GR WILLIAMS ENGINEERING, INC.
STUDIES - DESIGNS - CONSTRUCTION SERVICES - REVIEWS

Water, Sewer, and Drainage Systems
Roads and Municipal Engineering
Stormwater and Floodplain Management
Development Submittal Review

Memorandum

From: Gerald Williams, WEI
To: Holders of the Final Drainage Report for the Cotton Woods Subdivision

Re: Minor Revisions Subsequent to the January 2002 Final Drainage Report Submittal

Date: April 15, 2002

Subsequent to the January 2002 Final Drainage Report submittal, grading revisions were made that affected the volume of detention available. The upper basin has increased from 1.79-acre feet to 1.9 acre feet, and the lower basin has increased from 2.3 acre feet to 4.16 acre feet. Although we were not able to maximize the benefit from these increased volumes because of the limitations of incremental pipe sizes available for use in outflow structures, the increased volume does two things:

- The overall outfall from the site, including runoff from the site and upstream from the side, has been reduced resulting in a greater benefit of over-detention than was previously possible; and
- There is increased freeboard in the detention basins before overtopping of the dams will occur.

Because we were not able to capitalize on the increased volumes with reduced size outlet structures, there is no change in proposed facilities from the January, 2002 submitted report, and the only change to hydraulic calculations are the changed basin geometry and stage/volume parameters used in the proposed condition HEC I data file that was presented in Appendix G. Consequently, we have provided a revised Appendix G with this memorandum. Furthermore, because there is a change in outflow peaks, we have provided a revised Section VI "Final Conclusions & Recommendations" and revised Exhibits A & C that show the new peak flow rates. All other portions of the January, 2002 submitted Final Drainage Report are current and valid.

If you have any questions regarding the above, please feel free to call.

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VI FINAL CONCLUSIONS & RECOMMENDATIONS

The final lot layout, grading, and irrigation pond scheme all took its toll on anticipated available detention volume. Instead of 11 or 12 acre feet, we ended up with a 1.90 acre foot upper basin and 4.16 acre foot lower basin. This change has significantly lowered but not entirely removed the over-detention proposed earlier.

Exhibits A and C have been updated to reflect final conditions for complete development of Cotton Woods Subdivision. Each summarizes information that is provided in the appendices.

Conclusions are summarized below.

Street Capacities At the flattest gutter grade allowed, or 0.5%, half street allowed 2 year storm flow is 8 cfs. The greatest 100 year storm flow in a half street proposed for Cotton Woods is 7 cfs. Thus, street flow is in conformance. Reference is made to page HI in the Appendix.

Inlet Capacities All proposed inlets (for all phases of development of Cotton Woods) are in a sump. Single inlet allowed capacity is 13 cfs for 100 year conditions. The greatest proposed inlet interception is 7 cfs; thus, inlets are in conformance. Reference is made to page H2 in the Appendix.

Storm Drain Capacity Because the low points are sumps without a direct outfall, proposed storm drains are proposed for the 100 year runoff event. Although pipe flows are allowed to surcharge, the 100 year flow does not quite fill the 24" east storm drain pipe. The flow velocity is the 2 year storm is above the required 3 fps at 5.1 fps. The west storm drain pipe will be in a future phase, but it should be an 18" pipe with at least 0.28% slope, which will prevent surcharging. This would give a 2 year flow velocity of 3.4 fps. Thus, the storm drain is in conformance. Reference is made to pages JI through J4 in the Appendix.

Base Flow Pipe The GJDD irrigation tailwater and groundwater flow is estimated to be 5 cfs or less most of the time. The proposed 15" pipe has 5 cfs capacity with a flow velocity of 4.11 fps which exceeds the required minimum scour velocity of 3.0 fps. If in time the base flow proves to exceed the pipe capacity more often than desired, then the solution is a simple one -- just provide minor henning downstream of the large inlet to the base flow drain, which will increase hydraulic head on and capacity of the pipe and still not cause any significant impact on floodwaters flowing into the open detention basin. Reference is made to page JS in the Appendix.

Culverts The detention basin culverts have the capacity to discharge the 100 year runoff event without overtopping the detention basin dams. Reference is made to Appendices "K" and "L".

