SR 710 North Study

Engineering Document

Location Hydraulic Study

Prepared for

Caltrans
CALIFORNIA DEPARTMENT OF TRANSPORTATION

Metro
Los Angeles County
Metropolitan Transportation Authority

February 24, 2014

Signature Page

This Location Hydraulic Study has been prepared by CH2M HILL Engineers under the direction of the following Registered Civil Engineer. The undersigned attests to the technical information contained herein and the qualifications of any technical specialist providing engineering data upon which recommendations, conclusions, and decisions are based:

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Acronyms and Abbreviations

ADT	Average Daily Traffic
BRT	Bus Rapid Transit
FEMA	Federal Emergency Management Agency
FIRM	Federal Insurance Rate Maps
FIS	Flood Insurance Study
HGL	Hydraulic Grade Line
I	Interstate
LACDPW	Los Angeles County Department of Public Works
LACFCD	Los Angeles County Flood Control District
LAR	Los Angeles River
LRT	Light Rail Transit
Metro	Los Angeles County Metropolitan Transportation Authority
MVP	Maintenance Vehicle Pull-Out
NAVD88	North American Vertical Datum 1988
NGVD29	National Geodetic Vertical Datum 1929
Project	Freeway Tunnel Alternative
RCB	Reinforced Concrete Box
RCC	Reinforced Concrete Channel
RCPA	Reinforced Concrete Pipe Arch
Specific Plan	City of Los Angeles Specific Plan for the Management of Flood Hazards
SR	State Route
TDM	Traffic Demand Management
TSM	Transportation System Management
UPRR	Union Pacific Rail Road
WSE	Water Surface Elevation

Location Hydraulic Study for SR 710 North Study

1. Introduction

Los Angeles County Metropolitan Transportation Authority (Metro), in cooperation with California Department of Transportation (Caltrans), proposes to improve mobility and relieve congestion in the area between SR 2 and Interstates (I) 5, 10, 210, and 605 in east/northeast Los Angeles and the San Gabriel Valley. As part of the environmental document phase of the project, several alternatives are being considered, including No Build, Transportation System Management/Traffic Demand Management (TSM/TDM), Bus Rapid Transit (BRT), Light Rail Transit (LRT), and Freeway Tunnel alternatives.

Of the proposed alternatives, only the Freeway Tunnel Alternative would incur floodplain impacts. The BRT, LRT, and TSM/TDM alternatives would not affect any floodplain within the project areas.

The Freeway Tunnel alternative would start at the existing SR 710 in Monterey Park, south of I-10, and connect to the existing northern stub of SR 710, south of the I-210/SR 134 interchange in Pasadena (see Figure 1). One of the variations to the Freeway Tunnel alternative (the Project) comprises two-level, dual-bore tunnels with four lanes in each direction. Short segments of cut-and-cover tunnels would be located at the south and north termini to provide access via portals to the bored tunnels. The access to the south portal will require widening of the freeway approaches. The widening of the freeway will encroach into the Dorchester Avenue Storm Drain (Dorchester Channel) on the west side and the Laguna Regulating Basin (Basin) on the east side of the new freeway (see Figure 2). Whereas the dual-bore tunnel alternative would incur floodplain impacts to the Dorchester Channel, the single-bore tunnel design variation would not. Therefore, this study addresses the floodplain impacts of the dual-bore alternative only.

This report assesses the existing and project conditions of the Basin and Dorchester Channel between the I-10 Freeway and Valley Boulevard with respect to hydrology, floodplain impacts, hydraulic impacts of the encroachment, property at risk, and environment impacts. Both facilities are owned and maintained by the Los Angeles County Department of Public Works (LACDPW) and Los Angeles County Flood Control District (LACFCD).

2. Project Description

2.1 Laguna Regulating Basin

The proposed I-710 alternative would encroach horizontally into the west side of the Basin if it were to be built on a widened embankment. The extent of the encroachment would be up to 20 ft wide and would be approximately 700 ft long along the western boundary of the Basin (see Figure 3). The freeway widening would also affect the existing maintenance access road along the west side of the Basin.

To reduce the impacts on the Basin, instead of constructing a widened embankment, the freeway will be built on elevated structure (see Figure 3). Most of elevated structure will be above the Basin operation level of 381.00 feet (ft) North American Vertical Datum, 1988 [NAVD88]. Construction and maintenance of the bridge will reduce the final grade below the structure to approximately Elevations 375.8 to 380.7 ft NAVD88. The excavation for the bridge structure would actually increase some basin storage volume. To minimize the impact to the Basin maintenance road, the maintenance road will be replaced by a new entrance and maintenance vehicle pull-out (MVP) area from the I-10/I-710 Connector.

2.2 Dorchester Channel

Under the dual-bore Tunnel option, the proposed I-710 on-ramp would encroach into the Dorchester Channel. The grading will encroach into the existing reinforced concrete channel (RCC) for approximately 728 ft just north of Hellman Avenue, and again further north for approximately 267 ft further north (see Figure 4). Where the embankment encroaches into the channel, the existing 20 ft x 14 ft RCC would be replaced with a double 9.67 ft x 14 ft reinforced concrete box (RCB) along the original channel alignment. The embankment would be constructed atop the new RCB. This proposed channel layout is intended to minimize the hydraulic impact to the existing condition (see Figure 4).

3. Setting

The Dorchester Channel and the Basin receive runoff from the watersheds north of I-10. The watershed has a gentle southerly slope from north up to near I-110, including the communities of Alhambra, Monterey Hills, and South Pasadena. After the runoff discharges from the Basin, it drains through several channel systems, mostly located within Caltrans right-of-way and, eventually, discharges into the Los Angeles River in the City of Vernon.

The existing regional drainage systems information is based on As-Built plans and design reports gathered from LACDPW and Caltrans. There are two drainage facilities located near the south portal of the tunnel: the Laguna Regulating Basin located at northeast corner of the I-10 and I-710 intersection and the Dorchester Channel, which carries water into the Basin from north of Hellman Avenue.

3.1 Laguna Regulating Basin

Available engineering documents for this basin include a design report prepared in 1955 (LACDPW, 1955) and As-Built information for the construction of the basin and spillway (LACDPW, 1967, 1970, and 1991). There was no basin stage-storage or stage-flow information available. The design documents indicate the top of the basin wall at elevation 375.00 ft (National Geodetic Vertical Datum 1929 [NGVD29]) and the spillway crest at 374.00 ft NGVD29; however, current topographic data show the spillway crest at elevation 378.58 ft NGVD29 (or 381.00 ft NAVD88)[1]. No background documents (as-built plans or design reports) are available that describe the improvements which raised the basin crest (CH2M HILL, 2013b). Using the basin contours, the basin volume is estimated to be 290.6 acre-feet (ac-ft) at the spillway crest.

The outlet structure for this basin is a 12-foot (ft) reinforced concrete pipe arch (RCPA) culvert located just north of the I-10 freeway that discharges basin flows to the south. The basin outlet has an invert elevation of 340.87 ft NGVD29 (or 343.29 ft NAVD88).

The dominant inflow for this basin comes from the Dorchester Channel, with several other minor inflows from culverts draining the existing SR 710 and the surrounding neighborhoods.

3.2 Dorchester Channel

Available engineering documents for this storm drain channel include the 1956 (LACDPW, 1956) and 1960 (LACDPW, 1960) as-built information. The Dorchester Channel connection at the Laguna Regulating Basin is a 9.67- by 12.75-ft double RCB culvert (see Figure 2). Immediately upstream from the basin, it crosses SR 710 and runs generally north-south and approximately parallel to the new SR 710 alignment. It crosses Hellman Avenue and Valley Boulevard, and then approaches the Union Pacific Rail Road (UPRR) tracks before splitting into dual culverts.

[1] An adjustment of 2.42 ft is required to convert As-Built elevations from NGVD29 to NAVD88.

North of Hellman Avenue, the double RCB becomes a 20- by 14-ft reinforced concrete channel (RCC). The RCC runs between the west side of the freeway and the east side of a residential neighborhood. The RCC continues for about 1,875 ft upstream. The channel slope in the RCC is about 0.82 percent.

About 400 ft south of Valley Boulevard, the RCC then becomes a double 10- by 12-ft RCB. To the north of Valley Boulevard, the RCB continues for another 1,550 ft. The RCB then transitions to a double 12- by 12-ft RCPA at about 200 ft south of the UPRR.

The RCPA continues for about 185 ft further upstream; then the storm drain splits into two parallel RCBs: Line "A" West and Line "A" East. Line "A" West is an 11- by 12.5-ft RCB. Line "A" East is a 10.25- by 13.25-ft RCB. Line "A" West crosses the UPRR tracks, turns westerly along Alhambra Avenue, and then northerly toward Dorchester Avenue. Line "A" East crosses the UPRR tracks, continues northerly toward Lowell Avenue, and turns northeasterly along Concord Avenue.

4. Traffic

SR 710 is a north-south freeway currently connecting the cities of Long Beach and Alhambra. It passes through urbanized areas of Los Angeles County. There are between two and four lanes in each direction. Existing traffic volumes at the terminus of the freeway near Valley Boulevard are 43,000 vehicles/day (http://traffic-counts.dot.ca.gov/2011all/Route505-980.html). Traffic volumes to the south are much higher – up to 225,000 vehicles/day near SR 91. From the Alternative Analysis Report (Metro, 2012), future traffic volumes for the year 2035 in an eight-lane (untolled) SR 710 tunnel are expected to be approximately 180,000 vehicles/day.

According to the SR 710 Alternatives Analysis Report (Metro, 2012) and I-710 Major Corridor Study (Metro, 2005), "the I-710 freeway currently experiences high levels of congestion and emissions during the peak hours, a condition that is exacerbated by heavy truck volumes, design problems, and operational choke points along this 20-mile segment (Port of Los Angeles and Long Beach to SR 60) of the freeway. In addition, trucks and passenger vehicles that use surface streets and arterials as a means to avoid freeway congestion on I-710 contribute to existing traffic and quality of life concerns for the communities that line the I-710 Corridor."

No traffic interruption is expected to occur from the base flood. The base flood does not inundate beyond the southbound edge of the shoulder.

5. Hydrologic Analysis

5.1 Hydrologic Characteristics

The Project is located within the Los Angeles River (LAR) Watershed, which covers over 830 square miles. Within the LAR watershed most tributaries have been engineered to reduce stream instability and the impact of flood events. The watershed includes a portion of the San Gabriel Mountains, Santa Susana Mountains, Verdugo Hills, and Santa Monica Mountains. Watershed terrain consists of foothills, valleys, and coastal plain. Mountain areas generally have chaparral cover that becomes flammable and burns in the dry, windy weather. Most hills and valley areas have been developed and have grassy or little vegetal cover (LACDPW, 2006). The watershed is 37 percent residential with a population of 9 million. The remaining land use is 8 percent commercial, 11 percent industrial, and 44 percent open space (LACDPW, 2013b).

The annual average precipitation can range from 15.5 inches in the coastal plain to 32.9 inches near the San Gabriel Mountains. Winter storms comprise most of the rainfall within the area and most precipitation occurs between December and March. January and July are the coldest and warmest months, respectively (LACDPW, 2006).

5.2 Flood of Record and Base Flood

Available information to establish the flood of record for the combined system is limited. LACDPW indicated there has never been an overtopping flood in the basin since it was constructed, even in very wet years (CH2M HILL, 2013b). No new watershed drainage study or detention modeling has been performed to analyze the existing facilities under the 100-year flood conditions. Therefore, the highest possible inundated area prior to spillway activity is assumed to be the flood of record and the basis for analyzing impacts to the existing floodplain.

For Dorchester Channel, no historic stream gage data or FEMA FIRM maps are available. Available hydraulic design data indicate that the design flows for this system were based on 50-year frequency, also known as the Capital Flood. The Capital Flood is based on the design storm falling on a saturated watershed, and is the basis for most Federal Insurance Rate Maps (FIRMs) in Los Angeles County (LACHM, 2006).

LACDPW provided design flows of the Dorchester channel main line (Line “A”) and Line “A” West at various locations (LACDPW, 1955). These design flows are summarized in the Table 5-1. The system splits into Line “A” West and Line “A” East at the junction. Based on available hydrologic data, at the junction of Line “A” West and Line “A” East, a design flow of 2,813 (= 5,148-2,335) cubic feet per second (cfs) was derived for Line “A” East. These data were used for the hydraulic and floodplain analysis of the channel.

TABLE 5-1
Dorchester Channel Design Flows (Capital Flood)

Channel Reach	Design Flow [cfs]
Main Line/Line "A" West	
@ Gravios (Hellman) Avenue	5,481
@ Bohlig Road	5,392
@ Valley Boulevard	5,339
@ Junction with Line “A” East (Upstream becomes Line “A” West)	5,148
@ Alhambra Avenue	2,335
Line “A” East	
Alhambra Avenue	2,813

Note: Data extracted from microfilm design reports (LACDPW, 1955).
cfs = cubic feet per second

6. Hydraulic Analysis

Available hydrologic data were used to evaluate the performance of the physical structures in the storm drain system. No new hydrologic analysis was performed to evaluate the change in dynamics of the storm drainage system since the time of construction.

6.1 Laguna Regulating Basin

Outlet Analysis. No stage-discharge curves were available from existing LACDPW data (CH2M HILL, 2013a and 2013b). The existing Basin outflow discharge was estimated based on As-Built information and topographic elevation data. The maximum water surface elevation (WSE) was assumed to be the spillway crest at Elevation

381 ft (NAVD88). The Basin outlet is at Elevation 343.29 ft (NAVD88). Using the Basin contours, the Basin volume was estimated to be 290.6 ac-ft. At this WSE, the basin outlet would function under inlet-controlled conditions, with a peak flow capacity of about 3,500 cfs.

In the LACDPW design report (1955), the spillway crest was used to set the tail-water at the Laguna Regulating Basin for the hydraulic modeling of Dorchester Channel. However, it did not explain why the hydraulic jumps would occur in the Basin without sealing the Dorchester Channel RCB.

Drawdown Time. There are no published hydraulic data in the LACDPW records for the Dorchester Channel or Laguna Regulating Basin of flooding in the past. In the unlikely event that the Basin is full, it would take approximately 1.88 hours to drain the Basin empty or 0.66 hour to drain down to WSE 364.50 ft NAVD29 (or 366.92 ft NAVD88) when there is no major incoming flow to the Basin. This WSE was determined to be the maximum tail-water elevation that would not cause hydraulic jump in Dorchester Channel or affect the flow capacity of the channel. The drawdown analysis is presented in Attachment A.

Flood Routing. Because drawdown occurs rapidly, the likelihood of the peak inflow to the basin occurring at the same time as the peak WSE in the basin is extremely rare, i.e. the recurrence interval for this “peak-to-peak” event is likely to be much greater than 100 years. This may explain why the Basin has no history of overflowing its spillway and has not caused an overflow in Dorchester Channel. During a normal flood event, the peak inflow is therefore much more likely to occur at a time when the WSE in the basin is low. This study therefore takes a de-coupled approach, assuming the Basin has enough storage to attenuate the peak flood such that peak flow in Dorchester Channel will not arrive at the peak elevation at the Basin.

In the Project condition, the basin floodplain elevation will not change, although the floodplain limits may be modified slightly due to additional excavation under the bridge structure. The floodplain impacts to the basin are presented in Figures 5 and 6.

6.2 Dorchester Channel

Storm drain systems are analyzed using the LACDPW software package, Water Surface and Pressure Gradient Hydraulic Analysis System (WSPG, originally the F0515P program from LACDPW). The program used for this project is the Windows version, modified by CivilDesign, Inc (CivilDesign, 2000).

For hydraulic modeling purposes, the mainline was established as (from downstream up) Line “A,” Line “A” East, and ends at Line “B,” (Note that the flow rates for Line “B” were used to address the mitigation measures and not related to the project reaches.) Copies of related pages of the original report are presented in the Attachment A.

Existing Conditions. The hydraulic models for the channel were created using As-Built drawings (see Attachment A) and the older NGVD29 datum. The models cover at least 2,700 ft upstream of the open channel and ended downstream at the Basin.

As discussed above, it is reasonable to assume a tail water elevation within the Basin to be lower than Elevation 364.50 ft NGVD29 (or 366.92 ft NAVD88). A lower tail-water is also technically necessary for the channel modeling because a higher WSE assumption would result in a hydraulic jump in the Dorchester Channel, causing the model to fail. For the reach between the Hellman Avenue and Valley Boulevard crossings (Station [Sta.] 12+50 to Sta. 26+75), the water depths range from 9.95 to 10.92 ft, velocities from 24.63 to 27.12 ft per section (ft/s), and Froude Numbers from 1.51 to 1.30. Therefore, the existing channel maintains a supercritical flow to drain into the Basin when the WSE in the Basin WSE is not higher than Elevation 364.50 ft NGVD29 (or 366.92 ft NAVD88).

Project Conditions. Under the project conditions, the widening of SR 710 would raise the roadway profile and fill in to the sunken channel, which would slightly affect the floodplain boundary. Where the channel will be impacted, it will be reconstructed as an RCB; fill will be placed above the RCB.

The proposed alternative was developed by updating the existing conditions model to reflect the design improvements. The design calls for a smaller RCB section (double 9.67-ft by 14-ft) with three openings in the channel. The maximum hydraulic grade line (HGL) impact of 2.11 ft would occur at Sta. 14+85.00, approximately 235 ft upstream of the Hellman Avenue crossing. Flow velocities decrease slightly due to extra energy loss within

the RCB; however, the HGL would be contained with the channel. There would be no change in WSE in the upstream channel that is not altered, starting at Sta. 25+50, approximately 1,275 ft downstream of Valley Avenue crossing. Therefore, there would be no increase to flood risk to the upstream community.

Summaries of the existing and proposed channel layouts and hydraulic results are presented in Appendix B. The hydraulic results were adjusted to the NAVD88 datum by adding 2.42 ft to the WSPG outputs and are summarized in Table 6-1.

The floodplain analysis for the Dorchester Channel could be complicated because of the direct connection to the basin. FEMA guidelines require that a floodplain of a supercritical-flow channel be mapped by its critical flow depths (FEMA, 2006). The hydraulic analysis indicated the Dorchester channel can hold the critical depth within the channel under project conditions whenever the basin WSE is below 364.50 (NGVD29) or 366.92 NAVD88).

Backwater Effects in Channel. In an extreme flood the Basin may fill completely to the elevation of the spillway crest, 381.00 ft (NAVD88). For this assessment an assumption is made that for the portion of the channel affected by this backwater effect the floodplain elevation is 381.00 (see Figure 6). This elevation would completely submerge approximately 800 ft of RCC north of Hellman Avenue. Because the RCC is within a sunken area between the SR 710 and local developments, the flood would be completely contained.

In the Project Condition, this backwater effect would remain because a portion of the submerged length of RCC (just north of Hellman Avenue) will remain uncovered. The Project Condition would modify the floodplain boundary for approximately 650 ft, shifting it west (see Figure 6).

6.3 Overtopping Condition

The LACDPW has indicated that the Laguna Regulating Basin has never overtopped in its history, even during wet years. Therefore, the overtopping condition is an extreme event with a return frequency likely to be much greater than 100 years. In such an event, spillway activity may be anticipated, with a peak water surface in excess of 381.00 ft.

In the worst-case scenario, i.e. a full Basin downstream, the high water surface would cause a backwater condition upstream of the basin. The RCB near Hellman Avenue would become completely sealed. Southern portions of the new RCB section also will become sealed. In these areas, the floodplain extents will rise above the Dorchester Channel walls and inundate areas beyond the channel, as shown in Figure 5. The floodplain would be contained by the surrounding slopes. However, no addition flooding risk is expected in both areas.

TABLE 6-1
Summary of Hydraulics of the Dorchester Channel

	Project Condition		Existing Condition		
Cross Section	**WSE (ft)**	**Channel Velocity (ft/s)**	**WSE (ft)**	**Channel Velocity (ft/s)**	**WSE Difference (ft)**
At Laguna Regulating Basin					
491.00	366.27	23.57	366.18	23.75	0.09
517.00	366.48	23.57	366.37	23.79	0.11
544.03	366.71	23.57	366.59	23.80	0.12
916.00	369.94	23.22	369.35	24.34	0.56
1078.00	371.53	22.75	370.50	24.79	1.03
1088.00	371.08	23.61	370.25	25.38	0.83
1153.80	371.64	23.60	370.67	25.68	0.97
1173.80	371.80	23.59	370.79	25.78	1.01
1250.00	372.44	23.57	371.25	26.19	1.19
End Hellman Avenue RCB Crossing					
1250.00	371.34	25.09	370.52	27.14	0.82
1279.74	371.67	24.91	370.78	27.11	0.89
1309.00	371.99	24.78	371.03	27.07	0.96
1309.00	**373.07**	**23.29**	**371.03**	**27.07**	**2.04**
1398.74	**373.88**	**23.15**	**371.82**	**26.94**	**2.06**
1485.00	**374.69**	**22.95**	**372.58**	**26.80**	**2.12**
1505.00	**374.44**	**23.63**	**372.57**	**27.12**	**1.87**
1754.09	**376.42**	**23.74**	**374.75**	**26.75**	**1.68**
2013.40	**378.41**	**24.03**	**377.12**	**26.11**	**1.29**
2037.00	**378.58**	**24.06**	**377.35**	**25.52**	**1.24**
2037.00	377.59	25.42	377.35	25.52	0.25
2190.00	379.25	24.49	378.84	25.43	0.41
2220.00	379.25	24.90	378.86	25.85	0.40
2264.53	379.75	24.61	379.29	25.68	0.46
2283.00	379.96	24.47	379.50	24.78	0.46
2283.00	**381.10**	**22.95**	**379.50**	**24.78**	**1.60**
2333.00	**381.59**	**22.79**	**380.01**	**25.05**	**1.58**
2450.00	**382.98**	**22.02**	**381.24**	**24.68**	**1.75**
2482.31	**382.29**	**23.59**	**381.09**	**25.39**	**1.20**
2550.00	**382.83**	**23.61**	**381.79**	**25.05**	**1.04**
2550.00	381.79	25.05	381.79	25.05	0.00
2625.00	382.61	24.58	382.61	24.58	0.00
2675.00	382.88	24.63	382.88	24.63	0.00
Begin Valley Boulevard RCB Crossing					
2675.00	383.77	23.45	383.77	23.45	0.00
2780.00	384.15	24.12	384.15	24.12	0.00
2790.00	383.75	24.95	383.75	24.95	0.00

Elevations are based on NAVD 1988. An adjustment of 2.42 ft is required to convert As-Built elevations from NGVD29 to NAVD88.

7. Property at Risk

The inundation area at Dorchester Channel is bordered by Hellman Avenue to the south, SR 710 to the east, and residences to the west. The inundation area along Dorchester Channel does not pose any additional risk to surrounding properties. Ponding does not encroach into adjacent properties or travel ways.

8. Risk Assessment

8.1 Risk Associated with Implementation

The minor change in water surface elevation in Dorchester Channel would not result in any significant change in flood risks or damage, and does not have the potential for interruption or termination of emergency service or emergency routes. While there is a negligible increased risk to flooding and floodplains, the Project requires new slopes to be constructed on top of the RCB. There is a 2:1 (horizontal to vertical) slope located west of the channel, between the channel and residential properties. Project impacts to slope stability present a risk during flooded conditions. These impacts will be addressed by geotechnical engineering during the design.

At the Laguna Regulating Basin, proper design of the structures will consider geotechnical considerations potential for submerged slopes. There will be no impact to the Laguna Regulating Basin's flood detention storage or function.

8.2 Impacts to Floodplain Values

Natural and beneficial floodplain values are listed in the Caltrans Highway Manual. These values include, but are not limited to, fish, wildlife, plants, open space, natural beauty, scientific study, outdoor recreation, agriculture, forestry, natural moderation of floods, water quality maintenance, and groundwater recharge (Caltrans, 2012). The Laguna Regulating Basin and Dorchester Channel are constructed storm drain facilities in a developed urban area; changes to the floodplain are not expected to impact floodplain values. Because it is an engineered water way with restricted public access, the channel does not provide open space, natural beauty, or outdoor recreation value. It also has limited value to support fish, wildlife, and plant habitat. The Laguna Regulating Basin and Dorchester Channel are also not listed in the Los Angeles Region Basin Plan as having any beneficial uses (California Regional Water Quality Control Board [CRWQCB], 1994). These values are not anticipated to be adversely affected by the Project.

8.3 Support of Incompatible Development

The area surrounding the floodplain is already developed and there will be no changes to floodplain values. As such, the proposed Project will not support incompatible development.

8.4 Minimization of Floodplain Impact

Impacts to the Laguna Regulating Basin floodplain have been minimized by constructing the widened SR 710 on elevated bridge structures near the basin, allowing the freeway to be widened without grading into the basin. Fill within the Dorchester Channel reduces the overall floodplain area by 5 percent.

8.5 Restoration and Preservation of Floodplain Values

Since there will be no significant impacts to the floodplain and floodplain values, no restoration or preservation of floodplain values is required.

9. Alternatives to Longitudinal Encroachment

The dual-bore Freeway Tunnel Alternative design variation meets the design objectives, e.g. traffic capacity, while minimizing the longitudinal encroachment within the floodplain of the Dorchester Channel and Laguna Regulating Basin. Design variations that achieve the same design objectives would require geometric modifications to the horizontal or vertical alignment, or realignment of the freeway main line. Those design variations would induce more severe impacts to existing ROW, land use, and hydrology east of the Freeway. Alternatives to the longitudinal encroachment resulting from the dual-bore design variation may include the single-bore design variation. While this design variation will avoid the encroachment to the Dorchester Channel, it will not meet the same design objectives for traffic capacity. Therefore alternatives to the longitudinal encroachment are not feasible.

