DOE/NV/25946--2425

RCRA PART B PERMIT APPLICATION

NEVADA NATIONAL SECURITY SITE (NNSS)

FOR WASTE MANAGEMENT ACTIVITIES AT THE NNSS HAZARDOUS WASTE STORAGE UNIT (HWSU)

OCTOBER 2015

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Acronyms

ac	acre(s)
BLM	Bureau of Land Management
CFR	Code of Federal Regulations
cm	centimeter(s)
DoD	U.S. Department of Defense
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
DQO	Data Quality Objectives
EODU	Explosive Ordnance Disposal Unit
EPA	U.S. Environmental Protection Agency
EPIP	Emergency Plan Implementing Procedure
FEMA	Federal Emergency Management Agency
FFACO	*Federal Facility Agreement and Consent Order*
FIRM	Flood Insurance Rate Map
ft	foot (feet)
ft^3	cubic foot (feet)
gal	gallon(s)
ha	hectare(s)
HOC	Halogenated Organic Compounds
HWSU	Hazardous Waste Storage Unit
in.	inch(es)
kg	kilogram(s)
km	kilometer(s)
km^2	square kilometer(s)
L	liter(s)
lb	pound(s)
LDR	land disposal restriction
LLMW	low-level mixed waste
m	meter(s)
m^3	cubic meter(s)
MCC	Maximum Concentration of Contaminants
mi	mile(s)
mi^2	square mile(s)
MWDU	Mixed Waste Disposal Unit

Acronyms (continued)

MWSU	Mixed Waste Storage Unit
NDEP	Nevada Division of Environmental Protection
NNSA/NFO	U.S. Department of Energy, National Nuclear Security Administration Nevada Field Office
NNSS	Nevada National Security Site
ORM	Other Regulated Material
PCBs	polychlorinated biphenyls
PLO	Public Land Order
ppb	part(s) per billion
PPE	personal protective equipment
ppm	part(s) per million
QA	quality assurance
QC	quality control
RCRA	*Resource Conservation and Recovery Act*
RWMC	Radioactive Waste Management Complex
RWMS	Radioactive Waste Management Site
SDS	Safety Data Sheet
SWMU	Solid Waste Management Unit
TCLP	Toxicity Characterization Leaching Procedure
TSDF	treatment, storage, and disposal facility
UR	use restriction
yd^3	cubic yard(s)

B.1 Hazardous Waste Storage Unit Permit Application [40 CFR 270.14(b)(1)]

The Area 5 Hazardous Waste Storage Unit (HWSU) was established to support testing, research, and remediation activities at the Nevada National Security Site (NNSS), a large quantity generator of hazardous waste. The HWSU, located adjacent to the Area 5 Radioactive Waste Management Complex (RWMC), is a prefabricated, rigid steel-framed, roofed shelter used to store hazardous nonradioactive waste generated on the NNSS. No offsite-generated wastes are managed at the HWSU. Waste managed at the HWSU includes the following:

- Flammables/Combustibles
- Acid Corrosives
- Alkali Corrosives
- Oxidizers/Reactives
- Toxics/Poisons
- Other Regulated Materials (ORMs)

A list of regulated waste codes accepted for storage at the HWSU is provided in Section B.2. Hazardous wastes are stored at the HWSU in containers that are compliant with U.S. Department of Transportation (DOT) regulations and compatible with the stored waste. Waste packages (e.g., drums) without inner closed containers of waste remain closed except during inspection or sampling. Transfer of uncontainerized waste between waste packages at the HWSU is prohibited. Closed inner containers may be transferred or consolidated into larger waste packages, and small closed containers may be placed into larger containers. Containers are stored on secondary containment pallets, and the unit is inspected monthly.

B.1.a NNSS General Facility Description

The NNSS is a U.S. Department of Energy, National Nuclear Security Administration Nevada Field Office (NNSA/NFO) installation comprising approximately 3,561 square kilometers (km^2) (1,375 square miles [mi^2]) of federally owned land located in southeastern Nye County, Nevada. Located approximately 105 kilometers (km) (65 miles [mi]) northwest of Las Vegas, Nevada, the NNSS is accessed from U.S. Highway 95, which roughly forms the southern boundary of the site. The site is bordered to the west, north, and east by the Nevada Test and Training Range, another government-owned, restricted-access area. Public land to the south of the NNSS is managed by the Bureau of Land Management (BLM). Land in the surrounding area is predominantly rural, undeveloped public desert lands used for grazing and agriculture.
The NNSS is well buffered from public access. The greater Las Vegas area is the closest major population center to the NNSS. Smaller, rural communities near the NNSS include Amargosa Valley and Pahrump.

The NNSS varies in distance from 46 to 57 km (28 to 35 mi) in the east/west direction and from 65 to 90 km (40 to 55 mi) in the north/south direction. Elevation varies from approximately 915 to 2,345 meters (m) (3,000 to 7,700 feet [ft]) above sea level. The terrain of the NNSS is characteristic of the Basin and Range Physiographic Province in Nevada, Arizona, and Utah, which is a province of intervening valleys and ranges, all nearly parallel. There are numerous north to northeast trending mountain ranges separated by gently sloping linear valleys and broad flat basins. The principal valleys within the NNSS are Frenchman Flat, Yucca Flat, and Jackass Flats, with the principal highlands consisting of Pahute Mesa, Rainier Mesa, Timber Mountain, and Shoshone Mountain. Generally, large portions of the NNSS are within one or two elevation ranges from approximately 915 to 1,220 m (3,000 to 4,000 ft) in the valleys to the south and east to 1,675 to 2,225 m (5,500 to 7,300 ft) in the high country toward the northern and western boundaries.

Mercury, the base camp at the NNSS, is located in the southeast corner of the site, approximately 6.5 km (4.0 mi) north of U.S. Highway 95. Mercury has administrative and maintenance structures that currently support a working population of approximately 1,000 workers and a residential capacity of approximately 350. NNSS areas outside of Mercury were used for many activities. In Area 5, the Frenchman Flat vicinity was designated for atmospheric testing, hazardous materials spill testing, underground nuclear testing, and radioactive waste management. Yucca Flat and Rainier Mesa were both used for underground nuclear tests, and Yucca Flat was used for atmospheric nuclear tests. The Pahute Mesa vicinity was used for higher-yield underground nuclear tests.

Historically, the primary mission of the NNSS was to conduct nuclear weapons tests. Since the moratorium on nuclear weapons testing began in October 1992, this mission has changed to maintaining readiness to conduct these tests, if so directed. Because of its favorable environment and infrastructure, the NNSS supports national security-related research, development, and testing programs, as well as waste management activities.

Numerous government and/or research organizations use the NNSS for a variety of research activities and/or programs because of its specialized facilities, favorable climate, remote location, and controlled access. The research and testing activities comprising these programs are directly supported by NNSA/NFO.

National Security Technologies, LLC, the Management and Operations Contractor, provides a number of services including designing and operating the functioning hazardous waste management units at the NNSS. The contractor also provides onsite medical services and operates the NNSS Fire and Rescue Department. Additionally, NNSA/NFO maintains separate contracts for 24-hour security services (armed patrol and access control), while the Nye County Sheriff's Office provides law enforcement support on the NNSS.

In addition to *Resource Conservation and Recovery Act (*RCRA) requirements, the HWSU is subject to U.S. Department of Energy (DOE) Orders and other applicable federal and state regulations.

Table 1 provides the metric conversion factors used in this application. Table 2 provides a list of existing permits. The following figures are provided to further depict the features and uses of the NNSS.

- Figure 1, General Location Map
- Figure 2, Topographic Features and Infrastructure Map
- Figure 3, Area 5 HWSU Topographic Map/1,000-Foot Boundary
- Figure 4, NNSS Land Use Map
- Figure 5, Aerial View of the HWSU

Exhibit 1 includes construction drawings for the HWSU.

Table 1. Metric Conversion Factors

Unit	Equals
1 ha	2.471 ac
1 cm	0.394 in.
1 kg	2.205 lb
1 L	0.264 gal
1 m	3.281 ft
1 m^3	35.32 ft^3
1 m^3	1.308 yd^3
1 km	0.621 mi
1 km^2	0.386 mi^2
1 metric ton	1.102 short tons
The actual value (or real value), which is in metric units, is converted to the corresponding value in English units using the conversion factors listed above. The converted value is then rounded in the following manner.	
Numerical Range	**Rounded to the Nearest…**
0–10	0.10
10–100	1
100–5,000	5
5,000–10,000	10
10,000–500,000	100
500,000–1,000,000	1,000
>1,000,000	10,000

Table 2. List of Existing Permits

Number	Type, Area, Location
NY-1054	Septic System, Area 3, Waste Management Office
NY-1069	Septic System, Area 18, 820th Red Horse Squadron
NY-1077	Septic System, Area 27, Baker Compound
NY-1106	Septic System, Area 5, Building 5-8
NY-1079	Septic System, Area 12 (U12g Tunnel)
NY-1080	Septic System, Area 23, Building 1103
NY-1081	Septic System, Area 6, CP-170
NY-1082	Septic System, Area 22, Building 22-1
NY-1083	Septic System, Area 5, Radioactive Material Management Site (RWMS)
NY-1084	Septic System, Area 6, Device Assembly Facility
NY-1085	Septic System, Area 25, Central Support Area
NY-1086	Septic System, Area 25, Reactor Control Point
NY-1087	Septic System, Area 27, Able Compound
NY-1089	Septic System, Area 12 Camp
NY-1090	Septic System, Area 6, LANL Construction Campsite
NY-1091	Septic System, Area 23, Gate 100
NY-1103	Septic System, Area 22, Desert Rock Airport
NY-1110-HAA-A	Individual Sewage Disposal System, A-12, Bldg. 12-910
NY-1112	Commercial Sewage Disposal System, U1a, Area 1
NY-1113	Commercial Sewage Disposal System, Area 1, Building 121
NY-1124	Commercial Individual Sewage Disposal System, Area 6
NY-1128	Area 6 Yucca Lake Project
NY-1130	Commercial Individual Sewage Disposal System, Area 6, Fire Station #2
NY-17-06839	Septic Tank Pumping Contractor (5 units)
GNEV93001	Water Pollution Control General Permit
NEV96021	Water Pollution Control for E-Tunnel Waste Water Disposal System and Monitoring Well ER-12-1
31297	NNSS Hazardous Materials Permit
31304	Nonproliferation Test and Evaluation Complex Hazardous Materials Permit
NEV HW0101	NNSS Hazardous Waste Management Permit (RCRA)
AP9711-2557	NNSS Class II Air Quality Operating Permit
AP9711-2659	UGTA Surface Area Disturbance Permit ER-EC-13 and ER-EC-15
AP9711-2824	UGTA Surface Area Disturbance Permit ER-EC-14
NY-0360-12NTNC	Public Water System Area 23 and Area 6
NY-4098-12TNCWS	Public Water System Area 25
NY-4099-12TNCWS	Public Water System Area 12
NY-0835-12NP	NNSS (Water Hauler) #84846
NY-0836-12NP	NNSS (Water Hauler) #84847
SW 532	Area 5 Asbestiform Low-Level Solid Waste Disposal Site
SW 13 097 02	Area 6 Hydrocarbon Disposal Site
SW 13 097 03	Area 9 U10c Solid Waste Disposal Site
SW 13 097 04	Area 23 Solid Waste Disposal Site
UNEV2012203	NNSS Underground Injection Control Permit

Figure 1. General Location Map

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GRAPHIC SCALE
0 2000 10000 20000 30000 FEET
1" = 10000'

GS

NATIONAL NUCLEAR SECURITY ADMINISTRATION
NEVADA FIELD OFFICE — LAS VEGAS, NEVADA

NEVADA NATIONAL SECURITY SITE — AREA 05A
RCRA UNITS

GENERAL LOCATION MAP

DRAWN	PREPARER	CHECKER	PROJECT ENGINEER	APPROVER / USER
S. Plunk 4-21-15	[signature] 4/21/15	N/A	[signature] 4/21/15	N/A

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ENGINEERING NO. 01327
ORIGINAL SIGNATURES ON FILE
DRAWING NUMBER / WORK ORDER NUMBER: SK-01327-C-1001
REVISION 0

Figure 2. Topographic Features and Infrastructure Map

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NATIONAL NUCLEAR SECURITY ADMINISTRATION

NEVADA FIELD OFFICE — LAS VEGAS, NEVADA

NEVADA NATIONAL SECURITY SITE — AREA 05A

RCRA UNITS

TOPOGRAPHIC FEATURES & INFRASTRUCTURE

DRAWN	DATE	PREPARER	DATE	CHECKER	DATE	PROJECT ENGINEER	DATE	APPROVER / USER	DATE
S. Plub	4-21-15	J. Sowle	4/21/15	N/A		[signature]	4/21/15	N/A	

National Security Technologies LLC
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REVISION 0

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Figure 3. Area 5 HWSU Topographic Map 1,000-Foot Boundary

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Figure 4. NNSS Land Use Map

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Figure 5. Aerial View of the HWSU

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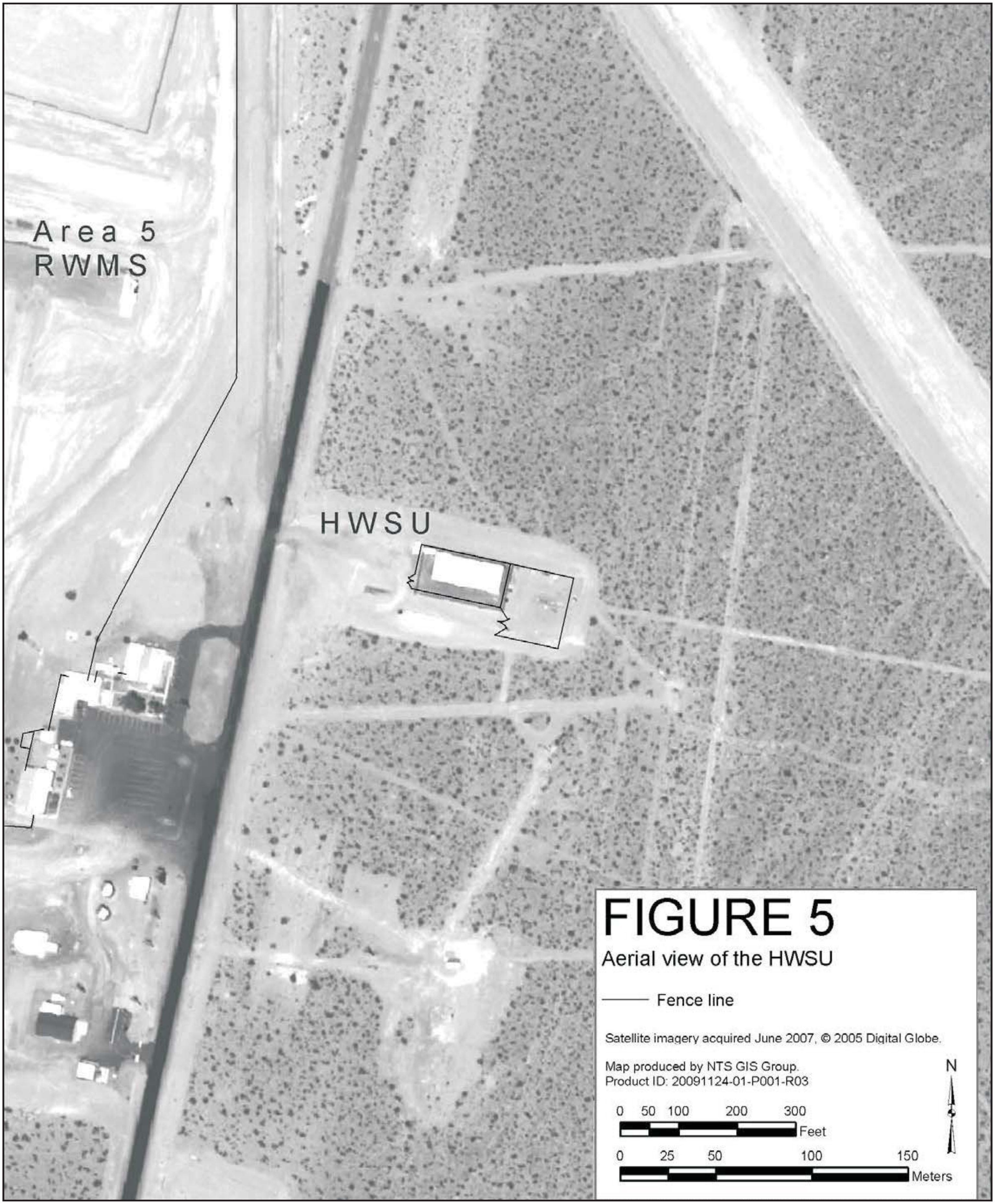

FIGURE 5

Aerial view of the HWSU

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EXHIBIT 1. HWSU Construction Drawings

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B.1.b RCRA Permit Application History

The HWSU was used from April 1990 to May 1995 as a 90-day storage area for hazardous waste. The Nevada Division of Environmental Protection (NDEP) issued a RCRA Part B Permit (Permit NEV HW009) for this facility on May 1, 1995, which was subsequently renewed in November 2000. The RCRA Part B Permit for the HWSU was re-issued in November 2005 as Permit NEV HW0021 and in October 2010 as Permit NEV HW0103. In April 2011, the HWSU was incorporated into Revision 2 of Permit NEV HW0101, which kept its original effective date of December 2010. Permit NEV HW0101 was subsequently modified in 2013 as Revision 3. Since 1995, the HWSU has been used for the storage of hazardous waste for a period not to exceed one year before offsite shipment to a treatment and disposal facility. There have been no reported releases at the Area 5 HWSU that have required reporting under RCRA; the *Comprehensive Environmental Response, Compensation, and Liability Act*; or the *Superfund Amendments and Reauthorization Act*.

B.1.c Summary of RCRA Operational Units

Figure 1 and Table 3 provide the locations of each RCRA operational unit on the NNSS and its regulatory status. Specific information for the Cell 18 Mixed Waste Disposal Unit (MWDU), the Area 11 Explosive Ordnance Disposal Unit (EODU), the Area 5 HWSU, and the Area 5 Mixed Waste Storage Unit (MWSU) can be found in the RCRA Part B Permit Application for each unit and the NDEP Permit for a Hazardous Waste Management Facility (NEV HW0101).

Table 3. Operational Unit Locations and Regulatory Status

Unit Name	Location	Regulatory Status	Permit	Effective Date
MWSU	Area 5 RWMC	Permitted	NEV HW0101	December 2010
Cell 18 MWDU	Area 5 RWMC	Permitted	NEV HW0101	December 2010
EODU	Area 11	Permitted	NEV HW0101	December 2010
HWSU	Area 5	Permitted	NEV HW0101	December 2010

Cell 18 MWDU

Cell 18 MWDU is a fully compliant, RCRA-permitted landfill that disposes of onsite and offsite containerized low-level mixed waste (LLMW) from an approved DOE nexus. The permitted capacity of the unit is 25,485 cubic meters (m^3) (33,300 cubic yards [yd^3]).

EODU

The Area 11 EODU is a permitted thermal treatment unit for explosive waste treatment operations. The unit encompasses approximately 8.1 hectares (ha) (20 acres [ac]) of land. A storage magazine is used to store explosive materials and serves as a satellite accumulation area for waste explosives. The unit has an annual estimated capacity of 1,875 kilograms (kg) (4,130 pounds [lb]) of waste. The process design capacity of the EODU is 45 kg per hour (100 lb per hour).

HWSU

The Area 5 HWSU is a permitted storage unit for hazardous nonradioactive waste generated on the NNSS. It is located immediately to the east of the Area 5 RWMC. The storage design capacity of the HWSU is approximately 61,600 liters (L) (16,300 gallons [gal]).

MWSU

The Area 5 MWSU is a permitted storage unit for onsite and offsite containerized LLMW from an approved DOE nexus. It is located within the Area 5 RWMC and uses existing facilities at the RWMC to store LLMW.

B.1.d General Dimensions and Structural Design

The HWSU structure is a prefabricated, rigid steel-framed, roofed shelter. The unit is a monolithic pour, cell-type unit with a coating applied to the exposed surfaces. The columns that support the roof are bolted to the foundation. The storage area floor is 31 m (100 ft) long by 9.1 m (30 ft) wide. Integral 15-centimeter (cm) (6-inch [in.]) curbs are provided above the 15-cm (6-in.) concrete floor slab, around the exterior of the structure, and between the five segregated storage cells. The structure is built on a compacted earthen pad.

The general HWSU and pallet layout, shown in Figure 6, provides an example of a typical waste segregation scheme. Because a flexible inventory of waste may be stored at the Area 5 HWSU, container segregation is consistent with the requirements of **40 CFR 264.177(c)** and may not conform to the specific configuration depicted in Figure 6.

Access to the HWSU is provided by a locked double gate. The facility is locked at all times, except during container management, inspection, or maintenance operations. Ramps along the south side of the Area 5 HWSU allow for access to storage cells A, B, C, D, and F. The perimeter of the Area 5 HWSU is surrounded by a chain-link cyclone fence. Figure 7 depicts the access to the Area 5 HWSU.

B.1.d.1 Secondary Containment Basic Design, Materials of Construction, Capacity, and Container Management

Secondary containment for hazardous wastes that could be released from containers is provided by the poly-spill pallet. The concrete surface is covered with a coating that is resistant to materials that may be stored on the HWSU. This coating serves as a cosmetic feature, although the coating material is chemical-resistant. Figure 7 provides the HWSU facility drawing.

The storage cells have no drainage sumps or piping. The concrete floor is level. Containers of both liquid and non-liquid waste are placed on spill pallets (except when consolidation is in progress) to minimize the potential for contact between the container and any incidental precipitation ponding on the storage cells. The poly-spill pallets, which meet the secondary containment requirements for liquid waste specified in **40 CFR 264.175(b)(3)**, can collect 10 percent of the volume of all the containers on the pallet or the volume of the largest container, whichever is greater. Spills from containers collect in the sump, preventing contamination of the HWSU floor. Furthermore, the poly-spill pallets offer excellent chemical resistance. The HWSU’s maximum capacity consists of a total volume of approximately 61,600 L (16,300 gal).

Figure 6. Area 5 HWSU and Pallet Layout

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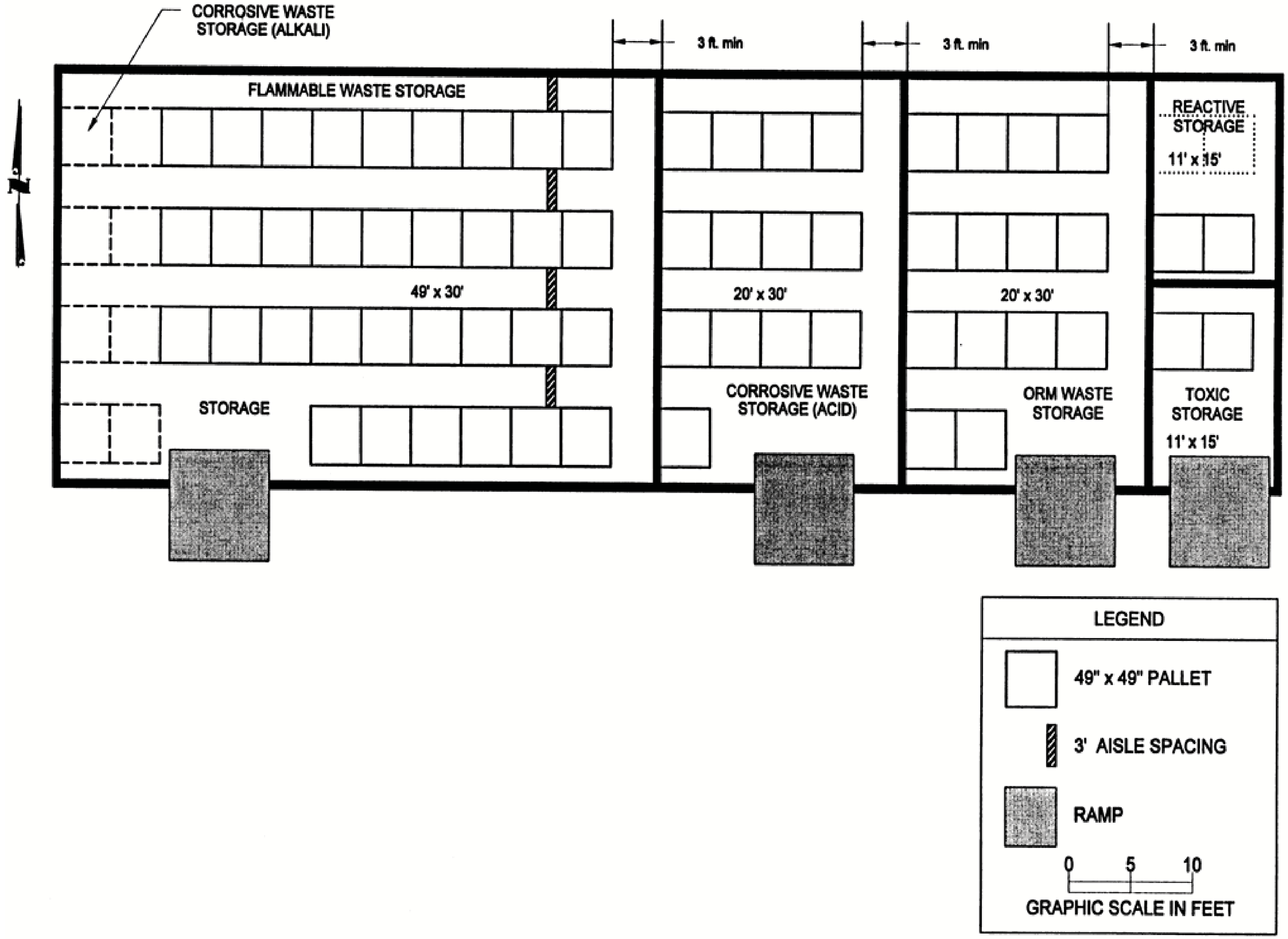

Area 5 HWSU and Pallet Layout

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Figure 7. HWSU Access and Utilities

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B.2 Chemical and Physical Analysis [40 CFR 270.14(b)(2)]

B.2.a Introduction

Hazardous, nonradioactive waste managed at the HWSU is generated within the NNSS at numerous locations. Solid wastes that are not regulated under Subtitle C of RCRA (and do not meet the acceptance criteria of permitted NNSS landfill disposal sites or sewage lagoons) may also be stored at the HWSU before offsite shipment.

Waste must be fully characterized to identify all hazardous waste codes before storage at the HWSU. Laboratory services, if required for waste characterization analyses, are provided by an offsite laboratory certified under Nevada Administrative Code 445A.0552 through 445A.0665.

The NNSS is a testing facility and maintains the capability to accept and manage a number of potential diverse hazardous waste streams. The maximum annual volume of hazardous waste generated from these activities for ultimate storage at the HWSU is not anticipated to exceed 246,500 L (65,100 gal).

B.2.b Hazardous Waste Characteristics

Hazardous waste at the NNSS is generated from a variety of sources, including routine and non-routine activities such as maintenance, construction, testing, laboratory, and research activities. Wastes include both characteristic and listed hazardous waste such as metals, expired chemicals and products, solvent waste, paint waste, aerosol products, expired medical products, compressed gases, soil and other media, contaminated personal protective equipment (PPE), and abandoned products.

Processes generating wastes include laboratory operations, fleet maintenance, site maintenance, custodial services, photographic processing, construction and demolition activities, experimental research, remediation activities, and medical support operations.

Occasionally, the hazardous wastes are shipped directly offsite to a contracted treatment, storage, and disposal facility (TSDF). Remediation wastes may be managed at the HWSU if they conform to the acceptance criteria.

B.2.c Chemical Compatibility

Wastes stored at the HWSU are fully characterized and containerized before transfer to the unit. This is done to ensure that all wastes are stored in a proper DOT container that is compatible with the stored waste.

Table 4 lists waste codes applicable to the HWSU and the design capacity of the unit.

Table 4. General Information – Area 5 HWSU

Process Code	S01 (Container Storage)
Waste Codes	D001 through D043
	F001 through F011, F027, and F039
	P001 through P018, P020 through P024, P026 through P031, P033, P034, P036 through P051, P054, P056 through P060, P062 through P078, P081[1], P082, P084, P085, P087 through P089, P092 through P099, P101 through P106, P108 through P116, P118 through P123, P127, P128, P185, P188 through P192, P194, P196 through P199, and P201 through P205
	U001 through U012, U014 through U039, U041 through U053, U055 through U064, U066 through U099, U101 through U103, U105 through U138, U140 through U174, U176 through U194, U196, U197, U200, U201, U203 through U211, U213 through U223, U225 through U228, U234 through U240, U243, U244, U246 through U249, U271, U278 through U280, U328, U353, U359, U364, U367, U372, U373, U387, U389, U394, U395, U404, and U409 through U411 Polychlorinated biphenyls (PCBs) – state hazardous waste
Estimated Annual Quantity of Waste	246,500 L (65,100 gal)
Process Design Capacity	61,600 L (16,300 gal)
[1] Nitroglycerin – nonreactive medical waste	

B.3 Waste Analysis Plan [40 CFR 270.14(b)(3)]

B.3.a Waste Analysis Plan

This Waste Analysis Plan describes the procedures that must be instituted to comply with **40 CFR 264.13**. When a waste is generated, a waste determination is made to ascertain if the waste is hazardous according to **40 CFR 262.11**. The hazardous waste is accumulated in a container with the appropriate marking, labeling, container compatibility, and management requirements. If the waste is to be subsequently managed at the HWSU, the generator, at a minimum, must provide acceptable knowledge information for storage, treatment, or disposal of the waste according to **40 CFR 264** and **268**.

B.3.a.1 Acceptable Knowledge

Acceptable knowledge information may include (1) sufficient process knowledge, (2) a detailed chemical and physical analysis of a representative sample of the waste to confirm the presence or absence of constituents regulated in **40 CFR 261**, or (3) a combination of both. For wastes with hazardous constituents that are either listed on the container, noted on the Safety Data Sheet (SDS) or manufacturer's information, or available through process knowledge, sampling and analysis is not required. This acceptable knowledge information is considered sufficient for identifying and managing the waste onsite according to federal and state regulations. SDSs and process knowledge information can be used to characterize wastes for which sampling is impractical (e.g., batteries, aerosol cans).

B.3.a.2 Chemical Analysis and Rationale

If sufficient information cannot be derived from generator knowledge or SDSs, sampling and analysis are performed on a waste to fulfill the characterization requirements. The test methods employed for each waste stream depend upon the type of waste and the quantity of information available from the generator. Table 5 presents each parameter, the rationale for the parameter selection, and the corresponding U.S. Environmental Protection Agency (EPA) SW-846 analytical methods, but is not intended to present an all-inclusive list of the test methods that can be used. Other EPA test methods may be employed as necessary. The volume of waste obtained for waste analysis depends upon the method of analysis requested and the specific requirements of the analytical laboratory.

B.3.a.3 Waste Analysis Frequency

All waste streams offered for storage are evaluated and characterized before pickup and transport to the HWSU.

Any noted changes in the characteristics of the waste are evaluated with regard to the adequacy and conformance to packaging and labeling specifications. In addition, a significant change in characteristics may render the waste unsuitable for storage at the HWSU. In this case, the waste would continue to be managed in a satellite or 90-day accumulation location until a permit modification is approved by NDEP, or it may be transported directly offsite. Waste container exteriors are radiologically assayed before being transported to the HWSU for storage, unless acceptable knowledge precludes the possibility of radioactive contamination.

Table 5. Waste Parameter Information

EPA Method[1]	Parameter	Rationale for Parameter Selection
9014 or 9034	Reactivity	Identify reactive wastes
1010 or 1020	Ignitability	Identify ignitable wastes (only if liquid is present) by testing and comparison with definitions in 40 CFR 261.21
9095 or 1311 (Pressure Test)	Free liquids	Identify free liquids prohibited by Land Disposal Restrictions (LDRs)
9040 or 9041	Corrosivity	Identify corrosive wastes (only if liquid) by testing and comparison with definitions in 40 CFR 261.22
1311[2]	Toxicity Characterization Leaching Procedure (TCLP)	Identify EPA-regulated toxic wastes by testing and comparison with definitions in 40 CFR 261.24
6010, 6020, or 7000 series	TCLP metals analysis	Identify EPA-regulated characteristic metals in waste
8000 series	TCLP volatiles analysis	Identify EPA-regulated characteristic or listed volatile compounds in waste
8000 series	TCLP semivolatiles analysis	Identify EPA-regulated characteristic or listed semivolatile compounds in waste
8000 series	Halogenated Organic Compounds (HOCs)[3]	Determine LDR compliance for HOC > 1,000 parts per million (ppm)
8082	PCBs	Determine compliance with LDR treatment standard
Atomic Absorption Spectroscopy methods listed in 40 CFR 261, Appendix III	Inorganics	Determine compliance with LDR treatment standard; detection limit range is low parts per billion (ppb) to low ppm.
Inductively Coupled Plasma-Atomic Emission Spectroscopy	Inorganics	Determine compliance with LDR treatment standard; detection limit range is low to high ppb.

[1]Referenced methods are from Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods, SW-846.

[2]An alternative to performing Method 1311 is to perform total contaminant concentration analysis and assume all contaminants to be leachable using the TCLP method. In this case, the total concentration in the waste is compared to a Maximum Concentration of Contaminants (MCC), which is 20 times higher than the MCC for the leachate.

[3]As specified in 40 CFR 268.2(a) and 40 CFR 268, Appendix III.

B.3.b Waste Sampling

If sufficient information for a waste determination cannot be derived from characterization activities including process knowledge, sampling and analysis are performed on a waste to fulfill the waste acceptance requirements.

(1) Sampling Devices

Commonly used sampling equipment is listed in Table 6.

Table 6. Sampling Devices

Liquid Waste These devices are used to sample aqueous and liquid materials.	Coliwasa	A Coliwasa sampler consists of an adjustable sampling tube made of plastic or glass. The tube has a closure-locking mechanism to trap liquid samples. The sampler is lowered into the liquid waste. When it reaches the bottom of the waste container, the sampler is closed to trap the waste sample.
	Dipper	A dipper consists of a telescoping fiberglass or aluminum pole to which a glass or beaker is attached by a clamp. The telescoping pole serves as a handle to dip the beaker into the waste.
	Weighted Bottle	The weighted bottle sampler is a plastic or glass bottle with a sinker and a stopper. The bottle is attached to a line that is used to raise, lower, and open the stopper.
Solid Waste These devices are used to sample solid and soil-like materials.	Thief	A thief sampler consists of a stainless steel tube with an inner tube that opens and closes. The device has a pointed tip that allows penetration into solid materials. The thief is inserted into the waste and the tube is rotated to open the inner tube to retrieve the waste sample and to close the inner tube to retain the waste sample.
	Trier	A trier is used to sample loosened soil or moist or sticky solid materials. The device is a long tube-like scoop with a sharpened end for cutting a core of the waste.
	Scoop or Shovel	These devices are used to obtain a cross-section of the waste.
	Auger	An auger consists of spiral blades attached to a metal shaft. The device bores into the soil or solid to be sampled until the desired depth is reached.
	Veihmeyer Soil Sampler	The device consists of a chromium-molybdenum tube with a drive head. A drive hammer is used to pound the device to the desired soil depth. The sample can be removed from the tube for analysis.

(2) Sampling Techniques

(a) Grab Sample

Grab samples are collected at a particular time and place and represent only the composition of the source at that time and place. The representativeness of grab samples is defined by the nature of the material being sampled. Grab samples are useful when a source is known to be reasonably constant (homogeneous) over time and location. In general, as sources vary over time and location, the representativeness of grab samples will decrease.

(b) Composite Samples

Composite samples are non-discrete samples composed of more than one specific aliquot collected at various sampling locations and/or different points in time. Analysis of this type of sample produces an average value and can be used as an alternative to analyzing a number of individual grab samples and calculating an average value.

(3) Sampling Methods

(a) Random Sampling

If a batch of waste is completely homogeneous with regard to the chemical properties of concern, and the chemical homogeneity is constant (uniform) over time (from batch to batch), a single sample collected from the waste at an arbitrary location and time theoretically generates an accurate and precise estimate of the chemical properties.

(b) Simple Random Sampling

If a batch of waste is randomly heterogeneous with regard to chemical characteristics, and the random chemical heterogeneity remains constant from batch to batch, accuracy and appropriate precision can be achieved by this method. All units in the population (essentially all locations or points in all batches of waste from which a sample could be collected) are identified, and a suitable number of samples is randomly selected from the population.

(c) Stratified Random Sampling

This method is appropriate if a batch of waste is known to be non-randomly heterogeneous in terms of its chemical properties and/or nonrandom chemical heterogeneity is known to exist from batch to batch. In such cases, the population is stratified to isolate the known sources of nonrandom chemical heterogeneity. After stratification, which may occur over space (locations or points in a batch of waste) and/or time (each batch of waste), the units in each stratum are numerically identified, and a simple random sample is taken from each stratum.

B.3.c Quality Assurance (QA) and Quality Control (QC)

QA/QC samples are obtained to confirm that accurate waste characterization information is collected, ensuring that the waste managed at each operational unit possesses the chemical and physical properties ascribed by the permit. The QA/QC procedures that are used conform to the technical aspects and specific test methods described in the current edition of EPA SW-846 (Test Methods for Evaluating Solid Waste, Physical/Chemical Methods).

The type of QA/QC samples depend upon the Data Quality Objectives (DQOs) relevant to the type of waste stream to be analyzed. DQOs are qualitative and quantitative statements that specify the quality of the data required (overall level of uncertainty that a decision-maker is willing to accept). They are based on the end uses of the data to be collected. This uncertainty is used to specify the quality of the measurement data required, usually in terms of objectives for precision, bias, representativeness, comparability, and completeness. DQOs are often determined by the nature of the test being performed. The purpose and goals of the project are to be defined before sampling activities begin, with the understanding that not all environmental programs require the same quality of data. Defining DQOs specific to a program by tailoring requirements (e.g., QA, QC, analytical methods) to the specific project can eliminate unnecessary requirements while still achieving accurate analytical results that are up to date. The DQOs developed for the project are translated into performance objectives (i.e., data quality requirements) that reflect requirements to meet **40 CFR 264.13**.

Analyzing waste is crucial to determine proper packaging, labeling, marking, segregating, and waste code assignment. Treatment technologies may require more accurate determination of contaminant concentrations to aid in the treatment process. Additional QA/QC samples may be required to validate the concentrations or presence of certain analytes.

(1) Sampling QA/QC

Procedures are implemented for QA/QC during sampling as specified in SW-846. A set of samples is defined as a group of 20 or fewer samples of the same matrix, collected at a specific point in time, and transported together from the sampling site. QA/QC samples will be collected at frequencies based on the prescribed DQOs. The following provides a description of the QA/QC samples that may be used based on the DQOs.

(a) Trip Blank

A trip blank is taken when samples for volatile organic analysis are required. The trip blank is prepared in an analyte-free environment from analyte-free media (such as distilled water) before leaving for the sampling site. The trip blank is taken to the sampling site and returned to the laboratory unopened. The trip blank serves to identify and document cross-contamination of volatile organic compounds during sample handling, transportation, and storage.

(b) Field Duplicate

The sample and its field duplicate are two independent samples taken from the same source, taken at the same point in time, stored in separate containers, and independently analyzed. The field duplicate is used to document the precision of the sampling process (variance in waste composition and/or sampling technique).

(c) Equipment Rinsate

An equipment rinsate/field blank consists of analyte-free aqueous aliquots that contact sampling equipment under field conditions. This blank is used to document adequate decontamination of sampling equipment, cross-contamination from previously collected samples, or contamination from conditions during sampling. An equipment rinsate/field blank is collected at specified frequencies according to the probability of contamination or cross-contamination.

(d) Matrix Spike

A matrix spike sample is an independent sample collected to document the bias of a method in a given sample matrix. This sample is spiked (in the laboratory) with a known concentration of target analytes before sample preparation and analysis.

(e) Matrix Spike Duplicate

A matrix spike duplicate is an independent sample collected to document precision and bias of a method in a given sample matrix. This sample is spiked (in the laboratory) with a known concentration of target analytes before sample preparation and analysis.

(2) Laboratory QA/QC

Any laboratory that analyzes waste managed at the NNSS must prepare and implement a QA/QC program to ensure that analytical data are reliable. Laboratory QA/QC activities will include the following:

- Use of EPA-recommended sample preparation and analytical methods
- Calibration of laboratory instruments
- Periodic inspection, maintenance, and servicing of instrumentation and standards

- Use of spikes, blanks, and duplicates
- Use of statistical procedures to monitor precision and accuracy
- Continuous review of results to identify and correct problems
- Participation in external laboratory evaluations
- Use of formal chain-of-custody procedures
- Maintenance and storage of records, charts, and logs of pertinent laboratory calibration, analytical, and QC activities and data
- Documenting the performance of systems and operators

B.3.d Land Disposal Restriction Storage Provisions

Hazardous waste is stored at the HWSU solely for the purpose of accumulating sufficient quantities of waste to facilitate offsite shipment for recycling, treatment, or disposal. Because no treatment is performed at the HWSU, NNSA/NFO complies with the notification requirements set forth in **40 CFR 268.7** for wastes that are restricted from land disposal. NNSA/NFO provides land disposal restriction (LDR) notifications to disposal facilities on forms that are provided by the individual facility.

Although these forms differ from one facility to another, in general, they include the following information:

- The manifest number associated with the wastes
- EPA hazardous waste codes
- Waste stream or profile number
- Underlying hazardous constituents
- Waste certification statement and signature

The information for completing LDR forms is derived from acceptable knowledge or from chemical analysis of the waste.

B.3.e Recordkeeping

HWSU records generated from characterization and management of hazardous waste are located in Mercury at Building 23-118 as part of the HWSU facility operating record (**40 CFR 264.73**). Records may be archived after three years.

B.4 Security [40 CFR 270.14(b)(4)]

The NNSS is bordered on three sides by 6,629 km^2 (2,560 mi^2) of federal land, providing restricted and secure access for the NNSS. This restricted zone provides an additional buffer between the HWSU and other properties. Land administered by the BLM borders the fourth side of the NNSS.

In addition to its remote location, NNSA/NFO maintains a contractor security force of highly trained security personnel who are present at the NNSS 24 hours a day, 7 days a week, including holidays. These personnel monitor entry to and exit from the NNSS and provide security measures throughout the NNSS. The size and location of the NNSS with respect to public highways have made the construction of a facility boundary fence impractical. General security measures taken at the NNSS are maintained by a two-level system: (1) security stations at all authorized entrances to the NNSS, property line warning signs, and surveillance patrolling; and (2) specific security measures taken at individual locations such as fencing, warning signs, and building security.

B.4.a NNSS Access

There are security stations at all authorized entrances to the NNSS. Only authorized and badged personnel are allowed access to the NNSS. Security personnel perform a visual and tactile inspection of each person’s badge before entry to and exit from the NNSS.

Signs stating **No Trespassing by Order of the United States Department of Energy** are located along the public highways that border the NNSS. The signs are legible from a distance of 7.6 m (25 ft) and are spaced at regular intervals. In areas where the visibility of the sign may be obstructed, signs may appear at more frequent intervals.

Security personnel also perform non-repetitive and random patrols of the NNSS boundaries and roads. Security patrols also check buildings, facilities, and vehicles on the NNSS 24-hours a day, including holidays.

B.4.b HWSU Access

The HWSU is surrounded on all four sides by a chain-link cyclone fence. The perimeter of the site is routinely checked for evidence of intrusion or fence deterioration. The entrance is on the west side of the facility and is guarded by a locked double gate that swings outward to open. The facility is locked at all times except during container management, inspection, or maintenance operations. Immediately inside the gate to the north is an office trailer where an access register is kept for personnel to sign in before going on to the HWSU structure itself. The access register is also annotated with the time personnel leave the HWSU. Signs visible from 7.6 m (25 ft) are posted at the entrance stating, **“DANGER - UNAUTHORIZED PERSONNEL KEEP OUT.”** For authorized personnel entering the area, warning signs visible from 7.6 m (25 ft) are posted concerning PPE requirements, prohibition on smoking, and a number to call in case of any emergency.

A fire detection system is installed in the HWSU roof. In the event of a fire, the wire shorts and automatically triggers the fire alarm system at the NNSS Fire Department. The fire alarm system can also be activated from two pull stations located at the HWSU, and fire extinguishers are maintained at the unit. The HWSU has telephone and radio communications, and vehicles are equipped with two-way radios.

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B.5 HWSU Inspection Requirements [40 CFR 270.14(b)(5)]

The inspection program targets spill response equipment, safety equipment, fire extinguishers, signage, waste containers and secondary containment, leaking containers, and adequate aisle space. Inspections address the need to maintain inventories of materials necessary to operate the facility, testing and maintenance of safety devices, frequent visual inspections of areas where wastes are handled, and damage or water accumulation related to heavy wind or rain events. Inspection frequencies are based upon the rate of possible deterioration of the equipment and the probability of an incident that adversely affects human health or the environment if deterioration, malfunction, or operator error goes undetected between inspections.

B.5.a HWSU Inspection Schedule

Inspections are conducted weekly and monthly (Table 7). Inspections are required daily when loading, unloading, or consolidating operations take place. During these operations, containers are inspected for deterioration, leakage, and damage; labels and markings must be legible and intact; and spill pallets are inspected for overall structural integrity. Weekly inspections include the examination of containers, signs, gates, fences, and aisle space. Monthly inspections cover spill response equipment, safety equipment, fire protection, and respiratory equipment.

Table 7. Area 5 HWSU Inspection Schedule

Inspection	Description	Frequency
Aisle Space	Verify that a minimum of 0.9-m (3-ft) spacing is maintained between rows of pallets.	Weekly
Container Condition	Verify that deterioration, leaks, or damage are not present. Ensure lids, bolts, and rims are secured.	Weekly
Container Label and Markings	Ensure labels and markings are intact and legible.	Weekly
Secondary Containment	Verify that containers containing liquids are stored on poly-spill pallets that are in good condition.	Weekly
Cell curbing, fences, and gates	Verify that cell curbing, fences, and gates are intact.	Weekly
Safety/Emergency Equipment	Ensure that equipment, including spill kits, eyewash, and showers, are present and in good condition.	Weekly
Signs	Ensure that signs are present and legible (i.e., hazardous class storage and No Smoking).	Weekly
Fire Alarms	Verify the alarm pull stations are accessible and in working condition.	Monthly
Fire Extinguishers[1]	Verify that hoses are in good condition and pressure gauges are in the appropriate range.	Monthly
Supply Inventories	Verify the availability and condition of safety and emergency equipment.	Monthly

[1] Fire extinguishers are inspected monthly by Area 5 HWSU personnel and certified annually by trained personnel according to National Fire Protection Association requirements.

Copies of completed inspection checklists are maintained at the HWSU (original copies are stored in Mercury, Building 23-118). Examples of inspection checklists are provided in Exhibit 2.

B.5.b Corrective Actions

When an inspection reveals the deterioration or malfunction of equipment or structures, the problem is noted on the inspection form, a schedule is developed to correct the problem, and corrective actions are tracked on the original inspection form. When a hazard is imminent or has already occurred, corrective action is taken immediately. If a leak is noted during an inspection, remedial action is performed according to the HWSU operating procedures.

EXHIBIT 2. Example Area 5 HWSU Inspection Checklists

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WEEKLY/DAILY INSPECTION WORKSHEET – AREA 5 HAZARDOUS WASTE STORAGE UNIT (HWSU)

DAILY INSPECTION DUE TO: ☐ **LOADING** ☐ **UNLOADING** ☐ **CONSOLIDATION**

Inspector (Print Name): ____________________ Date: __________ Time: __________

	Yes	No	
1.	☐	☐	Are the following signs present and readable? Authorized entry; No Smoking; Hazard Class Storage (Flammable, ORM, Toxic, Reactive, Corrosive [Acid/Alkali]); Emergency Shower; Handwash Station; Eyewash station; No Entry *(Spanish)*
2.	☐	☐	Is the integrity of the section divisions, gates, and fences being adequately maintained?
3.	☐	☐	Is a three-foot aisle space maintained between pallet rows?
4.	☐	☐	Are container labels and markings intact, legible and readable from aisle?
5.	☐	☐	Are all the EPA waste codes described on the containers listed in the Permit?
6.	☐	☐	Are containers free from leaks, deterioration, or other damage?
7.	☐	☐	Are container lids, rims, and bolts securely tightened?
8.	☐	☐	Do containers have a volume capacity of 55 gallons or less (if an overpack, then 85 gallons or less)?
9.	☐	☐	Are all containers placed completely on spill pallets?
10.	☐	☐	Are spill pallets in good condition and able to support up to 220 gallons (container volume)?
11.	☐	☐	Is the HWSU free from spills, leaks, or releases?
12.	☐	☐	Is the following safety equipment in good condition and ready for use? Absorbents; Shovels; Ratchets/Bung wrenches; Overpack containers; Tyvek Coveralls; Face Shields; Safety glasses; Hard hats; Gloves (Latex type & Liners); Rubber boots; Basestation Radio; Telephone; Eyewash station; Handwash station; Emergency shower
13.	☐	☐	Are waste containers currently stored in the HWAA? (If "Yes", complete FRM-2237.)

Number of containers (circle one) Added / Removed: __________ Total containers at the HWSU only: __________

Total number of HWO containers assigned to storage areas: __________

Annual quantity of waste (gallons) (Jan-Dec) __________

14. ☐ ☐ Is annual total < 65,120 gallons?

List Condition for each box checked "No": ____________________

____

____

____

Corrective Action required for each box checked "No": ____________________

____

____

____

____

Completed by (Printed Name and Signature): ____________________ Date: __________

Reviewed by (Printed Name and Signature): ____________________ Date: __________

Corrective Action Completed:

Printed Name and Signature: ____________________ Date: __________

(Reference: SOP-2151.101)

NSTec Form FRM-0388	MONTHLY INSPECTION WORKSHEET – AREA 5 HAZARDOUS WASTE STORAGE UNIT (HWSU)	07/30/12 Rev. 03 Page **1** of **2**

Inspector (Print Name): ______________________________

Date: ____________________ Time: ____________________

ITEM	RECOMMENDED QUANTITY	ACTUAL QUANTITY	IN GOOD CONDITION YES	NO
1. SPILL RESPONSE EQUIPMENT			**YES**	**NO**
Absorbent pillows	**5**	______	☐	☐
Shovels	**2**	______	☐	☐
Bung Wrench	**1**	______	☐	☐
Overpack containers	**5**	______	☐	☐
DOT approved containers	**10**	______	☐	☐
Sand bags	20 Bags	______	☐	☐
Absorbent materials	55 Gallon Equivalent	______	☐	☐
2. SAFETY EQUIPMENT			**YES**	**NO**
Face shields	**1**	______	☐	☐
Tyvek suits	**5**	______	☐	☐
Poly tyvek suits	**3**	______	☐	☐
Latex gloves	**1 Box**	______	☐	☐
Inner liner gloves	**1 Box**	______	☐	☐
Safety glasses	**5 pair**	______	☐	☐
Rubber boots	**1 pair**	______	☐	☐
Hard hats	**3**	______	☐	☐

(Reference: SOP-2151.101)

			YES	NO
Eyewash station	---	______	☐	☐
Emergency shower	---	______	☐	☐
Handwash station	---	______	☐	☐
Alarm system	---	______	☐	☐

3. RESPIRATORY EQUIPMENT			**YES**	**NO**
Large	---	______	☐	☐
Medium	---	______	☐	☐
Small	---	______	☐	☐
4. Have fire extinguishers been inspected?			☐	☐
5. Is clear access to the Alarm System maintained?			☐	☐
6. Has the alarm system been tested by Radio Services? (Date) ______			☐	☐

List Condition for each box checked "No":

Corrective Action required for each box checked "No":

Completed by
Printed Name & Signature: ______________________ Date: __________

Reviewed by
Printed Name & Signature: ______________________ Date: __________

Corrective Action Completed:

Printed Name & Signature: ______________________ Date: __________

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B.6 Preparedness and Prevention [40 CFR 270.14(b)(6)]

HWSU emergency response activities are performed by the DOE contractor and/or subcontractor. Contractor emergency services located on the NNSS include the NNSS Fire Department and NNSS Occupational Medicine, and the Nye County Sheriff's Office provides law enforcement services. Verbal and written notification requirements to the appropriate federal and state agencies are performed by an NNSA/NFO representative.

DOE maintains Memorandums of Understanding with Nye County, the BLM, Creech Air Force Base, and the DOE Office of Secure Transportation for emergency activities. Las Vegas area hospitals that are notified include University Medical Center, Mountain View Hospital, Sunrise Hospital, and Mercy Flight for Life air ambulance service. NNSA/NFO also maintains an Agreement-in-Principle with the State of Nevada.

Because of the complexity of operations at the NNSS, facilities are required to maintain individual emergency response procedures. Exhibit 3 is a copy of the Emergency Plan Implementing Procedure (EPIP) for the HWSU. As required in **40 CFR 264.51**, any imminent or actual emergency requiring implementation of the emergency response procedure is recorded in the operating record, and a written report is submitted to NDEP by NNSA/NFO within 15 days of the incident. The written report includes the following information:

- Name, address, and telephone number of the owner or operator
- Name, address, and telephone number of the facility
- Date, time, and type of incident
- Name and quantity of materials involved
- Extent of injuries (if any)
- An assessment of actual or potential hazards to human health or the environment (as applicable)
- Estimated quantity and disposition of recovered material that resulted from the incident

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B.7 Contingency Plan [40 CFR 270.14(b)(7)]

Exhibit 3 is a copy of EPIP-HWSU-HWAA.001, "Hazardous Waste Storage Unit and Hazardous Waste Accumulation Area Emergency Response Actions."

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EXHIBIT 3. EPIP-HWSU-HWAA.001, "Hazardous Waste Storage Unit and Hazardous Waste Accumulation Area Emergency Response Actions"

NOT AVAILABLE FOR PUBLIC VIEWING

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B.8 HWSU Procedures to Prevent Hazards [40 CFR 270.14(b)(8)]

This section describes the procedures that are used at the HWSU to prevent hazards to human health, safety, and the environment. A description of the procedures, structures, and equipment used at the HWSU are summarized below.

