HISTORIC ARKANSAS RIVERWALK PROJECT

PHASE I

DESIGN CALCULATIONS BY
SELLARDS AND GRIGG, INC.

1-KK-2

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JOB HARP
SHEET NO. 11 OF
CALCULATED BY CAM DATE 12-30-95
CHECKED BY DATE
SCALE

Analyze I-25 and Santa Fe Culverts D/s of HARP Channel

I-25 Culvert 2' 8'x8' RCBC
Inv. El. 52.74

Analyze Inlet Control
Assume Flare Angle of 30° to 75°

HWEL	HW/D	Q/B	Q
54.0	0.16	Off Chart	~
55.0	0.28	11.5	184
56.0	0.41	18.5	296
57.0	0.53	27.0	432
58.0	0.66	37.0	592
59.0	0.78	48.0	768
60.0	0.91	58.0	928
59.62	0.86	54.38	870
58.5	0.72	41.0	656

Determine HWEL for Design Flow of 870 cfs

$$\frac{Q}{B} = 54.38 \text{ cfs/ft}$$

$$HW/D = .86$$

$$HWEL = (.86)(8) + 52.74 = 59.62 \checkmark$$

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Analyze Outlet Control Condition for Santa Fe Culvert

TWEL = HWEL from I-25

TWEL	Q	H	HWEL
58	592	$2.91 \times 1.32^{2} = 3.84$	61.86
59	768	$2.91 \times 2.23^{2} = 6.48$	65.46

Weir Flow Begins @ 63.75 w/ Proposed Modification by WWE

$$H = \left\{ 1 + ke + \frac{29n^2L}{R^{4/3}} \right\} \frac{V^2}{2g}$$

$n = .013$ $ke = 0.2$
$L = 510'$

$$R = \frac{A}{WP} = \frac{64}{48} = 1.33$$

TWEL	Q	H	HWEL
58.5	656	$2.91 \times 1.63 = 4.74$	63.24

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Analyze Inlet Control Condition for Santa Fe Culvert

Invert = 54.9
D = 4'

2- 4'x8' RCBC's at Santa Fe

Assume Flare Angle of 30° to 75°

HWEL	HW/D	Q/B	Q
57.0	0.53	9.2	147
59.0	1.03	24	384
61.0	1.52	37	592
62.0	1.78	42	672
63.0	2.02	48	768
64.0	2.28	52	832
65.0	2.53	56	896
66.0	2.78	60	960

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JOB HARP
SHEET NO. 14 OF
CALCULATED BY CAM DATE 1-1-96
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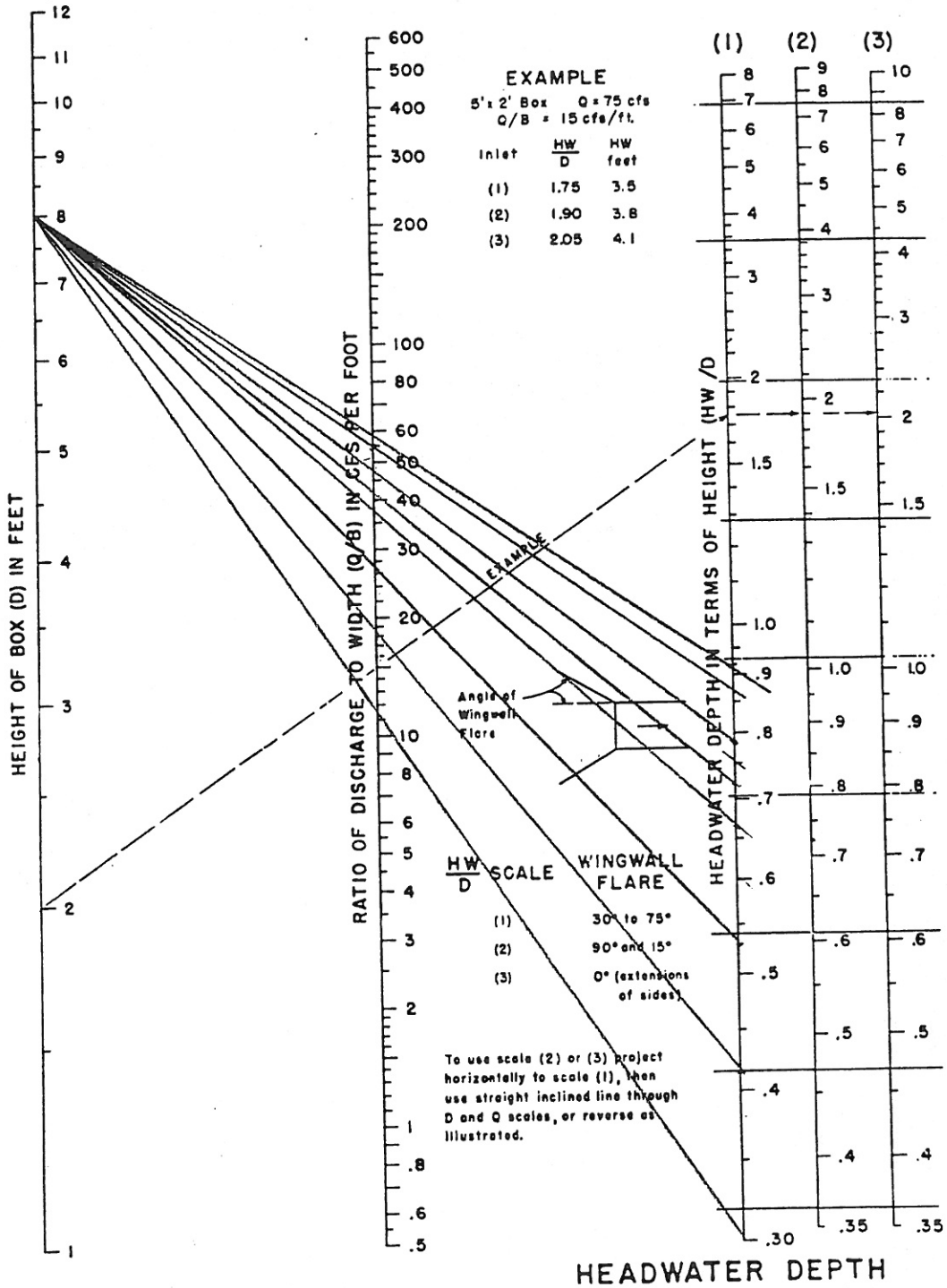
Calculate Weir Flow for Proposed Overflow Weir @ Santa Fe

