

November 17, 2014

Vikram Raju, P.E., CFM  
Scientech Engineers, Inc.  
701 Shepherd Drive, Suite 200  
Houston, Texas 77007-5833

RE: Project No. 2038653  
Neighborhood Street Redevelopment (NSR) 464  
HCFCD Unit W140-04-00 Key Map 451N, P, S, T; Pct. 3

Dear Mr. Raju:

The Flood Control District has reviewed the submitted report pursuant to the HCFCD Policy, Criteria, and Procedure Manual. This review addresses issues regarding hydraulic and hydrologic drainage design criteria only. Design criteria regarding the proposed development and drainage facilities will be reviewed upon submittal of site plans.

Our understanding of the report is described below.

**Submitted Report**

Neighborhood Street Redevelopment (NSR)  
464  
October 2014

**Consulting Engineer**

Scientech Engineers, Inc.  
701 Shepherd Drive, Suite 200  
Houston, Texas 77007-5833  
Vikram Raju, P.E.,CFM  
TX P.E. # 101237  
TBPE Firm Reg. No. 4014

**Project Summary**

The proposed project characteristics that are considered in this report are:

1. Replacement of Existing Roadway Cross Section with a Proposed Standard Roadway Cross Section to adhere to the criteria of the City of Houston Public Works (COH-PWE) Infrastructure Design Manual (IDM) Requirements.
2. Replacement of the Existing Type "B-B" inlets with Proposed Type "B-B" inlets.
3. Existing Outfall Pipes discharging to HCFCD Unit#: W140-04-00 are NOT replaced in the proposed conditions and shall remain unaltered with respect to size and location as in the Existing conditions.

**HCFCD Jurisdiction**

The project directly affects HCFCD Infrastructure; therefore, HCFCD criteria applies.

**Report Findings**

The report states, "Based on the study of the proposed design, which requires the replacement of the existing roadway cross section with proposed standard roadway cross section to adhere to the criteria of the City of Houston Public Works (COH-PWE) Infrastructure Design Manual

November 17, 2014  
Vikram Raju, P.E.,CFM  
Scientech Engineers, Inc.

Page 2

*(IDM) requirements, "No-Impact" is observed from drainage areas of Cedel Drive and Turquoise Lane to HCFCD Unit#: W140-04-00".*

### **Hydrologic & Hydraulic Technical Review**

HCFCD offers the following:

The report includes statements that the project will cause no adverse impact to the receiving waterways in storm events up to and including the 100-year event. The documentation within the report generally supports the conclusions stated by the engineer. Based on the stated conclusions, HCFCD interposes no objection to the referenced report. Please note, this acceptance does not necessarily mean that the entire report, including all supporting data and calculations, has been completely checked and verified. However, the report is signed, dated, and sealed by a Professional Engineer licensed to practice in the State of Texas, which therefore conveys the licensed engineer's responsibility and accountability.

### **Additional HCFCD Criteria**

Site plans must be submitted to HCFCD for review and signature.

All work proposed within existing and future HCFCD right-of-way must be designed and constructed in accordance with the HCFCD Policy, Criteria, and Procedure Manual.

### **Environmental Review & Permitting**

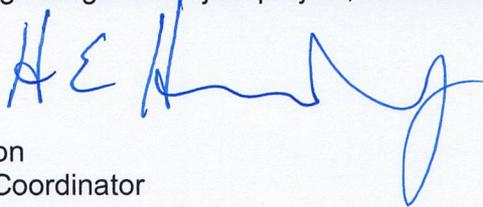
The Harris County Flood Control District's Environmental Department requires that the U.S. Army Corps of Engineers be contacted to determine if a permit is required for any portions of this project located within any existing or proposed HCFCD right-of-way. The type of permit required (if any) must be stated on the site plans. Actual copies of approved Corps of Engineers permits necessary for work within HCFCD rights-of-way must be submitted with the HCFCD permit application and be given to the HCFCD Property Management Department at least 48 hours prior to construction.

### **Floodplain Related Information**

**Please also note that the City of Houston is the Floodplain Administrator for the receiving waterways. All issues regarding local floodplain regulations must be coordinated through the City of Houston.**

Thank you for coordinating this project with the Flood Control District. If you have any other questions regarding the subject project, feel free to contact me at 713-316-4871.

Sincerely,



Herb Herndon  
Watershed Coordinator  
Watershed Management Department

HEH:RF:cf

Cc: Jamila Johnson, P.E., CFM, City of Houston

## HARRIS COUNTY FLOOD CONTROL DISTRICT

10555 Northwest Frwy, Suite 170

Houston, Texas 77092-8620

Commercial Receiving (713) 316-4892 OR (713) 316-4893

**DRAINAGE REPORT PROJECT REVIEW/ ROUTING****PROJECT'S NAME:** Neighborhood Street Redevelopment (NSR) 464 [WBS#: N-000397-0001-3]Consulting Firm: Sciencetech Engineers, Inc.Contact Person: Vikram Raju, P.E., CFMTelephone: 713-977-6090, Ext. 227 Email: vraju@sci-eng.comHCFCD Unit No.: W140-04-00 KMP # 451N, P, S & T PCT:  1  2  3  4 In Unincorporated Harris County  In City of Houston

## FOR OFFICE USE

A # \_\_\_\_\_ R# or P# \_\_\_\_\_ Received Date: \_\_\_\_\_

**PLEASE FILL THIS FORM OUT IN ITS ENTIRETY.**

<b>Submittal Type:</b>	<input checked="" type="checkbox"/> Impact Analysis	<input type="checkbox"/> CLOMR	<input type="checkbox"/> LOMR	<input type="checkbox"/> LOMR-F
	<input type="checkbox"/> Other: _____			
<b>Development Type:</b>	<input type="checkbox"/> Land	<input type="checkbox"/> Transportation	<input type="checkbox"/> Utility	
	<input checked="" type="checkbox"/> Other: <u>Neighborhood Street Redevelopment (NSR)</u>			
<b>Development Sponsor:</b>	<input type="checkbox"/> Private	<input type="checkbox"/> Harris County	<input type="checkbox"/> TxDOT	
	<input checked="" type="checkbox"/> City of <u>HOUSTON</u>		<input type="checkbox"/> Other _____	
<b>Development Size:</b>	<u>4.67</u> Acres			
<b>Project Outfall Location(s):</b>  <input type="checkbox"/> N/A	<input checked="" type="checkbox"/> HCFCD Facility: <u>HCFCD Unit#: W140-04-00</u>			
	<input type="checkbox"/> Harris County Facility: _____			
	<input type="checkbox"/> TxDOT Facility: _____			
	<input type="checkbox"/> City of _____ Facility: _____			
	<input type="checkbox"/> Other Facility: _____			

**Project Characteristics Considered in This Report:** (check all that apply)

- Storm Water Detention       Floodplain Fill       Channel Improvements  
 Bridge Culvert Crossing       Bridge Culvert Crossing       Roadway Drainage System  
     FEMA Modeled Stream      Non-FEMA Modeled Stream      Improvements  
 Other: Proposed Roadway Improvements - Replacement of Existing Roadway Cross Section with Proposed  
     Standard Roadway Cross Section per City of Houston Design Criteria.

<b>HCFCD Detention Method Utilized:</b>	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input checked="" type="checkbox"/> N/A
<b>Modeling Software Utilized:</b>	<input type="checkbox"/> HEC-HMS <input type="checkbox"/> HEC-RAS			<input checked="" type="checkbox"/> N/A
	<input type="checkbox"/> Other: _____			

**NEIGHBORHOOD STREET REDEVELOPMENT (NSR) 464  
(Area North of Hammerly Boulevard)**

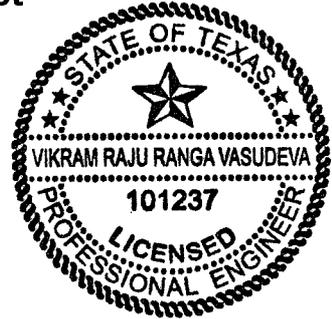
**Impact Analysis Report**

**For**

**Harris County Flood Control District  
(HCFCD)**

**Located in**

**Harris County,  
Texas**



**Scientech Engineers, F-4014**

**Prepared by**

*[Handwritten Signature]*  
10-22-2014

**City of Houston Public Works & Engineering Dept. (COH-PWE)  
Neighborhood Street Redevelopment (NSR) Division**

**&**

**Scientech Engineers, Inc.  
701 Shepherd Drive, Suite 200  
Houston, Texas 77007-5833**

**Engineer of Record:**

**Vikram Raju, P.E., CFM  
TBPE Licence. No. 101237**

**Scientech Engineers, Inc.  
701 Shepherd Drive, Suite 200  
Houston, TX 77007-5833  
TBPE Firm Reg. No. 4014**

**Location Information:**

**Key Map Pages: 451N, P, S & T  
County: Harris City: Houston  
FIRM Panel: 48201C0665M  
Watershed: Buffalo Bayou  
Flood Zone: Other Areas  
Latitude: 29° 48' 42.61" W  
Longitude: 95° 29' 14.20" N**

**October 2014**

# TABLE OF CONTENTS

Table of Contents.....	iii
List of Exhibits, Tables, References & Photos.....	iv
I. Introduction.....	1
II. Existing Conditions.....	1
1. Existing Hydrology.....	2
2. Existing Hydraulics.....	2
III. Proposed Conditions.....	2
1. Proposed Hydrology.....	3
2. Proposed Hydraulics.....	3
IV. No-Impact Statement.....	3
Results.....	4
V. APPENDICES.....	5
Appendix 1: Exhibits.....	6
Appendix 2: Tables.....	17
Appendix 3: References.....	19
Appendix 4: Photos.....	24