B.8.a Hazards Prevention for Loading and Off-Loading Operations

Specific precautions taken during loading, off-loading, and consolidation operations include the following preventative measures and monitoring activities to safely manage hazardous waste:

- The HWSU cells are designed to contain releases that occur within the unit.
- Appropriate PPE is used.
- Applicable personnel training requirements have been met.
- Container handling equipment used to prevent ruptured containers includes a drum dolly, mobile crane, or forklift with drum lift attachments or slings. Ramps may also be used during off-loading and to conduct visual inspections of containers.
- Inspections are required daily during loading, unloading, or consolidating operations.
- During container handling operations, only required personnel are allowed in the HWSU.

B.8.b Waste Handling Areas Surface Water Run-On and Runoff

Runoff and run-on to waste handling areas are not anticipated because of the location, grading elevation, roof, and the presence of a 15-cm (6-in.) curb surrounding the unit.

The storage cells have no drainage sumps or piping. The concrete surface is covered with a coating that is resistant to materials that may be stored on the HWSU. Secondary containment is provided by poly-spill pallets. Unit construction drawings are provided in Section B.1.

B.8.c Contamination of Water Supplies

Contamination of water supplies by the HWSU is highly unlikely due to the following conditions:

- There is no surface water near the HWSU.
- The average annual rainfall is approximately 13 cm (5 in.), and the average annual evaporation rate is high.
- The depth from the land surface to ground water in the uppermost aquifer is approximately 255 m (835 ft).
- Secondary containment for wastes that could be released from waste containers is provided by poly-spill pallets.
- The nearest drinking water well (Well 5b) is located approximately 6.5 km (4.0 mi) from the HWSU.
- The HWSU inspection program is designed to quickly discover safety concerns and environmental hazards. The emergency response plan/contingency plan facilitates rapid response and cleanup of releases.

B.8.d Equipment Failure and Effects of Power Outages

Equipment failures and power outages will not affect hazardous waste operations, cause a release of hazardous waste, or present safety hazards for the following reasons:

- A majority of waste containers are moved and placed by equipment. Failed equipment is replaced, or activities are delayed until the equipment is repaired.
- HWSU emergency communication equipment (telephone and radio) are available and inspected regularly. Hand-held radios are tested daily for proper functioning.
- Normal operations are limited to daylight hours.

B.8.e Exposure of Personnel to Hazardous Waste

Personnel exposure to hazardous waste at the HWSU is mitigated as follows:

- Waste stored at the HWSU is fully characterized before acceptance at the unit, which increases awareness of potential hazards.
- Waste is stored in DOT specification packaging or containers with secured lids.
- Containers are kept closed during storage and are only opened during repackaging, consolidation, or inspection operations.
- HWSU personnel are trained in the proper procedures for handling drums, equipment, and emergency response.
- Frequent inspections of the facility and equipment minimize exposure, accidents, and injuries.
- Applicable PPE is used by all personnel working at the HWSU.

B.8.f Aisle Space

Aisle space is maintained at a minimum of 0.9 m (3 ft) to allow for accurate container, label, and marking inspections and to facilitate access to containers in emergency situations.

B.8.g Releases to the Atmosphere

Wastes are containerized according to **40 CFR 264, Subpart CC, Air Emissions Standards**, preventing the release of contaminants to the atmosphere. Hazardous wastes are stored in DOT specification packaging or containers with secured lids.

Waste containers are kept closed except during repacking, consolidation, or inspection operations. Repacking and consolidation of waste is limited to waste that is containerized within a waste container. Bulk liquid or bulk solid hazardous wastes are not repacked or consolidated at the HWSU.

B.9 Ignitable, Reactive, and Incompatible Wastes [40 CFR 270.14(b)(9)]

Hazardous waste containers are segregated and stored in such a manner that unintended release of their contents and consequent mixing thereof does not result in a dangerous evolution of heat or gas (Figure 6). The unit is divided by hazard type using a 15-cm (6-in.) curb.

Only compatible wastes are stored together without a separating barrier. Separation and segregation of hazardous waste is performed according to **40 CFR 264.177**. Each storage cell of the HWSU is identified by a conspicuously posted sign describing the waste type as Flammable, Corrosive, ORM, Reactive, and/or Toxic. All containers of hazardous waste are stored on poly-spill pallets that provide additional segregation.

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B.10 Traffic [40 CFR 270.14(b)(10)]

Mercury Highway is the main entrance to the NNSS from U.S. Highway 95 and serves as the major traffic route, connecting the primary support area in Mercury with other areas of the NNSS. Major traffic flow into the HWSU is via the 5-01 Road, as shown in Figure 7. Direct access off the 5-01 Road to the HWSU is provided by a large parking and turnaround area located on the southwest side of the HWSU.

Traffic volume on the 5-01 Road ranges from 40 to 60 vehicles per day, and the posted speed limit is 73 km per hour (45 mi per hour). Conventional stop and yield signs at major intersections are used to maintain traffic flow and control throughout the NNSS. Traffic regulations are enforced by the Nye County Sheriff.

The 5-01 Road consists of medium-sized gravel chips compacted into a solid mass (surfacing) that uses bituminous (asphaltic) oil as a binding agent. Oil and chip applications are applied as needed. Total thickness varies from 2.5 to 7.6 cm (1 to 3 in.) along the length of the road.

An engineered-base, load-bearing capacity cannot be definitively stated due to the 5-01 Road not conforming to pavement structural design standards. Laboratory testing of the 5-01 Road sub-grade material (i.e., types of sub-grade soils and basic engineering index properties) indicates that they provide relatively good support for pavements based on the American Association of State Highway and Transportation Officials classification system.

Subjective engineering evaluations of the 5-01 Road were performed in 1994 and 1999. These evaluations included visual observation of the entire road; pavement thickness measurements; evaluation of cracking, heaving, and other unconformities; and a review of the road's history and maintenance. Based on engineering judgment, these evaluations indicate that the existing capacity is adequate to support existing and future waste shipments in conjunction with regular inspections, continued maintenance, and reduced speed limits.

Vehicles delivering or picking up waste are allowed inside the fenced compound. A loading/off-loading ramp is located outside the fenced area to facilitate transfer of waste containers off of or onto transporter vehicles when necessary.

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B.11 Facility Location [40 CFR 270.14(b)(11)]

The center of the HWSU is located at N 766,382.52 ft and E 709,865.40 ft based on Nevada State Plane Grid – Central Zone, North American Datum, 1983.

B.11.a Seismic Standard

Seismic standards for RCRA are derived from location standards that are related to the natural stability of the site and to the occurrence of surface-cutting Holocene faults. The southwestern United States, including Nevada, is tectonically active compared with other parts of the country (**40 CFR 264, Appendix VI**). Natural seismic risk is moderate in the NNSS region.

The structural development and present structure of the region have been summarized by Carr et al. (1974), Barnes et al. (1982), and Hudson (1992). The mountains surrounding Frenchman Flat have had a complex structural history. There are numerous surface expressions of faults in the area (Figure 8).

No known surface-cutting faults that have had displacement during Holocene time are present within 915 m (3,000 ft) of the HWSU.

B.11.b Flood Hazard

The HWSU is located outside the 100-year flood plain. Figure 9 presents the 100-year flood zone delineation for the HWSU. According to **40 CFR 270.14 (b)**, Flood Insurance Rate Maps (FIRMs) produced by the Federal Emergency Management Agency (FEMA) should be used to determine if a unit is within a 100-year flood hazard area (100-year flow depth greater than 0.30 m [1 ft]). When a FIRM has not been developed for an area, which is the case for Area 5, a flood hazard map must be developed using FEMA methodology. A flood study using FEMA methods was completed and submitted to NDEP in February 1993. *Flood Assessment at the Area 5 Radioactive Waste Management Site, DOE/Nevada Test Site, Nye County, Nevada* (Exhibit 4) evaluated the 100-year flood hazard.

Washes that drain toward the HWSU are normally dry and flow only in response to intense rainfall. Flow from the watersheds above the RWMC is diverted around the HWSU by flood control structures located on three upstream sides of the RWMC. These structures are engineered to maintain a run-on control system capable of preventing flow onto the HWSU during peak discharge from at least a 25-year, 24-hour storm. The HWSU also rests on an earthen pad; the floor is raised approximately 0.6 to 0.9 m (2 to 3 ft) above the surrounding grade. The storage cells of the HWSU are protected from direct precipitation by the metal roof, which extends 2.4 m (8 ft) beyond the outer edge of the containment curb. Onsite precipitation is the only run-on that may enter the HWSU. The storage cells are designed and constructed to collect and control this localized run-on, thus preventing runoff. The average annual precipitation in the vicinity of the HWSU is 13 cm (5 in.).

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Figure 8. Structural Pattern of Frenchmen Flat and Vicinity

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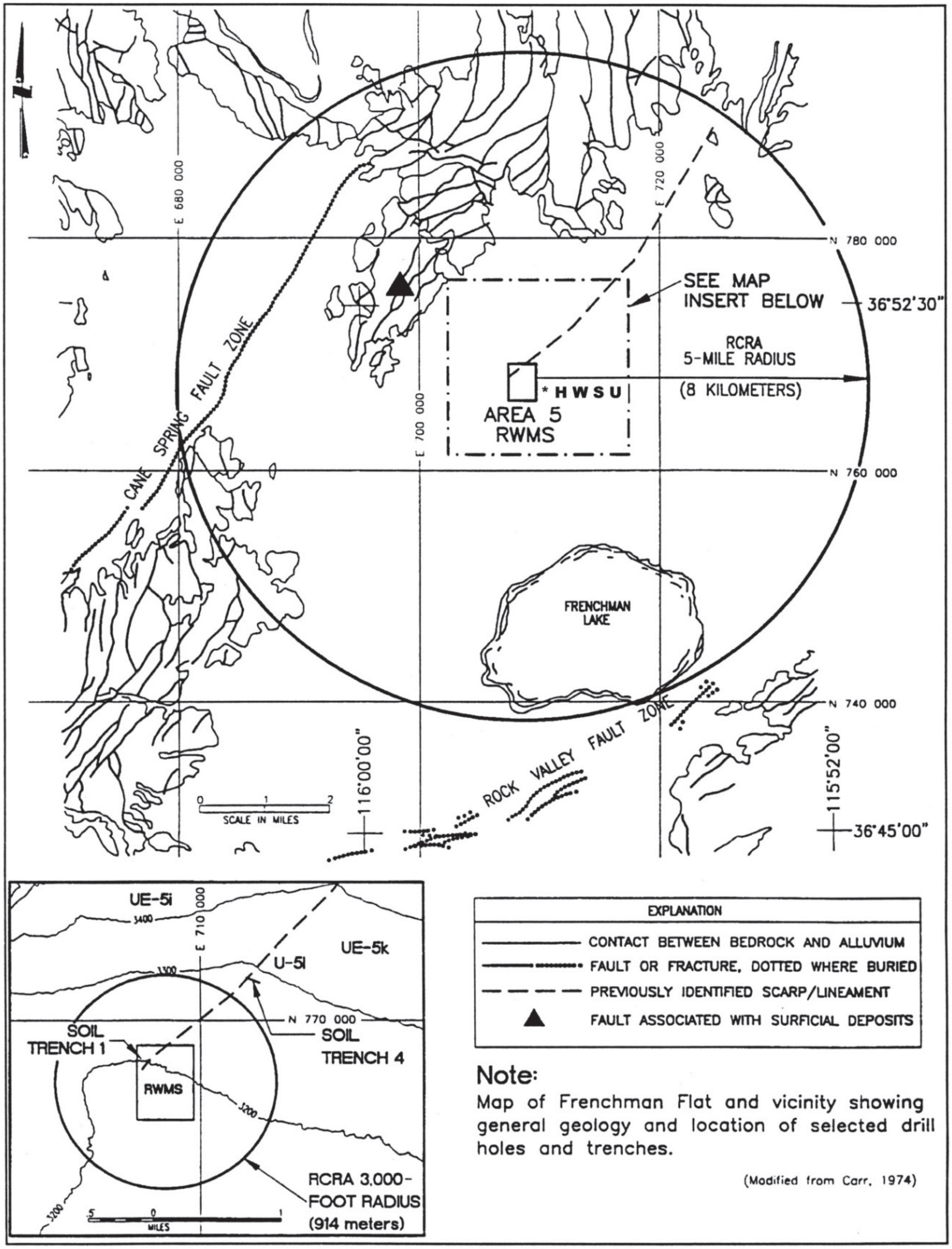

Structural Pattern of Frenchman Flat and Vicinity

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Figure 9. 100-Year Flood Zone Delineation

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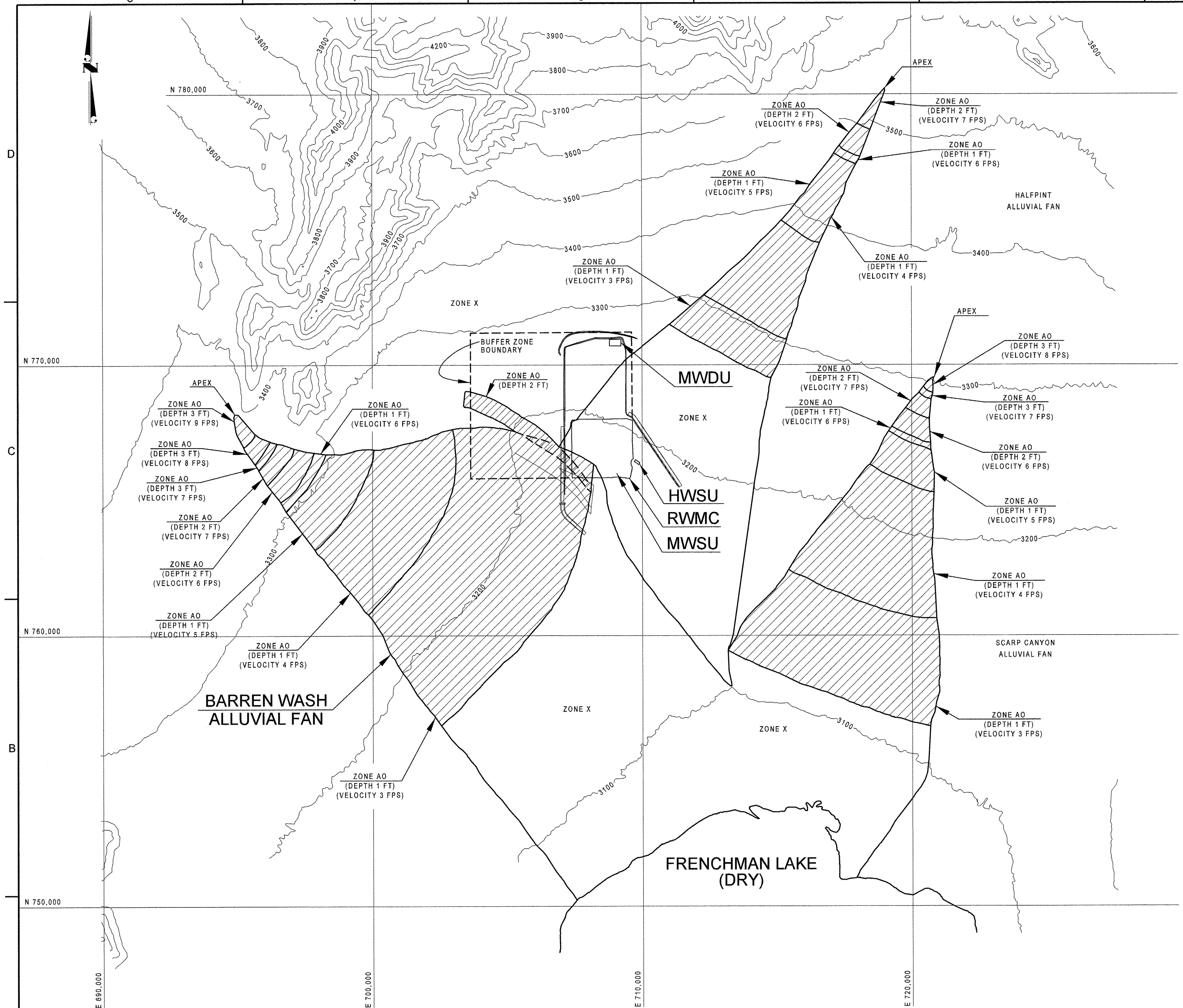

LEGEND

- ALLUVIAL FAN BOUNDARY
- BOUNDARY OF RADIOACTIVE WASTE MANAGEMENT COMPLEX (RWMC)
- BOUNDARY OF AREA PROPOSED FOR RWMC EXPANSION
- 100-YEAR FLOOD ZONE OF SHALLOW CONCENTRATED FLOW
- AREA OF ALLUVIAL FAN 100-YEAR FLOOD ZONE

ZONE AO (DEPTH 2 FT)	SHALLOW CONCENTRATED FLOW 100-YEAR FLOOD ZONE DESIGNATION: FEMA FLOOD ZONE THAT CORRESPONDS TO AREAS OF 100-YEAR SHALLOW FLOODING WHERE AVERAGE DEPTHS ARE BETWEEN 1 AND 3 FEET (0.30M AND 0.91M).
ZONE AO (DEPTH 2 FT) (VELOCITY 5 FPS)	ALLUVIAL FAN 100-YEAR FLOOD ZONE DESIGNATION: FEMA FLOOD ZONE THAT CORRESPONDS TO AREAS OF 100-YEAR SHALLOW FLOODING WHERE AVERAGE DEPTHS ARE BETWEEN 1 AND 3 FEET (0.30M AND 0.91M). ANYWHERE THROUGHOUT THE ZONE THERE IS AN EQUALLY LIKELY CHANCE THAT A CHANNEL CAN OCCUR OF THE DESIGNATED DEPTH WITH A FLOW OF THE DESIGNATED VELOCITY.
ZONE X	FEMA FLOOD ZONE THAT CORRESPONDS TO AREAS OUTSIDE THE 100-YEAR FLOOD HAZARD AND TO AREAS OF 100 YEAR SHEETFLOW FLOODING WHERE AVERAGE DEPTHS ARE LESS THAN 1 FOOT (0.30M).

100-YEAR FLOOD ZONE DELINEATION

SCALE : 1" = 2000'

GRAPHIC SCALE

0 1000 2000 4000 6000 FEET

1" = 2000'

GS

NATIONAL NUCLEAR SECURITY ADMINISTRATION

NEVADA FIELD OFFICE LAS VEGAS, NEVADA

NEVADA NATIONAL SECURITY SITE — AREA 05A

RWMC UTILITY INFRASTRUCTURE

100-YEAR FLOOD ZONE DELINEATION

DRAWN	PREPARER	CHECKER	PROJECT ENGINEER	APPROVER / USER
4-21-15	4/21/15	N/A	4/21/15	N/A

National Security Technologies LLC — Vision • Service • Partnership

NEVADA OPERATIONS P.O. BOX 98521 LAS VEGAS, NV 89193-8521

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EXHIBIT 4. Flood Assessment at the Area 5 Radioactive Waste Management Site, DOE/Nevada Test Site, Nye County, Nevada

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FLOOD ASSESSMENT AT THE
AREA 5 RADIOACTIVE WASTE MANAGEMENT SITE
DOE/Nevada Test Site, Nye County, Nevada

Prepared by Raytheon Services Nevada
Environmental Restoration and
Waste Management Division
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Las Vegas, Nevada 89134

For the United States Department of Energy
Nevada Operations Office
Office of Assistant Manager for Environmental
Restoration and Waste Management
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Las Vegas, Nevada 89193

Under Raytheon Services Nevada
Contract DE-AC08-91NV10833

FLOOD ASSESSMENT

EXECUTIVE SUMMARY

A flood assessment at the Radioactive Waste Management Site (RWMS) and the Hazardous Waste Storage Unit (HWSU) in Area 5 of the Nevada Test Site (NTS) was performed to determine the 100-year flood hazard at these facilities. No previous flood studies of these facilities delineated the 100-year flood hazard. This current study was conducted to determine whether the RWMS and HWSU are located within a 100-year flood hazard as defined by the Federal Emergency Management Agency (FEMA), and to provide discharges for the design of flood protection.

The overall watershed which could impact the RWMS and HWSU is approximately 140-square miles. This watershed was divided into 16 subbasins to best represent the hydrology of the study area. United States Geologic Survey (USGS) topographic maps were used to divide the drainage area into subbasins ranging in size from 0.3-square miles to 81.3-square miles. Barren Wash, Scarp Canyon, and Halfpint alluvial fans were delineated. These fans are characterized by incised channels in the upper parts of the fans decreasing to sheetflow in lower parts of the fan.

The 2-year, 10-year, and 100-year discharges were determined using methods and guidelines provided in the Clark County Regional Flood Control District (CCRFCD) *Hydrologic Criteria and Drainage Manual, 1990*. The methodology in the CCRFCD Manual was developed specifically for Southern Nevada by Clark County and the U.S. Army Corps of Engineers, Los Angeles District, and is the most current and region-specific approach to develop discharges. Flood studies conducted in Clark County following the methods provided in the CCRFCD Manual have been accepted by FEMA. The proximity of Area 5 to Clark County and their similar physical and climatic characteristics support the use of this region-specific method as the means of generating discharges for the study area.

As directed in CCRFCD Manual, the HEC-1 rainfall-runoff model developed by the U.S. Army Corps of Engineers was used to generate discharges for the RWMS and HWSU areas. Hydrologic models were developed for the 2-year, 10-year, and 100-year discharges. Point precipitation values used in this model were taken from NOAA Atlas 2, Volume VII. Field observations were made to determine the vegetation type and cover density, Manning roughness coefficient, slope, channel geometry, and concentration point locations. From this information, curve numbers (a method to quantify precipitation losses) and lag times for each of the subbasins were determined, routing parameters were applied, and discharges were calculated. Discharges developed in this hydrologic analysis were used in the subsequent analysis to define the 100-year flood hazard.

The 100-year flood hazard for the Barren Wash, Scarp Canyon, and Halfpint alluvial fans was analyzed using FAN, a computer program developed by FEMA. This program was used to delineate the flood hazard zones on these alluvial fans in accordance with FEMA methodology. The FAN model requires information regarding apex location, fan boundaries, potential flow obstructions and diversions, fan surface slopes, Manning roughness coefficients, single-channel versus multiple-channel regions, and the 2-year, 10-year, and 100-year discharges from the hydrologic analysis. This information was gathered from studies of available topographic and surficial geologic maps and intensive field investigations. The results of the alluvial fan analyses are shown on the maps included in this document.

Part of the RWMS is located within the 100-year flood hazard on the Barren Wash Alluvial Fan. The southwest corner of the RWMS is within the Zone AO of the Barren Wash Alluvial Fan. (This part of the RWMS does not include RCRA units covered in the NTS RCRA Part B Permit Application.) FEMA designates alluvial fan flooding, shallow concentrated flow, and sheetflow areas with 100-year flood depths between 1 and 3 feet as Zone AO. FEMA further designates an associated flow velocity for alluvial fan flood hazards.

The HEC-2 model developed by the U.S. Army Corps of Engineers to determine water surface elevations in channels was used to assess the flood hazard of shallow concentrated flow in a channel impacting the southwest corner of the RWMS. This analysis determined that flows exceed a depth of 1 foot along the southwest corner of the RWMS, which places this part of the RWMS in the AO zone.

For the remaining subbasins that could impact the RWMS and HWSU, flood hazard determinations were conducted assuming sheetflow conditions. This analysis, using FEMA methodology for sheetflow, concluded that depths of flow during the 100-year flow event were less than 1 foot. Thus, the RWMS and the HWSU are not in a 100-year flood hazard as defined by FEMA.

Although the RWMS and HWSU facilities that are included in the RCRA Part B Permit Application are not within a 100-year flood hazard per FEMA definition (100-year flood depth at or greater than 1 foot), flow from a 100-year event could impact the facilities. Flood protection requirements are being evaluated.

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1.0 INTRODUCTION

1.1 Location

A flood assessment was conducted at the Radioactive Waste Management Site (RWMS) and the Hazardous Waste Storage Unit (HWSU) in Area 5 of the Nevada Test Site (NTS) in Nye County, Nevada (Figure 1). In this report, the RWMS includes the Transuranic (TRU) Radioactive pad, Mixed-Waste Disposal Unit, and Pit 3 within the RWMS. The study area encompasses portions of the Massachusetts Mountains, the Halfpint Range, and the drainages of Barren Wash and Scarp Canyon.

1.2 Purpose

Flood assessment is one of the subtasks related to surficial geology studies at and near the RWMS. Surficial geology studies respond primarily to requirements and guidelines for site characterization found in federal regulations. The principal federal regulations and criteria pertaining to flooding with which the RWMS must comply are:

- Executive Order 11988 (*Floodplain Management*),
- 10 CFR 61.50 (*Technical Requirements for Land Disposal Facilities*),
- 40 CFR 264.18 (*Location Standards for Hazardous Waste Management Facility*),
- 40 CFR 270.14 (*General Requirements for a Hazardous Waste Facility*), and
- Department of Energy (DOE)/Nevada-341, *Environmental Compliance Handbook, September 1990.*

The RWMS must also comply with Nevada Administrative Code 444.8456 (*Restrictions on Locations of Stationary Facilities for Management of Hazardous Waste; Exceptions*). These regulations prohibit the placement of a hazardous waste facility in a 100-year floodplain. This subtask focuses on the potential 100-year flood hazard on the RWMS. Although the flood assessment subtask does not evaluate the erosion hazard over a geologic time scale (10,000 years), as required under 40 CFR 191.13 (*Environmental Standards for the Management and Disposal of Spent Nuclear Fuel, High-Level, and Transuranic Radioactive Waste; Final Rule*), other subtasks are being conducted to gather information regarding erosion on the RWMS. These subtasks include detailed trench and surface mapping, alluvial structure, and seismic fault definitions.

1.3 Objective

The objective of this flood assessment was to determine the 100-year flood hazard on and near the Area 5 RWMS using the most site-specific and applicable approaches for the hydrologic and hydraulic analyses. This flood assessment was conducted to provide hydrologic and hydraulic information for flood protection design and to follow the criteria for flood hazard determination required by the Federal Emergency Management Agency (FEMA), as specified in 40 CFR 270.14.

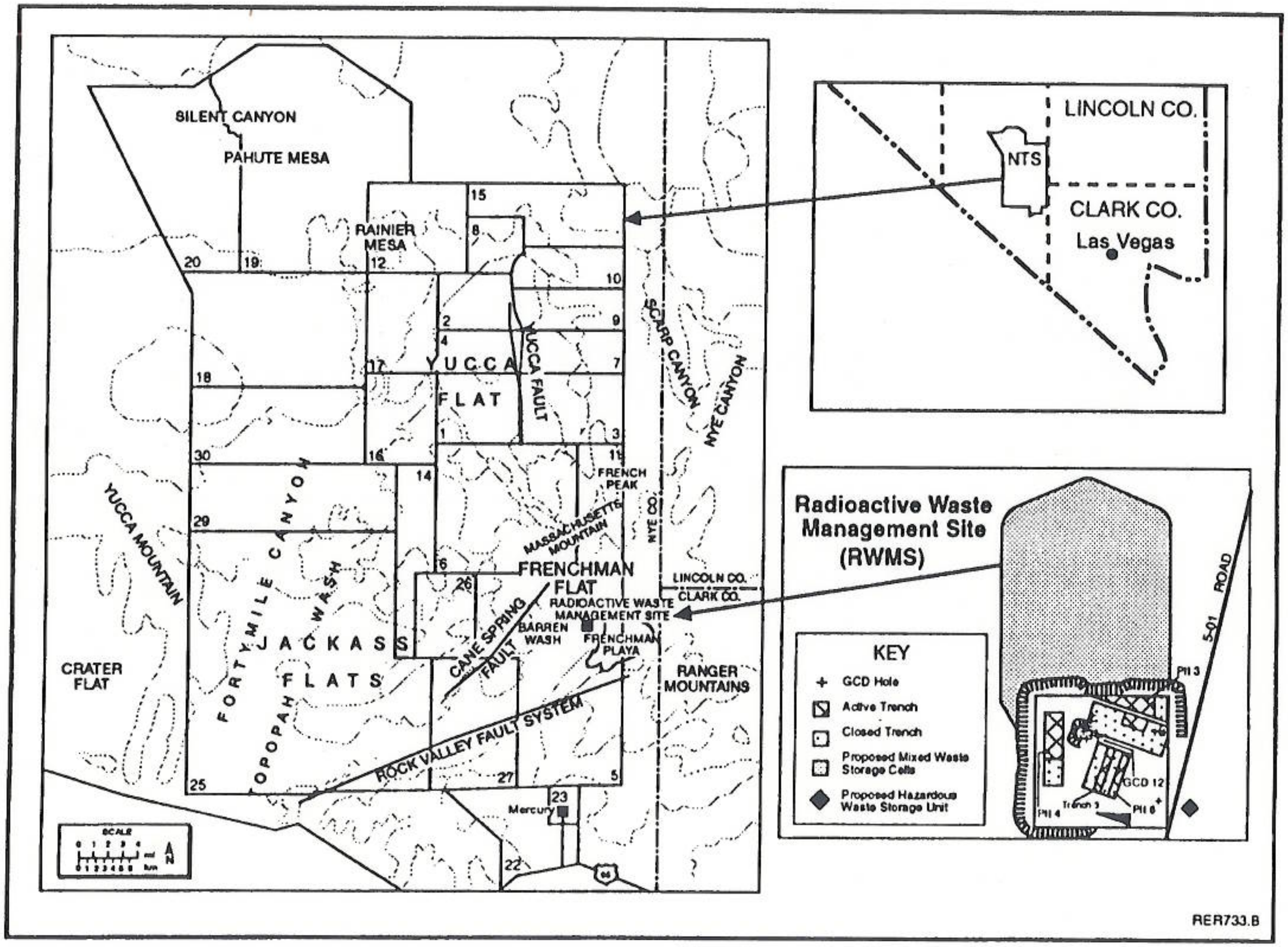


Figure 1. Location Map and Physiographic Features of the Nevada Test Site and the Area 5 Radioactive Waste Management Site

1.4 Previous Studies

Case *et al*., (1984), French and Lombardo (1984), and Cox (1986) discussed the potential for flooding at the Area 5 RWMS. Raytheon Services Nevada (1991) reported results of a limited study on surface water at and near the RWMS using methods discussed in these previous studies. These studies used regional flow equations that were developed in the late 1970's and early 1980's. At the time of these studies, the Clark County Regional Flood Control District Manual (CCRFCD Manual) had not yet been completed and the regional equations were the best method available. Methodology in the CCRFCD Manual is now the accepted method in Clark County. The proximity of Area 5 to Clark County and their similar physical and climatic characteristics support the use of this region-specific method as the means of generating discharges for the study area. Also since these studies, FEMA has adopted a methodology to evaluate flood hazards on alluvial fans. For these reasons, a more detailed flood assessment was required using the most updated information and methods.

2.0 WATERSHED DESCRIPTION

2.1 Introduction

The 140-square-mile watershed that could impact the RWMS and HWSU was divided into 16 subbasins (Figures 2 and 3). (For more detailed watershed maps, see Sheets 1 and 2.) Concentration points for the flow from the 16 delineated subbasins were chosen to best represent the hydrology of the study area. The apexes of Barren Wash, Scarp Canyon, and Halfpint alluvial fans represent three of these concentration points. The other concentration points were difficult to define because they represented the confluence of large areas of shallow concentrated flow and/or sheetflow that could impact the RWMS. Concentration point locations were based on aerial photographs, topographic data, and field observations.

2.2 Apex Definitions

In this study, both a geologic definition and a FEMA definition for the apex of an alluvial fan are described. The geologic apex of an alluvial fan is the intersection of the mountain front and the piedmont plain (Figure 4). On many alluvial fans, a channel is entrenched into the upper, and possibly the middle part of the fan (Bull, 1964). Fans with entrenched channels have the active apex farther down the fan. FEMA defines the apex as the point below which the flowpath of the major stream that formed the fan becomes unpredictable and flooding of the fan can occur (FEMA, 1991). The FEMA definition was used in this study to determine the concentration points of flow at the active apex of the three alluvial fans within the study area: Barren Wash, Scarp Canyon, and Halfpint alluvial fans (see *Figure 3* and *Sheet* 2) for locations of these apexes).

2.3 Barren Wash Alluvial Fan

The Barren Wash watershed covers 81.3-square miles and is located northwest of the RWMS (*Figure* 2 and *Sheet 1*). The wash drains to Frenchman Flat from an area that is bordered to the east by the Massachusetts Mountains, to the north by the CP Hogback, and to the west by the CP Hills. The watershed has been divided into two separate subbasins: Barren Wash 1 (BW1, 60.5-square miles) and Barren Wash 2 (BW2, 20.8-square miles).

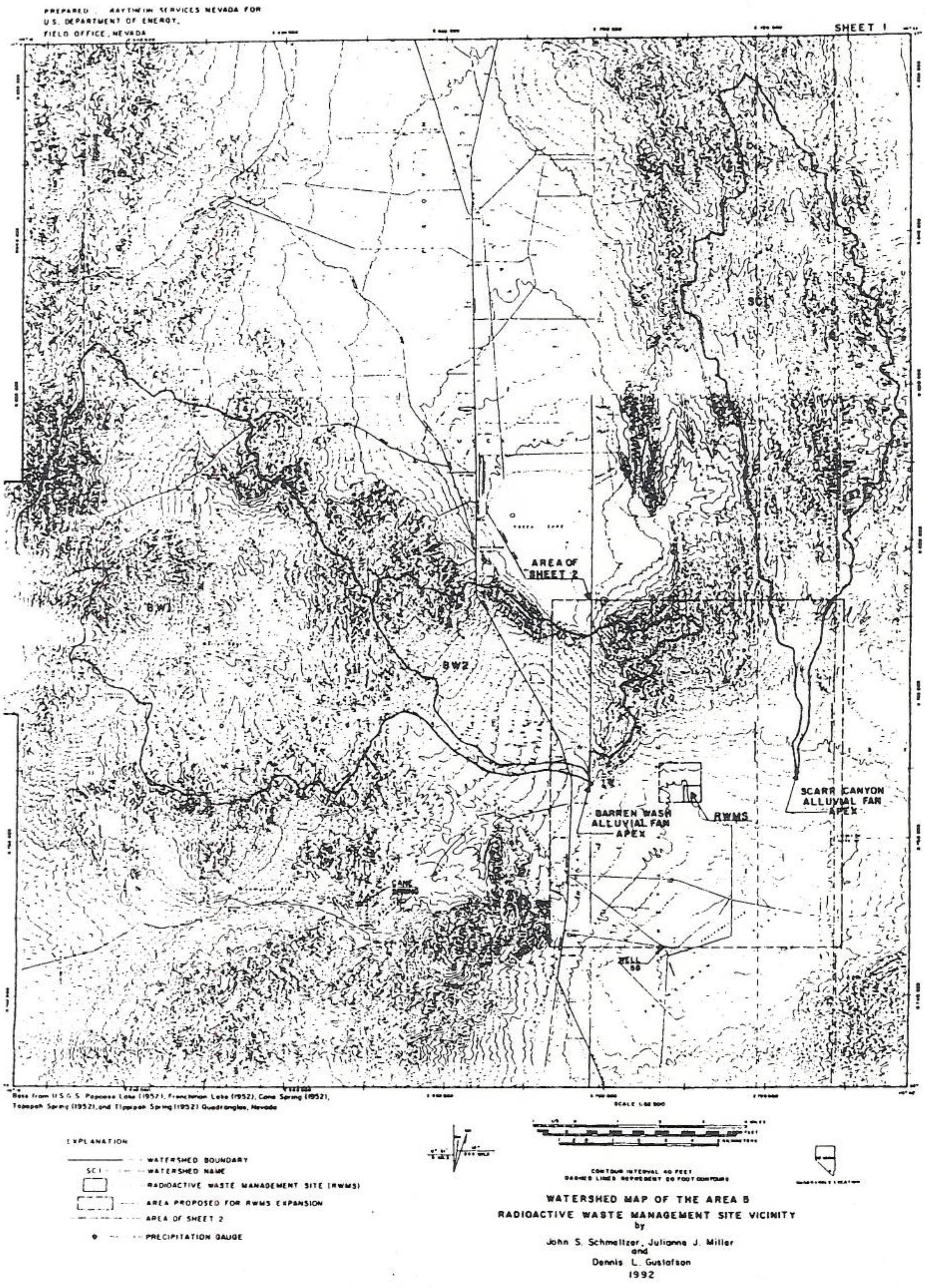
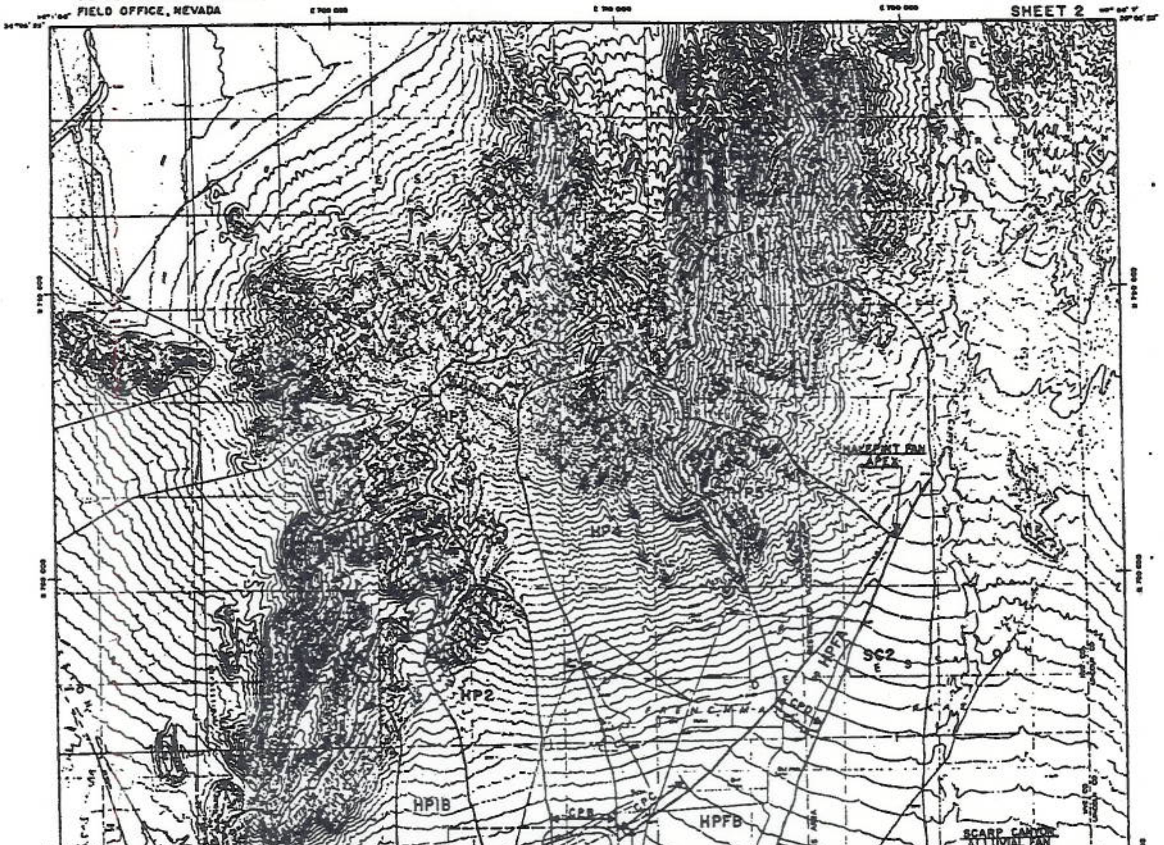


Figure 2. Watershed Map of the Area 5 Radioactive Waste Management Site Vicinity (Sheet 1). The overall watershed is divided into 16 subbasins; 13 are shown here, with the remainder shown on Figure 3 (Sheet 2).

PREPARED BY RAYTHEON SERVICES NEVADA FOR
U.S. DEPARTMENT OF ENERGY,
FIELD OFFICE, NEVADA

SHEET 2



Base from U.S.G.S. Plutonium Valley (1986), Frenchman Lake (1986) Yucca Lake (1986), and Cane Spring (1986) Quadrangles, Nevada

SCALE 1:24 000

CONTOUR INTERVAL 20 FEET
SUPPLEMENTARY CONTOUR INTERVAL 10 FEET

EXPLANATION

- WATERSHED BOUNDARY
- SC2 — WATERSHED NAME
- RADIOACTIVE WASTE MANAGEMENT SITE (RWMS)
- BOUNDARY OF AREA PROPOSED FOR RWMS EXPANSION

QUADRANGLE LOCATION

WATERSHED MAP OF THE AREA 5
RADIOACTIVE WASTE MANAGEMENT SITE VICINITY
by
John S. Schmeltzer, Julianne J. Miller
and
Dennis L. Gustafson
1992

Figure 3. Watershed Map of the Area 5 Radioactive Waste Management Site Vicinity.

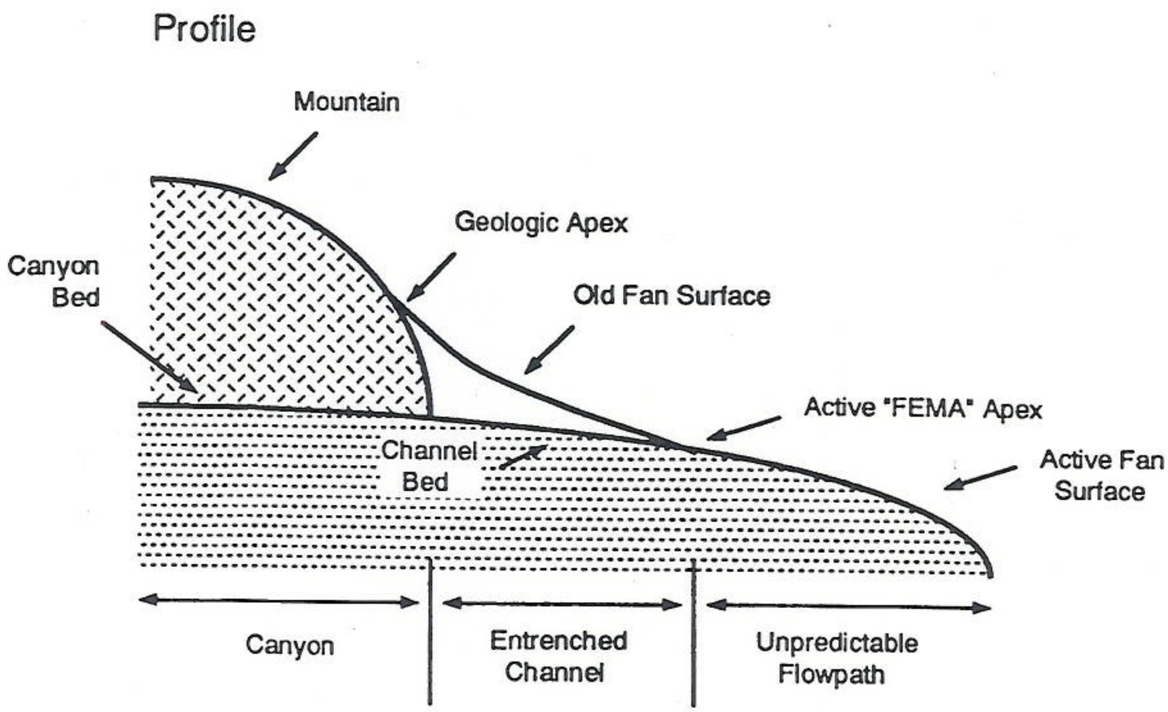


Figure 4. Idealized Alluvial Fan Profile. The geologic apex is the intersection of the mountain front and the piedmont plain. The active "FEMA" apex is the point below which the flow of the main channel becomes unpredictable.

The Barren Wash Alluvial Fan is the dominant landform in the watershed. The proximal part of the fan (the area on the alluvial fan near the apex) is deeply entrenched by a stream channel. Significant parts of the fan surface are covered by desert pavement with desert varnish, and vegetation covers 15 to 25 percent of the surface. Erosion is the primary geomorphological process occurring on the proximal part of the fan, as shown by scalloping of the fanhead trench.

Continued trench incision has shifted deposition to a distal part of the fan (the outermost area, or lower zone of the fan). The Barren Wash channel captures the channel draining from the Massachusetts Mountains 1A (MM1A) subbasin at the southwestern corner of the Massachusetts Mountains (*Figure 3* and *Sheet 2*). At this point a new, secondary fan is being formed which extends east toward the RWMS and south to Frenchman Flat. The RWMS is located on the lower-mid part of this secondary fan.

2.4 Scarp Canyon Alluvial Fan

The Scarp Canyon watershed, located northeast and east of the RWMS, covers about 40.9-square miles (*Figure 2* and *Sheet 1*). This watershed drains onto Scarp Canyon Alluvial Fan from an area that extends north to Carbonate Ridge (French and Lombardo, 1984), west to the Massachusetts Mountains, and east to Raysonde Butte. The watershed is divided into two subbasins: Scarp Canyon 1 (SC1, 39.4-square miles), the drainage area above the active apex; and Scarp Canyon 2 (SC2, 1.5-square miles), the area between the channel that drains SC1 and the eastern boundary of Halfpint Alluvial Fan (*Figure 3* and *Sheet 2*).

A large fanhead trench, ranging to a depth of 40 feet, cuts through a thin layer of alluvium and bedrock above the active apex. Below the active apex, the channel cuts through unconsolidated and calcrete-cemented alluvium. Parts of the fan surface are covered by desert pavement with desert varnish. Vegetation density is 15 to 25 percent over the fan surface.

The channel within the trench of Scarp Canyon is braided. Relatively flat interchannel bars and side terraces are approximately 1 to 5 feet above the streambeds, and covered by fine-grained sediment. High-water indicators are present on the bars and terraces several feet above the streambed. These indicators include large clasts and boulders, small logs and sticks, and uprooted Joshua trees found snagged in the vegetation. The vegetation also shows signs of being washed over by water. Concurrence of the high-water indicators with the fine-grained deposits suggests that these deposits are fluvial rather than eolian.

2.5 Halfpint Alluvial Fan

Halfpint Alluvial Fan, located northeast of the RWMS, develops from a channel that collects flow from the drainage area (HP6, 2.2-square miles) along the eastern front of the Halfpint Range (*Figure 3* and *Sheet 2*). The alluvial fan is divided into two separate subbasins: Halfpint Fan A (HPFA, 0.26-square miles) and Halfpint Fan B (HPFB, 1.61-square miles).

The channel located above the apex of the Halfpint Alluvial Fan is incised 2 to 3 feet in depth. The apex of the fan was located where the flowpath of the channel becomes unpredictable. Below the apex, a very braided channel system has developed. Relatively little desert pavement or desert varnish is found on this fan surface; vegetation cover density is approximately 20 percent. The RWMS is located in the lower-mid part of this fan.

2.6 Massachusetts Mountains/Halfpint Range Subbasins

The 13.6-square-mile watershed that drains from the Massachusetts Mountains/Halfpint Range toward the RWMS was divided into nine subbasins (*Figure 3* and *Sheet* 2). These subbasins include MM1A, MM1B, MM2, HP1A, HP1B, HP2, HP3, HP4, and HP5. The upper parts of these subbasins are located in bedrock consisting of several different tuffs. From a geomorphic viewpoint, the drainages in the lower regions extending into Frenchman Flat form coalescing alluvial fans along the mountain front. From a hydraulic engineering viewpoint, the flow system on these landforms are distributary-flow systems. Hjalmerson (1992) states that the ". . . major physiographic characteristics used to identify and categorize distributary-flow areas . . . include (1) vegetation density and soil color, (2) drainage texture, and (3) the random nature of channel links."

The proximal parts of these coalescing alluvial fans (geomorphic viewpoint) are characterized by channels incised 5 to 10 feet across the surface. Vegetation density on the fan surface is 20 to 35 percent. Undisturbed deposits covered by desert pavement with desert varnish are present.

Channel incisions, averaging 1 to 3 feet, decrease near the middle part of the fan. Debris flow deposits from the HP1A and HP1B subbasins in part compose the coalescing alluvial fans (geomorphic viewpoint). Channel depths decrease down gradient until sheetflow occurs.

Sheetflow, typical of areas of low relief and poorly established drainage systems, occurs on the distal parts of the coalescing alluvial fans (geomorphic viewpoint). The RWMS is located in the lower-mid parts of these coalescing alluvial fans where channel depths average less than 1 foot. Vegetation covers 20 to 30 percent of the fan surface. There are relatively few undisturbed areas of relic deposits covered by desert pavement with desert varnish.

3.0 HYDROLOGY

3.1 Methodology

Standard statistical methods to determine flood discharges for a specific return period are not applicable to a majority of the watersheds in the arid Southwest because most of the watersheds in this region are ungaged and do not have stream discharge information. Furthermore, arid watersheds that do have discharge data usually have a short period of record with many years of no flow. A study conducted by Hjalmarson and Thomas (1992) found that 20 years is the average recording period for stream gages located in Nevada, western Utah, western Arizona, and southeastern California.

In the arid Southwest, rainfall-runoff models are often used to estimate flood discharges. In this flood assessment, rainfall-runoff models were developed using the HEC-1 computer program developed by the U.S. Army Corps of Engineers (COE) (1990). The CCRFCD Manual lists the HEC-1 computer program as an acceptable tool to estimate discharges and to generate hydrographs for watersheds within Clark County. Methods in the CCRFCD Manual were used to produce the input parameters required for the HEC-1 computer program. Other jurisdictions in the arid Southwest, such as Maricopa County (central Arizona), Pima County (southern Arizona), and San Bernardino County (southern California), use similar approaches to estimate flood discharges.

The hydrologic approach described in the CCRFCD Manual was developed for Clark County from studies conducted by WRC Engineering and the COE. The methods described in the CCRFCD Manual were considered the best approach for estimating discharges for the flood assessment of the RWMS and vicinity for these reasons:

a. The physical setting and flood-producing storms for the RWMS and vicinity are similar to those of Clark County;

b. The eastern boundary of the study area is adjacent to the Clark County line;

c. Local and federal agencies (e.g., FEMA) accept the methods in the CCRFCD Manual; and,

d. Clark County is the nearest local jurisdiction with a hydrologic method based on region-specific information.

The Soil Conservation Service (SCS) unit hydrograph option in the HEC-1 computer program was used in the hydrologic models. The SCS unit hydrograph is widely used in rainfall-runoff models and is recommended as an option in the CCRFCD Manual. The input parameters required to run the HEC-1 computer model using the SCS unit hydrograph option are:

- precipitation parameters (depth of precipitation, storm duration and time distribution, and depth-area ratios);
- drainage area (total drainage area and subbasins);
- precipitation losses (curve numbers);
- lag time for each basin; and,
- channel routing parameters.

The procedure used to obtain these parameters generally followed the methods described in the CCRFCD Manual. The following sections provide an overview of how these parameters were determined and substantiate any deviations from the methods provided in the CCRFCD Manual. A detailed description of how these parameters are determined is in the CCRFCD Manual.

3.1.1 *Precipitation*

Rainfall events that cause flooding on the NTS and in southern Nevada are usually convectional storms. According to Christenson and Spahr (1980), the probable flood-generating storm in the NTS area would be from summer convectional storms. These flood-producing storms are normally characterized as short-duration (6 hours or less), high-intensity storms over a localized area. Methods regarding precipitation parameters in the CCRFCD Manual assume that summer convectional storms are the likely precipitation event to produce flooding in Clark County. In an analysis of precipitation records for southern Nevada, WRC Engineering and the COE determined that a 6-hour rainfall should be the design storm. A 6-hour mass curve (intensity of rainfall per 15-minute intervals over the 6-hour design storm) was developed and a relationship between precipitation depth and storm size (depth-area ratios) was determined. These parameters are discussed below in more detail.

a. Point Precipitation Values

As specified in the CCRFCD Manual, the design depths of precipitation for the 6-hour storm were taken from NOAA Atlas 2, Volume VII (1973) and are listed in Table 1.

Table 1. Six-Hour Storm Point Precipitation Values and Correction Factors (CCRFCD Manual, 1990). Correction factors used to adjust precipitation values for design depths of precipitation for the six-hour storm.

	NOAA Values (inches)	Correction Factor	Corrected Point Rainfall (inches)
2-Year, 6-Hour	0.70	1.00	0.70
10-Year, 6-Hour	1.10	1.24	1.36
100-Year, 6-Hour	1.60	1.43	2.43

The 100-year, 6-hour point precipitation value of 1.6-inches (NOAA Atlas 2, Volume VII, 1973) compares well with the 1.8-inch value generated from a figure developed by French (1983) for the Cane Springs precipitation gauge (Figure 5). A preliminary value of 2.6-inches for the 100-year, 24-hour storm taken from a statistical analysis of the rainfall data at Well 5b (*Figure 5*) by Reynolds Electrical & Engineering Co., Inc., (personal communication, Barker, 1992) compares well with the value listed in NOAA Atlas 2, Volume VII (1973). Locations of these gauges are shown on *Figure 3* and *Sheet 1*.

The CCRFCD Manual requires that the point precipitation values listed in NOAA Atlas 2, Volume VII (1973) be used to determine point precipitation; however, the CCRFCD Manual specifies that rainfall events above the 2-year storm be adjusted. *Table 1* shows the correction factors listed in the CCRFCD Manual. These correction factors were identified from studies conducted by WRC Engineering and COE for Clark County (CCRFCD Manual, 1990) based on available rainfall data, primarily from the Las Vegas Valley; these factors may not be applicable for the RWMS study area.

French (1983) hypothesized that the southern part of Nevada can be divided into three precipitation zones: an excess zone, a transition zone, and a deficient zone (Figure 6). French (1983) indicates that the Las Vegas Valley is located in the excess zone, and the NTS is located in the transition zone. He further hypothesizes that the excess zone is a result of storms tracking up the Colorado River Valley, and the influence of the river on precipitation values lessens with distance away from the Colorado River Valley. The precipitation analysis by French (1983) and Barker (1992) support this hypothesis and suggest that the noncorrected precipitation values for the RWMS study area are more applicable than using the precipitation correction factors specified in the CCRFCD Manual. Hydrologic models in this flood assessment used the nonadjusted values in NOAA Atlas 2, Volume VII (1973); however, a discharge model was developed using the adjustment factors specified in the CCRFCD Manual to compare with the hydrologic models developed without the adjustment factors. The results of this comparison are discussed in Section 3.4, *Hydrology Discussion*.

