

R E N O - N E V A D A

AN ADDENDUM REPORT ON

STORM DRAINAGE

PREPARED AS A SUPPLEMENT TO THE STORM DRAINAGE SECTION OF THE
MASTER PLAN REPORT ON STORM DRAINAGE AND SANITARY SEWERAGE OF OCTOBER 1957

PREPARED BY
CITY OF RENO - DEPARTMENT OF ENGINEERING
KENNEDY ENGINEERS - CONSULTING ENGINEER
AUGUST 1963

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TABLE OF CONTENTS

INTRODUCTION	PAGE 1
REVIEW OF FLOOD AND DRAINAGE PROBLEMS	PAGE 2
ADDITIONAL DATA OBTAINED SINCE 1957	PAGE 3
FACILITIES CONSTRUCTED SINCE 1957	PAGE 4
FLOOD CONTROL STRUCTURES	PAGE 5
REVISED MASTER PLAN	PAGE 6
TRUCKEE MEADOWS FLOOD PROTECTION	PAGE 8
SUMMARY OF FINDINGS	PAGE 9
RECOMMENDATIONS	PAGE 10

PLATE 1	STORM DRAINAGE MASTER PLAN
PLATE 2	MAJOR FLOOD AREAS, FEBRUARY 1963 FLOOD
PLATE 3	TRUCKEE MEADOWS FLOOD PLAIN

APPENDIX

EXCERPTS FROM U. S. ARMY CORPS OF ENGINEERS REPORT, MARCH 1960	PAGE A-1
TRUCKEE MEADOWS FLOOD PLAIN INVESTIGATIONS	PAGE A-2
PLATE A-1	FLOOD HYDROGRAPHS, FEBRUARY 1963, DECEMBER 1955
PLATE A-2	ROUTED FLOOD HYDROGRAPH, FEBRUARY 1963
PLATE A-3	FLOOD HYDROGRAPHS, DECEMBER 1955 FLOW, 1963 CHANNEL CONDITIONS

INTRODUCTION

This report is prepared as an addendum to the Report on Storm Drainage and Sanitary Sewerage for the City of Reno, a master plan report prepared by Kennedy Engineers (then Engineering Office of Clyde C. Kennedy) dated October 1957.

This report has been prepared jointly by the City of Reno Engineering Department and Kennedy Engineers, by authorization of the City Council.

The extensive flooding of large areas of the City of Reno during the storm of February 1963 directed attention to the need for implementation by the City of a storm drainage and flood control program. The major population growth and development of the City as well as other significant developments indicated the need for updating of the Storm Drainage Master Plan of 1957.

The population of the City of Reno has increased from an estimated 44,000 in 1957 to an estimated present population of 59,000. The rapid population growth and development of the surrounding metropolitan area has affected planning requirements of the City of Reno, significantly those relating to flood control and storm drainage.

Additional hydrologic data have been obtained since 1957 which justify a general hydrologic review and reconsideration of storm drainage design criteria.

Major improvements to the Truckee River channel have been constructed by the U.S. Army Corps of Engineers by channel improvement which included the removal of rock reefs in the Vista area. These improvements have greatly lowered the river water surface under storm flow conditions.

Construction of four detention reservoirs in the Peavine Mountain area northwest of Reno has been completed since 1957.

The City of Reno has constructed since 1957 portions of storm drainage facilities recommended in the initial report, primarily the Virginia and Truckee storm drain.

Completion of an Interim Survey Report for Flood Control - Reno Area - Truckee River and Tributaries by the U.S. Army Corps of Engineers in March 1960 outlined a definitive construction program to provide improved flood control of the Truckee River through the City of Reno. This report indicates the responsibilities and obligations of the City in gaining Federal assistance in aid of a flood control program and establishes a basis for an integrated flood control-storm drainage plan for the City.

Pressure for development in the area of Truckee Meadows subjected to periodic flooding has indicated a critical need for careful evaluation of the flood control program constructed by the U.S. Army Corps of Engineers on the Truckee River and its effect in reducing the area of the Truckee Meadows flood plain and potential damage to development therein.

Severe drainage problems in the vicinity of the airport were outlined by Quinton Engineers in a study of airport drainage dated 1961. The report indicated the need for construction of an integrated drainage system which would be required before on-site airport drainage facilities could function properly.

The purpose and scope of this Addendum Report is to review all pertinent changes which have occurred since the initial Master Plan Report; to revise the Storm Drainage Master Plan where indicated; to consolidate and summarize information and data developed by other agencies since 1957; to evaluate Truckee Meadows improved flood plain conditions resulting from recent U.S. Army Corps of Engineers construction; and to make recommendations for the early implementation of critical portions of the Storm Drainage Master Plan.

REVIEW OF FLOOD AND DRAINAGE PROBLEMS

The Truckee River has been and remains the major source of flood damage to the City of Reno. The Truckee River drains a watershed area of 1050 square miles of the eastern slope of the Sierra Nevada range through the center of the City. Heavy damage results when the existing 12,000 cfs channel capacity through the City is exceeded, as it has been six times during the period of record of measured flow. The major damaging floods during this period of record are as follows:

<u>Date</u>	<u>Peak Flow - cfs</u>
March 1907	18,500
March 1928	18,800
December 1937	17,000
November 1950	19,900
December 1955	20,800
February 1963	18,400

The standard project flood for Truckee River at Reno, developed by the U.S. Army Corps of Engineers for natural conditions, without stream control is 62,400 cfs peak flow. The standard project flood, Truckee River at Reno after completion of Boca, Stampede and Prosser Creek Reservoirs is 39,000 cfs peak flow. The addition of Martis Creek Reservoir would lower the standard project flood peak flow to 32,000 cfs peak flow.

The standard project flood for Truckee River is defined by the U.S. Army Corps of Engineers as "the flood that can be expected if the largest storm observed in the region should center over the basin at a time when ground conditions are reasonably conducive to high runoff". This storm, as defined by the Corps of Engineers, is approximately equivalent to a transposition of the November 1950 storm center over the center of the Truckee River drainage area between Lake Tahoe and Reno.