## LIST OF EXHIBITS, TABLES & REFERENCES

Exhibit 1: Location Map .....	7
Exhibit 2: Vicinity Map .....	8
Exhibit 3: Aerial Map .....	9
Exhibit 4: NFIP FEMA - FIRM.....	10
Exhibit 5: TSARP Sub-Watershed Map .....	11
Exhibit 6: Drainage Area Map-Cedel Drive & Turquoise Lane .....	12
Exhibit 7: Existing Roadway Typical Section .....	13
Exhibit 8: Proposed Roadway Typical Section.....	14
Exhibit 9: Plan & Profile – Cedel Drive.....	15
Exhibit 10: Plan & Profile – Turquoise Lane .....	16
Table 1: Peak Flows using Site Runoff Curve Methodology (10-year & 100-year).....	18
Reference 1: Equation for Site Runoff Curves & Variable Parameters .....	20
Reference 2: Site Runoff Curves Chart for 100-Year Frequency Storm.....	21
Reference 3: Site Runoff Curves Chart for 10-Year Frequency Storm.....	22
Reference 4: % Impervious Values for Land Use Categories .....	23

## I. INTRODUCTION

This report provides the Impact Analysis for the Improvements of Neighborhood Street Redevelopment proposed by City of Houston Public Works Engineering (COH-PWE) Dept., Neighborhood Street Redevelopment (NSR) Division. **Appendix 1, Exhibit 1** shows the location of the project at the West corner of Harris County, Spring Branch Subdivision, South of SH 290, East of Beltway 8, West of 610 Loop and North of IH 10 West. **Appendix 1, Exhibit 2** shows the vicinity of the project specifying the limits of the project as Vogue Lane to the North, Hammerly Blvd to the South, Bingle Road to the West and Wirt Road to the East. **Appendix 1, Exhibit 3** shows the aerial view with the limits of the Overall Development Area of the project and limits of Development Area discharging to HCFCD Unit#: W140-04-00. **Appendix 1, Exhibit 4**, Flood Insurance Rate Map (FIRM) from National Flood Insurance Program (NFIP) of Federal Emergency Management Program (FEMA) shows the Proposed Overall Development Area North of Hammerly Blvd. is approximately 41.75 acres. The map shows that the limits of the proposed project improvements are completely outside Zone AE (100-year floodplain) and Zone X (500-year floodplain).

The proposed project characteristics that are considered in this report are:

1. Replacement of Existing Roadway Cross Section with a Proposed Standard Roadway Cross Section to adhere to the criteria of the City of Houston Public Works (COH-PWE) Infrastructure Design Manual (IDM) Requirements.
2. Replacement of the Existing Type "B-B" inlets with Proposed Type "B-B" inlets.
3. Existing Outfall Pipes discharging to HCFCD Unit#: W140-04-00 are NOT replaced in the proposed conditions and shall remain unaltered with respect to size and location as in the Existing conditions.

## II. EXISTING CONDITIONS

The project is located in the Buffalo Bayou Sub-Watershed W140E as shown in the **Appendix 1, Exhibit 5**, and TSARP Watershed Map. **Appendix 1, Exhibit 6**, Drainage Area Map shows the portion of the existing area of Cedel Drive and Turquoise Lane discharging into HCFCD Unit#: W140-04-00. The total area of the Proposed Overall Development discharging to HCFCD Unit#: W140-04-00 is 4.67 acres only. The remaining area of 37.08 acres of the Proposed Development discharges to the City of Houston storm sewer trunkline along Hammerly Blvd. Existing typical roadway section is shown in **Appendix 1, Exhibit 7**. The total drainage area of Cedel Drive discharging to HCFCD Unit#: W140-04-00 is 2.34 acres. The total drainage area of Turquoise Lane discharging to HCFCD Unit#: W140-04-00 is 2.33 acres. The drainage divide is along the centerline of the roadway section. The existing roadway is a two lane concrete pavement with asphalt overlay within a 60 feet right-of-way. The existing roadway cross slope is approximately 2% to 3% is non-standard per COH-IDM. Drainage is mostly sheet flow along the roadside curb discharging to the existing Type B-B inlets. The existing roadway conditions do not have a specific gutter design for drainage along the roadside curb which is non-standard per COH-IDM and. The landuse is mostly Single Family Residential with lots  $\leq$  ¼ acre in area. The total drainage area of Cedel Drive discharging to HCFCD Unit#: W140-04-00 is sub-divided into CD-DA1 (1.15 ac.) and CD-DA2 (1.19 ac.). CD-DA1 discharges to the North inlet at Sta. 2+97.63, 13.50' LT. and CD-DA1 discharges to the South inlet at Sta. 3+3.48, 13.50' RT. as shown in **Appendix 1, Exhibit 9**, Plan & Profile of Cedel Drive. The North and South Inlets are

connected together by an 18" RCP lead storm sewer. The 18" RCP outfalls to the 40' easement of HCFCD Unit#: W140-04-00 as shown in **Appendix 1, Exhibit 9**. The total drainage area of Turquoise Lane discharging to HCFCD Unit#: W140-04-00 is sub-divided into TQ-DA1 (1.18 ac.) and TQ-DA2 (1.15 ac.). TQ-DA1 discharges to the North inlet at Sta. 3+00.00, 13.50' LT. and TQ-DA2 discharges to the South inlet at Sta. 3+00.00, 13.50' RT. as shown in **Appendix 1, Exhibit 10**, Plan & Profile of Cedel Drive. The North and South Inlets discharge to 24" RCP that outfall to the 40 feet easement of HCFCD Unit#: W140-04-00 as shown in **Appendix 1, Exhibit 10**. Refer to **Appendix 4** for site visit photos.

## 1. Existing Hydrology

Site Runoff Curve Methodology is used to develop the total discharge of Drainage System "A" and System "B" for the 100-year and 10-year rainfall events per the Section 3.3.5 of HCFCD's, PCPM as shown in **Appendix 3, Reference 1**.

The equation for the Site Runoff Curve is:

$$Q = bA^m$$

where: Q = peak discharge (cfs.)

A = drainage Area (acres)

m = 1.0 for 1 to 20 acres and 0.823 for more than 20 acres up to 640 acres

b = variable dependent on Impervious cover

**Appendix 1, Exhibit 6**, Drainage Area Map is used to develop the Hydrologic parameters. The Impervious Cover is evaluated based on the Land Use Categories which are identified by field inspections of the project site and aerial maps. The Land Use Category used for the drainage areas is Residential-Small Lot (<= ¼ Acre) with 40% Impervious and 100% Development. The percent impervious values for the various land uses are assigned from the Section 3.5.1 of the HCFCD's, PCPM as shown in **Appendix 3, Reference 4**. The detailed calculation for the total 100-year and 10-year discharge from drainage areas based on the Site Runoff Methodology for the existing conditions is provided in **Appendix 2, Table 1**. The calculated 100-year and 10-year total discharge values for drainage areas of Cedel Drive and Turquoise Lane can be verified by using the charts provided for the Site Runoff Curves in **Appendix 3, Reference 2 and 3** respectively.

## 2. Existing Hydraulics

The Impact analysis is entirely based on the results of the Hydrological analysis and hence, No Hydraulic Analysis is performed.

## III. PROPOSED CONDITIONS

**Appendix 1, Exhibit 6**, Drainage Area Map shows the portion of the proposed development area of Cedel Drive and Turquoise Lane discharging into HCFCD Unit#: W140-04-00. This is same as existing conditions since the high points along the proposed roadway profiles which determine the drainage area divides are the same as the high points along the existing roadway profiles as shown in **Appendix 1, Exhibit 9 & 10**. Proposed typical roadway section is shown in **Appendix 1, Exhibit 8**. The proposed design requires a roadway section with a

standard Curb & Gutter section and standard 2% cross slope to adhere to the City of Houston Public Works (CO-PWE) Infrastructure Design Manual (IDM) Requirements. Hence the existing roadway cross section is revised per the IDM requirements. The proposed roadway is a two lane concrete pavement with no asphalt overlay within a 60 feet right-of-way. Drainage is gutter flow along the roadside curb & gutter discharging to the proposed Type B-B inlets. The proposed roadway conditions have a specific gutter design for drainage along the roadside curb. The landuse is mostly Single Family Residential with lots  $\leq$  ¼ acre in area with no change in impervious areas. The proposed drainage path is same as the existing conditions. The existing North & South Type B-B inlets will be replaced by proposed B-B inlets at the same locations on Cedel Drive and Turquoise Lane. The existing outfall pipes are unaltered in the proposed conditions with respect to size and location and will discharge the flows from the proposed Type B-B inlets to the 40 feet easement HCFCU Unit#: W140-04-00. Refer to **Appendix 4** for site visit photos.