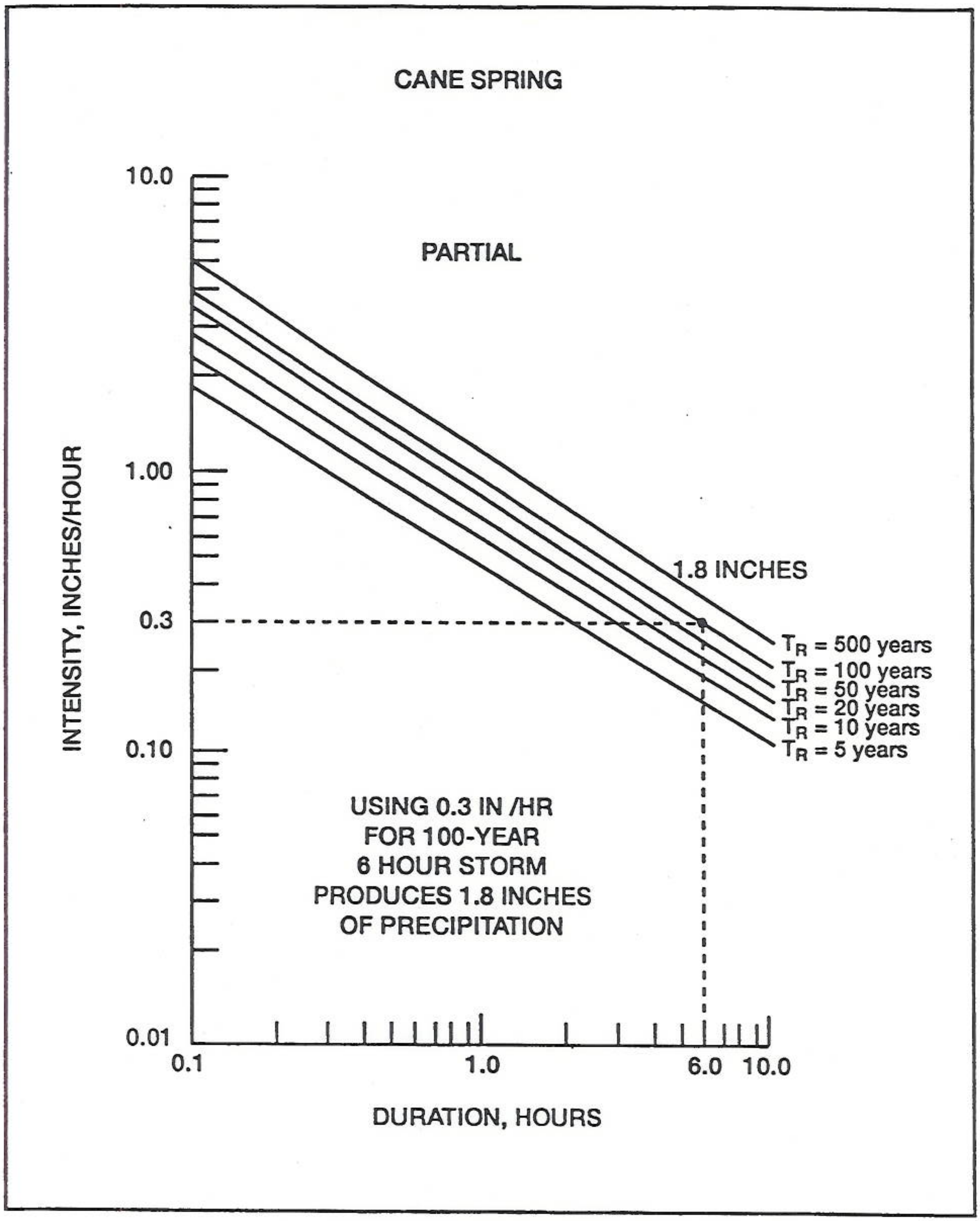


Figure 5. Intensity Duration Relationships for Various Return Periods, Cane Springs, Nevada Test Site, Nevada (modified from French, 1983). The 100-year, 6-hour point precipitation value of 1.6 inches compares well with the value from French, 1983.

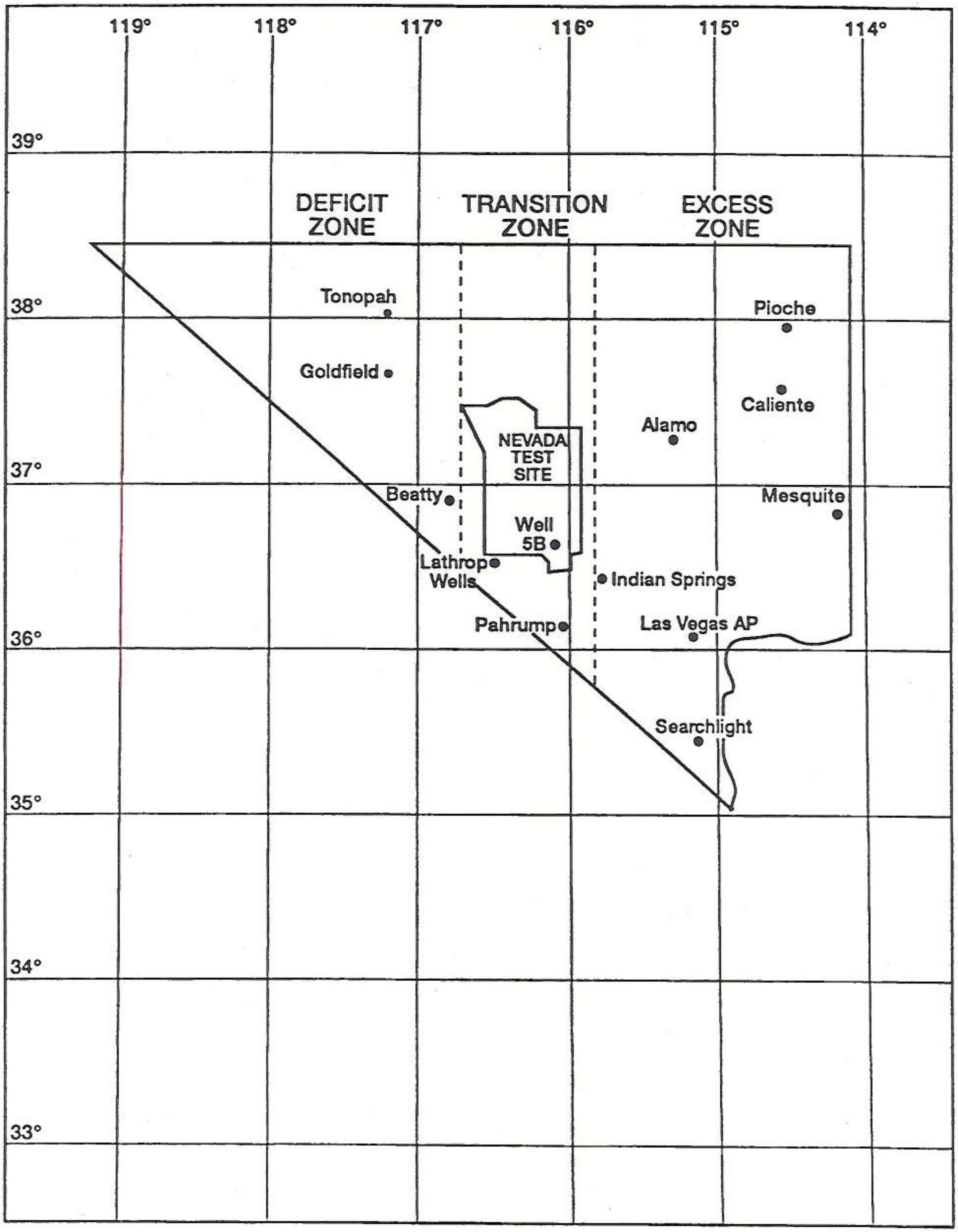


Figure 6. Hypothesized Zones of Precipitation in Southern Nevada (modified from French, 1983). The NTS is located in the transition zone of precipitation.

b. Storm Duration and Time Distribution

Clark County has adopted two 6-hour storm distribution tables to be used to generate discharges (CCRFCD Manual, 1990). The two storm distributions defined in this manual are for areas less than or larger than 10 square miles. These storm distributions were used for the subbasins in the hydrologic models for the RWMS. A mass curve of the two storm distributions is shown in Figure 7.

c. Depth-Area Ratios

During a flood-producing storm, usually a convectional storm in this region, point precipitation values probably would not apply to an entire drainage basin. Depth-area ratios have been developed for arid regions which reduce the point precipitation value for a watershed as a function of area. Clark County uses the depth-area ratios that were developed by the COE for Clark County and vicinity (Table 2). These depth-area ratios are a modification of ratios developed by Zehr (1984) on arid watersheds in Arizona and New Mexico. Ratios in the CCRFCD Manual were used in the hydrologic model for the RWMS.

3.1.2 *Drainage Areas*

The area of each drainage basin defined in the hydrologic model was delineated using 7.5- and 15-minute United States Geological Survey (USGS) topographic quadrangle maps of the area (*Figures* 2 and *3*; *Sheets 1* and 2), along with 1:6,000 orthophotos with a 10-foot contour interval that were developed for the area. Basin delineations were verified by field observations and study of color and infrared aerial photos. The area of each subbasin was determined using a planimeter. The drainage area, and the other watershed parameters for each subbasin used in the HEC-1 model, are listed in Table 3. The USGS topographic maps used to define the drainage area are:

15-minute Topographic Quadrangles (USGS):

- Papoose Lake (1952)
- Frenchman Lake (1952)
- Cane Spring (1952)
- Topopah Spring (1952)
- Tippipah Spring (1952)

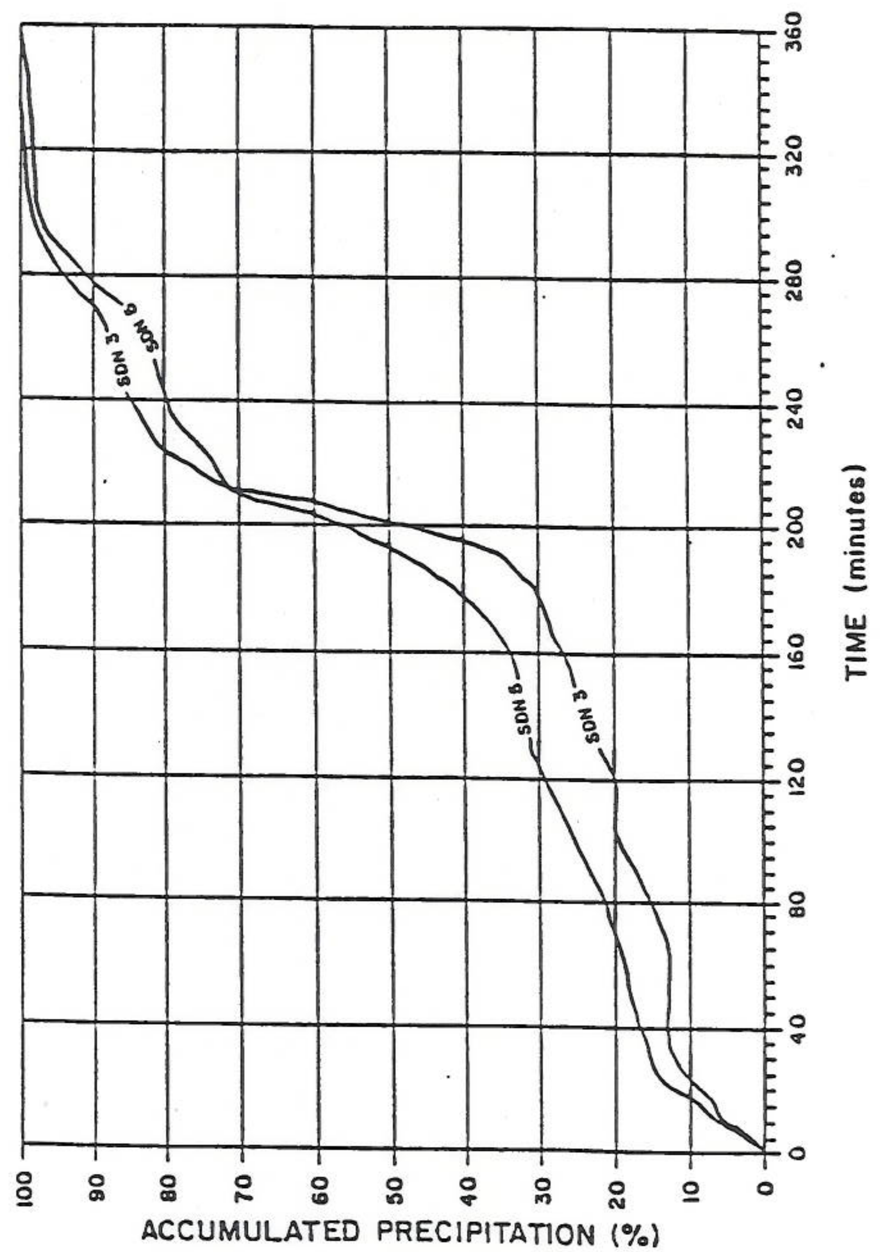
7.5-minute Topographic Quadrangles (USGS):

- Plutonium Valley (1986)
- Frenchman Lake (1986)
- Yucca Lake (1986)
- Cane Spring (1986)

3.1.3 *Precipitation Losses*

Precipitation losses were determined using the SCS curve number methodology and the applicable table (Table 4) found in the CCRFCD Manual. The following information is required to determine a curve number for a specific subbasin:

SIX-HOUR DESIGN STORM DISTRIBUTIONS



Notes:

1. For drainage areas less than 10 square miles in size, use SDN 3.
2. For drainage areas equal to or greater than 10 square miles in size, use SDN 5.

Figure 7. Storm Distributions (CCRFCD Manual, 1990 [reference USACE, Los Angeles District, 1988]). Storm distribution curves are selected based on drainage basin size.

Table 2. Six-Hour Precipitation Depth-Area Reduction Factors (CCRFCD Manual, 1990). Depth-area ratios reduce the point precipitation value for a watershed as a function of area.

Drainage Area (mi^2)	Reduction Factor	100-Year (in.)	10-Year (in.)	2-Year (in.)
0.01	1.00	2.43	1.36	0.70
1	0.97	2.36	1.32	0.68
10	0.86	2.09	1.17	0.60
20	0.79	1.92	1.07	0.55
30	0.74	1.80	1.01	0.52
50	0.68	1.65	0.92	0.48
100	0.60	1.46	0.82	0.42

Table 3. Watershed Parameters. Watershed parameters were delineated using topographic maps, aerial photos, and field investigations.

		Curve Numbers			
Watershed Name	Basin Area (mi^2)	AMC I	AMC II	AMC III	Lag Time (hrs)
MM1A	0.9	63	80	90	0.31
BW1	60.5	67	83	93	2.10
BW2	20.8	63	80	90	0.90
MM1B	2.1	59	77	87	0.48
MM2	1.4	62	79	89	0.47
HP1A	0.8	70	85	95	0.48
HP1B	1.0	60	78	88	0.51
HP2	1.2	60	78	88	0.51
HP3	1.7	66	82	92	0.59
HP4	3.3	62	79	89	0.52
HP5	1.2	62	79	89	0.30
HP6	2.2	63	80	90	0.55
HPFA	0.3	59	77	87	0.33
HPFB	1.6	59	77	87	0.44
SC1	39.4	66	82	92	2.10
SC2	1.5	59	77	87	0.48

Table 4. Runoff Curve Numbers (Semiarid Rangelands[1]) [CCRFCD Drainage Manual, 1990 {reference SCS TR-55, USDA, June 1986}]. Hydrologic soil group, vegetation type, and percent of ground cover determine curve numbers.

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, creosote bush, blackbrush, bursage, palo verde, mesquite, and cactus	Poor	63	77	85	88
	Fair	55	72	81	86
	Good	49	68	79	84

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

[2] *Poor:* < 30% ground cover (litter, grass, and brush overstory).
Fair: 30 to 70% ground cover.
Good: > 70% ground cover.

[3] Curve numbers for Group A have been developed only for desert shrub.

- hydrologic soil group;
- vegetation type; and
- percent vegetation cover.

The following procedures were used to obtain this information:

1. The percent of bedrock and alluvium was determined for each subbasin using aerial photos and geologic and topographic maps. Bedrock areas of the subbasins were assigned as hydrologic soil group D. This soil group has high runoff potential and applies to areas with shallow soils or exposed bedrock. The alluvium is mostly sand and was assigned as hydrologic

soil group B based on the preliminary surficial map by Rawlinson (1991), Romney (1973), and extensive field investigation conducted by the authors.

2. The cover type for the subbasins was determined to be desert shrub based on descriptions given in *Table 4*, field investigation, and study of aerial color and infrared photos.

3. The hydrologic condition was determined to be poor based on 30 ground surveys conducted on the alluvium (*Table 4*). Ground cover ranged between 5 and 30 percent. Results of these surveys were assumed to be representative of all subbasins. This assumption was verified by study of aerial photos and field investigations. Because of the very steep slopes and minimal or nonexistent soil, bedrock areas have less vegetation than alluvial areas; therefore, the hydrologic condition of the bedrock areas was also classified as poor.

According to the CCRFCD Manual, curve numbers for precipitation losses should be determined assuming an antecedent moisture condition of II (AMC-II). Antecedent moisture condition is dependent on the antecedent rainfall. The antecedent rainfall is the amount of rainfall between 5 and 30 days preceding a flood-producing storm. AMC-I assumes the soil is dry, and AMC-III assumes the soil is near or at saturation; AMC-II is halfway between AMC-I and AMC-III. The CCRFCD Manual designates AMC-II because data required to determine the antecedent moisture condition for an entire area are not quantifiable.

Assuming AMC-II, curve numbers for the alluvium and bedrock were 77 and 88, respectively. The curve number for each subbasin was determined by taking the weighted average between the percentage of alluvium and bedrock present in each subbasin. Curve numbers for each subbasin for AMC-I, AMC-II, and AMC-III are listed in *Table 3*. Hydrologic models in this study developed to estimate the 2-year and 10-year discharges assumed the antecedent moisture conditions were AMC-II. The 100-year hydrologic models developed for this study assumed conditions ranging between AMC-II and AMC-III. The results from all the models and the justification for varying the curve numbers per antecedent moisture conditions are addressed in Section 3.4, *Hydrology Discussion*.

3.1.4 *Lag Time*

In the SCS unit hydrograph method, only 1 input parameter, the lag time, is required. The CCRFCD Manual uses the lag time equation from the U.S. Bureau of Reclamation (Cudworth, 1989) for subbasins greater than 1-square mile:

$$TLag = 20K_n\left(\frac{LL_c}{S^{1/2}}\right)^{1/3}$$

where:

TLag = the lag time (hours) between the center of mass of rainfall excess and the peak of the unit hydrograph.

K_n = the Manning roughness factor (dimensionless) for the basin channels.

L = the length of the longest watercourse (miles) within the subbasin.

L_c = the length along the longest watercourse (miles) measured upstream to a point opposite the centroid of the basin.

S = the average slope of the longest watercourse (feet per mile).

As indicated in the CCRFCD Manual, K_n is subjective. Therefore, criteria listed in Table 604 in the CCRFCD Manual (Table 5) are recommended and were used for this study. Characteristics of the subbasins fell halfway between the "n" value description for 0.03 and 0.05. Parameters used to determine the lag time are listed in Table 6. The L and S values for each subbasin were determined using a map wheel on the watershed maps (*Sheets 1* and *2*). The L_c value was determined using a planimeter to find the centroid of each subbasin. A point on the longest watercourse of each subbasin which was closest to the respective centroid was selected.

3.1.5 *Channel Routing*

The Muskingum routing method was used for routing reaches. This routing method requires three parameters: x, K, and the integer step. The weighting factor (x) expresses the amount of attenuation of the flood wave within the reach (Dunne and Leopold, 1978), and was determined using criteria cited by Cudworth (1989). The Muskingum coefficient (K) accounts for the translation of the peak flow for the entire channel reach. This storage constant K is directly related to the length and the average velocity of the reach. The average channel velocity is determined using the Manning Equation. The Manning roughness coefficient was chosen based on field observations. Channel geometry was determined through field measurements. (The integer step and routing reach were determined so that the total travel time through the reach would be equal to K.) Only three reaches were routed in the models. Table 7 lists the routing parameters for these reaches.

Transmission losses for the routing reaches are ignored in the models. Variability of infiltration rates along a channel reach can be extensive; thus, these losses over an entire reach are difficult to quantify. Ignoring these losses adds another conservative assumption into the model.

3.2 Hydrologic Models

Seven hydrologic models were developed using the HEC-1 computer program to determine discharges for this flood assessment (Table 8). All the models have the same hydrologic parameters, with the exception of point precipitation values and curve numbers. The differences between the models are explained in each model description (*Table 8*). Output from the seven hydrologic models are located in Appendix A.

3.2.1 *Model Layout*

The overall watershed that could impact the RWMS was divided into 16 subbasins to provide discharges at key concentration points. Figure 8 is a schematic showing how the subbasins were connected in the HEC-1 models. The model layout was the same for all models.

Table 5. Lag Equation Roughness Factors (CCRFCD Manual, 1990 [reference USACE, Los Angeles District, 1982]). Characteristics of the subbasins fell halfway between the 0.030 and 0.50 "n" values.

Watershed Characteristics	Roughness Factor, K_n
Urbanized Areas: Water courses in the drainage area consist of street, storm sewer, and improved channels.	0.015
Natural Areas: Water courses in the drainage area are well defined, unimproved channels or washes. Watershed has minimal vegetation.	0.030
Natural Areas: Water courses in the drainage area are not well defined, and consist of many small rills and braided wash areas. Runoff from area combines slowly into channels. Includes mountainous channels with large boulders and flow restrictions.	0.050

Table 6. Lag Time Parameters. Parameters used to calculate lag times.

Watershed Name	L (mi)	Lc (mi)	S (ft/mi)	Kn	Lag Time (hrs)
MM1A	0.87	0.64	97.7	0.04	0.31
BW1	18.60	11.50	143.0	0.04	2.07
BW2	6.50	3.10	251.5	0.04	0.87
MM1B	2.46	0.72	71.9	0.04	0.48
MM2	2.16	1.33	215.3	0.04	0.47
HP1A	1.33	0.83	503.8	0.04	0.30
HP1B	2.54	1.33	173.2	0.04	0.51
HP2	2.58	1.55	242.2	0.04	0.51
HP3	3.79	2.27	459.1	0.04	0.59
HP4	3.18	1.70	415.1	0.04	0.52
HP5	1.48	0.64	378.4	0.04	0.30
HP6	3.37	1.74	332.3	0.04	0.55
HPFA	1.44	0.53	121.5	0.04	0.33
HPFB	2.08	0.80	103.4	0.04	0.44
SC1	18.10	10.60	106.1	0.04	2.10
SC2	2.69	0.85	119.0	0.04	0.48

NOTE:

$$TLag = 20K_n\left(\frac{LL_c}{S^{1/2}}\right)$$

where:

TLag = the lag time (hours) between the center of mass of rainfall excess and the peak of the unit hydrograph.

K_n = the Manning roughness factor (dimensionless) for the basin channels.

L = the length of the longest watercourse (miles) within the subbasin.

L_c = the length along the longest watercourse (miles) measured upstream to a point opposite the centroid of the basin.

S = the average slope of the longest watercourse (feet per mile).

Table 7. Routing Parameters. The Muskingum routing method was used for routing reaches.

Reach name	Integer Step	Storage Constant (K)	Weighting Factor (X)
HP1A to CPA	9	0.43	0.2
HP6 to CPD	5	0.27	0.2
CPD to CPE	8	0.39	0.2

NOTE:

Integer Step: The integer step is the number of subreaches for the Muskingum routing.

Storage Constant (K): The Muskingum "K" coefficient is the travel time (hours) through the reach.

Weighting Factor (X): The weighting factor expresses the amount of attentuation of the flood wave within the reach.

Table 8. Hydrologic Models. Hydrologic models were developed for the 2-year, 10-year, and 100-year flood events.

100-Year Hydrologic Model	
RWMS.OUT	Point precipitation values were taken from NOAA Atlas 2, Volume VII. Curve numbers were developed assuming AMC-II.
RWMSCN.OUT	Point precipitation values were taken from NOAA Atlas 2, Volume VII. Curve numbers for all basins were increased by 5 to account for an AMC greater than II.
RWMSW.OUT	Point precipitation values were taken from NOAA Atlas 2, Volume VII. Curve numbers for all basins were increased by 10 to account for AMC-III.
RWMSC.OUT	Clark County correction factors were used in conjunction with the point precipitation values taken from NOAA Atlas 2, Volume VII. Curve numbers are the same as those used in RWMS.OUTassuming AMC-II.
10-Year Hydrologic Model	
RWMS10.OUT	Point precipitation values were taken from NOAA Atlas 2, Volume VII. Curve numbers are the same as those used in RWMS.OUTassuming AMC-II.
RWMS10C.OUT	Clark County correction factors were used in conjunction with the point precipitation values taken from NOAA Atlas 2, Volume VII. Curve numbers are the same as those used in RWMS.OUTassuming AMC-II.
2-Year Hydrologic Model	
RWMS2.OUT	Point precipitation values were taken from NOAA Atlas 2, Volume VII. Curve numbers are the same as those used in RWMS.OUTassuming AMC-II. No correction factor to the 2-year point precipitation values from the NOAA Atlas 2, Volume VII, is required by the CCRFCD Manual.

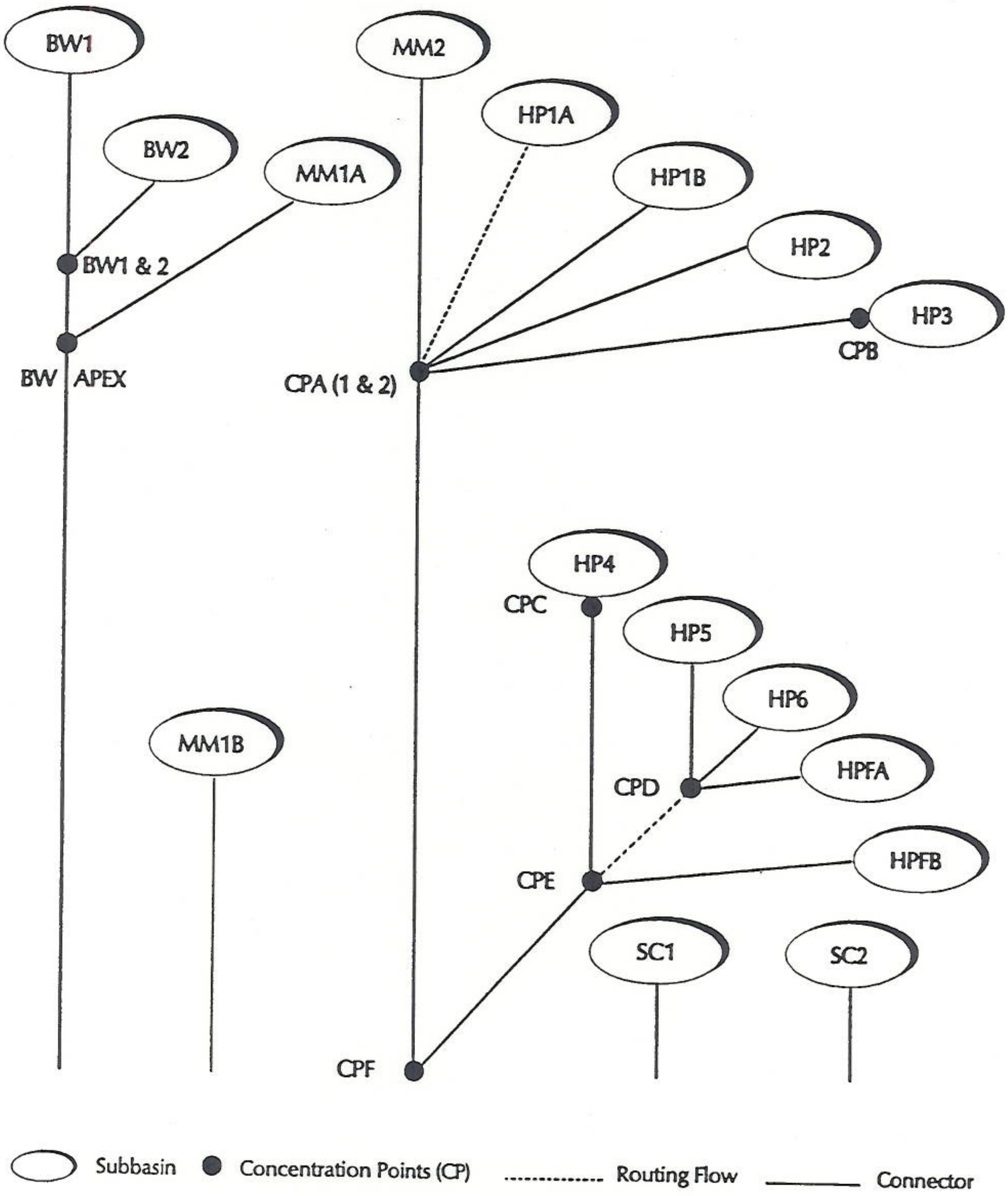


Figure 8. Schematic Diagram of Stream Network. This diagram shows how the 16 subbasins were combined in the HEC-1 models.

Conservative assumptions which simplified the model layout were made regarding routing and combining subbasins. For example, subbasins BW1, BW2, and MM1A within the HEC-1 models were considered to combine at the same point (*Figure 8*), but MM1A actually combines with the Barren Wash subbasins (BW1 and BW2) approximately 2,000 feet downstream. The HEC-1 models demonstrated little attenuation and translation of peak flows through this short reach; therefore, combining these basins without routing simplified the model and provided an additional conservative assumption to the model. Also, subbasins were combined along the perimeter of the RWMS without routing. First, flows from Concentration Point A (CPA1) were combined with flows from CPB; then flows from CPC and CPE were combined; and finally flows from CPA (1 and 2), CPC, and CPE were combined at CPF (*Figure 8*). CPF is located downstream from the RWMS. Again, the attenuation and translation of the peak flows as modeled using HEC-1 were minimal and, by combining the subbasins as shown on *Figure 8*, the models were simplified and conservative.

Another conservative assumption pertaining to subbasin HPFB was made in the model layout for a part of this subbasin that drains directly towards CPE. Difficulty in determining the percentage of discharge that could reach the RWMS from this subbasin led to the assumption that the entire subbasin would drain towards the RWMS.

Figure 8 shows flow from BW Apex, MM1B, SC1, and SC2 not connected to the major concentration points. Flow from BW Apex was not connected because flow from this drainage does not currently impact the RWMS; however, channel avulsions can potentially occur during a flood, thus directing flow towards the RWMS. This potential is addressed in Section 4.2, *Results and Discussion of Flood Hazard Determination*. Subbasin MM1B encompasses the Barren Wash Alluvial Fan, and flow that falls directly onto the fan would not drain towards the RWMS.

Subbasin SC1 is the Scarp Canyon watershed. The concentration point for this watershed is the apex of the Scarp Canyon alluvial fan. Flow from this watershed does not impact the RWMS, as shown in the Section 4.2, *Results and Discussion of Flood Hazard Determination*. Subbasin SC2 is a portion of the nonactive fan surface composed of sediments deposited by the Scarp Canyon channel. Because the channel has become entrenched and has extended the active apex approximately 2.5 miles down the existing fan surface, runoff from this surface would be sheetflow and, as indicated by the topography (*Figure 3* and *Sheet 2*), drains away from the RWMS.

3.2.2 *Concentration Points*

The concentration point locations were determined to provide discharges at the most appropriate location for the hydraulic analysis (*Figures 3* and *4* and *Sheets 1* and *2*). Concentration points were selected for sheetflow locations and at the active apexes of the alluvial fans. In the case of sheetflow, with the exception of CPC and CPD, the concentration points were spread across the area of potential flood impact with the RWMS. CPC was selected where all water from subbasin HP4 would be funneled southwest between subbasins HP4 and HPFB towards the RWMS. CPD was selected where water from subbasins HP5, HP6, and HPFA would be concentrated together before being routed to CPE.

3.3 Hydrology Results

Discharges of key concentration points from the seven models used in this analysis are listed in Table 9.

Table 9. Discharges From HEC-1 Models at Key Concentration Points

		100-Year Discharges (cfs)				10-Year Discharges (cfs)		2-Year Discharges (cfs)
Concentration Point	DA (mi^2)	RWMS.OUT	RWMSCN.OUT	RWMSW.OUT	RWMSC.OUT	RWMS10.OUT	RWMS10C.OUT	RWMS2.OUT
BWAPX*	82.20	1,848	3,513	6,018	5,498	510	1,083	22
CPA1	4.40	459	786	1,229	1,297	130	278	15
CPA2	6.10	659	1,126	1,757	1,827	187	399	23
CPB	1.70	263	420	624	661	87	170	14
CPC	3.30	360	626	984	1,060	88	210	8
CPD	3.70	333	570	884	945	90	199	10
CPE	8.60	603	1,180	1,819	1,898	168	335	9
CPF	14.70	878	1,462	2,396	2,462	301	576	25
SC1APX**	39.40	1,251	2,178	3,498	3,438	356	769	15

*Barren Wash Apex
**Scarp Canyon Apex

NOTE: Discharge outputs are from the HEC-1 model and do not incorporate significant figures.

Discharges from the models RWMS2.OUT, RWMS10.OUT, and RWMSW.OUT (2-year, 10-year, and 100-year discharges, respectively) were used in the analysis to determine the flood hazard zones for the Barren Wash, Scarp Canyon, and Halfpint alluvial fans. Discharges from RWMSW.OUT were used to evaluate the 100-year sheetflow and shallow concentrated flow that could impact the RWMS. Justification for choosing these models is discussed in the following section.

3.4 Hydrology Discussion

Although only three models were used in the flood assessment, a total of seven models were developed and evaluated in this study. A two-step approach was used to select the appropriate models for the 2-year, 10-year, and 100-year discharges. The following paragraphs provide a description of this approach.

The first step focused on the hydrologic model (HEC-1) for the 2-year flood. In arid regions, such as the RWMS location, it is common that no flow will occur in washes for several years; therefore, the 2-year model-generated discharges for the subbasins should be close to zero. The 2-year discharges from RWMS2.OUT (*Table 9*) were low, less than 25 cubic feet per second. These discharges from RWMS2.OUT appear reasonable so no other model was developed for the 2-year flood.

To verify the model-generated discharges for the 10-year and 100-year floods, another step was required. This step compared the skew coefficient developed from model-generated discharges and the regional skew coefficient (Water Resource Council [WRC] 17B, 1981). If the hydrologic models are producing reasonable discharges, then the skew coefficient from these models should be close to the regional skew coefficient.

A major assumption in using skew coefficients is that the relationship between discharge and return period must follow a Log-Pearson Type III (LPIII) probability distribution, as specified in WRC (1981). The FEMA FAN computer program (1990) contains a subroutine that calculates skew coefficients using a least-square fit and a LPIII probability distribution. This program calculated skew coefficients for specific concentration points using model-generated discharges. This program requires discharges for a minimum of three return periods to calculate the skew coefficient. (In this analysis the 2-year, 10-year, and 100-year model-generated discharges were entered into the FAN program.)

WRC (1981) contains a map which shows the regional skew coefficients for the country (Figure 9). According to the information on this map, the skew coefficient for washes on the NTS should be near zero. A zero skew coefficient means that if discharge versus probability were plotted on log-probability paper, then the flood frequency curve would plot as a log-normal distribution (a straight line). Preliminary results from a study by the USGS using stream gage data gathered after 1981 also support a zero skew for this region (Hjalmarson [personal communication], 1992).

The first three models that were evaluated using the skew comparison approach were RWMS2.OUT, RWMS10.OUT, and RWMS.OUT (Model Set 1). These models were developed using the noncorrected precipitation values from NOAA Atlas 2, Volume VII (1973) and followed the methods in CCRFCD Manual for the remaining input parameters. Discharges at the apexes of the Barren Wash, Halfpint, and Scarp Canyon alluvial fans were evaluated. Discharges at these apexes were entered into the FAN program to determine the skew coefficients. The skew coefficients, as shown in Table 10, were negative and were not close to zero. The discharges

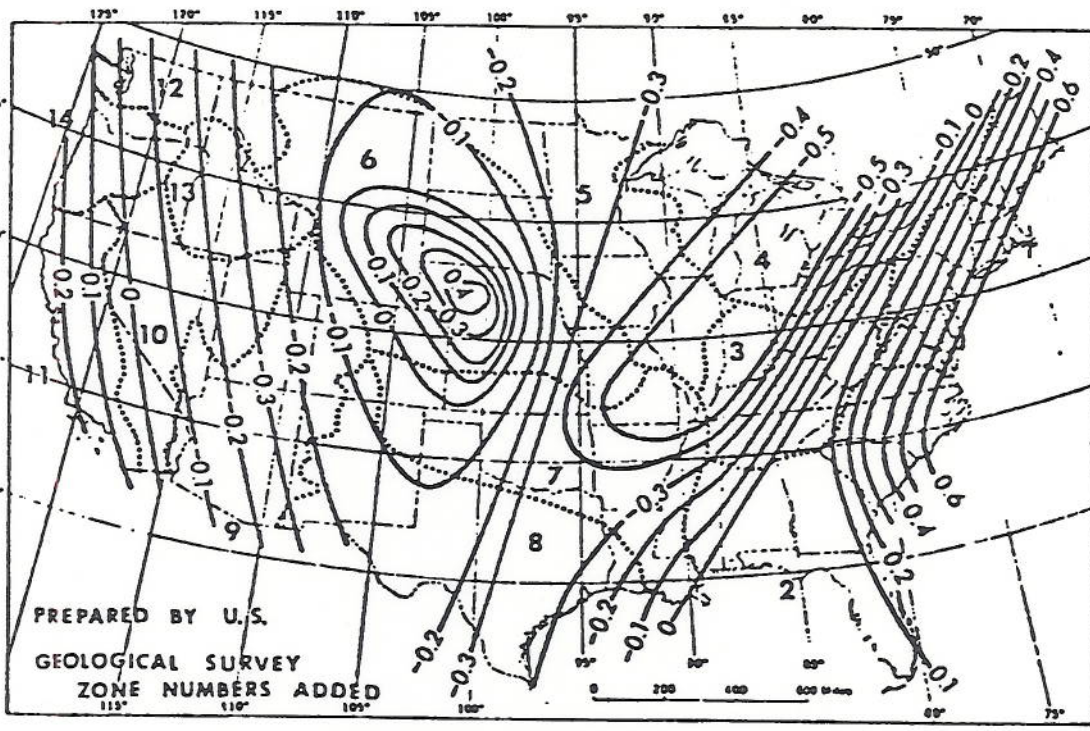


Figure 9. **Generalized U.S. Skew Coefficients (WRC [1981]).** The Nevada Test Site is located in an area with a zero skew coefficient value.

Table 10. Skew Coeffieicnts From Different Model Sets. Model Set 3 generated skew coefficients closest to zero for the three apexes.

Apex Locations	Model Set 1	Model Set 2	Model Set 3	Model Set 4
Barren Wash	–1.2	–0.6	–0.1	–1.2
Scarp Canyon	–1.2	–0.7	–0.3	–1.3
Halfpint	–1.1	–0.4	0.1	–1.0

Return Period	Model Set 1	Model Set 2	Model Set 3	Model Set 4
2–Year Model	RWMS2.OUT	RWMS2.OUT	RWMS2.OUT	RWMS2.OUT
10–Year Model	RWMS10.OUT	RWMS10.OUT	RWMS10.OUT	RWMS10C.OUT
100–Year Model	RWMS.OUT	RWMSCN.OUT	RWMSW.OUT	RWMSC.OUT

in this set must be adjusted to move the skew coefficients closer to zero. The 2–year model (RWMS.OUT2) was determined to generate reasonable results; therefore, adjustment must occur either to the 10–year, 100–year or both models.

The 10–year and 100–year hydrologic models could be modified by adjusting the curve numbers, depth of precipitation, or lag times. Of these three parameters, curve numbers have the widest variability because they are dependent on antecedent moisture conditions, as indicated in *Table 3.* Curve numbers for the subbasin in this study (*Table 3*) can range in the 50's and 60's under dry soil conditions (AMC–I) to the high 80's and low 90's (AMC–III) for saturated conditions. The CCRFCD Manual assumes AMC–II because antecedent moisture conditions for a drainage basin are impossible to quantify and a standard approach is required in Clark County to assure consistent analysis and design in drainage facilities and structures. The assumption of AMC–II may be reasonable for the 2–year flood event, as reflected in RWMS2.OUT, but may not be for the 10–year and 100–year flood events. For 10–year floods or greater, the antecedent moisture condition as well as rainfall may contribute to flooding.

Precipitation depth and lag times are not as variable. Variation from the precipitation depths in NOAA Atlas 2, Volume VII is not supportable because analysis of precipitation data in the study area (French, 1983; and Barker [personal communication], 1992) do not vary substantially from the values in NOAA Atlas 2, Volume VII, and any variation to precipitation data would be difficult to support. Variability in lag time is limited because three of the four parameters (L, L_c, and S) are measured from a topographic map, and significant variations in the K_n are not defensible using the methods described in the CCRFCD Manual (*Table* 5). Therefore, the curve numbers in the models were considered the most reasonable parameter to modify.

Modification of curve numbers in the 100–year model were evaluated first. Two additional 100–year models were created from the original 100–year model (RWMS.OUT): RWMSCN.OUT and RWMSW.OUT. In RWMSCN. OUT, curve numbers were 5 greater than the original model, and in RWMSW.OUT, curve numbers were 10 greater than the original model. Increasing the curve numbers by 5 assumes an antecedent moisture condition between AMC–II and AMC–III; increasing the curve numbers by 10 assumes AMC–III.

Using these models, two additional model sets were developed with these two models: Model Set 2 (RWMS2.OUT, RWMS10.OUT, and RWMSCN.OUT) and Model Set 3 (RWMS2.OUT, RWMS10.OUT, and RWMSW.OUT). The 2-year, 10-year, and 100-year discharges for each model set were entered into the FAN program. The skew coefficients of the apexes of the three fans were closer to zero (*Table 10*). Model Set 3 generated skew coefficients closest to zero for the three apexes. These models from Model Set 3 were used to define the 100-year flood hazards in this flood assessment.

The 10-year model was not modified because an increase in the curve numbers would require a corresponding increase in the curve numbers for the 100-year model to maintain a zero skew. Assuming AMC-III (saturated conditions), the discharges generated from RWMSW.OUT are at their upper limit; therefore, an increase in curve numbers for the 10-year model would result in a negative skew.

Additional HEC-1 models were developed using the precipitation correction factors in the CCRFCD Manual required to the 10-year and 100-year precipitation depths (*Table 1)*. Two additional models were necessary: RWMS10C.OUT and RWMSC.OUT. The skew coefficient using discharges from the models RWMS2.OUT, RWMS10C.OUT, and RWMSC.OUT (Model Set 4) were calculated and are listed in *Table 10.*

Adjusting the curve numbers for the 100-year event and not using precipitation correction factors varies from the methods given in the CCRFCD Manual, but the 100-year discharges generated using this approach (RWMSW.OUT) are comparable to 100-year discharges from the model (RWMSC.OUT). Plus, the skew coefficients calculated using RWMSW.OUT for the 100-year discharges (Model Set 3) are closer to zero than the model following CCRFCD Manual criteria (Model Set 4). For these reasons, Model Set 3 was used in this flood assessment instead of Model Set 4.

As a result of this two-step approach to determine the appropriate hydrologic models, seven models were developed but only three models (RWMS2.OUT, RWMS10.OUT, and RWMSW.OUT) were used in determining the flood hazard of the RWMS and HWSU facilities.

4.0 HYDRAULICS AND FLOOD HAZARD DETERMINATION

The RWMS and HWSU are located in an arid region where traditional approaches to define flood hazards (e.g., the hydraulic model HEC-2, which assumes a stable and fixed channel geometry) may not be appropriate for all types of flooding. Potential flooding of the RWMS and HWSU can occur as alluvial fan flooding, shallow concentrated flow, and sheetflow. FEMA has developed methodology to determine the 100-year flood hazards from these types of flooding. FEMA methodology was used to delineate the flood hazards impacting the RWMS and HWSU per 40 CFR 270.14. This section provides:

- a brief description of the FEMA methodology used to evaluate alluvial fan flooding, shallow concentrated flow, and sheetflow;
- the results and discussion of the flood hazard evaluation; and
- flood hazard maps.

4.1 Hydraulics and Flood Hazard Determination Methodology

4.1.1 FEMA Alluvial Fan Methodology

Flooding from the Barren Wash, Scarp Canyon, and Halfpint alluvial fans could impact these facilities. Hydraulic processes on alluvial fans are different than in riverine channels. Alluvial fan flooding, as described by FEMA (1991), ". . . is characterized by high-velocity flows; active processes of erosion, sediment transport, and deposition; and unpredictable flowpaths." Channel geometry and direction on alluvial fans can change in direct response to a flood discharge. Field investigations and study of topographic maps and aerial photos of the Barren Wash, Scarp Canyon, and Halfpint alluvial fans support this description because flowpaths are unpredictable, soil development is weak, and evidence of recent erosion and deposition is present.

FEMA (1991) states that if flowpaths below the active apex cannot be predicted (which is the case for the Barren Wash, Scarp Canyon, and Halfpint alluvial fans), the FEMA Alluvial Fan Methodology must be applied to evaluate the 100-year flood hazard. This methodology, which is a modification of the method proposed by Dawdy (1979), relates probability of discharges at the apex to probability of channel depths and flow velocities that occur on the alluvial fan.

According to Dawdy (1979), flood flow from the apex of a typical alluvial fan does not spread evenly over the fan surface, but is instead confined to a surface or channel that carries the flood waters from the apex to the toe of the fan (Figure 10). The active apex is selected at the point where the flowpath becomes unpredictable, and flow is no more likely to follow an existing channel than create a new path. In the upper region of an alluvial fan, flow is confined to a single channel where the depth and width of the channel is a function of the flow itself. In general, flow occurs at critical depth and velocity as a result of steep slopes associated with this upper region. As slopes decrease towards the mid and distal parts of the fans, channel bifurcation can occur resulting in a multiple-channel region. Dawdy (1979) did not incorporate a multiple-channel region into his methodology. FEMA (1985, 1991) modified the Dawdy methodology to address multiple-channel regions of alluvial fans.

Key assumptions of the FEMA Alluvial Fan Methodology follow (French, 1989):

1. The location of the flood event channel on the fan surface is random. Furthermore, the probability of the channel passing through any given point on a contour is uniform.

2. Flow occurs in flow-formed channels. Well-defined channels result from the subsequent erosion from this process.

   a. Incised channels do not exist previous to the first flow event.

   b. Existing channel capacity is not adequate to convey the flow, and overbank flooding occurs.

3. The width and depth of the channel is a function of discharge.

4. Transmission losses are not considered.

5. On-fan precipitation is not considered.

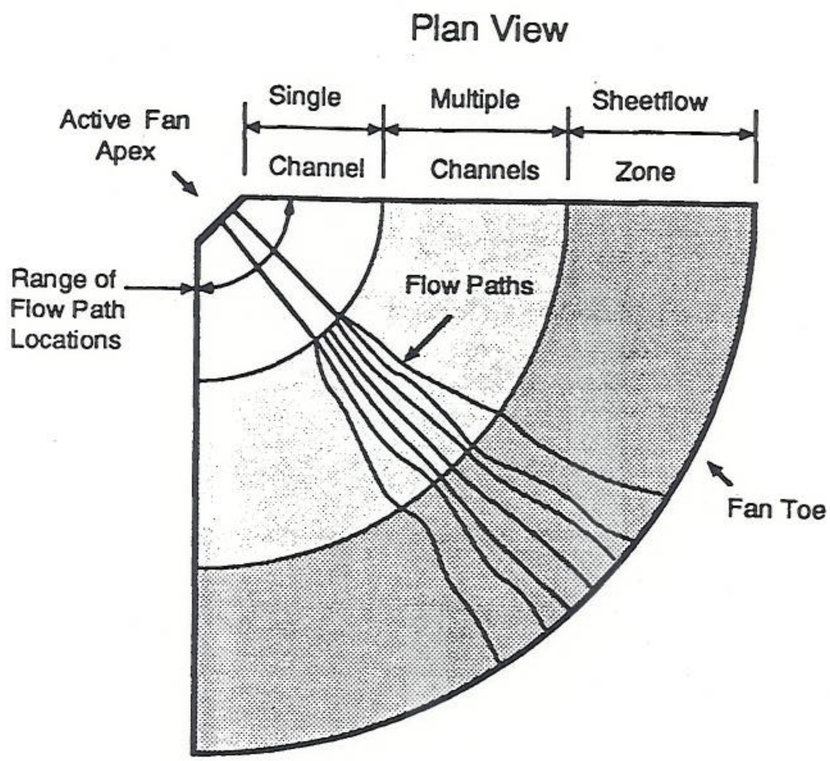


Figure 10. Alluvial Fan Plan View (modified from French, 1989). Plan view of an idealized alluvial fan showing the single channel, multiple channel, and sheetflow regions.

6. The alluvial fan is active; e.g., net deposition is occurring in both time and space and avulsions (the migration of channel from one location to another during a single event) are occurring.

7. Flood discharge frequency distribution must be available at the apex of the alluvial fan.

Field observations, a study of topographic and geologic maps, aerial photographs, and examination of historic records were made during the flood assessment of these alluvial fans. Sources of flooding were defined, an apex selected, active fan boundaries delineated, entrenched reaches of channels located and measured, and locations of barriers to flow determined.

The methodology used for defining flood hazards on alluvial fans incorporates FEMA's computer model, FAN (1990). Delineation of the 100-year flood hazard using the FEMA FAN Model requires the following parameters and assumptions:

- Discharge information
- Apex location
- Fan boundaries and dimensions
- Potential flow obstructions and/or diversions
- Multiple channel region parameters:
  - Manning roughness coefficient
  - Slope

The FAN model requires that at least three discharges of different return periods be used to define the flood hazard zones. The 2-year, 10-year, and 100-year flood discharges for the Barren Wash, Scarp Canyon, and Halfpint alluvial fans were taken from the HEC-1 models labeled RWMS2.OUT, RWMS10.OUT, and RWMSW.OUT, respectively (*Table 9*). Discharges calculated by the HEC-1 models for CPBWAPEX or CPBW1&BW2 (*Figure 8*), whichever were greater, were used as the discharges at the apex of the Barren Wash Alluvial Fan in the FAN model. Discharges used in the FAN model for Scarp Canyon were taken from the HEC-1 models at the active apex of Scarp Canyon (Subbasin SC2). Discharges for Halfpint Alluvial Fan were taken from CPE as calculated within the HEC-1 model, and were assumed to have originated from the fan apex. All approaches for selecting discharges at the apexes are considered to be conservative.

Apex locations and fan boundaries were determined from aerial photographs; available topographic, geologic, and surficial maps; and field investigations. Apexes were located using the FEMA definition for an active apex. Location of the apexes for Barren Wash, Scarp Canyon, and Halfpint alluvial fans are shown in Figure 11 and Sheet 3.

Potential flow obstructions and diversions such as roads, buildings and other structures which can prevent flooding in some areas and increase flooding in others must be designated. In this flood assessment, all barriers such as Mercury Highway, 5-01 road, all secondary roads, the nonengineered berms surrounding the RWMS perimeter, and all disturbed areas diverting flow away from the RWMS were ignored. Quantification of the diversion would be difficult. Assuming that all flow can reach the RWMS produces a more conservative flood analysis.

A Manning roughness coefficient of 0.030 was used for the multiple-channel regions of all three fans. The Manning roughness coefficient for the multiple-channel regions of the fan were

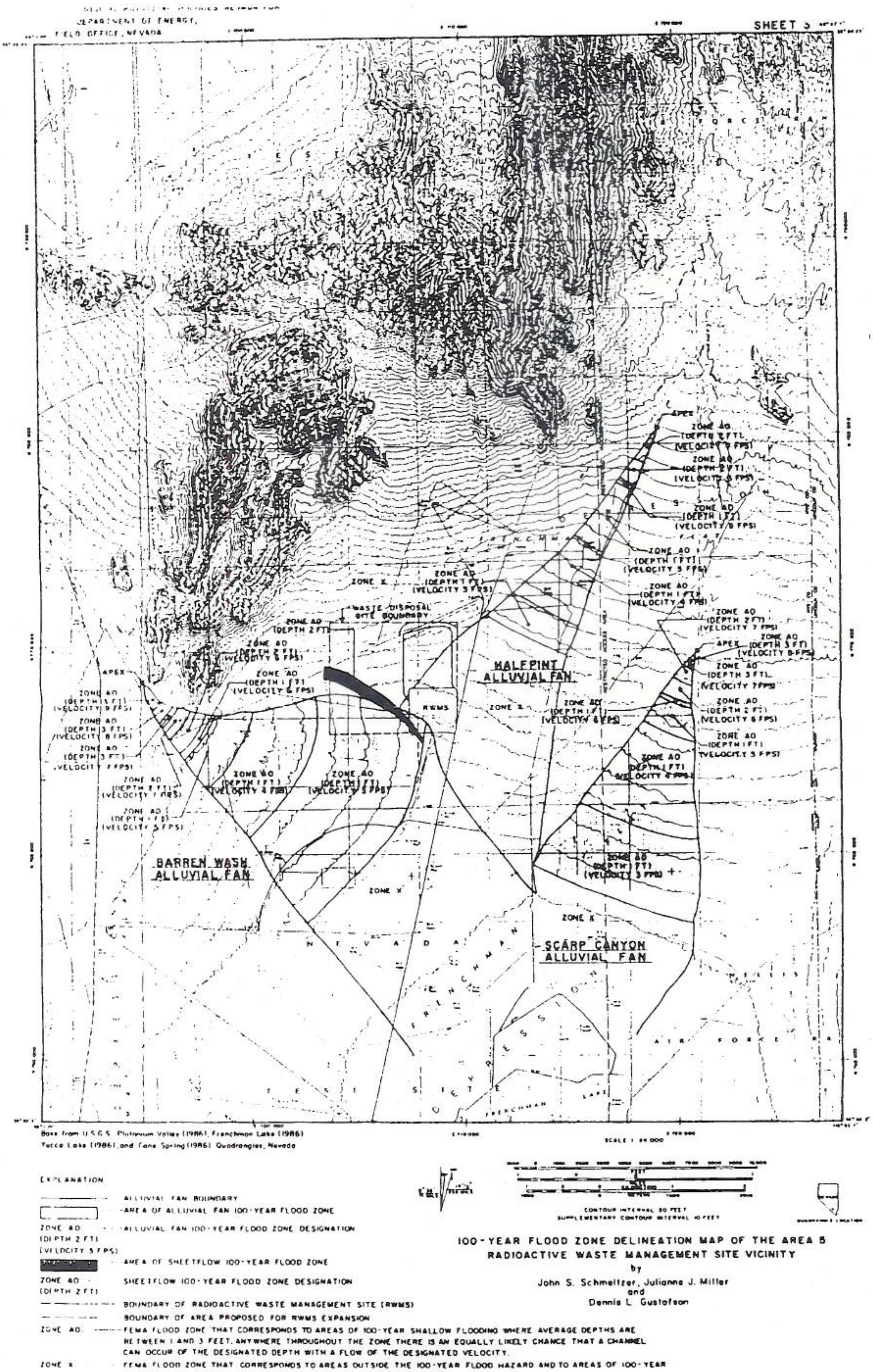


Figure 11. 100–Year Flood Zone Delineation Map of the Area 5 Radioactive Waste Management Site Vicinity (Sheet 3)

determined from field observations, and confirmed using the descriptions and values found in tables developed by Chow (1959). Slope of the fans for the multiple-channel region parameters were determined from the 1:6,000 orthophotos with a 10-foot contour interval.

