

TOWN OF PARADISE VALLEY
INDIAN BEND WASH IMPROVEMENTS

PRELIMINARY REPORT

April 8, 1975

Prop
Flood Control Dis
Plan

TOWN OF PARADISE VALLEY
INDIAN BEND WASH IMPROVEMENTS
PRELIMINARY REPORT

A. PURPOSE

This report has been prepared at the request of the Town of Paradise Valley. It is intended to provide a basis for preparation of final designs and drawings for construction of a broad depressed unlined channel for Indian Bend Wash to control the flow from a 100 year storm and permit the recovery of some land areas now in the flood plain. It defines the minimum channel requirements to satisfy the stated needs of the Town.

All hydraulic matters in this report and related drawings were prepared by Water Resources Associates under the direction of John R. Erickson, P.E.

B. CRITERIA

As the basis of design certain criteria were established by the Town as follows:

1. The existing drop structure in Camelback Country Club Golf Course will remain.
2. No changes will be made within the golf course property (east of a line one quarter mile east of Invergordon Road).
3. As a general criteria, the basic design width would be a maximum of 800 feet at the top with 20:1 side slopes.
4. So far as practicable the channel will be largely in cut section. There will be no dikes and the edges of the flood plain will be filled only to the extent there will be little or no interference with side drainage.
5. No study or consideration is to be given to means of disposal of excess excavation.
6. A comparatively small pilot channel will be constructed in the channel to handle small flows.
7. Culverts will be provided at the crossing at Invergordon Road and Double Tree Ranch Road. The culverts are to be capable of passing up to 1000 cfs without the flow overtopping the road. Concrete box culverts will not be used.

*in section
culverts p. 8*

8. It will be assumed there will be no improvements in the City of Phoenix north of the Town limits.

9. The Corps of Engineers' 4 foot contour interval topography will be used for all design work without additional surveys. For investigative purposes, City of Phoenix topography was used north of the Town limits as Corps topography in that area evidently does not exist.

C. SUMMARY AND CONCLUSIONS

1. A channel section with a 600 foot bottom width and 10:1 side slopes will handle 21,000 cfs flow established by the Corps of Engineers for a 100⁵⁰ year flood. For the most part the depth of the main channel would be about 5 to 6 feet below existing ground. The edges of the bottom would be about 0.75 foot higher than the center. The top width would be somewhere around 700 feet.

2. 20:1 side slopes could be provided if desired but this would add about 100 feet to the right-of-way width required without significantly changing other characteristics.

3. Stage construction is feasible only if started at the downstream end because this design contemplates lowering the water surface. If an intermediate section were to be built utilizing the existing unimproved cross section as the outfall, the present theoretical water surface would not be lowered appreciably.

4. If the channel is to be constructed in stages, a temporary transition section about 1,000 feet long will be needed to connect the excavated section to natural ground.

5. The transition slope will be comparatively steep and in the event of a flood there will be scour in the transition section and possibly upstream. In addition there probably will become deposition in the fully excavated channel. This condition will exist to some degree no matter what the length of the transition. Consequently this is the price of stage construction.

6. Unless some type of drop structure is provided for the local washes entering the channel, these washes will scour ultimately to a grade connecting to the bottom of the channel.

7. Because of a lack of head and because of the need to handle varying sizes of floods, it is not feasible to construct a completely satisfactory culvert at the two road crossings and the connecting pilot channel.

8. The skew crossing of the channel of the two main road crossings requires comparatively long culverts. The culverts cannot be turned to cross the roads at right angles because of the adverse influence on large floods. The crossing of Invergorden Road skews about 32° from 90° . If the required culvert crossing is 14 feet each lane plus two 6 foot shoulders the centerline length of 50" wide culverts would be about 48 feet to provide 40 feet at right angles, in other words the culvert length will be increased about $1/4$ from the normal. Similarly, the crossing of Double Tree Ranch Road (which is about 64° from a right angle) for the same criteria would require 95 feet of culvert or about $2-1/2$ times the right angle distance. In addition extra pipe is needed to compensate for the pipe angles at the end.

9. The selected culverts are 31" x 50" corrugated metal arch pipe culverts with a paved invert. Each crossing will require 16 pipes.

10. Consideration should be given to relocating the alignment of Double Tree Ranch Road so the culverts will not cross the road at such a flat angle. A relocation of this road probably would result in significant savings in the order of \$39,000.

