

RIVERSIDE COUNTY FLOOD CONTROL
AND WATER CONSERVATION DISTRICT
Riverside, California

REPORT ON

BANNING
MASTER
DRAINAGE PLAN

Zone Five

Revision No. 1
September 1994

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BANNING MASTER DRAINAGE PLAN

	<u>Date of Report</u>	<u>Date of Adoption By RCFC&WCD Board of Supervisors</u>
Original Plan	June 1975	February 25, 1975
Revision No. 1	September 1994	August 29, 1995

BANNING
 MASTER DRAINAGE PLAN
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SECTION I

PURPOSE

The purpose of this report is to investigate and evaluate the drainage problems of the Banning area. Presently this area is serviced by a report entitled "Master Drainage Plan for the City of Banning" prepared by the Riverside County Flood Control and Water Conservation District ("District") in 1975. The report presented here is a re-evaluation and expansion of that 1975 report and is meant to replace it.

SECTION II

SCOPE

The drainage area covered by this plan is approximately 19 square miles in size. It covers the bulk of the territory within the City of Banning and includes unincorporated lands of the County of Riverside. The plan area is bounded roughly by the San Gorgonio River on the north, Smith Creek on the south, Hathaway Street on the east and Highland Springs Road on the west. The extent of the studies establishing this master plan includes:

1. Determination of the quantity and points of concentration of storm runoff in the area.
2. Preparation of a drainage facility map.
3. Determination of the location, size and capacity of the proposed drainage structures.
4. Investigation of alternatives as a basis for selecting the most effective plan.
5. Preparation of supporting cost estimates.

SECTION III

GENERAL DISCUSSION

The proposed drainage plan involves the construction of several debris basins, major open channels and a network of underground storm drains. The drainage system will collect flows emanating from the foothills as well as local runoff, and transport the flows to natural washes leading south to Smith Creek. This plan can generally be divided into two separate study areas which share a common border at Sunset Avenue.

East of Sunset Avenue, a significant degree of flood protection presently exists since most of the major drainage facilities in the original plan have been constructed. Also,

facilities in the original plan have been constructed. Also, there has not been a significant change in proposed land use and other design parameters used in the 1975 report. Therefore, a major re-study of the overall drainage system in this area is not warranted at this time. Some additions and extensions of minor facilities are proposed, however, to improve certain localized drainage problems.

In the 1975 report only a few facilities were proposed to service the area west of Sunset Avenue. Since development within this area is now expected to increase within the next several years, however, additional facilities will be needed. The area has been studied to reflect the most recent projected land use and rainfall data. Proposed facilities include the expansion of the Pershing Channel system and the addition of a backbone facility for Smith Creek. Facilities have also been added to service the area near Highland Springs Road.

The master drainage plan (MDP) presented herein provides an economical method of collecting and conveying storm runoff through the study area. When completed, the facilities will provide the area with improved drainage and a high level of flood protection.

It should be noted by the reader that this report is a master plan, and therefore, should be read and used with this in mind. Simply stated, this plan is an overview; a study of the drainage problems that exist in a specific geographical area and provides a conceptual solution to those problems. As stated elsewhere in this report, the selection of the facilities presented in this plan is based on engineering and economic considerations and is by no means the only solution.

The alignment and location of the facilities proposed in this MDP are general; precise facility locations will be dictated by conditions and other factors existing at the time of design. Similarly, the sizing information shown on the enclosed map is preliminary. A more detailed analysis performed at the design stage will determine final sizing.

SECTION IV

CRITERIA

All underground storm drains proposed in this plan are intended to collect local urban runoff and, with few exceptions, are located either in existing or proposed street rights of way. Runoff from a 10 year frequency storm is allowed to accumulate in the streets until flow depths reach the top of curbs. At this point, except for Line D, Line D-2 and Lateral D-2A, the plan proposes the initiation of an underground drain which will intercept and convey the entire 10 year storm runoff to an outlet

downstream. Flows exceeding the 10 year frequency storm will generally be carried within street rights of way, and the combination of both street and underground storm drain conveyances will provide a high level of flood protection.

Open channels are proposed when the discharge is large and the construction and right of way costs for a channel prove to be less than the cost of an underground storm drain. Where open channels are provided, they are designed to carry the runoff from a 100 year frequency storm.

The alignments of all drains and channels are based on existing development, street patterns, flow paths, the ability to drain problem areas, and economics. Insofar as possible, the existing system should be utilized as part of the ultimate system in order to avoid duplication and unnecessary increased costs.

In addition to the criteria mentioned above, flood control facilities are proposed when:

- a. Relief for an overloaded existing drain is necessary.
- b. Economic consideration dictates a diversion from the normal path of storm flows.
- c. Relief for a major traffic carrying street or street intersections is needed.

SECTION V

HYDROLOGY

The hydrology for the plan was developed by two methods: the Modified Rational Method and the Synthetic Unit Hydrograph Method. The Modified Rational Method was used to determine the peak discharges generated from small watersheds (generally less than 300 to 500 acres in size). The Synthetic Unit Hydrograph Method was used for larger areas in generating the peak discharge rates for sizing major drainage facilities.

