MARK FOREST

Concept Level Report

Washoe County Flood Control Master Plan

Volume II

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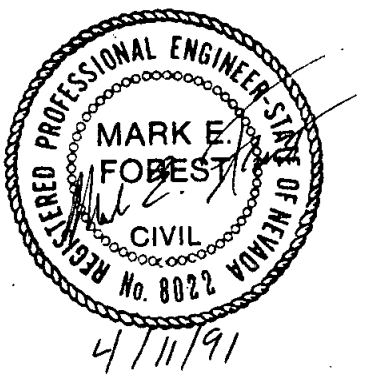
Kennedy/Jenks/Chilton
in association with
Kato & Warren, Inc. and FCS Group, Inc.

WASHOE COUNTY FLOOD CONTROL MASTER PLAN
CONCEPT LEVEL REPORT - VOLUME II

PREPARED FOR:

WASHOE COUNTY, NEVADA
CITY OF RENO, NEVADA
CITY OF SPARKS, NEVADA



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KATO & WARREN, INC.
AND
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The Washoe County Flood Control Master Plan, Concept Level Report was prepared under contract with Washoe County and coordinated through the Interlocal Agreement between Washoe County and the Cities of Reno and Sparks, dated April 1989. This project was supported by the Flood Control Technical Advisory Committee (TAC).

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Kennedy/Jenks/Chilton acknowledges the assistance of the many individuals who provided assistance in this project.

City of Reno Planning Department
City of Reno Engineering Department
City of Sparks Engineering Department
City of Sparks Planning Department
Washoe County Department of Public Works
Washoe County Department of Comprehensive Planning
Washoe Council of Governments

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CHAPTER 1

GOALS AND OBJECTIVES

INTRODUCTION

This chapter describes the consensus of the Washoe County Flood Control Master Plan Technical Advisory Committee (TAC) with regard to:

- The need for a flood control master plan.
- The goals and objectives to be accomplished by the Master Plan process.
- The approach, scope of work, and schedule for accomplishing the master plan.
- Outline of the final flood control master plan document.

For purposes of this document, the Washoe County Flood Control Master Plan is considered to consist of three parts:

- A Conceptual Level Flood Control Master Plan to provide an initial estimate of capital requirements to establish the general level of long term capital need early in the planning process.
- A Final Flood Control Master Plan providing a detailed plan for the trunk conveyance system for the Reno-Sparks urban area and developing areas of Washoe County.
- A plan for the organization, management, and funding of the master plan recommendations to be used to establish the legal basis for implementation.

The policy statement that follows outlines a consensus on the approach to preparation of the Washoe County Flood Control Plan as approved by the TAC under authority of the inter-governmental agreement between Reno, Sparks, and Washoe County dated April 27, 1989.

The approach is divided into three sections. The first covers the Conceptual Master Plan. The second deals with organization, management and funding. The last details the final master planning process as previously developed during the Design Criteria workshops and documented as a consensus memo.

STATEMENT OF POLICY AND APPROACH

Basic Flood Control Policy

It is stated in NRS 543.020 that the policy of the State of Nevada along with Washoe County and the cities of Reno and Sparks is (by inference) "to cooperate with the United States and its departments and agencies,..., in preventing loss of life and property, disruption of commerce, interruption of transportation and communication and waste of water resulting from floods, and in furthering the conservation, development, utilization and disposal of water."

In addition to this general statement regarding public safety, prevention of economic loss or disruption, and resource conservation it is the objective of the Regional Flood Control Master Plan to develop a method for planning, funding, construction, and maintenance of flood control improvements in Washoe County.

It is also the objective of this plan to use the identified projects to enhance the community environment to the maximum extent feasible and to create opportunities for multiple use of floodways including recreational facilities.

Goals of Flood Control Master Plan

To implement the above statement of policy the three local agencies intend to develop a flood control master plan that will provide:

- A method to provide a financial and institutional approach to meeting local obligations resulting from the U.S. Army Corps of Engineers Truckee Meadows Project.
- Estimation of peak flood flows in master plan study areas throughout Washoe County for existing and future conditions.
- Development of alternative plans describing flood control facilities, and selection of a recommended plan.
- Estimation of capital, operation and maintenance costs for the flood control alternatives and the recommended plan.
- Development of the organizational requirements needed to successfully implement a cost-effective, regional flood control program.
- Development of design standards to assure consistency in construction and operation of flood control facilities in Washoe County.
- Further development of a Flood Warning System to serve the developed areas in Washoe County.

Need for Flood Control and Local Drainage Improvements

The Reno-Sparks area and portions of surrounding Washoe County have been subject to periodic storm events that have resulted in damage to property, disruption of transportation, communications, and local services, and present a potential hazard to human health and safety.

The proposed Truckee Meadows Project of the U.S. Army Corps of Engineers will only provide for overbank protection from the flooding of the river and its major tributaries. Local internal drainage is the responsibility of the local agencies.

In addition, local agencies will be required to provide matching funds to construct the Truckee Meadows Project and will be responsible for operation and maintenance of these improvements.

The local agencies must also now begin to prepare to address the issue of storm runoff water quality from the urban and developing areas. The local jurisdictions will soon be required to obtain a permit or permits for the discharge of storm drainage under the provisions of the National Pollution Discharge Elimination System (NPDES) administered by the USEPA. In addition, each agency is faced with the need for funding for the ongoing operation, maintenance, and management of local storm drainage facilities.

All of these requirements indicate a need for interagency cooperation and increased funding for flood control and local drainage.

FLOOD CONTROL MASTER PLAN APPROACH

Preliminary Master Plan and Meteorological Investigation

Conceptual Level Flood Control Master Plan.

Purpose. The purpose of the Conceptual Level Flood Control Master Plan is to identify the most significant flood control improvement needs and estimate the capital costs and annual costs required to implement the Final Flood Control Master Plan and maintain the flood control facilities. For the Conceptual Level Flood Control Master Plan only preliminary improvement options are identified. These options are not the result of an alternatives evaluation process but instead may represent a non-optimal solution for the purpose of establishing approximate costs and budget data. These approximate capital improvement and annual costs have been used in the evaluation of financial and institutional alternatives. Additional detail on the purpose and approach to be used is identified in the Consensus Memorandum on Design and Planning Criteria and Approach dated 19 January 1990.

Approach. During the preparation of the Conceptual level Flood Control Master Plan, the following tasks have been performed:

- Literature Search. Collection of existing relevant studies and plans.
- System Inventory. Inventory of existing drainage structures and channel systems.
- Preliminary Hydraulic Analysis. Identification of capacity for structures and systems identified in the inventory.
- Identification of system for determining level of analysis detail for each portion of the study area.
- Approximate 100 year discharge values.
- Identification of deficiencies.
- Prepare preliminary flood control alternatives.
- Estimate construction, O&M and other related costs.
- Prepare conceptual level flood control master plan.

INSTITUTIONAL AND FUNDING ALTERNATIVES

Purpose

The purpose of this task is to document the consensus of the technical advisory committee and involved units of local government regarding the institutional and financial alternative to be used to implement the Washoe County Flood Control Master Plan.

INSTITUTIONAL ALTERNATIVES

The purpose of the institutional alternative analysis has been to determine what combination of local agencies or other institutional approach is best suited to implement the regulatory, capital improvement and operating recommendations of the master plan. The currently identified options available for consideration are listed below.

Currently Available Jurisdictional Options

- County Sponsored and Managed FCD (NRS 543).
- Interlocal Agreement between Cities and County for Joint Operation

- Interlocal Agreement for Independent County and City Responsibilities and Operation
- One City to be Sponsor (Manager)
- Local Improvement District (NRS 271)
- General Improvement District (NRS 318)
- Enterprise Fund - Location Budget Government Act (NRS 354)
- Subconservancy District - (i.e. Carson-Truckee Water Conservancy District - NRS 541)

With Legislative Action

- Drainage Utility Formation
  - Jointly
  - Separately
  - By Cities with County Forming Flood Control District (FCD)

Possible Combination

- County to form FCD. Cities to provide local facilities and operations with drainage utility when available.
- Independent but coordinated action by each entity with funding by County using FCD

FINANCIAL ALTERNATIVES

With each currently available flood control/drainage jurisdictional alternative, there are corresponding powers specified in the State statutes.

The jurisdictional-financial analysis considers all funding powers and certain approaches used elsewhere that may be applicable to the Reno, Sparks, Washoe County area. Some of these options may require specific State legislation to authorize their use.

The following list summarizes currently identified funding options that have been analyzed in this study effort.

Summary of Funding Options

- Capital Projects
  - FCD Assessments (NRS 543)
  - General Obligation Bonds w/FCD
  - Utility Revenues

- Revenue Bonds w/Utility
- Local Improvement District (LID) Assessments (NRS 271)
- Impact Fees
- Tax Increment Financing
- Other Dedicated Tax Revenues (NRS 354, et al)
- Other Special Assessment Districts
- Sales Tax Increase

• Operations and Maintenance

- FCD Assessments
- Utility Revenues
- Other Dedicated Tax Revenues
- Other Special Assessment Districts

SCOPE OF WORK FOR INSTITUTIONAL AND FUNDING ALTERNATIVES ANALYSIS

Define Agency Responsibilities

Purpose. To implement the Truckee Meadows Project may require a different form of organization than was required to fund and operate local drainage facilities. The purpose of this task was to develop an agreement between the three TAC agencies and other State, Federal, and local jurisdictions as to the division of responsibility for each aspect of the projects incorporated in the Flood Control Master Plan. The consensus of the TAC is presented in Chapter 2, Funding and Institutional Approach.

Approach. The approach to this task has been to carefully define the work to be accomplished to implement the flood control and storm drainage elements. This work scope has been built from the work of the Concept Level Master Plan and earlier work by the three TAC agencies relative to the Corps of Engineers project.

A series of interviews and workshops were used to define the issues and alternatives to be considered during the plan development.

Define Organizational Alternatives

Purpose. This task builds on the results of the previous task to develop a proposal, or proposals, for the organizational structure needed to insure implementation of the master plan.

Approach. The consultant investigated, with the help of County furnished legal assistance, all current legislative authority applicable to the implementation of the master plan. This information has been combined with the consensus developed in the previous tasks to arrive at a listing and analysis of organizational alternatives suitable for effecting the implementation of the master plan.

The alternatives were reviewed and discussed through a series of interviews and workshops involving not only the TAC, but also the City and County managers, finance officers, and elected officials.

These discussions culminated in a workshop on June 12, 1990 at which a recommended implementation and funding plan was discussed. Due to regional governance questions then being considered, it was decided to defer the TAC recommendations until the regional governance questions were decided.

Financial Alternatives Review

Purpose. The purpose of this task has been to document and recommend the funding approach needed to insure implementation of the flood control master plan.

Approach. The funding requirement considers:

- Local funding requirement for the Corps of Engineers Truckee Meadows Project.
- Funding needed for regional flood control facilities.
- Funding needed for drainage facilities in each local jurisdiction.
- Budgets required for the operation and management of the flood control and local drainage systems.
- Funding requirements to address water quality and permitting requirements resulting from the NPDES as administered by the USEPA.

The results of the Preliminary Flood Control Master Plan have been used to establish an estimate of capital and other financial needs.

Available funding sources were reviewed and alternative funding methods have been identified. Each source or combination of sources were reviewed for adequacy, ease of implementation, and jurisdictional requirements.

Additional State legislation is required to provide for the organizational structure and funding mechanisms needed to implement the master plan, and an outline of such legislation has been developed together with a strategy for obtaining approval of the State Legislature.

Public Information Program

Purpose. Implementation of the Truckee Meadows Project and/or the Washoe County Flood Control Master Plan will involve raising additional funds from local citizens, businesses, and property owners. The purpose of this task will be to provide information to the public so they may become aware of the funding need and have an opportunity to respond with their ideas and concerns.

Approach. Only an initial scoping workshop has been completed at this time. This workshop and the preparation for it define the extent of the public information program appropriate to the implementation of the master plan.

It is assumed that additional effort will be required throughout the master planning process. This work may be performed by the TAC agencies with or without consultant assistance.

Develop Policies and Procedures Manual

This task has been deferred until the master plan is completed.

Implementation Schedule

Purpose. The purpose of this task is to provide a guideline for implementation of the master plan recommendations.

Approach. The implementation schedule will be developed during the final master planning process. There will be a schedule for the organizational and funding elements which will, in turn, drive the schedule for the capital improvement program.

The schedule will be reviewed and approved by the TAC as part of workshops associated with other final master planning tasks.

SUMMARY OF INSTITUTIONAL-FINANCIAL WORK PRODUCTS

Task 1.0 - Memorandum on Project Responsibilities

Task 2.0 - Memorandum of Organizational Alternatives

- Memorandum of Consensus and Agreement as to Preferred Organizational Approach

Task 3.0 - Memorandum on Funding Alternatives

Task 4.0 - Outline of Required Legislation

Task 5.0 - Outline and Schedule for Public Information Program (deferred to next phase of work)

Task 6.0 - N/A

Task 7.0 - Schedule for Implementation for
Organizational Funding and CIP Elements
of the Master Plan (deferred to next phase of work)

FLOOD CONTROL MASTER PLAN

Purpose

The Final Flood Control Master Plan will refine the flood control improvements and associated costs identified in the Concept Level Flood Control Master Plan. Various alternatives will be evaluated to identify the recommended alternatives appropriate to each area of the County. The Final Flood Control Master Plan will also establish an order of priority for those improvements based upon an established criteria. The capital improvement cost will be estimated for each element of the plan. Operation and maintenance costs will also be estimated for the improvements identified in the plan as well as the Truckee River improvements to be constructed by the Corps of Engineers.

Approach

The methods of analysis, determination of study effort level and resource materials identified in the Concept Level Master Plan will be used in developing the final master plan. A detailed hydrologic analysis will be performed (where appropriate) to refine the hydrologic data. Flood control alternatives will be developed and ranked according to pre-determined evaluation criteria, and a final master plan document will be prepared.

REFERENCES AND BIBLIOGRAPHY

Appendix A contains a bibliography that summarizes the most significant reference sources identified to date. These references are currently available to Kennedy/Jenks/Chilton.

An additional source of information to be used for reconnaissance will be stereo photographs and other aerial photographs available from the Nevada Dept. of Transportation, Cooper Aerial Survey and others.

Additional resource materials may be identified and utilized during the execution of the project not identified in the attached bibliography. Additional resource materials recommended by the TAC or their staff will also be considered.

FINAL FLOOD CONTROL MASTER PLAN OUTLINE

Appendix D is a preliminary outline for the Final Flood Control Master Plan. This outline is intended to present the basic format and components of the Master Plan. This format will be subject to modification prior to completion of the project.

CHAPTER 2

FUNDING AND INSTITUTIONAL APPROACH

PURPOSE OF CHAPTER

The purpose of this chapter is to present the organizational and funding requirements for the management of flood control and urban drainage in the Reno-Sparks urban area and surrounding Washoe County. In addition, a presentation of organizational and funding alternatives along with the consensus recommendations of the Technical Advisory Committee is presented.

ORGANIZATIONAL REQUIREMENTS

Flood control and storm drainage management entails both regional and local agency components. On the one hand the control of runoff quantity and quality from the major watersheds drainage to the urban area is clearly a regional need. Drainage basins in the area cross jurisdictional lines and in many instances after the improvements needed to control a downstream problem are located in another jurisdiction, most often Washoe County.

Local drainage facilities, the catch basins in the streets and local collection drains, on the other hand are for the most part all within one jurisdiction and are closely related to the street system of the local agency.

There is no compelling reason for these facilities to be managed as regional facilities except perhaps for the overall concern for water quality. But since local facilities must discharge storm water in a manner consistent with the regional plan there is some argument for having a fully coordinated system to insure quantity and quality control of urban runoff. The final distribution of responsibility for the functional activities described in this section is currently the subject of negotiations between the Cities of Reno and sparks and Washoe County and will be determined in the context of regional governance issues currently being addressed.

Regardless of how regional and local flood control and storm drainage system are managed, certain functional activities must be accomplished.

The listing that follows covers only the broadest categories. Within each category are many specific work tasks and staff positions that must later be identified and filled by the responsible agency or agencies.

WORK PROGRAM TASKS

- Master Plan Implementation
- Regulation of Development
- Maintenance of System
- Surface and System Cleaning
- Water Quality
- Emergency Response
- Continuous Planning
- Facility Programming and Execution
- Fiscal Management
- Public Information and Education

A brief description of these major tasks follows.

Master Plan Implementation

If the flood control master plan is to be successfully implemented someone must oversee or manage the process. Even if the various components of the capital plan and operations plan are delegated to the individual local agencies there is still a need for coordination.

Coordination requires someone with responsibility to see that the coordination happens. It also requires a certain amount of staff and budget support. The implementation coordination could take the form of a joint board or committee or a more formally constituted flood control or other special district.

Regulation of Development

The flood control master plan will identify not only facility improvements, but also those regulatory requirements needed to insure adequate storm drainage and flood control. Some of the regulatory issues include:

- Preservation of floodways.
- Prevention of encroachment on drainageways.

- Provision of necessary right-of-way for drainage facilities. This includes both construction and maintenance.
- Provision of adequate facilities within development.
- Provision of detention/retention where required.
- Erosion control during construction.
- Inspection during development.
- On-going operation and maintenance.

Control of development is exercised through the development regulations of each agency. The platting, zoning, and building procedures provide a number of opportunities for an agency to require compliance with storm drainage regulations designed to reduce the runoff quantity and water quality impacts of urban development.

Maintenance of System

Like any public works system, the storm drainage system must be maintained if it is to retain its capacity and structural integrity.

For the Reno-Sparks-Washoe County area, three levels of system maintenance must be considered:

- The Truckee River itself, including the proposed Corps of Engineers improvements.
- Facilities defined as regional during the master plan development.
- Facilities defined as the responsibility of each local agency.

The level of maintenance or maintenance work plan is also an issue to be resolved at least as applied to the Truckee River and regional facilities.

Surface and System Cleaning

These activities are closely related to the maintenance of the system. They are identified separately to stress their importance in overall drainage system functioning and in reducing the impact of storm drainage runoff on water quality. They include leaf and litter control, street sweeping and flushing, and the cleaning of private parking areas.

Frequent street and parking area cleaning by mechanical means and flushing can reduce the amount of pollutants entering the drainage system. Cleaning of catch basins and the drainage conveyance system (re: pipes, ditches, channels) removes pollutants that might otherwise be flushed to the Truckee River during storm events.

Water Quality

Protection of the Truckee River water quality involves all aspects of the storm drainage management program from maintenance to public information. From the standpoint of the current study, what is needed is an agreement as to the standards to be enforced and each agency's area of responsibility. This issue will be defined through the planning activities associated with flood control and the NPDES permitting process. Issues of regulations, inspection, and enforcement remain to be addressed after adoption of an organization approach.

Emergency Response

Public works agencies are often not included in the planning for response to certain emergencies. Any emergency resulting in a spill of potentially dangerous materials into the ground is a threat to the storm drainage system and the subsequent receiving waters.

All too often the traditional response has been to flush spilled materials of the street or ground surface and into the drainage system. Today all storm drainage systems should have equipment, staffing, and facilities to respond to emergency spills and contain and remove such materials. These capabilities are currently the responsibility of a joint response team made up of the local fire department and the Washoe County Health Department.

Continuing Planning

A master flood control plan is an ongoing document. It must be used and modified on a continuous basis. To do this requires someone as a lead or focus for planning for regional facilities.

In addition there is a need for detailed sub-basin plans throughout the study area. These will form the basis for more detailed capital improvement plans for each local agency and for regional facilities.

Facility Programming and Execution

The capital improvement program and implementation schedule from the master plan and ongoing planning must be translated into projects and activities. This requires budgeting and planning for design,, surveys, bidding construction, construction administration, inspection and follow-up.

To accomplish a capital project requires considerable staff time. Even if the design and construction administration is performed by consultants the public agency needs staff to lead and support the construction of the capital improvements.

As in other areas there may be a differentiation between how regional and local facilities are accomplished.

Fiscal Management

Once a funding plan is implemented, there is the ongoing need for billing, collection, accounting, payments, and reporting. If, as appears likely, bonding is to be used for capital improvements, an agency with established credit and bonding authority must be the sponsor and perform the required record keeping and fund disbursement.

Annually budgets must be prepared for operation and maintenance, as well as capital improvements. Normal agency procedures will be followed, but the coordination between local and regional activities and funding will require experienced management.

The fiscal departments of each agency are capable of performing these tasks, but an agreement is necessary to establish how responsibilities are to be delegated.

Public Information and Education

An important aspect of the storm drainage water quality management is informing and educating the public so they will not cause pollutants to enter the drainage system. The public information program should also build support for the flood control program so that needed regulations and funding can be implemented by the respective agencies.

Environmental protection of wetlands, streamways, and receiving waters must also be explained to the public.

Finally, there must be a form and focus for receiving the public's concerns related to all aspects of the storm drainage system.

ORGANIZATIONAL ALTERNATIVES

Any consideration of an organizational structure must include the ability of the structure to meet the assigned responsibilities and raise the necessary funding to implement the flood control and storm drainage management program. The alternatives considered during the study included:

Currently Available Jurisdictional Options

- Flood Control District (NRS 543).
- Interlocal Agreement between Cities and County for Joint Operation.

- Interlocal Agreement for Independent County and City Responsibilities and Operation.
- One Agency to be Sponsor (Manager) with agreement between parties for operation and funding.
- Local Improvement District (NRS 271).
- General Improvement District (NRS 318).
- Water Conservancy District (NRS 541).
- Drainage Enterprise Fund (NRS 354):
  - Jointly
  - Separately
  - By Cities with County Forming FCD
  - Available by Legislative Action
- Creation of a regional authority.

Each of these alternatives is discussed in the following pages to provide information on the suitability of the approach in terms of management and funding powers for flood control and storm drainage.

FLOOD CONTROL DISTRICT (NRS 543)

Organizational Form

A Flood Control District is formed by action of the County Commissioners. In a County with more than 250,000 people, such as Washoe County, the District must encompass the entire County.

The Board of Directors of the Flood Control District in Washoe County would be, by statute, the Board of the Regional Transportation Commission (NRS 373). By statute (543.355) the District must also establish an Advisory Committee whose membership is spelled out in the law. Since the Regional Transportation Commission has broad representation between the Cities of Reno and Sparks and the County, the Advisory Committee may seem superfluous, but it is necessary and required by law and must consist of citizens, not elected officials.

Before the District may undertake any projects that involve more than one agency, an agreement must be drawn up between those agencies and the District. This is very similar to an interlocal governmental agreement on any other subject.

Powers and Duties

A Flood Control District has, by statute, broad powers related to flood control and drainage. It can deal with water quality, operation and maintenance, and the provision of amenities in conjunction with flood control and drainage projects. It would appear that a Flood Control District could provide all of the services envisioned for a regional flood control and drainage authority.
Funding is provided by two means:

- The use of ad valorem taxes exempt from the limitations of NRS ~~354~~ 543.59805.
- The use of a 0.25% retail sales tax NRS 377.

The use of the sales tax seems to have been preempted by the Regional Transportation Commission in Washoe County and probably is not available to a Flood Control District. In any case, before ad valorem taxes or sales taxes could be levied, it would be necessary to get voter approval in the County.

A Flood Control District may issue general obligation bonds only and these must be approved by a majority of the voters.

Advantages

A Flood Control District has broad powers related to flood control and storm drainage and could perform all of the management and capital construction duties necessary to coordinate with the Corps of Engineers Truckee project and to provide regional and even local facilities within the district.

The District's board, which would be the Regional Transportation Commission members, acting as a flood control district board and not as a Regional Transportation Commission, would provide good representation for the Cities and the County.

Disadvantages

Based on experience in Clark County, it would appear to be very cumbersome for a district to obtain public support for any form of ongoing and dependable annual taxation.

The requirement to vote for general obligation bonds for all projects is again a cumbersome and unreliable process given the nature of the storm events and the hydrology in the Washoe County area.

The Regional Transportation Commission members, acting as the Flood Control District Board, may find themselves in a position of reluctance in having this additional duty thrust upon them.

INTERLOCAL AGREEMENTS (NRS 277)

Organizational Form

Chapter 277 provides for a great deal of flexibility on the part of governmental agencies in working together to develop negotiated agreements. What is required is a negotiation and meeting of minds of the elected officials of those agencies that wish to cooperate, in this case the Cities of Reno, Sparks, and Washoe County.

An agreement could specify who would be the managing partner of the flood control and storm drainage program. This could be either of the three entities, or it could be a separate staff and management established by the entities and supervised by a board established with any make-up the entities may choose.

Powers and Duties

A flood control program adopted through an intergovernmental agreement could have all of the powers of any of the three entities. Since the County and the Cities each have broad powers related to flood control and drainage, it would appear that they could create by an interlocal agreement an organization that would have all of the necessary powers to accomplish the Washoe County program.

The entity created by the interlocal agreement could have powers to raise some funds and to budget and spend funds, but the basic authority and source of funding would come from each of the three entities acting under their own individual powers. What this would mean is that each agency would jointly arrive at an annual budget and program which could include long-term bond funding sponsored by one or more of the parties and then each party would have to pledge to provide the necessary revenues to the joint undertaking.

If each of the three entities were to enact full storm water user fee programs, the necessary funding could be guaranteed and it would appear to be possible for one or more of the agencies to issue revenue bonds sufficient to accomplish any type of capital program and to fund with revenues the level of operation and maintenance felt to be appropriate, both for the regional facilities and for their own individual local facilities.

Advantages

An interlocal agreement is a very flexible document that can be negotiated for any period of time by the elected officials and management of the three governmental entities involved.

The boundaries covered by the interlocal governmental agreement can be any portion of the Reno/Sparks urban area that the three entities so select. The boundaries can be modified from time to time by addendum to the agreement.

The interlocal agreement itself is a very flexible document that can be amended as necessary from time to time, and yet can still have sufficient force of law to allow long term funding of capital projects.

Disadvantages

Like any interlocal agreement, it is subject to potential for disagreement among the parties. Since the organization created by the interlocal agreement would have only those duties given to is by its member agencies, it would be possible that the organization could, in fact, become unworkable at some future time if sufficient disagreement were to occur at the elected official level.

All funding for such an organization would be subject to the approval of the elected officials of each of the three member agencies. This has worked very well in the past in other areas for a wide variety of public activities, but nevertheless, it does provide another potential for conflict.

LOCAL IMPROVEMENT DISTRICTS (NRS 271)

A Local Improvement District under Nevada State statute is nothing more than a funding mechanism for capital improvements. Since it provides no ongoing organization or funding for operation and maintenance, this statute will not be considered as the overall organization to manage flood control and storm drainage.

The use of Local Improvement Districts by whatever organizational form is established or by the County and the two Cities certainly remains a possibility for certain types of improvements that may be called for in the master plan.

GENERAL IMPROVEMENT DISTRICT (NRS 318)

Organizational Form

The General Improvement District law is perhaps the broadest and most powerful of all of the special district statutes in Nevada. General Improvement Districts can be formed by action of the County Commissioners who, in counties of 250,000 or more, are by statute the Board of Trustees of the GID regardless of proposed functions.

The law does provide for the Board of County Commissioners to appoint a local district managing board (NRS 318.09535) to whom they may delegate the responsibility for the GID.

The boundaries of a general improvement district can be set according to any agreed upon logical basis for the provision for the service for which it was intended.

Powers and Duties

General Improvement Districts can provide essentially all urban services in one form or another including storm drainage and even schools. The GID can also provide water and sewer service which could conceivably become an issue if the GID were to be formed for the Truckee Meadow area.

In conjunction with the services that it may provide, the statute specifically spells out that not only capital projects, but also operation and maintenance may be performed by the GID.

The funding for a General Improvement District is very broad and can include rates and charges (318.197), although this particular paragraph, while mentioning other services for which charges may be made does not specifically say storm drainage. This discrepancy will have to be reviewed with the legal advisors to determine whether or not legislative change is necessary or the fact that storm drainage is one of the basic services means that an implied service charge could be used.

The GID may also charge connection charges (318.202) and may levy general taxes in excess of the basic tax limitations within the area (318.225). All such rates, charges and connection fees may collected on the County tax rolls (318.201), and the GID may enforce the use of and payment for sanitary sewers and storm drainage (318.170).

Advantages

A General Improvement District has the ability to provide a broad range of regional-type urban facilities and could, perhaps, eventually expand to provide more than flood control and storm drainage if the local agencies so chose.

A GID has all of the necessary funding powers including the power to issue revenue bonds necessary to accomplish the storm drainage and flood control program.

A GID may be operated and managed as a separate entity from the County government or from any of the local agency governments.

The rates, charges, and taxes levied by a GID would appear as separate items to the users and would not be confused with charges that would be made by any of the local entities and, in this respect, would not appear to be an increase in taxes by the local entities.

Disadvantages

Since the County Commissioners act as the Board of Trustees and final authority for all GID's in Washoe County, it would appear that some additional interlocal agreement would be necessary to insure the participation by the other two cities in the governance of the GID.

A GID would be essentially another level of government and there has been some concern expressed over such an arrangement.

WATER CONSERVANCY DISTRICT (NRS 541)

Organizational Form

A Water Conservancy District is a creation of the State courts and can be created by petition of property owners or the County Commissioners of one or more counties. There already exists in the Carson/Washoe County area a Water Conservancy District that has been long established.

Within a Water Conservancy District, one or more sub-conservancy districts (NRS 541.150) may be organized again by petition of property owners in the sub-conservancy district area or by petition of the County Commissioners to the courts. In Carson City a sub-conservancy district was formed some years ago and is now being used to develop M&I water supply and a certain amount of flood control as a major project. A similar sub-conservancy district could be formed for the Truckee Meadows area. The directors for the sub-conservancy district are appointed by the governor.

Powers and Duties

A sub-conservancy district would appear to have all the necessary powers to provide flood control and storm drainage for the Truckee Meadow area. In addition it has powers to provide M&I water supply, although these need not be part of the agreed to duties or assigned duties of the sub-conservancy district.

A sub-conservancy district has the right to levy and collect taxes and assessments with certain limitations. It would appear that the Board of Directors power in this regard is quite strong, however, there is a remonstrance provision in the act which could overturn the proposed assessments and taxes in any given year.

Advantages

The use of a sub-conservancy district under the Water Conservancy District Act would provide an organization independent of the three entities in Truckee Meadows, the County or either of the two Cities.

Such a sub-conservancy district would have broad powers for both operation and funding of flood control and storm drainage facilities and services subject to the remonstrance provisions of the public.

Disadvantages

Establishment of a subconservancy district is a fairly cumbersome and sometimes unpredictable process that may or may not provide a timely solution for the Truckee Meadow area.

The Board of Directors of the sub-conservancy district being appointed by the governor could be somewhat less responsive to the local agency's concerns that a board made up of elected officials from each of the three agencies.

The funding mechanisms provided in the Water Conservancy District Act are again somewhat cumbersome and could become undependable. Bonding does require an election and this could become a serious problem in obtaining long-term funding for capital improvements.

DRAINAGE ENTERPRISE FUND (NRS 354)

Organizational Form

Each agency could form a storm drainage enterprise fund using general enterprise fund using general enterprise fund statutes (NRS 354). Reno and Sparks are collecting service charges for storm drainage at this time under this approach.

Each agency would operate independently and any joint action would have to be covered by an interlocal agreement.

Use of the enterprise approach would provide the necessary funding mechanisms to accomplish the flood control and local storm drainage program.

Use of this approach is probably necessary regardless of what form of joint organization is adopted for implementing regional needs. All local facilities and operation will require local funding that could be provided by expanding this approach.

CREATION OF A REGIONAL AUTHORITY

Organization Form

Nevada law provides a precedent for the creation of a quasi-municipal corporation or authority for specific public purposes through special legislative enactment. This has been done on numerous occasions, the most recent local example being the airport authority and the original Regional Water Authority legislation.

Since a new and distinct piece of legislation would be required, the organizational form can be whatever the cities and the County agree upon. Before such legislation could be drafted and enacted it would be necessary to have an intergovernmental agreement carefully detailing the structure powers, and duties of such a regional authority.

Powers and Duties

Like organizational form the powers and duties of a new regional agency for flood control and storm drainage can be as extensive as the three entities agree to support.

The basic duties should parallel those of the responsibilities listed in the previous section. The regional agency must be able to regulate development related to storm drainage and flood control; operate and maintain the systems; and have all of the necessary funding authority to pay for both capital improvements and annual operating expenses.

The powers and duties of the regional agency could be limited to only major regional facilities and activity or they could be expanded to include the full operation and management of local storm drainage facilities within each of the cities and the urban area of Washoe County.

Advantages

A single purpose agency with powers to manage flood control and storm drainage across jurisdictional lines would provide the needed focus and coordination to protect property and at the same time deal with the water quality issues associated with urban runoff.

Having full regulatory and funding powers and a separate governing board could remove flood control and storm drainage management from some of the political and jurisdictional rivalries inherent in other joint power agreements in Washoe County.

Being a separate governmental entity the funds raised for flood control and storm drainage would not impact the tax base or funds of any of the local jurisdictions. It is possible that the new regional agency could contribute funding to local agencies for certain work. Also funds now budgeted for these purposes by the local agencies could possibly be reduced and used for other purposes.

Disadvantages

A separate flood control and storm drainage agency would be another level of government and issues of control, responsiveness, priority, and overall environmental responsibility could arise.

Public input to the program could also be a concern especially if the regional governing body is not made up of elected officials answerable to the public.

While a regional approach to flood control and storm drainage should be cost effective, fiscal responsibility could also be an issue if there were any duplication of services or a build-up of a large management structure. Budgeting could be somewhat less public than the process followed by the cities and County.

SOURCES OF FUNDING

Regardless of the method that may be used to raise funds to support the flood control and storm drainage program, the ultimate source of such funds must be the properties and residents of the Reno/Sparks Washoe County urban area.

It is possible that some funding will be obtained from the COE for flood control improvements on the Truckee River main stem. However, the agency should consider the possibility that the Corp of Engineers will not be able to obtain congressional approval for this project, and consequently be faced with providing the flood control improvements themselves, either as planned by the Corp or through some subsequent interim or alternative plan. These local costs, whether matching funds for the Corp project, or as separate projects, will have to be combined with the regional facilities identified in the concept level master plan in arriving at the total funding requirement. In any case, the sources of funding available for regional facilities include.

- Voted general obligation tax supported bonds.
- Impact fees on new development.
- Contributions by development, in lieu of construction.
- User charge (enterprise funds).
- Special assessment districts.
- Revenue bonds financed by user charges or assessments

At least two of the organizational alternatives would provide a funding vehicle capable of issuing user charges for storm drainage and flood control. This is the storm drainage utility concept that is now finding favor throughout the country, and essentially entails one or more of the local entities, or the regional entity, whatever that may be, issuing periodic bills to all properties within the area for support of storm drainage and flood control activity.