It should be pointed out that this is a conservative basis for establishment of criteria as it does not make allowance for the basic orographic influence of the Sierra crest.

Local storm drainage problems affecting different areas of the City are varied as a result of widely varying conditions and storm exposure. The northwest sector of the City is subject to storms of high intensity and short duration associated with summer thunderstorms. Large tributary areas above the City on the slopes of Peavine Mountain still pose a hazard in spite of the construction of recent flood control works. Drainage from this area is concentrated through an area of high-density development with seriously inadequate storm drain capacity. The combined use of sewers for both storm drainage and sanitary sewerage in this area remains a critical problem. The continuing public health hazard resulting from frequent storms of very modest magnitude, the damage resulting from flooding of homes and other buildings with sewage, and the excess demands on sanitary sewerage facilities should be given serious consideration when allocating priority schedules to public works programs. There is no other single public works need facing the City at the present time which deserves more immediate attention in the interest of public welfare and safety than a storm water separation program.

Recent drainage problems in the northeast sector of the City, which is not subject to the high intensity storms of the northwest area, indicate that local drainage and additional development are also potential problems unless adequate facilities are provided. The northeast area has no well-defined drainageways through the mild terrain of the principal development area. The area is also separated from direct access to the Truckee River by a low ridge parallel to the river which naturally diverts runoff into adjacent downstream areas.

The southside area is subject to local drainage problems with a large high-density commercial and residential area which drains away from the Truckee River toward

the south. Added to this local drainage is a substantial quantity of runoff from the many tributary watershed areas of the Front Range which flows through the City to Truckee Meadows. Some of these watershed areas extend to an elevation of over 10,000 feet, where higher intensity precipitation patterns are experienced during critical winter rainstorms.

Superimposed on these general problems has been added a recent complication of the problem; the location of the proposed Interstate Route 80 freeway depressed section across several major northside drains.

ADDITIONAL DATA OBTAINED SINCE 1957

The investigation required in preparation of this Addendum Report on Storm Drainage included a review of all hydrologic experience and data collected subsequent to 1957. These data were collected and analyzed to determine their influence on basic hydrologic criteria. Rainfall Intensity-Duration-Frequency design probability curves based on records of precipitation at Reno Airport were modified to include recent records. However, revision to the I-D-F curves developed in 1957 is negligible.

Precipitation records collected at the Dog Valley watershed research project, being conducted by the U.S. Forest Service, were evaluated with particular attention directed to the storm of February 1963. These records were used primarily in determining the effect on runoff of excessive rainfall on frozen ground which existed during the February 1963 storm. Rainfall records representative of other areas of the watershed are not available but would be extremely useful, even if collected for a short representative period including at least one significant storm.

The most pertinent and useful runoff data collected in the watershed subsequent to 1957 are available from records of a recent program of stream gaging for small watersheds of the Front Ranges. This program is being operated by the U.S. Geological Survey with cooperative financing by the State of Nevada, Department of Conservation and Natural Resources, Division of Water Resources. Recording stream gages were installed in 1962 on Steamboat Creek, Galena

Creek, Whites Creek, and Hunter Creek. Stream flow recording on Dog Creek, near Verdi which was commenced by the U.S. Geological Survey in 1956 and discontinued in 1959 is now being continued by the U.S. Forest Service in conjunction with the Dog Valley research program and affords a valuable supplement to the U.S.G.S. small watershed gaging program.

Stream flows were recorded at all of the above stations during the storm of February 1963. Problems with ice and shifting control were encountered during these gagings, and the Dog Creek stage exceeded that of the rating curve. However, these stream flow data represent a major addition to existing information on local basin inflow. The data have established a reasonable basis for significant modification to criteria developed in 1957 which was necessarily more conservative due to the limited information available at that time. The availability of these data permits a more direct evaluation of runoff criteria, with less reliance on criteria developed by the Rational Method.

Additional important data were collected by measurement of Truckee River flow by the U.S. Geological Survey at both the Reno gage and the Vista gage during the flood of February 1963. This record is of particular significance since the February 1963 flow is the highest flow for which flow measurement is available at both Reno and Vista gaging stations. The flood of December 1955 was not recorded at Vista because of the destruction of the gaging station. The February 1963 flood was also particularly important in establishing a new rating for the Vista gage subsequent to the U.S. Army Corps of Engineers channel improvement project.

Additional flood plain high water marks were observed and surveyed during this study in order to establish a relationship between maximum flood plain elevation and maximum Truckee Meadows outflow as measured at Vista. Plate 3 indicates the limits of the observed February 1963 flood plain, the limit of a developed flood plain based on the inflow condition of December 1955 and present channel condition.

Additional data were collected during the February 1963 flood by the City Engineering Department. Areas affected by flooding from local storm drainage, areas affected by surcharge of sanitary sewers due to storm drainage, and the Truckee River flood plain through the City are shown on Plate 2. These observations and information derived therefrom were used as the basis for testing the adequacy of the Storm Drainage Master Plan.

FACILITIES CONSTRUCTED SINCE 1957

A major project was constructed on the Truckee River through Truckee Meadows in 1960 by the U.S. Army Corps of Engineers. Improvements to the channel were designed to provide a flow capacity of 6,000 cfs, with free-board allowances providing for approximately 7,000 cfs flow capacity without significant flooding. A major part of this channel improvement program was a lowering of the channel in the Vista area by removal of the rock reefs. The removal of the reefs was necessary to benefit from upstream channel improvements. The project also alleviated outflow restrictions of the river to assure improved drainage of the Truckee Meadows area through the existing drainage ditches flowing into the river. The project has reduced the Truckee Meadows flood plain. Development of areas above the present flood plain can now proceed. A detailed analysis of the Truckee Meadows flood plain which relates depth and area of flooding with total basin inflows of record has been included in this study. As a result of this study it is indicated that a reduction in elevation of the mean flood plain from 4394.8 to 4390.8 and a reduction in flood volume from 33,000 acre-feet to 15,600 acre-feet has been effected, based on flood volumes represented by the 1955 flood.

