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Colorado Springs
Denver

Engineering
Planning
Surveying

MASTER DEVELOPMENT DRAINAGE PLAN

FOR

OAK VALLEY

December, 1992

Job No. 8503

Prepared For:

RIDGE DEVELOPMENT CO., LTD.
4785 Granby Circle
Colorado Springs, CO 80919
(719) 594-0227

Prepared By:

JR ENGINEERING, LTD.
6455 North Union Boulevard, Suite 202
Colorado Springs, CO 80918
(719) 593-2593

MASTER DEVELOPMENT DRAINAGE PLAN
OAK VALLEY

DRAINAGE REPORT STATEMENT

ENGINEER'S STATEMENT:

The attached drainage plan and report were prepared under my direction and supervision and are correct to the best of my knowledge and belief. Said drainage report has been prepared according to the criteria established by the City for drainage reports and said report is in conformity with the master plan of the drainage basin. I accept responsibility for any liability caused by any negligent acts, errors, or omissions on my part in preparing this report.

COLORADO REGISTERED JOSEPH W DESJARDIN 24207 PROFESSIONAL ENGINEER

Joseph W. DesJardin, Colorado P.E. #24207
For and On Behalf of JR Engineering Ltd.

12.4.92
Date

DEVELOPER'S STATEMENT:

I, the developer, have read and will comply with all of the requirements specified in this drainage report and plan as it relates to property owned by Ridge Development, Co., Ltd.

Business Name: Ridge Development Co., Ltd.

By: Thomas E. Hausman
Thomas E. Hausman

Title: Manager

Address: P. O. Box 7711

Colorado Springs, CO 80933

CITY OF COLORADO SPRINGS ONLY:

Filed in accordance with Section 15-3-906 of the Code of the City of Colorado Springs, 1980, as amended.

City Engineer

12/8/92
Date

Conditions:

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APPENDIX

MASTER DEVELOPMENT DRAINAGE PLAN

OAK VALLEY

DECEMBER, 1992

PURPOSE:

This report is the Master Development Drainage Plan (MDDP) for the Oak Valley area. The Master Development Drainage Plan, as required by the City/County Drainage Criteria Manual, identifies major drainageways, ponding (detention areas), locations of culverts, bridges, open channels and tributary drainage areas.

As a result of existing drainage facility deficiencies, this report is necessary to specify additional drainage improvements required to cause the system to function per the current Drainage Criteria Manual.

GENERAL DESCRIPTION:

Ridge Development, the owner of Mountain Shadows, owns property south of Allegheny Drive, west of Centennial Boulevard and east of the existing Douglas Creek Concrete Channel. The future widening of Centennial Boulevard between the box culvert crossing and Allegheny Drive, along with associated storm sewer construction, caused a need to re-evaluate tributary storm water runoff quantities.

The current Drainage Basin Planning Study is the "Douglas Creek Drainage Basin" prepared by Leigh Whitehead & Associates, dated 1981. The current MDDP in the "Oak Valley Ranch Filing No. 1 and Master Drainage Report" prepared by United Planning & Engineering, Inc., revision dated February, 1981. Numerous drainage reports exist for each filing within the overall Oak Valley Development (refer to Exhibit "A" in the Appendix). All previous drainage reports were prepared prior to the adoption of the 1987 Drainage Criteria Manual.

This MDDP has analyzed the fully developed and existing conditions for the Oak Valley area using current criteria and provides recommendations for upstream drainage improvements required to be in conformance with the Douglas Creek Drainage Basin Planning Study.

EXISTING DRAINAGE CHARACTERISTICS:

Oak Valley (north of Allegheny Drive) consists of approximately 940 acres in northwest Colorado Springs. The basin includes steep front range hillside and extends to relatively mild slope creek bottom. The Peregrine Development and Dry Creek lie to the north. The average soil condition reflects Hydrologic Group "B" as determined by the "Soil Survey of El Paso County Area" prepared by SCS.

Existing drainage conditions without diversion, as shown on the enclosed Drainage Plan, have been calculated and tabulated (refer to Exhibit "B" in the Appendix). The heavy basin line originating at the intersection of Centennial Boulevard and Allegheny Drive, then traversing in a northwest direction, is the approximate limit between runoff that is tributary to the 42" RCP at the intersection versus runoff that is tributary to the concrete channel. Existing conditions (surface flows) at major design points are as follows:

Design Point	Location	10-Year Runoff (cfs)	100-Year Runoff (cfs)
A	North Allegheny/Centennial	52	136
B	Centennial Low Point	68	171
C	Silent Rain Low Point	111	251
D	Centennial North of Allegheny	28	188
F	South Allegheny/Centennial	43	239
E	Main Channel W. of Allegheny	421	883
G	Main Channel S. of Allegheny	491	977

In several places, the existing storm sewer system was not designed to intercept present runoff quantities. As a result, portions of existing development may be subject to occasional ponding and/or flooding, especially between Design Point "B" through Design Point "D".

PROPOSED DRAINAGE CHARACTERISTICS:

The fully developed drainage conditions without diversion have been modeled as shown on Exhibit "C" in the Appendix. Fully developed conditions merely magnify the existing deficiencies. At Design Point "B", the 100-year runoff will increase by 60 cfs, and Design Point "F" by 80 cfs, thereby further increasing the risk of flooding.