The longitudinal encroachment along the western boundary of the Laguna Regulating Basin is necessary to reduce impacts to existing ROW, slope easements, channel structures, land uses, hydrology, and potential geotechnical and seismic issues. As noted above, the longitudinal encroachment involves the construction of an elevated bridge structure to accommodate the widening of SR 710. The bridge structure would be supported by piers that would be placed in the floodplain. The area under the bridge would be excavated. By using a bridge structure to widen SR 710 at this location, the floodplain encroachment would not reduce the storage volume of the Laguna Regulating Basin; therefore, in the project condition, the base floodplain elevation would not change.

Alternatives to the longitudinal encroachment resulting from the dual-bore design variation may include the single-bore design variation. While this design variation may reduce the level of encroachment, it will not meet the same design objectives for traffic capacity.

10. Alternatives to Significant Encroachment

There is no significant encroachment to the Laguna Regulating Basin or the Dorchester Channel. As discussed above, the proposed flood improvements for the dual-bore design variation is designed to minimize physical impacts to these flood control facilities. Therefore there are no significant encroachments. No alternatives to significant encroachment are required.

11. Existing Watershed and Floodplain Management Programs

The Project is in compliance with the City of Los Angeles Specific Plan for the Management of Flood Hazards (Specific Plan), developed in 1980 and amended in 1988, 1998, and 2008. Per Section 4.C of the Specific Plan, the extent of flooding shall be considered in the planning, design, and construction of public and private development (City of Los Angeles, 1998). The impact to the floodplain has been minimized for this project.

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Figures

Figure 1
Location Map
SR-710 North Study

TBG/SCO

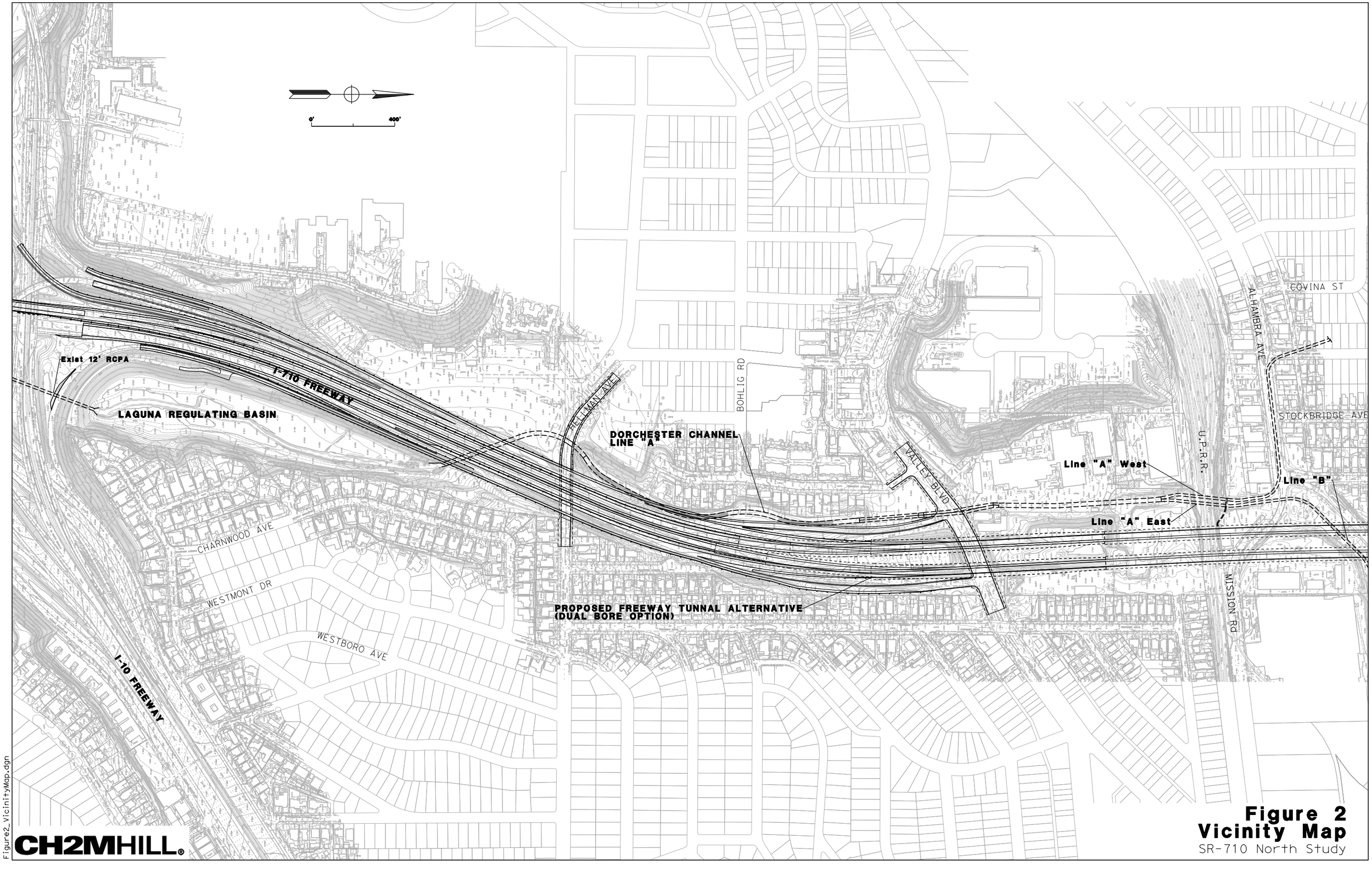
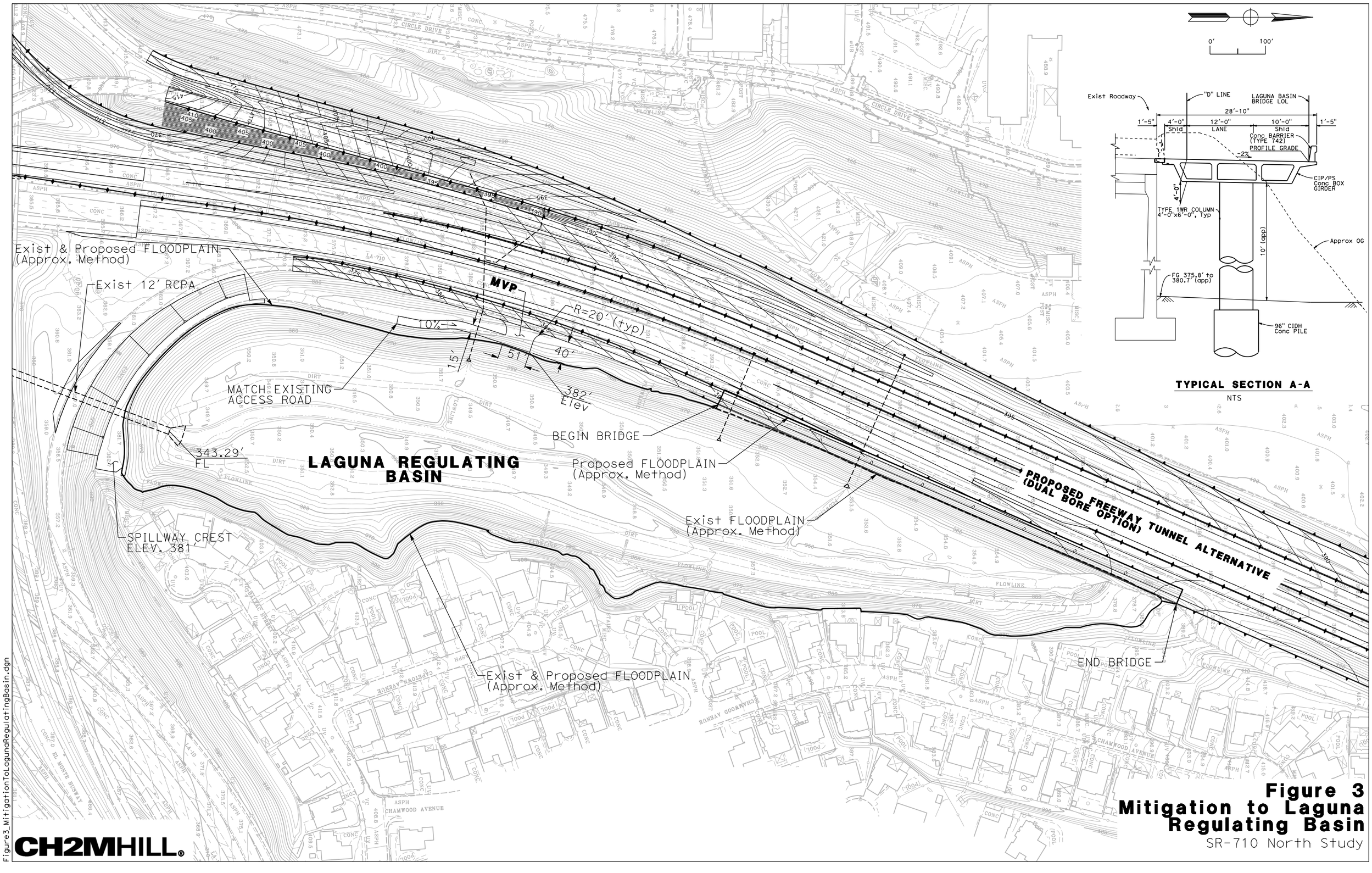


Figure 2
Vicinity Map
SR-710 North Study

CH2MHILL®

Figure2_VicinityMap.dgn



TYPICAL SECTION A-A

NTS

Figure 3
Mitigation to Laguna Regulating Basin
SR-710 North Study

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Figure3_MitigationToLagunaRegulatingBasin.dgn

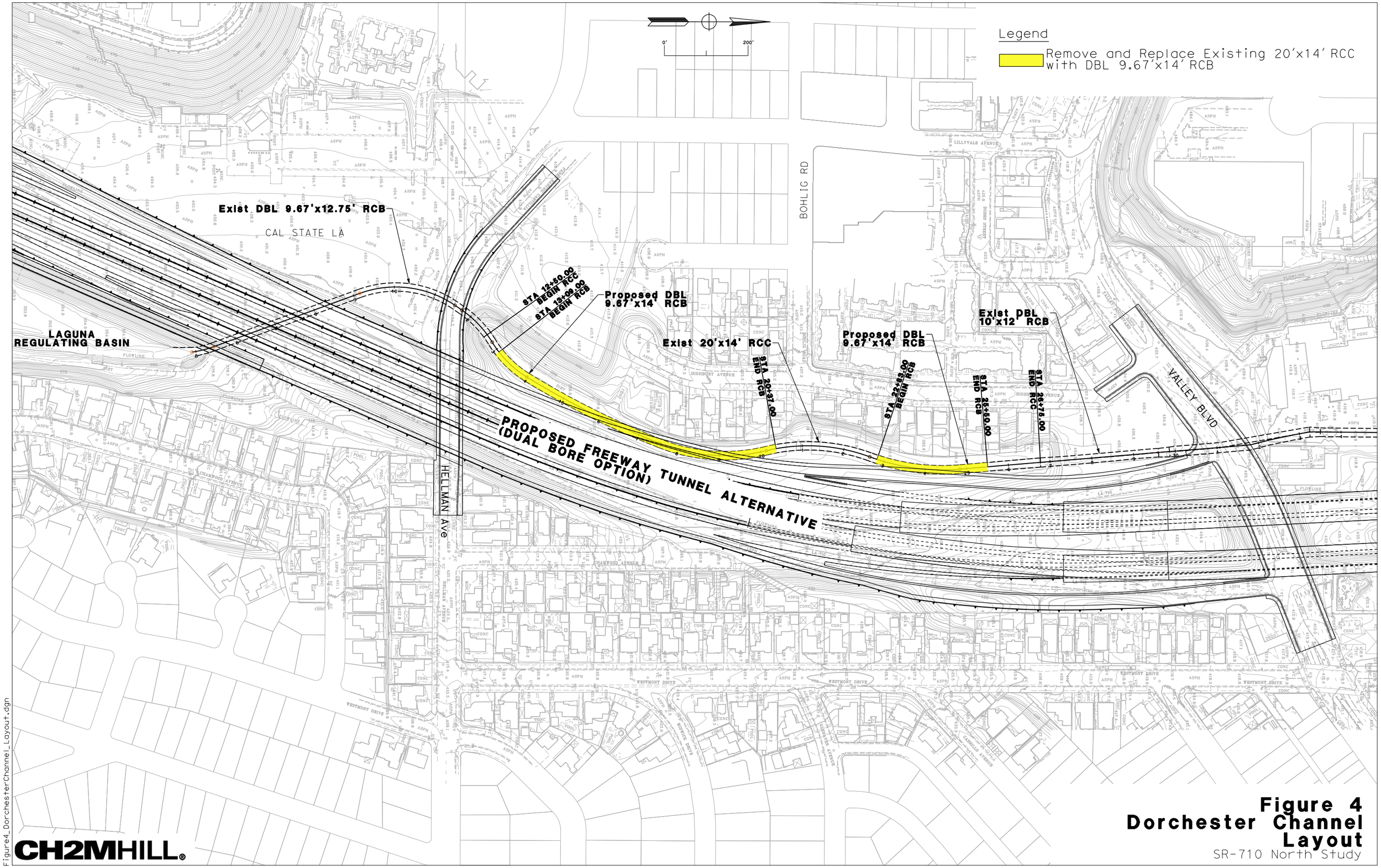

Figure 4
Dorchester Channel Layout
SR-710 North Study

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Figure4_DorchesterChannel_Layout.dgn

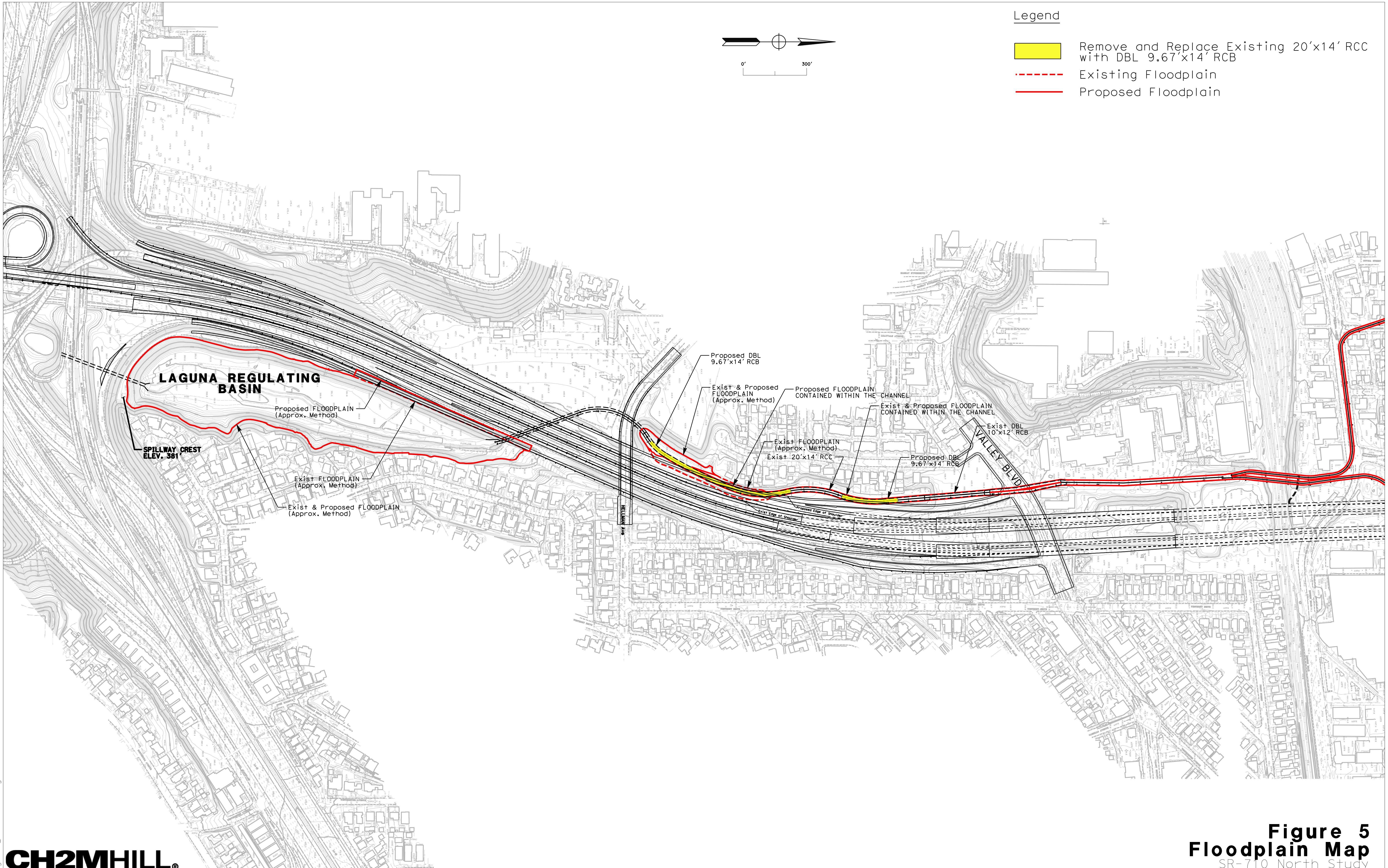

Figure 5
Floodplain Map
SR-710 North Study

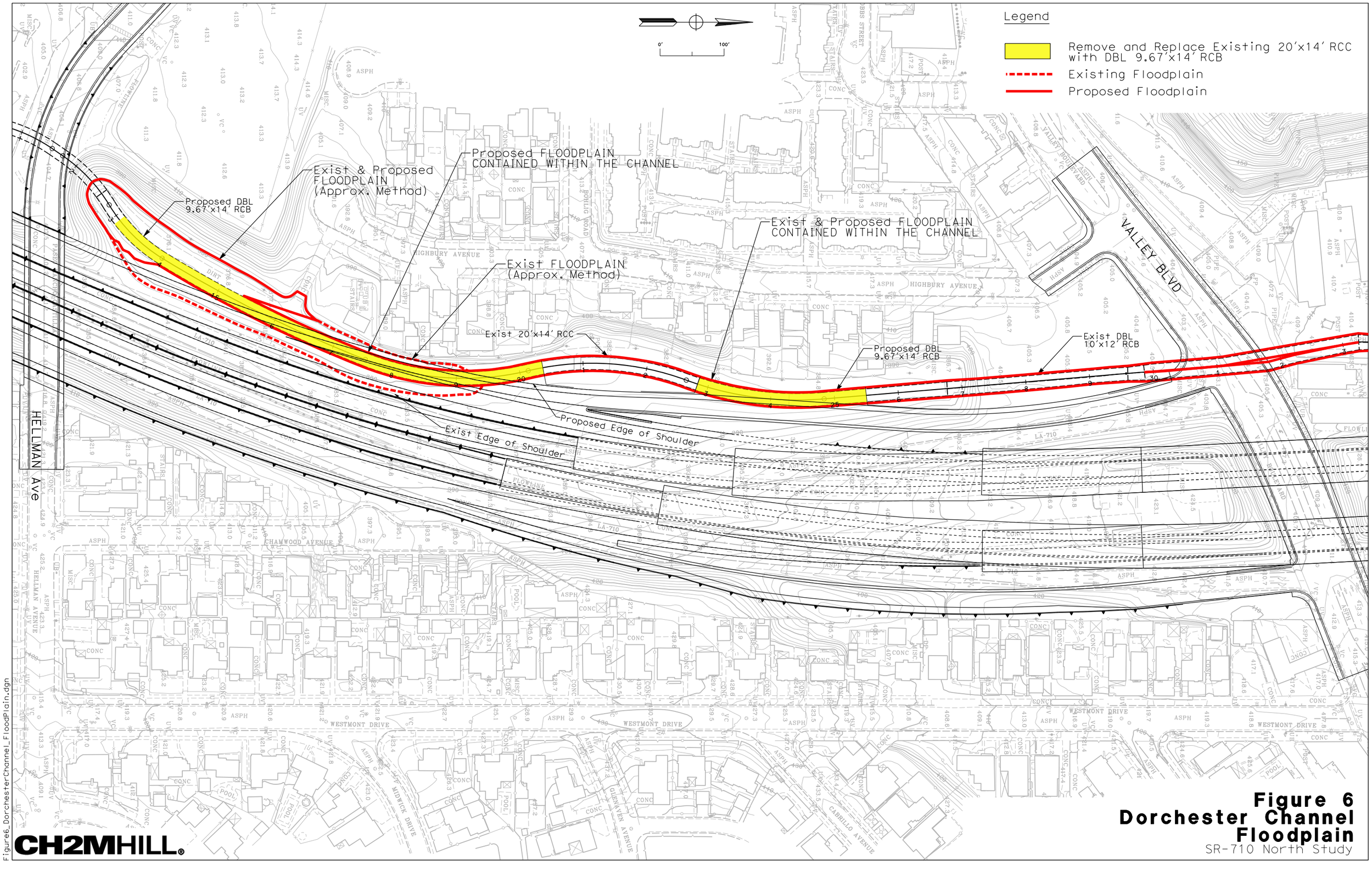

Figure 6
Dorchester Channel Floodplain
SR-710 North Study

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Figure6_DorchesterChannel_FloodPlain.dgn

Appendix A
Relevant Design Data

LOCATION HYDRAULIC STUDY FORM

Dist. ***7*** Co. ***LA*** Rte. ***710*** K.P. ***N/A***
EA TBD Bridge No. ***N/A***
Floodplain Description:
Floodplain is based on high water surface elevation in the Laguna Regulating Basin (downstream), and Capital Flood WSE in Dorchester Channel (upstream). Both are engineered LACDPW flood-control facilities.
1. Description of Proposal (include any physical barriers i.e. concrete barriers, soundwalls, etc. and design elements to minimize floodplain impacts)

Widening of Route 710 to provide proper transition to the proposed tunnel freeway, including southbound on-ramps. New bridge is proposed in the Laguna Regulating Basin to avoid storage impacts. Encroachment over Dorchester Channel will result in replacing two portions of rectangular channel with RC Box culvert on the existing alignment. See attached report for details.

2. ADT: Current **43,000 vpd** Projected **180,000 vpd (in 2035)**

3. Hydraulic Data: Base Flood $Q_{100=}$ **5,481** cfs
$WSE_{100=}$ **Varies (see Report)** The flood of record, if greater than $Q_{100:}$
Q= ***N/A*** m^3 / s WSE= ***N/A***
Overtopping flood Q= ***N/A*** cfs WSE= ***N/A***
Are NFIP maps and studies available? YES NO ***X***

4. Is the highway location alternative within a regulatory floodway ?
YES NO ***X***

5. Attach map with flood limits outlined showing all buildings or other improvements within the base floodplain. ***See Attached Report.***

Potential Q_{100} backwater damages:

A. Residences? NO ***X*** YES
B. Other Bldgs? NO ***X*** YES
C. Crops? NO ***X*** YES
D. Natural and beneficial
FLOODPLAIN VALUES? NO YES ***X***

6. Type of Traffic:

A. Emergency supply or evacuation route? NO YES ***X***
B. Emergency vehicle access? NO YES ***X***
C. Practicable detour available? NO YES ***X***
D. School bus or mail route? NO YES ***X***

7. Estimated duration of traffic interruption for 100-year event hours: ***0***

8. Estimated value of Q_{100} flood damages (if any) – moderate risk level.

A.	Roadway	$ 0
B	Property	$ 0
	Total	$ 0

9. Assessment of Level of Risk
Low ***X***
Moderate
High

For High Risk projects, during design phase, additional Design Study Risk Analysis May be necessary to determine design alternative.

Signature – Dist. Hydraulic Engineer _____ Date _____
(Item numbers 3,4,5,7,9)

Is there any longitudinal encroachment, significant encroachment, or any support of incompatible floodplain development? NO _____ YES ***X***

If yes, provide evaluation and discussion of practicability of alternatives in accordance with 23 CFR 650.113
See Report attached.

Information developed to comply with the Federal requirement for the Location Hydraulic Study shall be retained in the project files.