## 1. Proposed Hydrology

The hydrology of the proposed conditions is same as the existing conditions. The drainage area boundaries of Cedel Drive and Turquoise lane are the same as the existing conditions since high points along the proposed roadway profiles which determine the drainage area divides are the same as the high points along the existing roadway profiles. The adjacent landuse along the right-of-way is same as the existing conditions with no change in impervious areas. The right-of-way in the proposed conditions is 60 feet which is same as the existing conditions. The roadway lane configuration is 2 lanes which same as the existing conditions with no change in impervious areas. The existing North & South Type B-B inlets will be replaced by proposed B-B inlets at the same locations on Cedel Drive and Turquoise Lane with no change of inlet flow to the outfall pipes discharging to the 40 feet easement HCFCU Unit#: W140-04-00. Therefore, the detailed calculation for the total 100-year and 10-year discharge from drainage areas of Cedel Drive and Turquoise Lane which is based on the Site Runoff Curve Methodology is provided in **Appendix 2, Table 1** and is applicable for existing and the proposed conditions.

## 2. Proposed Hydraulics

The Impact analysis is entirely based on the results of the Hydrological analysis and hence, No Hydraulic Analysis is performed.

## IV. NO-IMPACT STATEMENT

The detailed calculation for the total 100-year and 10-year discharge from drainage areas of Cedel Drive and Turquoise Lane which is based on the Site Runoff Curve Methodology is provided in **Appendix 2, Table 1** and is applicable for existing and the proposed conditions. Based on the study of the proposed design, which requires the replacement of the existing roadway cross section with proposed standard roadway cross section to adhere to the criteria of the City of Houston Public Works (COH-PWE) Infrastructure Design Manual (IDM) requirements, “**No-Impact**” is observed from drainage areas of Cedel Drive and Turquoise Lane to HCFCU Unit#: W140-04-00. No detention is required for the proposed improvements.

## Results

The detailed calculation for the total 100-year and 10-year discharge from drainage areas of Cedel Drive and Turquoise Lane which is based on the Site Runoff Curve Methodology is provided in **Appendix 2, Table 1** is applicable for existing and the proposed conditions.

# **V. APPENDICES**

Appendix 1: Exhibits

Appendix 2: Tables

Appendix 3: References

Appendix 4: Photos

# **Appendix 1: Exhibits**

Exhibit 1: Location Map

Exhibit 2: Vicinity Map

Exhibit 3: Aerial Map

Exhibit 4: NFIP FEMA - FIRM

Exhibit 5: TSARP Sub-Watershed Map

Exhibit 6: Drainage Area Map – Cedel Drive & Turquoise Lane

Exhibit 7: Existing Roadway Typical Section

Exhibit 8: Proposed Roadway Typical Section

Exhibit 9: Plan & Profile - Cedel Drive

Exhibit 10: Plan & Profile - Turquoise Lane

## **Exhibit 1: Location Map**

PROJECT  
LOCATION

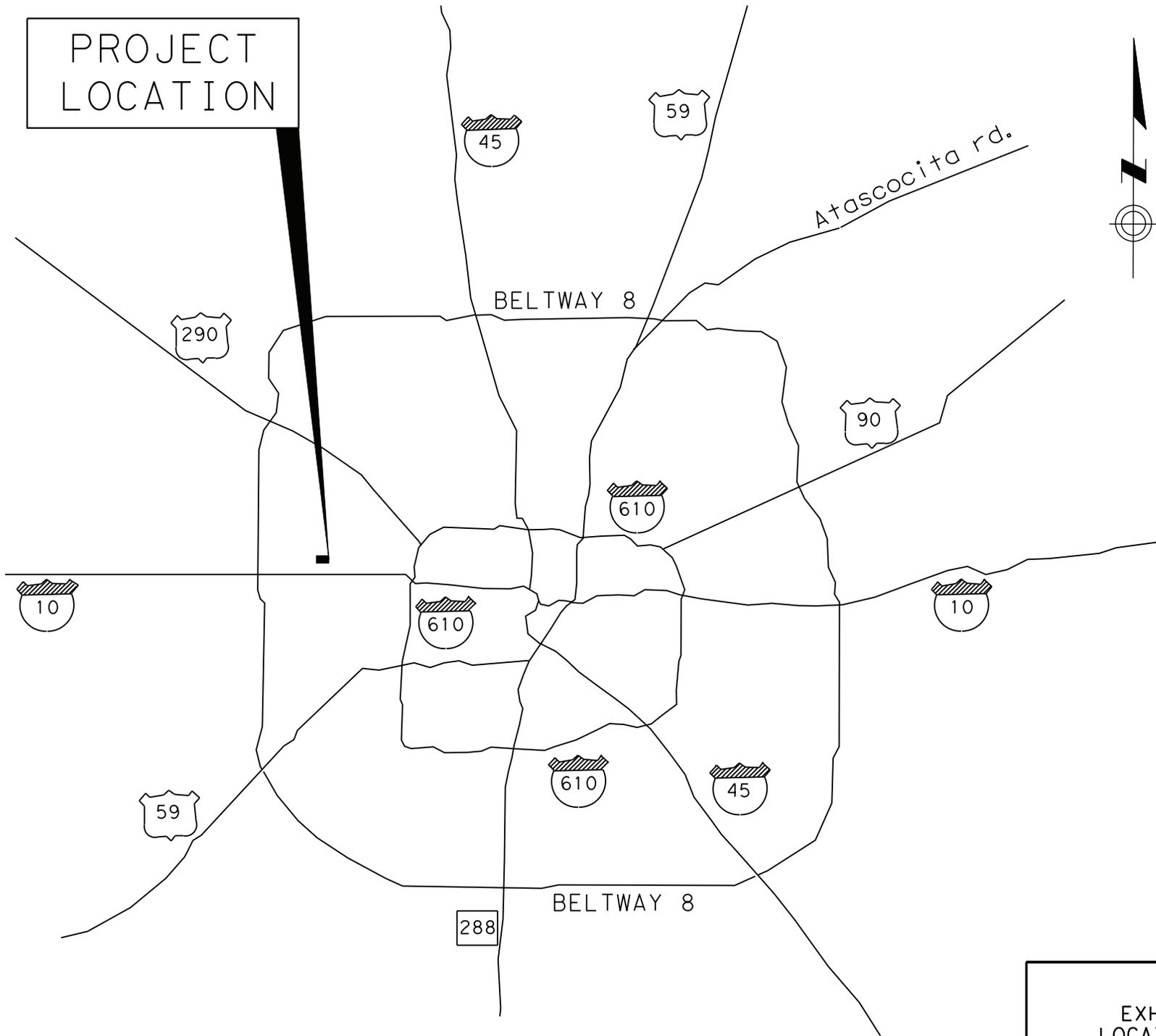


EXHIBIT 1  
LOCATION MAP

SCALE: NTS

## **Exhibit 2: Vicinity Map**



## **Exhibit 3: Aerial Map**

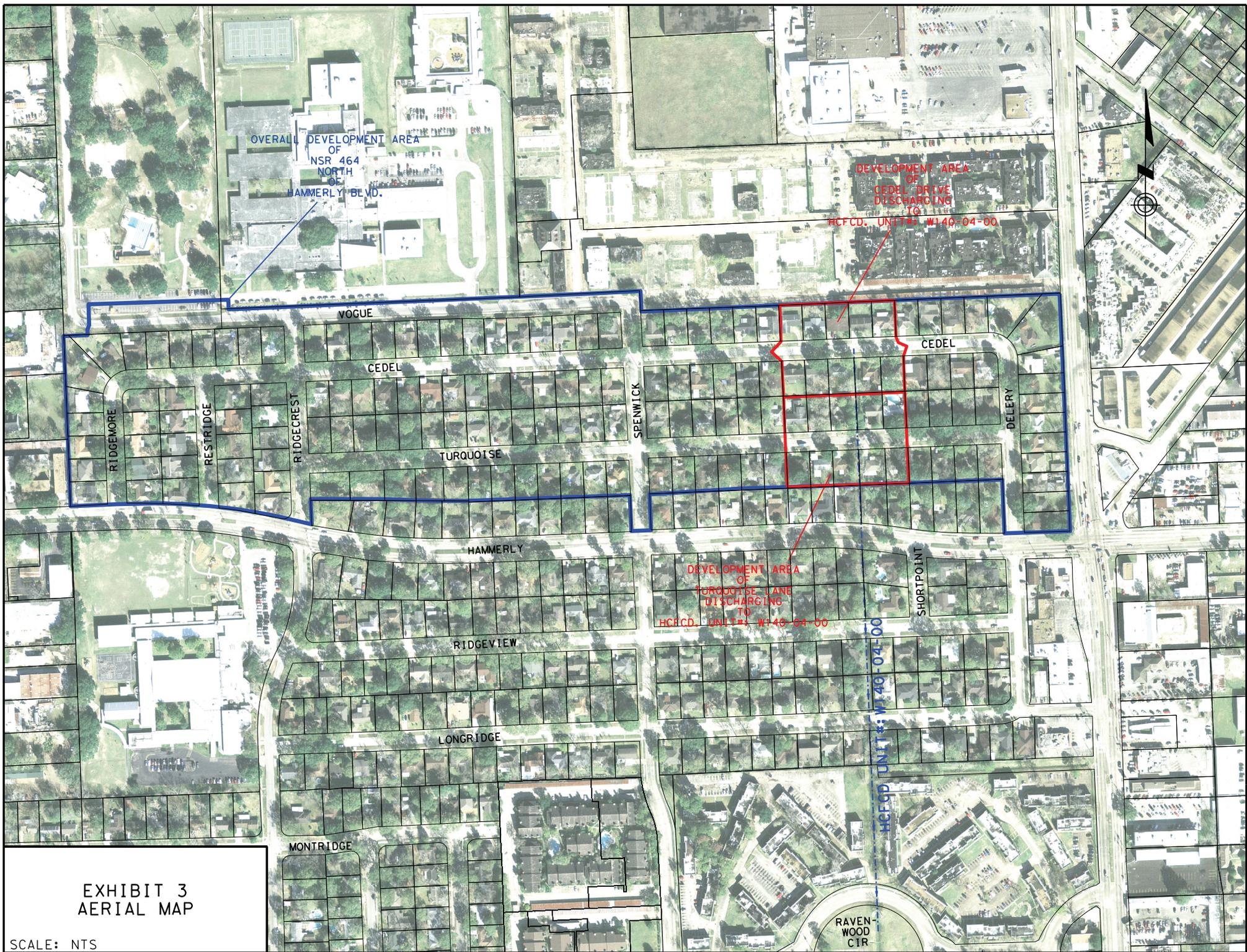


EXHIBIT 3  
AERIAL MAP  
SCALE: NTS

OVERALL DEVELOPMENT AREA  
OF  
NSR 464  
NORTH  
OF  
HAMMERLY BLVD.