Within the plan there are approximately 100,000 dwelling units. This, combined with the commercial activities and vacant land, would result in a billing base for user charges of approximately 250,000 billable units. On this basis, for each dollar of monthly service charge for storm drainage and flood control, the total regional revenue would be $3,000,000 per year.

RECOMMENDATIONS

Basic Conclusions

The basic conclusion of the concept level master plan process is that storm drainage and flood control must be considered on a regional basis in terms of capital facilities, operation and maintenance, water quality, and funding. Local storm drainage facilities can continue to be addressed at the local level, provided development standards for runoff control and the passage of stormwater are met, and provided further that water quality standards are also enforced uniformly across jurisdictional lines.

Organization

It is the recommendation of this study that a regional organization be created that has the necessary powers to regulate, plan, and finance flood control and storm drainage facilities. Either the general improvement district statutes (NRS 318), or new legislation providing for a regional authority would be the recommended format for implementation of the organizational structure and funding structure to meet the challenges of the flood control and storm drainage needs of the Washoe County area. It is recommended that an organizational structure be established at the regional level with funding capabilities to utilize service charges to fund the necessary capital, administrative, and operating expenses of the regional flood control and drainage system. Once the regional entity is formed, it should take steps to codify a basis of funding at the regional level, including development impact charges, user charges, and charges in lieu of construction to finance all regional activities.

Local storm drainage and flood control activity should remain the responsibility of the local agency for funding. It is recommended that these local agencies each establish storm drainage utilities or enterprise funds which would be billed separately as part of the user charges and would provide the necessary revenues within each jurisdiction to accomplish their share of the overall work program.

Implementation

In order to implement the study recommendations regarding regional organizational structure, it will be necessary to bring together representatives from each political subdivision. It is beyond the scope of the current study to conduct these negotiations. The negotiating teams should gather to put forward an interlocal agreement outlining the exact duties and powers they agree should be included in any such regional approach, and then move to the legislature in 1991 to seek any legislative action necessary to implement the agreements. Specifically, if the general improvement district laws are to be used, there are certain changes in the wording of that statute that need to be clarified by legislative action. These have been the subject of a separate memo issued by the technical advisory committee prior to this final report. These legislative enactments would involve, in addition to the change in the GID, also a change in the Reno City Charter to insure that storm drainage user fees could be used to fund Reno's share of the local improvements.

To the maximum extent possible, the interlocal agreement should commit each of the three entities to providing their necessary local share of activities in funding in order to insure the overall objectives of the flood control and storm drainage master plan.

Other Pending Actions

At the completion of the concept level master plan study, the Truckee Meadows Regional Planning Agency selected a fact finder to report back on the needs of the area with regard to sanitary sewage, water supply, and flood control. This fact finding effort is to identify the organizational requirements necessary to coordinate these three activities, and consequently the recommendations of this concept level master plan study must be subservient to the broader regional approach which is looking at all aspects of water supply and water quality.

CHAPTER 3

DESIGN AND PLANNING CRITERIA AND APPROACH

INTRODUCTION

The need for a Flood Control Master Plan to guide orderly construction and maintenance of flood control improvements within Washoe County and the Cities of Reno and Sparks has been recognized. For such a plan to be effective, the planning and design criteria to be used in its development must be carefully considered. The plan should be general in nature to allow for reasonable modifications to location and type of improvements during the design phase and yet specific enough to assure that identified improvements will be designed to achieve the overall goal.

The planning criteria used must be consistent with the regional planning effort and must provide a reasonable and defensible means of planning future facilities and attempt to anticipate future changes which might impact the improvements identified in the Flood Control Master Plan. Land use data to be used in the Final Flood Control Master Plan will include 5 and 20 year planning periods and ultimate development conditions. The 5 and 20 year data will be used for development of the capital improvement program (CIP). Ultimate development will be based upon zoning information, land use projections and development suitability studies as provided by the Planning Departments from each community. Ultimate development data will be used in establishing peak discharges and maximum runoff volumes for the planned facilities.

The design event for planning all flood control facilities to be included in the Flood Control Master Plan, is the 100-year event. Each portion of Washoe County was evaluated to determine the appropriate types of protection measures and analysis detail to be used in the development of flood control improvement options.

The Conceptual Level Flood Control Master Plan is a cursory document which is based upon approximate 100-year discharges, to identify the most significant flood control needs and to provide an early estimate of the total cost of improvements. The purpose of the Conceptual Level Flood Control Master Plan is to identify the most significant flood control improvement needs and estimate the capital costs and annual costs required to implement the final plan and maintain the flood control facilities. For this conceptual plan only a preliminary assessment of flood control alternatives is identified. These options are not the result of an alternatives evaluation process but instead represents a non-optimal solution for the purpose of establishing approximate costs and budget data. These approximate capital improvement and annual costs were used in evaluation of financial and institutional alternatives.

Prior to the development of the Final Flood Control Master Plan, a meteorological analysis will be performed to develop suitable design storm data to be used in the development of hydrologic models for the study area. The hydrologic models will be developed using the program developed by the Corps of Engineers Hydrologic Engineer Center (HEC), Flood Hydrograph Package, HEC-1. These models will include sufficient documentation and detail to allow relatively easy modification of the input data for future studies and updates to the Flood Control Master Plan.

The Final Flood Control Master Plan will refine the flood control improvements and associated costs identified in the Conceptual Level Flood Control Master Plan. Various alternatives will be evaluated to identify the recommended alternatives appropriate to each area of the County. The Final Flood Control Master Plan will also establish an order of priority for those improvements based upon an established criteria. The capital improvement, operation and maintenance, administration, legal, engineering, construction management and contingency costs will be estimated for each element of the plan. Operation and maintenance costs will also be estimated for the improvements identified by the Corps of Engineers in the Truckee River flood control project.

USE OF EXISTING STUDIES

There are numerous existing studies which provide useful data for preparation of the Flood Control Master Plan. Available information was utilized to the extent possible to prevent any unnecessary duplication of past efforts. Studies which provided useful data were collected and reviewed for appropriate application to the preparation of the Flood Control Master Plan. The results from these studies were not used "as is" unless a review of the information has resulted in the determination that the data are reasonable and defensible for the use for which it is applied.

PLANNING CRITERIA

Planning of flood control facilities requires information on existing and proposed land use conditions. Land use data will be used to assess need and priority of flood control improvements and to determine the impacts of future development on peak rates of runoff and runoff volumes from the watersheds contributing to those improvements. The facilities themselves also need to be compatible with the surrounding areas in relationship to aesthetics, land use, transportation and public safety. Wherever possible, multi-use facilities will be explored which will provide recreational or environmental enhancement.

Planning Period Data

Existing and projected land use data was used in the development of the Concept Level Flood Control Master Plan for identifying flood control facilities. Currently available land use data consists of existing land use data, projected land use data for 1992 and 2007 and zoning data. This data will also be used in development of the Final Flood Control Master Plan for the following two primary purposes:

Capital Improvement Program (CIP). For the CIP, appropriate improvements need to be identified which consider present and future land use conditions. The priority of each flood control improvement element should also be based upon present and future land uses. The type of proposed land use may also have an impact on the type of improvements selected.

Development of Hydrologic Models. Future land use conditions will be used in developing hydrologic models for watersheds contributing to the facilities to be identified in the Flood Control Master Plan. As development occurs in the watershed, downstream runoff peaks and volumes will increase. The impacts of development will be estimated by modifying the present condition hydrologic model to reflect the proposed changes to land use.

The planning period for this purpose must be sufficiently long enough to assure that facilities will not be undersized. For some drainage areas future land use may be critical to development of hydrologic models which would reasonably represent future conditions. Other drainage areas contain significant amounts of public land and land which is not suitable for development. In such cases the peak discharges at key points may not be significantly impacted by urbanization.

For development of a CIP, planning periods of 5 and 20 years are proposed. The 5 year planning period will provide useful information for establishing the most immediate flood control priorities. The 20 year planning period is consistent with other planning studies and will provide a sufficient time frame for prioritizing future flood control improvements. The Flood Control Master Plan will need to be updated periodically which will allow modifications to the CIP as revisions to projected land use conditions are made. It is assumed that update of the Flood Control Master Plan will be performed in approximately 5 year intervals.

prioritization of improvements ?

The hydrologic models that will be developed for the project need to be based on ultimate development conditions in order to assure that the peak discharges computed with the models are representative of a fully developed condition. Ultimate development land use will be based primarily upon existing zoning with development suitability and other factors used to modify land use based on physical constraints. For the Final Flood Control Master Plan, this data will be prepared from planning data provided by the planning departments from each community.

based on ultimate development

This approach will minimize the problem of constructing trunk facilities that are undersized due to improper consideration of future development impacts requiring expensive modification or reconstruction of hydraulic facilities. There may be situations where temporary flood control structures are cost effective.

In summary, land use data to be used will include 5 and 20 year planning periods and ultimate development conditions. The 5 and 20 year data will be used for development of the CIP. Ultimate development data will be used in establishing peak discharges and maximum runoff volumes for the planned facilities.

For both purposes, the planning data needs to be as specific as possible with respect to location and type of development that is proposed for each portion of the study area. These data are more critical to the development of the hydrologic models which will require specific inputs of location and percentage of impervious cover and drainage improvements. The ability of the model to accurately predict runoff response from a specific watershed will depend upon the assumptions made regarding location and type of development and drainage improvements. Because of the uncertainty in any assumptions regarding future land use, it may be appropriate to incorporate conservative assumptions in developing hydrologic models to represent the ultimate development conditions.

LEVEL OF PROTECTION AND ANALYSIS DETAIL

Each area within Washoe County was evaluated for applicable level of plan detail and level of flood control protection appropriate to that area. The following sections describe the process used to accomplish this purpose.

Design Event

The design event to be used in planning all primary flood control facilities is the 100-year event. The 100-year event is defined as an event which would have a 1% chance of being equalled or exceeded during any given year.

In the absence of sufficient flow data to estimate the 100-year discharge value using statistical methods, it is generally assumed that a 100-year rainfall event on a watershed will be used to estimate a 100-year peak discharge. The limitations of this assumption are recognized. Careful consideration must be given to assumptions regarding watershed conditions and type of storm event and duration to use in the analysis of the watershed for the Final Flood Control Master Plan. For the Concept Level Master Plan, 100-year discharges were estimated using regional methods.

Methods for Identification of Appropriate Analysis Methodology and Detail

Each area within the County was evaluated to determine the appropriate level of detail for the hydrologic analysis. The level of detail was based on a series of evaluation criteria established for classifying each hydrologic basin in Washoe County. Using a numerical ranking system from one to three, each basin was placed within a category level which indicates the study criteria to be applied to that area.

Evaluation Criteria. The evaluation criteria to be used for categorizing each area of the County may include:

- Presence of existing development or important transportation facilities.
- Proposed rate of growth for the 5 and 20 year planning periods.
- Number of existing flooding problems and relative seriousness of those problems.
- Impact of future development on existing flooding problems.
- Relative cost and effectiveness of structural or nonstructural measures which would eliminate potential flooding damages.
- Size of drainage area or magnitude of flow.
- Presence or existing drainage facilities.

Planning studies, maintenance reports, aerial photos and site investigations were used to obtain the necessary data for each area. The results of this evaluation is presented in Chapter 3.

METEOROLOGICAL ANALYSIS

Defensible rainfall data are a critical component of the hydrologic modeling that will be performed to estimate 100-year peak discharge values to be used in the Final Flood Control Master Plan. The rainfall data that are currently available for the study area is not sufficiently defensible to perform reliable hydrologic analyses for the study area. Rainfall event characteristics which are important for hydrologic modeling and must be prepared include:

- Duration of rainfall for typical types of storm events and seasons.
- Point rainfall depths and/or intensities for various return periods.
- Time distribution of rainfall.
- Storm size (spatial distribution of rainfall).
- Storm movement.
- Snow pack variability.

Much of this information is not currently available in the format or accuracy level required for the hydrologic modeling effort. A meteorological analysis will be performed during the next phase of the project to identify these design event characteristics.

Products of the Meteorologic Analysis

The products of the meteorologic analysis will include:

- Identification of Differences in Winter and Summer Storm Events
  - Differences in duration
  - Differences in peak intensity
  - Differences in aerial extent
- Intensity-Duration-Frequency and Depth-Duration-Frequency Data
  - Winter (wet season or general rain events) data
  - Summer (dry season or thunderstorm events) data
- Time Distribution For Important Types of Events
  - Winter distributions (eg. 10 day, 3 day, 24 hour and 6 hour)
  - Summer distributions (eg. 3 and 6 hour)
- Spatial Distributions.
  - Depth-area reduction factors for winter events
  - Depth-area reduction factors for summer events
  - Typical storm movement patterns
  - Variation in depth and intensity with elevation and location

- Snow
  - Snow pack data for annual and selected recurrence intervals
  - Variation in snowline with time of year
- Flood Warning System Evaluation and Recommendations (Optional)

HYDROLOGIC ANALYSIS

The hydrologic analysis will be performed in two phases; preliminary assessment of deficiencies and Final Flood Control Master Plan. As indicated in the Flood Control Master Plan Policy Statement, the preliminary assessment of deficiencies will be used in preparation of a Conceptual Level Flood Control Master Plan. The conceptual level master plan will identify the major flood control improvements required and identify approximate capital improvement costs. The Final Flood Control Master Plan will present the results of a more detailed hydrologic analysis (for both existing and ultimate development conditions) and the recommended flood control improvements.

Preliminary Assessment of Deficiencies

For the Concept Level Master Plan, existing hydrologic data was used to develop a regional relationship between watershed area, average stream slope, 100-year rainfall depth and 100-year peak discharge. This regional relationship was used to estimate peak discharges for portions of the study area where reliable peak discharges were not available. Data used in preparing the regional relationship was taken from several past hydrology studies. A more detailed description of the hydrologic methods used, is contained in Chapter 4. Studies used in the development of approximate peak discharges for the study area included:

- Corps of Engineers Truckee River hydrology (1980 report and subsequent studies)
- Thomas Creek Detention Feasibility Study
- FEMA Flood Insurance Studies
- Huffaker Hills detention feasibility study
- Statistical analyses conducted by the USGS
- Other studies by local consulting engineers

From this review, preliminary estimates of peak discharges were made and used to identify existing drainage structures which have inadequate capacity.

Methods of Analysis for Final Flood Control Master Plan

Hydrologic analysis for the Final Flood Control Master Plan will be at the detail level identified by the category of the area (See Section 4.2). The level of detail will vary from the use of a more detailed analysis in areas such as the Truckee Meadows to the use of approximate methods in areas such as portions of northern Washoe County.

For watersheds to be studied in detail, the 100-year peak discharge and/or runoff volume will be based upon a 100-year precipitation event and will be computed using the Corps of Engineers Flood Hydrograph Package, HEC-1. The HEC-1 model includes a variety of techniques for computing a flood hydrograph. The technique chosen for any analysis will depend upon available data. Techniques such as the SCS Curve Number method, the S-Graph Method (used in the Corps of Engineers models for the Truckee River system), and the Kinematic Wave method (for urban areas) will be evaluated for applicability to the study area.

Model Documentation

The models developed for the Final Flood Control Master Plan will be developed with the appropriate level of detail and documentation to allow the models to be used in the future for evaluation of proposed system modifications. The input data for each HEC-1 model will make use of comment records to explain methods of analysis, purpose of the model segment, source of data, etc. This will allow public works staff or future consultants to explore the impacts of various modifications to watershed conditions or system elements on downstream facilities. The technical appendix will also include documentation on sources of data and documentation of methods applied in development of the models.

Analysis of Closed Basin Lakes (Playas)

Closed basin lakes such as Silver Lake and the playas in Lemmon Valley and Cold Springs Valley present a unique type of flooding hazard and require unique methods of analysis and flood control solutions. Evaporation and infiltration are typically the means of discharge from a closed basin lake. As a result the lake can contain a certain amount of existing storage from the previous year. Extreme events which produce high runoff volumes typically are produced by weather patterns which can result in more than one significant rainfall event in the watershed contributing to the lake. Therefore, the 100-year volume (and resulting lake level) will likely result from carry over storage from the previous year plus the volume produced by an extreme event followed by a lesser event. Statistical methods would be the most accurate method of

developing a 100-year lake level for a closed basin lake. However, statistical methods require a significant period of record of historic lake levels. In the absence of such data, runoff volumes must be estimated using a hydrologic model.

The HEC-1 models developed for Silver Lake and Lemmon Valley playa as a part of the FY86 FIS will be utilized as appropriate for the Flood Control Master Plan. Any additional data not utilized in the preparation of the FIS model will be considered for inclusion or modification to the original analysis if deemed appropriate. Other closed basin lakes in the study area will be modeled using the same methods applied to Silver Lake and Lemmon Valley playas.

HYDRAULIC ANALYSIS

Various parts of the existing system were inventoried to determine the size and type of drainage structures presently constructed within the regional watercourses. Hydraulic analysis was performed only to the extent necessary to determine hydraulic capacity of culverts, bridges, channels and other hydraulic structures.

Hydraulic Analysis of Culverts

Hydraulic analysis of standard culverts was performed using the Federal Highway Administration, Hydraulic Design Series No. 5, Hydraulic Design of Highway Culverts (1985).

Hydraulic Analysis of Bridges and Unusual Hydraulic Structures

Hydraulic analysis of bridges and unusual hydraulic structures were performed with other applicable methods (or based upon existing analyses) such as a standard step backwater computations or other techniques as appropriate to the application and level of accuracy required.

Hydraulic Analysis of Channels

Hydraulic analysis of existing channel systems were necessary only to the extent necessary to determine the capacity of the system and to determine the net benefit (or impact) of flood control improvement options. Wherever possible, existing HEC-2 models that have been developed for natural channels were obtained for use in the study. Existing HEC-2 models include portions of the following watercourses:

- Truckee River (Original FIS, FY86 FIS and Corps of Engineers)
- Steamboat Creek (FY86 FIS, Corps of Engineers, Nimbus Engineers)
- Thomas Creek (FY88 FIS)
- Dry Creek (Original FIS and FY88 FIS)

- North Truckee Drain (FY86 FIS)
- Spanish Springs Area (FIS by Boyle Engineers and Spanish Springs Flood Control Master Plan)

For the Final Flood Control Master Plan, hydraulic analysis for proposed channel improvements will be performed only to the level of detail required to evaluate the feasibility of the proposed improvements. Standard methods of hydraulic analysis will be used. The Corps of Engineers Water Surface Profile Program HEC-2 will be used when a more detailed analysis is required or significant backwater effects need to be quantified. If HEC-2 is used, the model will be documented and provided to the agencies for future use.

Hydraulic Analysis of Storm Drains

When analysis of storm drain systems are necessary for the Final Flood Control Master Plan, the standard step approach will be used for systems which are flowing full. For partially full systems, Manning's equation will be used. It is anticipated that analyses of storm drains will be minimal since storm drains will not likely be included as flood control options in the Master Plan.

Analysis of Alluvial Fans

Alluvial fans are formed by deposition of sediments by streams emerging from the mountain front onto the shallower slopes of the valley floor. Active alluvial fans are undergoing a constant building process and are being reshaped by the deposition of sediments and the redistribution of those sediments with each significant event. Analysis of flow processes on active alluvial fans is difficult because of the random nature of the flow patterns on alluvial fan surfaces. In addition to flooding hazards, structures located on active alluvial fan surfaces can be subject to significant mud flow or debris flow hazards.

The Federal Emergency Management Agency (FEMA) has developed methods of identifying flooding hazards on alluvial fan surfaces. The FEMA method uses a probabilistic approach to identify potential depths and velocities of flow on each portion of the fan surface.

For portions of the study area where alluvial fan hazards are not identified, the FEMA method will be utilized if identification of net benefits of a proposed flood control improvement is necessary or if regulation is a more appropriate flood control measure. In such instances, submittal of these analyses to FEMA for inclusion on the Flood Insurance Rate Maps will be considered. Other areas may be identified for FEMA re-study requests.

The watercourses within Washoe County which have been studied with the FEMA alluvial fan methods include Evans Creek and Thomas Creek.

not whites >

FLOOD CONTROL OPTIONS - DESIGN CONSIDERATIONS

In order to develop cost effective flood control options, various methods of flood control should be explored. The methods to be explored for each area will include both structural and nonstructural types of methods. The recommended plan for each area should be a method that achieves the necessary goal, is cost effective, is constructable or enforceable, is maintainable and is compatible with the needs and desires of the affected citizens.

Structural Flood Control Improvements

The types of structural flood control improvements to be considered include:

- Open channels (lined or unlined)
- Detention basins
- Retention basins/Infiltration basins
- Debris basins
- Levees and diversion dikes
- Interbasin diversion
- Storm drains / Closed conduit
- Bridges and culverts

Non-structural Flood Control Measures

The types of non-structural flood control measures to be considered include:

- Land Acquisition
- Relocation
- Regulation (onsite detention/retention, zoning, flood plain mapping, modification of ordinances, etc.)
- Retrofitting existing structures (flood proofing)
- Flood warning
- Flood insurance
- Use of vegetation for slope stabilization

Special Cases

There are several unusual flooding sources that warrant additional consideration in the selection of flood control options. These special cases include: alluvial fans, closed basin lakes and irrigation ditches. Flood control options evaluated for these areas must consider the unique nature of the flooding problem and existing conditions.

Alluvial Fans. As indicated in section 7.5, flooding associated with alluvial fans is a very random process. Only a portion of the fan surface is flooded during any given event. Which portion of the fan is flooded during an extreme event is completely random on a natural alluvial fan. The FEMA method is based upon natural, active alluvial fans. The FEMA method does not account for man made improvements which may (or may not) alter the natural processes.

FEMA has maintained a policy of not revising alluvial fan flooding designations without the construction of adequate debris basins with downstream conveyance systems that will prevent the natural depositional and erosional processes from continuing on the alluvial fan surface. These types of systems will need to be considered for some areas.

Closed Basin Lakes. Flooding associated with closed basin lakes differs in many ways from the type of flooding associated with streams. Structures inundated by closed basin lakes could be flooded for days, weeks or months. The longer duration flooding often can result in complete destruction of a structure from saturation and foundation settlement or uplifting. Protection using levees can be difficult because of seepage and wave action.

Many of the closed basin lakes such as Silver Lake have considerable existing development near the lakes edge. As development continues in the watershed, runoff volumes entering the lake will increase. In some cases the developments also encroach on the lake itself resulting in slightly decreased storage. These factors will increase the 100-year lake level as development continues.

As a condition of participation in the National Flood Insurance Program, FEMA required the communities of Reno, Sparks and Washoe County to adopt ordinances that require the community to prevent an increase in the base flood elevation of more than one foot. Base flood elevations have been recently adopted by FEMA for Silver Lake and Lemmon Valley playas. The Flood Control Master Plan will need to address this problem as well as identify flood control measures for the areas surrounding these lakes.

Irrigation Ditches. Many irrigation ditches were constructed in the first half of the century to serve agricultural needs in the Truckee Meadows and Spanish Springs Valley. These irrigation ditches were constructed with a very shallow slope and therefore, have limited hydraulic capacity (generally between 50 and 150 cfs). In past years, subdivisions constructed near irrigation ditches have discharged storm drains into the irrigation ditches. During extreme events, natural surface drainage and discharge from storm drains exceeds the capacity of these ditches resulting in overtopping and breaching at random locations. When this occurs, properties below the ditches are flooded by the overflow.

The Flood Control Master Plan will need to consider this unique flooding hazard and attempt to address the hazard for critical areas.

Other Considerations and Design Constraints

Many flood control options have negative impacts on the other portions of the system or the environment which will need to be considered:

- Channelization of broad shallow floodplains (or construction of levees) can significantly increase downstream flood peaks by eliminating the natural storage in the overbanks of the floodplain.
- Improper location of detention facilities may increase downstream flood peaks or be ineffective because of the shift in timing of peak flow.
- Channelization and other improvements may have a detrimental impact on existing wetlands.
- Channelization and other improvements may increase the volume of sediment transported and impact water quality.
- The improvement may have an impact on downstream water rights.
- The improvement may not have a detrimental impact on fish and wildlife.

COST ESTIMATION

Cost estimation for construction and maintenance of flood control facilities must be performed in two phases. Preliminary (order of magnitude) costs will need to be developed with the Conceptual Level Flood Control Master Plan for the purpose of providing approximate figures to be used in the evaluation of financial alternatives. A more detailed method of estimating these costs will be performed for the Final Flood Control Master Plan.

Ultimately the costs developed will be used to evaluate financial alternatives and develop an implementation plan. The costs will need to be formatted to meet these needs. A computer database or spreadsheet format will be used to tabulate the data for the Final Flood Control Master Plan.

Costs will need to be identified by:

- Jurisdictional area
- Drainage basin or watercourse
- Type of flood control facility
- Type of improvement

Costs to be estimated for both plans will include:

- Construction costs
- Right of way, easement and land purchase, and relocation costs
- Engineering and construction management costs
- Administration and legal costs
- Contingencies
- Operation and maintenance costs

Cost Estimation for the Conceptual Level Flood Control Master Plan

The purpose of the Conceptual Level Flood Control Master Plan is to identify the most significant flood control improvement needs and estimate the capital costs and annual costs required to implement the Final Flood Control Master Plan and maintain the flood control facilities. For the Conceptual Level Flood Control Master Plan only preliminary improvement options will be identified. These options will not be the result of an alternatives evaluation process but instead may represent a non-optimal solution for the purpose of establishing approximate costs and budget data. These approximate capital improvement and annual costs will then be used in the evaluation of financial and institutional alternatives.

Construction Costs. Construction costs for the improvements identified in the Conceptual Level Flood Control Master Plan will be based on approximate unit costs for similar types of improvements. Typical unit costs will be developed based upon bid prices documented by the Nevada Department of Transportation and other available sources.

Right of Way, Easement and Land Purchase Costs. Right of way and land costs will be based on an approximate market value that will be determined using assessed value data reported by the Washoe County Assessor's Office. The assessed value will be multiplied by an approximate market value/assessed value factor. The costs for obtaining easements will be based upon a percentage of full market value.

Costs for acquisition of BLM land will need to be estimated based upon typical costs to be determined during the execution of the next task order.

Engineering and Construction Management Costs. Engineering and construction management costs will be estimated at 20% to 40% of construction cost.

Administration and Legal Costs. Administration and legal costs will be estimated at 5% to 15% of construction cost.

Contingencies. An additional 40% of construction cost will be included for additional contingencies.

Operation and Maintenance Costs. The estimate of operation and maintenance costs will be 0.5% to 2% of construction cost.

Cost Estimation for the Final Flood Control Master Plan

The cost estimation for the Final Flood Control Master Plan will be more refined than the methods used for the conceptual level plan. These methods will be defined more specifically prior to the execution of the final task order.

Construction costs will be based on more refined unit costs. The add ons for engineering, construction, administration and contingencies will also be refined and the contingency will be reduced to 30%. Operation and maintenance costs will be refined based on costs reported by similar flood control agencies located in the western United States.

CHAPTER 4

LEVEL OF ANALYSIS AND PLAN DETAIL

INTRODUCTION

This chapter describes each category for the level of analysis to be applied to the study area as well as presenting the results of the evaluation of each hydrologic province. The evaluation of analysis detail was performed by subdividing the entire County into 37 major drainage provinces. Each drainage province was reviewed to identify the location and amount of existing public and private improvements within each area which would be subject to flood damage. From this review, the recommended level of analysis detail was identified based upon three levels:

Level 1

Most detailed level of analysis and facilities planning. Seven of the 37 drainage provinces were identified for Level 1 analysis. These provinces include; Cold Springs, Lemmon and Spanish Springs Valleys, the Truckee Meadows and the Lake Tahoe and Washoe Lake areas.

Level 2

Facilities planning is limited to providing all-weather access and limited regional improvements or identification of areas requiring FEMA Flood Insurance Studies or independent studies to map areas subject to flooding. Floodplain maps for these areas would provide the communities with a tool to regulate future development in areas of significant flooding hazards. Seven of the 37 drainage provinces were included in this category.

Level 3

Analysis and facilities planning is not to be performed for these areas. Many of these areas will need to be re-evaluated in the future with the preparation of Flood Control Master Plan updates. 23 of the 37 drainage provinces were included in this category.

IDENTIFICATION OF LEVEL OF ANALYSIS DETAIL

Washoe County is approximately 6550 square miles in size. The northern three fourths of the County is sparsely populated and is 80 to 90% comprised of public lands. Private lands in this portion of the County are primarily utilized for ranching and mining purposes.

The majority of the County's population is located in the southern one fourth of the County. This portion of the County is approximately 70 to 80% privately owned.

The entire County was evaluated to determine the need for flood control improvements and analysis to support the conceptual design of these improvements. In order to accomplish this task, the County was subdivided into subareas based upon major drainage provinces for individual evaluation. These drainage provinces are shown on Sheets 1, 2 and 3 of the attached map set.

Criteria to be Used to Identify Level of Analysis

In order to rank each drainage province according to need, a preliminary three level classification system was developed. This system is described as follows:

Level 1. A level 1 area is an area with a significant amount of existing development and/or projected future development. These areas need regional flood control improvements to satisfy existing deficiencies and also have need for mitigation of the impacts from future development. These areas warrant the most detailed level of analysis in the Final Flood Control Master Plan. Hydrologic analysis for the Final Flood Control Master Plan will be accomplished using the Corps of Engineers Flood Hydrograph Package, HEC-1.

Level 2. A level 2 area contains major transportation routes which traverse the area and smaller communities or sparsely populated areas. The roadways may not provide all weather access for the populations served by these transportation facilities. Existing development may have minor drainage deficiencies or sparsely populated areas subject to flooding, but these deficiencies may not be cost effectively resolved with regional flood control facilities. Some limited flood control improvements may be warranted where the improvements will result in significant damage potential reduction or improved public safety. Flood hazard studies may be warranted in many of these areas to identify flooding hazards and provide the communities with floodplain management tools for use in regulating future development.

Level 3. A level 3 area contains only sparse improvements and transportation facilities which only serve a small number of people. Damage to these facilities should not isolate the majority of users since other exit and entrance routes are available. Regional flood control facilities would not be cost effective in Level 3 areas. No hydrologic analysis or flood control facilities planning is to be conducted at this time.

Evaluation of Study Areas

Using the criteria identified in section 1.1, each drainage province was reviewed using USGS 7.5 minute quadrangle maps, aerial photographs, and reference materials acquired as a part of the literature search. The aerial photography used as a part of this effort includes:

- Northern 3/4 (North of Latitude 40 degrees):
  8-7-85 Stereo pairs
  Scale 1:64,000 (approx)
  Source: Nevada Department of Transportation

- Southern 1/4 (South of Latitude 40 degrees):
  7-29-77 Stereo pairs
  Scale 1:34,000 (approx)
  Source: Nevada Department of Transportation

- Truckee Meadows:
  6-89 Prints
  Scale 1" = 400'
  Source: Cooper Aerial of Nevada

The results obtained from this evaluation are summarized for each area in Section 2.0.

RESULTS OF EVALUATION OF EACH STUDY AREA

Each study area was reviewed using stereo photographs, USGS topographic maps, the Nevada Bureau of Mines and Geology Land Status Map of Nevada (2nd Ed., 1972), FEMA Flood Insurance Rate Maps and other available resource materials. The area of each province was measured using a planimeter and Sheets 1, 2 and 3 from the attached map set. The approximate amount of private land was estimated based on the Land Status Map. The presence and amount of Bureau of Reclamation, Indian Reservation, Indian Trust Lands and Forest Service Lands have also been approximated and noted.

The following sections describe the results of the evaluation for each individual drainage province.

AREA 1 - WARNER VALLEY

Statistical Data:

Size of Area (within the County):	85 sq. miles
Percentage of Basin Within County:	N/A
Percentage of Private Lands:	15 %

The Warner Valley drainage area is located in the extreme northwestern part of the County. This area drains into neighboring Modoc County, California and Lake County, Oregon.

Barrel Springs Road traverses the center of the drainage area. This road provides access between Ft. Bidwell, California and ranches in northern Nevada. During extreme events this roadway would likely be sufficiently damaged to prevent access until repairs could be made. Access would be available from the south via Cederville, California and Vya, Nevada.

Existing improvements within Area 1 consist of isolated ranches with residential and ranch related facilities. The majority of these improvements do not appear to be within the most significant flood prone areas.

The FEMA Flood Insurance Rate Maps (Panel 25B) identify only a small flood hazard area located on the western border of Washoe County associated with a playa located predominantly in Modoc County, California. This flood hazard area is identified as an approximate A zone.

Recommendation: Level 3

Due to the infrequent use of roadway and limited population within Area 1, it is recommended that no flood control improvements be included in the Flood Control Master Plan within Area 1 at this time.

AREA 2 - COLEMAN VALLEY

Statistical Data:

Size of Area (within the County):	58 sq. miles
Percentage of Basin Within County:	N/A
Percentage of Private Lands:	35 %

The Coleman Valley drainage area is located on the northern boundary of the County. This area drains into Lake County, Oregon.

Improvements within this area include Route 34 and Coleman Ranch. This County maintained road provides access between Vya, Nevada and southern Oregon. Other available exit/entrance routes appear to be available.

The FEMA Flood Insurance Rate Maps (Panel 25B) identify a flood hazard area associated with Coleman Creek. This flood hazard area was identified using approximate methods.

Recommendation: Level 3

Due to the infrequent use of the roadways and limited damage potential within Area 1, it is recommended that no flood control improvements be included in the Flood Control Master Plan within Area 2 at this time.

AREA 3 - MACY FLAT

Statistical Data:

Size of Area (within the County):	25 sq. miles
Percentage of Basin Within County:	N/A
Percentage of Private Lands:	7 %
Percentage Within Antelope Range:	4 %

The Macy Flat drainage area is located at the center of the Northern border of Washoe County. This area drains into Lake County, Oregon.

With the exception of well traveled unimproved roads, no improvements could be identified within this area.

The FEMA Flood Insurance Rate Maps (Panel 50B) identify a flood hazard area associated with a small closed basin lake (playa). This flood hazard area was identified using approximate methods. Another larger playa is located in this province which is not identified on the Flood Insurance Rate Map.

Recommendation: Level 3

It is recommended that no flood control improvements be included in the Flood Control Master Plan within Area 3 at this time.

AREA 4 - SHELDON ANTELOPE RANGE

Statistical Data:

Size of Area (within the County):	346 sq. miles
Percentage of Basin Within County:	N/A
Percentage of Private Lands:	< 1 %
Percentage Within Antelope Range:	79 %

Area 4 is a very large drainage area which contributes to Lake and Harney Counties in Oregon. The majority of the drainage area is within the Charles Sheldon Antelope Range.