Signature – Dist. Project Engineer _____ Date _____
(Item numbers 1,2,6,8)

SR-710 NORTH STUDY -- REGIONAL CHANNEL SUMMARY, EXISTING CONDITION
(Project 65 Line A and Line B)

8/23/2013

System No	Station Model	Station Design plan	Channel Type	Elevation (NGVD29) (ft)	Length (LF)	Slope (%)	Q50 (City) cfs	Q (Study) cfs	Note
Main Lines									
Dorchester Drain Line "A"	4+91.00	4+13.00	SYSTEM OUTLET	351.820			5481	**5481**	
	5+17.00	4+39.00	TRAN. STRUCTURE	352.033	26.00	0.821%	5481	**5481**	Δ =-5.959 °, R = 250'
	5+44.03	4+66.03	DBL 9.67'x12.75' RCB	352.255	27.03	0.821%	5481	**5481**	Δ =-6.195 °, R = 250'
	9+16.00	8+38.00	DBL 9.67'x12.75' RCB	355.310	371.97	0.821%	5481	**5481**	
	10+78.00	10+00.00	DBL 9.67'x12.75' RCB	356.640	162.00	0.821%	5481	**5481**	Δ=37.127 °, R=250'
	10+88.00	+88.00	JUNCTION STRUCTURE	356.723	10.00	0.826%	5481	**5481**	10+00.00=0+78.00 JOIN 72" RCP (Q=30cfs) Δ =2.291 °, R = 250'
	11+53.80	1+53.80	DBL 9.67'x12.75' RCB	357.266	65.80	0.826%	N/A	**5451**	Δ =15.080 °, R = 250'
	11+73.80	1+73.80	DBL 9.67'x12.75' RCB	357.431	20.00	0.826%	N/A	**5451**	
	12+50.00	2+50.00	DBL 9.67'x12.75' RCB	358.060	76.20	0.826%	N/A	**5451**	Δ =17.464 °, R = 250'
	12+79.74	2+79.74	20.00'X14.00' RCC	358.304	29.74	0.819%	N/A	**5451**	Δ =6.816 °, R = 250'
	13+98.80	3+98.80	20.00'X14.00' RCC	359.279	119.06	0.819%	N/A	**5451**	Δ =-27.286 °, R = 250'
	14+85.00	4+85.00	20.00'X14.00' RCC	359.985	86.20	0.819%	N/A	**5451**	Δ =-2.469 °, R =2000'
	15+05.00	5+05.00	JUNCTION STRUCTURE	360.149	20.00	0.819%	N/A	**5451**	Δ =-0.573 °, R =2000' Lateral 30"RCP (Q=29 cfs)
	17+54.09	7+54.09	20.00'X14.00' RCC	362.189	249.09	0.819%	N/A	**5422**	Δ =-7.136 °, R =2000'
	20+13.40	10+13.40	20.00'X14.00' RCC	364.313	259.31	0.819%	N/A	**5422**	Δ =-34.960 °, R = 425'
	21+90.00	11+90.00	20.00'X14.00' RCC	365.760	176.60	0.819%	N/A	**5422**	Δ =23.808 °, R = 425'
	22+20.00	12+20.00	JUNCTION STRUCTURE	366.005	30.00	0.819%	N/A	**5422**	Δ =4.044 °, R = 425' Lateral 30" RCP (Q=30cfs)
	22+64.53	12+64.53	20.00'X14.00' RCC	366.370	44.53	0.819%	5392	**5392**	Δ =6.003 °, R = 425'
	24+50.00	14+50.00	20.00'X14.00' RCC	367.893	185.47	0.821%	5392	**5392**	Δ =-21.253 °, R = 500'
	24+82.31	14+82.31	JUNCTION STRUCTURE	368.158	32.31	0.821%	5392	**5392**	Δ =-3.702 °, R = 500' Lateral 45" RCP (Q=53cfs)
	26+25.00	16+25.00	20.00'X14.00' RCC	369.330	142.69	0.821%	5339	**5339**	
	26+75.00	16+75.00	TRAN. STRUCTURE	369.970	50.00	1.280%	5339	**5339**	
	27+80.00	17+80.00	DBL 10.00'x12.00' RCB	370.661	105.00	0.658%	5339	**5339**	
	27+90.00	17+90.00	JUNCTION STRUCTURE	370.727	10.00	0.658%	5339	**5339**	Lateral 30" RCP (Q=50cfs)
	29+57.51	19+57.51	DBL 10.00'x12.00' RCB	371.830	167.51	0.658%	N/A	**5289**	
	29+82.51	+25.21	TRAN. STRUCTURE	372.380	25.00	2.200%	N/A	**5289**	19+57.51=0+00.21
	31+89.30	2+32.00	DBL 10.00'x12.00' RCB	374.520	206.79	1.035%	N/A	**5289**	∠-5.027° MH 1
	31+99.30	2+42.00	JUNCTION STRUCTURE	374.623	10.00	1.035%	N/A	**5289**	Lateral 36" RCP(Q=45cfs)
	32+23.12	2+65.82	DBL 10.00'x12.00' RCB	374.870	23.82	1.035%	N/A	**5244**	MH 1
	33+03.90	3+46.60	DBL 10.00'x12.00' RCB	375.980	80.78	1.374%	N/A	**5244**	
	33+08.90	3+51.60	TRAN. STRUCTURE	376.015	5.00	0.703%	N/A	**5244**	
	33+29.44	3+72.14	TRAN. STRUCTURE	376.159	20.54	0.703%	N/A	**5244**	Δ =11.770 °, R =100'
	33+45.18	3+87.88	TRAN. STRUCTURE	376.270	15.74	0.703%	N/A	**5244**	
	33+55.18	3+97.88	JUNCTION STRUCTURE	376.384	10.00	1.144%	N/A	**5244**	Lateral 24" RCP(Q=48cfs)
	35+99.63	6+42.33	DBL 10.00'x12.00' RCB	379.180	244.45	1.144%	N/A	**5196**	MH
	36+25.79	6+68.49	DBL 10.00'x12.00' RCB	379.479	26.16	1.144%	N/A	**5196**	Δ =-4.282 °, R =350'
	38+87.30	9+30.00	TRAN. STRUCTURE	382.470	261.51	1.144%	N/A	**5196**	
	38+97.30	9+40.00	JUNCTION STRUCTURE	382.584	10.00	1.144%	N/A	**5196**	JOIN Line "A" West Lateral 24" RCP(Q=48cfs)
	40+89.30	11+32.00	DBL 10.00'x12.00' RCB	384.780	192.00	1.144%	5148	**5148**	
Line "A" East	41+35.72	11+78.42	JUNCTION STRUCTURE	385.310	46.42	1.142%	5148	**5148**	Lateral 10.00'x12.00' RCB (Q=2335cfs)
	41+41.60	11+84.30	DBL 10.00'x12.00' RCB	385.389	5.88	1.336%	5148	**2813**	
	42+11.51	12+54.21	DBL 10.00'x12.00' RCB	386.322	69.91	1.336%	5148	**2813**	Δ =10.54 °, R =380' MH
	42+23.54	12+66.24	DBL 10.00'x12.00' RCB	386.483	12.03	1.336%	5148	**2813**	
	42+43.54	12+86.24	TRAN. STRUCTURE	386.750	20.00	1.336%	5148	**2813**	
	44+20.54	14+63.24	12.00'x12.00' Horseshoe Arch*	389.120	177.00	1.339%	5148	**2813**	
	44+40.54	14+83.24	TRAN. STRUCTURE	390.218	20.00	5.488%	5148	**2813**	
	44+53.21	14+95.91	TRAN. STRUCTURE	390.913	12.67	5.488%	N/A	**2813**	Δ=-3.156 °, R=230'
	44+63.54	15+06.24	TRAN. STRUCTURE	391.480	10.33	5.488%	N/A	**2813**	Δ=-2.573 °, R=230'
	44+97.74	15+40.44	10.25'x13.25' RCB	391.638	34.20	0.462%	N/A	**2813**	Δ =-8.520 °, R =230'
	45+79.22	16+21.92	10.25'x13.25' RCB	392.015	81.48	0.462%	N/A	**2813**	
	45+95.38	16+38.08	TRAN. STRUCTURE	392.089	16.16	0.462%	N/A	**2813**	
	46+23.64	16+66.34	10.25'x13.25' RCB	392.220	28.26	0.462%	N/A	**2813**	
Line "B"	47+03.02	7+03.62	10.25'x13.25' RCB	393.220	79.38	1.260%	N/A	**2813**	16+66.34=7+83.00 MH
	47+13.02	6+93.62	TRAN. STRUCTURE	393.340	10.00	1.200%	N/A	**2813**	
	47+39.96	6+66.68	10.00'x13.25' RCB	393.663	26.94	1.198%	N/A	**2813**	
	48+80.82	5+25.82	10.00'x13.25' RCB	395.350	140.86	1.198%	N/A	**2813**	Δ =51.785 °, R =155.85'
	51+91.14	2+15.50	10.00'x13.25' RCB	397.650	310.32	0.741%	N/A	**2813**	
	53+83.64	+23.00	10.00'x13.25' RCB	399.749	192.50	1.090%	N/A	**2813**	Δ =46.177 °, R =238.85' MH
	53+92.38	+14.26	TRAN. STRUCTURE	399.844	8.74	1.090%	N/A	**2813**	Δ =2.096 °, R =238.85'
	54+06.64	+0.00	TRAN. STRUCTURE	400.000	14.26	1.090%	N/A	**2813**	Q=5148-2335 cfs

SR-710 NORTH STUDY -- REGIONAL CHANNEL SUMMARY, EXISTING CONDITION
(Project 65 Line A and Line B)

8/23/2013

System No	Station Model	Station Design plan	Channel Type	Elevation (NGVD29) (ft)	Length (LF)	Slope	Q50 (City) cfs	Q (Study) cfs	Note
Laterals									
Line "A" West	+35.72	11+78.04	JUNCTION STRUCTURE	385.310			2335	**2335**	Join Line "A" West
	1+18.58	12+60.90	10.00'x12.00' RCB	386.389	82.86	1.303%	2335	**2335**	
	1+38.58	12+80.90	TRAN. STRUCTURE	386.650	20.00	1.303%	2335	**2335**	
	3+23.58	14+65.90	12.00'x12.00' Horseshoe Arch*	389.650	185.00	1.622%	2335	**2335**	
	3+33.58	14+75.90	TRAN. STRUCTURE	390.180	10.00	5.299%	2335	**2335**	
	3+45.83	14+88.15	11.00'x12.50' RCB	390.829	12.25	5.299%	2335	**2335**	
	3+58.50	15+00.82	TRAN. STRUCTURE	391.501	12.67	5.299%	2335	**2335**	
	3+72.83	15+15.15	11.00'x12.50' RCB	392.260	14.33	5.299%	2335	**2335**	
	3+74.58	15+16.90	11.00'x12.50' RCB	392.274	1.75	0.805%	2335	**2335**	
	4+31.78	15+74.10	11.00'x12.50' RCB	392.735	57.20	0.805%	2335	**2335**	$\Delta = -14.250°$, R =230'
	5+15.61	16+57.93	11.00'x12.50' RCB	393.410	83.83	0.805%	2335	**2335**	
	6+35.25	17+78.04	11.00'x12.50' RCB	394.374	119.64	0.805%	2335	**2335**	1657.93=1658.40 $\Delta = -68.547°$, R=100'
	7+05.01	18+47.80	11.00'x12.50' RCB	394.935	69.76	0.805%	2335	**2335**	$\Delta = -21.037°$, R =190' MH
	11+42.21	22+85.00	11.00'x12.50' RCB	398.460	437.20	0.805%	2335	**2335**	MH
	11+58.13	23+00.92	11.00'x12.50' RCB	398.612	15.92	0.955%	2335	**2335**	
	11+96.76	23+39.55	11.00'x12.50' RCB	398.981	38.63	0.955%	2335	**2335**	$\Delta = 34.05°$, R =65'
	12+75.03	24+17.82	11.00'x12.50' RCB	399.729	78.27	0.955%	2335	**2335**	$\Delta = 44.848°$, R =100'
	15+22.21	26+65.00	11.00'x12.50' RCB	402.090	247.18	0.955%	2335	**2335**	

*For practical purpose, the Horse Shoe Arch was modeled as 9.73'x12.00' RCB.

SR-710 NORTH STUDY -- REGIONAL CHANNEL SUMMARY, PROPOSED CONDITION
(Project 65 Line A and Line B)

8/23/2013

System No	Station Model	Station Design plan	Channel Type	Elevation (NGVD29) (ft)	Length (LF)	Slope (%)	Q50 (City) cfs	Q (Study) cfs	Note
Main Lines									
Dorchester Drain	4+91.00	4+13.00	SYSTEM OUTLET	351.820			5481	**5481**	
Line "A"	5+17.00	4+39.00	TRAN. STRUCTURE	352.033	26.00	0.821%	5481	**5481**	Δ =-5.959 °, R = 250'
	5+44.03	4+66.03	DBL 9.67'x12.75' RCB	352.255	27.03	0.821%	5481	**5481**	Δ =-6.195 °, R = 250'
	9+16.00	8+38.00	DBL 9.67'x12.75' RCB	355.310	371.97	0.821%	5481	**5481**	
	10+78.00	10+00.00	DBL 9.67'x12.75' RCB	356.640	162.00	0.821%	5481	**5481**	Δ=37.127 °, R=250'
	10+88.00	+88.00	JUNCTION STRUCTURE	356.723	10.00	0.826%	5481	**5481**	10+00.00=0+78.00 JOIN 72" RCP (Q=30cfs) Δ =2.291 °, R = 250'
	11+53.80	1+53.80	DBL 9.67'x12.75' RCB	357.266	65.80	0.826%	N/A	**5451**	Δ =15.080 °, R = 250'
	11+73.80	1+73.80	DBL 9.67'x12.75' RCB	357.431	20.00	0.826%	N/A	**5451**	
	12+50.00	2+50.00	DBL 9.67'x12.75' RCB	358.060	76.20	0.826%	N/A	**5451**	Δ =17.464 °, R = 250'
	12+50.00	2+50.00	Bridge Entrance	358.060	0.00	0.826%	N/A	**5451**	
	12+79.74	2+79.74	20.00'X14.00' RCC	358.304	29.74	0.819%	N/A	**5451**	Δ =6.816 °, R = 250'
	13+09.00	3+09.00	20.00'X14.00' RCC	358.543	29.26	0.819%	N/A	**5451**	Δ =-6.706 °, R = 250'
	13+09.00	3+09.00	Bridge Exit	358.543	0.00	0.819%	N/A	**5451**	
	13+98.80	3+98.80	DBL 9.67'x14.00' RCB	359.279	89.80	0.819%	N/A	**5451**	Δ =-20.581 °, R = 250'
	14+85.00	4+85.00	DBL 9.67'x14.00' RCB	359.985	86.20	0.819%	N/A	**5451**	Δ =-2.469 °, R =2000'
	15+05.00	5+05.00	JUNCTION STRUCTURE	360.149	20.00	0.819%	N/A	**5451**	Δ =-0.573 °, R =2000' Lateral 30"RCP (Q=29 cfs)
	17+54.09	7+54.09	DBL 9.67'x14.00' RCB	362.189	249.09	0.819%	N/A	**5422**	Δ =-7.136 °, R =2000'
	20+13.40	10+13.40	DBL 9.67'x14.00' RCB	364.313	259.31	0.819%	N/A	**5422**	Δ =-34.960 °, R = 425'
	20+37.00	10+37.00	DBL 9.67'x14.00' RCB	364.506	23.60	0.819%	N/A	**5422**	Δ =3.182°, R = 425'
	20+37.00	10+37.00	Bridge Entrance	364.506	0.00	0.819%	N/A	**5392**	
	21+90.00	11+90.00	20.00'X14.00' RCC	365.760	153.00	0.819%	N/A	**5422**	Δ =20.626°, R = 425'
	22+20.00	12+20.00	JUNCTION STRUCTURE	366.005	30.00	0.819%	N/A	**5422**	Δ =4.044 °, R = 425' Lateral 30" RCP (Q=30cfs)
	22+64.53	12+64.53	20.00'X14.00' RCC	366.370	44.53	0.819%	5392	**5392**	Δ =6.003 °, R = 425'
	22+83.00	12+83.00	Bridge Exit	366.521	18.47	0.819%	5392	**5392**	
	22+83.00	12+83.00	DBL 9.67'x14.00' RCB	366.521	0.00	0.819%	5392	**5392**	Δ =-2.117 °, R = 500'
	24+50.00	14+50.00	DBL 9.67'x14.00' RCB	367.893	167.00	0.819%	5392	**5392**	Δ =-19.137 °, R = 500'
	24+82.31	14+82.31	JUNCTION STRUCTURE	368.158	32.31	0.821%	5392	**5392**	Δ =-3.702 °, R = 500' Lateral 45" RCP (Q=53cfs)
	25+50.00	15+50.00	DBL 9.67'x14.00' RCB	368.714	67.69	0.821%	5392	**5339**	
	25+50.00	15+50.00	Bridge Entrance	368.714	0.00	0.821%	5392	**5339**	
	26+25.00	16+25.00	20.00'X14.00' RCC	369.330	75.00	0.821%	5339	**5339**	
	26+75.00	16+75.00	TRAN. STRUCTURE	369.970	50.00	1.280%	5339	**5339**	
	27+80.00	17+80.00	DBL 10.00'x12.00' RCB	370.661	105.00	0.658%	5339	**5339**	
	27+90.00	17+90.00	JUNCTION STRUCTURE	370.743	10.00	0.819%	5339	**5339**	Lateral 30" RCP (Q=50cfs)
	29+57.51	19+57.51	DBL 10.00'x12.00' RCB	371.830	167.51	0.819%	N/A	**5289**	
	29+82.51	+25.21	TRAN. STRUCTURE	372.380	25.00	2.200%	N/A	**5289**	19+57.51=0+00.21
	31+89.30	2+32.00	DBL 10.00'x12.00' RCB	374.078	206.79	0.821%	N/A	**5289**	∠-5.027° MH 1
	31+99.30	2+42.00	JUNCTION STRUCTURE	374.160	10.00	0.821%	N/A	**5289**	Lateral 36" RCP(Q=45cfs)
	32+23.12	2+65.82	DBL 10.00'x12.00' RCB	374.870	23.82	0.821%	N/A	**5244**	MH 1
	33+03.90	3+46.60	DBL 10.00'x12.00' RCB	375.980	80.78	1.374%	N/A	**5244**	
	33+08.90	3+51.60	TRAN. STRUCTURE	376.023	5.00	0.856%	N/A	**5244**	
	33+29.44	3+72.14	TRAN. STRUCTURE	376.199	20.54	0.856%	N/A	**5244**	Δ =11.770 °, R =100'
	33+45.18	3+87.88	TRAN. STRUCTURE	376.270	15.74	0.856%	N/A	**5244**	
	33+55.18	3+97.88	JUNCTION STRUCTURE	376.234	10.00	-0.363%	N/A	**5244**	Lateral 24" RCP(Q=48cfs)
	35+99.63	6+42.33	DBL 10.00'x12.00' RCB	375.347	244.45	-0.363%	N/A	**5196**	MH
	36+25.79	6+68.49	DBL 10.00'x12.00' RCB	375.252	26.16	-0.363%	N/A	**5196**	Δ =-4.282 °, R =350'
	38+87.30	9+30.00	TRAN. STRUCTURE	374.303	261.51	-0.363%	N/A	**5196**	
	38+97.30	9+40.00	JUNCTION STRUCTURE	374.267	10.00	-0.363%	N/A	**5196**	JOIN Line "A" West
	40+89.30	11+32.00	DBL 10.00'x12.00' RCB	384.780	192.00	-0.363%	5148	**5148**	
Line "A" East	41+35.72	11+78.42	JUNCTION STRUCTURE	385.310	46.42	1.142%	5148	**5148**	Lateral 10.00'x12.00' RCB
	41+41.60	11+84.30	DBL 10.00'x12.00' RCB	385.296	5.88	-0.233%	5148	**2813**	
	42+11.51	12+54.21	DBL 10.00'x12.00' RCB	385.134	69.91	-0.233%	5148	**2813**	Δ =10.54 °, R =380' MH
	42+23.54	12+66.24	DBL 10.00'x12.00' RCB	385.106	12.03	-0.233%	5148	**2813**	
	42+43.54	12+86.24	TRAN. STRUCTURE	386.750	20.00	-0.233%	5148	**2813**	
	44+20.54	14+63.24	12.00'x12.00' Horseshoe Arch*	389.120	177.00	1.339%	5148	**2813**	
	44+40.54	14+83.24	TRAN. STRUCTURE	389.531	20.00	2.056%	5148	**2813**	
	44+53.21	14+95.91	TRAN. STRUCTURE	389.792	12.67	2.056%	N/A	**2813**	Δ=-3.156 °, R=230'
	44+63.54	15+06.24	TRAN. STRUCTURE	391.480	10.33	2.056%	N/A	**2813**	Δ=-2.573 °, R=230'
	44+97.74	15+40.44	10.25'x13.25' RCB	391.563	34.20	0.243%	N/A	**2813**	Δ =-8.520 °, R =230'
	45+79.22	16+21.92	10.25'x13.25' RCB	391.761	81.48	0.243%	N/A	**2813**	
	45+95.38	16+38.08	TRAN. STRUCTURE	391.800	16.16	0.243%	N/A	**2813**	
	46+23.64	16+66.34	10.25'x13.25' RCB	392.220	28.26	0.243%	N/A	**2813**	
Line "B"	47+03.02	7+03.62	10.25'x13.25' RCB	393.220	79.38	1.260%	N/A	**2813**	16+66.34=7+83.00 MH
	47+13.02	6+93.62	TRAN. STRUCTURE	393.340	10.00	1.200%	N/A	**2813**	
	47+39.96	6+66.68	10.00'x13.25' RCB	393.894	26.94	2.056%	N/A	**2813**	
	48+80.82	5+25.82	10.00'x13.25' RCB	395.350	140.86	2.056%	N/A	**2813**	Δ =51.785 °, R =155.85'
	51+91.14	2+15.50	10.00'x13.25' RCB	397.650	310.32	0.741%	N/A	**2813**	
	53+83.64	+23.00	10.00'x13.25' RCB	398.117	192.50	0.243%	N/A	**2813**	Δ =46.177 °, R =238.85' MH
	53+92.38	+14.26	TRAN. STRUCTURE	398.138	8.74	0.243%	N/A	**2813**	Δ =2.096 °, R =238.85'
	54+06.64	+0.00	TRAN. STRUCTURE	400.000	14.26	0.243%	N/A	**2813**	Q=5148-2335 cfs

SR-710 NORTH STUDY -- REGIONAL CHANNEL SUMMARY, PROPOSED CONDITION
(Project 65 Line A and Line B)

8/23/2013

System No	Station Model	Station Design plan	Channel Type	Elevation (NGVD29) (ft)	Length (LF)	Slope	Q50 (City) cfs	Q (Study) cfs	Note
Laterals									
Line "A" West	+35.72	11+78.04	JUNCTION STRUCTURE	385.310			2335	**2335**	Join Line "A" West
	1+18.58	12+60.90	10.00'x12.00' RCB	386.389	82.86	1.303%	2335	**2335**	
	1+38.58	12+80.90	TRAN. STRUCTURE	386.650	20.00	1.303%	2335	**2335**	
	3+23.58	14+65.90	12.00'x12.00' Horseshoe Arch*	389.650	185.00	1.622%	2335	**2335**	
	3+33.58	14+75.90	TRAN. STRUCTURE	390.180	10.00	5.299%	2335	**2335**	
	3+45.83	14+88.15	11.00'x12.50' RCB	390.829	12.25	5.299%	2335	**2335**	
	3+58.50	15+00.82	TRAN. STRUCTURE	391.501	12.67	5.299%	2335	**2335**	
	3+72.83	15+15.15	11.00'x12.50' RCB	392.260	14.33	5.299%	2335	**2335**	
	3+74.58	15+16.90	11.00'x12.50' RCB	392.274	1.75	0.805%	2335	**2335**	
	4+31.78	15+74.10	11.00'x12.50' RCB	392.735	57.20	0.805%	2335	**2335**	$\Delta = -14.250°$, R =230'
	5+15.61	16+57.93	11.00'x12.50' RCB	393.410	83.83	0.805%	2335	**2335**	
	6+35.25	17+78.04	11.00'x12.50' RCB	394.374	119.64	0.805%	2335	**2335**	1657.93=1658.40 $\Delta = -68.547°$, R=100'
	7+05.01	18+47.80	11.00'x12.50' RCB	394.935	69.76	0.805%	2335	**2335**	$\Delta = -21.037°$, R =190' MH
	11+42.21	22+85.00	11.00'x12.50' RCB	398.460	437.20	0.805%	2335	**2335**	MH
	11+58.13	23+00.92	11.00'x12.50' RCB	398.612	15.92	0.955%	2335	**2335**	
	11+96.76	23+39.55	11.00'x12.50' RCB	398.981	38.63	0.955%	2335	**2335**	$\Delta = 34.05°$, R =65'
	12+75.03	24+17.82	11.00'x12.50' RCB	399.729	78.27	0.955%	2335	**2335**	$\Delta = 44.848°$, R =100'
	15+22.21	26+65.00	11.00'x12.50' RCB	402.090	247.18	0.955%	2335	**2335**	

*For practical purpose, the Horse Shoe Arch was modeled as 9.73'x12.00' RCB.

gmk
7-11-55

PROJECT No. 65
HYDROLOGY REPORT

Intersection	City Q	L.A.C.F.C.D. Q	Adjusted Q	% Diff.
Stockbridge + Poplar "A"	1027	981	1125	9
Lathrop "C"	857	802	919	7
Junction "A" + "C"	2072	1675	1887	9
Allan St.	2155	1755	2013	6½
Alhambra	2335	1878	2153	8
Junction "A" + "B"	5148	4460	5114	0.7
Valley Blvd	5339	4638	5316	0.4
Bohlig Rd	5392	4712	5402	0.1
Travers Ave	5481	4781	5481	0

Ratio of intensity to 50 yr. Q. (City Freq.)

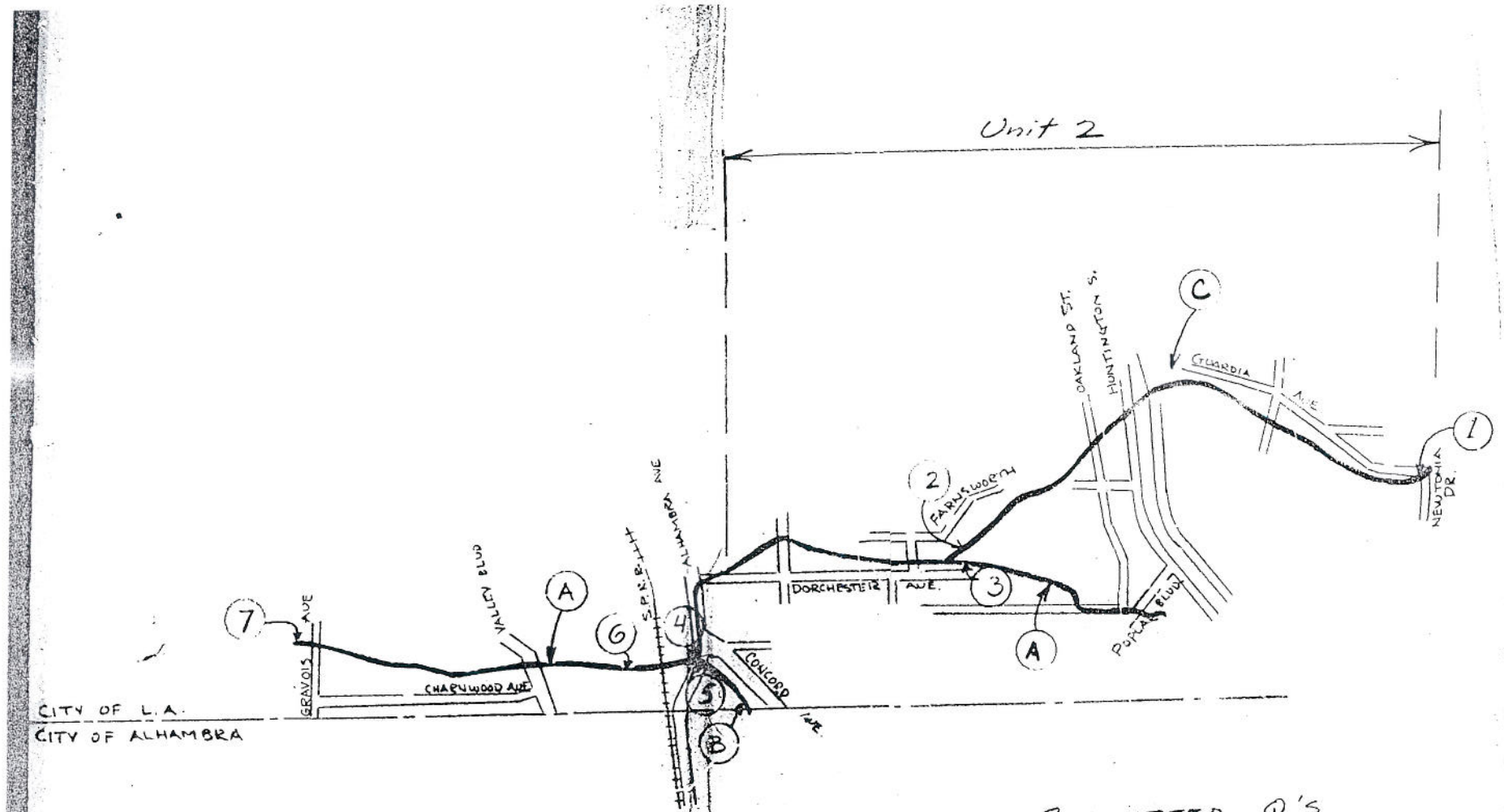
$$\frac{5481}{4781} \times 1.00 = 1.14$$

District frequency is 100 yrs. based on Alhambra Wash Curve.