11. Utilities must be relocated at both of the culvert crossings, i.e. Double Tree Ranch Road and Invergorden Road. Also a 12" water line on 56th Street must be rebuilt. Whether the cost of these relocations must be borne by the Town or by the utilities requires a legal determination.

12. An existing City of Phoenix sewer line at the northern limit of Paradise Valley (Mountain View Road) must be lowered. Because of grade problems a pump lift must be constructed. How the cost of this reconstruction and the pump lift is to be handled must be determined.

13. The total excavation required costs of 1,350,000 cubic yards. The excavation cost at \$.30 per cubic yard is estimated to be \$405,000 This estimate does not include disposition.

14. Approximately 350,000 cubic yards of material can be used in the filled areas east and immediately west of Invergorden Road. The cost of placing and compacting this material is not included as it can be construed as a property improvement presumably by the owner.

15. The costs for the street crossings are estimated as follows including 28 feet of paving, flush curbs serving as cutoff walls and slope paving of the outlet side.

Double Tree Ranch Road

Street	\$ 38,000
Culvert	72,000
Armoring Sewer	5,000

Invergordon Road

Street	\$ 25,000
Culvert	<u>39,000</u>

Total \$179,000

If the Alternate Road alignment crossing the channel at right angles can be used the cost for Double Tree Ranch Road would be as follows:

Double Tree Ranch Road

Street	\$ 44,000
Culvert	<u>32,000</u>
	\$ 76,000

This would reduce the total of the road crossings to \$140,000. These costs do not include any costs of utility relocations nor roads at 56th Street on Mountain View Road.

15. The total estimated cost excluding utilities and disposition of excavation is as follows:

Excavation	\$405,000
Roads	179,000
Engineering & Contingency 15%	<u>61,000</u>
Total	\$645,000

16. The channel alignment has been selected to place the channel in a location as near as practicable to the natural center of the channel. A lateral displacement of the channel from that shown will have little effect hydraulically but may affect construction quantities.

17. The selection of the channel location indicated on the drawings does not mean there are not other locations which could be equally justified for public policy or legal reasons.

18. Within limits the channel alignment may be altered without having a significant effect on costs.

19. A minor modification of the alignment of the channel, centerline proposed within the Phoenix City Limits (north of Mountain View Road) by its consultants will be necessary to provide a smooth curve to connect to the alignment suggested herein.

D. HYDRAULICS

The hydraulic analysis for an entrenched soft bottom channel within a 700 foot floodway in Paradise Valley was based on a flood plain in close agreement with an unpublished study made by the Corps of Engineers, dated June 1974.

In developing the invert slopes for a stable sub-critical flow for a discharge of 21,000 cfs, the Corps of Engineers' criteria was also used. This resulted in a trapezoidal channel with a base width of 600 feet and side slopes of 1 on 10. No channel improvements were considered within the Camelback Golf Course, and the point of beginning the downstream excavation is at Station 78+50 which is at the west edge of the golf course one quarter mile east of Invergordon Road.

Three water surface studies were completed. The first water surface profile was based on present conditions with Manning's coefficient "n" values of .035 and .043. The second profile was developed for the design conditions of the entrenched trapezoidal channel with an "n" value of 0.35. The third profile was a normal depth study to determine the greatest depth that could be generated with an "n" value of .04. The depth and velocities of the last two profiles were consistent with the proper parameters of design.

The water surface of the first profile on existing conditions as compared with the second profile on design conditions was compatible with the requirements of the Arizona Water Commission as indicated in the Flood Plain Delineation Criteria and Procedures, Report No. 4, dated October 1973.

The profile was drawn to a horizontal scale of 1"=500' and a vertical scale of 1"=5'. The invert slopes and grade changes are shown on the water surface computation for the improved channel based on normal depths.

As the design progressed to a more finalized stage of completion, a new profile with a horizontal scale of 1"=200' and a vertical scale of 1"=5' was completed.

The new profile indicates the final invert slopes of the main channel as well as the invert slopes of the depressed low flow channel. The variations in depth of the low flow channel are in response to the culverts that must be accommodated.

The required discharge for the low flow or pilot channel is to be 1000 cfs. It would have a base width of 108 feet and side slopes of 1 on 4. The normal depth for this discharge is approximately 2.00 feet, but the excess excavation is necessary due to the dip crossings at Invergordon Road and Double Tree Ranch Road. These crossings will take sixteen 31" x 50" corrugated metal arch pipes. This battery of culverts will require a head of 3 feet which can be achieved with a high headwall and by extending earth training dikes on the upstream side of each roadway for a distance of approximately 500 feet. Because of the low velocities involved and the desirability that they wash out for larger flows, these dikes should be constructed on the most economical basis possible.

