

RIVERSIDE COUNTY FLOOD CONTROL AND  
WATER CONSERVATION DISTRICT  
RIVERSIDE, CALIFORNIA

REPORT ON

MASTER PLAN FOR FLOOD CONTROL AND DRAINAGE  
GARNET WASH AND TRIBUTARIES

ZONE SIX

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AND WATER CONSERVATION DISTRICT

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ZONE SIX

FEBRUARY 1963

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RIVERSIDE COUNTY FLOOD CONTROL AND  
WATER CONSERVATION DISTRICT

RIVERSIDE, CALIFORNIA

IN REPLY REFER TO:

27 February 1963

Ex-Officio Board of Supervisors  
Riverside County Flood Control  
and Water Conservation District  
Courthouse  
Riverside, California

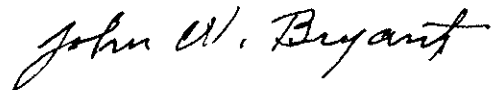
Gentlemen:

I have the honor to transmit herewith the Riverside County Flood Control and Water Conservation District report entitled "Master Plan for Flood Control and Drainage, Garnet Wash and Tributaries."

This report summarizes the studies made by the District and the Division of Highways to develop a mutually beneficial plan for flood control and drainage in this area. It also includes preliminary design plans and cost estimates for the project.

The data and information contained in this report will be useful to all agencies and individuals concerned with the development of this area. It will also serve as the basis of a cooperative agreement between the District and the Division of Highways regarding the location of future freeway drainage structures.

Very truly yours,



JOHN W. BRYANT  
Chief Engineer

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## SUMMARY

A serious flood hazard problem exists within the Garnet Wash drainage area, southwest of Desert Hot Springs, California. Large storm runoff could cause loss of life and severe property damage to any future developments in the area. The construction of the proposed Twenty-Nine Palms freeway will enable the District and the Division of Highways to cooperate in a plan to provide flood protection for an area of about 4,000 acres.

The plan provides for earth lined collection channels on the upstream side of the freeway to divert storm waters to two major culverts through the freeway and concrete lined outlet channels below the freeway to safely convey once in 100 year flood flows ranging from 3,400 cubic feet per second to 6,800 cubic feet per second through the area to be protected. The collection channels would be constructed and maintained by the Division of Highways and the outlet channels would be constructed and maintained by the District.

It was found that it was not feasible for the District to construct concrete lined outlet channels at this time because of the lack of any substantial development in the area. It was found, however, that interim type earth lined outlet channels, with capacity to accommodate once in 10 year flood flows, were feasible for the District to construct concurrently with the freeway construction. It was also found that construction of the interim earth channels would permit urban type development to take place in the overflow area.

It is recommended that the District adopt the plan whereby earth collection channels are constructed upstream from the freeway to divert all storm runoff to two major culverts outletting into concrete lined channels below the freeway; that the District immediately acquire the necessary right of way and construct interim earth channels concurrently with the construction of the freeway; and that the District enter into a cooperative agreement with the Division of Highways, whereby the State would construct and maintain the collector channels and culverts, and the District would assume the liability for any damages resulting from any diversion of flood waters.

## INTRODUCTION

General Statement - Garnet Wash and its tributaries, located in the Whitewater River Basin about four miles southwest of Desert Hot Springs, California, poses a serious flood hazard threat to prospective land developments covering an area of about four thousand acres surrounding the wash (see plate 2). The problem of controlling storm waters in the area has been complicated because the flood runoff coming off the hills tends to spread out in many small washes over a wide area. The State Division of Highways is now planning to construct a freeway between U. S. Highway 60-70-99 and Dry Morongo Canyon, just west of the existing Twenty-Nine Palms highway. In its original planning the Division of Highways planned to pass all of the flood waters through the freeway in a series of culverts of varying sizes. The District, being desirous of controlling these flood waters, proposed to collect the water on the upstream side of the freeway and divert it in earth channels to two major culverts. One culvert would be located in Garnet Wash and the other in a tributary, Devils Garden channel. The District would improve Garnet Wash and Devils Garden channel downstream from the freeway. The Division of Highways would construct and maintain the collector channels and culverts. The District would be required to assume all liability for any diversion of flood waters.

Authority - The authority for this study was granted by the Zone 6 Commissioners at the final budget hearing held on 28 May 1962.

Purpose - The purpose of this report is to evaluate the requirements for flood control along Garnet Wash, based on the present and anticipated future development of the watershed, and develop a plan of interim and ultimate improvements.

Scope - This report is limited to Garnet Wash and its tributary drainage area involving the southernmost 4 miles of the proposed freeway. The Mission Creek drainage and other areas affecting the northern portion of the freeway will be considered in a separate report.

