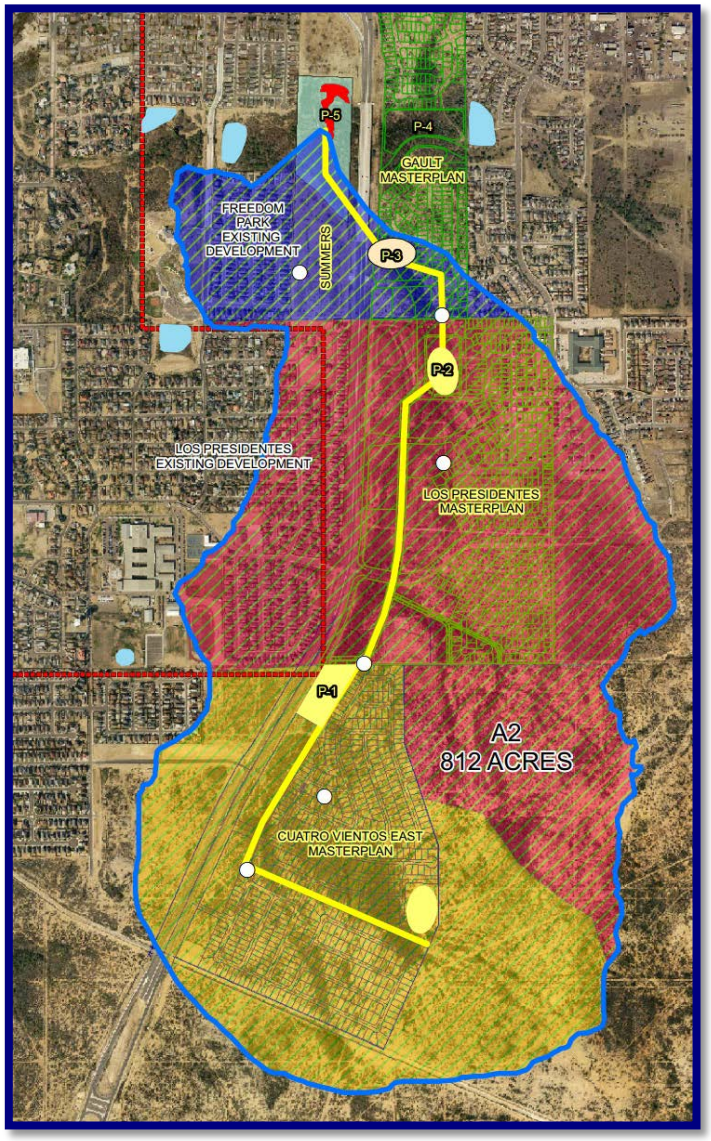
WEBB COUNTY DRAINAGE DISTRICT NO. 1

HYDRAULIC AND HYDROLOGIC STUDY
(CUATRO VIENTOS EAST, LOS PRESIDENTES, & GAULT)



WCDD BOARDMEMBERS

MS. LETI MARTINEZ
PRESIDENT

MR. AMBROSIO GARZA
TREASURER

MS. MARGIE ARCE
BOARDMEMBER

SUBMITTED BY:

CRANE ENGINEERING
CIVIL • PUBLIC WORKS • PLANNING • HYDROLOGY

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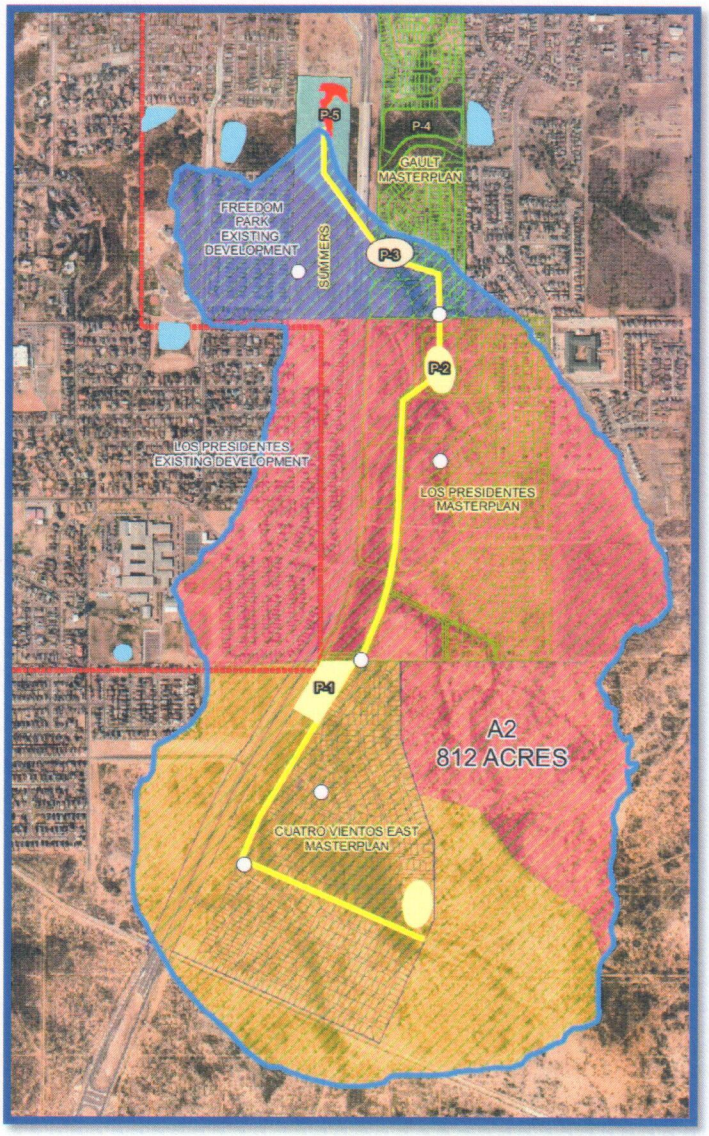

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THE STATE OF TEXAS
COUNTY OF WEBB

6/30/15

STATE OF TEXAS
EDWARD D. GARZA
75853
LICENSED
PROFESSIONAL ENGINEER

SUBMITTED BY:

CRANE ENGINEERING
CIVIL • PUBLIC WORKS • PLANNING • HYDROLOGY

TABLE OF CONTENTS

1. PURPOSE

The purpose of this report is to integrate three (3) individual developments into one (1) regional hydrologic and hydraulic analysis. The intent of this analysis is to determine the current 100 year base flood elevation (BFE) conditions of the existing creek system and ponds within the study area as well as develop regional stormwater management design criteria to culminate at an existing pond located on 15.38 acre tract currently owned by the City of Laredo. This will serve as a basis to establish levels of financial cooperation among the three developments to pursue a regional stormwater solution. Refer to Exhibit #1 for Location Map containing limits of study and Exhibit #2 for Existing Creek System (including Greenspace Stream Order).

By conveying post flow from the developments immediately upstream through Los Presidentes' future drainage system and Gault's future drainage system, a detention pond can be eliminated within Cuatro Vientos East, Los Presidentes as well as one of the masterplanned ponds within Gault thus reducing long term maintenance costs for the Webb County Drainage District. This reduction in detention ponds will increase land area available for residential and/or commercial purposes benefitting both private and governmental entities.

2. EXISTING CONDITIONS

Cuatro Vientos East Subdivision (CVE) is located upstream from Los Presidentes (LP). Its watershed is 420.04 acres or 51.70% of the total watershed while Los Presidentes watershed contains 306.36 acres or 37.80% of the total watershed, and the Summers and Gault properties (SG) watershed totals 85.61 acres or 10.50% of the total watershed. For the purpose of this analysis, the total watershed is being identified as A2. Subwatersheds are identified as CVE, LP, and SG respectively.

Watershed A2 is comprised of approximately 812 acres. Refer to Exhibits #1 "Location Map" and #5 "Overall Watershed Map" for watershed boundaries. Small areas of the watershed encroach onto existing developments including Lago Del Valle to the east, Los Presidentes to the west, as well as Cuatro Vientos Sur to the southwest. The watershed is comprised of primarily undeveloped land within the Laredo City limits.

There are two (2) major creeks and two (2) minor tributuaries that convey stormwater and converge at an existing pond adjacent to Cuatro Vientos Rd labeled "P-5" in Exhibit #1 "Location Map". Pond discharges through a natural creek and leaves the property due west along its natural course towards Merida Drive. The two tributaries are stream order 1 creeks, while the creek flowing south to north adjacent to Cuatro Vientos Rd. is a 2nd order stream. Stream order 1 & 2 creeks recommend 50' vegetative buffer. First and second order streams are voluntary and allow for disturbance of the immediate buffer if the requirements of section 24.57.7 of the City ordinance are met. The creek within the Summers and Gault properties is a 3rd order stream which requires a

mandatory 50' vegetative buffer. There are currently no effective special flood hazard areas within the watershed being studied. Exhibit 2 illustrates existing creek system.

The overall watershed (A2) is composed of three (3) types of soils that contain hydrologic properties that vary from being in groups B-D as depicted in Exhibit 3 Soils Map according to the NRCS Soil Survey of Webb County, Texas. The project site consists of Verick Fine Sandy Loam (VkC), Copita (CpB), and Jimenez-Quemado complex (JQD). The descriptions of these soils are as follows:

VkC – Verick Fine Sandy Loam (VkC)-*This soil is well drained. Surface runoff is medium, and permeability is moderate. Water erosion and soil blowing are moderate hazards if this soil is left bare of vegetation. This soil is poorly suited to most urban and recreation uses. Shallowness to sandstone is the main limitation. This soil is in the Shallow Sandy Loam range site.*

CpB – Copita fine sandy loam- This moderately deep, nearly level to gently sloping soil is on summits and side slopes of low hills and on broad, convex plains. Typically, the surface layer is brown fine sandy loam about 9 inches thick. Water erosion and soil blowing are moderate hazards if this soil is left bare of vegetation. This soil is moderately well suited to most urban uses.

JQD – Jimenez-Quemado Complex- These shallow to very shallow soils are on the summit and side slopes of hills and ridges. The Jimenez soil is mainly on side slopes of hills and ridges, and the Quemado soil is mainly on the summit of hills and ridges. The areas of these soils are so intricately mixed that mapping them separately was not practical at the scale used in mapping. The Jimenez soil is well drained. Surface runoff is medium, and permeability is moderate. The water erosion hazard is moderate, and the soil blowing hazard is slight if this soil is bare of vegetation. The Quemado soil is well drained. Surface runoff is medium, and permeability is moderate. The hazard of water erosion is moderate, and the hazard of soil blowing is slight if this soil is bare of vegetation. Both soils are an important source of caliche and gravel for use as construction materials. These soils are poorly suited to most urban and recreation uses.

Proposed Masterplans were provided by the developers for all three developments within this study and can be seen overlaid within many of the attached exhibits. Detailed land use information per development can be seen within the SCS Curve Number determination section of Exhibit #6. Land uses varied between single-family residential, multi-family residential, commercial, and park areas. Proposed land uses and preliminary drainage easement locations were incorporated into the H&H analysis further described in the following Section 4.

Also integrated into this analysis is the existing bridge crossing of Cuatro Vientos Rd. adjacent to the existing pond targeted as the regional detention area.

4. H&H ANALYSIS

A feasibility study for the three cooperating developments described in the previous section consisting of a H&H Analysis was prepared by integrating these proposed developments to determine if individual detention ponds can be replaced with a regional pond with adherence of certain design criteria which will be described further. Refer to Exhibits 8A "Channel Design Criteria/Estimated Storage Requirements" and 8B "Conduit Design Criteria".

Exhibit 4 provides watershed delineations used to estimate time of concentration. The SCS Curve Method was utilized to develop design flows. Pre-development and post-development flows take into consideration hydrologic soil types, current and future land use, proposed drainage designs provided by respective engineering consultants, antecedent moisture conditions, and existing storm drainage structures.

As per the future masterplans provided, channels were analyzed for adequate capacity in conveyance of multiple pre and post development flow scenarios (See Exhibits 8A and 8B). Post and predevelopment flows are indicated for the 25-year, 50-year, and 100-year return events. Flows determined within this analysis for Watershed A2's Subwatersheds are as follows:

H&H Run Results (Exhibit 6):

HEC-RAS, HY-8, and Pondpack were utilized to model the estimated flows for Cuatro Vientos East, Los Presidentes, and Gault. Models were developed utilizing masterplans received from Cuatro Vientos East consultants, Los Presidentes consultants, Gault property owners, previous studies commissioned by WCDD within the study area and plans from TxDOT. The following observations are made based on the available data as follows:

A1: The peak pre development outflow of Watershed A2 consisting of the three developments is estimated at 1,640 cfs for the 100 year event. The peak post development outflow is 3,159 cfs. The estimated storage requirement for this regional detention area is 117 ac-ft. Refer to Exhibit 6 for model output. Based on the existing contours gathered from the City of Laredo's 2013 database and assuming the pond is utilized entirely for detention, it is feasible to integrate Cuatro Vientos East, Los Presidentes and Gault into a regional stormwater management plan to be detained at this proposed location. Further detailed surveying will be required to determine the maximum available storage at the site. The existing pond does not encompass the entire City owned 15.38 acre tract available, therefore necessary enhancements can be made to achieve the required storage within the proposed regional pond.

A2: The following represents the individual storage requirements per development should each construct their own individual pond:

CVE (ac-ft)	LP (ac-ft)	SG (ac-ft)
44.17	38.26	25.00

Note: Cuatro Vientos East storage requirement is based on the 50-year event. Los Presidentes and Gault storages are based on the 100-yr event due to their location within the 100-yr floodplain.