DEVELOPMENT AREA  
OF  
CEDEL DRIVE  
DISCHARGING  
TO  
HCFCD UNIT #146-04-00

DEVELOPMENT AREA  
OF  
TURQUOISE LANE  
DISCHARGING  
TO  
HCFCD UNIT #146-04-00

HCFCD UNIT #146-04-00

RAVENWOOD  
CIR

## **Exhibit 4: NFIP FEMA - FIRM**

**NOTES TO USERS**

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The community map repository should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations (BFEs)** and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

**Coastal Base Flood Elevations** shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD 88). Users of this FIRM should be aware that coastal flood elevations are also provided in the summary of stillwater elevations table in the Flood Insurance Study Report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures in this jurisdiction.

The **projection** used in the preparation of this map was Universal Transverse Mercator, Zone 15. The **horizontal datum** was NAD83, GRS80 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same vertical datum. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at <http://www.ngs.noaa.gov> or contact the National Geodetic Survey at the following address:

NGS Information Services  
NOAA, NINGS12  
National Geodetic Survey  
SSMC-3, #9202  
1315 East-West Highway  
Silver Spring, Maryland 20910-3282  
(301) 713-3242

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at (301) 713-3242, or visit their website at <http://www.ngs.noaa.gov/>.

**Base map** information shown on this FIRM was provided in digital format by the Harris Galveston Area Council and was revised and enhanced by Harris County.

This map reflects more detailed and up-to-date **stream channel configurations** than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables in the Flood Insurance Study report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on this map.

**Corporate limits** shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels in which each community is located.

For information on available products associated with this FIRM visit the **FEMA Map Service Center (MSC)** website at <http://msc.fema.gov>. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the MSC website.

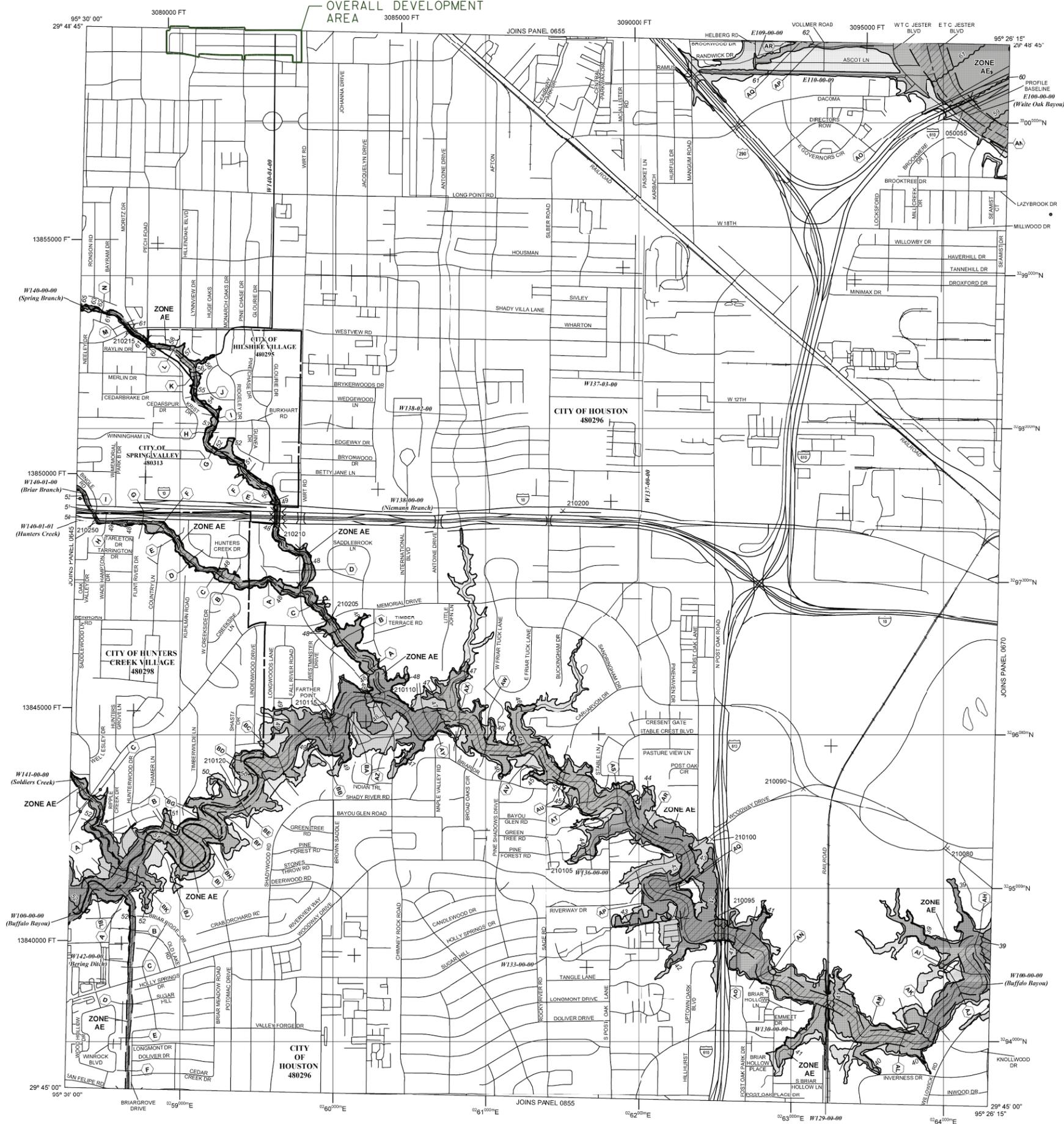
If you have **questions about this map**, how to order products or the National Flood Insurance Program in general, please call the FEMA Map Information Exchange (FMI) at 1-877-FEMA-MAP (1-877-336-2627) or visit the FEMA website at <http://www.fema.gov/business/nfip>.

Vertical Datum Adjustment due to subsidence is the 2001 adjustment.

Benchmarks shown on this map were provided by either Harris County or the National Geodetic Survey. To obtain elevation, description, and location information for benchmarks provided by Harris County, please contact the Permits Office of the Public Infrastructure Department at (713) 956-3000 or visit their website at <http://www.eng.hctx.net/permits>. For information regarding the benchmarks provided by the National Geodetic Survey, please see note above.

Some bridges and other structures shown on the detailed studied streams are not labeled. See corresponding flood profile for appropriate name.

**OVERALL DEVELOPMENT AREA**



**LEGEND**

- SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD
- ZONE A** No Base Flood Elevations determined.
- ZONE AE** Base Flood Elevations determined.
- ZONE AH** Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
- ZONE AO** Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
- ZONE AR** Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently identified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
- ZONE A99** Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
- ZONE V** Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
- ZONE VE** Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.
- FLOODWAY AREAS IN ZONE AE
- OTHER FLOOD AREAS**
- ZONE X** Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.
- OTHER AREAS**
- ZONE D** Areas determined to be outside the 0.2% annual chance floodplain. Areas in which flood hazards are undetermined, but possible.
- COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS
- OTHERWISE PROTECTED AREAS (OPAs)
- CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.
- Floodplain boundary
- Floodway boundary
- Zone D boundary
- CBRS and OPA boundary
- Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
- Base Flood Elevation line and value; elevation in feet\*
- Base Flood Elevation value where uniform within zone; elevation in feet\*
- \*Referenced to the North American Vertical Datum of 1988
- Cross section line
- Transect line
- Culvert, Flume, Intestock or Aqueduct
- Road or Railroad Bridge
- Footbridge
- Geographic coordinates referenced to the North American Datum of 1983 (NAD 83), Western Hemisphere
- 1000-meter Universal Transverse Mercator grid values, zone 15
- 5000-foot grid ticks; Texas State Plane coordinate system, zone South Central (FIPS/STATE 4204), Lambert Conformal Conic Projection
- Bench mark (see explanation in Notes to Users section of this FIRM panel)
- River file
- MAP REPOSITORIES  
Refer to Map Repositories list on Map Index.
- EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP PANEL  
SEPTEMBER 28, 1990
- EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL  
SEPTEMBER 30, 1992  
NOVEMBER 6, 1996  
APRIL 20, 2000  
JUNE 18, 2007  
OCTOBER 16, 2013  
JUNE 9, 2014
- For accompanying Reasons for Revision, refer to the Notice to Flood Insurance Study Users page in the Flood Insurance Study report.
- For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.
- To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

**NATIONAL FLOOD INSURANCE PROGRAM**

**PANEL 0665M**

**FIRM**  
FLOOD INSURANCE RATE MAP  
HARRIS COUNTY,  
TEXAS  
AND INCORPORATED AREAS  
MAP 665 OF 1150  
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
HILSHIRE VILLAGE, CITY OF	480295	0665	M
HOUSTON, CITY OF	480296	0665	M
HUNTERS CREEK VILLAGE	480298	0665	M
CITY OF SPRING VALLEY, CITY OF	480313	0665	M

Notes: This map was released on June 25, 2014 to make a correction. This version replaces any previous versions. See the Notice-to-User Letter that accompanied this correction for details.  
Notice to User: The Map Number shown below should be used when placing map orders. The Community Number shown above should be used on insurance applications for the subject community.