Four detention reservoirs have been constructed since 1957 in the Peavine Mountain area northwest of Reno under the U.S. Department of Agriculture Soil Conservation Service Watershed Improvement Program. An additional detention structure on Evans Creek upstream from the University of Nevada and outflow conduits below existing structures are required to complete the program. After completion, these facilities will afford a reasonable degree of protection to the northwest area.

Construction of a portion of the Master Storm Drainage plan as proposed in 1957 along the Virginia and Truckee Railroad right-of-way was completed by the City in 1959. This storm drain was constructed in accordance with the Master Plan utilizing criteria and design recommendations contained in the appendix thereto.

The remainder of the Storm Drainage Master Plan has not been implemented nor has it been utilized to any degree for the purpose of setting drainage facility requirements in areas of new development. It has not been used for the purpose of preventing encroachment on drainageways or as the basis for reserving rights-of-way for planned construction.

The importance of strict adherence by the City to a unified plan must be emphasized. The construction of drainage structures on a proper alignment to provide a reasonable degree of protection is to be preferred over a program permitting construction of inadequate structures or construction of drainage lines through areas where adequate rights-of-way have not been reserved. Adherence to a Master Plan also permits more equitable apportionment of cost relative to benefits.

FLOOD CONTROL STRUCTURES

The U.S. Army Corps of Engineers in their Interim Survey Report for Flood Control, Reno Area, dated 1 March 1960 recommended a plan of improvement for Truckee River.

The plan includes construction of a single purpose flood control reservoir on Martis Creek with 15,000 acre-foot capacity and minor capacity enlargement for the Truckee River channel through Reno. This project will require local participation including assurances that the local interests will: (1) furnish without cost to the United States all lands, easements, and rights-of-way necessary for construction of the works; (2) provide a channel with capacity of 14,000 cubic feet per second through Reno; (3) hold and save the United States free from damages due to the construction works; (4) maintain and operate all the works; (5) establish effective regulations to afford an adequate and unrestricted waterway. A more detailed description of the Corps of Engineers recommended program of construction is included in the Appendix to this report.

The City Council of Reno and the Board of County Commissioners of Washoe County have both furnished assurances that they will maintain the channel of the Truckee River upon completion of the work.

To assure the construction of the Corps of Engineers' recommended improvements the City of Reno must take such steps as necessary to initiate and implement the local interest participation required by the U.S. Government.

The Washoe Project, authorized under the Bureau of Reclamation, includes the construction of Stampede Reservoir in the Truckee River basin upstream from Reno. Already completed on the upstream watershed are Boca Reservoir and Prosser Creek Reservoir.

The proposed Stampede Reservoir is to be located on the Little Truckee River upstream from the existing Boca Reservoir and will have a capacity of 126,000 acre-feet and will be operated for irrigation-flood control multi-purpose use in conjunction with Boca Reservoir. Combined

Stampede Reservoir - Boca Reservoir flood control capacity allocation is 30,000 acre-feet, of which 22,000 acre-feet will be reserved in Stampede Reservoir.

Prosser Creek Reservoir, as completed, is an irrigation-flood control multi-purpose reservoir of 30,000 acre-feet capacity of which 20,000 acre-feet of capacity is allocated for flood control.

~~These newly constructed and proposed~~ reservoirs will each provide significant improvement to control of flood flows in the Truckee River through the Truckee Meadows. While the greatest benefit will be obtained if the storage allocations are strictly maintained for the flood control purpose assigned, it should be borne in mind that considerable reduction in peak flows is possible by the flood routing through even a full reservoir.

REVISED MASTER PLAN

REVISED CRITERIA

The criteria for determination of storm drainage facilities, based on full evaluation of recent additional data are revised as follows for this addendum study:

1. Design criteria developed by the U. S. Army Corps of Engineers for the Truckee River have been accepted for flood control measures proposed on the Truckee River. Design criteria for existing Peavine detention reservoirs as developed by the U. S. Department of Agriculture, Soil Conservation Service have been accepted.
2. Rainfall intensity-duration-frequency curves as developed for the 1957 Report are used without modification.
3. The Land Use Plan of the City of Reno and zoning ordinance of Washoe County is accepted as the basis of future development in the area.
4. The Rational Method of computing storm water quantity has been used for local urban runoff. Direct correlation with observed flow as an adjusted function of tributary area has been used in computing flow from undeveloped watersheds. The Basic Hydrograph method of defining hydrograph shape has been used in computing storm water quantity for smaller watersheds where actual hydrographs of flow are not available.
5. Standard methods of reservoir storage routing were utilized for both reservoir routing and flood plain routing.
6. Flood flow from a portion of the area south of the Truckee River will be routed through Virginia Lake to reduce peak flow downstream.
7. The design storm exceedence interval for the design of local storm drainage facilities in the downtown and residential areas in the City and the adjacent relatively flat agricultural areas is selected as five years.

8. The design storm exceedence interval for the design of local storm drainage facilities in the southwest and northeast areas expected to discharge through existing or future intensive development is selected as ten years.

9. The design storm exceedence interval for the design of storm drainage facilities for the northwest area, detention dam outflows, and Virginia Lake outflow expected to discharge into existing or future intensive development is selected as fifty years.

The revised Master Plan for Storm Drainage has been modified and is presented schematically on Plate 1. Revised flow capacity requirements are contained in the City Engineers' Design Appendix.

The Master Plan is divided into three basic priority categories: Emergency, Essential and Ultimate.

Emergency construction includes the construction of storm drainage facilities critically needed now to reduce major storm water damage and to eliminate the public health hazard resulting from the overflow of combined sewers conveying storm water and sanitary sewage.

Essential construction includes the construction of those additional storm drainage facilities required to provide a reasonable level of storm drainage protection for present developed area.

Ultimate construction includes the construction of those additional storm drainage facilities which will be required to provide a reasonable level of storm drainage protection at such time as future development warrants.

In addition, the Emergency priority construction program has been divided to provide for a logical first increment of the program designated Phase I, to be scheduled for immediate design and construction.