Existing Conditions Floodplain Analysis:

B1: This study includes an existing conditions floodplain analysis. Exhibit #7 "Revised Floodplain Map (Existing Conditions) indicates the current floodplain zoning, current Base Flood Elevations (BFEs) in previously studied areas submitted to FEMA, the revised floodplain inundation map for Reach 1, and Base Flood Elevations for Reaches 1 and 2. The average width of the revised floodplain for Reach 1 is 276.94ft with Base Flood Elevations ranging from 432.39ft to 545.11ft. For Reach 2, the average width of the floodplain is 548.6ft with Base Flood Elevations ranging from 434.17ft to 443.64ft. One area that offers an effective level of comparison between effective BFEs and BFEs determined within this study is within Reach 2 between STA:12+65.56 with a BFE of 440.54 and STA:9+45.55 with a BFE of 439. The effective BFE determined at a cross-section lying between the two aforementioned stations is 439. Supporting HEC-RAS output can be found within Exhibit #6.

Stormwater Management Design Criteria:

C1: Preliminary open channel designs were developed for various scenarios assuming channel design slopes equal to existing natural contours. Exhibit 8A displays various scenarios, flows, and preliminary design parameters for the purpose of comparison of typical flows consisting of upstream pre developments flows and post development flows for the respective development to flows for the respective development accepting post development flow from upstream development.

C2: For the channel section conveying stormwater through Los Presidentes within the effective 100-yr floodplain A zone, the preliminary channel design would consist of a 8ft deep channel with a 25ft bottom width, 3ft top width and 3 to 1 lateral slopes for a capacity of 2,005 cfs. In order to convey Cuatro Vientos East post flow, this channel would have to be increased in depth by 1 ft, bottom width by 11ft and top width by 17ft still within the drainage easement shown on the masterplan for increased capacity of 3,229 cfs.

C3: For the channel section conveying stormwater through Gault property which is partially within an effective 100-yr floodplain A zone and AE Zone, the preliminary channel design would consist of a 8ft deep channel with a 25ft bottom width, 81ft top width and 3.5 to 1 lateral slopes for a capacity of 1,647 cfs. In order to convey Cuatro Vientos East post flow and Los Presidentes post flow, this channel would have to be increased in depth by 1.5ft, bottom width by 18.5ft, increased top width by 19.5ft, and for an increased capacity of 3,160 cfs.

C4: Pipe alternatives were developed for conveying stormwater through Los Presidentes within the effective 100-yr floodplain A zone. The preliminary design would consist of a five (5) 60" diameter pipes and one (1) 66" diameter pipe for a capacity of 2,043 cfs. In order to convey Cuatro Vientos East post flow, this design would require upgrading to two (2) 72" diameter pipes and two (2) 72" diameter providing capacity of 3,291 cfs. Flow rate capacity determined under the assumption of slopes following natural contours and pipe material is Contech SmoothCor or approved equal.

C5: The pipe alternative for conveying stormwater through Gault property which is partially within an effective 100-yr floodplain A zone and AE Zone consists of a five (5) 66" diameter pipes and one (1) 42" diameter pipe for a capacity of 1,706 cfs. In order to convey Cuatro Vientos East post flow, this design would require upgrading the system to consisting of seven (7) 72" diameter pipes and one (1) 66" diameter pipe providing capacity of 3,165 cfs. Flow rate capacity determined under the assumption of slopes following natural contours and pipe material is Contech SmoothCor.

C6: A preliminary opinion of construction costs was developed to further conclude the feasibility of a regional stormwater management plan. See Exhibit #9. The cost difference between the scenarios described in observations C2 and C3 is approximately $301,905. The cost difference between the scenarios described in observations C4 and C5 is approximately $73,148. These costs should be adjusted for engineering, surveying and geotechnical services.

5. CONCLUSIONS & RECOMMENDATIONS

Developing an overall plan for regional detention integrating Cuatro Vientos East, Los Presidentes, and Gault stormwater management is feasible. This design criteria set forth in this study indicates there is value and benefits for all stakeholders. Land previously required for detention can be utilized more beneficially. The existing pond proposed for regional detention does contain adequate storage, although further environmental study is required to determine the ordinary high water mark as to pinpoint the precise amount of storage currently available above the ordinary high water mark. This environmental study is currently underway. The current pond does not encompass the entire 15.38 acre tract which offers room for enhancement of the pond to accommodate the necessary storage requirements of 117ac-ft.

Establishing a cooperative financial breakdown between developers is the next step in reaching a regional solution. A suggested breakdown of contributions to be made percentagewise of construction costs is provided in Exhibit 8A. Percentages were developed through comparison of the pre-development and post-development flows to be accepted by downstream developers.

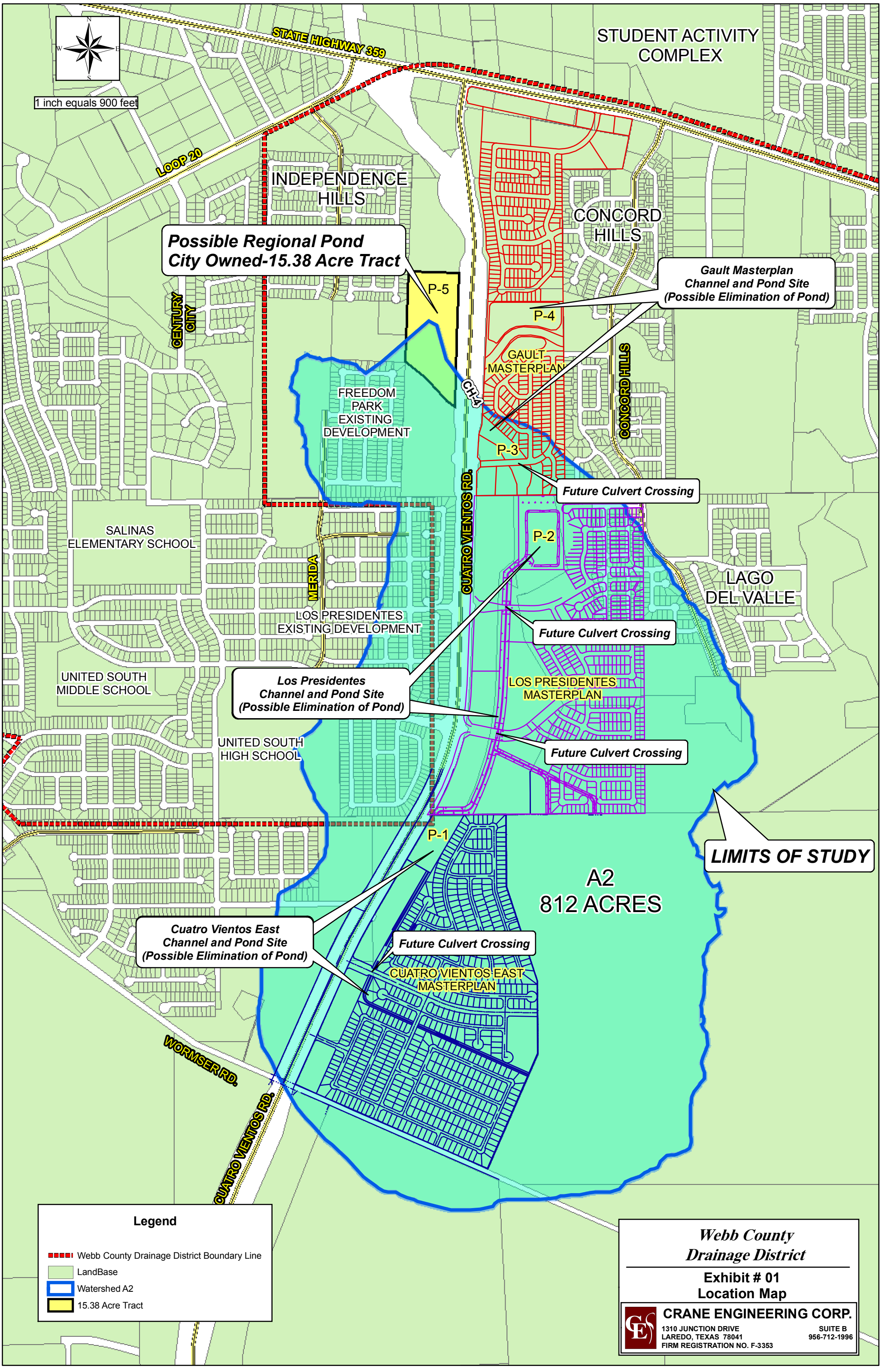
The existing conditions floodplain analysis indicates that the computed floodplain is smaller than the current floodplain. An existing condition Letter of Map Revision (LOMR) submittal is recommended to update the existing firm map. This will establish the baseline BFEs and model that can be updated to a CLOMR with proposed channel improvements after the environmental study is completed.

In order to implement a regional stormwater management program, the following action is recommended:

1) Submit existing condition LOMR to City and FEMA to reduce floodplain inundation within Los Presidentes and Gault properties and define BFEs;
2) Utilize Phase I Environmental Study upon completion to determine need for 404 Permit and establish detailed comprehensive stormwater management plan along existing creek with detailed cost estimate including future culvert crossings;
3) Complete detailed topographic survey of existing City of Laredo pond on Summers property to develop detailed topo and conditions to prepare schematic and cost estimate on necessary enhancements and cost sharing schedule for a regional detention pond.
4) Analyze, in detail, Watersheds A11, A5, and A3 containing a 3rd order stream contributing run-off to the proposed regional pond site. The limits of current study only encompass a small portion of Gault's masterplanned property with the remainder of the property being located within Watershed A11 (See Exhibit #5-Overall Watershed Map).

Implementing the above stated actions will emphasize the District's commitment to reducing long term maintenance cost and assisting land owners to properly plan their stormwater masterplans. Benefits include:

1) Enhancing tax base by removing land area from 100 year floodplain and converting into usable property for development based on existing conditions analysis herein. ***Requires Action 1) LOMR Submittal**;
2) Encourage platting and development by providing regional stormwater solutions that incorporate Federal, State, and Local requirements throughout the remainder of drainage district jurisdiction. These studies will set the baseline for platting these tracts with the City of Laredo.


1 inch equals 900 feet
STATE HIGHWAY 359
LOOP 20
STUDENT ACTIVITY COMPLEX
INDEPENDENCE HILLS
CONCORD HILLS
Possible Regional Pond
City Owned-15.38 Acre Tract
Gault Masterplan
Channel and Pond Site
(Possible Elimination of Pond)
P-5
P-4
P-3
P-2
P-1
CENTURY CITY
GAULT MASTERPLAN
FREEDOM PARK EXISTING DEVELOPMENT
CH-4
CONCORD HILLS
Future Culvert Crossing
SALINAS ELEMENTARY SCHOOL
MERIDA
CUATRO VIENTOS RD.
LAGO DEL VALLE
LOS PRESIDENTES EXISTING DEVELOPMENT
Future Culvert Crossing
UNITED SOUTH MIDDLE SCHOOL
Los Presidentes
Channel and Pond Site
(Possible Elimination of Pond)
LOS PRESIDENTES MASTERPLAN
Future Culvert Crossing
UNITED SOUTH HIGH SCHOOL
LIMITS OF STUDY
A2
812 ACRES
Cuatro Vientos East
Channel and Pond Site
(Possible Elimination of Pond)
Future Culvert Crossing
CUATRO VIENTOS EAST MASTERPLAN
WORMSER RD.
CUATRO VIENTOS RD.
Legend
Webb County Drainage District Boundary Line
LandBase
Watershed A2
15.38 Acre Tract
Webb County
Drainage District
Exhibit # 01
Location Map
CRANE ENGINEERING CORP.
1310 JUNCTION DRIVE
SUITE B
LAREDO, TEXAS 78041
956-712-1996
FIRM REGISTRATION NO. F-3353

Green Space Ordinance

-Buffer cannot be less than 25ft from the Ordinary High Water Mark on either side. Buffer may not exceed 100ft from the Ordinary High Water Mark on either side.

-First and Second Order Streams are voluntary and allow for disturbance of the immediate buffer if the requirements of section 24.57.7 of the Ordinance are met. Third Order stream buffers are mandatory.

-Existing ponds may be used as stormwater facilities, but shall have 20ft buffer in addition to Maintenance Access Agreement requirements. Refer to Stormwater Management Ordinance Section 24-59.3.2.5 "Retention/Detention Facilities"

N
W E
S

1 inch equals 750 feet

Legend

- WCDD Boundary
- Green Space Ordinance Stream Order with Buffer
- 1- 50' Buffer
- 2- 50' Buffer
- 3- 50' Buffer
- 4- 75' Buffer
- 5- 100' Buffer
- Watershed A1

EXISTING POND

EXISTING CREEKS

EXISTING TRIBUTARIES

1

2

3

VISTA DORADA

ARGUINDEGUI COMMERCIAL

EL RANCHO

SUMMERS

C.C.S.D.

