191st Avenue Wash Letter of Map Revision

Photo Credit 191st Avenue Wash CLOMR, Hoskin-Ryan Consultants Inc., 2012

Flood Control District of Maricopa County

Engineering Division

June 13, 2014

Flood Control District
of Maricopa County

INTEROFFICE MEMORANDUM

Date: June 25th, 2014

To: William D. Wiley, P.E., Chief Engineer and General Manager

From: Jennifer Thorne, P.E, Hydrologist, Hydrology and Hydraulics Branch

Subject: 191st Ave Wash LOMR

The floodplain redelination study and LOMR for the 191st Ave Wash is ready for use as the best available technical information. The study documentation will be sent to FEMA for review and incorporation into the County's FIRM panels.

The background for the study includes the following: The study revises 4.1 linear miles of existing Zone AE floodplains with floodway along the 191st Avenue Wash due to the construction of the White Tanks FRS#3 Outfall Channel. In January of 2012, Hoskin Ryan Consultants prepared a CLOMR package for the redelineation of the 191st Avenue Wash based on hydrologic changes that would occur in the area due to the design and construction of the White Tanks FRS #3 Outfall Channel. At the time, the submittal was deemed unnecessary by FEMA, as there were no changes made directly to the 191st Avenue Wash. Now, the Flood Control District of Maricopa County has modified HRC's submittal into a Letter of Map Revision (LOMR) submittal package for the 191st Avenue Wash Floodplain between the I-10 Freeway and Bethany Home Road. The project manager for the District was Jennifer Thorne, P.E.

Please concur and authorize below the use of this new study.

Date 6/25/14 Jennifer Thorne, P.E. Project Manager	Date: 6/26/2014 Ed Raleigh, P.E. Engineering Division Manager
Date: 6/26/14 Amir Motamedi, P.E., CFM Hydrology/Hydraulics Branch Manager	Date: 7-1-14 William D. Wiley, P.E., Chief Engineer and General Manager
Kelli A Sertich Date: 6/27/14 Kelli Sertich, AICP, CFM Floodplain Management & Services Division Manager	Date: _____
File Copies: 1. _____ 2. _____	YES ☐ GIS Posted (Pending Floodplain Only) Date: _____ N/A

2801 West Durango Street Phoenix, Arizona 85009 Phone: 602-506-1501 Fax: 602-506-4601

Online Letter of Map Change

LOMC Application

Application ID: R615964924455

Revision

Revision Review

Project Type

Project Type: LOMR

Payment Total

Fee: $0.00 (LOMR/PMR Based Solely on Submission of More Detailed Data)

Project Name/Identifier

Project Name/Identifier: 191st Avenue Wash Floodplain from Bethany Home Road to the I-10 Freeway

Community Information

State, District or Territory:	AZ
County:	Maricopa County
Community Name:	BUCKEYE, TOWN OF
Map Panel Number - Effective Date:	04013C1665L - 10/16/2013,04013C2130L - 10/16/2013
CID:	040039

State, District or Territory:	AZ
County:	Maricopa County
Community Name:	MARICOPA COUNTY*
Map Panel Number - Effective Date:	04013C2130L - 10/16/2013,04013C1665L - 10/16/2013
CID:	040037

Flooding

Flooding Source: 191st Avenue Wash

Types of Flooding: Riverine

Basis for Request

The basis for this revision request is: Hydraulic Analysis , Hydrologic Analysis , New Topographic Data

Zone Designation

FEMA Zone designations affected: AE

Revision Structures

The area of revision encompasses the following structures: Culvert

Primary Contact Information

Title:	Ms.
First Name:	Jennifer
Last Name:	Thorne
Address 1:	2801 W. Durango Street
City:	Phoenix
State, District or Territory:	AZ
ZIP Code:	85009
E-mail Address:	thornej@mail.maricopa.gov
Company/Organization:	Flood Control District of Maricopa County
Phone:	602-506-3320

Community Official Information

Title:	Mr.
First Name:	Stephen
Last Name:	Cleveland
Professional Title:	City Manager
Community Name:	BUCKEYE, TOWN OF
Address 1:	530 E. Monroe Avenue
City:	Buckeye
State, District or Territory:	AZ
ZIP Code:	85326
E-mail Address:	scleveland@buckeyeaz.gov
Phone:	623-349-6099

As the CEO or designee responsible for the floodplain management, I hereby acknowledge that we have received and reviewed this Letter of Map Revision (LOMR) or conditional LOMR request. Based upon the community's review, we find the completed or proposed project meets or is designed to meet all of the community floodplain management requirements, including the requirement for when fill is placed in the regulatory floodway, and that all necessary Federal, State, and local permits have been, or in the case of a conditional LOMR, will be obtained. For conditional LOMR request, the applicant has documented Endangered Species Act (ESA) compliance to DHS/FEMA prior to DHS/FEMA's review of the Conditional LOMR application. For LOMR request, I acknowledge that compliance with sections 9 and 10 of the ESA has been achieved independently of DHS/FEMA's process. For actions authorized, funded, or being carried out by Federal or State agencies, existing or proposed structures to be removed from the SFHA are or will be reasonably safe from flooding as defined in 44 CFR 65.2(c), and that we have available upon request by DHS/FEMA, all analyses and documentation used to make this determination.

Community Official Signature: _____

Date: _____

Title:	Mr.
First Name:	William D.
Last Name:	Wiley
Professional Title:	Chief Engineer and General Manager
Community Name:	MARICOPA COUNTY*
Address 1:	2801 W.Durango St
City:	Phoenix
State, District or Territory:	AZ
ZIP Code:	85009
E-mail Address:	williamwiley@mail.maricopa.gov
Phone:	602-506-4708

As the CEO or designee responsible for the floodplain management, I hereby acknowledge that we have received and reviewed this Letter of Map Revision (LOMR) or conditional LOMR request. Based upon the community's review, we find the completed or proposed project meets or is designed to meet all of the community floodplain management requirements, including the requirement for when fill is placed in the regulatory floodway, and that all necessary Federal, State, and local permits have been, or in the case of a conditional LOMR, will be obtained. For conditional LOMR request, the applicant has documented Endangered Species Act (ESA) compliance to DHS/FEMA prior to DHS/FEMA's review of the Conditional LOMR application. For LOMR request, I acknowledge that compliance with sections 9 and 10 of the ESA has been achieved independently of DHS/FEMA's process. For actions authorized, funded, or being carried out by Federal or State agencies, existing or proposed structures to be removed from the SFHA are or will be reasonably safe from flooding as defined in 44 CFR 65.2(c), and that we have available upon request by DHS/FEMA, all analyses and documentation used to make this determination.

Community Official Signature: _____

Date: 7-1-14

Certification by Registered Professional Engineer and/or Land Surveyor

This certification is to be signed and sealed by a licensed land surveyor, registered professional engineer, or architect authorized by law to certify elevation information data, hydrologic and hydraulic analysis, and any other supporting information as per NFIP regulations paragraph 65.2(b) and as described in the MT-2 Forms instruction. All documents submitted in support of this request are correct to the best of my knowledge. I understand that any false statement may be punishable by fine or imprisonment under Title 18 of the United States Code, Section 1001.

First Name:	Jennifer
Last Name:	Thorne
License Number:	50474
Expiration Date:	12/31/2015
Company Name:	Flood Control District of Maricopa County

E-mail Address:	thornej@mail.maricopa.gov
Telephone Number:	(602) 506-3320
Fax Number:	(602) 506-4601
Certifier's Signature:	
Date:	6/25/2014

AT FEMA FOR REVIEW

LETTER OF MAP REVISION REQUEST FOR THE 191st AVENUE WASH FLOODPLAIN BETHANY HOME ROAD TO THE I-10 FREEWAY

MARICOPA COUNTY AND TOWN OF BUCKEYE, ARIZONA

TECHNICAL DATA NOTEBOOK

June 13th, 2014

Prepared by:
Flood Control District of Maricopa County
2801 W. Durango Street
Phoenix, AZ 85009

Registered Professional Engineer
CERTIFICATE
50474
JENNIFER LYNN THORNE
DATE SIGNED
ARIZONA U.S.A.

EXPIRATION 12/31/2015

APPROVED

CITY OF BUCKEYE ENGINEER DATE

THE CITY APPROVES THIS REPORT FOR CONCEPT ONLY AND ACCEPTS NO LIABILITY FOR ERRORS OR OMISSIONS

LETTER OF MAP REVISION REQUEST FOR THE 191st AVENUE WASH FLOODPLAIN MARICOPA COUNTY, ARIZONA

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Registered Professional Engineer
CERTIFICATE NO. 50474
JENNIFER LYNN THORNE
DATE SIGNED
ARIZONA U.S.A.
EXPIRATION 12/31/2015

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MARICOPA COUNTY, ARIZONA

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Registered Professional Engineer (Civil)
CERTIFICATE NO.
50474
JENNIFER LYNN THORNE
DATE SIGNED
ARIZONA U.S.A.

EXPIRATION 12/31/2015

LETTER OF MAP REVISION REQUEST
FOR THE 191st AVENUE WASH FLOODPLAIN
MARICOPA COUNTY, ARIZONA

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Hydrology Exhibit Maps

See Hydrology Exhibit Maps in Reference 1. Please note that the "Post-Project Conditions" are now the "Existing Conditions," and the "Existing Conditions" in Reference 1 are from before the White Tanks #3 Outfall Channel had been constructed.

Existing Conditions Floodplain Work Maps

See Work Maps in Reference 1

Data CD (From the previous submittal of Reference 1)

HEC-1 Hydrologic Model
HEC-RAS Existing Conditions Model
HEC-RAS Duplicate Effective Model
Floodplain/Floodway CAD Files
Work Maps
White Tanks FRS No. 3 Outfall Channel 100% Design Plans
HDR Hydrology Report

1 Introduction

In January of 2012, Hoskin Ryan Consultants prepared a CLOMR package for the redelineation of the 191st Avenue Wash (Ref. 1) based on hydraulic changes that would occur in the area due to the design and construction of the White Tanks FRS #3 Outfall Channel (*Outfall Channel*). At the time, the submittal was deemed unnecessary by FEMA, as there were no changes made directly to the 191st Avenue Wash. Now, the Flood Control District of Maricopa County (District) has modified HRC's submittal into a Letter of Map Revision (LOMR) submittal package for the 191st Avenue Wash Floodplain between the I-10 Freeway and Bethany Home Road (Figure 1). The White Tanks FRS No. 3 Outfall Channel (*Outfall Channel*) has been constructed along the Jackrabbit Trail alignment, one-half mile to the west of and cuts off flow that previously reached the 191st Avenue Wash (Figure 1). Final Design plans for the *Outfall Channel* are complete and the channel has been built (Ref. 6). A CLOMR for the *Outfall Channel* has been prepared and has been submitted to FEMA (Ref. 5).

The 191st Avenue Wash LOMR request is currently covered by a FEMA-designated Flood Zone "AE" (Figure 2). Flow previously drained in a southerly direction primarily along the west side of the Beardsley Canal for most of the four mile reach, causing a broad floodplain which impacts many property owners within the area.

The purpose of this LOMR request is to revise the Zone "AE" floodplain limits which reflect the results of updated hydrology and topography and the construction of the *Outfall Channel.*

1.1 Authority for Study

The District contract number is FCD 2009C012, with an official Notice to Proceed Date of October 22, 2009.

1.2 Location of Study

The 191st Avenue Wash is located in west-central Maricopa County. It is adjacent to

and typically west of 191st Avenue, one-half mile east of Jackrabbit Trail, and between the I-10 Freeway and Bethany Home Road. Additionally, this area lies within Sections 16, 21, 28 and 33, Township 2 North, Range 2 West, of the Gila and Salt River Meridian (Figure 1).

1.3 Methodology Summary

The current Effective Zone AE floodplain delineation along the 191st Avenue Wash is from the *White Tanks / Agua Fria Area Drainage Master Study* (ADMS) (Ref. 7). The hydrology model in the ADMS includes a large watershed north of Camelback Road that extends west to Tuthill Road. An excerpt from the *White Tanks / Agua Fria ADMS* is provided in Appendix A.2.1 of Reference 1.

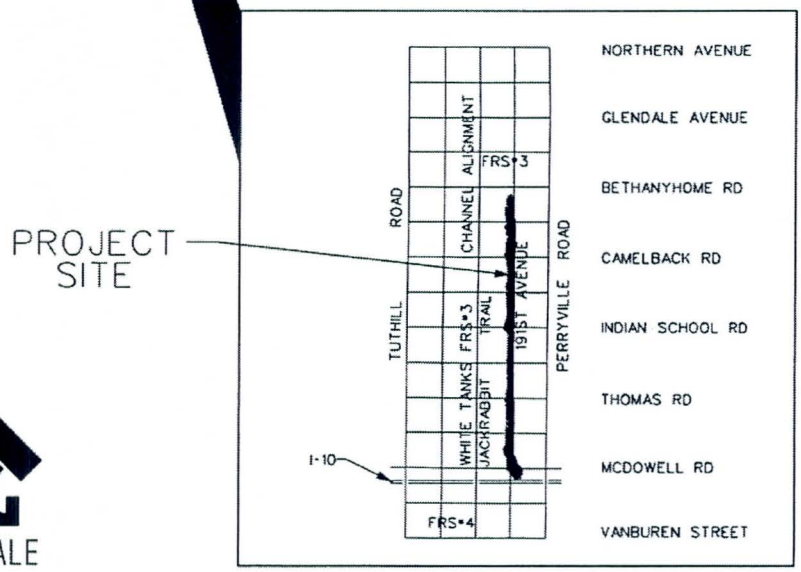
The hydrologic analysis for Existing Conditions with the *Outfall Channel* in place was updated by HDR in June of 2009 in the *Loop 303 / White Tanks Area Drainage Master Plan Update Area Hydrologic Analysis* (ADMPU AHA) (Ref. 9). Revisions were made to this model as part of this current study to reflect the design conditions of the Outfall Channel along the Jackrabbit Trail alignment. Changes include: adjustments to the rainfall depth, areal reduction, land use and channel routing. A summary of 100-year peak flow rates is included in Table 1 and the output from the HEC-1 model is included in Appendix D.6 of Reference 1.

This study includes updated cross-sections based on more accurate one foot contour interval topography. In addition, this study includes a detailed HEC-RAS model (converted from the ADMS HEC-2 model) which utilizes the revised hydrology and new cross-sections where appropriate. Cross-section geometry information is from the White Tanks FRS No. 3 Outfall Channel, Survey Report (Ref. 12). The culvert information is from the structure survey performed on October 6, 2010 (Appendix C.3 of Reference 1).

The updated HEC-1 and HEC-RAS model outputs are provided in the appendices and electronic copies are provided on the data CD. The resulting 100-year floodplain and floodway delineations are plotted and shown on Figures 4A, 4B and 4C – Annotated FIRM, and the CLOMR Submittal 100-Year Floodplain Work Maps, 1 through 10.

1.4 Acknowledgements

This report began as a CLOMR done by Hoskin Ryan Consultants, but has since been modified to be a LOMR, as the developments did not directly impact the 191st Ave Channel. Individuals from HRC responsible for the completion of this project include Paul Hoskin P.E., Project Manager; Doug Both C.F.M., Assistant Project Manager; and Nick Zavala E.I.T., Project Hydrologist.



