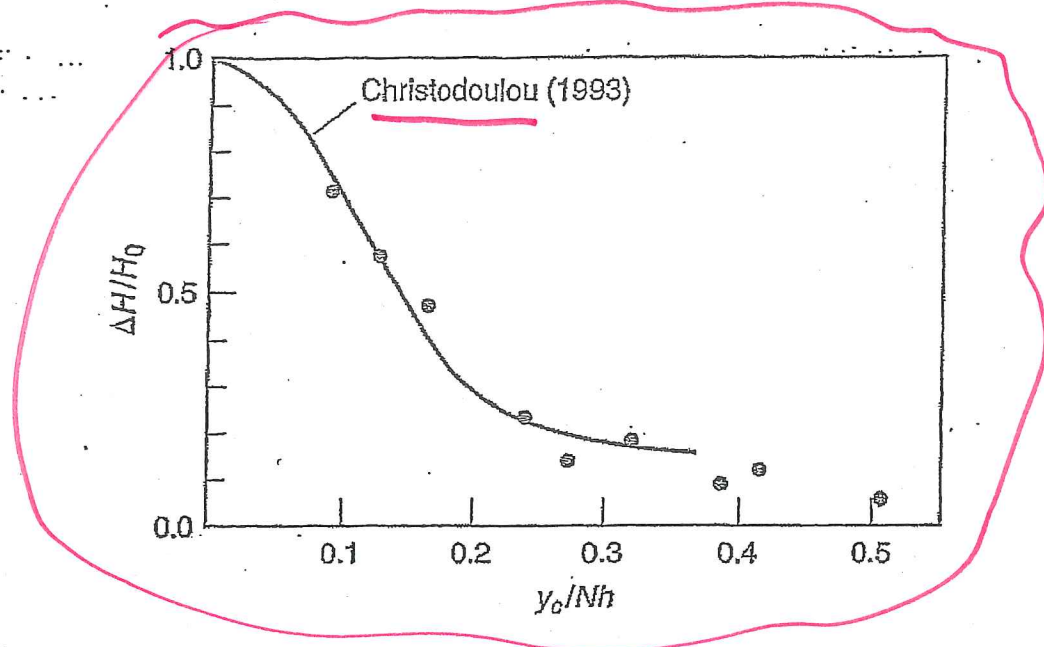


FIGURE 6.9

Model study results for head loss on a stepped spillway in skimming flow with N steps (Rice and Kadavy 1996). (Source: C. E. Rice and K. C. Kadavy, "Model Study of a Roller Compacted Concrete Stepped Spillway," *J. Hydr. Engrg.*, © 1996, ASCE. Reproduced by permission of ASCE.)

where y_c is the critical depth for the flow on the spillway and h is the height of an individual step.

The amount of energy dissipation that occurs on a stepped spillway for skimming flow is one of the primary design variables. Christodoulou (1993) suggested that the energy head dissipated, ΔH , in ratio to the total head, H_0 , upstream of the dam relative to the toe is related to y_c/Nh , in which y_c = critical depth; N = number of steps; and h = the height of each step, as shown in Figure 6.9. Rice and Kadavy (1996) have confirmed the validity of Figure 6.9 for a physical model of the Salado Creek spillway in Texas. Based on their data points, the Christodoulou curve in Figure 6.9 is valid for l/h values in the range of 0.7 to 2.5, $y_c/h \leq 4.5$, and $y_c/Nh \leq 0.5$.

Chanson (1994b) analyzed experimental data for stepped spillways from a large number of investigators and compared the results for relative energy loss with an analytical formulation for uniform flow conditions given by

$$\frac{\Delta H}{H_0} = 1 - \frac{C_f^{1/3} \cos \theta + 0.5 C_f^{-2/3}}{1.5 + \frac{H_{dam}}{y_c}} \quad (6.9)$$

in which $C_f = f/(8 \sin \theta)$; f = friction factor; $\theta = \tan^{-1}(h/l)$; H_{dam} = dam crest height above the toe; and y_c = critical flow depth. He found reasonable agreement with the experimental results, considering the degree of scatter, using $f = 1.0$ (non-aerated flow) and $\theta = 52^\circ$ over a very wide range of H_{dam}/y_c from approximately 2 to 90. Usually, $H_{dam} = Nh$, so Equation 6.9 corresponds with the variables of Fig-

ure 6.9 except that it covers a wider range in y_c/Nh . Equation 6.9 must be used with care because of the uncertainty in the friction factor due to the effects of aeration.

Stepped spillways offer the advantage of enhanced air entrainment as well as energy dissipation. Chanson (1994b) shows that the inception of air entrainment occurs in a shorter distance on a stepped spillway than on a smooth spillway because of the more rapid rate of boundary-layer growth. However, the equilibrium air concentration is similar on stepped and smooth spillways and primarily is a function of slope. For more details on the design of stepped spillways, refer to the comprehensive treatment of the subject by Chanson (1994b).

6.5

CULVERTS

Culverts seem to be simple hydraulic structures but in fact are among the most complicated because of the wide variety of flow conditions that can occur in them. Flow can be gradually varied or rapidly varied and also a function of time. A culvert can flow full, in which case it operates under pressure-flow conditions as in pipe flow, or it can flow partly full, as an open channel. The open channel flow can be supercritical or subcritical, and its analysis may include computation of a gradually varied flow profile or a hydraulic jump. Culverts flow full when the outlet is submerged due to high tailwater but also may flow full for a very high headwater with the outlet unsubmerged. In both full and partly full flow, the submergence of the inlet or outlet is an important criterion in determining the type of flow that occurs. Perhaps the most important distinguishing characteristic of a culvert flow is whether it is under inlet or outlet control. In the case of inlet control, the head-discharge relation is determined entirely by the inlet geometry, including the inlet area, edge rounding, and shape. Tailwater conditions are immaterial for inlet control. In outlet control, on the other hand, the head-discharge relation is affected not only by the inlet but also by the barrel roughness, length, slope, shape, and area as well as the tailwater elevation. These influences on inlet and outlet control are summarized in Table 6-1. Inlet control generally occurs for short, steep culverts with a free outlet, while outlet control prevails for long, rough-barreled culverts with high tailwater conditions.