Detention Basin Dams Up to a 100 year event, the dams should not be overtopped. However, if there issignificant blockage, overtopping can occur. We looked at overtopping depths and velocities under the condition that the culverts were completely blocked and conveyed no flow. Under these conditions, overtopping of the upper dam would be 63 cfs at 0.82 foot at a non-erodible (less than 3 fps) velocity of 1.70 fps. Overtopping of the lower dam would be 79 cfs at 0.93 feet at a non-erodible velocity of 1.84 fps. However, these non-erodible velocities would be across the dam crest.

Velocities down the downstream face of the dam would be higher and could result in minor erosion, notwithstanding the sheet flow nature of the overflow. Consequently, proposed is a geo-web or honey comb type surface treatment that will protect the dam top and downstream embankment from erosion and breach.

Flow depths under these overtopping conditions would not result in ponding on lots.

Reference is made to Appendix M.

Reduced Runoff I00 year runoff from the site under existing conditions is estimated at 26 cfs to the south and 2 cfs to the north, or a total of 28 cfs. This must be reduced by 48% or 13 cfs to meet the necessary reduction required by the outfall facilities at the highway, railroad, and 1-70. Our proposed condition reduces runoff to the south from 28 cfs to 1 cfs, a drop of 27 cfs, and at the northwest comer of the site in the Compton drain, flows were reduced overall from 115 cfs to 74 cfs, a reduction of 41 cfs. The combined decrease in runoff is 68 cfs, or 55 cfs more than required. Thus, the proposed drainage scheme more than meets requirements. Reference is made to Appendices "F" and "G".

Over-Detention The proposed Cotton Woods subdivision would provide 55 cfs more detention than required. The total required drop in runuff at the highway is 0.48 X 255 = 122 cfs. (The additional drop to the 110 cfs culvert capacity under the railroad comes from the detention capacity of the open drains between the railroad and the highway, which should be preserved.) The Cotton Woods must provide 13 cfs of the 122 cfs drop, and 109 cfs must come from others. This means that the over-detention represents 55 cfs/109 cfs or 50.5% of all excess detention required in the balance of the Murray Drain system. This is a significant amount.

Recapture The Cotton Woods as proposed would meet drainage requirements plus over-detain. As mentioned in the Preliminary Report, the developer requests credit or recapture opportunities or a mixture of both.

EXHIBIT "10A"

GJDD MURRAY DRAIN

100 Year Storm Condition
Actual & Allowed* Flows

*ALLOWED FLOWS ARE LESS THAN HISTORIC FOR THE 100 YEAR EVENT. SEE GENERAL RECOMMENDATION NO. 1.

*PROPOSED CONDITION IS W/ COTTON WOODS SUBDIVISION

L ROAD

K ROAD

N. COMPTON

J ROAD

I ROAD

20 ROAD

19 ROAD

M1 M2 M3 M4 M5 M6 M7 M8

NC1 NC2 NC5

C1 C2 C3 C4 C5 C6

S1 S2

K1 K2

P1 P2 P3 P4 P5 P6

A B C

KETTLES

PALMER

RANCHMAN'S DITCH

ADOBE CREEK

MURRAY DRAIN

HWY 6&50

I-70

COLORADO

THIS JUNE 2001 UPDATED HYDROLOGY WAS PREPARED AS PART OF THE COTTON WOODS SUBDIVISION DRAINAGE REPORT. TECHNICAL SUPPORT MATERIAL MAY BE FOUND THERE.

LEGEND

FACILITY	EXISTING	PROPOSED	REMOVE & REPLACE
CONTOURS	(ROP 1975)		
GJDD DRAIN CHANNEL			
GJDD DRAIN PIPE			
IRRIGATION CANAL/ DITCH			
IRRIGATION PIPE			
STORM DETENTION FACILITY			
STORM DRAIN CHANNEL			
STORM DRAIN PIPE			
STORM PEAK TOP OF HEADGATE VALVE AT CONFLUENCE POINT (INCLUDING GJDD DRAIN FLOWS)	POINT B (* ACTUAL ALLOWED) (PEAK ACTUAL ALLOWED)		
STREAM, CREEK, RIVER, OR WASH			
WATERSHED SUBDIVISION BOUNDARY			
WATERSHED SUBDIVISION IDENTIFIER	1A	1A	

