DEPARTMENT OF HOMELAND SECURITY

Federal Emergency Management Agency

RIVERINE HYDROLOGY & HYDRAULICS FORM (FORM 2)

OMB Control Number: 1660-0016
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PAPERWORK BURDEN DISCLOSURE NOTICE

Public reporting burden for this form is estimated to average 3.5 hours per response. The burden estimate includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the needed data, and completing, reviewing, and submitting the form. You are not required to respond to this collection of information unless it displays a valid OMB control number. Send comments regarding the accuracy of the burden estimate and any suggestions for reducing this burden to: Information Collections Management, Department of Homeland Security, Federal Emergency Management Agency, 500 C Street, SW, Washington, DC 20472 , Paperwork Reduction Project (1660-0016). Submission of the form is required to obtain or retain benefits under the National Flood Insurance Program. **Please do not send your completed survey to the above address.**

PRIVACY ACT STATEMENT

AUTHORITY: The National Flood Insurance Act of 1968, Public Law 90-448, as amended by the Flood Disaster Protection Act of 1973, Public Law 93-234.
PRINCIPAL PURPOSE(S): This information is being collected for the purpose of determining an applicant's eligibility to request changes to National Flood Insurance Program (NFIP) Flood Insurance Rate Maps (FIRM).
ROUTINE USE(S): The information on this form may be disclosed as generally permitted under 5 U.S.C § 552a(b) of the Privacy Act of 1974, as amended. This includes using this information as necessary and authorized by the routine uses published in DHS/FEMA/NFIP/LOMA-1 National Flood Insurance Program (NFIP); Letter of Map Amendment (LOMA) February 15, 2006, 71 FR 7990.
DISCLOSURE: The disclosure of information on this form is voluntary; however, failure to provide the information requested may delay or prevent FEMA from processing a determination regarding a requested change to a (NFIP) Flood Insurance Rate Maps (FIRM).

Flooding Source: Granite Reef Wash

Note: Fill out one form for each flooding source studied

A. HYDROLOGY

1. Reason for New Hydrologic Analysis (check all that apply):

☐ Not revised (skip to section B) ☐ No existing analysis ☒ Improved data
☐ Alternative methodology ☒ Proposed Conditions (CLOMR) ☒ Changed physical condition of watershed

2. Comparison of Representative 1%-Annual-Chance Discharges

Location	Drainage Area (Sq. Mi.)	Effective/FIS (cfs)	Revised (cfs)
Van Buren St (McKellips Rd)	Old: 7.5 / New: 4.7	1,417	700
McDowell Road	Old: 7.2 / New: 3.7	1,240	500
Pima Road (Thomas Rd)	Old: 6.2 / New: 2.7	644	230

3. Methodology for New Hydrologic Analysis (check all that apply)

☒ Precipitation/Runoff Model → Specify Model: FLO-2D Pro Model Duration: 6 & 24 hr Rainfall Amount: 2.7 & 3.6 in

☐ Statistical Analysis of Gage Records

☐ Regional Regression Equations ☐ Other (please attach description)

Please enclose all relevant models in digital format, maps, computations (including computation of parameters), and documentation to support the new analysis.

4. Review/Approval of Analysis

If your community requires a regional, state, or federal agency to review the hydrologic analysis, please attach evidence of approval/review. 4. HEC-RAS File Description**:

5. Impacts of Sediment Transport on Hydrology

Is the hydrology for the revised flooding source(s) affected by sediment transport? ☐ Yes ☒ No

If yes, then fill out Section F (Sediment Transport) of Form 3. If No, then attach your explanation.

B. HYDRAULICS

1. Reach to be Revised

	Description	Cross Section	Water-Surface Elevation (ft.)	
			Effective	Proposed/Revised
Downstream Limit*	Entire lenght of Granite...			
Upstream Limit*	Reef Wash to be revised.			

*Proposed/Revised elevations must tie-into the Effective elevations within 0.5 foot at the downstream and upstream limits of revision.

2. Hydraulic Method/Model Used: FLO-2D Pro Model

☐ Steady State ☒ Unsteady State ☐ One-Dimensional ☒ Two-Dimentional

3. Pre-Submittal Review of Hydraulic Models*

DHS-FEMA has developed two review programs, CHECK-2 and CHECK-RAS, to aid in the review of HEC-2 and HEC-RAS hydraulic models, respectively. We recommend that you review your HEC-2 and HEC-RAS models with CHECK-2 and CHECK-RAS.

4. HEC-RAS File Description**:

Models Submitted	Natural Run		Floodway Run		Datum
Duplicate Effective Model*	File Name:	Plan Name:	File Name:	Plan Name:	
Corrected Effective Model*	File Name:	Plan Name:	File Name:	Plan Name:	
Existing or Pre-Project Conditions Model	File Name:	Plan Name:	File Name:	Plan Name:	
Revised or Post-Project Conditions Model	File Name:	Plan Name:	File Name:	Plan Name:	
Other - (attach description)	File Name:	Plan Name:	File Name:	Plan Name:	

* For details, refer to the corresponding section of the instructions.
**See instructions for information about modeling other then HEC-RAS. ☐ Digital Models Submitted? (Required)

C. MAPPING REQUIREMENTS

A **certified topographic work map** must be submitted showing the following information (where applicable): the boundaries of the effective, existing, and proposed conditions 1%-annual-chance floodplain (for approximate Zone A revisions) or the boundaries of the 1%- and 0.2%-annual-chance floodplains and regulatory floodway (for detailed Zone AE, AO, and AH revisions); location and alignment of all cross sections with stationing control indicated; stream, road, and other alignments (e.g., dams, levees, etc.); current community easements and boundaries; boundaries of the requester's property; certification of a registered professional engineer registered in the subject State; location and description of reference marks; and the referenced vertical datum (NGVD, NAVD, etc.).