Submitted T_c, Line A = 10.5 min.
Line C = 12.5 min.
County T_c, Line A = 10.0 min.
Line C = 12.1 min.

Note that B.I. originally called for a large portion of the project to be Open Channel.
By agreement, in which the City proposed to Design either Box or pipe, and approved by Mr. Hedger, the City is to pay the difference in cost between the Open channel and Both.
See C.W.O. memo, no date

PROJECT



PROJECT 65

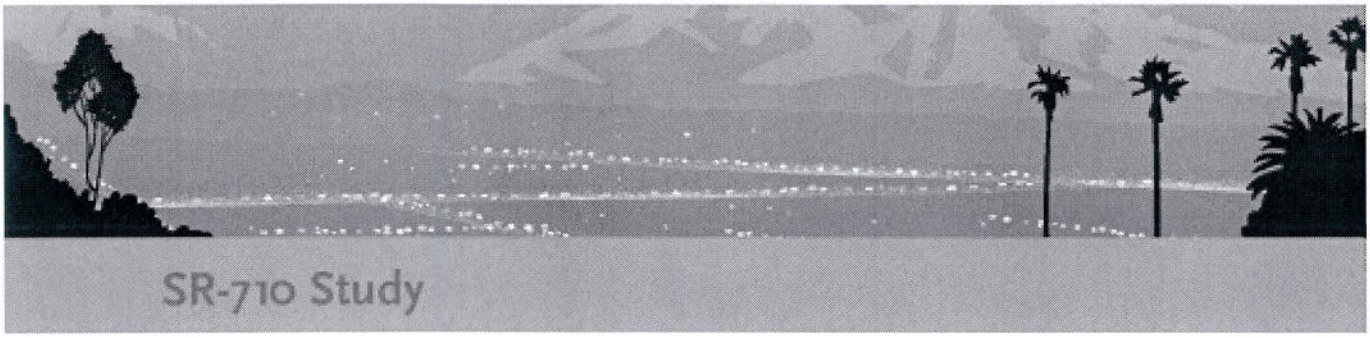
SUBMITTED Q's
Based on 50 yr. curve.

(1)	Q = 857	c.f.s.
(2)	Q = 1049	c.f.s.
(3)	Q = 1076	c.f.s.
(4)	Q = 5131	c.f.s.
(5)	Q = 2270	c.f.s.
(C)	Q = 5148	c.f.s.
(7)	Q = 5481	c.f.s.

JMK
6-7-55

Elevation	Outlet Elevatin	HW	HW/D	Area	Volume (ft^3)	Q (ft^3/s)	Average Q (ft^3/s)	Time(s)	Time(hr)	
381	343.29	37.71	3.1	539,305		3500				
380	343.29	36.71	3.1	529,757	534,531	3500	3500	152.72	0.04	
378	343.29	34.71	2.9	513,118	1,042,875	3300	3400	306.73	0.09	
376	343.29	32.71	2.7	496,686	1,009,804	3200	3250	310.71	0.09	
374	343.29	30.71	2.6	480,527	977,213	3100	3150	310.23	0.09	
372	343.29	28.71	2.4	465,357	945,884	3000	3050	310.13	0.09	
370	343.29	26.71	2.2	450,046	915,404	2700	2850	321.19	0.09	
368	343.29	24.71	2.1	435,194	885,240	2600	2650	334.05	0.09	Time Needed
366	343.29	22.71	1.9	420,228	855,422	2400	2500	342.17	0.10	0.66
364	343.29	20.71	1.7	405,492	825,720	2200	2300	359.01	0.10	
362	343.29	18.71	1.6	390,334	795,826	2100	2150	370.15	0.10	
360	343.29	16.71	1.4	374,141	764,475	1850	1975	387.08	0.11	
358	343.29	14.71	1.2	355,641	729,781	1600	1725	423.06	0.12	
356	343.29	12.71	1.1	330,590	686,231	1400	1500	457.49	0.13	
354	343.29	10.71	0.9	295,074	625,664	1000	1200	521.39	0.14	
352	343.29	8.71	0.7	241,980	537,054	690	845	635.57	0.18	
350	343.29	6.71	0.6	97,974	339,953	500	595	571.35	0.16	
348	343.29	4.71	0.4	34,334	132,307	260	380	348.18	0.10	
346	343.29	2.71	0.2	18,822	53,156	80	170	312.68	0.09	
				Total Volume	12,656,542			Total Time	1.88	

≈ 290.6 Ac-ft



SR 710 Study
Draft - Meeting Summary Notes
Los Angeles County Department of Public Works Coordination Meeting

PREPARED FOR: Michelle Smith/Metro

PREPARED BY: CH2M HILL

DATE: January 22, 2013

TIME: 3:00 p.m.

LOCATION: LACDPW Office, Alhambra, CA

ATTENDEES: See attached sign-in sheet.

OVERVIEW: The purpose of the meeting was to discuss the SR 710 Study alternatives and solicit feedback from LACFCD.

1. Yoga gave an introduction of the project, including the alternatives that are being considered and where we are currently in the schedule for the SR 710 Study.

2. Tom Ionta gave an overview of the Freeway tunnel alternative.

3. Ryan Mitry located the LACDPW facilities that would be impacted by the freeway tunnel alternative. The first impact is to the detention basin east of the SR 710 and north of the I-10, as the freeway is proposed to be widened in this area in order to accommodate the new improvements.

    a. The connector ramp from westbound I-10 to northbound SR 710 will need to be realigned to accommodate the widened freeway.
    b. The connector ramp and a portion of the SR 710 will encroach into the detention basin area.

    CH2M HILL provided LACDPW maps and cross sections showing the impacts to the detention basin area. Ryan informed LACDPW that the access road located on the west edge of the basin would be impacted and will need to be relocated or removed.

Metro

Caltrans

4. Amir Zandieh said CH2M HILL will need to evaluate the storage impacts to the detention basin and propose mitigating measures to ensure there is minimal impact to the capacity and the hydraulic grade line.

    a. LACDPW will provide CH2M HILL with the design storage volume and the design HGL of the basin.
    b. Amir also stated that the County maintenance staff will need to review the plans and they will inform CH2M HILL of the access requirements needed.

5. George Hsu noted that the houses on the east side of the basin appear to be lower in elevation than that of the access road on the west. With the design HGL lower than the houses the proposed impacts might not affect the design capacity of the basin. CH2M HILL will confirm once information is received from County.

6. The second impact is on Dorchester Storm Drain Channel south of Valley Blvd., along the southbound on ramp from Valley Blvd. CH2M HILL provided LACDPW with maps and cross sections showing the impacts to the channel and proposed converting the encroached open channel segment into a reinforced concrete box (RCB).

    a. Amir said LACDPW will provide CH2M HILL with the design flow rate and the design HGL of the channel. CH2M HILL will need to evaluate the hydraulic impacts to the channel and ensure the minimal HGL impact to the upstream reaches.
    b. LACDPW will review the analysis and provide comments.
    c. Amir noted that maintenance access to the RCB could be an issue with the channel.

7. Jamal Al-Mashat from AECOM described the light rail transit alternative and potential impacts on the basin, located on the east side of the I-710 south of I-10. The elevated LRT alignment passes near this basin.

    a. Jamal noted that there will not be any construction proposed in the basin but there are proposed bridge piers just north of this area.
    b. Amir said to evaluate the piers and see if they will have any effect on the basin.

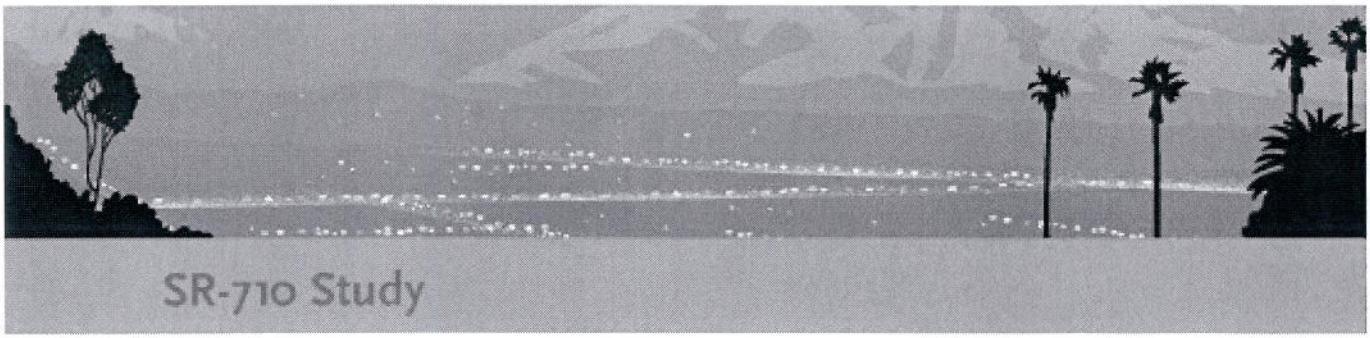
Action Items:

1. Erik Bautista to send Tom Ionta design criteria for the Dorchester channel and the 2 basins.
2. CH2M HILL to determine impacts to the hydraulics of the facilities and propose mitigation solutions for LACDPW to review.
3. AECOM will evaluate the piers along the southerly basin to confirm there is no impact to the LACDPW basin.

SR 710 Study
LACDPW Coordination Meeting

Date: January 22, 2013
Location: LACDPW

Name	Role	Agency	Phone	E-mail	Initial
Smith, Michelle	Project Manager	Metro	213-922-3057	smithmi@metro.net	MES
Govan, Cleavon	Environmental Lead	Metro	213-922-3034	govanc@metro.net	CG
Higa, Derek	Design Manager	Caltrans	213-897-0394	derek.higa@dot.ca.gov	DH
Saghafi, Abdi	Corridor Manager	Caltrans	213-897-9810	abdi.saghafi@dot.ca.gov	
Gaur, Jatinder		Caltrans		jatinder.gaur@dot.ca.gov	
Kung, Ainsley		Caltrans		ainsley.kung@dot.ca.gov	A.K.
Thurow, Jim		LACDPW	626 458-7844	jthurow@dpw.lacounty.cog	JT
Lasao, Manolito		LACDPW		mlasao@dpw.lacounty.gov	
Zandieh, Amir		LACDPW		azandieh@dpw.lacounty.gov	AZ
Chandran, Yoga	Project Manager	CH2M HILL	714-435-6111	Cyoga.Chandran@ch2m.com	CyC
Ionta, Tom	Engineering	CH2M HILL	714-435-6238	tionta@ch2m.com	TI
Mitry, Ryan	Engineering	CH2M HILL	714-435-6337	rmitry@ch2m.com	RM
Hsu, George	Drainage	CH2M HILL	714-435-6205	melissa.delapena@ch2m.com	GH
Greene, Steve	AA/Transit	AECOM	213-330-7182	steve.greene@aecom.com	
Acuna, Lilly	Project Assisatant	CH2M HILL	213-228-8250	lacuna@ch2m.com	
JAMAL AL-MASHAT	PROJECT ENGINEER MANG.	AECOM	213-330-7235	JAMAL.AL-MASHAT@AECOM.COM	J.A.
ERIK BAUTISTA		LADPW	6264587964	ebautista@dpw.lacounty.gov ↓ See record	



SR 710 North Study
Draft - Meeting Summary Notes
LACDPW Hydraulic Discussion Meeting

PREPARED FOR: Michelle Smith/Metro

PREPARED BY: CH2M HILL

DATE: April 03, 2013

TIME: 10:00 a.m.

LOCATION: LACDPW Office, Alhambra, CA

ATTENDEES: See attached sign-in sheet.

OVERVIEW: The purpose of the meeting was to discuss the alternatives for Dorchester Channel and Laguna Regulating Basin and solicit feedback from LACFCD.

1. George H. started with a summary of the data provided by LACDPW since the last meeting on 1/22/2013. CH2M HILL obtained the Dorchester channel design flows on 3/11/2013 from the original design report. The report was in microfilm format and the calculations were prepared by hand in 1995. George A. also provided some as-builts of the basin. The basin storage curve and FEMA floodplain map are still pending.

2. George H. gave an introduction of the channel layout, developed from the channel as-builts, and the two rectangular concrete channel (RCC) segments, impacted by the proposed roadway. The impacted segments of 20 ft channel width will be converted to double-barrel reinforced concrete boxes (RCBs). From upstream to downstream, there will be 3 openings – approximately 150 ft, 250 ft, and 50 ft long, respectively. The curvilinear channel alignment will remain unchanged because of housing on the west side of the channel. The channel design flows were based on the design report.

3. Amir said the LACDPW has switched from rainfall zoning to isohyets method a few years ago. CH2M HILL has the choice of re-investigating the whole watershed hydrology based on the new method, which could produce 30 to 40% less in the peak flows.

4. George H. presented the channel hydraulics of the existing and 4 proposed alternatives, assuming low tailwater condition. The analyses were mainly to address the mitigation

issues and would apply to most of flow conditions. With the channel slope steeper than 0.82%, the flow will be supercritical and the hydraulic grade line (HGL) is sensitive to channel size. The results showed that a smaller RCB width (9.67 ft each barrel) as that of under Hellman Avenue would provide the best results. The HGL in the proposed RCB will be unavoidably higher due to additional friction caused by the partition wall in the box. A wider RCB actually would cause a higher HGL and potential for a hydraulic jump. Under the best alternative, the maximum HGL impact is about 2.13 ft within the new RCB segment. The RCB will not be "sealed" or under pressure. There will be no hydraulic jump within the project reach and no impact to existing RCB upstream of the existing RCC.

5. Amir said higher HGLs occurring in the proposed RCB could be acceptable, as long as it does not cause flooding in the upstream reaches. He was concerned about the high tailwater condition in the basin to which the channel discharges. George H. said the 1955 design report started the calculations at Valley Blvd. assuming a HGL at the RCB soffit. The calculations did not include the downstream reaches or the basin. If a high tailwater was used in the model, the whole channel will be flooded, even under the existing condition. But the flooding will not reach the surrounding houses, at approximately Elev. 390 ft. The high tailwater condition will be assessed to conduct the floodplain mapping.

6. The discussion then moved to the basin. George A. said Water Resource Department (WRD) did not study the whole system north of the I-10 Freeway. It was unclear what the design basin elevation was or the chance of overflow from the crest onto the I-10 Freeway. There was no record of basin overflow in the past, even in the very wet years. George A. cannot find any hydrologic analysis to support why the spillway crest was raised in 1992 from Elev. 374.0 to 380.3 ft or would it adversely impact the upstream channel.

7. George H. stated that no record of flooding in this area seems to support the fact that the channel and basin were over-designed. George H. questioned where the water would go if it overflowed onto the I-10 and I-710 interchange, as the storage in the interchange area is very limited without flooding the I-10 Freeway. George H. then explained the potential impact to the basin from the roadway widening. There will be about 900 ft longitudinal encroachment into the basin storage volume with widths varying from zero to 20 ft. It will be difficult to restore the access road on the top of the basin, along the northbound side of the SR-710 freeway. Instead, CH2M HILL proposes to provide a pull-out and driveway from the I-10 connector to connect to the existing access road. To address the encroachment to the storage, CH2M HILL is proposing to calculate and compare the storage volumes between the existing and proposed conditions based on the 2012 project topo contours. Instead of a retaining wall, a bridge overhanging structure could be proposed for the roadway widening, which will minimize the volume reduction. If feasible, additional basin grading will be proposed to compensate any volume loss. Every effort will be taken to restore the original storage volume.

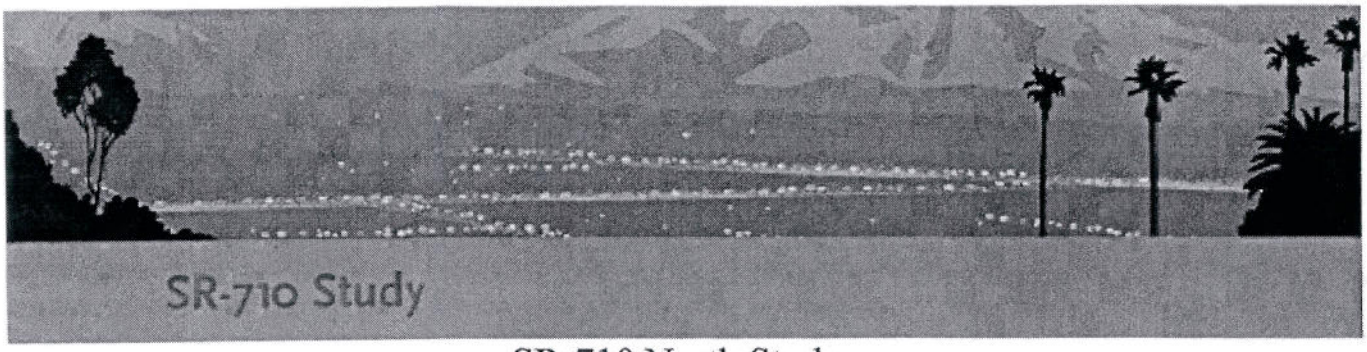
8. Amir asked George A. to contact WRD again about the hydrologic modeling of the basin. If such analysis was not conducted, the LACDPW will not impose extra requirements to ask CH2M HILL to conduct a further study. In this case, he would agree that the approaches proposed by CH2M HILL seem reasonable. He said the LACDPW could accept the mitigation for the basin access road.

9. George A. asked if CH2M HILL should study an alternative to divert some flow from the channel before entering the basin, as the downstream RCC may have extra capacity. The new storm drain could run along the west side of I-710 to connect the open channel south of I-10 Freeway. George H. said the idea seems to defeat the purpose of using the basin for the peak flow attenuation. He pointed out some hydraulic problems of this idea, such as adding more flow to the downstream RCC and potential hydraulic instability at the diverting junction structure. George H. said such idea could be explored by the LACDPW as part of the master drainage plan, and not for this roadway project. In addition, this alternative may extend the environmental footprint beyond the current project limit. The new storm drain will be about 5,500 ft long and very costly to go under I-10 Freeway and connectors.

10. George H. said that CH2M HILL will prepare a preliminary drainage report to document the hydraulic analyses on the channel and basin mitigations. The report will be ready for LACDPW's review in a few weeks. In the meantime, CH2M HILL provided a set of as-builts, WSPG runs, and summary of results to George A. and asked for feedback on the hydraulic analyses from LACDPW.

Action Items:

1. George A. to check WRD about the basin routing and storage curve.
2. CH2M HILL to prepare a preliminary drainage report to document the hydraulic analyses on the channel and basin mitigations for LACDPW to review.
3. George A. to provide FEMA floodplain map of the channel and basin, if available.



SR-710 North Study
LACDPW Hydraulic Discussion Meeting
4/03/13 @ 10:00 am

ATTENDANCE FORM

Name	Role	Agency	Phone	E-mail
Wai Chen	Drainage	CH2M HILL	714-435-6156	wai.chen@ch2m.com
George Hsu	"	"	714-435-6205	ghsu2@ch2m.com
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Amir Zandi	"	"	" - " 7894	azandi@ladpw

Metro

Caltrans

Appendix B
Hydraulic Analysis

CARD CODE	SECT NO	CHN TYPE	NO OF PIER/PIP	AVE PIER WIDTH	HEIGHT 1 DIAMETER	BASE WIDTH	ZL	ZR	INV DROP	Y(1)	Y(2)	Y(3)	Y(4)	Y(5)	Y(6)	Y(7)	Y(8)	Y(9)	Y(10)
CD	1	3	1	.670	12.750	20.000	.000	.000	.00										
CD	2	2	0	.000	14.000	20.000			.00										
CD	3	4	1		6.000														
CD	4	3	1	.670	12.000	20.670	.000	.000	.00										
CD	5	3	1	.670	12.000	20.670	.000	.000	.00										
CD	6	3	0	.000	12.000	9.730	.000	.000	.00										
CD	7	3	0	.000	13.250	10.250	.000	.000	.00										
CD	8	3	0	.000	12.500	11.000	.000	.000	.00										
CD	9	4	1		3.750														
CD	10	4	1		3.000														
CD	11	4	1		2.000														
CD	12	4	1		2.500														
CD	13	2	0	.000	14.000	20.670			.00										
CD	14	3	0	.000	12.000	10.000	.000	.000	.00										

WATER SURFACE PROFILE - TITLE CARD LISTING

HEADING LINE NO 1 IS -
SR-710 NORTH STUDY

HEADING LINE NO 2 IS -
DORCHESTER DRAIN LINE-A EAST & LINE-B (Existing)(NGVD 29)

HEADING LINE NO 3 IS -
MODEL: W.CHEN REVIEW: G.HSU

WATER SURFACE PROFILE - ELEMENT CARD LISTING

ELEMENT NO 1 IS A SYSTEM OUTLET

U/S DATA	STATION	INVERT	SECT	W S ELEV
	491.000	351.820	1	364.500

ELEMENT NO 2 IS A TRANSITION

U/S DATA	STATION	INVERT	SECT	N	RADIUS	ANGLE
	517.000	352.033	1	.013	249.990	-5.959

ELEMENT NO 3 IS A REACH

U/S DATA	STATION	INVERT	SECT	N	RADIUS	ANGLE	ANG PT	MAN H
	544.030	352.255	1	.013	249.993	-6.195	.000	0

ELEMENT NO 4 IS A REACH

U/S DATA	STATION	INVERT	SECT	N	RADIUS	ANGLE	ANG PT	MAN H
	916.000	355.310	1	.013	.000	.000	.000	0

ELEMENT NO 5 IS A REACH

U/S DATA	STATION	INVERT	SECT	N	RADIUS	ANGLE	ANG PT	MAN H
	1078.000	356.640	1	.013	250.004	37.127	.000	0

ELEMENT NO 6 IS A JUNCTION

U/S DATA	STATION	INVERT	SECT	LAT-1	LAT-2	N	Q3	Q4	INVERT-3	INVERT-4	PHI 3	PHI 4
	1088.000	356.723	1	3	0	.013	30.000	.000	361.000	.000	-76.000	.000