Weir Crest 63.75
Length 65' C= 2.7

ws Elev	H	Q
64.0	0.25	22
64.2	0.45	53
64.4	0.65	92
64.5	0.75	114
64.6	0.85	138
65.0	1.25	246

CHART 8

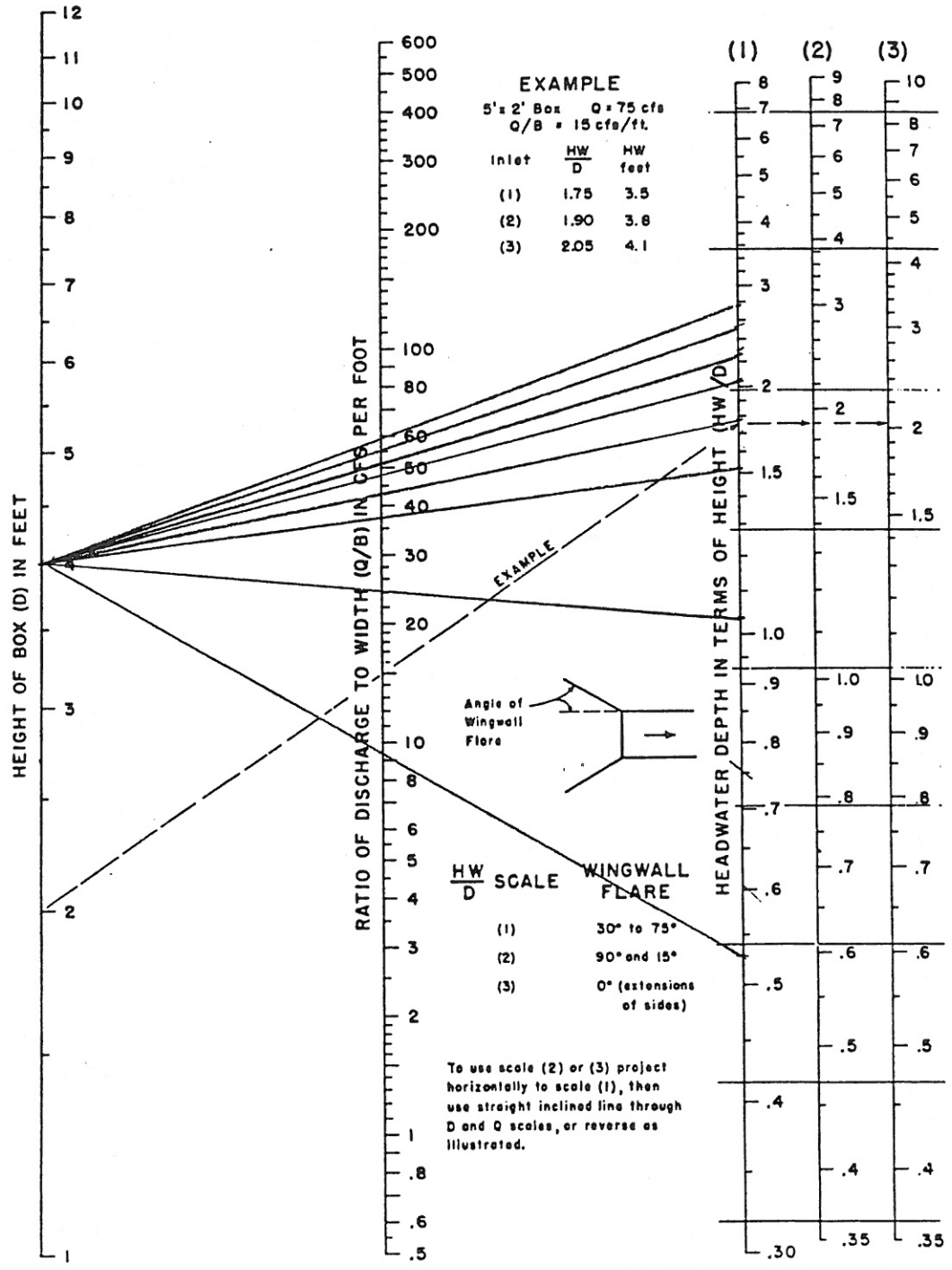


HEADWATER DEPTH FOR BOX CULVERTS WITH INLET CONTROL

BUREAU OF PUBLIC ROADS JAN. 1963

I-25 Culvert Inlet Control Analysis

CHART 8