State Routes 8A and 34A traverse the area. These Routes provide access between Highway 140 and Vya, Nevada and Fort Bidwell, California as well as private lands in northern Nevada. Several ranches and reservoirs have also been constructed within this area.

State Routes 8A and 34A would be damage by extreme flooding events. Access appears to be available through alternate routes.

The FEMA Flood Insurance Rate Maps (Panels 50B, 75B, 125B, 150B, 225B) identify numerous approximate flood hazard areas associated with Rye Creek, Rye Creek Reservoir, Racetrack Reservoir, Catnip Creek, Round Mountain Lake, Fish Creek, Badger Creek, Swan Lake Reservoir, Fatty Martin Lake and numerous unnamed streams, playas and reservoirs.

Recommendation: Level 3

Due to the infrequent use of the roadways and limited population within Area 4, it is recommended that no flood control improvements be included in the Flood Control Master Plan within Area 4 at this time.

AREA 5 - MOSQUITO VALLEY

Statistical Data:

Size of Area (within the County):	31 sq. miles
Percentage of Basin Within County:	100 %
Percentage of Private Lands:	34 %

Area 5 is a small closed basin located in northwestern Washoe County. Several ranches are located around the parameter of Mosquito Valley. During periods of extreme lake levels in the playa, a portion of the access road leading to the ranches in the northern portion of this area, would likely be inundated. This ranch would need to gain access from the north via the unnamed roadway which provides access to Fort Bidwell, California.

The FEMA Flood Insurance Rate Maps (Panels 25 B, 100B and 125B) identify approximate flood hazard areas associated with Mosquito Lake and two unnamed playas.

Recommendation: Level 3

Due to the infrequent use of roadway and limited population within Area 5, it is recommended that no flood control improvements be included in the Flood Control Master Plan within Area 5 at this time.

AREA 6 - SURPRISE VALLEY

Statistical Data:

Size of Area (within the County):	199 sq. miles
Percentage of Basin Within County:	23 %
Percentage of Private Lands:	12 %
Percentage of Bureau of Reclamation Lands:	< 1 %

Area 6 comprises the eastern slopes of the drainage area contributing to Surprise Valley in northeastern California (Modoc County). Surprise Valley is a closed basin.

Route 8A which connects Vya, Nevada and Cederville, California, traverses the center of Area 6. Route 8A does not appear to be seriously threatened by any major drainages within Area 6. Another unimproved roadway traverses the northern portion of Area 6. Other improvements in this area include ranches and other related improvements.

The FEMA Flood Insurance Rate Maps (Panels 100B, 175B, 250B, 325B, 400B and 475B) identify approximate flood hazard areas associated with New Year Lake, Mud Lake, Carter Reservoir, the southeastern edge of Lower Lake, and the unnamed stream entering Lower Lake.

Recommendation: Level 3

Due to the infrequent use of the roadways and limited population within Area 6, it is recommended that no flood control improvements be included in the Flood Control Master Plan within Area 6 at this time.

AREA 7 - LONG VALLEY

Statistical Data:

Size of Area (within the County):	432 sq. miles
Percentage of Basin Within County:	100 %
Percentage of Private Lands:	15 %
Percentage Within Antelope Range:	1 %
Percentage of Bureau of Reclamation Lands:	< 1 %

Long Valley is a large closed basin located in northern Washoe County. The community of Vya is located near the center of this drainage area. Existing improvements within this area include several ranches and significant portions of Routes 8A and 34. Should damage to a portion of these routes occur as a result of extreme flooding events, alternative routes may be available.

The FEMA Flood Insurance Rate Maps (Panels 50B, 100B, 125B, 175B, 200B, 250B, 275B, 325B, 350B, and 425B) identify approximate flood hazard areas associated with Calcutta Lake, Cow Lake, Horse Lake, Middle Lake, Alkali Lake, Forty Nine Lake, Central Lake, East Creek and several unnamed playas and streams.

Recommendation: Level 3

Due to the infrequent use of the roadway and limited population within Area 7, it is recommended that no flood control improvements be included in the Flood Control Master Plan within Area 7 at this time.

AREA 8 - MASSACRE LAKE VALLEY

Statistical Data:

Size of Area (within the County):	170 sq. miles
Percentage of Basin Within County:	100 %
Percentage of Private Lands:	12 %
Percentage Within Antelope Range:	< 1 %

Area 8 is a closed basin located in north central Washoe County. Existing improvements include a portion of Route 8A and several ranches. Alternate access appears to be available should a segment of roadway be damaged.

The FEMA Flood Insurance Rate Maps (Panels 125B, 200B, 225B, 275B, and 300B) identify approximate flood hazard areas associated with Massacre Lake, Middle Lake, West Lake, Massacre Creek and several unnamed playas and streams.

Recommendation: Level 3

Due to the infrequent use of the roadway and limited population within Area 8, it is recommended that no flood control improvements be included in the Flood Control Master Plan within Area 8 at this time.

AREA 9 - BOULDER VALLEY

Statistical Data:

Size of Area (within the County):	92 sq. miles
Percentage of Basin Within County:	100 %
Percentage of Private Lands:	21 %

Area 9 is a closed basin located in northern Washoe County. Existing improvements consist of several unimproved roads and ranch related improvements. Hays Canyon Road which connects Route 34 with Eagleville, California traverses this area. This roadway would be damaged by extreme lake levels in Boulder Lake.

The FEMA Flood Insurance Rate Maps (Panels 325B, 350B and 400B) identify approximate flood hazard areas associated with Boulder Lake and Boulder Creek.

Recommendation: Level 3

Due to the infrequent use of the roadway and limited population within Area 9, it is recommended that no flood control improvements be included in the Flood Control Master Plan within Area 9 at this time.

AREA 10 - HIGH ROCK LAKE VALLEY

Statistical Data:

Size of Area (within the County):	561 sq. miles
Percentage of Basin Within County:	84 %
Percentage of Private Lands:	7 %
Percentage Within Antelope Range:	3 %
Percentage of Bureau of Reclamation Lands:	< 1 %

Area 10 is located on the eastern border of Washoe County. This drainage area contributes to High Rock Canyon and High Rock Lake located in Humboldt County. Route 34 and an unnamed road which connects Route 34 to Route 81, traverse the lower portion of this drainage province. These roadways would be damaged by extreme events at several locations. The location of greatest potential damage is the Route 34 crossing at Cottonwood Creek.

The FEMA Flood Insurance Rate Maps (Panels 225B, 275B, 300B, 350B, 375B, 425B, 450B, 500B, and 525B) identify approximate flood hazard areas associated with Boulder Lake and Boulder Creek.

Recommendation: Level 2

Improvements to protect Route 34 at Cottonwood Creek may need to be considered. A culvert capable of passing the 25-year event with sufficient embankment protection to prevent the 100-year overflow from damaging the roadway, may be the most appropriate flood protection measure for this roadway.

AREA 11 - DUCK LAKE VALLEY

Statistical Data:

Size of Area (within the County):	533 sq. miles
Percentage of Basin Within County:	90 %
Percentage of Private Lands:	11 %
Percentage of Bureau of Reclamation Lands:	< 1 %

Area 11 is a closed basin located near the center of Washoe County. A portion of this drainage province extends into Lassen County, California. Improvements within this area include Route 81, an unnamed roadway which connects Route 81 with Route 34 to the northeast, several ranches and ranch related improvements.

Route 81 would be damaged by extreme events on Wall Creek and Lost Creek.

The FEMA Flood Insurance Rate Maps (Panels 400B, 425B, 475B, 500B, 550B, 575B, 625B, and 650B) identify approximate flood hazard areas associated with Wall Creek, Bordwell Creek, Cherry Creek, Lost Creek, Duck Flat, Tuledad Canyon Creek, Burnt Lake and several unnamed streams.

Recommendation: Level 2

Improvements to protect Route 81 at Wall Creek and Lost Creek may need to be considered. Culverts capable of passing the 25-year event with sufficient embankment protection to prevent the 100-year overflow from damaging the roadway, may be the most appropriate flood protection measure for this roadway.

AREA 12 - HUALAPAI FLAT

Statistical Data:

Size of Area (within the County):	221 sq. miles
Percentage of Basin Within County:	70 %
Percentage of Private Lands:	20 %
Percentage of Bureau of Reclamation Lands:	< 1 %

Area 12 is located on the eastern border of central Washoe County. This drainage province extends into Humboldt and Pershing Counties. This area is a closed basin with the drainage concluding in Hualapai Flat.

Route 34 traverses the center of this province. Route 34 could potentially be damaged by several watercourses which must cross the roadway.

The FEMA Flood Insurance Rate Maps (Panels 525B, 575B, 600B, and 675B) do not identify any flood hazards within this province. Panel 525B is the only printed panel for this area. Panels 575B and 600B indicate that the entire area is Zone C (minimal flood hazards). Panel 600B is indicated as all Zone D (undetermined, but possible flood hazards).

Recommendation: Level 2

Improvements to protect Route 34 may need to be considered. Culverts capable of passing the 25-year event with sufficient embankment protection to prevent the 100-year overflow from damaging the roadway, may be the most appropriate flood protection measure for this roadway.

AREA 13 - BUCKHORN CANYON

Statistical Data:

Size of Area (within the County):	13 sq. miles
Percentage of Basin Within County:	N/A
Percentage of Private Lands:	0 %

Area 13 is a very small portion of a large drainage area primarily located in Lassen County, California. There are two lakes located within this drainage province; SOB Lake and Pilgram Lake. The drainage from this province ultimately enters Buckhorn Canyon in Lassen County.

Buckhorn Road traverses this province. This road connects Route 81 with Ravendale, California, but does not appear to be impacted by any major drainages.

The FEMA Flood Insurance Rate Map (Panel 625B) does not identify any flood hazard areas within this province. Approximate A zones should be shown for SOB Lake and Pilgram Lake.

Recommendation: Level 3

Due to the infrequent use of the roadway and limited flooding hazards within Area 13 and the lack of private lands in this area, it is recommended that no flood control improvements be included in the Flood Control Master Plan within Area 13 at this time.

AREA 14 - PAINTER FLAT

Statistical Data:

Size of Area (within the County):	26 sq. miles
Percentage of Basin Within County:	51 %
Percentage of Private Lands:	4 %

Area 14 is the eastern portion of the Painters Creek watershed. Painters Creek ultimately drains into Smoke Creek which re-enters Washoe County at the western edge of Area 15.

No significant improvements were identified within this area.

The FEMA Flood Insurance Rate Maps (Panels 625B and 700B) identify an approximate flood hazard area associated with Painters Flat.

Recommendation: Level 3

It is recommended that no flood control improvements be included in the Flood Control Master Plan within Area 14 at this time.

AREA 15 - SMOKE CREEK DESERT

Statistical Data:

Size of Area (within the County):	977 sq. miles
Percentage of Basin Within County:	87 %
Percentage of Private Lands:	5 %
Percentage Within Indian Reservation:	7 %
Percentage of Bureau of Reclamation Lands:	< 1 %

Area 15 is a very large closed basin located in central Washoe County. This area drains to the Smoke Creek Desert at the center of Area 15. Existing improvements include Route 81 which connects Gerlach and Empire, Nevada with Herlong, California and the Reno/Sparks area. Alternative access is available via Route 34 which connects Gerlach and Empire with Interstate 80.

Other improvements in this area include several ranches and ranch related improvements.

The FEMA Flood Insurance Rate Maps (Panels 625B, 650B, 675B, 700B, 725B, 750B, 775B, 800B, 825B, 850B, 875B, 925B, and 950B) do not identify any flood hazard areas within this drainage province. The majority of this area was not studied due to "insufficient data".

Recommendation: Level 3

Due to the infrequent use of the roadway and availability of alternative access routes within Area 15, it is recommended that no flood control improvements be included in the Flood Control Master Plan within Area 15 at this time.

AREA 16 - BLACK ROCK DESERT

Statistical Data:

Size of Area (within the County):	56 sq. miles
Percentage of Basin Within County:	N/A
Percentage of Private Lands:	12 %

Area 16 includes the communities of Gerlach and Empire. The principal flooding hazard identified is the alluvial fan located at the mouth of Bowen Canyon approximately 4 miles north of Gerlach.

The FEMA Flood Insurance Rate Map (Panel 750B and 825B) do not identify flood hazard areas within this area. The map panel for this area is not printed since no flood hazard areas were identified within this panel as a part of the original study.

Recommendation: Level 2

The Bowen Canyon alluvial fan should be mapped using the FEMA alluvial fan methods in order to define the hazard and provide Washoe County with a floodplain management tool for regulating future improvements in this area.

AREA 17 - SAN EMIDIO DESERT

Statistical Data:

Size of Area (within the County):	243 sq. miles
Percentage of Basin Within County:	89 %
Percentage of Private Lands:	< 1 %
Percentage Within Indian Reservation:	16 %

Area 17 drains into the San Emidio Desert. Under normal conditions, Area 17 is a closed basin. However, during very wet seasons flow will overflow the divide between the San Emidio and Black Rock Deserts and contribute to the playas in the Black Rock Desert to the northeast.

With the exception of Route 34, no significant improvements were identified in this area.

The FEMA Flood Insurance Rate Maps (Panels 825B, 875B, 900B, 950B, 975B and 1050B) do not identify any flood hazard areas within this area. This entire area has been designated as Zone C.

Recommendation: Level 3

It is recommended that no flood control improvements be included in the Flood Control Master Plan within Area 17 at this time.

AREA 18 - SKEDADDLE CREEK VALLEY

Statistical Data:

Size of Area (within the County):	42 sq. miles
Percentage of Basin Within County:	49 %
Percentage of Private Lands:	0 %

Area 18 is the eastern half of the Skedaddle Creek watershed which ultimately discharges into Honey Lake Valley. No significant improvements have been identified within this area.

The FEMA Flood Insurance Rate Maps (Panels 850B and 925B) identify an approximate flood hazard area associated with Skedaddle Creek.

Recommendation: Level 3

It is recommended that no flood control improvements be included in the Flood Control Master Plan within Area 18 at this time.

AREA 19 - DRY VALLEY

Statistical Data:

Size of Area (within the County):	42 sq. miles
Percentage of Basin Within County:	100 %
Percentage of Private Lands:	2 %

Area 19 is a closed basin located in west central Washoe County. The drainage from this area discharges into a playa in the center of Dry Valley. No significant improvements were identified in this area.

The FEMA Flood Insurance Rate Maps (Panels 850B and 925B) do not identify any flood hazard areas in this area. The eastern half of the area was not mapped due to "insufficient data".

Recommendation: Level 3

It is recommended that no flood control improvements be included in the Flood Control Master Plan within Area 19 at this time.

AREA 20 - HONEY LAKE VALLEY

Statistical Data:

Size of Area (within the County):	191 sq. miles
Percentage of Basin Within County:	N/A
Percentage of Private Lands:	40 %
Percentage Within Indian Reservation:	3 %

Area 20 is the eastern portion of the Honey Lake Valley. Drainage from this area ultimately discharges into Honey Lake in Lassen County, California. There are many private and public improvements within this area including; Wendel Road and several other County roads, Western Pacific Railroad, Southern Pacific Railroad and several ranches.

The FEMA Flood Insurance Rate Maps (Panels 925B, 1000B, 1025B and 1075B) identify an approximate flood hazard area associated with Honey Lake Valley.

Recommendation: Level 3

Due to the limited flooding hazards associated with the existing improvements, it is recommended that no flood control improvements be included in the Flood Control Master Plan within Area 20 at this time.

AREA 21 - PYRAMID LAKE VALLEY

Statistical Data:

Size of Area (within the County):	794 sq. miles
Percentage of Basin Within County:	100 %
Percentage of Private Lands:	10 %
Percentage Within Indian Reservation:	70 %

Area 21 is the lower portion of the Truckee River watershed which terminates at Pyramid Lake. The majority of the existing improvements located in this area, are within the boundaries of the Pyramid Lake Indian Reservation.

The FEMA Flood Insurance Rate Maps (Panels 950B, 975B, 1000B, 1025B, 1050B, 1100B, 1125B, 1175B, 1200B, 1225B, 1300B, 1325B, 1400B, and 1405B) identify approximate flood hazard areas associated with Mullen Creek, Perry Canyon Creek and a playa in Little Valley.

Recommendation: Level 3

Due to the limited number of improvements outside of the Reservation boundary, it is recommended that no flood control improvements be included in the Flood Control Master Plan within Area 21 at this time.

AREA 22 - WINNEMUCCA LAKE VALLEY

Statistical Data:

Size of Area (within the County):	188 sq. miles
Percentage of Basin Within County:	52 %
Percentage of Private Lands:	5 %
Percentage Within Indian Reservation:	41 %

Area 22 is a closed basin on the eastern boundary of Washoe County. Prior to the irrigation diversions in the early 1900's Pyramid Lake would periodically overflow into the Winnemucca Lake Valley which supported a large lake surface during most years. Since Pyramid Lake no longer contributes to Winnemucca Lake Valley, Winnemucca Lake is now a dry lake bed.

The only significant improvement in this area is Route 34. Route 34 is impacted by relatively small drainages originating in the Lake Range to the east.

The FEMA Flood Insurance Rate Maps (Panels 900B, 975B, 1050B, 1125B, 1200B and 1225B) are not printed map panels. Therefore, there are not any identified flooding hazards in Area 22.

Recommendation: Level 3

Due to the limited flooding hazards within Area 22, it is recommended that no flood control improvements be included in the Flood Control Master Plan within Area 22 at this time.

AREA 23 - DRY VALLEY

Statistical Data:

Size of Area (within the County):	89 sq. miles
Percentage of Basin Within County:	N/A
Percentage of Private Lands:	18 %

Area 23 is the eastern extreme of the Long Valley watershed which ultimately discharges into the Honey Lake Valley. Improvements within this area consist of unimproved roads such as Dry Valley Road and several ranch improvements.

The FEMA Flood Insurance Rate Maps (Panels 1075B, 1100B and 1150B) identify approximate flood hazard areas associated with Dry Valley Creek and North Fork of Dry Valley Creek.

Recommendation: Level 3

Due to the infrequent use of the roadways and limited population within Area 23, it is recommended that no flood control improvements be included in the Flood Control Master Plan within Area 23 at this time.

AREA 24 - UPPER LONG VALLEY

Statistical Data:

Size of Area (within the County):	20 sq. miles
Percentage of Basin Within County:	N/A
Percentage of Private Lands:	40 %
Percentage of Indian Trust Lands:	< 1 %

The portion of Area 24 within Washoe County is the extreme eastern portion of the Upper Long Valley drainage area. No significant improvements have been identified within this area.

The FEMA Flood Insurance Rate Maps (Panels 1150B, 1250B and 1350C) identify approximate flood hazard areas associated with Red Rock Canyon Creek.

Recommendation: Level 3

It is recommended that no flood control improvements be included in the Flood Control Master Plan within Area 24 at this time.

AREA 25 - RED ROCK VALLEY

Statistical Data:

Size of Area (within the County):	42 sq. miles
Percentage of Basin Within County:	100 %
Percentage of Private Lands:	35 %

Area 25 ultimately discharges into Upper Long Valley at the northeast corner of Area 24. The Red Rock Valley has been undergoing slow to moderate residential development over the past 15 years. There are a significant number of existing roadway and residential improvements within this area and many of these improvements are located within flood prone areas.

The FEMA Flood Insurance Rate Maps (Panels 1150B and 1250B) identify approximate flood hazard areas associated with Red Rock Canyon Creek.

Recommendation: Level 2

Due to the development potential and amount of existing improvements subject to flooding damage, it is recommended that Area 25 be included in the Flood Control Master Plan as an area warranting detailed floodplain mapping. Accurate identification of flood hazards would provide floodplain management tools for Washoe County to use in regulating future development in these areas. This information would also provide home owners who would be subject to flood damage with sufficient technical information to use in evaluating appropriate flood protection measures for improvements on their property.

AREA 26 - BEDELL FLAT

Statistical Data:

Size of Area (within the County):	51 sq. miles
Percentage of Basin Within County:	100 %
Percentage of Private Lands:	9 %

Area 26 ultimately discharges into Red Rock Canyon Creek in Area 25. This area includes some unimproved roads and ranch improvements.

The FEMA Flood Insurance Rate Maps (Panels 1150B, 1175B and 1250C) identify approximate flood hazard areas associated with Red Rock Canyon Creek.

Recommendation: Level 3

Due to the infrequent use of the roadways and limited population within Area 26, it is recommended that no flood control improvements be included in the Flood Control Master Plan within Area 26 at this time.

AREA 27 - WARM SPRINGS VALLEY

Statistical Data:

Size of Area (within the County):	265 sq. miles
Percentage of Basin Within County:	100 %
Percentage of Private Lands:	67 %

Area 27 is a large drainage area in south central Washoe County. This area ultimately discharges to Mullen Creek and into Pyramid Lake near Sutcliff. This area has become a popular rural development area. Improvements include Pyramid Highway, Winnemucca Ranch Road, Whiskey Spring Road and many homes and private roads.

Extreme events, such as the February 1986 event cause damages to Pyramid Highway, overtop Winnemucca Ranch Road and result in damages to private property. Access is limited during such events.

The FEMA Flood Insurance Rate Maps (Panels 1150B, 1175B, 1250C, 1275B, 1300B, 1375C, and 1400B) identify approximate flood hazard areas associated with Cottonwood Creek, Mullen Creek and several unnamed streams.

Recommendation: Level 2

Due to the limitations to access and increasing residential development, this area should be included in the Flood Control Master Plan. Flood control improvements in this area would be limited to improvements to roadways to assure all-weather access. Accurate identification of flood hazards should also be prepared to provide floodplain management tools for Washoe County for use in regulating future development in these areas. This information would also provide home owners who would be subject to flood damage with sufficient technical information to use in evaluating appropriate flood protection measures for improvements on their property.

AREA 28 - COLD SPRINGS VALLEY

Statistical Data:

Size of Area (within the County):	30 sq. miles
Percentage of Basin Within County:	98 %
Percentage of Private Lands:	60 %

Area 28 is a closed basin that contributes to the playa in Cold Springs Valley. This area has experienced increasing development pressures in recent years.

The FEMA Flood Insurance Rate Maps (Panels 1250C and 1350C) identify approximate flood hazard areas associated with the playa and the primary unnamed stream entering the playa from the north.

Recommendation: Level 1

Increasing development will result in increased runoff volumes to the playa and increased peak discharges through the existing developments where significant flood hazards currently exist. This area should be included in the Flood Control Master Plan.

AREA 29 - LEMMON VALLEY, WESTERN PART

Statistical Data:

Size of Area (within the County):	54 sq. miles
Percentage of Basin Within County:	100 %
Percentage of Private Lands:	87 %

Area 29 is a closed basin that contributes to Silver Lake. This area has experienced increasing residential and industrial development pressures in recent years.

The FEMA Flood Insurance Rate Maps (Panels 1239C, 1250C, 1243C, 1327C, 1329C, 1331C, 1333C and 1350C) identify flood hazard areas associated with Silver Lake and the adjoining playas. A flood insurance study completed in 1987 provided a base flood elevation of 4967 for Silver Lake.

Recommendation: Level 1

Increasing development will result in increased runoff volumes to Silver Lake and increased peak discharges through the existing developments. This area should be included in the Flood Control Master Plan.

AREA 30 - ANTELOPE VALLEY

Statistical Data:

Size of Area (within the County):	19 sq. miles
Percentage of Basin Within County:	100 %
Percentage of Private Lands:	50 %

Area 30 is a closed basin. Although much of the area is privately owned, no significant improvements were identified.

The FEMA Flood Insurance Rate Map (Panel 1250C) does not identify any flood hazard areas within this area.

Recommendation: Level 2

It is recommended that no flood control improvements be included in the Flood Control Master Plan within Area 30 at this time, but significant flood hazards be identified. Accurate identification of flood hazards would provide floodplain management tools for Washoe County to use in regulating future development in these areas. This information would also provide home owners who would be subject to flood damage with sufficient technical information to use in evaluating appropriate flood protection measures for improvements on their property.

AREA 31 - LEMMON VALLEY, EASTERN PART

Statistical Data:

Size of Area (within the County):	43 sq. miles
Percentage of Basin Within County:	100 %
Percentage of Private Lands:	75 %

Area 31 is a closed basin that contributes to a playa. This area has experienced increasing residential development pressures in recent years.

The FEMA Flood Insurance Rate Maps (Panels 1331C, 1333C, 1342C, and 1350C) identify approximate flood hazard areas associated with the unnamed stream entering the playa from the south, as well as several low areas which result in ponding. A flood insurance study completed in 1987 provided a base flood elevation of 4920 for the playa.

Recommendation: Level 1

Increasing development will result in increased runoff volumes to the playa and increased peak discharges through the existing developments. This area should be included in the Flood Control Master Plan.

AREA 32 - SPANISH SPRINGS VALLEY

Statistical Data:

Size of Area (within the County):	73 sq. miles
Percentage of Basin Within County:	100 %
Percentage of Private Lands:	80 %

Spanish Springs Valley has experienced a significant increase in development pressures since the late 1970's. Drainage from the Spanish Springs area enters the City of Sparks via North Truckee Drain. Prior to the recent construction of a regional detention facility in Spanish Springs, the North Truckee Drain did not have adequate capacity to convey 100 year discharges emanating from the Spanish Springs Valley. As development increases in the valley, the 100 year discharges will again exceed the capacity of the North Truckee Drain improvements.

The FEMA Flood Insurance Rate Maps (Panels 1275B, 1355C, 1363C, 1364C, 1365C, 1370C, and 1375C) identify approximate and detailed flood hazard areas associated with several unnamed streams in Spanish Springs Valley.

Recommendation: Level 1

Spanish Springs Valley is projected to have a significant increase in development over the next 20 years. Increased development and channelization or floodplain encroachments will result in significant increases in peak discharges in North Truckee Drain within the City of Sparks. Due to limited downstream capacity and existing flooding problems within the City of Sparks, Spanish Springs Valley must be given considerable attention in the Flood Control Master Plan.

AREA 33 - TRUCKEE CANYON

Statistical Data:

Size of Area (within the County):	83 sq. miles
Percentage of Basin Within County:	100 %
Percentage of Private Lands:	89 %
Percentage of Forest Service Lands:	10 %

Area 33 is the eastern portion of the upper Truckee River watershed. It includes Dog Valley Creek.

The FEMA Flood Insurance Rate Maps (Panels 1350C, 1427C, 1429C, 1450C and 1500B) identify approximate flood hazard areas associated with the Truckee River and several unnamed streams.

Recommendation: Level 2

Dog Valley Creek caused significant damage during the 1986 event. This area should be included in the Flood Control Master Plan. Flood control improvements in this area would be limited to improvements to roadways to assure all-weather access. Dog Creek as well as several other significant Truckee River tributaries do not presently have the flood hazards identified. Accurate identification of flood hazards should be prepared for several of these tributaries to provide floodplain management tools for Washoe County for use in regulating future development in these areas. This information would also provide home owners who would be subject to flood damage with sufficient technical information to use in evaluating appropriate flood protection measures for improvements on their property.

AREA 34 - TRUCKEE MEADOWS

Statistical Data:

Size of Area (within the County):	255 sq. miles
Percentage of Basin Within County:	100 %
Percentage of Private Lands:	88 %
Percentage of Forest Service Lands:	5 %

Area 34 includes the Reno/Sparks metropolitan area and the most densely populated area of Washoe County.

Many FEMA Flood Insurance Rate Maps have been published for this area which identify approximate and detailed flood hazard areas associated with several watercourses in the Truckee Meadows. Floodway maps have also been published by FEMA for portions of the Truckee River, Steamboat Creek, Dry Creek, Bailey Canyon Creek and North Truckee Drain.

Recommendation: Level 1

The majority of the flood control improvements to be identified in the Flood Control Master Plan would be within the Truckee Meadows.

AREA 35 - LAKE TAHEO, NORTHEAST

Statistical Data:

Size of Area (within the County):	51 sq. miles
Percentage of Basin Within County:	N/A
Percentage of Private Lands:	30 %
Percentage of State Park Lands:	12 %

Area 35 is located in the northeast quadrant of the Tahoe Basin and includes the community of Incline Village.

The FEMA Flood Insurance Rate Maps (Panels 1500B and 1550B) identify approximate flood hazard areas associated with Lake Tahoe, Incline Creek and two other unnamed drainages.

Recommendation: Level 1

The drainages in Incline Village are extremely steep and subject to high flow velocities and significant debris and sediment loads. The Lake Tahoe Basin is also the area with the most stringent water quality requirements. Flood control improvements in this area would consist primarily of debris basins and channel conveyance systems with bridges and culverts at all road crossings.

AREA 36 - WASHOE VALLEY

Statistical Data:

Size of Area (within the County):	85 sq. miles
Percentage of Basin Within County:	97 %
Percentage of Private Lands:	75 %
Percentage of State Park Lands:	15 %

Area 37 has undergone significant residential development over the last 30 years. Many of these developments were constructed without benefit of adequate drainage improvements.

The FEMA Flood Insurance Rate Maps (Panels 1511B, 1525B and 1575B) identify approximate flood hazard areas associated with Washoe Lake, Ophir Creek, Davis Creek, Franktown Creek, Sawmill Canyon Creek, Big Canyon Creek, Jumbo Grade and several unnamed drainages.

Recommendation: Level 1

The Flood Control Master Plan should include regional flood control improvements for Ophir Creek and other significant drainages in Area 36. Accurate identification of flood hazards should be prepared for several of these drainages to provide floodplain management tools for Washoe County for use in regulating future development in these areas. This information would also provide home owners who would be subject to flood damage with sufficient technical information to use in evaluating appropriate flood protection measures for improvements on their property.

AREA 37 - EAST TRUCKEE RIVER CANYON

Statistical Data:

Size of Area (within the County):	71 sq. miles
Percentage of Basin Within County:	100 %
Percentage of Private Lands:	50 %

The FEMA Flood Insurance Rate Maps identify flood hazard areas associated with the Truckee River.

Recommendation: Level 3

It is recommended that no flood control improvements be included in the Flood Control Master Plan within Area 37 at this time.

CHAPTER 5

HYDROLOGIC ANALYSIS

INTRODUCTION

Estimates of 100-year peak discharges were needed to determine approximate drainage structure sizes throughout the study area. For the Concept Level Flood Control Master Plan, only approximate 100-year values were needed. During the preparation of the final flood control master plan, hydrologic models will need to be prepared to provide more accurate hydrologic data to be used in the selection of the final master plan recommendations.

REGIONAL ANALYSIS

Approximate 100-year discharges were obtained through use of a regional analysis. Published 100-year discharges from reports prepared by the Corps of Engineers and consulting engineers were compiled for use in the analysis. The discharge value was tabulated along with quantifiable physical and meteorological characteristics of the watershed. Watershed characteristics used in the analysis included; watershed area, average stream slope, 100-year rainfall depth, length of longest watercourse, and length of watercourse to centriod of watershed. Using this data, a multiple non-linear regression analysis was performed using the discharge value as the dependant variable and various combinations of watershed data as the independent variable. The analysis that produced the best fit to the data set was used to develop a regional regression equation to be used in predicting discharge values in other regions of the study area.

Limitations of Regional Analysis

Use of a regional regression equation to estimate a 100-year discharge value results in a estimate that could be ± 50%. A regional analysis averages the unique conditions of each watershed into a single relationship or value. Such an analysis tends to disregard differences in watershed shape, channel conditions that would impact average flow velocity and other unique watershed conditions that would influence a watershed's response to runoff.

Results of the Analysis

Discharge values for watersheds with unusual conditions were removed from the data set. These consisted primarily of watersheds with large percentages of the watersheds with sheet flow conditions and unusually low 100-year discharge values. Inclusion of these watersheds in the analysis would have skewed the analysis toward the lower values.

After removal of the anomalous values, the regional regression analysis yielded the following results.

TABLE 5.1

RESULTS OF NON-LINEAR REGRESSION ANALYSIS

Number of Observations:	23
Dependant Variable:	100-year discharge (cfs)
Independent Variables:	Area (mi^2) Slope (%) 100-yr, 24 hr rainfall (in)
Range of Discharges used:	300 to 4000 cfs
Computed Statistics:	
Correlation Coefficient:	0.94
Coefficient of Determination:	0.8751
Standard Error:	424 cfs

The resulting regional regression equation is:

$$Q = 41.21\ (A)^{0.896}\ (S)^{0.297}\ (P)^{0.143}$$

Where: A = Area in square miles
S = Average stream slope in percent
P = 100-yr, 24 hr rainfall depth in inches

This equation was used to estimate discharges where acceptable discharge values had not been presented in other studies. The results of this analysis are presented in the Tables contained in Appendices B and C.

CHAPTER 6

SYSTEM INVENTORY

DESIGNATION OF REGIONAL WATERCOURSES

The watercourses within the drainage provinces identified for Level 1 analysis (as discussed in Chapter 4) were evaluated for identification as regional watercourses. A stream was identified as a regional watercourse if it met several criteria including:

- Watershed area was at least one square mile in size
- Stream crosses through more than one jurisdiction
- Stream is an important part of a larger stream system such as the Truckee River
- Stream had significant flood control considerations

Upon identification of an initial set of regional watercourses, the TAC was provided opportunity to comment on the streams selected. Some additional streams were added to the list based upon comments or requests received from the TAC.

IDENTIFICATION OF PRINCIPAL DRAINAGE STRUCTURES

The principal drainage structures on the regional watercourses were located using the USGS quadrangle maps, aerial photos, Nevada Department of Transportation (NDOT) construction drawings, Flood Insurance Studies, various other maps and field investigation. These structures were identified and tagged with a system inventory number for reference.

SURVEY OF DRAINAGE STRUCTURES

Each of the structures identified in the inventory were field surveyed (with exception to Incline Village). The field surveys were intended to collect sufficient data to establish approximate capacity of each structure. Survey data collected at each structure included; size/dimensions of culverts, culvert and channel slope, available headwater at culvert entrance, maximum flow depth for channels, condition of channel or culvert (presence of sediment, damage to structure, approximate roughness, tailwater conditions, etc), culvert entrance type, and any other relevant data. Each drainage structure was also photo-documented for future reference.

A previously conducted drainage system inventory prepared by Washoe County was used for assessing drainage system capacities in Incline Village.

HYDRAULIC ANALYSIS OF DRAINAGE SYSTEM

Using the data collected for the system inventory, each surveyed component of the drainage system was analyzed using standard methods to determine approximate hydraulic capacity. Culverts were analyzed using the methods recommended by the Federal Highway Administration (1986). Channels were analyzed using Manning's equation, assuming normal depth applies.