RADIUS	ANGLE
250.091	2.291

ELEMENT NO 7 IS A REACH

U/S DATA	STATION	INVERT	SECT	N	RADIUS	ANGLE	ANG PT	MAN H
	1153.800	357.266	1	.013	250.004	15.080	.000	0

Existing

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ELEMENT NO   8 IS A REACH                *         *     *
                U/S DATA   STATION    INVERT  SECT              N                      RADIUS    ANGLE     ANG PT  MAN H
                           1173.800  357.431    1              .013                       .000     .000       .000      0
ELEMENT NO   9 IS A REACH                *         *     *
                U/S DATA   STATION    INVERT  SECT              N                      RADIUS    ANGLE     ANG PT  MAN H
                           1250.000  358.060    1              .013                    249.996   17.464       .000      0
ELEMENT NO  10 IS A BRIDGE ENTRANCE                          *
                U/S DATA   STATION    INVERT  SECT             FP
                           1250.000  358.060    2              .100
ELEMENT NO  11 IS A REACH                *         *     *
                U/S DATA   STATION    INVERT  SECT              N                      RADIUS    ANGLE     ANG PT  MAN H
                           1279.740  358.304    2              .014                    249.996    6.816       .000      0
ELEMENT NO  12 IS A REACH                *         *     *
                U/S DATA   STATION    INVERT  SECT              N                      RADIUS    ANGLE     ANG PT  MAN H
                           1309.000  358.543    2              .014                    249.996   -6.706       .000      0
                                                  W S P G W                                                  PAGE NO   3
                                WATER SURFACE PROFILE - ELEMENT CARD LISTING
ELEMENT NO  13 IS A REACH                *         *     *
                U/S DATA   STATION    INVERT  SECT              N                      RADIUS    ANGLE     ANG PT  MAN H
                           1398.800  359.279    2              .014                    250.008  -20.580       .000      0
ELEMENT NO  14 IS A REACH                *         *     *
                U/S DATA   STATION    INVERT  SECT              N                      RADIUS    ANGLE     ANG PT  MAN H
                           1485.000  359.985    2              .014                   2000.362   -2.469       .000      0
ELEMENT NO  15 IS A JUNCTION             *         *     *     *                 *          *                 *
                U/S DATA   STATION    INVERT  SECT LAT-1 LAT-2   N      Q3         Q4      INVERT-3 INVERT-4  PHI 3  PHI 4
                           1505.000  360.149    2    12     0   .014   29.000       .000   361.500       .000  60.000      .000
                                                                                          RADIUS    ANGLE
                                                                                         1999.853   -.573
ELEMENT NO  16 IS A REACH                *         *     *
                U/S DATA   STATION    INVERT  SECT              N                      RADIUS    ANGLE     ANG PT  MAN H
                           1754.090  362.189    2              .014                   1999.972   -7.136       .000      0
ELEMENT NO  17 IS A REACH                *         *     *
                U/S DATA   STATION    INVERT  SECT              N                      RADIUS    ANGLE     ANG PT  MAN H
                           2013.400  364.313    2              .014                    424.982  -34.960       .000      0
ELEMENT NO  18 IS A REACH                *         *     *
                U/S DATA   STATION    INVERT  SECT              N                      RADIUS    ANGLE     ANG PT  MAN H
                           2190.000  365.760    2              .014                    425.001   23.808       .000      0
ELEMENT NO  19 IS A JUNCTION             *         *     *     *                 *          *                 *
                U/S DATA   STATION    INVERT  SECT LAT-1 LAT-2   N      Q3         Q4      INVERT-3 INVERT-4  PHI 3  PHI 4
                           2220.000  366.005    2    12     0   .014   30.000       .000   367.000       .000  60.000      .000
                                                                                          RADIUS    ANGLE
                                                                                          425.043   4.044
ELEMENT NO  20 IS A REACH                *         *     *
                U/S DATA   STATION    INVERT  SECT              N                      RADIUS    ANGLE     ANG PT  MAN H
                           2264.530  366.370    2              .014                    425.018    6.003       .000      0
ELEMENT NO  21 IS A REACH                *         *     *
                U/S DATA   STATION    INVERT  SECT              N                      RADIUS    ANGLE     ANG PT  MAN H
                           2450.000  367.893    2              .014                    500.007  -21.253       .000      0
ELEMENT NO  22 IS A JUNCTION             *         *     *     *                 *          *                 *
                U/S DATA   STATION    INVERT  SECT LAT-1 LAT-2   N      Q3         Q4      INVERT-3 INVERT-4  PHI 3  PHI 4
                           2482.310  368.158    2     9     0   .014   53.000       .000   370.000       .000  45.000      .000
                                                                                          RADIUS    ANGLE
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                                                                                    500.062  -3.702
                                          W S P G W                                                             PAGE NO    4
                      WATER SURFACE PROFILE - ELEMENT CARD LISTING
ELEMENT NO  23 IS A REACH         *          *      *
                 U/S DATA   STATION     INVERT  SECT              N                         RADIUS     ANGLE      ANG PT   MAN H
                            2550.000  368.714     2              .014                        .000       .000       .000      0
ELEMENT NO  24 IS A REACH         *          *      *
                 U/S DATA   STATION     INVERT  SECT              N                         RADIUS     ANGLE      ANG PT   MAN H
                            2625.000  369.330     2              .014                        .000       .000       .000      0
ELEMENT NO  25 IS A TRANSITION    *          *      *
                 U/S DATA   STATION     INVERT  SECT              N                         RADIUS     ANGLE
                            2675.000  369.970    13              .014                        .000       .000
ELEMENT NO  26 IS A BRIDGE EXIT                     *
                 U/S DATA   STATION     INVERT  SECT
                            2675.000  369.970     4
ELEMENT NO  27 IS A REACH         *          *      *
                 U/S DATA   STATION     INVERT  SECT              N                         RADIUS     ANGLE      ANG PT   MAN H
                            2780.000  370.661     4              .013                        .000       .000       .000      0
ELEMENT NO  28 IS A JUNCTION      *          *      *      *              *                   *                    *
                 U/S DATA   STATION     INVERT  SECT LAT-1 LAT-2  N       Q3          Q4      INVERT-3 INVERT-4  PHI 3  PHI 4
                            2790.000  370.727     4     12     0 .013   50.000         .000   371.500     .000  60.000      .000
                                                                                             RADIUS     ANGLE
                                                                                              .000       .000

ELEMENT NO  29 IS A REACH         *          *      *
                 U/S DATA   STATION     INVERT  SECT              N                         RADIUS     ANGLE      ANG PT   MAN H
                            2957.510  371.830     4              .013                        .000       .000       .000      0
ELEMENT NO  30 IS A TRANSITION    *          *      *
                 U/S DATA   STATION     INVERT  SECT              N                         RADIUS     ANGLE
                            2982.510  372.380     5              .013                        .000       .000
ELEMENT NO  31 IS A REACH         *          *      *
                 U/S DATA   STATION     INVERT  SECT              N                         RADIUS     ANGLE      ANG PT   MAN H
                            3189.300  374.520     5              .013                        .000       .000     -5.027      1
ELEMENT NO  32 IS A JUNCTION      *          *      *      *              *                   *                    *
                 U/S DATA   STATION     INVERT  SECT LAT-1 LAT-2  N       Q3          Q4      INVERT-3 INVERT-4  PHI 3  PHI 4
                            3199.300  374.623     5     10     0 .013   45.000         .000   374.623     .000 -90.000      .000
                                                                                             RADIUS     ANGLE
                                                                                              .000       .000
                                          W S P G W                                                             PAGE NO    5
                      WATER SURFACE PROFILE - ELEMENT CARD LISTING
ELEMENT NO  33 IS A REACH         *          *      *
                 U/S DATA   STATION     INVERT  SECT              N                         RADIUS     ANGLE      ANG PT   MAN H
                            3223.120  374.870     5              .013                        .000       .000       .000      1
ELEMENT NO  34 IS A REACH         *          *      *
                 U/S DATA   STATION     INVERT  SECT              N                         RADIUS     ANGLE      ANG PT   MAN H
                            3303.900  375.980     5              .013                        .000       .000       .000      0
ELEMENT NO  35 IS A TRANSITION    *          *      *
                 U/S DATA   STATION     INVERT  SECT              N                         RADIUS     ANGLE
                            3308.900  376.015     4              .013                        .000       .000
ELEMENT NO  36 IS A TRANSITION    *          *      *
                 U/S DATA   STATION     INVERT  SECT              N                         RADIUS     ANGLE
                            3329.440  376.159     4              .013                        .000       .000
ELEMENT NO  37 IS A TRANSITION    *          *      *
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                    U/S DATA   STATION    INVERT  SECT              N                          RADIUS   ANGLE
                               3345.180  376.270    4              .013                           .000    .000
ELEMENT NO  38 IS A JUNCTION         *         *     *     *                      *                   *       *
                    U/S DATA   STATION    INVERT  SECT LAT-1 LAT-2   N      Q3        Q4     INVERT-3 INVERT-4  PHI 3  PHI 4
                               3355.180  376.384    4    11     0   .013    48.000      .000   376.384      .000 -90.000      .000
                                                                                             RADIUS   ANGLE
                                                                                               .000    .000
ELEMENT NO  39 IS A REACH            *         *     *
                    U/S DATA   STATION    INVERT  SECT              N                          RADIUS    ANGLE     ANG PT  MAN H
                               3599.630  379.180    4              .013                           .000    .000       .000      1
ELEMENT NO  40 IS A REACH            *         *     *
                    U/S DATA   STATION    INVERT  SECT              N                          RADIUS    ANGLE     ANG PT  MAN H
                               3625.790  379.479    4              .013                        350.039   -4.282       .000      0
ELEMENT NO  41 IS A REACH            *         *     *
                    U/S DATA   STATION    INVERT  SECT              N                          RADIUS    ANGLE     ANG PT  MAN H
                               3887.300  382.470    4              .013                           .000    .000       .000      0
ELEMENT NO  42 IS A JUNCTION         *         *     *     *                      *                   *       *
                    U/S DATA   STATION    INVERT  SECT LAT-1 LAT-2   N      Q3        Q4     INVERT-3 INVERT-4  PHI 3  PHI 4
                               3897.300  382.584    4    11     0   .013    48.000      .000   382.584      .000 -90.000      .000
                                                                                             RADIUS   ANGLE
                                                                                               .000    .000
                                                          W S P G W                                                PAGE NO   6
                                WATER SURFACE PROFILE - ELEMENT CARD LISTING
ELEMENT NO  43 IS A REACH            *         *     *
                    U/S DATA   STATION    INVERT  SECT              N                          RADIUS    ANGLE     ANG PT  MAN H
                               4089.300  384.780    4              .013                           .000    .000       .000      0
ELEMENT NO  44 IS A JUNCTION         *         *     *     *                      *                   *       *
                    U/S DATA   STATION    INVERT  SECT LAT-1 LAT-2   N      Q3        Q4     INVERT-3 INVERT-4  PHI 3  PHI 4
                               4135.720  385.310   14    14     0   .013  2335.000      .000   385.310      .000    .000      .000
                                                                                             RADIUS   ANGLE
                                                                                               .000    .000
ELEMENT NO  45 IS A REACH            *         *     *
                    U/S DATA   STATION    INVERT  SECT              N                          RADIUS    ANGLE     ANG PT  MAN H
                               4141.600  385.389   14              .013                           .000    .000       .000      0
ELEMENT NO  46 IS A REACH            *         *     *
                    U/S DATA   STATION    INVERT  SECT              N                          RADIUS    ANGLE     ANG PT  MAN H
                               4211.510  386.322   14              .013                        380.031   10.540       .000      1
ELEMENT NO  47 IS A REACH            *         *     *
                    U/S DATA   STATION    INVERT  SECT              N                          RADIUS    ANGLE     ANG PT  MAN H
                               4223.540  386.483   14              .013                           .000    .000       .000      0
ELEMENT NO  48 IS A TRANSITION       *         *     *
                    U/S DATA   STATION    INVERT  SECT              N                          RADIUS   ANGLE
                               4243.540  386.750    6              .013                           .000    .000
ELEMENT NO  49 IS A REACH            *         *     *
                    U/S DATA   STATION    INVERT  SECT              N                          RADIUS    ANGLE     ANG PT  MAN H
                               4420.540  389.120    6              .013                           .000    .000       .000      0
ELEMENT NO  50 IS A TRANSITION       *         *     *
                    U/S DATA   STATION    INVERT  SECT              N                          RADIUS   ANGLE
                               4440.540  390.218    7              .013                           .000    .000
ELEMENT NO  51 IS A TRANSITION       *         *     *
                    U/S DATA   STATION    INVERT  SECT              N                          RADIUS   ANGLE
                               4453.210  390.913    7              .013                        230.017   -3.156
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ELEMENT NO  52 IS A TRANSITION          *          *     *
                 U/S DATA   STATION    INVERT  SECT              N          RADIUS   ANGLE
                            4463.540  391.480    7              .013       230.031   -2.573
ELEMENT NO  53 IS A REACH               *          *     *
                 U/S DATA   STATION    INVERT  SECT              N          RADIUS    ANGLE     ANG PT  MAN H
                            4497.740  391.638    7              .013       229.991   -8.520     .000      0
ELEMENT NO  54 IS A REACH               *          *     *
                 U/S DATA   STATION    INVERT  SECT              N          RADIUS    ANGLE     ANG PT  MAN H
                            4579.220  392.015    7              .013         .000      .000     .000      0
                                                  W S P G W                                               PAGE NO   7
                                WATER SURFACE PROFILE - ELEMENT CARD LISTING
ELEMENT NO  55 IS A TRANSITION          *          *     *
                 U/S DATA   STATION    INVERT  SECT              N          RADIUS   ANGLE
                            4595.380  392.089    7              .013         .000     .000
ELEMENT NO  56 IS A REACH               *          *     *
                 U/S DATA   STATION    INVERT  SECT              N          RADIUS    ANGLE     ANG PT  MAN H
                            4623.640  392.220    7              .013         .000      .000     .000      0
ELEMENT NO  57 IS A REACH               *          *     *
                 U/S DATA   STATION    INVERT  SECT              N          RADIUS    ANGLE     ANG PT  MAN H
                            4703.020  393.220    7              .013         .000      .000     .000      1
ELEMENT NO  58 IS A TRANSITION          *          *     *
                 U/S DATA   STATION    INVERT  SECT              N          RADIUS   ANGLE
                            4713.020  393.340    7              .013         .000     .000
ELEMENT NO  59 IS A REACH               *          *     *
                 U/S DATA   STATION    INVERT  SECT              N          RADIUS    ANGLE     ANG PT  MAN H
                            4739.960  393.663    7              .013         .000      .000     .000      0
ELEMENT NO  60 IS A REACH               *          *     *
                 U/S DATA   STATION    INVERT  SECT              N          RADIUS    ANGLE     ANG PT  MAN H
                            4880.820  395.350    7              .013       155.850    51.785     .000      0
ELEMENT NO  61 IS A REACH               *          *     *
                 U/S DATA   STATION    INVERT  SECT              N          RADIUS    ANGLE     ANG PT  MAN H
                            5191.140  397.650    7              .013         .000      .000     .000      0
ELEMENT NO  62 IS A REACH               *          *     *
                 U/S DATA   STATION    INVERT  SECT              N          RADIUS    ANGLE     ANG PT  MAN H
                            5383.640  399.749    7              .013       238.851    46.177     .000      1
ELEMENT NO  63 IS A TRANSITION          *          *     *
                 U/S DATA   STATION    INVERT  SECT              N          RADIUS   ANGLE
                            5392.380  399.844    7              .013       238.908    2.096
ELEMENT NO  64 IS A TRANSITION          *          *     *
                 U/S DATA   STATION    INVERT  SECT              N          RADIUS   ANGLE
                            5406.640  400.000    7              .013         .000     .000
ELEMENT NO  65 IS A SYSTEM HEADWORKS                  *                          *
                 U/S DATA   STATION    INVERT  SECT                      W S ELEV
                            5406.640  400.000    7                       400.000
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SR-710 NORTH STUDY
DORCHESTER DRAIN LINE-A EAST & LINE-B (Existing)(NGVD 29)
MODEL: W.CHEN REVIEW: G.HSU

Station / L/Elem	Invert Elev / Ch Slope	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head / SF Ave	Energy Grd.El. / HF	Super Elev / SE Dpth	Critical Depth / Froude N	Flow Top Width / Norm Dp	Height/ Dia.-FT / "N"	Base Wt or I.D. / X-Fall	ZL / ZR	No Wth Prs/Pip / Type Ch
491.000	351.820	11.941	363.761	5481.00	23.75	8.76	372.52	12.75	12.75	20.00	12.750	20.000	.00	1 .7
TRANS STR	.0082					.0083	.22	12.75	1.23		.013	.00	.00	BOX
---------- WARNING - Flow depth near top of box conduit ----------														
517.000	352.033	11.920	363.953	5481.00	23.79	8.79	372.74	12.75	12.75	20.00	12.750	20.000	.00	1 .7
27.030	.0082					.0084	.23	12.75	1.24	12.00	.013	.00	.00	BOX
---------- WARNING - Flow depth near top of box conduit ----------														
544.030	352.255	11.912	364.167	5481.00	23.80	8.80	372.97	.00	12.75	20.00	12.750	20.000	.00	1 .7
371.970	.0082					.0086	3.19	11.91	1.24	12.00	.013	.00	.00	BOX
---------- WARNING - Flow depth near top of box conduit ----------														
916.000	355.310	11.648	366.958	5481.00	24.34	9.20	376.16	12.75	12.75	20.00	12.750	20.000	.00	1 .7
162.000	.0082					.0090	1.46	12.75	1.28	12.00	.013	.00	.00	BOX
---------- WARNING - Flow depth near top of box conduit ----------														
1078.000	356.640	11.440	368.080	5481.00	24.79	9.54	377.62	12.75	12.75	20.00	12.750	20.000	.00	1 .7
JUNCT STR	.0083					.0095	.09	12.75	1.31		.013	.00	.00	BOX

SR-710 NORTH STUDY
DORCHESTER DRAIN LINE-A EAST & LINE-B (Existing)(NGVD 29)
MODEL: W.CHEN REVIEW: G.HSU

Station / L/Elem	Invert Elev / Ch Slope	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head / SF Ave	Energy Grd.El. / HF	Super Elev / SE Dpth	Critical Depth / Froude N	Flow Top Width / Norm Dp	Height/Dia.-FT / "N"	Base Wt or I.D. / X-Fall	ZL / ZR	No Wth Prs/Pip / Type Ch
1088.000	356.723	11.111	367.834	5451.00	25.38	10.00	377.84	1.55	12.75	20.00	12.750	20.000	.00	1 .7
65.800	.0083					.0099	.65	12.66	1.36	11.92	.013	.00	.00	BOX
1153.800	357.266	10.980	368.246	5451.00	25.68	10.24	378.49	.00	12.75	20.00	12.750	20.000	.00	1 .7
20.000	.0083					.0101	.20	10.98	1.39	11.92	.013	.00	.00	BOX
1173.800	357.431	10.937	368.368	5451.00	25.78	10.32	378.69	1.60	12.75	20.00	12.750	20.000	.00	1 .7
76.200	.0083					.0103	.79	12.53	1.40	11.92	.013	.00	.00	BOX
1250.000	358.060	10.767	368.827	5451.00	26.19	10.65	379.48	1.65	12.75	20.00	12.750	20.000	.00	1 .7
BRIDGE ENTRANCE														
1250.000	358.060	10.041	368.101	5451.00	27.14	11.44	379.54	1.83	13.21	20.00	14.000	20.000	.00	0 .0
29.740	.0082					.0076	.23	11.87	1.51	9.77	.014	.00	.00	RECTANG
1279.740	358.304	10.055	368.359	5451.00	27.11	11.41	379.77	1.83	13.21	20.00	14.000	20.000	.00	0 .0
29.260	.0082					.0076	.22	11.88	1.51	9.79	.014	.00	.00	RECTANG
1309.000	358.543	10.068	368.611	5451.00	27.07	11.38	379.99	1.82	13.21	20.00	14.000	20.000	.00	0 .0
89.800	.0082					.0075	.68	11.89	1.50	9.77	.014	.00	.00	RECTANG
1398.800	359.279	10.116	369.395	5451.00	26.94	11.27	380.67	.23	13.21	20.00	14.000	20.000	.00	0 .0
86.200	.0082					.0074	.64	10.34	1.49	9.78	.014	.00	.00	RECTANG
1485.000	359.985	10.171	370.156	5451.00	26.80	11.15	381.31	.22	13.21	20.00	14.000	20.000	.00	0 .0
JUNCT STR	.0082					.0075	.15	10.39	1.48		.014	.00	.00	RECTANG

SR-710 NORTH STUDY
DORCHESTER DRAIN LINE-A EAST & LINE-B (Existing)(NGVD 29)
MODEL: W.CHEN REVIEW: G.HSU

Station / L/Elem	Invert Elev / Ch Slope	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head / SF Ave	Energy Grd.El. / HF	Super Elev / SE Dpth	Critical Depth / Froude N	Flow Top Width / Norm Dp	Height/ Dia.-FT / "N"	Base Wt or I.D. / X-Fall	ZL / ZR	No Wth Prs/Pip / Type Ch
1505.000	360.149	9.997	370.146	5422.00	27.12	11.42	381.57	.23	13.17	20.00	14.000	20.000	.00	0 .0
249.090	.0082					.0075	1.87	10.23	1.51	9.74	.014	.00	.00	RECTANG
1754.090	362.189	10.136	372.325	5422.00	26.75	11.11	383.43	1.05	13.17	20.00	14.000	20.000	.00	0 .0
259.310	.0082					.0071	1.85	11.18	1.48	9.74	.014	.00	.00	RECTANG
2013.400	364.313	10.383	374.696	5422.00	26.11	10.59	385.28	1.00	13.17	20.00	14.000	20.000	.00	0 .0
176.600	.0082					.0067	1.18	11.38	1.43	9.74	.014	.00	.00	RECTANG
2190.000	365.760	10.662	376.422	5422.00	25.43	10.04	386.46	.94	13.17	20.00	14.000	20.000	.00	0 .0
JUNCT STR	.0082					.0066	.20	11.61	1.37		.014	.00	.00	RECTANG
2220.000	366.005	10.431	376.436	5392.00	25.85	10.37	386.81	.98	13.12	20.00	14.000	20.000	.00	0 .0
44.530	.0082					.0067	.30	11.41	1.41	9.70	.014	.00	.00	RECTANG
2264.530	366.370	10.500	376.870	5392.00	25.68	10.24	387.11	.82	13.12	20.00	14.000	20.000	.00	0 .0
185.470	.0082					.0063	1.17	11.32	1.40	9.69	.014	.00	.00	RECTANG
2450.000	367.893	10.923	378.816	5392.00	24.68	9.46	388.28	.76	13.12	20.00	14.000	20.000	.00	0 .0
JUNCT STR	.0082					.0062	.20	11.68	1.32		.014	.00	.00	RECTANG
2482.310	368.158	10.512	378.670	5339.00	25.39	10.01	388.68	.00	13.03	20.00	14.000	20.000	.00	0 .0
67.690	.0082					.0064	.43	10.51	1.38	9.62	.014	.00	.00	RECTANG
2550.000	368.714	10.657	379.371	5339.00	25.05	9.74	389.11	.00	13.03	20.00	14.000	20.000	.00	0 .0
75.000	.0082					.0061	.46	10.66	1.35	9.62	.014	.00	.00	RECTANG

SR-710 NORTH STUDY
DORCHESTER DRAIN LINE-A EAST & LINE-B (Existing)(NGVD 29)
MODEL: W.CHEN REVIEW: G.HSU

Station / L/Elem	Invert Elev / Ch Slope	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head / SF Ave	Energy Grd.El. / HF	Super Elev / SE Dpth	Critical Depth / Froude N	Flow Top Width / Norm Dp	Height/ Dia.-FT / "N"	Base Wt or I.D. / X-Fall	ZL / ZR	No Wth Prs/Pip / Type Ch
2625.000	369.330	10.861	380.191	5339.00	24.58	9.38	389.57	.00	13.03	20.00	14.000	20.000	.00	0 .0
TRANS STR	.0128					.0060	.30	10.86	1.31		.014	.00	.00	RECTANG
2675.000	369.970	10.485	380.455	5339.00	24.63	9.42	389.88	.00	12.75	20.67	14.000	20.670	.00	0 .0
BRIDGE EXIT														
2675.000	369.970	11.384	381.354	5339.00	23.45	8.54	389.89	.00	12.00	20.67	12.000	20.670	.00	1 .7
105.000	.0066					.0083	.87	11.38	1.25	12.00	.013	.00	.00	BOX
		---------- WARNING - Flow depth near top of box conduit ----------												
2780.000	370.661	11.068	381.729	5339.00	24.12	9.03	390.76	.00	12.00	20.67	12.000	20.670	.00	1 .7
JUNCT STR	.0066					.0089	.09	11.07	1.30		.013	.00	.00	BOX
		---------- WARNING - Flow depth near top of box conduit ----------												
2790.000	370.727	10.601	381.328	5289.00	24.95	9.66	390.99	.00	12.00	20.67	12.000	20.670	.00	1 .7
27.323	.0066					.0094	.26	10.60	1.37	12.00	.013	.00	.00	BOX
2817.323	370.907	10.509	381.416	5289.00	25.16	9.83	391.25	.00	12.00	20.67	12.000	20.670	.00	1 .7
140.187	.0066					.0101	1.42	10.51	1.39	12.00	.013	.00	.00	BOX
2957.510	371.830	10.020	381.850	5289.00	26.39	10.82	392.67	.00	12.00	20.67	12.000	20.670	.00	1 .7
TRANS STR	.0220					.0104	.26	10.02	1.49		.013	.00	.00	BOX

SR-710 NORTH STUDY
DORCHESTER DRAIN LINE-A EAST & LINE-B (Existing)(NGVD 29)
MODEL: W.CHEN REVIEW: G.HSU

Station	Invert Elev	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head	Energy Grd.El.	Super Elev	Critical Depth	Flow Top Width	Height/ Dia.-FT	Base Wt or I.D.	ZL	No Wth Prs/Pip
L/Elem	Ch Slope					SF Ave	HF	SE Dpth	Froude N	Norm Dp	"N"	X-Fall	ZR	Type Ch
2982.510	372.380	10.243	382.623	5289.00	25.82	10.35	392.97	.00	12.00	20.67	12.000	20.670	.00	1 .7
206.790	.0103					.0101	2.08	10.24	1.45	10.16	.013	.00	.00	BOX
3189.300	374.520	10.300	384.820	5289.00	25.68	10.24	395.06	.00	12.00	20.67	12.000	20.670	.00	1 .7
JUNCT STR	.0103					.0103	.10	10.30	1.43		.013	.00	.00	BOX
3199.300	374.623	9.965	384.588	5244.00	26.31	10.75	395.34	.00	12.00	20.67	12.000	20.670	.00	1 .7
23.820	.0104					.0107	.25	9.96	1.49	10.08	.013	.00	.00	BOX
3223.120	374.870	9.959	384.829	5244.00	26.33	10.76	395.59	.00	12.00	20.67	12.000	20.670	.00	1 .7
80.780	.0137					.0104	.84	9.96	1.49	8.99	.013	.00	.00	BOX
3303.900	375.980	10.211	386.191	5244.00	25.68	10.24	396.43	.00	12.00	20.67	12.000	20.670	.00	1 .7
TRANS STR	.0070					.0101	.05	10.21	1.44		.013	.00	.00	BOX
3308.900	376.015	10.185	386.200	5244.00	25.74	10.29	396.49	.00	12.00	20.67	12.000	20.670	.00	1 .7
TRANS STR	.0070					.0102	.21	10.19	1.45		.013	.00	.00	BOX
3329.440	376.159	10.081	386.240	5244.00	26.01	10.50	396.74	.00	12.00	20.67	12.000	20.670	.00	1 .7
TRANS STR	.0071					.0105	.16	10.08	1.47		.013	.00	.00	BOX
3345.180	376.270	10.002	386.272	5244.00	26.21	10.67	396.94	.00	12.00	20.67	12.000	20.670	.00	1 .7
JUNCT STR	.0114					.0109	.11	10.00	1.48		.013	.00	.00	BOX
3355.180	376.384	9.677	386.061	5196.00	26.85	11.19	397.25	.00	12.00	20.67	12.000	20.670	.00	1 .7
244.450	.0114					.0112	2.73	9.68	1.55	9.61	.013	.00	.00	BOX