NO SCALE

FLOOD CONTROL DISTRICT
OF MARICOPA COUNTY
ENGINEERING DIVISION

Figure 1 191st Avenue Wash
LOMR Vicinity Map

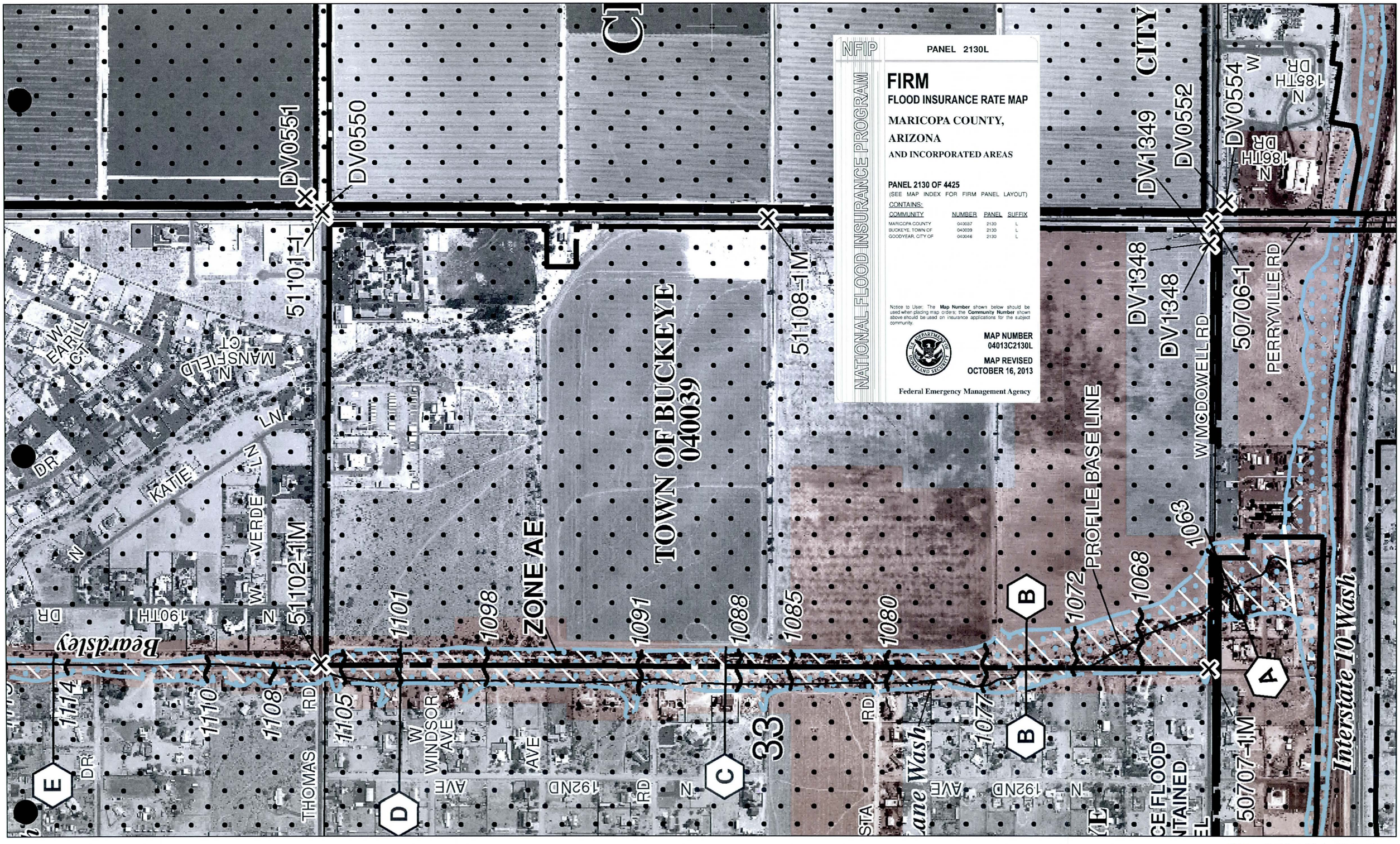
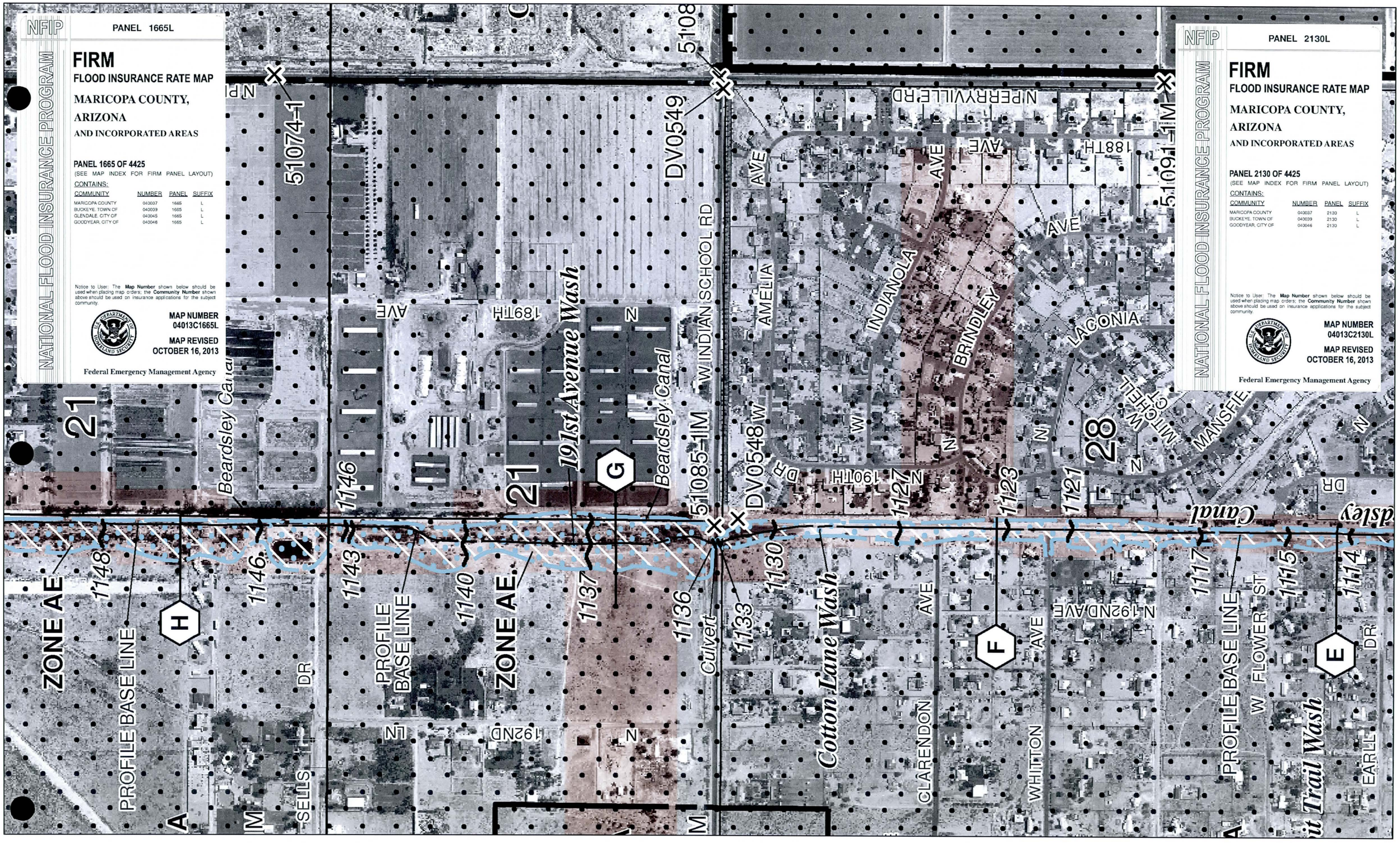


Figure 2A
Effective Flood Insurance Rate Map

Flood Control District of Maricopa County
2801 West Durango Street
Phoenix, Arizona 85009
Phone: (602) 506-1501
Fax: (602) 506-4601
http://www.fcd.maricopa.gov



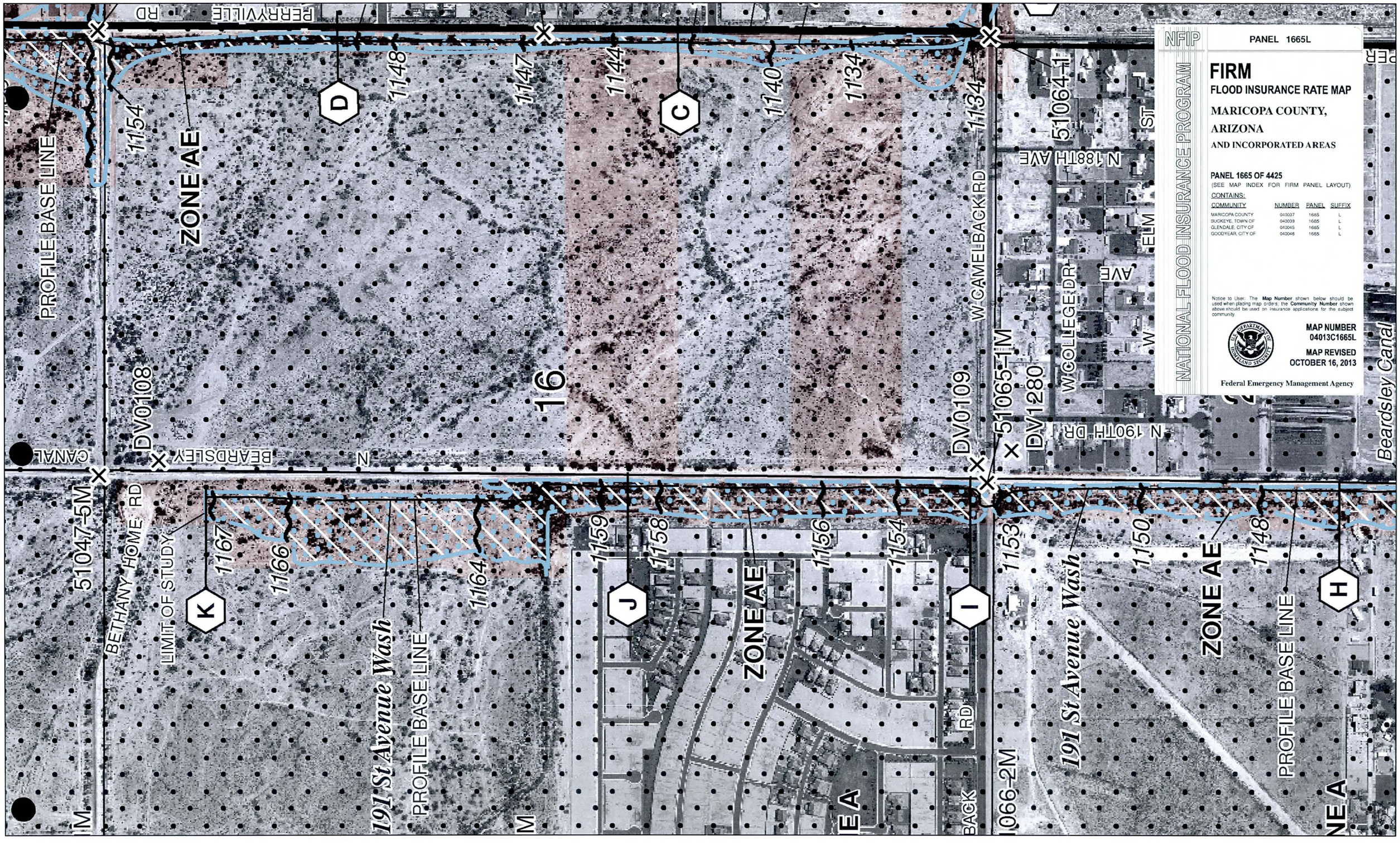
N

0 250 500 1,000 Feet

1 inch = 500 feet

Figure 2B
Effective Flood Insurance Rate Map

Flood Control District of Maricopa County
2801 West Durango Street
Phoenix, Arizona 85009
Phone: (602) 506-1501
Fax: (602) 506-4601
http://www.fcd.maricopa.gov



N

0 250 500 1,000 Feet

1 inch = 500 feet

Figure 2C
Effective Flood Insurance Rate Map

Flood Control District of Maricopa County
2801 West Durango Street
Phoenix, Arizona 85009
Phone: (602) 506-1501
Fax: (602) 506-4601
http://www.fcd.maricopa.gov

2 ADWR/FEMA Forms

2.1 Study Documentation Abstract for FEMA Submittals

2.1: Study Documentation Abstract for FEMA Submittals		Initial Study		Restudy		LOMR	X	LOMR		Other	
2.1.1	Date Study Accepted										
	Study Contractor	Flood Control District of Maricopa County									
	Contact(s)										
	Address	2801 W. Durango St. Phoenix, AZ, 85009									
	Phone	(602) 506-1501									
	Internal Ref. No.	FCD 2009 C012									
	Subcontractors w/ Phone										
	FEMA Technical Review Contractor	FEMA National Service Provider									
	Contact(s)										
	Address	3601 Eisenhower Ave Alexandria, VA 22304-6425									
	Phone										
	Internal Ref. No.										
	FEMA Regional Reviewer										
	Phone										
	State Technical Reviewer										
	Phone										
	Local Technical Reviewer	Flood Control District of Maricopa County 2801 W Durango Street Phoenix, AZ 85009									
	Phone	(602)506-1501									
	Internal Ref. No.	2009C012									
	Reach Description	191st Avenue Wash Floodplain, between Bethany Home Road and the I-10 Freeway FIRM 04013C2130L, 04013C1665L									

	USGS Quad Sheet(s) with original photo date & latest photo revision date	Waddell, Arizona; 1957; Photo-inspected 1975 Perryville, Arizona; 1957, Photo-revised 1982
	Unique Conditions and Problems	1. Multiple split flows. 2. Breakout conditions along the Beardsley canal bank.
	Coordination of Discharges (Agency, Date, Comments)	Peak flows are from the updated HEC-1 model in Appendix D of Reference 1.

2.2 FEMA Forms

FEMA MT-2 FORMS ATTACHMENT

Form 1, Section C – Review Fee

The fee will be paid upon request.

Form 2, Section A, Item 2 – Drainage Area:

In the Effective FIS, the Drainage Areas (square miles) were not computed because the discharges were derived by performing HEC-2 split flow analysis. In a similar manner, the Existing Conditions discharges along the 191st Avenue Wash are computed by performing HEC-RAS split flow analysis using the lateral weir options. As a result, the final drainage areas are not computed.

Form 2, Section B, Item 4 – Models Submitted:

There are two HEC-RAS models prepared for this LOMR. The first model (191W_FLOWSPLIT.prj and 191W_FLOWSPLIT.p02) uses the flow optimization options to calculate the flow that remains in the wash after the flow splits through the lateral structures.

The second HEC-RAS model (191W.prj and 191W.p02) uses the remaining flow in the channel to do the floodplain and floodway delineations. This second model does not include the lateral structures. Therefore, flow optimization is not performed.

Form 2, Section D, Item 1 – NFIP Section 65.12 Compliance:

The conditions of NFIP Regulation 44CFR Ch. 1, Section 65.12 include:

(1) An evaluation of alternatives, which would not result in a BFE increase above that permitted demonstrating why these alternatives are not feasible;

(2) Documentation of individual legal notice to all affected property owners within and outside of the community, explaining the impact of the proposed action on their property;

(3) Concurrence of the Chief Executive Officer (CEO) and any other communities affected by the proposed actions; and

(4) Certification that no structures are located in areas that would be impacted by the increased base flood elevation.

To comply with these conditions,

(1) The rise of water surface elevations along the 191st Avenue Wash is not caused by the proposed *Outfall Channel*, but by the updated hydrology and topographic mapping. No alternative analysis is necessary.

(2) The typical notice and a list of affected properties have been provided in Appendix B.6 of Reference 1.

(3) See the signatures of Community Official on Form 1.

(4) The hydraulic models have proven that the revised base flood elevations are similar to the Effective base flood elevations. As a result, no structures will be impacted by this delineation.

U.S. DEPARTMENT OF HOMELAND SECURITY
FEDERAL EMERGENCY MANAGEMENT AGENCY

OVERVIEW & CONCURRENCE FORM

O.M.B No. 1660-0016
Expires February 28, 2014

PAPERWORK BURDEN DISCLOSURE NOTICE

Public reporting burden for this form is estimated to average 1 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, 1800 South Bell Street, Arlington, VA 20958-3005, 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).

A. REQUESTED RESPONSE FROM DHS-FEMA

This request is for a (check one):

☐ CLOMR: A letter from DHS-FEMA commenting on whether a proposed project, if built as proposed, would justify a map revision, or proposed hydrology changes (See 44 CFR Ch. 1, Parts 60, 65 & 72).

☒ LOMR: A letter from DHS-FEMA officially revising the current NFIP map to show the changes to floodplains, regulatory floodway or flood elevations. (See 44 CFR Ch. 1, Parts 60, 65 & 72)

B. OVERVIEW

1. The NFIP map panel(s) affected for all impacted communities is (are):

Community No.	Community Name	State	Map No.	Panel No.	Effective Date
Example: 480301 480287	City of Katy Harris County	TX TX	48473C 48201C	0005D 0220G	02/08/83 09/28/90
040037	City of Buckeye	AZ	04013C	2130L	10/16/13
040037	City of Buckeye	AZ	04013C	1665L	10/16/13

2. a. Flooding Source: 191st Avenue Wash

   b. Types of Flooding: ☒ Riverine ☐ Coastal ☐ Shallow Flooding (e.g., Zones AO and AH) ☐ Alluvial fan ☐ Lakes ☐ Other (Attach Description)

3. Project Name/Identifier: 191st Avenue Wash

4. FEMA zone designations affected: AE (choices: A, AH, AO, A1-A30, A99, AE, AR, V, V1-V30, VE, B, C, D, X)

5. Basis for Request and Type of Revision:

   a. The basis for this revision request is (check all that apply)

   ☐ Physical Change ☐ Improved Methodology/Data ☐ Regulatory Floodway Revision ☐ Base Map Changes
   ☐ Coastal Analysis ☒ Hydraulic Analysis ☒ Hydrologic Analysis ☐ Corrections
   ☐ Weir-Dam Changes ☐ Levee Certification ☐ Alluvial Fan Analysis ☐ Natural Changes
   ☒ New Topographic Data ☐ Other (Attach Description)

   Note: A photograph and narrative description of the area of concern is not required, but is very helpful during review.

b. The area of revision encompasses the following structures (check all that apply)

Structures: ☐ Channelization ☐ Levee/Floodwall ☒ Bridge/Culvert

☐ Dam ☐ Fill ☐ Other (Attach Description)

6. ☐ Documentation of ESA compliance is submitted (required to initiate CLOMR review). Please refer to the instructions for more information.