Topographic Information: ☒ Digital Mapping (GIS/CADD) Data Submitted (preferred)

Source: Flood Control District of Maricopa County | Date: 2007 (Year of Aerial Survey)

Vertical Datum: NAVD 88 | Spatial Projection: NAD 83

Accuracy: 2-foot contour interval

Note that the boundaries of the existing or proposed conditions floodplains and regulatory floodway to be shown on the revised FIRM and/or FBFM must tie-in with the effective floodplain and regulatory floodway boundaries. Please attach **a copy of the effective FIRM and/or FBFM**, at the same scale as the original, annotated to show the boundaries of the revised 1%-and 0.2%-annual-chance floodplains and regulatory floodway that tie-in with the boundaries of the effective 1%-and 0.2%-annual-chance floodplain and regulatory floodway at the upstream and downstream limits of the area on revision.

☒ Annotated FIRM and/or FBFM (Required)

D. COMMON REGULATORY REQUIREMENTS*

1. For LOMR/CLOMR requests, do Base Flood Elevations (BFEs) or Special Flood Hazard Areas (SFHAs) increase compared to the effective BFEs? ☐ Yes ☒ No

   If Yes, please attach **proof of property owner notification**. Examples of property owner notifications can be found in the MT-2 Form 2 Instructions.

2. For CLOMR requests, if either of the following is true, please submit **evidence of compliance with Section 65.12 of the NFIP regulations**:

   - The proposed project encroaches upon a regulatory floodway and would result in increases above 0.00 foot compared to pre-project conditions.
   - The proposed project encroaches upon a SFHA with or without BFEs established and would result in increases above 1.00 foot compared to pre-project conditions.

3. Does the request involve the placement or proposed placement of fill? ☐ Yes ☒ No

   If Yes, the community must be able to certify that the area to be removed from the special flood hazard area, to include any structures or proposed structures, meets all of the standards of the local floodplain ordinances, and is reasonably safe from flooding in accordance with the NFIP regulations set forth at 44 CFR 60.3(A)(3), 65.5(a)(4), and 65.6(a)(14). Please see the MT-2 instructions for more information.

4. Does the request involve the placement or proposed placement of fill? ☐ Yes ☒ No

   If Yes, attach **evidence of regulatory floodway revision notification**. As per Paragraph 65.7(b)(1) of the NFIP Regulations, notification is required for requests involving revisions to the regulatory floodway Elements and examples of regulatory floodway revision notification can be found in the MT-2 Form 2 Instructions.

5. For CLOMR requests, please submit documentation to FEMA and the community to show that you have complied with Sections 9 and 10 of the Endangered Species Act (ESA). For actions authorized, funded, or being carried out by Federal or State agencies, please submit documentation from the agency showing its compliance with Section 7(a)(2) of the ESA. Please see the MT-2 instructions for more detail.

3.0 SURVEY AND MAPPING INFORMATION

Aerial topographic mapping as well as aerial imagery is submitted as part of this CLOMR request. The mapping and aerial imagery was obtained from the Flood Control District of Maricopa County. The topographic mapping is based on aerial photography that was flown on November 2nd 2007 and has a 2-foot contour interval accuracy. The aerial survey information submitted as part of this CLOMR consists of a Triangulated Irregular Network (TIN) surface. In addition to the TIN surface, a shapefile that includes 2-foot contours based on the surface is included as part of the submittal. The 2007 aerial imagery is also included for reference purposes. The aerial survey is based on the North American Vertical Datum of 1988 (NAVD 88) vertical datum and the North American Datum of 1983 (NAD 83) horizontal datum (the GIS projected coordinate system for the TIN Surface, contour shapefile and aerial imagery is: *NAD 1983 HARN State Plane Arizona Central FIPS 0202 Feet Intl*).

No field survey was performed as part of the analysis. The hydrology and hydraulic analysis, the proposed watershed improvements, and the conditional floodplain redelineation is solely based on the aerial topographic mapping described above.

4.0 HYDROLOGY

The hydrologic analysis for this CLOMR submittal was performed using the FLO-2D program (*Pro Model – Build No. 16.06.16*). The FLO-2D hydrologic model is documented under separate cover in the *Granite Reef Wash Hydrology Update: Hydrologic Study* prepared by TY Lin International, for the City of Scottsdale in April 2018 (TY Lin model). A copy of this report is included in Appendix A.

The *Hydrologic Study* prepared by TY Lin found that under existing conditions, the 100-year, 24-hour storm governs in terms of peak discharge along Granite Reef Wash. However, the addition of the proposed watershed improvements, particularly the new storm drains, has a significant impact on travel time. The effect is a decrease in the time of concentration which results in the 100-year, 6-hour storm governing most of the Granite Reef Wash floodplain. The exception is the upstream end of the floodplain from Thomas Road down to Lewis Avenue which is still governed by the 24-hour storm. The proposed drainage improvements were designed for the 6-hour storm, but for the purpose of determining the conditional floodplain boundary, both the 24-hour and 6-hour storm events were modeled and the storm that produced the highest water surface elevations

was used to determine the base flood elevations (BFEs) and delineate the conditional floodplain boundary.

As described below, updates were made to the TY Lin model to include recently constructed storm drains that were built since the completion of the study. In addition, certain revisions were made to the model where it did not accurately represent the existing flow conditions.

4.1 UPDATES TO EXISTING CONDITIONS HYDROLOGIC MODEL

The TY Lin FLO-2D model did not incorporate the Granite Reef Watershed – Phase I Drainage Improvements at Jackrabbit Road, Chaparral Road, Camelback Road and Indian School Road that were recently constructed by the City of Scottsdale, nor did it incorporate the Scottsdale Autoshow development which was built by the Salt River Pima-Maricopa Indian Community on the southeast corner of Pima Road and Indian School Road.

In addition, a review of the hydrologic results indicated that there were two locations where the model did not accurately represent existing flow conditions. One location was the General Dynamics complex in the southern part of the watershed which showed that runoff was not reaching the site's large storm water retention basins. The other location is the 1400-foot-long concrete lined channel north of McKellips Road that was not adequately represented with the TY Lin FLO-2D model grids. Refer to Figure 2 for the location of the model revisions that were done to update the TY Lin FLO-2D model to be more representative of the existing conditions.