HEADWATER DEPTH FOR BOX CULVERTS WITH INLET CONTROL

BUREAU OF PUBLIC ROADS JAN. 1963

Santa Fe Culvert
Inlet Control
Analysis

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JOB HARP
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CALCULATED BY CAM DATE 1-1-96
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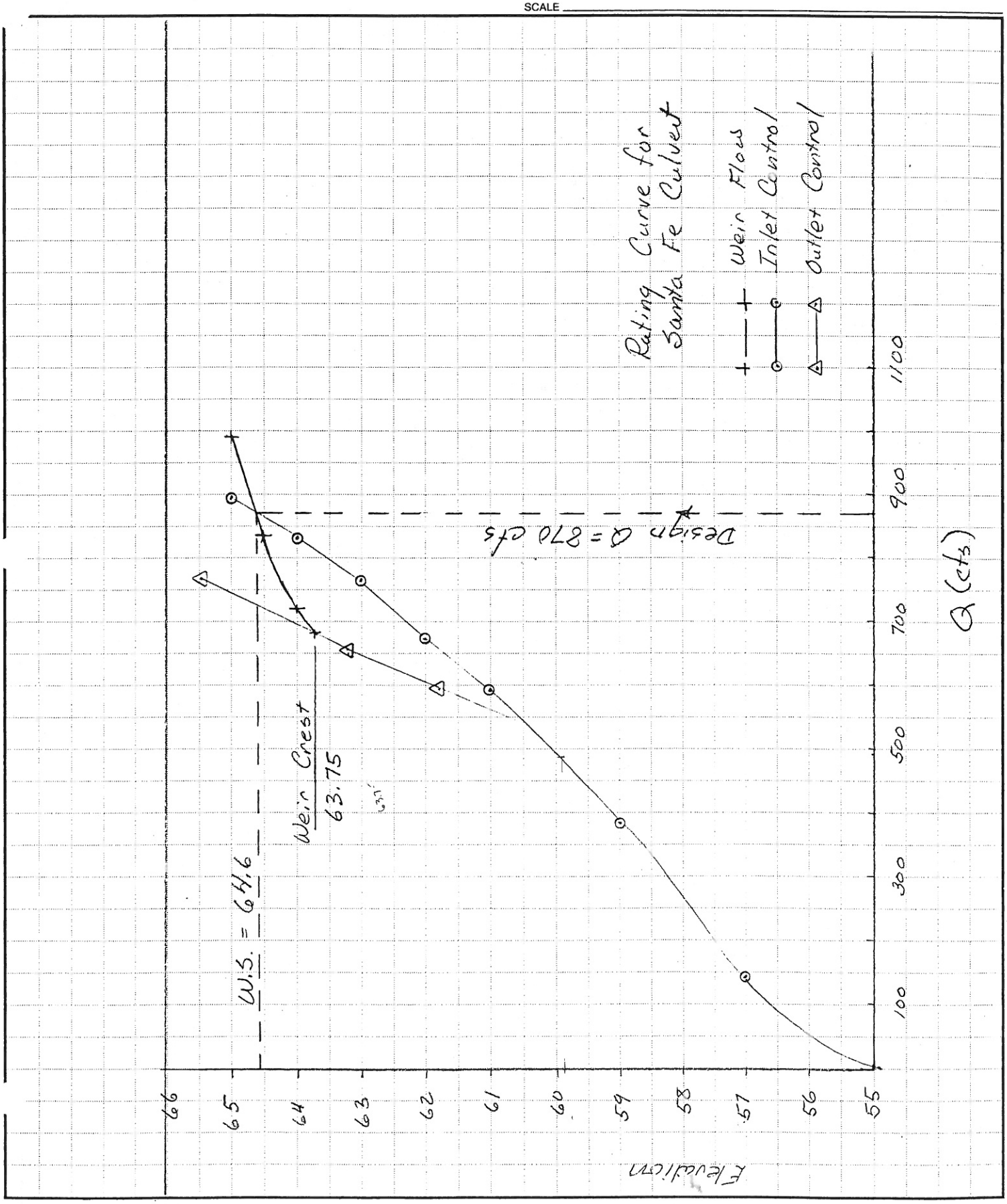

