ARIZONA DEPARTMENT OF WATER RESOURCES
FLOOD MITIGATION SECTION

REQUIREMENT FOR

FLOOD STUDY TECHNICAL DOCUMENTATION

The Director of the Arizona Department of Water Resources under the authority outlined in ARS 48-3605(A) establishes the following technical documentation requirement for all flood studies submitted to the Arizona Department of Water Resources or the Federal Emergency Management Agency by communities, counties or individuals in Arizona:

Flood Studies submitted to the Arizona Department of Water Resources or the Federal Emergency Management Agency for the purpose of delineating floodplains or revising existing floodplains shall meet the technical documentation standards as set forth in the Department's publication entitled "Instructions for Organizing and Submitting Technical Documentation for Flood Studies."

This requirement is effective November 1, 1997. State Standard 1-97 and State Standard Attachment 1-97 replace State Standard 1-90 and State Standard Attachment 1-90, adopted in September, 1990. Please discard all copies of the superseded standard and attachment.

Copies of this State Standard and State Standard Attachment can be obtained by contacting the Department's Dam Safety Section at (602) 417-2445.

NOTICE

This document is available in alternative formats. Contact the Department of Water Resources, Flood Mitigation Section at (602) 417-2445 or (602) 417-2455 (TDD).

ARIZONA DEPARTMENT OF WATER RESOURCES
FLOOD MITIGATION SECTION

Instructions for

Organizing and Submitting

Technical Documentation

for Flood Studies

500 North Third Street
Phoenix, Arizona 85004

(602) 417-2445

STATE STANDARD ATTACHMENT
SSA1-97

November 1997

DISCLAIMER OF LIABILITY

The Arizona Department of Water Resources is not responsible for the application of the methods outlined in this publication and accepts no liability for their use. Sound engineering judgment is recommended in all cases.

The Arizona Department of Water Resources reserves the right to modify, update, or otherwise revise this document. Questions regarding information contained in this document and/or floodplain management should be directed to the local floodplain administrator or the office below:

Dam Safety Section
Arizona Department of Water Resources
500 North Third Street
Phoenix, Arizona 85004

Phone: 602-417-2445
FAX: 602-417-2423

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I. INTRODUCTION

Overview

The Arizona Department of Water Resources (ADWR) has established documentation standards that affect flood studies submitted to the ADWR or to the Federal Emergency Management Agency (FEMA). Flood studies for the purpose of delineating floodplains or revising floodplains in Arizona must meet the technical documentation standards outlined in this publication. This technical documentation standard is to be applied for all Level 3 Methodology studies as defined in ADWR State Standard Attachment SSA2-96.

The purpose of this requirement is to ensure that adequate technical documentation for all flood studies will be available in the future. Past experiences with the documentation available from studies completed for FEMA indicate that many of the technical details of the studies have been lost. This results in additional costs to public agencies and private individuals whenever the studies need to be updated or changed. In addition, adequate review by communities, counties, ADWR and FEMA of any proposed revisions or additions to the floodplain areas of the state will insure that the quality of all studies remains adequate.

This publication requires the study preparer to incorporate all essential technical data into one comprehensive data package to be known as the Technical Data Notebook (TDN). This publication outlines the documentation indexing system to be used in preparation of the TDN.

Submission of a completed TDN is required whenever a study is to be reviewed by ADWR and forwarded to FEMA. ADWR suggests that all Arizona communities require TDN submittals whenever floodplain studies are submitted that modify existing flood hazard areas or delineate new flood hazard areas. A TDN should be forwarded to ADWR for inclusion in the Archives even if approval by ADWR and FEMA is not a requirement.

Reports for Submittals to ADWR and FEMA

The outline for a TDN report submitted to ADWR and FEMA is different than for submittals only made to local government entities and ADWR. Section 1 of the TDN is the same for both types of submittals. Section 2 of the TDN is the main body of the report and contains the Study Documentation Abstract for FEMA submittals, and the application and certification forms for Conditional Letters of Map Revision (CLOMR), Letters of Map Revision (LOMR), and Physical Map Revisions (PMR). The remaining sections of the TDN are to be used for supplemental information that cannot fit within the space allowed on the appropriate FEMA form. FEMA MT-2 Form 3 (Hydrologic Information Form), for instance, would be expanded using Section 4 of the TDN. A reference to the applicable section and sub-section in the TDN is to be placed on the appropriate line of the FEMA form. Maps are to be organized and located as described in the TDN outline. Refer to Table 1 for a direct comparison of the outlines used for the two types of submittals. Refer to Section III of this document for additional information.

Reports for Submittals to Local Government and ADWR

The outline for a TDN report submitted to local government entities and ADWR is different than for submittals to ADWR and FEMA. Section 1 of the TDN is the same for both types of submittals. Section 2 of the TDN is used for abstract data as listed and described in the Appendix. The remaining sections of the TDN are used as the main body of the report and should contain detailed descriptions of the substantiating data, assumptions, results and conclusions for the floodplain delineation. Refer to Table 1 for a direct comparison of the outlines used for the two types of submittals. Refer to Section III of this document for additional information.