C. REVIEW FEE

Has the review fee for the appropriate request category been included? ☒ Yes Fee amount: $0

☐ No, Attach Explanation

Please see the DHS-FEMA Web site at http://www.fema.gov/plan/prevent/fhm/frm_fees.shtm **for Fee Amounts and Exemptions.**

D. SIGNATURE

All documents submitted in support of this request are correct to the best of my knowledge. I understand that any false statement may be punishable by fine or imprisonment under Title 18 of the United States Code, Section 1001.

Name: Jennifer Thorne, P.E.	Company: Flood Control District, Maricopa County	
Mailing Address: 2801 W. Durango Street Phoenix, AZ, 85009	Daytime Telephone No.: (602)506-3320	Fax No.: (602)506-4601
	E-Mail Address: thornej@mail.maricopa.gov	
Signature of Requester (required):	Date:	

As the community official responsible for floodplain management, I hereby acknowledge that we have received and reviewed this Letter of Map Revision (LOMR) or conditional LOMR request. Based upon the community's review, we find the completed or proposed project meets or is designed to meet all the community floodplain management requirements, including the requirements for when fill is placed in the regulatory floodway, and that all necessary Federal, State, and local permits have been, or in the case of a conditional LOMR, will be obtained. For Conditional LOMR requests, the applicant has documented Endangered Species Act (ESA) compliance to FEMA prior to FEMA's review of the Conditional LOMR application. For LOMR requests, I acknowledge that compliance with Sections 9 and 10 of the ESA has been achieved independently of FEMA's process. For actions authorized, funded, or being carried out by Federal or State agencies, documentation from the agency showing its compliance with Section 7(a)(2) of the ESA will be submitted. In addition, we have determined that the land and any existing or proposed structures to be removed from the SFHA are or will be reasonably safe from flooding as defined in 44CFR 65.2(c), and that we have available upon request by FEMA, all analyses and documentation used to make this determination.

Community Official's Name and Title: Stephen S. Cleveland, City Manager	Community Name: City of Buckeye	
Mailing Address: 530 East Monroe Avenue Buckeye, AZ, 85326	Daytime Telephone No.: (623) 349-6910	Fax No.: (623) 349-6099
	E-Mail Address: scleveland@buckeyeaz.gov	
Community Official's Signature (required):	Date:	

CERTIFICATION BY REGISTERED PROFESSIONAL ENGINEER AND/OR LAND SURVEYOR

This certification is to be signed and sealed by a licensed land surveyor, registered professional engineer, or architect authorized by law to certify elevation information data, hydrologic and hydraulic analysis, and any other supporting information as per NFIP regulations paragraph 65.2(b) and as described in the MT-2 Forms Instructions. All documents submitted in support of this request are correct to the best of my knowledge. I understand that any false statement may be punishable by fine or imprisonment under Title 18 of the United States Code, Section 1001.

Certifier's Name: Jennifer Thorne, P.E.	License No.: 50474	Expiration Date: 12/31/2015
Company Name: Flood Control District, Maricopa County	Telephone No.: (602)506-3320	Fax No.: (602)506-4601
Signature:	Date:	E-Mail Address: thornej@mail.maricopa.gov

Ensure the forms that are appropriate to your revision request are included in your submittal.

Form Name and (Number)	Required if ...
☒ Riverine Hydrology and Hydraulics Form (Form 2)	New or revised discharges or water-surface elevations
☒ Riverine Structures Form (Form 3)	Channel is modified, addition/revision of bridge/culverts, addition/revision of levee/floodwall, addition/revision of dam
☐ Coastal Analysis Form (Form 4)	New or revised coastal elevations
☐ Coastal Structures Form (Form 5)	Addition/revision of coastal structure
☐ Alluvial Fan Flooding Form (Form 6)	Flood control measures on alluvial fans

Seal (Optional)

U.S. DEPARTMENT OF HOMELAND SECURITY
FEDERAL EMERGENCY MANAGEMENT AGENCY

OVERVIEW & CONCURRENCE FORM

O.M.B No. 1660-0016
Expires February 28, 2014

PAPERWORK BURDEN DISCLOSURE NOTICE

Public reporting burden for this form is estimated to average 1 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, 1800 South Bell Street, Arlington, VA 20958-3005, 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).

A. REQUESTED RESPONSE FROM DHS-FEMA

This request is for a (check one):

☐ CLOMR: A letter from DHS-FEMA commenting on whether a proposed project, if built as proposed, would justify a map revision, or proposed hydrology changes (See 44 CFR Ch. 1, Parts 60, 65 & 72).

☒ LOMR: A letter from DHS-FEMA officially revising the current NFIP map to show the changes to floodplains, regulatory floodway or flood elevations. (See 44 CFR Ch. 1, Parts 60, 65 & 72)

B. OVERVIEW

1. The NFIP map panel(s) affected for all impacted communities is (are):

Community No.	Community Name	State	Map No.	Panel No.	Effective Date
Example: 480301 480287	City of Katy Harris County	TX TX	48473C 48201C	0005D 0220G	02/08/83 09/28/90
040037	Maricopa County	AZ	04013C	2130L	10/16/13
040037	Maricopa County	AZ	04013C	1665L	10/16/13

2. a. Flooding Source: 191st Avenue Wash

   b. Types of Flooding: ☒ Riverine ☐ Coastal ☐ Shallow Flooding (e.g., Zones AO and AH) ☐ Alluvial fan ☐ Lakes ☐ Other (Attach Description)

3. Project Name/Identifier: 191st Avenue Wash

4. FEMA zone designations affected: AE (choices: A, AH, AO, A1-A30, A99, AE, AR, V, V1-V30, VE, B, C, D, X)

5. Basis for Request and Type of Revision:

   a. The basis for this revision request is (check all that apply)

   ☐ Physical Change ☐ Improved Methodology/Data ☐ Regulatory Floodway Revision ☐ Base Map Changes
   ☐ Coastal Analysis ☒ Hydraulic Analysis ☒ Hydrologic Analysis ☐ Corrections
   ☐ Weir-Dam Changes ☐ Levee Certification ☐ Alluvial Fan Analysis ☐ Natural Changes
   ☒ New Topographic Data ☐ Other (Attach Description)

   Note: A photograph and narrative description of the area of concern is not required, but is very helpful during review.

b. The area of revision encompasses the following structures (check all that apply)

Structures: ☐ Channelization ☐ Levee/Floodwall ☒ Bridge/Culvert

☐ Dam ☐ Fill ☐ Other (Attach Description)

☐ Documentation of ESA compliance is submitted (required to initiate CLOMR review). Please refer to the instructions for more information.

C. REVIEW FEE

Has the review fee for the appropriate request category been included? ☒ Yes Fee amount: $0

☐ No, Attach Explanation

Please see the DHS-FEMA Web site at http://www.fema.gov/plan/prevent/fhm/frm_fees.shtm **for Fee Amounts and Exemptions.**

D. SIGNATURE

All documents submitted in support of this request are correct to the best of my knowledge. I understand that any false statement may be punishable by fine or imprisonment under Title 18 of the United States Code, Section 1001.

Name: Jennifer Thorne, P.E.	Company: Flood Control District, Maricopa County	
Mailing Address: 2801 W. Durango Street Phoenix, AZ, 85009	Daytime Telephone No.: (602)506-3320	Fax No.: (602)506-4601
	E-Mail Address: thornej@mail.maricopa.gov	
Signature of Requester (required):	Date: 6/26/2014	

As the community official responsible for floodplain management, I hereby acknowledge that we have received and reviewed this Letter of Map Revision (LOMR) or conditional LOMR request. Based upon the community's review, we find the completed or proposed project meets or is designed to meet all of the community floodplain management requirements, including the requirements for when fill is placed in the regulatory floodway, and that all necessary Federal, State, and local permits have been, or in the case of a conditional LOMR, will be obtained. For Conditional LOMR requests, the applicant has documented Endangered Species Act (ESA) compliance to FEMA prior to FEMA's review of the Conditional LOMR application. For LOMR requests, I acknowledge that compliance with Sections 9 and 10 of the ESA has been achieved independently of FEMA's process. For actions authorized, funded, or being carried out by Federal or State agencies, documentation from the agency showing its compliance with Section 7(a)(2) of the ESA will be submitted. In addition, we have determined that the land and any existing or proposed structures to be removed from the SFHA are or will be reasonably safe from flooding as defined in 44CFR 65.2(c), and that we have available upon request by FEMA, all analyses and documentation used to make this determination.

Community Official's Name and Title: William D. Wiley, P.E.,FCDMC General Manager and Chief Engineer	Community Name: Maricopa County	
Mailing Address: 2801 W. Durango Street Phoenix, AZ, 85009	Daytime Telephone No.: (602)506-4708	Fax No.: (602)506-4601
	E-Mail Address: WilliamWiley@mail.maricopa.gov	
Community Official's Signature (required):	Date:	

CERTIFICATION BY REGISTERED PROFESSIONAL ENGINEER AND/OR LAND SURVEYOR

This certification is to be signed and sealed by a licensed land surveyor, registered professional engineer, or architect authorized by law to certify elevation information data, hydrologic and hydraulic analysis, and any other supporting information as per NFIP regulations paragraph 65.2(b) and as described in the MT-2 Forms Instructions. All documents submitted in support of this request are correct to the best of my knowledge. I understand that any false statement may be punishable by fine or imprisonment under Title 18 of the United States Code, Section 1001.

Certifier's Name: Jennifer Thorne, P.E.	License No.: 50474	Expiration Date: 12/31/2015
Company Name: Flood Control District, Maricopa County	Telephone No.: (602)506-3320	Fax No.: (602)506-4601
Signature:	Date:	E-Mail Address: thornej@mail.maricopa.gov

Ensure the forms that are appropriate to your revision request are included in your submittal.

Form Name and (Number)	Required if ...
☒ Riverine Hydrology and Hydraulics Form (Form 2)	New or revised discharges or water-surface elevations
☒ Riverine Structures Form (Form 3)	Channel is modified, addition/revision of bridge/culverts, addition/revision of levee/floodwall, addition/revision of dam
☐ Coastal Analysis Form (Form 4)	New or revised coastal elevations
☐ Coastal Structures Form (Form 5)	Addition/revision of coastal structure
☐ Alluvial Fan Flooding Form (Form 6)	Flood control measures on alluvial fans

Seal (Optional)

U.S. DEPARTMENT OF HOMELAND SECURITY
FEDERAL EMERGENCY MANAGEMENT AGENCY

RIVERINE HYDROLOGY & HYDRAULICS FORM

O.M.B No. 1660-0016
Expires February 28, 2014

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 a valid OMB control number appears in the upper right corner of this form. 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, 1800 South Bell Street, Arlington VA 20958-3005, 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: 191st Avenue 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)
N. Of 1-10 Freeway	N/A	617	199
At Indian School Rd.	N/A	147	150
At Camelback Rd.	N/A	564	328

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

☐ Statistical Analysis of Gage Records ☒ Precipitation/Runoff Model → Specify Model: HEC-1
☐ 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.

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 Elevations (ft.) Effective	Proposed/Revised
Downstream Limit*	I-10 Freeway 5-10'x3' CBC Inlet Control	RS 0.000	N/A	1056.68 NAVD88
Upstream Limit*	Bethany Home Rd	RS 4.104	1168.49 NAVD88	1168.26 NAVD88

*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: HEC-RAS

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.

Models Submitted	Natural Run		Floodway Run		Datum
Duplicate Effective Model*	File Name: 191W_CEM.prj	Plan Name: 191W_CEM.p01	File Name:	Plan Name:	NGVD29
Corrected Effective Model*	File Name:	Plan Name:	File Name:	Plan Name:	
Existing or Pre-Project Conditions Model	File Name: 191W_ECM.prj	Plan Name: 191W_ECM.p02	File Name:	Plan Name:	NAVD88
Revised or Post-Project Conditions Model	File Name: 191W.prj	Plan Name: 191W.p02	File Name: 191W.prj	Plan Name: 191W.p02	NAVD88
Other - (attach description)	File Name: 191W_FLOWSPLIT.p ri	Plan Name: 191W_FLOWSPLIT. n	File Name:	Plan Name:	NAVD88

* For details, refer to the corresponding section of the instructions.

☒ 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.).

☒ Digital Mapping (GIS/CADD) Data Submitted (preferred)

Topographic Information: _____

Source: _____ Date: _____

Accuracy: _____

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) increase? ☒ Yes ☐ No

   a. 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.

   b. Does this LOMR request cause increase in the BFE and/or SFHA compared with the effective BFEs and/or SFHA? ☐ Yes ☐ No

      If Yes, please attach **proof of property owner notification and acceptance (if available)**. Elements of and examples of property owner notifications can be found in the MT-2 Form 2 Instructions.

2. 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.

3. For LOMR requests, is the regulatory floodway being revised? ☒ 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. (Not required for revisions to approximate 1%-annual-chance floodplains [studied Zone A designation] unless a regulatory floodway is being established. Elements and examples of regulatory floodway revision notification can be found in the MT-2 Form 2 Instructions.)

4. 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.

* Not inclusive of all applicable regulatory requirements. For details, see 44 CFR parts 60 and 65.

DEPARTMENT OF HOMELAND SECURITY
FEDERAL EMERGENCY MANAGEMENT AGENCY

RIVERINE STRUCTURES FORM

O.M.B. NO. 1660-0016
Expires February 28, 2014

PAPERWORK BURDEN DISCLOSURE NOTICE

Public reporting burden for this form is estimated to average 7 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 a valid OMB control number appears in the upper right corner of this form. 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, 1800 South Bell Street, Arlington, VA 20598-3005, 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; 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: 191st Avenue Wash

Note: Fill out one form for each flooding source studied.

A. GENERAL

Complete the appropriate section(s) for each Structure listed below:

Channelization.....complete Section B
Bridge/Culvert.....complete Section C
Dam.....complete Section D
Levee/Floodwall.....complete Section E
Sediment Transport.....complete Section F (if required)

Description Of Modeled Structure

1. Name of Structure: 191st Avenue Wash (Existing)

   Type (check one): ☒ Channelization ☐ Bridge/Culvert ☐ Levee/Floodwall ☐ Dam

   Location of Structure: Along 191st Avenue between the I-10 Freeway and Bethany Home Road

   Downstream Limit/Cross Section: I-10 Freeway 5-10'x3' CBC Inlent Control/RS 0.000

   Upstream Limit/Cross Section: Beathany Home Rd. / RS 4.104

2. Name of Structure: (2)-36" CMP and (1)-24" CMP at RS 1.188 (Existing)

   Type (check one): ☐ Channelization ☒ Bridge/Culvert ☐ Levee/Floodwall ☐ Dam

   Location of Structure: Thomas Rd. / RS 1.188

   Downstream Limit/Cross Section: RS 1.179

   Upstream Limit/Cross Section: RS 1.196

3. Name of Structure: (2)-36" RCP at RS 2.198 (Existing)

   Type (check one) ☐ Channelization ☒ Bridge/Culvert ☐ Levee/Floodwall ☐ Dam

   Location of Structure: Indian School Rd. / RS 2.198

   Downstream Limit/Cross Section: RS 2.190

   Upstream Limit/Cross Section: RS 2.206

NOTE: FOR MORE STRUCTURES, ATTACH ADDITIONAL PAGES AS NEEDED.

B. CHANNELIZATION

Flooding Source: 191st Avenue Wash

Name of Structure: 191st Avenue Wah (Existing)

1. Hydraulic Considerations

The channel was designed to carry _____ (cfs) and/or the _____-year flood.

The design elevation in the channel is based on (check one):

☒ Subcritical flow ☐ Critical flow ☐ Supercritical flow ☐ Energy grade line

If there is the potential for a hydraulic jump at the following locations, check all that apply and attach an explanation of how the hydraulic jump is controlled without affecting the stability of the channel.

☐ Inlet to channel ☐ Outlet of channel ☐ At Drop Structures ☐ At Transitions

☐ Other locations (specify): _____

2. Channel Design Plans

Attach the plans of the channelization certified by a registered professional engineer, as described in the instructions.

3. Accessory Structures

The channelization includes (check one):

☐ Levees [Attach Section E (Levee/Floodwall)] ☐ Drop structures ☐ Superelevated sections

☐ Transitions in cross sectional geometry ☐ Debris basin/detention basin [Attach Section D (Dam/Basin)] ☐ Energy dissipator

☐ Weir ☐ Other (Describe):

4. Sediment Transport Considerations

Are the hydraulics of the channel affected by sediment transport? ☐ Yes ☒ No

If yes, then fill out Section F (Sediment Transport) of Form 3. If No, then attach your explanation for why sediment transport was not considered.