The study also includes the following:

1. Determination of the location and size of the freeway drainage structures to accommodate peak design discharges.
2. Investigation of alternative methods of controlling the flood flows downstream from the freeway.
3. Preparation of preliminary design plans and cost estimates.
4. Establishment of a basis for a cooperative agreement between the District and the Division of Highways regarding the location of freeway drainage structures.

Description of Watershed - The watershed covers a total area of approximately 21.2 square miles (see plate 1). The proposed freeway crosses the drainage area with about 13.6 square miles west and 7.6 square miles east of the freeway and is divided into subwatersheds as shown on plate 1.

A large alluvial fan begins at the base of the hills to the west and extends south and east. The Painted Hill formation outcrops over much of the area with the Coachella, Imperial, and Cabazon formations

also present. These formations are largely fanglomerate and unconsolidated conglomerate. Most of the lower watershed is overlain by unindurated gravel and alluvium. In parts of the upper watershed there is a layer of red soil which at present is being submerged in the lower areas by alluvium.

There are faults trending east-west and north-south through the watershed. The Banning fault trends east and lies just north of Garnet Wash. This fault is a major geologic structural feature and is evidenced by a prominent scarp.

Elevations range from 3280 feet in the upper drainage area west of the freeway to 730 feet in lower Garnet Wash. Gradients are very steep and the slope of the land is to the southeast.

Vegetation is limited except in the upper watershed where there is some growth. There are scattered residential dwellings in the area and there are some subdivided tracts which are sparsely developed. There is no significant agricultural development.

Description of Problem - The drainage area below the freeway lies on an alluvial fan. The watercourses are generally poorly defined and as a result flood flows coming out of the hills tend to spread out over large areas following unpredictable paths. The Division of Highways originally planned to pass the flows through the freeway in a series of culverts of various sizes. In general, this would be maintaining flow conditions throughout the area as they presently exist, with the exception of the points just below the culverts where some concentration of flow would exist. The presence of these unpredictable flow conditions severely restricts development of the area. Large, infrequent storm runoff could

cause loss of life in the area and would cause severe property damage to any developments that might be located in the area. Smaller, more frequent thunderstorms that often occur in these desert areas would be a nuisance, cause minor property damage and have an adverse affect on property values.

Flows from the entire 21.2 square mile drainage area concentrate at the lower end of Garnet Wash just upstream of U. S. Highway 60-70-99 and pass through a double 20 x 8 foot bridge. In its present condition the capacity of this bridge is not sufficient to pass the 100 year peak discharge.

## HYDROLOGY

General - The Garnet Wash drainage area is located in the southeast corner of the San Bernardino Mountain range in an arid desert region. The climate is characterized by extreme heat and dryness during the summer months and mild temperatures during the winter months. Mean seasonal precipitation in the drainage area is about 9 inches per year. The season totals in these desert areas vary widely from the mean seasonal and it is possible for the mean seasonal precipitation to be exceeded in one month. Most precipitation in the Garnet Wash drainage area results from winter storms. However, summer thunderstorms are fairly frequent in the area and are of high intensity and short duration and usually cause the most damage. The duration of critical rainfall intensity is usually not more than two hours.

Runoff Records - There are no runoff records available for Garnet Wash. However, historical records indicate flooding in the past on various streams in the Whitewater River Basin such as Tachevah Creek, Tahquitz Creek, Mission Creek, Long Canyon Wash and East Wide Canyon Wash. The lack of development around Garnet Wash would account for the lack of any specific data on past storm runoff.

Design Discharges - The discharges used for channel design in this report were computed by Troxell's Method, using the once in 100 year storm event. Flood hydrographs were also computed for areas A and B, shown on plate 1, by the unit hydrograph method for use in a routing study through a proposed reservoir.

The once in 100 year peak discharge from subdrainage area B is about 4,000 cubic feet per second and would be the design discharge for Devils Garden channel from the freeway to the confluence with Garnet Wash. The once in 100 year peak discharge from subdrainage area A is about 3,400 cubic feet per second and would be the design discharge for Garnet Wash from the freeway to the confluence with Devils Garden channel. Routing these respective peak discharges produces a peak design discharge of about 6,800 cubic feet per second at the confluence. Combining the 6,800 cubic feet per second with runoff from subdrainage area C produces a peak discharge of about 8,900 cubic feet per second at the highway bridge.

## PLANS OF IMPROVEMENTS CONSIDERED

General - In developing a plan for flood control along Garnet Wash, it became apparent that with early construction of the proposed freeway it would be necessary to construct some type of interim improvement in the very near future. It was necessary therefore, to develop a plan for ultimate conditions of improvement for which interim improvements could be made that would not add to the cost of providing ultimate protection at some future date. The interim improvements would provide a degree of flood protection consistent with present economic development of the area.