4.1.1 Granite Reef Watershed – Phase I Drainage Improvements

There are four existing storm drains in the upper watershed that are in Jackrabbit, Chaparral, Camelback and Indian School Road. All four storm drains extend from Indian Bend Wash into the Granite Reef Wash watershed. An analysis performed by Gavan & Barker Inc. in 2014 and documented in the *Granite Reef Watershed: Existing Storm Drain Assessment* memorandum, showed that the existing storm drains had excess capacity and could intercept more runoff from the Granite Reef Watershed and convey it to Indian Bend Wash. As a result of this analysis, the City of Scottsdale contracted with Gavan & Barker to design improvements to all four storm drains to fully utilize their capacity and reduce the amount of runoff that contributes to Granite Reef Wash, south of Thomas Road. These Phase I drainage improvements which consisted of new storm drain laterals to the existing main storm drains were constructed between the spring of 2018 and the summer of 2020. Refer to digital data in Appendix G for the storm drain as-built plans.

These improvements were not included in the TY Lin FLO-2D model because it only considered existing conditions, and at the time the model was developed these storm drains were still in the design phase. But now that the storm drain construction is complete, they were added to the updated FLO-2D model for this CLOMR application.

4.1.2 Scottsdale Autoshow Development

Like the recently completed storm drain improvements, the Scottsdale Autoshow development was also added to the updated FLO-2D Model. It is a car dealership complex that was recently constructed on the southeast corner of Indian School and Pima Roads. The development included a large offsite retention basin on the north side of Indian School Road which was designed to intercept the 100-year, offsite runoff that impacts the dealership complex. South of Indian School Road, the Scottsdale Autoshow is a large master-planned complex of individual dealership lots that are each required to provide 100-year, 2-hour storm water retention. Refer to digital data folder in Appendix G for the retention basin construction documents.

To update the TY Lin FLO-2D model, the offsite retention basin was added by depressing the grid cells to represent the bottom elevation of the basin and raising other grid cells to represent the containment berm along the south and west sides of the basin. The dealership complex was also added to the model by depressing grid cells based on the as-built grading plans and changing the land use characteristics to represent the onsite roadways and the dealership parking lots. Since the onsite retention requirement for each individual dealership was provided with underground storage, the 100-year rainfall depths for the Autoshow grids were reduced to account for the 100-

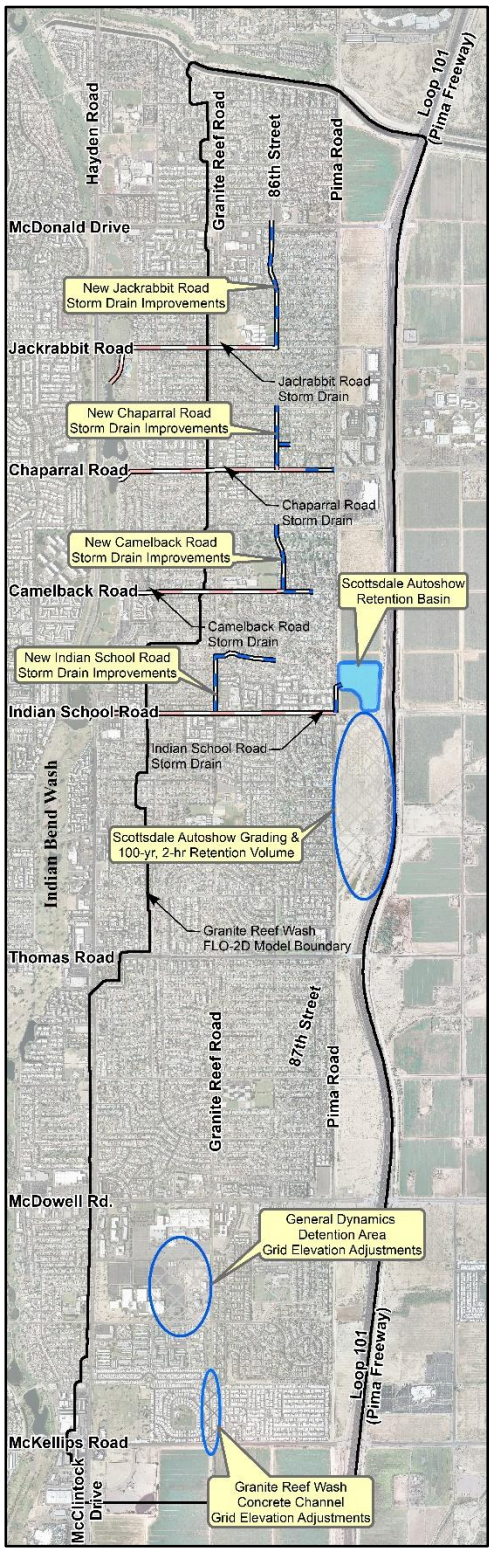

Figure 2: Adjustments/Updates to Existing Conditions Model

year, 2-hour onsite stormwater storage that was provided. At the location of the Scottsdale Autoshow, the 100-year, 2-hour rainfall depth per NOAA Atlas 14 is 2.15 inches.

4.1.3 General Dynamics Retention Basin

A review of the hydrologic results in the southern part of the watershed, specifically near the existing General Dynamics campus on the northwest corner of Roosevelt Street and Granite Reef Road, indicated that the existing large retention basins (6-feet deep) were not fully utilized with only about 1.5 feet of water depth. From a detailed review of flow patterns, it was found that the ditches and small channels that convey runoff from the large, paved parking areas were not adequately represented with the FLO-2D model grids. Therefore, a considerable amount of the onsite runoff was erroneously bypassing the existing stormwater retention basins.

In order to route the runoff from the campus parking lots to their respective retention basins, as-built plans for the campus were obtained from the City of Scottsdale and grid elevation adjustments were made to route runoff to the existing retention basins. Refer to digital data folder in Appendix G for the as-built plans (note that the as-built plans refer to the area as the Motorola Campus, which previously owned the site before being transferred to General Dynamics).