II. REPORT STRUCTURE

Description

The general TDN structure is shown in Table 1.

Table 1

General structure of a TDN report

	Report outline main headings	
Section	**ADWR/FEMA Submittals**	**Local Government/ADWR Submittals**
TOC	Table of Contents	Table of Contents
1	Introduction	Introduction
2	ADWR/FEMA Forms	Local Government/ADWR Abstracts
3	Mapping and Survey Information	Mapping and Survey Information
4	Hydrology	Hydrology
5	Hydraulics	Hydraulics
6	Erosion and Sediment Transport	Erosion and Sediment Transport
7	Draft FIS Data	N/A
Appendix A	References	References
Appendix B	General Documentation and Correspondence	General Documentation and Correspondence
Appendix C	Survey Field Notes	Survey Field Notes
Appendix D	Hydrologic Analysis Supporting Documentation	Hydrologic Analysis Supporting Documentation
Appendix E	Hydraulic Analysis Supporting Documentation	Hydraulic Analysis Supporting Documentation
Appendix F	Erosion and Sediment Transport Analyses Supporting Documentation	Erosion and Sediment Transport Analyses Supporting Documentation
Diskettes	Digital data files	Digital data files
A. Maps	Hydrology Exhibit Maps	Hydrology Exhibit Maps
B. Maps	Hydraulics Exhibit Maps	Hydraulics Exhibit Maps
C. Maps	Floodplain Work Study Maps	Floodplain Work Study Maps

Each report is to follow the structure set forth in Table 1. The structure is presented in more detail in section III of this document. The following are guidelines for use of the structure in preparing TDN reports. Refer to section IV for general standards for the appearance of the materials contained in the TDN.

Guidelines for use of the TDN Report Structure

1. TDN reports submitted to ADWR and FEMA: The latest edition of the MT-2 FEMA form series shall be used for Section 2 of the TDN in addition to the Study Documentation Abstract for FEMA Submittals. Refer to Section 2 for more information, and the Appendix for an abstract form. The remaining sections and appendices shall be used to organize and document overflow and supplemental information that can not fit within the room allotted on the FEMA forms. Report sections that are not pertinent are to be identified accordingly in the text. The MT-2 FEMA Form 81-89, May 96 can be obtained from the following sources:

Arizona Division of Emergency Management
The State Coordinator for the NFIP
5636 East McDowell Road
Phoenix, Arizona 85008-3495
(602) 244-0504

FEMA Distribution Warehouse
8231 Stayton Drive
Suite E
Jessup, Md 20794
(800) 480-2520

These forms are available in Adobe Acrobat Reader Version 3.0 digital format on the Internet at HTTP://www.fema.gov/library.

2. TDN reports submitted to Local Government Entities and ADWR: The abstract forms in the Appendix shall be used for Section 2 of the TDN report instead of the FEMA forms. Each field of the abstract forms is explained in Section III of this document.

3. Voluminous reports: Reports that are too large to fit within one binder may be split into multiple volumes. A possible procedure is to separate the hydrology and hydraulics sections into two volumes. Other methods are possible and may be used with the approval of the reviewing agency. For this example, the appropriate data pertinent to each subject should be included in each volume. Project specific information applicable to both categories should be included in only one volume, with appropriate references made in the other volume. Examples, assuming a two volume set with volume 1 covering hydrology and volume 2 covering hydraulics, are:

Section 1, Introduction: The introduction should be similar in both volumes, with reference made to the other volume.

Section 2, ADWR/FEMA forms and Local Government/ADWR Abstracts: The FEMA forms or ADWR abstracts may be placed in either volume, with appropriate references made, or split between volumes by topic, at the discretion of the preparer.

Section 3, Mapping and Survey Information: Mapping and survey information specific to hydrology should be placed in the hydrology volume. Mapping and survey information specific to floodplain and floodway delineation should be placed in the hydraulics volume.

Section 4, Hydrology: A summary of the hydrology results used for floodplain delineation along with a reference to the hydrology volume would be included in the hydraulics volume. The hydrology volume would contain the complete discussion of hydrology methods, parameters and results.

Section 5, Hydraulics: The hydraulics volume should contain a complete discussion of the floodplain and floodway delineation methods, parameters and results. The hydrology volume should contain a reference to the hydraulics volume.

Section 6, Erosion and Sediment Transport: This section is be placed in the hydraulics volume, and reference made in the hydrology volume to the hydraulics volume.

Section 7, Draft FIS Data: This section only applies to reports submitted to ADWR and FEMA. The draft FIS Summary of Discharges, Floodway Data tables, annotated Flood Insurance Rate Maps and Flood Profiles are to be included in either or both volumes, at the discretion of the study preparer.

Appendix A, Reference Materials: The appropriate reference materials specific to hydrology or hydraulics would be included in the appropriate volume.

Appendix B, General Documentation and Correspondence: All general documentation and correspondence should be in either the hydrology or hydraulics volume. Reference should be made in the other volume. The TDN should only contain appropriate technical correspondence between the study preparer and the reviewing agencies. This appendix is not intended to burden the study preparer by requiring a complete project correspondence file.