HYDROLOGICAL DATA

I.D.	AREA (AC / SQ.MI)	EXISTING CONDITION FLOWS (CFS) ACTUAL	EXISTING CONDITION FLOWS (CFS) ALLOWED*	PROPOSED CONDITION FLOWS (CFS) Pre-Detention & Post-Detention
D	+ 1734.0	44	27	SAME AS EXISTING UNLESS NOTED OTHERWISE
C1	45.9	13	7	
C2	17.4	10	8	
C4	17.3	20	10	
C5	58.7	20	10	
C6	34.7	15	8	
NC1	38.3	1	1	
NC2	110.8	31	16	
P1	18/28.0	2	1	17 -30
P2	346/.54	26	14	6
K1	85.3	26	13	
K2	34.4	20	10	
M	+ 64.2	7	4	
P3	+ 23.6	8	4	
P3	1376.4	26	13	
P4	67.8	19	10	
P5	118.5	23	11	
P6	+ 48.1	19	10	
M7	69.3	15	8	
M2	+ 10.1	6	3	
M3	+ 17.1	8	4	
M4	49.6	17	9	
M5	44.8	13	8	
M6	+ 74.0	+ 5.0	4	
M7	69.3	15	8	
M8	58.8	8	4	

GENERAL RECOMMENDATIONS

1. THE GJDD DRAIN CULVERTS AND OUTFALL ACROSS THE HIGHWAY AND RAILROAD ARE NOT ADEQUATE TO CONVEY RUNOFF FROM HISTORIC DESIGN STORM EVENTS. DEVELOPMENT IN THE MURRAY DRAIN WATERSHED SHOULD NOT CAUSE ANY INCREASE IN RUNOFF IN THE 2 YR STORM EVENT, AND NO MORE THAN 50% OF THE HISTORIC PEAK SHOULD BE RELEASED FROM DEVELOPED SITES IN THE 100 YR STORM EVENT UNLESS THERE IS A RECAPTURE OF OVER-RELEASED FLOWS FROM ELSEWHERE.

2. DRAINAGE IMPACT FEES SHOULD BE USED TO FUND CONSTRUCTION OF A REGIONAL PARK/DETENTION FACILITY ON THE PALMER DRAIN SYSTEM. A FACILITY IN CONJUNCTION WITH THE SPORTS PARK OR SEPARATELY WOULD BE ACCEPTABLE. ALSO, DEPENDING UPON THE SEQUENCE OF DEVELOPMENT, DETENTION ON THE KETTLE DRAIN EAST OF RANCHMANS DITCH IS RECOMMENDED. SOME CULVERT UPGRADES AND THE 19 ROAD 36" DRAIN ARE ALSO REQUIRED.

3. ADOBE CREEK IS A LONG NARROW WATERSHED, AND THE LOCALIZED RUNOFF COULD BE PASSED THROUGH IN ADVANCE OF THE FULL BASIN CONTRIBUTING. THEREFORE IT WOULD BE ADVISABLE TO DIRECT AS MUCH FLOW FROM THE MURRAY DRAIN AS POSSIBLE TO ADOBE CREEK.

4. MORE SPECIFIC RECOMMENDATIONS CANNOT BE GIVEN WITHOUT A MORE DETAILED ANALYSIS FOR THIS AREA.

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GRAPHIC SCALE (METRIC) 0 200 400