4.1.2 Shallow Concentrated Flow

For subbasins MM2 and HP1B, a defined natural drainage exists that traverses the southwest corner of the RWMS. Field investigation of the geomorphology and a study of aerial photos suggest that shallow concentrated flow occurs through this reach and that standard hydraulic analysis may be appropriate. The 100-year flood hazard elevation of this drainage was estimated using the HEC-2 computer program (COE, 1990), a standard hydraulic method. HEC-2 is a hydraulic model developed by the COE and is used by FEMA to delineate flood hazards of channelized flow. The input requirements of the HEC-2 model include channel cross section information; distances between cross sections; and Manning roughness coefficient. Cross section information and distances were taken from a 1:4,800 topographic map with a 5-foot contour interval (Appendix C contains HEC-2 output, work map and cross sections) in conjunction with field observations and measurements. As in the alluvial fan analysis, Manning roughness coefficients were estimated from field observations, and confirmed using the descriptions and values found in tables developed by Chow (1959).

4.1.3 Sheetflow

According to FEMA (1991), sheetflow

> . . . is the broad, relatively unconfined downslope movement of water across sloping terrain that results from . . . a channel that crosses a drainage divide, . . . and overflow from a perched channel onto . . . plains of lower elevations . . . . [Sheetflow] is typical in areas of low topographic relief and poorly established drainage systems . . . . Shallow flooding is often characterized by poorly defined channels and highly unpredictable flow direction because of low relief or shifting channels and debris loads. Where such conditions exist, the entire area susceptible to this unpredictable flow should be delineated as an area of equal risk. Small-scale topographic relief that is not evident on existing topographic mapping and that might lead to "islands" of one flood hazard zone within larger areas of another should be ignored.

This definition of sheetflow describes the distributary-flow system (hydraulic engineering viewpoint) areas that drain from the Halfpint Range towards the RWMS. With current elevation information (10-foot contour interval) on available orthophotos, a detailed assessment of the flood hazard was not possible because of the inability to distinguish channels and nonchannel regions; therefore, per FEMA (1991) the 100-year flood hazard of this area was analyzed assuming that the entire area is prone to flooding and is delineated as an area of equal risk. Geomorphologic evidence gathered from analysis of color and infrared aerial photos and field observations supports this assumption because these areas have weak soil development and relatively few areas of relic deposits covered by desert pavement with desert varnish.

4.2 Results and Discussion of Flood Hazard Determination

Using the methods described in the previous section, the 100-year flood hazard areas were defined on the topographic maps (*Figure 11* and *Sheet 3*). Zone AO and Zone X were used to denote the flood hazards in the vicinity of the RWMS.

FEMA designates alluvial fan, shallow concentrated flow, and sheetflow areas with a 100-year flood depth of greater than 1 foot as a Zone AO. FEMA (1990) defines Zone AO as the area of 100-year shallow flooding where average depths are between 1 and 3 feet. For alluvial fans, anywhere throughout the zone there is a probability of 0.01 that a channel can occur at the designated depth with flow at the designated velocity. Zone X, shown on *Figure 11* and *Sheet 3* and Figure 12 and Sheet 4, represents areas outside the 100-year flood hazard and/or areas of the 100-year shallow flooding (sheetflow or shallow concentrated flow) where average depths are less than 1 foot. A Zone X delineation does not mean that floods will not occur within this zone. For this reason, flood hazard protection must be addressed.

4.2.1 Alluvial Fan Flooding

The 100-year flood hazard zones for the Barren Wash, Scarp Canyon, and the Halfpint fans are shown on *Figure 11* and *Sheet 3*. The 100-year flood hazard for the RWMS and its immediate vicinity is also shown on an 1:6,000 orthophoto (*Figure 12* and *Sheet 4*).

Using the FEMA Fan Methodology, the southwest corner of the RWMS is within the 100-year flood hazard zone, designated as Zone AO; depth 1 foot; velocity 3 feet per second, of the Barren Wash Alluvial Fan. The part of the RWMS that is located within Zone AO of this alluvial fan is not included in the RCRA Part B Permit Application for the Area 5 RWMS because it is not used for storage or disposal of hazardous, mixed, or radioactive waste. This designation means that the southwest corner of the RWMS has a probability of 0.01 (a 100-year event) to be impacted by channelized flow averaging 1 foot of depth and having a velocity of 3 feet per second. The HWSU is not within the 100-year flood hazard of the Barren Wash Alluvial Fan.

Neither the RWMS nor the HWSU are located within the 100-year flood hazard of the Halfpint Alluvial Fan (100-year flow depths 1 foot or greater), but are located in the Zone X area of the Halfpint Alluvial Fan (100-year flow depths less than 1 foot). This study determined that 100-year flow from the Scarp Canyon Alluvial Fan does not impact the RWMS or HWSU. Appendix B contains the output of the FAN model results.

The review of field data; topographic, geologic, and surficial maps; and aerial photographs does not invalidate the assumptions of the FEMA Alluvial Fan Methodology. However, other methods for determining flood hazards in arid regions are currently being developed. At the time of the writing of this report, none of these other methods have been adopted by FEMA; therefore, the FEMA methods were the only methods used. For example, French (1992) argues that the FEMA assumption of an uniform probability of a channel being formed on any given contour may not be valid. As a result of analyzing channel orientation of over 90 alluvial fans in the United States, French found that fanhead channels tend to form along or near the centerline of alluvial fans (an imaginary line which bisects the alluvial fan from the apex to the toe of the alluvial fan). In his study, French modified the FEMA Alluvial Fan Methodology to incorporate this tendency. Using French's approach, the flood hazard potential from the Barren Wash Alluvial Fan is less than the potential determined from the FEMA methodology because the RWMS is located adjacent to the north boundary of the fan.

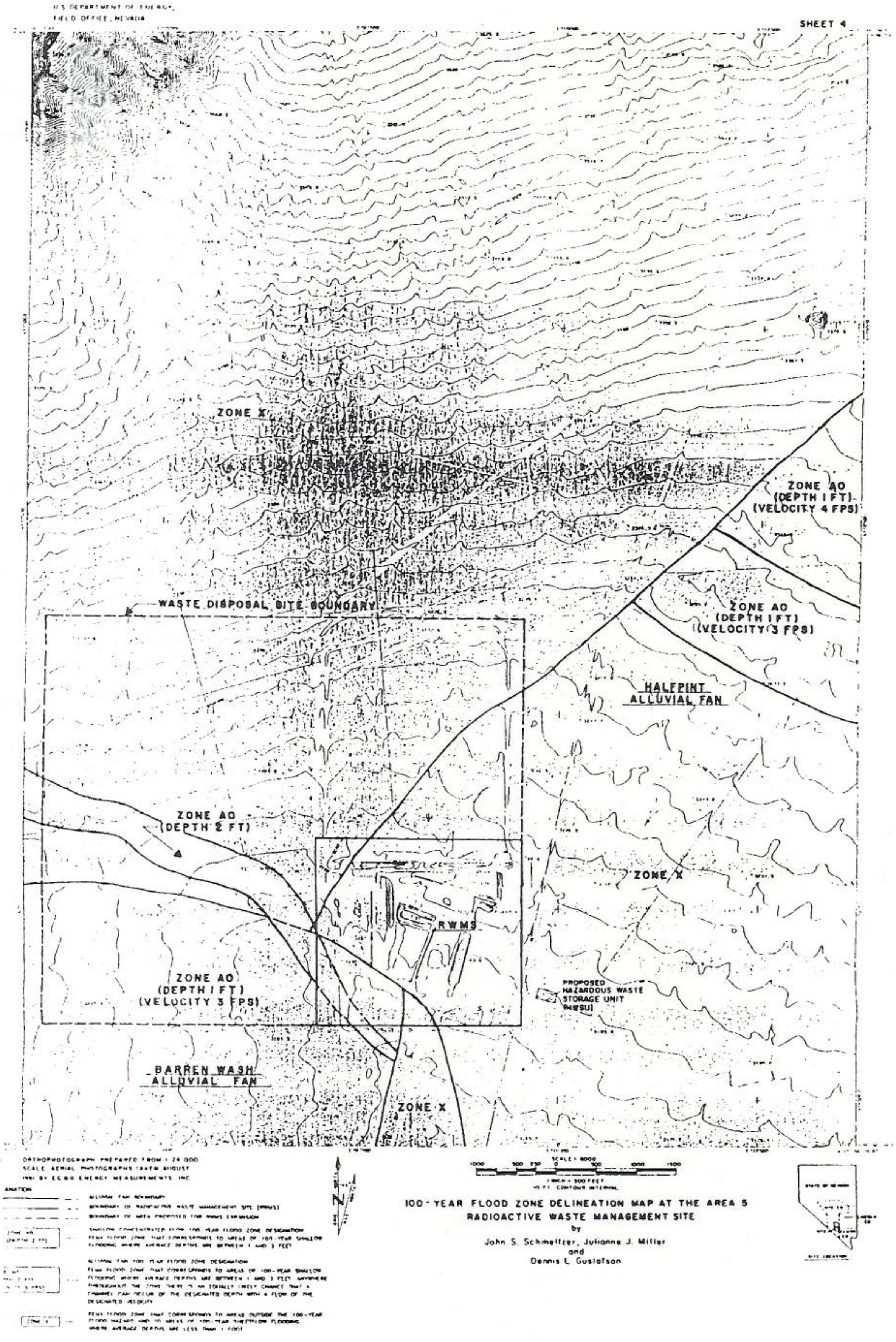


Figure 12. Orthophoto With Fans (Sheet 4)

4.2.2 Shallow Concentrated Flooding

Results of the HEC-2 analysis for the watercourses draining subbasins MM2 and HP1A&B estimated the 100-year flow depths at 2 feet. The southwest corner of the site is also located within the 100-year flood hazard of this drainage, and is designated as Zone AO; depth 2 feet (*Figure 11* and *Sheet 3*). Again, this portion of the RWMS is not used for disposal of waste and is not included in the RCRA Part B Permit Application for the Area 5 RWMS. Appendix C contains the output of the HEC-2 model, the workmap, and cross sections used to analyze this drainage.

4.2.3 Sheetflow

FEMA (1991) usually describes areas that experience sheetflow as Zone X (an area of flooding with depths less than 1 foot). Calculations to determine the average 100-year depths for sheetflow areas support this assertion. Calculated depths within the proposed RWMS boundary and the HWSU were all less than 1 foot. These facilities are not in a 100-year flood hazard from flow draining from the Massachusetts Mountains/Halfpint Range. Appendix D contains the calculations used to estimate the depth of flow in sheetflow regions.

Several measures were taken to assure that this flood assessment would be as conservative as reasonable. Discharges were calculated using a "state-of-the-art" approach for this region (i.e., CCRFCD Manual). All flow barriers such as roads, structures and existing nonengineered dikes were ignored to assume that all flow could reach the RWMS. The entire area was assumed to be prone to flooding and was delineated as an area of equal risk because of the inability to distinguish channels from the available topographic maps.

A Zone X designation is somewhat misleading. Although FEMA requires flood protection only for areas listed as Zone AO, a flood hazard must still be recognized within a Zone X. The sheetflow region to the north of the RWMS contains channels which range in depth up to 3 feet. FEMA (1991) states that discharge in sheetflow regions must be spread equally over the entire surface area. To the north of the RWMS, this results in average flow depths of less than 1 foot, and thus the designation of Zone X. Field observations of channels within this region indicate that flows greater than 1 foot could occur in these channels during a 100-year flood. Any type of flood protection design criteria must address the potential of channelized flow for this area.

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HEC-1 MODEL OUTPUT

FILENAME: RWMSCN.OUT

(100-YEAR MODEL)

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                  X       X  X        X     X          X
                  X       X  XXXXXXX   XXXXX          XXX


THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

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


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  2        ID     100-YEAR 6-HOUR STORM 1.6 INCHES
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  4        ID     DEPTH-AREA REDUCTION FACTORS FROM TABLE 502 IN
  5        ID     CLARK COUNTY HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL (CCRFCD, 1990)
  6        ID     CURVE NUMBERS DETERMINED USING TABLE 602 IN CCRFCD, 1990
  7        ID     LAG TIMES DETERMINED USING METHOD IN SECTION 606.3 IN CCRFCD, 1990
  8        ID     DRAINAGE AREAS FROM 7.5 MINUTE AND 15 MINUTE QUADS
  9        ID     THIS MODEL ADDRESSES DRAINAGES THAT COULD IMPACT THE RWMS
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 12        IN       5
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           * RAINFALL DISTRIBUTION FROM CLARK COUNTY MANUAL LESS THAN 10 SQ. MILES
 14        PC       0       2     5.7     7.0     8.7    10.8    12.4    13.0    13.0    13.0
 15        PC    13.0    13.0    13.0    13.3    14.0    14.2    14.8    15.8    17.2    18.1
 16        PC    19.0    19.7    19.9    20.0    20.1    20.4    21.4    22.9    24.1    24.9
 17        PC    25.1    25.6    27.0    27.8    28.1    28.3    29.5    32.2    35.2    40.9
 18        PC    49.9    59.0    71.0    74.4    78.1    81.2    81.9    83.5    85.1    85.6
 19        PC    86.0    86.8    87.6    88.8    91.0    92.6    93.7    95.0    97.0    97.6
 20        PC    98.2    98.5    98.7    98.9    99.0    99.3    99.3    99.4    99.5    99.8
 21        PC    99.8    99.9   100.0
 22        JD    1.55       1
 23        JD    1.38    9.99
           * CHANGED RAINFALL DISTRIBUTION ABOVE 10 SQ. MILES PER CLARK COUNTY MANUAL
 24        JD    1.38   10.01
 25        PC       0     2.0     5.9     8.0    11.0    14.4    15.0    16.0    16.8    17.1
 26        PC    18.0    18.2    18.7    19.0    19.7    20.2    21.0    22.0    23.0    24.1
 27        PC    25.0    25.9    26.5    28.0    29.0    30.0    30.5    30.9    31.0    31.7
 28        PC    32.1    32.7    33.3    34.6    36.1    38.1    40.8    43.0    47.7    51.4
 29        PC    56.1    63.0    71.0    72.0    73.1    75.2    77.9    79.0    79.5    80.4
 30        PC    81.0    82.0    82.6    84.0    85.9    88.9    91.0    93.8    96.6    97.0
 31        PC    97.4    97.9    98.1    98.3    98.5    98.9    99.0    99.2    99.3    99.6
 32        PC    99.7    99.9   100.0
 33        JD    1.26      20
 34        JD    1.18      30
 35        JD    1.09      50
 36        JD     .96     100

 37        KK    MM1A
 38        KM     Basin runoff calculation for Mass. Mountains 1A
 39        BA      .9
 40        LS              80
 41        UD     .31

 42        KK     BW1
 43        KM     Basin runoff calculation for Barren Wash 1
 44        BA    60.5
 45        LS              83
 46        UD     2.1
```

```
KK     BW2
KM      Basin runoff calculation for Barren Wash 2
BA     20.8
LS               80
UD       .9

KK    BW1&2
KM    Combined BW1 and BW2
HC       2

KK  BW APX
KM    Combine BW1,BW2, and MM1A (assume dischcarge of Barren Wash "active apex")
HC       2

KK     MM1B
KM     Basin runoff calulation for Mass. Mountains 1B
*   Flow was not combined with BW APX because flow from this watershed
*   will not directly impact RWMS wereas a channel migration at the apex
*   could impact the RWMS
BA     2.1
LS               77
UD      .48

KK     MM2
KM     Basin runoff calculation for Mass. Mountains 2
BA     1.4
LS               79
UD      .47

KK     HP1A
KM     Basin runoff calculation for Half Pint Range 1A
BA       .8
LS               85
UD      .48

KK    RTCPA
KM    Route Flow from HP1A to CPA
RM       9      .43       .2

KK     HP1B
KM     Basin runoff calculation for Half Pint Range 1B
BA     1.0
LS               78
UD      .51

KK     HP2
KM     Basin runoff calculation for Half Pint Range 2
BA     1.2
LS               78
UD      .51

KK     CPA1
KM     Combine MM2, routed HP1A, HP1B, HP2
HC       4

KK      HP3
KM      (CPB) Basin runoff calculation for Half Pint Range 3
BA      1.7
LS               82
UD      .59

KK     CPA2
KM     Combine HP3 with flow from CPA1
HC       2

KK      HP4
KM      (CPC) Basin runoff calculation for Half Pint Range 4
BA      3.3
LS               79
UD      .52

KK      HP5
KM      Basin runoff calculation for Half Pint Range 5
BA      1.2
LS               79
UD       .3

KK      HP6
KM      Basin runoff calculation for Half Pint Range 6
BA      2.2
LS               80
UD      .55

KK    RTCPD
KM     Route HP6 to CPD
RM       5      .27       .2
```

```
115        KK    HPFA
116        KM     Basin runoff calculation for Half Pint Range FA
117        BA      .3
118        LS               77
119        UD     .33

120        KK     CPD
121        KM     Combine HP5, routed HP6, and HPFA
122        HC       3

123        KK    RTCPE
124        KM     Route flow from CPD to CPE
125        RM       8     .39      .2

126        KK     HPFB
127        KM     Basin runoff calculation for Half Pint Range FB
128        BA     1.6
129        LS               77
130        UD     .44

131        KK     CPE
132        KM    Combine HP4 (CPC) with routed flow from CPD, and HPFB
133        HC       3

134        KK     CPF
135        KM    Combine all flow at Concentration just below RWMS (Flow from CPA & CPE)
136        HC       2

137        KK     SC1
138        KM     Basin runoff calculation for Scarp Canyon 1
           * Concentration Pt of this watershed is the active apex of the Scarp Canyon Fan
139        BA    39.4
140        LS               82
141        UD     2.1

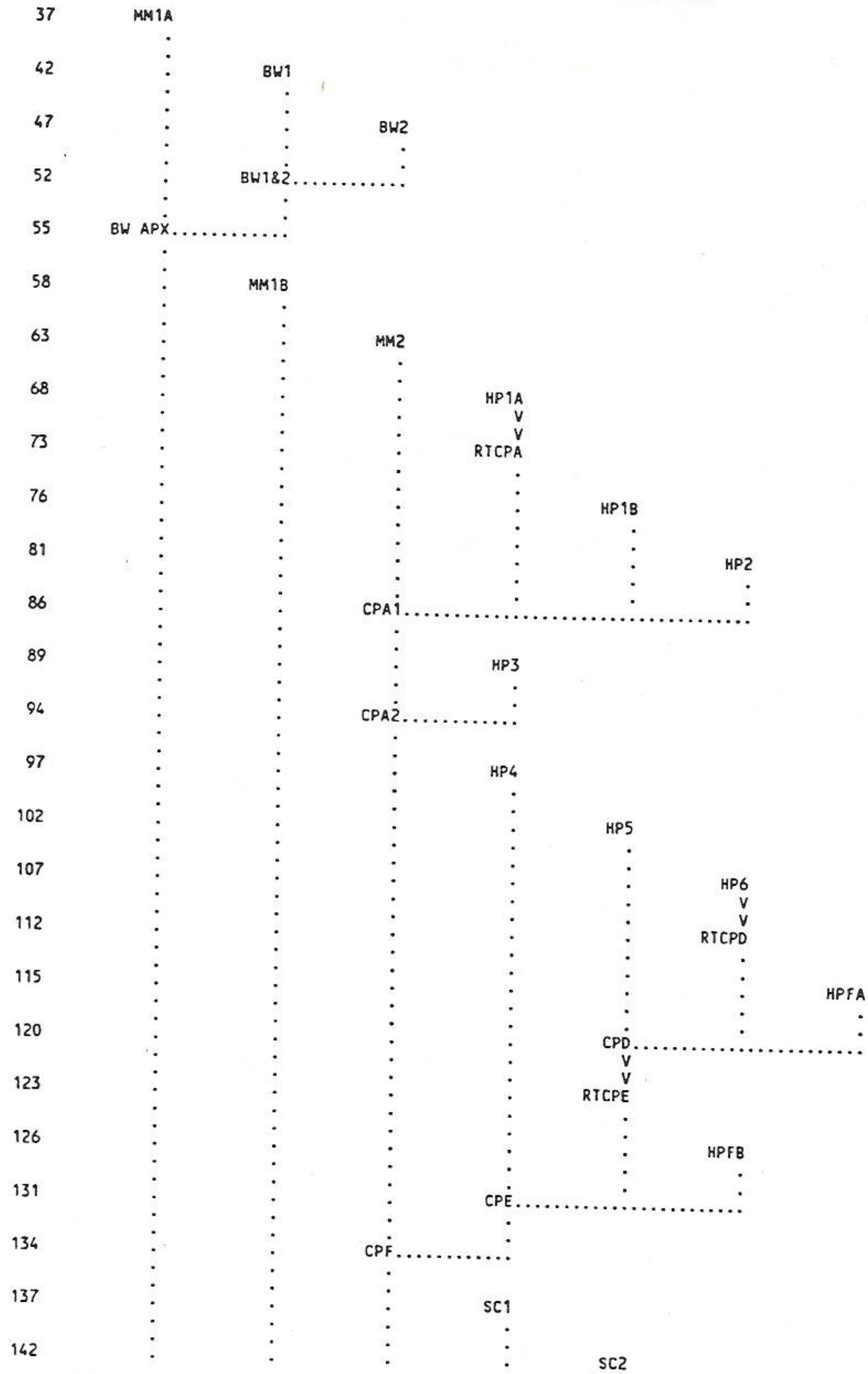
142        KK     SC2
143        KM     Basin runoff calculation for Scarp Canyon 2
144        BA     1.5
145        LS               77
146        UD     .48
147        ZZ
```

SCHEMATIC DIAGRAM OF STREAM NETWORK

INPUT LINE NO.

(V) ROUTING (--->) DIVERSION OR PUMP FLOW

(.) CONNECTOR (<---) RETURN OF DIVERTED OR PUMPED FLOW



(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

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*           (916) 756-1104              *
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                    100-YEAR 6-HOUR STORM 1.6 INCHES
                    POINT RAINFALL VALUES FORM NOAA ATLAS 2 VOL VII
                    DEPTH-AREA REDUCTION FACTORS FROM TABLE 502 IN
                    CLARK COUNTY HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL (CCRFCD, 1990)
                    CURVE NUMBERS DETERMINED USING TABLE 602 IN CCRFCD, 1990
                    LAG TIMES DETERMINED USING METHOD IN SECTION 606.3 IN CCRFCD, 1990
                    DRAINAGE AREAS FROM 7.5 MINUTE AND 15 MINUTE QUADS
                    THIS MODEL ADDRESSES DRAINAGES THAT COULD IMPACT THE RWMS

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

   IT           HYDROGRAPH TIME DATA
                      NMIN          3  MINUTES IN COMPUTATION INTERVAL
                     IDATE      1   0  STARTING DATE
                     ITIME       0000  STARTING TIME
                        NQ        300  NUMBER OF HYDROGRAPH ORDINATES
                    NDDATE      1   0  ENDING DATE
                    NDTIME       1457  ENDING TIME
                     ICENT         19  CENTURY MARK

                COMPUTATION INTERVAL      .05 HOURS
                     TOTAL TIME BASE    14.95 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

 13 JD          INDEX STORM NO. 1
                      STRM       1.60  PRECIPITATION DEPTH
                      TRDA        .01  TRANSPOSITION DRAINAGE AREA

 14 PI            PRECIPITATION PATTERN
                     1.20     1.54      2.22      1.26       .78      1.02      1.10      1.26      1.06       .96
                      .36      .24       .00       .00       .00       .00       .00       .00       .00       .00
                      .18      .26       .42       .22       .12       .36       .44       .60       .76       .84
                      .54      .54       .54       .46       .42       .12       .10       .06       .06       .06
                      .18      .32       .60       .80       .90       .72       .64       .48       .24       .12
                      .30      .48       .84       .60       .48       .18       .16       .12       .52       .72
                     1.62     1.68      1.80      2.88      3.42      5.40      5.42      5.46      6.62      7.20
                     2.04     2.10      2.22      1.98      1.86       .42       .60       .96       .96       .96
                      .30      .28       .24       .40       .48       .48       .56       .72      1.12      1.32
                      .96      .86       .66       .74       .78      1.20       .92       .36       .36       .36
                      .18      .16       .12       .12       .12       .06       .10       .18       .06       .00
                      .06      .06       .06       .14       .18       .00       .02       .06       .06       .06

 22 JD          INDEX STORM NO. 2
                      STRM       1.55  PRECIPITATION DEPTH
                      TRDA       1.00  TRANSPOSITION DRAINAGE AREA

  0 PI            PRECIPITATION PATTERN
                     1.20     1.54      2.22      1.26       .78      1.02      1.10      1.26      1.06       .96
                      .36      .24       .00       .00       .00       .00       .00       .00       .00       .00
                      .18      .26       .42       .22       .12       .36       .44       .60       .76       .84
                      .54      .54       .54       .46       .42       .12       .10       .06       .06       .06
                      .18      .32       .60       .80       .90       .72       .64       .48       .24       .12
                      .30      .48       .84       .60       .48       .18       .16       .12       .52       .72
                     1.62     1.68      1.80      2.88      3.42      5.40      5.42      5.46      6.62      7.20
                     2.04     2.10      2.22      1.98      1.86       .42       .60       .96       .96       .96
                      .30      .28       .24       .40       .48       .48       .56       .72      1.12      1.32
                      .96      .86       .66       .74       .78      1.20       .92       .36       .36       .36
                      .18      .16       .12       .12       .12       .06       .10       .18       .06       .00
                      .06      .06       .06       .14       .18       .00       .02       .06       .06       .06
```

23 JD INDEX STORM NO. 3

STRM 1.38 PRECIPITATION DEPTH

TRDA 9.99 TRANSPOSITION DRAINAGE AREA

0 PI PRECIPITATION PATTERN

1.20	1.54	2.22	1.26	.78	1.02	1.10	1.26	1.06	.96
.36	.24	.00	.00	.00	.00	.00	.00	.00	.00
.18	.26	.42	.22	.12	.36	.44	.60	.76	.84
.54	.54	.54	.46	.42	.12	.10	.06	.06	.06
.18	.32	.60	.80	.90	.72	.64	.48	.24	.12
.30	.48	.84	.60	.48	.18	.16	.12	.52	.72
1.62	1.68	1.80	2.88	3.42	5.40	5.42	5.46	6.62	7.20
2.04	2.10	2.22	1.98	1.86	.42	.60	.96	.96	.96
.30	.28	.24	.40	.48	.48	.56	.72	1.12	1.32
.96	.86	.66	.74	.78	1.20	.92	.36	.36	.36
.18	.16	.12	.12	.12	.06	.10	.18	.06	.00
.06	.06	.06	.14	.18	.00	.02	.06	.06	.06

24 JD INDEX STORM NO. 4

STRM 1.38 PRECIPITATION DEPTH

TRDA 10.01 TRANSPOSITION DRAINAGE AREA

25 PI PRECIPITATION PATTERN

1.20	1.58	2.34	1.62	1.26	1.80	1.88	2.04	.92	.36
.60	.56	.48	.28	.18	.54	.40	.12	.24	.30
.18	.26	.42	.34	.30	.48	.52	.60	.60	.60
.66	.62	.54	.54	.54	.36	.54	.90	.70	.60
.60	.50	.30	.26	.24	.06	.18	.42	.30	.24
.36	.36	.36	.64	.78	.90	1.00	1.20	1.48	1.62
1.32	1.82	2.82	2.42	2.22	2.82	3.26	4.14	4.58	4.80
.60	.62	.66	1.06	1.26	1.62	1.30	.66	.42	.30
.54	.48	.36	.52	.60	.36	.52	.84	1.04	1.14
1.80	1.62	1.26	1.54	1.68	1.68	1.20	.24	.24	.24
.30	.24	.12	.12	.12	.12	.16	.24	.12	.06
.12	.10	.06	.14	.18	.06	.08	.12	.08	.06

33 JD INDEX STORM NO. 5

STRM 1.26 PRECIPITATION DEPTH

TRDA 20.00 TRANSPOSITION DRAINAGE AREA

0 PI PRECIPITATION PATTERN

1.20	1.58	2.34	1.62	1.26	1.80	1.88	2.04	.92	.36
.60	.56	.48	.28	.18	.54	.40	.12	.24	.30
.18	.26	.42	.34	.30	.48	.52	.60	.60	.60
.66	.62	.54	.54	.54	.36	.54	.90	.70	.60
.60	.50	.30	.26	.24	.06	.18	.42	.30	.24
.36	.36	.36	.64	.78	.90	1.00	1.20	1.48	1.62
1.32	1.82	2.82	2.42	2.22	2.82	3.26	4.14	4.58	4.80
.60	.62	.66	1.06	1.26	1.62	1.30	.66	.42	.30
.54	.48	.36	.52	.60	.36	.52	.84	1.04	1.14
1.80	1.62	1.26	1.54	1.68	1.68	1.20	.24	.24	.24
.30	.24	.12	.12	.12	.12	.16	.24	.12	.06
.12	.10	.06	.14	.18	.06	.08	.12	.08	.06

34 JD INDEX STORM NO. 6

STRM 1.18 PRECIPITATION DEPTH

TRDA 30.00 TRANSPOSITION DRAINAGE AREA

0 PI PRECIPITATION PATTERN

1.20	1.58	2.34	1.62	1.26	1.80	1.88	2.04	.92	.36
.60	.56	.48	.28	.18	.54	.40	.12	.24	.30
.18	.26	.42	.34	.30	.48	.52	.60	.60	.60
.66	.62	.54	.54	.54	.36	.54	.90	.70	.60
.60	.50	.30	.26	.24	.06	.18	.42	.30	.24
.36	.36	.36	.64	.78	.90	1.00	1.20	1.48	1.62
1.32	1.82	2.82	2.42	2.22	2.82	3.26	4.14	4.58	4.80
.60	.62	.66	1.06	1.26	1.62	1.30	.66	.42	.30
.54	.48	.36	.52	.60	.36	.52	.84	1.04	1.14
1.80	1.62	1.26	1.54	1.68	1.68	1.20	.24	.24	.24
.30	.24	.12	.12	.12	.12	.16	.24	.12	.06
.12	.10	.06	.14	.18	.06	.08	.12	.08	.06

35 JD INDEX STORM NO. 7

STRM 1.09 PRECIPITATION DEPTH

TRDA 50.00 TRANSPOSITION DRAINAGE AREA

0 PI PRECIPITATION PATTERN

1.20	1.58	2.34	1.62	1.26	1.80	1.88	2.04	.92	.36
.60	.56	.48	.28	.18	.54	.40	.12	.24	.30
.18	.26	.42	.34	.30	.48	.52	.60	.60	.60
.66	.62	.54	.54	.54	.36	.54	.90	.70	.60
.60	.50	.30	.26	.24	.06	.18	.42	.30	.24
.36	.36	.36	.64	.78	.90	1.00	1.20	1.48	1.62
1.32	1.82	2.82	2.42	2.22	2.82	3.26	4.14	4.58	4.80
.60	.62	.66	1.06	1.26	1.62	1.30	.66	.42	.30
.54	.48	.36	.52	.60	.36	.52	.84	1.04	1.14
1.80	1.62	1.26	1.54	1.68	1.68	1.20	.24	.24	.24
.30	.24	.12	.12	.12	.12	.16	.24	.12	.06
.12	.10	.06	.14	.18	.06	.08	.12	.08	.06

36 JD INDEX STORM NO. 8

STRM	.96	PRECIPITATION DEPTH
TRDA	100.00	TRANSPOSITION DRAINAGE AREA

0 PI PRECIPITATION PATTERN

1.20	1.58	2.34	1.62	1.26	1.80	1.88	2.04	.92	.36
.60	.56	.48	.28	.18	.54	.40	.12	.24	.30
.18	.26	.42	.34	.30	.48	.52	.60	.60	.60
.66	.62	.54	.54	.54	.36	.54	.90	.70	.60
.60	.50	.30	.26	.24	.06	.18	.42	.30	.24
.36	.36	.36	.64	.78	.90	1.00	1.20	1.48	1.62
1.32	1.82	2.82	2.42	2.22	2.82	3.26	4.14	4.58	4.80
.60	.62	.66	1.06	1.26	1.62	1.30	.66	.42	.30
.54	.48	.36	.52	.60	.36	.52	.84	1.04	1.14
1.80	1.62	1.26	1.54	1.68	1.68	1.20	.24	.24	.24
.30	.24	.12	.12	.12	.12	.16	.24	.12	.06
.12	.10	.06	.14	.18	.06	.08	.12	.08	.06

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

	OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
+	HYDROGRAPH AT	MM1A	174.	3.80	30.	12.	12.	.90		
+	HYDROGRAPH AT	BW1	1786.	6.35	961.	405.	405.	60.50		
+	HYDROGRAPH AT	BW2	1016.	5.40	389.	156.	156.	20.80		
+	2 COMBINED AT	BW1&2	1848.	5.95	1003.	421.	421.	81.30		
+	2 COMBINED AT	BW APX	1841.	5.95	1004.	421.	421.	82.20		
+	HYDROGRAPH AT	MM1B	200.	4.05	47.	19.	19.	2.10		
+	HYDROGRAPH AT	MM2	184.	4.00	41.	16.	16.	1.40		
+	HYDROGRAPH AT	HP1A	200.	3.95	42.	17.	17.	.80		
+	ROUTED TO	RTCPA	190.	4.40	42.	17.	17.	.80		
+	HYDROGRAPH AT	HP1B	116.	4.05	27.	11.	11.	1.00		
+	HYDROGRAPH AT	HP2	136.	4.05	32.	13.	13.	1.20		
+	4 COMBINED AT	CPA1	459.	4.15	120.	48.	48.	4.40		
+	HYDROGRAPH AT	HP3	263.	4.10	64.	26.	26.	1.70		
+	2 COMBINED AT	CPA2	659.	4.15	170.	68.	68.	6.10		
+	HYDROGRAPH AT	HP4	360.	4.05	86.	35.	35.	3.30		
+	HYDROGRAPH AT	HP5	206.	3.80	36.	14.	14.	1.20		
+	HYDROGRAPH AT	HP6	277.	4.10	67.	27.	27.	2.20		
+	ROUTED TO	RTCPD	268.	4.35	67.	27.	27.	2.20		
+	HYDROGRAPH AT	HPFA	41.	3.85	8.	3.	3.	.30		
+	3 COMBINED AT	CPD	333.	4.25	99.	40.	40.	3.70		
+	ROUTED TO	RTCPE	326.	4.65	99.	40.	40.	3.70		
+	HYDROGRAPH AT	HPFB	167.	4.00	37.	15.	15.	1.60		
+	3 COMBINED AT	CPE	603.	4.20	191.	77.	77.	8.60		
+	2 COMBINED AT	CPF	878.	5.15	301.	121.	121.	14.70		
+	HYDROGRAPH AT	SC1	1251.	6.35	673.	283.	283.	39.40		
+	HYDROGRAPH AT	SC2	151.	4.05	35.	14.	14.	1.50		

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

HEC-1 MODEL OUTPUT

FILENAME: RWMS.OUT

(100-YEAR MODEL)

```
*****************************************                    ***************************************
*                                       *                    *                                     *
*  FLOOD HYDROGRAPH PACKAGE   (HEC-1)   *                    *  U.S. ARMY CORPS OF ENGINEERS       *
*           SEPTEMBER 1990              *                    *  HYDROLOGIC ENGINEERING CENTER      *
*             VERSION 4.0               *                    *        609 SECOND STREET            *
*                                       *                    *     DAVIS, CALIFORNIA 95616         *
* RUN DATE  01/29/1993  TIME  21:59:18  *                    *        (916) 756-1104               *
*                                       *                    *                                     *
*****************************************                    ***************************************


                 X       X  XXXXXXX   XXXXX           X
                 X       X  X        X     X         XX
                 X       X  X        X                X
                 XXXXXXX    XXXX     X       XXXXX    X
                 X       X  X        X                X
                 X       X  X        X     X          X
                 X       X  XXXXXXX   XXXXX          XXX


THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

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          ID    FLOOD ASSESSMENT FOR RWMS JOB #:51056          FILE: RWMSCN.DAT
   2          ID    100-YEAR 6-HOUR STORM 1.6 INCHES
   3          ID    POINT RAINFALL VALUES FROM NOAA ATLAS 2 VOL VII
   4          ID    DEPTH-AREA REDUCTION FACTORS FROM TABLE 502 IN
   5          ID    CLARK COUNTY HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MODEL (CCRFCD, 1990)
   6          ID    CURVE NUMBERS DETERMINED USING TABLE 602 IN CCRFCD, 1990
   7          ID    LAG TIMES DETERMINED USING METHOD IN SECTION 606.3 IN CCRFCD, 1990
   8          ID    DRAINAGE AREAS FROM 7.5 MINUTE AND 15 MINUTE QUADS
   9          ID    THIS MODEL ADDRESSES DRAINAGES THAT COULD IMPACT THE RWMS
  10          ID    ADJUSTED CURVE NUMBERS BY 5 TO ACCOUNT FOR MOISTER SOILS DURING THE 100-YR EV
              *DIAGRAM
  11          IT       3       0       0     300
  12          IO       5
  13          IN       5
  14          JD     1.6     .01
              * RAINFALL DISTRIBUTION FROM CLARK COUNTY MANUAL LESS THAN 10 SQ. MILES
  15          PC       0       2     5.7     7.0     8.7    10.8    12.4    13.0    13.0    13.0
  16          PC    13.0    13.0    13.0    13.3    14.0    14.2    14.8    15.8    17.2    18.1
  17          PC    19.0    19.7    19.9    20.0    20.1    20.4    21.4    22.9    24.1    24.9
  18          PC    25.1    25.6    27.0    27.8    28.1    28.3    29.5    32.2    35.2    40.9
  19          PC    49.9    59.0    71.0    74.4    78.1    81.2    81.9    83.5    85.1    85.6
  20          PC    86.0    86.8    87.6    88.8    91.0    92.6    93.7    95.0    97.0    97.6
  21          PC    98.2    98.5    98.7    98.9    99.0    99.3    99.3    99.4    99.5    99.8
  22          PC    99.8    99.9   100.0
  23          JD    1.55       1
  24          JD    1.38    9.99
              * CHANGED RAINFALL DISTRIBUTION ABOVE 10 SQ. MILES PER CLARK COUNTY MANUAL
  25          JD    1.38   10.01
  26          PC       0     2.0     5.9     8.0    11.0    14.4    15.0    16.0    16.8    17.1
  27          PC    18.0    18.2    18.7    19.0    19.7    20.2    21.0    22.0    23.0    24.1
  28          PC    25.0    25.9    26.5    28.0    29.0    30.0    30.5    30.9    31.0    31.7
  29          PC    32.1    32.7    33.3    34.6    36.1    38.1    40.8    43.0    47.7    51.4
  30          PC    56.1    63.0    71.0    72.0    73.1    75.2    77.9    79.0    79.5    80.4
  31          PC    81.0    82.0    82.6    84.0    85.9    88.9    91.0    93.8    96.6    97.0
  32          PC    97.4    97.9    98.1    98.3    98.5    98.9    99.0    99.2    99.3    99.6
  33          PC    99.7    99.9   100.0
  34          JD    1.26      20
  35          JD    1.18      30
  36          JD    1.09      50
  37          JD     .96     100

  38          KK    MM1A
  39          KM    Basin runoff calculation for Mass. Mountains 1A
  40          BA      .9
  41          LS              85
  42          UD     .31

  43          KK     BW1
  44          KM     Basin runoff calculation for Barren Wash 1
  45          BA    60.5
  46          LS              88
  47          UD     2.1
```

```
KK     BW2
KM      Basin runoff calculation for Barren Wash 2
BA    20.8
LS              85
UD       .9

KK    BW1&2
KM    Combined BW1 and BW2
HC       2

KK   BW APX
KM    Combine BW1,BW2, and MM1A (assume dischcarge of Barren Wash "active apex")
HC       2

KK     MM1B
KM     Basin runoff calulation for Mass. Mountains 1B
*   Flow was not combined with BW APX because flow from this watershed
*   will not directly impact RWMS wereas a channel migration at the apex
*   could impact the RWMS
BA      2.1
LS              82
UD      .48

KK      MM2
KM     Basin runoff calculation for Mass. Mountains 2
BA      1.4
LS              84
UD      .47

KK     HP1A
KM     Basin runoff calculation for Half Pint Range 1A
BA       .8
LS              90
UD      .48

KK    RTCPA
KM    Route Flow from HP1A to CPA
RM       9     .43      .2

KK     HP1B
KM     Basin runoff calculation for Half Pint Range 1B
BA      1.0
LS              83
UD      .51

KK      HP2
KM     Basin runoff calculation for Half Pint Range 2
BA     1.2
LS              83
UD      .51

KK     CPA1
KM     Combine MM2, routed HP1A, HP1B, HP2
HC       4

KK      HP3
KM      (CPB) Basin runoff calculation for Half Pint Range 3
BA      1.7
LS              87
UD      .59

KK     CPA2
KM     Combine HP3 with flow from CPA1
HC       2

KK      HP4
KM      (CPC) Basin runoff calculation for Half Pint Range 4
BA      3.3
LS              84
UD      .52

KK      HP5
KM      Basin runoff calculation for Half Pint Range 5
BA      1.2
LS              84
UD       .3

KK      HP6
KM      Basin runoff calculation for Half Pint Range 6
BA      2.2
LS              85
UD      .55

KK    RTCPD
KM     Route HP6 to CPD
RM       5     .27       .2
```

```
KK     HPFA
KM      Basin runoff calculation for Half Pint Range FA
BA      .3
LS               82
UD      .33

KK      CPD
KM      Combine HP5, routed HP6, and HPFA
HC        3

KK    RTCPE
KM      Route flow from CPD to CPE
RM        8      .39       .2

KK     HPFB
KM      Basin runoff calculation for Half Pint Range FB
BA      1.6
LS               82
UD      .44

KK      CPE
KM     Combine HP4 (CPC) with routed flow from CPD, and HPFB
HC        3

KK      CPF
KM     Combine all flow at Concentration just below RWMS (Flow from CPA & CPE)
HC        2

KK      SC1
KM      Basin runoff calculation for Scarp Canyon 1
* Concentration Pt of this watershed is the active apex of the Scarp Canyon Fan
BA     39.4
LS               87
UD      2.1

KK      SC2
KM      Basin runoff calculation for Scarp Canyon 2
BA      1.5
LS               82
UD      .48
ZZ
```

```
                 SCHEMATIC DIAGRAM OF STREAM NETWORK
INPUT
 LINE      (V) ROUTING         (--->) DIVERSION OR PUMP FLOW

  NO.      (.) CONNECTOR       (<---) RETURN OF DIVERTED OR PUMPED FLOW

  38         MM1A
                .
                .
  43            .         BW1
                .           .
                .           .
  48            .           .         BW2
                .           .           .
                .           .           .
  53            .       BW1&2............
                .           .
                .           .
  56       BW APX............
                .
                .
  59            .        MM1B
                .           .
                .           .
  64            .           .         MM2
                .           .           .
                .           .           .
  69            .           .           .        HP1A
                .           .           .           V
                .           .           .           V
  74            .           .           .       RTCPA
                .           .           .           .
                .           .           .           .
  77            .           .           .           .        HP1B
                .           .           .           .           .
                .           .           .           .           .
  82            .           .           .           .           .         HP2
                .           .           .           .           .           .
                .           .           .           .           .           .
  87            .           .        CPA1....................................
                .           .           .
                .           .           .
  90            .           .           .         HP3
                .           .           .           .
                .           .           .           .
  95            .           .        CPA2............
                .           .           .
                .           .           .
  98            .           .           .         HP4
                .           .           .           .
                .           .           .           .
 103            .           .           .           .         HP5
                .           .           .           .           .
                .           .           .           .           .
 108            .           .           .           .           .         HP6
                .           .           .           .           .           V
                .           .           .           .           .           V
 113            .           .           .           .           .       RTCPD
                .           .           .           .           .           .
                .           .           .           .           .           .
 116            .           .           .           .           .           .        HPFA
                .           .           .           .           .           .           .
                .           .           .           .           .           .           .
 121            .           .           .           .         CPD........................
                .           .           .           .           V
                .           .           .           .           V
 124            .           .           .           .       RTCPE
                .           .           .           .           .
                .           .           .           .           .
 127            .           .           .           .           .        HPFB
                .           .           .           .           .           .
                .           .           .           .           .           .
 132            .           .           .         CPE........................
                .           .           .           .
                .           .           .           .
 135            .           .         CPF............
                .           .           .
                .           .           .
 138            .           .           .         SC1
                .           .           .           .
                .           .           .           .
 143            .           .           .           .         SC2

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION
```

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*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*             SEPTEMBER 1990            *
*               VERSION 4.0             *
*                                       *
* RUN DATE  01/29/1993  TIME  21:59:18  *
*                                       *
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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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```
FLOOD ASSESSMENT FOR RWMS JOB #:51056          FILE: RWMSCN.DAT
100-YEAR 6-HOUR STORM 1.6 INCHES
POINT RAINFALL VALUES FROM NOAA ATLAS 2 VOL VII
DEPTH-AREA REDUCTION FACTORS FROM TABLE 502 IN
CLARK COUNTY HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MODEL (CCRFCD, 1990)
CURVE NUMBERS DETERMINED USING TABLE 602 IN CCRFCD, 1990
LAG TIMES DETERMINED USING METHOD IN SECTION 606.3 IN CCRFCD, 1990
DRAINAGE AREAS FROM 7.5 MINUTE AND 15 MINUTE QUADS
THIS MODEL ADDRESSES DRAINAGES THAT COULD IMPACT THE RWMS
ADJUSTED CURVE NUMBERS BY 5 TO ACCOUNT FOR MOISTER SOILS DURING THE 100-YR EV

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

   IT        HYDROGRAPH TIME DATA
                  NMIN           3  MINUTES IN COMPUTATION INTERVAL
                  IDATE      1   0  STARTING DATE
                  ITIME       0000  STARTING TIME
                     NQ        300  NUMBER OF HYDROGRAPH ORDINATES
                 NDDATE      1   0  ENDING DATE
                 NDTIME       1457  ENDING TIME
                  ICENT         19  CENTURY MARK

             COMPUTATION INTERVAL     .05 HOURS
                  TOTAL TIME BASE   14.95 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

14 JD        INDEX STORM NO. 1
                  STRM        1.60  PRECIPITATION DEPTH
                  TRDA         .01  TRANSPOSITION DRAINAGE AREA

15 PI        PRECIPITATION PATTERN
```

1.20	1.54	2.22	1.26	.78	1.02	1.10	1.26	1.06	.96
.36	.24	.00	.00	.00	.00	.00	.00	.00	.00
.18	.26	.42	.22	.12	.36	.44	.60	.76	.84
.54	.54	.54	.46	.42	.12	.10	.06	.06	.06
.18	.32	.60	.80	.90	.72	.64	.48	.24	.12
.30	.48	.84	.60	.48	.18	.16	.12	.52	.72
1.62	1.68	1.80	2.88	3.42	5.40	5.42	5.46	6.62	7.20
2.04	2.10	2.22	1.98	1.86	.42	.60	.96	.96	.96
.30	.28	.24	.40	.48	.48	.56	.72	1.12	1.32
.96	.86	.66	.74	.78	1.20	.92	.36	.36	.36
.18	.16	.12	.12	.12	.06	.10	.18	.06	.00
.06	.06	.06	.14	.18	.00	.02	.06	.06	.06

```
23 JD        INDEX STORM NO. 2
                  STRM        1.55  PRECIPITATION DEPTH
                  TRDA        1.00  TRANSPOSITION DRAINAGE AREA

 0 PI        PRECIPITATION PATTERN
```

1.20	1.54	2.22	1.26	.78	1.02	1.10	1.26	1.06	.96
.36	.24	.00	.00	.00	.00	.00	.00	.00	.00
.18	.26	.42	.22	.12	.36	.44	.60	.76	.84
.54	.54	.54	.46	.42	.12	.10	.06	.06	.06
.18	.32	.60	.80	.90	.72	.64	.48	.24	.12
.30	.48	.84	.60	.48	.18	.16	.12	.52	.72
1.62	1.68	1.80	2.88	3.42	5.40	5.42	5.46	6.62	7.20
2.04	2.10	2.22	1.98	1.86	.42	.60	.96	.96	.96
.30	.28	.24	.40	.48	.48	.56	.72	1.12	1.32
.96	.86	.66	.74	.78	1.20	.92	.36	.36	.36
.18	.16	.12	.12	.12	.06	.10	.18	.06	.00
.06	.06	.06	.14	.18	.00	.02	.06	.06	.06

24 JD INDEX STORM NO. 3

STRM	1.38	PRECIPITATION DEPTH
TRDA	9.99	TRANSPOSITION DRAINAGE AREA

0 PI PRECIPITATION PATTERN

1.20	1.54	2.22	1.26	.78	1.02	1.10	1.26	1.06	.96
.36	.24	.00	.00	.00	.00	.00	.00	.00	.00
.18	.26	.42	.22	.12	.36	.44	.60	.76	.84
.54	.54	.54	.46	.42	.12	.10	.06	.06	.06
.18	.32	.60	.80	.90	.72	.64	.48	.24	.12
.30	.48	.84	.60	.48	.18	.16	.12	.52	.72
1.62	1.68	1.80	2.88	3.42	5.40	5.42	5.46	6.62	7.20
2.04	2.10	2.22	1.98	1.86	.42	.60	.96	.96	.96
.30	.28	.24	.40	.48	.48	.56	.72	1.12	1.32
.96	.86	.66	.74	.78	1.20	.92	.36	.36	.36
.18	.16	.12	.12	.12	.06	.10	.18	.06	.00
.06	.06	.06	.14	.18	.00	.02	.06	.06	.06

25 JD INDEX STORM NO. 4

STRM	1.38	PRECIPITATION DEPTH
TRDA	10.01	TRANSPOSITION DRAINAGE AREA

26 PI PRECIPITATION PATTERN

1.20	1.58	2.34	1.62	1.26	1.80	1.88	2.04	.92	.36
.60	.56	.48	.28	.18	.54	.40	.12	.24	.30
.18	.26	.42	.34	.30	.48	.52	.60	.60	.60
.66	.62	.54	.54	.54	.36	.54	.90	.70	.60
.60	.50	.30	.26	.24	.06	.18	.42	.30	.24
.36	.36	.36	.64	.78	.90	1.00	1.20	1.48	1.62
1.32	1.82	2.82	2.42	2.22	2.82	3.26	4.14	4.58	4.80
.60	.62	.66	1.06	1.26	1.62	1.30	.66	.42	.30
.54	.48	.36	.52	.60	.36	.52	.84	1.04	1.14
1.80	1.62	1.26	1.54	1.68	1.68	1.20	.24	.24	.24
.30	.24	.12	.12	.12	.12	.16	.24	.12	.06
.12	.10	.06	.14	.18	.06	.08	.12	.08	.06

34 JD INDEX STORM NO. 5

STRM	1.26	PRECIPITATION DEPTH
TRDA	20.00	TRANSPOSITION DRAINAGE AREA

0 PI PRECIPITATION PATTERN

1.20	1.58	2.34	1.62	1.26	1.80	1.88	2.04	.92	.36
.60	.56	.48	.28	.18	.54	.40	.12	.24	.30
.18	.26	.42	.34	.30	.48	.52	.60	.60	.60
.66	.62	.54	.54	.54	.36	.54	.90	.70	.60
.60	.50	.30	.26	.24	.06	.18	.42	.30	.24
.36	.36	.36	.64	.78	.90	1.00	1.20	1.48	1.62
1.32	1.82	2.82	2.42	2.22	2.82	3.26	4.14	4.58	4.80
.60	.62	.66	1.06	1.26	1.62	1.30	.66	.42	.30
.54	.48	.36	.52	.60	.36	.52	.84	1.04	1.14
1.80	1.62	1.26	1.54	1.68	1.68	1.20	.24	.24	.24
.30	.24	.12	.12	.12	.12	.16	.24	.12	.06
.12	.10	.06	.14	.18	.06	.08	.12	.08	.06

35 JD INDEX STORM NO. 6

STRM	1.18	PRECIPITATION DEPTH
TRDA	30.00	TRANSPOSITION DRAINAGE AREA

0 PI PRECIPITATION PATTERN

1.20	1.58	2.34	1.62	1.26	1.80	1.88	2.04	.92	.36
.60	.56	.48	.28	.18	.54	.40	.12	.24	.30
.18	.26	.42	.34	.30	.48	.52	.60	.60	.60
.66	.62	.54	.54	.54	.36	.54	.90	.70	.60
.60	.50	.30	.26	.24	.06	.18	.42	.30	.24
.36	.36	.36	.64	.78	.90	1.00	1.20	1.48	1.62
1.32	1.82	2.82	2.42	2.22	2.82	3.26	4.14	4.58	4.80
.60	.62	.66	1.06	1.26	1.62	1.30	.66	.42	.30
.54	.48	.36	.52	.60	.36	.52	.84	1.04	1.14
1.80	1.62	1.26	1.54	1.68	1.68	1.20	.24	.24	.24
.30	.24	.12	.12	.12	.12	.16	.24	.12	.06
.12	.10	.06	.14	.18	.06	.08	.12	.08	.06

36 JD INDEX STORM NO. 7

STRM	1.09	PRECIPITATION DEPTH
TRDA	50.00	TRANSPOSITION DRAINAGE AREA

0 PI PRECIPITATION PATTERN

1.20	1.58	2.34	1.62	1.26	1.80	1.88	2.04	.92	.36
.60	.56	.48	.28	.18	.54	.40	.12	.24	.30
.18	.26	.42	.34	.30	.48	.52	.60	.60	.60
.66	.62	.54	.54	.54	.36	.54	.90	.70	.60
.60	.50	.30	.26	.24	.06	.18	.42	.30	.24
.36	.36	.36	.64	.78	.90	1.00	1.20	1.48	1.62
1.32	1.82	2.82	2.42	2.22	2.82	3.26	4.14	4.58	4.80
.60	.62	.66	1.06	1.26	1.62	1.30	.66	.42	.30
.54	.48	.36	.52	.60	.36	.52	.84	1.04	1.14
1.80	1.62	1.26	1.54	1.68	1.68	1.20	.24	.24	.24
.30	.24	.12	.12	.12	.12	.16	.24	.12	.06
.12	.10	.06	.14	.18	.06	.08	.12	.08	.06

37 JD INDEX STORM NO. 8

STRM .96 PRECIPITATION DEPTH

TRDA 100.00 TRANSPOSITION DRAINAGE AREA

0 PI PRECIPITATION PATTERN

1.20	1.58	2.34	1.62	1.26	1.80	1.88	2.04	.92	.36
.60	.56	.48	.28	.18	.54	.40	.12	.24	.30
.18	.26	.42	.34	.30	.48	.52	.60	.60	.60
.66	.62	.54	.54	.54	.36	.54	.90	.70	.60
.60	.50	.30	.26	.24	.06	.18	.42	.30	.24
.36	.36	.36	.64	.78	.90	1.00	1.20	1.48	1.62
1.32	1.82	2.82	2.42	2.22	2.82	3.26	4.14	4.58	4.80
.60	.62	.66	1.06	1.26	1.62	1.30	.66	.42	.30
.54	.48	.36	.52	.60	.36	.52	.84	1.04	1.14
1.80	1.62	1.26	1.54	1.68	1.68	1.20	.24	.24	.24
.30	.24	.12	.12	.12	.12	.16	.24	.12	.06
.12	.10	.06	.14	.18	.06	.08	.12	.08	.06

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

	OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
+	HYDROGRAPH AT	MM1A	284.	3.75	47.	19.	19.	.90		
+	HYDROGRAPH AT	BW1	3190.	6.15	1762.	745.	745.	60.50		
+	HYDROGRAPH AT	BW2	1645.	4.40	678.	273.	273.	20.80		
+	2 COMBINED AT	BW1&2	3513.	5.75	1943.	817.	817.	81.30		
+	2 COMBINED AT	BW APX	3506.	5.75	1948.	819.	819.	82.20		
+	HYDROGRAPH AT	MM1B	361.	4.00	78.	31.	31.	2.10		
+	HYDROGRAPH AT	MM2	311.	3.95	65.	26.	26.	1.40		
+	HYDROGRAPH AT	HP1A	300.	3.95	62.	25.	25.	.80		
+	ROUTED TO	RTCPA	284.	4.35	62.	25.	25.	.80		
+	HYDROGRAPH AT	HP1B	200.	4.00	44.	18.	18.	1.00		
+	HYDROGRAPH AT	HP2	235.	4.00	52.	21.	21.	1.20		
+	4 COMBINED AT	CPA1	786.	4.10	194.	78.	78.	4.40		
+	HYDROGRAPH AT	HP3	420.	4.10	99.	40.	40.	1.70		
+	2 COMBINED AT	CPA2	1126.	4.10	274.	110.	110.	6.10		
+	HYDROGRAPH AT	HP4	626.	4.00	139.	56.	56.	3.30		
+	HYDROGRAPH AT	HP5	345.	3.75	56.	23.	23.	1.20		
+	HYDROGRAPH AT	HP6	465.	4.05	106.	42.	42.	2.20		
+	ROUTED TO	RTCPD	449.	4.30	106.	42.	42.	2.20		
+	HYDROGRAPH AT	HPFA	71.	3.80	12.	5.	5.	.30		
+	3 COMBINED AT	CPD	570.	4.20	161.	64.	64.	3.70		
+	ROUTED TO	RTCPE	558.	4.55	161.	64.	64.	3.70		
+	HYDROGRAPH AT	HPFB	299.	3.95	61.	25.	25.	1.60		
+	3 COMBINED AT	CPE	1108.	4.15	319.	128.	128.	8.60		
+	2 COMBINED AT	CPF	1462.	4.10	513.	206.	206.	14.70		
+	HYDROGRAPH AT	SC1	2178.	6.15	1201.	508.	508.	39.40		
+	HYDROGRAPH AT	SC2	269.	4.00	58.	23.	23.	1.50		

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

HEC-1 MODEL OUTPUT

FILENAME: RWMSW.OUT

(100-YEAR MODEL)