Methodology and supportive data for the Rational and Synthetic hydrology can be found in "The Riverside County Flood Control and Water Conservation District Hydrology Manual", dated April 1978. The design discharges used in sizing all future appurtenant facilities in the study area should be determined by one of these two methods.

A map showing the complete drainage plan and location of major existing and all proposed facilities is included in the rear of this report.

As discussed previously, this plan can generally be divided into two separate study areas which border at Sunset Avenue. The following are some particulars regarding the hydrology for these areas:

EAST OF SUNSET AVENUE - This area generally covers the central and eastern portions of the City of Banning. The area southerly and downstream of the Banning Bench is near complete build-out with the majority of the MDP facilities already constructed. The Bench itself is presently undeveloped. The design of the existing MDP facilities was based on an anticipated development density of 1/4 acre single family lots on the Bench. If development takes place at a higher density, detention facilities should be required in order to ensure the downstream facilities are not overtaxed.

It is important to note that the hydrology for this area remains unchanged from the 1975 MDP study. No significant change in land use or rainfall has occurred, therefore the degree of protection provided by the master plan facilities has not diminished.

WEST OF SUNSET AVENUE - New hydrology was generated for this area to reflect currently projected land use and updated rainfall data. The projected land use was based on the General Plan of the City of Banning, certain specific plan developments, and overall development patterns assumed by the District.

The Federal Emergency Management Agency (FEMA) has mapped a flood plain for Smith Creek which required hydrologic and hydraulic calculations. Flow rates were determined by stream gage analysis and then bulked 25% to account for debris. In recent correspondence, FEMA has stated that the flow rates used remain valid and appropriate at this time. Therefore, the FEMA values were used to "calibrate" the District's model.

Debris was accounted for in the proposed Smith Creek and Pershing systems. However, according to FEMA, the Highland Springs watershed has a low debris potential and thus no bulking was used for this particular system.

SECTION VI

EXISTING FACILITIES

Several existing storm drains are located within the Banning area watershed. These lines have been constructed by various agencies during the past five decades. Those that are utilized directly by the plan were assigned "line numbers" for ease of

reference in this report. A brief description of these existing lines which are an integral part of the master plan is presented in this section.

A table showing all major existing facilities is shown on the MDP map in the rear of this report.

LINE A - EAST GILMAN HOME CHANNEL - This facility is a WPA constructed, rock and mortar channel which was rebuilt in 1938 following severe flood damage experienced in the floods of 1937 and 1938. It collects runoff from a 1.14 square mile watershed, one of the major watersheds draining into Banning. The channel begins in the mouth of a canyon approximately 2,000 feet north of the intersection of Wilson Street and 16th Street, and continues southeasterly to the intersection of Nicolet and 8th Streets. The channel section upstream from George Street has reasonably adequate capacity but does not nearly match current construction standards. It is proposed to be replaced as discussed on Page 11.

During a major flood, indeed, during any flood exceeding a 10 year frequency event, runoff is expected to exceed the capacity of the existing channel in the vicinity of 10th Street. It would likely fan out from there in a wide area causing damage to homes and businesses along its path. A new facility is proposed to relieve this particular situation as also discussed on Page 11.

The District has constructed a re-aligned segment of Line A as a reinforced concrete box (RCB) in Nicolet Street, extending from 8th Street to 4th Street, where it joins with Line C. A segment of Line A has also been constructed in 4th Street from Williams Street to just south of Westward Avenue. This facility was designed to convey the 100 year flow rate. The connecting reach of Line A between Williams and Nicolet has not yet been constructed and is included in the recommended improvement discussion on Page 11

The old WPA channel at the south side of the intersection of 8th Street and Nicolet Street was blocked off when the re-aligned segment of Line A was constructed in Nicolet Street. The old channel runs southeasterly from this point to Williams Street, where it transitions to an underground facility that transverses through a trailer park and an adjacent commercial property. The facility continues southward under Interstate 10 as a 5' x 5.5' RCB, and eventually discharges into the District's Line A channel along 4th Street south of the Southern Pacific Railroad.

LINE A-2 - 8th STREET UNDERPASS DRAIN - Line A-2 currently extends from Line A and the Southern Pacific Railroad westerly to 8th Street, and then northerly along 8th to Ramsey Street. This line also picks up runoff along the

Southern Pacific Railroad flowing easterly from west of 8th Street. The line varies in size from 54" to 33" in diameter and was constructed as part of the railroad underpass, grade separation project by the City of Banning on 8th Street. The drain serves as an integral part of the overall master plan system.

LINE B - GILMAN HOME CHANNEL - Line B is commonly referred to as the Gilman Home Channel. This line receives storm flows from a 0.88 square mile watershed tributary to the natural wash at Wilson Street, 300 feet east of 16th Street. The channel is concrete lined from the junction with Line A upstream to a point 600 feet south of Wilson, where it joins the existing wash. The District completed this 1,150 feet reach in 1973. It is designed to convey 100 year frequency runoff and is an important part of the ultimate planned system.