Appendix C, Survey Field Notes: Field survey notes specific to each topic are be included in the appropriate volume.

Appendix D, Hydrologic Analysis Supporting Documentation: This appendix should only be included in the hydrology volume.

Appendix E, Hydraulic Analysis Supporting Documentation: This appendix should only be included in the hydraulics volume.

Appendix F, Erosion/Sediment Transport Analysis Supporting Documentation: This appendix is to be included in the hydraulics volume.

Diskettes: Diskettes containing hydrology and hydraulics specific digital files are to be included in the appropriate volume.

Maps: Hydrology and hydraulics specific maps or exhibits are be included in the appropriate volume.

4. Exhibits and Maps: Exhibits and maps are to be included in pockets at the back of the report whenever possible. Larger maps, such as the Work Study Maps, can be provided bound and rolled under

separate cover.

5. Duplication: Duplication of data within the report is to be avoided where possible. Use references to one location to avoid duplication.

6. Expansion of Report: The TDN outline can be expanded beyond Section 7 and Appendix F. This may be desirable when using the TDN format for a drainage design report or drainage master plan.

The report outline can be broken down into subsections as necessary for a particular report. For example, Section 3.2.2 Physical Parameters could be broken down into sub-sections as follows:

Section 3.2.2.1 Watershed subbasin parameters
Section 3.2.2.2 Reach Route Parameters
Section 3.2.2.3 Storage Route Parameters

7. Sections that are not used, and restructuring: Sections that are not appropriate for a particular study must still be included in the TDN. Make a statement or reference accordingly under the unused section. Renumbering of TDN report sections in the main body for other purposes will not be permitted.

III. TDN OUTLINE

The material contained within the TDN will be organized as listed and described below. Sections that are not applicable do not have to be contained in the TDN; however, the numbering system should not be changed. Specific minimum standards are listed when appropriate.

The following is the detailed outline of the TDN:

Title Page: The title page is to contain the name and location of the study, and the name, address, phone number and project number (or contract number) of the study requestor and the study preparer, and the date of preparation. The title page must bear the professional registration seal of the study preparer.

Table of Contents: The table of contents is to include a list of figures, list of tables, a list of appendices and the professional registration seal of the study preparer.

Section 1: Introduction

The introduction is to be structured to provide an overview of the material contained in the TDN. The introduction should include the following, organized at the discretion of the study preparer:

- Purpose of study (LOMR, CLOMR, new delineation, hydrology only or hydraulics only). Describe why a CLOMR or LOMR is necessary and the reasons for any revisions to hydrology or hydraulics.
- Authority for study (client name, contract number and date, project manager, etc).
- Location of study reach by section, township, range, community and county. Provide a location map and vicinity map.
- Brief statement of methodology used for hydrology and hydraulics.
- Acknowledgments.
- Brief description of study results.

Section 2: ADWR/FEMA Forms and Local Government/ADWR Abstracts

TDN Section 2 is to contain the Study Documentation Abstract for FEMA Submittals and the FEMA MT-2 forms for reports submitted to ADWR and FEMA, or the complete Study Documentation Abstract for reports submitted to Local Governments and/or ADWR. The FEMA forms provide the main report data, with TDN Sections 3 through 7 and the Appendices used for overflow and additional information that cannot be placed within the form structure. The purpose of the Local Government/ADWR abstracts is to provide a number of key facts about the study being documented. Sample abstract forms are contained in Appendix A. The following is an explanatory list of the required information for both the Study Documentation Abstract for FEMA Submittals and the complete Study Documentation Abstract form:

SECTION 2 FOR REPORTS SUBMITTED TO ADWR AND FEMA

The Study Documentation Abstract for FEMA Submittals (see abstract form in Appendix A) is to be provided as Section 2.1 and must contain the following information. Items 2.1.1, 2.1.3, 2.1.4 and 2.1.5 will be completed by ADWR after the study is accepted by FEMA.

Section 2: ADWR/FEMA Forms

Section 2.1: Study Documentation Abstract for FEMA Submittals

2.1.1 **Date Study Accepted:** Date that study was accepted by FEMA

2.1.2 **Study Contractor:** Study Contractor-Firm or agency name, address and telephone number of firm or agency that completed the study. Name of contact person at firm or agency who would be able to discuss the technical aspects of the study. Study Contractor contract number and list of subcontractors.

2.1.3 **FEMA Technical Review Contractor:** Name, address and phone number of FEMA technical review contractor that reviewed the study.

2.1.4 **FEMA Regional Reviewer:** FEMA Regional reviewer and telephone number.

2.1.5 **State Technical Reviewer:** State reviewer (if any) along with telephone number.

2.1.6 **Local Technical Reviewer:** County or community reviewer and telephone number.

2.1.7 **Reach Description:** Description of the reaches of each river, stream or watercourse studied in documented report. This should include FIRM panel numbers and EPA reach number, if available.

2.1.8 **USGS Quad Sheets:** A list of map names and dates for the USGS 7.5' or 15' quadrangle maps of the study area. If desired, other maps that better describe the study area can be referenced instead of the USGS quads if these maps are easily obtainable. Dates of maps and photography referenced should be included.