**MAP NUMBER**  
482100665M

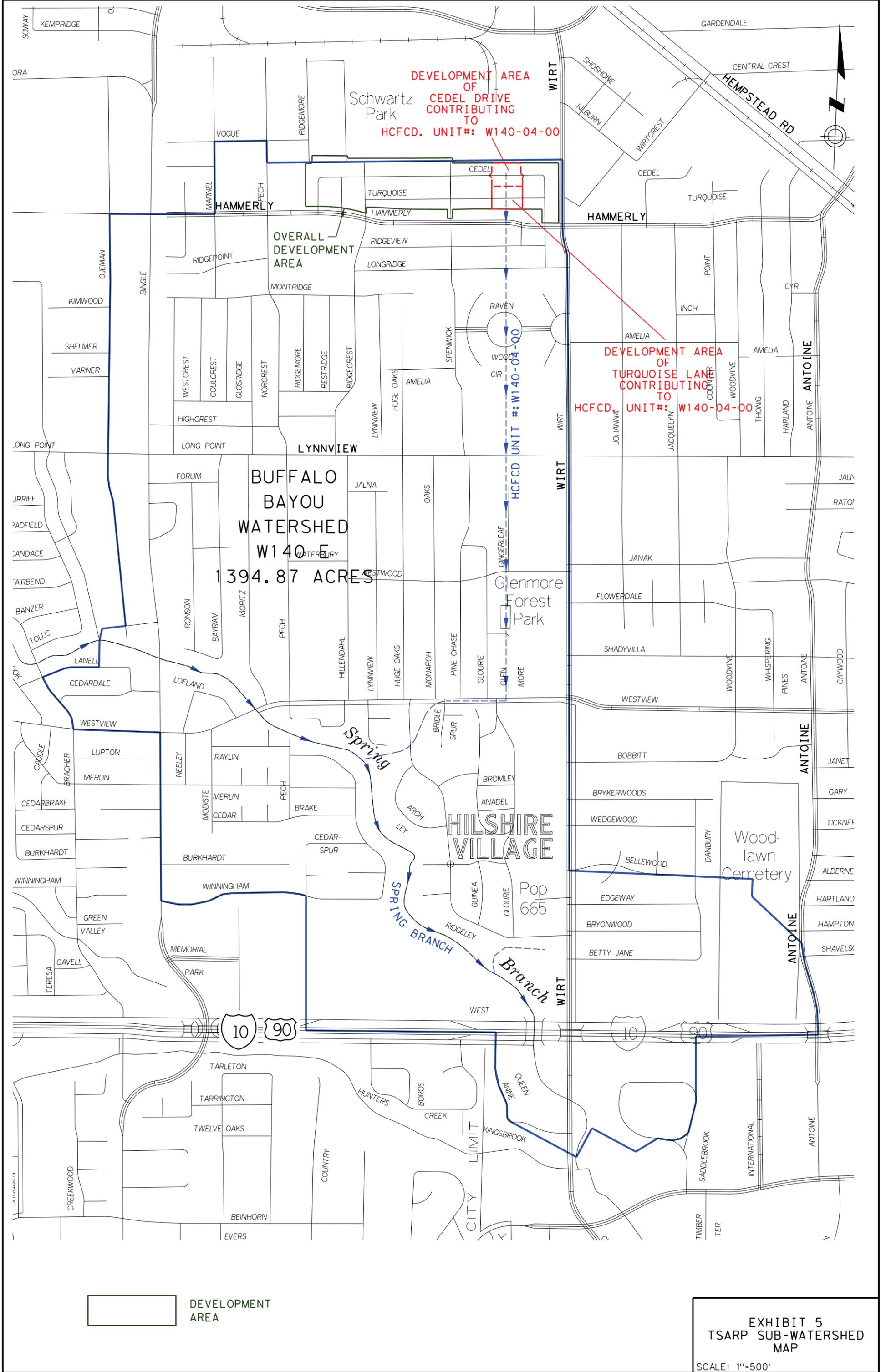
**MAP REVISED**  
JUNE 9, 2014

Federal Emergency Management Agency

**EXHIBIT 4**  
**NFIP FEMA FIRM**

SCALE: NTS

## **Exhibit 5: TSARP Sub-Watershed Map**



**BUFFALO BAYOU WATERSHED W140 E**  
 1394.87 ACRES

**DEVELOPMENT AREA OF CEDEL DRIVE CONTRIBUTING TO HCFCU. UNIT#: W140-04-00**

**DEVELOPMENT AREA OF TURQUOISE LANE CONTRIBUTING TO HCFCU. UNIT#: W140-04-00**

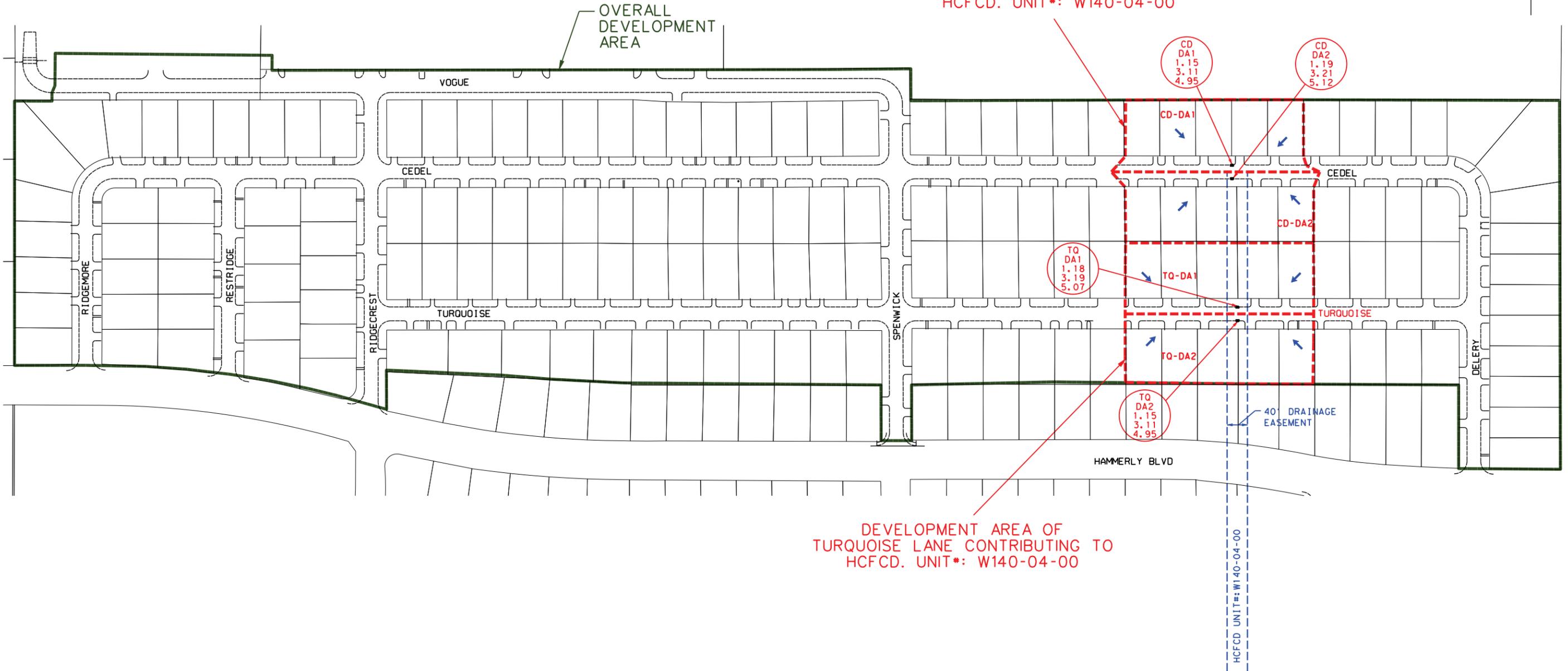
**OVERALL DEVELOPMENT AREA**

**HILSHIRE VILLAGE**  
 Pop 665

 **DEVELOPMENT AREA**

**EXHIBIT 5**  
**TSARP SUB-WATERSHED MAP**  
 SCALE: 1"=500'