ZAFTEX

INDEPENDENCE HILLS

FREEDOM PARK

CONCORD HILLS

CENTURY CITY

GEORGE WASHINGTON

Octavio Sch

LOS PRESIDENTES

LAS MISIONES

LAGO DEL VALLE

LAS AMERICAS

CUATRO VIENTOS NORTE

450 500 505 487 499 546 550

Webb County Drainage District

Exhibit #2
Existing Creek System

CRANE ENGINEERING CORP.
1310 JUNCTION DRIVE SUITE B
LAREDO, TEXAS 78041 956-712-1996
FIRM REGISTRATION NO. F-3353

LOOP 20

1 inch equals 750 feet

STATE HIGHWAY 359

MERIDA

CUATRO VIENTOS (TxDOT)

FREEDOM PARK EXISTING DEVELOPMENT

GAULT MASTERPLAN

LOS PRESIDENTES EXISTING DEVELOPMENT

LOS PRESIDENTES PROPOSED MASTERPLAN

CUATRO VIENTOS EAST PROPOSED MASTERPLAN

P-4

P-3

P-1

CH-4

VkC

MCE

W

CpB

JQD

Legend

NRCS_SURGO

MUSYM

- CpB
- JQD
- MCE
- VkC
- W
- Watershed A2
- Webb County Drainage District Boundary Line

Webb County Drainage District

Exhibit # 3
Soils Map

CRANE ENGINEERING CORP.
1310 JUNCTION DRIVE SUITE B
LAREDO, TEXAS 78041 956-712-1996
FIRM REGISTRATION NO. F-3353

Pre Development				
Watershed	Area (Acres)	Composite SCS CN	Time of Concentration (Tc) min.	Flow Rate
CVE	324.01	56	79.80	Q25=308.58 Q50 = 399.14 Q100 = 513.52
LP	402.38	64	27.06	Q25=940.91 Q50 = 1163.08 Q100 = 1437.03
SG	85.61	67	10.00	Q25=305.72 Q50 = 372.66 Q100 = 454.52

*Minimum time of concentration used for runoff determination is 10mins.

Post Development				
Watershed	Area (Acres)	Composite SCS CN	Time of Concentration (Tc) min.	Flow Rate
CVE	324.01	66	12.12	Q25= 1075.93 Q50 = 1320.32 Q100 = 1620.33
LP	402.38	70	18.96	Q25=1295.18 Q50 = 1563.63 Q100 =1890.24
SG	85.61	72	10.00	Q25=349.38 Q50 = 418.39 Q100 = 501.98

*Minimum time of concentration used for runoff determination is 10 mins.

N
W
E
S
1 inch equals 900 feet

15.38 Acre Tract Owned by City

Proposed Regional Pond Location

Detention Area As Per Subdivision Masterplan

Detention Area As Per Subdivision Masterplan

Detention Area As Per Subdivision Masterplan

Park Area As Per Subdivision Masterplan

P-1
P-2
P-3
P-4
P-5
P-6

SG
J-3
LP
J-2
CVE
J-1

GAULT MASTERPLAN
FREEDOM PARK EXISTING DEVELOPMENT
SUMMERS
LOS PRESIDENTES EXISTING DEVELOPMENT
LOS PRESIDENTES MASTERPLAN
CUATRO VIENTOS EAST MASTERPLAN
A2
812 ACRES
EJIDO
CUATRO VIENTOS

Legend

- Webb County Drainage District Boundary Line
- Los Presidentes Masterplan (LP)
- Cuatro Vientos East Master Plan (CVE)
- Masterplan-GAULT
- Cumulative Watershed

Sub-Watersheds

LAYER

- SubWatershed-CVE
- SubWatershed-LP
- SubWatershed-SG
- 15.38 Acre Tract
- Proposed Drainage Easement As Per Subdivision Masterplan

Junction	Contributing Watershed	Combined Flow Rates
J-1	CVE (Pre)	Q25=308.58 Q50 = 399.14 Q100 = 513.52
J-1	CVE (Post)	Q25= 1075.93 Q50 = 1320.32 Q100 = 1620.33
J-2	CVE (Pre) + LP (Post)	Q25= 1340.57 Q50 =1637.23 Q100 = 2002.17
J-2	CVE (Post) + LP (Post)	Q25= 2153.29 Q50 =2636.85 Q100 = 3229.16
J-3	CVE (Pre)+LP (Pre)+SG (Post)	Q25= 998.79 Q50 = 1267.63 Q100 = 1703.17
J-3	CVE (Post)+LP (Post)+SG (Post)	Q25= 2079.42 Q50 = 2565.04 Q100 = 3159.17
Regional Pond	CVE (Post)+LP (Post)+SG (Post) + A3 (Post) + A5 (Post) +A11 (Post)	Q25= 7458.27 Q50 = 8754.66 Q100 = 10317.68

Webb County Drainage District

Exhibit #4
Watershed Map

CRANE ENGINEERING CORP.
1310 JUNCTION DRIVE SUITE B
LAREDO, TEXAS 78041 956-712-1996
FIRM REGISTRATION NO. F-3353

Legend

- Webb County Drainage District Boundary Line
- Proposed Development
- Cumulative Watershed

1 inch equals 1,600 feet

EJIDO

PITA MANGANA

A1

A2

A3

A4

A5

A6

A7

A8

A9

A10

A11

Webb County Drainage District

Exhibit #5

Overall Watershed Map

CRANE ENGINEERING CORP.

1310 JUNCTION DRIVE SUITE B
LAREDO, TEXAS 78041 956-712-1996
FIRM REGISTRATION NO. F-3353

Subsection: Master Network Summary

Catchments Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft^3/s)
LP	Pre-Development 25 year	25	115.558	12.350	940.91
LP	Post-Development 25 year	25	137.751	12.250	1,295.18
LP	Pre-Development 50 year	50	142.285	12.350	1,163.08
LP	Post-Development 50 year	50	166.560	12.250	1,563.63
LP	Pre-Development 100 year	100	175.593	12.350	1,437.03
LP	Post-Development 100 year	100	202.057	12.250	1,890.24
CVE	Pre-Development 25 year	25	69.305	12.950	308.58
CVE	Post-Development 25 year	25	99.204	12.150	1,075.93
CVE	Pre-Development 50 year	50	87.966	12.950	399.14
CVE	Post-Development 50 year	50	121.362	12.150	1,320.32
CVE	Pre-Development 100 year	100	111.680	12.950	513.52
CVE	Post-Development 100 year	100	148.862	12.150	1,620.33
SG	Pre-Development 25 year	25	26.999	12.150	305.72
SG	Post-Development 25 year	25	30.942	12.150	349.38
SG	Pre-Development 50 year	50	32.929	12.150	372.66
SG	Post-Development 50 year	50	37.207	12.150	418.39
SG	Pre-Development 100 year	100	40.274	12.150	454.52
SG	Post-Development 100 year	100	44.9	12.150	501.98

Node Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft^3/s)
J-2	Pre-Development 25 year	25	184.141	12.350	1,010.31
J-2	Post-Development 25 year	25	236.197	12.250	2,153.29
J-2	Pre-Development 50 year	50	229.433	12.350	1,269.39
J-2	Post-Development 50 year	50	287.076	12.250	2,636.85
J-2	Pre-Development 100 year	100	286.340	12.350	1,592.78
J-2	Post-Development 100 year	100	349.970	12.250	3,229.16
J-1	Pre-Development 25 year	25	69.305	12.950	308.58
J-1	Post-Development 25 year	25	99.204	12.150	1,075.93
J-1	Pre-Development 50 year	50	87.966	12.950	399.14
J-1	Post-Development 50 year	50	121.362	12.150	1,320.32
J-1	Pre-Development 100 year	100	111.680	12.950	513.52
J-1	Post-Development 100 year	100	148.862	12.150	1,620.33
J-3	Pre-Development 25 year	25	209.737	12.450	1,021.80
J-3	Post-Development 25 year	25	265.6664	12.350	2,079.42
J-3	Pre-Development 50 year	50	260.775	12.450	1,296.22
J-3	Post-Development 50 year	50	322.632	12.350	2,565.04
J-3	Pre-Development 100 year	100	324.815	12.450	1,639.46
J-3	Post-Development 100 year	100	393.023	12.350	3,159.17
O-2	Post-Development 25 year	25	264.863	12.400	2,029.30
O-2	Post-Development 50 year	50	321.737	12.400	2,510.58
O-2	Post-Development 100 year	100	392.020	12.400	3,098.57

Post Development

Label: CVE

Time of Concentration Results

Segment #1: TR-55 Shallow Concentrated Flow		
Hydraulic Length	2,470.00	ft
Is Paved?	True	
Slope	0.028	ft/ft
Average Velocity	3.40	ft/s
Segment Time of Concentration	0.202	hours

Time of Concentration (Composite)		
Time of Concentration (Composite)	0.202	hours

==== SCS TR-55 Shallow Concentration Flow

Tc =

Unpaved surface:
V = 16.1345 * (Sf**0.5)

Paved Surface:
V = 20.3282 * (Sf**0.5)

(Lf / V) / 3600

Where:

V= Velocity, ft/sec
Sf= Slope, ft/ft
Tc= Time of concentration, hours
Lf= Flow length, feet

Pre Development

Label: CVE

Time of Concentration Results

Segment #1: TR-55 Sheet Flow		
Hydraulic Length	2,470.00	ft
Manning's n	0.200	
Slope	0.028	ft/ft
2 Year 24 Hour Depth	9.8	in
Average Velocity	0.52	ft/s
Segment Time of Concentration	1.330	hours

Time of Concentration (Composite)		
Time of Concentration (Composite)	1.330	hours

==== SCS Channel Flow

Tc =
R = Qa / Wp
V = (1.49 * (R**(2/3)) * (Sf**-0.5)) / n

(Lf / V) / 3600

Where:
R= Hydraulic radius
Aq= Flow area, square feet
Wp= Wetted perimeter, feet
V= Velocity, ft/sec
Sf= Slope, ft/ft
n= Manning's n
Tc= Time of concentration, hours
Lf= Flow length, feet

Post Development

Label: LP

Time of Concentration Results

Segment #1: TR-55 Channel Flow		
Flow Area	559.5	ft²
Hydraulic Length	4,150.00	ft
Manning's n	0.035	
Slope	0.010	ft/ft
Wetted Perimeter	345.00	ft
Average Velocity	5.82	ft/s
Segment Time of Concentration	0.198	hours

Segment #2: TR-55 Channel Flow		
Flow Area	559.5	ft²
Hydraulic Length	45.00	ft
Manning's n	0.035	
Slope	0.008	ft/ft
Wetted Perimeter	345.00	ft
Average Velocity	5.09	ft/s
Segment Time of Concentration	0.002	hours

Segment #3: TR-55 Channel Flow		
Flow Area	559.5	ft²
Hydraulic Length	2,800.00	ft
Manning's n	0.035	
Slope	0.013	ft/ft
Wetted Perimeter	345.00	ft
Average Velocity	6.75	ft/s
Segment Time of Concentration	0.115	hours

Time of Concentration (Composite)		
Time of Concentration (Composite)	0.316	hours

==== SCS TR-55 Sheet Flow

Tc = (0.007 * ((n * Lf)**0.8)) / ((P**0.5) * (Sf**0.4))

Tc= Time of concentration, hours
n= Manning's n
Where:
Lf= Flow length, feet
P= 2yr, 24hr Rain depth, inches
Sf= Slope, %

Subsection: Time of Concentration Calculations — Pre Development
Label: LP

Time of Concentration Results

Segment #1: TR-55 Channel Flow		
Flow Area	559.5	ft²
Hydraulic Length	4,150.00	ft
Manning's n	0.050	
Slope	0.010	ft/ft
Wetted Perimeter	345.00	ft
Average Velocity	4.07	ft/s
Segment Time of Concentration	0.283	hours

Segment #2: TR-55 Channel Flow		
Flow Area	559.5	ft²
Hydraulic Length	45.00	ft
Manning's n	0.050	
Slope	0.008	ft/ft
Wetted Perimeter	345.00	ft
Average Velocity	3.56	ft/s
Segment Time of Concentration	0.004	hours

Segment #3: TR-55 Channel Flow		
Flow Area	559.5	ft²
Hydraulic Length	2,800.00	ft
Manning's n	0.050	
Slope	0.013	ft/ft
Wetted Perimeter	345.00	ft
Average Velocity	4.73	ft/s
Segment Time of Concentration	0.165	hours

Time of Concentration (Composite)		
Time of Concentration (Composite)	0.451	hours

==== SCS TR-55 Sheet Flow

Tc = (0.007 * ((n * Lf)**0.8)) / ((P**0.5) * (Sf**0.4))

Where:
Tc= Time of concentration, hours
n= Manning's n
Lf= Flow length, feet
P= 2yr, 24hr Rain depth, inches
Sf= Slope, %

Subsection: Time of Concentration Calculations — Post Development

Label: SG

Time of Concentration Results

Segment #1: TR-55 Shallow Concentrated Flow	
Hydraulic Length	465.00 ft
Is Paved?	True
Slope	0.069 ft/ft
Average Velocity	5.34 ft/s
Segment Time of Concentration	0.024 hours

Time of Concentration (Composite)	
Time of Concentration (Composite)	0.167 hours

==== SCS TR-55 Shallow Concentration Flow

Tc = (Lf / V) / 3600

Unpaved surface:
V = 16.1345 * (Sf**0.5)

Paved Surface:
V = 20.3282 * (Sf**0.5)

Where:
V= Velocity, ft/sec
Sf= Slope, ft/ft
Tc= Time of concentration, hours
Lf= Flow length, feet

Pre Development

Label: SG

Time of Concentration Results

Segment #1: TR-55 Sheet Flow	
Hydraulic Length	465.00 ft
Manning's n	0.050
Slope	0.069 ft/ft
2 Year 24 Hour Depth	9.8 in
Average Velocity	1.60 ft/s
Segment Time of Concentration	0.081 hours

Time of Concentration (Composite)	
Time of Concentration (Composite)	0.167 hours

==== SCS Channel Flow

Tc = R = Qa / Wp
V = (1.49 * (R**(2/3)) * (Sf**-0.5)) / n

(Lf / V) / 3600

Where:
R= Hydraulic radius
Aq= Flow area, square feet
Wp= Wetted perimeter, feet
V= Velocity, ft/sec
Sf= Slope, ft/ft
n= Manning's n
Tc= Time of concentration, hours
Lf= Flow length, feet