LINE C - INDIAN CANYON CHANNEL - Line C upstream of Wilson Street, commonly referred to as the Indian Canyon Channel, was a WPA project built in the early 1930's and constructed of rock and mortar. Its relative flood carrying capacity and condition is similar to that described for the old upstream portions of Line A, and thus replacement is also proposed for this facility. The channel intercepts flows concentrated at the mouth of the canyon, which drains a 0.70 square mile watershed near Indian School Lane and 8th Street. Around 1983 the District built an underground segment of Line C from Line A at Williams Street to Line C-1 at Wilson Street. The completed reach was designed to handle the 100 year storm flows.

LINE C-1 - SIDNEY STREET CHANNEL - The Sidney Street Channel, designed to intercept flood flows from a watershed south of the Sunnyslope Cemetery, consists primarily of a concrete lined trapezoidal section constructed in 1958 by the District. It traverses downstream along the rear lot lines of several homes to Wilson Street and joins the Indian Canyon Channel (Line C) north of Replier Park.

LINE D - RAMSEY STREET STORM DRAIN - Line D, the Ramsey Street Storm Drain, begins at George Street in Replier Park. It extends southeasterly to Ramsey Street and Alola Street, continues in Ramsey Street to Hathaway Street, and then crossed under Interstate 10 and the Southern Pacific Railroad tracks to a point of discharge into a dirt channel north of the Banning Airport. The underground reaches of this line consist mostly of 4' x 5.5' RCB. The system previously had capacity for only about 25 percent of the recommended 100 year frequency design flood, but the upstream interception of tributary flows accomplished by the construction of Line C has greatly improved the functional capacity of Line D. Having now only to provide local drainage, Line D design

capacity is considered adequate.

LINE E - MONTGOMERY CREEK CHANNEL - Line E is a concrete lined open channel that carries Montgomery Creek flows through the westerly part of Banning. The channel was constructed in several stages by the District between 1960 and 1964. It begins in the natural wash area west of Sunset Avenue and north of Wilson Street, and extends southeasterly to Nicolet Street and Roberge Avenue. It continues downstream as an open channel facility to Ramsey Street, aligned within the median of Roberge Avenue. At Ramsey Street, it transitions to a 10'x6' RCB and passes under Interstate 10, through a Pacific Railroad trestle, and discharges back into the existing natural wash of Montgomery Creek.

LINE E-2 - SUNSHINE PARK STORM DRAIN - Line E-2 was constructed in 1972 by the developer of the existing trailer park at Wilson Street and Sunshine Drive as a means of protecting the trailer park from floodwaters emanating from the north of Wilson Street. The facility varies from a 42" CMP to a 58" x 36" CMPA, and extends from Wilson Street to Montgomery Creek Channel downstream of Sunnyside Drive. The District's evaluation of this storm drain indicates that it has limited capacity for use as a master plan drain. The District does not recommend that the facility be immediately replaced, however, the City should be aware that its capacity could be exceeded by floods of less than 10 year frequency magnitude.

LINE E-3 SUNRISE AVENUE DRAIN - Line E-3 was constructed in 1992 by the developer of Tract 23598 at Wilson Street and Sunrise Avenue as a means of protecting the tract from offsite storm flows originating in the foothills to the north. It varies in size from a 24" RCP to a 39" RCP, and is aligned within Sunrise Avenue from Wilson Street to Montgomery Creek Channel. The District's evaluation of this storm drain indicates that it has capacity for the 100 year frequency storm flows.

LINE E-4 - BIRDS NEST CANYON DRAIN - This line is a 54" CMP drain constructed in 1969 by the City of Banning to carry flows under Wilson Street to Montgomery Creek Channel. A large natural channel carries flows from the mouth of an upstream canyon to the inlet at Wilson Street, where the facility begins. The natural channel should be improved at the time the adjacent land is developed.

LINE G - The District built a segment of this line as a 54" SRP (Spiral Rib Pipe) in Hargrave Street from Smith Creek to Porter Street in 1987. Construction was done as part of the Smith Creek Prison Farm Channel project. The storm drain was extended to Wesley Street by the District in 1990, as part of

a joint effort with the City of Banning and the County of Riverside. Line G was designed as a 10 year drain to handle local flows.

LINE I - SMITH CREEK CHANNEL - This concrete lined channel was constructed in 1991 by the developer of Tract 21882, from Highland Home Road northwesterly some 2400 feet to Wilson Street.

The uppermost 1000 feet to Wilson Street exists as concrete slope protection along the eastern bank. The project was built to protect the roadways and homes in the area.

LINE J - HIGHLAND SPRINGS CHANNEL - The Highland Springs Channel facility extending north of Wilson Street was constructed as a joint roadway improvement project by the District and the Riverside County Transportation Department, following the severe damage to the roadway incurred during the floods of 1969. During this period, the roadway was nearly washed out in many reaches, and critical access to the San Gorgonio Pass Memorial Hospital was cut off due to uncontrolled floodwaters flowing down Highland Springs Road and across Wilson Street near the hospital.