C. BRIDGE/CULVERT

Flooding Source: 191st Avenue Wash

Name of Structure: (2)-36" CMP and (1)-24" CMP at RS 1.188 (Existing)

1. This revision reflects (check one):

☒ Bridge/culvert not modeled in the FIS

☐ Modified bridge/culvert previously modeled in the FIS

☐ Revised analysis of bridge/culvert previously modeled in the FIS

2. Hydraulic model used to analyze the structure (e.g., HEC-2 with special bridge routine, WSPRO, HY8): HEC-RAS
If different than hydraulic analysis for the flooding source, justify why the hydraulic analysis used for the flooding source could not analyze the structures. Attach justification.

3. Attach plans of the structures certified by a registered professional engineer. The plan detail and information should include the following (check the information that has been provided):

☒ Dimensions (height, width, span, radius, length)

☒ Shape (culverts only)

☒ Material

☐ Beveling or Rounding

☐ Wing Wall Angle

☐ Skew Angle

☐ Distances Between Cross Sections

☐ Erosion Protection

☐ Low Chord Elevations – Upstream and Downstream

☐ Top of Road Elevations – Upstream and Downstream

☐ Structure Invert Elevations – Upstream and Downstream

☐ Stream Invert Elevations – Upstream and Downstream

☐ Cross-Section Locations

4. Sediment Transport Considerations

Are the hydraulics of the structure affected by sediment transport? ☐ Yes ☐ No

If Yes, then fill out Section F (Sediment Transport) of Form 3. If no, then attach an explanation.

B. CHANNELIZATION

Flooding Source: 191st Avenue Wash

Name of Structure: 191st Avenue Wah (Existing)

1. Hydraulic Considerations

The channel was designed to carry _____ (cfs) and/or the _____-year flood.

The design elevation in the channel is based on (check one):

☒ Subcritical flow ☐ Critical flow ☐ Supercritical flow ☐ Energy grade line

If there is the potential for a hydraulic jump at the following locations, check all that apply and attach an explanation of how the hydraulic jump is controlled without affecting the stability of the channel.

☐ Inlet to channel ☐ Outlet of channel ☐ At Drop Structures ☐ At Transitions

☐ Other locations (specify): _____

2. Channel Design Plans

Attach the plans of the channelization certified by a registered professional engineer, as described in the instructions.

3. Accessory Structures

The channelization includes (check one):

☐ Levees [Attach Section E (Levee/Floodwall)] ☐ Drop structures ☐ Superelevated sections

☐ Transitions in cross sectional geometry ☐ Debris basin/detention basin [Attach Section D (Dam/Basin)] ☐ Energy dissipator

☐ Weir ☐ Other (Describe):

4. Sediment Transport Considerations

Are the hydraulics of the channel affected by sediment transport? ☐ Yes ☒ No

If yes, then fill out Section F (Sediment Transport) of Form 3. If No, then attach your explanation for why sediment transport was not considered.

C. BRIDGE/CULVERT

Flooding Source: 191st Avenue Wash

Name of Structure: (2)-36" RCP at RS 2.198 (Existing)

1. This revision reflects (check one):

☒ Bridge/culvert not modeled in the FIS

☐ Modified bridge/culvert previously modeled in the FIS

☐ Revised analysis of bridge/culvert previously modeled in the FIS

2. Hydraulic model used to analyze the structure (e.g., HEC-2 with special bridge routine, WSPRO, HY8): HEC-RAS
If different than hydraulic analysis for the flooding source, justify why the hydraulic analysis used for the flooding source could not analyze the structures. Attach justification.

3. Attach plans of the structures certified by a registered professional engineer. The plan detail and information should include the following (check the information that has been provided):

☒ Dimensions (height, width, span, radius, length)

☒ Shape (culverts only)

☒ Material

☐ Beveling or Rounding

☐ Wing Wall Angle

☐ Skew Angle

☐ Distances Between Cross Sections

☐ Erosion Protection

☐ Low Chord Elevations – Upstream and Downstream

☐ Top of Road Elevations – Upstream and Downstream

☐ Structure Invert Elevations – Upstream and Downstream

☐ Stream Invert Elevations – Upstream and Downstream

☐ Cross-Section Locations

4. Sediment Transport Considerations

Are the hydraulics of the structure affected by sediment transport? ☐ Yes ☐ No

If Yes, then fill out Section F (Sediment Transport) of Form 3. If no, then attach an explanation.

D. DAM/BASIN

Flooding Source: _____
Name of Structure: _____

1. This request is for (check one): ☐ Existing dam/basin ☐ New dam/basin ☐ Modification of existing dam/basin

2. The dam/basin was designed by (check one): ☐ Federal agency ☐ State agency ☐ Private organization ☐ Local government agency

   Name of the agency or organization: _____

3. The Dam was permitted as (check one): ☐ Federal Dam ☐ State Dam

   Provide the permit or identification number (ID) for the dam and the appropriate permitting agency or organization

   Permit or ID number _____ Permitting Agency or Organization _____

   a. ☐ Local Government Dam ☐ Private Dam

   Provided related drawings, specification and supporting design information.

4. Does the project involve revised hydrology? ☐ Yes ☐ No

   If Yes, complete the Riverine Hydrology & Hydraulics Form (Form 2).

   Was the dam/basin designed using critical duration storm? (must account for the maximum volume of runoff)

   ☐ Yes, provide supporting documentation with your completed Form 2.

   ☐ No, provide a written explanation and justification for not using the critical duration storm.

5. Does the submittal include debris/sediment yield analysis? ☐ Yes ☐ No

   If Yes, then fill out Section F (Sediment Transport). If No, then attach your explanation for why debris/sediment analysis was not considered?

6. Does the Base Flood Elevation behind the dam/basin or downstream of the dam/basin change? ☐ Yes ☐ No

   If Yes, complete the Riverine Hydrology & Hydraulics Form (Form 2) and complete the table below.

FREQUENCY (% annual chance)	Stillwater Elevation Behind the Dam/Basin FIS	REVISED
10-year (10%)	_____	_____
50-year (2%)	_____	_____
100-year (1%)	_____	_____
500-year (0.2%)	_____	_____
Normal Pool Elevation	_____	_____

7. Please attach a copy of the formal Operation and Maintenance Plan

E. LEVEE/FLOODWALL

1. System Elements

a. This Levee/Floodwall analysis is based on (check one): ☐ upgrading of an existing levee/floodwall system ☐ a newly constructed levee/floodwall system ☐ reanalysis of an existing levee/floodwall system

b. Levee elements and locations are (check one):

☐ earthen embankment, dike, berm, etc. Station _____ to _____
☐ structural floodwall Station _____ to _____
☐ Other (describe): Station _____ to _____

c. Structural Type (check one): ☐ monolithic cast-in place reinforced concrete ☐ reinforced concrete masonry block ☐ sheet piling
☐ Other (describe): _____

d. Has this levee/floodwall system been certified by a Federal agency to provide protection from the base flood?

☐ Yes ☐ No

If Yes, by which agency? _____

e. Attach certified drawings containing the following information (indicate drawing sheet numbers):

1. Plan of the levee embankment and floodwall structures. Sheet Numbers: _____
2. A profile of the levee/floodwall system showing the Base Flood Elevation (BFE), levee and/or wall crest and foundation, and closure locations for the total levee system. Sheet Numbers: _____
3. A profile of the BFE, closure opening outlet and inlet invert elevations, type and size of opening, and kind of closure. Sheet Numbers: _____
4. A layout detail for the embankment protection measures. Sheet Numbers: _____
5. Location, layout, and size and shape of the levee embankment features, foundation treatment, Floodwall structure, closure structures, and pump stations. Sheet Numbers: _____

2. Freeboard

a. The minimum freeboard provided above the BFE is:

Riverine

3.0 feet or more at the downstream end and throughout	☐ Yes	☐ No
3.5 feet or more at the upstream end	☐ Yes	☐ No
4.0 feet within 100 feet upstream of all structures and/or constrictions	☐ Yes	☐ No

Coastal

1.0 foot above the height of the one percent wave associated with the 1%-annual-chance stillwater surge elevation or maximum wave runup (whichever is greater).	☐ Yes	☐ No
2.0 feet above the 1%-annual-chance stillwater surge elevation	☐ Yes	☐ No

Please note, occasionally exceptions are made to the minimum freeboard requirement. If an exception is requested, attach documentation addressing Paragraph 65.10(b)(1)(ii) of the NFIP Regulations.

If No is answered to any of the above, please attach an explanation.

b. Is there an indication from historical records that ice-jamming can affect the BFE? ☐ Yes ☐ No

If Yes, provide ice-jam analysis profile and evidence that the minimum freeboard discussed above still exists.

3. Closures

a. Openings through the levee system (check one): ☐ exists ☐ does not exist

If opening exists, list all closures:

Channel Station	Left or Right Bank	Opening Type	Highest Elevation for Opening Invert	Type of Closure Device

(Extend table on an added sheet as needed and reference)

Note: Geotechnical and geologic data

In addition to the required detailed analysis reports, data obtained during field and laboratory investigations and used in the design analysis for the following system features should be submitted in a tabulated summary form. (Reference U.S. Army Corps of Engineers [USACE] EM-1110-2-1906 Form 2086.)

4. Embankment Protection

a. The maximum levee slope land side is: _____

b. The maximum levee slope flood side is: _____

c. The range of velocities along the levee during the base flood is: _____ (min.) to _____ (max.)

d. Embankment material is protected by (describe what kind): _____

e. Riprap Design Parameters (check one): ☐ Velocity ☐ Tractive stress
Attach references

Reach		Sideslope	Flow Depth	Velocity	Curve or Straight	Stone Riprap			Depth of Toedown
						D_{100}	D_{50}	Thickness	
Sta	to								
Sta	to								
Sta	to								
Sta	to								
Sta	to								
Sta	to								

(Extend table on an added sheet as needed and reference each entry)

f. Is a bedding/filter analysis and design attached? ☐ Yes ☐ No

g. Describe the analysis used for other kinds of protection used (include copies of the design analysis):

Attach engineering analysis to support construction plans.

5. Embankment And Foundation Stability

a. Identify locations and describe the basis for selection of critical location for analysis:
_____

☐ Overall height: Sta.: _____, height _____ ft.

☐ Limiting foundation soil strength:

Strength ϕ = _____ degrees, c = _____ psf

Slope: SS = _____ (h) to _____ (v)

(Repeat as needed on an added sheet for additional locations)

b. Specify the embankment stability analysis methodology used (e.g., circular arc, sliding block, infinite slope, etc.):
_____

c. Summary of stability analysis results:

E. LEVEE/FLOODWALL (CONTINUED)

5. Embankment And Foundation Stability (continued)

Case	Loading Conditions	Critical Safety Factor	Criteria (Min.)
I	End of construction		1.3
II	Sudden drawdown		1.0
III	Critical flood stage		1.4
IV	Steady seepage at flood stage		1.4
VI	Earthquake (Case I)		1.0

(Reference: USACE EM-1110-2-1913 Table 6-1)

d. Was a seepage analysis for the embankment performed? ☐ Yes ☐ No

If Yes, describe methodology used:

e. Was a seepage analysis for the foundation performed? ☐ Yes ☐ No

f. Were uplift pressures at the embankment landside toe checked? ☐ Yes ☐ No

g. Were seepage exit gradients checked for piping potential? ☐ Yes ☐ No

h. The duration of the base flood hydrograph against the embankment is _____ hours.

Attach engineering analysis to support construction plans.

6. Floodwall And Foundation Stability

a. Describe analysis submittal based on Code (check one): ☐ UBC (1988) ☐ Other (specify): _____

b. Stability analysis submitted provides for: ☐ Overturning ☐ Sliding If not, explain: _____

c. Loading included in the analyses were: ☐ Lateral earth @ P_A = _____ psf; P_p = _____ psf

☐ Surcharge-Slope @ _____, ☐ surface _____ psf

☐ Wind @ P_w = _____ psf

☐ Seepage (Uplift); _____ ☐ Earthquake @ P_{eq} = _____ %g

☐ 1%-annual-chance significant wave height: _____ ft.

☐ 1%-annual-chance significant wave period: _____ sec.

d. Summary of Stability Analysis Results: Factors of Safety.
Itemize for each range in site layout dimension and loading condition limitation for each respective reach.

Loading Condition	Criteria (Min)		Sta	To	Sta	To
	Overturn	Sliding	Overturn	Sliding	Overturn	Sliding
Dead & Wind	1.5	1.5				
Dead & Soil	1.5	1.5				
Dead, Soil, Flood, & Impact	1.5	1.5				
Dead, Soil, & Seismic	1.3	1.3				

(Ref: FEMA 114 Sept 1986; USACE EM 1110-2-2502)
Note: (Extend table on an added sheet as needed and reference)

E. LEVEE/FLOODWALL (CONTINUED)

6. Floodwall And Foundation Stability (continued)

e. Foundation bearing strength for each soil type:

Bearing Pressure	Sustained Load (psf)	Short Term Load (psf)
Computed design maximum		
Maximum allowable		

f. Foundation scour protection ☐ is, ☐ is not provided. If provided, attach explanation and supporting documentation:

Attach engineering analysis to support construction plans.

7. Settlement

a. Has anticipated potential settlement been determined and incorporated into the specified construction elevations to maintain the established freeboard margin? ☐ Yes ☐ No

b. The computed range of settlement is _____ ft. to _____ ft.

c. Settlement of the levee crest is determined to be primarily from : ☐ Foundation consolidation ☐ Embankment compression ☐ Other (Describe): _____

d. Differential settlement of floodwalls ☐ has ☐ has not been accommodated in the structural design and construction.

Attach engineering analysis to support construction plans.

8. Interior Drainage

a. Specify size of each interior watershed:

Draining to pressure conduit: _____ acres
Draining to ponding area: _____ acres

b. Relationships Established

Ponding elevation vs. storage	☐ Yes	☐ No
Ponding elevation vs. gravity flow	☐ Yes	☐ No
Differential head vs. gravity flow	☐ Yes	☐ No

c. The river flow duration curve is enclosed: ☐ Yes ☐ No

d. Specify the discharge capacity of the head pressure conduit: _____ cfs

e. Which flooding conditions were analyzed?

• Gravity flow (Interior Watershed)	☐ Yes	☐ No
• Common storm (River Watershed)	☐ Yes	☐ No
• Historical ponding probability	☐ Yes	☐ No
• Coastal wave overtopping	☐ Yes	☐ No

If No for any of the above, attach explanation.

e. Interior drainage has been analyzed based on joint probability of interior and exterior flooding and the capacities of pumping and outlet facilities to provide the established level of flood protection. ☐ Yes ☐ No If No, attach explanation.

g. The rate of seepage through the levee system for the base flood is _____ cfs

h. The length of levee system used to drive this seepage rate in item g: _____ ft.

E. LEVEE/FLOODWALL (CONTINUED)

8. Interior Drainage (continued)

i. Will pumping plants be used for interior drainage? ☐ Yes ☐ No

If Yes, include the number of pumping plants: _____ For each pumping plant, list:

	Plant #1	Plant #2
The number of pumps		
The ponding storage capacity		
The maximum pumping rate		
The maximum pumping head		
The pumping starting elevation		
The pumping stopping elevation		
Is the discharge facility protected?		
Is there a flood warning plan?		
How much time is available between warning and flooding?		

Will the operation be automatic? ☐ Yes ☐ No

If the pumps are electric, are there backup power sources? ☐ Yes ☐ No

(Reference: USACE EM-1110-2-3101, 3102, 3103, 3104, and 3105)

Include a copy of supporting documentation of data and analysis. Provide a map showing the flooded area and maximum ponding elevations for all interior watersheds that result in flooding.

9. Other Design Criteria

a. The following items have been addressed as stated:

Liquefaction ☐ is ☐ is not a problem

Hydrocompaction ☐ is ☐ is not a problem

Heave differential movement due to soils of high shrink/swell ☐ is ☐ is not a problem

b. For each of these problems, state the basic facts and corrective action taken:

Attach supporting documentation

c. If the levee/floodwall is new or enlarged, will the structure adversely impact flood levels and/or flow velocities floodside of the structure?
☐ Yes ☐ No Attach supporting documentation

d. Sediment Transport Considerations:

Was sediment transport considered? ☐ Yes ☐ No
If Yes, then fill out Section F (Sediment Transport). If No, then attach your explanation for why sediment transport was not considered.

10. Operational Plan And Criteria

a. Are the planned/installed works in full compliance with Part 65.10 of the NFIP Regulations? ☐ Yes ☐ No

b. Does the operation plan incorporate all the provisions for closure devices as required in Paragraph 65.10(c)(1) of the NFIP regulations?
☐ Yes ☐ No

c. Does the operation plan incorporate all the provisions for interior drainage as required in Paragraph 65.10(c)(2) of the NFIP regulations?
☐ Yes ☐ No If the answer is No to any of the above, please attach supporting documentation.