Subsection: Runoff CN-Area — Post Development
Label: CVE

Runoff Curve Number Data

Soil/Surface Description	CN	Area (acres)	C (%)	UC (%)	Adjusted CN
Residential Districts - Soil B	60.000	191.600	0.0	0.0	60.000
Residential Districts - Soil C	70.000	96.000	0.0	0.0	70.000
Urban Districts - Commercial & Business - Soil B	87.000	21.870	0.0	0.0	87.000
Urban Districts - Commercial & Business - Soil C	90.000	14.540	0.0	0.0	90.000
COMPOSITE AREA & WEIGHTED CN --->	(N/A)	324.010	(N/A)	(N/A)	66.132

Subsection: Runoff CN-Area — Pre Development
Label: CVE

Runoff Curve Number Data

Soil/Surface Description	CN	Area (acres)	C (%)	UC (%)	Adjusted CN
Open Space (Lawns, parks,etc.) -Soil B	52.000	213.470	0.0	0.0	52.000
Open Space (Lawns, parks, etc.) -Soil C	65.000	110.530	0.0	0.0	65.000
COMPOSITE AREA & WEIGHTED CN --->	(N/A)	324.000	(N/A)	(N/A)	56.435

Post Development
Label: LP

Runoff Curve Number Data

Soil/Surface Description	CN	Area (acres)	C (%)	UC (%)	Adjusted CN
Residential Districts - Soil B	60.000	63.890	0.0	0.0	60.000
Residential Districts - Soil C	70.000	296.890	0.0	0.0	70.000
Urban Districts - Commercial & Business - Soil B	87.000	5.080	0.0	0.0	87.000
Urban Districts - Commercial & Business - Soil C	90.000	36.520	0.0	0.0	90.000
COMPOSITE AREA & WEIGHTED CN --->	(N/A)	402.380	(N/A)	(N/A)	70.442

Pre Development

Label: LP

Runoff Curve Number Data

Soil/Surface Description	CN	Area (acres)	C (%)	UC (%)	Adjusted CN
Open space (Lawns,parks etc.) - Soil B	52.000	28.170	0.0	0.0	52.000
Open space (Lawns,parks etc.) - Soil C	65.000	374.210	0.0	0.0	65.000
COMPOSITE AREA & WEIGHTED CN --->	(N/A)	402.380	(N/A)	(N/A)	64.090

Post Development

Label: SG

Runoff Curve Number Data

Soil/Surface Description	CN	Area (acres)	C (%)	UC (%)	Adjusted CN
Residential Districts - Soil C	70.000	77.100	0.0	0.0	70.000
Urban Districts - Commercial & Business- Soil C	90.000	8.500	0.0	0.0	90.000
COMPOSITE AREA & WEIGHTED CN --->	(N/A)	85.600	(N/A)	(N/A)	71.986

Pre Development

Label: SG

Runoff Curve Number Data

Soil/Surface Description	CN	Area (acres)	C (%)	UC (%)	Adjusted CN
Open Space (Lawns, parks, etc.) - Soil C-	65.000	56.270	0.0	0.0	65.000
Residential Districts - Soil C	70.000	29.340	0.0	0.0	70.000
COMPOSITE AREA & WEIGHTED CN --->	(N/A)	85.610	(N/A)	(N/A)	66.714

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Node Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft^3/s)
J-2	CVE (Pre) + LP (Post) 25 year	25	206.329	12.25	1,340.57
J-2	CVE (Pre) + LP (Post) 50 year	50	253.702	12.25	1,637.23
J-2	CVE (Pre) + LP (Post) 100 year	100	312.796	12.25	2,002.17
J-3	CVE (Pre) + LP (Pre) + SG (Post) 25 year	25	211.306	12.45	1,027.48
J-3	CVE (Pre) + LP (Pre) + SG (Post) 50 year	50	262.485	12.45	1,302.08
J-3	CVE (Pre) + LP (Pre) + SG (Post) 100 year	100	326.673	12.45	1,645.44

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WCDD- Cuatro Vientos East, Los Presidentes, and Gault
H+H - HEC-RAS Model Output-Existing Condition 100-Yr

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
1	10647.08	100 yr	513.52	543	545.11	545.11	545.44	0.015507	4.61	111.34	171.52	1.01
1	10460.69	100 yr	513.52	542	542.83	542.73	542.96	0.009957	2.9	177.29	395.14	0.76
1	10081.69	100 yr	513.52	537.19	537.91	537.91	538.19	0.01623	4.21	122.11	224.41	1
1	9483.272	100 yr	513.52	529	530.19		530.24	0.003849	1.94	264.88	528.18	0.48
1	9365.301	100 yr	513.52	529	529.28	529.28	529.43	0.015282	2.63	174.1	546.66	0.87
1	9209.23	100 yr	513.52	529.81	524.38	524.38	524.68	0.015869		116.53	196.28	0
1	8891.685	100 yr	513.52	515	516.57	516.5	516.94	0.011519	4.89	105.01	118.96	0.92
1	8466.334	100 yr	513.52	509	511.13	511.13	511.48	0.01436	4.78	107.51	148.81	0.99
1	7876.374	100 yr	513.52	499	502.22	502.22	502.75	0.012046	5.9	88.2	86.44	0.97
1	7417.19	100 yr	513.52	493	496.18		496.37	0.004578	3.59	143.23	128.81	0.6
1	6605.645	100 yr	1592.78	488	489.81	489.68	490.19	0.009235	4.94	322.54	305.11	0.85
1	6169.58	100 yr	1592.78	482.41	485.8	485.65	486.25	0.008857	5.38	295.93	238.13	0.85
1	5719.856	100 yr	1592.78	479.71	480.83	480.83	481.24	0.014354	5.13	310.53	386.4	1.01
1	5212.156	100 yr	1592.78	470.32	475.17	475.17	475.75	0.007865	8.92	293.44	241.02	0.86
1	4855.791	100 yr	1592.78	466	470.34	470.28	470.93	0.010188	6.21	264.06	205.48	0.92
1	4561.672	100 yr	1592.78	462	468.12	467.94	468.63	0.006077	7.7	318.35	252.41	0.76
1	4176.031	100 yr	1592.78	459	464.73	464.73	465.53	0.010918	8.12	225.35	140.43	0.98
1	3833.299	100 yr	1592.78	455	461.13	461.13	461.76	0.010316	6.52	260.51	217.22	0.93
1	3478.32	100 yr	1592.78	454	458.92		459.32	0.003819	6.43	356.01	227.7	0.64
1	3063.676	100 yr	1592.78	452	456.49	456.49	457.09	0.007968	7.03	280.56	218.71	0.87
1	2567.792	100 yr	1679.03	447	452.38	452.38	452.93	0.006737	7.91	337.75	293.91	0.82
1	2306.258	100 yr	1679.03	443	449.96	449.96	450.57	0.005018	8.36	331.41	235.4	0.72
1	2136.087	100 yr	1679.03	442	448.3	448.3	448.99	0.0041	8.22	326.62	216.95	0.69
1	1871.093	100 yr	1679.03	439	446.22		446.45	0.002203	5.04	450.8	226.1	0.44
1	1758.3	100 yr	1679.03	438	445.9		446.26	0.001286	5.45	452.23	238.32	0.41
1	1352.945	100 yr	1679.03	435	441.51	441.51	442.21	0.011844	6.74	249.1	175.73	1
1	1047.725	100 yr	1679.03	434	436.87		436.97	0.001468	2.5	672.07	443.49	0.36
1	733.9229	100 yr	1679.03	429	435.68	435.68	436.11	0.005856	6.72	429.81	582.36	0.76
1	377.6291	100 yr	1679.03	431.17	434.48	433.69	434.57	0.001602	2.43	690.59	508.05	0.37
1	127.8124	100 yr	1679.03	431.09	432.39	432.36	432.77	0.013006	4.97	338.12	410.13	0.96

WCDD- Cuatro Vientos East, Los Presidentes, and Gault
H+H - HEC-RAS Model Output (Chacon Creek Main Channel)-Existing Condition 100-Yr

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
2	1424.905	100 Year	7440	438.07	443.64	443.64	444.86	0.011715	9.01	859.98	371.5	0.96
2	1265.557	100 Year	7440	435	440.54		441.35	0.009767	8.88	1072.66	524.83	0.89
2	945.5499	100 Year	7440	434	439	438.15	439.41	0.003921	5.13	1481.59	624.96	0.55
2	713.0168	100 Year	7440	433	436.9	436.9	437.81	0.015167	7.81	977.77	558.88	1.02
2	416.0582		Culvert									
2	148.2544	100 Year	7440	430	435.2		435.38	0.001575	3.43	2167.35	743.91	0.35
2	10.83096	100 Year	7440	431	434.17	433.76	434.93	0.007806	7.14	1090	467.52	0.78

PondMaker Worksheet Detailed Report: Worksheet (P-1) - CVE

Element Details

ID	109
Label	Worksheet (P-1) - CVE
Select Pond to Design	P-1
Flow Allowed Below Target	25.0
Flow Allowed Above Target	10.0
Flow Allowed Below Target	25.0
Flow Allowed Above Target	0.0
Volume Allowed Below Target	25.0
Volume Allowed Above Target	50.0
Tolerance Display	Display PASS for values within specified tolerance