Phase I of the Emergency Construction Program proposes the construction of the following briefly described sections of the Storm Drainage Master Plan:

VINE STREET DRAIN

This portion of proposed drainage facilities located in the northwest sector extends from the Truckee River up Vine Street, Seventh Street, and Elmcrest Drive to a point of connection with the Peavine Dam outflow ditch. Construction of this drain will complete the Peavine Creek flood control system and will also intercept local surface drainage which is responsible for surcharge of combined sewers over a large portion of the northwest sector. Plate 2 shows these areas affected by storm water surcharge of sanitary sewers. Construction of the Vine Street Drain will permit separation of storm drainage connections from sanitary sewers in a large area and will alleviate a serious public health hazard in this area.

SOUTHSIDE DRAIN

This portion of proposed drainage facilities is the major drainageway for a large area of the City south of the Truckee River and extends from the point of confluence of the Virginia and Truckee Drain and the Virginia Lake Outflow Line to the south perimeter airport ditch presently under construction. The Southside Drain is essential to the proper functioning of the Virginia and Truckee Drain and as a central collector drain for that area immediately east of South Virginia Street. Construction of this drain is required before any additional drainage facilities in the south sector can be completely effective. Construction of the Southside Drain will permit separation of storm drainage connections from sanitary sewers in a large area and will alleviate a serious public health hazard in this area.

NORTHEAST DRAIN

This portion of proposed drainage facilities is required to provide adequate outflow from essentially the entire northeast sector of the City. Drainage from this area of Reno presently discharges directly into the City of Sparks, eventually flowing to the Truckee River through existing irrigation drains at a point near Vista. There is a critical need for this adequate and direct drainage to the river.

Phase II of the Emergency Construction Program includes the remaining portion of storm drainage facilities critically needed now to reduce major storm water damage and to eliminate the remaining overflow of combined storm and sanitary sewers which causes public health hazard. The most significant item of work in this category is the proposed construction of a detention dam on Evans Creek which would be of primary benefit to the University of Nevada and areas tributary to Evans Street in the northwest sector. Construction of this dam was deferred on the original Peavine Mountain Watershed Improvement Program because of right-of-way difficulties. This project should be reconsidered at this time.

Essential construction of the additional storm drainage facilities required to provide a reasonable level of storm drainage protection for existing developed areas are shown on Plate 1.

Ultimate construction of the additional storm drainage facilities which will be required to provide a reasonable level of storm drainage protection at such a time as future development warrants are shown on Plate 1.

Projects not classified under one of these three categories include a proposed detention dam near the Huffaker Hills, diversion of Dry Creek, and improvements to Steamboat Creek.

The Huffaker detention reservoir, with both Steamboat Creek and diverted Dry Creek flows routed through storage, would materially decrease Truckee Meadows flooding and reduce potential flooding of probable areas of annexation south of the airport. Improvement to airport drainage would also provide a significant benefit. This project is complicated because of multiple benefit with areas of the County. At the present time, it appears more reasonable that this project would be sponsored by the County of Wahoe. Qualification under the Soil Conservation Service Watershed Improvement Program may be possible.

TRUCKEE MEADOWS FLOOD PROTECTION

Additional consideration has been given the development potential of the Truckee Meadows area and the problems of flood protection which would result from development of land area within the present flood plain. Considerable improvement in this flood plain condition has been made by the various projects and construction previously noted.

A detailed investigation of the problem facing a major potential growth in this area adjacent to the City of Reno is not included within the authorized scope of this study. As a result of a resolution submitted by the City Council, the U.S. Army Corps of Engineers has indicated that it would review the problem.

Without the benefit of the rather extensive study and investigation which would be required to compare alternative programs for flood protection of this area, it is difficult to state precisely the most beneficial and economical alternative solution. Basic alternatives for flood control in the Truckee Meadows area would be expected to consist of any one or combination of the following construction programs:

- (a) Deepening and enlargement of the Truckee River and lower tributaries to further lower the control previously improved by the Vista reef removal.
- (b) Construction of a system of flood plain containment levees on the Truckee River and lower tributaries.
- (c) Construction of additional local basin flood detention structures such as the Steamboat Creek Detention Reservoir previously mentioned.
- (d) Construction of supplemental channels and levees for tributaries including local storm water pumping facilities.

Considering the apparent costs of further channel improvement in the Vista area which would be an essential requisite of further Truckee River channel deepening and enlargement, it would appear more feasible to construct a system of levees designed to partially contain and reduce the Truckee Meadows flood plain to permit the reclamation of remaining areas for urban development. Pumping or local storage of local storm drainage in these areas protected by levees would be required. Detention of flows from Steamboat Creek, including diversion of Dry Creek would be an important supplement to a levee construction program.

Feasibility determination of this program should be based on the benefit resulting from increased valuation of areas reclaimed for possible urban development.

The potential for severe flood damage to areas protected by levee systems in the event of levee failure during flood conditions should be carefully evaluated and considered.

SUMMARY OF FINDINGS

1. Growth and development of the City of Reno since 1957 have resulted in conditions requiring minor modifications of the Storm Drainage Master Plan, dated 1957.

2. Additional hydrologic data have been collected since 1957. Modification of storm drainage design criteria are substantiated on the basis of these additional data.

3. Major improvements to the Truckee River channel, construction of flood detention dams in the northwest sector, and construction of a portion of the Master Storm Drainage Plan have been accomplished since 1957.

4. The U.S. Army Corps of Engineers completed in 1960 its interim study of flood problems of the Truckee River and has outlined a program for Truckee River flood control. Appropriations for projects recommended therein have not been made.

5. The public health hazard resulting from the overflow of sanitary sewers and the flooding of both public and private property with sewage resulting from the combined use of sewers for both storm drainage and sanitary sewage has increased since 1957. There is no other single public works need facing the City of Reno at the present time which is more critical than the need for a program of storm water separation.

6. Flooding caused by storm drainage in the northeast sector of the City has become seriously critical since 1957 because of additional development permitted without provision for adequate storm drainage facilities.