4.1.4 Concrete Lined Channel

The TY Lin FLO-2D model used the grids to represent the existing trapezoidal shaped concrete lined channel between the Granite Reef Road cul-de-sac and McKellips Road. Refer to Figure 2 for the location of the concrete lined channel. A review of the FLO-2D model found that the channel's 12-foot-wide bottom width was modeled using only one row of depressed grid elements, which unreasonably confined the flow. Since the FLO-2D model grids are 15 foot by 15 foot squares, the effective flow width in any of the cardinal and intercardinal directions is only 6.2 feet, half of the actual conveyance width of the trapezoidal channel (in FLO-2D, there are 8 flow directions arranged in an octagonal shape from each 15'x15' grid, each having an effective flow width of 6.2 feet). Even though the whole grid width of 15 feet is larger than the channel bottom width 12 feet, the effective flow width in the southern direction is significantly smaller at 6.2 feet. Therefore, a second row of FLO-2D grids was depressed to increase the modeled width to 12.4 feet, which provides a better representation of the conveyance capacity of the existing concrete lined trapezoidal channel.

4.2 PROPOSED CONDITIONS HYDROLOGIC MODEL

Once the updated existing conditions FLO-2D model was developed, the proposed Granite Reef Watershed – Phase II Drainage Improvements were added to the model. The resulting proposed conditions hydrologic model incorporates all six (6) major elements that comprise the Phase II Drainage Improvements which consist of improving the existing channels, constructing new storm drains and building a new regional detention basin at the upstream end of the Granite Reef Wash floodplain. The proposed drainage improvements were developed as part of a comprehensive drainage planning project whose primary goal was to reduce the effective BFEs and shrink the floodplain boundary in order to remove the SFHA designation from the impacted structures. The development of the drainage improvement plan and the preliminary plan and profile drawings are documented in the *"Granite Reef Watershed Improvement Project Phase II – Drainage Planning Study" (Phase II Drainage Planning Study)* that was prepared by Gavan & Barker Inc. for the City of Scottsdale in February 2020 (revised July 2020). Refer to Appendix B for a copy of the report.

The following provides a brief description of each of the major elements that were incorporated into the hydrologic and hydraulic model to determine the conditional floodplain boundary and updated BFEs. The *Phase II Drainage Planning Study* only consisted of a planning level analysis. The design calculations and FLO-2D modeling will be refined as part of the final design effort. For a detailed description of the proposed Phase II drainage improvements as well as the preliminary design plans, refer to the *Phase II Drainage Planning Study* Report in Appendix B.

4.2.1 Thomas Road Storm Drain and Pima Park Detention Basin

The most upstream element of the proposed improvements consists of a new detention basin located within Pima Park and new feeder storm drains that intercept surface runoff from the upstream watershed and discharge it into the new basin. The basin's primary outfall consists of a 36-inch outlet pipe at an invert elevation of 1217.9 ft that connects to the new Pima Road storm drain, completely bypassing Granite Reef Wash during most storms. A secondary, high-level outfall consists of a 30-foot-wide spillway at elevation 1228.0 ft. The spillway was designed to spill 80 cfs during the 100-year storm event. The flows that surface spill from the basin will be the only flows that enters Granite Reef Wash from upstream of Thomas Road.

4.2.2 Pima/McKellips Road Storm Drain

The proposed Pima/McKellips Road storm drain runs along Pima Road from Thomas Road to McKellips Road and along McKellips Road from Pima Road to Granite Reef Wash. This proposed

storm drain has two main purposes. The first is to convey both the low-flow bypass and the primary outflow from the new Pima Park Detention Basin. Its second purpose is to provide an outfall for the drainage area between Pima Road and the Loop 101 Freeway, effectively cutting that drainage area off from contributing to Granite Reef Wash.

4.2.3 87th Street Storm Drain Improvements

The 87th Street Storm Drain Improvements extend from McDowell Road north to Sheridan Street along 87th Street. These improvements include replacing the existing 48-inch storm drain with a larger diameter pipe and providing a low-flow bypass pipe in McDowell Road. Under existing conditions, this segment of Granite Reef Wash along 87th Street is an inverted crown street with a 48-inch storm drain. The hydrologic analysis found that even by cutting off the flow to Granite Reef Wash at Thomas Road, the combined capacity of the existing storm drain and inverted crown street gets exceeded by local runoff from the drainage area downstream of Thomas Road. Therefore, the new storm drain improvements consist of replacing the downstream portion of the existing storm drain with a larger diameter pipe to limit the flow depth on the street to an elevation that is below the lowest adjacent