2.1.9 **Unique Conditions and Problems:** Description of any unique conditions or problems found during the study.

2.1.10 **Coordination of Peak Discharges:** Description of process to coordinate peak flows with applicable agencies. Should include date, agency name, person contacted and indication of agency concurrence or comments.

Section 2.2: FEMA Forms

The FEMA forms are to be placed under this section, with overflow and additional data and information placed in Sections 3 through 7 and the Appendices, as appropriate.

SECTION 2 FOR REPORTS SUBMITTED TO LOCAL GOVERNMENTS AND/OR ADWR

The complete Study Documentation Abstract (see abstract form in Appendix A) is to be provided as Section 2 and must contain the following information:

Section 2: Local Government/ADWR Abstracts

Section 2.1: General Information

2.1.1 **Community:** Community name

2.1.2 **Community Number:** National Flood Insurance Program (NFIP) Community Number

2.1.3 **County:** County or Counties where community is located

2.1.4 **State:** State where community is located

2.1.5 **Date Study Accepted:** Date study was accepted by ADWR and/or the Local Government entity.

2.1.6 **Study Contractor:** Study Contractor-Firm or agency name, address and telephone number of firm or agency that completed the study. Name of contact person at firm or agency that would be able to discuss the technical aspects of the study. Study Contractor contract number and list of subcontractors.

2.1.7 **State Technical Reviewer:** State reviewer (if any) along with telephone number.

2.1.8 **Local Technical Reviewer:** County or community reviewer along with telephone number.

2.1.9 **River or Stream Name:** Names of rivers, streams or watercourses analyzed in the documented study.

2.1.10 **Reach Description:** Description of the reaches of each river, stream or watercourse studied in documented report.

2.1.11 **Study Type:** Type of study completed on each river, stream or watercourse. This item is to clearly identify whether the study was riverine, alluvial fans, or other special hazard type study.

Section 2.2: Mapping Information

2.2.1 **USGS Quad Sheets:** A list of map names and dates for the USGS 7.5' or 15' quadrangle maps of the study area. If desired, other maps that better describe the study area can be referenced instead of the USGS quads if these maps are easily obtainable. Dates of maps and photography referenced should be included.

2.2.2 **Mapping for Hydrologic Study:** Description of maps used in the hydrologic portion of the study (if any) including type/source, scale, the dates of the maps, and the dates aerials were flown.

2.2.3 Mapping for Hydraulic Study: Description of maps used in the hydraulic portion of the study including type/source, scale, the dates of the maps, and the dates of aerial topography.

Section 2.3: Hydrology

2.3.1 Model or Method Used: Description of the hydrologic methodology or computer model used to estimate the peak flow rates used in the study. Description should include computer model vendor and version of model used.

2.3.2 Storm Duration: Indication of the storm duration used to estimate peak flow rate.

2.3.3 Hydrograph Type: Description of hydrograph type used in modeling.

2.3.4 Frequencies Determined: List of peak flow frequencies estimated in the hydrologic study (i.e., 10, 50, and 100-year, etc.).

2.3.5 List of Gages used in Frequency Analysis or Calibration: List of gages used to calibrate the computer model or used in a statistical frequency computation. Information should include gage name, gage location, USGS number (if any), ownership and years of record.

2.3.6 Rainfall Amounts and Reference: List rainfall amount(s), duration(s), aerial and temporal distribution(s) used for hydrologic modeling. Provide additional data and description in Section 4.2.5.

2.3.7 Unique Conditions and Problems: Description of any unique conditions or problems found during the study.

2.3.8 Coordination of Q's: Description of process to coordinate peak flows with applicable agencies. Should include date, agency name, person contacted and indication of agency concurrence or comments.

Section 2.4: Hydraulics

2.4.1 Model or Method Used: Description of hydraulic methodology or computer model used to determine flood elevations. Description should include computer model vendor and version of model used and any program modifications made by the contractor with supporting documentation.

2.4.2 Regime: Description of flow regime (i.e., subcritical, supercritical, mixed, etc.)

2.4.3 Frequencies for which Profiles were Computed: List of frequencies for which water surface elevations were calculated.

2.4.4 Method of Floodway Calculation: Description of method used to determine floodway (if any).

2.4.5 Unique Conditions and Problems: Description of any unique conditions or problems that impacted the study. This should include any hydraulic conditions such as jumps as well as any portion of the study where elevations were set, rather than computed by the computer model.

Section 2.5: Additional Study Information: Provide additional detail for any of the above sections.

Section 3: Survey and Mapping Information

3.1 Field Survey Information

Provide a description of all survey information used in the study, including the dates when the survey work was performed. Document the professional responsible for field work, and the company name and project number if the work is done by a sub-consultant. Provide a description of how the field notes in Appendix C are organized, and any other pertinent information necessary to understand the information in Appendix C. The information in Appendix C are to be sealed by a Land Surveyor registered in the State of Arizona.