7. Additional rainfall and runoff records are needed in representative watersheds tributary to the City.

RECOMMENDATIONS

1. It is recommended that the Storm Drainage Master Plan, as revised, be adopted as the governing basis for all storm drainage construction within the City of Reno.

2. It is recommended that the construction program outlined under Emergency Construction - Phase I be implemented immediately.

3. It is recommended that a schedule for construction of the remainder of the Emergency Construction program be established.

4. It is recommended that an annual program for construction of storm water separation facilities be scheduled to supplement construction of major storm drainage works.

5. It is recommended that the Reno City Council adopt the program proposed by the U.S. Army Corps of Engineers for flood control of the Truckee River and initiate a program of vigorous "local interest" in an effort to obtain Federal appropriation for the authorized Martis Creek Dam project. Construction of downtown Reno-Truckee River channel improvements in accordance with U.S. Army Corps of Engineers plan would be a major indication of "local interest".

6. It is recommended that the Reno City Council adopt a resolution requesting U.S. Department of Agriculture, Soil Conservation Service assistance in planning and constructing the Evans Creek flood water detention dam and naming the City of Reno as sponsoring agency.

7. It is recommended that a policy be established governing the correction of existing drainageway encroachments, considering recommendations by the City Attorney as to the legal responsibility of the owners involved.

8. It is recommended that policy be established through modification of the City of Reno subdivision ordinance which would prevent future drainageway encroachments and require adherence to the Storm Drainage Master Plan.

9. It is recommended that the City Council adopt an ordinance controlling development within known flood plain areas utilizing information contained in this report and in the report of March 1960 prepared by the U.S. Army Corps of Engineers.

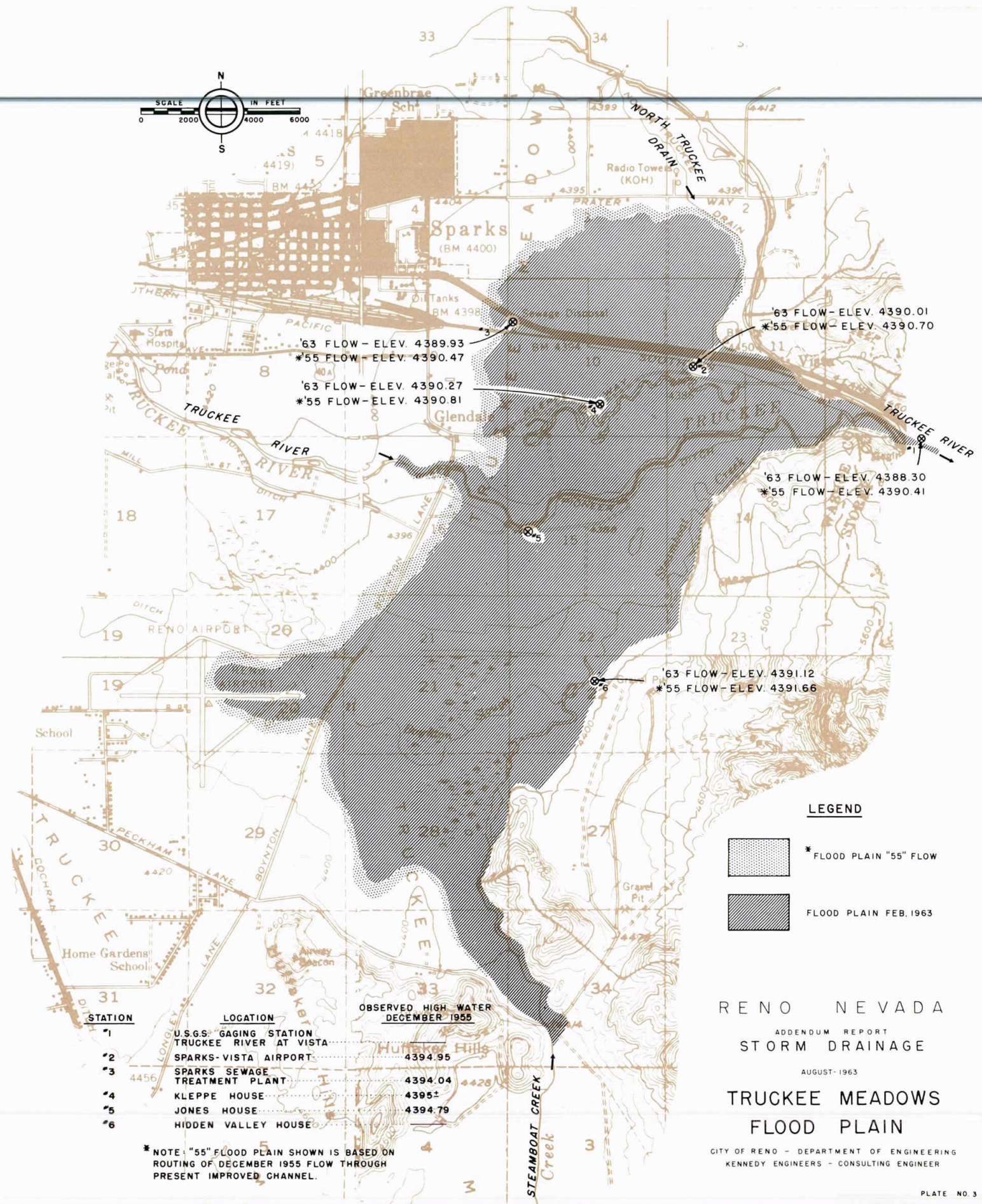
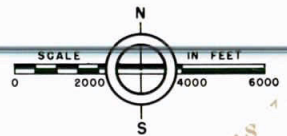
10. It is recommended that a policy be established and adopted which will govern the City of Reno participation and owner participation in cost of construction of Master Plan storm drains. This policy should consider the recommendations of the City Attorney.

11. It is recommended that the City of Reno consider joint sponsorship with the County of Washoe in requesting U.S. Department of Agriculture, Soil Conservation Service assistance in planning and constructing a flood detention structure on Steamboat Creek near Huffaker Hills, diversion of Dry Creek, and downstream channel improvements on Steamboat Creek.