Construction of the one and one half mile long channel was completed in 1970. The newly improved facility terminated at Wilson Street where it discharged into a small existing channel extending southerly to the freeway along the west right of way line of Highland Springs Road. That particular reach of channel south of Wilson Street was replaced by a 6' x 6' RCB in 1974 by the District. Access to the San Gorgonio Pass Memorial Hospital, which is vital to both the communities of Beaumont and Banning, is now possible during adverse weather.

In 1983, the developer of Tract 14209-1 built an underground storm drain extension upstream from the District's channel near 16th Street, to a concrete lined channel constructed with Tract 4636 located to the north. The storm drain is approximately 5700 feet in length.

LINE J-1 - Part of Line J-1 was built by the developer of Tract 12428 in 1979 to protect development from flows north of Wilson Street. The 48" RCP storm drain connects to an existing 48" CMP under Wilson Street then proceeds south in Apex Avenue about 1200 feet and discharges in a natural wash south of Evelyn Drive.

In 1981 a local church built a 21" RCP lateral to this line in Wilson Street, in order to drain onsite runoff.

LINE K - WEST PERSHING CHANNEL - A critical segment of this channel was constructed by the District in 1968, along the

west side of Highland Home Road from Wilson Street northerly some 1800 feet. The project was built to provide badly needed protection to the roadways and homes in the area.

LINE M - SAN GORGONIO RIVER - BANNING LEVEE - The Banning Levee was constructed by the U.S. Army Corps of Engineers in 1965. The project was justified by the Federal Government due to the potential for major flood damage to the northeasterly section of the City, should the San Gorgonio River escape its banks. The levee was severely attacked by major floods in 1966 and again in 1969, with some significant damage sustained in each flood. The steep natural banks of the river upstream from the original levee construction were also severely eroded by floodwaters threatening to flank the levee. As a result, the Corps of Engineers repaired the damaged levee and stabilized about 1000 feet of the steep bank upstream of the levee with gabions.

LINE M-1 - SAN GORGONIO AVENUE STORM DRAIN - This particular line was constructed within San Gorgonio Avenue by the District in 1974. It is a 39" diameter pipe that extends to the San Gorgonio River from the northerly boundary of the Sunnyslope Cemetery. It intercepts runoff from a drainage area of 25.0 acres that previously flowed south through the City along San Gorgonio Avenue to Smith Creek - a distance of about 2.5 miles.

LINE N - SMITH CREEK CHANNEL - The District constructed Smith Creek improvements from Porter Street northeasterly in 1967 at the request of the City of Banning. That particular project, consisting of about 1300 feet of concrete lined revetment along the north bank, provides flood protection to the City's adjacent sewer plant. In 1979, the District extended the concrete protection some 1500 feet downstream.

LINE N-1 - SMITH CREEK PRISON FARM CHANNEL - In 1987 the District improved Smith Creek Channel from Hargrave Street westerly some 1000 feet to protect the river bank adjacent to the County prison facility. The project consists of 1/2-ton class rock slope protection.

BANNING ESTATES STORM DRAIN - This line was constructed around 1980 by the developer of Tract 13605. The tract covers approximately 65 acres and is located at the northeast corner of Winchester Drive and Jacinto View Road. The storm drain ranges from a 30" to 42" RCP and conveys local onsite flows to an existing 48" RCP under Interstate 10.

SECTION VII

MAINTENANCE AND PROTECTION OF EXISTING FLOOD CHANNELS

The City of Banning presently maintains Line D and portions of Lines A and C. A vital part of the City's flood protection relies upon continued maintenance of these facilities. Most reaches of these lines were constructed by the WPA and have been maintained as required by the City over the past five decades. The type of construction where rock and mortar lining was used is extremely vulnerable to failure if flood flows exceed the capacity of these channels.

The capacity has been analyzed in relation to 100 year frequency discharges and upon completion of the master plan as proposed (with reconstruction of some reaches of these facilities), Lines A and C will have capacity for discharges equal to the 100 year frequency design.

An important aspect in the operation and maintenance of any flood control channel is the accessibility to the facility as necessary to permit repairs that may be required. Several reaches of the aforementioned channels do not currently have sufficient rights of way in City ownership to allow adequate access for such maintenance purposes. The 1975 report recommended that the City take the steps necessary to protect ready access by preventing future encroachments into the areas adjacent to the channels. This recommendation is again expressed here. Additionally, a program should be initiated that gradually completes the purchase of access roadways along the existing City-owned channels where none are presently available.

SECTION VIII

PROTECTION OF NATURAL WASHES

This master plan proposes no facilities south of the Southern Pacific Railroad tracks for either the Highland Springs, Smith Creek or Pershing Creek systems. The existing watercourses into which these systems outlet south of the railroad are well entrenched and should provide adequate capacity to contain the 100 year flows.

Development should be encouraged to stay out of the natural washes by restrictive subdivision, building permit and zoning regulations. The waterways should be considered as an open space asset to the community and be protected by the City and property owners. Development to be located adjacent to these washes should be required to set back a sufficiently safe distance to prevent future damages which might occur from erosion during a flood. Greenbelt type revetment and stabilizers are recommended for these washes.