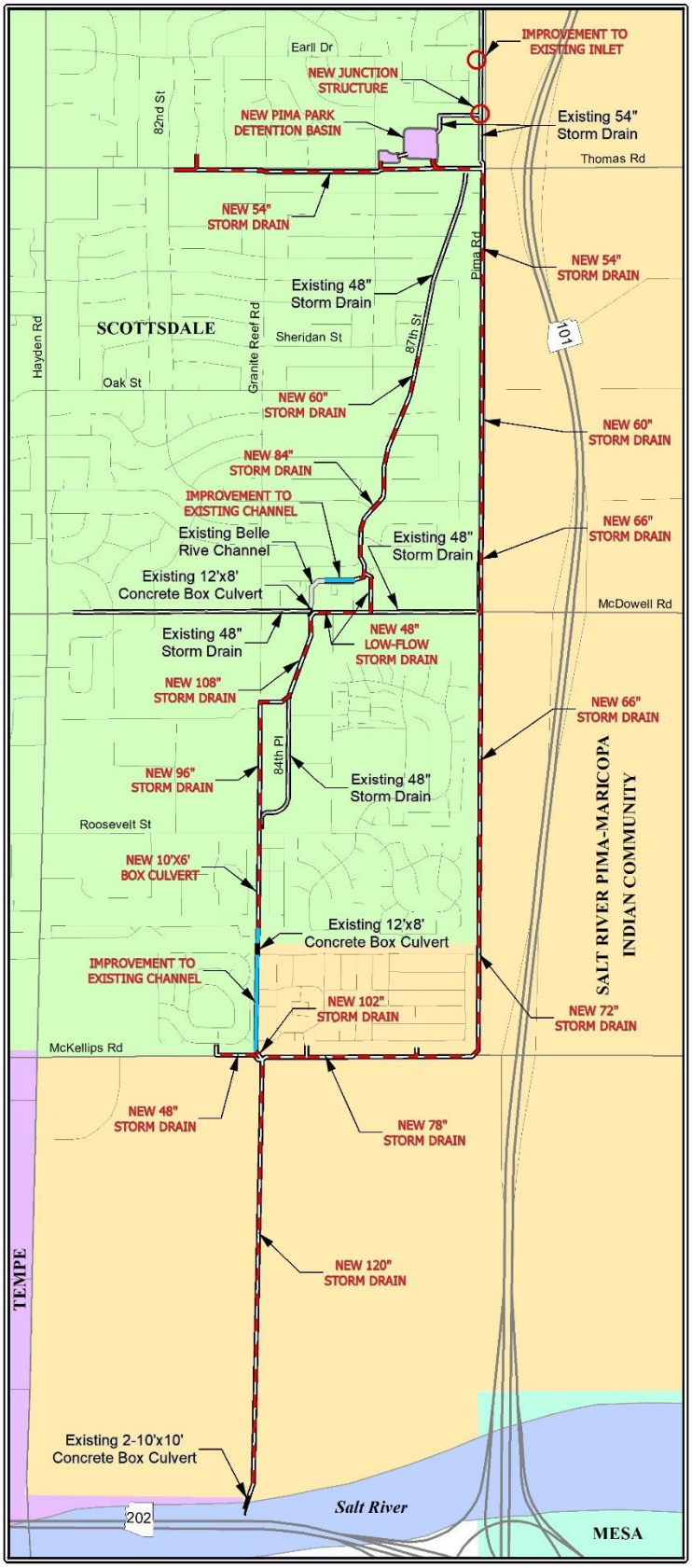

Figure 3: Phase II Drainage Improvements

grades (LAGs) of the surrounding properties. Since the new storm drain is larger and deeper than the existing storm drain, a new low-flow bypass pipe is planned in McDowell Road to drain the sump in the proposed storm drain. Finally, the constricted flow area through the 20-foot-wide alley between 87th Street and the upstream end of the Belle Rive channel will be widened to lower the BFEs on 87th Street, just north of McDowell Road. Refer to Figure 4 for an exhibit of the proposed Phase II drainage improvement plans showing the low-flow bypass pipe and the location of the widening of the existing 20-foot-wide alley upstream of the Belle Rive channel.

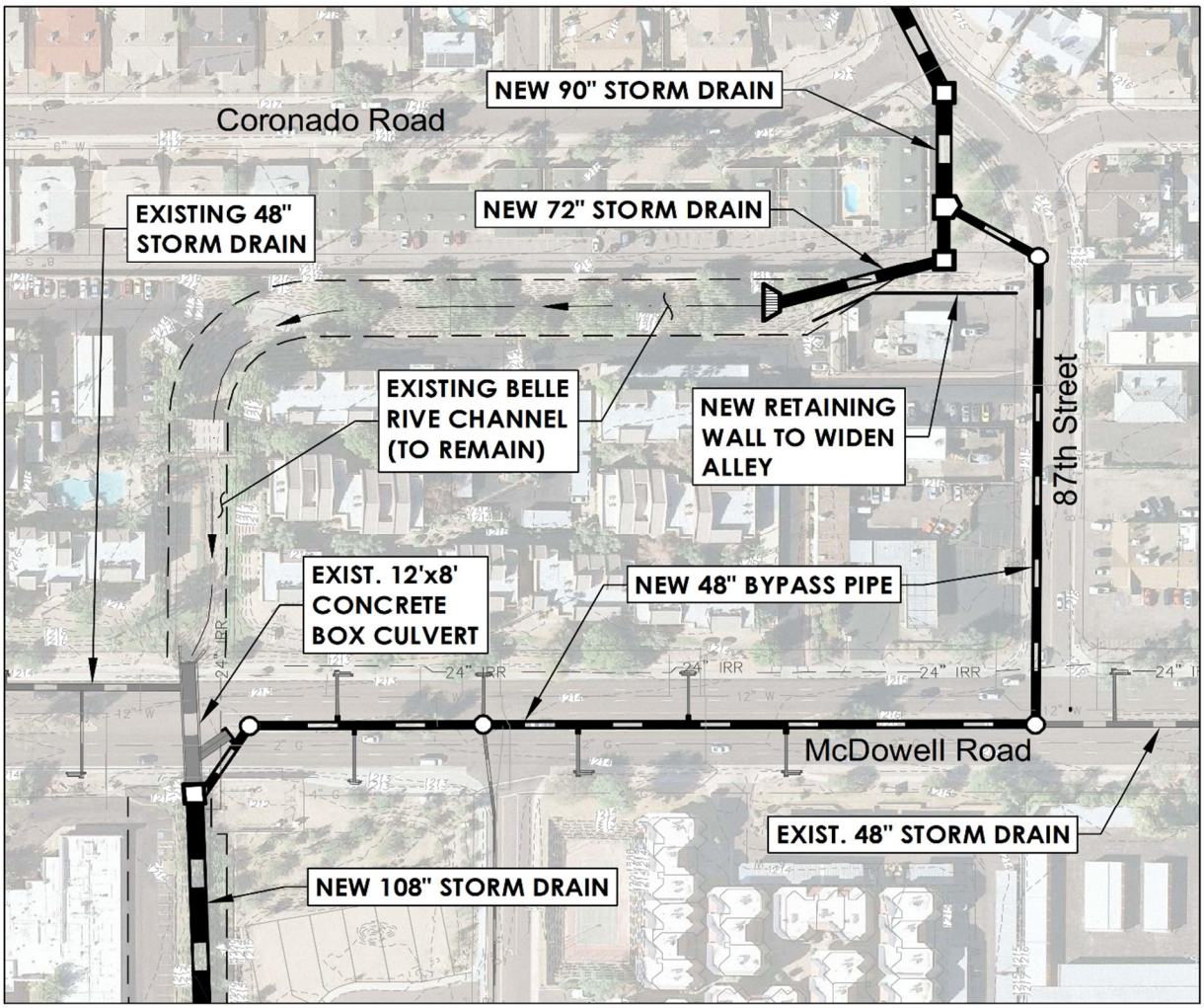

Figure 4: 87th Street Low-Flow Bypass Storm Drain and Alley Widening

4.2.4 84th Place/Granite Reef Road Storm Drain

The 84th Place/Granite Reef Road Storm Drain runs from the existing 12'x8' McDowell Road box culvert to the Granite Reef Road cul-de-sac which lies about 1/5 of a mile south of Roosevelt Street. The new storm drain follows the alignment of the existing earthen channel south of McDowell Road to a new junction structure located at the upstream headwall for the existing,