12. It is recommended that a detailed investigation be made concerning the feasibility of construction of a debris removal structure at a point upstream from the City of Reno.
in the Truckee River?

13. It is recommended on the basis of the schedule of storm drainage construction adopted, that a review be made of the required fiscal program necessary to support this construction schedule.

14. It is recommended that the City of Reno establish or sponsor on a cooperative basis with the appropriate Federal agency, a short term supplemental program of rainfall and stream gaging on representative tributary watersheds where data are not available.



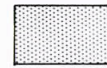
'63 FLOW - ELEV. 4389.93
 *'55 FLOW - ELEV. 4390.47
 '63 FLOW - ELEV. 4390.27
 *'55 FLOW - ELEV. 4390.81

'63 FLOW - ELEV. 4390.01
 *'55 FLOW - ELEV. 4390.70

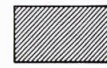
'63 FLOW - ELEV. 4388.30
 *'55 FLOW - ELEV. 4390.41

'63 FLOW - ELEV. 4391.12
 *'55 FLOW - ELEV. 4391.66

LEGEND



* FLOOD PLAIN "55" FLOW



FLOOD PLAIN FEB. 1963

STATION	LOCATION	OBSERVED HIGH WATER DECEMBER 1955
*1	U.S.G.S. GAGING STATION TRUCKEE RIVER AT VISTA	4394.95
*2	SPARKS-VISTA AIRPORT	4394.95
*3	SPARKS SEWAGE TREATMENT PLANT	4394.04
*4	KLEPPE HOUSE	4395±
*5	JONES HOUSE	4394.79
*6	HIDDEN VALLEY HOUSE	

* NOTE: "55" FLOOD PLAIN SHOWN IS BASED ON ROUTING OF DECEMBER 1955 FLOW THROUGH PRESENT IMPROVED CHANNEL.

RENO NEVADA
 ADDENDUM REPORT
 STORM DRAINAGE
 AUGUST-1963
**TRUCKEE MEADOWS
 FLOOD PLAIN**
 CITY OF RENO - DEPARTMENT OF ENGINEERING
 KENNEDY ENGINEERS - CONSULTING ENGINEER

APPENDIX
TO
AN ADDENDUM REPORT ON
STORM DRAINAGE

CITY OF RENO

1963

EXCERPTS FROM "INTERIM SURVEY REPORT FOR
FLOOD CONTROL" PREPARED BY U. S. ARMY
CORPS OF ENGINEERS, MARCH 1960

The following excerpts from the U. S. Army Corps of Engineers' report on flood control for "The Reno Area, Truckee River and Tributaries" are included herein and provide the bases for related findings and conclusions presented in this report. These excerpts describe the Corps of Engineers' proposed program to reduce Truckee River flood damage. Of considerable significance are those sections relating to previous commitments regarding channel maintenance entered into by the City and those commitments required as conditions to any program of construction to be financed in part by the Federal Government:

"REPORT OF THE DISTRICT ENGINEER
SYLLABUS"

"The District Engineer finds that floods in the Truckee River cause serious damages, particularly at and in the vicinity of Reno, Nevada. He finds that under present conditions the average annual flood damages at Reno amount to about \$775,000; and further, that following completion of the authorized Washoe Project of the U. S. Bureau of Reclamation, involving construction of two reservoirs in the Basin upstream from Reno, average annual damages amounting to \$274,000 will continue to occur in Reno unless additional protective measures are taken. He also finds that the most practical and economical means of providing urgently needed additional flood protection is by construction of a 15,000 acre-foot reservoir on Martis Creek, together with minor supplemental channel work in the Truckee River through Reno. The plan of improvement is economically justified by a benefit-cost ratio of 1.4 to 1.0.

Accordingly, the District Engineer recommends that the plan of improvement comprising a reservoir on Martis Creek and minor capacity enlargement of the Truckee River through Reno be authorized at an estimated cost to the United States of \$2,060,000, exclusive of cost of preauthorization studies, provided that local interests, through the medium of a public body legally authorized and financially capable, give assurances satisfactory to the Secretary of the Army that they will:

(a) furnish without cost to the United States all lands, easements, and rights-of-way necessary for construction of the works, including in this provision the undertaking of all necessary modifications and relocations of roads and other existing structures and utilities; (b) accomplish at their own expense the work required to provide a channel capacity of 14,000 cubic feet per second through Reno; (c) hold and save the United States free from damages due to the construction works; (d) maintain and operate all the works at their own expense in accordance with rules and regulations prescribed by the Secretary of the Army, including in this provision the removal of accumulated bedload material and other debris from the river channel in Reno following all floods and otherwise as required to preserve a nondamaging capacity of 14,000 cubic feet per second; (e) establish effective regulations to prevent the placement of fills, buildings, and other encroachments within the channel in Reno, and to insure that all future bridges or other structures to be built or rebuilt across the channel in Reno afford an adequate and unrestricted waterway; and (f) adequately inform interests affected that the project does not provide protection against maximum floods."

A resolution adopted by the City of Reno:

" . . . BE IT RESOLVED by the City Council of the City of Reno, that the City of Reno will cooperate with the Carson-Truckee Water Conservancy District to the fullest extent possible in providing local cooperation and will especially contribute to the work involved in providing a channel capacity of 14,000 cubic-feet per second through Reno during flood periods and will establish effective regulations to prevent the placement of fills, buildings and other encroachments within the channel in Reno, and to insure that all future bridges or other structures to be built or rebuilt across the channel in Reno afford an adequate and unrestricted waterway . . ."

TRUCKEE MEADOWS FLOOD PLAIN INVESTIGATIONS

Investigations and analyses accomplished during the preparation of this report were required to determine the Truckee Meadows flood plain for various conditions of flow. The work was based on available topographic data, records of the U.S. Geological Survey, and on field observations of high water marks and survey ties to provide a record high water elevations of the flood of January-February 1963.