SR-710 NORTH STUDY
DORCHESTER DRAIN LINE-A EAST & LINE-B (Existing)(NGVD 29)
MODEL: W.CHEN REVIEW: G.HSU

Station	Invert Elev	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head	Energy Grd.El.	Super Elev	Critical Depth	Flow Top Width	Height/ Dia.-FT	Base Wt or I.D.	ZL	No Wth Prs/Pip
L/Elem	Ch Slope					SF Ave	HF	SE Dpth	Froude N	Norm Dp	"N"	X-Fall	ZR	Type Ch
3599.630	379.180	9.727	388.907	5196.00	26.71	11.08	399.98	1.27	12.00	20.67	12.000	20.670	.00	1 .7
26.160	.0114					.0111	.29	10.99	1.53	9.61	.013	.00	.00	BOX
3625.790	379.479	9.734	389.213	5196.00	26.69	11.06	400.27	.00	12.00	20.67	12.000	20.670	.00	1 .7
261.510	.0114					.0109	2.86	9.73	1.53	9.61	.013	.00	.00	BOX
3887.300	382.470	9.840	392.310	5196.00	26.40	10.82	403.13	.00	12.00	20.67	12.000	20.670	.00	1 .7
JUNCT STR	.0114					.0111	.11	9.84	1.51		.013	.00	.00	BOX
3897.300	382.584	9.523	392.107	5148.00	27.03	11.34	403.45	.00	12.00	20.67	12.000	20.670	.00	1 .7
192.000	.0114					.0115	2.21	9.52	1.57	9.54	.013	.00	.00	BOX
4089.300	384.780	9.515	394.295	5148.00	27.05	11.36	405.66	.00	12.00	20.67	12.000	20.670	.00	1 .7
JUNCT STR	.0114					.0120	.56	9.52	1.57		.013	.00	.00	BOX
4135.720	385.310	9.913	395.223	2813.00	28.38	12.50	407.73	.00	12.00	10.00	12.000	10.000	.00	0 .0
5.880	.0134					.0124	.07	9.91	1.59	9.60	.013	.00	.00	BOX
4141.600	385.389	9.917	395.306	2813.00	28.37	12.49	407.80	.66	12.00	10.00	12.000	10.000	.00	0 .0
69.910	.0133					.0123	.86	10.57	1.59	9.63	.013	.00	.00	BOX
4211.510	386.322	9.964	396.286	2813.00	28.23	12.38	408.66	.00	12.00	10.00	12.000	10.000	.00	0 .0
12.030	.0134					.0123	.15	9.96	1.58	9.62	.013	.00	.00	BOX
4223.540	386.483	9.973	396.456	2813.00	28.21	12.36	408.81	.00	12.00	10.00	12.000	10.000	.00	0 .0
TRANS STR	.0133					.0121	.24	9.97	1.57		.013	.00	.00	BOX

SR-710 NORTH STUDY
DORCHESTER DRAIN LINE-A EAST & LINE-B (Existing)(NGVD 29)
MODEL: W.CHEN REVIEW: G.HSU

Station / L/Elem	Invert Elev / Ch Slope	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head / SF Ave	Energy Grd.El. / HF	Super Elev / SE Dpth	Critical Depth / Froude N	Flow Top Width / Norm Dp	Height/Dia.-FT / "N"	Base Wt or I.D. / X-Fall	ZL / ZR	No Wth Prs/Pip / Type Ch
4243.540	386.750	10.440	397.190	2813.00	27.69	11.91	409.10	.00	12.00	9.73	12.000	9.730	.00	0 .0
177.000	.0134					.0115	2.03	10.44	1.51	9.93	.013	.00	.00	BOX
4420.540	389.120	10.722	399.842	2813.00	26.96	11.29	411.13	.00	12.00	9.73	12.000	9.730	.00	0 .0
TRANS STR	.0549					.0107	.21	10.72	1.45		.013	.00	.00	BOX
4440.540	390.218	10.429	400.647	2813.00	26.31	10.75	411.40	.96	13.25	10.25	13.250	10.250	.00	0 .0
TRANS STR	.0549					.0097	.12	11.39	1.44		.013	.00	.00	BOX
4453.210	390.913	10.944	401.857	2813.00	25.08	9.76	411.62	.87	13.25	10.25	13.250	10.250	.00	0 .0
TRANS STR	.0549					.0085	.09	11.81	1.34		.013	.00	.00	BOX
4463.540	391.480	11.531	403.011	2813.00	23.80	8.80	411.81	.39	13.25	10.25	13.250	10.250	.00	0 .0
34.200	.0046					.0082	.28	11.92	1.24	13.25	.013	.00	.00	BOX
4497.740	391.638	11.316	402.954	2813.00	24.25	9.13	412.09	.00	13.25	10.25	13.250	10.250	.00	0 .0
81.480	.0046					.0088	.72	11.32	1.27	13.25	.013	.00	.00	BOX
4579.220	392.015	10.840	402.855	2813.00	25.32	9.95	412.81	.00	13.25	10.25	13.250	10.250	.00	0 .0
TRANS STR	.0046					.0095	.15	10.84	1.36		.013	.00	.00	BOX
4595.380	392.089	10.682	402.771	2813.00	25.69	10.25	413.02	.00	13.25	10.25	13.250	10.250	.00	0 .0
28.260	.0046					.0098	.28	10.68	1.39	13.25	.013	.00	.00	BOX
4623.640	392.220	10.530	402.750	2813.00	26.06	10.55	413.30	.00	13.25	10.25	13.250	10.250	.00	0 .0
79.380	.0126					.0097	.77	10.53	1.42	9.58	.013	.00	.00	BOX

SR-710 NORTH STUDY
DORCHESTER DRAIN LINE-A EAST & LINE-B (Existing)(NGVD 29)
MODEL: W.CHEN REVIEW: G.HSU

Station / L/Elem	Invert Elev / Ch Slope	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head / SF Ave	Energy Grd.El. / HF	Super Elev / SE Dpth	Critical Depth / Froude N	Flow Top Width / Norm Dp	Height/Dia.-FT / "N"	Base Wt or I.D. / X-Fall	ZL / ZR	No Wth Prs/Pip / Type Ch
4703.020	393.220	10.774	403.994	2813.00	25.47	10.07	414.07	.00	13.25	10.25	13.250	10.250	.00	0 .0
TRANS STR	.0120					.0094	.09	10.77	1.37		.013	.00	.00	BOX
4713.020	393.340	10.798	404.138	2813.00	25.42	10.03	414.17	.00	13.25	10.25	13.250	10.250	.00	0 .0
26.940	.0120					.0093	.25	10.80	1.36	9.77	.013	.00	.00	BOX
4739.960	393.663	10.885	404.548	2813.00	25.21	9.87	414.42	1.30	13.25	10.25	13.250	10.250	.00	0 .0
52.066	.0120					.0090	.47	12.18	1.35	9.78	.013	.00	.00	BOX
4792.026	394.287	11.087	405.373	2813.00	24.75	9.51	414.89	1.25	13.25	10.25	13.250	10.250	.00	0 .0
88.794	.0120					.0083	.74	12.34	1.31	9.78	.013	.00	.00	BOX
4880.820	395.350	11.628	406.978	2813.00	23.60	8.65	415.63	.00	13.25	10.25	13.250	10.250	.00	0 .0
310.320	.0074					.0082	2.56	11.63	1.22	11.91	.013	.00	.00	BOX
5191.141	397.650	11.184	408.833	2813.00	24.54	9.35	418.18	.80	13.25	10.25	13.250	10.250	.00	0 .0
47.437	.0109					.0085	.40	11.99	1.29	10.16	.013	.00	.00	BOX
5238.577	398.167	11.367	409.534	2813.00	24.14	9.05	418.59	.78	13.25	10.25	13.250	10.250	.00	0 .0
87.583	.0109					.0078	.69	12.14	1.26	10.16	.013	.00	.00	BOX
5326.160	399.122	11.922	411.044	2813.00	23.02	8.23	419.27	.71	13.25	10.25	13.250	10.250	.00	0 .0
42.513	.0109					.0070	.30	12.63	1.17	10.16	.013	.00	.00	BOX
5368.673	399.586	12.504	412.089	2813.00	21.95	7.48	419.57	.64	13.25	10.25	13.250	10.250	.00	0 .0
14.967	.0109					.0062	.09	13.15	1.09	10.16	.013	.00	.00	BOX

---------- WARNING - Flow depth near top of box conduit ----------

SR-710 NORTH STUDY
DORCHESTER DRAIN LINE-A EAST & LINE-B (Existing)(NGVD 29)
MODEL: W.CHEN REVIEW: G.HSU

Station	Invert Elev	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head	Energy Grd.El.	Super Elev	Critical Depth	Flow Top Width	Height/ Dia.-FT	Base Wt or I.D.	ZL	No Wth Prs/Pip
L/Elem	Ch Slope					SF Ave	HF	SE Dpth	Froude N	Norm Dp	"N"	X-Fall	ZR	Type Ch
5383.640	399.749	13.114	412.863	2813.00	20.93	6.80	419.66	13.25	13.25	10.25	13.250	10.250	.00	0 .0
TRANS STR	.0109					.0061	.05	13.25	1.02		.013	.00	.00	BOX
			---------- WARNING - Flow depth near top of box conduit ----------											
5392.380	399.844	12.816	412.660	2813.00	21.41	7.12	419.78	.00	13.25	10.25	13.250	10.250	.00	0 .0
TRANS STR	.0109					.0060	.09	12.82	1.05		.013	.00	.00	BOX
			---------- WARNING - Flow depth near top of box conduit ----------											
5406.640	400.000	13.250	413.250	2813.00	20.71	6.66	419.91	.00	13.25	10.25	13.250	10.250	.00	0 .0

8/23/2013

SR-710 NORTH STUDY -- DORCHESTER CHANNEL MAJOR ALTERNATIVES SUMMARY

Preferred Alternative

		Existing			P18	One Opening		P19	All Covered		P20	3 Opening		P22	3 Opening	
Station	FL Elevation	Existing Channel Type	100% Q (cfs)	HGL Above FL(ft)	Proposed Channel Type	HGL Above FL(ft)	Δ HGL (ft)	Proposed Channel Type	HGL Above FL(ft)	Δ HGL (ft)	Proposed Channel Type	HGL Above FL(ft)	Δ HGL (ft)	Proposed Channel Type	HGL Above FL(ft)	Δ HGL (ft)
4+91.00	351.820	SYSTEM OUTLET	5481	11.941	SYSTEM OUTLET	12.032	0.091	SYSTEM OUTLET	12.032	0.091	SYSTEM OUTLET	12.029	0.088	SYSTEM OUTLET	12.029	0.088
5+17.00	352.033	TRAN. STRUCTURE	5481	11.920	TRAN. STRUCTURE	12.032	0.112	TRAN. STRUCTURE	12.033	0.113	TRAN. STRUCTURE	12.029	0.109	TRAN. STRUCTURE	12.029	0.109
5+44.03	352.255	DBL 9.67'x12.75' RCB	5481	11.912	DBL 9.67'x12.75' RCB	12.036	0.124	DBL 9.67'x12.75' RCB	12.036	0.124	DBL 9.67'x12.75' RCB	12.032	0.120	DBL 9.67'x12.75' RCB	12.032	0.120
9+16.00	355.310	DBL 9.67'x12.75' RCB	5481	11.648	DBL 9.67'x12.75' RCB	12.242	0.594	DBL 9.67'x12.75' RCB	12.245	0.597	DBL 9.67'x12.75' RCB	12.210	0.562	DBL 9.67'x12.75' RCB	12.214	0.566
10+78.00	356.640	DBL 9.67'x12.75' RCB	5481	11.440	DBL 9.67'x12.75' RCB	12.561	1.121	DBL 9.67'x12.75' RCB	12.570	1.130	DBL 9.67'x12.75' RCB	12.465	1.025	DBL 9.67'x12.75' RCB	12.476	1.036
10+88.00	356.723	JUNCTION STRUCTURE	5481	11.111	JUNCTION STRUCTURE	12.010	0.899	JUNCTION STRUCTURE	12.016	0.905	JUNCTION STRUCTURE	11.944	0.833	JUNCTION STRUCTURE	11.951	0.840
11+53.80	357.266	DBL 9.67'x12.75' RCB	5451	10.980	DBL 9.67'x12.75' RCB	12.035	1.055	DBL 9.67'x12.75' RCB	12.043	1.063	DBL 9.67'x12.75' RCB	11.950	0.970	DBL 9.67'x12.75' RCB	11.960	0.980
11+73.80	357.431	DBL 9.67'x12.75' RCB	5451	10.937	DBL 9.67'x12.75' RCB	12.045	1.108	DBL 9.67'x12.75' RCB	12.053	1.116	DBL 9.67'x12.75' RCB	11.952	1.015	DBL 9.67'x12.75' RCB	11.962	1.025
12+50.00	358.060	DBL 9.67'x12.75' RCB	5451	10.767	DBL 9.67'x12.75' RCB	12.089	1.322	DBL 9.67'x12.75' RCB	12.102	1.335	DBL 9.67'x12.75' RCB	11.962	1.195	DBL 9.67'x12.75' RCB	11.976	1.209
12+50.00	358.060	Bridge Entrance	5451	10.041	DBL 9.67'x12.75' RCB	12.089	2.048	DBL 9.67'x12.75' RCB	12.102	2.061	Bridge Entrance	10.862	0.821	Bridge Entrance	10.870	0.829
12+79.74	358.304	20.00'X14.00' RCC	5451	10.055	DBL 9.67'x12.75' RCB	12.107	2.052	DBL 10.00'x14.00' TS	12.121	2.066	20.00'x14.00' RCC	10.941	0.886	20.00'x14.00' RCC	10.950	0.895
13+09.00	358.543	20.00'X14.00' RCC	5451	10.068	DBL 9.67'x12.75' RCB	12.132	2.064				20.00'x14.00' RCC	11.026	0.958	20.00'x14.00' RCC	11.036	0.968
13+09.00	358.543	20.00'X14.00' RCC	5451	10.068	DBL 9.67'x12.75' RCB	12.132	2.064				Bridge Exit	12.109	2.041	Bridge Exit	12.126	2.058
13+98.80	359.279	20.00'X14.00' RCC	5451	10.116	DBL 9.67'x12.75' RCB	12.207	2.091	DBL 10.00'x14.00' RCB	12.232	2.116	DBL 9.67'x14' RCB	12.180	2.064	DBL 9.67'x14' RCB	12.207	2.091
14+85.00	359.985	20.00'X14.00' RCC	5451	10.171	DBL 9.67'x12.75' RCB	12.330	2.159	DBL 10.00'x14.00' RCB	12.372	2.201	DBL 9.67'x14' RCB	12.286	2.115	DBL 9.67'x14' RCB	12.330	2.159
15+05.00	360.149	JUNCTION STRUCTURE	5451	9.997	JUNCTION STRUCTURE	11.904	1.907	JUNCTION STRUCTURE	11.938	1.941	JUNCTION STRUCTURE	11.869	1.872	JUNCTION STRUCTURE	11.904	1.907
17+54.09	362.189	20.00'X14.00' RCC	5422	10.136	DBL 9.67'x12.75' RCB	11.902	1.766	DBL 10.00'x14.00' RCB	11.997	1.861	DBL 9.67'x14' RCB	11.813	1.677	DBL 9.67'x14' RCB	11.902	1.766
20+13.40	364.313	20.00'X14.00' RCC	5422	10.383	DBL 9.67'x12.75' RCB	11.897	1.514	DBL 10.00'x14.00' RCB	12.215	1.832	DBL 9.67'x14' RCB	11.674	1.291	DBL 9.67'x14' RCB	11.897	1.514
20+37.00	364.506	20.00'X14.00' RCC	5422	10.420	DBL 9.67'x12.75' RCB	11.896	1.476	DBL 10.00'x14.00' RCB	12.240	1.820	DBL 9.67'x14' RCB	11.656	1.236	DBL 9.67'x14' RCB	11.896	1.476
20+37.00	364.506	20.00'X14.00' RCC	5422	10.420	Bridge Entrance	10.810	0.390	DBL 10.00'x14.00' RCB	12.240	1.820	Bridge Entrance	10.665	0.245	Bridge Entrance	10.810	0.390
21+90.00	365.760	20.00'X14.00' RCC	5422	10.662	20.00'X14.00' RCC	11.339	0.677	DBL 10.00'x14.00' RCB	12.829	2.167	20.00'X14.00' RCC	11.071	0.409	20.00'X14.00' RCC	11.339	0.677
22+20.00	366.005	JUNCTION STRUCTURE	5422	10.431	JUNCTION STRUCTURE	11.083	0.652	JUNCTION STRUCTURE	12.131	1.700	JUNCTION STRUCTURE	10.827	0.396	JUNCTION STRUCTURE	11.083	0.652
22+33.00	366.112	20.00'X14.00' RCC	5392	10.451	20.00'X14.00' RCC	11.134	0.683	DBL 10.00'x14.00' RCB	12.150	1.699	20.00'X14.00' RCC	10.863	0.412	20.00'X14.00' RCC	11.134	0.683
22+64.53	366.370	20.00'X14.00' RCC	5392	10.500	20.00'X14.00' RCC	11.269	0.769	DBL 10.00'x14.00' RCB	12.196	1.696	20.00'X14.00' RCC	10.956	0.456	20.00'X14.00' RCC	11.269	0.769
22+83.00	366.522	20.00'X14.00' RCC	5392	10.554	20.00'X14.00' RCC	11.361	0.807	DBL 10.00'x14.00' RCB	12.231	1.677	20.00'X14.00' RCC	11.018	0.464	20.00'X14.00' RCC	11.361	0.807
22+83.00	366.522	20.00'X14.00' RCC	5392	10.554	Bridge Exit	13.422	2.868	DBL 10.00'x14.00' RCB	12.231	1.677	Bridge Exit	12.156	1.602	Bridge Exit	13.422	2.868
23+33.00	366.932	20.00'X14.00' RCC	5392	10.656	DBL 9.77'x14.00' TS	12.227	1.571	DBL 10.00'x14.00' RCB	12.344	1.688	DBL 9.67'x14' RCB	12.239	1.583	DBL 9.67'x14' TS	14.378	3.722
24+50.00	367.893	20.00'X14.00' RCC	5392	10.923	DBL 9.77'x14.00' RCB	14.438	3.515	DBL 10.00'x14.00' RCB	13.422	2.499	DBL 9.67'x14' RCB	12.671	1.748	DBL 10'x14' RCB	14.658	3.735
24+82.31	368.158	JUNCTION STRUCTURE	5392	10.512	JUNCTION STRUCTURE	14.621	4.109	JUNCTION STRUCTURE	14.141	3.629	JUNCTION STRUCTURE	11.709	1.197	JUNCTION STRUCTURE	14.817	4.305
25+20.00	368.468	20.00'X14.00' RCC	5392	10.593	DBL 9.77'x14.00' RCB	14.273	3.680	DBL 10.00'x14.00' RCB						DBL 10'x14' RCB	14.758	4.165
25+50.00	368.714	20.00'X14.00' RCC	5339	10.657	DBL 9.77'x14.00' RCB	13.996	3.339	DBL 10.00'x14.00' RCB			DBL 9.67'x14' RCB	11.700	1.043	DBL 9.67'x14' TS	14.404	3.747
25+50.00	368.714	20.00'X14.00' RCC	5339	10.657	DBL 9.77'x14.00' RCB	13.996	3.339	DBL 10.00'x14.00' RCB			Bridge Entrance	10.657	0.000	Bridge Entrance	21.861	11.204
26+25.00	369.330	20.00'X14.00' RCC	5339	10.861	DBL 9.77'x14.00' RCB	14.467	3.606	DBL 10.00'x14.00' RCB	14.017	3.156	20.00'x14.00' RCC	10.861	0.000	20.00'x14.00' RCC	21.172	10.311
26+75.00	369.970	TRAN. STRUCTURE	5339	10.485	DBL 10.00'x12.00' TS	12.843	2.358	DBL 10.00'x12.00' TS	12.497	2.012	20.00'x14.00' RCC	10.485	0.000	20.00'x14.00' RCC	20.622	10.137
26+75.00	369.970	Bridge Exit	5339	11.384		12.843	1.459		12.497	1.113	Bridge Exit	11.384	0.000	Bridge Exit	20.622	9.238
27+80.00	370.661	DBL 10.00'x12.00' RCB	5339	11.068	DBL 10.00'x12.00' RCB	13.196	2.128	DBL 10.00'x12.00' RCB	12.849	1.781	DBL 10.00'x12.00' RCB	11.068	0.000	DBL 10.00'x12.00' RCB	20.975	9.907
27+90.00	370.727	JUNCTION STRUCTURE	5339	10.601	JUNCTION STRUCTURE	13.482	2.881	JUNCTION STRUCTURE	13.135	2.534	JUNCTION STRUCTURE	10.601	0.000	JUNCTION STRUCTURE	21.261	10.660
29+57.51	371.830	DBL 10.00'x12.00' RCB	5289	10.020	DBL 10.00'x12.00' RCB	14.013	3.993	DBL 10.00'x12.00' RCB	13.666	3.646	DBL 10.00'x12.00' RCB	10.020	0.000	DBL 10.00'x12.00' RCB	21.792	11.772
29+82.51	372.380	TRAN. STRUCTURE	5289	10.243	TRAN. STRUCTURE	13.707	3.464	TRAN. STRUCTURE	13.360	3.117	TRAN. STRUCTURE	10.243	0.000	TRAN. STRUCTURE	21.486	11.243
31+89.30	374.520	DBL 10.00'x12.00' RCB	5289	10.300	DBL 10.00'x12.00' RCB	14.086	3.786	DBL 10.00'x12.00' RCB	13.739	3.439	DBL 10.00'x12.00' RCB	10.300	0.000	DBL 10.00'x12.00' RCB	21.865	11.565
31+99.30	374.623	JUNCTION STRUCTURE	5289	9.965	JUNCTION STRUCTURE	14.335	4.370	JUNCTION STRUCTURE	13.989	4.024	JUNCTION STRUCTURE	9.965	0.000	JUNCTION STRUCTURE	22.114	12.149
32+23.12	374.870	DBL 10.00'x12.00' RCB	5244	9.959	DBL 10.00'x12.00' RCB	14.687	4.728	DBL 10.00'x12.00' RCB	14.341	4.382	DBL 10.00'x12.00' RCB	9.959	0.000	DBL 10.00'x12.00' RCB	22.466	12.507
33+03.90	375.980	DBL 10.00'x12.00' RCB	5244	10.211	DBL 10.00'x12.00' RCB	14.352	4.141	DBL 10.00'x12.00' RCB	14.005	3.794	DBL 10.00'x12.00' RCB	10.211	0.000	DBL 10.00'x12.00' RCB	22.131	11.920
33+08.90	376.015	TRAN. STRUCTURE	5244	10.185	TRAN. STRUCTURE	14.365	4.180	TRAN. STRUCTURE	14.018	3.833	TRAN. STRUCTURE	10.185	0.000	TRAN. STRUCTURE	22.144	11.959
33+29.44	376.159	TRAN. STRUCTURE	5244	10.081	TRAN. STRUCTURE	14.418	4.337	TRAN. STRUCTURE	14.071	3.990	TRAN. STRUCTURE	10.081	0.000	TRAN. STRUCTURE	22.197	12.116
33+45.18	376.270	TRAN. STRUCTURE	5244	10.002	TRAN. STRUCTURE	14.458	4.456	TRAN. STRUCTURE	14.111	4.109	TRAN. STRUCTURE	10.002	0.000	TRAN. STRUCTURE	22.237	12.235
33+55.18	376.384	JUNCTION STRUCTURE	5244	9.677	JUNCTION STRUCTURE	14.709	5.032	JUNCTION STRUCTURE	14.362	4.685	JUNCTION STRUCTURE	9.677	0.000	JUNCTION STRUCTURE	22.488	12.811
35+99.63	379.180	DBL 10.00'x12.00' RCB	5196	9.727	DBL 10.00'x12.00' RCB	14.578	4.851	DBL 10.00'x12.00' RCB	14.232	4.505	DBL 10.00'x12.00' RCB	9.727	0.000	DBL 10.00'x12.00' RCB	22.357	12.630
36+25.79	379.479	DBL 10.00'x12.00' RCB	5196	9.734	DBL 10.00'x12.00' RCB	14.843	5.109	DBL 10.00'x12.00' RCB	14.496	4.762	DBL 10.00'x12.00' RCB	9.734	0.000	DBL 10.00'x12.00' RCB	22.622	12.888
38+87.30	382.470	TRAN. STRUCTURE	5196	9.840	TRAN. STRUCTURE	14.314	4.474	TRAN. STRUCTURE	13.967	4.127	TRAN. STRUCTURE	9.840	0.000	TRAN. STRUCTURE	22.093	12.253
38+97.30	382.584	JUNCTION STRUCTURE	5196	9.523	JUNCTION STRUCTURE	14.561	5.038	JUNCTION STRUCTURE	14.214	4.691	JUNCTION STRUCTURE	9.523	0.000	JUNCTION STRUCTURE	22.340	12.817
40+89.30	384.780	DBL 10.00'x12.00' RCB	5148	9.515	DBL 10.00'x12.00' RCB	14.139	4.624	DBL 10.00'x12.00' RCB	13.793	4.278	DBL 10.00'x12.00' RCB	9.515	0.000	DBL 10.00'x12.00' RCB	21.918	12.403
41+35.72	385.310	JUNCTION STRUCTURE	5148	9.913	JUNCTION STRUCTURE	13.916	4.003	JUNCTION STRUCTURE	9.913	0.000	JUNCTION STRUCTURE	9.913	0.000	JUNCTION STRUCTURE	21.695	11.782
41+41.60	385.389	10.00'x12.00' RCB	2813	9.917	10.00'x12.00' RCB	13.901	3.984	10.00'x12.00' RCB	9.917	0.000	10.00'x12.00' RCB	9.917	0.000	10.00'x12.00' RCB	21.680	11.763
42+11.51	386.322	10.00'x12.00' RCB	2813	9.964	10.00'x12.00' RCB	14.751	4.787	10.00'x12.00' RCB	14.404	4.440	10.00'x12.00' RCB	9.964	0.000	10.00'x12.00' RCB	22.530	12.566
42+23.54	386.483	10.00'x12.00' RCB	2813	9.973	10.00'x12.00' RCB	14.723	4.750	10.00'x12.00' RCB	14.376	4.403	10.00'x12.00' RCB	9.973	0.000	10.00'x12.00' RCB	22.502	12.529
42+43.54	386.750	TRAN. STRUCTURE	2813	10.440	TRAN. STRUCTURE	14.301	3.861	TRAN. STRUCTURE	13.954	3.514	TRAN. STRUCTURE	10.440	0.000	TRAN. STRUCTURE	22.080	11.640
44+20.54	389.120	12.00'x12.00' Horseshoe Arch	2813	10.722	12.00'x12.00' Horseshoe Arch	14.036	3.314	12.00'x12.00' Horseshoe Arch	13.689	2.967	12.00'x12.00' Horseshoe Arch	10.722	0.000	12.00'x12.00' Horseshoe Arch	21.815	11.093
44+40.54	390.218	TRAN. STRUCTURE	2813	10.429	JUNCTION STRUCTURE	15.723	5.294	JUNCTION STRUCTURE	15.377	4.948	JUNCTION STRUCTURE	10.429	0.000	JUNCTION STRUCTURE	23.502	13.073
44+53.21	390.913	TRAN. STRUCTURE	2813	10.944	TRAN. STRUCTURE	15.129	4.185	TRAN. STRUCTURE	14.783	3.839	TRAN. STRUCTURE	10.944	0.000	TRAN. STRUCTURE	22.908	11.964
44+63.54	391.480	TRAN. STRUCTURE	2813	11.531	TRAN. STRUCTURE	14.645	3.114	TRAN. STRUCTURE	14.298	2.767	TRAN. STRUCTURE	11.531	0.000	TRAN. STRUCTURE	22.424	10.893
44+97.74	391.638	10.25'x13.25' RCB	2813	11.316	10.25'x13.25' RCB	15.169	3.853	10.25'x13.25' RCB	14.823	3.507	10.25'x13.25' RCB	11.316	0.000	10.25'x13.25' RCB	22.948	11.632
45+79.22	392.015	10.25'x13.25' RCB	2813	10.840	10.25'x13.25' RCB	15.442	4.602	10.25'x13.25' RCB	15.096	4.256	10.25'x13.25' RCB	10.840	0.000	10.25'x13.25' RCB	23.221	12.381
45+95.38	392.089	TRAN. STRUCTURE	2813	10.682	TRAN. STRUCTURE	15.497	4.815	TRAN. STRUCTURE	15.151	4.469	TRAN. STRUCTURE	10.682	0.000	TRAN. STRUCTURE	23.276	12.594
46+23.64	392.220	10.25'x13.25' RCB	2813	10.530	10.25'x13.25' RCB	15.592	5.062	10.25'x13.25' RCB	15.245	4.715	10.25'x13.25' RCB	10.530	0.000	10.25'x13.25' RCB	23.371	12.841
47+03.02	393.220	10.25'x13.25' RCB	2813	10.774	10.25'x13.25' RCB	15.558	4.784	10.25'x13.25' RCB	15.212	4.438	10.25'x13.25' RCB	10.774	0.000	10.25'x13.25' RCB	23.337	12.563
47+13.02	393.340	TRAN. STRUCTURE	2813	10.798	TRAN. STRUCTURE	15.518	4.720	TRAN. STRUCTURE	15.171	4.373	TRAN. STRUCTURE	10.798	0.000	TRAN. STRUCTURE	23.297	12.499
47+39.96	393.663	10.00'x13.25' RCB	2813	10.885	10.00'x13.25' RCB	15.410	4.525	10.00'x13.25' RCB	15.063	4.178	10.00'x13.25' RCB	10.885	0.000	10.00'x13.25' RCB	23.189	12.304
48+80.82	395.350	10.00'x13.25' RCB	2813	11.628	10.00'x13.25' RCB	15.857	4.229	10.00'x13.25' RCB	15.511	3.883	10.00'x13.25' RCB	11.628	0.000	10.00'x13.25' RCB	23.636	12.008
51+91.14	397.650	10.00'x13.25' RCB	2813	11.184	10.00'x13.25' RCB	16.033	4.849	10.00'x13.25' RCB	15.686	4.502	10.00'x13.25' RCB	11.184	0.000	10.00'x13.25' RCB	23.812	12.628
53+83.64	399.749	10.00'x13.25' RCB	2813	13.114	10.00'x13.25' RCB	16.757	3.643	10.00'x13.25' RCB	16.410	3.296	10.00'x13.25' RCB	13.114	0.000	10.00'x13.25' RCB	24.536	11.422
53+92.38	399.844	TRAN. STRUCTURE	2813	12.816	TRAN. STRUCTURE	16.731	3.915	TRAN. STRUCTURE	16.385	3.569	TRAN. STRUCTURE	12.816	0.000	TRAN. STRUCTURE	24.510	11.694
54+06.64	400.000	TRAN. STRUCTURE	2813	13.250	TRAN. STRUCTURE	16.689	3.439	TRAN. STRUCTURE	16.343	3.093	TRAN. STRUCTURE	13.250	0.000	TRAN. STRUCTURE	24.468	11.218