## **Exhibit 6: Drainage Area Map-Cedel Drive & Turquoise Lane**



DEVELOPMENT AREA OF  
CEDEL DRIVE CONTRIBUTING TO  
HCFCO. UNIT#: W140-04-00

DEVELOPMENT AREA OF  
TURQUOISE LANE CONTRIBUTING TO  
HCFCO. UNIT#: W140-04-00

HCFCO UNIT#: W140-04-00

**LEGEND**

➔ DIRECTION OF SHEET FLOW

--- DRAINAGE AREA CONTRIBUTING TO PROPOSED INLET

■ PROPOSED INLET

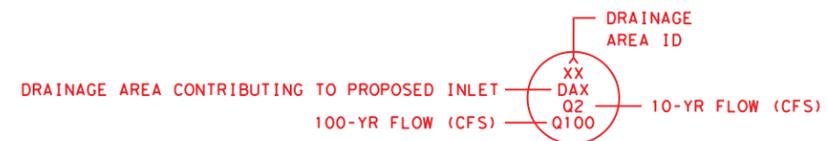
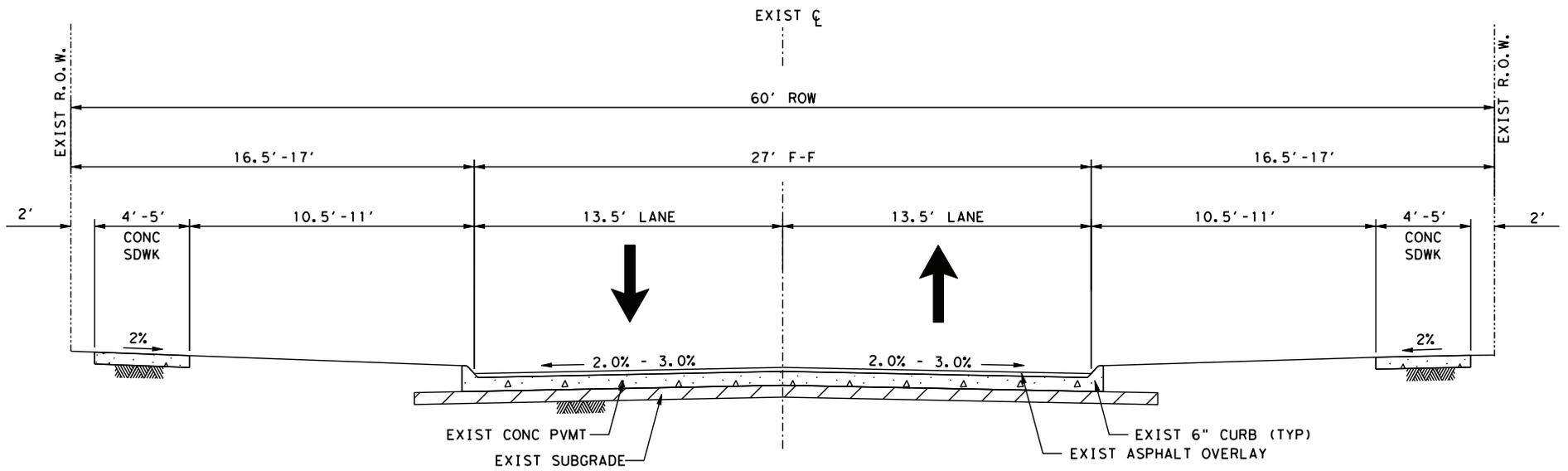


EXHIBIT 6  
DRAINAGE AREA MAP  
CEDEL & TURQUOISE  
SCALE: 1"=100'

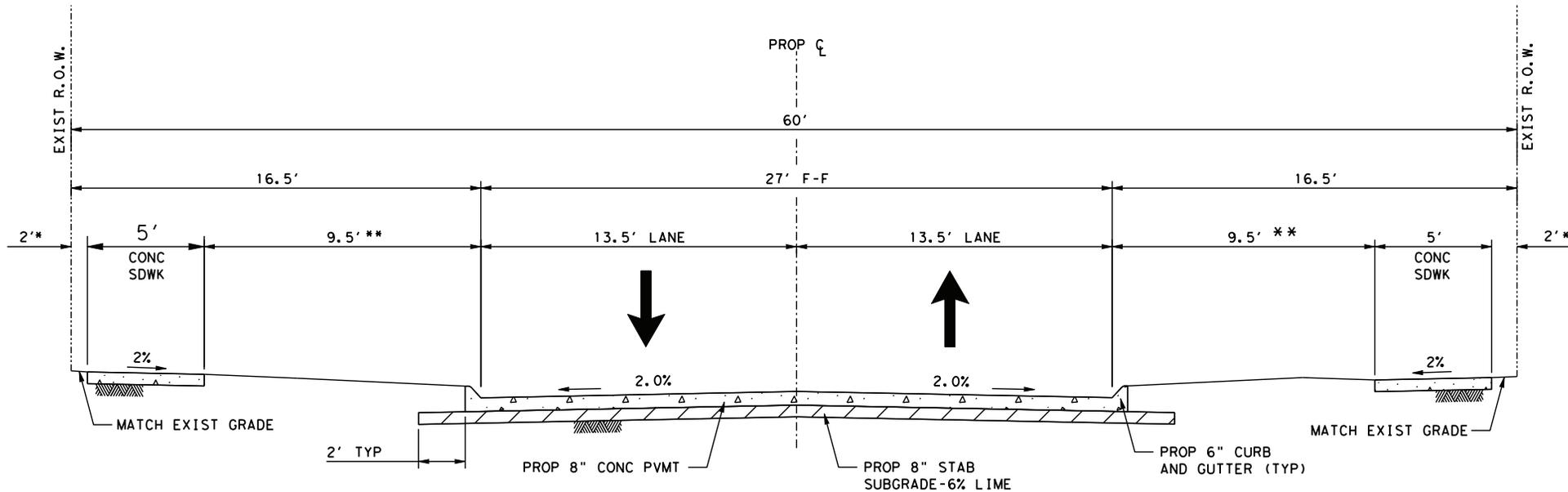
## **Exhibit 7: Existing Roadway Typical Section**