3.2 Mapping

Provide a description of mapping and map control used in the study. Provide a narrative overview identifying the mapping datum (both horizontal and vertical), date of the aerial photography, mapping scale, and contour interval. Document the date of the last overall vertical control survey upon which the referenced benchmarks are based. Provide additional documentation verifying the accuracy of benchmarks located in areas of known subsidence. Describe the flight path followed, the time-of-day photographs were taken, the number of stereo models used, and the photo scale. Distinguish between mapping used for hydrology and mapping used for hydraulics. Document the professional responsible for developing the mapping, and the company name and project number if the work is done by a sub-consultant.

Section 4: Hydrology

4.1 Method description.

Provide a narrative description of the hydrologic methods or models used in the study. Include the model name, date, and source.

4.2 Parameter estimation.

This section and its subsections should include a complete description of the methodology and calculations used to develop the hydrology.

4.2.1 Drainage area boundaries.

Describe the limits of the study watershed and the general watershed characteristics. Provide a general watershed map of the study area no larger than 11" x 17" to scale, showing the study area boundary, major sub-basin boundaries, and concentration points.

4.2.2 Watershed work maps

Describe the watershed work maps prepared as a part of the study and included as exhibit drawings. Discuss the nomenclature used to name subbasins, concentration points, routing reaches, reservoir routes and flow diversions. Exhibits should be prepared covering the watershed, to scale, that depict the following, as a minimum:

1. Subbasin boundaries and concentration points;

2. Time-of-concentration or lag flow paths;
3. Hydrograph routing paths;
4. Soils boundaries; and
5. Land-use boundaries.

The exhibits are to be placed in pockets at the end of the report, or bound under separate cover if too voluminous. Reduced copies of the exhibits are to be placed in this section if practical.

4.2.3 Gage Data.

Identify and discuss locations of any National Weather Service (NWS), USGS or other agency gage stations in or adjacent to the region and watershed in relation to historic precipitation, watershed runoff and statistical parameters.

4.2.4 Statistical parameters

Provide a narrative discussion of the data record and information available on precipitation, runoff and discharge for the region and the study watershed. Assess the adequacy and applicability of the record for use with Water Resources Council Bulletin 17B, (March 1982). Discuss factors that may effect the reasonableness of frequency analysis for the study watershed and describe why or why not the methods in Bulletin 17B are used for estimating peak discharges for the study. Refer to Basin Characteristics and Streamflow Statistics in Arizona as of 1989, USGS Water-Resources Investigations Report 91-4041 for state-wide data and results of log-Pearson Type III analyses.

4.2.5 Precipitation.

Provide further detail than described in Section 4.2.4. The additional detail should include a narrative discussion with supporting data of the historic precipitation records in or adjacent to the study watershed. Discuss the watershed size, the nature of historic flooding, the types of storms that result in flooding and the typical aerial extent of historic storms. State the rainfall duration and distribution pattern and the point rainfall values used for hydrologic modeling. Relate the hypothetical model design precipitation and distribution from stated reference sources to the historic record and statistical parameters.

4.2.6 Physical parameters.

Describe the methods used for estimation of the physical hydrologic parameters, such as rainfall losses, the unit hydrograph used and time-of-concentration or lag. The discussion of rainfall losses should include the soils information used including the data source, surface retention losses, percent impervious estimates for natural and developed watersheds, and the effects of vegetation cover. Provide summary tables listing the physical parameters for every subbasin in the hydrologic models.

4.3 Problems encountered during the study.

4.3.1 Special problems and solutions

Special problems are unique situations that are not addressed by the standard TDN outline. Provide a narrative discussion of any special problems that were encountered during the study. Describe the alternatives examined and the final solution used for each problem.

4.3.2 Modeling warning and error messages

Discuss any warning and error messages present in the computer model output and the effects of such messages on the accuracy of the results.

4.4 Calibration.

Provide a narrative discussion of hydrologic model calibration that was accomplished or attempted. This would include adjustment of model parameters to provide a closer correlation with physical runoff volumes and/or peak discharges of record for the study wash.

4.5 Final results.

4.5.1 Hydrologic analysis results.

Describe the results of the statistical or modeling efforts. Provide summary tables of results for each sub-basin modeled, at the locations necessary for proper floodplain delineation, and at other points of interest. The tables should include the following:

1. Peak discharge and time-to-peak for each recurrence interval storm analyzed;
2. Runoff volume for each recurrence interval storm analyzed;
3. Peak stage and inflow and outflow peak discharges for reservoir route operations; and
4. Peak flow rates for each branch of a flow split or diversion.

4.5.2 Verification of results.

Discuss the reasonableness of the results. Describe comparisons of the results with indirect methods such as:

1. Other FIS studies in the area;
2. Gaged watershed data for similar watersheds; and
3. Indirect methods set forth in the Highway Drainage Design Manual, Hydrology, April 1994 by the Arizona Department of Transportation, including regression equations, envelope curves and other confidence checks.

Section 5: Hydraulics

5.1 Method description.

Describe the location and physical characteristics of the streams or washes for which floodplain limits are defined. Provide a narrative description of the water surface profile model used in the study. Include the model name, date and source. Explain how the starting water surface elevations (WSEL) for the various streams are determined.