CARD CODE	SECT NO	CHN TYPE	NO OF PIER/PIP	AVE PIER WIDTH	HEIGHT 1 DIAMETER	BASE WIDTH	ZL	ZR	INV DROP	Y(1)	Y(2)	Y(3)	Y(4)	Y(5)	Y(6)	Y(7)	Y(8)	Y(9)	Y(10)
CD	1	3	1	.670	12.750	20.000	.000	.000	.00										
CD	2	2	0	.000	14.000	20.000			.00										
CD	3	4	1		6.000														
CD	4	3	1	.670	12.000	20.670	.000	.000	.00										
CD	5	3	1	.670	12.000	20.670	.000	.000	.00										
CD	6	3	0	.000	12.000	9.730	.000	.000	.00										
CD	7	3	0	.000	13.250	10.250	.000	.000	.00										
CD	8	3	0	.000	12.500	11.000	.000	.000	.00										
CD	9	4	1		3.750														
CD	10	4	1		3.000														
CD	11	4	1		2.000														
CD	12	4	1		2.500														
CD	13	2	0	.000	14.000	20.670			.00										
CD	14	3	1	.670	14.000	20.000	.000	.000	.00										
CD	15	3	1	.670	14.000	20.670	.000	.000	.00										
CD	25	3	0	.000	12.000	10.000	.000	.000	.00										

WATER SURFACE PROFILE - TITLE CARD LISTING

HEADING LINE NO 1 IS -
SR-710 NORTH STUDY

HEADING LINE NO 2 IS -
DORCHESTER DRAIN LINE-A EAST & LINE-B (P22)

HEADING LINE NO 3 IS -
MODEL: W.CHEN REVIEW: G.HSU

WATER SURFACE PROFILE - ELEMENT CARD LISTING

ELEMENT NO 1 IS A SYSTEM OUTLET * * *

U/S DATA	STATION	INVERT	SECT	W S ELEV
	491.000	351.820	1	364.500

ELEMENT NO 2 IS A TRANSITION * * *

U/S DATA	STATION	INVERT	SECT	N	RADIUS	ANGLE
	517.000	352.033	1	.013	249.990	-5.959

ELEMENT NO 3 IS A REACH * * *

U/S DATA	STATION	INVERT	SECT	N	RADIUS	ANGLE	ANG PT	MAN H
	544.030	352.255	1	.013	249.993	-6.195	.000	0

ELEMENT NO 4 IS A REACH * * *

U/S DATA	STATION	INVERT	SECT	N	RADIUS	ANGLE	ANG PT	MAN H
	916.000	355.310	1	.013	.000	.000	.000	0

ELEMENT NO 5 IS A REACH * * *

U/S DATA	STATION	INVERT	SECT	N	RADIUS	ANGLE	ANG PT	MAN H
	1078.000	356.640	1	.013	250.004	37.127	.000	0

ELEMENT NO 6 IS A JUNCTION * * * * * * *

U/S DATA	STATION	INVERT	SECT	LAT-1	LAT-2	N	Q3	Q4	INVERT-3	INVERT-4	PHI 3	PHI 4
	1088.000	356.723	1	3	0	.013	30.000	.000	361.000	.000	-76.000	.000

RADIUS	ANGLE
250.091	2.291

ELEMENT NO 7 IS A REACH * * *

Proposed

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                    U/S DATA   STATION    INVERT  SECT              N                      RADIUS    ANGLE     ANG PT  MAN H
                               1153.800  357.266    1              .013                   250.004   15.080      .000      0
ELEMENT NO   8 IS A REACH              *         *     *
                    U/S DATA   STATION    INVERT  SECT              N                      RADIUS    ANGLE     ANG PT  MAN H
                               1173.800  357.431    1              .013                     .000     .000      .000      0
ELEMENT NO   9 IS A REACH              *         *     *
                    U/S DATA   STATION    INVERT  SECT              N                      RADIUS    ANGLE     ANG PT  MAN H
                               1250.000  358.060    1              .013                   249.996   17.464      .000      0
ELEMENT NO  10 IS A BRIDGE ENTRANCE                  *
                    U/S DATA   STATION    INVERT  SECT             FP
                               1250.000  358.060    2              .100
ELEMENT NO  11 IS A REACH              *         *     *
                    U/S DATA   STATION    INVERT  SECT              N                      RADIUS    ANGLE     ANG PT  MAN H
                               1279.740  358.304    2              .014                   249.996    6.816      .000      0
ELEMENT NO  12 IS A REACH              *         *     *
                    U/S DATA   STATION    INVERT  SECT              N                      RADIUS    ANGLE     ANG PT  MAN H
                               1309.000  358.543    2              .014                   249.996   -6.706      .000      0
                                                    W S P G W                                                    PAGE NO   3
                          WATER SURFACE PROFILE - ELEMENT CARD LISTING
ELEMENT NO  13 IS A BRIDGE EXIT                      *
                    U/S DATA   STATION    INVERT  SECT
                               1309.000  358.543   14
ELEMENT NO  14 IS A REACH              *         *     *
                    U/S DATA   STATION    INVERT  SECT              N                      RADIUS    ANGLE     ANG PT  MAN H
                               1398.800  359.279   14              .013                   250.008  -20.580      .000      0
ELEMENT NO  15 IS A REACH              *         *     *
                    U/S DATA   STATION    INVERT  SECT              N                      RADIUS    ANGLE     ANG PT  MAN H
                               1485.000  359.985   14              .013                  2000.362   -2.469      .000      0
ELEMENT NO  16 IS A JUNCTION           *         *     *     *              *                 *                 *
                    U/S DATA   STATION    INVERT  SECT LAT-1 LAT-2   N      Q3       Q4     INVERT-3 INVERT-4  PHI 3  PHI 4
                               1505.000  360.149   14    12     0    .013   29.000     .000   361.500      .000  60.000      .000
                                                                                              RADIUS    ANGLE
                                                                                             1999.853   -.573
ELEMENT NO  17 IS A REACH              *         *     *
                    U/S DATA   STATION    INVERT  SECT              N                      RADIUS    ANGLE     ANG PT  MAN H
                               1754.090  362.189   14              .013                  1999.972   -7.136      .000      0
ELEMENT NO  18 IS A REACH              *         *     *
                    U/S DATA   STATION    INVERT  SECT              N                      RADIUS    ANGLE     ANG PT  MAN H
                               2013.400  364.313   14              .013                   424.982  -34.960      .000      0
ELEMENT NO  19 IS A REACH              *         *     *
                    U/S DATA   STATION    INVERT  SECT              N                      RADIUS    ANGLE     ANG PT  MAN H
                               2037.000  364.506   14              .013                   424.946    3.182      .000      0
ELEMENT NO  20 IS A BRIDGE ENTRANCE                  *
                    U/S DATA   STATION    INVERT  SECT             FP
                               2037.000  364.506    2              .100
ELEMENT NO  21 IS A REACH              *         *     *
                    U/S DATA   STATION    INVERT  SECT              N                      RADIUS    ANGLE     ANG PT  MAN H
                               2190.000  365.760    2              .014                   425.010   20.626      .000      0
ELEMENT NO  22 IS A JUNCTION           *         *     *     *              *                 *                 *
                    U/S DATA   STATION    INVERT  SECT LAT-1 LAT-2   N      Q3       Q4     INVERT-3 INVERT-4  PHI 3  PHI 4
                               2220.000  366.005    2    12     0    .014   30.000     .000   367.000      .000  60.000      .000
                                                                                              RADIUS    ANGLE
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ELEMENT NO	23	IS A REACH		*	*	*								
		U/S DATA	STATION	INVERT	SECT		N				RADIUS	ANGLE	ANG PT	MAN H
			2233.000	366.112	2		.014				424.897	1.753	.000	0
ELEMENT NO	24	IS A REACH		*	*	*								
		U/S DATA	STATION	INVERT	SECT		N				RADIUS	ANGLE	ANG PT	MAN H
			2264.530	366.370	2		.014				424.968	4.251	.000	0
ELEMENT NO	25	IS A REACH		*	*	*								
		U/S DATA	STATION	INVERT	SECT		N				RADIUS	ANGLE	ANG PT	MAN H
			2283.000	366.522	2		.014				499.883	-2.117	.000	0
ELEMENT NO	26	IS A BRIDGE EXIT				*								
		U/S DATA	STATION	INVERT	SECT									
			2283.000	366.522	14									
ELEMENT NO	27	IS A TRANSITION		*	*	*								
		U/S DATA	STATION	INVERT	SECT		N				RADIUS	ANGLE		
			2333.000	366.932	15		.013				499.963	-5.730		
ELEMENT NO	28	IS A REACH		*	*	*								
		U/S DATA	STATION	INVERT	SECT		N				RADIUS	ANGLE	ANG PT	MAN H
			2450.000	367.893	15		.013				500.008	-13.407	.000	0
ELEMENT NO	29	IS A JUNCTION		*	*	*	*		*		*		*	
		U/S DATA	STATION	INVERT	SECT	LAT-1	LAT-2	N	Q3	Q4	INVERT-3	INVERT-4	PHI 3	PHI 4
			2482.310	368.158	15	9	0	.013	53.000	.000	370.000	.000	45.000	.000
											RADIUS	ANGLE		
											500.062	-3.702		
ELEMENT NO	30	IS A REACH		*	*	*								
		U/S DATA	STATION	INVERT	SECT		N				RADIUS	ANGLE	ANG PT	MAN H
			2520.000	368.468	15		.013				.000	.000	.000	0
ELEMENT NO	31	IS A TRANSITION		*	*	*								
		U/S DATA	STATION	INVERT	SECT		N				RADIUS	ANGLE		
			2550.000	368.714	14		.013				.000	.000		
ELEMENT NO	32	IS A BRIDGE ENTRANCE				*								
		U/S DATA	STATION	INVERT	SECT		FP							
			2550.000	368.714	2		.100							
ELEMENT NO	33	IS A REACH		*	*	*								
		U/S DATA	STATION	INVERT	SECT		N				RADIUS	ANGLE	ANG PT	MAN H
			2625.000	369.330	2		.014				.000	.000	.000	0
ELEMENT NO	34	IS A TRANSITION		*	*	*								
		U/S DATA	STATION	INVERT	SECT		N				RADIUS	ANGLE		
			2675.000	369.970	13		.014				.000	.000		

ELEMENT NO	35	IS A BRIDGE EXIT				*								
		U/S DATA	STATION	INVERT	SECT									
			2675.000	369.970	4									
ELEMENT NO	36	IS A REACH		*	*	*								
		U/S DATA	STATION	INVERT	SECT		N				RADIUS	ANGLE	ANG PT	MAN H
			2780.000	370.661	4		.013				.000	.000	.000	0
ELEMENT NO	37	IS A JUNCTION		*	*	*	*		*		*		*	
		U/S DATA	STATION	INVERT	SECT	LAT-1	LAT-2	N	Q3	Q4	INVERT-3	INVERT-4	PHI 3	PHI 4
			2790.000	370.727	4	12	0	.013	50.000	.000	371.500	.000	60.000	.000

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                                                                                       RADIUS     ANGLE
                                                                                         .000      .000
ELEMENT NO  38 IS A REACH          *         *     *
                    U/S DATA   STATION    INVERT  SECT                 N                            RADIUS     ANGLE      ANG PT  MAN H
                               2957.510  371.830   4                 .013                             .000      .000       .000     0
ELEMENT NO  39 IS A TRANSITION     *         *     *
                    U/S DATA   STATION    INVERT  SECT                 N                            RADIUS    ANGLE
                               2982.510  372.380   5                 .013                             .000      .000
ELEMENT NO  40 IS A REACH          *         *     *
                    U/S DATA   STATION    INVERT  SECT                 N                            RADIUS     ANGLE      ANG PT  MAN H
                               3189.300  374.520   5                 .013                             .000      .000     -5.027     1
ELEMENT NO  41 IS A JUNCTION       *         *     *      *                    *                      *                 *
                    U/S DATA   STATION    INVERT  SECT LAT-1 LAT-2     N      Q3          Q4      INVERT-3 INVERT-4  PHI 3  PHI 4
                               3199.300  374.623   5    10      0    .013   45.000        .000    374.623      .000 -90.000      .000
                                                                                                    RADIUS     ANGLE
                                                                                                      .000      .000

ELEMENT NO  42 IS A REACH          *         *     *
                    U/S DATA   STATION    INVERT  SECT                 N                            RADIUS     ANGLE      ANG PT  MAN H
                               3223.120  374.870   5                 .013                             .000      .000       .000     1
ELEMENT NO  43 IS A REACH          *         *     *
                    U/S DATA   STATION    INVERT  SECT                 N                            RADIUS     ANGLE      ANG PT  MAN H
                               3303.900  375.980   5                 .013                             .000      .000       .000     0
ELEMENT NO  44 IS A TRANSITION     *         *     *
                    U/S DATA   STATION    INVERT  SECT                 N                            RADIUS    ANGLE
                               3308.900  376.015   4                 .013                             .000      .000
                                                  W S P G W                                                             PAGE NO   6
                        WATER SURFACE PROFILE - ELEMENT CARD LISTING
ELEMENT NO  45 IS A TRANSITION     *         *     *
                    U/S DATA   STATION    INVERT  SECT                 N                            RADIUS    ANGLE
                               3329.440  376.159   4                 .013                             .000      .000
ELEMENT NO  46 IS A TRANSITION     *         *     *
                    U/S DATA   STATION    INVERT  SECT                 N                            RADIUS    ANGLE
                               3345.180  376.270   4                 .013                             .000      .000
ELEMENT NO  47 IS A JUNCTION       *         *     *      *                    *                      *                 *
                    U/S DATA   STATION    INVERT  SECT LAT-1 LAT-2     N      Q3          Q4      INVERT-3 INVERT-4  PHI 3  PHI 4
                               3355.180  376.384   4    11      0    .013   48.000        .000    376.384      .000 -90.000      .000
                                                                                                    RADIUS     ANGLE
                                                                                                      .000      .000

ELEMENT NO  48 IS A REACH          *         *     *
                    U/S DATA   STATION    INVERT  SECT                 N                            RADIUS     ANGLE      ANG PT  MAN H
                               3599.630  379.180   4                 .013                             .000      .000       .000     1
ELEMENT NO  49 IS A REACH          *         *     *
                    U/S DATA   STATION    INVERT  SECT                 N                            RADIUS     ANGLE      ANG PT  MAN H
                               3625.790  379.479   4                 .013                           350.039    -4.282      .000     0
ELEMENT NO  50 IS A REACH          *         *     *
                    U/S DATA   STATION    INVERT  SECT                 N                            RADIUS     ANGLE      ANG PT  MAN H
                               3887.300  382.470   4                 .013                             .000      .000       .000     0
ELEMENT NO  51 IS A JUNCTION       *         *     *      *                    *                      *                 *
                    U/S DATA   STATION    INVERT  SECT LAT-1 LAT-2     N      Q3          Q4      INVERT-3 INVERT-4  PHI 3  PHI 4
                               3897.300  382.584   4    11      0    .013   48.000        .000    382.584      .000 -90.000      .000
                                                                                                    RADIUS     ANGLE
                                                                                                      .000      .000
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ELEMENT NO  52 IS A REACH          *           *      *
               U/S DATA   STATION    INVERT  SECT              N                              RADIUS     ANGLE     ANG PT  MAN H
                          4089.300  384.780   4               .013                             .000      .000      .000     0
ELEMENT NO  53 IS A JUNCTION       *           *      *      *             *                    *                  *
               U/S DATA   STATION    INVERT  SECT LAT-1 LAT-2  N      Q3           Q4     INVERT-3 INVERT-4  PHI 3  PHI 4
                          4135.720  385.310   25    25    0   .013  2335.000      .000   385.310     .000    .000      .000
                                                                                          RADIUS     ANGLE
                                                                                           .000      .000
                                                    W S P G W                                                PAGE NO    7
                                  WATER SURFACE PROFILE - ELEMENT CARD LISTING
ELEMENT NO  54 IS A REACH          *           *      *
               U/S DATA   STATION    INVERT  SECT              N                              RADIUS     ANGLE     ANG PT  MAN H
                          4141.600  385.389   25              .013                             .000      .000      .000     0
ELEMENT NO  55 IS A REACH          *           *      *
               U/S DATA   STATION    INVERT  SECT              N                              RADIUS     ANGLE     ANG PT  MAN H
                          4211.510  386.322   25              .013                           380.031    10.540     .000     1
ELEMENT NO  56 IS A REACH          *           *      *
               U/S DATA   STATION    INVERT  SECT              N                              RADIUS     ANGLE     ANG PT  MAN H
                          4223.540  386.483   25              .013                             .000      .000      .000     0
ELEMENT NO  57 IS A TRANSITION     *           *      *
               U/S DATA   STATION    INVERT  SECT              N                              RADIUS    ANGLE
                          4243.540  386.750    6              .013                             .000      .000
ELEMENT NO  58 IS A REACH          *           *      *
               U/S DATA   STATION    INVERT  SECT              N                              RADIUS     ANGLE     ANG PT  MAN H
                          4420.540  389.120    6              .013                             .000      .000      .000     0
ELEMENT NO  59 IS A TRANSITION     *           *      *
               U/S DATA   STATION    INVERT  SECT              N                              RADIUS    ANGLE
                          4440.540  390.218    7              .013                             .000      .000
ELEMENT NO  60 IS A TRANSITION     *           *      *
               U/S DATA   STATION    INVERT  SECT              N                              RADIUS    ANGLE
                          4453.210  390.913    7              .013                           230.017    -3.156
ELEMENT NO  61 IS A TRANSITION     *           *      *
               U/S DATA   STATION    INVERT  SECT              N                              RADIUS    ANGLE
                          4463.540  391.480    7              .013                           230.031    -2.573
ELEMENT NO  62 IS A REACH          *           *      *
               U/S DATA   STATION    INVERT  SECT              N                              RADIUS     ANGLE     ANG PT  MAN H
                          4497.740  391.638    7              .013                           229.991    -8.520     .000     0
ELEMENT NO  63 IS A REACH          *           *      *
               U/S DATA   STATION    INVERT  SECT              N                              RADIUS     ANGLE     ANG PT  MAN H
                          4579.220  392.015    7              .013                             .000      .000      .000     0
ELEMENT NO  64 IS A TRANSITION     *           *      *
               U/S DATA   STATION    INVERT  SECT              N                              RADIUS    ANGLE
                          4595.380  392.089    7              .013                             .000      .000
ELEMENT NO  65 IS A REACH          *           *      *
               U/S DATA   STATION    INVERT  SECT              N                              RADIUS     ANGLE     ANG PT  MAN H
                          4623.640  392.220    7              .013                             .000      .000      .000     0
ELEMENT NO  66 IS A REACH          *           *      *
               U/S DATA   STATION    INVERT  SECT              N                              RADIUS     ANGLE     ANG PT  MAN H
                          4703.020  393.220    7              .013                             .000      .000      .000     1
ELEMENT NO  67 IS A TRANSITION     *           *      *
               U/S DATA   STATION    INVERT  SECT              N                              RADIUS    ANGLE
                          4713.020  393.340    7              .013                             .000      .000
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W S P G W