E. LEVEE/FLOODWALL (CONTINUED)

11. Maintenance Plan

Please attach a copy of the fomal maintenance plan for the levee/floodwall

12. Operations and Maintenance Plan

Please attach a copy of the formal Operations and Maintenance Plan for the levee/floodwall.

CERTIFICATION OF THE LEVEE DOCUMENTION

This certification is to be signed and sealed by a licensed registered professional engineer authorized by law to certify elevation information data, hydrologic and hydraulic analysis, and any other supporting information as per NFIP regulations paragraph 65.10(e) and as described in the MT-2 Forms Instructions. All documents submitted in support of this request are correct to the best of my knowledge. I understand that any false statement may be punishable by fine or imprisonment under Title 18 of the United States Code, Section 1001.

Certifier's Name: _____ License No.: _____ Expiration Date: _____

Company Name: _____ Telephone No.: _____ Fax No.: _____

Signature: _____ Date: _____ E-Mail Address: _____

F. SEDIMENT TRANSPORT

Flooding Source: _____

Name of Structure: _____

If there is any indication from historical records that sediment transport (including scour and deposition) can affect the Base Flood Elevation (BFE); and/or based on the stream morphology, vegetative cover, development of the watershed and bank conditions, there is a potential for debris and sediment transport (including scour and deposition) to affect the BFEs, then provide the following information along with the supporting documentation:

Sediment load associated with the base flood discharge: Volume _____ acre-feet

Debris load associated with the base flood discharge: Volume _____ acre-feet

Sediment transport rate _____ (percent concentration by volume)

Method used to estimate sediment transport: _____

Most sediment transport formulas are intended for a range of hydraulic conditions and sediment sizes; attach a detailed explanation for using the selected method.

Method used to estimate scour and/or deposition: _____

Method used to revise hydraulic or hydrologic analysis (model) to account for sediment transport: _____

Please note that bulked flows are used to evaluate the performance of a structure during the base flood; however, FEMA does not map BFEs based on bulked flows.

If a sediment analysis has not been performed, an explanation as to why sediment transport (including scour and deposition) will not affect the BFEs or structures must be provided.

Form 3, Sections B and C, Number 4 – Sediment Transport Considerations:

Sediment transport analysis is not included in this study. Velocities are generally less than 5 fps.

3 Survey and Mapping Information

3.1 Field Survey Information

Detailed topographic survey was obtained for the structure crossings (Ref. 12). Cross Sections for aerial topography checks were performed by the District Survey Department and by Cooper Aerial Surveying Company.

In addition, the new field survey data consisted of horizontal and vertical control. All field data has been collected on the Arizona State Plane Coordinate System NAD83 (North American Datum 1983) and realized to NAVD88 (North American Vertical Datum 1988).

The calibration was based on the Maricopa County Geodetic Densification and Cadastral Survey (GDACS) for horizontal position of sectional control. The vertical control was based on the Maricopa County Department of Transportation Benchmark WT-4, a 9/16" Stainless Steel Rod drilled and domed in handhole 6.5' deep with carsonite marker, Elevation=1046.3'.

3.2 Mapping

One foot contour interval topographic mapping for the entire 191st Avenue Wash floodplain area was produced by Cooper Aerial Surveying Company at a mapping scale of 1"=40' (Ref. 13). All topography was acquired on November 15, 2009 at a photo scale of

1"=300' (1:3,600). Fifty (50) Aerial Panels were set and observations taken on the center points for map control. In addition, six (6) "Blind Panels" were set to check the accuracy of the aerial topography.

3.3 Vertical Datum

The Effective FEMA floodplain study was based on the National Geodetic Vertical Datum of 1929 (NGVD29), while this project is based on North American Vertical Datum of 1988 (NAVD88). At this study area, a difference of 1.99 feet needs to be added to elevations when converted from NGVD29 to NAVD88. The difference was identified using VERTCON web service and results are provided in Appendix C of Reference 1.

4 Hydrology

4.1 Method Description

The FEMA Effective floodplain delineation was based on the *White Tanks / Agua Fria Area Drainage Master Study* (ADMS) completed in 1992 (Ref. 7). The 1992 study was updated in 2004 by URS (Ref. 8). In 2009, the URS study was updated by HDR to adopt the NOAA 14 precipitation (Ref. 9). The HDR Study conducted two 100-year hydrologic analysis models for the Existing Conditions with and without the *Outfall Channel* project in place (Ref. 9).

Revisions have been made to the Existing Conditions HEC-1 model with the *Outfall Channel* project in place as part of this current study to prepare the Existing Conditions hydraulic model. Refer to Exhibit 1 for the Existing Conditions HEC-1 Schematic Map. Changes include: adjustments to the rainfall depth, areal reduction, land use and channel routing. Peak flows from the 100-Year storm event HEC-1 model dated May 14, 2010, is used for the hydraulics modeling and the floodplain delineation. A summary of 100-year

peak flow rates is included in Table 2 and the output from the HEC-1 model is included in Appendix D.6 of Reference 1.

4.2 Parameter Estimation

No changes to the ADMPU AHA are shown in the Existing Conditions HEC-1 Schematic Map or the contributing sub basin areas, although several parameters have been modified to reflect current conditions as follows:

- The rainfall depth was modified to reflect NOAA 14 precipitation values, which for this location is 3.661 inches.
- The updated hydrology model includes land use parameter changes for the Jackrabbit Estates Subdivision. These changes include a change to the land use code from 900 (vacant land) to 140 (medium lot residential). In addition, retention is included in the model to reflect the as-built condition of the subdivision.
- Normal depth routings are adopted for the wash alignment routing from Bethany Home Road to the I-10 Freeway. Geometry of the wash, number of steps, and n values are modified for the routing.

4.3 Problems encountered during the study

There are no problems with the hydrologic study.

4.4 Calibration

No data is available and no calibration was performed for the hydrologic model.

4.5 Final Results

4.5.1 Hydrologic Analysis Results

4.5.1.1 Existing Conditions

The Existing Conditions HEC-1 output is provided in Appendix D.6 of Reference 1 and Table 1 summarizes the peak discharges along the 191st Avenue Wash. In addition, the flows from the HEC-1 Sub-Basins W28 and W31 were prorated and summarized in Table 9.

Table 1: 100-Year Peak Flow Rates (Existing Conditions)

HEC-1 I.D.	Q100 (cfs)	Time to Peak (hr)	Contributing Drainage Area (sq. mi.)
W28	465	12.17	0.35
RW28	353	12.08	0.35
DW28RE	444	12.25	0.35
W28W29	257	12.67	0.35
W29	615	12.33	0.64
RW29	451	12.17	0.64
DW29RE	615	12.33	0.64
CPW29	615	12.33	0.99
W29W30	594	12.5	0.99
W30	367	12.25	0.27
CPW30	719	12.42	1.26
W31	305	12.25	0.23
W31W32	235	12.5	0.23
W32	418	12.5	0.61
CPW32	651	12.5	0.85

4.5.2 Verification of Results

Two methods were used to verify the Existing Conditions peak discharges, comparison with USGS Data for Arizona, and comparison with Regional Regression Equations.

4.5.2.1 USGS Data for Arizona

The District has adopted a chart to describe the general relationship between peak discharges and watershed size for Maricopa County (Ref. 2). This relationship is based on Log-Pearson Type 3 (LP3) Regression Curve analysis using USGS streamflow and statistical data taken from 314 continuous or partial-record gage stations throughout Arizona, and is a function of drainage area. The peak discharges from the HEC-1 output were plotted on the chart for comparison, as shown in Figure 3A, and lie within the 75th percentile confidence limits. Detailed results are included in Appendix D.7 of Reference 1.

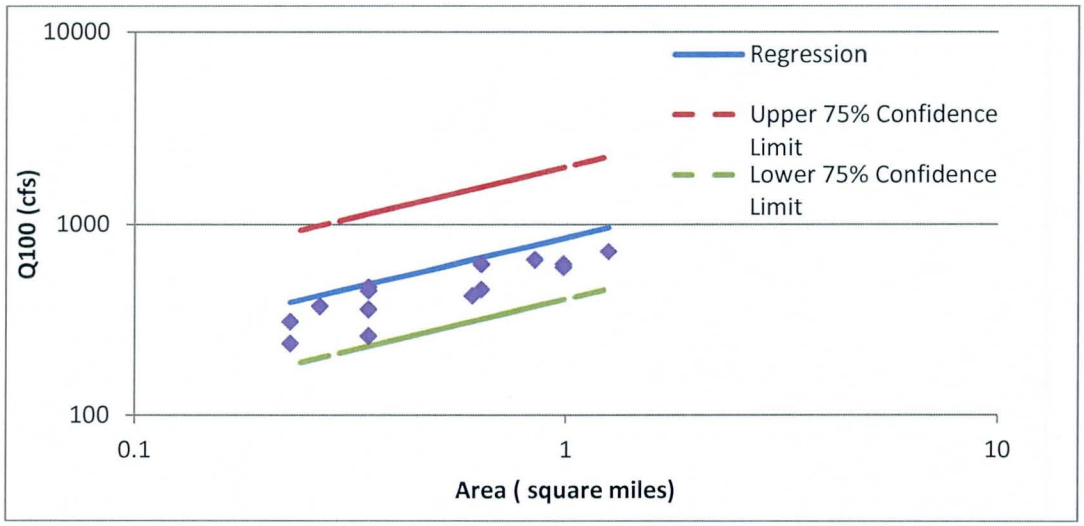


Figure 3A – Comparison of 100-Year HEC-1 Output with USGS Data for Arizona

4.5.2.2 Regional Regression Equations

The second method used to verify results was comparison with USGS Regional Regression Equations. The Region 12 Regression Equations are a function of drainage area and elevation. Based on the terrain model, the average elevation for the project area is 1112.5 feet (NAVD88). Figure 3B shows the comparison with the 100-year discharge. Based on the comparison, the HEC-1 output results are generally lower than the Regional Regression Equation results for the 100-year event. Detailed results are included in Appendix D.7 of Reference 1.

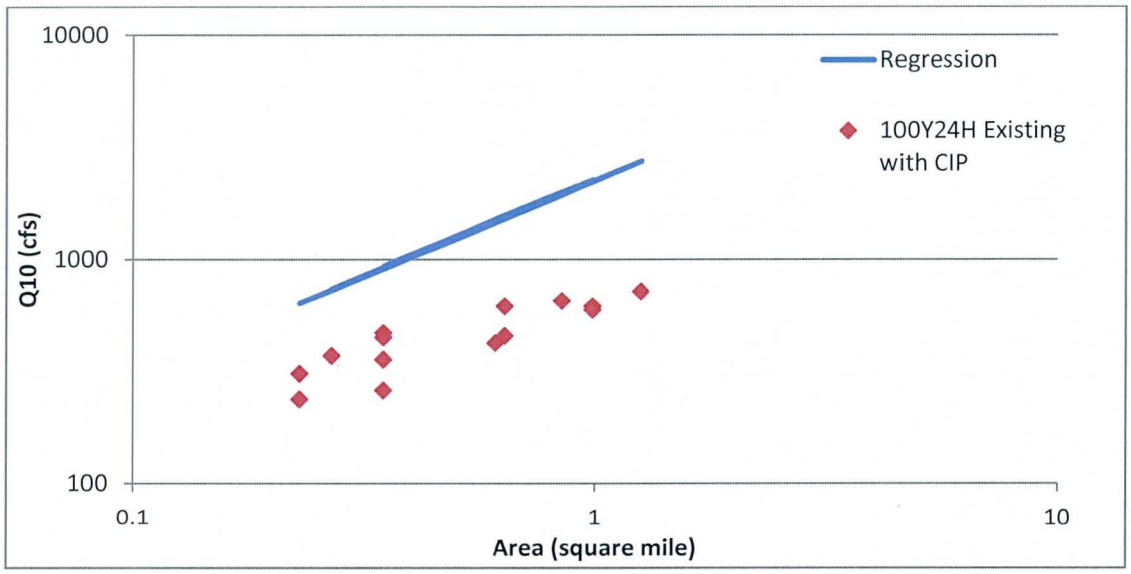


Figure 3B – Comparison of 100-Year HEC-1 Output with USGS Regional Regression Equation

5 Hydraulics

5.1 Method Description

The U.S. Army Corps of Engineers computer program, HEC-RAS version 4.1 (Ref. 11) was utilized to analyze the 100-year floodplain conditions along the 191st Avenue Wash. The Effective Zone "AE" floodplain along the 191st Avenue Wash was previously delineated using the HEC-2 hydraulic model in the ADMS. The Effective HEC-2 model was converted to a HEC-RAS model known as the Duplicate Effective model. The Duplicate Effective model was then used to create the Existing Conditions model. The Duplicate Effective and the Existing Conditions hydraulic models are included in this report and are described in more detail below. In addition, detailed hydraulic results for all three models are included in Appendix E of Reference 1.

5.1.1 Duplicate Effective Model

After converting the Effective HEC-2 model to a HEC-RAS model, the following minor changes were made to be able to run the HEC-RAS model:

- Revised the culvert upstream distance from 0-feet to 1-foot.
- Revised the culvert deck width from 20-feet to 18-feet because it was greater than or equal to the length between bounding cross sections.
- Added the n-value to the bottom of the culvert. Used the same n-value as the top of the culvert (0.012).

The conveyance computational method in HEC-RAS was set to HEC-2 style (conveyance calculations for every segment between coordinate points). As a result, the Water Surface Elevations (WSE) between the Duplicate Effective HEC-RAS model showed little to no difference compared to the Effective HEC-2 model. Refer to Table 2 for the WSE comparison between the two models.

Table 2: WSE Comparison Between the Effective HEC-2 Model and the Duplicate Effective HEC-RAS Model

Note: Elevations shown are on the NGVD29 Datum.

River Station RS	Flow Q (cfs)	Effective (HEC-2) WSE (ft)	Duplicate Effective (HEC-RAS) WSE (ft)	Change in WSE (ft)
4.024	503	1166.47	1166.47	0.00
3.929	503	1163.44	1163.45	0.01
3.829	503	1163.2	1163.21	0.01
3.73	1006	1162.07	1162.07	0.00
3.635	883	1158.55	1158.55	0.00
3.547	816	1156.42	1156.42	0.00
3.446	785	1155.68	1155.68	0.00

Table 2: WSE Comparison Between the Effective HEC-2 Model and the Duplicate Effective HEC-RAS Model - Continued

Note: Elevations shown are on the NGVD29 Datum.

River Station RS	Flow Q (cfs)	Effective (HEC-2) WSE (ft)	Duplicate Effective (HEC-RAS) WSE (ft)	Change in WSE (ft)
3.352	625	1154.83	1154.84	0.01
3.247	583	1152.24	1152.24	0
3.161	583	1151.87	1151.87	0
3.129	564	1151.28	1151.27	-0.01
3.057	564	1149.83	1149.83	0
2.938	490	1148.22	1148.22	0
2.845	448	1146.09	1146.09	0
2.731	448	1145.03	1145.03	0
2.555	391	1143.9	1143.91	0.01
2.544	391	1140.91	1140.6	-0.01
2.438	554	1138.48	1138.58	0.00
2.337	544	1136.2	1136.19	-0.01
2.241	554	1134.61	1134.57	-0.04
2.155	178	1134.7	1134.67	-0.03
2.140	147	1134.57	1134.67	0.01
2.138	Culvert			
2.136	147	1131.2	1131.2	0.00
2.083	147	1128.45	1128.45	0.00
2.000	147	1127.02	1127.02	0.00
1.969	376	1124.58	1124.58	0.00
1.821	379	1121.38	1121.38	0.00
1.734	376	1119.11	1119.11	0.00
1.654	376	1116.95	1116.95	0.00
1.594	286	1115.14	1115.15	0.01
1.509	263	1113.57	1113.57	0.00
1.438	180	1112.51	1112.50	-0.01
1.354	132	1110.63	1110.64	0.01

Table 2: WSE Comparison Between the Effective HEC-2 Model and the Duplicate Effective HEC-RAS Model - Continued

Note: Elevations shown are on the NGVD29 Datum.

River Station RS	Flow Q (cfs)	Effective (HEC-2) WSE (ft)	Duplicate Effective (HEC-RAS) WSE (ft)	Change in WSE (ft)
1.271	605	1109.22	1109.22	0.00
1.184	605	1106.67	1106.68	0.01
1.138	116	1103.99	1103.99	0.00
1.045	116	1098.53	1098.53	0.00
0.950	116	1095.63	1095.64	0.01
0.863	404	1092.58	1092.58	0
0.773	404	1089.1	1089.1	0
0.68	354	1086.3	1086.3	0
0.508	354	1079	1078.98	-0.02
0.426	655	1076.01	1076.02	0.01
0.342	655	1072.61	1072.59	-0.02
0.266	655	1069.04	1069.07	0.03
0.165	655	1064.11	1064.1	-0.01
0.087	635	1060.42	1060.42	0
0	617	1056.65	1056.65	0

5.1.2 Existing Conditions Model

To represent the Existing Conditions of the channel alignment, the following changes were made to the Duplicate Effective model.