COMPARISON OF RESULTS TO APPROXIMATE 100-YEAR DISCHARGES

The results of the hydraulic analysis were compared to the approximate 100-year discharge estimated for the location of that component. If the approximate discharge exceeded the estimated capacity of the structure, that structure was identified as inadequate.

RESULTS

The results of the system inventory performed as a part of the Concept Level Flood Control Master Plan, are summarized in a table contained in Appendix B. The table contains a description of the structure type, size, slope (if applicable), approximate capacity and estimated peak discharge at the upstream end of the structure. These structures are sorted by identification number (first column) which can be used to locate the structure on the system inventory maps. The identification number has two parts to identify the system inventory map page number where the structure can be found and the number of the structure within that individual map page (e.g. 10-1 is structure number 1 on map page 10, Dog Creek bridge or box culvert). A reduced set of the system inventory maps are also included in Appendix B.

CHAPTER 7

FACILITY COST ESTIMATES

INTRODUCTION

Appendix C contains a table that summarizes the results of the capital cost estimates performed as a part of the Concept Level Flood Control Master Plan. These cost estimates were based upon approximate unit costs and some basic assumptions regarding topography, soils and other site conditions. Four basic types of drainage facilities were utilized in the capital program; channels, culverts/bridges, detention basins, and debris basins. The following sections describe the procedures used in estimating the costs of these facilities.

It should be understood that these estimates are based on structural solutions to conveying and or detaining flood flows for the identified drainages. Neither Kennedy/Jenks/Chilton nor the Technical Advisory Committee are recommending an overall approach of structural improvements. The estimates are intended only to define high range estimates for the implementation of the Flood Control Master Plan capital improvement program and will be revised to reflect the actual recommended facilities in the next phase of the project.

CHANNEL COST ESTIMATES

Estimates of capital cost for channels identified in the Concept Level Master Plan were based upon two basic types of channels; earthen channels with rock rip-rap erosion protection and concrete lined channels. Unit costs ($/ft) were developed for each channel type. Earthwork estimates were based upon an assumption that the cut consists of the channel template cross sectional area. Rock and concrete costs were based upon a single thickness applied to each channel geometry. Land costs were based on average land values which were based upon the Assessor's land valuation estimates.

CULVERT & BRIDGE COST ESTIMATES

Estimates of capital cost for culverts and bridges were based upon average bid prices and cost data for similar structures. The unit costs developed, also include costs of concrete, steel, excavation and reconstruction the roadway bedding and pavement. Costs for culverts quantified in cost per unit length ($/ft) for various culvert dimensions. Generally land acquisition costs were not a factor for bridges and culverts since it was assumed that the structure could be constructed within the existing right-of-way.

DETENTION BASIN COST ESTIMATES

Detention basin costs were based upon estimates of earthwork volume, approximate spillway costs and land acquisition costs. The total costs were also compared with average cost per unit volume of storage required using costs from the Thomas Creek detention study and the Dant Boulevard detention basin.

DEBRIS BASIN COST ESTIMATES

Debris basin costs were based upon a cost per unit volume of storage required using costs from similar facilities. Land costs were based on average land values which were based upon the Assessor's land valuation estimates.

CONSTRUCTION COSTS IN INCLINE VILLAGE

Construction costs in Incline Village are higher than other parts of the County due to availability of material, additional environmental measures, higher land costs and other factors. The cost estimates for Incline Village were adjusted to account for these factors.

OTHER COSTS

Contingencies, operation, maintenance, legal, administration, engineering and construction management costs were based upon percentages of capital costs mutually agreed upon by Kennedy/Jenks/Chilton and the TAC. These percentages are discussed in greater detail in Chapter 3.

APPENDIX A
PROJECT BIBLIOGRAPHY

BIBLIOGRAPHY

1. American Public Works Association, Urban Stormwater Management, Special Report No. 49, 1981.

2. American Society of Civil Engineers, Proceedings of the Conference on Stormwater Detention Facilities, Planning, Design, Operation and Maintenance, 1982.

3. American Society of Civil Engineers, Annotated Bibliography on Urban Design Storms, 1983.

4. Arizona Department of Water Resources, Design Manual for Engineering Analysis of Fluvial Systems, March 1985.

5. Arizona Highway Department, Bridge Division, Hydrologic Design for Highway Drainage in Arizona, March 1969.

6. Austin, Texas, Drainage Criteria Manual, 1988.

7. Austin, Texas, Environmental Criteria Manual, 1988.

8. Boyle Engineering Corporation, Revisions to: Addendum to the Flood Insurance Study for Washoe County, Nevada, Unincorporated Areas of February 1, 1984, June 1987.

9. Boulder County, Colorado, Boulder County Storm Drainage Criteria Manual, 1984.

10. Brown, John Webster, Incline Village, Washoe County, Nevada Drainage Study, Phase 1, October 1967.

11. Brown, John Webster, Incline Village, Washoe County, Nevada Drainage Study, Phase II, February 1970.

12. California Department of Water Resources, Rainfall Depth-Duration-Frequency for California, February 1981, Revised November 1982 and August 1986.

13. Chow, V.T., Handbook of Applied Hydrology. McGraw-Hill, New York, 1964.

14. City of Reno, Department of Engineering, An Addendum Report on Storm Drainages, Supplement to the Storm Drainage Section of the Master Plan Report on Storm Drainage and Sanitary Sewerage, October 1957, August 1963.

15. City of Reno, Department of Public Works, Engineering Division, Public Works Design Manual, July 1, 1985.

16. City of Reno, Reno City Engineer's Office, Flood Hazard Mitigation Plan, September 1986.

17. Clark County Regional Flood Control District, Rainfall for the CCRFCD Area, undated.

18. Clark County Regional Flood Control District, Hydrologic Criteria and Drainage Design Manual, Draft, March 1990.

19. Davis, D.W. 1974, Optimal Sizing of Urban Flood Control Systems, Journal of the Hydraulics Division 101, pp. 1077-1092, American Society of Civil Engineers.

20. Dawdy, D.R., Flood Frequency Estimates on Alluvial Fans, ASCE Journal of the Hydraulics Division, Volume 105 (HY11), pp. 1407-1412, 1979.

21. Dawdy, D.R., New FEMA Guidelines for Alluvial Fan Flooding, Proceedings of a Western State High Risk Flood Areas Symposium. Association of State Floodplain Managers, pp. 2-\0-22, March 1986.

22. Earthinfo, Inc., Hydrodata, USGS Daily Values, 1989.

23. Earthinfo, Inc., Hydrodata, USGS Peak Values, 1989.

24. Ekern, Michael W., Report on the February 1986 Flood in Western Nevada, National Weather Service Forecast Office - Reno, March 1986.

25. Federal Emergency Management Agency, Flood Insurance Study Guidelines and Specifications for Study contractors, September 1985.

26. Federal Emergency Management Agency, Flood Proofing Non-Residential Structures, May 1986.

27. Federal Emergency Management Agency, Design Manual for Retrofitting Flood-Prone Residential Structures, September 1986.

28. Federal Emergency Management Agency, National Flood Insurance Program and Related Regulations, Revised October 1986.

29. Federal Emergency Management Agency, Flood Insurance Study, Placer County, California, January 1987.

30. Federal Emergency Management Agency, Flood Insurance Study, Lyon County, Nevada, February 1987.

31. Federal Emergency Management Agency, Flood Insurance Study, Storey County, Nevada, Scale 1:24,000, February 1987.

32. Federal Emergency Management Agency, Flood Insurance Study for the City of Reno, Nevada, July 5, 1983, Revised April 16, 1990.

33. Federal Emergency Management Agency, Flood Insurance Study, City of Sparks, Nevada, December 1, 1983, Revised April 16, 1990.

34. Federal Emergency Management Agency, Flood Insurance Study for Washoe County, Nevada (unincorporated areas), February 1, 1984, Revised April 16, 1990.

35. Forest, Mark E., "Variability of Short- and Long-Duration 100-Year Rainfall Values in Eastern California and Western Nevada," Proceedings of the Conference on Arid West Floodplain Management Issues, Association of State Floodplain Managers, 1989.

36. Frederick, Ralph H., Interstorm Relations in Pacific Northwest, ASCE Journal of the Hydraulics Division, December 1978, pp. 1577-1586.

37. French, Richard H., Precipitation in Southern Nevada, ASCE Journal of Hydraulic Engineering, Vol. 109, No. 7, July 1983, pp. 1023-1036.

38. French, Richard M., Open-Channel Hydraulics, McGraw-Hill Book Company, New York, 1985

39. French, R.H., Hydraulic Processes on Alluvial Fans, Developments in Water Science Series, No. 31, Elsevier Science Publishers, New York, NY, 1987.

40. French, Richard H., Effect of Length of Record on Estimates of Annual Precipitation in Nevada, ASCE Journal of Hydraulic Engineering, Volume 115, No. 4, April 1989.

41. G.C. Wallace, Inc., Lewis Homes of Nevada, Lakeside Estates, Reno, Nevada, Flood Hazard Analysis, December 11, 1987.

42. Glancy, Patrick A., A Mudflow In The Second Creek Drainage, Lake Tahoe Basin, And Its Relation To Sedimentation And Urbanization, U.S. Geological Survey Professional Paper 650-C, 1969.

43. Glancy, Patrick A., Katzer, T.L., Flood And Related Debris Flow Hazard Maps, U.S. Geological Survey, 1977, 1978 and 1986.

44. Goldman, Steven J., Katherine Jackson, Taras A. Bursztynsky, Erosion and Sediment Control Handbook, McGraw-Hill, Inc., 1986.

45. Great Basin Aerial Survey Co., Spot Elevations for Lemmon Valley Playa, Scale 1" = 400', June 1987.

46. Harding Lawson Associates, Stormwater Detention Facility, Spanish Springs Valley, Construction Plans, Dated October 14, 1987.

47. Huber, Wayne C., Bedient, Philip B., Hydrology and Flood Plain Analysis, Appison-Wesley Publishing Company, 1988.

48. Kennedy Engineers, Reno Nevada, A Report on Storm Drainage and Sanitary Sewerage, October 1957.

49. Kennedy Engineers, Sparks, Nevada, A Report on Storm Drainage, June 1964.

50. Kennedy Engineers, A Report on Storm Drainage and Sanitary Sewerage, Reno-Sparks-Washoe County Metropolitan Area, January 1961.

51. Kennedy/Jenks/Chilton, Supplemental Engineering Report for Plumas/Moana Storm Drain, April 1988

52. Kennedy/Jenks/Chilton, Design Report: Dant Boulevard Storm Water Detention Dam, November 1988.

53. Kennedy/Jenks/Chilton, Supplemental Engineering Report for Plumas/Moana Storm Drain, March 1989.

54. Kennedy/Jenks/Chilton, Thomas Creek Detention Basin Study, Volume I - Report & Volume II - Technical Appendix, June 1990.

55. Kenney Aerial Mapping Inc., Aerial Photos of Spanish Springs Area.

56. Kenney Aerial Mapping Inc., Dry Creek and Thomas Creek Topographic Mapping, Scale 1" = 400', CI = 4", August 1989.

57. Kenney Aerial Mapping Inc., Topographic Mapping for Huffaker Hills Detention Site, July 1989.

58. Klieforth, Harold, Albright, William, Ashby, James, Measurement, Tabulation and Analysis of Rain and Snowfall in the Truckee River Basin, Desert Research Institute Report to Regional Administrative Planning Agency, August 1983.

59. Linsley, Ray K., Kohler, Max A., Paulhus, Joseph L.H., Hydrology for Engineers, McGraw Hill Book Company, Third Edition, 1982.

60. Los Angeles County Department of Public Works, Debris Dams and Basins Design Manual, Revised 1980.

61. Los Angeles County Department of Public Works, Hydrology Manual, 1989.

62. McCuen, R.H., Wong, S.L., Rawls, W.J., "Estimating Urban Time of Concentration", Journal of Hydraulic Engineering, ASCE, Vol. 110, No. 7, July 1984, PP 887-904.

63. McCuen, Richard H., Downstream Effects of Stormwater Management Basins, ASCE Journal of the Hydraulics Division, Vol. 105, No. HY11, November 1979.

64. Nevada, State of, Department of Conservation and Natural Resources, Division of Water Resources, Water Resources-Reconnaissance Series Report 57, A Brief Water-Resources Appraisal of the Truckee River Basin, Western Nevada, 1973.

65. Nevada, State of, Department of Conservation and Natural Resources, Division of Water Resources, Designated Groundwater Basins of Nevada, Scale 1:750,000, Undated.

66. Nevada, State of, Department of Transportation, Aerial Photography, Scale 1:30,000 & 1:60,000, 1977 and 1985.

67. Nimbus Engineers, Hydrologic analysis of Silver Lake and Lemmon Valley Playas, Revised December 1987.

68. Nimbus Engineers, Technical Appeal to the Washoe County FIS, Hydrologic Evaluation of Spanish Springs Area, Washoe County, Nevada, October 1986.

69. Nimbus Engineers, Hydrology Report for North Truckee Drain, December 1987.

70. Nimbus Engineers, Alternatives for Providing All-Weather Access to the Hidden Valley Area, February 1988.

71. Nimbus Engineers, Request for Letter of Map Revision for Evans Creek, October 1988.

72. Nimbus Engineers, Feasibility Study, Huffaker Detention Facility Near the City of Reno, Washoe County, Nevada, December 1989, Revised February 1990.

73. Nimbus Engineers, Hydrologic Analysis, Thomas Creek, Dry Creek, and Evans Creek, Washoe County, Nevada, August 1990.

74. Osborn, Herbert B., Estimating Precipitation in Mountainous Regions, ASCE Journal of Hydraulic Engineering, Vol. 110, No. 12, December 1984, pp. 1859-1863.

75. Peterson, Mark M., Short-Duration Precipitation for Billings, Montana, ASCE Journal of Hydraulic Engineering, Volume 112, No. 11, November 1986.

76. Pictorial Sciences, Inc., Aerial Photography Contour Mapping, Spanish Springs, Nevada, Scale 1:4800, September 1984.

77. Pima County Department of Transportation and Flood Control District, Hydrology Manual for Engineering Design and Floodplain Management within Pima County, Arizona, 1979.

78. Pima County Department of Transportation and Flood Control District, Drainage and Channel Design Standards for Local Drainage, 1984.

79. Pima County Department of Transportation and Flood Control District, Stormwater Detention/Retention Manual, July 1987.

80. Pyramid Engineers and Land Surveyors, North Reno Business Center, Moya Boulevard Improvements, "As-Built" plans dated February 1987.

81. The Regional Planning Commission, Reno and Sparks, and Washoe County, Growth in Washoe County 1870-1975, March 1976.

82. City of Reno Department of Planning and Community Development, Reno Policy Plan.

83. Resource Concepts, Inc., Spanish Springs Valley, Stormwater Detention Facility, Hydrologic and Hydraulic Analysis, June 1987 & July 1989.

84. SEA Inc., Feasibility Study of Flood Control in Hidden Valley, Washoe County, Nevada, January 1977.

85. SEA Inc., Reno Freeport Aircenter Unit No. 1, Sparks, Nevada, June 1978.

86. SEA Inc., Dry Creek Rerouting, Capurro Ranch, Sparks, Nevada, August 1978.

87. SEA Inc., McCarran Boulevard, Southeast Quadrant, Mira Loma Drive to Mill Street, Sparks, Nevada, January, 1981.

88. SEA Inc., Reno Aircenter Airport Access, Sparks, Nevada, April 1982.

89. SEA Inc., Tahoe/Pyramid Link Alignment Study, October 1983.

90. SEA Inc., Flood Plain Analysis for Spanish Springs Ranch, May 1984.

91. SEA Inc., Floodplain Study for Double P Development, Washoe County, Nevada, September 1985.

92. SEA Inc., Huffaker Hills Storm Drain Relief System, December 9, 1986.

93. SEA Inc., Feasibility Report Update, Sun Valley Flood Control Detention Dam, February 1987.

94. SEA Inc., Steamboat Station, Proposed Steamboat Creek and Bailey Canyon Creek Improvements, Design Report, Washoe County, Nevada, March 1987.

95. SEA Inc, Jumbo Watershed Flood Feasibility Study Final Report, Washoe County, Nevada, March 1988.

96. SEA Inc., Drainage Relief Study for Reno Rendering Plant, Manogue High School, Evans Avenue - UPRR, Our Mother of Sorrows Cemetery, November 1989.

97. Sparks Planning Department, City of Sparks, Master Plan for Growth Management.

98. Spink Corporation, Truckee River Survey, Scale 1:1,200, Contour interval, 2 feet, Reno, Nevada, 1975.

99. Summit Engineering, Paradise Pond Watershed, July 1985.

100. Summit Engineering, Hydrologic Analysis of the City of Reno's Major Drainage Basins, October 1985.

101. Towill Inc. of San Francisco, Contour Maps, Truckee River, Steamboat Creek and Tributaries, Scale 1:4,800', CI=2 feet, Reno, NV 1979.

102. TRICO International, Inc., Sky Ranch Subdivision, Flood Plain Analysis, June 1981.

103. Tung, Yeou-Koung, Point Rainfall Estimation for a Mountainous Region, ASCE Journal of Hydraulic Engineering, October 1983.

104. Tung, Yeou-Koung, Uncertainty Analysis of National Weather Service Rainfall Frequency Atlas, ASCE Journal of Hydraulic Engineering, Volume 113, No.2, February 1987.

105. Urban Drainage and Flood Control District, Urban Storm Drainage Criteria Manual, Denver Colorado, Revised 1984.

106. U.S. Department of Agriculture, Soil Conservation Service, Incline Village Watershed Investigation Report, Central Lahontan Basin, Truckee River Subbasin, Washoe County, Nevada, February 1971.

107. U.S. Department of Agriculture, Soil Conservation Service, SCS National Engineering Handbook, Section 4, Hydrology, August 1972.

108. U.S. Department of Agriculture, Soil Conservation Service, Galena Creek Watershed Investigation Report, Central Lahontan Basin, Truckee River Subbasin, Washoe County, Nevada, November 1972.

109. U.S. Department of Agriculture, Soil Conservation Service, Galena Creek Watershed Investigation Report, Central Lahontan Basin, Truckee River Subbasin, Washoe County, Nevada, November 1972.

110. U.S. Department of Agriculture, Soil Conservation Service, Soil Survey of Washoe County, Nevada, Surprise Valley-Home Camp, April 1974

111. U.S. Department of Agriculture, Soil Conservation Service, Advance Data, Soil Survey of Washoe County, Nevada, North Part, August 1977, Unpublished.

112. U.S. Department of Agriculture, Soil Conservation Service, Guides for Erosion & Sediment Control, September 1977.

113. U.S. Department of Agriculture, Soil Conservation Service, Soil Survey of Washoe County, Nevada, South Part, August 1983.

114. U.S. Department of Agriculture, Soil Conservation Service, Earth Dams and Reservoirs, Technical Release No. 60., October 1985.

115. U.S. Department of Agriculture, Soil Conservation Service, Evans Creek Watershed, Flood Management Study, Washoe County, Nevada, March 1989.

116. U.S. Department of Agriculture, Soil Conservation Service, Soil Survey of Washoe County, Nevada, Central Part, Unpublished

117. U.S. Department of the Army, Corps of Engineers, Hydrologic Engineering Center, Multiple Linear Regression, Generalized Computer Program, September 1970.

118. U.S. Department of the Army, Corps of Engineers, Hydrologic Engineering Center, Computer Program 723-X6-LZ010, HEC-1, Flood Hydrograph Package, June 1988.

119. U.S. Department of the Army, Corps of Engineers, Hydrologic Engineering Center, Computer Program 723-X6-L202A, HEC-2, Water Surface Profiles, September 1988.

120. U.S. Department of the Army, Corps of Engineers, Engineering and Design, Routing of Floods Through River Channels - EM-1110-2-1408, March 1, 1960.

121. U.S. Department of the Army, Corps of Engineers, Statistical Methods in Hydrology, January 1962.

122. U.S. Department of the Army, Corps of Engineers, Flood Proofing Regulations, June 1972.

123. U.S. Department of the Army, Corps of Engineers, Flood Proofing Systems and Techniques, December 1984.

124. U.S. Department of the Army, Corps of Engineers, Sacramento District, Floodplain Information, Truckee River, Reno-Sparks-Truckee Meadows, Nevada, October 1970.

125. U.S. Department of the Army, Corps of Engineers, Sacramento District, Flood Plain Information Report, Steamboat and Pleasant Valley,s Nevada, Steamboat Creek and Tributaries, June 1972.

126. U.S. Department of the Army, Corps of Engineers, Sacramento District, Flood Plain Information, Southwest Foothill Streams (Evans, Thomas and Whites Creeks & Skyline Wash), Reno, Nevada, June 1974.

127. U.S. Department of the Army, Corps of Engineers, Sacramento District, Phase I Inspection Report for Upper Peavine Creek Dam, Washoe County, Nevada, Nation Program for Inspection of Dams, June 1978.

128. U.S. Department of the Army, Corps of Engineers, Sacramento District, Phase I Inspection Report for Lower Peavine Creek Dam, Washoe County, Nevada, Nation Program for Inspection of Dams, November 1978.

129. U.S. Department of the Army, Corps of Engineers, Sacramento District, Phase I Inspection Report for East Wash Diversion Dam, Washoe County, Nevada, Nation Program for Inspection of Dams, November 1978.

130. U.S. Department of the Army, Corps of Engineers, Sacramento District, Phase I Inspection Report for West Wash Dam, Washoe County, Nevada, Nation Program for Inspection of Dams, November 1978.

131. U.S. Department of the Army, Corps of Engineers, Sacramento District, Truckee River, California and Nevada Hydrology, February 1980.

132. U.S. Department of the Army, Corps of Engineers, Sacramento District, Truckee Meadows Investigation (Reno-Sparks Metropolitan Area) Nevada, Information Summary on Alternatives for Flood Control and Related Water Resources Problems, July 1980.

133. U.S. Department of the Army, Corps of Engineers, Sacramento District, Design Memorandum 1 (as amended), Martis Creek Project, Hydrology: Martis Creek, Truckee River Tributaries, California and Nevada, November 1984.

134. U.S. Department of the Army, Corps of Engineers, Sacramento District, Master Report on Reservoir Regulation for Flood Control, Truckee River Reservoirs, Nevada and California, 1985.

135. U.S. Department of the Army, Corps of Engineers, Sacramento District, Truckee Meadows (Reno-Sparks Metropolitan Area) Nevada, Feasibility Study and Environmental Impact Statement, February 1985.

136. U.S. Department of Commerce, National Weather Service, Two to Ten-day Precipitation for Return Periods of 2 to 100 years in the Contiguous United States, Technical Paper No. 49, 1964.

137. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, NOAA Atlas 2, Precipitation - Frequency Atlas of Western United States, Volume VII - Nevada, 1973.

138. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Precipitation Frequency Atlas of the Western United States, Atlas 2, Volume XI, California, 1973.

139. U.S. Department of Interior, Geological Survey, Nevada Streamflow Characteristics, Water Resources-Information Series Report 28, October 1978.

140. U.S. Department of Transportation, Federal Highway Administration, Office of Engineering, Bridge Division, Hydraulics Branch, Debris - Control Structures, Hydraulic Engineering Circular No. 2, March 1971.

141. U.S. Department of Transportation, Federal Highway Administration, Hydraulic Design of Highway Culverts, Hydraulic Design Series No. 5, September 1985.

142. U.S. Department of Transportation, Federal Highway Administration, HY8 Culvert Analysis Microcomputer Program Applications Guide, May 1987.

143. U.S. Environmental Protection Agency, Stormwater Management Model, Version 4: User's Manual, August 1988.

144. U.S. Water Resources Council, Guidelines for Determining Flood Flow Frequency, Bulletin No. 17B, Revised September 1981.

145. University of California, Davis, University Extension, Flood Plain Hydrology Using HEC-1 on the IBM PC (Short Course), April 1986.

146. Viesmann, W., et al, Introduction to Hydrology, Harper and Row, Second Edition, 1972.

147. Waterresource Consulting Engineers, Virginia Foothills Flood Control Study, 1979.

148. Washoe County Department of Comprehensive Planning, Comprehensive Regional Plan.

149. Washoe County Department of Comprehensive Planning, Washoe County Area Plans.

150. Winzler and Kelly Consulting Engineers, Reno Drainage Study, Preliminary Report: Analysis of Drainage Deficiency Areas within the City Limits.

APPENDIX B
SYSTEM INVENTORY SUMMARY

WASHOE COUNTY FLOOD CONTROL MASTER PLAN
SYSTEM INVENTORY SUMMARY
KENNEDY/JENKS/CHILTON, INC.

REFERENCE NO.	TYPE	STRUCTURE DESCRIPTION	SLOPE (FT/ FT)	CAPA-CITY (CFS)	APPROX. 100 YR (CFS)
04-01	CMP	1 Cell, 36"Dia. x approx 50'L, Projecting	N/A	Min.	3200
04-02	CMP	1 Cell, 36"Dia. x approx 50'L, Projecting	N/A	Min.	2500
04-03	CMP	1 Cell, 36"Dia. x approx 50'L, Projecting	N/A	Min.	1500
05-01	RCB	1 Cell, 3'H x 4'W x 30'L	.017	85	2500
05-02	RCB	3 Cell, 4'H x 6'W x 36'L	.008	630	5400
05-03	RCB	2 Cell, 4'H x 11'W x 83'L, 45° Skew	.005	800	9000
05-04	CHANNEL	Rect., 6'D x 25'BW, Earth	.003	680	9000
06-01	CHANNEL	Trap, 2'-8'D x 15'BW x 2:1SS, Earth	.006	2000	200
06-02	CHANNEL	Trap, 5'D x 15'BW x 1:1SS, Earth	.007	600	2900
06-03	RCP	2 Cell, 30"Dia. x 180'L, Headwall	.007	60	3100
06-04	CMP	2 Cell, 24"Dia. x 40'L, Headwall	.015	50	900
06-05	CMP	2 Cell, 24"Dia. x 40'L, Headwall	Min.	30	900
07-01		Dip Section			4600
08-01	CMAP	2 Cell, 27"H x 43"W x 50'L, Headwall	.007	50	3100
08-02	RCB RCB	1 Cell, 3'H x 6'W x 70'L, Headwall 1 Cell, 3'H x 6'W x 218'L, Headwall	.001 .002	255	1200
08-03	RCP	1 Cell, 48"Dia. x 473'L, Headwall, 30° Skew	.059	170	1300

WASHOE COUNTY FLOOD CONTROL MASTER PLAN
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KENNEDY/JENKS/CHILTON, INC.

REFERENCE NO.	TYPE	STRUCTURE DESCRIPTION	SLOPE (FT/ FT)	CAPA-CITY (CFS)	APPROX. 100 YR (CFS)
08-04	CMP	1 Cell, 5' Dia. x 70'L, Headwall	.021	150	1600
08-05	CMAP	3 Cell, 40"H x 65"W x 64'L, Headwall	.009	480	1600
08-06	CMP	2 Cell, 36" Dia. x 100'L, Projecting	.020	140	600
08-07	RCP	1 Cell, 36"Dia. x 218'L, Projecting	.010	40	600
08-08	RCP	1 Cell, 30" Dia. x 84'L, Headwall	.020	55	600
08-09	CHANNEL	Trap, 5.6'D x 20'BW x 3:1SS, Grouted Riprap	.005	1000	900
08-10	CMAP	3 Cell, 44"H x 72"W x 160'L, Headwall	.004	450	900
08-11	RCP	2 Cell, 24"Dia. x 40'L, Headwall	Min.	30	900
08-12	CMP	1 Cell, 36"Dia. x 50'L, Projecting	.004	60	1000
09-01	RCB	1 Cell, 4'H x 10'W x 60'L, 30° Skew	.012	325	1800
09-02	CHANNEL	Trap, 4'D x 15'BW x 1:1SS, Earth	.010	450	1800
09-03	RCB	3 Cell, 4'H x 5'W x 32'L	.013	500	1800
09-04	CHANNEL	Trap, 4'D x 10'BW x 1:1SS, Earth	.014	370	1800
09-05	RCB	3 Cell, 4'H x 5'W x 32'L	.013	480	1800
09-06	CHANNEL	Trap, 3'D x 15' BW x 1:1 SS Earth	.006	200	2500
09-07	RCB	3 Cell, 4'H x 5'D x 32'L	.003	480	2500
09-08	CHANNEL	Trap, 4'D x 15'BW x 1:1SS, Earth	.003	250	2500

WASHOE COUNTY FLOOD CONTROL MASTER PLAN
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KENNEDY/JENKS/CHILTON, INC.

REFERENCE NO.	TYPE	STRUCTURE DESCRIPTION	SLOPE (FT/ FT)	CAPA-CITY (CFS)	APPROX. 100 YR (CFS)
09-09	RCB	3 Cell, 4'H x 5'W x 32'L	.015	260	2500
09-10	CHANNEL	Trap, 3'D x 15'BW x 1:1SS, Earth	.007	215	2500
09-11	RCB	3 Cell, 4'H x 5'W x 32'L	.013	270	2500
09-12	CHANNEL	Trap, 4'D x 15'BW x 1:1SS, Earth	.009	430	2500
09-13	RCB	3 Cell, 4'H x 5'W x 50'L, 45° Skew	.010	450	2500
09-14	CHANNEL	Trap, 5'D x 15'BW x 1:1SS, Earth	.007	590	2500
09-15	RCB	3 Cell, 4'H x 5'W x 40'L	.015	390	2500
09-16	DAM	Earth Fill, Earth Spillway			200
09-17	CMAP	1 Cell, 29"H x 42"W x 50'L, Projecting	.010	30	1000
09-18	CMAP	1 Cell, 29"H x 42"W x 46'L, Projecting	.011	45	1000
09-19	CMAP	1 Cell, 27"H x 43"W x 80'L, Projecting	.014	25	1954
09-20	CMP	3 Cell, 42" Dia. x 270'L, Headwall	.004	150	1954
09-21	RCP	3 Cell, 42" Dia. x 55'L, Headwall, 30° Skew	.002	300	1954
09-22	DAM	Earth Fill, Earth Spillway			2170
09-23	CMP	1 Cell, 42" Dia. x 35'L, Headwall	I.C.	70	1300
09-24	CMAP	2 Cell, 38"H x 57"W x 55'L, Headwall	Min.	136	1300
09-25	RCB - CMP	1 Cell, 6'H x 6'W, Transition to 6'Dia., 1700'L	I.C.	470	900

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REFERENCE NO.	TYPE	STRUCTURE DESCRIPTION	SLOPE (FT/ FT)	CAPA-CITY (CFS)	APPROX. 100 YR (CFS)
09-26	CMP	1 Cell, 36"Dia. x 60'L, Projecting	.042	65	400
09-27	CMP	1 Cell, 30"Dia. x 244'L, Headwall	.016	30	400
09-28	CAMP	1 Cell, 36"Dia. x 85'L, Improved	.009	90	400
09-29	CAMP	1 Cell, 36"H x 58"W x 60'L, Headwall	.025	100	400
09-30	CMAP	1 Cell, 36"H x 58"W x 40'L, Projecting	.008	50	400
09-31	CMAP	1 Cell, 36"H x 58"W x 60'L, Projecting	.007	100	400
09-32	CM ARCH	1 Cell, 3'H x 13'W x 40'L, Headwall	.023	300	900
09-34		Dip Section and Deversion			900
09-35	CMP	1 Cell, 4'Dia. x 65'L, Projecting	.014	200	800
10-01	RCB	1 Cell, 6.5'H x 30'W x 25'L	.008	1850	5200
10-02	RCB	3 Cell, 4'H x 9'W x 35'L	.014	820	900
10-03	RCB	1 Cell, 4'H x 6'W x 79'L	.014	240	900
10-04	RCB	1 Cell, 4'H x 6'W x 400'L	I.C.	360	900
10-05	CHANNEL	Trap, 5'D x 8'BW x 3:1SS	.017	820	1500
10-06	RCB RCB	1 Cell, 5.5'H x 17'W x 35'L 2 Cell, 5.5 x 14.5'W x 35'L	.001 .001	2100	1500
10-07	CHANNEL	Trap, 4.5'D x 8'BW x 3:1SS	.020	890	1500

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REFERENCE NO.	TYPE	STRUCTURE DESCRIPTION	SLOPE (FT/ FT)	CAPA-CITY (CFS)	APPROX. 100 YR (CFS)
10-08	RCP	1 Cell, 54" Dia. x 215'L, Projecting	.023	360	400
10-09	RCP	1 Cell, 54" Dia. x 360'L, Projecting	.025	400	400
10-10	RCP	1 Cell, 54" Dia. x 400'L, Projecting	.028	450	400
10-11	SPP	2 Cell, 8.5'Dia. x 588'L, Headwall	.051	3000	1100
10-12	CHANNEL	Trap, 4'D x 20' BW x 2:1 SS, Earth	.026	1000	900
10-13	RCB	1 Cell, 7'H x 8'W x 65'L	.015	950	400
10-14	RCB	1 Cell, 6'H x 6'W x 230'L	.010	320	1500
11-01	RCB	1 Cell, 6'H x 6'W x 400'L	.050	1020	300
11-02	DAM	Earth Fill, Rock Face, Concrete Spillway			300
11-03	CMP	1 Cell, 30" Dia. x 58'L, Headwall	.043	60	400
11-04	RCB	2 Cell, 4'H x 10'W x 80'L	.001	660	400
11-05	RCB	1 Cell, 6'H x 10'W x 450'L	.020	280	400
11-06	RCP	1 Cell, 5' Dia. x 300'L	.011	280	400
11-07	RCEP RCP	1 Cell, 43"H x 68"W x 470'L 1 Cell, 48" Dia. x 470'L	.010 .007	180	400
11-08	CHANNEL	Trap, 5.5'D x 10'W x 2:1SS, Earth	.019	970	400
11-09	RCB	1 Cell, 3'H x 10'W x 70'L	.004	300	400