WATER SURFACE PROFILE - ELEMENT CARD LISTING

ELEMENT NO 68 IS A REACH * * *

U/S DATA	STATION	INVERT	SECT	N	RADIUS	ANGLE	ANG PT	MAN H
	4739.960	393.663	7	.013	.000	.000	.000	0

ELEMENT NO 69 IS A REACH * * *

U/S DATA	STATION	INVERT	SECT	N	RADIUS	ANGLE	ANG PT	MAN H
	4880.820	395.350	7	.013	155.850	51.785	.000	0

ELEMENT NO 70 IS A REACH * * *

U/S DATA	STATION	INVERT	SECT	N	RADIUS	ANGLE	ANG PT	MAN H
	5191.140	397.650	7	.013	.000	.000	.000	0

ELEMENT NO 71 IS A REACH * * *

U/S DATA	STATION	INVERT	SECT	N	RADIUS	ANGLE	ANG PT	MAN H
	5383.640	399.749	7	.013	238.851	46.177	.000	1

ELEMENT NO 72 IS A TRANSITION * * *

U/S DATA	STATION	INVERT	SECT	N	RADIUS	ANGLE
	5392.380	399.844	7	.013	238.908	2.096

ELEMENT NO 73 IS A TRANSITION * * *

U/S DATA	STATION	INVERT	SECT	N	RADIUS	ANGLE
	5406.640	400.000	7	.013	.000	.000

ELEMENT NO 74 IS A SYSTEM HEADWORKS * *

U/S DATA	STATION	INVERT	SECT	W S ELEV
	5406.640	400.000	7	400.000

W S P G W - CIVILDESIGN Version 14.06

Program Package Serial Number: 1806

WATER SURFACE PROFILE LISTING

Date: 8-23-2013 Time:10:45: 9

SR-710 NORTH STUDY
DORCHESTER DRAIN LINE-A EAST & LINE-B (P20)(NGVD 29)
MODEL: W.CHEN REVIEW: G.HSU

Station / L/Elem	Invert Elev / Ch Slope	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head / SF Ave	Energy Grd.El. / HF	Super Elev / SE Dpth	Critical Depth / Froude N	Flow Top Width / Norm Dp	Height/ Dia.-FT / "N"	Base Wt or I.D. / X-Fall	ZL / ZR	No Wth Prs/Pip / Type Ch
491.000	351.820	12.029	363.849	5481.00	23.57	8.63	372.48	12.75	12.75	20.00	12.750	20.000	.00	1 .7
TRANS STR	.0082					.0082	.21	12.75	1.22		.013	.00	.00	BOX
			WARNING - Flow depth near top of box conduit											
517.000	352.033	12.029	364.062	5481.00	23.57	8.63	372.69	12.75	12.75	20.00	12.750	20.000	.00	1 .7
27.030	.0082					.0082	.22	12.75	1.22	12.00	.013	.00	.00	BOX
			WARNING - Flow depth near top of box conduit											
544.030	352.255	12.032	364.287	5481.00	23.57	8.62	372.91	.00	12.75	20.00	12.750	20.000	.00	1 .7
371.970	.0082					.0080	2.98	12.03	1.22	12.00	.013	.00	.00	BOX
			WARNING - Flow depth near top of box conduit											
916.000	355.310	12.210	367.521	5481.00	23.22	8.37	375.89	12.75	12.75	20.00	12.750	20.000	.00	1 .7
162.000	.0082					.0077	1.25	12.75	1.19	12.00	.013	.00	.00	BOX
			WARNING - Flow depth near top of box conduit											
1078.000	356.640	12.465	369.105	5481.00	22.75	8.04	377.14	12.75	12.75	20.00	12.750	20.000	.00	1 .7
JUNCT STR	.0083					.0079	.08	12.75	1.15		.013	.00	.00	BOX
			WARNING - Flow depth near top of box conduit											

SR-710 NORTH STUDY
DORCHESTER DRAIN LINE-A EAST & LINE-B (P20)(NGVD 29)
MODEL: W.CHEN REVIEW: G.HSU

Station	Invert Elev	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head	Energy Grd.El.	Super Elev	Critical Depth	Flow Top Width	Height/ Dia.-FT	Base Wt or I.D.	ZL	No Wth Prs/Pip
L/Elem	Ch Slope					SF Ave	HF	SE Dpth	Froude N	Norm Dp	"N"	X-Fall	ZR	Type Ch
1088.000	356.723	11.944	368.667	5451.00	23.61	8.66	377.32	12.75	12.75	20.00	12.750	20.000	.00	1 .7
65.800	.0083					.0082	.54	12.75	1.22	11.92	.013	.00	.00	BOX
			---------- WARNING - Flow depth near top of box conduit ----------											
1153.800	357.266	11.950	369.216	5451.00	23.60	8.65	377.86	.00	12.75	20.00	12.750	20.000	.00	1 .7
20.000	.0083					.0082	.16	11.95	1.22	11.92	.013	.00	.00	BOX
			---------- WARNING - Flow depth near top of box conduit ----------											
1173.800	357.431	11.952	369.383	5451.00	23.59	8.64	378.03	12.75	12.75	20.00	12.750	20.000	.00	1 .7
76.200	.0083					.0082	.62	12.75	1.22	11.92	.013	.00	.00	BOX
			---------- WARNING - Flow depth near top of box conduit ----------											
1250.000	358.060	11.962	370.022	5451.00	23.57	8.63	378.65	12.75	12.75	20.00	12.750	20.000	.00	1 .7
BRIDGE ENTRANCE														
			---------- WARNING - Flow depth near top of box conduit ----------											

SR-710 NORTH STUDY
DORCHESTER DRAIN LINE-A EAST & LINE-B (P20)(NGVD 29)
MODEL: W.CHEN REVIEW: G.HSU

Station	Invert Elev	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head	Energy Grd.El.	Super Elev	Critical Depth	Flow Top Width	Height/ Dia.-FT	Base Wt or I.D.	ZL	No Wth Prs/Pip
L/Elem	Ch Slope					SF Ave	HF	SE Dpth	Froude N	Norm Dp	"N"	X-Fall	ZR	Type Ch
1250.000	358.060	10.862	368.922	5451.00	25.09	9.78	378.70	1.56	13.21	20.00	14.000	20.000	.00	0 .0
29.740	.0082					.0061	.18	12.43	1.34	9.77	.014	.00	.00	RECTANG
1279.740	358.304	10.941	369.245	5451.00	24.91	9.64	378.88	1.54	13.21	20.00	14.000	20.000	.00	0 .0
29.260	.0082					.0060	.18	12.48	1.33	9.79	.014	.00	.00	RECTANG
1309.000	358.543	11.026	369.569	5451.00	24.72	9.49	379.06	1.52	13.21	20.00	14.000	20.000	.00	0 .0
BRIDGE EXIT														
1309.000	358.543	12.109	370.652	5451.00	23.29	8.42	379.07	1.30	13.52	20.00	14.000	20.000	.00	1 .7
89.800	.0082					.0079	.71	13.41	1.20	11.95	.013	.00	.00	BOX
1398.800	359.279	12.180	371.459	5451.00	23.15	8.32	379.78	.16	13.52	20.00	14.000	20.000	.00	1 .7
86.200	.0082					.0078	.67	12.34	1.19	11.96	.013	.00	.00	BOX
1485.000	359.985	12.286	372.271	5451.00	22.95	8.18	380.45	.16	13.52	20.00	14.000	20.000	.00	1 .7
JUNCT STR	.0082					.0080	.16	12.44	1.17		.013	.00	.00	BOX
1505.000	360.149	11.869	372.018	5422.00	23.63	8.67	380.69	.17	13.47	20.00	14.000	20.000	.00	1 .7
249.090	.0082					.0083	2.07	12.04	1.23	11.91	.013	.00	.00	BOX
1754.090	362.189	11.813	374.002	5422.00	23.74	8.75	382.76	.80	13.47	20.00	14.000	20.000	.00	1 .7
259.310	.0082					.0085	2.19	12.61	1.24	11.90	.013	.00	.00	BOX
2013.400	364.313	11.674	375.987	5422.00	24.03	8.96	384.95	.82	13.47	20.00	14.000	20.000	.00	1 .7
23.600	.0082					.0086	.20	12.49	1.26	11.91	.013	.00	.00	BOX

SR-710 NORTH STUDY
DORCHESTER DRAIN LINE-A EAST & LINE-B (P20)(NGVD 29)
MODEL: W.CHEN REVIEW: G.HSU

Station / L/Elem	Invert Elev / Ch Slope	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head / SF Ave	Energy Grd.El. / HF	Super Elev / SE Dpth	Critical Depth / Froude N	Flow Top Width / Norm Dp	Height/ Dia.-FT / "N"	Base Wt or I.D. / X-Fall	ZL / ZR	No Wth Prs/Pip / Type Ch
2037.000	364.506	11.656	376.162	5422.00	24.06	8.99	385.15	.82	13.47	20.00	14.000	20.000	.00	1 .7
BRIDGE ENTRANCE														
2037.000	364.506	10.665	375.171	5422.00	25.42	10.03	385.20	.94	13.17	20.00	14.000	20.000	.00	0 .0
153.000	.0082					.0061	.94	11.61	1.37	9.74	.014	.00	.00	RECTANG
2190.000	365.760	11.071	376.831	5422.00	24.49	9.31	386.14	.88	13.17	20.00	14.000	20.000	.00	0 .0
JUNCT STR	.0082					.0060	.18	11.95	1.30		.014	.00	.00	RECTANG
2220.000	366.005	10.827	376.832	5392.00	24.90	9.63	386.46	.91	13.12	20.00	14.000	20.000	.00	0 .0
13.000	.0082					.0061	.08	11.73	1.33	9.68	.014	.00	.00	RECTANG
2233.000	366.112	10.863	376.975	5392.00	24.82	9.56	386.54	.90	13.12	20.00	14.000	20.000	.00	0 .0
31.530	.0082					.0060	.19	11.76	1.33	9.70	.014	.00	.00	RECTANG
2264.530	366.370	10.956	377.326	5392.00	24.61	9.40	386.73	.75	13.12	20.00	14.000	20.000	.00	0 .0
18.470	.0082					.0059	.11	11.71	1.31	9.68	.014	.00	.00	RECTANG
2283.000	366.522	11.018	377.540	5392.00	24.47	9.30	386.84	.74	13.12	20.00	14.000	20.000	.00	0 .0
BRIDGE EXIT														
2283.000	366.522	12.156	378.678	5392.00	22.95	8.18	386.85	.63	13.42	20.00	14.000	20.000	.00	1 .7
50.000	.0082					.0076	.38	12.79	1.18	11.84	.013	.00	.00	BOX
2333.000	366.932	12.239	379.171	5392.00	22.79	8.07	387.24	.62	13.42	20.00	14.000	20.000	.00	1 .7
117.000	.0082					.0073	.85	12.86	1.17	11.84	.013	.00	.00	BOX

SR-710 NORTH STUDY
DORCHESTER DRAIN LINE-A EAST & LINE-B (P20)(NGVD 29)
MODEL: W.CHEN REVIEW: G.HSU

Station	Invert Elev	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head	Energy Grd.El.	Super Elev	Critical Depth	Flow Top Width	Height/ Dia.-FT	Base Wt or I.D.	ZL	No Wth Prs/Pip
L/Elem	Ch Slope					SF Ave	HF	SE Dpth	Froude N	Norm Dp	"N"	X-Fall	ZR	Type Ch
2450.000	367.893	12.671	380.564	5392.00	22.02	7.53	388.09	.58	13.42	20.00	14.000	20.000	.00	1 .7
JUNCT STR	.0082					.0076	.25	13.25	1.11		.013	.00	.00	BOX
WARNING - Flow depth near top of box conduit														
2482.310	368.158	11.709	379.867	5339.00	23.59	8.64	388.51	.00	13.33	20.00	14.000	20.000	.00	1 .7
67.690	.0082					.0083	.56	11.71	1.24	11.74	.013	.00	.00	BOX
2550.000	368.714	11.700	380.414	5339.00	23.61	8.65	389.07	.00	13.33	20.00	14.000	20.000	.00	1 .7
BRIDGE ENTRANCE														
2550.000	368.714	10.657	379.371	5339.00	25.05	9.74	389.11	.00	13.03	20.00	14.000	20.000	.00	0 .0
75.000	.0082					.0061	.46	10.66	1.35	9.62	.014	.00	.00	RECTANG
2625.000	369.330	10.861	380.191	5339.00	24.58	9.38	389.57	.00	13.03	20.00	14.000	20.000	.00	0 .0
TRANS STR	.0128					.0060	.30	10.86	1.31		.014	.00	.00	RECTANG
2675.000	369.970	10.485	380.455	5339.00	24.63	9.42	389.88	.00	12.75	20.67	14.000	20.670	.00	0 .0
BRIDGE EXIT														
2675.000	369.970	11.384	381.354	5339.00	23.45	8.54	389.89	.00	12.00	20.67	12.000	20.670	.00	1 .7
105.000	.0066					.0083	.87	11.38	1.25	12.00	.013	.00	.00	BOX
WARNING - Flow depth near top of box conduit														

SR-710 NORTH STUDY
DORCHESTER DRAIN LINE-A EAST & LINE-B (P20)(NGVD 29)
MODEL: W.CHEN REVIEW: G.HSU

Station	Invert Elev	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head	Energy Grd.El.	Super Elev	Critical Depth	Flow Top Width	Height/ Dia.-FT	Base Wt or I.D.	ZL	No Wth Prs/Pip
L/Elem	Ch Slope					SF Ave	HF	SE Dpth	Froude N	Norm Dp	"N"	X-Fall	ZR	Type Ch
2780.000	370.661	11.068	381.729	5339.00	24.12	9.03	390.76	.00	12.00	20.67	12.000	20.670	.00	1 .7
JUNCT STR	.0066					.0089	.09	11.07	1.30		.013	.00	.00	BOX
---------- WARNING - Flow depth near top of box conduit ----------														
2790.000	370.727	10.601	381.328	5289.00	24.95	9.66	390.99	.00	12.00	20.67	12.000	20.670	.00	1 .7
27.323	.0066					.0094	.26	10.60	1.37	12.00	.013	.00	.00	BOX
2817.323	370.907	10.509	381.416	5289.00	25.16	9.83	391.25	.00	12.00	20.67	12.000	20.670	.00	1 .7
140.187	.0066					.0101	1.42	10.51	1.39	12.00	.013	.00	.00	BOX
2957.510	371.830	10.020	381.850	5289.00	26.39	10.82	392.67	.00	12.00	20.67	12.000	20.670	.00	1 .7
TRANS STR	.0220					.0104	.26	10.02	1.49		.013	.00	.00	BOX
2982.510	372.380	10.243	382.623	5289.00	25.82	10.35	392.97	.00	12.00	20.67	12.000	20.670	.00	1 .7
206.790	.0103					.0101	2.08	10.24	1.45	10.16	.013	.00	.00	BOX
3189.300	374.520	10.300	384.820	5289.00	25.68	10.24	395.06	.00	12.00	20.67	12.000	20.670	.00	1 .7
JUNCT STR	.0103					.0103	.10	10.30	1.43		.013	.00	.00	BOX
3199.300	374.623	9.965	384.588	5244.00	26.31	10.75	395.34	.00	12.00	20.67	12.000	20.670	.00	1 .7
23.820	.0104					.0107	.25	9.96	1.49	10.08	.013	.00	.00	BOX
3223.120	374.870	9.959	384.829	5244.00	26.33	10.76	395.59	.00	12.00	20.67	12.000	20.670	.00	1 .7
80.780	.0137					.0104	.84	9.96	1.49	8.99	.013	.00	.00	BOX

SR-710 NORTH STUDY
DORCHESTER DRAIN LINE-A EAST & LINE-B (P20)(NGVD 29)
MODEL: W.CHEN REVIEW: G.HSU

Station / L/Elem	Invert Elev / Ch Slope	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head / SF Ave	Energy Grd.El. / HF	Super Elev / SE Dpth	Critical Depth / Froude N	Flow Top Width / Norm Dp	Height/ Dia.-FT / "N"	Base Wt or I.D. / X-Fall	ZL / ZR	No Wth Prs/Pip / Type Ch
3303.900	375.980	10.211	386.191	5244.00	25.68	10.24	396.43	.00	12.00	20.67	12.000	20.670	.00	1 .7
TRANS STR	.0070					.0101	.05	10.21	1.44		.013	.00	.00	BOX
3308.900	376.015	10.185	386.200	5244.00	25.74	10.29	396.49	.00	12.00	20.67	12.000	20.670	.00	1 .7
TRANS STR	.0070					.0102	.21	10.19	1.45		.013	.00	.00	BOX
3329.440	376.159	10.081	386.240	5244.00	26.01	10.50	396.74	.00	12.00	20.67	12.000	20.670	.00	1 .7
TRANS STR	.0071					.0105	.16	10.08	1.47		.013	.00	.00	BOX
3345.180	376.270	10.002	386.272	5244.00	26.21	10.67	396.94	.00	12.00	20.67	12.000	20.670	.00	1 .7
JUNCT STR	.0114					.0109	.11	10.00	1.48		.013	.00	.00	BOX
3355.180	376.384	9.677	386.061	5196.00	26.85	11.19	397.25	.00	12.00	20.67	12.000	20.670	.00	1 .7
244.450	.0114					.0112	2.73	9.68	1.55	9.61	.013	.00	.00	BOX
3599.630	379.180	9.727	388.907	5196.00	26.71	11.08	399.98	1.27	12.00	20.67	12.000	20.670	.00	1 .7
26.160	.0114					.0111	.29	10.99	1.53	9.61	.013	.00	.00	BOX
3625.790	379.479	9.734	389.213	5196.00	26.69	11.06	400.27	.00	12.00	20.67	12.000	20.670	.00	1 .7
261.510	.0114					.0109	2.86	9.73	1.53	9.61	.013	.00	.00	BOX
3887.300	382.470	9.840	392.310	5196.00	26.40	10.82	403.13	.00	12.00	20.67	12.000	20.670	.00	1 .7
JUNCT STR	.0114					.0111	.11	9.84	1.51		.013	.00	.00	BOX
3897.300	382.584	9.523	392.107	5148.00	27.03	11.34	403.45	.00	12.00	20.67	12.000	20.670	.00	1 .7
192.000	.0114					.0115	2.21	9.52	1.57	9.54	.013	.00	.00	BOX

SR-710 NORTH STUDY
DORCHESTER DRAIN LINE-A EAST & LINE-B (P20)(NGVD 29)
MODEL: W.CHEN REVIEW: G.HSU

Station	Invert Elev	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head	Energy Grd.El.	Super Elev	Critical Depth	Flow Top Width	Height/ Dia.-FT	Base Wt or I.D.	ZL	No Wth Prs/Pip
L/Elem	Ch Slope					SF Ave	HF	SE Dpth	Froude N	Norm Dp	"N"	X-Fall	ZR	Type Ch
4089.300	384.780	9.515	394.295	5148.00	27.05	11.36	405.66	.00	12.00	20.67	12.000	20.670	.00	1 .7
JUNCT STR	.0114					.0120	.56	9.52	1.57		.013	.00	.00	BOX
4135.720	385.310	9.913	395.223	2813.00	28.38	12.50	407.73	.00	12.00	10.00	12.000	10.000	.00	0 .0
5.880	.0134					.0124	.07	9.91	1.59	9.60	.013	.00	.00	BOX
4141.600	385.389	9.917	395.306	2813.00	28.37	12.49	407.80	.66	12.00	10.00	12.000	10.000	.00	0 .0
69.910	.0133					.0123	.86	10.57	1.59	9.63	.013	.00	.00	BOX
4211.510	386.322	9.964	396.286	2813.00	28.23	12.38	408.66	.00	12.00	10.00	12.000	10.000	.00	0 .0
12.030	.0134					.0123	.15	9.96	1.58	9.62	.013	.00	.00	BOX
4223.540	386.483	9.973	396.456	2813.00	28.21	12.36	408.81	.00	12.00	10.00	12.000	10.000	.00	0 .0
TRANS STR	.0133					.0121	.24	9.97	1.57		.013	.00	.00	BOX
4243.540	386.750	10.440	397.190	2813.00	27.69	11.91	409.10	.00	12.00	9.73	12.000	9.730	.00	0 .0
177.000	.0134					.0115	2.03	10.44	1.51	9.93	.013	.00	.00	BOX
4420.540	389.120	10.722	399.842	2813.00	26.96	11.29	411.13	.00	12.00	9.73	12.000	9.730	.00	0 .0
TRANS STR	.0549					.0107	.21	10.72	1.45		.013	.00	.00	BOX
4440.540	390.218	10.429	400.647	2813.00	26.31	10.75	411.40	.96	13.25	10.25	13.250	10.250	.00	0 .0
TRANS STR	.0549					.0097	.12	11.39	1.44		.013	.00	.00	BOX
4453.210	390.913	10.944	401.857	2813.00	25.08	9.76	411.62	.87	13.25	10.25	13.250	10.250	.00	0 .0
TRANS STR	.0549					.0085	.09	11.81	1.34		.013	.00	.00	BOX

SR-710 NORTH STUDY
DORCHESTER DRAIN LINE-A EAST & LINE-B (P20)(NGVD 29)
MODEL: W.CHEN REVIEW: G.HSU

Station / L/Elem	Invert Elev / Ch Slope	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head / SF Ave	Energy Grd.El. / HF	Super Elev / SE Dpth	Critical Depth / Froude N	Flow Top Width / Norm Dp	Height/ Dia.-FT / "N"	Base Wt or I.D. / X-Fall	ZL / ZR	No Wth Prs/Pip / Type Ch
4463.540	391.480	11.531	403.011	2813.00	23.80	8.80	411.81	.39	13.25	10.25	13.250	10.250	.00	0 .0
34.200	.0046					.0082	.28	11.92	1.24	13.25	.013	.00	.00	BOX
4497.740	391.638	11.316	402.954	2813.00	24.25	9.13	412.09	.00	13.25	10.25	13.250	10.250	.00	0 .0
81.480	.0046					.0088	.72	11.32	1.27	13.25	.013	.00	.00	BOX
4579.220	392.015	10.840	402.855	2813.00	25.32	9.95	412.81	.00	13.25	10.25	13.250	10.250	.00	0 .0
TRANS STR	.0046					.0095	.15	10.84	1.36		.013	.00	.00	BOX
4595.380	392.089	10.682	402.771	2813.00	25.69	10.25	413.02	.00	13.25	10.25	13.250	10.250	.00	0 .0
28.260	.0046					.0098	.28	10.68	1.39	13.25	.013	.00	.00	BOX
4623.640	392.220	10.530	402.750	2813.00	26.06	10.55	413.30	.00	13.25	10.25	13.250	10.250	.00	0 .0
79.380	.0126					.0097	.77	10.53	1.42	9.58	.013	.00	.00	BOX
4703.020	393.220	10.774	403.994	2813.00	25.47	10.07	414.07	.00	13.25	10.25	13.250	10.250	.00	0 .0
TRANS STR	.0120					.0094	.09	10.77	1.37		.013	.00	.00	BOX
4713.020	393.340	10.798	404.138	2813.00	25.42	10.03	414.17	.00	13.25	10.25	13.250	10.250	.00	0 .0
26.940	.0120					.0093	.25	10.80	1.36	9.77	.013	.00	.00	BOX
4739.960	393.663	10.885	404.548	2813.00	25.21	9.87	414.42	1.30	13.25	10.25	13.250	10.250	.00	0 .0
52.066	.0120					.0090	.47	12.18	1.35	9.78	.013	.00	.00	BOX
4792.026	394.287	11.087	405.373	2813.00	24.75	9.51	414.89	1.25	13.25	10.25	13.250	10.250	.00	0 .0
88.794	.0120					.0083	.74	12.34	1.31	9.78	.013	.00	.00	BOX

SR-710 NORTH STUDY
DORCHESTER DRAIN LINE-A EAST & LINE-B (P20)(NGVD 29)
MODEL: W.CHEN REVIEW: G.HSU

Station / L/Elem	Invert Elev / Ch Slope	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head / SF Ave	Energy Grd.El. / HF	Super Elev / SE Dpth	Critical Depth / Froude N	Flow Top Width / Norm Dp	Height/ Dia.-FT / "N"	Base Wt or I.D. / X-Fall	ZL / ZR	No Wth Prs/Pip / Type Ch
4880.820	395.350	11.628	406.978	2813.00	23.60	8.65	415.63	.00	13.25	10.25	13.250	10.250	.00	0 .0
310.320	.0074					.0082	2.56	11.63	1.22	11.91	.013	.00	.00	BOX
5191.141	397.650	11.184	408.833	2813.00	24.54	9.35	418.18	.80	13.25	10.25	13.250	10.250	.00	0 .0
47.437	.0109					.0085	.40	11.99	1.29	10.16	.013	.00	.00	BOX
5238.577	398.167	11.367	409.534	2813.00	24.14	9.05	418.59	.78	13.25	10.25	13.250	10.250	.00	0 .0
87.583	.0109					.0078	.69	12.14	1.26	10.16	.013	.00	.00	BOX
5326.160	399.122	11.922	411.044	2813.00	23.02	8.23	419.27	.71	13.25	10.25	13.250	10.250	.00	0 .0
42.513	.0109					.0070	.30	12.63	1.17	10.16	.013	.00	.00	BOX
5368.673	399.586	12.504	412.089	2813.00	21.95	7.48	419.57	.64	13.25	10.25	13.250	10.250	.00	0 .0
14.967	.0109					.0062	.09	13.15	1.09	10.16	.013	.00	.00	BOX
---------- WARNING - Flow depth near top of box conduit ----------														
5383.640	399.749	13.114	412.863	2813.00	20.93	6.80	419.66	13.25	13.25	10.25	13.250	10.250	.00	0 .0
TRANS STR	.0109					.0061	.05	13.25	1.02		.013	.00	.00	BOX
---------- WARNING - Flow depth near top of box conduit ----------														
5392.380	399.844	12.816	412.660	2813.00	21.41	7.12	419.78	.00	13.25	10.25	13.250	10.250	.00	0 .0
TRANS STR	.0109					.0060	.09	12.82	1.05		.013	.00	.00	BOX
---------- WARNING - Flow depth near top of box conduit ----------														

W S P G W - CIVILDESIGN Version 14.06

Program Package Serial Number: 1806

WATER SURFACE PROFILE LISTING

Date: 8-23-2013 Time:10:45: 9

SR-710 NORTH STUDY
DORCHESTER DRAIN LINE-A EAST & LINE-B (P20)(NGVD 29)
MODEL: W.CHEN REVIEW: G.HSU

Station	Invert Elev	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head	Energy Grd.El.	Super Elev	Critical Depth	Flow Top Width	Height/ Dia.-FT	Base Wt or I.D.	ZL	No Wth Prs/Pip
L/Elem	Ch Slope					SF Ave	HF	SE Dpth	Froude N	Norm Dp	"N"	X-Fall	ZR	Type Ch
5406.640	400.000	13.250	413.250	2813.00	20.71	6.66	419.91	.00	13.25	10.25	13.250	10.250	.00	0 .0