The downstream terminal point of the low flow channel is an existing depression which is an extension of a side drain approaching Indian Bend Wash from the north at approximately Station 78+50. Downstream for a distance of about 50 feet from this depression, there is another parallel depression that extends the full width of Indian Bend Wash with a depth of approximately 15 feet.

In all cases, however, the hydraulic control for water surface profiles is the existing drop structure in Camelback Country Club at Station 65+50, with a base width of 700 feet and crest elevation of 1308.0 to 1309.0.

The upstream alignment of the main channel from Double Tree Ranch Road to Shea Boulevard was based on the proposed location of the Shea Boulevard bridge, the existing topography and the extended downstream reach. The City of Phoenix Master Drainage Study indicates a centerline for Indian Bend Wash that is east of our centerline and a flat curve immediately north of the Phoenix City Limits would be needed to provide a smooth transition.

The presentation of this project as described above in Paradise Valley is our recommended design for a feasible floodway from the existing drop structure in Camelback Country Club Golf Course, Station 65+50, to a point approximately 1000 feet downstream from Shea Boulevard Station 195+00, a distance of 12,950 feet or 2.45 miles. That part north of Mountain View Road lies in the City of Phoenix and presumably will ultimately be excavated under the jurisdiction of that city.

E. CHANNEL ALIGNMENT

Essentially the proposed channel was located following the low area of the cross-section. In other words the channel was located as near as practicable to the same general area where a comparatively small flow would run. This location was made on the assumption that this would be the proper location for the channel. The basic reason is that under natural conditions water would flow most often in this location so it is also the property most affected by the existing wash. Where the existing channel cross-section is uniform (i.e. where the side slopes have the same slope), this would be in the center of the flood plain. However, if the bottom is not in the center of the flood plain the constructed channel would be offset.

The recommended location within Phoenix adjacent to Paradise Valley was selected in this manner. However, just before the channel enters Paradise Valley a flat curve is needed to connect to the channel similarly selected in Paradise Valley. There is a 50 foot difference in the top widths of the two channels, i.e. 650 feet more or less for Phoenix and 700 feet more or less for Paradise Valley. The differences in channel widths can readily be accommodated by an appropriate transition.

In establishing the channel location as shown herein it should be emphasized the location was based on topography alone. We deliberately avoided looking into ownerships so we do not know who is involved or what the sizes of the parcels are. The final location can be adjusted laterally to accommodate the various conditions assuming the property owners involved are in agreement. The hydraulics will not be affected by such changes, although excavation quantities might, assuming there are no radical or abrupt changes. A legal opinion on the appropriate location would be in order.

Similarly if for legal policy or other reasons a change of alignment is desired from that shown herein, the hydraulic gradient will be affected very little. Unless radical changes are made, the design proposal herein will be affected very little, if at all.

F. CULVERTS

Each of the road crossings would require long culverts.

Those on Invergordon show about 32° from a right angle crossing and those on Double Tree about 64° .

Allowing for two 14 foot traffic lanes, 6 foot shoulders and 12" headwalls the total pipe lengths for each pipe at the two roads would be about 54 feet and 102 feet respectively. Because of the expense of the headwalls, it would not appear desirable to build the culverts to other than a permanent width.

31" deep by 50" wide corrugated metal arch pipe culverts with paved inverts would require about a 3 foot drop in water surface through the culverts with 1000 cfs passing through the 16 sections required.

To accommodate the loss at Invergordon it would be necessary to construct the upstream headwall about 3 feet higher than the road surface. Earth training dikes would need to be built on a diagonal upstream to train the water to reach the culverts without crossing the road. These dikes probably would wash out if more than 1000 cfs flowed in the channel and in fact they should be a minimum size so they would wash out. It should be recognized that if they suddenly broke there might be some hazard for a vehicle which happened to be crossing the channel at that time.

At Double Tree Ranch Road the headwall could not be quite so high on one end as on the other but it would need to be constructed level from the high end so water would not spill across the road before 1000 cfs was running.

In both cases it should be recognized that brush may accumulate at the upstream end of the culverts so there would be no guarantee they would carry 1000 cfs.

Because of the extra length of culvert required for Double Tree Ranch Road, consideration should be given to realigning the road to provide a crossing more nearly at right angles.