- Incorporated more detailed topographic and survey information.
- Added some new cross-sections where appropriate to achieve a representative channel and bank geometry, especially at culvert locations, road crossings and where abrupt channel or bank changes occur.
- Added several lateral weirs along the east overbank to model the flows that overtop the Beardsley Canal and to model the flows that leave the system where the 191st Avenue Wash is not confined.
- Split the channel reach into two reaches (Upstream Reach and Downstream Reach) because all the runoff from the Upstream Reach leaves the system at approximately RS 1.624.
- Revised the boundary conditions.
- Revised the culvert length and invert at Indian School Road to reflect the Existing Conditions.
- Updated the flows to accurately represent the changes due to the construction of the *Outfall Channel.*

In addition to the above changes, the levee option was used in a few cross-sections along the west bank of the Beardsley Canal to contain the WSE.

Table 3 shows the WSE comparison results between the Effective HEC-2 model and the Existing Conditions model. As a result, the WSE difference between these two models showed significant increases and/or decreases due to the flow changes and due to the more detailed topographic and survey information.

Table 3: WSE Comparison Between the Effective HEC-2 Model and the Existing Conditions HEC-RAS Model

Note: Elevations shown are on the NAVD88 Datum.

Effective (HEC-2) Model			Existing Conditions (HEC-RAS) Model			Change in WSE (ft)
River Station RS	Flow (cfs)	WSE (ft)	River Station RS	Flow (cfs)	WSE (ft)	
4.024	503	1168.46	4.104	319	1168.25	-0.21
3.929	503	1165.43	4.009	319	1165.22	-0.21
3.829	503	1165.19	3.909	319	1163.85	-1.34
3.73	1006	1164.06	3.811	319	1162.87	-1.19
			3.746	319	1161.74	
3.635	883	1160.54	3.703	319	1159.51	-1.03
3.547	816	1158.41	3.617	319	1158.45	0.04
3.446	785	1157.67	3.517	444	1157.81	0.14
3.352	625	1156.82	3.423	444	1156.6	-0.22
3.247	583	1154.23	3.318	327.78	1154.22	-0.01
3.161	583	1153.86	3.231	327.78	1153.2	-0.66
			3.214	327.78	1152.9	
3.129	564	1153.27				
			3.194	327.78	1152.79	
3.057	564	1151.82				
			3.098	327.78	1151.24	
2.938	490	1150.21	3.02	327.78	1149.85	-0.36
2.845	448	1148.08	2.927	327.78	1147.43	-0.65
2.731	448	1147.02	2.814	327.78	1146.45	-0.57
			2.791	272.69	1146.31	
			2.774	245.71	1146.17	
2.555	391	1145.89	2.721	416.71	1145.69	-0.20
2.544	391	1142.9	2.625	416.71	1143.36	0.46
2.438	554	1140.57	2.508	416.71	1139.98	-0.59
2.337	554	1138.19	2.405	416.71	1135.87	-2.32
2.241	554	1136.6	2.311	221.48	1135.49	-1.11
2.155	178	1136.69	2.226	149.73	1135.48	-1.21

Table 3: WSE Comparison Between the Effective HEC-2 Model and the Existing Conditions HEC-RAS Model - Continued

Note: Elevations shown are on the NAVD88 Datum.

Effective (HEC-2) Model			Existing Conditions (HEC-RAS) Model			Change in WSE (ft)
River Station RS	Flow (cfs)	WSE (ft)	River Station RS	Flow (cfs)	WSE (ft)	
			2.206	149.57	1135.44	
2.14	147	1136.56				
2.138	Culvert		2.198	Culvert		
2.136	147	1133.19				
			2.19	149.57	1132.13	
2.083	147	1130.44	2.136	149.57	1129.46	-0.98
2	147	1129.01	2.053	149.57	1127.71	-1.30
1.969	376	1126.57	1.962	253.57	1125.2	-1.37
1.821	376	1123.37	1.875	253.57	1122.51	-0.86
1.734	376	1121.1	1.787	253.57	1119.6	-1.50
1.654	376	1118.94	1.708	253.57	1117.08	-1.86
1.594	289	1117.13	1.647	253.57	1115.52	-1.61
			1.633	253.57	1114.98	
			1.624	253.57	1114.52	
			1.61	13	1114.92	
1.509	263	1115.56	1.561	13	1114.4	-1.16
1.438	180	1114.5	1.489	52	1112.67	-1.83
1.354	132	1112.62	1.404	52	1111.21	-1.41
1.271	605	1111.21	1.319	305	1109.07	-2.14
1.184	605	1108.66	1.234	305	1107.23	-1.43
			1.196	305	1107.01	
1.138	116	1105.98	1.188	Culvert		
			1.179	305	1105.98	
1.045	116	1100.52	1.096	305	1101.68	1.16
0.95	116	1097.62	1.001	305	1098.4	0.78
0.863	404	1094.57	0.914	305	1095.21	0.64

Table 3: WSE Comparison Between the Effective HEC-2 Model and the Existing Conditions HEC-RAS Model - Continued

Note: Elevations shown are on the NAVD88 Datum.

Effective (HEC-2) Model			Existing Conditions (HEC-RAS) Model			Change in WSE (ft)
River Station RS	Flow (cfs)	WSE (ft)	River Station RS	Flow (cfs)	WSE (ft)	
0.773	404	1091.09	0.826	305	1092.49	1.40
0.68	354	1088.29	0.731	478	1089.69	1.40
0.593	354	1084.27	0.643	478	1085.95	1.68
0.508	354	1080.99	0.556	478	1082.21	1.22
0.426	655	1078	0.472	478	1078.99	0.99
0.342	655	1074.6	0.388	478	1075.23	0.63
0.266	655	1071.03	0.314	478	1071.53	0.50
0.165	655	1066.1	0.211	478	1066.87	0.77
			0.179	478	1065.14	
			0.171	478	1064.53	
			0.158	651	1063.94	
0.087	635	1062.41	0.122	564.49	1062.95	0.54
			0.092	373.17	1061.31	
0	617	1058.64				
			0.028	198.69	1058.56	
			0	198.69	1056.68	

The 100-year, 24-hour downstream boundary condition of 1056.68 feet (NAVD88) for the 191st Avenue Wash Downstream Reach is based on the I-10 Freeway 5-10' x 3' Concrete Box Culvert (CBC) inlet control calculations. Refer to Appendix E.4.1 of Reference 1 for the CBC inlet control calculations. The HEC-RAS stationing starts at RS 0.000 which is approximately ten feet upstream of the culvert.

However, the Effective HEC-2 model downstream boundary condition is set at an elevation of 1058.65 feet (NAVD88), approximately 200 feet north of the CBC at RS 0 (Ref. 7). To compare the downstream boundary conditions between the Existing Conditions model and the Effective HEC-2 model, the WSE of 1058.53 at RS 0.028 was used. RS 0.028 is relatively close to the RS 0 of the Effective HEC-2 model. The Effective HEC-2 model WSE at RS 0 is approximately 0.11 feet higher than the WSE at RS 0.028. Refer to Table 3 for the WSE summary.

The downstream boundary condition for the Upstream Reach is set at normal depth with a slope of 0.0185 ft/ft. The Effective HEC-2 model has no downstream boundary condition at this location.

Two HEC-RAS Models are prepared for the Existing Conditions. The first model uses the flow optimization options to calculate the flow that remains in the wash after the flow splits through the lateral structures. The second model uses the remainder flow in the channel to delineate the boundaries of the Existing Conditions Zone AE floodplain and floodway as shown in Figures 4A to 4C and Sheets 1 through 10 of the Existing Conditions 100-Year Floodplain Work Maps. This second model does not include the lateral structures. Where necessary, the levee option was used at different cross-sections along the west bank of the Beardsley Canal to contain the WSE.

5.2 Work Study Maps

Work Maps are prepared at 1"=200' full-size scale, and are included in within Reference 1. The Work Maps illustrate the Effective HEC-2 and the Existing Conditions floodplains.

5.3 Parameter Estimation

5.3.1 Roughness Coefficients

Manning's roughness coefficients ('n'-values) are chosen based on values presented in the FCDMC *Drainage Design Manual for Maricopa County, Volume II – Hydraulics* (Ref 3) and the USGS *Selection of Manning's Roughness Coefficient for Natural and Constructed Vegetated and Non-Vegetated Channels* (Ref. 13). The range of 'n' values is summarized in Table 4. To give a representation of different segments of the study area, photographs and 'n'-value calculations are included in Appendix E.1 of Reference 1.

Table 4: HEC-RAS Manning's Roughness Coefficients

Location	Roughness Coefficient
Channel Banks	0.035-0.094
Channel Bottom	0.026-0.100
Concrete culverts	0.013
CMP Culverts	0.024

5.3.2 Expansion and Contraction Coefficients

Expansion and contraction coefficients are based on values presented in the *HEC-RAS Hydraulic Reference Manual* (Ref. 15). For cross-sections without dramatic contraction or expansion, values of 0.3 and 0.1 are used for the expansion and contraction coefficients, respectively. For cross-sections before and after culverts (cross sections 2, 3 and 4), dramatic contraction and expansion cause a greater energy loss; therefore, 0.5 and 0.3 are used for the expansion and contraction coefficients, respectively.

5.3.3 Entrance Loss Coefficients

Culvert entrance loss coefficients are based on values presented in the HEC-RAS *Hydraulic Reference Manual*, dated March 2008 (Ref. 15). The coefficients chosen are summarized in Table 5.

Table 5: Entrance Loss Coefficients

River Station	Road Crossing	Material	Shape	Entrance Type	Entrance Loss Coefficient
2.198	Indian School Road	RCP	Circular	Projected from Fill	0.2
1.188	Thomas Road	CMP	Circular	Headwall	0.5

5.4 Cross-Section Description

Cross-sections are located along the channel such that the distance between two consecutive sections is approximately 500 ft. Cross-sections are also added upstream and downstream of the culvert crossings based on placement recommendations in the *HEC-RAS Hydraulic Reference Manual* (Ref. 15). Cross-section topographic data is from the one foot contour interval topography dated February 2, 2009 (Ref. 12). Elevations are on the NAVD 1988 vertical datum.

5.5 Modeling Considerations

5.5.1 Hydraulic Jump

No adjustments are made to the model regarding hydraulic jump.

5.5.2 Culverts and Bridges

Two sets of existing culverts were added to the HEC-RAS models. The culverts are located at the Indian School Road and Thomas Road crossings. Only the existing culvert at Indian School Road was previously modeled in the Effective

HEC-2 model. Invert elevations of the culverts are on the NAVD 1988 vertical datum. Refer to Table 6 for the culvert summary.

Table 6: Culvert Summary

River Station	Road Crossing	Material	Shape	Size	Length (ft)
2.198	Indian School Road	RCP	Circular	2-36"	68'
1.188	Thomas Road	CMP	Circular	1-24"	69'
		CMP	Circular	2-36"	79'

5.5.3 Levees and Dikes

Levees or berms impact the study assumptions and results for much of the reach. The majority of the 191st Avenue Wash is adjacent to the Beardsley Canal. The Beardsley Canal bank is mostly elevated above the 100-year water surface elevation. However, at several locations along the reach, the 100-year water surface elevation is above the Canal bank.

For the Beardsley Canal, the approach is to include several lateral weirs along the west bank to account for the diversion of a portion of the flow to the east where the elevation of the Beardsley Canal bank is lower than the 100-year water surface elevation. The project scope of work limit and the new topography limit is at the canal. Therefore, the delineation limit is at the canal and is noted on the Floodplain Work Maps as "Limit of Detailed Study" (Sheets 1-10).

5.5.4 Islands and Flow Splits

As stated in Section 5.5.3 above; the Beardsley Canal bank does not contain the 100-year flow for the entire reach. Therefore, three lateral weirs are added to the hydraulic model to represent the most accurate flow for the delineation along the 191st Avenue Wash.

A fourth lateral weir is added near McDowell Road because the 191th Avenue Wash is not well defined at this crossing; therefore, much of the runoff flows east away from the wash.

Islands are not delineated because berms (high ground in the wash corridor) do not meet FEMA requirements. Therefore, the Zone AE floodplain delineation extends over these berms. As a result, divided flows, wherever they occur, are due to the braided channel nature of the wash.

5.5.5 Ineffective Flow Areas

Ineffective flow locations are modeled upstream and downstream of the culvert crossings and based upon recommended guidelines in the *HEC-RAS Hydraulic Reference Manual* (Ref. 15).

5.5.6 Supercritical Flow

All models are in the subcritical flow regime. Therefore, supercritical flow adjustments are not made to any of the HEC-RAS models.

5.6 Floodway Modeling

For the first iteration of the floodway modeling, Encroachment Method #4 is used, then Encroachment Method #1. Encroachment stations are then modified as necessary to match the floodplain stations. Additional iterations are performed as follows:

- Floodway WSE to be equal to the floodplain WSE.
- Floodway WSE to have no negative surcharge.

5.7 Problems Encountered During the Study

5.7.1 Special Problems and Solutions

No special problems or solutions are associated with this study.

5.7.2 Modeling Warning and Error Messages

HEC-RAS

The following types of warning messages are encountered for the steady flow HEC-RAS model. Discussions regarding the messages are also provided below.

(1) The conveyance ratio is higher than 1.4 or less than 0.7, which may indicate the need for additional cross-sections.

Response: The distance between 2 neighboring cross-sections in the HEC-RAS model is generally less than 500 feet. Cross-sections are located where channel geometry (including slope, n value etc.) changes. It is believed that no additional cross-sections are necessary.

(2) The cross-section end points had to be extended vertically for the computed water surface.

Response: This occurs at two locations. The first at the lateral weir locations. Therefore, the WSE is generally higher than the cross-section end points. No changes are necessary. The second location occurs where the flow is divided and since the WSE is assumed to be level. Therefore, the levee option is used to contain the flow and to assume all the flow goes downstream.

(3) The velocity head has changed by more than 0.5 feet. This may indicate the need for additional cross-sections.

Response: As discussed above, no additional cross-sections are necessary.

(4) The energy loss was greater than 1.0 foot between the current and previous cross section. This may indicate the need for additional cross sections.

Response: As discussed above, no additional cross-sections are necessary.

(5) The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations. *Response: At some cross-sections with dramatic changes in*

geometry or discharge, the flow profile changes, e.g. from M2 to S2. It is okay to set critical depth at these locations.

(6) During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to critical depth.

Response: As discussed on item #5 above, it is okay to set critical depth at these locations.

(7) Divided flow computed for this cross-section.

Response: Divided flows, wherever they occur, are due to the braided channel nature of the wash.

CHECK-RAS NT

The following warning messages were generated by CHECK-RAS NT, and they are addressed below.

(1) The left overbank n-value of 0.045 and the right overbank n-value of 0.045 are less than or equal to the channel n-value of 0.045. The overbank n-values should be reevaluated.

Response: The n-value of 0.045 is conservative and reflects a mature and unmaintained vegetation condition. Generally, the same n-value of 0.045 was used to represent the left and right overbanks and the channel. This is a typical comment for many other cross sections. Therefore, it is okay to keep the n-values as they are.

(2) The left overbank n-value of 0.06 and the right overbank n-value of 0.059 are less than or equal to the channel n value of 0.1. The overbank n-values should be reevaluated.

Response: Typically, the channel has much more mature and unmaintained vegetation

condition than the overbank areas. This is a typical comment for many other cross sections. Therefore, it is okay to keep the n-values as they are.

(3) RS 2.206, Section 3: The channel n-value of 0.031 is less than the channel n-value of 0.1 at section 4.

Response: There is less vegetation present at Section 3 than at Section 4. Therefore, it is okay to keep the n-values as they are.

CHECK-RAS XS

The following warning messages were generated by CHECK-RAS XS, and they are addressed below.

(1) Left levee option is used at river stations. Please investigate whether the NFIP requirements for levees are met.

Response: The levee option is used to encroach the wash cross section because as mentioned in Section 5.5.3, the levee options were used to evaluate the different encroachment options to calculate the most conservative WSE.

(2) Discharge decreases in the downstream direction.

Response: Flow decreases at multiple locations where the lateral weirs are present and at the beginning of the Downstream Reach because all the flow from the Upstream Reach leaves the system near RS 1.624.

(3) RS 1.561: This cross-section is located too far upstream from the critical depth cross-section.

Response: The downstream cross-sections are generally located within 500 feet. This is a typical comment for other cross-sections. Cross-sections are located where channel geometry (including slope, n value etc.) changes. It is believed that no additional cross-sections are necessary.

(4) RS 3.746: There is no flow on the right overbank at the downstream

cross section. There is no flow on the left overbank at this section.

Response: At RS 3.746, the flow stays along the channel and the right overbank areas because there is a berm along the left bank that impedes flow from entering the left overbank area. Between RS 3.746 and RS 3.703, there is a break on the berm in which the runoff crosses to the left overbank area and there is no runoff on the right overbank area. The majority of the runoff south or RS 3.703 stays east of the berm.