Notes

Volume

Pond Type	Elevation-Area	Use Void Space?	False

Elevation-Area

Pond Elevation (ft)	Pond Area (acres)
0.00	7.542
2.50	9.524
6.50	10.055

Infiltration

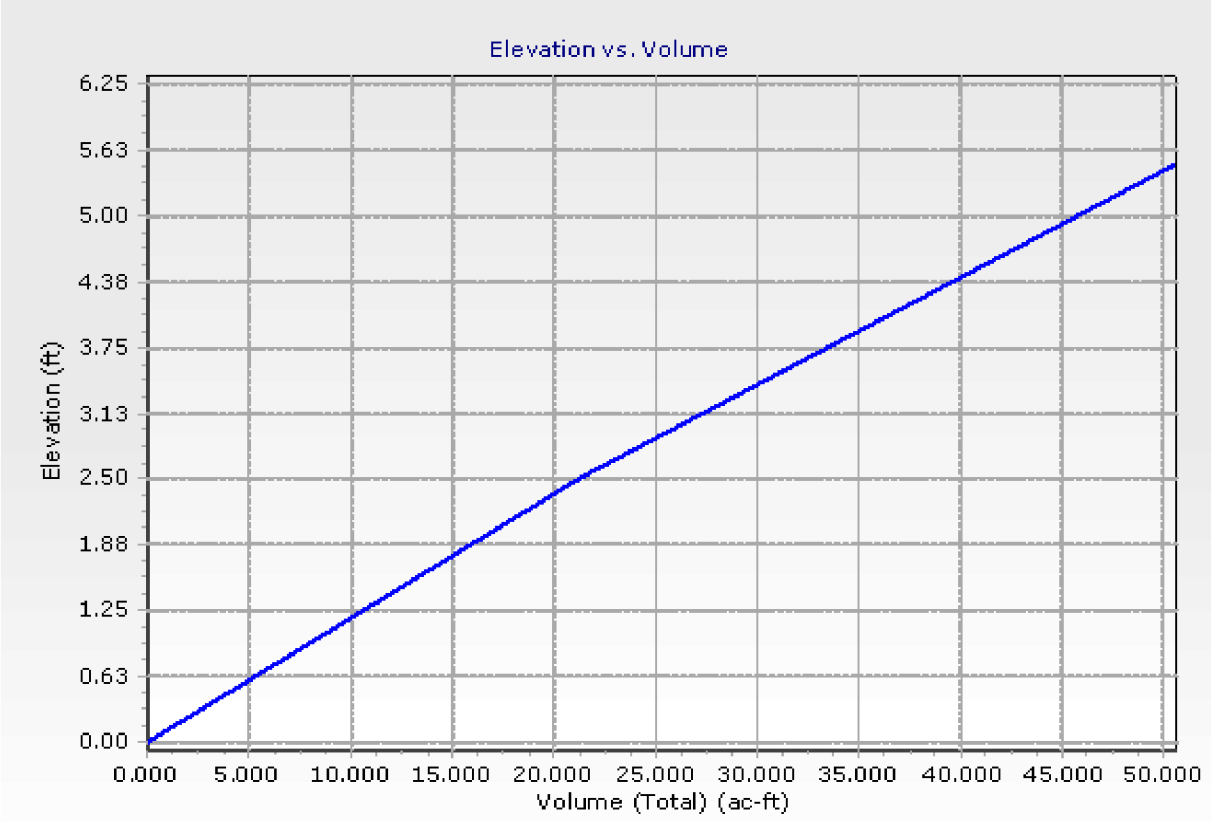
Infiltration Method	No Infiltration

Output

Detention Time	None

Initial Conditions

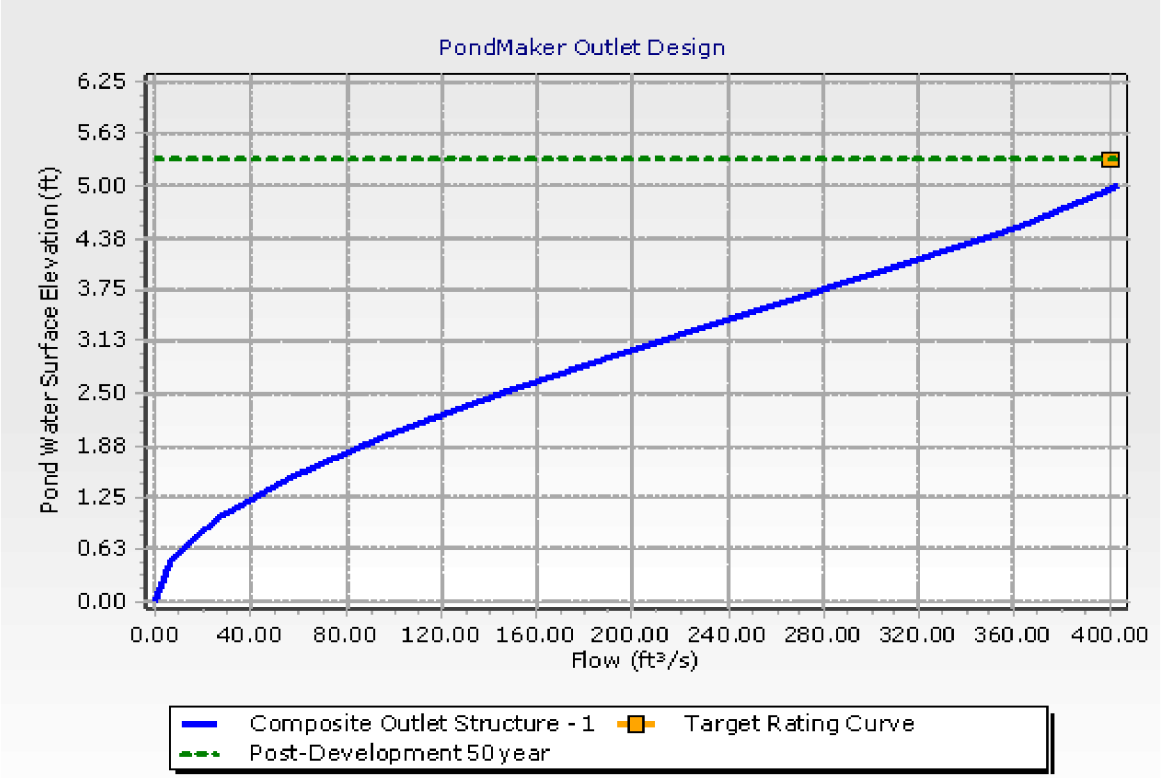
Is Outflow Averaging On?	False	Define Starting Water Surface Elevation	Pond Invert



PondMaker Worksheet (Outlet Design)

Design Scenario	Design Return Event	Target Peak Outflow (ft^3/s)	Target Outflow Volume (ac-ft)	Peak Pond Inflow (ft^3/s)	Total Inflow Volume (ac-ft)
Post-Development 50 year	50	400.00	27.618	1,113.79	121.045

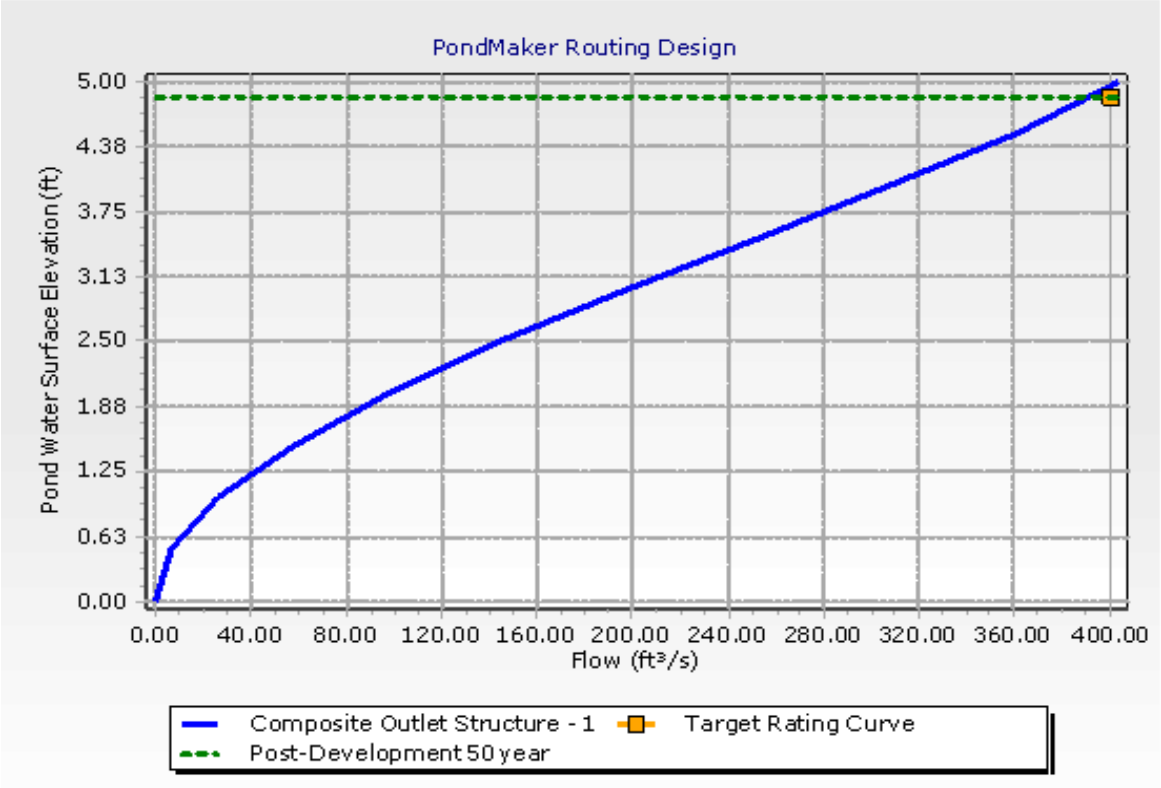
Estimated Storage (ac-ft)	Estimated Max Water Surface Elevation (ft)	Estimated Freeboard Depth	Design Outlet Structure	Estimated Peak Outflow (ft^3/s)	Estimated Peak Outflow vs. Target
48.871	5.32	Fail	Composite Outlet Structure - 1	430.84	Pass



PondMaker Worksheet (Routing Design)

Design Scenario	Design Return Event	Target Peak Outflow (ft³/s)	Computed Peak Outflow (ft³/s)	Computed Peak Outflow vs. Target	Target Outflow Volume (ac-ft)
Post-Development 50 year	50	400.00	391.08	Pass	27.618

Computed Volume Outflow (ac-ft)	Computed Outflow Volume vs. Target	Routing Outlet Structure	Computed Max Water Elevation (ft)	Freeboard Depth	Maximum Storage (ac-ft)
113.171	Fail	Composite Outlet Structure - 1	4.85	Pass	44.170


PondMaker Routing Design
Pond Water Surface Elevation (ft)
5.00
4.38
3.75
3.13
2.50
1.88
1.25
0.63
0.00
0.00
40.00
80.00
120.00
160.00
200.00
240.00
280.00
320.00
360.00
400.00
Flow (ft³/s)
Composite Outlet Structure - 1
Target Rating Curve
Post-Development 50 year

PondMaker Worksheet Detailed Report: Worksheet (P-2) - LP

Element Details

ID	150
Label	Worksheet (P-2) - LP
Select Pond to Design	P-2
Flow Allowed Below Target	25.0
Flow Allowed Above Target	10.0
Flow Allowed Below Target	25.0
Flow Allowed Above Target	0.0
Volume Allowed Below Target	25.0
Volume Allowed Above Target	50.0
Tolerance Display	Display PASS for values within specified tolerance

Notes

Volume

Pond Type	Elevation-Area	Use Void Space?	False

Elevation-Area

Pond Elevation (ft)	Pond Area (acres)
444.50	3.000
446.50	4.500
455.00	5.000

Infiltration

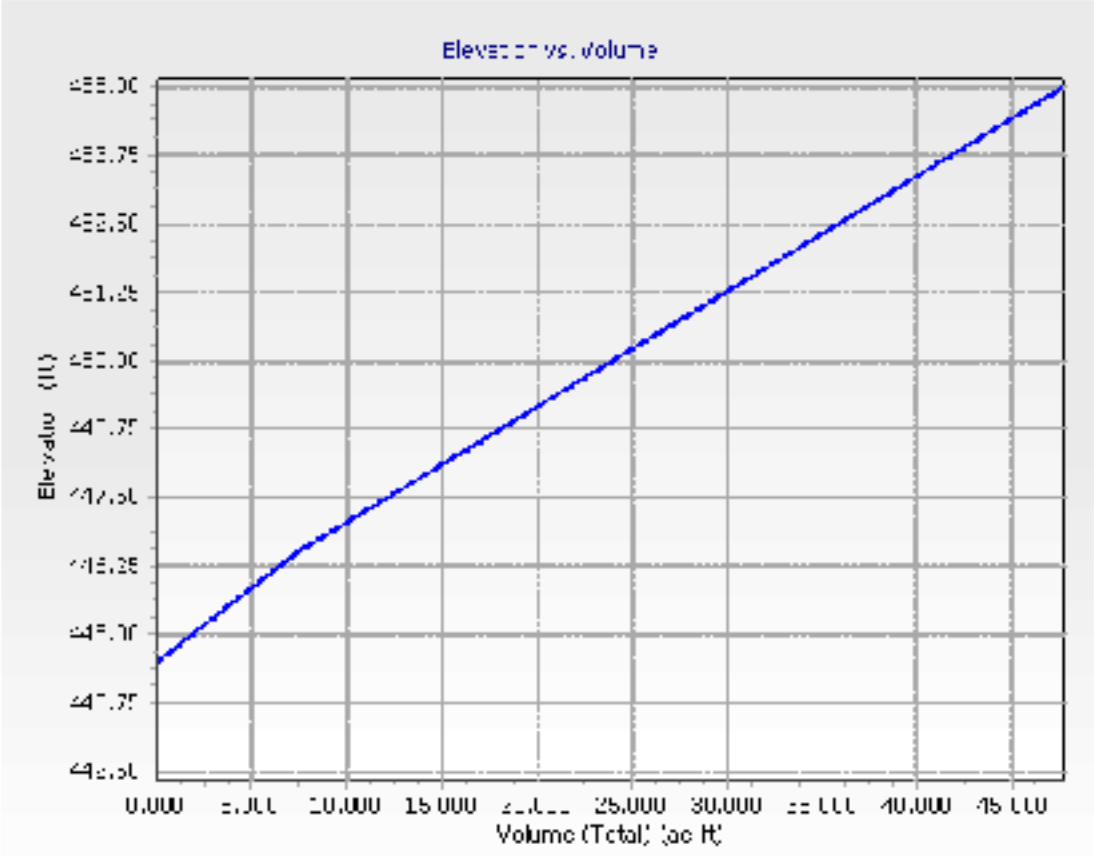
Infiltration Method	No

Output

Detention Time	None

Initial Conditions

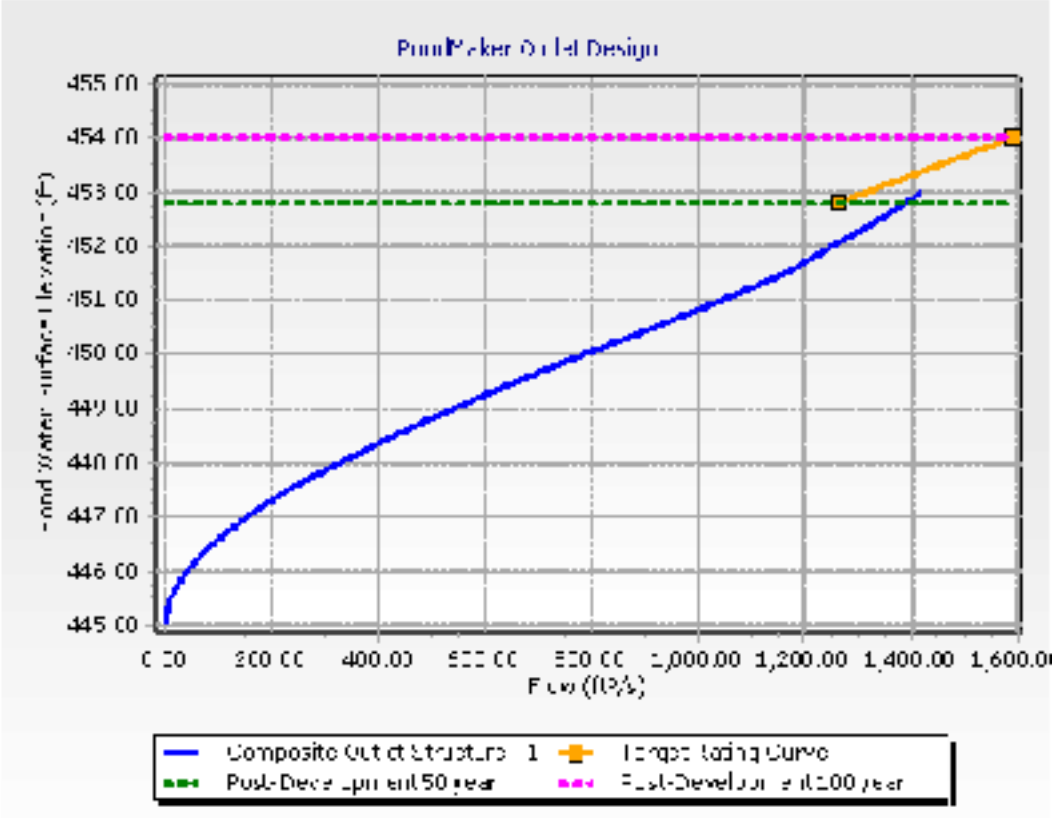
Is Outflow Averaging On?	False	Define Starting Water Surface Elevation	Pond Invert



PondMaker Worksheet (Outlet Design)