```
*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*            SEPTEMBER 1990             *
*              VERSION 4.0              *
*                                       *
* RUN DATE  01/29/1993  TIME  22:01:21  *
*                                       *
*****************************************
```

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

```
X     X  XXXXXXX   XXXXX           X
X     X  X        X     X         XX
X     X  X        X                X
XXXXXXX  XXXX     X         XXXXX  X
X     X  X        X                X
X     X  X        X     X          X
X     X  XXXXXXX   XXXXX          XXX
```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

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
        1    ID    FLOOD ASSESSMENT FOR RWMS JOB #:51056          FILE: RWMSW.DAT
        2    ID    100-YEAR 6-HOUR STORM 1.6 INCHES
        3    ID    POINT RAINFALL VALUES FROM NOAA ATLAS 2 VOL VII
        4    ID    DEPTH-AREA REDUCTION FACTORS FROM TABLE 502 IN
        5    ID    CLARK COUNTY HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MAUAL (CCRFCD, 1990)
        6    ID    CURVE NUMBER DETERMINED USING TABLE 602 IN CCRFCD, 1990
        7    ID    LAG TIMES DETERMINED USING METHOD IN SECTION 606.3 IN CCRFCD, 1990
        8    ID    DRAINAGE AREAS FROM 7.5 MINUTE AND 15 MINUTE QUADS
        9    ID    THIS MODEL ADDRESSES DRAINAGES THAT COULD IMPACT THE RWMS
       10    ID    ADJUSTED CURVE NUMBERS BY 10 TO ACCOUNT FOR MOISTER SOILS DURING THE 100-YR E
             *DIAGRAM
       11    IT       3        0        0      300
       12    IO       5
       13    IN       5
       14    JD     1.6      .01
             * RAINFALL DISTRIBUTION FROM CLARK COUNTY MANUAL LESS THAN 10 SQ. MILES
       15    PC       0        2      5.7      7.0      8.7     10.8     12.4     13.0     13.0     13.0
       16    PC    13.0     13.0     13.0     13.3     14.0     14.2     14.8     15.8     17.2     18.1
       17    PC    19.0     19.7     19.9     20.0     20.1     20.4     21.4     22.9     24.1     24.9
       18    PC    25.1     25.6     27.0     27.8     28.1     28.3     29.5     32.2     35.2     40.9
       19    PC    49.9     59.0     71.0     74.4     78.1     81.2     81.9     83.5     85.1     85.6
       20    PC    86.0     86.8     87.6     88.8     91.0     92.6     93.7     95.0     97.0     97.6
       21    PC    98.2     98.5     98.7     98.9     99.0     99.3     99.3     99.4     99.5     99.8
       22    PC    99.8     99.9    100.0
       23    JD    1.55        1
       24    JD    1.38     9.99
             * CHANGED RAINFALL DISTRIBUTION ABOVE 10 SQ. MILES PER CLARK COUNTY MANUAL
       25    JD    1.38    10.01
       26    PC       0      2.0      5.9      8.0     11.0     14.4     15.0     16.0     16.8     17.1
       27    PC    18.0     18.2     18.7     19.0     19.7     20.2     21.0     22.0     23.0     24.1
       28    PC    25.0     25.9     26.5     28.0     29.0     30.0     30.5     30.9     31.0     31.7
       29    PC    32.1     32.7     33.3     34.6     36.1     38.1     40.8     43.0     47.7     51.4
       30    PC    56.1     63.0     71.0     72.0     73.1     75.2     77.9     79.0     79.5     80.4
       31    PC    81.0     82.0     82.6     84.0     85.9     88.9     91.0     93.8     96.6     97.0
       32    PC    97.4     97.9     98.1     98.3     98.5     98.9     99.0     99.2     99.3     99.6
       33    PC    99.7     99.9    100.0
       34    JD    1.26       20
       35    JD    1.18       30
       36    JD    1.09       50
       37    JD     .96      100

       38    KK     MM1A
       39    KM    Basin runoff calculation for Mass. Mountains 1A
       40    BA      .9
       41    LS               90
       42    UD     .31

       43    KK     BW1
       44    KM      Basin runoff calculation for Barren Wash 1
       45    BA    60.5
       46    LS               93
       47    UD     2.1
```

```
KK     BW2
KM     Basin runoff calculation for Barren Wash 2
BA    20.8
LS              90
UD      .9

KK    BW1&2
KM    Combined BW1 and BW2
HC       2

KK   BW APX
KM    Combine BW1,BW2, and MM1A (assume dischcarge of Barren Wash "active apex")
HC       2

KK     MM1B
KM     Basin runoff calulation for Mass. Mountains 1B
*    Flow was not combined with BW APX because flow from this watershed
*    will not directly impact RWMS wereas a channel migration at the apex
*    could impact the RWMS
BA     2.1
LS              87
UD     .48

KK     MM2
KM     Basin runoff calculation for Mass. Mountains 2
BA     1.4
LS              89
UD     .47

KK     HP1A
KM     Basin runoff calculation for Half Pint Range 1A
BA      .8
LS              95
UD     .48

KK    RTCPA
KM    Route Flow from HP1A to CPA
RM       9     .43      .2

KK     HP1B
KM     Basin runoff calculation for Half Pint Range 1B
BA     1.0
LS              88
UD     .51

KK     HP2
KM     Basin runoff calculation for Half Pint Range 2
BA     1.2
LS              88
UD     .51

KK     CPA1
KM     Combine MM2, routed HP1A, HP1B, HP2
HC       4

KK     HP3
KM     (CPB) Basin runoff calculation for Half Pint Range 3
BA     1.7
LS              92
UD     .59

KK     CPA2
KM     Combine HP3 with flow from CPA1
HC       2

KK     HP4
KM     (CPC) Basin runoff calculation for Half Pint Range 4
BA     3.3
LS              89
UD     .52

KK     HP5
KM     Basin runoff calculation for Half Pint Range 5
BA     1.2
LS              89
UD      .3

KK     HP6
KM     Basin runoff calculation for Half Pint Range 6
BA     2.2
LS              90
UD     .55

KK    RTCPD
KM     Route HP6 to CPD
RM       5     .27      .2
```

```
KK    HPFA
KM     Basin runoff calculation for Half Pint Range FA
BA      .3
LS              87
UD     .33

KK     CPD
KM     Combine HP5, routed HP6, and HPFA
HC       3

KK   RTCPE
KM     Route flow from CPD to CPE
RM       8      .39       .2

KK    HPFB
KM     Basin runoff calculation for Half Pint Range FB
BA     1.6
LS              87
UD     .44

KK     CPE
KM    Combine HP4 (CPC) with routed flow from CPD, and HPFB
HC       3

KK     CPF
KM    Combine all flow at Concentration just below RWMS (Flow from CPA & CPE)
HC       2

KK     SC1
KM     Basin runoff calculation for Scarp Canyon 1
* Concentration Pt of this watershed is the active apex of the Scarp Canyon Fan
BA    39.4
LS              92
UD     2.1

KK     SC2
KM     Basin runoff calculation for Scarp Canyon 2
BA     1.5
LS              87
UD     .48
ZZ
```

```
                 SCHEMATIC DIAGRAM OF STREAM NETWORK
INPUT
 LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

 NO.       (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

  38         MM1A
                .
  43            .         BW1
                .           .
  48            .           .         BW2
                .           .           .
  53            .       BW1&2............
                .           .
  56        BW APX............
                .
  59            .        MM1B
                .           .
  64            .           .         MM2
                .           .           .
  69            .           .           .        HP1A
                .           .           .           V
                .           .           .           V
  74            .           .           .       RTCPA
                .           .           .           .
  77            .           .           .           .        HP1B
                .           .           .           .           .
  82            .           .           .           .           .         HP2
                .           .           .           .           .           .
  87            .           .        CPA1....................................
                .           .           .
  90            .           .           .         HP3
                .           .           .           .
  95            .           .        CPA2............
                .           .           .
  98            .           .           .         HP4
                .           .           .           .
 103            .           .           .           .         HP5
                .           .           .           .           .
 108            .           .           .           .           .        HP6
                .           .           .           .           .           V
                .           .           .           .           .           V
 113            .           .           .           .           .       RTCPD
                .           .           .           .           .           .
 116            .           .           .           .           .           .        HPFA
                .           .           .           .           .           .           .
 121            .           .           .           .         CPD........................
                .           .           .           .           V
                .           .           .           .           V
 124            .           .           .           .       RTCPE
                .           .           .           .           .
 127            .           .           .           .           .        HPFB
                .           .           .           .           .           .
 132            .           .           .         CPE........................
                .           .           .           .
 135            .           .         CPF............
                .           .           .
 138            .           .           .         SC1
                .           .           .           .
 143            .           .           .           .         SC2

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION
```

```
*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*            SEPTEMBER 1990             *
*             VERSION 4.0               *
*                                       *
*  RUN DATE  01/29/1993  TIME  22:01:21 *
*                                       *
*****************************************
```

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

```
FLOOD ASSESSMENT FOR RWMS JOB #:51056          FILE: RWMSW.DAT
100-YEAR 6-HOUR STORM 1.6 INCHES
POINT RAINFALL VALUES FROM NOAA ATLAS 2 VOL VII
DEPTH-AREA REDUCTION FACTORS FROM TABLE 502 IN
CLARK COUNTY HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MAUAL (CCRFCD, 1990)
CURVE NUMBER DETERMINED USING TABLE 602 IN CCRFCD, 1990
LAG TIMES DETERMINED USING METHOD IN SECTION 606.3 IN CCRFCD, 1990
DRAINAGE AREAS FROM 7.5 MINUTE AND 15 MINUTE QUADS
THIS MODEL ADDRESSES DRAINAGES THAT COULD IMPACT THE RWMS
ADJUSTED CURVE NUMBERS BY 10 TO ACCOUNT FOR MOISTER SOILS DURING THE 100-YR E

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

 IT          HYDROGRAPH TIME DATA
                NMIN           3  MINUTES IN COMPUTATION INTERVAL
                IDATE      1   0  STARTING DATE
                ITIME       0000  STARTING TIME
                   NQ        300  NUMBER OF HYDROGRAPH ORDINATES
               NDDATE      1   0  ENDING DATE
               NDTIME       1457  ENDING TIME
                ICENT         19  CENTURY MARK

          COMPUTATION INTERVAL     .05 HOURS
               TOTAL TIME BASE   14.95 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

14 JD        INDEX STORM NO. 1
                 STRM       1.60  PRECIPITATION DEPTH
                 TRDA        .01  TRANSPOSITION DRAINAGE AREA

15 PI          PRECIPITATION PATTERN
```

1.20	1.54	2.22	1.26	.78	1.02	1.10	1.26	1.06	.96
.36	.24	.00	.00	.00	.00	.00	.00	.00	.00
.18	.26	.42	.22	.12	.36	.44	.60	.76	.84
.54	.54	.54	.46	.42	.12	.10	.06	.06	.06
.18	.32	.60	.80	.90	.72	.64	.48	.24	.12
.30	.48	.84	.60	.48	.18	.16	.12	.52	.72
1.62	1.68	1.80	2.88	3.42	5.40	5.42	5.46	6.62	7.20
2.04	2.10	2.22	1.98	1.86	.42	.60	.96	.96	.96
.30	.28	.24	.40	.48	.48	.56	.72	1.12	1.32
.96	.86	.66	.74	.78	1.20	.92	.36	.36	.36
.18	.16	.12	.12	.12	.06	.10	.18	.06	.00
.06	.06	.06	.14	.18	.00	.02	.06	.06	.06

```
23 JD        INDEX STORM NO. 2
                 STRM       1.55  PRECIPITATION DEPTH
                 TRDA       1.00  TRANSPOSITION DRAINAGE AREA

 0 PI          PRECIPITATION PATTERN
```

1.20	1.54	2.22	1.26	.78	1.02	1.10	1.26	1.06	.96
.36	.24	.00	.00	.00	.00	.00	.00	.00	.00
.18	.26	.42	.22	.12	.36	.44	.60	.76	.84
.54	.54	.54	.46	.42	.12	.10	.06	.06	.06
.18	.32	.60	.80	.90	.72	.64	.48	.24	.12
.30	.48	.84	.60	.48	.18	.16	.12	.52	.72
1.62	1.68	1.80	2.88	3.42	5.40	5.42	5.46	6.62	7.20
2.04	2.10	2.22	1.98	1.86	.42	.60	.96	.96	.96
.30	.28	.24	.40	.48	.48	.56	.72	1.12	1.32
.96	.86	.66	.74	.78	1.20	.92	.36	.36	.36
.18	.16	.12	.12	.12	.06	.10	.18	.06	.00
.06	.06	.06	.14	.18	.00	.02	.06	.06	.06

```
24 JD          INDEX STORM NO. 3
                    STRM         1.38   PRECIPITATION DEPTH
                    TRDA         9.99   TRANSPOSITION DRAINAGE AREA

 0 PI             PRECIPITATION PATTERN
                    1.20      1.54      2.22      1.26       .78      1.02      1.10      1.26      1.06       .96
                     .36       .24       .00       .00       .00       .00       .00       .00       .00       .00
                     .18       .26       .42       .22       .12       .36       .44       .60       .76       .84
                     .54       .54       .54       .46       .42       .12       .10       .06       .06       .06
                     .18       .32       .60       .80       .90       .72       .64       .48       .24       .12
                     .30       .48       .84       .60       .48       .18       .16       .12       .52       .72
                    1.62      1.68      1.80      2.88      3.42      5.40      5.42      5.46      6.62      7.20
                    2.04      2.10      2.22      1.98      1.86       .42       .60       .96       .96       .96
                     .30       .28       .24       .40       .48       .48       .56       .72      1.12      1.32
                     .96       .86       .66       .74       .78      1.20       .92       .36       .36       .36
                     .18       .16       .12       .12       .12       .06       .10       .18       .06       .00
                     .06       .06       .06       .14       .18       .00       .02       .06       .06       .06

25 JD          INDEX STORM NO. 4
                    STRM         1.38   PRECIPITATION DEPTH
                    TRDA        10.01   TRANSPOSITION DRAINAGE AREA

26 PI             PRECIPITATION PATTERN
                    1.20      1.58      2.34      1.62      1.26      1.80      1.88      2.04       .92       .36
                     .60       .56       .48       .28       .18       .54       .40       .12       .24       .30
                     .18       .26       .42       .34       .30       .48       .52       .60       .60       .60
                     .66       .62       .54       .54       .54       .36       .54       .90       .70       .60
                     .60       .50       .30       .26       .24       .06       .18       .42       .30       .24
                     .36       .36       .36       .64       .78       .90      1.00      1.20      1.48      1.62
                    1.32      1.82      2.82      2.42      2.22      2.82      3.26      4.14      4.58      4.80
                     .60       .62       .66      1.06      1.26      1.62      1.30       .66       .42       .30
                     .54       .48       .36       .52       .60       .36       .52       .84      1.04      1.14
                    1.80      1.62      1.26      1.54      1.68      1.68      1.20       .24       .24       .24
                     .30       .24       .12       .12       .12       .12       .16       .24       .12       .06
                     .12       .10       .06       .14       .18       .06       .08       .12       .08       .06

34 JD          INDEX STORM NO. 5
                    STRM         1.26   PRECIPITATION DEPTH
                    TRDA        20.00   TRANSPOSITION DRAINAGE AREA

 0 PI             PRECIPITATION PATTERN
                    1.20      1.58      2.34      1.62      1.26      1.80      1.88      2.04       .92       .36
                     .60       .56       .48       .28       .18       .54       .40       .12       .24       .30
                     .18       .26       .42       .34       .30       .48       .52       .60       .60       .60
                     .66       .62       .54       .54       .54       .36       .54       .90       .70       .60
                     .60       .50       .30       .26       .24       .06       .18       .42       .30       .24
                     .36       .36       .36       .64       .78       .90      1.00      1.20      1.48      1.62
                    1.32      1.82      2.82      2.42      2.22      2.82      3.26      4.14      4.58      4.80
                     .60       .62       .66      1.06      1.26      1.62      1.30       .66       .42       .30
                     .54       .48       .36       .52       .60       .36       .52       .84      1.04      1.14
                    1.80      1.62      1.26      1.54      1.68      1.68      1.20       .24       .24       .24
                     .30       .24       .12       .12       .12       .12       .16       .24       .12       .06
                     .12       .10       .06       .14       .18       .06       .08       .12       .08       .06

35 JD          INDEX STORM NO. 6
                    STRM         1.18   PRECIPITATION DEPTH
                    TRDA        30.00   TRANSPOSITION DRAINAGE AREA

 0 PI             PRECIPITATION PATTERN
                    1.20      1.58      2.34      1.62      1.26      1.80      1.88      2.04       .92       .36
                     .60       .56       .48       .28       .18       .54       .40       .12       .24       .30
                     .18       .26       .42       .34       .30       .48       .52       .60       .60       .60
                     .66       .62       .54       .54       .54       .36       .54       .90       .70       .60
                     .60       .50       .30       .26       .24       .06       .18       .42       .30       .24
                     .36       .36       .36       .64       .78       .90      1.00      1.20      1.48      1.62
                    1.32      1.82      2.82      2.42      2.22      2.82      3.26      4.14      4.58      4.80
                     .60       .62       .66      1.06      1.26      1.62      1.30       .66       .42       .30
                     .54       .48       .36       .52       .60       .36       .52       .84      1.04      1.14
                    1.80      1.62      1.26      1.54      1.68      1.68      1.20       .24       .24       .24
                     .30       .24       .12       .12       .12       .12       .16       .24       .12       .06
                     .12       .10       .06       .14       .18       .06       .08       .12       .08       .06

36 JD          INDEX STORM NO. 7
                    STRM         1.09   PRECIPITATION DEPTH
                    TRDA        50.00   TRANSPOSITION DRAINAGE AREA

 0 PI             PRECIPITATION PATTERN
                    1.20      1.58      2.34      1.62      1.26      1.80      1.88      2.04       .92       .36
                     .60       .56       .48       .28       .18       .54       .40       .12       .24       .30
                     .18       .26       .42       .34       .30       .48       .52       .60       .60       .60
                     .66       .62       .54       .54       .54       .36       .54       .90       .70       .60
                     .60       .50       .30       .26       .24       .06       .18       .42       .30       .24
                     .36       .36       .36       .64       .78       .90      1.00      1.20      1.48      1.62
                    1.32      1.82      2.82      2.42      2.22      2.82      3.26      4.14      4.58      4.80
                     .60       .62       .66      1.06      1.26      1.62      1.30       .66       .42       .30
                     .54       .48       .36       .52       .60       .36       .52       .84      1.04      1.14
                    1.80      1.62      1.26      1.54      1.68      1.68      1.20       .24       .24       .24
                     .30       .24       .12       .12       .12       .12       .16       .24       .12       .06
                     .12       .10       .06       .14       .18       .06       .08       .12       .08       .06
```

37 JD INDEX STORM NO. 8

STRM .96 PRECIPITATION DEPTH

TRDA 100.00 TRANSPOSITION DRAINAGE AREA

0 PI PRECIPITATION PATTERN

1.20	1.58	2.34	1.62	1.26	1.80	1.88	2.04	.92	.36
.60	.56	.48	.28	.18	.54	.40	.12	.24	.30
.18	.26	.42	.34	.30	.48	.52	.60	.60	.60
.66	.62	.54	.54	.54	.36	.54	.90	.70	.60
.60	.50	.30	.26	.24	.06	.18	.42	.30	.24
.36	.36	.36	.64	.78	.90	1.00	1.20	1.48	1.62
1.32	1.82	2.82	2.42	2.22	2.82	3.26	4.14	4.58	4.80
.60	.62	.66	1.06	1.26	1.62	1.30	.66	.42	.30
.54	.48	.36	.52	.60	.36	.52	.84	1.04	1.14
1.80	1.62	1.26	1.54	1.68	1.68	1.20	.24	.24	.24
.30	.24	.12	.12	.12	.12	.16	.24	.12	.06
.12	.10	.06	.14	.18	.06	.08	.12	.08	.06

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

	OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
+	HYDROGRAPH AT	MM1A	426.	3.75	70.	28.	28.	.90		
+	HYDROGRAPH AT	BW1	5241.	6.00	2989.	1289.	1289.	60.50		
+	HYDROGRAPH AT	BW2	2759.	4.35	1102.	445.	445.	20.80		
+	2 COMBINED AT	BW1&2	6018.	5.65	3425.	1462.	1462.	81.30		
+	2 COMBINED AT	BW APX	6014.	5.65	3441.	1469.	1469.	82.20		
+	HYDROGRAPH AT	MM1B	580.	3.95	120.	48.	48.	2.10		
+	HYDROGRAPH AT	MM2	477.	3.95	98.	39.	39.	1.40		
+	HYDROGRAPH AT	HP1A	423.	3.90	91.	37.	37.	.80		
+	ROUTED TO	RTCPA	401.	4.35	91.	37.	37.	.80		
+	HYDROGRAPH AT	HP1B	309.	4.00	66.	27.	27.	1.00		
+	HYDROGRAPH AT	HP2	365.	4.00	78.	32.	32.	1.20		
+	4 COMBINED AT	CPA1	1229.	4.05	298.	120.	120.	4.40		
+	HYDROGRAPH AT	HP3	624.	4.05	148.	59.	59.	1.70		
+	2 COMBINED AT	CPA2	1757.	4.05	423.	170.	170.	6.10		
+	HYDROGRAPH AT	HP4	984.	4.00	214.	86.	86.	3.30		
+	HYDROGRAPH AT	HP5	526.	3.75	85.	34.	34.	1.20		
+	HYDROGRAPH AT	HP6	711.	4.00	160.	64.	64.	2.20		
+	ROUTED TO	RTCPD	689.	4.30	160.	64.	64.	2.20		
+	HYDROGRAPH AT	HPFA	110.	3.80	19.	8.	8.	.30		
+	3 COMBINED AT	CPD	884.	4.15	246.	99.	99.	3.70		
+	ROUTED TO	RTCPE	868.	4.50	246.	99.	99.	3.70		
+	HYDROGRAPH AT	HPFB	476.	3.90	94.	38.	38.	1.60		
+	3 COMBINED AT	CPE	1819.	4.10	502.	202.	202.	8.60		
+	2 COMBINED AT	CPF	2396.	4.05	820.	330.	330.	14.70		
+	HYDROGRAPH AT	SC1	3498.	6.00	1988.	855.	855.	39.40		
+	HYDROGRAPH AT	SC2	427.	3.95	89.	36.	36.	1.50		

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

HEC-1 MODEL OUTPUT

FILENAME: RWMSC.OUT

(100-YEAR MODEL)

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*****************************************                    *****************************************
*                                       *                    *                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *                    *   U.S. ARMY CORPS OF ENGINEERS        *
*             SEPTEMBER 1990            *                    *   HYDROLOGIC ENGINEERING CENTER       *
*               VERSION 4.0             *                    *          609 SECOND STREET            *
*                                       *                    *       DAVIS, CALIFORNIA 95616         *
*  RUN DATE  01/29/1993  TIME  22:03:06 *                    *          (916) 756-1104               *
*                                       *                    *                                       *
*****************************************                    *****************************************


                    X     X  XXXXXXX   XXXXX           X
                    X     X  X        X     X         XX
                    X     X  X        X                X
                    XXXXXXX  XXXX     X        XXXXX   X
                    X     X  X        X                X
                    X     X  X        X     X          X
                    X     X  XXXXXXX   XXXXX          XXX


THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

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        ID    FLOOD ASSESSMENT FOR RWMS JOB #:51056         FILE: RWMSC.DAT
    2        ID    100-YEAR 6-HOUR STORM 2.43 INCHES
    3        ID    POINT RAINFALL VALUES FROM NOAA ATLAS 2 VOL VII
    4        ID    ADJUSTED RAINFALL PER CORRECTION FACTOR IN TABLE 501 OF
    5        ID    CLARK COUNTY HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL (CCRFCD, 1990)
    6        ID    DEPTH-AREA REDUCTION FACTORS FROM TABLE 502 IN CCRFCD, 1990
    7        ID    CURVE NUMBERS DETERMINED USING TABLE 602 IN CCRFCD, 1990
    8        ID    LAG TIMES DETERMINED USING METHOD IN SECITON 606.3 IN CCRFCD, 1990
    9        ID    DRAINAGE AREAS FROM 7.5 MINUTE AND 15 MINUTE QUADS
   10        ID    THIS MODEL ADDRESSES DRAINAGES THAT COULD IMPACT THE RWMS
             *DIAGRAM
   11        IT       3       0       0     300
   12        IO       5
   13        IN       5
   14        JD    2.43     .01
             * RAINFALL DISTRIBUTION FROM CLARK COUNTY MANUAL LESS THAN 10 SQ. MILES
   15        PC       0       2     5.7     7.0     8.7    10.8    12.4    13.0    13.0    13.0
   16        PC    13.0    13.0    13.0    13.3    14.0    14.2    14.8    15.8    17.2    18.1
   17        PC    19.0    19.7    19.9    20.0    20.1    20.4    21.4    22.9    24.1    24.9
   18        PC    25.1    25.6    27.0    27.8    28.1    28.3    29.5    32.2    35.2    40.9
   19        PC    49.9    59.0    71.0    74.4    78.1    81.2    81.9    83.5    85.1    85.6
   20        PC    86.0    86.8    87.6    88.8    91.0    92.6    93.7    95.0    97.0    97.6
   21        PC    98.2    98.5    98.7    98.9    99.0    99.3    99.3    99.4    99.5    99.8
   22        PC    99.8    99.9   100.0
   23        JD    2.36       1
   24        JD    2.09    9.99
             * CHANGED RAINFALL DISTRIBUTION ABOVE 10 SQ. MILES PER CLARK COUNTY MANUAL
   25        JD    2.09   10.01
   26        PC       0     2.0     5.9     8.0    11.0    14.4    15.0    16.0    16.8    17.1
   27        PC    18.0    18.2    18.7    19.0    19.7    20.2    21.0    22.0    23.0    24.1
   28        PC    25.0    25.9    26.5    28.0    29.0    30.0    30.5    30.9    31.0    31.7
   29        PC    32.1    32.7    33.3    34.6    36.1    38.1    40.8    43.0    47.7    51.4
   30        PC    56.1    63.0    71.0    72.0    73.1    75.2    77.9    79.0    79.5    80.4
   31        PC    81.0    82.0    82.6    84.0    85.9    88.9    91.0    93.8    96.6    97.0
   32        PC    97.4    97.9    98.1    98.3    98.5    98.9    99.0    99.2    99.3    99.6
   33        PC    99.7    99.9   100.0
   34        JD    1.92      20
   35        JD    1.80      30
   36        JD    1.65      50
   37        JD    1.46     100

   38        KK    MM1A
   39        KM    Basin runoff calculation for Mass. Mountains 1A
   40        BA      .9
   41        LS              80
   42        UD     .31

   43        KK     BW1
   44        KM     Basin runoff calculation for Barren Wash 1
   45        BA    60.5
   46        LS              83
   47        UD     2.1
```

```
KK    BW2
KM     Basin runoff calculation for Barren Wash 2
BA    20.8
LS              80
UD      .9

KK   BW1&2
KM   Combined BW1 and BW2
HC      2

KK  BW APX
KM   Combine BW1,BW2, and MM1A (assume dischcarge of Barren Wash "active apex")
HC      2

KK    MM1B
KM    Basin runoff calulation for Mass. Mountains 1B
*   Flow was not combined with BW APX because flow from this watershed
*   will not directly impact RWMS wereas a channel migration at the apex
*   could impact the RWMS
BA     2.1
LS              77
UD     .48

KK    MM2
KM    Basin runoff calculation for Mass. Mountains 2
BA     1.4
LS              79
UD     .47

KK    HP1A
KM    Basin runoff calculation for Half Pint Range 1A
BA      .8
LS              85
UD     .48

KK   RTCPA
KM   Route Flow from HP1A to CPA
RM      9      .43       .2

KK    HP1B
KM    Basin runoff calculation for Half Pint Range 1B
BA     1.0
LS              78
UD     .51

KK    HP2
KM    Basin runoff calculation for Half Pint Range 2
BA    1.2
LS              78
UD     .51

KK    CPA1
KM    Combine MM2, routed HP1A, HP1B, HP2
HC      4

KK     HP3
KM     (CPB) Basin runoff calculation for Half Pint Range 3
BA     1.7
LS              82
UD     .59

KK    CPA2
KM    Combine HP3 with flow from CPA1
HC      2

KK     HP4
KM     (CPC) Basin runoff calculation for Half Pint Range 4
BA     3.3
LS              79
UD     .52

KK     HP5
KM     Basin runoff calculation for Half Pint Range 5
BA     1.2
LS              79
UD      .3

KK     HP6
KM     Basin runoff calculation for Half Pint Range 6
BA     2.2
LS              80
UD     .55

KK    RTCPD
KM    Route HP6 to CPD
RM      5      .27      .2
```

```
KK    HPFA
KM     Basin runoff calculation for Half Pint Range FA
BA      .3
LS              77
UD     .33

KK     CPD
KM     Combine HP5, routed HP6, and HPFA
HC       3

KK   RTCPE
KM     Route flow from CPD to CPE
RM       8     .39      .2

KK     HPFB
KM     Basin runoff calculation for Half Pint Range FB
BA     1.6
LS              77
UD     .44

KK     CPE
KM    Combine HP4 (CPC) with routed flow from CPD, and HPFB
HC       3

KK     CPF
KM    Combine all flow at Concentration just below RWMS (Flow from CPA & CPE)
HC       2

KK     SC1
KM     Basin runoff calculation for Scarp Canyon 1
* Concentration Pt of this watershed is the active apex of the Scarp Canyon Fan
BA    39.4
LS              82
UD     2.1

KK     SC2
KM     Basin runoff calculation for Scarp Canyon 2
BA     1.5
LS              77
UD     .48
ZZ
```

```
                  SCHEMATIC DIAGRAM OF STREAM NETWORK
INPUT
 LINE       (V) ROUTING            (--->) DIVERSION OR PUMP FLOW

  NO.       (.) CONNECTOR          (<---) RETURN OF DIVERTED OR PUMPED FLOW

  38       MM1A
              .
              .
  43          .       BW1
              .         .
              .         .
  48          .         .       BW2
              .         .         .
              .         .         .
  53          .     BW1&2..........
              .         .
              .         .
  56     BW APX..........
              .
              .
  59          .      MM1B
              .         .
              .         .
  64          .         .       MM2
              .         .         .
              .         .         .
  69          .         .         .      HP1A
              .         .         .         V
              .         .         .         V
  74          .         .         .     RTCPA
              .         .         .         .
              .         .         .         .
  77          .         .         .         .      HP1B
              .         .         .         .         .
              .         .         .         .         .
  82          .         .         .         .         .       HP2
              .         .         .         .         .         .
              .         .         .         .         .         .
  87          .         .      CPA1..............................
              .         .         .
              .         .         .
  90          .         .         .       HP3
              .         .         .         .
              .         .         .         .
  95          .         .      CPA2..........
              .         .         .
              .         .         .
  98          .         .         .       HP4
              .         .         .         .
              .         .         .         .
 103          .         .         .         .       HP5
              .         .         .         .         .
              .         .         .         .         .
 108          .         .         .         .         .       HP6
              .         .         .         .         .         V
              .         .         .         .         .         V
 113          .         .         .         .         .     RTCPD
              .         .         .         .         .         .
              .         .         .         .         .         .
 116          .         .         .         .         .         .      HPFA
              .         .         .         .         .         .         .
              .         .         .         .         .         .         .
 121          .         .         .         .       CPD....................
              .         .         .         .         V
              .         .         .         .         V
 124          .         .         .         .     RTCPE
              .         .         .         .         .
              .         .         .         .         .
 127          .         .         .         .         .      HPFB
              .         .         .         .         .         .
              .         .         .         .         .         .
 132          .         .         .       CPE....................
              .         .         .         .
              .         .         .         .
 135          .         .       CPF..........
              .         .         .
              .         .         .
 138          .         .         .       SC1
              .         .         .         .
              .         .         .         .
 143          .         .         .         .       SC2

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION
```

```
*****************************************
*                                       *
*  FLOOD HYDROGRAPH PACKAGE  (HEC-1)    *
*           SEPTEMBER 1990              *
*             VERSION 4.0               *
*                                       *
*  RUN DATE  01/29/1993  TIME  22:03:06 *
*                                       *
*****************************************
```

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

FLOOD ASSESSMENT FOR RWMS JOB #:51056   FILE: RWMSC.DAT
100-YEAR 6-HOUR STORM 2.43 INCHES
POINT RAINFALL VALUES FROM NOAA ATLAS 2 VOL VII
ADJUSTED RAINFALL PER CORRECTION FACTOR IN TABLE 501 OF
CLARK COUNTY HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL (CCRFCD, 1990)
DEPTH-AREA REDUCTION FACTORS FROM TABLE 502 IN CCRFCD, 1990
CURVE NUMBERS DETERMINED USING TABLE 602 IN CCRFCD, 1990
LAG TIMES DETERMINED USING METHOD IN SECITON 606.3 IN CCRFCD, 1990
DRAINAGE AREAS FROM 7.5 MINUTE AND 15 MINUTE QUADS
THIS MODEL ADDRESSES DRAINAGES THAT COULD IMPACT THE RWMS

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

   IT      HYDROGRAPH TIME DATA
                  NMIN          3  MINUTES IN COMPUTATION INTERVAL
                 IDATE      1   0  STARTING DATE
                 ITIME       0000  STARTING TIME
                    NQ        300  NUMBER OF HYDROGRAPH ORDINATES
                NDDATE      1   0  ENDING DATE
                NDTIME       1457  ENDING TIME
                 ICENT         19  CENTURY MARK

            COMPUTATION INTERVAL     .05 HOURS
                 TOTAL TIME BASE   14.95 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

14 JD      INDEX STORM NO. 1
                  STRM       2.43  PRECIPITATION DEPTH
                  TRDA        .01  TRANSPOSITION DRAINAGE AREA
```

15 PI   PRECIPITATION PATTERN

1.20	1.54	2.22	1.26	.78	1.02	1.10	1.26	1.06	.96
.36	.24	.00	.00	.00	.00	.00	.00	.00	.00
.18	.26	.42	.22	.12	.36	.44	.60	.76	.84
.54	.54	.54	.46	.42	.12	.10	.06	.06	.06
.18	.32	.60	.80	.90	.72	.64	.48	.24	.12
.30	.48	.84	.60	.48	.18	.16	.12	.52	.72
1.62	1.68	1.80	2.88	3.42	5.40	5.42	5.46	6.62	7.20
2.04	2.10	2.22	1.98	1.86	.42	.60	.96	.96	.96
.30	.28	.24	.40	.48	.48	.56	.72	1.12	1.32
.96	.86	.66	.74	.78	1.20	.92	.36	.36	.36
.18	.16	.12	.12	.12	.06	.10	.18	.06	.00
.06	.06	.06	.14	.18	.00	.02	.06	.06	.06

```
23 JD      INDEX STORM NO. 2
                  STRM       2.36  PRECIPITATION DEPTH
                  TRDA       1.00  TRANSPOSITION DRAINAGE AREA
```

0 PI   PRECIPITATION PATTERN

1.20	1.54	2.22	1.26	.78	1.02	1.10	1.26	1.06	.96
.36	.24	.00	.00	.00	.00	.00	.00	.00	.00
.18	.26	.42	.22	.12	.36	.44	.60	.76	.84
.54	.54	.54	.46	.42	.12	.10	.06	.06	.06
.18	.32	.60	.80	.90	.72	.64	.48	.24	.12
.30	.48	.84	.60	.48	.18	.16	.12	.52	.72
1.62	1.68	1.80	2.88	3.42	5.40	5.42	5.46	6.62	7.20
2.04	2.10	2.22	1.98	1.86	.42	.60	.96	.96	.96
.30	.28	.24	.40	.48	.48	.56	.72	1.12	1.32
.96	.86	.66	.74	.78	1.20	.92	.36	.36	.36
.18	.16	.12	.12	.12	.06	.10	.18	.06	.00
.06	.06	.06	.14	.18	.00	.02	.06	.06	.06

```
24 JD          INDEX STORM NO. 3
                  STRM        2.09  PRECIPITATION DEPTH
                  TRDA        9.99  TRANSPOSITION DRAINAGE AREA

 0 PI            PRECIPITATION PATTERN
                   1.20     1.54     2.22     1.26      .78     1.02     1.10     1.26     1.06      .96
                    .36      .24      .00      .00      .00      .00      .00      .00      .00      .00
                    .18      .26      .42      .22      .12      .36      .44      .60      .76      .84
                    .54      .54      .54      .46      .42      .12      .10      .06      .06      .06
                    .18      .32      .60      .80      .90      .72      .64      .48      .24      .12
                    .30      .48      .84      .60      .48      .18      .16      .12      .52      .72
                   1.62     1.68     1.80     2.88     3.42     5.40     5.42     5.46     6.62     7.20
                   2.04     2.10     2.22     1.98     1.86      .42      .60      .96      .96      .96
                    .30      .28      .24      .40      .48      .48      .56      .72     1.12     1.32
                    .96      .86      .66      .74      .78     1.20      .92      .36      .36      .36
                    .18      .16      .12      .12      .12      .06      .10      .18      .06      .00
                    .06      .06      .06      .14      .18      .00      .02      .06      .06      .06

25 JD          INDEX STORM NO. 4
                  STRM        2.09  PRECIPITATION DEPTH
                  TRDA       10.01  TRANSPOSITION DRAINAGE AREA

26 PI            PRECIPITATION PATTERN
                   1.20     1.58     2.34     1.62     1.26     1.80     1.88     2.04      .92      .36
                    .60      .56      .48      .28      .18      .54      .40      .12      .24      .30
                    .18      .26      .42      .34      .30      .48      .52      .60      .60      .60
                    .66      .62      .54      .54      .54      .36      .54      .90      .70      .60
                    .60      .50      .30      .26      .24      .06      .18      .42      .30      .24
                    .36      .36      .36      .64      .78      .90     1.00     1.20     1.48     1.62
                   1.32     1.82     2.82     2.42     2.22     2.82     3.26     4.14     4.58     4.80
                    .60      .62      .66     1.06     1.26     1.62     1.30      .66      .42      .30
                    .54      .48      .36      .52      .60      .36      .52      .84     1.04     1.14
                   1.80     1.62     1.26     1.54     1.68     1.68     1.20      .24      .24      .24
                    .30      .24      .12      .12      .12      .12      .16      .24      .12      .06
                    .12      .10      .06      .14      .18      .06      .08      .12      .08      .06

34 JD          INDEX STORM NO. 5
                  STRM        1.92  PRECIPITATION DEPTH
                  TRDA       20.00  TRANSPOSITION DRAINAGE AREA

 0 PI            PRECIPITATION PATTERN
                   1.20     1.58     2.34     1.62     1.26     1.80     1.88     2.04      .92      .36
                    .60      .56      .48      .28      .18      .54      .40      .12      .24      .30
                    .18      .26      .42      .34      .30      .48      .52      .60      .60      .60
                    .66      .62      .54      .54      .54      .36      .54      .90      .70      .60
                    .60      .50      .30      .26      .24      .06      .18      .42      .30      .24
                    .36      .36      .36      .64      .78      .90     1.00     1.20     1.48     1.62
                   1.32     1.82     2.82     2.42     2.22     2.82     3.26     4.14     4.58     4.80
                    .60      .62      .66     1.06     1.26     1.62     1.30      .66      .42      .30
                    .54      .48      .36      .52      .60      .36      .52      .84     1.04     1.14
                   1.80     1.62     1.26     1.54     1.68     1.68     1.20      .24      .24      .24
                    .30      .24      .12      .12      .12      .12      .16      .24      .12      .06
                    .12      .10      .06      .14      .18      .06      .08      .12      .08      .06

35 JD          INDEX STORM NO. 6
                  STRM        1.80  PRECIPITATION DEPTH
                  TRDA       30.00  TRANSPOSITION DRAINAGE AREA

 0 PI            PRECIPITATION PATTERN
                   1.20     1.58     2.34     1.62     1.26     1.80     1.88     2.04      .92      .36
                    .60      .56      .48      .28      .18      .54      .40      .12      .24      .30
                    .18      .26      .42      .34      .30      .48      .52      .60      .60      .60
                    .66      .62      .54      .54      .54      .36      .54      .90      .70      .60
                    .60      .50      .30      .26      .24      .06      .18      .42      .30      .24
                    .36      .36      .36      .64      .78      .90     1.00     1.20     1.48     1.62
                   1.32     1.82     2.82     2.42     2.22     2.82     3.26     4.14     4.58     4.80
                    .60      .62      .66     1.06     1.26     1.62     1.30      .66      .42      .30
                    .54      .48      .36      .52      .60      .36      .52      .84     1.04     1.14
                   1.80     1.62     1.26     1.54     1.68     1.68     1.20      .24      .24      .24
                    .30      .24      .12      .12      .12      .12      .16      .24      .12      .06
                    .12      .10      .06      .14      .18      .06      .08      .12      .08      .06

36 JD          INDEX STORM NO. 7
                  STRM        1.65  PRECIPITATION DEPTH
                  TRDA       50.00  TRANSPOSITION DRAINAGE AREA

 0 PI            PRECIPITATION PATTERN
                   1.20     1.58     2.34     1.62     1.26     1.80     1.88     2.04      .92      .36
                    .60      .56      .48      .28      .18      .54      .40      .12      .24      .30
                    .18      .26      .42      .34      .30      .48      .52      .60      .60      .60
                    .66      .62      .54      .54      .54      .36      .54      .90      .70      .60
                    .60      .50      .30      .26      .24      .06      .18      .42      .30      .24
                    .36      .36      .36      .64      .78      .90     1.00     1.20     1.48     1.62
                   1.32     1.82     2.82     2.42     2.22     2.82     3.26     4.14     4.58     4.80
                    .60      .62      .66     1.06     1.26     1.62     1.30      .66      .42      .30
                    .54      .48      .36      .52      .60      .36      .52      .84     1.04     1.14
                   1.80     1.62     1.26     1.54     1.68     1.68     1.20      .24      .24      .24
                    .30      .24      .12      .12      .12      .12      .16      .24      .12      .06
                    .12      .10      .06      .14      .18      .06      .08      .12      .08      .06
```

37 JD INDEX STORM NO. 8

STRM	1.46	PRECIPITATION DEPTH
TRDA	100.00	TRANSPOSITION DRAINAGE AREA

0 PI PRECIPITATION PATTERN

1.20	1.58	2.34	1.62	1.26	1.80	1.88	2.04	.92	.36
.60	.56	.48	.28	.18	.54	.40	.12	.24	.30
.18	.26	.42	.34	.30	.48	.52	.60	.60	.60
.66	.62	.54	.54	.54	.36	.54	.90	.70	.60
.60	.50	.30	.26	.24	.06	.18	.42	.30	.24
.36	.36	.36	.64	.78	.90	1.00	1.20	1.48	1.62
1.32	1.82	2.82	2.42	2.22	2.82	3.26	4.14	4.58	4.80
.60	.62	.66	1.06	1.26	1.62	1.30	.66	.42	.30
.54	.48	.36	.52	.60	.36	.52	.84	1.04	1.14
1.80	1.62	1.26	1.54	1.68	1.68	1.20	.24	.24	.24
.30	.24	.12	.12	.12	.12	.16	.24	.12	.06
.12	.10	.06	.14	.18	.06	.08	.12	.08	.06

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

	OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
+	HYDROGRAPH AT	MM1A	467.	3.75	77.	31.	31.	.90		
+	HYDROGRAPH AT	BW1	4883.	6.15	2699.	1141.	1141.	60.50		
+	HYDROGRAPH AT	BW2	2778.	4.40	1133.	456.	456.	20.80		
+	2 COMBINED AT	BW1&2	5498.	5.75	3049.	1282.	1282.	81.30		
+	2 COMBINED AT	BW APX	5488.	5.75	3060.	1287.	1287.	82.20		
+	HYDROGRAPH AT	MM1B	644.	4.00	136.	55.	55.	2.10		
+	HYDROGRAPH AT	MM2	526.	3.95	108.	44.	44.	1.40		
+	HYDROGRAPH AT	HP1A	444.	3.95	92.	37.	37.	.80		
+	ROUTED TO	RTCPA	420.	4.40	92.	37.	37.	.80		
+	HYDROGRAPH AT	HP1B	346.	4.00	75.	30.	30.	1.00		
+	HYDROGRAPH AT	HP2	407.	4.00	89.	36.	36.	1.20		
+	4 COMBINED AT	CPA1	1297.	4.05	317.	127.	127.	4.40		
+	HYDROGRAPH AT	HP3	661.	4.05	156.	63.	63.	1.70		
+	2 COMBINED AT	CPA2	1827.	4.10	442.	177.	177.	6.10		
+	HYDROGRAPH AT	HP4	1060.	4.00	233.	94.	94.	3.30		
+	HYDROGRAPH AT	HP5	582.	3.75	94.	38.	38.	1.20		
+	HYDROGRAPH AT	HP6	766.	4.05	174.	70.	70.	2.20		
+	ROUTED TO	RTCPD	741.	4.30	174.	70.	70.	2.20		
+	HYDROGRAPH AT	HPFA	125.	3.80	21.	9.	9.	.30		
+	3 COMBINED AT	CPD	945.	4.15	266.	107.	107.	3.70		
+	ROUTED TO	RTCPE	927.	4.55	266.	107.	107.	3.70		
+	HYDROGRAPH AT	HPFB	533.	3.95	107.	43.	43.	1.60		
+	3 COMBINED AT	CPE	1898.	4.10	537.	215.	215.	8.60		
+	2 COMBINED AT	CPF	2462.	4.05	854.	343.	343.	14.70		
+	HYDROGRAPH AT	SC1	3438.	6.15	1900.	804.	804.	39.40		
+	HYDROGRAPH AT	SC2	478.	4.00	101.	41.	41.	1.50		

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

HEC-1 MODEL OUTPUT

FILENAME: RWMS10.OUT

(10-YEAR MODEL)

```
*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE   (HEC-1)  *
*            SEPTEMBER 1990             *
*             VERSION 4.0               *
*                                       *
*  RUN DATE  01/29/1993  TIME  22:05:10 *
*                                       *
*****************************************
```

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

```
X     X  XXXXXXX   XXXXX          X
X     X  X        X     X        XX
X     X  X        X               X
XXXXXXX  XXXX     X       XXXXX   X
X     X  X        X               X
X     X  X        X     X         X
X     X  XXXXXXX   XXXXX         XXX
```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

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   ID   FLOOD ASSESSMENT FOR RWMS JOB #:51056          FILE: RWMS10.DAT
  2   ID   10-YEAR 6-HOUR STORM 1.1 INCHES
  3   ID   POINT RAINFALL VALUE FROM NOAA ATLASS 2 VOL VII
  4   ID   DEPTH-AREA REDUCTION FACTORS FROM TABLE 502 IN
  5   ID   CLARK COUNTY HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL (CCRFCD, 1990)
  6   ID   CURVE NUMBERS DETERMINED USING TABLE 602 IN CCRFCD, 1990
  7   ID   LAG TIMES DETEMINED USING METHOD IN SECTION 606.3 IN CCRFCD, 1990
  8   ID   DRAINAGE AREAS FROM 7.5 MINUTE AND 15 MINUTE QUADS
  9   ID   THIS MODEL ADDRESSES DRAINAGES THAT COULD IMPACT THE RWMS
      *DIAGRAM
 10   IT      3       0       0     300
 11   IO      5
 12   IN      5
 13   JD    1.1     .01
      * RAINFALL DISTRIBUTION FROM CLARK COUNTY MANUAL LESS THAN 10 SQ. MILES
 14   PC      0       2     5.7     7.0     8.7    10.8    12.4    13.0    13.0    13.0
 15   PC   13.0    13.0    13.0    13.3    14.0    14.2    14.8    15.8    17.2    18.1
 16   PC   19.0    19.7    19.9    20.0    20.1    20.4    21.4    22.9    24.1    24.9
 17   PC   25.1    25.6    27.0    27.8    28.1    28.3    29.5    32.2    35.2    40.9
 18   PC   49.9    59.0    71.0    74.4    78.1    81.2    81.9    83.5    85.1    85.6
 19   PC   86.0    86.8    87.6    88.8    91.0    92.6    93.7    95.0    97.0    97.6
 20   PC   98.2    98.5    98.7    98.9    99.0    99.3    99.3    99.4    99.5    99.8
 21   PC   99.8    99.9   100.0
 22   JD   1.07       1
 23   JD    .95    9.99
      * CHANGED RAINFALL DISTRIBUTION ABOVE 10 SQ. MILES PER CLARK COUNTY MANUAL
 24   JD    .95   10.01
 25   PC      0     2.0     5.9     8.0    11.0    14.4    15.0    16.0    16.8    17.1
 26   PC   18.0    18.2    18.7    19.0    19.7    20.2    21.0    22.0    23.0    24.1
 27   PC   25.0    25.9    26.5    28.0    29.0    30.0    30.5    30.9    31.0    31.7
 28   PC   32.1    32.7    33.3    34.6    36.1    38.1    40.8    43.0    47.7    51.4
 29   PC   56.1    63.0    71.0    72.0    73.1    75.2    77.9    79.0    79.5    80.4
 30   PC   81.0    82.0    82.6    84.0    85.9    88.9    91.0    93.8    96.6    97.0
 31   PC   97.4    97.9    98.1    98.3    98.5    98.9    99.0    99.2    99.3    99.6
 32   PC   99.7    99.9   100.0
 33   JD    .87      20
 34   JD    .81      30
 35   JD    .75      50
 36   JD    .66     100

 37   KK   MM1A
 38   KM   Basin runoff calculation for Mass. Mountains 1A
 39   BA     .9
 40   LS             80
 41   UD    .31

 42   KK   BW1
 43   KM   Basin runoff calculation for Barren Wash 1
 44   BA   60.5
 45   LS             83
 46   UD    2.1
```

```
KK    BW2
KM     Basin runoff calculation for Barren Wash 2
BA    20.8
LS              80
UD      .9