Recommended Plan - The plan herein recommended as the best plan for the ultimate control of storm runoff in the Garnet Wash drainage area consists of (a) an improved channel along the main branch of Garnet Wash, and (b) an improved tributary, Devils Garden channel (see plates 3, 4 and 5).

The Garnet Wash channel would be about 12,300 feet long, beginning at the freeway culvert, located about 6,000 feet north of U. S. Highway 60-70-99, and extending in a southeasterly direction towards U. S. Highway 60-70-99. The first 5,100 feet of channel would be trapezoidal in section with a 10 foot bottom width,  $1\frac{1}{2}$  to 1 side slopes and a depth of 6 feet. From the confluence with the Devils Garden channel, the channel would have a 12 foot bottom width,  $1\frac{1}{2}$  to 1 side slopes and depths varying from 8 feet to 9 feet. The channel would be excavated below natural ground surface and would be lined with 4 inch thick unreinforced concrete. Velocities would range from 37 to 44 feet per second. Right of way widths would vary from 60 to 65 feet.

Devils Garden channel would be about 14,200 feet long beginning at the freeway culvert, located about 1,000 feet south of Pierson Boulevard, and extending in a southeasterly direction to the confluence with Garnet Wash. The channel section would be trapezoidal with a 10 foot bottom width, a 7 foot depth and  $1\frac{1}{2}$  to 1 side slopes. The channel would be excavated below natural ground and would be lined with 4 inch thick unreinforced concrete. Velocities in the channel would range from 40 to 45 feet per second. The right of way width would be about 60 feet.

The existing double 20 x 8 foot bridge crossing Highway 60-70-99 over Garnet Wash has inadequate capacity for the Garnet Wash once in 100 year design discharge of 8,900 cubic feet per second at that point. The existing structure has capacity to pass about 5,000 cubic feet per second. Since the Division of Highways has no plans to enlarge this structure it would be necessary to terminate the Garnet Wash channel upstream from the bridge in a manner that would return the flows to a natural flow condition. An outlet structure would therefore be provided to reduce channel flow velocities and bring the channel invert to ground surface. The outlet structure would be a stone transition 200 feet long (see plate 3). A grouted stone channel would extend from the concrete lined channel at Station 2+00, where the invert width would be 12 feet and the side slopes  $1\frac{1}{2}$  to 1, to Station 1+50, where the invert width would increase to 25 feet and the side slopes would be 2 to 1. The invert and side slopes would be revetted with grouted stone 2 feet thick. An ungrouted stone channel would extend from Station 1+50, where the invert width would be 25 feet and the side slopes 2 to 1, to Station 0+00,

where the invert width would be 80 feet and the side slopes 2 to 1. The invert and side slopes would be revetted with ungrouted stone 3 feet thick. This outlet transition would reduce the velocity of flow from 37 feet per second at the upstream end to about 17 feet per second at the downstream end.

If, prior to the construction of the ultimate improvement, the Division of Highways increases the capacity of this bridge, the channel could be continued to the bridge. The alignment of the channel was designed for this possibility.

Recommended Interim Plan - Because construction of the ultimate improvements is not feasible at this time, an interim plan of improvement is recommended for concurrent construction with the freeway. This would consist of unlined, excavated earth channels that would have capacities to accommodate a 10 year flood. Devils Garden channel and Garnet Wash channel to the confluence with Devils Garden channel would be trapezoidal sections with 10 foot bottom widths, depths of 3 feet, and  $1\frac{1}{2}$  to 1 side slopes. Garnet Wash downstream from the confluence would be a trapezoidal section with a 12 foot wide bottom, a depth of 5 feet, and  $1\frac{1}{2}$  to 1 side slopes.

Although erosion will take place in the earth channels, there would be sufficient area between the interim and ultimate channel sections to accommodate the erosion within the limits of the ultimate section.

Alternative Plans of Improvement - Consideration was given to control of flood runoff from subdrainage area B by means of a detention dam and reservoir located on Devils Garden channel about 3,500 feet upstream from the confluence with Garnet Wash. The purpose of this plan was to detain

the peak discharge from area B long enough to allow most of the runoff from area A to flow past the confluence, thus reducing the size of channel required on Garnet Wash below the confluence. In order for this to be feasible it would be necessary for the cost savings in reduced channel size to be equal to or greater than the cost of the dam. This plan was abandoned after considerable study when it was determined that:

- (1) the storage available was insufficient to materially reduce peak discharges
- (2) the reduction in downstream channel costs were substantially less than the cost of the dam and
- (3) the presence of a critical fault zone created an uncertainty regarding foundation conditions for any dam.