undersized 48-inch storm drain in 84th Place. The junction structure connects the new storm drain to both the existing 48-inch storm drain in 84th Place and the new 96-inch storm drain in Granite Reef Road. Most of the peak discharge will be conveyed in the new Granite Reef Road storm drain with the excess flow running through the existing 84th Place 48-inch storm drain. Similar to the 87th Street Storm Drain Improvements, this new storm drain was not designed to convey the entire 100-year peak discharge in Granite Reef Wash, but it was sized large enough to allow for the existing 84th Place storm drain and inverted crown street to convey the 100-year flow while keeping the base flood elevations (BFEs) along 84th Place below the lowest adjacent grades (LAGs) of the surrounding structures.

4.2.5 Granite Reef Wash Channel Improvements

The Granite Reef Wash Channel runs for about 1,500 feet from the Granite Reef Road cul-de-sac south to McKellips Road. The existing concrete-lined channel as well as the concrete box culvert at the SRP well site were found to have sufficient capacity to convey the Granite Reef Wash revised peak discharges. However, due to the age of the channel, the concrete lining has started to deteriorate which has become a maintenance problem for the City of Scottsdale. Since the channel has sufficient capacity, the proposed improvements only consist of removing and replacing the existing concrete channel lining.

4.2.6 SRPMIC Section 12 Storm Drain

The SRPMIC 120" diameter storm drain is the most downstream element of the Phase II Drainage Improvements. It runs for one (1) mile from McKellips Road to the Salt River. The storm drain serves as the outfall for both the existing concrete lined channel upstream of McKellips Road and the proposed Pima/McKellips Road Storm Drain. The outlet for the 120" storm drain is an existing, dual 10'x10' concrete box culvert that penetrates the north levee of the Salt River, just north of the Loop 202 Freeway.

4.3 MODEL CALIBRATION

FEMA guidance for FLO-2D models indicates that they should be calibrated to known high water marks. The original FLO-2D model developed by TY Lin International and documented in *Granite Reef Wash Hydrology Update: Hydrologic Study* calibrated the model to the observed storm event on September 8th 2014. Refer to the TY Lin Report in Appendix A for documentation of the model calibration effort.

4.4 MODEL RUNS: WITH WALLS VS. WITHOUT WALLS

The original FLO-2D model developed by TY Lin International and documented in the ***Granite Reef Wash Hydrology Update: Hydrologic Study*** incorporated residential walls which were modeled as levees. However, FEMA policy does not allow residential block walls to function as a levee in the model. In order to ensure that there are no reductions in water surface elevation due to storage behind non-accredited, non-surveyed levee features, the proposed conditions FLO-2D model was run once with and once without the residential wall levees for both the 6- and 24-hour storm events. The resulting water surface elevations from these four separate models were compared and the highest water surface elevation along the floodplain profile base line was taken as the governing BFE.

It was found that the governing storm is the100-year, 6-hour event for most of the Granite Reef Wash floodplain, but there are some segments that are governed by the 100-year, 24-hour storm. As was previously mentioned, the original TY Lin FLO-2D model found that the 24-hour storm event governed. However, the addition of the proposed watershed improvements, particularly the new storm drains, has a significant impact on travel time. The effect is a decrease in the time of concentration which results in the 100-year, 6-hour storm governing most of the Granite Reef floodplain. The proposed watershed improvements were designed for the 100-year, 6-hour storm including the subdivision walls. However, for the purpose of redelineating the Granite Reef Wash floodplain for this CLOMR, three additional scenarios were modeled and the highest water surface elevation along the Wash was used to map the conditional floodplain. The four models that were developed to determine the worst-case scenario are:

- 100-year 6-hour storm with Walls
- 100-year 6-hour storm without Walls
- 100-year 24-hour storm with Walls
- 100-year 24-hour storm without Walls

Refer to the Floodplain Maximum WSEL Maps in Exhibit 1 which identify the governing models used to establish the 100-year water surface elevations.

4.5 REDUCTION IN CONTRIBUTING DRAINAGE AREA

As part of the data collection effort for this floodplain redelineation, an effort was made to find the original Flood Insurance Study (FIS) that developed the current effective peak discharges for Granite Reef Wash. Entellus, Inc., who delineated the current effective floodplain delineation in

1997, was also unsuccessful in obtaining the original hydrologic study. However, the FIS for Maricopa County states that the drainage area for Granite Reef Wash at Pima Road is 6.2 square miles, whereas the current drainage area is only 2.7 square miles. This indicates that the original hydrologic study included the area east of the Loop 101 Pima Freeway in the contributing drainage area. However, since the construction of the Freeway in 1998, the drainage area east of the Freeway is collected in the Freeway drainage system and diverted south to the Salt River.