KK    BW1&2
KM    Combined BW1 and BW2
HC       2

KK  BW APX
KM   Combine BW1,BW2, and MM1A (assume dischcarge of Barren Wash "active apex")
HC       2

KK     MM1B
KM      Basin runoff calulation for Mass. Mountains 1B
*   Flow was not combined with BW APX because flow from this watershed
*   will not directly impact RWMS wereas a channel migration at the apex
*   could impact the RWMS
BA     2.1
LS              77
UD     .48

KK     MM2
KM     Basin runoff calculation for Mass. Mountains 2
BA     1.4
LS              79
UD     .47

KK     HP1A
KM     Basin runoff calculation for Half Pint Range 1A
BA      .8
LS              85
UD     .48

KK    RTCPA
KM    Route Flow from HP1A to CPA
RM       9     .43       .2

KK     HP1B
KM     Basin runoff calculation for Half Pint Range 1B
BA     1.0
LS              78
UD     .51

KK     HP2
KM     Basin runoff calculation for Half Pint Range 2
BA     1.2
LS              78
UD     .51

KK     CPA1
KM     Combine MM2, routed HP1A, HP1B, HP2
HC       4

KK      HP3
KM      (CPB) Basin runoff calculation for Half Pint Range 3
BA      1.7
LS              82
UD     .59

KK     CPA2
KM     Combine HP3 with flow from CPA1
HC       2

KK      HP4
KM      (CPC) Basin runoff calculation for Half Pint Range 4
BA      3.3
LS              79
UD     .52

KK      HP5
KM      Basin runoff calculation for Half Pint Range 5
BA      1.2
LS              79
UD      .3

KK      HP6
KM      Basin runoff calculation for Half Pint Range 6
BA      2.2
LS              80
UD     .55

KK    RTCPD
KM     Route HP6 to CPD
RM       5     .27       .2
```

```
KK     HPFA
KM      Basin runoff calculation for Half Pint Range FA
BA       .3
LS               77
UD      .33

KK      CPD
KM      Combine HP5, routed HP6, and HPFA
HC       3

KK    RTCPE
KM      Route flow from CPD to CPE
RM       8      .39      .2

KK     HPFB
KM      Basin runoff calculation for Half Pint Range FB
BA      1.6
LS               77
UD      .44

KK      CPE
KM     Combine HP4 (CPC) with routed flow from CPD, and HPFB
HC       3

KK      CPF
KM     Combine all flow at Concentration just below RWMS (Flow from CPA & CPE)
HC       2

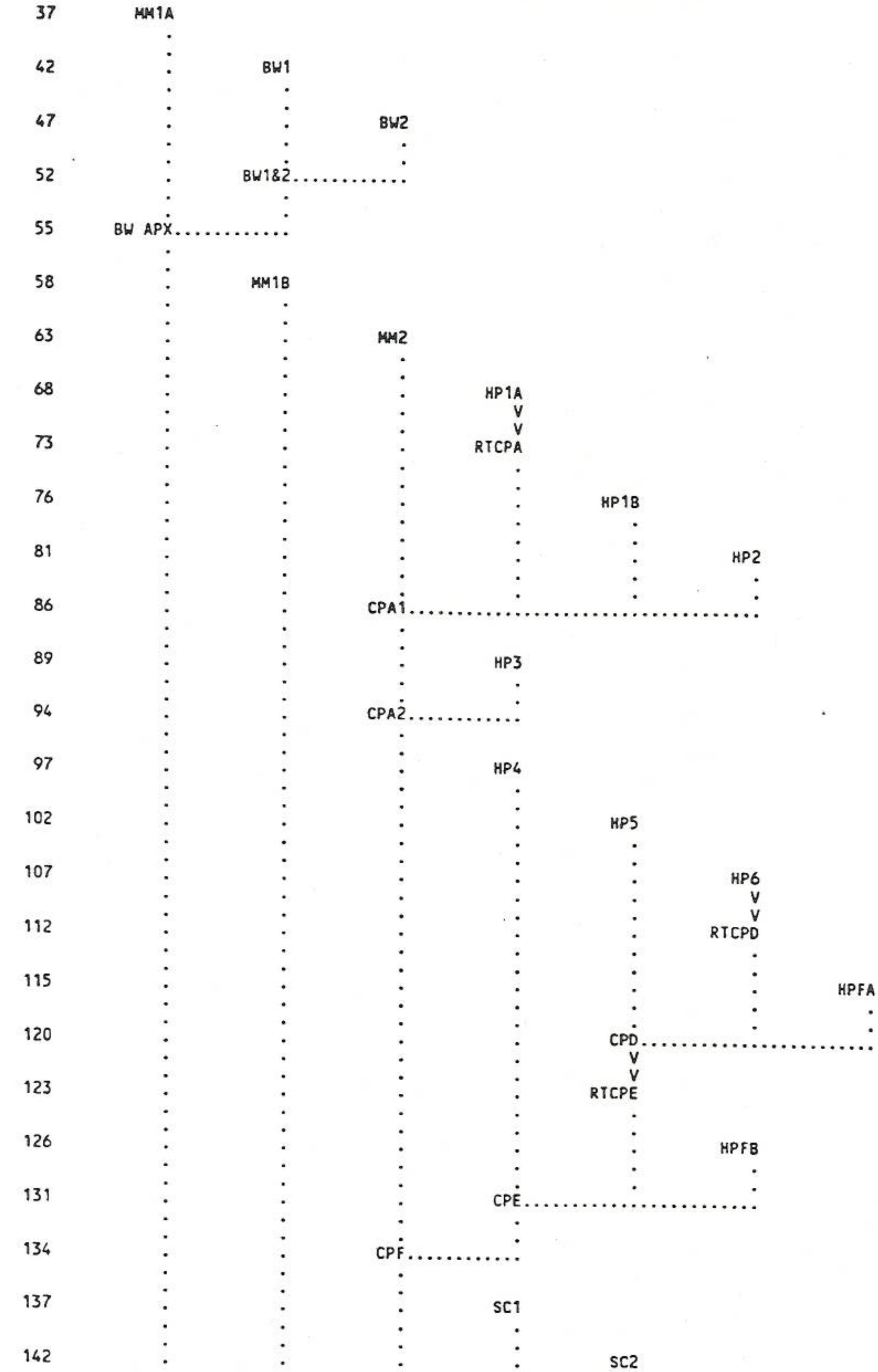
KK      SC1
KM      Basin runoff calculation for Scarp Canyon 1
* Concentration Pt of this watershed is the active apex of the Scarp Canyon Fan
BA     39.4
LS               82
UD      2.1

KK      SC2
KM      Basin runoff calculation for Scarp Canyon 2
BA      1.5
LS               77
UD      .48
ZZ
```

SCHEMATIC DIAGRAM OF STREAM NETWORK

INPUT LINE NO. (V) ROUTING (--->) DIVERSION OR PUMP FLOW

(.) CONNECTOR (<---) RETURN OF DIVERTED OR PUMPED FLOW



(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
****************************************                    ****************************************
*                                      *                    *                                      *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *                    *  U.S. ARMY CORPS OF ENGINEERS         *
*            SEPTEMBER 1990            *                    *  HYDROLOGIC ENGINEERING CENTER       *
*             VERSION 4.0              *                    *       609 SECOND STREET              *
*                                      *                    *    DAVIS, CALIFORNIA 95616           *
* RUN DATE  01/29/1993  TIME  22:05:10 *                    *        (916) 756-1104                *
*                                      *                    *                                      *
****************************************                    ****************************************


                          FLOOD ASSESSMENT FOR RWMS JOB #:51056          FILE: RWMS10.DAT
                          10-YEAR 6-HOUR STORM 1.1 INCHES
                          POINT RAINFALL VALUE FROM NOAA ATLASS 2 VOL VII
                          DEPTH-AREA REDUCTION FACTORS FROM TABLE 502 IN
                          CLARK COUNTY HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL (CCRFCD, 1990)
                          CURVE NUMBERS DETERMINED USING TABLE 602 IN CCRFCD, 1990
                          LAG TIMES DETEMINED USING METHOD IN SECTION 606.3 IN CCRFCD, 1990
                          DRAINAGE AREAS FROM 7.5 MINUTE AND 15 MINUTE QUADS
                          THIS MODEL ADDRESSES DRAINAGES THAT COULD IMPACT THE RWMS

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

   IT           HYDROGRAPH TIME DATA
                      NMIN          3  MINUTES IN COMPUTATION INTERVAL
                     IDATE      1   0  STARTING DATE
                     ITIME       0000  STARTING TIME
                        NQ        300  NUMBER OF HYDROGRAPH ORDINATES
                    NDDATE      1   0  ENDING DATE
                    NDTIME       1457  ENDING TIME
                     ICENT         19  CENTURY MARK

                COMPUTATION INTERVAL     .05 HOURS
                     TOTAL TIME BASE   14.95 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

 13 JD           INDEX STORM NO. 1
                      STRM       1.10  PRECIPITATION DEPTH
                      TRDA        .01  TRANSPOSITION DRAINAGE AREA

 14 PI           PRECIPITATION PATTERN
                     1.20      1.54      2.22      1.26       .78      1.02      1.10      1.26      1.06       .96
                      .36       .24       .00       .00       .00       .00       .00       .00       .00       .00
                      .18       .26       .42       .22       .12       .36       .44       .60       .76       .84
                      .54       .54       .54       .46       .42       .12       .10       .06       .06       .06
                      .18       .32       .60       .80       .90       .72       .64       .48       .24       .12
                      .30       .48       .84       .60       .48       .18       .16       .12       .52       .72
                     1.62      1.68      1.80      2.88      3.42      5.40      5.42      5.46      6.62      7.20
                     2.04      2.10      2.22      1.98      1.86       .42       .60       .96       .96       .96
                      .30       .28       .24       .40       .48       .48       .56       .72      1.12      1.32
                      .96       .86       .66       .74       .78      1.20       .92       .36       .36       .36
                      .18       .16       .12       .12       .12       .06       .10       .18       .06       .00
                      .06       .06       .06       .14       .18       .00       .02       .06       .06       .06

 22 JD           INDEX STORM NO. 2
                      STRM       1.07  PRECIPITATION DEPTH
                      TRDA       1.00  TRANSPOSITION DRAINAGE AREA

  0 PI           PRECIPITATION PATTERN
                     1.20      1.54      2.22      1.26       .78      1.02      1.10      1.26      1.06       .96
                      .36       .24       .00       .00       .00       .00       .00       .00       .00       .00
                      .18       .26       .42       .22       .12       .36       .44       .60       .76       .84
                      .54       .54       .54       .46       .42       .12       .10       .06       .06       .06
                      .18       .32       .60       .80       .90       .72       .64       .48       .24       .12
                      .30       .48       .84       .60       .48       .18       .16       .12       .52       .72
                     1.62      1.68      1.80      2.88      3.42      5.40      5.42      5.46      6.62      7.20
                     2.04      2.10      2.22      1.98      1.86       .42       .60       .96       .96       .96
                      .30       .28       .24       .40       .48       .48       .56       .72      1.12      1.32
                      .96       .86       .66       .74       .78      1.20       .92       .36       .36       .36
                      .18       .16       .12       .12       .12       .06       .10       .18       .06       .00
                      .06       .06       .06       .14       .18       .00       .02       .06       .06       .06
```

23 JD INDEX STORM NO. 3

STRM .95 PRECIPITATION DEPTH

TRDA 9.99 TRANSPOSITION DRAINAGE AREA

0 PI PRECIPITATION PATTERN

1.20	1.54	2.22	1.26	.78	1.02	1.10	1.26	1.06	.96
.36	.24	.00	.00	.00	.00	.00	.00	.00	.00
.18	.26	.42	.22	.12	.36	.44	.60	.76	.84
.54	.54	.54	.46	.42	.12	.10	.06	.06	.06
.18	.32	.60	.80	.90	.72	.64	.48	.24	.12
.30	.48	.84	.60	.48	.18	.16	.12	.52	.72
1.62	1.68	1.80	2.88	3.42	5.40	5.42	5.46	6.62	7.20
2.04	2.10	2.22	1.98	1.86	.42	.60	.96	.96	.96
.30	.28	.24	.40	.48	.48	.56	.72	1.12	1.32
.96	.86	.66	.74	.78	1.20	.92	.36	.36	.36
.18	.16	.12	.12	.12	.06	.10	.18	.06	.00
.06	.06	.06	.14	.18	.00	.02	.06	.06	.06

24 JD INDEX STORM NO. 4

STRM .95 PRECIPITATION DEPTH

TRDA 10.01 TRANSPOSITION DRAINAGE AREA

25 PI PRECIPITATION PATTERN

1.20	1.58	2.34	1.62	1.26	1.80	1.88	2.04	.92	.36
.60	.56	.48	.28	.18	.54	.40	.12	.24	.30
.18	.26	.42	.34	.30	.48	.52	.60	.60	.60
.66	.62	.54	.54	.54	.36	.54	.90	.70	.60
.60	.50	.30	.26	.24	.06	.18	.42	.30	.24
.36	.36	.36	.64	.78	.90	1.00	1.20	1.48	1.62
1.32	1.82	2.82	2.42	2.22	2.82	3.26	4.14	4.58	4.80
.60	.62	.66	1.06	1.26	1.62	1.30	.66	.42	.30
.54	.48	.36	.52	.60	.36	.52	.84	1.04	1.14
1.80	1.62	1.26	1.54	1.68	1.68	1.20	.24	.24	.24
.30	.24	.12	.12	.12	.12	.16	.24	.12	.06
.12	.10	.06	.14	.18	.06	.08	.12	.08	.06

33 JD INDEX STORM NO. 5

STRM .87 PRECIPITATION DEPTH

TRDA 20.00 TRANSPOSITION DRAINAGE AREA

0 PI PRECIPITATION PATTERN

1.20	1.58	2.34	1.62	1.26	1.80	1.88	2.04	.92	.36
.60	.56	.48	.28	.18	.54	.40	.12	.24	.30
.18	.26	.42	.34	.30	.48	.52	.60	.60	.60
.66	.62	.54	.54	.54	.36	.54	.90	.70	.60
.60	.50	.30	.26	.24	.06	.18	.42	.30	.24
.36	.36	.36	.64	.78	.90	1.00	1.20	1.48	1.62
1.32	1.82	2.82	2.42	2.22	2.82	3.26	4.14	4.58	4.80
.60	.62	.66	1.06	1.26	1.62	1.30	.66	.42	.30
.54	.48	.36	.52	.60	.36	.52	.84	1.04	1.14
1.80	1.62	1.26	1.54	1.68	1.68	1.20	.24	.24	.24
.30	.24	.12	.12	.12	.12	.16	.24	.12	.06
.12	.10	.06	.14	.18	.06	.08	.12	.08	.06

34 JD INDEX STORM NO. 6

STRM .81 PRECIPITATION DEPTH

TRDA 30.00 TRANSPOSITION DRAINAGE AREA

0 PI PRECIPITATION PATTERN

1.20	1.58	2.34	1.62	1.26	1.80	1.88	2.04	.92	.36
.60	.56	.48	.28	.18	.54	.40	.12	.24	.30
.18	.26	.42	.34	.30	.48	.52	.60	.60	.60
.66	.62	.54	.54	.54	.36	.54	.90	.70	.60
.60	.50	.30	.26	.24	.06	.18	.42	.30	.24
.36	.36	.36	.64	.78	.90	1.00	1.20	1.48	1.62
1.32	1.82	2.82	2.42	2.22	2.82	3.26	4.14	4.58	4.80
.60	.62	.66	1.06	1.26	1.62	1.30	.66	.42	.30
.54	.48	.36	.52	.60	.36	.52	.84	1.04	1.14
1.80	1.62	1.26	1.54	1.68	1.68	1.20	.24	.24	.24
.30	.24	.12	.12	.12	.12	.16	.24	.12	.06
.12	.10	.06	.14	.18	.06	.08	.12	.08	.06

35 JD INDEX STORM NO. 7

STRM .75 PRECIPITATION DEPTH

TRDA 50.00 TRANSPOSITION DRAINAGE AREA

0 PI PRECIPITATION PATTERN

1.20	1.58	2.34	1.62	1.26	1.80	1.88	2.04	.92	.36
.60	.56	.48	.28	.18	.54	.40	.12	.24	.30
.18	.26	.42	.34	.30	.48	.52	.60	.60	.60
.66	.62	.54	.54	.54	.36	.54	.90	.70	.60
.60	.50	.30	.26	.24	.06	.18	.42	.30	.24
.36	.36	.36	.64	.78	.90	1.00	1.20	1.48	1.62
1.32	1.82	2.82	2.42	2.22	2.82	3.26	4.14	4.58	4.80
.60	.62	.66	1.06	1.26	1.62	1.30	.66	.42	.30
.54	.48	.36	.52	.60	.36	.52	.84	1.04	1.14
1.80	1.62	1.26	1.54	1.68	1.68	1.20	.24	.24	.24
.30	.24	.12	.12	.12	.12	.16	.24	.12	.06
.12	.10	.06	.14	.18	.06	.08	.12	.08	.06

36 JD INDEX STORM NO. 8

STRM .66 PRECIPITATION DEPTH

TRDA 100.00 TRANSPOSITION DRAINAGE AREA

0 PI PRECIPITATION PATTERN

1.20	1.58	2.34	1.62	1.26	1.80	1.88	2.04	.92	.36
.60	.56	.48	.28	.18	.54	.40	.12	.24	.30
.18	.26	.42	.34	.30	.48	.52	.60	.60	.60
.66	.62	.54	.54	.54	.36	.54	.90	.70	.60
.60	.50	.30	.26	.24	.06	.18	.42	.30	.24
.36	.36	.36	.64	.78	.90	1.00	1.20	1.48	1.62
1.32	1.82	2.82	2.42	2.22	2.82	3.26	4.14	4.58	4.80
.60	.62	.66	1.06	1.26	1.62	1.30	.66	.42	.30
.54	.48	.36	.52	.60	.36	.52	.84	1.04	1.14
1.80	1.62	1.26	1.54	1.68	1.68	1.20	.24	.24	.24
.30	.24	.12	.12	.12	.12	.16	.24	.12	.06
.12	.10	.06	.14	.18	.06	.08	.12	.08	.06

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

	OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
+	HYDROGRAPH AT	MM1A	50.	3.90	10.	4.	4.	.90		
+	HYDROGRAPH AT	BW1	511.	6.55	265.	111.	111.	60.50		
+	HYDROGRAPH AT	BW2	328.	5.50	104.	42.	42.	20.80		
+	2 COMBINED AT	BW1&2	510.	6.35	268.	112.	112.	81.30		
+	2 COMBINED AT	BW APX	452.	6.40	237.	99.	99.	82.20		
+	HYDROGRAPH AT	MM1B	43.	5.10	13.	5.	5.	2.10		
+	HYDROGRAPH AT	MM2	48.	4.10	13.	5.	5.	1.40		
+	HYDROGRAPH AT	HP1A	81.	4.00	18.	7.	7.	.80		
+	ROUTED TO	RTCPA	77.	4.45	18.	7.	7.	.80		
+	HYDROGRAPH AT	HP1B	28.	4.20	8.	3.	3.	1.00		
+	HYDROGRAPH AT	HP2	33.	4.20	10.	4.	4.	1.20		
+	4 COMBINED AT	CPA1	130.	4.35	39.	16.	16.	4.40		
+	HYDROGRAPH AT	HP3	87.	4.20	24.	10.	10.	1.70		
+	2 COMBINED AT	CPA2	187.	4.30	56.	22.	22.	6.10		
+	HYDROGRAPH AT	HP4	88.	4.20	26.	10.	10.	3.30		
+	HYDROGRAPH AT	HP5	54.	3.90	11.	5.	5.	1.20		
+	HYDROGRAPH AT	HP6	77.	4.20	22.	9.	9.	2.20		
+	ROUTED TO	RTCPD	75.	4.45	22.	9.	9.	2.20		
+	HYDROGRAPH AT	HPFA	9.	3.95	2.	1.	1.	.30		
+	3 COMBINED AT	CPD	90.	4.70	31.	12.	12.	3.70		
+	ROUTED TO	RTCPE	90.	5.05	31.	12.	12.	3.70		
+	HYDROGRAPH AT	HPFB	35.	5.05	10.	4.	4.	1.60		
+	3 COMBINED AT	CPE	168.	5.10	53.	21.	21.	8.60		
+	2 COMBINED AT	CPF	301.	5.20	84.	34.	34.	14.70		
+	HYDROGRAPH AT	SC1	356.	6.55	184.	78.	78.	39.40		
+	HYDROGRAPH AT	SC2	32.	5.10	10.	4.	4.	1.50		

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

HEC-1 MODEL OUTPUT

FILENAME: RWMS10C.OUT

(10-YEAR MODEL)

```
*****************************************                    ***************************************
*                                       *                    *                                     *
*  FLOOD HYDROGRAPH PACKAGE  (HEC-1)    *                    *   U.S. ARMY CORPS OF ENGINEERS      *
*            SEPTEMBER 1990             *                    *   HYDROLOGIC ENGINEERING CENTER     *
*             VERSION 4.0               *                    *         609 SECOND STREET           *
*                                       *                    *      DAVIS, CALIFORNIA 95616        *
*  RUN DATE  01/29/1993  TIME  22:06:45 *                    *          (916) 756-1104             *
*                                       *                    *                                     *
*****************************************                    ***************************************


                    X     X  XXXXXXX   XXXXX           X
                    X     X  X        X     X         XX
                    X     X  X        X                X
                    XXXXXXX  XXXX     X       XXXXX    X
                    X     X  X        X                X
                    X     X  X        X     X          X
                    X     X  XXXXXXX   XXXXX          XXX
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THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

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         ID    FLOOD ASSESSMENT FOR RWMS JOB #:51056          FILE: RWMS10C.DAT
   2         ID    10-YEAR 6-HOUR STORM 1.1 INCHES
   3         ID    POINT RAINFALL VALUES FROM NOAA ATLAS 2 VOL VII
   4         ID    ADJUSTED RAINFALL PER CORRECTION FACTOR IN CLARK COUNTY MANUAL TABLE 501
   5         ID    DEPTH-AREA REDUCTION FACTORS FROM TABLE 502 IN
   6         ID    CLARK COUNTY HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL (CCRFCD, 1990)
   7         ID    CURVE NUMBERS DETERMINED USING TABLE 602 IN CCRFCD, 1990
   8         ID    LAG TIMES DETEMINED USING METHOD IN SECITON 606.3 IN CCRFCD, 1990
   9         ID    DRAINAGE AREAS FROM 7.5 MINUTE AND 15 MINUTE QUADS
  10         ID    THIS MODEL ADDRESSES DRAINAGES THAT COULD IMPACT THE RWMS
             *DIAGRAM
  11         IT        3       0       0     300
  12         IO        5
  13         IN        5
  14         JD     1.36     .01
             * RAINFALL DISTRIBUTION FROM CLARK COUNTY MANUAL LESS THAN 10 SQ. MILES
  15         PC        0       2     5.7     7.0     8.7    10.8    12.4    13.0    13.0    13.0
  16         PC     13.0    13.0    13.0    13.3    14.0    14.2    14.8    15.8    17.2    18.1
  17         PC     19.0    19.7    19.9    20.0    20.1    20.4    21.4    22.9    24.1    24.9
  18         PC     25.1    25.6    27.0    27.8    28.1    28.3    29.5    32.2    35.2    40.9
  19         PC     49.9    59.0    71.0    74.4    78.1    81.2    81.9    83.5    85.1    85.6
  20         PC     86.0    86.8    87.6    88.8    91.0    92.6    93.7    95.0    97.0    97.6
  21         PC     98.2    98.5    98.7    98.9    99.0    99.3    99.3    99.4    99.5    99.8
  22         PC     99.8    99.9   100.0
  23         JD     1.32       1
  24         JD     1.17    9.99
             * CHANGED RAINFALL DISTRIBUTION ABOVE 10 SQ. MILES PER CLARK COUNTY MANUAL
  25         JD     1.17   10.01
  26         PC        0     2.0     5.9     8.0    11.0    14.4    15.0    16.0    16.8    17.1
  27         PC     18.0    18.2    18.7    19.0    19.7    20.2    21.0    22.0    23.0    24.1
  28         PC     25.0    25.9    26.5    28.0    29.0    30.0    30.5    30.9    31.0    31.7
  29         PC     32.1    32.7    33.3    34.6    36.1    38.1    40.8    43.0    47.7    51.4
  30         PC     56.1    63.0    71.0    72.0    73.1    75.2    77.9    79.0    79.5    80.4
  31         PC     81.0    82.0    82.6    84.0    85.9    88.9    91.0    93.8    96.6    97.0
  32         PC     97.4    97.9    98.1    98.3    98.5    98.9    99.0    99.2    99.3    99.6
  33         PC     99.7    99.9   100.0
  34         JD     1.07      20
  35         JD     1.01      30
  36         JD      .92      50
  37         JD      .82     100

  38         KK     MM1A
  39         KM    Basin runoff calculation for Mass. Mountains 1A
  40         BA       .9
  41         LS               80
  42         UD      .31

  43         KK      BW1
  44         KM      Basin runoff calculation for Barren Wash 1
  45         BA     60.5
  46         LS               83
  47         UD      2.1
```

```
KK    BW2
KM     Basin runoff calculation for Barren Wash 2
BA    20.8
LS              80
UD      .9

KK    BW1&2
KM    Combined BW1 and BW2
HC       2

KK  BW APX
KM    Combine BW1,BW2, and MM1A (assume dischcarge of Barren Wash "active apex")
HC       2

KK     MM1B
KM     Basin runoff calulation for Mass. Mountains 1B
*   Flow was not combined with BW APX because flow from this watershed
*   will not directly impact RWMS wereas a channel migration at the apex
*   could impact the RWMS
BA      2.1
LS              77
UD      .48

KK     MM2
KM     Basin runoff calculation for Mass. Mountains 2
BA      1.4
LS              79
UD      .47

KK     HP1A
KM     Basin runoff calculation for Half Pint Range 1A
BA      .8
LS              85
UD      .48

KK    RTCPA
KM    Route Flow from HP1A to CPA
RM       9      .43      .2

KK     HP1B
KM     Basin runoff calculation for Half Pint Range 1B
BA      1.0
LS              78
UD      .51

KK      HP2
KM     Basin runoff calculation for Half Pint Range 2
BA     1.2
LS              78
UD      .51

KK     CPA1
KM     Combine MM2, routed HP1A, HP1B, HP2
HC        4

KK      HP3
KM     (CPB) Basin runoff calculation for Half Pint Range 3
BA      1.7
LS              82
UD      .59

KK     CPA2
KM     Combine HP3 with flow from CPA1
HC        2

KK      HP4
KM      (CPC) Basin runoff calculation for Half Pint Range 4
BA      3.3
LS              79
UD      .52

KK      HP5
KM      Basin runoff calculation for Half Pint Range 5
BA      1.2
LS              79
UD       .3

KK      HP6
KM      Basin runoff calculation for Half Pint Range 6
BA      2.2
LS              80
UD      .55

KK     RTCPD
KM      Route HP6 to CPD
RM        5      .27      .2
```

```
116    KK    HPFA
117    KM     Basin runoff calculation for Half Pint Range FA
118    BA      .3
119    LS              77
120    UD      .33

121    KK     CPD
122    KM     Combine HP5, routed HP6, and HPFA
123    HC       3

124    KK    RTCPE
125    KM     Route flow from CPD to CPE
126    RM       8      .39      .2

127    KK     HPFB
128    KM     Basin runoff calculation for Half Pint Range FB
129    BA     1.6
130    LS              77
131    UD      .44

132    KK     CPE
133    KM    Combine HP4 (CPC) with routed flow from CPD, and HPFB
134    HC       3

135    KK     CPF
136    KM    Combine all flow at Concentration just below RWMS (Flow from CPA & CPE)
137    HC       2

138    KK     SC1
139    KM     Basin runoff calculation for Scarp Canyon 1
       * Concentration Pt of this watershed is the active apex of the Scarp Canyon Fan
140    BA    39.4
141    LS              82
142    UD     2.1

143    KK     SC2
144    KM     Basin runoff calculation for Scarp Canyon 2
145    BA     1.5
146    LS              77
147    UD     .48
148    ZZ
```

```
*****************************************
*                                       *
*  FLOOD HYDROGRAPH PACKAGE  (HEC-1)    *
*         SEPTEMBER 1990                *
*          VERSION 4.0                  *
*                                       *
*  RUN DATE  01/29/1993  TIME  22:06:45 *
*                                       *
*****************************************
```

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

```
                 FLOOD ASSESSMENT FOR RWMS JOB #:51056         FILE: RWMS10C.DAT
                 10-YEAR 6-HOUR STORM 1.1 INCHES
                 POINT RAINFALL VALUES FROM NOAA ATLAS 2 VOL VII
                 ADJUSTED RAINFALL PER CORRECTION FACTOR IN CLARK COUNTY MANUAL TABLE 501
                 DEPTH-AREA REDUCTION FACTORS FROM TABLE 502 IN
                 CLARK COUNTY HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL (CCRFCD, 1990)
                 CURVE NUMBERS DETERMINED USING TABLE 602 IN CCRFCD, 1990
                 LAG TIMES DETEMINED USING METHOD IN SECITON 606.3 IN CCRFCD, 1990
                 DRAINAGE AREAS FROM 7.5 MINUTE AND 15 MINUTE QUADS
                 THIS MODEL ADDRESSES DRAINAGES THAT COULD IMPACT THE RWMS

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

  IT           HYDROGRAPH TIME DATA
                      NMIN            3  MINUTES IN COMPUTATION INTERVAL
                      IDATE      1    0  STARTING DATE
                      ITIME        0000  STARTING TIME
                        NQ          300  NUMBER OF HYDROGRAPH ORDINATES
                     NDDATE      1    0  ENDING DATE
                     NDTIME        1457  ENDING TIME
                      ICENT          19  CENTURY MARK

                COMPUTATION INTERVAL    .05 HOURS
                     TOTAL TIME BASE  14.95 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

14 JD          INDEX STORM NO. 1
                      STRM         1.36  PRECIPITATION DEPTH
                      TRDA          .01  TRANSPOSITION DRAINAGE AREA

15 PI            PRECIPITATION PATTERN
                   1.20    1.54    2.22    1.26     .78    1.02    1.10    1.26    1.06     .96
                    .36     .24     .00     .00     .00     .00     .00     .00     .00     .00
                    .18     .26     .42     .22     .12     .36     .44     .60     .76     .84
                    .54     .54     .54     .46     .42     .12     .10     .06     .06     .06
                    .18     .32     .60     .80     .90     .72     .64     .48     .24     .12
                    .30     .48     .84     .60     .48     .18     .16     .12     .52     .72
                   1.62    1.68    1.80    2.88    3.42    5.40    5.42    5.46    6.62    7.20
                   2.04    2.10    2.22    1.98    1.86     .42     .60     .96     .96     .96
                    .30     .28     .24     .40     .48     .48     .56     .72    1.12    1.32
                    .96     .86     .66     .74     .78    1.20     .92     .36     .36     .36
                    .18     .16     .12     .12     .12     .06     .10     .18     .06     .00
                    .06     .06     .06     .14     .18     .00     .02     .06     .06     .06

23 JD          INDEX STORM NO. 2
                      STRM         1.32  PRECIPITATION DEPTH
                      TRDA         1.00  TRANSPOSITION DRAINAGE AREA

 0 PI            PRECIPITATION PATTERN
                   1.20    1.54    2.22    1.26     .78    1.02    1.10    1.26    1.06     .96
                    .36     .24     .00     .00     .00     .00     .00     .00     .00     .00
                    .18     .26     .42     .22     .12     .36     .44     .60     .76     .84
                    .54     .54     .54     .46     .42     .12     .10     .06     .06     .06
                    .18     .32     .60     .80     .90     .72     .64     .48     .24     .12
                    .30     .48     .84     .60     .48     .18     .16     .12     .52     .72
                   1.62    1.68    1.80    2.88    3.42    5.40    5.42    5.46    6.62    7.20
                   2.04    2.10    2.22    1.98    1.86     .42     .60     .96     .96     .96
                    .30     .28     .24     .40     .48     .48     .56     .72    1.12    1.32
                    .96     .86     .66     .74     .78    1.20     .92     .36     .36     .36
                    .18     .16     .12     .12     .12     .06     .10     .18     .06     .00
                    .06     .06     .06     .14     .18     .00     .02     .06     .06     .06
```

24 JD INDEX STORM NO. 3

STRM 1.17 PRECIPITATION DEPTH

TRDA 9.99 TRANSPOSITION DRAINAGE AREA

0 PI PRECIPITATION PATTERN

1.20	1.54	2.22	1.26	.78	1.02	1.10	1.26	1.06	.96
.36	.24	.00	.00	.00	.00	.00	.00	.00	.00
.18	.26	.42	.22	.12	.36	.44	.60	.76	.84
.54	.54	.54	.46	.42	.12	.10	.06	.06	.06
.18	.32	.60	.80	.90	.72	.64	.48	.24	.12
.30	.48	.84	.60	.48	.18	.16	.12	.52	.72
1.62	1.68	1.80	2.88	3.42	5.40	5.42	5.46	6.62	7.20
2.04	2.10	2.22	1.98	1.86	.42	.60	.96	.96	.96
.30	.28	.24	.40	.48	.48	.56	.72	1.12	1.32
.96	.86	.66	.74	.78	1.20	.92	.36	.36	.36
.18	.16	.12	.12	.12	.06	.10	.18	.06	.00
.06	.06	.06	.14	.18	.00	.02	.06	.06	.06

25 JD INDEX STORM NO. 4

STRM 1.17 PRECIPITATION DEPTH

TRDA 10.01 TRANSPOSITION DRAINAGE AREA

26 PI PRECIPITATION PATTERN

1.20	1.58	2.34	1.62	1.26	1.80	1.88	2.04	.92	.36
.60	.56	.48	.28	.18	.54	.40	.12	.24	.30
.18	.26	.42	.34	.30	.48	.52	.60	.60	.60
.66	.62	.54	.54	.54	.36	.54	.90	.70	.60
.60	.50	.30	.26	.24	.06	.18	.42	.30	.24
.36	.36	.36	.64	.78	.90	1.00	1.20	1.48	1.62
1.32	1.82	2.82	2.42	2.22	2.82	3.26	4.14	4.58	4.80
.60	.62	.66	1.06	1.26	1.62	1.30	.66	.42	.30
.54	.48	.36	.52	.60	.36	.52	.84	1.04	1.14
1.80	1.62	1.26	1.54	1.68	1.68	1.20	.24	.24	.24
.30	.24	.12	.12	.12	.12	.16	.24	.12	.06
.12	.10	.06	.14	.18	.06	.08	.12	.08	.06

34 JD INDEX STORM NO. 5

STRM 1.07 PRECIPITATION DEPTH

TRDA 20.00 TRANSPOSITION DRAINAGE AREA

0 PI PRECIPITATION PATTERN

1.20	1.58	2.34	1.62	1.26	1.80	1.88	2.04	.92	.36
.60	.56	.48	.28	.18	.54	.40	.12	.24	.30
.18	.26	.42	.34	.30	.48	.52	.60	.60	.60
.66	.62	.54	.54	.54	.36	.54	.90	.70	.60
.60	.50	.30	.26	.24	.06	.18	.42	.30	.24
.36	.36	.36	.64	.78	.90	1.00	1.20	1.48	1.62
1.32	1.82	2.82	2.42	2.22	2.82	3.26	4.14	4.58	4.80
.60	.62	.66	1.06	1.26	1.62	1.30	.66	.42	.30
.54	.48	.36	.52	.60	.36	.52	.84	1.04	1.14
1.80	1.62	1.26	1.54	1.68	1.68	1.20	.24	.24	.24
.30	.24	.12	.12	.12	.12	.16	.24	.12	.06
.12	.10	.06	.14	.18	.06	.08	.12	.08	.06

35 JD INDEX STORM NO. 6

STRM 1.01 PRECIPITATION DEPTH

TRDA 30.00 TRANSPOSITION DRAINAGE AREA

0 PI PRECIPITATION PATTERN

1.20	1.58	2.34	1.62	1.26	1.80	1.88	2.04	.92	.36
.60	.56	.48	.28	.18	.54	.40	.12	.24	.30
.18	.26	.42	.34	.30	.48	.52	.60	.60	.60
.66	.62	.54	.54	.54	.36	.54	.90	.70	.60
.60	.50	.30	.26	.24	.06	.18	.42	.30	.24
.36	.36	.36	.64	.78	.90	1.00	1.20	1.48	1.62
1.32	1.82	2.82	2.42	2.22	2.82	3.26	4.14	4.58	4.80
.60	.62	.66	1.06	1.26	1.62	1.30	.66	.42	.30
.54	.48	.36	.52	.60	.36	.52	.84	1.04	1.14
1.80	1.62	1.26	1.54	1.68	1.68	1.20	.24	.24	.24
.30	.24	.12	.12	.12	.12	.16	.24	.12	.06
.12	.10	.06	.14	.18	.06	.08	.12	.08	.06

36 JD INDEX STORM NO. 7

STRM .92 PRECIPITATION DEPTH

TRDA 50.00 TRANSPOSITION DRAINAGE AREA

0 PI PRECIPITATION PATTERN

1.20	1.58	2.34	1.62	1.26	1.80	1.88	2.04	.92	.36
.60	.56	.48	.28	.18	.54	.40	.12	.24	.30
.18	.26	.42	.34	.30	.48	.52	.60	.60	.60
.66	.62	.54	.54	.54	.36	.54	.90	.70	.60
.60	.50	.30	.26	.24	.06	.18	.42	.30	.24
.36	.36	.36	.64	.78	.90	1.00	1.20	1.48	1.62
1.32	1.82	2.82	2.42	2.22	2.82	3.26	4.14	4.58	4.80
.60	.62	.66	1.06	1.26	1.62	1.30	.66	.42	.30
.54	.48	.36	.52	.60	.36	.52	.84	1.04	1.14
1.80	1.62	1.26	1.54	1.68	1.68	1.20	.24	.24	.24
.30	.24	.12	.12	.12	.12	.16	.24	.12	.06
.12	.10	.06	.14	.18	.06	.08	.12	.08	.06

37 JD INDEX STORM NO. 8

STRM	.82	PRECIPITATION DEPTH
TRDA	100.00	TRANSPOSITION DRAINAGE AREA

0 PI PRECIPITATION PATTERN

1.20	1.58	2.34	1.62	1.26	1.80	1.88	2.04	.92	.36
.60	.56	.48	.28	.18	.54	.40	.12	.24	.30
.18	.26	.42	.34	.30	.48	.52	.60	.60	.60
.66	.62	.54	.54	.54	.36	.54	.90	.70	.60
.60	.50	.30	.26	.24	.06	.18	.42	.30	.24
.36	.36	.36	.64	.78	.90	1.00	1.20	1.48	1.62
1.32	1.82	2.82	2.42	2.22	2.82	3.26	4.14	4.58	4.80
.60	.62	.66	1.06	1.26	1.62	1.30	.66	.42	.30
.54	.48	.36	.52	.60	.36	.52	.84	1.04	1.14
1.80	1.62	1.26	1.54	1.68	1.68	1.20	.24	.24	.24
.30	.24	.12	.12	.12	.12	.16	.24	.12	.06
.12	.10	.06	.14	.18	.06	.08	.12	.08	.06

```
                   SCHEMATIC DIAGRAM OF STREAM NETWORK
INPUT
 LINE      (V) ROUTING           (--->) DIVERSION OR PUMP FLOW

  NO.      (.) CONNECTOR         (<---) RETURN OF DIVERTED OR PUMPED FLOW

  38         MM1A
                .
                .
  43            .        BW1
                .          .
                .          .
  48            .          .        BW2
                .          .          .
                .          .          .
  53            .      BW1&2...........
                .          .
                .          .
  56       BW APX...........
                .
                .
  59            .       MM1B
                .          .
                .          .
  64            .          .        MM2
                .          .          .
                .          .          .
  69            .          .          .       HP1A
                .          .          .          V
                .          .          .          V
  74            .          .          .      RTCPA
                .          .          .          .
                .          .          .          .
  77            .          .          .          .       HP1B
                .          .          .          .          .
                .          .          .          .          .
  82            .          .          .          .          .        HP2
                .          .          .          .          .          .
                .          .          .          .          .          .
  87            .          .       CPA1.................................
                .          .          .
                .          .          .
  90            .          .          .        HP3
                .          .          .          .
                .          .          .          .
  95            .          .       CPA2...........
                .          .          .
                .          .          .
  98            .          .          .        HP4
                .          .          .          .
                .          .          .          .
 103            .          .          .          .        HP5
                .          .          .          .          .
                .          .          .          .          .
 108            .          .          .          .          .        HP6
                .          .          .          .          .          V
                .          .          .          .          .          V
 113            .          .          .          .          .      RTCPD
                .          .          .          .          .          .
                .          .          .          .          .          .
 116            .          .          .          .          .          .       HPFA
                .          .          .          .          .          .          .
                .          .          .          .          .          .          .
 121            .          .          .          .        CPD......................
                .          .          .          .          V
                .          .          .          .          V
 124            .          .          .          .      RTCPE
                .          .          .          .          .
                .          .          .          .          .
 127            .          .          .          .          .       HPFB
                .          .          .          .          .          .
                .          .          .          .          .          .
 132            .          .          .        CPE......................
                .          .          .          .
                .          .          .          .
 135            .          .        CPF...........
                .          .          .
                .          .          .
 138            .          .          .        SC1
                .          .          .          .
                .          .          .          .
 143            .          .          .          .        SC2

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION
```

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

	OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
+	HYDROGRAPH AT	MM1A	108.	3.85	20.	8.	8.	.90		
+	HYDROGRAPH AT	BW1	1083.	6.40	574.	242.	242.	60.50		
+	HYDROGRAPH AT	BW2	653.	5.45	232.	93.	93.	20.80		
+	2 COMBINED AT	BW1&2	1083.	6.10	581.	244.	244.	81.30		
+	2 COMBINED AT	BW APX	1078.	6.10	581.	244.	244.	82.20		
+	HYDROGRAPH AT	MM1B	110.	4.10	28.	11.	11.	2.10		
+	HYDROGRAPH AT	MM2	110.	4.05	26.	10.	10.	1.40		
+	HYDROGRAPH AT	HP1A	139.	4.00	30.	12.	12.	.80		
+	ROUTED TO	RTCPA	132.	4.40	30.	12.	12.	.80		
+	HYDROGRAPH AT	HP1B	68.	4.10	17.	7.	7.	1.00		
+	HYDROGRAPH AT	HP2	79.	4.10	20.	8.	8.	1.20		
+	4 COMBINED AT	CPA1	278.	4.25	76.	31.	31.	4.40		
+	HYDROGRAPH AT	HP3	170.	4.15	43.	17.	17.	1.70		
+	2 COMBINED AT	CPA2	399.	4.20	108.	43.	43.	6.10		
+	HYDROGRAPH AT	HP4	210.	4.10	54.	21.	21.	3.30		
+	HYDROGRAPH AT	HP5	123.	3.85	23.	9.	9.	1.20		
+	HYDROGRAPH AT	HP6	168.	4.10	43.	17.	17.	2.20		
+	ROUTED TO	RTCPD	164.	4.40	43.	17.	17.	2.20		
+	HYDROGRAPH AT	HPFA	23.	3.90	5.	2.	2.	.30		
+	3 COMBINED AT	CPD	199.	4.30	62.	25.	25.	3.70		
+	ROUTED TO	RTCPE	196.	4.70	62.	25.	25.	3.70		
+	HYDROGRAPH AT	HPFB	93.	4.05	23.	9.	9.	1.60		
+	3 COMBINED AT	CPE	335.	4.25	116.	46.	46.	8.60		
+	2 COMBINED AT	CPF	576.	5.20	182.	73.	73.	14.70		
+	HYDROGRAPH AT	SC1	769.	6.40	408.	172.	172.	39.40		
+	HYDROGRAPH AT	SC2	84.	4.10	21.	9.	9.	1.50		

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

HEC-1 MODEL OUTPUT

FILENAME: RWMS2.OUT

(2-YEAR MODEL)

```
*****************************************                    ****************************************
*                                       *                    *                                      *
*  FLOOD HYDROGRAPH PACKAGE  (HEC-1)    *                    *  U.S. ARMY CORPS OF ENGINEERS        *
*            SEPTEMBER 1990             *                    *  HYDROLOGIC ENGINEERING CENTER       *
*             VERSION 4.0               *                    *        609 SECOND STREET             *
*                                       *                    *      DAVIS, CALIFORNIA 95616         *
* RUN DATE  01/29/1993  TIME  22:08:57  *                    *         (916) 756-1104               *
*                                       *                    *                                      *
*****************************************                    ****************************************
```

```
X      X  XXXXXXX   XXXXX           X
X      X  X        X     X         XX
X      X  X        X                X
XXXXXXX   XXXX     X         XXXXX  X
X      X  X        X                X
X      X  X        X     X          X
X      X  XXXXXXX   XXXXX          XXX
```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

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   ID   FLOOD ASSESSMENT FOR RWMS JOB #:51056          FILE: RWMS2.DAT
  2   ID    2-YEAR 6-HOUR STORM 0.7 INCHES
  3   ID   POINT RAINFALL FROM NOAA ATLAS 2 VOL VII (NO ADJUSTMENT NECESSARY)
  4   ID   DEPTH-AREA REDUCTION FACTORS FROM TABLE 502 IN
  5   ID   CLARK COUNTY HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL (CCFRCD, 1990)
  6   ID   CURVE NUMBERS DETERMINED USING TABLE 602 IN CCFRCD, 1990
  7   ID   LAG TIMES DETERMINED USING METHOD IN SECTION 606.3 IN CCFRCD, 1990
  8   ID   DRAINAGE AREAS FROM 7.5 MINUTE AND 15 MINUTE QUADS
  9   ID   THIS MODEL ADDRESSES DRAINAGES THAT COULD IMPACT THE RWMS
      *DIAGRAM
 10   IT        3        0        0      300
 11   IO        5
 12   IN        5
 13   JD      0.7      .01
      * RAINFALL DISTRIBUTION FROM CLARK COUNTY MANUAL LESS THAN 10 SQ. MILES
 14   PC        0        2      5.7      7.0      8.7     10.8     12.4     13.0     13.0     13.0
 15   PC     13.0     13.0     13.0     13.3     14.0     14.2     14.8     15.8     17.2     18.1
 16   PC     19.0     19.7     19.9     20.0     20.1     20.4     21.4     22.9     24.1     24.9
 17   PC     25.1     25.6     27.0     27.8     28.1     28.3     29.5     32.2     35.2     40.9
 18   PC     49.9     59.0     71.0     74.4     78.1     81.2     81.9     83.5     85.1     85.6
 19   PC     86.0     86.8     87.6     88.8     91.0     92.6     93.7     95.0     97.0     97.6
 20   PC     98.2     98.5     98.7     98.9     99.0     99.3     99.3     99.4     99.5     99.8
 21   PC     99.8     99.9    100.0
 22   JD      .68        1
 23   JD      .60     9.99
      * CHANGED RAINFALL DISTRIBUTION ABOVE 10 SQ. MILES PER CLARK COUNTY MANUAL
 24   JD      .60    10.01
 25   PC        0      2.0      5.9      8.0     11.0     14.4     15.0     16.0     16.8     17.1
 26   PC     18.0     18.2     18.7     19.0     19.7     20.2     21.0     22.0     23.0     24.1
 27   PC     25.0     25.9     26.5     28.0     29.0     30.0     30.5     30.9     31.0     31.7
 28   PC     32.1     32.7     33.3     34.6     36.1     38.1     40.8     43.0     47.7     51.4
 29   PC     56.1     63.0     71.0     72.0     73.1     75.2     77.9     79.0     79.5     80.4
 30   PC     81.0     82.0     82.6     84.0     85.9     88.9     91.0     93.8     96.6     97.0
 31   PC     97.4     97.9     98.1     98.3     98.5     98.9     99.0     99.2     99.3     99.6
 32   PC     99.7     99.9    100.0
 33   JD      .55       20
 34   JD      .52       30
 35   JD      .48       50
 36   JD      .42      100

 37   KK     MM1A
 38   KM   Basin runoff calculation for Mass. Mountains 1A
 39   BA       .9
 40   LS                80
 41   UD      .31

 42   KK      BW1
 43   KM      Basin runoff calculation for Barren Wash 1
 44   BA     60.5
 45   LS                83
 46   UD      2.1
```

```
 47    KK    BW2
 48    KM     Basin runoff calculation for Barren Wash 2
 49    BA    20.8
 50    LS                80
 51    UD      .9

 52    KK    BW1&2
 53    KM    Combined BW1 and BW2
 54    HC       2

 55    KK   BW APX
 56    KM    Combine BW1,BW2, and MM1A (assume dischcarge of Barren Wash "active apex")
 57    HC       2

 58    KK     MM1B
 59    KM     Basin runoff calulation for Mass. Mountains 1B
       *    Flow was not combined with BW APX because flow from this watershed
       *    will not directly impact RWMS wereas a channel migration at the apex
       *    could impact the RWMS
 60    BA      2.1
 61    LS                77
 62    UD      .48

 63    KK     MM2
 64    KM     Basin runoff calculation for Mass. Mountains 2
 65    BA      1.4
 66    LS                79
 67    UD      .47

 68    KK     HP1A
 69    KM     Basin runoff calculation for Half Pint Range 1A
 70    BA       .8
 71    LS                85
 72    UD      .48

 73    KK     RTCPA
 74    KM     Route Flow from HP1A to CPA
 75    RM       9      .43       .2

 76    KK     HP1B
 77    KM     Basin runoff calculation for Half Pint Range 1B
 78    BA      1.0
 79    LS                78
 80    UD      .51

 81    KK     HP2
 82    KM     Basin runoff calculation for Half Pint Range 2
 83    BA     1.2
 84    LS                78
 85    UD      .51

 86    KK     CPA1
 87    KM     Combine MM2, routed HP1A, HP1B, HP2
 88    HC       4

 89    KK      HP3
 90    KM      (CPB) Basin runoff calculation for Half Pint Range 3
 91    BA      1.7
 92    LS                82
 93    UD      .59

 94    KK     CPA2
 95    KM     Combine HP3 with flow from CPA1
 96    HC       2

 97    KK      HP4
 98    KM      (CPC) Basin runoff calculation for Half Pint Range 4
 99    BA      3.3
100    LS                79
101    UD      .52

102    KK      HP5
103    KM      Basin runoff calculation for Half Pint Range 5
104    BA      1.2
105    LS                79
106    UD       .3

107    KK      HP6
108    KM      Basin runoff calculation for Half Pint Range 6
109    BA      2.2
110    LS                80
111    UD      .55

112    KK    RTCPD
113    KM     Route HP6 to CPD
114    RM       5      .27       .2
```

```
KK    HPFA
KM     Basin runoff calculation for Half Pint Range FA
BA      .3
LS               77
UD     .33

KK     CPD
KM     Combine HP5, routed HP6, and HPFA
HC      3

KK    RTCPE
KM     Route flow from CPD to CPE
RM      8     .39      .2

KK    HPFB
KM     Basin runoff calculation for Half Pint Range FB
BA     1.6
LS               77
UD     .44

KK     CPE
KM    Combine HP4 (CPC) with routed flow from CPD, and HPFB
HC      3

KK     CPF
KM    Combine all flow at Concentration just below RWMS (Flow from CPA & CPE)
HC      2

KK     SC1
KM     Basin runoff calculation for Scarp Canyon 1
* Concentration Pt of this watershed is the active apex of the Scarp Canyon Fan
BA    39.4
LS               82
UD     2.1

KK     SC2
KM     Basin runoff calculation for Scarp Canyon 2
BA     1.5
LS               77
UD     .48
ZZ
```

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

  37       MM1A
             .
  42         .        BW1
             .         .
  47         .         .        BW2
             .         .         .
  52         .       BW1&2........
             .         .
  55       BW APX.......
             .
  58         .        MM1B
             .         .
  63         .         .        MM2
             .         .         .
  68         .         .         .        HP1A
             .         .         .         V
             .         .         .         V
  73         .         .         .        RTCPA
             .         .         .         .
  76         .         .         .         .        HP1B
             .         .         .         .         .
  81         .         .         .         .         .        HP2
             .         .         .         .         .         .
  86         .         .        CPA1............................
             .         .         .
  89         .         .         .        HP3
             .         .         .         .
  94         .         .        CPA2........
             .         .         .
  97         .         .         .        HP4
             .         .         .         .
 102         .         .         .         .        HP5
             .         .         .         .         .
 107         .         .         .         .         .        HP6
             .         .         .         .         .         V
             .         .         .         .         .         V
 112         .         .         .         .         .        RTCPD
             .         .         .         .         .         .
 115         .         .         .         .         .         .        HPFA
             .         .         .         .         .         .         .
 120         .         .         .         .        CPD......................
             .         .         .         .         V
             .         .         .         .         V
 123         .         .         .         .        RTCPE
             .         .         .         .         .
 126         .         .         .         .         .        HPFB
             .         .         .         .         .         .
 131         .         .         .        CPE.................
             .         .         .         .
 134         .         .        CPF.........
             .         .         .
 137         .         .         .        SC1
             .         .         .         .
 142         .         .         .         .        SC2

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION
```

FLOOD HYDROGRAPH PACKAGE (HEC-1)
SEPTEMBER 1990
VERSION 4.0

RUN DATE 01/29/1993 TIME 22:08:57

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

FLOOD ASSESSMENT FOR RWMS JOB #:51056 FILE: RWMS2.DAT
2-YEAR 6-HOUR STORM 0.7 INCHES
POINT RAINFALL FROM NOAA ATLAS 2 VOL VII (NO ADJUSTMENT NECESSARY)
DEPTH-AREA REDUCTION FACTORS FROM TABLE 502 IN
CLARK COUNTY HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL (CCFRCD, 1990)
CURVE NUMBERS DETERMINED USING TABLE 602 IN CCFRCD, 1990
LAG TIMES DETERMINED USING METHOD IN SECTION 606.3 IN CCFRCD, 1990
DRAINAGE AREAS FROM 7.5 MINUTE AND 15 MINUTE QUADS
THIS MODEL ADDRESSES DRAINAGES THAT COULD IMPACT THE RWMS