Culvert design usually is based on the selection of a design discharge determined from frequency analysis. Interstate highway culverts, for example, may be designed to carry the 100 year peak discharge. The culvert is sized to limit the headwater resulting from the design discharge to a specified value to prevent overtopping the highway embankment. Once the design culvert size is determined, its performance may be analyzed over a wide range of discharges, including discharges that overtop the embankment. This analysis can be summarized by a plot of the complete head-discharge relation, called the *performance curve*. This step is important to accurately determine whether the culvert operates under inlet or outlet control for the design discharge. The design process is based on a selected peak discharge in steady flow, and a conservative approach is taken in which both inlet

ENERGY DISSIPATION ON STEPPED SPILLWAYS

By George C. Christodoulou,¹ Member, ASCE

ABSTRACT: Potentially high energy dissipation on stepped overflow spillways would imply a significant reduction of the size of downstream stilling basins. The amount of energy loss on such spillways under skimming-flow conditions is examined experimentally for structures with a moderate number of steps and a width-to-height ratio equal to 0.7. The experimental results, supported by dimensional considerations, indicate that the most important parameters governing energy dissipation are the ratio of the critical depth of flow passing over the spillway to the step height y_c/h , and the number of steps N . Dissipation is highest for the small values of y_c/h tested, near unity, and decreases with increasing y_c/h ; for a certain y_c/h the dissipation increases with N . The results are compared to those of earlier investigations referring to a large number of steps. For commonly used ranges of the step dimensions, a general relation is established between the energy loss and the parameter y_c/h , which may be useful in practical applications.

INTRODUCTION

Usually, the crest of overflow spillways follows the standard shapes that were determined after extensive experiments at the U.S. Waterways Experiment Station (Chow 1959). The flow accelerates along the downstream face and high velocities are attained at the spillway toe, so that stilling basins or other types of energy dissipators need to be provided. Some concrete gravity dams and the associated spillways are being constructed with a step-wise profile by application of rollcrete technology [e.g., Hollingworth and Drayts (1986); Bouyge et al. (1988)]. However, the performance of stepped spillways is not well known. Limited experimental research in the past (Young 1982; Sorensen 1985) has suggested that considerable energy dissipation may take place on the stepped surface of the spillway, and, consequently, the stilling basin might be severely reduced in size or even eliminated. Rajaratnam (1990) proposed a theoretical estimate for the energy loss due to the steps, assuming the establishment of uniform skimming flow. This assumption would imply a high spillway with many steps—a requirement that may not be typical of stepped structure. Peyras et al. (1992) presented experimental results for small gabion weirs with a flat crest and up to seven steps. According to these results, the relative energy dissipation decreases with increasing flowrate and also depends on the slope of the downstream face. The objective of the present paper is to further assess the energy loss characteristics of stepped spillways by means of laboratory experiments.

EXPERIMENTS

The experiments were conducted at the Applied Hydraulics Laboratory of the National Technical University of Athens. The spillway tested had the form shown in Fig. 1, in which all dimensions are given in centimeters. The

¹Assoc. Prof., Dept. Civ. Engrg., Nat. Tech. Univ. of Athens, Athens 15773, Greece.

Note. Discussion open until October 1, 1993. To extend the closing date one month, a written request must be filed with the ASCE Manager of Journals. The manuscript for this paper was submitted for review and possible publication on May 22, 1992. This paper is part of the *Journal of Hydraulic Engineering*, Vol. 119, No. 5, May, 1993. ©ASCE, ISSN 0733-9429/93/0005-0644/\$1.00 + \$.15 per page. Paper No. 4137.

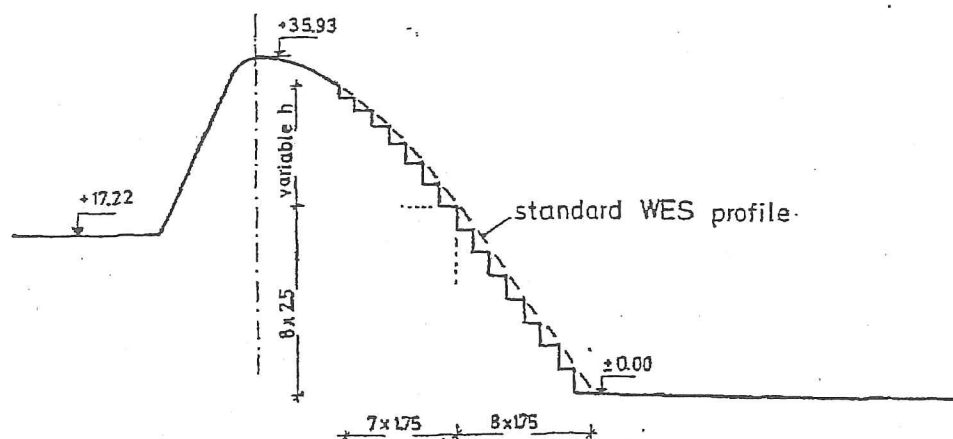


FIG. 1. Side View of Spillway Tested (Dimensions in cm)

steps are designed so that the envelope of their tips, indicated by the broken line, follows the standard Waterways Experiment Station (WES) profile up to a constant slope of 1:0.7 (55° angle to the horizontal). There are seven steps on the curved part of the spillway face with variable height-to-width ratios, and eight steps on the straight part with constant width $l = 1.75$ cm and height $h = 2.50$ cm ($l/h = 0.7$). The spillway was made of wood, and epoxy coated to avoid warping. It was placed in a laboratory flume 10 m long and 0.5 m wide, which was connected upstream to a 2.0 m $\times$ 1.5 m supply reservoir through an elliptical transition. Beyond the toe of the spillway, the flume had a bottom slope of 0.04, and there was no downstream control, so that supercritical flow was maintained without formation of a hydraulic jump.