The 1963 flood provides the most significant flood records for the Truckee Meadows area, being the only major flood of record for which accurate and continuous records of Truckee Meadows inflow and outflow quantities have been recorded. The 1963 flood permitted the first field rating of the U.S.G.S. Truckee River gaging station at Vista since completion of extensive channel improvements on the Truckee River by the U.S. Army Corps of Engineers. This channel improvement, particularly the removal of rock reefs at Vista, resulted in significant improvement in the flow characteristics at the point of hydraulic control of the Truckee Meadows flood plain, being also the point of hydraulic control for the Vista gaging station.

Flood plain investigations and analyses involved a determination of Truckee Meadows flood plain elevations for three basic conditions:

1. February 1963 Flow - 1963 Hydraulic Conditions.
2. December 1955 Flow - 1963 Hydraulic Conditions.
3. U.S. Army Corps of Engineers Standard Project Flood - 1963 Hydraulic Conditions

Analysis of the flood of February 1963 and utilization of observed flood plain elevations for 1963 hydraulic conditions provided the basic criteria required for flow routings for all other conditions of flow. Using measurements of inflow and outflow to the Truckee Meadows Basin,

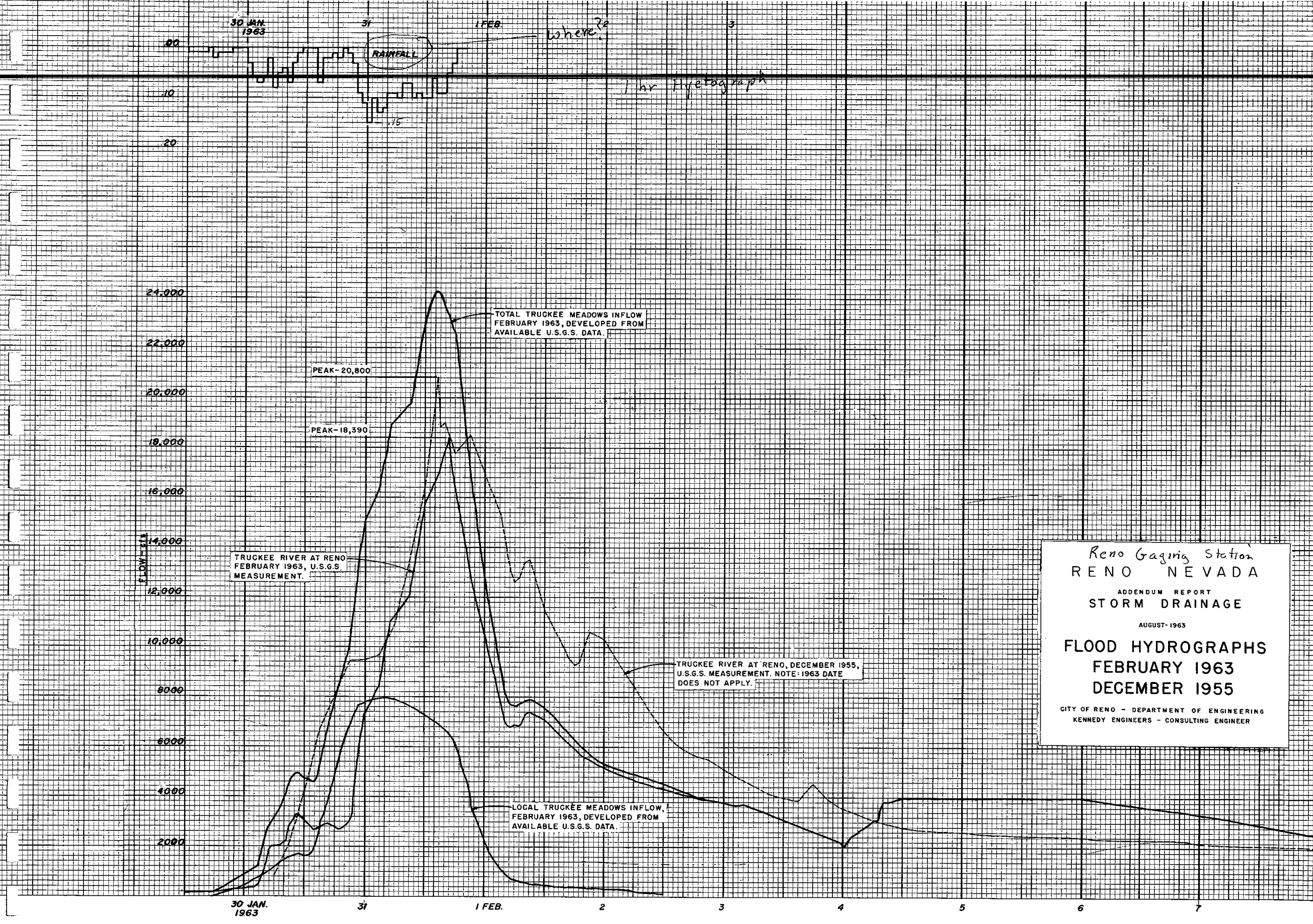
the volume of Local Basin Inflow was computed. Truckee River measured flow at the Reno gaging station for February 1963 is shown on Plate A-1. Truckee River measured flow at the Vista gaging station for February 1963 is shown on Plate A-3.

Using standard flood routing procedures, a reconstitution of 1963 flood conditions was derived. A comparison of calculated basin outflow at Vista plotted with measured basin outflow is shown on Plate A-2. Derived Local Basin Inflow and combined Total Basin Inflow for reconstituted February 1963 conditions of flow are shown on Plate A-1.

Using a correlation based on probability relationships, Local Basin Inflow for December 1955 conditions was computed and combined with measured Truckee River flow at Reno to give Total Basin Inflow for December 1955 storm conditions. This derived Total Basin Inflow for December 1955 storm conditions was then routed through the Truckee Meadows flood basin, using standard flood routing procedures and hydraulic conditions as they existed in February 1963.

Flood plain elevations derived from this analysis of 1955 flow under 1963 hydraulic conditions, and for February 1963 observed high water at various points throughout the Truckee Meadows flood plain are shown on Plate 3 of the report.