11 IO OUTPUT CONTROL VARIABLES

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

IT HYDROGRAPH TIME DATA

NMIN		3	MINUTES IN COMPUTATION INTERVAL
IDATE	1	0	STARTING DATE
ITIME		0000	STARTING TIME
NQ		300	NUMBER OF HYDROGRAPH ORDINATES
NDDATE	1	0	ENDING DATE
NDTIME		1457	ENDING TIME
ICENT		19	CENTURY MARK

COMPUTATION INTERVAL .05 HOURS
TOTAL TIME BASE 14.95 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

13 JD INDEX STORM NO. 1

STRM	.70	PRECIPITATION DEPTH
TRDA	.01	TRANSPOSITION DRAINAGE AREA

14 PI PRECIPITATION PATTERN

1.20	1.54	2.22	1.26	.78	1.02	1.10	1.26	1.06	.96
.36	.24	.00	.00	.00	.00	.00	.00	.00	.00
.18	.26	.42	.22	.12	.36	.44	.60	.76	.84
.54	.54	.54	.46	.42	.12	.10	.06	.06	.06
.18	.32	.60	.80	.90	.72	.64	.48	.24	.12
.30	.48	.84	.60	.48	.18	.16	.12	.52	.72
1.62	1.68	1.80	2.88	3.42	5.40	5.42	5.46	6.62	7.20
2.04	2.10	2.22	1.98	1.86	.42	.60	.96	.96	.96
.30	.28	.24	.40	.48	.48	.56	.72	1.12	1.32
.96	.86	.66	.74	.78	1.20	.92	.36	.36	.36
.18	.16	.12	.12	.12	.06	.10	.18	.06	.00
.06	.06	.06	.14	.18	.00	.02	.06	.06	.06

22 JD INDEX STORM NO. 2

STRM	.68	PRECIPITATION DEPTH
TRDA	1.00	TRANSPOSITION DRAINAGE AREA

0 PI PRECIPITATION PATTERN

1.20	1.54	2.22	1.26	.78	1.02	1.10	1.26	1.06	.96
.36	.24	.00	.00	.00	.00	.00	.00	.00	.00
.18	.26	.42	.22	.12	.36	.44	.60	.76	.84
.54	.54	.54	.46	.42	.12	.10	.06	.06	.06
.18	.32	.60	.80	.90	.72	.64	.48	.24	.12
.30	.48	.84	.60	.48	.18	.16	.12	.52	.72
1.62	1.68	1.80	2.88	3.42	5.40	5.42	5.46	6.62	7.20
2.04	2.10	2.22	1.98	1.86	.42	.60	.96	.96	.96
.30	.28	.24	.40	.48	.48	.56	.72	1.12	1.32
.96	.86	.66	.74	.78	1.20	.92	.36	.36	.36
.18	.16	.12	.12	.12	.06	.10	.18	.06	.00
.06	.06	.06	.14	.18	.00	.02	.06	.06	.06

23 JD INDEX STORM NO. 3

STRM .60 PRECIPITATION DEPTH

TRDA 9.99 TRANSPOSITION DRAINAGE AREA

0 PI PRECIPITATION PATTERN

1.20	1.54	2.22	1.26	.78	1.02	1.10	1.26	1.06	.96
.36	.24	.00	.00	.00	.00	.00	.00	.00	.00
.18	.26	.42	.22	.12	.36	.44	.60	.76	.84
.54	.54	.54	.46	.42	.12	.10	.06	.06	.06
.18	.32	.60	.80	.90	.72	.64	.48	.24	.12
.30	.48	.84	.60	.48	.18	.16	.12	.52	.72
1.62	1.68	1.80	2.88	3.42	5.40	5.42	5.46	6.62	7.20
2.04	2.10	2.22	1.98	1.86	.42	.60	.96	.96	.96
.30	.28	.24	.40	.48	.48	.56	.72	1.12	1.32
.96	.86	.66	.74	.78	1.20	.92	.36	.36	.36
.18	.16	.12	.12	.12	.06	.10	.18	.06	.00
.06	.06	.06	.14	.18	.00	.02	.06	.06	.06

24 JD INDEX STORM NO. 4

STRM .60 PRECIPITATION DEPTH

TRDA 10.01 TRANSPOSITION DRAINAGE AREA

25 PI PRECIPITATION PATTERN

1.20	1.58	2.34	1.62	1.26	1.80	1.88	2.04	.92	.36
.60	.56	.48	.28	.18	.54	.40	.12	.24	.30
.18	.26	.42	.34	.30	.48	.52	.60	.60	.60
.66	.62	.54	.54	.54	.36	.54	.90	.70	.60
.60	.50	.30	.26	.24	.06	.18	.42	.30	.24
.36	.36	.36	.64	.78	.90	1.00	1.20	1.48	1.62
1.32	1.82	2.82	2.42	2.22	2.82	3.26	4.14	4.58	4.80
.60	.62	.66	1.06	1.26	1.62	1.30	.66	.42	.30
.54	.48	.36	.52	.60	.36	.52	.84	1.04	1.14
1.80	1.62	1.26	1.54	1.68	1.68	1.20	.24	.24	.24
.30	.24	.12	.12	.12	.12	.16	.24	.12	.06
.12	.10	.06	.14	.18	.06	.08	.12	.08	.06

33 JD INDEX STORM NO. 5

STRM .55 PRECIPITATION DEPTH

TRDA 20.00 TRANSPOSITION DRAINAGE AREA

0 PI PRECIPITATION PATTERN

1.20	1.58	2.34	1.62	1.26	1.80	1.88	2.04	.92	.36
.60	.56	.48	.28	.18	.54	.40	.12	.24	.30
.18	.26	.42	.34	.30	.48	.52	.60	.60	.60
.66	.62	.54	.54	.54	.36	.54	.90	.70	.60
.60	.50	.30	.26	.24	.06	.18	.42	.30	.24
.36	.36	.36	.64	.78	.90	1.00	1.20	1.48	1.62
1.32	1.82	2.82	2.42	2.22	2.82	3.26	4.14	4.58	4.80
.60	.62	.66	1.06	1.26	1.62	1.30	.66	.42	.30
.54	.48	.36	.52	.60	.36	.52	.84	1.04	1.14
1.80	1.62	1.26	1.54	1.68	1.68	1.20	.24	.24	.24
.30	.24	.12	.12	.12	.12	.16	.24	.12	.06
.12	.10	.06	.14	.18	.06	.08	.12	.08	.06

34 JD INDEX STORM NO. 6

STRM .52 PRECIPITATION DEPTH

TRDA 30.00 TRANSPOSITION DRAINAGE AREA

0 PI PRECIPITATION PATTERN

1.20	1.58	2.34	1.62	1.26	1.80	1.88	2.04	.92	.36
.60	.56	.48	.28	.18	.54	.40	.12	.24	.30
.18	.26	.42	.34	.30	.48	.52	.60	.60	.60
.66	.62	.54	.54	.54	.36	.54	.90	.70	.60
.60	.50	.30	.26	.24	.06	.18	.42	.30	.24
.36	.36	.36	.64	.78	.90	1.00	1.20	1.48	1.62
1.32	1.82	2.82	2.42	2.22	2.82	3.26	4.14	4.58	4.80
.60	.62	.66	1.06	1.26	1.62	1.30	.66	.42	.30
.54	.48	.36	.52	.60	.36	.52	.84	1.04	1.14
1.80	1.62	1.26	1.54	1.68	1.68	1.20	.24	.24	.24
.30	.24	.12	.12	.12	.12	.16	.24	.12	.06
.12	.10	.06	.14	.18	.06	.08	.12	.08	.06

35 JD INDEX STORM NO. 7

STRM .48 PRECIPITATION DEPTH

TRDA 50.00 TRANSPOSITION DRAINAGE AREA

0 PI PRECIPITATION PATTERN

1.20	1.58	2.34	1.62	1.26	1.80	1.88	2.04	.92	.36
.60	.56	.48	.28	.18	.54	.40	.12	.24	.30
.18	.26	.42	.34	.30	.48	.52	.60	.60	.60
.66	.62	.54	.54	.54	.36	.54	.90	.70	.60
.60	.50	.30	.26	.24	.06	.18	.42	.30	.24
.36	.36	.36	.64	.78	.90	1.00	1.20	1.48	1.62
1.32	1.82	2.82	2.42	2.22	2.82	3.26	4.14	4.58	4.80
.60	.62	.66	1.06	1.26	1.62	1.30	.66	.42	.30
.54	.48	.36	.52	.60	.36	.52	.84	1.04	1.14
1.80	1.62	1.26	1.54	1.68	1.68	1.20	.24	.24	.24
.30	.24	.12	.12	.12	.12	.16	.24	.12	.06
.12	.10	.06	.14	.18	.06	.08	.12	.08	.06

36 JD INDEX STORM NO. 8

STRM	.42	PRECIPITATION DEPTH
TRDA	100.00	TRANSPOSITION DRAINAGE AREA

0 PI PRECIPITATION PATTERN

1.20	1.58	2.34	1.62	1.26	1.80	1.88	2.04	.92	.36
.60	.56	.48	.28	.18	.54	.40	.12	.24	.30
.18	.26	.42	.34	.30	.48	.52	.60	.60	.60
.66	.62	.54	.54	.54	.36	.54	.90	.70	.60
.60	.50	.30	.26	.24	.06	.18	.42	.30	.24
.36	.36	.36	.64	.78	.90	1.00	1.20	1.48	1.62
1.32	1.82	2.82	2.42	2.22	2.82	3.26	4.14	4.58	4.80
.60	.62	.66	1.06	1.26	1.62	1.30	.66	.42	.30
.54	.48	.36	.52	.60	.36	.52	.84	1.04	1.14
1.80	1.62	1.26	1.54	1.68	1.68	1.20	.24	.24	.24
.30	.24	.12	.12	.12	.12	.16	.24	.12	.06
.12	.10	.06	.14	.18	.06	.08	.12	.08	.06

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

	OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
+	HYDROGRAPH AT	MM1A	6.	5.00	1.	0.	0.	.90		
+	HYDROGRAPH AT	BW1	22.	7.10	11.	4.	4.	60.50		
+	HYDROGRAPH AT	BW2	7.	6.00	2.	1.	1.	20.80		
+	2 COMBINED AT	BW1&2	22.	7.10	11.	4.	4.	81.30		
+	2 COMBINED AT	BW APX	9.	7.10	4.	2.	2.	82.20		
+	HYDROGRAPH AT	MM1B	2.	5.30	0.	0.	0.	2.10		
+	HYDROGRAPH AT	MM2	5.	5.15	1.	0.	0.	1.40		
+	HYDROGRAPH AT	HP1A	16.	4.15	4.	2.	2.	.80		
+	ROUTED TO	RTCPA	15.	4.55	4.	2.	2.	.80		
+	HYDROGRAPH AT	HP1B	3.	5.25	0.	0.	0.	1.00		
+	HYDROGRAPH AT	HP2	3.	5.25	1.	0.	0.	1.20		
+	4 COMBINED AT	CPA1	15.	5.40	4.	2.	2.	4.40		
+	HYDROGRAPH AT	HP3	14.	5.20	4.	2.	2.	1.70		
+	2 COMBINED AT	CPA2	23.	5.30	6.	3.	3.	6.10		
+	HYDROGRAPH AT	HP4	8.	5.25	2.	1.	1.	3.30		
+	HYDROGRAPH AT	HP5	6.	5.00	1.	0.	0.	1.20		
+	HYDROGRAPH AT	HP6	10.	5.25	2.	1.	1.	2.20		
+	ROUTED TO	RTCPD	10.	5.50	2.	1.	1.	2.20		
+	HYDROGRAPH AT	HPFA	1.	5.10	0.	0.	0.	.30		
+	3 COMBINED AT	CPD	10.	5.40	2.	1.	1.	3.70		
+	ROUTED TO	RTCPE	9.	5.75	2.	1.	1.	3.70		
+	HYDROGRAPH AT	HPFB	2.	5.25	0.	0.	0.	1.60		
+	3 COMBINED AT	CPE	9.	5.55	2.	1.	1.	8.60		
+	2 COMBINED AT	CPF	25.	5.50	6.	3.	3.	14.70		
+	HYDROGRAPH AT	SC1	15.	7.10	7.	3.	3.	39.40		
+	HYDROGRAPH AT	SC2	2.	5.30	0.	0.	0.	1.50		

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

FEMA FAN MODEL OUTPUT

BARREN WASH ALLUVIAL FAN

(Model Sets 1, 2, 3 & 4)

Barren Wash Alluvial Fan: Model Set 1

AVULSION FACTOR = 1.5000

FLOOD FREQUENCY CURVE DEFINED BY LEAST-SQUARES FIT OF DATA

RETURN INTERVAL (YEARS)	INPUT DISCHARGE (CFS)	BEST FIT DISCHARGE (CFS)
2	22	22
10	510	511
100	1848	1845

MEAN = 1.042752
STANDARD DEVIATION = 1.533850
SKEW = -1.2

SUMMARY OF DISCHARGES:

10-YEAR DISCHARGE = 511
50-YEAR DISCHARGE = 1440
100-YEAR DISCHARGE = 1845
500-YEAR DISCHARGE = 2633

STATISTICS AFTER TRANSFORMATION OF Y=LOG(Q) TO Z=1.6502+0.5415 LOG(Q)

MEAN OF Z = 2.214841
STANDARD DEVIATION = 0.830596
SKEW = -1.200000
TRANSFORMATION CONSTANT = 4.989660

SINGLE-CHANNEL REGION

ENERGY (FT)	DEPTH (FT)	DISCHARGE (CFS)	PROBABILITY OF DISCHARGE BEING EXCEEDED AT THE APEX BY: Q	$44.6869\ Q^{0.5415}$	WIDTH (FT)
0.5	0.3	49	0.39939	0.77515	5458
1.5	1.0	756	0.06472	0.22080	1555

VELOCITY (FT/SEC)	DEPTH (FT)	DISCHARGE (CFS)	PROBABILITY OF DISCHARGE BEING EXCEEDED AT THE APEX BY: Q	$44.6869\ Q^{0.5415}$	WIDTH (FT)
3.5	0.4	68	0.35475	0.72986	5139
4.5	0.6	238	0.18938	0.50031	3523
5.5	0.9	649	0.07853	0.25818	1818
6.5	1.3	1496	0.01847	0.07781	548

MULTIPLE-CHANNEL REGION

SLOPE = 0.0120000
N-VALUE = 0.0300000

ENERGY (FT)	DEPTH (FT)	DISCHARGE (CFS)	PROBABILITY OF DISCHARGE BEING EXCEEDED AT THE APEX BY: Q	$44.6869\ Q^{0.5415}$	WIDTH (FT)
0.5	0.4	429	0.12044	0.35977	9627

OCITY FT/SEC)	DEPTH (FT)	DISCHARGE (CFS)	PROBABILITY OF DISCHARGE BEING EXCEEDED AT THE APEX BY: Q	$44.6869\ Q^{0.5415}$	WIDTH (FT)
3.5	0.5	1046	0.03859	0.14838	3970

Barren Wash Alluvial Fan: Model Set 2

AVULSION FACTOR = 1.5000

FLOOD FREQUENCY CURVE DEFINED BY LEAST-SQUARES FIT OF DATA

RETURN INTERVAL (YEARS)	INPUT DISCHARGE (CFS)	BEST FIT DISCHARGE (CFS)
2	22	22
10	510	508
100	3513	3523

MEAN = 1.220155
STANDARD DEVIATION = 1.237478
SKEW = -0.6

SUMMARY OF DISCHARGES:

10-YEAR DISCHARGE = 508
50-YEAR DISCHARGE = 2234
100-YEAR DISCHARGE = 3523
500-YEAR DISCHARGE = 8018

STATISTICS AFTER TRANSFORMATION OF Y=LOG(Q) TO Z=1.3608+0.7454 LOG(Q)

MEAN OF Z = 2.270321
STANDARD DEVIATION = 0.922428
SKEW = -0.600000
TRANSFORMATION CONSTANT = 5.221557

SINGLE-CHANNEL REGION

ENERGY (FT)	DEPTH (FT)	DISCHARGE (CFS)	PROBABILITY OF DISCHARGE BEING EXCEEDED AT THE APEX BY: Q	$22.9512\ Q^{0.7454}$	WIDTH (FT)
0.5	0.3	49	0.38603	0.75342	5552
1.5	1.0	756	0.07282	0.27335	2014
2.5	1.7	2712	0.01575	0.08826	650

VELOCITY (FT/SEC)	DEPTH (FT)	DISCHARGE (CFS)	PROBABILITY OF DISCHARGE BEING EXCEEDED AT THE APEX BY: Q	$22.9512\ Q^{0.7454}$	WIDTH (FT)
3.5	0.4	68	0.33839	0.70932	5227
4.5	0.6	238	0.17753	0.49364	3637
5.5	0.9	649	0.08326	0.30011	2211
6.5	1.3	1496	0.03427	0.16404	1209
7.5	1.7	3059	0.01310	0.07724	566

MULTIPLE-CHANNEL REGION

SLOPE = 0.0120000
N-VALUE = 0.0300000

ENERGY (FT)	DEPTH (FT)	DISCHARGE (CFS)	PROBABILITY OF DISCHARGE BEING EXCEEDED AT THE APEX BY: Q	$22.9512\ Q^{0.7454}$	WIDTH (FT)
0.5	0.4	429	0.11715	0.37930	10621

OCITY (FT/SEC)	DEPTH (FT)	DISCHARGE (CFS)	PROBABILITY OF DISCHARGE BEING EXCEEDED AT THE APEX BY: Q	$22.9512\ Q^{0.7454}$	WIDTH (FT)
3.5	0.5	1046	0.05069	0.21668	6067
4.5	0.8	2981	0.01367	0.07961	2218

Barren Wash Alluvial Fan: Model Set 3

AVULSION FACTOR = 1.5000

FLOOD FREQUENCY CURVE DEFINED BY LEAST-SQUARES FIT OF DATA

RETURN INTERVAL (YEARS)	INPUT DISCHARGE (CFS)	BEST FIT DISCHARGE (CFS)
2	22	22
10	510	511
100	6018	6011

MEAN = 1.323916
STANDARD DEVIATION = 1.089877
SKEW = -0.1

SUMMARY OF DISCHARGES:

10-YEAR DISCHARGE = 511
50-YEAR DISCHARGE = 3187
100-YEAR DISCHARGE = 6011
500-YEAR DISCHARGE = 21319

STATISTICS AFTER TRANSFORMATION OF Y=LOG(Q) TO Z=1.1038+0.9523 LOG(Q)

MEAN OF Z = 2.364550
STANDARD DEVIATION = 1.037845
SKEW = -0.100000
TRANSFORMATION CONSTANT = 5.498632

SINGLE-CHANNEL REGION

ENERGY (FT)	DEPTH (FT)	DISCHARGE (CFS)	PROBABILITY OF DISCHARGE BEING EXCEEDED AT THE APEX BY: Q	$12.7010\,Q^{0.9523}$	WIDTH (FT)
0.5	0.3	49	0.37636	0.74376	5771
1.5	1.0	756	0.07741	0.31531	2447
2.5	1.7	2712	0.02368	0.15673	1203

VELOCITY (FT/SEC)	DEPTH (FT)	DISCHARGE (CFS)	PROBABILITY OF DISCHARGE BEING EXCEEDED AT THE APEX BY: Q	$12.7010\,Q^{0.9523}$	WIDTH (FT)
3.5	0.4	68	0.32668	0.70074	5438
4.5	0.6	238	0.17183	0.50209	3896
5.5	0.9	649	0.08625	0.33928	2633
6.5	1.3	1496	0.04176	0.22110	1712
7.5	1.7	3059	0.02093	0.14484	1104
8.5	2.2	5719	0.01078	0.08963	639

MULTIPLE-CHANNEL REGION

SLOPE = 0.0120000
N-VALUE = 0.0300000

ENERGY (FT)	DEPTH (FT)	DISCHARGE (CFS)	PROBABILITY OF DISCHARGE BEING EXCEEDED AT THE APEX BY: Q	$12.7010\,Q^{0.9523}$	WIDTH (FT)
0.5	0.4	429	0.11639	0.40412	11916

VELOCITY (FT/SEC)	DEPTH (FT)	DISCHARGE (CFS)	PROBABILITY OF DISCHARGE BEING EXCEEDED AT THE APEX BY: Q	$12.7010\,Q^{0.9523}$	WIDTH (FT)
3.5	0.5	1046	0.05870	0.26939	7936
4.5	0.8	2981	0.02152	0.14740	4278

Barren Wash Alluvial Fan: Model Set 4

AVULSION FACTOR = 1.5000

FLOOD FREQUENCY CURVE DEFINED BY LEAST-SQUARES FIT OF DATA

RETURN INTERVAL (YEARS)	INPUT DISCHARGE (CFS)	BEST FIT DISCHARGE (CFS)
2	22	22
10	1083	1100
100	5498	5436

MEAN = 0.967763
STANDARD DEVIATION = 1.909410
SKEW = -1.2

SUMMARY OF DISCHARGES:

10-YEAR DISCHARGE = 1100
50-YEAR DISCHARGE = 3994
100-YEAR DISCHARGE = 5436
500-YEAR DISCHARGE = 8466

STATISTICS AFTER TRANSFORMATION OF Y=LOG(Q) TO Z=2.1296+0.4869 LOG(Q)

MEAN OF Z = 2.600766
STANDARD DEVIATION = 0.929608
SKEW = -1.200000
TRANSFORMATION CONSTANT = 6.163823

SINGLE-CHANNEL REGION

ENERGY (FT)	DEPTH (FT)	DISCHARGE (CFS)	PROBABILITY OF DISCHARGE BEING EXCEEDED AT THE APEX BY: Q	PROBABILITY OF DISCHARGE BEING EXCEEDED AT THE APEX BY: $134.7735\,Q^{0.4869}$	WIDTH (FT)
0.5	0.3	49	0.41930	0.84140	7319
1.5	1.0	756	0.13521	0.45395	3949
2.5	1.7	2712	0.03806	0.17863	1554

LOCITY (FT/SEC)	DEPTH (FT)	DISCHARGE (CFS)	PROBABILITY OF DISCHARGE BEING EXCEEDED AT THE APEX BY: Q	PROBABILITY OF DISCHARGE BEING EXCEEDED AT THE APEX BY: $134.7735\,Q^{0.4869}$	WIDTH (FT)
3.5	0.4	68	0.38395	0.81578	7096
4.5	0.6	238	0.24947	0.66394	5775
5.5	0.9	649	0.14958	0.48573	4225
6.5	1.3	1496	0.07778	0.30563	2659
7.5	1.7	3059	0.03212	0.15540	1352

MULTIPLE-CHANNEL REGION

SLOPE = 0.0120000
N-VALUE = 0.0300000

ENERGY (FT)	DEPTH (FT)	DISCHARGE (CFS)	PROBABILITY OF DISCHARGE BEING EXCEEDED AT THE APEX BY: Q	0.4869 134.7735 Q	WIDTH (FT)
0.5	0.4	429	0.18835	0.56624	18717

ELOCITY (FT/SEC)	DEPTH (FT)	DISCHARGE (CFS)	PROBABILITY OF DISCHARGE BEING EXCEEDED AT THE APEX BY: Q	0.4869 134.7735 Q	WIDTH (FT)
3.5	0.5	1046	0.10475	0.38461	12713
4.5	0.8	2981	0.03340	0.16040	5302

FEMA FAN MODEL OUTPUT

SCARP CANYON ALLUVIAL FAN

(Model Sets 1, 2, 3 & 4)

Scarp Canyon Alluvial Fan: Model Set 1

AVULSION FACTOR = 1.5000

FLOOD FREQUENCY CURVE DEFINED BY LEAST-SQUARES FIT OF DATA

RETURN INTERVAL (YEARS)	INPUT DISCHARGE (CFS)	BEST FIT DISCHARGE (CFS)
2	15	15
10	356	351
100	1251	1265

MEAN = 0.878659
STANDARD DEVIATION = 1.533991
SKEW = -1.2

SUMMARY OF DISCHARGES:

10-YEAR DISCHARGE = 351
50-YEAR DISCHARGE = 987
100-YEAR DISCHARGE = 1265
500-YEAR DISCHARGE = 1805

STATISTICS AFTER TRANSFORMATION OF Y=LOG(Q) TO Z=1.5751+0.5415 LOG(Q)

MEAN OF Z = 2.050915
STANDARD DEVIATION = 0.830638
SKEW = -1.200000
TRANSFORMATION CONSTANT = 4.290921

SINGLE-CHANNEL REGION

ENERGY (FT)	DEPTH (FT)	DISCHARGE (CFS)	PROBABILITY OF DISCHARGE BEING EXCEEDED AT THE APEX BY: Q	$37.5951\ Q^{0.5415}$	WIDTH (FT)
0.5	0.3	49	0.34883	0.72387	4383
1.5	1.0	756	0.03535	0.13698	829

VELOCITY (FT/SEC)	DEPTH (FT)	DISCHARGE (CFS)	PROBABILITY OF DISCHARGE BEING EXCEEDED AT THE APEX BY: Q	$37.5951\ Q^{0.5415}$	WIDTH (FT)
3.5	0.4	68	0.30420	0.67202	4069
4.5	0.6	238	0.14528	0.41207	2495
5.5	0.9	649	0.04559	0.17003	1030

MULTIPLE-CHANNEL REGION

SLOPE = 0.0148000
N-VALUE = 0.0300000

ENERGY (FT)	DEPTH (FT)	DISCHARGE (CFS)	PROBABILITY OF DISCHARGE BEING EXCEEDED AT THE APEX BY: Q	$37.5951\ Q^{0.5415}$	WIDTH (FT)
0.5	0.4	443	0.07886	0.25909	5962

VELOCITY (FT/SEC)	DEPTH (FT)	DISCHARGE (CFS)	PROBABILITY OF DISCHARGE BEING EXCEEDED AT THE APEX BY: Q	$37.5951\ Q^{0.5415}$	WIDTH (FT)
3.5	0.4	805	0.03152	0.12353	2842

Scarp Canyon Alluvial Fan: Model Set 2

AVULSION FACTOR = 1.5000

FLOOD FREQUENCY CURVE DEFINED BY LEAST-SQUARES FIT OF DATA

RETURN INTERVAL (YEARS)	INPUT DISCHARGE (CFS)	BEST FIT DISCHARGE (CFS)
2	15	15
10	356	351
100	2178	2198

MEAN = 1.030262
STANDARD DEVIATION = 1.279943
SKEW = -0.7

SUMMARY OF DISCHARGES:

10-YEAR DISCHARGE = 351
50-YEAR DISCHARGE = 1443
100-YEAR DISCHARGE = 2198
500-YEAR DISCHARGE = 4604

STATISTICS AFTER TRANSFORMATION OF Y=LOG(Q) TO Z=1.3680+0.7081 LOG(Q)

MEAN OF Z = 2.097573
STANDARD DEVIATION = 0.906384
SKEW = -0.700000
TRANSFORMATION CONSTANT = 4.459600

SINGLE-CHANNEL REGION

ENERGY (FT)	DEPTH (FT)	DISCHARGE (CFS)	PROBABILITY OF DISCHARGE BEING EXCEEDED AT THE APEX BY: Q	$23.3345\ Q^{0.7081}$	WIDTH (FT)
0.5	0.3	49	0.33492	0.70714	4450
1.5	1.0	756	0.04683	0.19857	1250

VELOCITY (FT/SEC)	DEPTH (FT)	DISCHARGE (CFS)	PROBABILITY OF DISCHARGE BEING EXCEEDED AT THE APEX BY: Q	$23.3345\ Q^{0.7081}$	WIDTH (FT)
3.5	0.4	68	0.28883	0.65373	4114
4.5	0.6	238	0.14038	0.42021	2645
5.5	0.9	649	0.05653	0.22635	1425
6.5	1.3	1496	0.01914	0.09895	623

MULTIPLE-CHANNEL REGION

SLOPE = 0.0148000
N-VALUE = 0.0300000

ENERGY (FT)	DEPTH (FT)	DISCHARGE (CFS)	PROBABILITY OF DISCHARGE BEING EXCEEDED AT THE APEX BY: Q	$23.3345\ Q^{0.7081}$	WIDTH (FT)
0.5	0.4	443	0.08348	0.29635	7087

VELOCITY (FT/SEC)	DEPTH (FT)	DISCHARGE (CFS)	PROBABILITY OF DISCHARGE BEING EXCEEDED AT THE APEX BY: Q	$23.3345\ Q^{0.7081}$	WIDTH (FT)
3.5	0.4	805	0.04358	0.18942	4530

Scarp Canyon Alluvial Fan: Model Set 3

AVULSION FACTOR = 1.5000

FLOOD FREQUENCY CURVE DEFINED BY LEAST-SQUARES FIT OF DATA

RETURN INTERVAL (YEARS)	INPUT DISCHARGE (CFS)	BEST FIT DISCHARGE (CFS)
2	15	15
10	356	357
100	3498	3491

MEAN = 1.117872
STANDARD DEVIATION = 1.152607
SKEW = -0.3

SUMMARY OF DISCHARGES:

10-YEAR DISCHARGE = 357
50-YEAR DISCHARGE = 1976
100-YEAR DISCHARGE = 3491
500-YEAR DISCHARGE = 10458

STATISTICS AFTER TRANSFORMATION OF Y=LOG(Q) TO Z=1.2079+0.8628 LOG(Q)

MEAN OF Z = 2.172367
STANDARD DEVIATION = 0.994433
SKEW = -0.300000
TRANSFORMATION CONSTANT = 4.652288

SINGLE-CHANNEL REGION

ENERGY (FT)	DEPTH (FT)	DISCHARGE (CFS)	PROBABILITY OF DISCHARGE BEING EXCEEDED AT THE APEX BY:		WIDTH (FT)
			Q	$16.1400\ Q^{0.8628}$	
0.5	0.3	49	0.32531	0.70098	4602
1.5	1.0	756	0.05446	0.24845	1631
2.5	1.7	2712	0.01444	0.09633	625

LOCITY (T/SEC)	DEPTH (FT)	DISCHARGE (CFS)	PROBABILITY OF DISCHARGE BEING EXCEEDED AT THE APEX BY:		WIDTH (FT)
			Q	$16.1400\ Q^{0.8628}$	
3.5	0.4	68	0.27964	0.64926	4263
4.5	0.6	238	0.13909	0.43758	2873
5.5	0.9	649	0.06377	0.27117	1780
6.5	1.3	1496	0.02760	0.16044	1051
7.5	1.7	3059	0.01232	0.08785	565

MULTIPLE-CHANNEL REGION

SLOPE = 0.0148000
N-VALUE = 0.0300000

ENERGY (FT)	DEPTH (FT)	DISCHARGE (CFS)	PROBABILITY OF DISCHARGE BEING EXCEEDED AT THE APEX BY: Q	$16.1400\ Q^{0.8628}$	WIDTH (FT)
0.5	0.4	443	0.08692	0.33143	8269

ELOCITY (FT/SEC)	DEPTH (FT)	DISCHARGE (CFS)	PROBABILITY OF DISCHARGE BEING EXCEEDED AT THE APEX BY: Q	$16.1400\ Q^{0.8628}$	WIDTH (FT)
3.5	0.4	805	0.05067	0.23920	5968
4.5	0.6	2293	0.01738	0.11285	2774

Scarp Canyon Alluvial Fan: Model Set 4

AVULSION FACTOR = 1.5000

FLOOD FREQUENCY CURVE DEFINED BY LEAST-SQUARES FIT OF DATA

RETURN INTERVAL (YEARS)	INPUT DISCHARGE (CFS)	BEST FIT DISCHARGE (CFS)
2	15	15
10	769	779
100	3438	3406

MEAN = 0.751408
STANDARD DEVIATION = 2.011177
SKEW = -1.3

SUMMARY OF DISCHARGES:

10-YEAR DISCHARGE = 779
50-YEAR DISCHARGE = 2597
100-YEAR DISCHARGE = 3406
500-YEAR DISCHARGE = 4925

STATISTICS AFTER TRANSFORMATION OF Y=LOG(Q) TO Z=2.0997+0.4540 LOG(Q)

MEAN OF Z = 2.440823
STANDARD DEVIATION = 0.913058
SKEW = -1.300000
TRANSFORMATION CONSTANT = 5.305945

SINGLE-CHANNEL REGION

ENERGY (FT)	DEPTH (FT)	DISCHARGE (CFS)	PROBABILITY OF DISCHARGE BEING EXCEEDED AT THE APEX BY: Q	PROBABILITY OF DISCHARGE BEING EXCEEDED AT THE APEX BY: $125.8027\,Q^{0.4540}$	WIDTH (FT)
0.5	0.3	49	0.38263	0.81739	6120
1.5	1.0	756	0.10286	0.37538	2811
2.5	1.7	2712	0.01841	0.09197	689

LOCITY rT/SEC)	DEPTH (FT)	DISCHARGE (CFS)	PROBABILITY OF DISCHARGE BEING EXCEEDED AT THE APEX BY: Q	PROBABILITY OF DISCHARGE BEING EXCEEDED AT THE APEX BY: $125.8027\,Q^{0.4540}$	WIDTH (FT)
3.5	0.4	68	0.34751	0.78692	5892
4.5	0.6	238	0.21491	0.61188	4582
5.5	0.9	649	0.11751	0.41056	3074
6.5	1.3	1496	0.05029	0.21689	1624
7.5	1.7	3059	0.01396	0.07173	537

MULTIPLE-CHANNEL REGION

SLOPE = 0.0148000
N-VALUE = 0.0300000

ENERGY (FT)	DEPTH (FT)	DISCHARGE (CFS)	PROBABILITY OF DISCHARGE BEING EXCEEDED AT THE APEX BY: Q	125.8027 Q 0.4540	WIDTH (FT)
0.5	0.4	443	0.15397	0.49326	14035

:LOCITY (FT/SEC)	DEPTH (FT)	DISCHARGE (CFS)	PROBABILITY OF DISCHARGE BEING EXCEEDED AT THE APEX BY: Q	125.8027 Q 0.4540	WIDTH (FT)
3.5	0.4	805	0.09752	0.36091	10269
4.5	0.6	2293	0.02578	0.12522	3563

FEMA FAN MODEL OUTPUT

HALFPINT ALLUVIAL FAN

(Model Sets 1, 2, 3 & 4)

Halfpint Alluvial Fan: Model Set 1

AVULSION FACTOR = 1.5000

FLOOD FREQUENCY CURVE DEFINED BY LEAST-SQUARES FIT OF DATA

RETURN INTERVAL (YEARS)	INPUT DISCHARGE (CFS)	BEST FIT DISCHARGE (CFS)
2	10	10
10	168	170
100	603	598

MEAN = 0.759609
STANDARD DEVIATION = 1.328618
SKEW = -1.1

SUMMARY OF DISCHARGES:

10-YEAR DISCHARGE = 170
50-YEAR DISCHARGE = 464
100-YEAR DISCHARGE = 598
500-YEAR DISCHARGE = 876

STATISTICS AFTER TRANSFORMATION OF Y=LOG(Q) TO Z=1.2765+0.5980 LOG(Q)

MEAN OF Z = 1.730742
STANDARD DEVIATION = 0.794495
SKEW = -1.100000
TRANSFORMATION CONSTANT = 3.392134

SINGLE-CHANNEL REGION

ENERGY (FT)	DEPTH (FT)	DISCHARGE (CFS)	PROBABILITY OF DISCHARGE BEING EXCEEDED AT THE APEX BY: Q	$18.9020\ Q^{0.5980}$	WIDTH (FT)
0.5	0.3	49	0.26742	0.59475	2847

VELOCITY (FT/SEC)	DEPTH (FT)	DISCHARGE (CFS)	PROBABILITY OF DISCHARGE BEING EXCEEDED AT THE APEX BY: Q	$18.9020\ Q^{0.5980}$	WIDTH (FT)
3.5	0.4	68	0.21876	0.52204	2499
4.5	0.6	238	0.06832	0.21587	1033

MULTIPLE-CHANNEL REGION

SLOPE = 0.0196000
N-VALUE = 0.0300000

ENERGY (FT)	DEPTH (FT)	DISCHARGE (CFS)	PROBABILITY OF DISCHARGE BEING EXCEEDED AT THE APEX BY: Q	$18.9020\ Q^{0.5980}$	WIDTH (FT)
0.5	0.3	449	0.02168	0.08480	1543

'ELOCITY (FT/SEC)	DEPTH (FT)	DISCHARGE (CFS)	PROBABILITY OF DISCHARGE BEING EXCEEDED AT THE APEX BY: Q	$18.9020\ Q^{0.5980}$	WIDTH (FT)
3.5	0.4	566	0.01212	0.04847	882

Halfpint Alluvial Fan: Model Set 2

AVULSION FACTOR = 1.5000

FLOOD FREQUENCY CURVE DEFINED BY LEAST-SQUARES FIT OF DATA

RETURN INTERVAL (YEARS)	INPUT DISCHARGE (CFS)	BEST FIT DISCHARGE (CFS)
2	10	10
10	168	169
100	1180	1176

MEAN = 0.928731
STANDARD DEVIATION = 1.055311
SKEW = -0.4

SUMMARY OF DISCHARGES:

10-YEAR DISCHARGE = 169
50-YEAR DISCHARGE = 731
100-YEAR DISCHARGE = 1176
500-YEAR DISCHARGE = 2890

STATISTICS AFTER TRANSFORMATION OF Y=LOG(Q) TO Z=1.0090+0.8374 LOG(Q)

MEAN OF Z = 1.786716
STANDARD DEVIATION = 0.883714
SKEW = -0.400000
TRANSFORMATION CONSTANT = 3.569505

SINGLE-CHANNEL REGION

ENERGY (FT)	DEPTH (FT)	DISCHARGE (CFS)	PROBABILITY OF DISCHARGE BEING EXCEEDED AT THE APEX BY: Q	0.8374 10.2094 Q	WIDTH (FT)
0.5	0.3	49	0.24808	0.57142	2878
1.5	1.0	756	0.01928	0.09924	500

VELOCITY T/SEC)	DEPTH (FT)	DISCHARGE (CFS)	PROBABILITY OF DISCHARGE BEING EXCEEDED AT THE APEX BY: Q	0.8374 10.2094 Q	WIDTH (FT)
3.5	0.4	68	0.20017	0.50667	2552
4.5	0.6	238	0.07596	0.26560	1338
5.5	0.9	649	0.02353	0.11884	599

MULTIPLE-CHANNEL REGION

SLOPE = 0.0196000
N-VALUE = 0.0300000

ENERGY (FT)	DEPTH (FT)	DISCHARGE (CFS)	PROBABILITY OF DISCHARGE BEING EXCEEDED AT THE APEX BY: Q	$10.2094\ Q^{0.8374}$	WIDTH (FT)
0.5	0.3	449	0.03741	0.16695	3196

VELOCITY (FT/SEC)	DEPTH (FT)	DISCHARGE (CFS)	PROBABILITY OF DISCHARGE BEING EXCEEDED AT THE APEX BY: Q	$10.2094\ Q^{0.8374}$	WIDTH (FT)
3.5	0.4	566	0.02835	0.13656	2614

Halfpint Alluvial Fan: Model Set 3

AVULSION FACTOR = 1.5000

FLOOD FREQUENCY CURVE DEFINED BY LEAST-SQUARES FIT OF DATA

RETURN INTERVAL (YEARS)	INPUT DISCHARGE (CFS)	BEST FIT DISCHARGE (CFS)
2	10	10
10	168	168
100	1819	1821

MEAN = 1.016033
STANDARD DEVIATION = 0.935309
SKEW = 0.1

SUMMARY OF DISCHARGES:

10-YEAR DISCHARGE = 168
50-YEAR DISCHARGE = 970
100-YEAR DISCHARGE = 1821
500-YEAR DISCHARGE = 6634

STATISTICS AFTER TRANSFORMATION OF Y=LOG(Q) TO Z=0.7953+1.0450 LOG(Q)

MEAN OF Z = 1.857036
STANDARD DEVIATION = 0.977359
SKEW = 0.100000
TRANSFORMATION CONSTANT = 3.728261

SINGLE-CHANNEL REGION

ENERGY (FT)	DEPTH (FT)	DISCHARGE (CFS)	PROBABILITY OF DISCHARGE BEING EXCEEDED AT THE APEX BY: Q	$6.2420\ Q^{1.0450}$	WIDTH (FT)
0.5	0.3	49	0.23709	0.56316	2963
1.5	1.0	756	0.02605	0.15414	802

VELOCITY (FT/SEC)	DEPTH (FT)	DISCHARGE (CFS)	PROBABILITY OF DISCHARGE BEING EXCEEDED AT THE APEX BY: Q	$6.2420\ Q^{1.0450}$	WIDTH (FT)
3.5	0.4	68	0.19242	0.50416	2653
4.5	0.6	238	0.07866	0.29407	1546
5.5	0.9	649	0.03085	0.16909	883
6.5	1.3	1496	0.01313	0.09258	462

MULTIPLE-CHANNEL REGION

SLOPE = 0.0196000
N-VALUE = 0.0300000

ENERGY (FT)	DEPTH (FT)	DISCHARGE (CFS)	PROBABILITY OF DISCHARGE BEING EXCEEDED AT THE APEX BY: Q	$6.2420\ Q^{1.0450}$	WIDTH (FT)
0.5	0.3	449	0.04315	0.20703	4126

VELOCITY (FT/SEC)	DEPTH (FT)	DISCHARGE (CFS)	PROBABILITY OF DISCHARGE BEING EXCEEDED AT THE APEX BY: Q	$6.2420\ Q^{1.0450}$	WIDTH (FT)
3.5	0.4	566	0.03509	0.18232	3625
4.5	0.5	1614	0.01192	0.08813	1651

Halfpint Alluvial Fan: Model Set 4

AVULSION FACTOR = 1.5000

FLOOD FREQUENCY CURVE DEFINED BY LEAST-SQUARES FIT OF DATA

RETURN INTERVAL (YEARS)	INPUT DISCHARGE (CFS)	BEST FIT DISCHARGE (CFS)
2	10	10
10	335	343
100	1898	1867

MEAN = 0.734788
STANDARD DEVIATION = 1.596884
SKEW = -1.0

SUMMARY OF DISCHARGES:

10-YEAR DISCHARGE = 343
50-YEAR DISCHARGE = 1310
100-YEAR DISCHARGE = 1867
500-YEAR DISCHARGE = 3269

STATISTICS AFTER TRANSFORMATION OF Y=LOG(Q) TO Z=1.6637+0.5765 LOG(Q)

MEAN OF Z = 2.087308
STANDARD DEVIATION = 0.920624
SKEW = -1.000000
TRANSFORMATION CONSTANT = 4.101043

SINGLE-CHANNEL REGION

ENERGY (FT)	DEPTH (FT)	DISCHARGE (CFS)	PROBABILITY OF DISCHARGE BEING EXCEEDED AT THE APEX BY: Q	$46.0992\,Q^{0.5765}$	WIDTH (FT)
0.5	0.3	49	0.31010	0.71462	4136
1.5	1.0	756	0.04476	0.19714	1141

VELOCITY T/SEC)	DEPTH (FT)	DISCHARGE (CFS)	PROBABILITY OF DISCHARGE BEING EXCEEDED AT THE APEX BY: Q	$46.0992\,Q^{0.5765}$	WIDTH (FT)
3.5	0.4	68	0.27085	0.66516	3850
4.5	0.6	238	0.13611	0.43540	2520
5.5	0.9	649	0.05423	0.22757	1317
6.5	1.3	1496	0.01626	0.08582	497

MULTIPLE-CHANNEL REGION

SLOPE = 0.0196000
N-VALUE = 0.0300000

ENERGY (FT)	DEPTH (FT)	DISCHARGE (CFS)	PROBABILITY OF DISCHARGE BEING EXCEEDED AT THE APEX BY: Q	$46.0992\ Q^{0.5765}$	WIDTH (FT)
0.5	0.3	449	0.08068	0.30203	6642

VELOCITY (FT/SEC)	DEPTH (FT)	DISCHARGE (CFS)	PROBABILITY OF DISCHARGE BEING EXCEEDED AT THE APEX BY: Q	$46.0992\ Q^{0.5765}$	WIDTH (FT)
3.5	0.4	566	0.06397	0.25496	5607
4.5	0.5	1614	0.01411	0.07631	1678

```
*********************************************          ***************************************
* HEC-2 WATER SURFACE PROFILES              *          * U.S. ARMY CORPS OF ENGINEERS        *
*                                           *          * HYDROLOGIC ENGINEERING CENTER       *
* Version   4.6.2;  May 1991                *          * 609 SECOND STREET, SUITE D          *
*                                           *          * DAVIS, CALIFORNIA 95616-4687        *
* RUN DATE    29JAN93    TIME    15:20:50   *          *        (916) 756-1104               *
*********************************************          ***************************************
```

```
X     X  XXXXXXX   XXXXX              XXXXX
X     X  X        X     X            X     X
X     X  X        X                        X
XXXXXXX  XXXX     X          XXXXX    XXXXX
X     X  X        X                  X
X     X  X        X     X            X
X     X  XXXXXXX   XXXXX             XXXXXXX
```

```
T1  HEC-2 RUN TO DETERMINE 100-YEAR FLOOD HAZARD LIMITS AND DEPTHS
T2  SOUTHWEST CORNER OF RWMS ASSUMING NO BERM
T3  FLOW CONDITION OF "NATURAL CONDITIONS" FILE: SWCRWMS.DAT
    SUBCRITICAL FLOW
    CROSS SECTIONS DEVELOPED FROM 1"=400', 5' C.I. TOPOGRAPHIC MAP OF THE RWMS.
    THE 100-YEAR DISCHARGE AT CROSS SECTION 1 FROM HEC-1 MODEL RWMSW.OUT (CPF)
    IS 2396 CFS.  THE REMAINING CROSS SECTIONS (2-7) USED THE 100-YEAR DISCHARGE
    OF 1230 CFS FROM HEC-1 MODEL RWMSW.OUT (CPA1).

J1  ICHECK    INQ     NINV     IDIR     STRT    METRIC   HVINS     Q      WSEL     FQ

      0        2       0        0        -1       0        0       0      3166      0

J2  NPROF    IPLOT   PRFVS    XSECV    XSECH     FN     ALLDC    IBW    CHNIM    ITRACE

      1        0      -1        0        0       -1       0        0       0        0

NC   0.040     0.040      .035       .1        .3        0         0         0
QT       1      2396
X1     1.0         6         0      670         0         0         0
GR    3175         0      3165      300      3167       340      3165       360      3170      390
GR    3175       670

QT       1      1229
X1     2.0        19       445      661      1240      1240      1240
GR    3180         0    3177.5      420    3177.5       445      3177       446    3176.5      460
GR    3176       461      3176      470    3175.5       471    3175.5       490      3176      491
GR    3176       555      3175      556      3175       590    3176.5       591    3176.5      610
GR    3176       611      3176      660      3178       661      3180       930

X1     3.0         9       765      821       560       560       560
GR    3185         0      3181      740      3181       765      3180       766      3180      775
GR    3181       776      3181      820      3182       821      3185      1100

X1     4.0         3         0     1060       800       800       800
GR    3190         0      3185      660      3190      1060

X1     5.0         3         0     1440      1840      1840      1840
GR    3215         0      3210      770      3215      1440

X1     6.0         3         0     1130       820       820       820
GR    3220         0      3215      440      3220      1130

X1       7         3         0     1150       780       780       780
GR    3230         0      3225      590      3230      1150
```

```
 SECNO      DEPTH      CWSEL      CRIWS      WSELK      EG         HV         HL         OLOSS      L-BANK ELEV
 Q          QLOB       QCH        QROB       ALOB       ACH        AROB       VOL        TWA        R-BANK ELEV
 TIME       VLOB       VCH        VROB       XNL        XNCH       XNR        WTN        ELMIN      SSTA
 SLOPE      XLOBL      XLCH       XLOBR      ITRIAL     IDC        ICONT      CORAR      TOPWID     ENDST

*PROF 1
0

CCHV=    .100 CEHV=     .300
*SECNO 1.000
3720 CRITICAL DEPTH ASSUMED
   1.000     3.18   3168.18   3168.18   3166.00   3169.09       .91       .00       .00   3175.00
  2396.0       .0    2396.0        .0        .0     312.8        .0        .0        .0   3175.00
     .00      .00      7.66       .00      .000      .035      .000      .000   3165.00    204.61
 .015002       0.        0.        0.         0        22         0       .00    174.47    379.08

*SECNO 2.000

3301 HV CHANGED MORE THAN HVINS

   2.000     2.68   3177.68       .00       .00   3177.84       .16      8.67       .08   3177.50
  1229.0      3.6    1225.4        .0       7.0     383.9        .0      10.0       6.3   3178.00
     .11      .52      3.19       .00      .040      .035      .000      .000   3175.00    390.55
 .002669    1240.     1240.     1240.         6         0         0       .00    270.29    660.84

*SECNO 3.000
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED
   3.000     2.30   3182.30   3182.30       .00   3182.70       .40      2.92       .07   3181.00
  1229.0    691.4     532.6       5.1     187.7      82.1       4.1      14.3      10.3   3182.00
     .14     3.68      6.49      1.25      .040      .035      .040      .000   3180.00    500.26
 .014448     560.      560.      560.        20        12         0       .00    348.26    848.52

*SECNO 4.000

3302 WARNING:  CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE,  KRATIO =  2.19

   4.000     2.17   3187.17       .00       .00   3187.26       .09      4.54       .03   3190.00
  1229.0       .0    1229.0        .0        .0     499.9        .0      21.4      17.7   3190.00
     .23      .00      2.46       .00      .000      .035      .000      .000   3185.00    373.34
 .003005     800.      800.      800.         5         0         0       .00    460.39    833.73

*SECNO 5.000
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED
   5.000     1.34   3211.34   3211.34       .00   3211.69       .35     11.64       .08   3215.00
  1229.0       .0    1229.0        .0        .0     260.3        .0      37.4      35.6   3215.00
     .34      .00      4.72       .00      .000      .035      .000      .000   3210.00    562.95
 .021001    1840.     1840.     1840.        20        14         0       .00    387.21    950.16

*SECNO 6.000

3302 WARNING:  CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE,  KRATIO =  2.55

   6.000     2.09   3217.09       .00       .00   3217.18       .10      5.47       .03   3220.00
  1229.0       .0    1229.0        .0        .0     494.3        .0      44.6      43.7   3220.00
     .43      .00      2.49       .00      .000      .035      .000      .000   3215.00    255.94
 .003231     820.      820.      820.         8         0         0       .00    472.69    728.63

*SECNO 7.000
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED
   7.000     1.47   3226.47   3226.47       .00   3226.85       .38      5.16       .09   3230.00
  1229.0       .0    1229.0        .0        .0     248.4        .0      51.2      51.0   3230.00
     .47      .00      4.95       .00      .000      .035      .000      .000   3225.00    416.57
 .020478     780.      780.      780.        20        19         0       .00    338.04    754.61


NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST
```

CONDITION OF "NATURAL C

SUMMARY PRINTOUT TABLE 150

	SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIWS	EG	10*KS	VCH	AREA	.01K
*	1.000	.00	.00	.00	3165.00	2396.00	3168.18	3168.18	3169.09	150.02	7.66	312.77	195.62
	2.000	1240.00	.00	.00	3175.00	1229.00	3177.68	.00	3177.84	26.69	3.19	390.85	237.88
*	3.000	560.00	.00	.00	3180.00	1229.00	3182.30	3182.30	3182.70	144.48	6.49	273.88	102.25
*	4.000	800.00	.00	.00	3185.00	1229.00	3187.17	.00	3187.26	30.05	2.46	499.89	224.21
*	5.000	1840.00	.00	.00	3210.00	1229.00	3211.34	3211.34	3211.69	210.01	4.72	260.30	84.81
*	6.000	820.00	.00	.00	3215.00	1229.00	3217.09	.00	3217.18	32.31	2.49	494.33	216.23
*	7.000	780.00	.00	.00	3225.00	1229.00	3226.47	3226.47	3226.85	204.78	4.95	248.41	85.88
*	1.000	2396.00	3168.18	.00	.00	2.18	174.47	.00					
	2.000	1229.00	3177.68	.00	9.50	.00	270.29	1240.00					
*	3.000	1229.00	3182.30	.00	4.62	.00	348.26	560.00					
*	4.000	1229.00	3187.17	.00	4.87	.00	460.39	800.00					
*	5.000	1229.00	3211.34	.00	24.17	.00	387.21	1840.00					
*	6.000	1229.00	3217.09	.00	5.74	.00	472.69	820.00					
*	7.000	1229.00	3226.47	.00	9.38	.00	338.04	780.00					