CHECK-RAS Structure

The following warning messages were generated by CHECK-RAS Structure, and they are addressed below.

(1) RS 1.179: This is Section 2. Weir flow occurs at Culvert Group 2. However, the ineffective flow elevation of 1106.5 between stations 1094.52 and 1366 is equal to or greater than the WSEL of 1105.98. The RMnTpRdD is 1106.211 and the MxLoCdD is 1105.4. The ineffective flow elevation should be between the RMnTpRdD and the MxLoCdD. It should also be less than the WSEL.

Response: If the ineffective flow elevation is greater than either the RMnTpRdD and the MxLoCdD, it does not affect the WSE. It is okay to keep these settings. This is a typical comment for other culverts and cross-section. Therefore, it is okay to keep these settings for all culverts.

(2) RS 1.179: This is Section 2. Weir flow occurs at Culvert Group 1. However, the ineffective flow elevation of 1106.9 between stations 938.71 and 988.73 is equal to or greater than the WSEL of 1105.98. The LMnTpRdD is 1106.834 and the MxLoCdD is 1105.07. The ineffective flow elevation should be between the LMnTpRdD and the MxLoCdD. It should also be less than the WSEL.

Response: If the ineffective flow elevation is greater than either the LMnTpRdD and the MxLoCdD, it does not affect the WSE. It is okay to keep these settings. This is a typical comment for other culverts and cross-section. Therefore, it is okay to keep these settings for all culverts.

(3) RS 2.198: This is Culvert. Encroachment Method was not specified at this river station. For flood insurance studies Encroachment Methods 4 and 1 should be used.

Response: No encroachment can be specified at any culvert. The encroachment used is from the bounding cross-sections. This is a typical comment for other culverts. Therefore, it is okay to keep these settings for all culverts.

(4) RS 2.19: This is Section 2. The left encroachment station of 971.72 is greater than the left bank station of 968.79. The left encroachment station is within the channel. The encroachment station and/or channel bank station should be reevaluated.

Response: The floodway encroachment stations are okay because the floodway WSE are all equal to the floodplain WSE. The right and left bank stations are all set primarily based on the vegetation limits. In addition, the bank stations vary due to the braided channel nature of the wash. This a typical comment for other cross-sections. Therefore, it is okay to keep these settings for all cross-sections.

(5) RS 2.19: This is Section 2. The right encroachment station of 1027.53 is less than the right bank station of 1031.21. The encroachment station and/or channel bank station should be reevaluated.

Response: Refer to Item 4 response above.

(6) RS 1.196: This is Section 3. The right station effective of 1264.98 for the natural profile is greater than the right channel bank station of 1010.82. The right encroachment station is outside the channel. The right encroachment station of 1265 is greater than the right station effective of 1264.98 for the natural profile. The right encroachment station should be adjusted.

Response: As mentioned in item #4 response above, the floodway WSE are all equal to the floodplain WSE. The majority of the floodway encroachment stations are all equal to the floodplain stations. In a few situations like this one, the floodway encroachment stations are greater

than the floodplain stations by 0.01 or 0.02 feet. Since the station difference is so small, the floodway encroachment stations are all considered to be equal to the floodplain stations. This a typical comment for other cross-sections. Therefore, it is okay to keep these settings for all cross-sections.

CHECK-RAS Floodway

(1) RS 4.104: Left encroachment station 977.15 is more than the left channel bank station of 971.56 and less than the right channel bank station 1034.89. The left encroachment station is within the channel. The encroachment station or channel bank station should be adjusted.

Response: The floodway encroachment stations are okay because the floodway WSE are all equal to the floodplain WSE. This a typical comment for other cross-sections. Therefore, it is okay to keep these settings for all cross-sections.

(2) RS 3.02: The right channel bank station may not be at the proper location.

Response: The right and left bank stations are all set primarily based on the vegetation limits. In addition, the bank stations vary due to the braided channel nature of the wash. This a typical comment for other cross-sections. Therefore, it is okay to keep these settings for all cross-sections.

(3) RS 2.198 and 1.188: Floodway encroachment method is not selected at these sections.

Response: RS 2.198 and 1.188 are at culvert locations. The floodway encroachment methods are not necessary at culvert locations.

(4) RS 2.508: The right station effective of 1044.14 for 1% annual chance floodplain is greater than the right channel bank station (1015.72). The 1% annual

chance floodplain is outside the channel. However, the right encroachment station (1044.15) is outside of 1% annual chance floodplain. The right encroachment station should be adjusted.

Response: As mentioned in item #1 response above, the floodway WSE are all equal to the floodplain WSE. The majority of the floodway encroachment stations are all equal to the floodplain stations. In a few situations like this one, the floodway encroachment stations are greater than the floodplain stations by 0.01 or 0.02 feet. Since the station difference is so small, the floodway encroachment stations are all considered to be equal to the floodplain stations. This a typical comment for other cross-sections. Therefore, it is okay to keep these settings for all cross-sections.

5.8 Calibration

This study does not include special calibration.

5.9 Final Results

5.9.1 Hydraulic Analysis Results

Refer to Table 7 for the flows used in the Existing Conditions HEC-RAS model to calculate the flows remaining in the wash. The floodplain results are summarized in Table 8. HEC-RAS output reports, tables, and cross-sections are included in Appendix E.5 of Reference 1.

The 100-year, 24-hour flow summary table used in the Existing Conditions HEC-RAS model is included in Appendix E.5.3 of Reference 1.

Table 7: 100-Year Flows Used in the Existing Conditions HEC-RAS Modeling

(Flow Calculation)

River Station	HEC-1 ID	Peak Discharge (cfs)
RS 4.104	W28A	319*
RS 3.517	DW28RE	444
RS 2.721	CPW29	615
RS 1.962	CPW30	719
RS 1.610	W31A	13*
RS 1.489	W31B	52*
RS 1.319	W31	305
RS 0.731	W31 & CPW32	478**
RS 0.158	CPW32	651

* Prorated flows from Sub-Basins W28 and W31 (refer to Exhibit 3 for the Prorated Flow Map)
** Average flow from Sub-Basin W31 and CPW32

Table 8 Existing Conditions Floodplain Summary Table

Note: Elevations shown are on the NAVD88 Datum.

River Station	Peak Discharge	100-Year Floodplain Elevation
RS	(cfs)	(ft)
4.104	319	1168.25
4.009	319	1165.22
3.909	319	1163.85
3.811	319	1162.87
3.746	319	1161.74
3.703	319	1159.51
3.617	319	1158.45
3.517	444	1157.81
3.423	444	1156.6
3.318	327.78	1154.22
3.231	327.78	1153.2
3.214	327.78	1152.9
3.194	327.78	1152.79

Table 8: Existing Conditions Floodplain Summary Table - Continued

Note: Elevations shown are on the NAVD88 Datum.

River Station (RS)	Q (cfs)	100-Year Floodplain Elevation (ft)
3.098	327.78	1151.24
3.02	327.78	1149.85
2.927	327.78	1147.43
2.814	327.78	1146.45
2.791	272.69	1146.31
2.774	245.71	1146.17
2.721	416.71	1145.69
2.625	416.71	1143.36
2.508	416.71	1139.98
2.405	416.71	1135.87
2.311	221.48	1135.49
2.226	149.73	1135.48
2.206	149.57	1135.44
2.198	Culvert	
2.19	149.57	1132.13
2.136	149.57	1129.46
2.053	149.57	1127.71
1.962	253.57	1125.2
1.875	253.57	1122.51
1.787	253.57	1119.6
1.708	253.57	1117.08
1.647	253.57	1115.52
1.633	253.57	1114.98
1.624	253.57	1114.52
1.61	13	1114.92
1.561	13	1114.4
1.489	52	1112.67
1.404	52	1111.21
1.319	305	1109.07
1.234	305	1107.23

Table 8: Existing Conditions Floodplain Summary Table - Continued

Note: Elevations shown are on the NAVD88 Datum.

River Station (RS)	Q (cfs)	100-Year Floodplain Elevation (ft)
1.196	305	1107.01
1.188	Culvert	
1.179	305	1105.98
1.096	305	1101.68
1.001	305	1098.4
0.914	305	1095.21
0.826	305	1092.49
0.731	478	1089.69
0.643	478	1085.95
0.556	478	1082.21
0.472	478	1078.99
0.388	478	1075.23
0.314	478	1071.53
0.211	478	1066.87
0.179	478	1065.14
0.171	478	1064.53
0.158	651	1063.94
0.122	564.49	1062.95
0.092	373.17	1061.31
0.028	198.69	1058.56
0	198.69	1056.68

Nineteen properties were surveyed along the 191st Avenue that are close to the floodplain. As a result, the FFE of all nineteen properties is higher than the floodplain delineation presented in this report. Refer to 100-Year Floodplain Work Maps for the property locations and Table 9 for the FFE summary. In addition, refer to Appendix E.5.6 of Reference 1 for the properties parcel and owners

information. Also, refer to Appendix B.4 of Reference 1 for copies of the field survey letters sent out to the property owners to check the FFE.

Table 9: FFE and Wash WSE Comparison

Note: Elevations shown are on the NAVD88 Datum.

Lot ID	FFE	WSE	FFE & WSE Difference	Within Effective Floodplain	Within Existing Conditions Floodplain
	(ft)	(ft)	(ft)	Yes (Y) / No (N)	Yes (Y) / No (N)
1	1062.95	1061.30	1.7	N	N
2	1061.56	1061.30	0.3	N	N
3	1076.12	1075.23	0.9	N	N
4	1078.95	1078.00	1.0	N	N
5	1080.22	1078.99	1.2	N	N
6	1082.24	1081.57	0.7	N	N
7	1109.72	1107.13	2.6	N	N
8	1108.61	1107.25	1.4	N	N
9	1112.12	1108.59	3.5	N	N
10	1114.54	1109.5	5.0	N	N
11	1114.67	1111.56	3.1	N	N
12	1116.28	1112.36	3.9	N	N
13	1118.44	1117.48	1.0	N	N
14	1125.83	1121.07	4.8	N	N
15	1125.91	1122.35	3.6	N	N
16	1125.43	1123.13	2.3	N	N
17	1127.06	1123.73	3.3	N	N
18	1129.21	1125.20	4.2	N	N
19	1149.69	1146.33	3.4	N	N

5.9.2 Verification of Results

With the use of the new topography and hydrology data, the majority of the floodplain delineation is very similar to the Effective FEMA delineation. The results of this study show that the Existing Conditions delineation generally retains the east boundary of the Effective floodplain (the west bank of the Beardsley Canal).

6 Erosion and Sediment Transport

Erosion and sediment transport are not part of this report. Velocities in the wash are generally less than 5 fps.

7 Draft FIS Report Data

7.1 Summary of Discharges

The draft summary of discharges is provided in Table 10.

Table 10: Summary of Discharges

Flooding Source and Location	Drainage Area* (Square Miles)	Peak Discharges (cfs)			
		10-Year**	50-Year**	100-Year*	500-Year**
191st Avenue Wash					
North of I-10 Freeway	==	==	==	199	==
At Indian School Road	==	==	==	150	==
At Camelback Road	==	==	==	328	==

* Discharges are computed by performing HEC-RAS split flow analysis using the lateral weir options. As a result, the final drainage areas are not computed.

** Not computed.

7.2 Floodway Data

The floodway data results are summarized in Table 11.

Table 11: Floodway Data Summary

Note: Elevations shown are on the NAVD88 Datum.

Cross-Section	Distance[1]	Floodway			Base Flood Water Surface Elevation			
		Width (feet)	Section Area (square feet)	Mean Velocity (feet per second)	Regulatory	Without Floodway	With Floodway	Increase
					(Feet NAVD88)			
4.104	4.104	100.41	114.09	2.8	1168.25	1168.25	1168.25	0
4.009	4.009	149.46	136.08	2.34	1165.22	1165.22	1165.22	0
3.909	3.909	277.18	225.47	1.41	1163.85	1163.85	1163.85	0
3.811	3.811	200.55	186.95	1.71	1162.87	1162.87	1162.87	0
3.746	3.746	266.1	201.26	1.59	1161.74	1161.74	1161.74	0
3.703	3.703	93.16	120.72	2.64	1159.51	1159.51	1159.51	0
3.617	3.617	162.45	286.52	1.11	1158.45	1158.45	1158.45	0
3.517	3.517	169.2	294.91	1.51	1157.81	1157.81	1157.81	0
3.423	3.423	160.34	212.7	2.09	1156.6	1156.6	1156.6	0
3.318	3.318	130.02	156.43	2.1	1154.22	1154.22	1154.22	0
3.231	3.231	144.81	289.05	1.13	1153.2	1153.2	1153.2	0
3.214	3.214	68.6	103.63	3.16	1152.9	1152.9	1152.9	0
3.194	3.194	188.43	314.09	1.04	1152.79	1152.79	1152.79	0
3.098	3.098	99.45	159.08	2.06	1151.24	1151.24	1151.24	0
3.02	3.02	127.98	205.5	1.6	1149.85	1149.85	1149.85	0
2.927	2.927	46.37	94.94	3.45	1147.43	1147.43	1147.43	0
2.814	2.814	240.98	354.14	0.93	1146.45	1146.45	1146.45	0
2.791	2.791	177.29	184.32	1.48	1146.31	1146.31	1146.31	0
2.774	2.774	154.29	114.8	2.14	1146.17	1146.17	1146.17	0
2.721	2.721	103.84	186.26	2.24	1145.69	1145.69	1145.69	0
2.625	2.625	169.09	161.12	2.59	1143.36	1143.36	1143.36	0
2.508	2.508	148.43	236.65	1.76	1139.98	1139.98	1139.98	0
2.405	2.405	79.24	93.01	4.48	1135.87	1135.87	1135.87	0
2.311	2.311	246.17	405.67	0.55	1135.49	1135.49	1135.49	0
2.226	2.226	400.53	1018.17	0.15	1135.48	1135.48	1135.48	0

[1] Miles above confluence with the I-10 Freeway box culvert

Table 11: Floodway Data Summary - Continued

Note: Elevations shown are on the NAVD88 Datum.

Cross-Section	Distance[1]	Floodway			Base Flood Water Surface Elevation			
		Width (feet)	Section Area (square feet)	Mean Velocity (feet per second)	Regulatory	Without Floodway	With Floodway	Increase
					(Feet NAVD88)			
2.206	2.206	23	528.29	1.43	1135.44	1135.44	1135.44	0
2.198	2.198	Culvert						
2.19	2.19	24.6	67.1	3.38	1132.13	1132.13	1132.13	0
2.136	2.136	62.99	44.66	3.35	1129.46	1129.46	1129.46	0
2.053	2.053	52.34	46.02	3.25	1127.71	1127.71	1127.72	0
1.962	1.962	46.41	52.64	4.82	1125.2	1125.2	1125.2	0
1.875	1.875	84.89	65.96	3.84	1122.51	1122.51	1122.51	0
1.787	1.787	52.58	54.74	4.63	1119.6	1119.6	1119.6	0
1.708	1.708	80.95	59.89	4.23	1117.08	1117.08	1117.08	0
1.647	1.647	113.13	79.11	3.21	1115.52	1115.52	1115.52	0
1.633	1.633	50.73	53.27	4.76	1114.98	1114.98	1114.98	0
1.624	1.624	43.36	58.32	4.35	1114.52	1114.52	1114.52	0
1.61	1.61	41.24	5.99	2.17	1114.92	1114.92	1114.92	0
1.561	1.561	47.43	17.21	0.76	1114.4	1114.4	1114.39	0
1.489	1.489	34.04	14.39	3.61	1112.67	1112.67	1112.68	0
1.404	1.404	33.08	30.55	1.7	1111.21	1111.21	1111.21	0
1.319	1.319	106.58	77.43	3.94	1109.07	1109.07	1109.07	0
1.234	1.234	109.33	143.15	2.13	1107.23	1107.23	1107.23	0
1.196	1.196	273.27	260.72	1.17	1107.01	1107.01	1107.01	0
1.188	1.188	Culvert						
1.179	1.179	46.19	309.34	3.19	1105.98	1105.98	1105.98	0
1.096	1.096	122.45	148.14	2.06	1101.68	1101.68	1101.68	0
1.001	1.001	118.12	173.78	1.76	1098.4	1098.4	1098.4	0
0.914	0.914	118.5	141.92	2.15	1095.21	1095.21	1095.21	0
0.826	0.826	177.72	211.13	1.44	1092.49	1092.49	1092.49	0
0.731	0.731	212.6	247.27	1.93	1089.69	1089.69	1089.69	0
0.643	0.643	189.43	214.55	2.23	1085.95	1085.95	1085.96	0
0.556	0.556	267.04	265.28	1.8	1082.21	1082.21	1082.2	0
0.472	0.472	240.68	230.45	2.07	1078.99	1078.99	1078.99	0

[1] Miles above confluence with the I-10 Freeway box culvert

Table 11: Floodway Data Summary - Continued

Note: Elevations shown are on the NAVD88 Datum.