G. ROADWAY SECTION - WASH CROSSINGS

The two roadway crossings (Invergordon and Double Tree) would be built to match the level of the channel bottom as nearly as practicable except at the culvert. An 18" deep curb section flush with the pavement should be provided at each edge of the pavement to prevent it from being scoured. Pavement should also be placed between the edges of the pavement and the culvert headwalls. On the downstream side a short section of the pilot channel should be paved to protect against scour. Small vertical pipes or markers should be placed along the headwalls at intervals as warnings and by appropriate striping as depth indicators.

Without benefit of specific soil tests at the crossings but based on tests in the general area, it appears the base course will be 10" as per City of Phoenix Standards for major streets. The width will in part be subject to the width prescribed for the culverts.

Sect. on plan also shows 12" select

H. ROADWAY COST ESTIMATES

Invergordon Road Crossing

Culverts - 864 LF 50" x 31" CMP	
@ \$30.00	\$25,920
Headwalls - 45 CY @ \$200	9,000
Compaction - 300 CY @ \$4.00	1,200
Aprons - 3800 SF @ \$0.60	<u>2,280</u>
Total	\$38,400
	Say \$39,000

Street Replacement

1300 LF - 28' width pavement	
4100 SY @ \$3.60	\$14,760
2600 LF curb & cutoff wall @ \$4.00	<u>10,400</u>
Total	\$25,160
	Say \$25,000

Double Tree Ranch Road Crossing

Culverts - 1630 LF 50" x 31" CMP	
@ \$30.00	\$48,900
Headwalls - 80 CY @ \$200	16,000
Compaction - 500 CY @ \$4.00	2,000
Aprons - 7800 SF @ \$0.60	<u>4,680</u>
Total	\$71,580
	Say \$72,000

Street Replacement

2000 LF - 28' width pavement	
6200 SY @ \$3.60	\$22,320
4000 LF curb & cutoff wall @ \$4.00	<u>16,000</u>
Total	\$38,320
	Say \$38,000

1200 LF Armoring of existing 15" sewer @ \$4.00	\$ 4,800
Say	\$ 5,000

Double Tree Ranch Road Alternate Alignment

Culverts - 672 LF 50" x 31" CMP @ \$30.00	\$20,160
Headwalls - 45 CY @ \$200	9,000
Compaction - 300 CY @ \$4.00	1,200
Aprons - 3300 SF @ \$0.60	<u>1,980</u>
Total	\$32,340
Say	\$32,000

Street Replacement	
2300 LF - 28' width pavement 7150 SY @ \$3.60	\$25,740
4600 LF curb & cutoff wall @ \$4.00	<u>18,400</u>
Total	\$44,140
Say	\$44,000

J. UTILITIES

At each of the road crossings existing utilities will need to be lowered. These include telephone, water and a TV cable. A determination should be made to determine who will be responsible for the relocations.

There is a ^{Plan says 15"} 21" diameter sewer at the Double Tree crossing. If the datum of the topography and of the sewer is the same, the culverts will barely clear the sewer.

The only other utility crossing known is the City of Phoenix sanitary sewer on the Mountain View Road alignment. This sewer is comparatively shallow and must be lowered substantially. Unfortunately this cannot be done without the use of a sewage pump. The means of handling this relocation should also be determined.

K. STAGE CONSTRUCTION

Obviously it would be advantageous to develop the channel in stages. Preferably any single property owner should be able to develop his property independently of the others. This essentially is the manner in which Scottsdale was able to construct its greenbelt channel.

The Scottsdale portion of Indian Bend Wash, however, has a significantly different design concept; i.e., the hydraulic gradient (water surface) was not changed appreciably from the preconstruction condition. Thus it was possible for any single property to be developed without affecting the water level on the neighboring properties.

In the manner specified for this study the hydraulic gradient has been lowered to ground surface so far as practicable. This means that to be effective the property downstream has to be developed first or concurrently. Otherwise the water surface at the downstream end of any development would be at the preconstruction level and the new channel would be of little benefit.

It also is evident that the water surface immediately upstream from a new portion of the channel would also remain at its preconstruction level. Thus there would be a drop of several feet in the level of the water surface. Ideally a transition several thousand feet long would be needed to connect the excavated portion to natural ground. A long slope would not be greatly different from the bottom slope of the excavated section so there would be similar velocities in the two sections.

As a practical matter, a long slope could affect several property owners and would probably not be feasible.