EXISTING TYPICAL SECTION  
 CEDEL DR STA 1+00.00 TO STA 27+14.49  
 TURQUOISE LN STA 1+13.36 TO STA 22+50.89

EXHIBIT 7  
 EXISTING ROADWAY  
 TYPICAL SECTION  
 SCALE: NTS

## **Exhibit 8: Proposed Roadway Typical Section**



PROPOSED TYPICAL SECTION

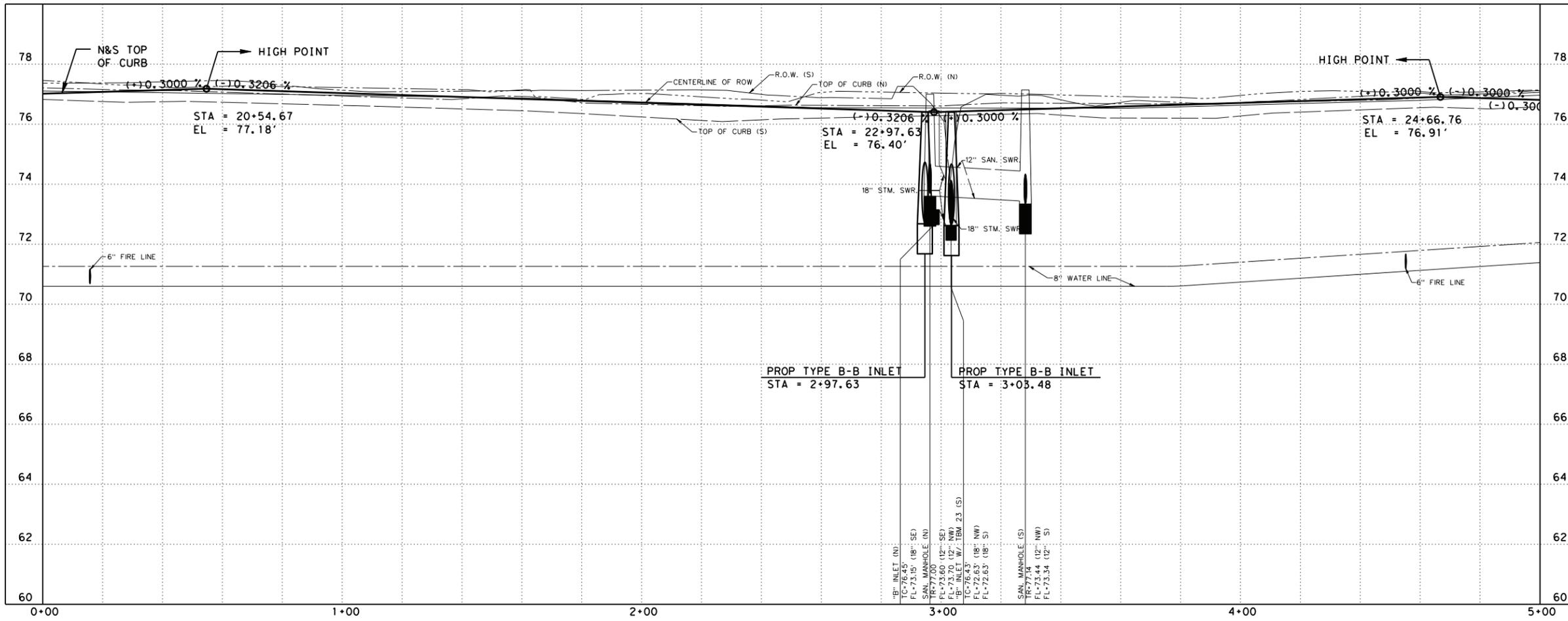
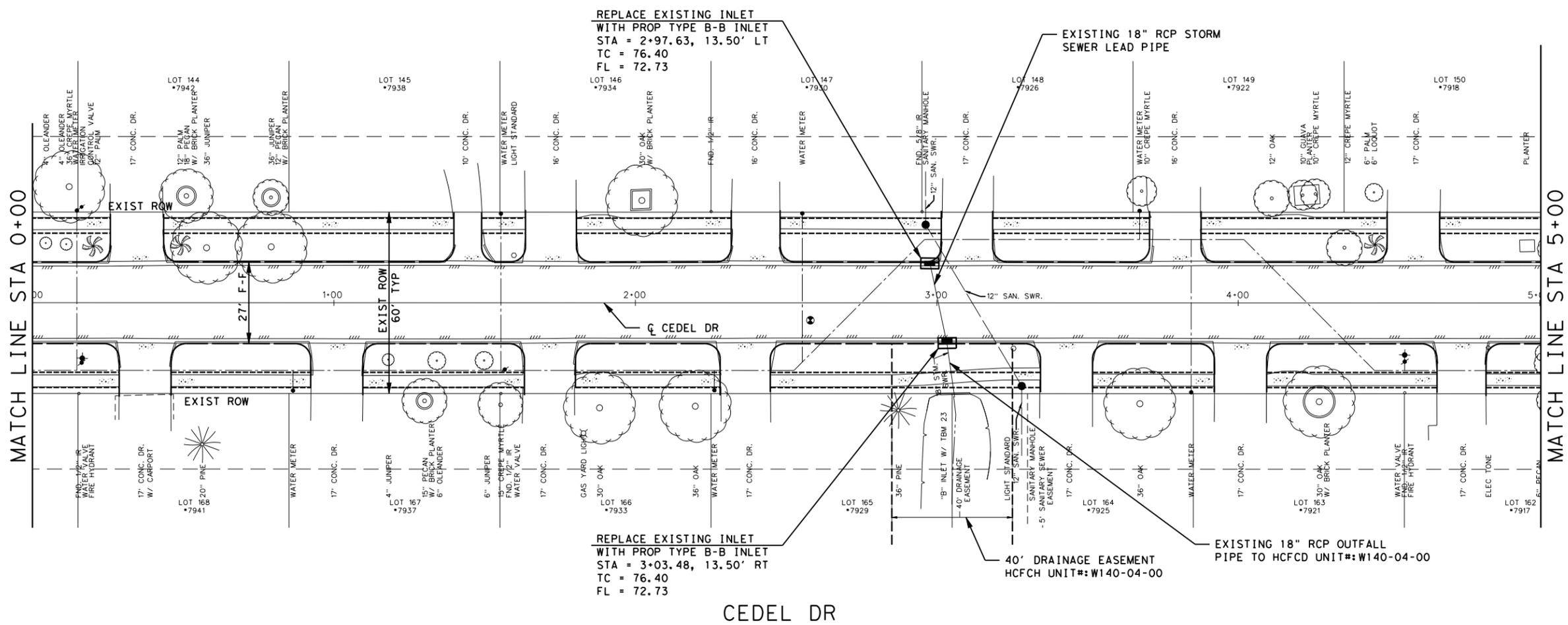
CEDEL DR STA 1+00.00 TO STA 27+14.49

TURQUOISE LN STA 1+13.36 TO STA 22+50.89

EXHIBIT 8  
PROPOSED ROADWAY  
TYPICAL SECTION

SCALE: NTS

## **Exhibit 9: Plan & Profile – Cedel Drive**



**SCIENTECH**  
 ENGINEERS

EXHIBIT 9  
 CEDEL DRIVE  
 PLAN AND PROFILE  
 STA 0+00 TO STA 5+00  
 SCALE: H: 1" = 40', V: 1" = 4'

## **Exhibit 10: Plan & Profile – Turquoise Lane**



## **Appendix 2: Tables**

Table 1: Peak Flows using Site Runoff Curve Methodology  
(10-year & 100-year)

**Table 1: Peak Flows using Site Runoff Curve Methodology (10-year & 100-year)**

**TABLE 1: Total Discharge (Q)**

Drainage Area	Total Area	Impervious	m	b 10-yr.	b 100-yr.	Q=bA <sup>m</sup> 10-yr. cfs.	Q=bA <sup>m</sup> 100-yr. cfs.
	ac.	%					
<b>CD-DA1</b>	1.15	40.00	1.000	2.70	4.30	<b>3.11</b>	<b>4.95</b>
<b>CD-DA2</b>	1.19	40.00	1.000	2.70	4.30	<b>3.21</b>	<b>5.12</b>
<b>TQ-DA1</b>	1.18	40.00	1.000	2.70	4.30	<b>3.19</b>	<b>5.07</b>
<b>TQ-DA2</b>	1.15	40.00	1.000	2.70	4.30	<b>3.11</b>	<b>4.95</b>

Impervious %	b 10-yr.	b 100-yr.
0	1.2	2.0
10	1.5	2.5
20	1.8	3.1
30	2.3	3.8
40	2.7	4.3
85	3.5	5.1

Note: Refer to Section 3.3.5 of HCFCD, PCPM provided in the Appendix for the "m" & "b" values  
 Refer to E 3-1& E 3-2 of the HCFCD, PCPM provided in the Appendix for the "Q" values

## **Appendix 3: References**

Reference 1: Equation for Site Runoff Curves & Variable Parameters

Reference 2: Site Runoff Curves Chart for 1% Probability  
(100-Year Frequency Storm)

Reference 3: Site Runoff Curves Chart for 10% Probability  
(10-Year Frequency Storm)

Reference 4: Percent Impervious Values for Land Use Categories

## **Reference 1: Equation for Site Runoff Curves & Variable Parameters**

### 3.3 Site Runoff Curves, Continued

**Equations for  
Site Runoff  
Curves  
3.3.5**

The equation for the Site Runoff Curves is:

$$Q = bA^m$$

where:  $Q$  = peak discharge (cfs)

$A$  = drainage area (acres)

$m$  = 1.0 for 1 to 20 acres and  
0.823 for more than 20 acres up to 640 acres

$b$  = variable dependent on impervious cover. See table below.

Impervious Cover	10 % Prob.		1% Prob.	
	≤ 20 acres	> 20 acres	≤ 20 acres	> 20 acres
0%	1.2	2.1	2.0	3.4
10%	1.5	2.6	2.5	4.3
20%	1.8	3.1	3.1	5.3
30%	2.3	3.9	3.8	6.4
40%	2.7	4.6	4.3	7.3
85%	3.5	5.9	5.1	8.7

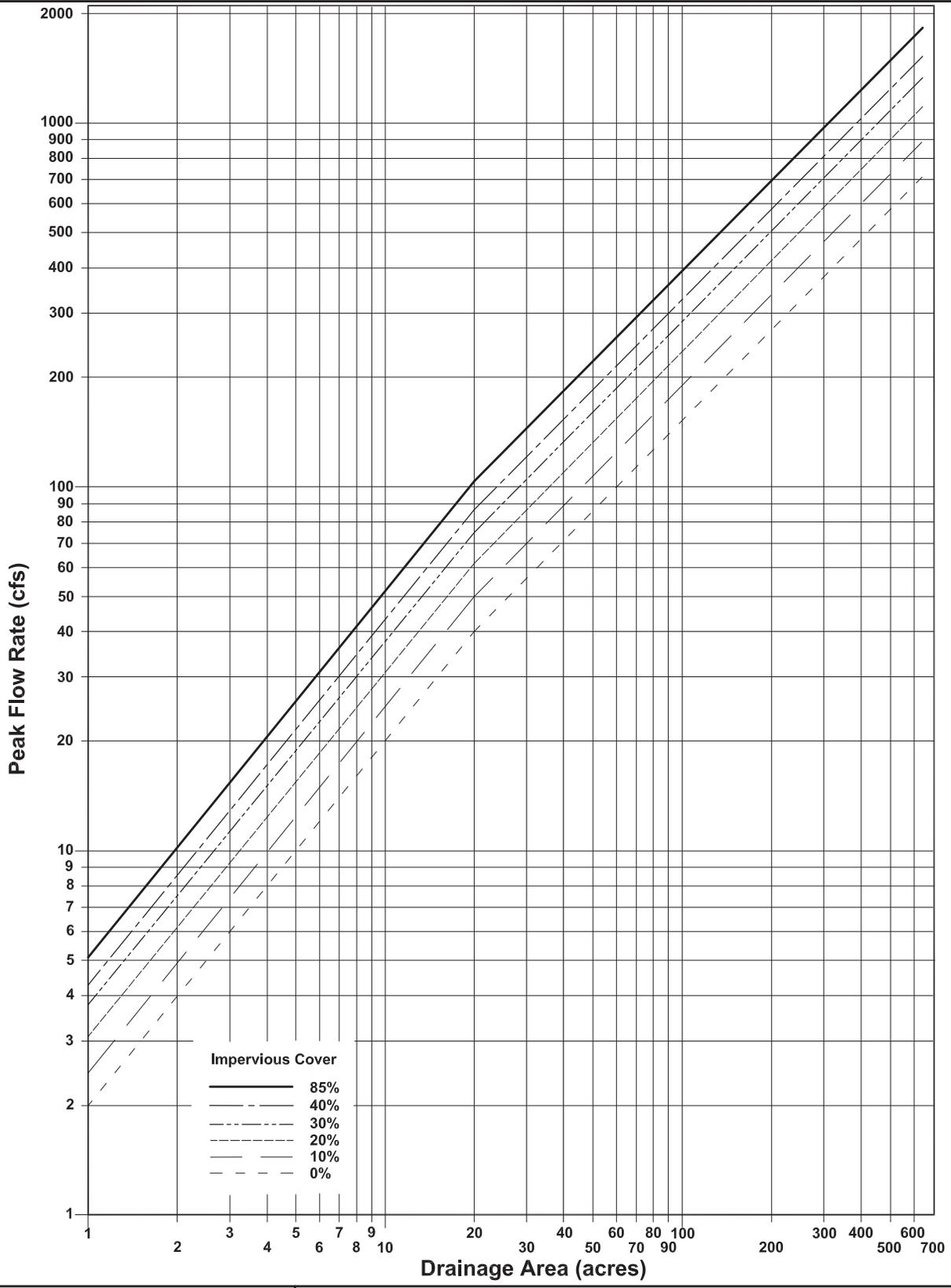
Notes:

Interpolate “b” linearly to determine peak discharges for percentages of impervious cover between those listed in the table.