WASHOE COUNTY FLOOD CONTROL MASTER PLAN
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REFERENCE NO.	TYPE	STRUCTURE DESCRIPTION	SLOPE (FT/ FT)	CAPA-CITY (CFS)	APPROX. 100 YR (CFS)
11-10	CHANNEL	Trap, 6'D x 5'BW x 2:1SS, Grout	.024	970	400
11-11	RCB	1 Cell, 3'H x 10'W x 180'L	.020	190	400
11-12	CHANNEL	Trap, 4'D x 8'BW x 1:1SS, Riprap	.009	240	400
11-13	RCB	1 Cell, 3'H x 10'W x 60'L	Min.	220	400
11-14	CHANNEL	Rect, 4'D x 12'BW, Riprap	.008	310	400
11-15	RCB	2 Cell, 2.5'H x 6'W x 90'L, 30° Skew	.001	210	400
11-16	PRECAST ARCH	1 Cell, 9'H x 24'W x 80'L	.036	2750	700
11-17	CONC BRIDGE	3 Cell, 6'H x 25'W x 28'L	.004	2500	900
11-18	RCB	1 Cell, 8'H x 10'W x 147'L 2 Cell, 9'H x 12'W x 147'L	.011	2430	1200
11-19	PRECAST ARCH	1 Cell, 7'H x 24'W x 120'L, Improved Inlet	.007	1900	1200
11-20	RCP	3 Cell, 5' Dia. x 130'L, Headwall	.031	510	500
11-21	RCB	1 Cell, 10'H x 10'W x 68'L	.049	800	1100
11-22	SPP	1 Cell, 8'Dia. x 528'L, Projecting	.030	1100	200
11-23	DAM	Earth Fill, Earth Spillway			800
11-24	CMP	1 Cell, 4'Dia. x 310'L, Projecting	.045	230	900
11-25	CMP	1 Cell, 6' Dia. x 210'L, Projecting	.029	400	900

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REFERENCE NO.	TYPE	STRUCTURE DESCRIPTION	SLOPE (FT/ FT)	CAPA-CITY (CFS)	APPROX. 100 YR (CFS)
11-26	CMP	1 Cell, 6' Dia. x 110'L, Projecting	.025	340	900
11-27	DAM	Earth Fill, Earth Spillway			900
11-28	SPP	1 Cell, 6'Dia. x 310'L, Headwall	.042	660	300
11-29	CMP	1 Cell, 7'Dia. x 136'L, Headwall	.044	350	600
11-30	DAM	Earth Fill, Conc. Spillway, Diversion/Detention			600
11-31	DAM	Earth Fill, Earth Spillway			800
11-32	RCB	1 Cell, 10'H x 10'W x 273'L, 30° Skew	.036	1450	900
11-33	CMP	1 Cell, 36" Dia. Projecting	I.C.	90	1000
11-34	RCP	1 Cell, 48" Dia. x 100'L, Projecting	.001	250	500
11-35	CMP	1 Cell, 7' Dia. x 260'L, Improved inlet	.020	900	500
11-36	CMP	1 Cell, 6'Dia. x 220'L, Projecting	.014	170	500
11-37	CMP	2 Cell, 4'Dia. x 200'L, Projecting	I.C.	480	500
11-39	CMP	2 Cell, 6' Dia. x 100'L, Projecting	.048	270	1300
11-40	DAM	Earth Fill, Rock Face, Earth Spillway			1600
11-41	CMAP	1 Cell, 44"H x 72"W x 40'L, Headwall	.010	110	1600
11-42	RCB	5 Cell, 1.5'H x 6.3'W, Storm drain inlet	I.C.	205	1600
11-43	CMAP	1 Cell, 44"H x 72"W x 32'L, Headwall	.013	200	935

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REFERENCE NO.	TYPE	STRUCTURE DESCRIPTION	SLOPE (FT/ FT)	CAPA-CITY (CFS)	APPROX. 100 YR (CFS)
11-44	RCB	2 Cell, 5'H x 12'W x 44'L, 20° Skew	.009	1300	935
11-45	CHANNEL	Trap, 4'D x 30'BW x 1:1SS, Earth	.005	1000	935
11-46	RCB	3 Cell, 5'H x 8'W x 42'L	.005	1100	935
11-47	CHANNEL	Trap, 5'D x 20'BW x 1:1SS, Riprap	.005	740	935
11-48	RCB	2 Cell			1106
11-49	CHANNEL	Trap, Grout			1106
11-50	RCB	2 Cell			1106
11-51	CHANNEL	Trap, Grass			1170
11-52	RCB	3 Cell			1170
11-53	CHANNEL	Trap, Riprap			1170
11-54	RCB	3 Cell			1170
11-55	CHANNEL	Trap, Riprap			2065
11-56	RCB	3 Cell			2065
11-57	CHANNEL	Trap, Riprap			2065
11-60	RCB	2 Cell			2243
11-61	CHANNEL	Trap, Riprap/Brush			2243
11-62	RCB	3 Cell			2243

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REFERENCE NO.	TYPE	STRUCTURE DESCRIPTION	SLOPE (FT/ FT)	CAPA-CITY (CFS)	APPROX. 100 YR (CFS)
11-63	CHANNEL	Trap			3131
11-64	WOOD BRIDGE	11'H x 12'W x 33'L	.015	1300	3131
11-65	CHANNEL	Trap, 10'D x 25'BW x 1/2:1SS, Riprap	.010	3670	3182
11-66	CMAP	1 Cell, 16'H x 24'W x 110'L, Mitered	Min.	3500	3182
11-67	RCB	1 Cell, 4'H x 12'W x 100'L	.014	470	700
11-68	RCB	3 Cell, 8'H x 12'W x 145'L, 30° Skew	.003	2630	3950
11-69	CHANNEL	Trap, 10'D x 25'BW x 1/2:1SS, Earth	.010	4300	3950
11-70	RCP RCP	2 Cell, 5' Dia. x 110'L, Projecting 2 Cell, 7' Dia. x 110'L, Projecting	.029 .025	1510	3950
11-71	CHANNEL	Trap, 10'D x 40'W x 1:1SS, Riprap	.006	4500	3950
11-72	RCB	3 Cell, 8'H x 12'W x 155'L	.003	2600	3950
11-73	CONC BRIDGE	8'H x 77'W x 57'L	Min.	2500	3950
11-74	RCB	5 Cell, 6.5'H x 12'W x 105'L	.013	4750	3950
11-75	WOOD BRIDGE	10'H x 50'W x 42'L	.007	2500	6650
11-76	CONC BRIDGE	15'H x 67'W x 28'L	.0003	2500	7000
11-77	RCP	1 Cell, 24"Dia. x 360'L, Headwall	.011	20	700
11-78	RCP	1 Cell, 24"Dia. x 270'L, Headwall	.013	20	700

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REFERENCE NO.	TYPE	STRUCTURE DESCRIPTION	SLOPE (FT/ FT)	CAPA-CITY (CFS)	APPROX. 100 YR (CFS)
11-79	RCP	1 Cell, 24"Dia., Headwall	I.C.	25	700
11-80	CMP	1 Cell, 8' Dia. x 82'L, Mitered	.021	680	500
12-01	CMP	1 Cell, 36" Dia. x 60'L, Projecting	.062	100	900
12-02	RCB	1 Cell, 5'H x 6'W x 50'L, 30° Skew	Min.	330	1000
12-03	RCB	1 Cell, 6'H x 6'W x 35'L	.011	480	300
12-04	RCB	1 Cell, 5.5'H x 10'W x 32'L	.034	590	300
12-05	RCB	2 Cell, 8'H x 10'W x 35'L	.017	1620	2000
12-06	CMP	2 Cell, 6' Dia. x 56'L, Headwall	.018	250	2000
12-07	RCB	3 Cell, 5'H x 12'W x 163'L, 20° Skew	.010	2000	2500
12-08	RCB	4 Cell, 7'H x 12'W x 72'L	.002	4000	2700
12-09	RCB	4 Cell, 7'H x 12'W x 224'L, 38° Skew	.002	3460	2700
12-10	RCB - ARCH	3 Cell, 7'H x 12'W, Transition to 8'H x 37'W Arch	.020	1000	3000
12-11	RCB	1 Cell, 4.5'H x 10.5'W x 60'L	.017	380	2200
12-12	WOOD BRIDGE	3.5'H x 13'W x 45'L	.031	500	2200
12-13	RCB	2 Cell, 4'H x 10'W x 1540'L	I.C.	800	2200
12-14	CHANNEL	Rect, 8'D x 25'BW x Vert SS, Concrete	.014	3780	2200
12-15	CHANNEL	Trap, 14'D x 15'BW x 1:1 SS, Earth	.001	2500	3950

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REFERENCE NO.	TYPE	STRUCTURE DESCRIPTION	SLOPE (FT/ FT)	CAPA-CITY (CFS)	APPROX. 100 YR (CFS)
12-16	RCB	2 Cell, 4.6'H x 8'W x 45'L, 30° Skew	Min.	250	3800
12-17	CMP	1 Cell, 36" Dia. x 30'L, Mitered	Min.	50	3800
12-18	CMP	1 Cell, 6' Dia. x 30'L, Projecting	Min.	100	3800
12-19	RCB	1 Cell, 5.5'H x 10'W x 100'L, 30° Skew	.014	650	4000
12-20	CMAP	1 Cell, 43"H x 64"W x 35'L, Headwall	.017	35	4400
12-21	CMAP	1 Cell, 36"H x 58"W x 25'L, Projecting	.004	45	4400
12-22	CMAP	1 Cell, 43"H x 64"W x 56'L, Projecting	.009	110	4400
12-23	WOOD BRIDGE	6'H x 16'W x 28'L	.014	2050	4640
12-24	CMP	3 Cell, 10' Dia. x 105'L, Mitered	.004	3000	6000
12-25	RCB	1 Cell, 5'H x 11'W x 44'L, 30° Skew	.019	510	2500
12-26	WOOD BRIDGE	1 Cell, 7'H x 12'W x 40'L	.060	650	2500
12-28	CMP	1 Cell, 48" Dia. x 30'L, Headwall	.020	75	2500
12-29	RCB	1 Cell, 3'H x 7'W x 120'L, 20° Skew	.003	135	2500
12-30	RCB	3 Cell, 5'H x 6'W x 52'L, 20° Skew	.001	780	4640
12-31	CMAP	1 Cell, 27"H x 43"W x 34'L	.041	20	3100
12-32	RCB	N/A			3100
12-33	CMP	N/A			3100

REFERENCE NO.	TYPE	STRUCTURE DESCRIPTION	SLOPE (FT/ FT)	CAPA-CITY (CFS)	APPROX. 100 YR (CFS)
12-34	CMP	2 Cell, 5' Dia. x 50'L, Mitered	.022	300	500
12-35	RCB	1 Cell, 6'H x 10'W x 47'L	.087	750	500
12-36	RCB	1 Cell, 6'H x 25'W x 80'L	.014	1270	2200
12-37	RCB	3 Cell, 7'H x 19'W x 55'L	Min.	1680	2200
12-38	CMP	N/A			3100
12-39	CMP	N/A			3100
13-01	RCB	1 Cell, 6'H x 6'W x 40'L	.058	625	2800
13-02	CONC BRIDGE	20'H x 30'W, ARCH	.050	20,000	2900
13-03	WOOD BRIDGE	7.7'H x 12.7'W x 16'L	Min.	600	3700
13-04	RCB RCB	2 Cell, 5'H x 10'W x 90'L, 30° Skew 1 Cell, 6'H x 8'W x 90'L, 30° Skew	.048 .048	1700	4900
13-05	RCB	1 Cell, 6'H x 8'W x 40'L, Headwall	.008	1020	800
13-06	WOOD BRIDGE	6.8'H x 16'W x 16L	Min.	2000	4234
13-07	CMAP	1 Cell, 57"H x 83"W x 58'L, Headwall	.049	320	1100
13-08	CMAP	1 Cell, 57"H x 83"W x 190'L, Headwall	.018	260	1400
13-09	CHANNEL/ CMAP	Trap, 8'D x 5'BW x 1:1SS, Riprap/ 1 Cell, 57"H x 83"W x 30'L, Headwall	.060	290	1400

WASHOE COUNTY FLOOD CONTROL MASTER PLAN
SYSTEM INVENTORY SUMMARY
KENNEDY/JENKS/CHILTON, INC.

REFERENCE NO.	TYPE	STRUCTURE DESCRIPTION	SLOPE (FT/ FT)	CAPA-CITY (CFS)	APPROX. 100 YR (CFS)
13-10	CMAP/ CMP	1 Cell, 57"H x 83"W x 45'L, Headwall 1 Cell, 48" Dia. x 45'L, Headwall	.005 .005	310	1400
13-11	CHANNEL	Trap, 5'D x 10' BW x 2:1SS, Earth	.010	670	1500
13-12	CMAP	1 Cell, 36"H x 58"W x 34'L, Headwall and 1 Cell, 44"H x 72"W x 34'L, Headwall	.038	150	800
13-13	CMAP	1 Cell, 36"H x 58'W x 33'L, Headwall and 1 Cell, 44"H x 72"W x 33'L, Headwall	.042 .033	145	800
13-14	CAMP	1 Cell, 36"H x 58'W x 40'L, Headwall and 1 Cell, 44"H x 72"W x 33'L, Headwall	.033 .038	210	800
13-15	CMAP	1 Cell, 44"H x 72"W x 61'L, Projecting	.013	100	800
13-16	CHANNEL	Trap, 6' Dia. x 10'BW x 2:1 SS, Earth	.015	700	4900
13-17	CMP	1 Cell, 24" Dia. x 36'L, Headwall	.045	25	500
13-18	CHANNEL	Trap, 6' D x 3' BW x 1:1 SS, Earth	.029	300	500
13-19	CMP	1 Cell, 24" Dia. x 100'L, Projecting	Min.	Min.	500
13-20	CHANNEL	Trap, 3' D x 3' BW x 2:1 SS, Earth	.017	100	500
14-01	CMP	1 Cell, 5' Dia. x 89'L	.190	60	500
14-02		N/A			
14-03	CMP	4 Cell, 48" Dia. x 94'L	.100	440	500
14-04	CMP	1 Cell, 48" Dia. x 66'L	.121	260	700

WASHOE COUNTY FLOOD CONTROL MASTER PLAN
SYSTEM INVENTORY SUMMARY
KENNEDY/JENKS/CHILTON, INC.

REFERENCE NO.	TYPE	STRUCTURE DESCRIPTION	SLOPE (FT/ FT)	CAPA-CITY (CFS)	APPROX. 100 YR (CFS)
14-05	RCB	1 Cell, 5'H x 6'W x 52'L	.050	450	700
14-06	CMP	3 Cell, 6' Dia. x 50'L	.121	600	700
14-07	CMP	1 Cell, 8' Dia. x 280'L	.091	1150	800
14-08	CMAP	1 Cell, 44"H x 72"W x 92'L	.154	220	800
14-09	CMP	2 Cell, 36" Dia. x 50'L	.050	60	900
14-10	CMP	1 Cell, 48" Dia. x 60'L	.052	90	900
14-11	RCB	1 Cell, 5'H x 10'W x 70'L	.046	475	900
14-12	RCB	1 Cell, 4'H x 6'W x 102'L	.173	300	900
14-13	CMP	1 Cell, 36" Dia. x 117'L	.111	120	900
14-14		N/A			900
14-15		N/A			900
14-16		N/A			900
14-17	CMP	2 Cell, 8' Dia. x 230'L	.047	1640	1000
14-18	RCB	1 Cell, 5'H x 7'W x 50'L	.058	50	1000
14-19	CMAP	1 Cell, 40"H x 65"W x 62'L	.017	170	1000
14-21	CMP	1 Cell, 5' Dia. x 40'L	.035	100	1000
14-22	CMP	1 Cell, 5' Dia. x 40'L	.048	150	1000

WASHOE COUNTY FLOOD CONTROL MASTER PLAN
SYSTEM INVENTORY SUMMARY
KENNEDY/JENKS/CHILTON, INC.

REFERENCE NO.	TYPE	STRUCTURE DESCRIPTION	SLOPE (FT/ FT)	CAPA-CITY (CFS)	APPROX. 100 YR (CFS)
14-24	CMP	1 Cell, 5' Dia. x 50'L	.020	125	1000
14-26		N/A			1000
14-29	CMP	1 Cell, 5' Dia. x 50'L	.058	100	1000
14-30	CMAP	1 Cell, 44"H x 72"W x 72'L	.019	200	1000
14-31	CMAP	1 Cell, 44"H x 72"W x 53'L	.068	125	1000
14-32		N/A			1000
14-33	CMP	1 Cell, 6'Dia. x 52'L	.033	390	1000
14-34	CMP	1 Cell, 6' Dia. x 56'L	.011	220	1000
14-35	RCB	2 Cell, 2'H x 3'W x 43'L	.009	90	1000
14-36	CMP	1 Cell, 30" Dia. x 133'L	.057	50	600
14-37	CMP	1 Cell, 36" Dia. x 186'L	.042	60	600
14-38	CMP	1 Cell, 36" Dia. x 81'L	.052	45	600
14-39	CMP	1 Cell, 36" Dia. x 56'L	.029	70	600
14-40	CMP	1 Cell, 36" Dia. x 48'L	.063	60	600
14-41	CMP	1 Cell, 48" Dia. x 71'L	.041	105	600
14-42		N/A			700
14-43		N/A			2000

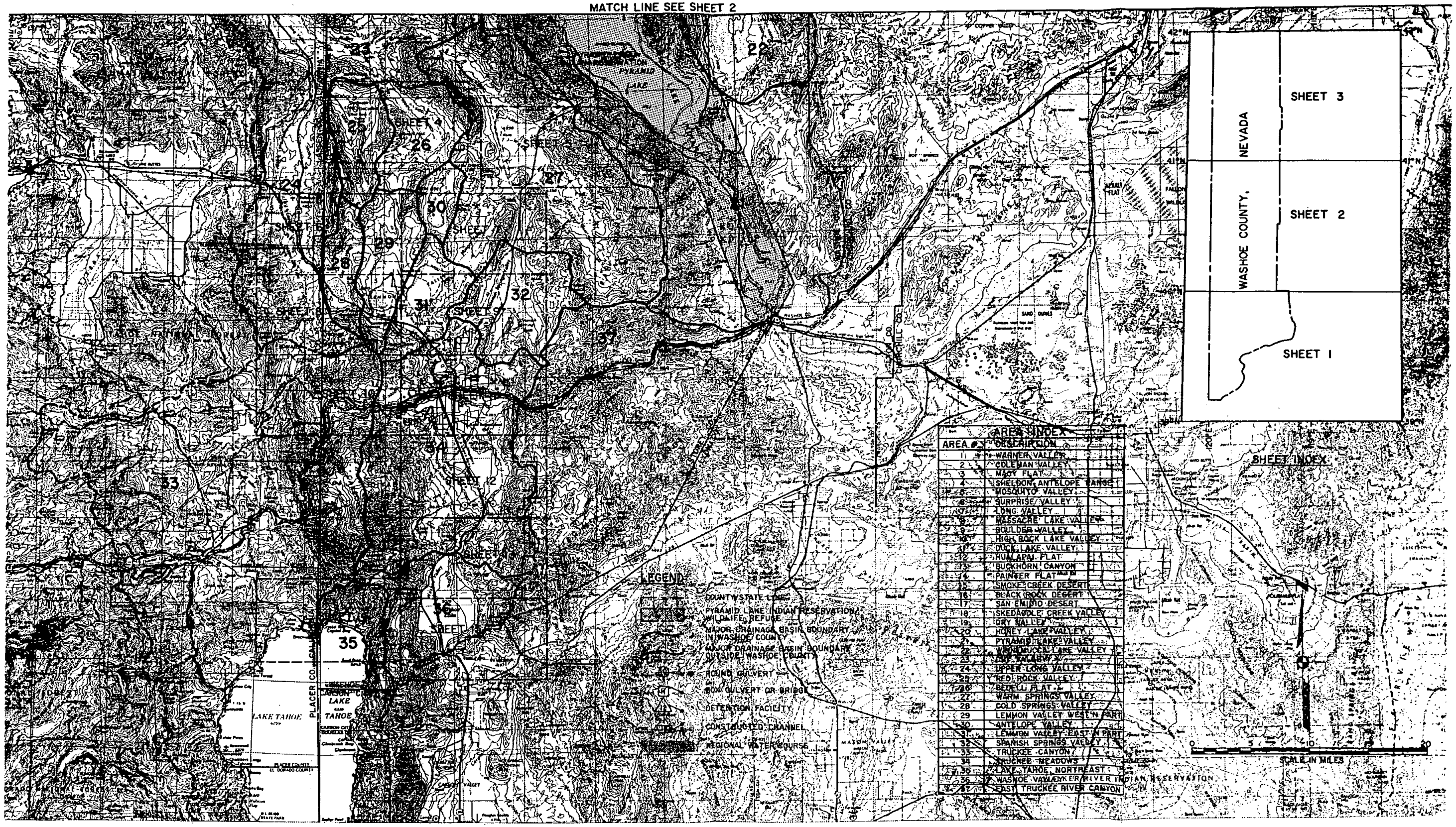
WASHOE COUNTY FLOOD CONTROL MASTER PLAN
SYSTEM INVENTORY SUMMARY
KENNEDY/JENKS/CHILTON, INC.

REFERENCE NO.	TYPE	STRUCTURE DESCRIPTION	SLOPE (FT/ FT)	CAPA-CITY (CFS)	APPROX. 100 YR (CFS)
14-44	CMP	1 Cell, 5.5′ Dia. x 65′L	.031	330	2100
14-45	CMP	1 Cell, 5.5′ Dia. x 73′L	.073	340	2100
14-46	CMAP	2 Cell, 44"H x 72"W x 69′L	.039	440	2100
14-47	CMP	2 Cell, 6′ Dia. x 89′L	.034	800	2100
14-48	CMAP	2 Cell, 44"H x 72"W x 61′L	.013	280	2600
14-49	RCB	2 Cell, 6′H x 11.5′W x 31′L	.026	1090	2600
14-50	CMP	1 Cell, 30" Dia. x 90′L	.077	40	300
14-51	CMP	1 Cell, 60" Dia. x 140′L	.075	150	400
14-52		N/A			600
14-53	CMAP	1 Cell, 36"H x 58"H x 203′L	.066	125	700
14-54	CMP CMP	1 Cell, 30" Dia. x 91′L 1 Cell, 24" Dia. x 78′L	.053 .051	90	800
14-56	CMAP	1 Cell, 44"H x 72"W x 70′L	.036	130	900
14-58	CMP	2 Cell, 24" Dia. x 34′L	.043	40	900
14-59	CMAP	1 Cell, 36"H x 58" x 40′L	.020	90	1000
14-60	CMAP	1 Cell, 36"H x 58"W x 142′L	.042	70	1000
14-61	CMAP	1 Cell, 36"H x 58"W x 70′L	.039	90	1000

WASHOE COUNTY FLOOD CONTROL MASTER PLAN
SYSTEM INVENTORY SUMMARY
KENNEDY/JENKS/CHILTON, INC.

REFERENCE NO.	TYPE	STRUCTURE DESCRIPTION	SLOPE (FT/ FT)	CAPA-CITY (CFS)	APPROX. 100 YR (CFS)
14-62	CMAP	1 Cell, 36"H x 58"W x 72'L	.051	100	1000
14-64	CMP	1 Cell, 36" Dia. x 61'L	.005	80	1000
14-65		N/A			2000
14-66	CMAP	2 Cell, 44"H x 72"W x 60'L	.023	300	2000
14-67	CMP	2 Cell, 5' Dia. x 125'L	.006	440	2100
14-68	CMP	2 Cell, 5.5' Dia. x 61'L	.010	560	2100
14-69	RCB	1 Cell, 4'H x 5'W x 37'L	.070	225	2900
14-70	CMP	1 Cell, 48" Dia. x 56'L	.029	140	800
14-71	CMP	1 Cell, 54" Dia. x 110'L	.022	160	800
14-72	CMP	2 Cell, 36" Dia. x 55'L	.038	110	800
14-73	CMP CMP	2 Cell, 36" Dia. x 39'L 1 Cell, 30" Dia. x 40'L	.013 .013	170	1000
14-74	CMP	1 Cell, 24" Dia. x 60' L	Min.	25	1000
15-01	RCB	1 Cell, 4'H x 12'W x 45'L, Headwall	.011	420	4900
15-02	CMP	1 Cell, 36" Dia. x 35'L, Headwall	.056	85	1000
15-03	RCB	1 Cell, 5'H x 6'W x 61'L	.009	360	1100
15-04	RCB	1 Cell, 4'H x 10'W x 191'L	.005	410	1100

MATCH LINE SEE SHEET 2



Rev'd	By	Date	Description
		0/90	ADDED REGIONAL WATER COURSES AND STRUCTURES

Reference Information and Notes:

U.S.G.S. 1°x2° TOPOGRAPHIC MAPS:
CHICO, CA
RENO, NV

Designed
Drafted
Checked
Date

Washoe County &
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Kennedy/Jenks/Chilton
160 Hubbard Way
Reno, Nevada 89502
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WASHOE COUNTY REGIONAL
FLOOD CONTROL MASTER PLAN

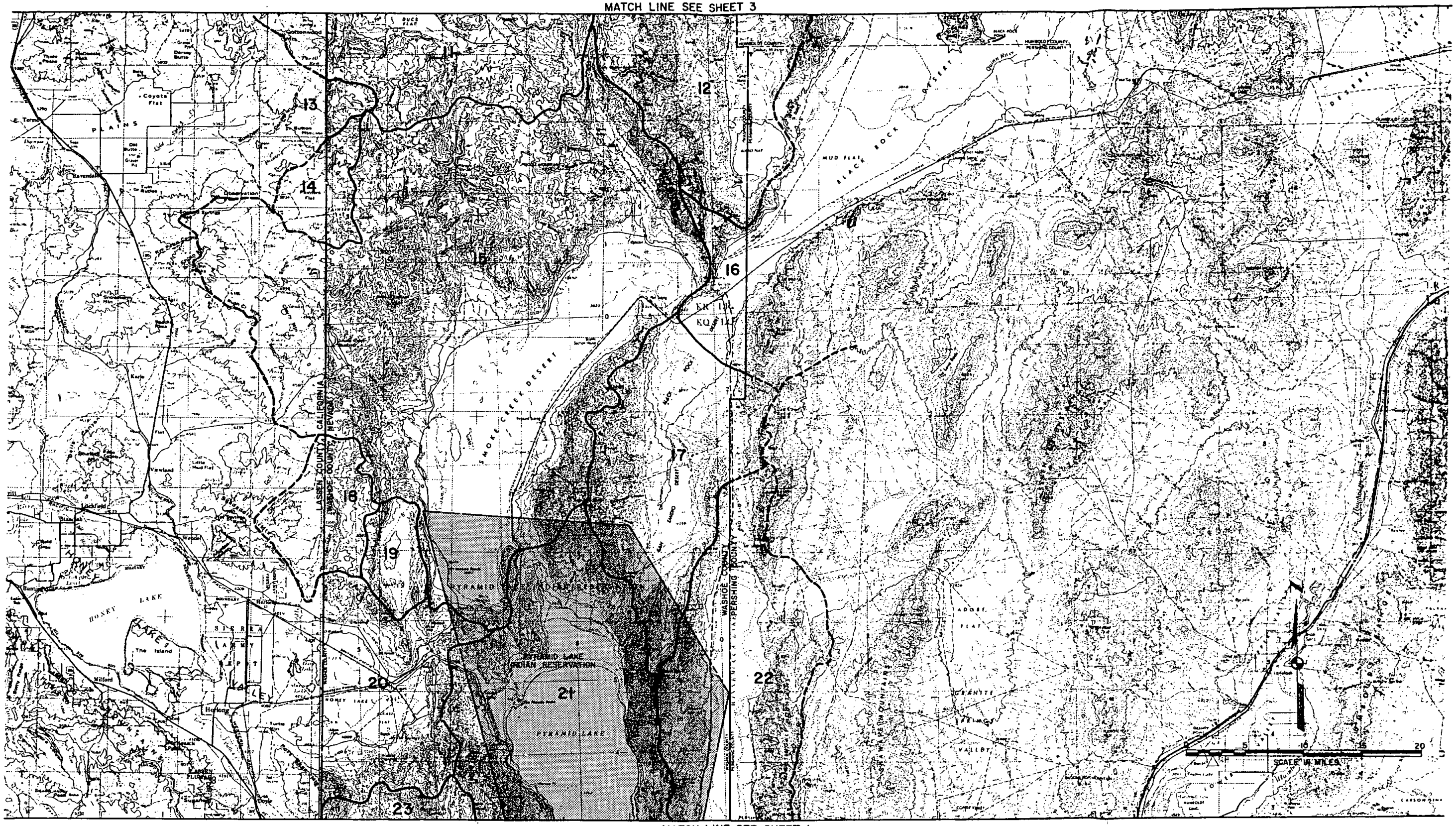
MAJOR DRAINAGE BASINS AND MAP INDEX

Drawing No.

Job No. 897043.01

Sheet 1 of 15

MATCH LINE SEE SHEET 3



MATCH LINE SEE SHEET 1

Rev'd	By	Date	Description
		6/90	ADDED REGIONAL WATER COURSES AND STRUCTURES

Reference Information and Notes:

U.S.G.S. 1°x2° TOPOGRAPHIC MAPS:
SUSANVILLE, CA
LOVELOCK, NV

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Date

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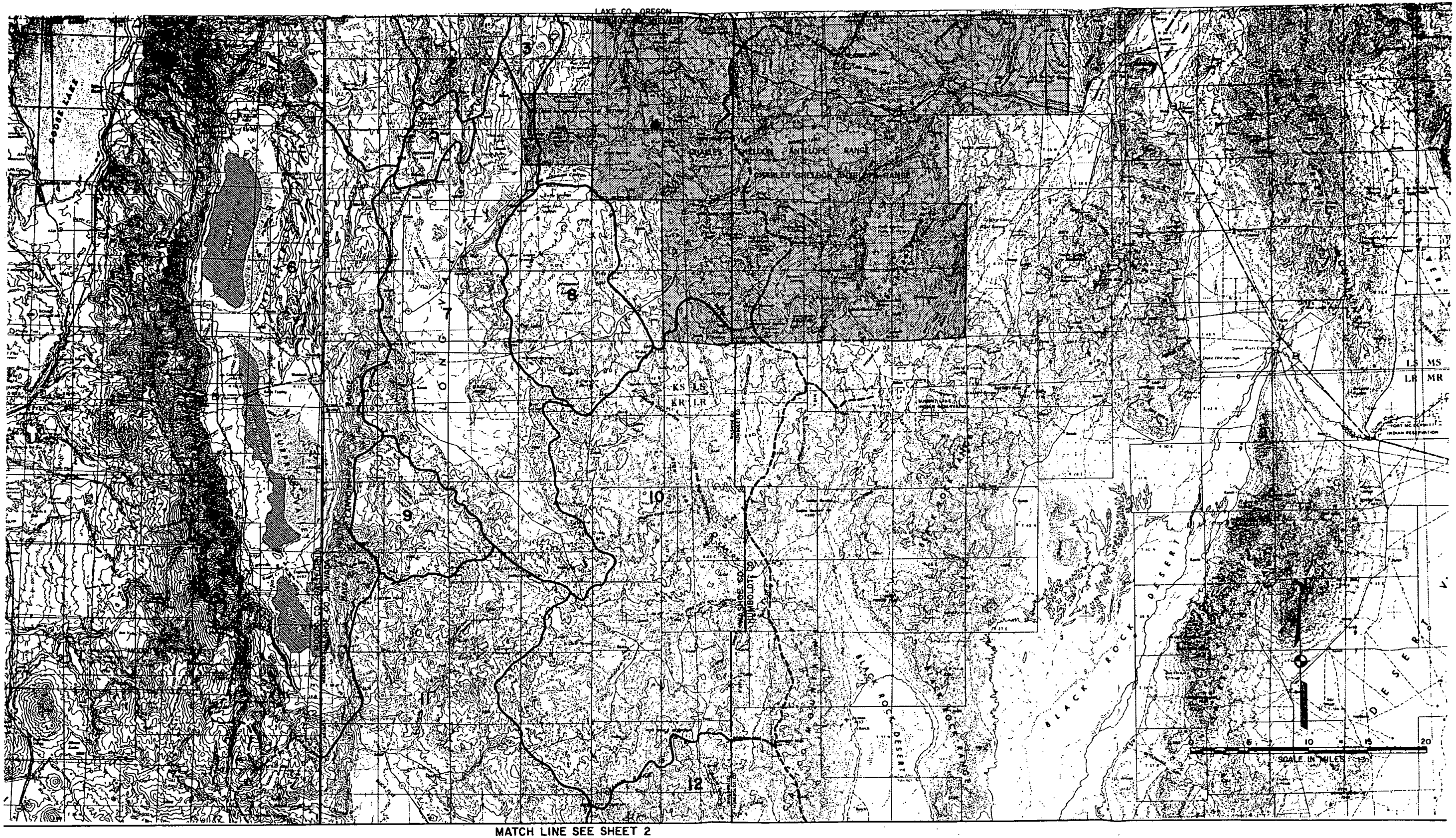
WASHOE COUNTY REGIONAL
FLOOD CONTROL MASTER PLAN

MAJOR DRAINAGE BASINS AND MAP INDEX

Drawing No.
Job No. 897043.01
Sheet 2 of 15



MATCH LINE SEE SHEET 2

Rev'd	By	Date	Description
		6/90	ADDED REGIONAL WATER COURSES AND STRUCTURES

Reference Information and Notes:

U.S.G.S. 1°x2° TOPOGRAPHIC MAPS:
ALTURAS, CA
VYA, NV

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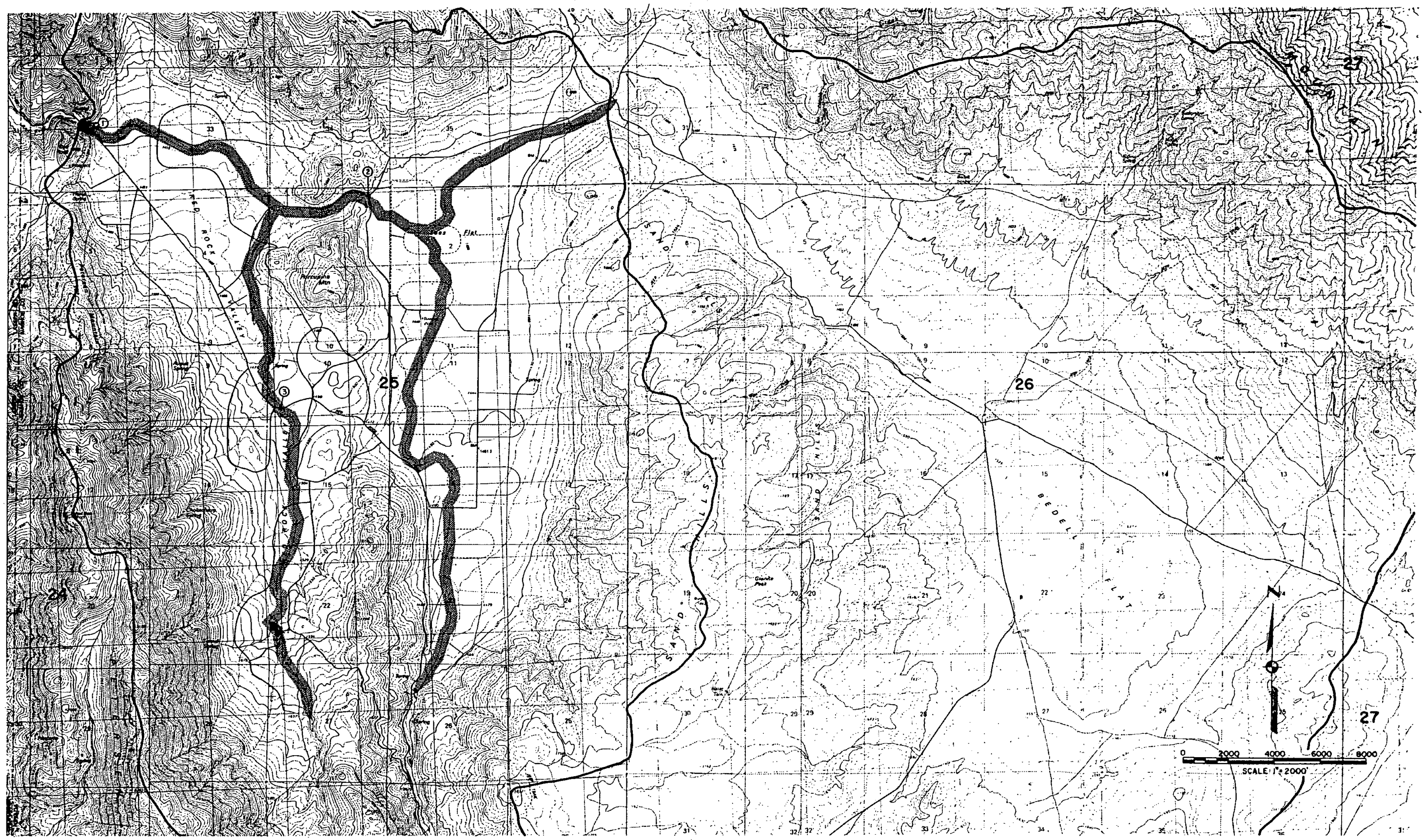
WASHOE COUNTY REGIONAL
FLOOD CONTROL MASTER PLAN