JOB NO. FR-SWMP

FILE: MURRAY

DATE: 04/12/02

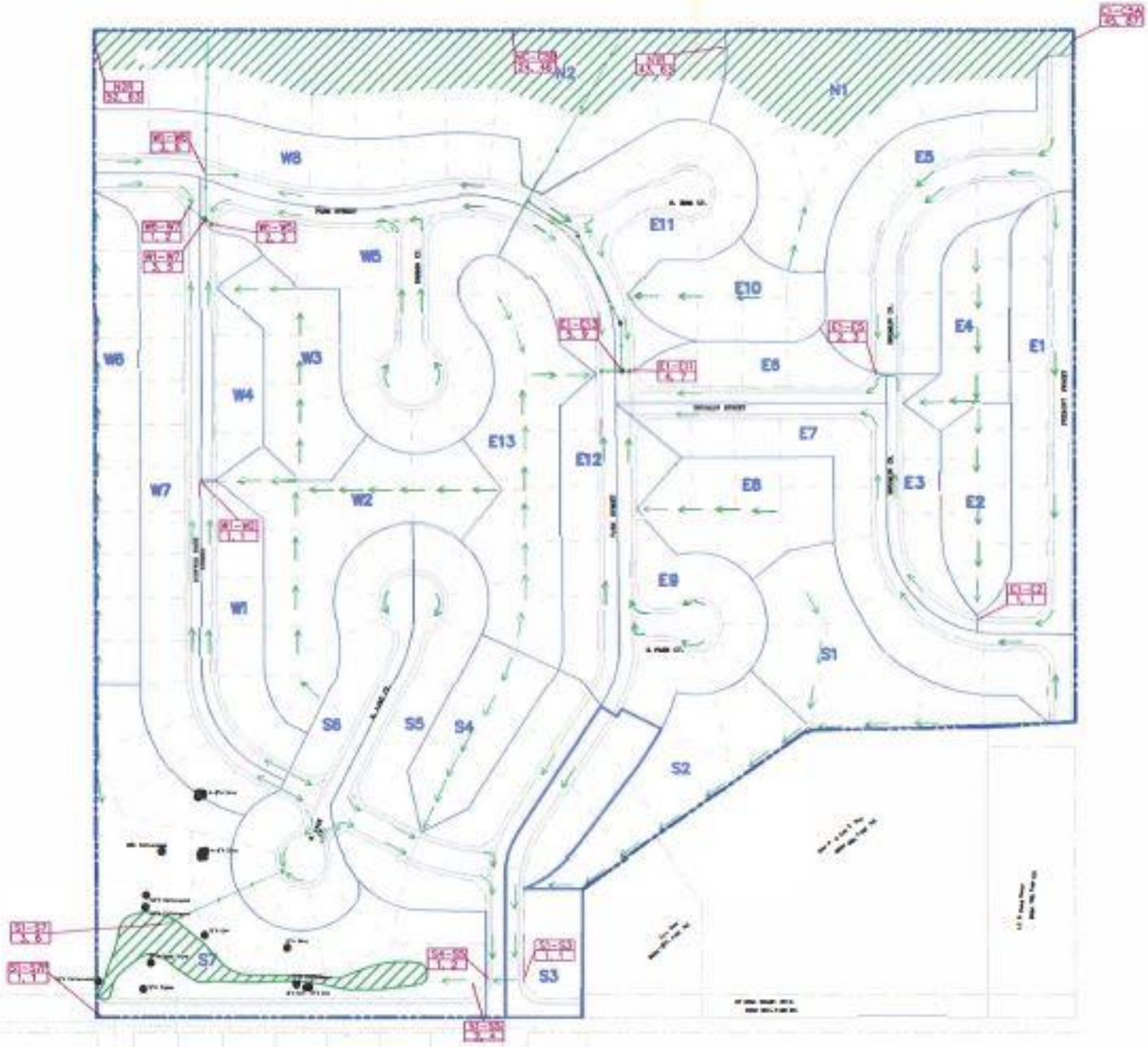

EXHIBIT C

Onsite Drainage: Proposed Condition

LEGEND

FACILITY	EXISTING	PROPOSED	REMOVE & REPLACE
CONTOURS	(EXIST. 10.0ft)		
STORM DETENTION FACILITY			
STORM DRAIN PIPE			
STORM OVERLAND FLOW			
STORM PEAK RUNOFF VALUES AT CONCENTRATION POINTS. EXCLUSIVE OF OFF-SITE FLOWS (CFS)		POINT ID 2 YR, 100 YR	
STORM DRAIN INLET			
WATERSHED SUBBASIN BOUNDARY			
WATERSHED SUBBASIN IDENTIFIER	2		

HYDROLOGICAL DATA

SUBBASIN	ACRES	Q2 (CFS)	Q100 (CFS)	ONSITE SUBBASIN
E1	1.2	1	1	E3
E2	0.5	0	0	E3
E3	0.5	0	0	E8
E4	0.8	0	0	E8
E5	1.8	1	2	E8
E6	0.8	0	1	PIPE E
E7	1.4	1	1	PIPE E
E8	0.7	0	0	E9
E9	1.1	1	1	PIPE E
E10	0.8	0	0	E11
E11	1.1	1	1	PIPE E
E12	1.1	1	1	PIPE E
E13	1.3	0	0	PIPE E
W1	1.8	0	1	W2
W2	2.7	1	1	C2
W3	1.0	0	0	W2
W4	0.8	0	0	W3
W5	1.8	0	1	W4
W6	1.2	1	1	W7
W7	2.6	0	1	W2
W8	0.7	0	1	W4
S1	1.9	0	1	W4
S2	0.7	0	0	W4
S3	0.8	0	1	PIPE W
S4	1.3	1	2	PIPE W
S5	0.8	0	0	W7
S6	1.2	1	2	PIPE W
S7	0.8	1	1	PIPE W

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