5.2 Work study maps

Describe the work study floodplain maps prepared as a part of the report. Discuss the nomenclature used in preparation of the maps. Explain how the streams and washes are divided into reaches based on changes in peak discharge and roughness coefficients. Provide a report figure which is a general overview map of the study area. The floodplain delineation reaches and key features of the study area are to be identified on the map. The figure is to be no larger than 11" x 17" and drawn to scale. Provide reduced scale work-study maps no larger than 11" x 17", in the report volume, in addition to full scale work study maps. All maps must have a graphic scale bar. Refer to Section IV of this document for required information to be placed on all maps and exhibits.

5.3 Parameter estimation.

5.3.1 Roughness coefficients.

Document the source or method of estimating the channel roughness coefficients, such as Manning's n-values. Include photographs of appropriate stream reaches. Provide a summary table of the selected coefficients organized by reach.

5.3.2 Expansion and contraction coefficients.

Document the source or method used to estimate expansion and contraction coefficients. Describe the physical characteristics of the stream and obstructions to flow that require changes in coefficients from the norm.

5.4 Cross section description.

Provide a narrative discussion of the placement of cross sections and the cross section orientation. Describe how the cross sections are obtained.

5.5 Modeling considerations.

5.5.1 Hydraulic Jump and drop analysis.

Describe locations where a hydraulically significant hydraulic jump or drop may be expected to occur. State how the floodplain limits are adjusted, if at all, to account for these phenomena.

5.5.2 Bridges and culverts.

Provide a narrative discussion of the methods used to model bridges and culverts. Describe any assumptions made in the analyses. Provide a summary table listing the location of each structure, a description of the type of structure, and the method used to model it. List any as-built drawings available (with date of preparation and year of construction, if known) for each structure or state that as-built dimensions are obtained by field survey.

5.5.3 Levees and dikes.

Describe the location, extent and physical characteristics of hydraulically significant levees or dikes present along the study streams or washes. Provide a narrative discussion of the methods used to model the effects of these structures. List any as-built drawings available (with date of preparation and year of construction, if known) for each structure or state that as-built dimensions are obtained by field survey.

5.5.4 Islands and flow splits.

Describe the location, extent and physical characteristics of hydraulically significant islands or flow splits present along the study streams or reaches. Provide a narrative description of how the effects of these areas are modeled. List any assumptions made.

5.5.5 Ineffective flow areas.

Describe the location, extent and physical characteristics of hydraulically ineffective flow areas present along the study streams or reaches. Provide a narrative description of how the effects of these areas are modeled. List any assumptions made.

5.5.6 Supercritical flow.

List and describe reaches of supercritical flow in each stream or wash as set forth in ADWR State Standard 3-94.

5.6 Floodway modeling.

Provide a narrative discussion of the encroachment methods and procedures used to define floodway limits.

5.7 Problems encountered during the study.

5.7.1 Special problems and solutions.

Special problems are unique situations that are not addressed by the standard TDN outline.

Provide a narrative discussion of any special problems that were encountered during the study. Describe alternatives examined and the final solution used for each problem.

5.7.2 Modeling warning and error messages.

Discuss any warning and error messages present in the computer model output and the effects of such messages on the accuracy of the results.

5.8 Calibration.

Provide a narrative description of any model calibration procedure attempted or accomplished.

5.9 Final results.

5.9.1 Hydraulic analysis results.

Describe the results of the hydraulic modeling efforts. Provide summary tables of results for each stream or wash. The tables should include the following:

Normal stream results:

1. Cross section identifier;
2. Peak discharge;
3 Water surface elevation;
4. Critical water surface elevation;
5. Average velocity;
6. Top width of flow;
7. Depth of flow;
8. Froude number; and
9. Left and right stations where water surface meets existing ground.

Bridge or Culvert Results for all cross sections defining the structure:

1. Cross section identifier;
2. Water surface elevation;
3. Energy grade line elevation;
4. Peak discharge;
5. Discharge through structure;
6. Discharge over weir;
7. Velocity head;
8. Friction loss; and
9. Contraction and expansion coefficients.

5.9.2 Verification of results.

Discuss the reasonableness of the results. Describe comparisons of the results with any previous studies.

Section 6: Erosion and Sediment Transport

6.1 Method description.

Describe the location and physical characteristics of the streams or washes for which erosion limits are estimated and/or sediment transport analyses are performed. Provide a narrative description of the methodologies and models used in the study. Include the model name, date and source. Describe efforts to use historical data such as aerial photographs to establish the geomorphology of the river. List the dates and sources of aerial photographs and any other data sources used. Describe apparent changes to the channel alignment or geometry over time. Document whether those changes are due to natural

processes, man-made obstructions or disturbances, or a combination of both.

6.2 Parameter estimation.
This section and any subsections should include a complete description of the methodology, sources and calculations used to develop the parameters for erosion and sediment transport modeling.

6.4 Modeling considerations.
Create subsections as necessary to describe the modeling considerations addressed during the study.

6.5 Problems encountered during the study.

6.5.1 Special problems and solutions.
Special problems are unique situations that are not addressed by the standard TDN outline. Provide a narrative discussion of any special problems that were encountered during the study. Describe alternatives examined and the final solution used for each problem.