Eight experimental runs were carried out, with discharges ranging between 10 L/s and 45 L/s. The measurement of discharge Q was performed by means of a carbon-tetrachloride differential manometer installed on the main supply line of the laboratory. In each run, the vertical water depth was measured at the brink of the 10th and the 13th step by means of a point gage mounted on an aluminum frame so that it could be moved longitudinally and transversely over any point on the spillway. The gage was equipped with a vernier, readable to within 0.1 mm. However, minor irregularities of the water surface, due primarily to the influence of the side walls, render an overall accuracy on the order of 0.1 cm. The depth was recorded at three points across each step (at $B/4, B/2, 3B/4$, where B is the flume width), and the arithmetic mean of the three values was considered as the vertical depth d over the respective step. The water level was measured on the flume axis 1 m upstream of the crest. Based on the preceding measurements, the head loss was calculated as discussed in the following section.

ANALYSIS OF RESULTS

Referring to the notation shown in Fig. 2, the total head loss up to a certain step is expressed by

$$\Delta H = H_0 - H \quad \dots \dots \dots (1)$$

where $H = y \cos \theta + (V^2/2g)$ = head on the step under consideration; $H_0 = \Delta z + Y + (V_0^2/2g)$ = head upstream of the spillway relative to the same datum; $V = Q/(yB)$ = local mean velocity; and $V_0 = Q/(YB)$ = approach velocity.

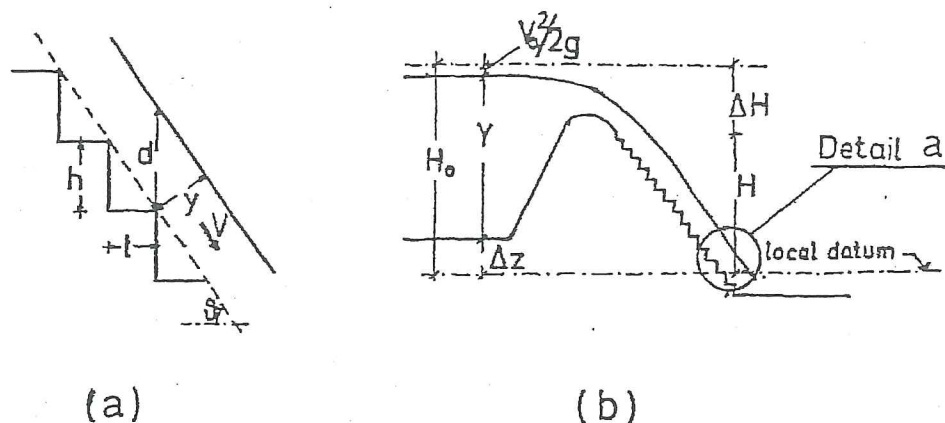


FIG. 2. Notation Sketches

Provided $B \gg y$, the head loss should be primarily dependent on the number of steps N , the geometry of the steps (h, l), and the discharge Q ; the latter may be expressed equivalently by the critical depth $y_c = \sqrt[3]{(Q/B)^2/g}$. Simple dimensional analysis leads to the relation

$$\frac{\Delta H}{h_0} = f\left(N, \frac{y_c}{h}, \frac{l}{h}\right) \dots\dots\dots (2)$$

In the present experiments, the ratio of l/h was 0.7. This value is close to the practically applied values of 0.78 (Sorensen 1985), 0.60–0.62 (Hollingworth and Druyts 1988), and 0.75 (Bouyge et al. 1988). The importance of the parameter y_c/h was suggested earlier by Rajaratnam (1990). He determined that for $y_c/h > 0.8$, skimming flow is expected to occur over a stepped spillway, whereas for smaller values of y_c/h , there is a nappe-flow regime, i.e., the flow from each step hits the step below as a falling jet. According to observations on gabion weirs by Peyras et al. (1992), isolated nappe flow occurs at very small flow rates, in the range of $y_c/h < 0.5$, and partial nappe flow occurs at somewhat higher discharges. Although the nappe-flow conditions are evidently most efficient in terms of energy dissipation, they are not likely to be sought in practice, due to the anticipated considerable damage of the stepped structure.

The theoretical description of flow over a spillway is not simple, even for the conventional form without the steps. The flow accelerates down the slope, and a boundary layer develops starting at the crest. After fully developed flow is established, the entrainment of air due to high velocities may lead to considerable flow bulking. In attempting to estimate the energy loss due to the steps, Rajaratnam (1990) adopted the assumption of uniform skimming flow, and derived the following expression for the effective roughness coefficient c_f of the stepped surface:

$$c_f = \frac{2y_0^3 g \sin \theta}{\left(\frac{Q}{B}\right)^2} \dots\dots\dots (3)$$

where y_0 = (uniform) depth normal to the flow direction. Rajaratnam reported values of c_f for stepped structures ranging between 0.05 and 0.18. For the stepped spillway tested by Sorensen (1985), Rajaratnam calculated values of c_f in the range $0.11 \div 0.20$, with an average of 0.18.

TABLE 1. Summary of Experimental Data

Q (L/s) (1)	d (cm) (2)	Y (cm) (3)	V (cm/s) (4)	H (cm) (5)	H_0 (cm) (6)	$\Delta H/H_0$ (7)	c_f (8)	Y_c/h (9)
(a) Step No. 13								
10	2.82	1.62	124	8.82	38.02	0.768	0.171	1.34
15	2.77	1.59	188	18.93	39.26	0.518	0.072	1.75
20	3.20	1.83	218	25.41	40.41	0.372	0.062	2.12
25	3.65	2.09	239	30.30	41.43	0.268	0.059	2.45
30	4.57	2.62	229	28.25	42.38	0.333	0.080	2.78
35	5.02	2.89	242	31.53	43.22	0.270	0.080	3.07
40	5.69	3.26	245	32.45	44.00	0.265	0.087	3.35
45	6.55	3.76	240	31.46	45.17	0.303	0.105	3.64
(b) Step No. 10								
10	2.67	1.53	132	9.74	30.27	0.678	0.048	1.34
15	2.68	1.54	195	20.30	31.51	0.355	0.065	1.75
20	3.18	1.82	220	25.69	32.66	0.214	0.061	2.12
25	3.75	2.15	232	28.74	33.68	0.147	0.064	2.45
30	4.34	2.49	241	31.05	34.63	0.104	0.069	2.78
35	5.12	2.93	239	30.76	35.47	0.133	0.083	3.07
40	5.59	3.21	248	33.21	36.25	0.084	0.084	3.35
45	7.09	4.07	222	27.35	37.42	0.266	0.133	3.64

Table 1 summarizes the present experimental results for the 10th and the 13th step. The experimental range of y_c/h clearly belongs to the skimming-flow regime. It is seen that for each y_c/h the relative head loss is higher at the 13th step, close to the spillway toe. There is high energy dissipation for small y_c/h , apparently due to the more pronounced effect of the steps for small water depths relative to the step size. In fact, the presence of the steps may be considered as a macroroughness of the boundary, at a scale much larger than the usual wall roughness. The values of c_f calculated by (3) are also shown in Table 1; although not strictly uniform, the observed local depth is used for the sake of comparison. Their average value is 0.089 at the 13th step and 0.076 at the 10th step. These are within the expected range, but less than half the value corresponding to Sorensen's experiments.