Design Scenario	Design Return Event	Target Peak Outflow (ft³/s)	Target Outflow Volume (ac-ft)	Peak Pond Inflow (ft³/s)	Total Inflow Volume (ac-ft)
Post-Development 100 year	100	1,590.00	167.422	1,855.22	314.816
Post-Development 50 year	50	1,265.00	164.854	1,508.42	255.570

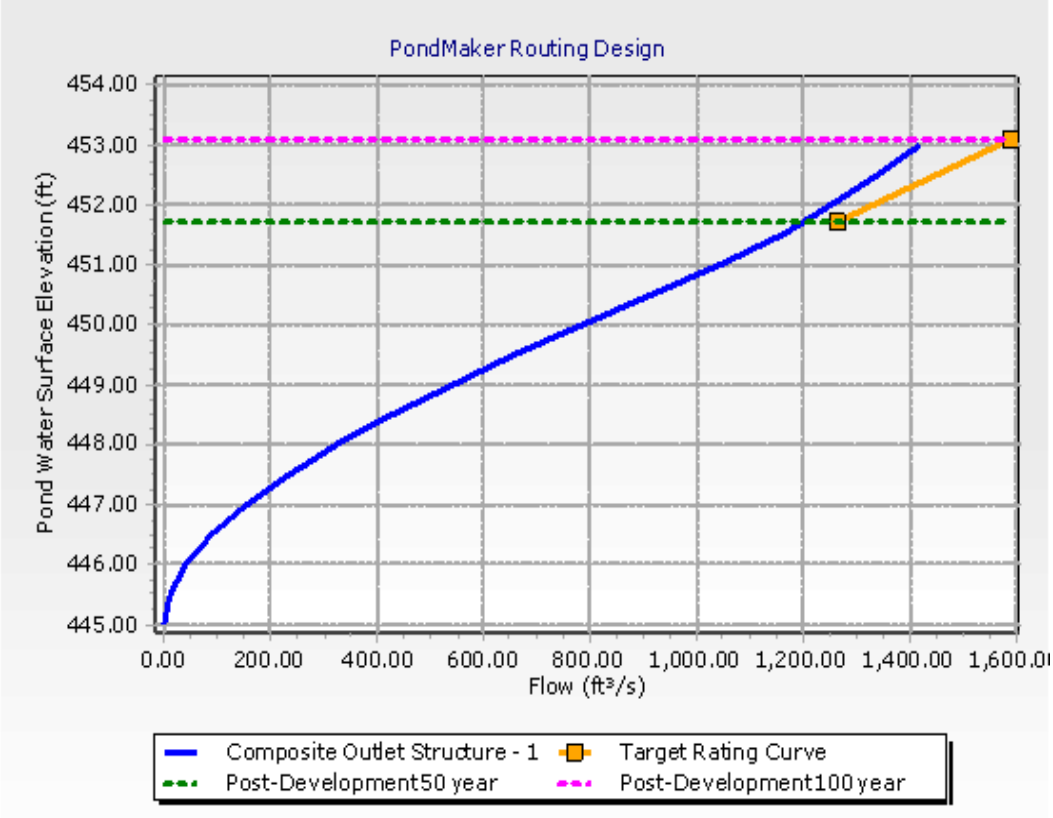
Estimated Storage (ac-ft)	Estimated Max Water Surface Elevation (ft)	Estimated Freeboard Depth	Design Outlet Structure	Estimated Peak Outflow (ft³/s)	Estimated Peak Outflow vs. Target
43.209	454.03	Fail	Composite Outlet Structure - 1	1,582.61	Pass
37.508	452.83	Pass	Composite Outlet Structure - 1	1,392.28	Fail



PondMaker Worksheet (Routing Design)

Design Scenario	Design Return Event	Target Peak Outflow (ft³/s)	Computed Peak Outflow (ft³/s)	Computed Peak Outflow vs. Target	Target Outflow Volume (ac-ft)
Post-Development 100 year	100	1,590.00	1,429.29	Pass	167.422
Post-Development 50 year	50	1,265.00	1,201.66	Pass	164.854

Computed Volume Outflow (ac-ft)	Computed Outflow Volume vs. Target	Routing Outlet Structure	Computed Max Water Elevation (ft)	Freeboard Depth	Maximum Storage (ac-ft)
308.601	Fail	Composite Outlet Structure - 1	453.07	Pass	38.258
249.770	Fail	Composite Outlet Structure - 1	451.70	Pass	31.645


PondMaker Routing Design
Pond Water Surface Elevation (ft)
454.00
453.00
452.00
451.00
450.00
449.00
448.00
447.00
446.00
445.00
0.00
200.00
400.00
600.00
800.00
1,000.00
1,200.00
1,400.00
1,600.00
Flow (ft³/s)
Composite Outlet Structure - 1
Target Rating Curve
Post-Development50 year
Post-Development100 year

PondMaker Worksheet Detailed Report: Worksheet (P-3) - SG

Element Details

ID	154
Label	Worksheet (P-3) - SG
Select Pond to Design	P-3
Flow Allowed Below Target	25.0
Flow Allowed Above Target	10.0
Flow Allowed Below Target	25.0
Flow Allowed Above Target	0.0
Volume Allowed Below Target	25.0
Volume Allowed Above Target	50.0
Tolerance Display	Display PASS for values within specified tolerance

Notes

Volume

Pond Type	Elevation-Area	Use Void Space?	False

Elevation-Area

Pond Elevation (ft)	Pond Area (acres)
425.00	3.000
426.50	4.000
432.50	5.000

Infiltration

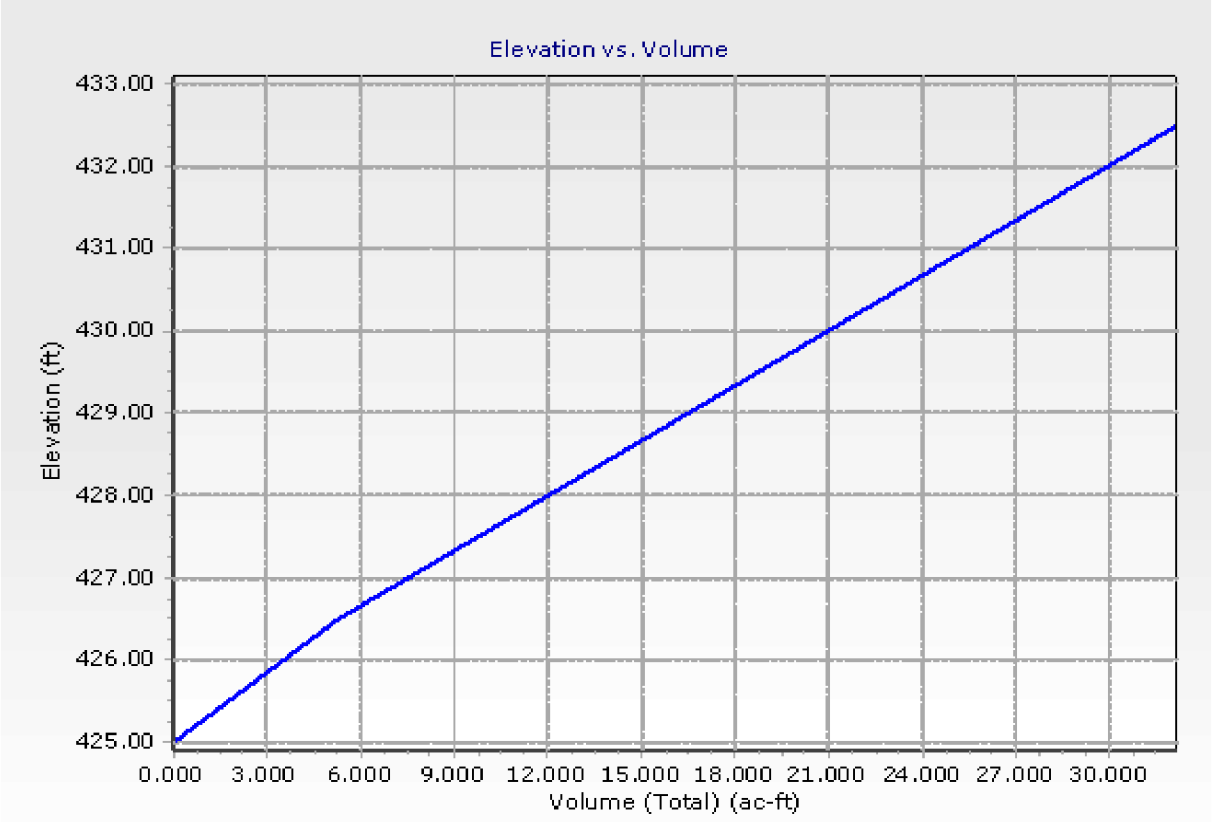
Infiltration Method	No Infiltration

Output

Detention Time	None

Initial Conditions

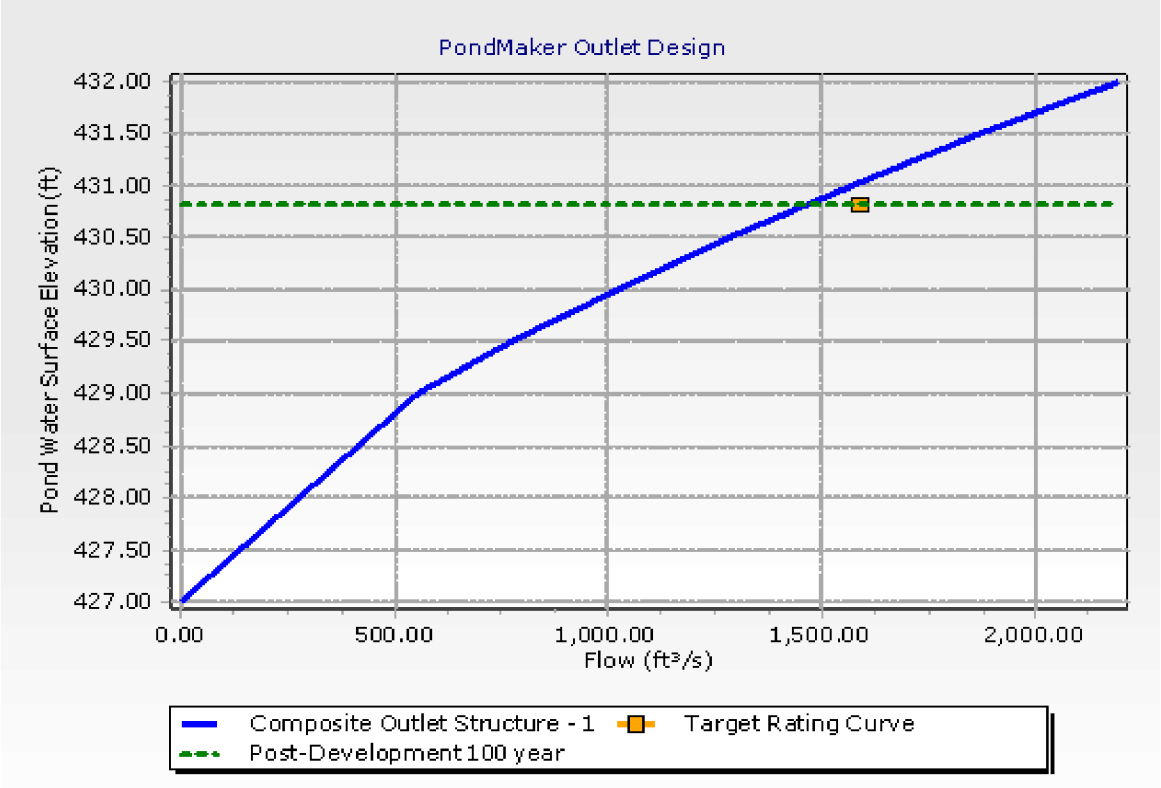
Is Outflow Averaging On?	False	Define Starting Water Surface Elevation	Pond Invert



PondMaker Worksheet (Outlet Design)

Design Scenario	Design Return Event	Target Peak Outflow (ft³/s)	Target Outflow Volume (ac-ft)	Peak Pond Inflow (ft³/s)	Total Inflow Volume (ac-ft)
Post-Development 100 year	100	1,590.00	205.388	1,647.31	329.270