E10

TECHNICAL MEMORANDUM

DRAFT
REVIEW & COMMENT

TO: Mark Austin
Design Studios West, Inc.

FROM: John L. Blanchard and Mark R. Bonner
Wright Water Engineers, Inc.

DATE: July 25, 1995

RE: Historical Arkansas River Project (HARP)
Capacity of Existing 8'x10' RCBC in Greenwood Street

At your request, Wright Water Engineers, Inc. (WWE) has revisited our computations for the capacity of the existing 8-foot by 10-foot reinforced concrete box culvert (RCBC) feeding the HARP channel. As you know, our January 1994 report entitled "Preliminary Hydraulic Design Analysis" found the capacity under pre- and post-project conditions to be 550 and 630 cubic feet per second (cfs), respectively. These values differ from the design reports prepared by Sellards and Griggs, Inc. (S&G) for construction of the facilities in the early 1980's. We are providing the following brief technical memorandum to discuss our assumptions, methodologies, and findings in more detail.

As stated in our report, the primary reason for the reduced capacity is that WWE considered the effects of downstream controls including the twin 4-foot by 8-foot RCBC's at Santa Fe Street. To determine these effects, WWE completed a detailed analysis of the capacity of this control section using the special culvert option in HEC-2. The capacity of the twin 4-foot by 8-foot RCBC's before overtopping the roadway was calculated to be approximately 750 cfs. To pass the WWE pre-project design flow of 1,060 cfs, approximately 310 cfs overtops the roadway at elevation 4,664.8 feet with a depth of approximately 0.9 feet. These flows are supported by the attached calculations. Using HEC-2, a standard backwater analysis was performed upstream to the outfall of the twin 96-inch reinforced concrete pipes (RCP's). The results of this analysis yielded a tailwater elevation of approximately 4,665.3 feet. By comparison, the S&G analysis assumed a tailwater depth at the outfall of the twin 96-inch RCP's of 4,664.0 feet, 1.3 feet lower than the WWE analysis.

Moving upstream, a critical manhole location with minimal cover over the 8-foot by 10-foot RCBC was identified by WWE at the intersection of Greenwood and 5th Streets. This location is critical because the ground surface elevation of 4,671.1 feet at this location represents the maximum Energy Grade Line (E.G.L.) the culvert can maintain.

In other words, the culvert cannot be pressurized with a head greater than the elevation of the manhole lid at this location. Between these two locations, approximately 5.8 feet of head exists (71.1 feet - 65.3 feet = 5.8 feet) to drive flow through the storm sewers.

The attached calculations show that after accounting for minor losses in the pipes and additional inflows to the system downstream of the outfall of the 8-foot by 10-foot RCBC, the capacity of this culvert is approximately 550 cfs. A hydraulic profile of the existing storm sewer system is shown in Figure 1.

Post-project conditions were analyzed in a similar manner. For post-project conditions, the southerly 96-inch RCP has been replaced with a wide open channel which can pass larger flows with lower velocities and therefore less headloss. This reserves more head for the 8-foot by 10-foot RCBC which therefore increases its capacity to approximately 630 cfs. However, for the same reason, the capacity of the remaining 96-inch RCP is reduced to approximately 250 cfs. A hydraulic profile of the future storm sewer system is shown in Figure 2.

It should be noted that while the capacity of the 8-foot by 10-foot RCBC is important, the overall system hydraulics form the basis for design of HARP channel improvements. In fact, the system will balance inflows such that the maximum capacity is about 1100 cfs at Santa Fe Street. If the full flows computed for the connecting storm sewer laterals or the full 200 cfs discharge from the West Plains Energy Plant are not contributed, the capacity of the 8-foot by 10-foot RCBC will increase modestly. It is the overall system discharges, however, that are essential for sizing the HARP channel and related features.

DRAFT
REVIEW & COMMENT

Encl.
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