According to Rajaratnam (1990), for a large number of identical steps and for a high Froude number, the theoretical energy loss at the spillway toe is 88% of the energy present without the steps. Sorensen (1985) reported a 84% kinetic energy dissipation up to the toe for the maximum discharge passing over a model spillway of 58 steps. However, the present results, obtained for a much smaller number of steps, indicate significantly lower energy losses. A plot of the present data of $\Delta H/H_0$ versus y_c/h is shown in Fig. 3. On the same figure the respective results of Sorensen are presented, as calculated from his original data. The effect of the number of steps N is evident, since at any specific y_c/h the relative energy loss increases with the number of steps; in fact the importance of N is more pronounced at higher y_c/h . Fig. 4 illustrates the dependence of $\Delta H/H_0$ on the parameter y_c/Nh . The data points suggest a single experimental curve, indicated by the broken line. Clearly, a stepped spillway is most effective for energy dissipation when y_c/Nh is small or when the discharge is small. For a certain discharge, the dissipation decreases with increasing Nh , which roughly equals the total

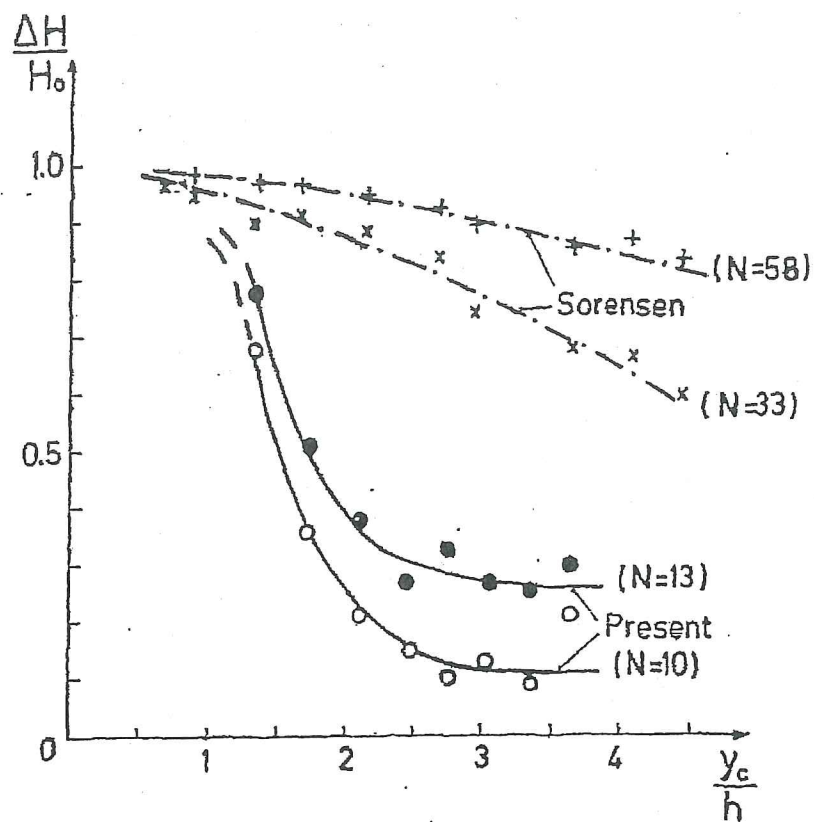


FIG. 3. Variation of Relative Head Loss $\Delta H/H_0$ with y_c/h and N .

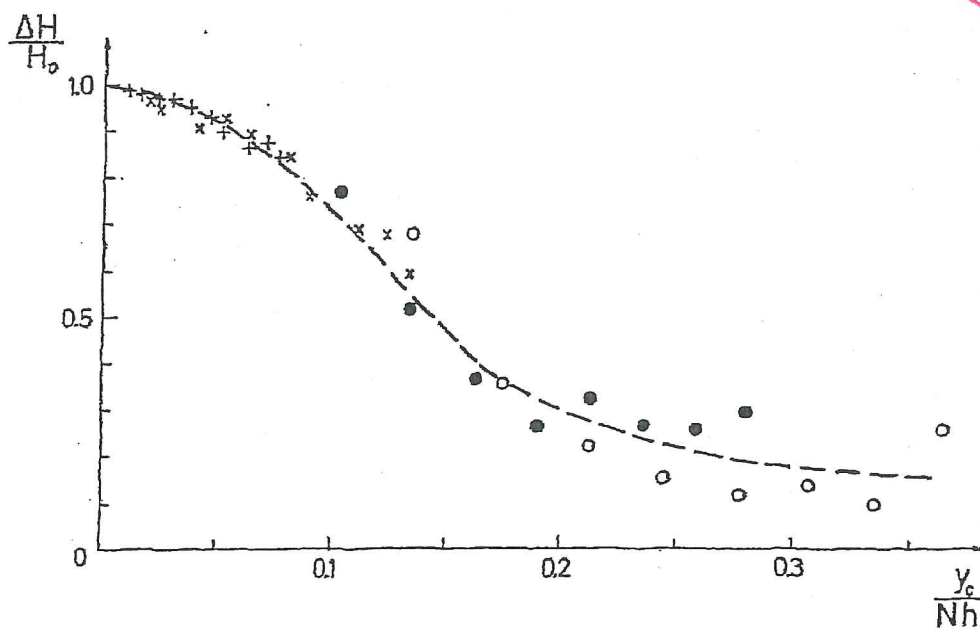


FIG. 4. Dependence of $\Delta H/H_0$ on y_c/Nh .

height of the spillway. This somewhat unexpected dependence on the total height holds provided that the values of y_c/h and l/h are within the ranges tested. (This dependence obviously cannot be generalized for any step size.) With the stated limitations, the experimental curve of Fig. 4 may be used in design practice for straightforward preliminary estimates of the energy loss.