Cross-Section	Distance[1]	Floodway			Base Flood Water Surface Elevation			
		Width (feet)	Section Area (square feet)	Mean Velocity (feet per second)	Regulatory	Without Floodway	With Floodway	Increase
					(Feet NAVD88)			
0.388	0.388	250.05	204.1	2.34	1075.23	1075.23	1075.23	0
0.314	0.314	327.98	235.21	2.03	1071.53	1071.53	1071.53	0
0.211	0.211	441.48	275.91	1.73	1066.87	1066.87	1066.87	0
0.179	0.179	550.73	258.23	1.85	1065.14	1065.14	1065.14	0
0.171	0.171	406	184.74	2.59	1064.53	1064.53	1064.53	0
0.158	0.158	406.17	228.18	2.85	1063.94	1063.94	1063.94	0
0.122	0.122	334.75	184.38	3.06	1062.95	1062.95	1062.95	0
0.092	0.092	366.43	161.42	2.31	1061.31	1061.31	1061.31	0
0.028	0.028	279.98	97.25	2.04	1058.56	1058.56	1058.56	0
0	0	68.02	61.77	3.22	1056.68	1056.68	1056.68	0

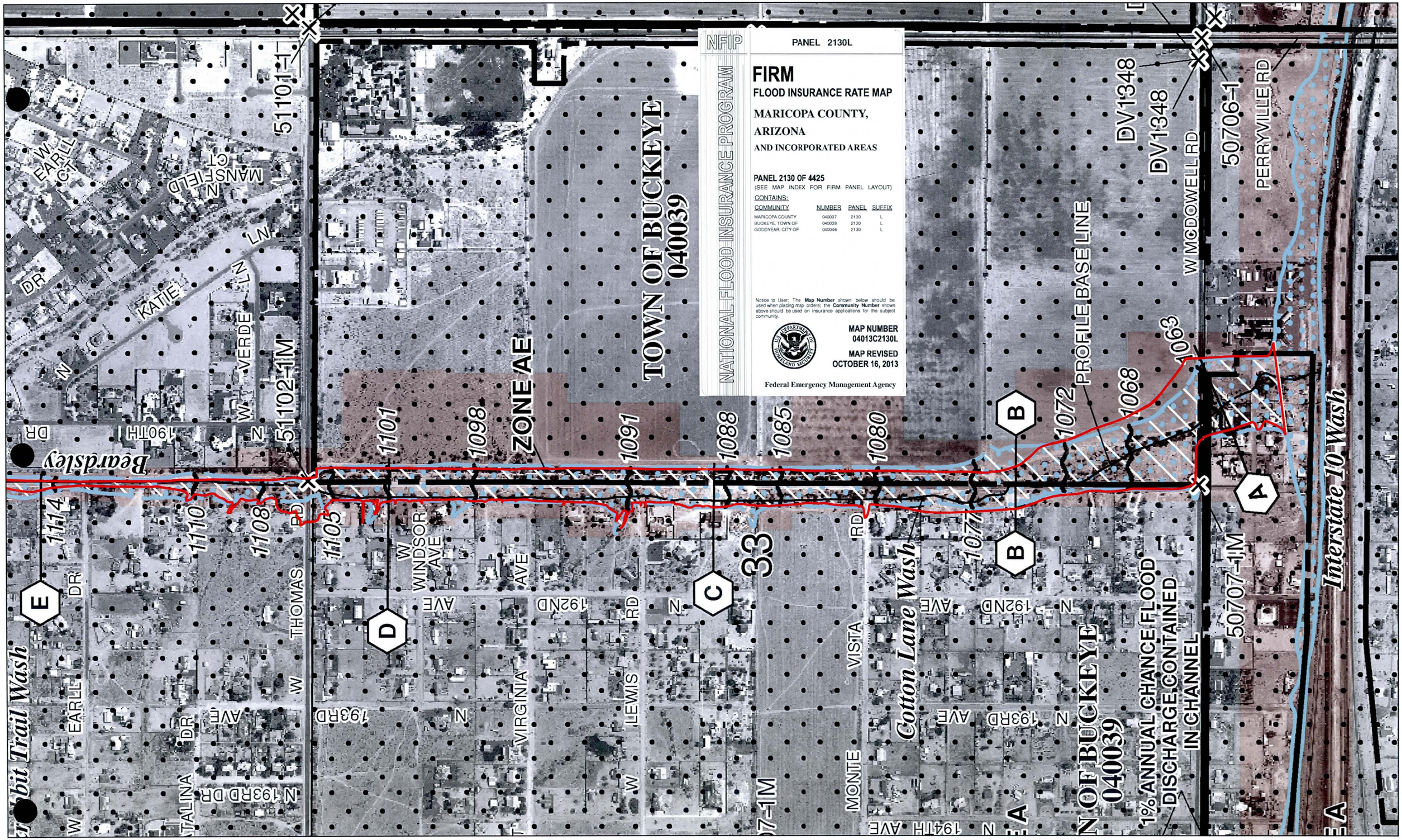
[1] Miles above confluence with the I-10 Freeway box culvert

7.3 Annotated Flood Insurance Rate Map

The Annotated Flood Insurance Rate Maps are shown in Figures 4A to 4C.

7.4 Flood Profiles

The flood profiles for the 100-year flood are provided in Appendix E.5.5 of Reference 1.



N

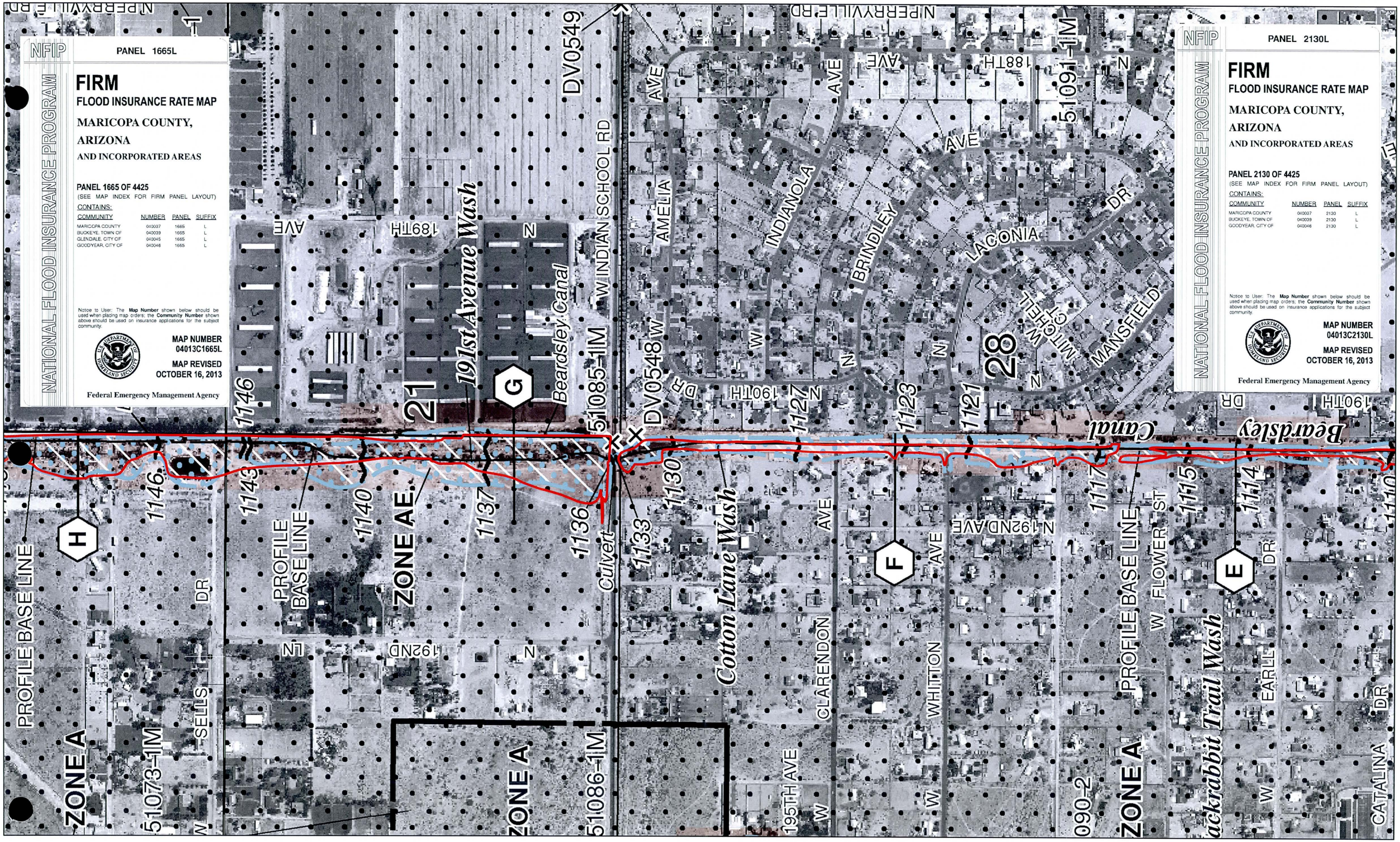
0 250 500 1,000 Feet

1 inch = 500 feet

Revised Floodplain

Figure 4A
Annotated Flood Insurance Rate Map

Flood Control District of Maricopa County
2801 West Durango Street
Phoenix, Arizona 85009
Phone: (602) 506-1501
Fax: (602) 506-4601
http://www.fcd.maricopa.gov



N

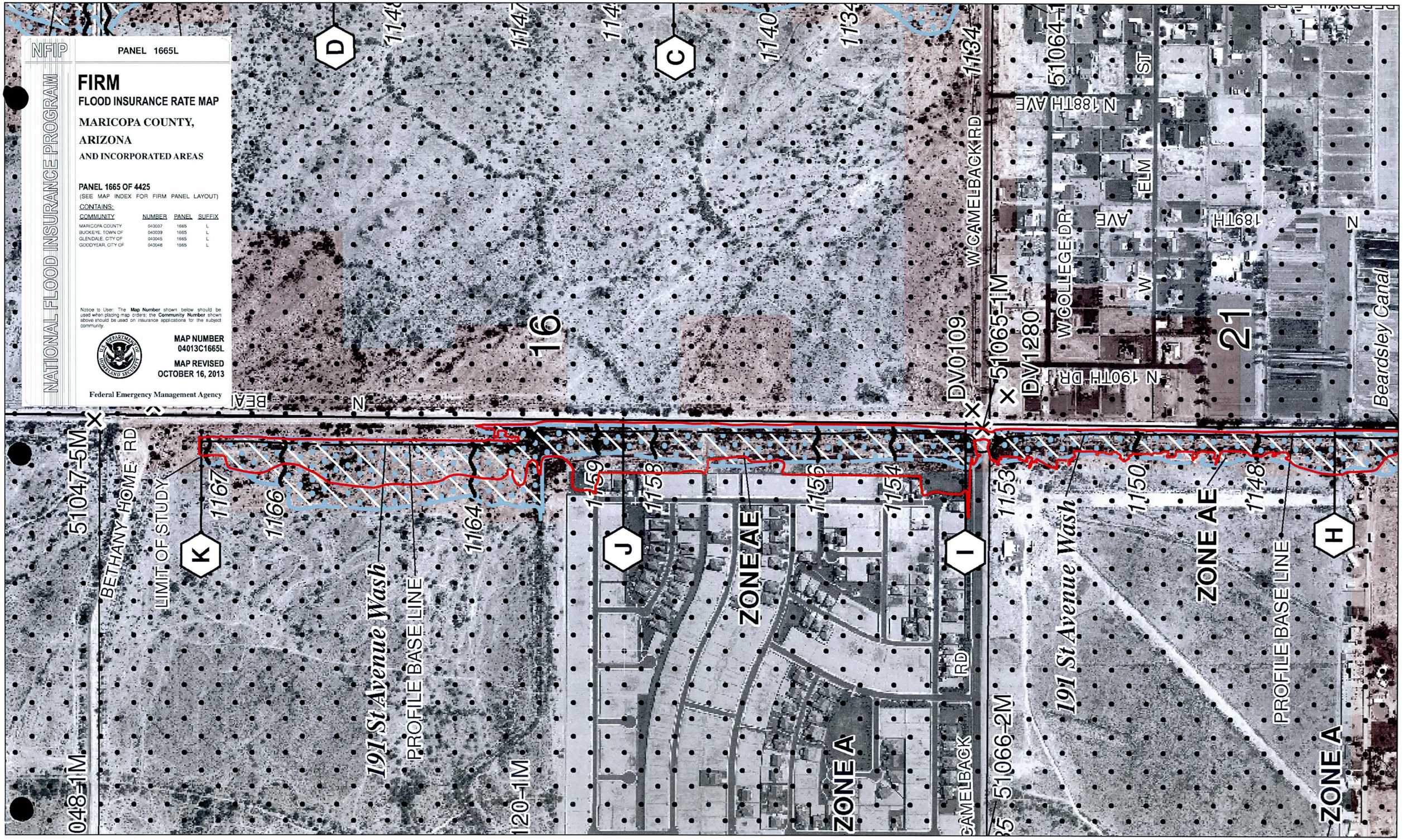
0 250 500 1,000 Feet

1 inch = 500 feet

Revised Floodplain

Figure 4B
Annotated Flood Insurance Rate Map

Flood Control District of Maricopa County
2801 West Durango Street
Phoenix, Arizona 85009
Phone: (602) 506-1501
Fax: (602) 506-4601
http://www.fcd.maricopa.gov



N

0 250 500 1,000 Feet

1 inch = 500 feet

Revised Floodplain

Figure 4C
Annotated Flood Insurance Rate Map

Flood Control District of Maricopa County
2801 West Durango Street
Phoenix, Arizona 85009
Phone: (602) 506-1501
Fax: (602) 506-4601
http://www.fcd.maricopa.gov

Appendix A: References

A.1 Data Collection Summary (References)

A.2 Referenced Documents

A.2.1 Full Package of *Conditional Letter of Map Revision Request for the 19th Avenue Wash Floodplain, Bethany Home Road to the I-10 Freeway* (Ref. 1)

A.1 Data Collection Summary

(References)

A.1 References

1. Hoskin-Ryan Consultants, Inc, *Conditional Letter of Map Revision Request for the 191st Avenue Wash Floodplain, Bethany Home Road to the i-10 Freeway,* January 26th, 2012.

2. Flood Control District of Maricopa County, *Drainage Design Manual for Maricopa County Arizona, Volume I – Hydrology,* June 14, 2010.

3. Flood Control District of Maricopa County, *Drainage Design Manual for Maricopa County Arizona, Volume II – Hydraulics,* Draft June 24, 2010.

4. Federal Emergency Management Agency, *Flood Insurance Rate Map (FIRM): Maricopa County, Arizona and Unincorporated Areas, Maps Numbered 04013C1590H and 04013C2055G,* both dated September 30, 2005.

5. Hoskin Ryan Consultants, Inc., *White Tanks FRS No. 3 Outfall Channel, Final Design, FCD 2009C012 – Conditional Letter of Map Revision Report*, October 17, 2011.

6. Hoskin Ryan Consultants, Inc., *100% Plans for the Construction of White Tanks FRS No. 3 Outfall Channel, Final Design, PCN 470.04.32, FCD Contract No. 2009-C012,* November , 2010.

7. The WLB Group, *White Tanks / Agua Fria Area Drainage Master Study*, prepared for Flood Control District of Maricopa County, October, 1992.

8. URS, *Loop 303 / White Tanks Area Drainage Master Plan Update,* Flood Control District of Maricopa County Contract No. 99-40, April, 2004.

9. HDR, *Loop 303 / White Tanks Area Drainage Master Plan Update Area Hydrologic Analysis* (ADMPU AHA), September 2009

10. United States Army Corps of Engineers, Hydrologic Engineering Center, *HEC-1, Version 4.1*, June 1998.

11. United States Army Corps of Engineers, Hydrologic Engineering Center, *HEC-RAS River Analysis System, Version 4.1*, January 2010.

12. Hoskin Ryan Consultants, Inc., *White Tanks FRS No. 3 Outfall Channel, FCD 2009C012 –Survey Report*, April 2010.

13. Phillips, J.V., and Tadayon,S., 2006, Selection of Manning's Roughness Coefficient for Natural and Constructed Vegetation and Non-Vegetated Channels, and Vegetation Maintenance Plan Guidelines for Vegetated Channels in Central Arizona: U.S. Geological Survey, Scientific Investigation Report 2006-5108, 41 p.

14. Flood Control District of Maricopa County, *White Tanks FRS #3 Outfall Channel Project, Nationwide Permit No. 43 Verification,* December 14, 2010.

15. United States Army Corps of Engineers, Hydrologic Engineering Center, *HEC-RAS River Analysis System, Version 4.1, Hydraulic Reference Manual*, January 2010.

A.2.1 *Conditional Letter of Map Revision Request for the 191st Avenue Wash Floodplain, Bethany Home Road to the I-10 Freeway*