SUMMARY OF ERRORS AND SPECIAL NOTES

```
CAUTION SECNO=      1.000  PROFILE=  1  CRITICAL DEPTH ASSUMED

    ION SECNO=      3.000  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=      3.000  PROFILE=  1  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO=      3.000  PROFILE=  1  20 TRIALS ATTEMPTED TO BALANCE WSEL

WARNING SECNO=      4.000  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

CAUTION SECNO=      5.000  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=      5.000  PROFILE=  1  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO=      5.000  PROFILE=  1  20 TRIALS ATTEMPTED TO BALANCE WSEL

WARNING SECNO=      6.000  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

CAUTION SECNO=      7.000  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=      7.000  PROFILE=  1  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO=      7.000  PROFILE=  1  20 TRIALS ATTEMPTED TO BALANCE WSEL
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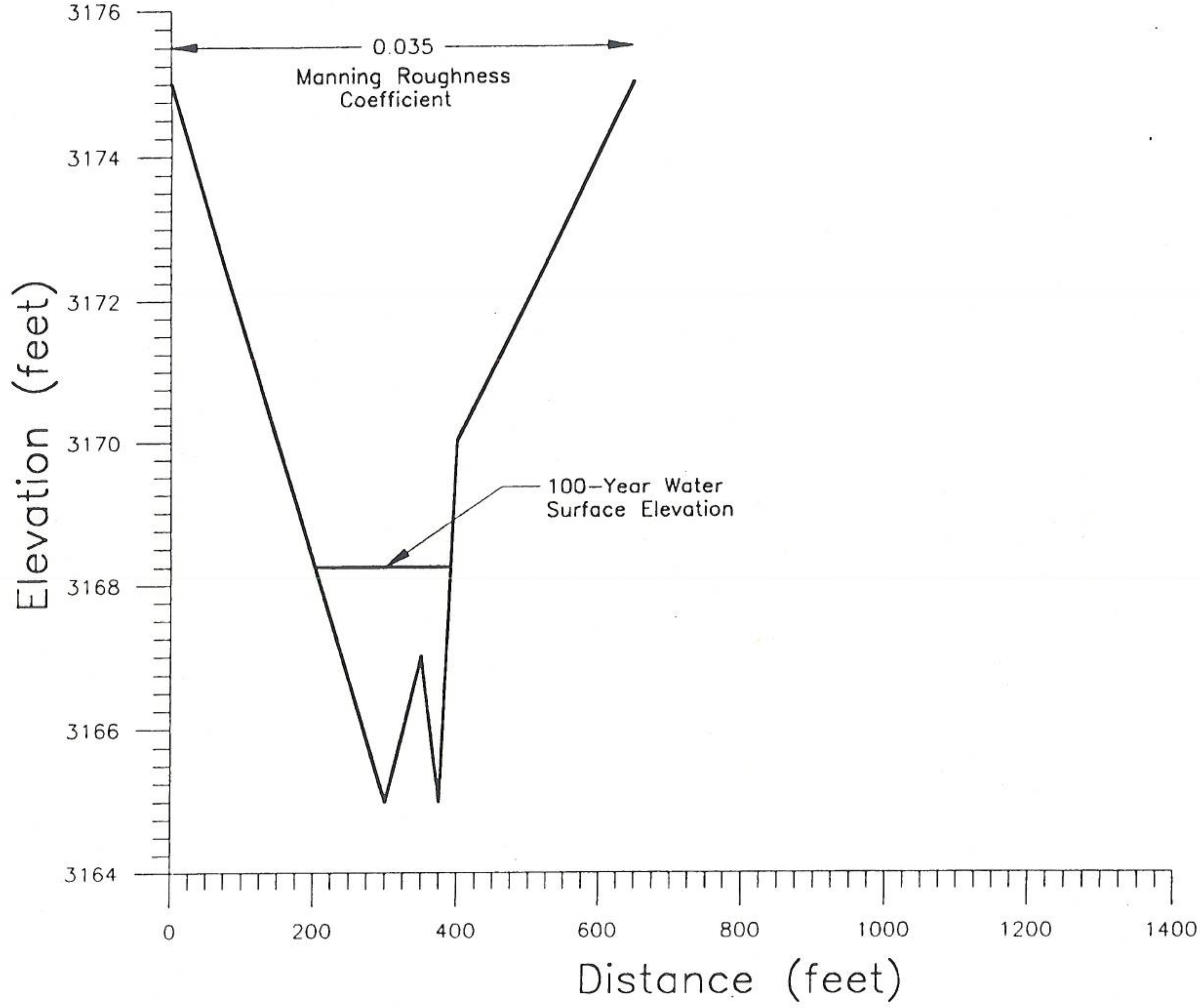
HEC-2 MODEL OUTPUT

CROSS SECTIONS

Cross-Section 1.000



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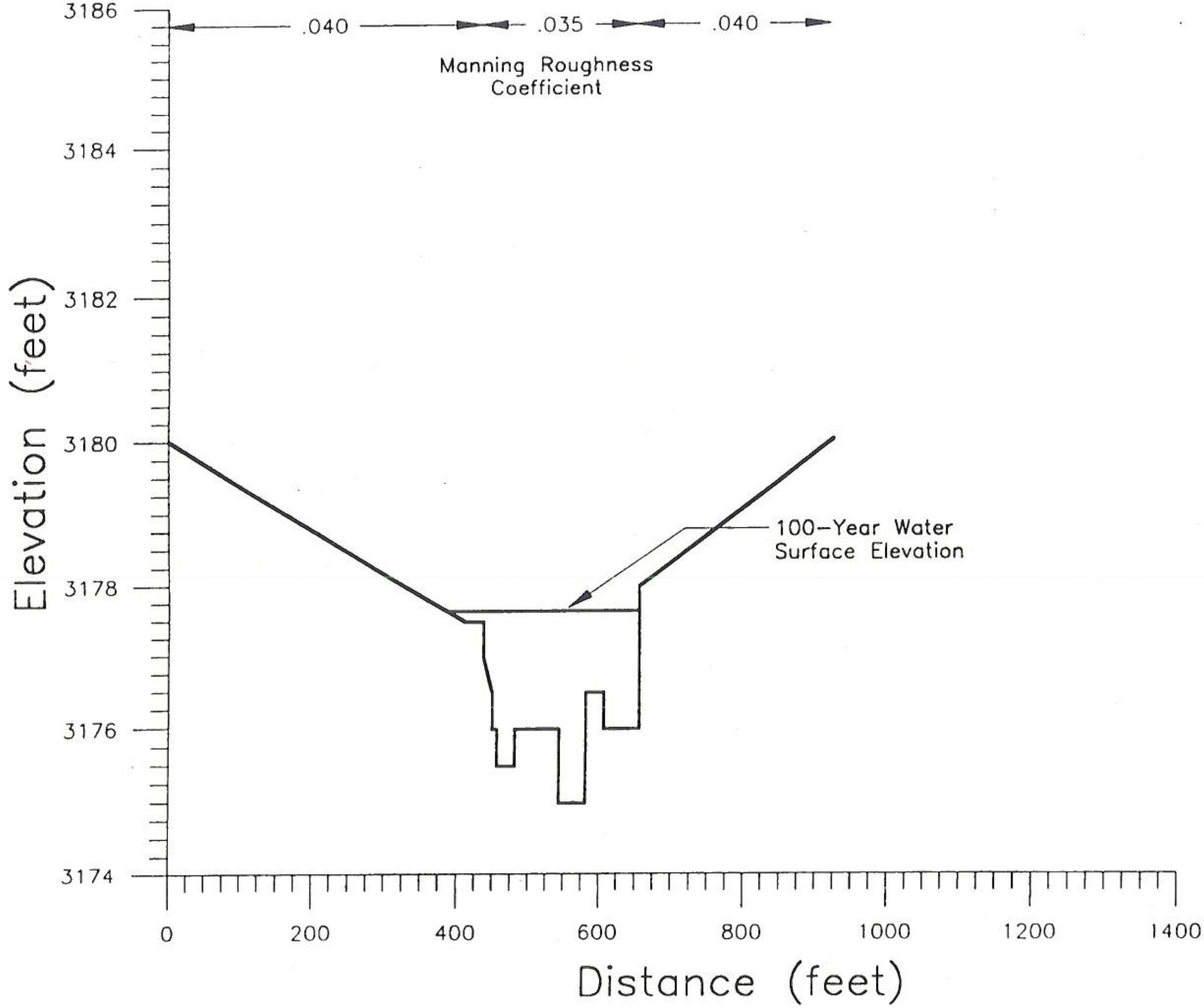
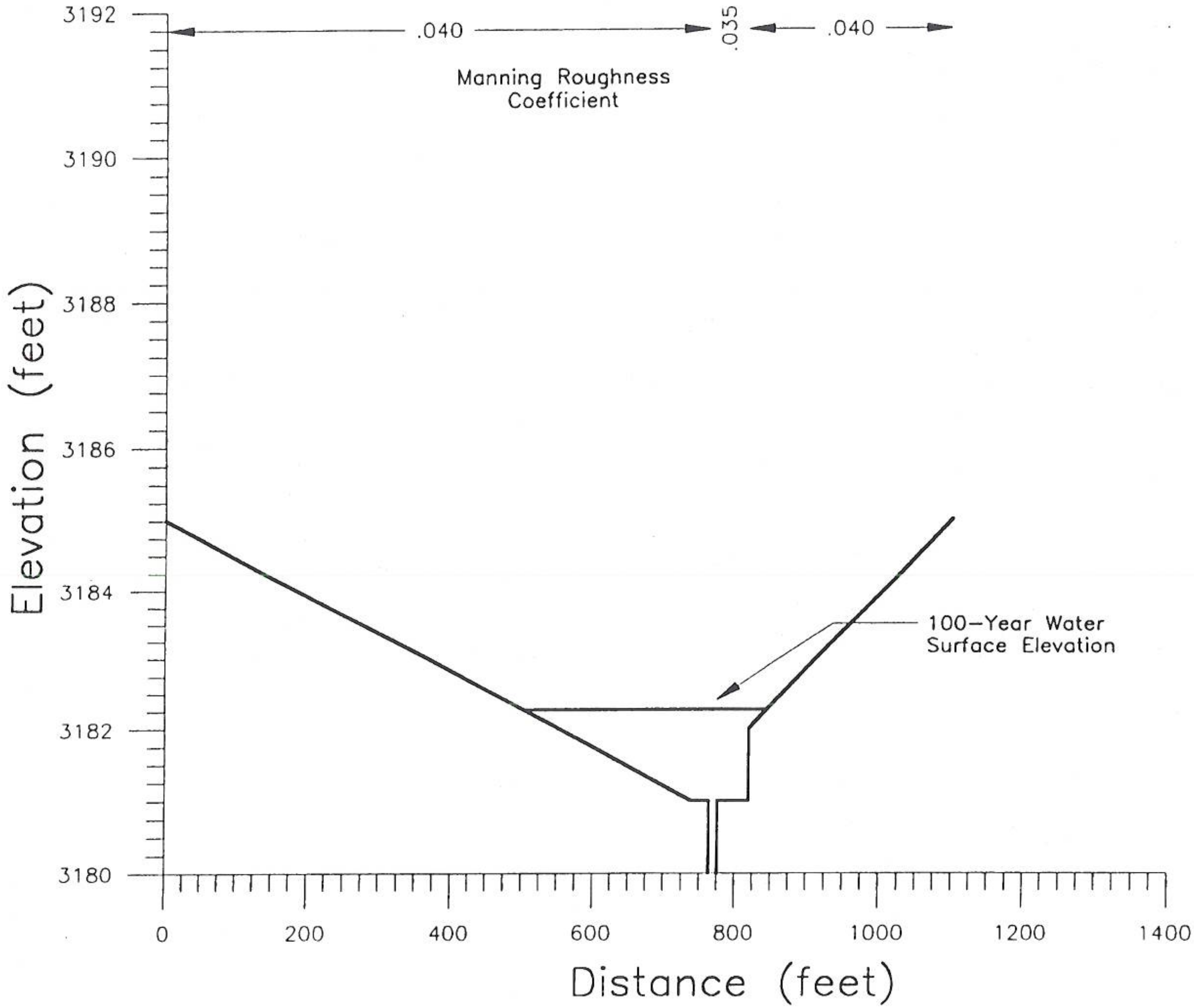
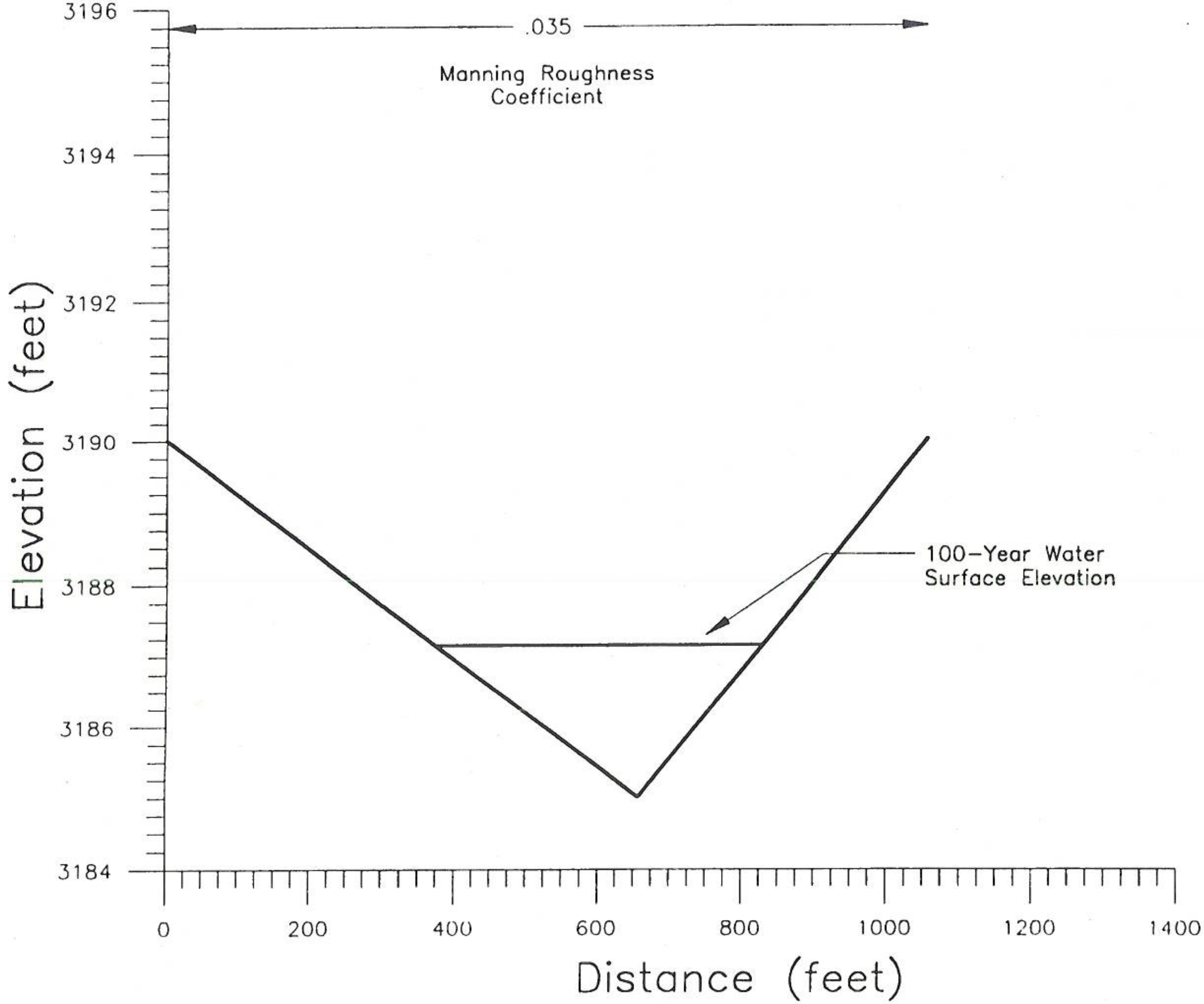


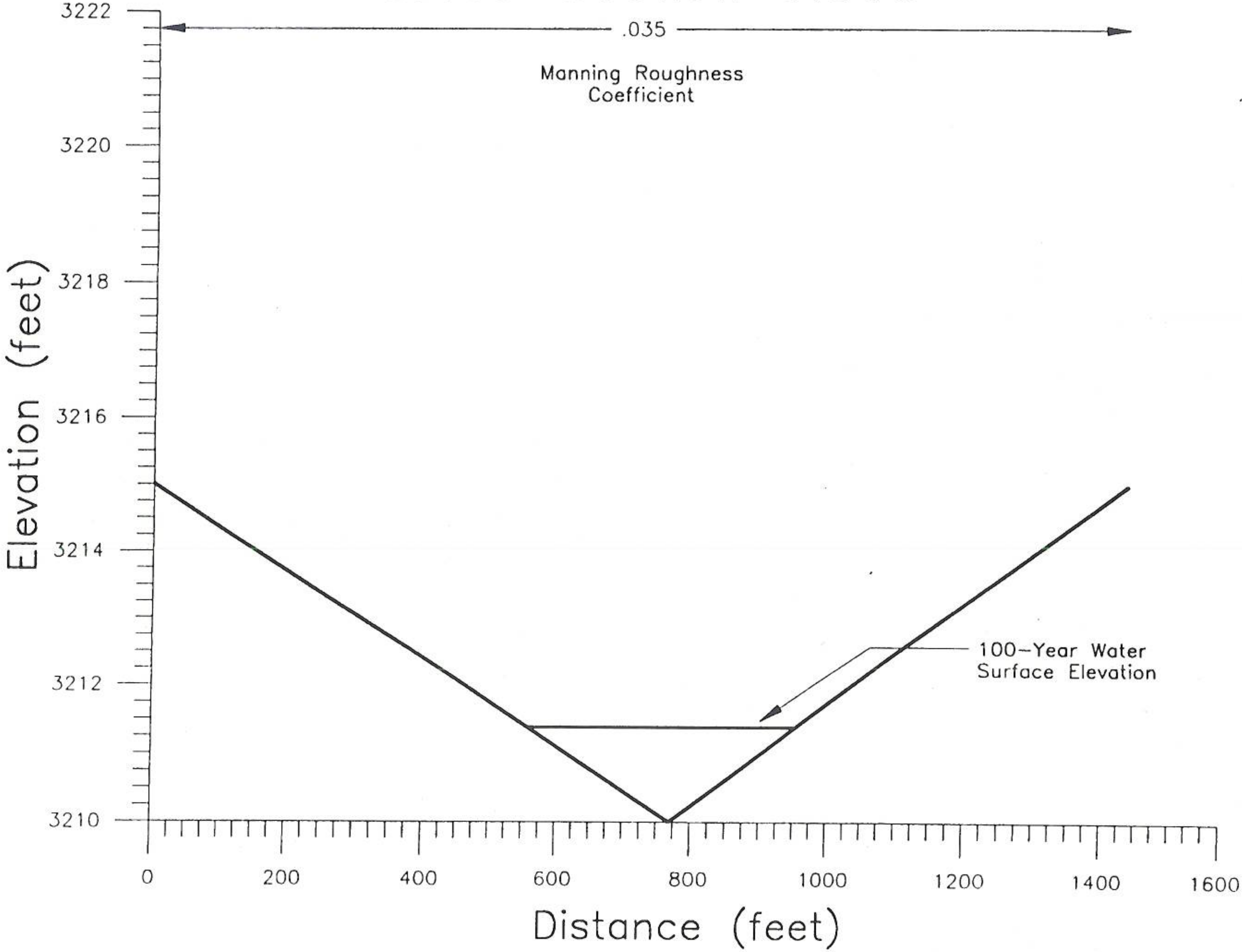
Cross-Section 3.000



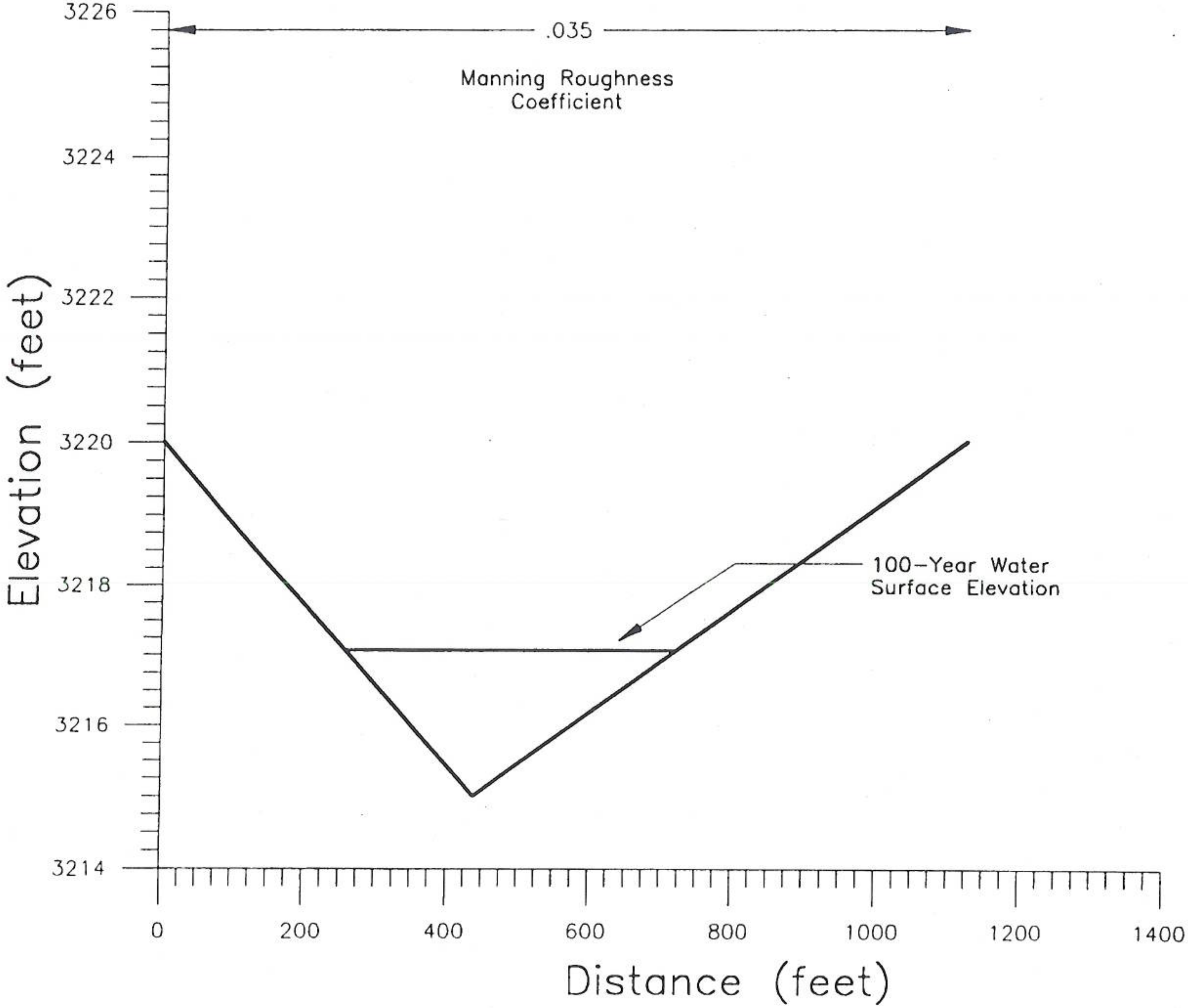
Cross-Section 4.000



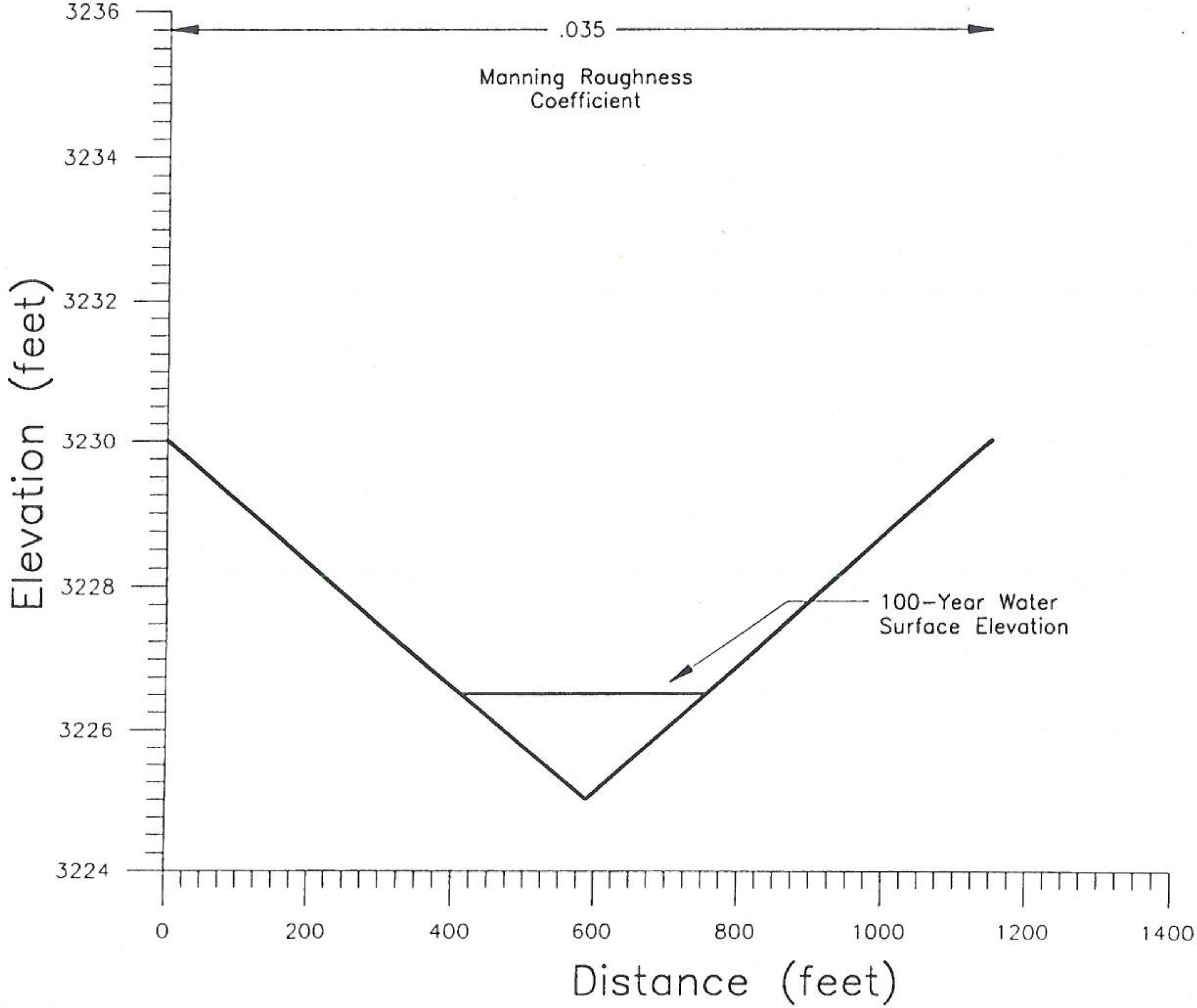
Cross-Section 5.000



Cross-Section 6.000



Cross-Section 7.000



SHEETFLOW CALCULATIONS FOR THE NORTH SIDE OF THE AREA 5 RWMS

CHANGE IN ELEVATION (ft)	REACH LENGTH (ft)	MANNING COEFFICIENT	SLOPE (ft/ft)	WIDTH (ft)	DISCHARGE (ft^3/sec)
90	3500	0.035	0.026	2500	624

Q=DISCHARGE (ft^3/sec)
V=VELOCITY (ft/sec)
A=AREA (ft^2) (For a rectangular channel, area = depth * width)
R=HYDRAULIC RADIUS (ft) (For a shallow channel, assume R=depth)
S=SLOPE (ft/ft)
n=MANNING COEFFICIENT
W=WIDTH (ft)
d=DEPTH (ft)

EQUATIONS:

$$Q=VA$$

$$V=\frac{1.49}{n}R^{2/3}S^{1/2}$$

$$Q=\frac{1.49}{n}R^{2/3}S^{1/2}A$$

CALCULATIONS:

$$Q=\frac{1.49}{n}d^{2/3}S^{1/2}dW$$

$$Q=\frac{1.49}{n}d^{5/3}S^{1/2}W$$

$$d=\frac{Qn}{(1.49S^{1/2}W)^{3/5}}$$

DEPTH CALCULATION:

FLOW DEPTH = 0.11 ft

SHEETFLOW CALCULATIONS FOR THE EAST SIDE OF THE AREA 5 RWMS

CHANGE IN ELEVATION (ft)	REACH LENGTH (ft)	MANNING COEFFICIENT	SLOPE (ft/ft)	WIDTH (ft)	DISCHARGE (ft^3/sec)
75	4250	0.035	0.018	2460	1100

Q = DISCHARGE (ft^3/sec)
V = VELOCITY (ft/sec)
A = AREA (ft^2) (For a rectangular channel, area = depth * width)
R = HYDRAULIC RADIUS (ft) (For a shallow channel, assume R = depth)
S = SLOPE (ft/ft)
n = MANNING COEFFICIENT
W = WIDTH (ft)
d = DEPTH (ft)

EQUATIONS:

$$Q = VA$$

$$V = \frac{1.49}{n} R^{2/3} S^{1/2}$$

$$Q = \frac{1.49}{n} R^{2/3} S^{1/2} A$$

CALCULATIONS:

$$Q = \frac{1.49}{n} d^{2/3} S^{1/2} dW$$

$$Q = \frac{1.49}{n} d^{5/3} S^{1/2} W$$

$$d = \frac{Qn}{(1.49 S^{1/2} W)^{3/5}}$$

DEPTH CALCULATION:

FLOW DEPTH = 0.22 ft

SHEETFLOW CALCULATIONS FOR THE WEST SIDE OF THE AREA 5 RWMS

CHANGE IN ELEVATION (ft)	REACH LENGTH (ft)	MANNING COEFFICIENT	SLOPE (ft/ft)	WIDTH (ft)	DISCHARGE (ft^3/sec)
100	3500	0.035	0.029	2780	450

Q=DISCHARGE (ft^3/sec)
V=VELOCITY (ft/sec)
A=AREA (ft^2) (For a rectangular channel, area = depth * width)
R=HYDRAULIC RADIUS (ft) (For a shallow channel, assume R=depth)
S=SLOPE (ft/ft)
n=MANNING COEFFICIENT
W=WIDTH (ft)
d=DEPTH (ft)

EQUATIONS:

$$Q=VA$$

$$V=\frac{1.49}{n}R^{2/3}S^{1/2}$$

$$Q=\frac{1.49}{n}R^{2/3}S^{1/2}A$$

CALCULATIONS:

$$Q=\frac{1.49}{n}d^{2/3}S^{1/2}dW$$

$$Q=\frac{1.49}{n}d^{5/3}S^{1/2}W$$

$$d=\frac{Qn}{(1.49S^{1/2}W)^{3/5}}$$

DEPTH CALCULATION:

FLOW DEPTH = 0.10 ft

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B.12 Training Program [40 CFR 270.14(b)(12)]

This section identifies the training requirements applicable to personnel assigned to perform duties at the HWSU.

B.12.a HWSU Training Program

Training requirements are established using the contractor's Training Program Manual. The manual uses a systematic approach that ensures personnel assigned to waste handling operations are trained and qualified to safely and effectively perform their assigned work. Qualified training personnel work with the Waste Generator Services Manager and subject matter experts, who are knowledgeable of hazardous and radioactive waste management and emergency procedures, to develop job descriptions for each functional title. Based on job descriptions, qualification programs are developed for each position that identify critical task assignments, entry-level qualifications, and additional training needs. Qualification cards are prepared for all HWSU personnel to document completion of the assigned training program for their functional title. Annual reviews of training programs and qualification statuses for HWSU personnel are performed to ensure personnel training qualifications are current. Personnel qualification cards are maintained by the contractor's Training Division. Personnel training records are accessible at the Waste Generator Services office via the contractor's training database. The Waste Generator Services Manager also maintains a List of Qualified Individuals at the HWSU to ensure personnel training and qualifications are current.

B.12.b Training Matrix

The information provided in Table 8 includes functional titles and required training for personnel assigned to perform work at the HWSU. Current functional titles and job descriptions are maintained in the Waste Generator Services Training Records.

B.12.c Visitors

Visitors are not permitted within the boundaries of the HWSU without an escort or the appropriate PPE. Training requirements for HWSU visitors are reviewed on a case-by-case basis by the HWSU training director or project manager. The amount of training required for a visitor is dependent upon the task the visitor is performing, the type of operations occurring at the HWSU at the time of visitation, and whether exposure to waste or hazardous constituents could occur. Visitors include inspectors, auditors, vendors, consultants, subcontractors, and TSDF contractors. In addition, visitors could include personnel not assigned to perform normal day-to-day operations at the HWSU. Visitors receive a facility briefing that, at a minimum, includes the following:

- Elements of the contingency plan and emergency procedures (e.g., alarms, evacuation routes, emergency equipment)
- Hazards communication
- Hazard awareness and PPE requirements

Visitors or non-assigned personnel performing work within the boundaries of the HWSU must receive approval from the operations supervisor. At a minimum, visitors must present credentials certifying that they have successfully completed and are current with Hazardous

Waste General Site Worker/Annual Refresher (**29 CFR 1910.120**). They must also receive a detailed facility briefing specific to the task to be performed, including additional hazard communication if required. Visitors must sign in and out each day they are visiting.

Table 8. HWSU Training Matrix

Functional Title	Outline of Required Training
Waste Generator Services Manager (Qualification HWS0001)	Hazard Communication Hazardous Waste Site General Worker/Refresher Basic RCRA and Hazardous Waste Manifest HWSU & HWAA Site-Specific Emergency Management Briefing
Operations Supervisor (Qualification HWS0002)	Hazard Communication Hazardous Waste Site General Worker/Supervisor Basic RCRA and Hazardous Waste Manifest/Refresher Hazardous Waste Site General Worker/Refresher HWSU & HWAA Site-Specific Emergency Management Briefing
Field Engineer (Qualification HWS0003)	Hazard Communication Basic RCRA and Hazardous Waste Manifest/Refresher Hazardous Waste Site General Worker/Refresher HWSU & HWAA Site-Specific Emergency Management Briefing
Waste Handler (Qualification HWS0004)	Hazard Communication Hazardous Waste Site General Worker/Refresher Basic RCRA HWSU & HWAA Site-Specific Emergency Management Briefing

B.12.d Course Descriptions

- Hazard Communication (**29 CFR 1910.1200**) – This course provides employees with an awareness of the hazard communication standard and its basic requirements. Course elements include hazards in the workplace, employee right-to-know, methods and observations, and safe work practices. (Frequency – one time)
- Hazardous Waste Site General Worker/Annual Refresher (**29 CFR 1910.120** and **40 CFR 264.16**) – Workers at a hazardous waste or LLMW TSDF are required to have a minimum of 40 hours of training with an 8-hour annual refresher. The training includes regulations, PPE, toxicology, basic chemistry, decontamination techniques, monitoring instruments, risk assessment/hazard evaluation, sampling methods and techniques, and emergency management. (Frequency – one time 40-hour training and annual 8-hour refresher)
- Hazardous Waste Site Supervisor (**29 CFR 1910.120**) – This course provides a review of the supervisor's responsibilities concerning the health and safety program, associated employee training programs, the PPE Program, the spill containment program, health hazard monitoring procedures and techniques, and the legal aspects of supervising when conducting hazardous waste operations. (Frequency – one time)

- Basic RCRA and Hazardous Waste Manifest/Annual Refresher (**40 CFR 260** through **268**) – This course discusses RCRA regulations, how they apply to LLMW handling and disposal, types of waste, how to identify hazardous waste, emergency response, and the LDRs for hazardous waste. Hazardous waste manifest requirements are also covered. (Frequency – annual refresher)
- Site-Specific Emergency Training for HWSU and HWAA (**40 CFR 264.16**) – This course is locally presented and covers the emergency plan implementation for the HWSU. The briefing identifies local emergency coordinators, emergency equipment, evacuation/shelter-in-place procedures, and notification requirements for credible emergencies. (Frequency – annual)

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B.13 Closure and Post-Closure Care Plan [40 CFR 270.14(b)(13)]

This information presents the Closure and Post-Closure Care Plan for the HWSU. A description of the waste managed at the HWSU can be found in Section B.2 and the facility operating record. Closure activities are subject to the requirements of **40 CFR Part 264**. A copy of this closure plan will be maintained in the facility operating record. The receipt of new information concerning this proposed closure system's performance or constructability or the development of new technologies applicable to the NNSS may warrant an amendment to this plan. In such instances, NNSA/NFO will amend this plan according to **40 CFR 264.112**.

Closure of the HWSU will include the following considerations:

- Use of engineering and administrative controls during closure to minimize or eliminate, to the extent necessary, the release of hazardous substances from the unit
- Minimization of the need for maintenance
- Protection of human health and the environment during and after closure activities

B.13.a Description of Closure

The HWSU will be clean-closed by removing existing hazardous waste inventories and decontaminating or removing contaminated facility structures and equipment **(40 CFR 264.178)**.

Closure of the HWSU will involve the following activities:

- Containers of hazardous waste that are present at the time of closure will be removed from the unit and transported to an offsite permitted TSDF.
- The storage pad and equipment will be evaluated for the presence of hazardous waste residue. This will include a review of the HWSU facility operating record to determine if documented hazardous waste releases have occurred and if adequate corrective actions were performed at the time of the release. In addition, the concrete pad and sealant will be visually inspected for indications of spills or contamination (e.g., discoloration, staining).
- If the HWSU facility operating record or inspections of the pad and container management areas indicate possible hazardous waste contamination, samples will be collected from the suspect areas. Samples will be analyzed for volatiles, semivolatiles, and TCLP metals. The selection of the analytical parameters is based on the waste types managed at the HWSU. If sampling and analysis demonstrate the presence of any hazardous contaminant, NNSA/NFO and NDEP will agree on a cleanup standard.

B.13.a.1 Maximum Waste Inventory

The maximum amount of hazardous waste in storage at the HWSU during the operational life of the unit is estimated not to exceed 7,395,000 L (1,950,000 gal). This estimate is based on the maximum annual quantities over a 30-year period. At the time of closure, this estimate will be based on the Area 5 HWSU facility operating record.

B.13.a.2 Removal of Contamination

At closure, all hazardous waste and hazardous waste residue will be removed from the unit. Any media resulting from decontamination of the HWSU equipment or the facility will be tested and disposed in compliance with the regulations in effect at the time of closure.

B.13.a.3 Closure Schedule

Table 9 depicts a closure activity schedule for the unit. Closure of the unit is anticipated to be clean closure.

Table 9. Area 5 HWSU Closure Activity Schedule

Closure Activity	Duration (days)
(1) Notify NDEP of closure	Within 45 days before commencement of closure activities and within 30 days of shipment or removal of the last known volume of hazardous waste
(2) Conduct closure of the unit	Initiated 45 days after notification of closure and completed within 180 days of receiving the final volume of hazardous waste
(3) Submit certification of closure to NDEP	Within 60 days after completion of closure activities

(1) Notification of Closure

NDEP will be notified in writing 45 days before commencing closure activities and within 30 days of shipment or removal of the last known volume of hazardous waste.

(2) Time Allowed for Closure

The final volume of hazardous waste will be shipped offsite within 90 days of notification of closure. The unit will be closed within 180 days after receiving the final volume of hazardous waste.

(3) Disposal or Decontamination of Equipment, Structures, and Soils

Residues from the decontamination of equipment, structures, and soil will be collected, containerized, characterized, and disposed in compliance with the regulations in effect at the time of closure.

(4) Certificate of Closure

Within 60 days after closure of the unit, NNSA/NFO will certify that closure was performed according to the approved closure plan. This certification will be submitted to NDEP.

B.13.a.4 Amendment to Closure Plan

Any amendments to the closure plan will be submitted to NDEP for approval as a permit modification at least 60 days before a proposed change in facility design or operation or no later than 60 days after an unexpected event that affects the closure plan. However, if an unexpected event occurs during the partial or final closure period, NNSA/NFO will request a permit modification no later than 30 days after the unexpected event. The approved closure plan will become a condition of the permit.

It is anticipated that if hazardous waste contamination is detected, this closure plan will be amended to provide specific decontamination and removal procedures applicable to the type and extent of contamination.

B.13.a.5 Post-Closure Care

The HWSU will be clean-closed by removing hazardous waste and hazardous waste constituents; therefore, this unit will not be subject to post-closure care requirements.

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B.14 Post-Closure Notices [40 CFR 270.14(b)(14)]

Closed hazardous waste disposal units on the NNSS are noted in NDEP Permit NEV HW0101, Section 9.

Closure of hazardous waste management sites on the NNSS is carried out through the *Federal Facility Agreement and Consent Order* (FFACO). The FFACO is an agreement between the State of Nevada, the U.S. Department of Defense (DoD), DOE Legacy Management, and NNSA/NFO. The process requires that use restrictions (URs) be instituted at sites where contamination above regulatory limits is being closed in place. Two types of URs are established in the FFACO, administrative and standard. Administrative URs differ from standard URs in that they do not require onsite postings or other physical barriers. Administrative URs apply to remote locations and occasional-use areas where future land use scenarios are used to calculate final action levels.

Each UR site is identified and documented on a UR form with an enclosed map. The completed form and map are the official records documenting the sites where contamination remains in place after closure. The DOE and the DoD will maintain UR records as long as the land is under their jurisdiction. The information on the form and the maps are filed in the FFACO database, the DOE Corrective Action Unit/Corrective Action Site files, and in the U.S. Air Force Geographical Information System.

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B.15 Closure Cost Estimate [40 CFR 270.14(b)(15)]

The federal government is exempt from the financial requirements according to **40 CFR 264.140(c)**.

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B.16 Post-Closure Cost Estimate [40 CFR 270.14(b)(16)]

The federal government is exempt from the financial requirements according to **40 CFR 264.140(c)**.

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B.17 Liability Requirements [40 CFR 270.14(b)(17)]

The federal government is exempt from the financial requirements according to **40 CFR 264.140(c)**.

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B.19 Topographic Map [40 CFR 270.14(b)(19)]

B.19.a HWSU Topographic Maps and Facility Location

Figure 3 is a topographic map with a scale of 2.5 cm (1 in.) equal to 61 m (200 ft) that illustrates the HWSU boundaries and extends a distance of 305 m (1,000 ft) outside the unit boundaries. This figure also depicts access and internal roads, fences, gates, and existing facilities. Potential surface water flows are illustrated by a 0.3-m (1-ft) contour interval.

Figure 7 illustrates the area utilities, including water, sewer, and electrical site plans. Figure 7 also illustrates the waste loading and unloading areas, access control fencing, office trailer, material storage freight containers, and fire alarm pull box.

B.19.b Land Use

Several Public Land Orders (PLO) withdrew land from the public domain to establish the NNSS. PLO 805, issued in 1952, withdrew the land where the HWSU is located. Since then, the land has been used for national defense and energy-related testing and research purposes. In 2009, the BLM determined that a portion of the land withdrawn in Area 5 was unsuitable for return to the public domain and transferred custody to the DOE under Public Law 107-217. The NNSS is not open to public entry for any purposes (e.g., agriculture, mining, homesteading, or recreation). Due to the nature of land use at the NNSS, it is unlikely that the area will be returned to public use in the future. Certain areas in and adjacent to Area 5 were used for atmospheric and underground nuclear weapons testing. Current land uses in the vicinity of the HWSU include low-level waste disposal, LLMW disposal, non-proliferation testing and evaluation, and hazardous material spill testing.

B.19.c Wind Rose

Wind speed and direction are provided in Figure 10, Wind Rose Diagram for the RWMC Meteorology Station. Winds in this area are generally from the southwest, with wind velocities varying from 0 to 20 m (0 to 66 ft) per second. However, there is diurnal reversal effect such that winds are predominantly southerly during the day and northerly at night. In a similar manner, there is a seasonal reversal such that winds are predominantly southerly during the summer and northerly during the winter.

B.19.d Well Locations

Figure 11 shows the HWSU and surrounding area, including nearby well locations.

B.19.e Utility Characteristics

Utilities at the HWSU are shown in Figure 7.

(1) Potable Water, Wastewater, and Fire Protection

The potable and fire protection water system for the HWSU is governed by Public Water System Permit NY-0360-12NTNC. The HWSU does not generate domestic wastewater. HWSU fire alarm pull boxes are located on the southeast and southwest corners of the storage pad. Personnel working in the HWSU have access to vehicle radio, base station radio, and cell phone communications. Emergency response is discussed in Section B.7.

(2) Power System

Offsite electrical power is supplied to the NNSS and transmitted through a loop. The voltage is transformed down to a distribution voltage and then to a working voltage. Power is provided to the HWSU through an underground power line.

(3) Storm Water Drainage

Precipitation from storm events that deposit water on the HWSU storage pad is allowed to evaporate. The storage pad is protected from run-on and runoff by a raised curb.

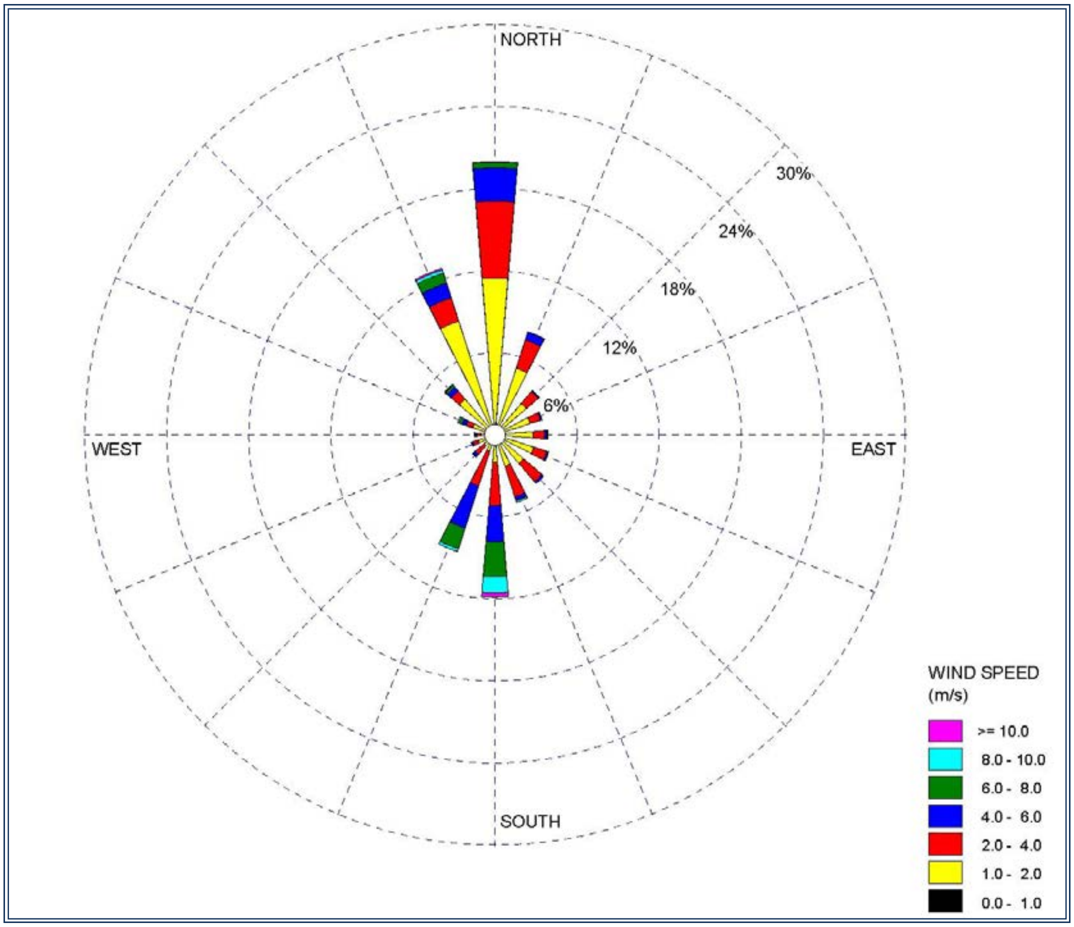

Figure 10. Wind Rose Diagram for the RWMC Meteorology Station

Figure 11. Overall Location

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B.20 Additional Information [40 CFR 270.14(b)(20)]

B.20.a Operations

No wastes are accepted at the HWSU that have not been characterized. Waste determinations are made by HWSU personnel as described in Section B.3. Wastes are containerized before being shipped to the HWSU.

When conducting unloading operations at the HWSU, personnel are required to wear PPE as specified in the HWSU operating procedures. The facility is locked at all times, except during container management, inspection, or maintenance operations. Upon entry, HWSU personnel sign the access register; containers are inspected for proper packaging, labeling, marking, and integrity; and the containers are weighed. Containers may be staged outside the chain-link cyclone fence during unloading and loading operations.

Light containers may be moved manually or with the aid of a drum dolly to the appropriate storage cell. The containers are kept closed during storage and are only opened during repackaging, consolidation, or inspection operations. Heavier packages may require the use of mobile cranes or forklifts.

Spill pallets provide secondary containment for both liquid and non-liquid wastes (except when consolidation is in progress). This minimizes the potential for contact between the container and any incidental precipitation ponding on the storage cells. The rows of pallets are separated by a minimum 0.9-m (3-ft) aisle space to allow for accurate container, label, and marking inspections. Hazardous waste is stored in DOT specification packaging or containers that meet the shipping and disposal requirements of the offsite TSDF. Repackaging and consolidation maximize efficiency in transportation to the TSDF. Offsite shipments are accompanied by an EPA Uniform Hazardous Waste Manifest, LDR forms, and Underlying Hazardous Constituent information.

In preparation for offsite transportation to a TSDF, HWSU personnel may consolidate and then reweigh the consolidated containers of compatible material. This information is documented in the HWSU facility operating record. The Uniform Hazardous Waste Manifest (**40 CFR 262.11**), LDR documents (**40 CFR 268, Underlying Hazardous Constituents**), and each container are evaluated to ensure that EPA and DOT guidelines have been followed. Containers of hazardous waste may be secured to a pallet and then loaded into a contractor's vehicle. The appropriate placarding is placed on the vehicle.

HWSU inspections are performed according to the inspection schedule in Section B.5 and maintained in the HWSU facility operating record.

B.20.b RCRA Hazardous Waste

Hazardous waste is stored in DOT specification packaging or containers with secured lids. Hazardous waste containers are segregated and stored in such a manner that unintended release of their contents and consequent mixing does not result in a dangerous evolution of heat or gas. Packages are clearly labeled and marked according to EPA and DOT regulations. The storage unit is divided by type of hazard using a 15-cm (6-in.) curb (Section B.9). Only compatible wastes are stored together without a separating barrier (**40 CFR 264.177**). Each storage cell of the pad is identified by a conspicuously posted sign describing the waste as flammable, corrosive, ORM, reactive, and or toxic. In addition, liquid and non-liquid hazardous wastes are stored on poly-spill pallets, which provide secondary containment and a supplemental segregation barrier for incompatible wastes.

Hazardous waste destined for storage at the HWSU is packaged, marked, and labeled before transport to the HWSU. If it is determined that a container does not meet the shipping or disposal requirement of the transporter or the offsite TSDF, it may be repackaged at the HWSU. Typically, compliant containers are provided at the accumulation point by HWSU personnel.

B.20.b.1 State of Nevada Hazardous Waste

PCBs must be managed as a hazardous waste if stored in a permitted storage unit. PCBs may be stored in containers of 55 gal or less and managed as described in **40 CFR 761.65(b)(2)**. The accumulation time may not exceed 1 year.

B.20.c Container Management [40 CFR 270.15]

Containers that are used for the storage of hazardous waste range in size from 4 to 208 L (1 to 55 gal); any non-bulk container (less than 450 L [119 gal]) may be used as an overpack. Hazardous waste is stored in DOT specification packaging or containers with secured lids. The type and size of container depends upon the amount and type of waste being stored. Packages are clearly labeled and marked according to EPA and DOT regulations.

Wastes are stored in containers that are in good condition. Waste containers are inspected weekly according to the inspection schedule provided in Section B.5. If the container integrity has been compromised by a structural defect or other physical damage, the contents of the defective container are transferred to another container that is in good condition. Containers are stored on poly-spill pallets for secondary containment (**40 CFR 270.15[a][1]** and **[2]**). In the event of a breach in a package, the spillage is collected in the sump of the poly-spill pallet and a potential emergency situation is minimized.

The minimum 0.9-m (3-ft) aisle provides adequate space for the movement of an overpack or for lifting a container into a larger container. Any spilled waste is removed from the sump of the poly-spill pallet and properly containerized. Containers are kept closed at all times except during repacking, consolidation, or inspections.

As illustrated in Figure 6, rows of pallets may be aligned and butted up to one another in a manner that maintains sufficient space for conducting inspections and accessing labels and markings from the aisle. Containers along the north edge of the pad are placed at least 0.9 m (3 ft) from the outside edge of the curb to allow for unobstructed movement. Containers on the south edge of the pad are accessible from that side; therefore, no specified aisle space is needed for access or inspection. The labels and markings of containers that cannot be easily moved are placed visibly outward facing the aisle. However, the labels and markings of containers that can be moved easily do not need to be visibly accessible from the aisle. A minimum 0.9-m (3-ft) aisle space also exists between pallets in different segregation areas. For example, pallets in the Flammable Waste cell are located at least 0.9 m (3 ft) from the pallets in the Acid and Alkali Corrosive Waste cells.

Containers are handled with care to prevent accidents and to avoid rupture. Light containers may be moved manually or with the aid of a drum dolly, and heavier packages may require the use of mobile cranes or forklifts.

Forklifts, drum lift attachments, slings, and drum dollies may be used at the HWSU to aid in the movement of containers and/or pallets. A list of emergency equipment available for use at the HWSU is provided in Section B.7.

Containers are stored within the curbed storage area; however, they may be staged outside the chain-link cyclone fence during loading and unloading operations. The requirements specified in the **Subpart CC, Air Emission Standards,** are met because hazardous waste is stored in DOT specification packaging or containers with secured lids. The containers are closed at all times, except during repackaging, consolidation, or inspections.

B.20.d Wind Dispersal

Containers of hazardous waste stored at the HWSU are kept closed, except during repackaging, consolidation, or inspection; therefore, wind dispersal effects are minimal.

B.20.e Surface Water Run-On and Runoff Control [40 CFR 15(a)(4)]

(1) Run-On

As stated in Section B.11, the HWSU is located outside the 100-year flood zone and is adequately protected from at least a 100-year, 6-hour storm and a 25-year, 24-hour storm.

The HWSU rests on an earthen pad, and the floor is raised approximately 0.6 to 0.9 m (2 to 3 ft) above the surrounding grade. The storage cells of the HWSU are protected from direct precipitation by the metal roof, which extends 2.4 m (8 ft) beyond the outer edge of the curb.

(2) Runoff

Runoff is prevented by the 15-cm (6-in.) containment curbs. Precipitation falling on the pad, despite the cover, is minimal and is allowed to evaporate.

B.20.f Other Federal Laws [40 CFR 270.3]

Other federal laws that apply to operations at the HWSU include the following:

- *Clean Water Act* – Containers stored at the HWSU are stored on spill pallets in a segregated, curbed area. Secondary containment on spill pallets minimizes release of waste that could affect surface or ground water.
- *Clean Air Act* – Containers are closed while stored on the HWSU. When necessary, containers may be opened to facilitate repackaging, consolidation, or inspection operations. Closed containers minimize the release of airborne contaminants to the environment.

B.20.g Exposure Information Report [40 CFR 270.10(j)]

An exposure information report for this operational unit is not required.

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C.1 HWSU Groundwater Protection [40 CFR 270.14(c)]

Additional information regarding protection of groundwater, including a groundwater monitoring plan, is required for regulated units under **40 CFR 270.14(c)**. A regulated unit is a surface impoundment, waste pile, land treatment unit, or landfill (**40 CFR 264.90 [a][2]**). The HWSU is a storage facility, not a regulated unit; therefore, a groundwater monitoring plan is not required.

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D.1 Characterize Solid Waste Management Units (SWMU) [40 CFR 270.14(d)]

Closed SWMUs on the NNSS are noted in NDEP Permit NEV HW0101, Section 9.

Closure reports for each unit are maintained in NNSA/NFO contractor files; copies are provided to NDEP. Reports contain characterization parameters, location maps, and a description of each facility, time of operation, wastes managed, and the sampling and analysis results of characterization.

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