CONCLUSIONS

Experiments on a moderately sized stepped spillway indicate that the energy dissipation may be significantly less than suggested by earlier studies based on the establishment of uniform flow on high spillways. It is found that the energy loss due to the steps depends primarily on the ratio y_c/h , where y_c is the critical depth of flow passing over the spillway, and h is the step height, as well as on the number of steps N . For small values of y_c/h near unity, i.e., near the limit of skimming flow, the stepped surface is very effective in dissipating energy. For higher values of y_c/h , the effect of N becomes appreciable: at a certain y_c/h , the relative energy loss increases with N . The present and previous experimental results can be combined in a single experimental curve expressing the relative energy loss in terms of the parameter y_c/Nh for the commonly used values of l/h close to 0.7 and y_c/h in the range of 1–4.

ACKNOWLEDGMENTS

Partial financial support for this study was provided by the Public Power Corporation of Greece. Experimental measurements were taken by the students H. Tsiodra and G. Halari.

APPENDIX I. REFERENCES

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APPENDIX II. NOTATION

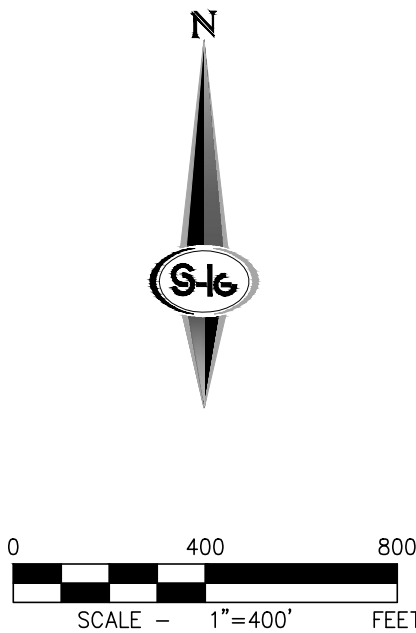
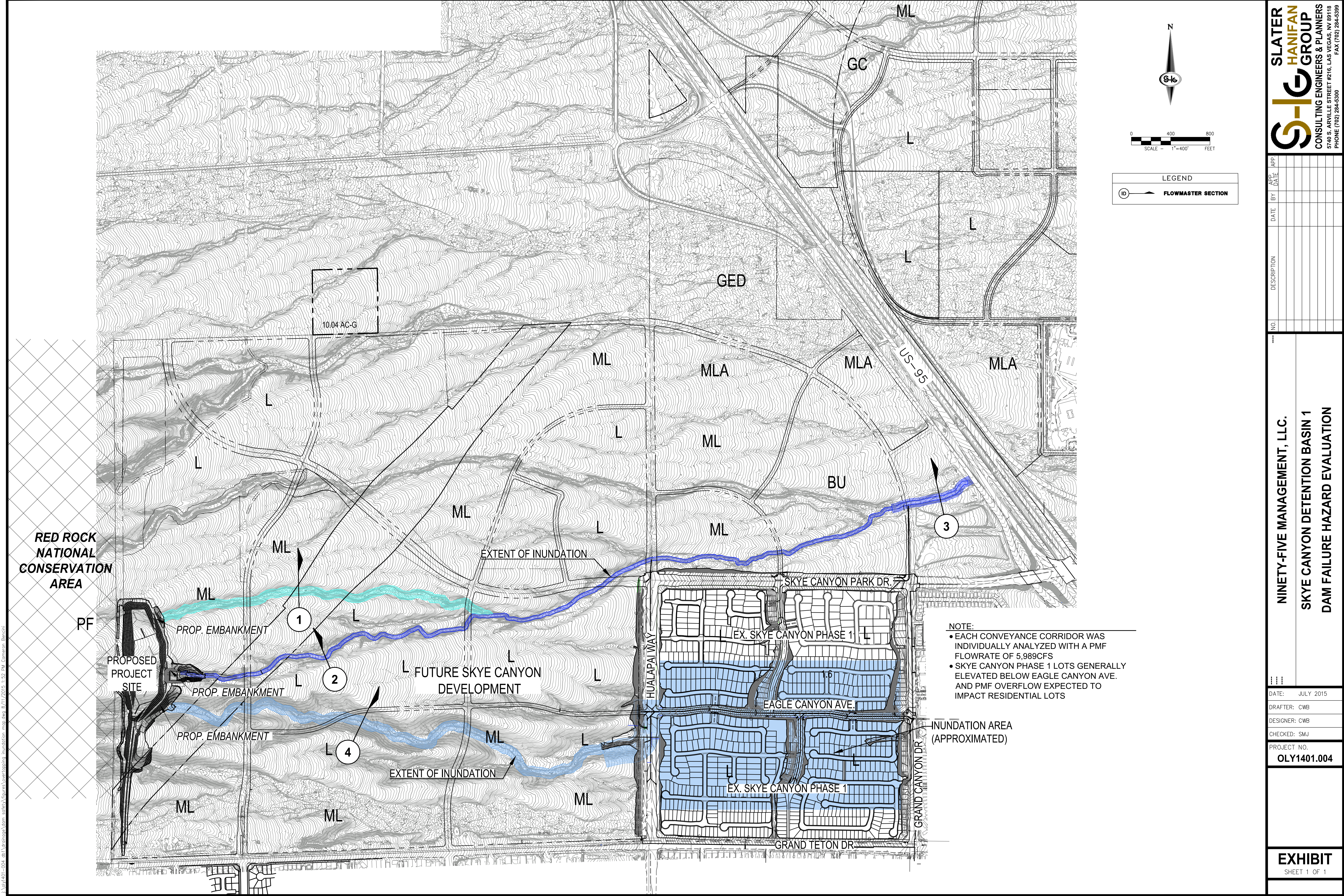
The following symbols are used in this paper:

- B = flume width;
 c_f = effective roughness coefficient;
 d = vertical depth of flow over brink of step;
 f = function;

g = acceleration due to gravity;
 H = local energy head, above chosen step;
 H_0 = upstream head, referred to step elevation;
 h = step height;
 l = step width;
 N = number of steps from crest to chosen level;
 Q = discharge;
 V = local mean velocity;
 V_0 = approach velocity;
 Y = upstream depth;
 y = depth of flow normal to spillway slope;
 y_c = critical depth;
 y_0 = uniform depth;
 $\Delta H = H_0 - H$;
 Δz = elevation difference between chosen step and bottom of flume in front of spillway; and
 θ = angle of downstream face of spillway to horizontal [Fig. 2(a)].