In addition, the U.S. Army Corps of Engineers derived "Standard Project Flood" for Truckee River at Reno assuming Stampede Reservoir constructed and Martis Creek Reservoir not constructed (see U.S.C.E. Report Appendix A, Chart 46) was routed through the Truckee Meadows flood basin, using 1963 hydraulic conditions. Derived mean flood plain elevation for this condition was determined to be elevation 4391.72. Local Basin Inflow was not added to the Standard Project Flood for this routing.



Reno Gaging Station
 RENO NEVADA
 ADDENDUM REPORT
 STORM DRAINAGE
 AUGUST 1963
 FLOOD HYDROGRAPHS
 FEBRUARY 1963
 DECEMBER 1955
 CITY OF RENO - DEPARTMENT OF ENGINEERING
 KENNEDY ENGINEERS - CONSULTING ENGINEER

24,000
22,000
20,000
18,000
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0

FLOW - cfs

30 JAN.
1963

31

1 FEB.

2

3

4

5

6

7

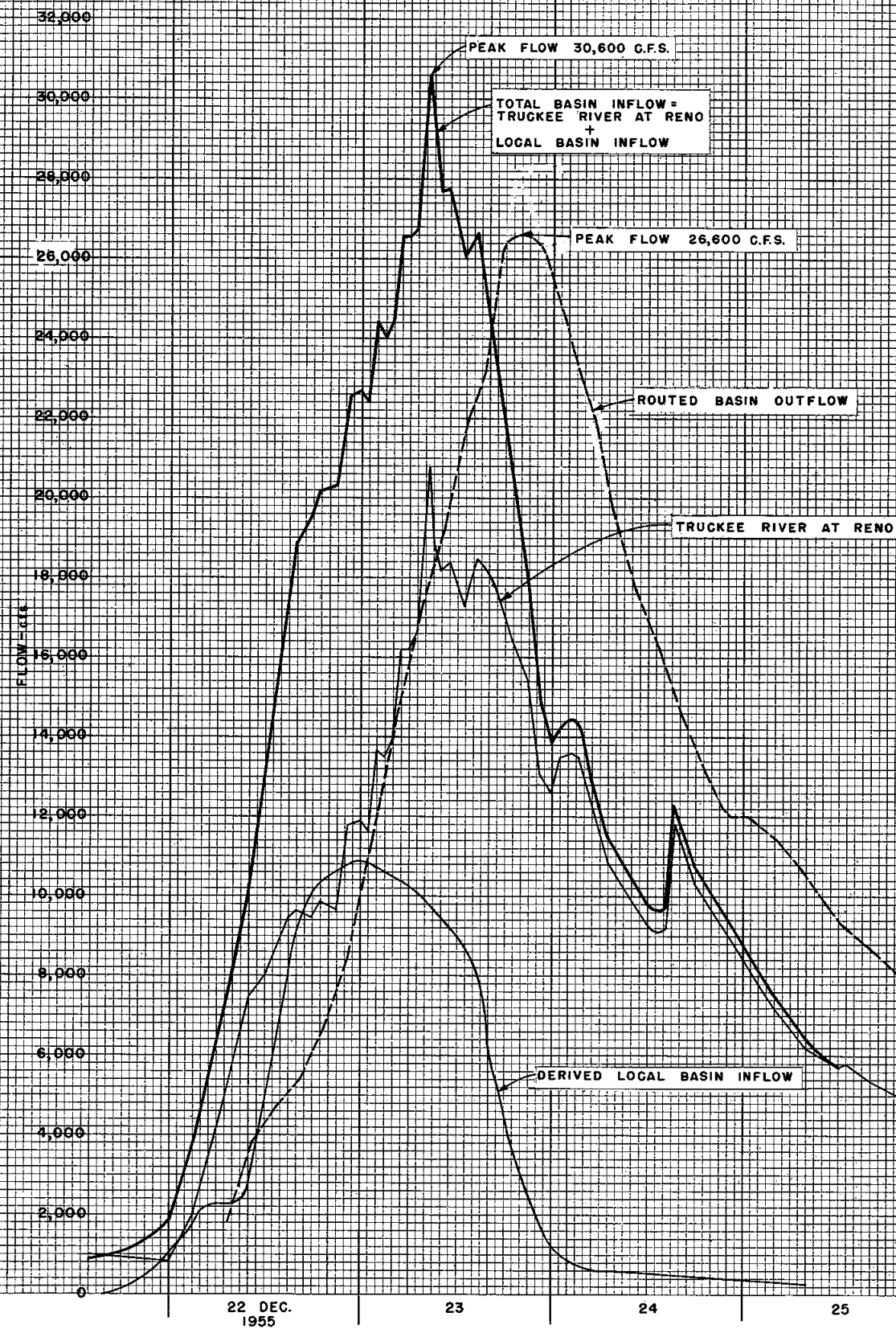
8

PEAK FLOW 21,300 C.F.S.

TRUCKEE RIVER AT VISTA,
JANUARY-FEBRUARY, 1963
U.S.G.S. MEASUREMENT
(OBSERVED)

ROUTED BASIN OUTFLOW - SYNTHESIZED JANUARY-FEBRUARY
1963 TOTAL BASIN INFLOW ROUTED THROUGH
TRUCKEE MEADOWS FLOOD BASIN.
(COMPUTED)

RENO NEVADA
ADDENDUM REPORT
STORM DRAINAGE
AUGUST-1963
ROUTED FLOOD HYDROGRAPH
FEBRUARY 1963
CITY OF RENO - DEPARTMENT OF ENGINEERING
KENNEDY ENGINEERS - CONSULTING ENGINEER



RENO NEVADA
 ADDENDUM REPORT
 STORM DRAINAGE
 AUGUST-1963
 FLOOD HYDROGRAPHS
 DECEMBER 1955 FLOW
 1963 CHANNEL CONDITIONS
 CITY OF RENO - DEPARTMENT OF ENGINEERING
 KENNEDY ENGINEERS - CONSULTING ENGINEER