A transition of 1000 feet in length would more than double the bottom slope and scouring velocities could be expected. At least part of the eroded material probably would be deposited in the finished channel section where the velocities are lower. So long as it is clearly understood that a transition length of 1000 feet may result in scouring and deposition, we feel this is a practical approach. Further it is entirely possible there would not be sufficient flow to create a problem before the channel is completed.

As another alternative a concrete drop similar to that in the Camelback Golf Course could be built. However, the expense of this structure would be prohibitive, and if these were required, we see little opportunity of constructing the channel.

L. SIDE DRAINAGE

There are a number of washes and swales which empty into the present Indian Bend channel. These will continue to do so with the added problem that the excavation of the channel will create a substantial drop where each swale or wash enters. This drop will create erosive velocities which ultimately will result in substantial deepening of the present washes and swales. Ultimately the deepening will work its way upstream until the channel is again stabilized.

It is recommended that drop structures be constructed at the ends of these drainageways where they enter the main channel. Although these have been specifically excluded from the present planning we feel they are necessary and should not be deferred indefinitely.

M. FILL AREAS

The only area contemplated to be filled is that on the east side and immediately west of Invergordon Road. While the details of how that fill is to be placed should remain with the ultimate developer of that property, the general statement can be made that filling within the limits indicated will permit the recovery of property in the present flood plain without detriment to other owners. In fact it will be advantageous in that it will help create a more uniform flow in Indian Bend Wash. Needless to say such filling must be done in such a manner that side drainage flowing through the property to be filled will not be blocked. Specifically channels will need to be provided so that water entering the property from each wash will reach the main stream. No purpose will be served by specifying at this time the manner in which the side flows are to be carried through the property. This will be controlled in part by the manner in which the property is developed.

N. DRAWINGS AND COMPUTATIONS

The following drawings and computations are submitted with this report and are to be considered part of the report.

1. Floodway Plan - 3 sheets
2. Profile
3. Cross Sections
4. Computation Sheets
5. Cross Sections showing profiles for Invergordon Road, Double Tree Ranch Road, 56th Street and Mountain View Road. (Proposed street profiles for the last two streets are not indicated.)

Town of Paradise Valley
Indian Bend Wash Improvements
Preliminary Report
Page 13

Note: Items 1-5 were prepared by Water Resources Associates under
the direction of John R. Erickson, P.E.



PRELIMINARY PLAN
 TOWN OF PARADISE VALLEY
 INDIAN BEND WASH IMPROVEMENTS

FROM Drop Structure in Camelback Country Club Golf Course
 TO A point Approximately 1000' downstream of Shea Blvd.

Water Resources Associates, Inc.
 APRIL 1975 SCOTTSDALE ARIZ.

SCALE 1" = 200'
 4' Contour Interval

INDIAN BEND WASH
 MAP MANUSCRIPT NO. 22A
 SCALE 1" = 200' CONTOUR INTERVAL 4' (Partial)
 DATE FLOWN 4-27-75 FLIGHT ALTITUDE 4000' DRAWN BY P. H. H. (P. H. H.)
 DATUM NAD 83 FLIGHT LINE NO. 10
 PHOTO NO. 1-1-75 GROUND CONTROL BY USCE & P. H. H.