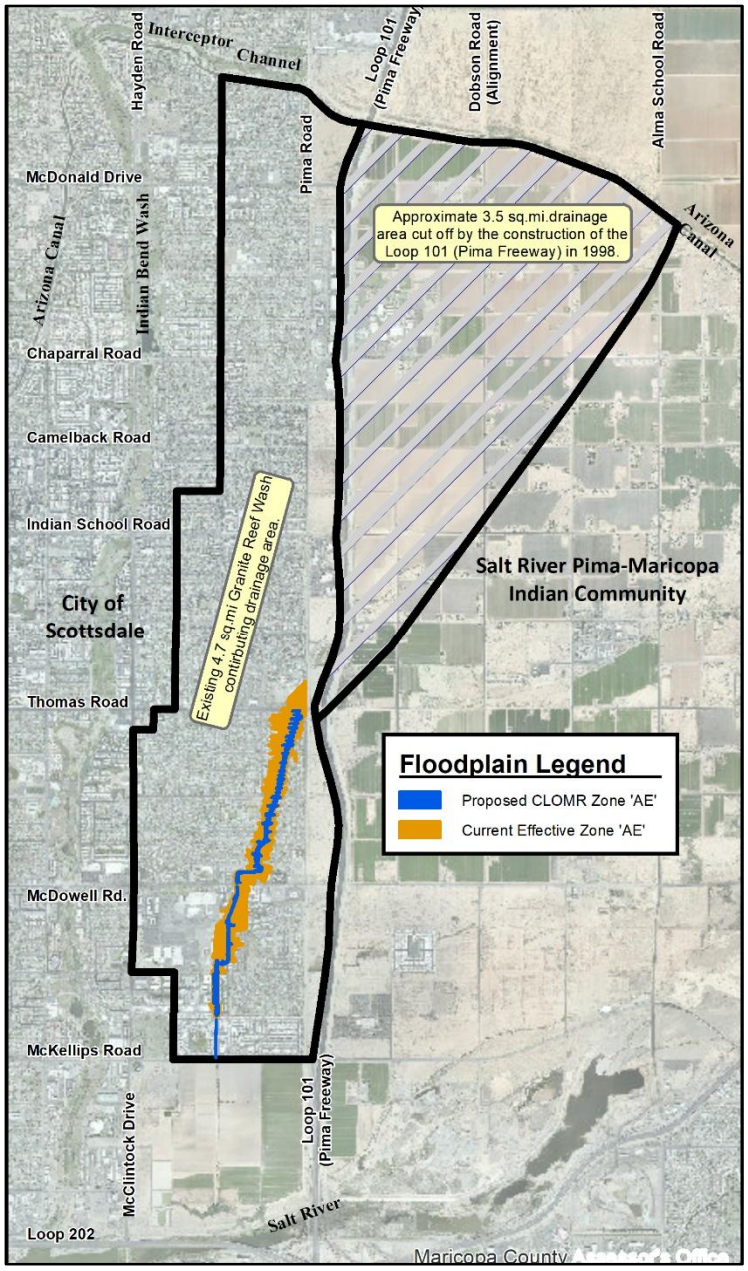

Figure 5: Granite Reef Wash Watershed Boundary

According to the drainage design reports for the Loop 101 Pima Freeway; the offsite drainage infrastructure was designed for the 100-year, 24-hour storm event. The drainage infrastructure, which consists of a storm drain upstream of Chaparral Road and an open channel south of Chaparral Road, intercepts the flow from the upstream watershed and conveys it south along the east side of the Freeway to the Salt River. As can be seen in Figure 5, the construction of the Loop 101 Pima Freeway, cut off approximately 3.5 square miles of contributing drainage area from the upstream portion of the Granite Reef Wash watershed. The reduction in contributing drainage area significantly reduced the 1% annual chance peak discharges within Granite Reef Wash.

4.6 PEAK DISCHARGE SUMMARY TABLE

The following tables summarize the conditional 1% annual chance surface peak discharges for the Granite Reef Wash flooding source with the proposed Granite Reef Watershed – Phase II Drainage Improvements in place. Table 1 summarizes the revised 1% annual chance peak discharges with the corresponding contributing drainage areas, while Table 2 compares the revised peak discharges and drainage areas to the current effective, FIS 1% annual chance peak discharges and contributing drainage areas. Since four FLO-2D models were run, which includes the 6-hour and 24-hour storms with and without walls, the model that produced the highest surface peak discharge at each location was incorporated into the Table 1 below.

Flooding Source and Location	Drainage Area (sq. Miles)	Peak Discharges (cfs)			
		10% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance
GRANITE REEF WASH					
Upstream of McKellips Road	4.7	--^	--^	700[1]	--^
Upstream of McDowell Road	3.7	--^	--^	500[2]	--^
Downstream of Thomas Road	2.7	--^	--^	230[3]	--^

--^ Data not computed

[1] Governing surface peak discharge from the 100-year, 6-hour FLO-2D model with Walls

[2] Governing surface peak discharge from the 100-year, 6-hour FLO-2D model without Walls

[3] Governing surface peak discharge from the 100-year, 24-hour FLO-2D model without Walls

Table1: Summary of Peak Discharges

Flooding Source and Location	Drainage Area (sq.mi.)		Peak Discharge (cfs)	
	Effectieve/ FIS	Revised/ CLOMR	Effectieve/ FIS	Revised/ CLOMR
GRANITE REEF WASH				
Upstream of McKellips Road	7.5	4.7	1417	700
Upstream of McDowell Road	7.2	3.7	1240	500
Downstream of Thomas Road	6.2	2.7	644	230

Table 2: Comparison of Peak Discharges

As is indicated in Table 1, from Thomas Road downstream to Lewis Avenue the peak discharges and the corresponding BFEs are governed by the 100-year, 24-hour storm event without walls, meaning that the LEVEE.DAT file that represents flow obstructions caused by residential walls

was removed from the model. Downstream of Lewis Avenue to the cul-de-sac on Granite Reef Road, which lies approximately 1/5 of a mile south of Roosevelt Street, the 100-year, 6-hour storm without walls was found to govern. Finally, the 100-year, 6-hour model with walls governs for the channelized section of the wash that runs from the Granite Reef Road cul-de-sac downstream to McKellips Road. The conditional floodplain delineation for each section of Granite Reef Wash is based on the governing FLO-2D model.

5.0 HYDRAULICS

The hydraulic analysis for this CLOMR submittal was performed using the FLO-2D program, which includes the EPA SWMM software to analyze the existing and proposed storm drain infrastructure. The development of the FLO-2D model is documented under separate cover in the *Granite Reef Wash Hydrology Update: Hydrologic Study* prepared by TY Lin International, for the City of Scottsdale in April 2018 and the *Granite Reef Watershed Improvement Project Phase II – Drainage Planning Study* prepared by Gavan & Barker Inc. for the City of Scottsdale in February 2020. The reports can be found in Appendix A and Appendix B, respectively.