SECTION IX

RECOMMENDED IMPROVEMENTS

It should be again noted that the main line trunk facilities (primarily the open channels such as Lines A, B, C, E, I, K and L) are designed for 100 year frequency capacity. The collector lines feeding into these main trunks are designed for 10 year frequency capacity as discussed in the "Criteria" section of this report.

Line A - Line A serves the developed central portion of the City of Banning from 16th Street to 4th Street. This line will be the main trunk line through the area and will serve as the outlet for many existing and proposed lateral facilities.

A 7'Wx6'H rectangular channel is proposed to replace the existing rock and mortar channel between George Street and the proposed East Gilman Home Debris Basin. The line continues downstream as a RCB southeasterly from George Street to Cottonwood Street, following the existing channel alignment. At Cottonwood, the proposed RCB facility leaves the existing alignment and extends easterly in Cottonwood. The drain then continues southward in 8th Street and connects to existing re-aligned Line A segment at Nicolet Street.

At present the existing Line A segment in Nicolet Street has a temporarily point of discharge into the existing Line C segment at 4th Street. Ultimately, an underground box facility running parallel to Line C between Nicolet Street and Williams Street will be necessary for conveyance of Line A flows. The existing Line C facility southerly of Williams Street is adequately sized to convey the combined Line A and Line C flows from this point downstream.

Line A-1 - Line A-1 drains the intersection of Westward Avenue and 8th Street. The line is an underground drain that extends easterly in Westward Avenue to a point of junction with Line A at 4th Street.

Line A-2 - Line A-2 is a future extension of the underground drain which is now completed to the intersection of Ramsey Street and 8th Street. The proposed drain extends westerly from 8th Street in Ramsey Street to a point approximately 600 feet west of 12th Street.

Line A-3 - Line A-3 drains the intersection of 8th Street and Williams Street. The line is an underground drain that extends easterly in Williams Street to an outlet into the old Line A storm drain.

Line A-4 - Line A-4 drains a large local area north of Gilman Street between Lines A and C. The line is an underground drain

which extends some 1200 feet easterly in Gilman Street to 8th Street. From there it continues southward in 8th Street and discharges into the existing realigned segment of Line A at Cottonwood Street. It should be noted that the design of Line A-4 is dependent upon ultimate completion of an upstream collection dike that would train flows into the proposed East Gilman Home Debris Basin, as shown on the master plan map.

Line B - Line B extends northerly to Wilson Street, the Gilman Home Channel segment completed in 1972. The line proposed is a concrete lined channel located within the existing well-defined wash. A double 10' x 6' box culvert is proposed to replace the existing double 48" CMP's under Wilson Street when the street is improved in the future.

Line C - Line C is a 7'Wx6'H rectangular concrete channel that will replace the existing rock and mortar channel upstream from Wilson Street, and extend to the proposed Indian Canyon Debris Basin.

Line C-1 - This is an improvement to the existing upstream inlet structure to provide a debris storage capacity of 0.5 ac-ft.

Line C-2 - Line C-2 is an underground drain that relieves a drainage problem on Indian School Lane. The line extends some 500 feet westerly in Indian School Lane to an outlet into Line C.

Line C-3 - Line C-3 is an underground drain which collects runoff from about 35 acres tributary to Indian School Lane. It extends southeasterly 1300 feet along a wash and outlets into Sidney Street Channel (Line C-1).

Line D - Since the completion of Line C, the existing Line D can be utilized for local drainage without major modification. However, increased inlet capacity is required at several locations and some improvement of the restriction just upstream from the freeway is necessary.

It is recommended that 378 feet of catch basin inlets be added at locations as discussed in the "Inlets" section of this report. The improvement to Line D between Hathaway Street and Interstate 10 will involve the removal of an existing restricted covered channel and construction of an 8'w x 4'h RCB in Ramsey Street. An 8'w x 4'h rectangular channel is recommended to connect the proposed 8'w x 4'h RCB in Ramsey Street to the existing 8'w x 4'h RCB at Interstate 10. It should be noted that design hydrology for Line D, Line D-2 and Lateral D-2A are recommended at 85% of Q10 to achieve a balanced design with existing capacity in Line D. This avoids costly reconstruction of Line D between Hargrave Street and Hathaway Street which would otherwise be required.

Line D-1 - Line D-1 is an underground drain that begins at Cherry

Street, extends easterly in George Street to Hathaway Street, and continues south in Hathaway Street to confluence with Line D at Ramsey Street.

Line D-2 - Line D-2 is an underground drain that extends south in Hargrave Street from Indian School Lane, to confluence with Line D at Ramsey Street (see Line D for design hydrology).

Lateral D-2A - Lateral D-2A is an underground drain in Theodore Street that begins at Florida Street and outlets into Line D-2 at Hargrave Street (see Line D for design hydrology).