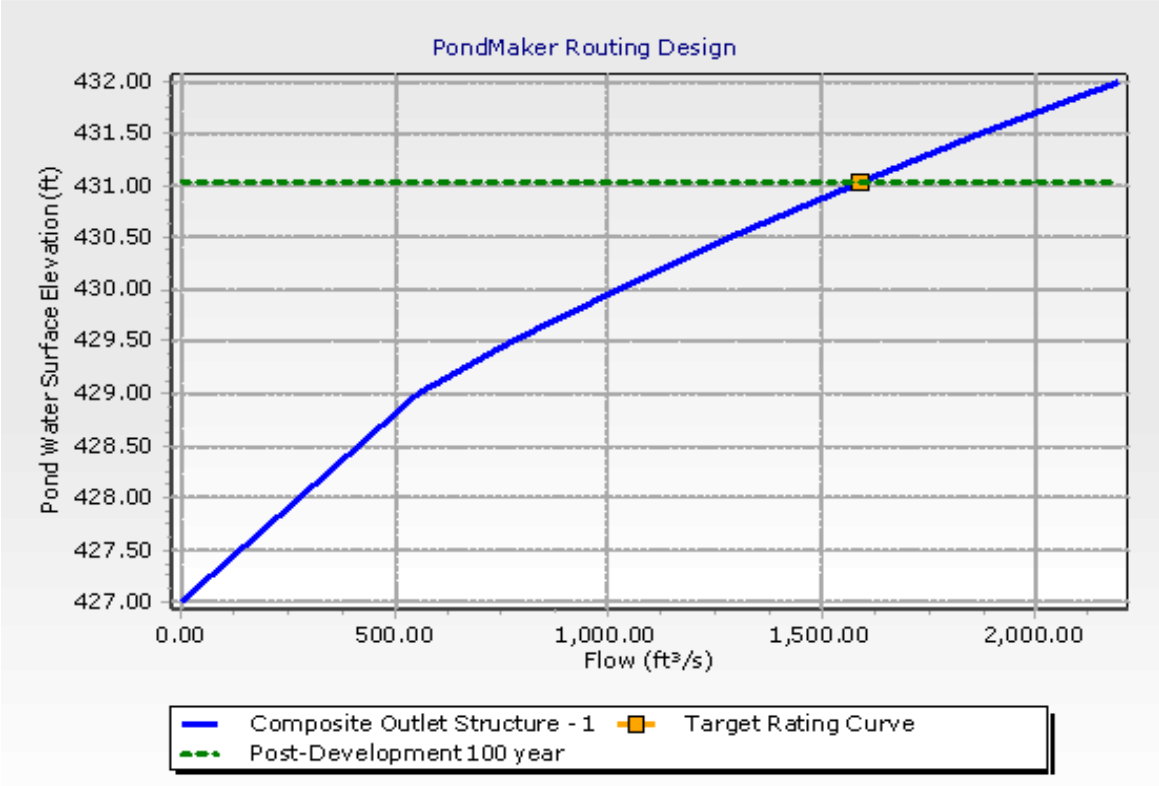
Estimated Storage (ac-ft)	Estimated Max Water Surface Elevation (ft)	Estimated Freeboard Depth	Design Outlet Structure	Estimated Peak Outflow (ft³/s)	Estimated Peak Outflow vs. Target
24.604	430.81	Pass	Composite Outlet Structure - 1	1,463.40	Pass



PondMaker Worksheet (Routing Design)

Design Scenario	Design Return Event	Target Peak Outflow (ft³/s)	Computed Peak Outflow (ft³/s)	Computed Peak Outflow vs. Target	Target Outflow Volume (ac-ft)
Post-Development 100 year	100	1,590.00	1,587.19	Pass	205.388

Computed Volume Outflow (ac-ft)	Computed Outflow Volume vs. Target	Routing Outlet Structure	Computed Max Water Elevation (ft)	Freeboard Depth	Maximum Storage (ac-ft)
321.038	Fail	Composite Outlet Structure - 1	431.03	Pass	25.010


PondMaker Routing Design
Pond Water Surface Elevation (ft)
432.00
431.50
431.00
430.50
430.00
429.50
429.00
428.50
428.00
427.50
427.00
0.00
500.00
1,000.00
1,500.00
2,000.00
Flow (ft³/s)
Composite Outlet Structure - 1
Target Rating Curve
Post-Development 100 year

PondMaker Worksheet Detailed Report: Worksheet (P-5) - CVE-LP-SG

Element Details

ID	154
Label	Worksheet (P-5) - CVE-LP-SG
Select Pond to Design	P-5
Flow Allowed Below Target	25.0
Flow Allowed Above Target	10.0
Flow Allowed Below Target	25.0
Flow Allowed Above Target	0.0
Volume Allowed Below Target	25.0
Volume Allowed Above Target	50.0
Tolerance Display	Display PASS for values within specified tolerance

Notes

Volume

Pond Type	Elevation-Area	Use Void Space?	False

Elevation-Area

Pond Elevation (ft)	Pond Area (acres)
425.00	15.000
430.00	15.200
437.00	15.250

Infiltration

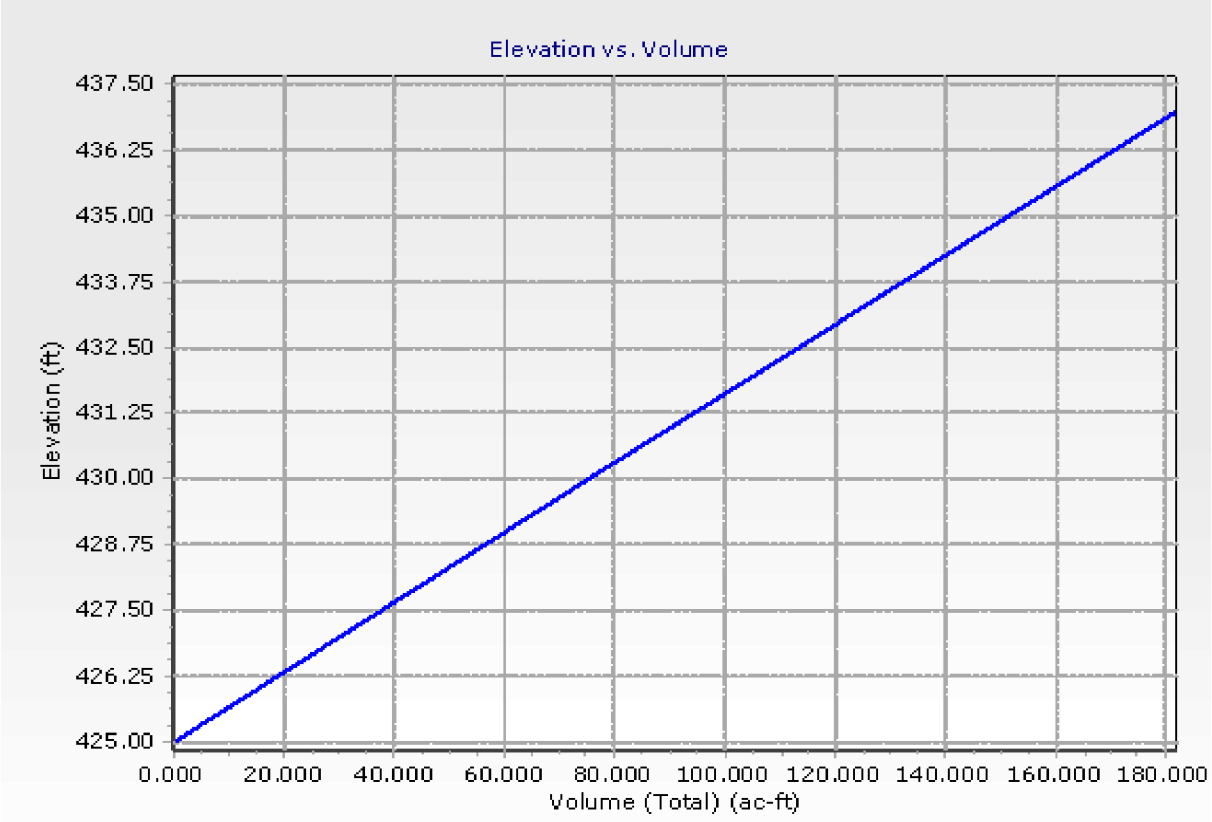
Infiltration Method	No Infiltration

Output

Detention Time	None

Initial Conditions

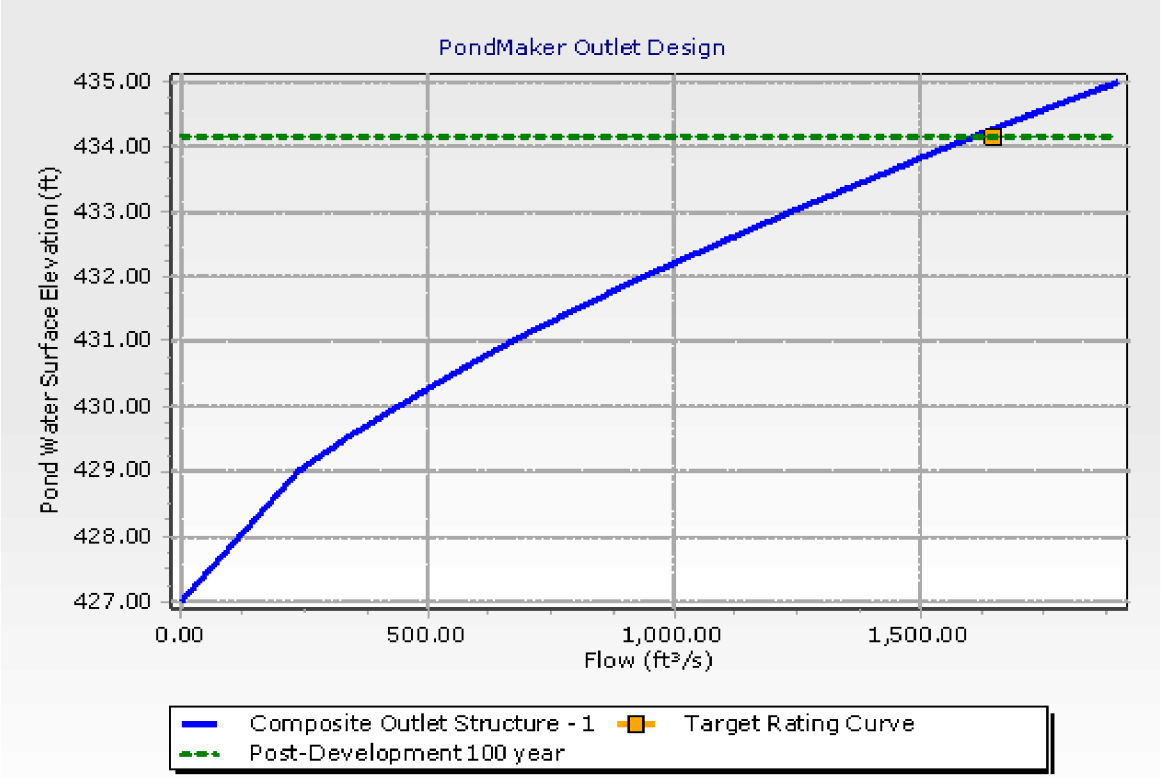
Is Outflow Averaging On?	False	Define Starting Water Surface Elevation	Pond Invert



PondMaker Worksheet (Outlet Design)

Design Scenario	Design Return Event	Target Peak Outflow (ft^3/s)	Target Outflow Volume (ac-ft)	Peak Pond Inflow (ft^3/s)	Total Inflow Volume (ac-ft)
Post-Development 100 year	100	1,650.00	205.388	3,097.62	392.014

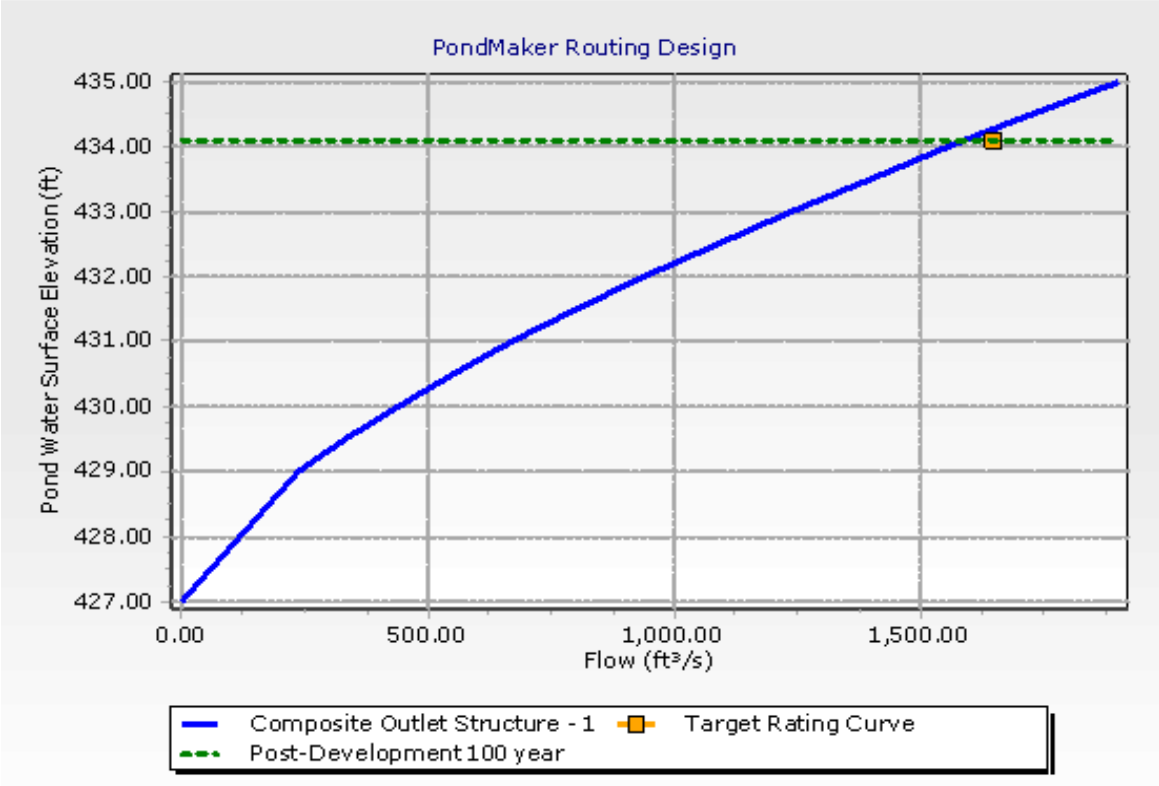
Estimated Storage (ac-ft)	Estimated Max Water Surface Elevation (ft)	Estimated Freeboard Depth	Design Outlet Structure	Estimated Peak Outflow (ft^3/s)	Estimated Peak Outflow vs. Target
138.741	434.15	Pass	Composite Outlet Structure - 1	1,609.46	Pass



PondMaker Worksheet (Routing Design)

Design Scenario	Design Return Event	Target Peak Outflow (ft³/s)	Computed Peak Outflow (ft³/s)	Computed Peak Outflow vs. Target	Target Outflow Volume (ac-ft)
Post-Development 100 year	100	1,650.00	1,590.99	Pass	205.388