APPROX PRESENT FLOOD LIMITS

ENCROACHMENT LINE PER 1964 RPT USCE

1964 REF LINE 7 USCE

ENCROACHMENT LINE PER 1964 RPT. USCE

W.R.A. PREFERENCE

APPROX PRESENT FLOOD LIMITS

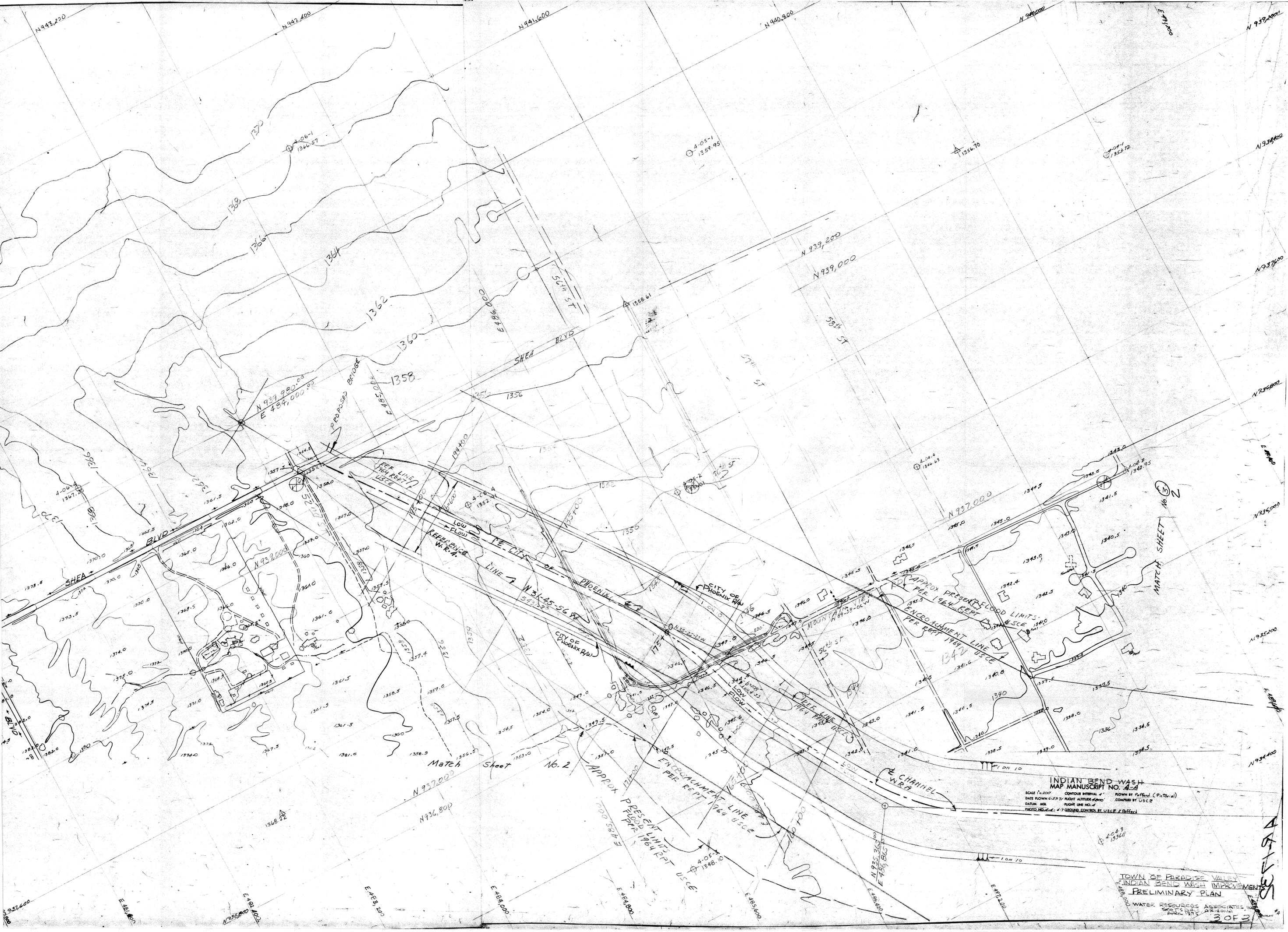
INDIAN BEND WASH
MAP MANUSCRIPT NO. 2013

SCALE 1/2" = 200' CONTOUR INTERVAL 1' DRAWN BY R. J. GARDNER (P.E.)
DATE FLOWING 27-7-74 FLIGHT ALTITUDE 4800' COMPILED BY USCE
DATUM: M.S.L. HEIGHT LINE NO. 5
PHOTO NO. 54-5-B GROUND CONTROL BY USCE 1/4/74

TOWN OF PARADISE VALLEY - INDIAN BEND WASH IMPROVEMENTS - PRELIMINARY PLAN

WATER RESOURCES ASSOCIATES, INC.
SCOTTSDALE, ARIZONA
APRIL 1975

AR-1235
2013



INDIAN BEND WASH
 MAP MANUSCRIPT NO. 4-114
 SCALE 1"=200' CONTOUR INTERVAL 1'
 DATE PLOTTED 4-27-77 PLIGHT ALTITUDE 4000'
 DATUM, MSL PLIGHT LINE NO. 4
 PHOTO NO. 4-47 GROUND CONTROL BY USCE # 11667

TOWN OF PARADISE VALLEY
 INDIAN BEND WASH IMPROVEMENT
 PRELIMINARY PLAN
 WATER RESOURCES ASSOCIATES, INC.
 APRIL 1977
 3 OF 3

A
 13364