MAJOR DRAINAGE BASINS AND MAP INDEX

Drawing No.
Job No. 897043.01
Sheet 3 of 15



Rev'd	By	Date	Description
		8/90	ADDED REGIONAL WATER COURSES AND STRUCTURES

Reference Information and Notes:

U.S.G.S. 7-1/2 MINUTE TOPOGRAPHIC MAPS:
DOGSKIN MT., NV (7-1/2 x 15 MINUTE)
GRANITE PEAK, NV
BEDELL FLAT, NV

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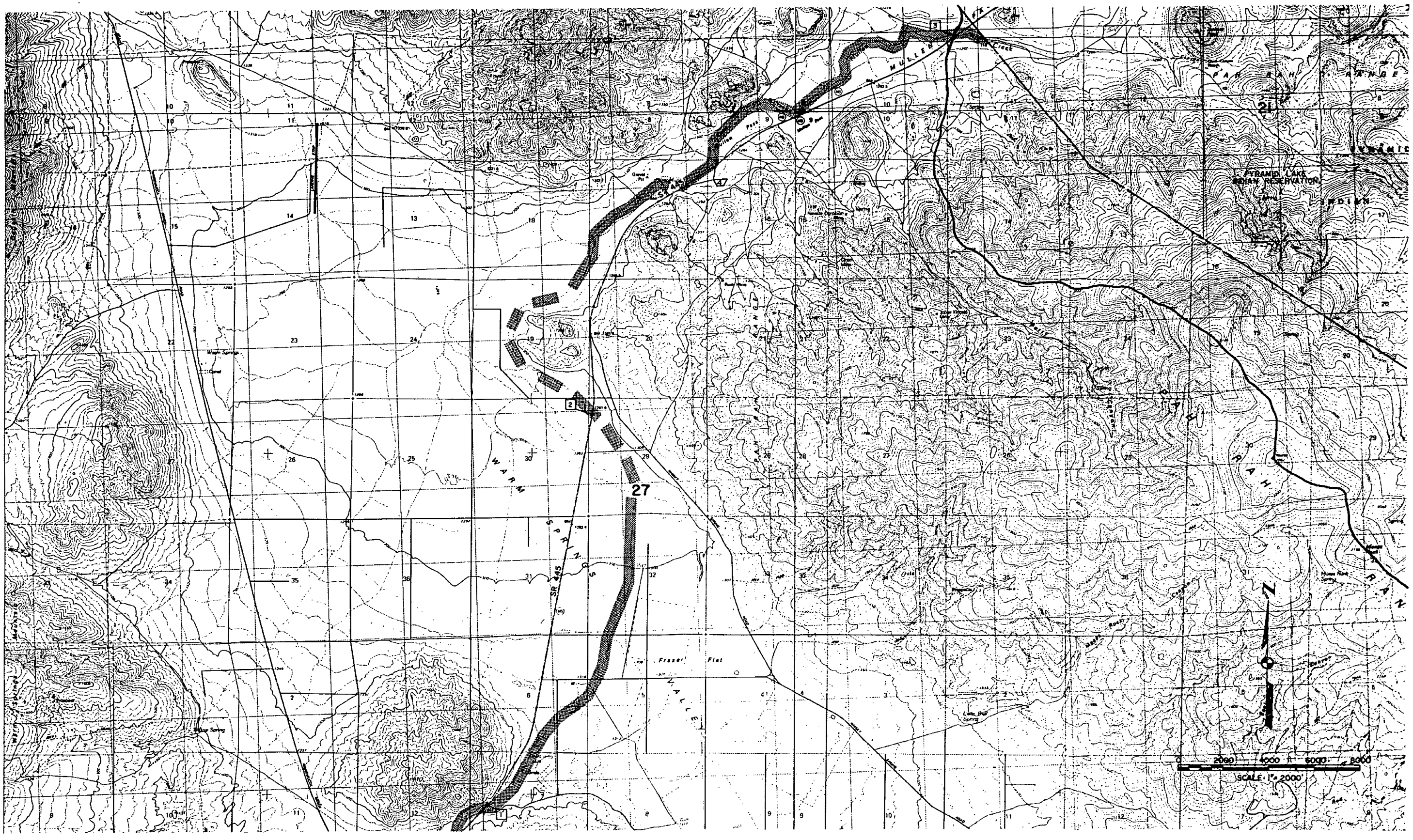
WASHOE COUNTY REGIONAL FLOOD CONTROL MASTER PLAN

EXISTING DRAINAGE FACILITY INVENTORY

Drawing No.
Job No. 897043.01
Sheet 4 of 15



Rev'd	By	Date	Description
		6/90	ADDED REGIONAL WATER COURSES AND STRUCTURES

Reference Information and Notes:

U.S.G.S. 7-1/2 MINUTE TOPOGRAPHIC MAPS:
TULE PEAK, NV
SUTCLIFFE, NV
FRASIER FLAT, NV
MOSES ROCK, NV.

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Drafted
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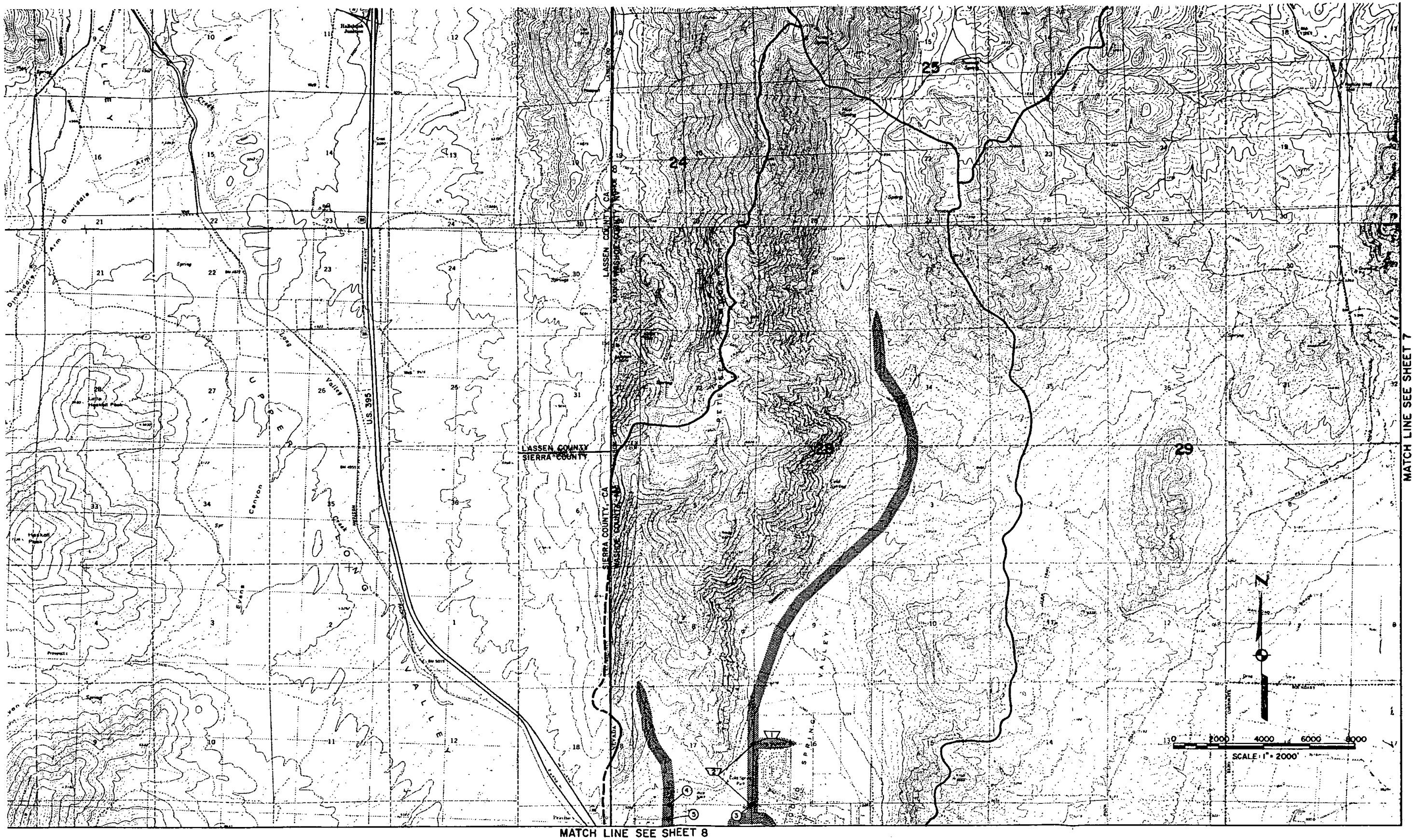
WASHOE COUNTY REGIONAL
FLOOD CONTROL MASTER PLAN

EXISTING DRAINAGE FACILITY INVENTORY

Drawing No.

Job No. 897043.01

Sheet 5 of 15



MATCH LINE SEE SHEET 7

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Rev'd	By	Date	Description
	SPH	11/90	REALIGNED REGIONAL WATER COURSE
			COLD SPRING WASH, ADDED #5
		8/90	ADDED REGIONAL WATER COURSES AND STRUCTURES

Reference Information and Notes:

U.S.G.S. 7-1/2 MINUTE TOPOGRAPHIC MAPS:
BECKWORTH PASS, CA
GRANITE PEAK, NV
EVANS CANYON, CA
RENO NW, NV

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Date

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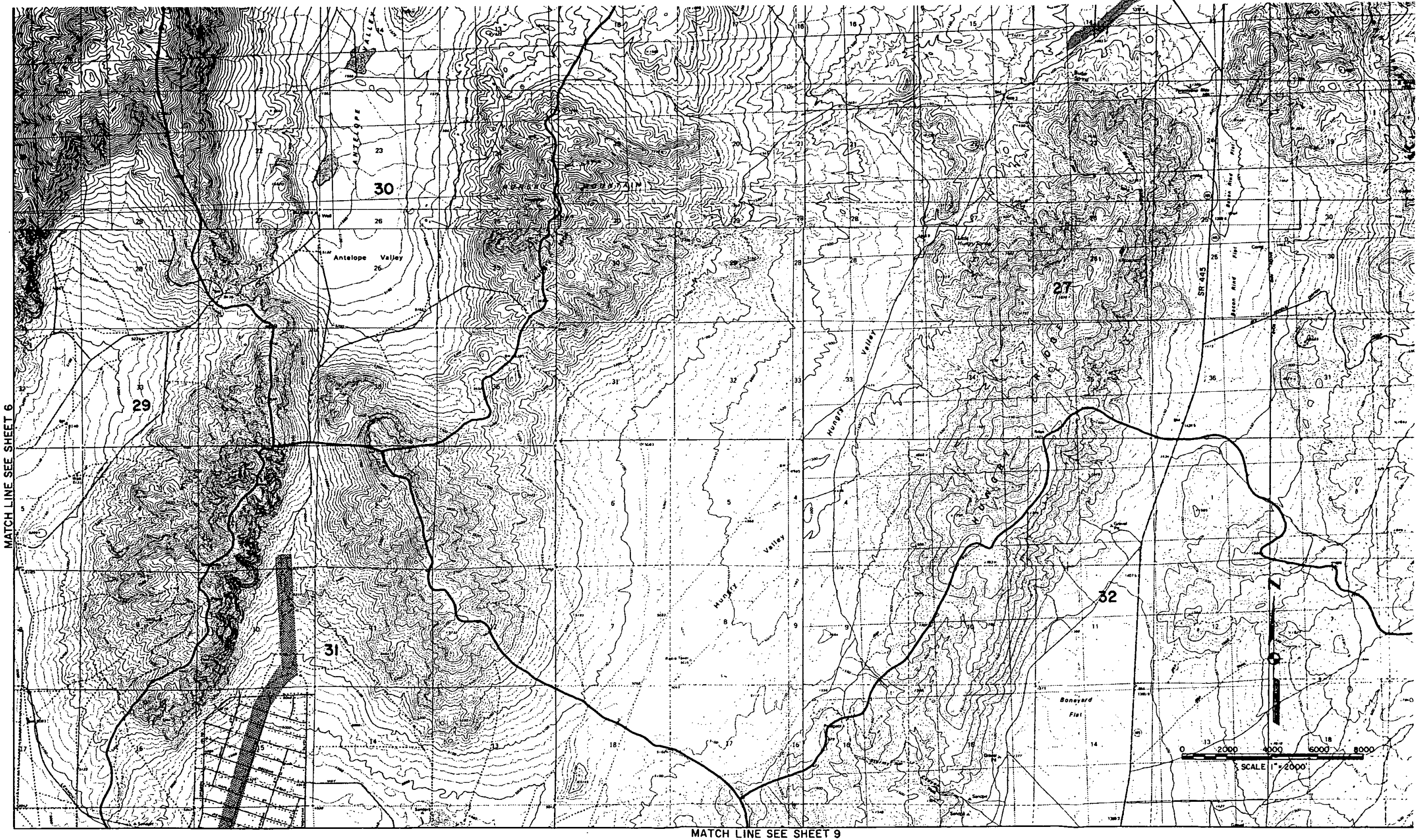
WASHOE COUNTY REGIONAL
FLOOD CONTROL MASTER PLAN

EXISTING DRAINAGE FACILITY INVENTORY

Drawing No.
Job No. 897043.01
Sheet 6 of 15



Rev'd	By	Date	Description
		6/90	ADDED REGIONAL WATER COURSES AND STRUCTURES

Reference Information and Notes:

U.S.G.S. 7-1/2 MINUTE TOPOGRAPHIC MAPS:
BEDELL FLAT, NV
FRASIER FLAT, NV
RENO NE, NV
GRIFFITH CANYON, NV

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Date

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WASHOE COUNTY REGIONAL FLOOD CONTROL MASTER PLAN

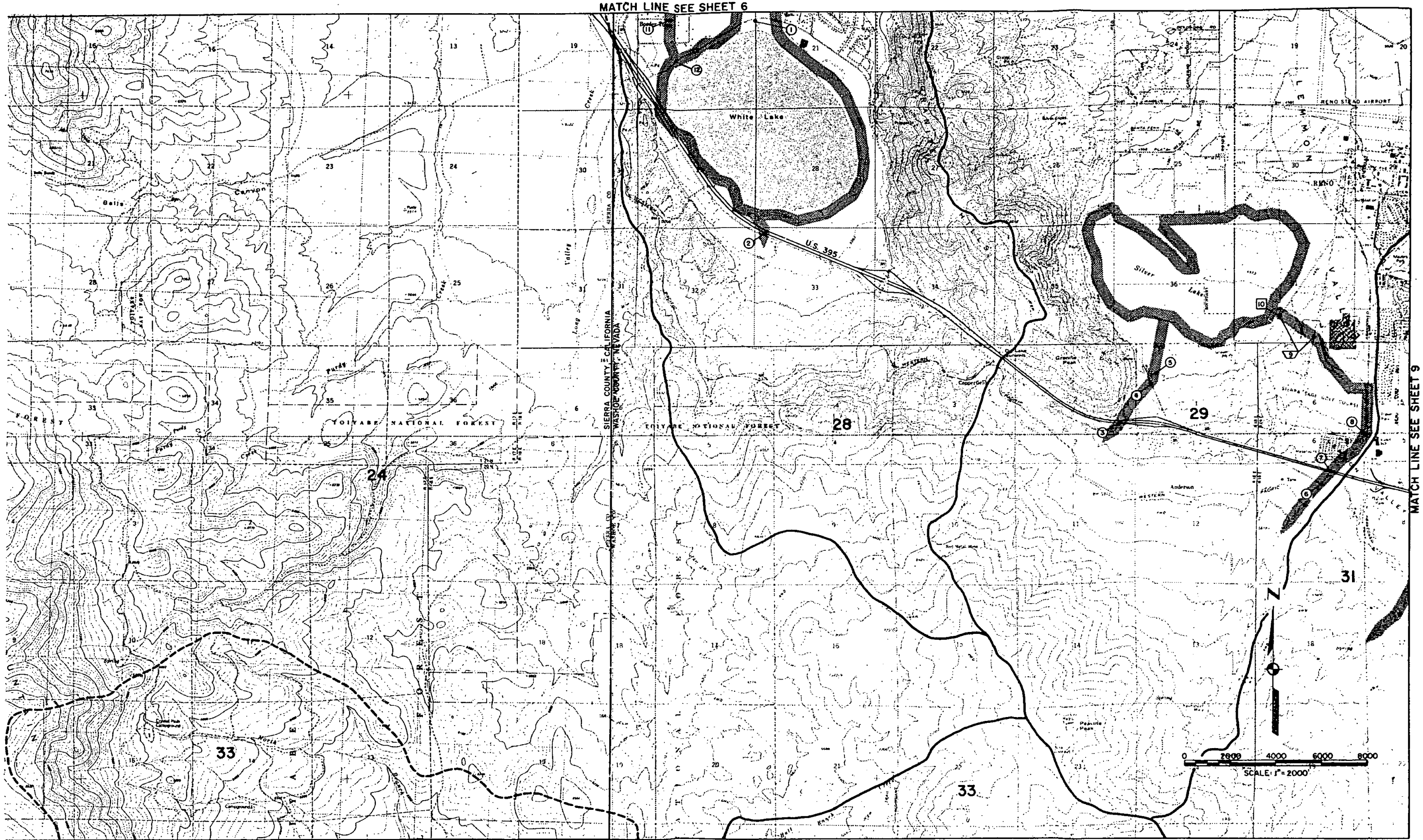
EXISTING DRAINAGE FACILITY INVENTORY

Drawing No.

Job No. 897043.01

Sheet 7 of 15

MATCH LINE SEE SHEET 6



MATCH LINE SEE SHEET 9

MATCH LINE SEE SHEET 10

Rev'd	By	Date	Description
	SPH	11/90	REALIGNED REGIONAL WATER COURSE COLD SPRING WASH, ADDED #12
		8/90	ADDED REGIONAL WATER COURSES AND STRUCTURES

Reference Information and Notes:

U.S.G.S. 7-1/2 MINUTE TOPOGRAPHIC MAPS:
EVANS CANYON, CA
RENO NW, NV
DOG VALLEY, CA
VERDI, NV

Designed
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Date

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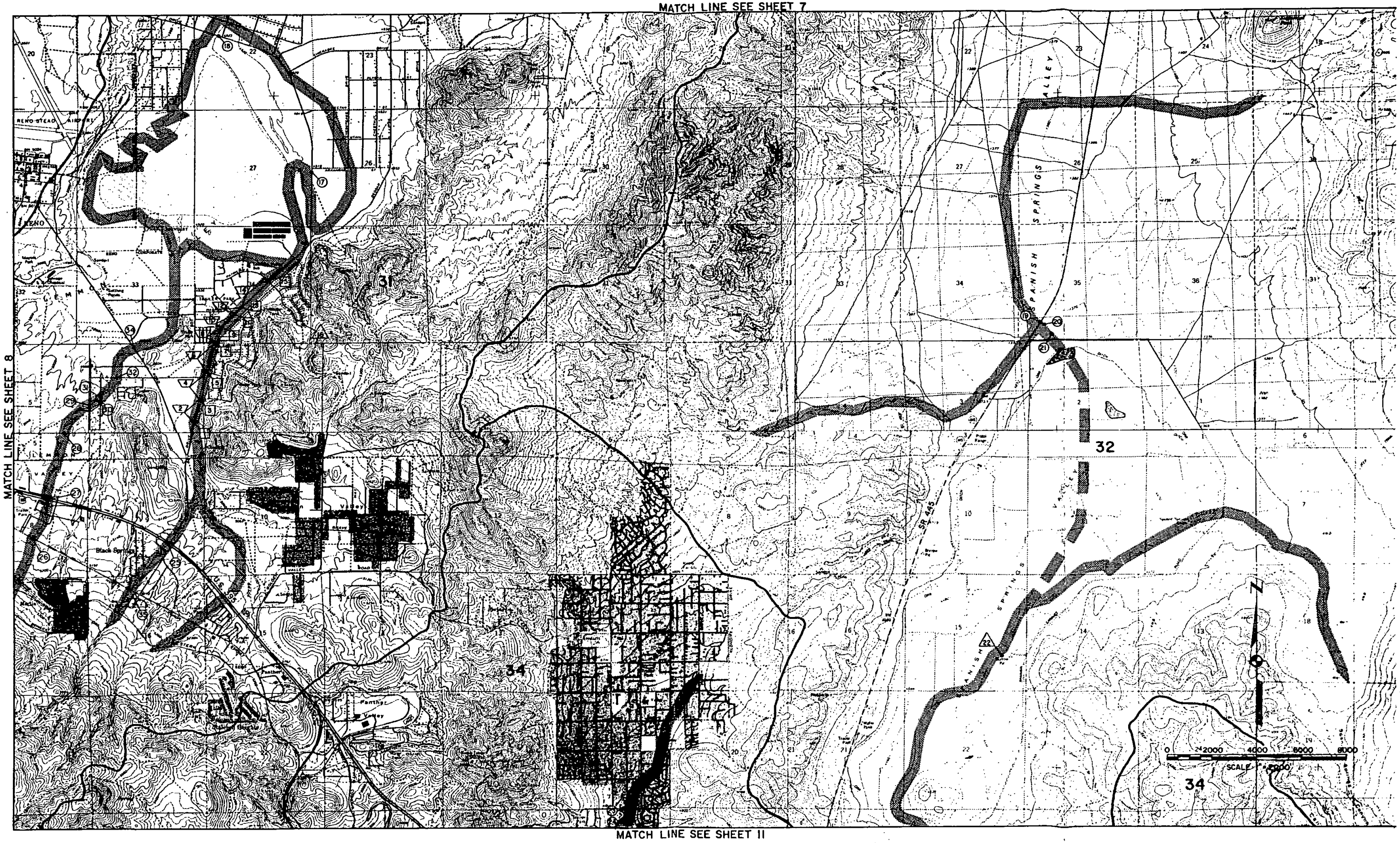
WASHOE COUNTY REGIONAL
FLOOD CONTROL MASTER PLAN

EXISTING DRAINAGE FACILITY INVENTORY

Drawing No.
Job No. 897043.01
Sheet 8 of 15

MATCH LINE SEE SHEET 7



MATCH LINE SEE SHEET 8

MATCH LINE SEE SHEET 11

Rev'd	By	Date	Description
	SPH	11/90	ADDED #35, DELETED #33
		6/90	ADDED REGIONAL WATER COURSES AND STRUCTURES

Reference Information and Notes:

U.S.G.S. 7-1/2 MINUTE TOPOGRAPHIC MAPS:
RENO NE, NV
GRIFFITH CANYON, NV
RENO, NV
VISTA, NV

Designed
Drafted
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Date

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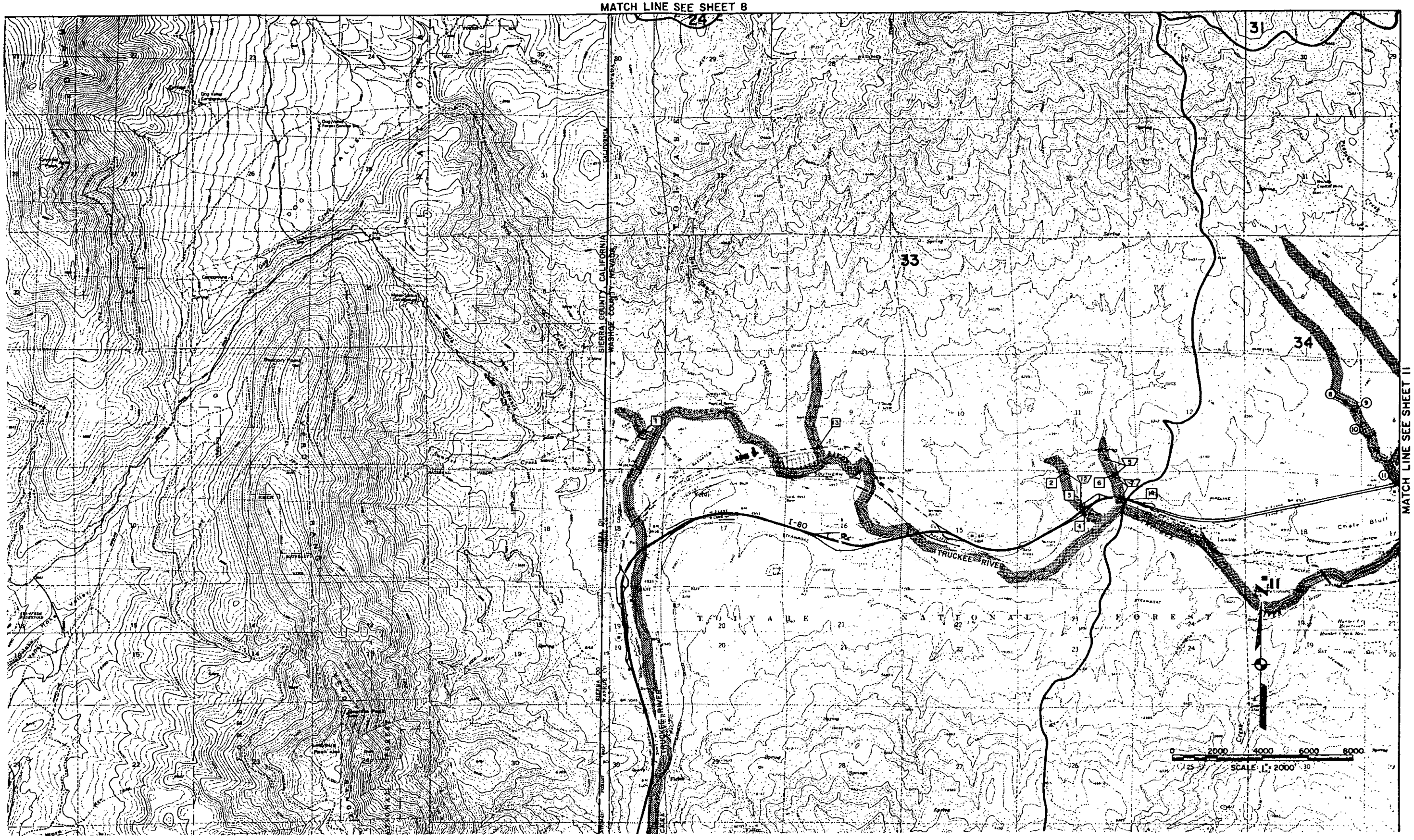
WASHOE COUNTY REGIONAL FLOOD CONTROL MASTER PLAN

EXISTING DRAINAGE FACILITY INVENTORY

Drawing No.
Job No. 897043.01
Sheet 9 of 15

MATCH LINE SEE SHEET 8

MATCH LINE SEE SHEET 11



Rev'd	By	Date	Description
	SPH	11/90	ADDED REGIONAL WATER COURSE
			ON DOG VALLEY CREEK
		6/90	ADDED REGIONAL WATER COURSES AND STRUCTURES

Reference Information and Notes:

U.S.G.S. 7-1/2 MINUTE TOPOGRAPHIC MAPS:
DOG VALLEY, CA
VERDI, NV
BOCA, CA
MT. ROSE NW, NV

Designed
Drafted
Checked
Date

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WASHOE COUNTY REGIONAL
FLOOD CONTROL MASTER PLAN

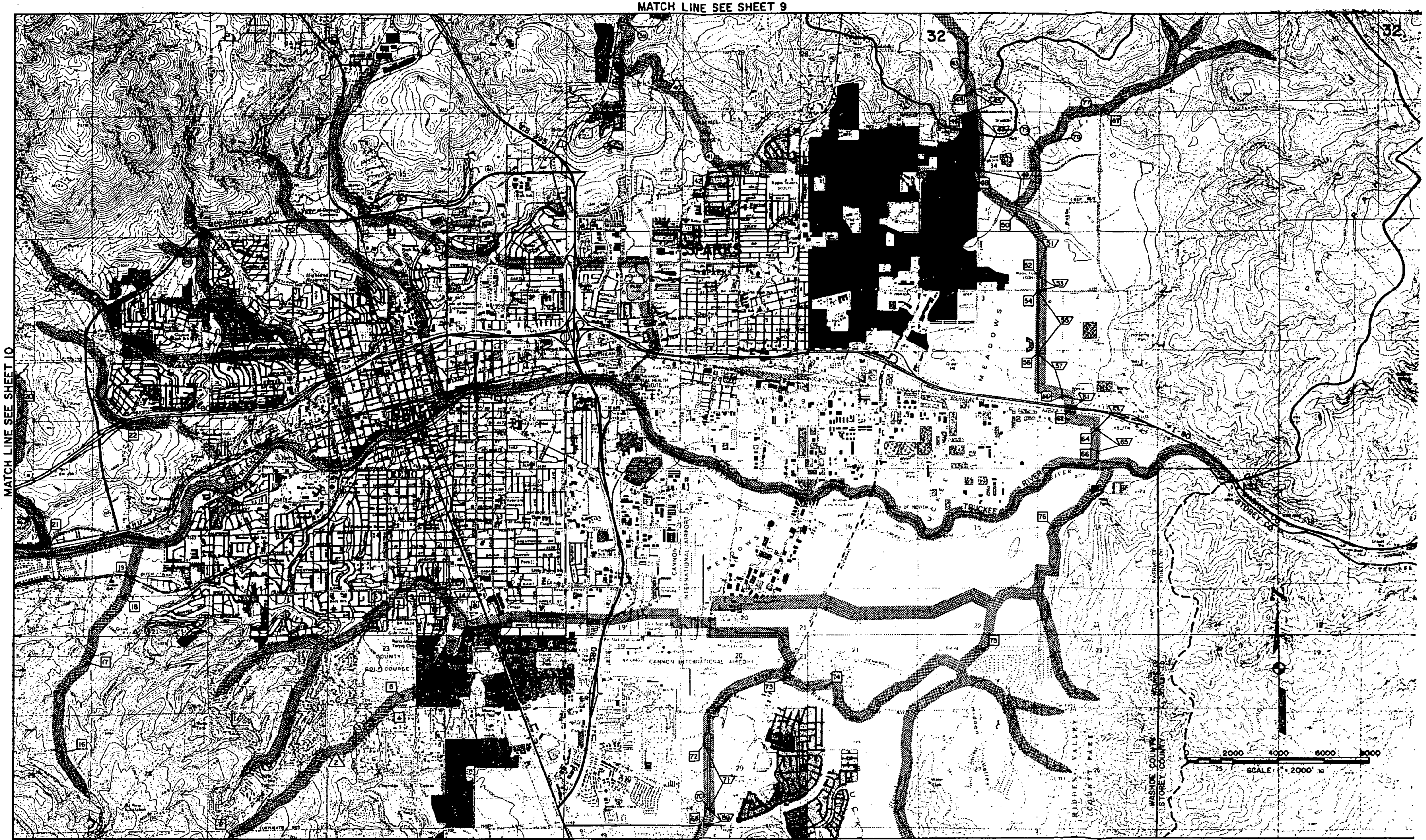
EXISTING DRAINAGE FACILITY INVENTORY

Drawing No.