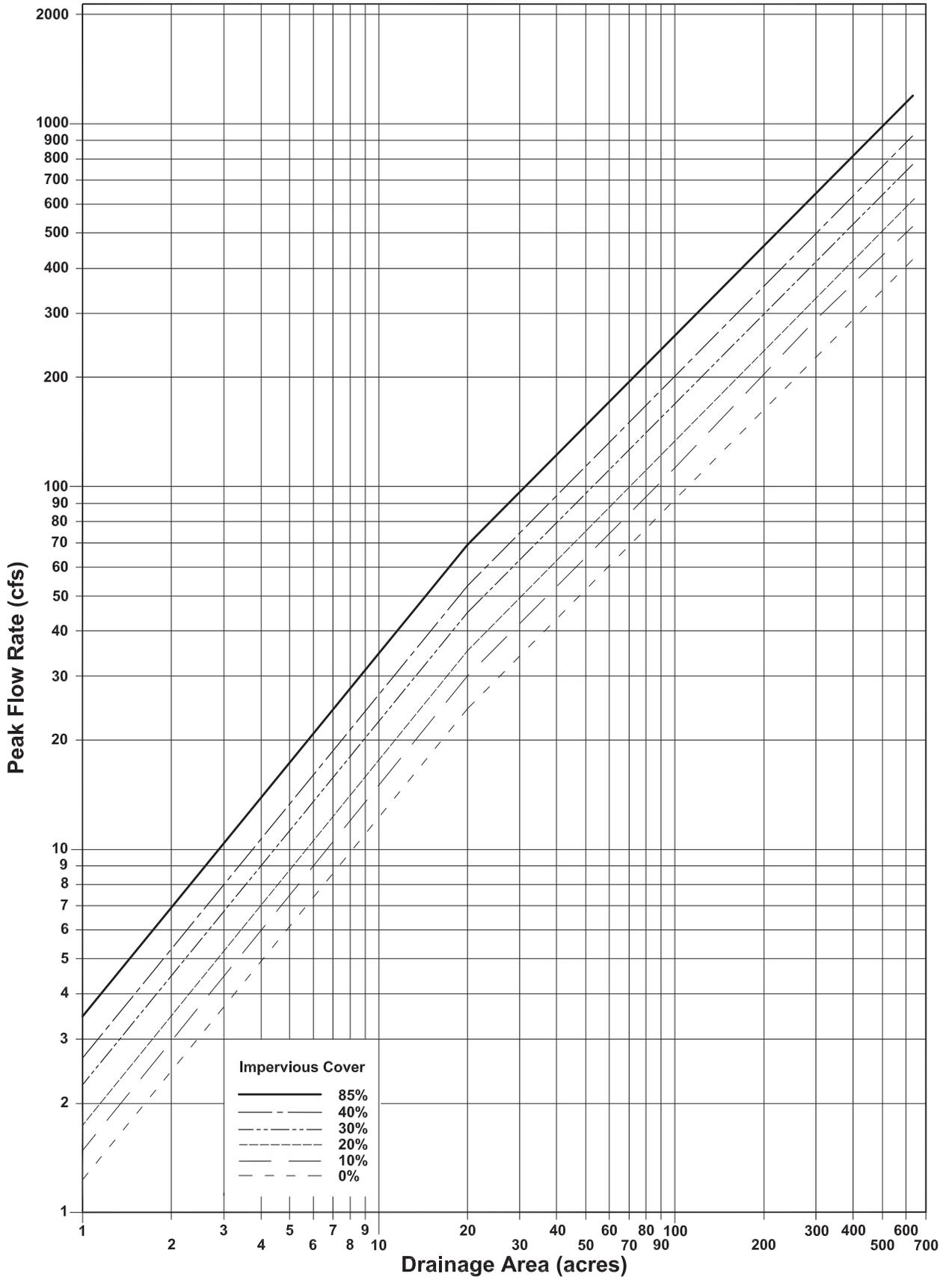
For areas with more than 85% impervious cover, use the 85% impervious curve.

Plots of these curves are shown in Exhibits 3-1 and 3-2.

## **Reference 2: Site Runoff Curves Chart for 100-Year Frequency Storm**



## **Reference 3: Site Runoff Curves Chart for 10-Year Frequency Storm**



**POLICY,  
CRITERIA, &  
PROCEDURE  
MANUAL**

**SITE RUNOFF CURVES FOR 10% EXCEEDANCE  
PROBABILITY (10-YEAR FREQUENCY) STORM**

DATE: 12/21/2010

EXHIBIT 3-1

## **Reference 4: % Impervious Values for Land Use Categories**

### 3.5 Impervious Cover

#### Relationship to Development 3.5.1

The generalized relationship between percent land development and percent impervious cover is shown below for various land uses:

Land Use Categories	Land Use Descriptions	% Impervious	% Development
Undeveloped	Unimproved, natural, or agricultural	0	0
Residential – Rural Lot	≥ 5 acre ranch or farm	5	0
Residential – Large Lot (Newer)	> ½ acre new residential neighborhoods, storm sewers or roadside ditches with adequate capacity	20	100
Residential – Large Lot (Older)	> ¼ acre, older neighborhoods with limited capacity roadside ditches	20	50
Residential – Small Lot	≤ ¼ acre	40	100
Schools	Schools with non-paved areas	40	50
Developed Green Areas	Parks or golf courses	15	50
Light Industrial/ Commercial	Office parks, nurseries, airports, warehouses, or manufacturing with non-paved areas	60	100
High Density	Commercial, business, industrial, or apartments	85	100
Isolated Transportation	Highway or major thoroughfare corridors	90	100
Water	Detention basins, lakes, and channels	100	100

Note: Based on HCFCD Hydrology and Hydraulics Guidance Manual

*Continued on next page*

## **Appendix 4: Photos**

Photo 1: Existing Inlets North and South of CEDEL Drive at Sta. 22+97.63 LT. & Sta. 23+00 RT. (Looking North)

Photo 2: Existing Inlet South of CEDEL Drive at Sta. 23+00 RT. & downstream of 40' easement of HCFCD Unit#: W140-04-00 south of CEDEL Drive. (Looking South)

Photo 3: Existing 18" RCP Outfall of CEDEL Drive to HCFCD Unit#: W140-04-00 at Sta. 23+00 RT. (Looking North)

Photo 4: 40' easement of HCFCD Unit#: W140-04-00 south of CEDEL Drive. (Looking South)

Photo 5: Existing Inlets North and South of Turquoise Lane at Sta. 18+00 LT. & Sta. 18+00 RT. (Looking North)

Photo 6: Existing Inlets North and South of Turquoise Lane at Sta. 18+00 LT. & Sta. 18+00 RT. (Looking South)

Photo 7: Existing Inlet North of Turquoise Lane at Sta. 18+00 LT. (Looking North)

Photo 8: Existing Inlet South of Turquoise Lane at Sta. 18+00 RT. (Looking South)

**PHOTOS**

**PHOTO #1: (Looking North)**



**Existing Inlets North and South of CEDEL Drive at Sta. 22+97.63 LT. & Sta. 23+00 RT.**

**PHOTO #2: (Looking South)**



**Existing Inlet South of CEDEL Drive at Sta. 23+00 RT. & downstream of 40' easement of HCFCD Unit#: W140-04-00 south of CEDEL Drive.**

**PHOTOS**

**PHOTO #3: (Looking North)**



**Existing 18" RCP Outfall of CEDEL Drive to HCFCD Unit#: W140-04-00 at Sta. 23+00 RT.**

**PHOTO #4: (Looking South)**



**40' easement of HCFCD Unit#: W140-04-00 south of CEDEL Drive.**

**PHOTOS**  
**PHOTO #5: (Looking North)**



**Existing Inlets North and South of Turquoise Lane at Sta. 18+00 LT. & Sta. 18+00 RT.**

**PHOTO #6: (Looking South)**



**Existing Inlets North and South of Turquoise Lane at Sta. 18+00 LT. & Sta. 18+00 RT.**

**PHOTOS**

**PHOTO#7: (Looking North)**



**Existing Inlet North of Turquoise Lane at Sta. 18+00 LT.**

**PHOTO#8: (Looking South)**



**Existing Inlet South of Turquoise Lane at Sta. 18+00 RT.**