APPENDIX E

Downstream Hazard Evaluation



LEGEND	
(ID)	FLOWMASTER SECTION

- NOTE:**
- EACH CONVEYANCE CORRIDOR WAS INDIVIDUALLY ANALYZED WITH A PMF FLOWRATE OF 5,989CFS
 - SKYE CANYON PHASE 1 LOTS GENERALLY ELEVATED BELOW EAGLE CANYON AVE. AND PMF OVERFLOW EXPECTED TO IMPACT RESIDENTIAL LOTS

INUNDATION AREA
(APPROXIMATED)

SLATER
HANIFAN
GROUP

CONSULTING ENGINEERS & PLANNERS

5740 S. ARVILLE STREET #216, LAS VEGAS, NV 89118

PHONE (702) 284-5300 FAX (702) 284-5399

NO.	DESCRIPTION	DATE	BY	APP.	DATE

NINETY-FIVE MANAGEMENT, LLC.

SKYE CANYON DETENTION BASIN 1

DAM FAILURE HAZARD EVALUATION

DATE: JULY 2015

DRAFTER: CWB

DESIGNER: CWB

CHECKED: SMJ

PROJECT NO.
OLY1401.004

EXHIBIT

SHEET 1 OF 1

Dam Breach - Section 1

Worksheet for Irregular Channel

Project Description	
Worksheet	Section 1
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data	
Channel Slope	5.00 %
Discharge	5,989.00 cfs

Options	
Current Roughness Method	Improved Lotter's Method
Open Channel Weighting Method	Improved Lotter's Method
Closed Channel Weighting Method	Horton's Method

Results	
Mannings Coefficient	0.035
Water Surface Elevation	2,990.58 ft
Elevation Range	2,986.00 to 2,994.00
Flow Area	290.4 ft ²
Wetted Perimeter	90.69 ft
Top Width	89.66 ft
Actual Depth	4.58 ft
Critical Elevation	2,992.64 ft
Critical Slope	1.11 %
Velocity	20.62 ft/s
Velocity Head	6.61 ft
Specific Energy	2,997.19 ft
Froude Number	2.02
Flow Type	Supercritical

Roughness Segments		
Start Station	End Station	Mannings Coefficient
0+00.0	1+25.0	0.035

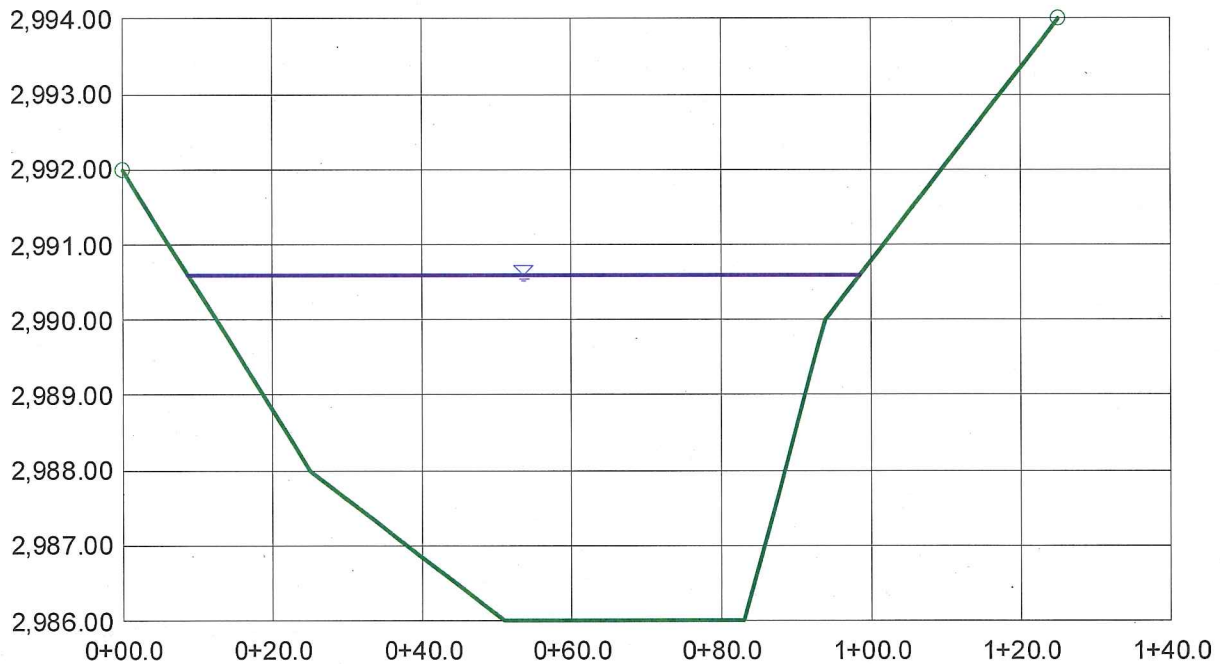
Natural Channel Points	
Station (ft)	Elevation (ft)
0+00.0	2,992.00
0+25.0	2,988.00
0+51.0	2,986.00
0+83.0	2,986.00
0+94.0	2,990.00
1+25.0	2,994.00

Dam Breach - Section 1

Cross Section for Irregular Channel

Project Description	
Worksheet	Section 1
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data	
Mannings Coefficient	0.035
Channel Slope	5.00 %
Water Surface Elevation	2,990.58 ft
Elevation Range	2,986.00 to 2,994.00
Discharge	5,989.00 cfs



V:10.0
H:1
NTS

Dam Breach - Section 2

Worksheet for Irregular Channel

Project Description	
Worksheet	Section 2
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data	
Channel Slope	2.50 %
Discharge	5,989.00 cfs