Job No. 897043.01

Sheet 10 of 15

MATCH LINE SEE SHEET 9



MATCH LINE SEE SHEET 10

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Rev'd	By	Date	Description
	SPH	11/90	REALIGNED REGIONAL WATER COURSE FROM VIRGINIA LAKE TO BOYNTON SLOUGH
		6/90	ADDED REGIONAL WATER COURSES AND STRUCTURES

Reference Information and Notes:

U.S.G.S. 7-1/2 MINUTE TOPOGRAPHIC MAPS:
RENO, NV
VISTA, NV
MOUNT ROSE NE, NV
STEAMBOAT, NV

Designed
Drafted
Checked
Date

Washoe County & Cities of Reno and Sparks, Nevada

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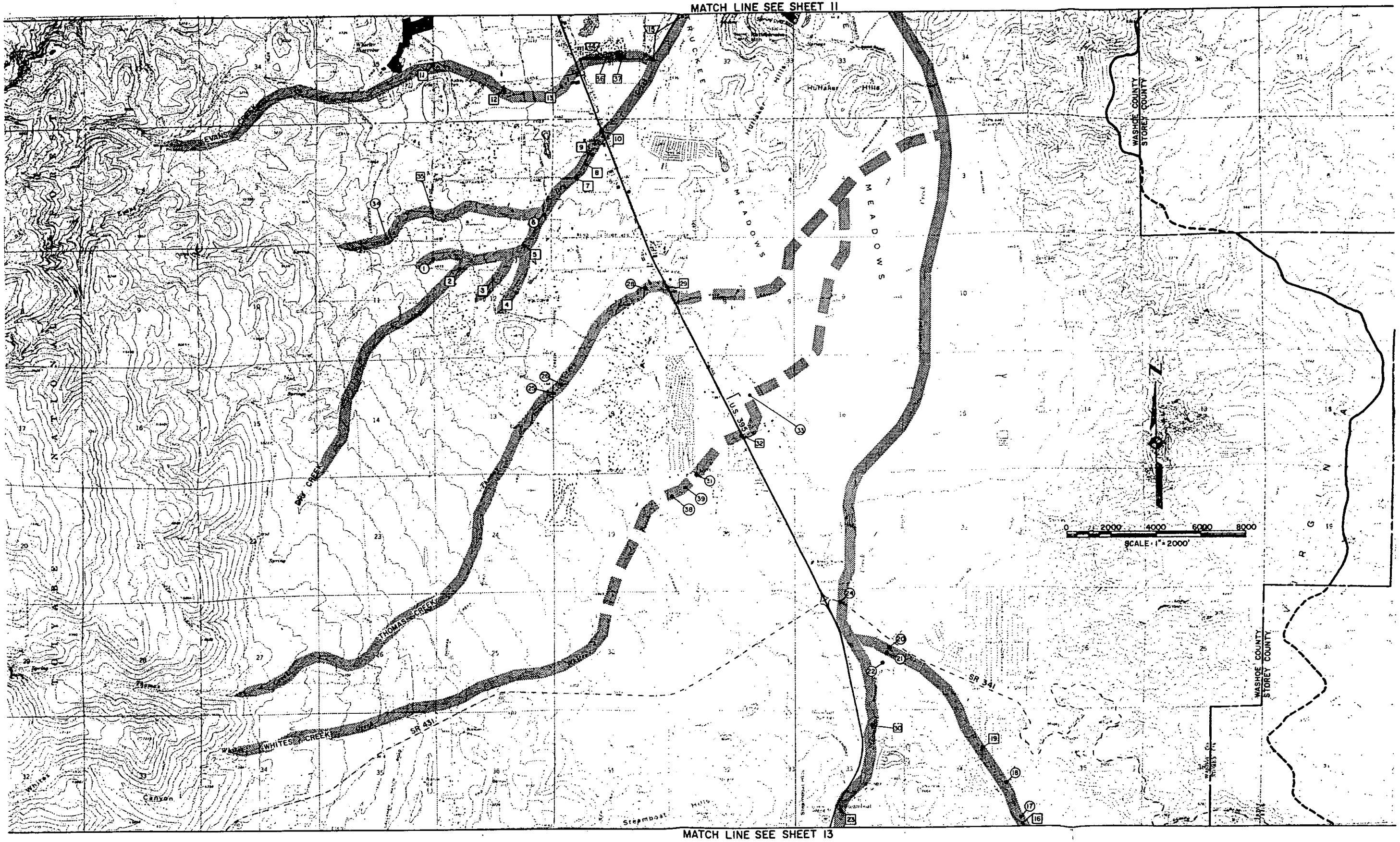
WASHOE COUNTY REGIONAL FLOOD CONTROL MASTER PLAN

EXISTING DRAINAGE FACILITY INVENTORY

Drawing No.
Job No. 897043.01
Sheet 11 of 15

MATCH LINE SEE SHEET II



MATCH LINE SEE SHEET 13

Rev'd	By	Date	Description
	SPH	11/90	ADDED #38 AND #39, DELETED #27
		6/90	ADDED REGIONAL WATER COURSES AND STRUCTURES

Reference Information and Notes:

U.S.G.S. 7-1/2 MINUTE TOPOGRAPHIC MAPS:
MOUNT ROSE NE, NV
STEAMBOAT, NV

Designed
Drafted
Checked
Date

Washoe County & Cities of Reno and Sparks, Nevada

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WASHOE COUNTY REGIONAL FLOOD CONTROL MASTER PLAN

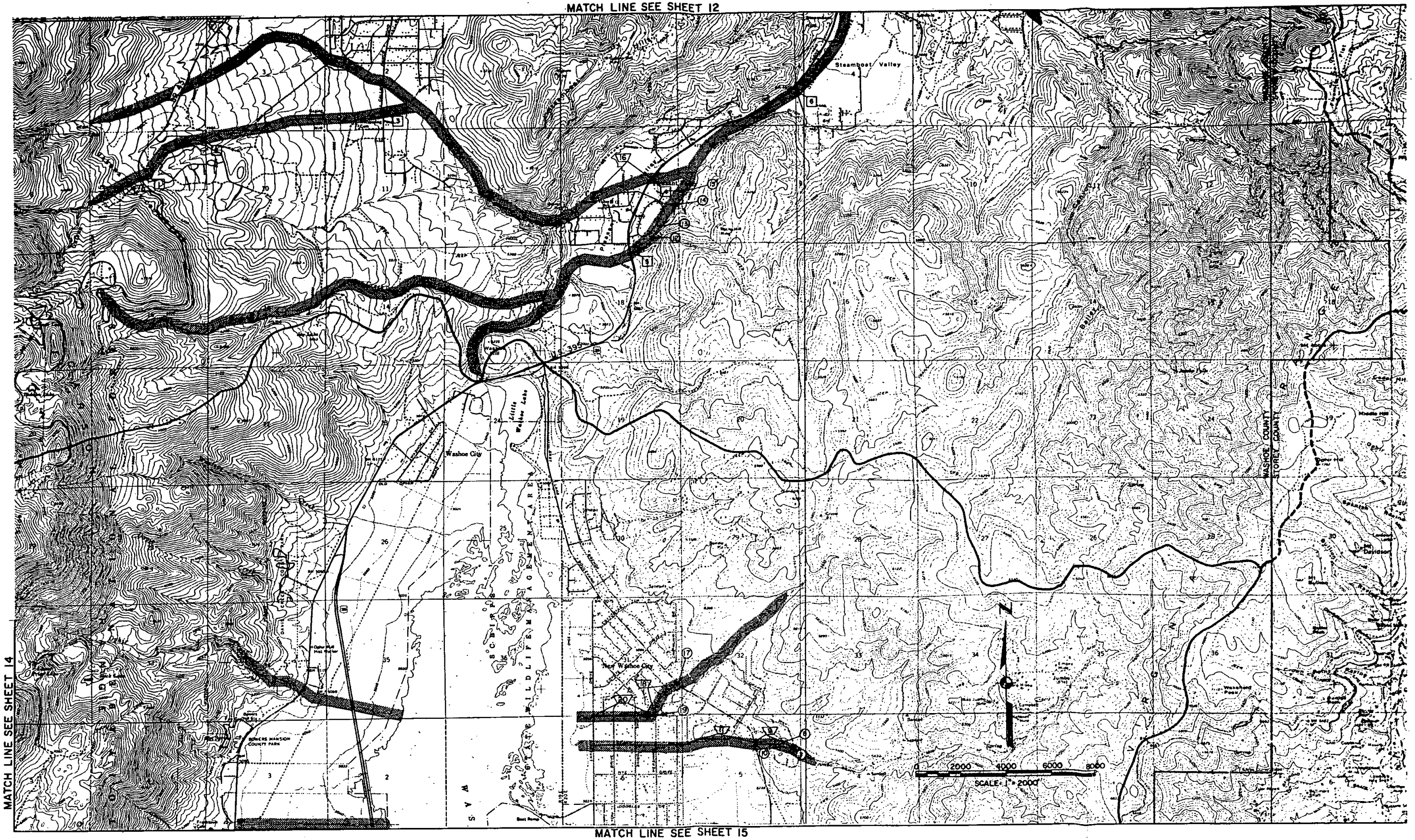
EXISTING DRAINAGE FACILITY INVENTORY

Drawing No.

Job No. 897043.01

Sheet 12 of 15

MATCH LINE SEE SHEET 12



MATCH LINE SEE SHEET 14

MATCH LINE SEE SHEET 15

Rev'd	By	Date	Description
		6/90	ADDED REGIONAL WATER COURSES AND STRUCTURES

Reference Information and Notes:

U.S.G.S. 7-1/2 MINUTE TOPOGRAPHIC MAPS:
WASHOE CITY, NV
VIRGINIA CITY, NV

Designed
Drafted
Checked
Date

Washoe County & Cities of Reno and Sparks, Nevada

Kennedy/Jenks/Chilton
160 Hubbard Way
Reno, Nevada 89502
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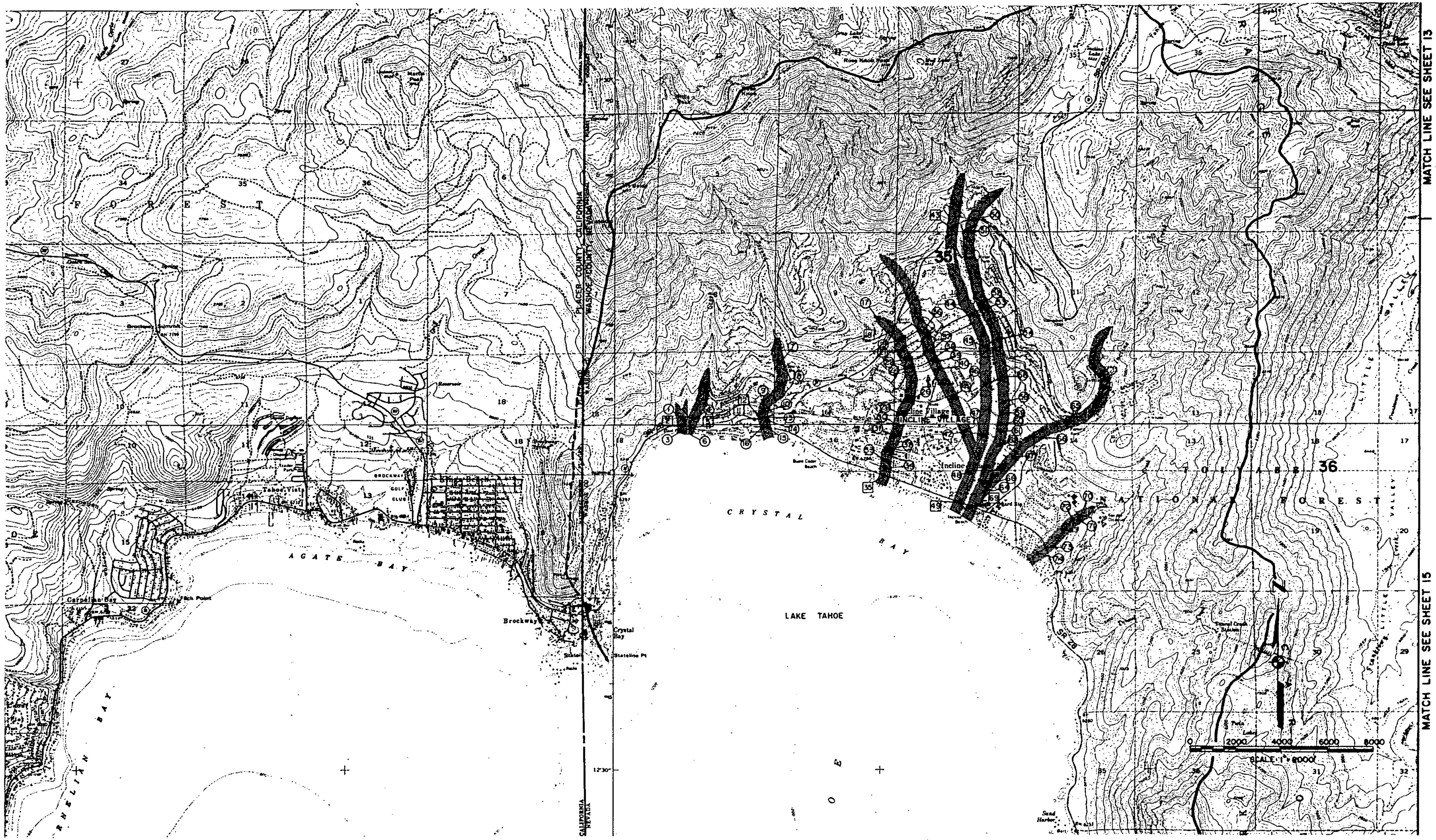
WASHOE COUNTY REGIONAL FLOOD CONTROL MASTER PLAN

EXISTING DRAINAGE FACILITY INVENTORY

Drawing No.

Job No. 897043.01

Sheet 13 of 15



Rev'd	By	Date	Description
	SPH	11/90	ADDED REGIONAL WATER COURSE ON
			WEST FORK FIRST CREEK, DELETED #83
		6/90	ADDED REGIONAL WATER COURSES AND STRUCTURES

Reference Information and Notes:

U.S.G.S. 7-1/2 MINUTE TOPOGRAPHIC MAPS:
MARTIS PEAK, CA
MOUNT ROSE, NV
KINGS BEACH, CA
MARLETTE LAKE, NV

Designed
Drafted
Checked
Date

Washoe County &
Cities of Reno and Sparks, Nevada

Kennedy/Jenks/Chilton
160 Hubbard Way
Reno, Nevada 89502
(702) 827-7900

WASHOE COUNTY REGIONAL
FLOOD CONTROL MASTER PLAN

EXISTING DRAINAGE FACILITY INVENTORY

Drawing No.

Job No. 897043.01

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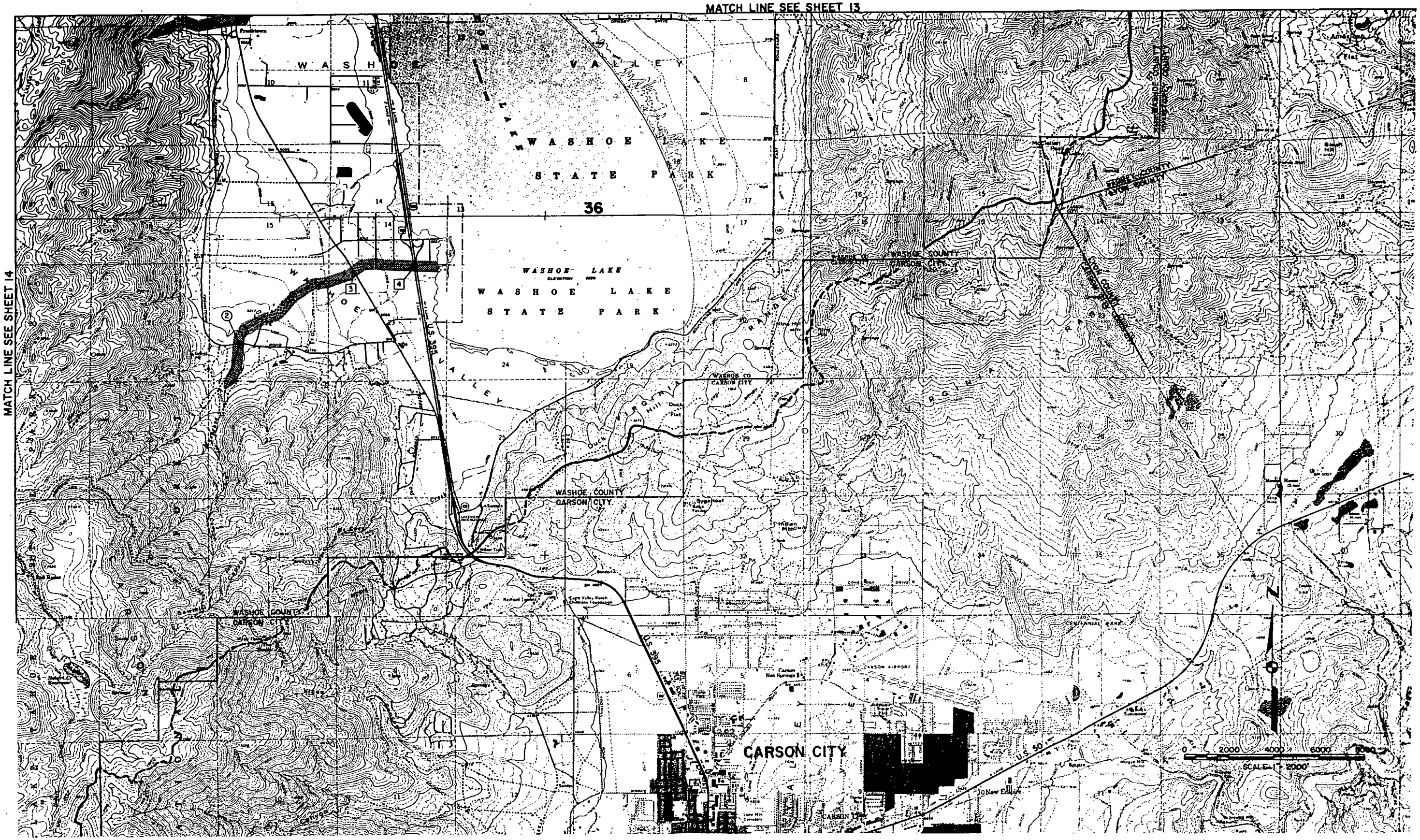

Rev'd	By	Date	Description
		6/90	ADDED REGIONAL WATER COURSES AND STRUCTURES

Reference Information and Notes:

U.S.G.S. 7-1/2 MINUTE TOPOGRAPHIC MAPS:
WASHOE CITY, NV
VIRGINIA CITY, NV
CARSON CITY, NV
NEW EMPIRE, NV

Designed	
Drafted	
Checked	
Date	

Washoe County & Cities of Reno and Sparks, Nevada

Kennedy/Jenks/Chilton
160 Hubbard Way
Reno, Nevada 89502
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WASHOE COUNTY REGIONAL FLOOD CONTROL MASTER PLAN

EXISTING DRAINAGE FACILITY INVENTORY

Drawing No.

Job No. 897043.01

Sheet 15 of 15

APPENDIX C
CAPITAL IMPROVEMENT COST SUMMARY

WASHOE COUNTY FLOOD CONTROL MASTER PLAN
CAPITAL IMPROVEMENT COSTS SUMMARY
KENNEDY/JENKS/CHILTON, INC.

PAGE-ELEMENT	INVENTORY REF. #	WATERSHED NAME	CONCENTRATION POINT\REACH	FACILITY	JURISICTION	Q (CFS)	COST X $1000	HYDRO BASIN
			BASIN LT 01					
A9-001		WEST FORK FIRST CREEK	U/S PRIVATE ROAD	DEBR BAS	WASHOE	500	750	35
A9-002		WEST FORK FIRST CREEK	PRIVATE ROAD 1 - SR 28	CHANNEL	WASHOE	500	135	35
A9-003	14-02	WEST FORK FIRST CREEK	SR 28	CULVERT	WASHOE	500	105	35
A9-004		WEST FORK FIRST CK	SR 28 - PRIVATE RD 2	CHANNEL	WASHOE	500	90	35
A9-005	14-03	WEST FORK FIRST CK	PRIVATE ROAD 2	CULVERT	WASHOE	500	100	35
A9-006		FIRST CREEK	U/S PONDEROSA AVE	DEB. BAS.	WASHOE	700	750	35
A9-007		FIRST CREEK	PONDEROSA AVE - SR 28	CHANNEL	WASHOE	700	135	35
A9-008	14-05	FIRST CREEK	SR 28	CULVERT	WASHOE	700	105	35
A9-009		FIRST CREEK	SR 28 - PRIVATE RD	CHANNEL	WASHOE	700	90	35
A9-010	14-06	FIRST CREEK	PRIVATE DRIVE	CULVERT	WASHOE	700	100	35
A9-011	14-07	SECOND CREEK	U/S TYNER WAY	DEBR BASIN	WASHOE	800	750	35
A9-012		SECOND CREEK	TYNER WY - SECOND CREEK DR	CHANNEL	WASHOE	800	115	35
A9-013	14-08	SECOND CREEK	SECOND CREEK DRIVE	CULVERT	WASHOE	800	150	35
A9-014		SECOND CREEK	SECOND CK DR - SILVERTIP DR	CHANNEL	WASHOE	900	165	35
A9-015	14-09	SECOND CREEK	SILVERTIP DRIVE	CULVERT	WASHOE	900	85	35
A9-016		SECOND CREEK	SILVERTIP DR - LAKE TAHOE	CHANNEL	WASHOE	900	145	35
A9-017	14-10	SECOND CREEK	PONDEROSA AVENUE	CULVERT	WASHOE	900	100	35
A9-018	14-12	SECOND CREEK	SR 28	OK	WASHOE	0	0	35
A9-019	14-16	SECOND CREEK	LAKE SHORE BLVD	CULVERT	WASHOE	900	145	35
A9-020		WOOD CREEK	U/S JENIFER STREET	DEBR BAS	WASHOE	1000	750	35
A9-021		WOOD CREEK	JENIFER ST - MT ROSE HWY	CHANNEL	WASHOE	1000	285	35
A9-022		WOOD CREEK	MT ROSE HWY	CULVERT	WASHOE	1000	205	35

WASHOE COUNTY FLOOD CONTROL MASTER PLAN
CAPITAL IMPROVEMENT COSTS SUMMARY
KENNEDY/JENKS/CHILTON, INC.

PAGE-ELEMENT	INVENTORY REF. #	WATERSHED NAME	CONCENTRATION POINT\REACH	FACILITY	JURISICTION	Q (CFS)	COST X $1000	HYDRO BASIN
BASIN LT 01								
A9-023		WOOD CREEK	MT ROSE HWY - LUCILLE DR	CHANNEL	WASHOE	1000	255	35
A9-024		WOOD CREEK	LUCILLE DR	CULVERT	WASHOE	1000	240	35
A9-025		WOOD CREEK	LUCILLE DR - MCDONALD WAY	CHANNEL	WASHOE	1000	160	35
A9-026		WOOD CREEK	MCDONALD WAY	CULVERT	WASHOE	1000	195	35
A9-027		WOOD CREEK	MCDONALD WAY - THIRD CK	CHANNEL	WASHOE	1000	30	35
A9-028		WEST FORK THIRD CREEK	U/S COLLEGE ROAD	DEBR BAS	WASHOE	600	750	35
A9-029		WEST FORK THIRD CREEK	COLLEGE RD - SHOP DRIVEWAY	CHANNEL	WASHOE	1440	135	35
A9-030		WEST FORK THIRD CREEK	MAINTENANCE SHOP DRIVEWAY	CULVERT	WASHOE	1400	700	35
A9-031		WEST FORK THIRD CREEK	SHOP DRIVEWAY - DONNA DR	CHANNEL	WASHOE	1440	105	35
A9-032		WEST FORK THIRD CREEK	DONNA DRIVE	CULVERT	WASHOE	1440	320	35
A9-033		WEST FORK THIRD CREEK	DONNA DR - VILLAGE BOULEVARD	CHANNEL	WASHOE	1500	75	35
A9-034		WEST FORK THIRD CREEK	VILLAGE BOULEVARD	CULVERT	WASHOE	1500	270	35
A9-035		WEST FORK THIRD CREEK	VILLAGE BL - HAROLD DR.	CHANNEL	WASHOE	1500	105	35
A9-036		WEST FORK THIRD CREEK	HAROLD DRIVE	CULVERT	WASHOE	1500	240	35
A9-037		WEST FORK THIRD CREEK	HAROLD DR - NORTHWD BL	CHANNEL	WASHOE	1500	450	35
A9-038		WEST FORK THIRD CREEK	NORTHWOOD BOULEVARD	CULVERT	WASHOE	1500	340	35
A9-039		WEST FORK THIRD CREEK	NORTHWOOD BL - TAHOE BL	CHANNEL	WASHOE	1500	625	35
A9-040		WEST FORK THIRD CREEK	TAHOE BOULEVARD	CULVERT	WASHOE	1500	670	35
A9-041		WEST FORK THIRD CREEK	TAHOE BLVD - JUNCT W/3RD CK	CHANNEL	WASHOE	1500	475	35
A9-042		WEST FORK THIRD CREEK	JUNCT W/3RD CK - INCLINE WAY	CHANNEL	WASHOE	3300	375	35
A9-043		THIRD CREEK	400' U/S MT ROSE HWY	DEBR BAS	WASHOE	2000	750	35
A9-044		THIRD CREEK	400' U/S MT ROSE - MT ROSE	CHANNEL	WASHOE	2000	145	35

WASHOE COUNTY FLOOD CONTROL MASTER PLAN
CAPITAL IMPROVEMENT COSTS SUMMARY
KENNEDY/JENKS/CHILTON, INC.

PAGE-ELEMENT	INVENTORY REF. #	WATERSHED NAME	CONCENTRATION POINT\REACH	FACILITY	JURISICTION	Q (CFS)	COST X $1000	HYDRO BASIN
BASIN LT 01								
A9-045	14-43	THIRD CREEK	MT ROSE HIGHWAY	CULVERT	WASHOE	2000	480	35
A9-046		THIRD CREEK	MT ROSE HWY - VILLAGE BLVD	CHANNEL	WASHOE	2100	1380	35
A9-047	14-44	THIRD CREEK	VILLAGE BOULEVARD	CULVERT	WASHOE	2100	240	35
A9-048		THIRD CREEK	VILLLAGE BLVD - DRIVER WAY	CHANNEL	WASHOE	2100	550	35
A9-049	14-45	THIRD CREEK	DRIVER WAY	CULVERT	WASHOE	2100	210	35
A9-050		THIRD CREEK	DRIVER WY - FAIRWAY BLVD	CHANNEL	WASHOE	2100	550	35
A9-051	14-46	THIRD CREEK	FAIRWAY BOULEVARD	CULVERT	WASHOE	2100	360	35
A9-052		THIRD CREEK	FAIRWAY BLVD - TAHOE BLVD	CHANNEL	WASHOE	2100	1030	35
A9-053	14-47	THIRD CREEK	TAHOE BOULEVARD	CULVERT	WASHOE	2100	330	35
A9-054		THIRD CREEK	TAHOE BLVD - JUNCT W/ W FORK	CHANNEL	WASHOE	2100	450	35
A9-055	14-48	THIRD CREEK	INCLINE WAY	CULVERT	WASHOE	3300	435	35
A9-056		THIRD CREEK	INCLINE WAY - LAKESHORE BLVD	CHANNEL	WASHOE	3300	690	35
A9-057	14-49	THIRD CREEK	LAKESHORE BOULEVARD	CULVERT	WASHOE	3300	250	35
A9-058		THIRD CREEK	LAKESHORE BLVD - LAKE TAHOE	CHANNEL	WASHOE	3300	295	35
A9-059		WEST FORK INCLINE CK	BASIN SITE	DEBR BAS	WASHOE	300	750	35
A9-060		WEST FORK INCLINE CK	BASIN - MT ROSE HWY	CHANNEL	WASHOE	300	295	35
A9-061	14-50	WEST FORK INCLINE CK	MT ROSE HIGHWAY	CULVERT	WASHOE	300	150	35
A9-062		WEST FORK INCLINE CK	MT ROSE HWY - DANA DR	CHANNEL	WASHOE	300	85	35
A9-064		WEST FORK INCLINE CK	DANA DR - COUNTRY CLUB	CHANNEL	WASHOE	600	720	35
A9-065	14-52	WEST FORK INCLINE CK	COUNTRY CLUB DR	CULVERT	WASHOE	600	190	35
A9-066		WEST FORK INCLINE CK	COUNTRY CLUB DR - VILLAGE BL	CHANNEL	WASHOE	700	60	35
A9-067	14-53	WEST FORK INCLINE CK	VILLAGE BOULEVARD	CULVERT	WASHOE	700	360	35

WASHOE COUNTY FLOOD CONTROL MASTER PLAN
CAPITAL IMPROVEMENT COSTS SUMMARY
KENNEDY/JENKS/CHILTON, INC.

PAGE-ELEMENT	INVENTORY REF. #	WATERSHED NAME	CONCENTRATION POINT\REACH	FACILITY	JURISICTION	Q (CFS)	COST X $1000	HYDRO BASIN
			BASIN LT 01					
A9-068		WEST FORK INCLINE CK	VILLAGE BLVD - DRIVER WAY	CHANNEL	WASHOE	800	350	35
A9-068	14-51	WEST FORK INCLINE CK	DANA DRIVE	CULVERT	WASHOE	300	220	35
A9-069	14-54	WEST FORK INCLINE CK	DRIVER WAY	CULVERT	WASHOE	800	160	35
A9-070		WEST FORK INCLINE CK	DRIVER WY - FAIRWAY BLVD	CHANNEL	WASHOE	800	2550	35
A9-071	14-56	WEST FORK INCLINE CK	FAIRWAY BOULEVARD	CULVERT	WASHOE	800	225	35
A9-072		WEST FORK INCLINE CK	FAIRWAY BLVD - 3RD GREEN CT	CHANNEL	WASHOE	900	1660	35
A9-073	14-58	WEST FORK INCLINE CK	3RD GREEN COURT	CULVERT	WASHOE	900	135	35
A9-074		WEST FORK INCLINE CK	3RD GREEN CT - WEDGE CT	CHANNEL	WASHOE	900	165	35
A9-075	14-59	WEST FORK INCLINE CK	WEDGE COURT	CULVERT	WASHOE	900	165	35
A9-076		WEST FORK INCLINE CK	WEDGE CT - 4TH GREEN CT	CHANNEL	WASHOE	900	265	35
A9-077	14-61	WEST FORK INCLINE CK	4TH GREEN COURT	CULVERT	WASHOE	900	270	35
A9-078		WEST FORK INCLINE CK	4TH GREEN CT - TAHOE BLVD	CHANNEL	WASHOE	900	235	35
A9-079	14-63	WEST FORK INCLINE CK	TAHOE BOULEVARD	CULVERT	WASHOE	900	235	35
A9-080		WEST FORK INCLINE CK	TAHOE BLVD - INCLINE WAY	CHANNEL	WASHOE	900	595	35
A9-081	14-64	WEST FORK INCLINE CK	INCLINE WAY	CULVERT	WASHOE	900	150	35
A9-082		WEST FORK INCLINE CK	INCLINE WY - INCLINE CREEK	CHANNEL	WASHOE	900	300	35
A9-083	14-65	INCLINE CREEK	U/S SKI WAY	DEB BASIN	WASHOE	2000	750	35
A9-084		INCLINE CREEK	SKI WAY - COUNTRY CLUB DR	CHANNEL	WASHOE	2000	495	35
A9-085	14-69	INCLINE CREEK	COUNTRY CLUB DRIVE	CULVERT	WASHOE	2000	285	35
A9-086		INCLINE CREEK	COUNTRY CLUB DR - TAHOE BLVD	CHANNEL	WASHOE	2000	565	35
A9-087	14-67	INCLINE CREEK	TAHOE BOULEVARD	CULVERT	WASHOE	2000	435	35
A9-088		INCLINE CREEK	TAHOE BLVD - INCLINE WAY	CHANNEL	WASHOE	2000	735	35

WASHOE COUNTY FLOOD CONTROL MASTER PLAN
CAPITAL IMPROVEMENT COSTS SUMMARY
KENNEDY/JENKS/CHILTON, INC.

PAGE-ELEMENT	INVENTORY REF. #	WATERSHED NAME	CONCENTRATION POINT\REACH	FACILITY	JURISICTION	Q (CFS)	COST X $1000	HYDRO BASIN
			BASIN LT 01					
A9-089	14-68	INCLINE CREEK	INCLINE WAY	CULVERT	WASHOE	2100	270	35
A9-089	14-68	INCLINE CREEK	INCLINE WAY	CULVERT	WASHOE	2100	270	35
A9-090		INCLINE CREEK	INCLINE WAY - LAKESHORE BLVD	CHANNEL	WASHOE	2900	495	35
A9-091		INCLINE CREEK	LAKESHORE BLVD	CULVERT	WASHOE	2900	235	35
A9-092		INCLINE CREEK	LAKESHORE BLVD - LAKE TAHOE	CHANNEL	WASHOE	2900	295	35
A9-093		MILL CREEK	1000' U/S SWEETWATER DRIVE	DEBR BAS	WASHOE	700	750	35
A9-094		MILL CREEK	1000' U/S SW DR - SW DR	CHANNEL	WASHOE	700	240	35
A9-095	14-70	MILL CREEK	SWEETWATER DRIVE	CULVERT	WASHOE	700	160	35
A9-096		MILL CREEK	SWEETWATER DRIVE - TAHOE BLVD	CHANNEL	WASHOE	700	55	35
A9-097	14-71	MILL CREEK	TAHOE BOULEVARD	CULVERT	WASHOE	700	210	35
A9-098		MILL CREEK	TAHOE BLVD - TRAMWAY ROAD	CHANNEL	WASHOE	700	100	35
A9-099	14-72	MILL CREEK	TRAMWAY ROAD	CULVERT	WASHOE	700	165	35
A9-100		MILL CREEK	TRAMWAY ROAD - LAKESHORE BLVD	CHANNEL	WASHOE	900	620	35
A9-101	14-73	MILL CREEK	LAKESHORE BLVD	CULVERT	WASHOE	900	135	35
A9-102		MILL CREEK	LAKESHORE BLVD - PINE CONE CR	CHANNEL	WASHOE	1000	135	35
A9-103	14-74	MILL CREEK	PINE CONE CIRCLE	CULVERT	WASHOE	1000	195	35
A9-104		MILL CREEK	PINE CONE CIRCLE - LAKE TAHOE	CHANNEL	WASHOE	1000	135	35
Some Easements are Currently Dedicated for Drainage, Some Additional Easements Needed. Assumed 15% of Const							5650	
				Total Cost for Area LT01 =			43315	

WASHOE COUNTY FLOOD CONTROL MASTER PLAN
CAPITAL IMPROVEMENT COSTS SUMMARY
KENNEDY/JENKS/CHILTON, INC.