6.5.2 Modeling warning and error messages.
Discuss any warning and error messages present in the computer model output and the effects of such messages on the accuracy of the results.

6.6 Calibration.
Provide a narrative description of any model calibration procedure attempted or accomplished.

6.7 Final results.

6.7.1 Erosion and sediment transport analysis results.
Describe the results of the erosion and sediment transport efforts. Provide summary tables of results for each stream or wash.

6.7.2 Verification of results.
Discuss the reasonableness of the results. Describe comparisons of the results with any previous studies.

Section 7: Draft FIS Report Data

This section only applies to reports submitted to ADWR and FEMA.

7.1 Summary of Discharges.
Provide a draft Summary of Discharges results table in FEMA format.

7.2 Floodway Data.
Provide a draft Floodway Data results table in FEMA format.

7.3 Annotated Flood Insurance Rate Maps
Provide draft Flood Insurance Rate Maps in FEMA format.

7.4 Flood Profiles
Provide draft Flood Profiles in FEMA format.

Appendix A: References

A.1 Data collection summary.
Include a list of previous studies, other applicable studies, published and unpublished historical flood information, and research contacts.

A.2 Referenced documents.
Provide a list of all technical papers and documents pertaining to the methodology used in the study. Provide a copy of any paper or document critical to the analysis if there is any question of the reviewing agency having the referenced papers or documents.

Appendix B: General Documentation & Correspondence

B.1 Special Problem Reports.

B.2 Contact (telephone) reports.
Provide copies of correspondence documenting notification of the client and the methods of addressing any special problems described in Sections 4.4.1, 5.5 and 6.5.

B.3 Meeting minutes or reports.

B.4 General Correspondence.

B.5 Contract Documents.
Provide a copy of the contract Scope of Work, not financial documents.

Appendix C: Survey Field Notes

The field survey notes are to be clear and concise with appropriate sketches and notations. All field survey procedures and notes should meet requirements of State Board of Technical Registration and be sealed by a registered land surveyor. Provide copies of the field survey notes organized per sections C.1 through C.3. Document the date of the last overall vertical control survey upon which the referenced benchmarks are based. Provide additional documentation verifying the accuracy of benchmarks located in areas of known subsidence.

C.1 Survey field notes for aerial mapping control.

C.2 Survey field notes for hydrologic modeling.
Routing cross sections
Field reconnaissance notes for subbasin boundary verification and estimation of physical parameters.
Structures

C.3 Survey field notes for hydraulic modeling.
Cross sections
Structures
As-built drawings
ERM's

Appendix D: Hydrologic Analysis Supporting Documentation

D.1 Precipitation data.
Provide a copy of Precip output or other calculations done to estimate precipitation frequency values described in Section 4.2.4.

D.2 Physical parameter calculations.
Include detailed summaries of parameter calculations in spreadsheet or table format.

D.3 Hydrograph routing data.
Include routing data, confidence checks on results and cross section plots.

D.4 Reservoir routing data.
Include hydraulic calculations and rating curve plots for control structures, and volume calculations.

D.5 Flow splits and diversions data.
Include hydraulic calculations and rating curve plots used to define each flow split and diversion table.

D.6 Hydrologic calculations.
Include computer model output, logic diagrams and any hand calculations.

Appendix E: Hydraulic Analysis Supporting Documentation

E.1 Roughness coefficient estimation.
Include copies of photographs and calculations.

E.2 Cross section plots.

E.3 Expansion and contraction coefficients.
Include any special data or calibration efforts made for estimation of expansion and contraction coefficients.

E.4 Analysis of structures.
Include any separate hydraulic modeling of structures used to estimate control data for floodplain delineation calculations.

E.5 Hydraulic calculations.
Include computer model output for floodplain and floodway hydraulic calculations.

Appendix F: Erosion and Sediment Transport Analysis Supporting Documentation

Include supporting documentation, parameter calculations, computer model output and any other data and results prepared as a part of the analyses.

Exhibit Maps

Hydrology watershed maps
Hydrology soils maps
Hydrology land-use maps
ERM location map
Hydraulics work study map index
Hydraulics work study maps
Hydraulic profiles
Erosion setback limit maps

IV. GENERAL DOCUMENTATION STANDARDS

This section outlines general format standards for the material to be contained in the TDN.

Appearance and Legibility

All materials contained in the TDN must be legible and of an appearance that makes tracking and review possible. It is not required that the material be typed, but if printed, it must be legible. Pencil and colored pens should be avoided unless the writing is dark enough to be reproduced on copier or microfiche. This is especially important in the case of technical analysis notes that describe the assumptions made in any analysis and the parameters selected by the engineer.

Size

Material in the TDN should be 8½" by 11". Material which is larger than standard size may be folded and included in the notebook or it may be rolled separately, clearly marked and referenced in the TDN. Reduced maps and drawings may be included provided a bar scale is legible after reduction.

Data Identification

Material included in the TDN or attached separately will be marked with the following minimum information.

- Community name, county and state.
- Date material prepared.
- Study contractor name and internal project number.
- Name of flooding sources.
- Appropriate documentation index number as outlined in Section IV of these instructions.
- Whether the product is one of several.
- Any other relevant information that can assist users in identifying the data.