Line E - The recommended improvements for Line E consist of improving the inlet capacity on Ramsey Street by the addition of 157 lineal feet of catch basin inlets as discussed in the "Inlets" section of this report. The existing 24" CMP and small catch basins in Ramsey Street are adequate for only minor street drainage. The design of the downstream Line A-2 system depends upon removal of floodwaters collected in Ramsey Street, into the Montgomery Creek Channel. Therefore, this project is an important element of the overall plan. When this project is reviewed for funding, additional consideration should be given to constructing a storm drain parallel to and along the entire length of the existing drain in Ramsey Street. This added conveyance capacity would ensure that Ramsey Street flows do not escape down 22nd Street. Otherwise, some costly modifications of the street intersection would be required.

Line E-1 - Line E-1 is an underground drain that helps relieve a serious drainage problem downstream on Ramsey Street. The line extends easterly in George Street to Woodland Avenue and continues southerly in Woodland Avenue to Nicolet Street. The line then proceeds east in Nicolet Street to an outlet into Montgomery Creek Channel at Roberge Avenue.

Line F - Line F is an underground drain in San Gorgonio Avenue, extending from the Southern Pacific Railroad tracks south to an outlet at Smith Creek. The need for this drain will become increasingly apparent as the property between 4th Street and San Gorgonio Avenue develops.

Line G - Line G is an underground drain that extends southerly in Hargrave Street from Lincoln Street to the existing drain at Wesley Street. Like the drain proposed in San Gorgonio Avenue, the need for this drain and the one proposed on Hathaway Street (see Line H below), will be increasingly evident as their tributary drainage areas develop.

Line H - Line H is an underground drain that extends southerly in Hathaway Street from Barbour Street, to an outlet at Smith Creek.

Line I - Smith Creek - Smith Creek is the most prominent watercourse in the southwesterly region of the City. By the time

Smith Creek joins the San Gorgonio River near the eastern end of the Banning Airport, some 32 square miles of tributary drainage is accumulated.

With the exception of Line N-1 (described below) and the bank improvements already completed by the District, no additional structural measures are proposed along Smith Creek south of Interstate 10. The creekbed is well defined at the base of the mountains along the southern edge of the City. It should be kept open, essentially in its natural state, with any future adjacent improvements located well away from its banks. Upstream from Interstate 10, the creek branches into three significant watercourses, each of which are capable of carrying damaging floodwaters in a major storm. The flood plain above Wilson Street widens out across a broad alluvial agricultural cone that extends to the base of the northern foothills.

Runoff traversing this broad alluvial cone has defined, at least to some degree, a watercourse dividing Section 1 of T3S, R1W, essentially down its mid-section line. During any major storm, however, its course is not predictable and can potentially concentrate along other paths across the cone, or spread into several streams which could more properly be described as broad sheet flow. With the exception of one subdivision lying westerly of Highland Home Road and north of Wilson Street, the majority of the flood plain is used for agricultural purposes. Land holdings in this area are large parcels, allowing flood protection improvements to take several alternative forms.

The Deutsch properties north of Wilson Street encompass a majority of the alluvial farm land traversed by Smith Creek. Proposed development in this area has prompted a specific drainage study as part of this report to address the control of tributary storm runoff.

The study has resulted in Smith Creek (Line I) being proposed as a concrete lined channel from the mouth of the main tributary canyon to the north, down to the existing underground storm drain at the upstream side of the Interstate 10 freeway. Reinforced concrete boxes are proposed for road crossings. Since FEMA has determined this watershed to have a high debris potential, an inlet structure with a debris storage capacity of 6 ac-ft. is proposed at the upstream end, which is some 2½ miles north of Wilson Street. The channel will intercept flows from approximately 2.6 square miles tributary to the mouth of the canyon. In order to maximize the flow capacity of the Interstate 10 freeway culvert at Pershing Creek and to perpetuate the Smith Creek and Pershing Creek flow patterns that exist today, a retention basin (see Smith Creek Basin) is proposed at Gilman Street, along with a proposed "split-flow" facility (see Line K-1) in Ramsey Street.

Line I-1 - Smith Creek Lateral - Line I-1 is a concrete channel

branching off to the east from Line I about 1 mile north of Wilson Street. It extends northeasterly some 5200 feet to the base of the foothills. This channel is intended to intercept storm runoff from a drainage area of approximately 1 square mile and is considered to be an important part of the overall plan.

Smith Creek Basin - This basin, located along Smith Creek between Gilman Street and Wilson Street, is proposed to reduce the 100 year peak runoff from 6,100 cfs to 3,500 cfs. This reduction is critical due to the limited capacity of the existing double 10' x 8' RCB culvert at the Interstate 10 freeway. The basin will provide a debris storage volume of 96 ac-ft and will require 46 acres of right of way.

As this area develops, open space, parks and other recreational facilities will no doubt be required which may create opportunities for joint use of the basin site. This could significantly reduce the overall cost of the flood control basin facility. The District will work closely with the City and developers to take advantage of these opportunities as they arise.

Line J - Highland Springs Storm Drain - This is an underground drain in Highland Springs Road extending downstream from Wilson Street to the existing Caltrans' channel alongside Interstate 10. It is intended to carry the majority of the 100 year tributary flow, while the existing parallel 6' x 6' RCB will convey the difference. A small flood plain along Caltrans' channel will remain, however, due to the limited capacity of the existing 10' x 8' RCB under Interstate 10 freeway. The City should condition future development to adequately setback in this area for protection. Line J master plan improvements also include construction of an additional RCB crossing at the Southern Pacific Railroad in order to reduce the size of the upstream flood plain.