Computed Volume Outflow (ac-ft)	Computed Outflow Volume vs. Target	Routing Outlet Structure	Computed Max Water Elevation (ft)	Freeboard Depth	Maximum Storage (ac-ft)
351.834	Fail	Composite Outlet Structure - 1	434.10	Pass	137.869


PondMaker Routing Design
435.00
434.00
433.00
432.00
431.00
430.00
429.00
428.00
427.00
Pond Water Surface Elevation (ft)
0.00
500.00
1,000.00
1,500.00
Flow (ft³/s)
Composite Outlet Structure - 1
Target Rating Curve
Post-Development 100 year

1 inch equals 900 feet

STATE HIGHWAY 359

LOOP 20

REACH 1- STA:00+00
REACH 2- STA:00+00

Reach 2 - STA:14+24.905

REACH 1- STA:106+47.08

394
398
400
402
406
410
412
414
418
420
424
428
430
432
434.3877
434.4828
435.6755
436.8711
436
439.0037
440.5425
441.5058
445.8984
446.2196
446
452
456
460
462
452.383
456.488
458.9239
461.1266
464.7336
468.1204
470.3421
475.1656
480.828
485.797
489.8123
496.1753
502.2154
530.1861
537.9105
542.825
545.1054

FREEDOM PARK EXISTING DEVELOPMENT

LOS PRESIDENTES EXISTING DEVELOPMENT

LOS PRESIDENTES MASTERPLAN

LAGO DEL VALLE MASTERPLAN

CUATRO VIENTOS EAST MASTERPLAN

LOMAS DEL SUR MASTERPLAN

CUATRO VIENTOS

SUMMERS

GAULT

A2
812 ACRES

CH-6

CH-5

P-7

P-6

EJIDO

Legend

- Webb County Drainage District Boundary Line
- Existing_Condition_BFEs
- EXISTING FEMA BFE
- Existing Conditions Analysis Floodplain

Webb County
Drainage District

Exhibit #7
Revised Floodplain Map
(Existing Conditions)

CRANE ENGINEERING CORP.
1310 JUNCTION DRIVE SUITE B
LAREDO, TEXAS 78041 956-712-1996
FIRM REGISTRATION NO. F-3353

WEBB COUNTY DRAINAGE DISTRICT -Cuatro Vientos East, Los Presidentes, Gault
HYDROLOGY ANALYSIS-PRE AND POST DEVELOPMENT DESIGN CONSIDERATIONS
OPEN CHANNEL OPTIONS

SUBDIVISION WATERSHED	Map Legend Label	Overall Watershed ID	25-yr Pre Development Flow (cfs)	25-yr Post Development Flow (cfs)	50-yr Pre Development Flow (cfs)	50-yr Post Development Flow (cfs)	100-yr Pre Development Flow (cfs)	100-yr Post Development Flow (cfs)	Design Scenario	Design Storm Event	Design Flow (cfs)	Pondpack Junction ID	Pond ID	Channel Flow Capacity (cfs)	Slope (%)	Channel Depth (ft)	Bottom Width (ft)	Top Width (ft)	Lateral Slope (X:1)	Velocity (ft/s)	Avg. Easement Width Currently Masterplanned (ft)	Easement Width Required for Regional Pond (ft)
Cuatro Vientos East (Ultimate Build 324 acres)	**CVE**	**A2**	309	NA	399	NA	514	NA	CVE Pre	25-yr	309	J-1	P-1	325	0.98	4.5	8	44	4	2.78	50	45
Cuatro Vientos East (Ultimate Build 324 acres)	**CVE**	**A2**	NA	1076	NA	1320	NA	1620	CVE Post	25-yr	1076	J-1	P-1	1090	0.98	7.5	14	59	3	3.98	50	60
Los Presidentes Master plan (Ultimate Build 402 acres)	**LP**	**A2**	941	1295	1163	1564	1437	1890	LP Post + CVE Pre	25-yr	1348	J-2	P-2	1354	1.32	7.5	16	61	3	4.69	90	65
Los Presidentes Master plan (Ultimate Build 402 acres)	**LP**	**A2**	941	1295	1163	1564	1437	1890	LP Post + CVE Post	25-yr	2153	J-2	P-2	2159	1.32	8.5	23	74	3	5.24	90	75
Los Presidentes Master plan (Ultimate Build 402 acres)	**LP**	**A2**	941	1295	1163	1564	1437	1890	LP Post + CVE Pre	100-yr	2002	J-2	P-2	2005	1.32	8	25	73	3	5.11	90	75
Los Presidentes Master plan (Ultimate Build 402 acres)	**LP**	**A2**	941	1295	1163	1564	1437	1890	LP Post + CVE Post	100-yr	3229	J-2	P-2	3232	1.32	9	36	90	3	5.70	90	90
Summers/Gault Watershed (85.60 acres)	**SG**	**A2**	306	NA	373	NA	455	NA	LP Pre + CVE Pre+ SG Post	100-yr	1645	J-3	P-5	1647	0.78	8	25	81	3.5	3.89	200	85
Summers/Gault Watershed (85.60 acres)	**SG**	**A2**	NA	349	NA	418	NA	502	LP Post + CVE Post+ SG Post	100-yr	3159	J-3	P-5	3160	0.78	9.5	43.5	100.5	3	4.62	200	105

	Subdivision(s)	Pond ID	Estimated Storage Required (ac-ft)	Pond Acreage Shown on Masterplan (acres)	Estimated Pond Depth (ft)	Subdivision Contributing to Regional Pond	Storage Contribution to Regional Pond (%)
FUTURE PONDS/POSSIBLE REGIONAL POND							
	CVE Post	P-1	*1 44.17	4.45	9.93	CVE	39.90
	LP Post+ CVE Pre	P-2	*2 38.26	5.2	7.36	LP	49.51
	SG Post + LP Pre + CVE Pre	P-3	*2 25.00	3.72	6.72	SG	10.54
	LP Post+CVE Post+SG Post	P-5	*2 137.87	15.5	8.89		

*1- Pond volume based on 50-yr event.
*2- Pond volume based on 100-yr event.

	Runoff Contribution (%) to Downstream Channel by Developer		
Channel Scenario	**Gault**	**Hilltop Farms**	**Cuatro Vientos East**
CVE Post + Los Presidentes Post (25yr)	N/A	63	37
CVE Post + Los Presidentes Post (100yr)	N/A	62	38
CVE Post + Los Presidentes Post+ Gault Post (100yr)	52	30	18

Assumptions

1) Pond outlets are circular pipe runs.*Quick conceptual design
2) All channels with Lateral Slope of "X" equal to or greater than 3 are earthen.
3) Slopes follow natural contours.
4) Run-off flows developed with SCS Curve Method

SUBDIVISION WATERSHED	Sub-Watershed Label	Overall Watershed ID	25-yr Pre Development Flow (cfs)	25-yr Post Development Flow (cfs)	50-yr Pre Development Flow (cfs)	50-yr Post Development Flow (cfs)	100-yr Pre Development Flow (cfs)	100-yr Post Development Flow (cfs)	Design Scenario	Design Storm Event	Design Flow (cfs)	Pondpack Junction ID	Pond ID	Single Run Pipe Diameter (1) Flow Capacity (cfs)	Single Run Pipe Diameter (2) Flow Capacity (cfs)	Cumulative Pipe Flow Capacity (cfs)	Slope (%)	Manning's Coefficient (n)	Material Type	Pipe Diameter Required (in)	Pipe Diameter (1) Recommended (in)	Pipe Runs	Pipe Diameter (2) Recommended (in)	Pipe Runs	Velocity (ft/s)
Cuatro Vientos East (Ultimate Build 324 acres)	**CVE**	**A2**	309	NA	399	NA	496	NA	CVE Pre	25-yr	309	J-1	P-2	154	24	333	0.98	0.012	Contech SmoothCor	62.32834	48	2	24	1	10.93
Cuatro Vientos East (Ultimate Build 324 acres)	**CVE**	**A2**	NA	1076	NA	1320	NA	547	CVE Post	25-yr	1076	J-1	P-2	280	0	1120	0.98	0.012	Contech SmoothCor	99.51321	60	4			13.71
Los Presidentes Master plan (Ultimate Build 402 acres)	**LP**	**A2**	941	1295	1163	1564	1437	1890	LP Post + CVE Pre	25-yr	1348	J-2	P-3	325	51	1351	1.32	0.012	Contech SmoothCor	102.4076	60	4	30	1	16.16
Los Presidentes Master plan (Ultimate Build 402 acres)	**LP**	**A2**	941	1295	1163	1564	1437	1890	LP Post + CVE Post	25-yr	2153	J-2	P-3	419	83	2178	1.32	0.012	Contech SmoothCor	122.0647	66	5	36	1	17.11
Los Presidentes Master plan (Ultimate Build 402 acres)	**LP**	**A2**	941	1295	1163	1564	1437	1890	LP Post + CVE Pre	100-yr	2002	J-2	P-3	325	419	2043	1.32	0.012	Contech SmoothCor	118.7811	60	5	66	1	16.43
Los Presidentes Master plan (Ultimate Build 402 acres)	**LP**	**A2**	941	1295	1163	1564	1437	1890	LP Post + CVE Post	100-yr	3229	J-2	P-3	528	325	3291	1.32	0.012	Contech SmoothCor	142.1016	72	5	60	2	17.88
Summers/Gault Watershed (85.60 acres)	**SG**	**A2**	306	NA	373	NA	455	NA	LP Pre + CVE Pre+ SG Post	100-yr	1645	J-3	P-4	322	96	1706	0.78	0.012	Contech SmoothCor	121.7869	66	5	42	1	12.82
Summers/Gault Watershed (85.60 acres)	**SG**	**A2**	NA	349	NA	418	NA	502	LP Post + CVE Post+ SG Post	100-yr	3159	J-3	P-4	406	322	3165	0.78	0.012	Contech SmoothCor	155.5498	72	7	66	1	14.26

Assumptions

1) Pipe diameters based on average existing natural slope, listed under "Slope (%)" column.
2) Run-off flows developed with SCS Curve Method
3) Velocity determined by design flow traveling through recommended pipe diameter and pipe runs.

Webb County Drainage District 06/26/2015
Cuatro Vientos East, Los Presidentes, and Gault H + H Analysis
Preliminary Opinion of Cost for Channels

I. Channel Improvements (LP Post + CVE Pre) 100-yr Design

Item No.	Description	Estimated Quantity	Unit	Unit Price	Extended
1	Channel Excavation	52,847	CY	$ 4.00	$ 211,389.63
2	Erosion Control Blanket	248,346	SF	$ 2.00	$ 496,692.00
3	60" RCP	1,400	LF	$ 200.00	$ 280,000.00
4	66" RCP	280	LF	$ 225.00	$ 63,000.00
5	Concrete-Lined Channel	26,838	SF	$ 5.00	$ 134,190.00
LP Share = 100% CVE Share = 0%		**Total Drainage Channel Improvements**			**$ 1,185,271.63**

II. Channel Improvements (LP Post + CVE Post) 100-Yr Design

Item No.	Description	Estimated Quantity	Unit	Unit Price	Extended
1	Channel Excavation	76,440	CY	$ 4.00	$ 305,760.00
2	Erosion Control Blanket	305,242	SF	$ 2.00	$ 610,484.40
3	60" RCP	280	LF	$ 200.00	$ 56,000.00
4	72" RCP	1,400	LF	$ 250.00	$ 350,000.00
5	Concrete-Lined Channel	32,987	SF	$ 5.00	$ 164,933.00
LP Share = 80% CVE Share = 20%		**Total Drainage Channel Improvements**			**$ 1,487,177.40**

III. Channel Improvements (LP Pre + CVE Pre+ SG Post) 100-Yr Design

Item No.	Description	Estimated Quantity	Unit	Unit Price	Extended
1	Channel Excavation	13,741	CY	$ 4.00	$ 54,962.96
2	Erosion Control Blanket	72,835	SF	$ 2.00	$ 145,670.00
3	66" RCP	350	LF	$ 225.00	$ 78,750.00
4	42" RCP	70	LF	$ 140.00	$ 9,800.00
SG Share = 100%LP Share = 0% CVE Share = 0%		**Total Drainage Channel Improvements**			**$ 289,182.96**

IV. Channel Improvements (LP Post + CVE Post+ SG Post) 100-Yr Design

Item No.	Description	Estimated Quantity	Unit	Unit Price	Extended
1	Channel Excavation	22,167	CY	$ 4.00	$ 88,666.67
2	Erosion Control Blanket	90,633	SF	$ 2.00	$ 181,265.00
3	72" RCP	420	LF	$ 200.00	$ 84,000.00
4	66" RCP	70	LF	$ 120.00	$ 8,400.00
SG Share = 80% LP Share = 13% CVE Share = 7%		**Total Drainage Channel Improvements**			**$ 362,331.67**

ASSUMPTIONS:

1) Purpose of this estimate is to demonstrate cost differential between Pre + Post Flow scenarios.
2) Headwalls not included, as they are a common cost to each estimate.
3) Cost Estimate for pond pending. See pond storage distribution percentage in Exhibit #8A.

6/30/15

STATE OF TEXAS
EDWARD D. GARZA
75853
LICENSED
PROFESSIONAL ENGINEER

This document is released for the purpose of interim review under the authority of Edward D. Garza P.E. 75853 on June 26, 2015. It is not to be used for bidding purposes.

CRANE ENGINEERING CORP.
1310 JUNCTION DRIVE SUITE B
LAREDO, TX 78041 956-712-1996
FIRM REGISTRATION NO. F-3353

EXHIBIT #9