Options	
Current Roughness Method	Improved Lotter's Method
Open Channel Weighting Method	Improved Lotter's Method
Closed Channel Weighting Method	Horton's Method

Results	
Mannings Coefficient	0.035
Water Surface Elevation	2,990.19 ft
Elevation Range	2,982.00 to 3,002.00
Flow Area	279.6 ft ²
Wetted Perimeter	49.05 ft
Top Width	41.76 ft
Actual Depth	8.19 ft
Critical Elevation	2,992.25 ft
Critical Slope	1.14 %
Velocity	21.42 ft/s
Velocity Head	7.13 ft
Specific Energy	2,997.32 ft
Froude Number	1.46
Flow Type	Supercritical

Roughness Segments		
Start Station	End Station	Mannings Coefficient
0+00.0	1+62.0	0.035

Natural Channel Points	
Station (ft)	Elevation (ft)
0+00.0	3,002.00
0+25.0	3,001.00
0+35.0	2,999.00
0+46.0	2,994.00
0+59.0	2,983.00
0+63.0	2,982.00
0+80.0	2,982.00
0+90.0	2,984.00
0+94.0	2,995.00
1+01.0	2,997.00
1+13.0	2,998.00
1+51.0	2,999.00
1+59.0	3,000.00
1+62.0	3,001.00

Dam Breach - Section 2

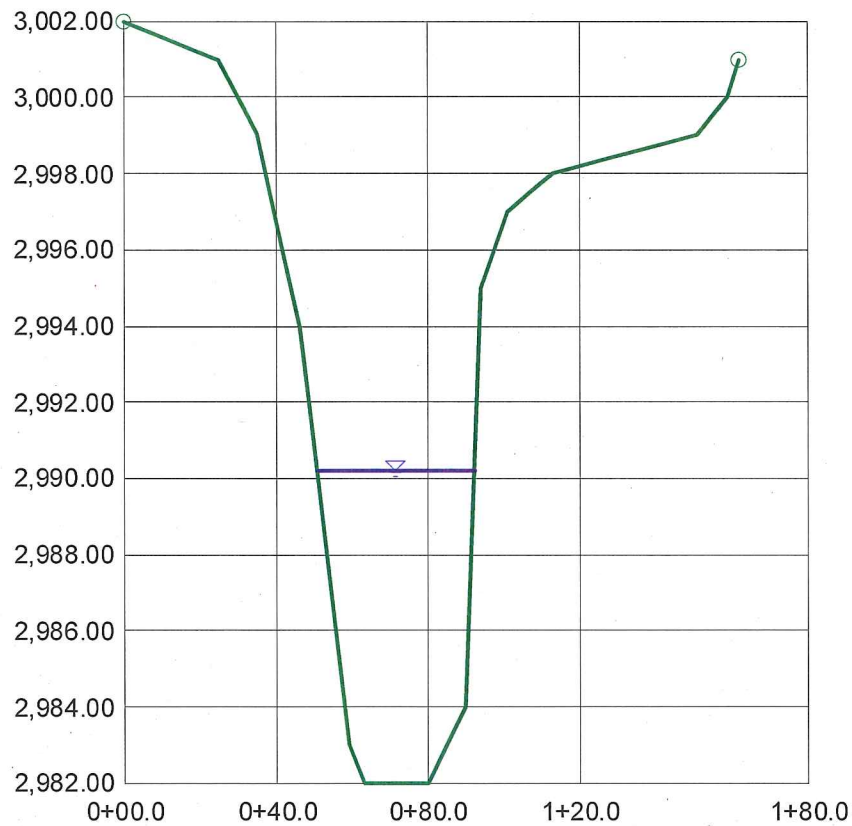
Cross Section for Irregular Channel

Project Description

Worksheet	Section 2
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data

Mannings Coefficient	0.035
Channel Slope	2.50 %
Water Surface Elevation	2,990.19 ft
Elevation Range	2,982.00 to 3,002.00
Discharge	5,989.00 cfs



V:10.0
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NTS

Dam Breach - Section 3

Worksheet for Irregular Channel

Project Description	
Worksheet	Section 3
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data	
Channel Slope	1.64 %
Discharge	2,989.00 cfs

Options	
Current Roughness Method	Improved Lotter's Method
Open Channel Weighting Method	Improved Lotter's Method
Closed Channel Weighting Method	Horton's Method

Results	
Mannings Coefficient	0.030
Water Surface Elevation	2,746.02 ft
Elevation Range	2,743.00 to 2,749.00
Flow Area	243.0 ft²
Wetted Perimeter	90.00 ft
Top Width	88.92 ft
Actual Depth	3.02 ft
Critical Elevation	2,746.58 ft
Critical Slope	0.91 %
Velocity	12.30 ft/s
Velocity Head	2.35 ft
Specific Energy	2,748.37 ft
Froude Number	1.31
Flow Type	Supercritical

Roughness Segments		
Start Station	End Station	Mannings Coefficient
0+00.0	1+09.0	0.030

Natural Channel Points	
Station (ft)	Elevation (ft)
0+00.0	2,749.00
0+08.0	2,747.00
0+13.0	2,744.00
0+18.0	2,743.00
0+88.0	2,743.00
1+09.0	2,749.00