PAGE-ELEMENT	INVENTORY REF. #	WATERSHED NAME	CONCENTRATION POINT\REACH	FACILITY	JURISICTION	Q (CFS)	COST X $1000	HYDRO BASIN
			BASIN NV 01					
A2-003	08-03	ANDERSON WASH	US 395	CULVERT	WASHOE	1700	700	29
A2-001	08-04	ANDERSON WASH	RED ROCK ROAD	CULVERT	WASHOE	2100	365	29
A2-002	08-05	ANDERSON WASH	MOYA BLVD	CULVERT	RENO	2100	365	29
		BEDELL VALLEY CREEK	RED ROCK VALLEY	STUDY	WASHOE		30	25
		WHITE LAKE & TRIBS	WHITE LAKE	STUDY	WASHOE		20	28
A1-001		BORDERTOWN WASH	1000'U/S COLD SPR - COLD SPR	CHANNEL	WASHOE	1000	230	28
A1-002	06-04	BORDERTOWN WASH	COLD SPRINGS DRIVE	CULVERT	WASHOE	1000	165	28
A1-003		BORDERTOWN WASH	COLD SPRINGS DR - PINON AVE	CHANNEL	WASHOE	1000	160	28
A1-004	06-05	BORDERTOWN WASH	PINON AVENUE	CULVERT	WASHOE	1000	225	28
A1-005		BORDERTOWN WASH	PINON AVE - MESQUITE AVE	CHANNEL	WASHOE	1000	215	28
A1-006	08-11	BORDERTOWN WASH	MESQUITE AVENUE	CULVERT	WASHOE	1000	320	28
A1-007		BORDERTOWN WASH	MESQUITE AVE - RENO PARK BLVD	CHANNEL	WASHOE	1000	550	28
A1-008	08-12	BORDERTOWN WASH	RENO PARK BOULEVARD	CULVERT	WASHOE	1000	155	28
A1-009	06-02	COLD SPR VALLEY WASH	MUDSPRNGS DR - COLDSPRINGS DR	CHANNEL	WASHOE	900	860	28
A1-010	06-03	COLD SPR VALLEY WASH	COLDSPRINGS DRIVE	CULVERT	WASHOE	900	165	28
A1-011		COLD SPR VALLEY WASH	COLDSPRINGS DR - RENO PARK BL	CHANNEL	WASHOE	900	390	28
A1-012	08-01	COLD SPR VALLEY WASH	RENO PARK BOULEVARD	CULVERT	WASHOE	1000	205	28
B1-001		ANTELOPE VALLEY WASH	800'U/S OREGON BL - OREGON BL	CHANNEL	WASHOE	1000	165	31
B1-002		ANTELOPE VALLEY WASH	OREGON BOULEVARD	CULVERT	WASHOE	1000	135	31
B1-003		ANTELOPE VALLEY WASH	OREGON BLVD - JUNIPER DRIVE	CHANNEL	WASHOE	1000	150	31
B1-004		ANTELOPE VALLEY WASH	JUNIPER DRIVE	CULVERT	WASHOE	1000	135	31
B1-005		ANTELOPE VALLEY WASH	JUNIPER DRIVE - OVERLAND ROAD	CHANNEL	WASHOE	1000	210	31

WASHOE COUNTY FLOOD CONTROL MASTER PLAN
CAPITAL IMPROVEMENT COSTS SUMMARY
KENNEDY/JENKS/CHILTON, INC.

PAGE-ELEMENT	INVENTORY REF. #	WATERSHED NAME	CONCENTRATION POINT\REACH	FACILITY	JURISICTION	Q (CFS)	COST X $1000	HYDRO BASIN
			BASIN NV 01					
B1-006		ANTELOPE VALLEY WASH	OVERLAND ROAD	CULVERT	WASHOE	1200	175	31
B1-007		ANTELOPE VALLEY WASH	OVERLAND - FIR DRIVE	CHANNEL	WASHOE	1200	210	31
B1-008		ANTELOPE VALLEY WASH	FIR DRIVE	CULVERT	WASHOE	1200	175	31
B1-009		ANTELOPE VALLEY WASH	FIR DRIVE - HEARTPINE STREET	CHANNEL	WASHOE	1200	195	31
B1-010		ANTELOPE VALLEY WASH	HEARTPINE STREET	CULVERT	WASHOE	1200	175	31
B1-011		ANTELOPE VALLEY WASH	HEARTPINE STREET - DEODAR WAY	CHANNEL	WASHOE	1200	210	31
B1-012		ANTELOPE VALLEY WASH	DEODAR WAY	CULVERT	WASHOE	1200	175	31
B1-013		ANTELOPE VALLEY WASH	DEODAR WAY - CHESAPEAK DRIVE	CHANNEL	WASHOE	1400	190	31
B1-014		ANTELOPE VALLEY WASH	CHESAPEAK DRIVE	CULVERT	WASHOE	1400	175	31
B1-015		ANTELOPE VALLEY WASH	CHESAPEAK DRIVE - MAPLE	CHANNEL	WASHOE	1400	210	31
B1-016		ANTELOPE VALLEY WASH	MAPLE	CULVERT	WASHOE	1400	175	31
B1-017		ANTELOPE VALLEY WASH	MAPLE - PEPPER WAY	CHANNEL	WASHOE	1400	210	31
B1-018		ANTELOPE VALLEY WASH	PEPPER WAY	CULVERT	WASHOE	1400	175	31
B1-019		ANTELOPE VALLEY WASH	PEPPER WAY - SITKA STREET	CHANNEL	WASHOE	1400	210	31
B1-020		ANTELOPE VALLEY WASH	SITKA STREET	CULVERT	WASHOE	1500	175	31
B1-021		ANTELOPE VALLEY WASH	SITKA STREET- TUPELO STREET	CHANNEL	WASHOE	1500	210	31
B1-022		ANTELOPE VALLEY WASH	TUPELO STREET	CULVERT	WASHOE	1500	175	31
B1-023		ANTELOPE VALLEY WASH	TUPELO STREET - LEMMON DRIVE	CHANNEL	WASHOE	1500	230	31
B1-024	09-18	ANTELOPE VALLEY WASH	LEMMON DRIVE	CULVERT	WASHOE	1500	175	31
B1-025		ANTELOPE VALLEY WASH	LEMMON DR - LEMMON VAL PLAYA	CHANNEL	WASHOE	1500	455	31
B2-001	08-06	PAYMASTER WASH	OLD 395	CULVERT	WASHOE	700	130	29
B2-002	08-07	PAYMASTER WASH	US 395	CULVERT	WASHOE	700	440	29

WASHOE COUNTY FLOOD CONTROL MASTER PLAN
CAPITAL IMPROVEMENT COSTS SUMMARY
KENNEDY/JENKS/CHILTON, INC.

PAGE-ELEMENT	INVENTORY REF. #	WATERSHED NAME	CONCENTRATION POINT\REACH	FACILITY	JURISICTION	Q (CFS)	COST X $1000	HYDRO BASIN
			BASIN NV 01					
B2-003		PAYMASTER WASH	US 395 - SILVERLAKE DRIVE	CHANNEL	RENO	700	290	29
B2-004	08-08	PAYMASTER WASH	SILVERLAKE DRIVE	CULVERT	RENO	700	150	29
B2-005		PAYMASTER WASH	SILVERLAKE DR - JC PENNEY	CHANNEL	RENO	700	1080	29
B2-006	08-09	PAYMASTER WASH	JC PENNEY OUTFALL - MOYA BLVD	OK	RENO		0	29
B2-007	08-10	PAYMASTER WASH	MOYA BOULEVARD	CULVERT	RENO	1100	390	29
B2-008	09-26	BLACK SPRINGS WASH	OLD 395	CULVERT	WASHOE	500	85	31
B2-009	09-27	BLACK SPRINGS WASH	NEW 395	CULVERT	WASHOE	500	385	31
B2-010	09-28	BLACK SPRINGS WASH	SILVER LAKE DRIVE	CULVERT	WASHOE	500	70	31
B2-011	09-29	BLACK SPRINGS WASH	CASSILIS DRIVE	CULVERT	WASHOE	500	140	31
B2-012		BLACK SPRINGS WASH	CASSILIS DRIVE - LEATHER LANE	CHANNEL	WASHOE	500	145	31
B2-013	09-30	BLACK SPRINGS WASH	LEATHER LANE	CULVERT	WASHOE	500	90	31
B2-014		BLACK SPRINGS WASH	LEATHER LANE - WISE AVENUE	CHANNEL	WASHOE	500	70	31
B2-015	09-31	BLACK SPRINGS WASH	WISE AVENUE	CULVERT	WASHOE	500	80	31
B2-016		BLACK SPRINGS WASH	WISE AVENUE - THOLL DRIVE	CHANNEL	WASHOE	500	230	31
B2-017	09-32	BLACK SPRINGS WASH	THOLL DRIVE	CULVERT	WASHOE	500	70	31
B2-018		BLACK SPRINGS WASH	THOLL DRIVE - MILITARY ROAD	CHANNEL	WASHOE	500	440	31
B2-019	09-34	BLACK SPRINGS WASH	MILITARY ROAD	CULVERT	WASHOE	500	35	31
B2-020		BLACK SPRINGS WASH	MILITARY - LEMMON VALLEY PLAYA	CHANNEL	RENO	500	1200	31
B2-021		BLACK SPRINGS WASH	RURAL ROAD	CULVERTS	RENO	500	90	31
B3-001	09-35	LEMMON VALLEY WASH	OLD 395	CULVERT	WASHOE	1300	110	31
B2-022	09-25	LEMMON VALLEY WASH	US 395	CULVERT	WASHOE	1300	415	31
B2-023	09-01	LEMMON VALLEY WASH	LEMMON VALLEY DRIVE	CULVERT	WASHOE	2300	345	31

WASHOE COUNTY FLOOD CONTROL MASTER PLAN
CAPITAL IMPROVEMENT COSTS SUMMARY
KENNEDY/JENKS/CHILTON, INC.

PAGE-ELEMENT	INVENTORY REF. #	WATERSHED NAME	CONCENTRATION POINT\REACH	FACILITY	JURISICTION	Q (CFS)	COST X $1000	HYDRO BASIN
			BASIN NV 01					
B2-024	09-02	LEMMON VALLEY WASH	LEMMON VALLEY DR - BERNOULLI ST	CHANNEL	WASHOE	2300	365	31
B2-025	09-03	LEMMON VALLEY WASH	BERNOULLI STREET	CULVERT	WASHOE	2300	195	31
B2-026	09-04	LEMMON VALLEY WASH	BERNOULLI ST - HYDRAULIC ST	CHANNEL	WASHOE	2300	415	31
B2-027	09-05	LEMMON VALLEY WASH	HYDRAULIC STREET	CULVERT	WASHOE	3200	195	31
B2-028	09-06	LEMMON VALLEY WASH	HYDRAULIC STREET - SERGE LANE	CHANNEL	WASHOE	3200	590	31
B2-029	09-07	LEMMON VALLEY WASH	SERGE LANE	CULVERT	WASHOE	3200	220	31
B2-030	09-08	LEMMON VALLEY WASH	SERGE LN - SHOP CTR ACCESS	CHANNEL	WASHOE	3200	395	31
B2-031	09-09	LEMMON VALLEY WASH	SHOPPING CENTER ACCESS RD	CULVERT	WASHOE	3200	335	31
B2-032	09-10	LEMMON VALLEY WASH	SHOP CTR ACCESS - FLEETWOOD	CHANNEL	WASHOE	3200	290	31
B2-033	09-11	LEMMON VALLEY WASH	FLEETWOOD DRIVE	CULVERT	WASHOE	3200	320	31
B2-034	09-12	LEMMON VALLEY WASH	FLEETWOOD DRIVE - LEMMON DR	CHANNEL	WASHOE	3200	105	31
B2-035	09-13	LEMMON VALLEY WASH	LEMMON DRIVE	CULVERT	WASHOE	3300	465	31
B2-036	09-14	LEMMON VALLEY WASH	LEMMON DR - PATRICIAN DRIVE	CHANNEL	WASHOE	3300	785	31
B2-037	09-15	LEMMON VALLEY WASH	PATRICIAN DRIVE	CULVERT	WASHOE	3300	415	31
B2-038		LEMMON VALLEY WASH	PATRICIAN - LEMMON VALLEY PLAYA	CHANNEL	WASHOE	3300	2800	31
C1-001		CHICKADEE WASH	6100' U/S - 1600' U/S DEODAR	CHANNEL	WASHOE	1300	1760	31
C1-002		CHICKADEE WASH	1600'U/S DEODAR - DEODAR WAY	CHANNEL	WASHOE	2000	625	31
C1-003		CHICKADEE WASH	DEODAR WAY	CULVERT	WASHOE	2000	230	31
B1-026		CHICKADEE WASH	DEODAR WAY - LEMMON DRIVE	CHANNEL	WASHOE	2400	2370	31
B1-027		CHICKADEE WASH	LEMMON DRIVE	CULVERT	WASHOE	2400	415	31
B1-028		CHICKADEE WASH	LEMMON DR - LEMMON VALLEY PLAYA	CHANNEL	WASHOE	2400	2880	31
C2-001		ARKANSAS STREET WASH	DAM SITE	DEBR BAS	WASHOE	1000	500	31

WASHOE COUNTY FLOOD CONTROL MASTER PLAN
CAPITAL IMPROVEMENT COSTS SUMMARY
KENNEDY/JENKS/CHILTON, INC.

PAGE-ELEMENT	INVENTORY REF. #	WATERSHED NAME	CONCENTRATION POINT\REACH	FACILITY	JURISICTION	-Q (CFS)	COST X $1000	HYDRO BASIN
			BASIN NV 01					
C2-002		ARKANSAS STREET WASH	DAM SITE - DEODAR WAY	CHANNEL	WASHOE	1000	410	31
C2-003		ARKANSAS STREET WASH	DEODAR WAY	CULVERT	WASHOE	1000	100	31
B2-039		ARKANSAS STREET WASH	DEODAR WAY - LEMMON DRIVE	CHANNEL	WASHOE	1000	1015	31
B2-040	09-17	ARKANSAS STREET WASH	LEMMON DRIVE	CULVERT	WASHOE	1000	160	31
B2-041		ARKANSAS STREET WASH	LEMMON DR - LEMMON VALLEY PLAYA	CHANNEL	WASHOE	1000	420	31
				Total Cost for Area NV01 (WASHOE) =			31685	
				Total Cost for Area NV01 (RENO) =			3565	
				Total Cost for Area NV01 =			35250	
			BASIN PV 01					
C7-005	13-13	STEAMBOAT CREEK	CONESTOGA CIRCLE	CULVERT	WASHOE	800	115	34
C7-006	13-14	STEAMBOAT CREEK	LARAMIE DRIVE	CULVERT	WASHOE	800	115	34
C7-007	13-15	STEAMBOAT CREEK	CONCHO DRIVE	CULVERT	WASHOE	800	145	34
C7-004	13-12	STEAMBOAT CREEK	BLACK WILLOW WAY	CULVERT	WASHOE	800	115	34
				Total Cost for Area PV01 =			490	
			BASIN PV 02					
B7-001		GALENA CREEK	500' U/S SR 431 - SR 431	CHANNEL	WASHOE	3600	110	34
B7-002	13-01	GALENA CREEK	SR 431	CULVERT	WASHOE	3600	310	34
B7-003		GALENA CREEK	SR 431 - 500' D/S SR 431	CHANNEL	WASHOE	3600	110	34
C7-002	13-03	GALENA CREEK	CALLAHAN RANCH ROAD	CULVERT	WASHOE	3600	310	34
C7-003		GALENA CREEK	GALENA NARROWS	DET BASIN	WASHOE	100	2505	34

WASHOE COUNTY FLOOD CONTROL MASTER PLAN
CAPITAL IMPROVEMENT COSTS SUMMARY
KENNEDY/JENKS/CHILTON, INC.

PAGE-ELEMENT	INVENTORY REF. #	WATERSHED NAME	CONCENTRATION POINT\REACH	FACILITY	JURISICTION	Q (CFS)	COST X $1000	HYDRO BASIN
			BASIN PV 02					
B7-004		JONES CREEK	MOUNTAIN MEADOW LANE	CULVERT	WASHOE	1400	190	34
C7-001		JONES CREEK	CALLAHAN RANCH ROAD	CULVERT	WASHOE	1500	220	34
				Total Cost for Area PV02 =			3755	
			BASIN SS 03					
D2-001		SPANISH SPRINGS WASH	WATER TANK ROAD - SR 445	CHANNEL	WASHOE	600	2080	32
D2-002	09-19	SPANISH SPRINGS WASH	SR 445	CULVERT	WASHOE	600	115	32
D2-008		SPANISH SPRINGS WASH	SR 445 - ORR DITCH	CHANNEL	WASHOE	600	485	32
C2-004		DOLORES DRIVE WASH	1100'U/S ERIN DR - ERIN DR	CHANNEL	WASHOE	550	220	32
D2-003		DOLORES DRIVE WASH	ERIN DRIVE	CULVERT	WASHOE	550	80	32
D2-004		DOLORES DRIVE WASH	ERIN DRIVE - DOLORES DRIVE	CHANNEL	WASHOE	550	240	32
D2-005		DOLORES DRIVE WASH	DOLORES DRIVE	CULVERT	WASHOE	550	80	32
D2-006		DOLORES DRIVE WASH	SR 445	CULVERT	WASHOE	550	130	32
D2-007		DOLORES DRIVE WASH	SR 445 - ORR DITCH	CHANNEL	WASHOE	550	315	32
D1-001		SPANISH SPRINGS WASH	CALLE DE LA PLATA	CULVERT	WASHOE	2800	130	32
D1-002		SPANISH SPRINGS WASH	SUGARLOAF PK - SS03 BOUNDARY	CHANNEL	WASHOE	2800	420	32
				Total Cost for Area SS03 =			4385	
			BASIN SS 05					
D1-004		SPANISH SPRINGS WASH	SR 445	CULVERT	WASHOE	2800	225	32
D1-005		SPANISH SPRINGS WASH	SR 445 - BONEYARD FLAT	CHANNEL	WASHOE	2800	1300	32
				Total Cost for Area SS05 =			2835	

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			BASIN TM 01					
C3-001		SUN VALLEY WASH	AMARAGOSA DRIVE - GRAVEL PIT	CHANNEL	WASHOE	100	1040	34
C3-002		SUN VALLEY WASH	5TH AVENUE - GRAVEL PIT	CHANNEL	WASHOE	200	445	34
C3-003		SUN VALLEY WASH	SUN VALLEY GRAVEL PIT	DET BASIN	WASHOE	120	1935	34
C3-004		SUN VALLEY WASH	LEON ST - FIRST AVENUE	CHANNEL	WASHOE	1200	470	34
C3-005	09-23	SUN VALLEY WASH	FIRST AVENUE	CULVERT	WASHOE	1200	155	34
C3-006		SUN VALLEY WASH	FIRST AVE - FRANKS LANE	CHANNEL	WASHOE	1200	280	34
C3-007	09-24	SUN VALLEY WASH	FRANKS LANE	CULVERT	WASHOE	1200	170	34
C3-008		SUN VALLEY WASH	FRANKS LANE - RAMPION AVE	CHANNEL	WASHOE	1200	280	34
C3-009	11-39	SUN VALLEY WASH	RAMPION AVENUE	CULVERT	WASHOE	1200	285	34
				Total Cost for Area TM01 =			5060	
			BASIN TM 03					
B4-003	11-34	DANDINI WASH	COMSTOCK DRIVE	CULVERT	WASHOE	500	75	34
				Total Cost Area TM03 (RENO) =			155	
				Total Cost Area TM03 =			75	
			BASIN TM 04					
B3-002		BLOCK N WASH	DAM SITE	DET BASIN	RENO	115	2600	34
B3-003		BLOCK N WASH	NORTH VIRGINIA	CULVERT	WASHOE	710	295	34
				Total Cost Area TM04 =			2895	
			BASIN TM 05					
B4-001	11-23	PEAVINE CREEK	UPPER PEAVINE CREEK DAM	DAM STR INC	RENO		440	34
B4-007	11-29	RECALL MINE WASH	MCCARRAN BLVD	CULVERT	RENO	600	150	34

WASHOE COUNTY FLOOD CONTROL MASTER PLAN
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KENNEDY/JENKS/CHILTON, INC.

PAGE-ELEMENT	INVENTORY REF. #	WATERSHED NAME	CONCENTRATION POINT\REACH	FACILITY	JURISICTION	Q (CFS)	COST X $1000	HYDRO BASIN
			BASIN TM 05					
B4-002	11-31	RECALL MINE WASH	WEST WASH DAM	DAM STR INC	RENO		700	34
				Total Cost for Area TM05 =			1290	
			BASIN TM 07					
B4-004	11-21	McQUEEN WASH	WEST 4TH STREET	CULVERT	WASHOE	1300	250	34
				Total Cost for Area TM07 =			250	
			BASIN TM 08					
A4-007		MOGUL WASH EAST	DAM SITE	DET BASIN	WASHOE	100	1105	33
				Total Cost for Area TM08 =			1105	
			BASIN TM 09					
A4-006		MOGUL WASH WEST	DAM SITE	DET BASIN	WASHOE	100	695	33
				Total Cost for Area TM09 =			695	
			BASIN TM 12					
		ALUM CREEK	US OF MAYBERRY DR	STUDY	WASHOE		40	34
B4-005		ALUM CREEK	500'U/S McCARRAN - MAYBERRY	CHANNEL	WASHOE	1300	495	34
				Total Cost Area TM 12 =			535	

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KENNEDY/JENKS/CHILTON, INC.

PAGE-ELEMENT	INVENTORY REF. #	WATERSHED NAME	CONCENTRATION POINT\REACH	FACILITY	JURISICTION	Q (CFS)	COST X $1000	HYDRO BASIN
			BASIN TM 17					
D5-001		N. HIDDEN VALLEY WASH	DAM SITE	DET BASIN	WASHOE	50	1680	34
D5-002		S. HIDDEN VALLEY WASH	DAM SITE	DET BASIN	WASHOE	50	600	34
				Total Cost Area TM 17 =			2280	
			BASIN TM 22					
B4-005		ROSEWOOD CREEK	1000'U/S ARLNGTN - ARLINGTON	CHANNEL	RENO	400	215	34
C4-002	11-06	ROSEWOOD CREEK	ARLINGTON AVENUE	CULVERT	RENO	400	60	34
C4-003		ROSEWOOD CREEK	DAM SITE	DET BASIN	RENO	150	755	34
B5-001	11-03	PLUMAS/MOANA WASH	PHEASANT LANE	CULVERT	WASHOE	350	70	34
C5-001	11-05	PLUMAS/MOANA WASH	CLASSIC RESIDENCE PARKING LOT	CULVERT	RENO	400	10	34
				Total Cost Area TM22 (RENO) =			1040	
				Total Cost Area TM22 (CO) =			70	
				Total Cost Area TM22 =			1110	
			BASIN TM 24					
B5-002		EVANS CREEK	DAM SITE	DET BASIN	WASHOE	100	3260	34
C5-002		EVANS CREEK	1500'U/S LAKESIDE - LAKESIDE	CHANNEL	RENO	400	275	34
C5-003	12-11	EVANS CREEK	LAKESIDE DRIVE	CULVERT	WASHOE	400	85	34
C5-004		EVANS CREEK	LAKESIDE DR - DEL MONTE LANE	CHANNEL	WASHOE	500	610	34
C5-005	12-12	EVANS CREEK	DEL MONTE LANE	CULVERT	WASHOE	500	75	34
C5-006		EVANS CREEK	DEL MONTE LANE - I-580	CHANNEL	WASHOE	500	1400	34
				Total Cost Area TM24 =			5705	

WASHOE COUNTY FLOOD CONTROL MASTER PLAN
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KENNEDY/JENKS/CHILTON, INC.

PAGE-ELEMENT	INVENTORY REF. #	WATERSHED NAME	CONCENTRATION POINT\REACH	FACILITY	JURISICTION	Q (CFS)	COST X $1000	HYDRO BASIN
			BASIN TM 25					
C5-007	12-34	DRY CREEK NORTH FORK	FROST LANE	CULVERT	WASHOE	650	95	34
C5-008	12-01	DRY CREEK	LAKESIDE DRIVE	CULVERT	WASHOE	1000	195	34
C5-009	12-05	DRY CREEK	DIERINGER LANE	CULVERT	WASHOE	2400	175	34
C5-010	12-06	DRY CREEK	PANORAMA DRIVE	CULVERT	WASHOE	2500	155	34
C5-011		DRY CREEK	DAM SITE	DET BASIN	WASHOE	350	3605	34
C6-001	12-02	DRY CREEK	HOLCOMB LANE	CULVERT	WASHOE	1100	165	34
C6-003		THOMAS CREEK	DIXON LANE - S VIRGINIA ST	CHANNEL	WASHOE	500	490	34
C6-004		THOMAS CREEK	SIERRA MANOR	CULVERT	WASHOE	500	75	34
				Total Cost Area TM25 =			4955	
			BASIN TM 27					
C6-015	12-24	STEAMBOAT CREEK	SR 341	CULVERT	WASHOE	40000	405	34
C7-008	12-30	STEAMBOAT CREEK	TOWNE DRIVE	CULVERT	WASHOE	2000	230	34
D6-001		VIRG. FOOTHILL WASH	DEBRIS BASIN SITE	DEBR BASIN	WASHOE	500	450	34
D6-002		VIRG. FOOTHILL WASH	DEBRIS BASIN - MIRA LOMA ROAD	CHANNEL	WASHOE	500	765	34
D6-003		VIRG. FOOTHILL WASH	MIRA LOMA ROAD	CULVERT	WASHOE	500	70	34
D6-004		VIRG. FOOTHILL WASH	MIRA LOMA RD - STEAMBOAT CK	CHANNEL	WASHOE	700	805	34
D7-001		BAILEY CREEK	DAM SITE	DET BASIN	WASHOE	100	5360	34
D7-002		BAILEY CREEK	DAM SITE - TOLL ROAD	CHANNEL	WASHOE	100	280	34
D7-003	12-16	BAILEY CREEK	TOLL ROAD	CULVERT	WASHOE	100	20	34
D7-004	12-22	BAILEY CREEK	TOLL ROAD - TEMPLE HILL ROAD	CHANNEL	WASHOE	200	340	34
D7-005	12-17	BAILEY CREEK	PRIVATE DRIVEWAY	CULVERT	WASHOE	100	20	34

WASHOE COUNTY FLOOD CONTROL MASTER PLAN
CAPITAL IMPROVEMENT COSTS SUMMARY
KENNEDY/JENKS/CHILTON, INC.

PAGE-ELEMENT	INVENTORY REF. #	WATERSHED NAME	CONCENTRATION POINT\REACH	FACILITY	JURISICTION	Q (CFS)	COST X $1000	HYDRO BASIN
			BASIN TM 27					
D7-006	12-18	BAILEY CREEK	TEMPLE HILL ROAD	CULVERT	WASHOE	200	20	34
D7-007		BAILEY CREEK	TEMPLE HILL ROAD - KIEVETT LN	CHANNEL	WASHOE	300	365	34
C6-012		BAILEY CREEK	KIEVETT LANE - TOLL ROAD	CHANNEL	WASHOE	1000	1700	34
C6-013	12-20	BAILEY CREEK	TOLL ROAD	CULVERT	WASHOE	1000	125	34
C6-014		BAILEY CREEK	TOLL ROAD - STEAMBOAT CREEK	CHANNEL	WASHOE	1000	480	34
D7-008		GEIGER FK BAILEY CK	SR 341	CULVERT	WASHOE	200	50	34
D7-009		GEIGER FK BAILEY CK	SR 341 - PINION DR	CHANNEL	WASHOE	200	390	34
D7-010		GEIGER FK BAILEY CK	PINION DRIVE	CULVERT	WASHOE	200	50	34
D7-011		GEIGER FK BAILEY CK	PINION DR - KIVETT LN	CHANNEL	WASHOE	200	95	34
D7-012		GEIGER FK BAILEY CK	KIVETT LANE	CULVERT	WASHOE	200	50	34
D7-013		GEIGER FK BAILEY CK	KIVETT LN - JUNCT W/BAILEY CK	CHANNEL	WASHOE	200	150	34
				Total Cost Area TM27 =			12220	
			BASIN TM 28					
C6-002		THOMAS CREEK	DAM SITE	DET BASIN	WASHOE	250	3100	34
C6-005	12-29	THOMAS CREEK	SOUTH VIRGINIA	CULVERT	WASHOE	600	210	34
				Total Cost Area TM28 =			3310	
			BASIN TM 29					
C6-006		WHITES CREEK	DAM SITE	DET BASIN	WASHOE	100	4630	34
C6-007	12-38	WHITES CREEK	THUNDERBOLT DRIVE	CULVERT	WASHOE	400	125	34
C6-008	12-39	WHITES CREEK	LA GUARDIA ROAD	CULVERT	WASHOE	400	125	34

WASHOE COUNTY FLOOD CONTROL MASTER PLAN
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KENNEDY/JENKS/CHILTON, INC.

PAGE-ELEMENT	INVENTORY REF. #	WATERSHED NAME	CONCENTRATION POINT\REACH	FACILITY	JURISICTION	Q (CFS)	COST X $1000	HYDRO BASIN
			BASIN TM 29					
C6-009	12-31	WHITES CREEK	ZOLEZZI LANE	CULVERT	WASHOE	400	125	34
C6-010	12-32	WHITES CREEK	US 395	CULVERT	WASHOE	400	150	34
C6-011	12-33	WHITES CREEK	OLD VIRGINIA ROAD	CULVERT	WASHOE	400	70	34
				Total Cost Area TM29 =			5225	
			BASIN TM 31					
D3-001		WHITEHEAD SCHOOL WASH	DAM SITE	DET BASIN	WASHOE	10	585	34
D3-002		WHITEHEAD SCHOOL WASH	VISTA BLVD - SHADOW LANE	CHANNEL	SPARKS	100	230	34
				Total Cost Area TM31 (CO) =			585	
				Total Cost Area TM31 (SPARKS)=			230	
				Total Cost Area TM31 =			815	
			BASIN VE 03					
A4-004		NORTH FLAT WASH	1000' U/S OLD HWY 40 - HWY 40	CHANNEL	WASHOE	500	210	33
A4-005		NORTH FLAT WASH	OLD HWY 40 - TRUCKEE RIVER	CHANNEL	WASHOE	500	165	33
				Total Cost Area VE03 =			375	
			BASIN VE 06					
A4-001		DOG VALLEY CREEK	800' U/S BRIDGE ST - BRIDGE	CHANNEL	WASHOE	5200	400	33
A4-002	10-01	DOG VALLEY CREEK	BRIDGE STREET	BRIDGE	WASHOE	5200	215	33
A4-003		DOG VALLEY CREEK	BRIDGE STREET - TRUCKEE RIVER	CHANNEL	WASHOE	5200	200	33
				Total Cost Area VE06 =			815	

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BASIN WMSP								
		COTTONWOOD CREEK	U/S OF SR 445	STUDY	WASHOE		20	27
		MULLEN CREEK	U/S OF COTTONWOOD CREEK	STUDY	WASHOE		30	27
				Total Cost for Area WMSP =			50	
BASIN WV 01								
B9-001	15-01	FRANKTOWN CREEK	FRANKTOWN ROAD	BRIDGE	WASHOE	5100	600	36
B9-002	15-02	MUSGROVE CREEK	FRANKTOWN ROAD	CULVERT	WASHOE	1100	170	36
B9-003	15-03	MUSGROVE CREEK	OLD US 395	CULVERT	WASHOE	1100	270	36
C9-001	15-04	MUSGROVE CREEK	US 395	CULVERT	WASHOE	1100	650	36
C8-001		ESMERALDA WASH	1000' U/S E LAKE BL - E LAKE BL	CHANNEL	WASHOE	500	350	36
C8-002	13-17	ESMERALDA WASH	EAST LAKE BLVD	CULVERT	WASHOE	500	70	36
C8-003	13-18	ESMERALDA WASH	EAST LAKE BLVD - ESMERALDA DR	CHANNEL	WASHOE	600	470	36
C8-004	13-20	ESMERALDA WASH	PERSHING LANE	CULVERT	WASHOE	600	210	36
C8-005	13-19	ESMERALDA WASH	PERSHING - LAKESIDE ALONG ESM	CHANNEL	WASHOE	600	595	36
C8-006		ESMERALDA WASH	WHITE PINE DRIVE	CULVERT	WASHOE	600	110	36
C8-007		ESMERALDA WASH	LYON DRIVE	CULVERT	WASHOE	600	110	36
C8-008		ESMERALDA WASH	LAKESIDE DRIVE	CULVERT	WASHOE	600	110	36
C8-009	13-07	JUMBO CREEK	DRAKE WAY	CULVERT	WASHOE	1400	150	36
C8-010		JUMBO CREEK	PINTAIL DRIVE	BASIN	WASHOE	1400	980	36
C8-011	13-09	JUMBO CREEK	GANDER LANE - EAST LAKE BLVD	CHANNEL	WASHOE	1500	440	36
C8-012	13-10	JUMBO CREEK	EAST LAKE BLVD	CULVERT	WASHOE	1500	95	36
C8-013		JUMBO CREEK	EAST LAKE BLVD - ORMSBY LANE	CHANNEL	WASHOE	1700	1950	36

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BASIN WV 01								
				Total Cost Area WV01 =			7330	
NORTHERN COUNTY BASINS								
		BASIN 10, 11 & 12	SR 31 & SR 81	CULV/BRDG	WASHOE		1985	10,11,12
				Total Cost Area NCB =			1985	
TOTALS								
TOTAL FOR WASHOE COUNTY							139020	
TOTAL FOR RENO							8770	
TOTAL FOR SPARKS							230	
GRAND TOTAL CAPITAL IMPROVEMENT COSTS							148020	

APPENDIX D
FINAL FLOOD CONTROL MASTER PLAN OUTLINE

WASHOE COUNTY FLOOD CONTROL MASTER PLAN

DRAFT OUTLINE

VOLUME DESCRIPTIONS:

VOLUME 1 - FLOOD CONTROL MASTER PLAN
VOLUME 2 - MAPS AND TABLES
VOLUME 3 - POLICIES AND PROCEDURES MANUAL
VOLUME 4 - TECHNICAL APPENDIX
VOLUME 5 - DRAINAGE DESIGN STANDARDS AND CRITERIA

VOLUME 1
FLOOD CONTROL MASTER PLAN

I) EXECUTIVE SUMMARY
- A) GOALS AND OBJECTIVES
- B) DESCRIPTION OF STUDY AREAS
- C) REVIEW OF METHODS UTILIZED
- D) RESULTS
- E) MASTER PLAN REVISION/UPDATE PROCESS

II) INTRODUCTION
- A) AUTHORIZATION & OVERVIEW OF PROJECT
- B) GOALS AND OBJECTIVES
- C) DESCRIPTION OF STUDY AREA

III) PROJECTED GROWTH AND LAND USE CONDITIONS
- A) HISTORICAL GROWTH IN WASHOE COUNTY
- B) PROJECTED GROWTH IN WASHOE COUNTY
- C) LAND USE
  - 1) EXISTING CONDITIONS
  - 2) FUTURE CONDITIONS

IV) SYSTEM INVENTORY
- A) PURPOSE
- B) LEVEL OF DETAIL
- C) ANALYSIS OF HYDRAULIC CAPACITY
- D) RESULTS

V) METEOROLOGICAL INVESTIGATION

A) PURPOSE OF STUDY

1) USE OF STATISTICAL PRECIPITATION DATA IN HYDROLOGIC STUDIES

a) PRECIPITATION DEPTH
b) TIME DISTRIBUTION OF PRECIPITATION
c) SPATIAL DISTRIBUTION OF PRECIPITATION
d) ROLE OF SNOWFALL AND SNOWMELT

B) HISTORIC STORM CHARACTERISTICS

C) EXISTING STUDIES

D) METEOROLOGICAL ANALYSIS

1) DEPTH-DURATION-FREQUENCY DATA

a) VARIATION IN DEPTH-DURATION-FREQUENCY DATA WITH ELEVATION AND LOCATION
b) VARIATION WITH SEASON

2) TIME DISTRIBUTION OF PRECIPITATION DURING EXTREME EVENTS

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