Line J-1 - Line J-1 is an underground drain which services the tributary area between Highland Springs Channel and Smith Creek Channel. It carries runoff from the existing 48" RCP built by the developer of Tract 12428, downstream to the Caltrans channel adjacent to the Interstate 10 freeway.

Line J-2 - Line J-2 is an underground drain extending easterly in Ramsey Street some 2000 feet to the junction with Line J-1. This drain will help relieve the local drainage problem on Ramsey Street.

Line K - West Pershing Channel - The proposed West Pershing Channel includes an upstream extension of the existing channel along Highland Home Road. It is proposed to be constructed within the street right of way to the vicinity of 14th Street. At this point, the channel will extend easterly some 2200 feet to the natural channel emanating from the base of the hills. A

downstream extension of the existing Line K Channel will begin at the existing 10' x 5' RCB under Wilson Street and proceed southeasterly as a concrete channel toward Ramsey Street. The channel junctions with Line L north of Ramsey Street and westerly of Omar Street. The crossing at Ramsey Street is proposed as a double 9' x 6' RCB to replace the existing double 6' x 3' RCB. One cell of this box is to be used by proposed Line L. At this point, proposed Line K-1 (see below) merges with the double 9' x 6' RCB. A rectangular concrete channel is proposed south of Ramsey Street to connect to an existing double 10' x 10' RCB under Interstate 10.

Line K-1 - Line K-1 takes advantage of the remainder flow capacity of the double 10' x 10' RCB freeway culvert at Pershing Creek. This 9' x 7' RCB will drain 960 cfs from the total Smith Creek Basin peak discharge rate of 3,500 cfs, and convey these flows to Pershing Creek Channel (Line K) via Ramsey Street. This facility combines with Line K just south of Ramsey Street crossing.

Line L - East Pershing Channel - The East Pershing Channel is required to drain the 340 acre watershed tributary to the low in Wilson Street located 1300 feet east of Highland Home Road. The proposed channel extends downstream from the southern limits of the Morongo Indian Reservation, some 1200 feet south along Mountain Avenue then southwesterly to the natural low mentioned above. The channel then proceeds south some 2000 feet where it junctions with Line K south of Ramsey Street. The crossing at Ramsey Street is proposed as a double 9' x 6' RCB to replace the existing double 6' x 3' RCB. One cell of this box is to be used by proposed Line K.

Line L-1 - Line L-1 provides an outlet for the area tributary to the intersection of Wilson Street and Mountain Avenue. The line is an underground drain that extends westerly in Wilson Street from Mountain Avenue some 450 feet. The drain then continues south about 1600 feet, and then westerly to the confluence with Line L just north of Ramsey Street.

Line N-1 - Line N-1 is the upstream extension of the existing rock slope protection adjacent to the Prison Farm. It will reach to San Gorgonio Avenue along the north bank of Smith Creek. The project is intended to protect an existing City sewer line from Smith Creek flows.

Line O - Currently during times of heavy storms, water flowing south on Sunset Avenue travels easterly onto Ramsey Street causing considerable flooding of the roadway and adjacent properties. Line O is a drain in Sunset Avenue proposed to replace an existing 18" CMP between the SPRR and Ramsey Street. It is intended to intercept 10 year storm flows at the intersection of Ramsey Street and Sunset Avenue.

Debris Basins - Four debris basins, namely Montgomery Creek (Line E), West Gilman Home (Line B), East Gilman Home (Line A), and Indian Canyon (Line C), are proposed to alleviate existing debris problems as well as to provide additional flood protection for the existing developments downstream. These basins are located at the upstream end of the major existing and proposed drainage facilities listed above.

Montgomery Creek Basin has a debris storage capacity of 22.7 ac-ft and a maximum embankment height of 16 feet. Right of way required is 3 acres.

West Gilman Home Basin has a maximum embankment height of 26 feet with 14.3 ac-ft of debris storage capacity. Required right of way is 5.4 acres.

East Gilman Home Basin requires a right of way take of 5.4 acres. The 28-foot high embankment provides 18.7 ac-ft of debris storage.

Indian Canyon Basin has a right of way requirement of 3 acres. It has a debris storage capacity of 14.1 ac-ft and a maximum embankment height of 12 feet.

SECTION X

INLETS

Inlets and their proper locations are an integral part of any drainage or flood control system. Inlets provide the means of intercepting uncontrolled flows and directing them into channels and storm drains. Most of the inlets to be used in this plan will be the curb opening type catch basins. Field investigations have been made in order to establish the general location of the proposed new inlets. Existing inlets have also been identified which can be utilized in the proposed system.

The table below lists the location of proposed catch basins and the approximate length of curb opening required to intercept storm runoff. It should be noted that the catch basin openings proposed are intended to be used as a guide only. The precise location and size of opening required for any system should be determined at the time of final design, and should reflect changes which may, have occurred during the intervening period.