5.1 FLOODPLAIN MAX WSEL MAPS

The maps contained in Exhibit 1 show the maximum water surface elevations from the updated FLO-2D models that incorporate the Granite Reef Watershed Drainage and Flood Control Improvements Phase I (completed) and the proposed Phase II drainage improvement plans. The water surface elevations along the Granite Reef Wash profile base line (thalweg) were used to delineate the conditional Zone 'AE' floodplain and determine the conditional BFEs. As described in Section 4, the maximum water surface elevations were obtained from four separate FLO-2D models, including the 100-year, 6-hour and 24-hour storms with and without the residential walls.

The BFEs were determined from the FLO-2D model that produced the highest maximum water surface elevations at each grid cell along the study reach. The conditional BFEs are indicated on the Floodplain Maximum WSEL Maps in Exhibit 1. These maps also show the underlying maximum water surface elevations in each grid that were used to establish the BFEs.

5.2 WORK STUDY MAPS

The Work Study Maps in Exhibit 2 show the proposed Zone 'AE' floodplain boundary for Granite Reef Wash after incorporating the Granite Reef Watershed – Phase II Drainage Improvements.

After determining the BFEs along the study reach, the conditional floodplain boundary was delineated by projecting the BFEs onto the digital terrain model of the topographic mapping. This process was accomplished by creating a water surface raster from the BFEs that were established along the Granite Reef Wash thalweg. This water surface raster was then compared to the topographic TIN surface that was obtained from the Flood Control District of Maricopa County. The areas for which the BFE water surface raster was found to be higher (i.e. base flood elevations greater than the ground elevations of the topographic TIN surface) were incorporated into the conditional Zone 'AE' floodplain boundary. The areas for which the BFE surface raster was found to be lower were deemed outside of the conditional floodplain. Therefore, the location where the BFE raster was found to intersect the topographic TIN surface was taken as the proposed Zone 'AE' floodplain boundary.

On the upstream end, the current effective Zone 'AE' floodplain extends north of Thomas Road to Pima Road. However, the CLOMR hydraulic analysis indicates that the depth of flow upstream of Thomas Road is less than one foot. Therefore, the upstream end of the proposed conditional Zone 'AE' floodplain boundary was terminated at Thomas Road (River STA: 3.255). On the downstream end, the current effective Zone 'AE' ends at the Granite Reef Road cul-de-sac, approximately 1500 feet north of McKellips Road, but the conditional Zone 'AE' floodplain boundary extends farther downstream to the proposed storm drain drop inlet structure at McKellips Road. From McKellips Road south to the Salt River, there is no floodplain because the Granite Reef Wash flows will be contained within the proposed 120" diameter storm drain. Also, McKellips Road is the municipal boundary between the City of Scottsdale and the Salt River Pima-Maricopa Indian Community, with the latter not participating in the National Flood Insurance Program (NFIP).

Refer to the Work Study Maps in Exhibit 2 for the location of the existing and proposed drainage infrastructure as well as the upstream and downstream limits of the conditional Zone 'AE' floodplain boundary.

6.0 EROSION, SEDIMENT TRANSPORT, GEOMORPHIC ANALYSIS

Most of the contributing drainage area to Granite Reef Wash is a developed urban watershed, but there is some agricultural land. The agricultural land, which is located within the Salt River Pima-Maricopa Indian Community between Pima Road and the Loop 101 is level, furrowed and irrigated

farmland that utilizes tailwater ditches to intercept the excess irrigation water and storm water runoff. The erosion potential and sediment transport from these farmlands is minimal, with any sediment transport being intercepted by the tailwater ditches before entering the urban watershed. Also, the city has not experienced erosion or sediment deposition issues along Pima Road, which separates the developed urban watershed from the agricultural crop land. Therefore, it was assumed that sediment will not affect the BFEs of the proposed conditional floodplain redelineation. No erosion, sediment transport, or geomorphic analysis was done as part of this CLOMR.

7.0 DRAFT FIS DATA

The current effective SFHA for Granite Reef Wash is a Zone AE floodplain that is subject to inundation by the 1% annual chance flood. The purpose of this study is to redelineate the floodplain based on implementation the proposed Granite Reef Watershed - Phase II Drainage Improvements and obtain conditional approval from the Federal Emergency Management Agency (FEMA) through the submittal of this request for Conditional Letter of Map Revision (CLOMR). In addition to the proposed Phase II drainage improvements, the conditional redelineation incorporates new detailed topographic mapping, updated hydrologic and hydraulic analysis and several physical changes that have occurred in the watershed since the effective floodplain was delineated in 1997.

The conditional Zone ‘AE’ redelineation results in a significant decrease in the width of the floodplain; removing the SFHA designation from all but one structure along Granite Reef Wash. Also, the current effective floodplain ends at the cul-de-sac on Granite Reef Road, about 1,500 feet north of McKellips Road, whereas the conditional redelineation extends all the way to McKellips Road. For a comparison of the current effective Granite Reef Wash Zone ‘AE’ with the conditional redelineation refer to the annotated FEMA FIRM map in Exhibit 3. Also refer to the work study maps in Exhibit 2 which show the BFEs and floodplain boundary for the conditional Granite Reef Wash Zone ‘AE.’

The purpose of this Conditional Letter of Map Revision is to gain concurrence on the proposed Phase II Drainage Improvement Plan and the new hydrologic and hydraulic modeling approach using the FLO-2D program. The aim of the completed Phase I storm drain improvements and the proposed Phase II improvements is to reduce the size of the current effective Granite Reef Wash floodplain. The completed Phase I storm drain improvements consisted of new storm drain, while

the proposed Phase II improvements consist of constructing a new regional detention basin, new storm drains and improvements to the conveyance capacity of existing drainage channels. Since the estimated cost of the Phase II drainage improvements is over $40 million, the conditional acceptance of the redelineation is being sought before final design and construction begins.