Consideration was also given to a plan to carry the concrete lined channel to the bridge at U. S. Highway 60-70-99. However, the present capacity of the bridge is about 5,000 cubic feet per second and the design discharge for the channel would be about 8,900 cubic feet per second. In order to safely pass the design flow through the bridge it would be necessary to enlarge the bridge and improve the downstream channel some distance. Since very little benefit to the District would accrue from this additional improvement, the plan was dropped. Continuing the lined channel to the bridge without improving its capacity could create a serious hazard to the bridge and surrounding property in the event flows in excess of 5,000 cubic feet per second occurred. In such an event, the District would probably be held liable for any damages that might occur. It was therefore proposed to terminate the channel some distance upstream from the bridge, returning the water to its natural flow conditions.

Estimated Cost of Project - The estimated cost of construction for the recommended improvement is summarized in Tables 1 and 2. All costs are based on present (1963) prices.

TABLE 1

Detailed estimates of costs for construction of the ultimate Garnet Wash and Devils Garden channels:

Item	Unit	Quantity	Unit Price	Cost	
				Subtotal	Total
Garnet Wash Channel					
Excavation	Cu.Yd.	75,000	\$ 0.50	\$ 37,500	
Concrete	Cu.Yd.	5,800	35.00	203,000	
Cutoff Wall				300	
Stone Revetment	Cu.Yd.	1,340	7.00	9,380	
Grouted Stone	Cu.Yd.	300	18.00	5,400	
Contingencies				<u>25,560</u>	
Sub-total					\$281,140
Devils Garden Channel					
Excavation	Cu.Yd.	75,500	\$ 0.50	\$ 37,750	
Concrete	Cu.Yd.	6,200	35.00	217,000	
Contingencies				<u>25,500</u>	
Sub-total					\$280,250
Right of Way					
Devils Garden				\$ 12,000	
Garnet Wash				12,000	
Contingencies				<u>3,000</u>	
Sub-total					\$ 27,000
Engineering					<u>56,360</u>
TOTAL					\$644,750
Say					<u>\$645,000</u>

TABLE 2

Detailed estimates of costs for construction of  
the interim Garnet Wash and Devils Garden Channels:

Item	Unit	Quantity	Unit Price	Cost	
				Subtotal	Total
Garnet Wash Channel					
Excavation	Cu.Yd.	34,000	0.60	\$20,400	
Contingencies				<u>2,000</u>	
Sub-total					\$22,400
Devils Garden Channel					
Excavation	Cu.Yd.	22,200	0.60	\$13,300	
Contingencies				<u>1,300</u>	
Sub-total					\$14,600
Engineering					<u>3,000</u>
TOTAL					<u>\$40,000</u>

The right of way costs, which are included in the cost for the ultimate plan, would actually be a cost for the interim construction since it would be necessary to acquire the right of way prior to any such construction.

No estimates have been made for bridges because the existing roads are not presently improved to any high standard. During the period of interim development dip crossings would be provided. If, when ultimate development takes place, certain bridges are needed, they can be easily provided for.

## CONCLUSIONS

On the basis of the studies made for this report, it is concluded that:

1. A serious flood hazard exists along Garnet Wash near Desert Hot Springs, California, that prevents the area from being developed and that could cause the loss of life.
2. The construction of the proposed Twenty-Nine Palms freeway will enable the District and the Division of Highways to cooperate in a plan to provide flood protection to the area by collecting all floodwaters originating upstream from the freeway in collector channels and diverting the flows to two major culverts through the highway into improved outlet channels. An area of about 4,000 acres would be protected by this plan.
3. The Division of Highways would construct and maintain the collector channels and culverts and the District would construct and maintain the outlet channels. The total cost to the District for the ultimate channel improvements to control the once in 100 year flood would amount to about \$645,000, including right of way.
4. The District could construct interim channel improvements at the time the freeway is constructed that would provide protection from the once in 10 year flood at a cost of about \$67,000, including the right of way. The interim improvements would permit development to take place in the area and are highly justified. At such time that sufficient development has taken place, the District would be justified in constructing the ultimate improvements.

## RECOMMENDATIONS

It is recommended that:

1. The District adopt the ultimate plan to provide flood protection for the Garnet Wash area by providing concrete lined channels downstream from the proposed Twenty-Nine Palms freeway along Garnet Wash and Devils Garden channel.
2. The District immediately acquire the right of way for the ultimate channel improvement at an estimated cost of \$27,000 and construct earth lined channels concurrently with the construction of the proposed freeway at an estimated cost of \$40,000, the total cost being \$67,000 for the interim improvements.
3. The District enter into a cooperative agreement with the State Division of Highways whereby the State will construct and maintain earth lined collector channels along the west side of the freeway and will locate the outlet culverts in line with the District's proposed channel improvements, and the District will hold and save the State free and harmless from liability for any damages resulting from the diversion of any flood waters.