Exhibit Maps

All exhibit maps, included in the TDN or attached separately, will be marked with the following information in addition to the information listed under DATA IDENTIFICATION:

- Index of maps *(8 ½" x 11" suggested size)*.
- Map bar scale.
- Source of base map and date including aerial mapping subcontractor, address, telephone number and internal project number, if applicable.
- Land surveyor's seal and engineer's seal with an appropriate certification and description of what each seal covers.
- North arrow.
- Names of streams, and major streets.
- Date flown (if aerial).
- Reference marks or known benchmarks. Maps should include section, township and range lines, and the location and datum of all points used for horizontal control. The maps should also include all bench marks used for vertical control, and the basis for the datum such as NGVD 1988 or local.

Computer Products

Computer printouts will be marked with the following information in addition to the list under DATA IDENTIFICATION:

- Multiple-profile or single profile.
- Enough information for the reviewer to understand whether this run is the final run or a supplementary run, and to describe the intent in preparing the computer run.
- Hydraulic model printouts will be further annotated to show the applicable cross/section lettering used on the draft report text. Include comment cards in the model to clearly identify road crossings, bridges and key concentration points.

Computer runs that are superseded but contained in the TDN for clarity of review will be marked "SUPERSEDED" or "VOID" in large letters.

Input data files of final runs of computerized hydraulic and hydrologic computations from standard programs such as HEC-1, TR-20 or HEC-2 will be submitted on 3½ inch diskettes, CD-ROM, or other media acceptable to the reviewing agency that meet the following specifications:

- Disks will be formatted for MS DOS 3.1 or greater and have a capacity of 1.44 megabytes.
- Data files may be partitioned to multiple diskettes provided the files are self-extracting or the extraction software is proved with the TDN.
- An ASCII text file named "README" will be created for each diskette and will contain a description of each computer file on the diskette along with the information required under DATA IDENTIFICATION. A list of files along with the information required under DATA IDENTIFICATION will be placed on the diskette label.
- All computer files should be "write protected" by the use of write protect tabs or MS DOS ATTRIB command to make files "read only".

Input and output from other types of computer compilations should be included under the appropriate index number and should clearly be identified by program name and source.

APPENDIX STUDY DOCUMENTATION ABSTRACTS

The forms on the following pages are to be used in Section 2 of the TDN as described in Section III.

Study Documentation Abstract for FEMA Submittals	Initial Study		Restudy		CLOMR		LOMR		Other	

Section 2.1: Study Documentation Abstract for FEMA Submittals

2.1.1	Date Study Accepted	
2.1.2	Study Contractor Contact(s) Address Phone Internal Reference Number	
2.1.3	FEMA Technical Review Contractor Contact(s) Address Phone Internal Reference Number	
2.1.4	FEMA Regional Reviewer Phone	
2.1.5	State Technical Reviewer Phone	
2.1.6	Local Technical Reviewer Phone	
2.1.7	Reach Description	
2.1.8	USGS Quad Sheet(s) with original photo date & latest photo revision date	
2.1.9	Unique Conditions and Problems	
2.1.10	Coordination of Q's Discharges (Agency, Date, Comments)	

Study Documentation Abstract for Local Government and ADWR Submittals		
Section 2.1: General Information		
2.1.1	Community	
2.1.2	Community Number	
2.1.3	County	
2.1.4	State	
2.1.5	Date Study Accepted	
2.1.6	Study Contractor Contact(s) Address Phone Internal Reference Number	
2.1.7	State Technical Reviewer Phone	
2.1.8	Local Technical Reviewer Phone	
2.1.9	River or Stream Name	
2.1.10	Reach Description	
2.1.11	Study type (Riverine, Alluvial Fan, etc.)	
Section 2.2: Mapping Information		
2.2.1	USGS Quad Sheet(s) with original photo date & latest photo revision date.	
2.2.2	Mapping for Hydrologic Study Type/Source Scale Date	

Study Documentation Abstract for Local Government and ADWR Submittals		
2.2.3	Mapping for Hydraulic Study Type/Source Scale Date Subcontractor (Aerial) Date of Aerial Mapping	
Section 2.3: Hydrology		
2.3.1	Model or Method Used (including vendor and version description)	
2.3.2	Storm Duration	
2.3.3	Hyetograph Type	
2.3.4	Frequencies Determined	
2.3.5	List of Gages Used in Frequency Analysis or Calibration (Location, Years of Record, Gage Ownership)	
2.3.6	Rainfall Amounts and Reference	
2.3.7	Unique Conditions and Problems	
2.3.8	Coordination of Q's (Agency, Date, Comments)	
2.4: Hydraulics		
2.4.1	Model or Method Used (including vendor and version description)	
2.4.2	Regime	
2.4.3	Frequencies for which Profiles Were Computed	
2.4.4	Method of Floodway Calculation	
2.4.5	Unique Conditions and Problems	

Study Documentation Abstract for Local Government and ADWR Submittals	
Section 2.5: Additional Study Information	
Item	Description / Discussion