Dam Breach - Section 3

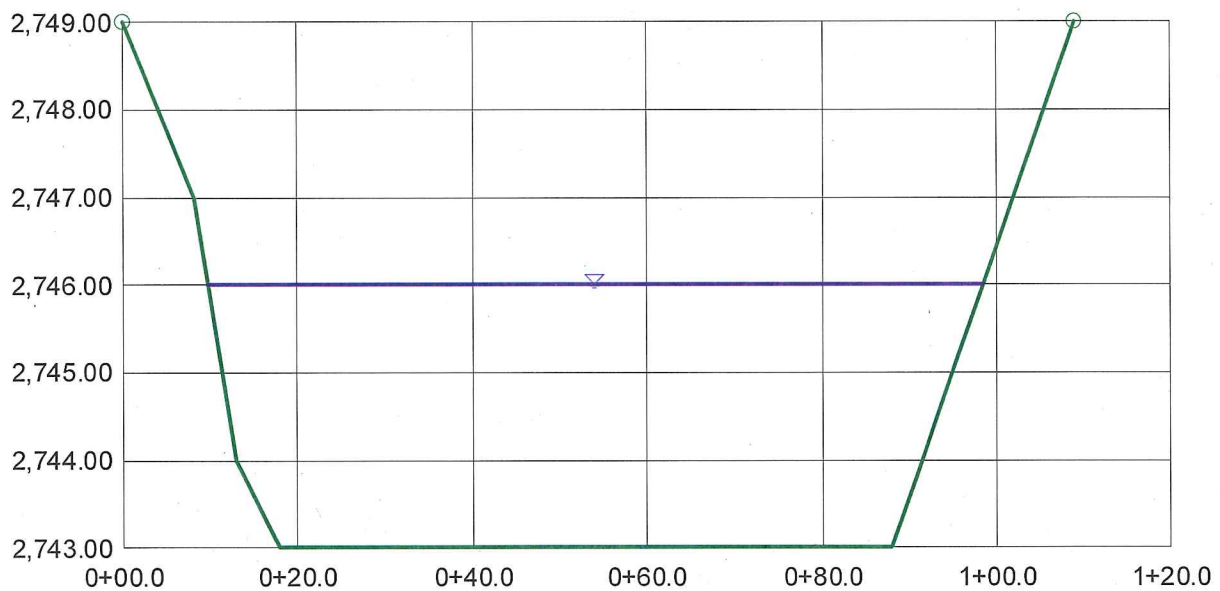
Cross Section for Irregular Channel

Project Description

Worksheet	Section 3
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data

Mannings Coefficient	0.030
Channel Slope	1.64 %
Water Surface Elevation	2,746.02 ft
Elevation Range	2,743.00 to 2,749.00
Discharge	2,989.00 cfs



V:10.0
H:1
NTS

Dam Breach - Section 4

Worksheet for Irregular Channel

Project Description	
Worksheet	Section 4
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data	
Channel Slope	2.00 %
Discharge	5,989.00 cfs

Options	
Current Roughness Method	Improved Lotter's Method
Open Channel Weighting Method	Improved Lotter's Method
Closed Channel Weighting Method	Horton's Method

Results	
Mannings Coefficient	0.035
Water Surface Elevation	2,949.06 ft
Elevation Range	2,942.00 to 2,955.00
Flow Area	387.3 ft ²
Wetted Perimeter	93.67 ft
Top Width	91.80 ft
Actual Depth	7.06 ft
Critical Elevation	2,950.09 ft
Critical Slope	1.10 %
Velocity	15.47 ft/s
Velocity Head	3.72 ft
Specific Energy	2,952.78 ft
Froude Number	1.33
Flow Type	Supercritical

Roughness Segments		
Start Station	End Station	Mannings Coefficient
0+00.0	1+58.0	0.035

Natural Channel Points	
Station (ft)	Elevation (ft)
0+00.0	2,955.00
0+26.0	2,950.00
0+47.0	2,947.00
0+69.0	2,945.00
0+78.0	2,942.00
1+03.0	2,942.00
1+10.0	2,944.00
1+24.0	2,949.00
1+58.0	2,955.00

Dam Breach - Section 4

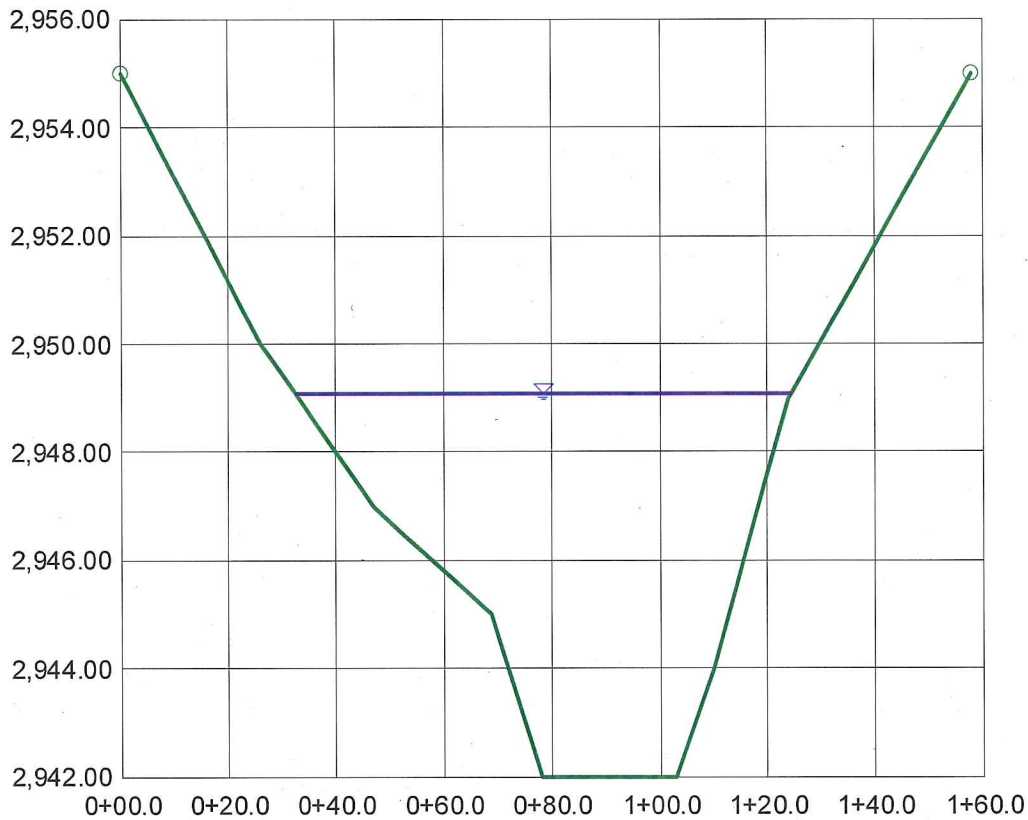
Cross Section for Irregular Channel

Project Description

Worksheet	Section 4
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data

Mannings Coefficient	0.035
Channel Slope	2.00 %
Water Surface Elevation	2,949.06 ft
Elevation Range	2,942.00 to 2,955.00
Discharge	5,989.00 cfs



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H:1
NTS