Line	Location	Inlet Length (ft)
D	Line D at George	13
	Line D at Nicolet	22
	Line D at San Gorgonio	124
	Williams at Alessandro	110
	Williams at Martin	5
	Line D at Williams	10
	Ramsey at Alola	30
	Ramsey at Livingston	7
	Ramsey at Hargrave	13
	Ramsey at Phillips	17
	Ramsey at Hathaway	27
E	Ramsey at Roberge	157

SECTION XI

ALTERNATIVE STUDIES

Several alternatives were developed and studied during the generation of the Banning Master Drainage Plan. Those alternatives considered full channelization of Smith Creek (Line I) from the Interstate 10 freeway upstream to its proposed terminus; different alignment schemes for open channel systems; and various hydraulic considerations. As the study progressed, alternates considered for the major facilities proposed in this plan were presented to the City Council and staff. General concurrence with the plan selected was obtained based on cost differentials, accessibility to collector drains, and ease of construction.

SECTION XII

ESTIMATED COST

The master plan presented herein is an accumulation of the preferred features of all of the alternatives studied. This plan presents an economical drainage facility system while also affecting the least impact on the existing character of development within the study area.

The majority of underground facilities are proposed to be aligned within existing or proposed street rights of way. Property acquisitions will be required for any proposed open channels constructed on private land.

Storm drain facility costs were developed from current construction cost data researched by the District.

All prices tabulated herein were adjusted to reflect present 1994 cost levels and are shown in Table I, "COST SUMMARY". These costs include necessary rights of way and 31% for engineering, administration and contingencies.

SECTION XIII

CONCLUSIONS

Based on the studies and investigations made for this report, it is concluded that:

1. The Banning area has experienced serious flooding problems in the past. As the area continues to urbanize, these damages are expected to increase. A more orderly growth pattern can safely occur with the construction of these proposed facilities.
2. A drainage system is required to safely convey storm runoff through the Banning area to Smith Creek. This master drainage plan presented in the report is such a system and it is the most feasible of the alternatives studied.
3. Due to the limited capacity of the freeway culvert, during a 100 year storm event, Highland Springs (Line J) will still have a small flood plain along the existing Caltrans channel at Interstate 10 when the plan is fully implemented. The City should condition for necessary setbacks.
4. The proposed plan indicated herein will lend itself to a staged construction program as funds are available.
5. The total cost of the recommended improvements, including right of way, engineering, contingencies, and administration is estimated to be \$28,902,000.

SECTION XIV

RECOMMENDATIONS

It is recommended that:

1. The Banning Master Drainage Plan, as set forth herein, be adopted by the Banning City Council and the Riverside County Flood Control and Water Conservation District's Board of Supervisors.
2. The Banning Master Drainage Plan, as set forth herein, shall replace the Master Drainage Plan adopted in June 1975.
3. The Master Drainage Plan, as set forth herein, shall be used as a guide for all future developments in the study area and that such developments be required to conform to the plan insofar as much as possible.
4. The right of way required for the plan and lands located in or immediately adjacent to the existing natural watercourses shall be protected from encroachment.

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TABLE I
BANNING MASTER DRAINAGE PLAN
COST SUMMARY

<u>FACILITY</u>	<u>CONSTRUCTION*</u>	<u>RIGHT OF WAY</u>	<u>TOTAL COST</u>
Line A	\$ 1,958,000	\$157,000	\$ 2,115,000
A-1	333,000	- - -	333,000
A-2	339,000	- - -	339,000
A-3	87,000	- - -	87,000
A-4	783,000	- - -	783,000
Line B	165,000	5,000	170,000
Line C	1,044,000	174,000	1,218,000
C-1	20,000	- - -	20,000
C-2	116,000	- - -	116,000
C-3	164,000	17,000	181,000
Line D	282,000	22,000	304,000
D-1	603,000	- - -	603,000
D-2	890,000	- - -	890,000
Lateral D-2A	115,000	- - -	115,000
Line E	86,000	- - -	86,000
E-1	288,000	- - -	288,000
Line F	872,000	- - -	872,000
Line G	749,000	- - -	749,000
Line H	798,000	- - -	798,000
Line I	4,524,000	465,000	4,989,000
I-1	679,000	263,000	942,000
Line J	963,000	- - -	963,000
J-1	446,000	25,000	471,000
J-2	455,000	- - -	455,000
Line K	1,388,000	275,000	1,663,000
K-1	324,000	- - -	324,000
Line L	943,000	279,000	1,222,000
L-1	693,000	- - -	693,000
Line N-1	702,000	- - -	702,000
Line O	173,000	- - -	173,000
Smith Creek Basin	2,743,000	1,131,000	3,874,000
DEBRIS BASINS:			
Montgomery Creek	427,000	154,000	581,000
West Gilman Home	328,000	228,000	556,000
East Gilman Home	363,000	456,000	819,000
Indian Canyon	<u>250,000</u>	<u>158,000</u>	<u>408,000</u>
TOTALS	\$25,093,000	\$3,809,000	\$28,902,000

* Includes 31% for Engineering, Administration and Contingencies.