To be in conformance with the approved Drainage Basin Planning Study, upstream drainage facilities must be constructed. The Douglas Creek Drainage Basin Planning Study identified a diversion channel to limit the runoff tributary to Design Point "D" (see Exhibit "D"). The areas requiring diversion are as follows:

1. Centennial Boulevard near Basin 14: Q_{10}=83cfs, Q_{100}=195cfs. A 165 foot catch basin, or equivalent structure, is required to pickup 100% of this runoff on a continuous grade. A 60 inch RCP outfall storm sewer with 7.5 feet of headwater and minimum slope of 0.56% will be adequate.

2. Silent Rain Drive near Basin 15: Q_{10}=15cfs, Q_{100}=28cfs. A pair of 5 foot onsite sump catch basins, or equivalent structure, is required to pickup 100% of this runoff along a future residential street or other onsite location. If the future street with the pair of 5 foot sump inlets is not constructed, the surface runoff will enter the north flowline of Silent Rain Drive where a 93 foot catch basin at continuous grade would be required. A 60 inch RCP

outfall storm sewer at minimum slope of 0.69% will be adequate.

3. Silent Rain Drive near Basin 10: Q_{10}=115cfs, Q_{100}=256cfs. The existing concrete trickle channel with steep grass side slopes would need to be rebuilt. A 60 inch RCP at a minimum slope of 0.97% will be adequate. If the pipe alternative is selected, the existing 30 foot curb opening chase section must be replaced with a continuous grade 30 foot catch basin. For cost estimating purposes, the 60 inch RCP is shown outfalling to the main channel. Pipe realignment, channel realignment, or construction phasing will be required to accommodate crossing the existing natural drainageway.

4. White Buffalo Drive near Basin 19: Q_{10}=21cfs, Q_{100}=40cfs. An additional 8 feet of sumped catch basin adjacent to the existing Catch Basin #33, or equivalent structure, is required to pickup 100% of this runoff. If a continuous grade catch basin is desired to the north, along White Buffalo Drive, a length of 72 feet will be required.

5. Allegheny Drive near Basin 20: Q_{10}=31cfs, Q_{100}=56cfs. A 141 foot catch basin, or equivalent structure, will be required to pickup 100% of this runoff on a continuous grade of 4.5%. Since physical constraints (guardrail, fence, walk, etc.) will not permit construction of this facility, add 18 feet of sumped inlet (D-11) adjacent to existing Catch Basin #33 mentioned above. Total length of new inlet due to increased capacity of both sides to be 30 feet D-11 catch basin.

6. Allegheny Drive near Basin 21: Q_{10}=20cfs, Q_{100}=42cfs. A 120 foot catch basin, or equivalent structure, will be required to pickup 100% of this runoff on a continuous

grade of 4.5%.

With these upstream diversions, the potential for flooding between Design Point "B" and Design Point "D" will be greatly reduced. At Design Point "F", the existing 42 inch RCP will be near capacity of 180cfs and the corresponding surface flow in both west and east Centennial Boulevard flowlines will be within Drainage Criteria Manual tolerances for major arterial roadways.

Construction of the previously designed 42 inch RCP along Centennial Boulevard from Allegheny Drive to Flying W Ranch Road will safely channel storm water runoff to the existing 42 inch RCP outfall of similar capacity.

HYDROLOGIC & HYDRAULIC MODEL:

The Rational Method was used to estimate the anticipated peak runoff quantities for each sub-basin. Most sub-basins were delineated in order to evaluate individual catch basins or culvert crossings. There has been no attempt made to calibrate rational flows with SCS Method quantities at cumulative design points even though tributary areas may be greater than 100 acres. Routing of flowby from partial basin interception in combination with downstream basins was performed by the "Equivalent CA" Method. Storm sewer and channel flows were also attenuated to reflect compatible time of concentration with tributary basins.

The Appendix includes calculations of existing flows (Exhibit "B") to reflect current (1989 FIMS map) development and flooding potential. Exhibit "C" reflects the impacts of fully developed basins with current drainage patterns. Exhibits "D" and "E" show proposed hydrologic and hydraulic calculations for the diversions specified in the Douglas Creek Drainage Basin Planning Study.

CONSTRUCTION COST ESTIMATE:

The following four construction cost estimates reflect a reach by reach summary of future facilities as shown on the Drainage Plan for each storm sewer system necessary to cause the area to be in conformance with the current Drainage Criteria Manual.

FUTURE STORM SEWER SYSTEM #1

1 - 10' D-10-R Catch Basin	$2,500/Each	$ 2,500
1 - 20' D-10-R Catch Basin	$5,000/Each	5,000
Tie into Existing Channel	Lump Sum	1,000
2 - 45° Bends - 48" RCP	$ 800/Each	1,600
550 LF - 48" RCP, Class III	$ 60/LF	33,000
1 - Box Manhole	$3,500/Each	3,500
600 LF - 42" RCP, Class III	$ 54/LF	32,400
1 - Box Manhole - Junction	$3,500/Each	3,500
1 - Realign 24" RCP Lateral	Lump Sum	500
1 - Street/Utility Crossing	Lump Sum	20,000
500 LF - 42" RCP, Class III	$ 54/LF	27,000
1 - Box Manhole	$3,500/Each	3,500
500 LF - 42" RCP, Class III	$ 54/LF	27,000
Tie into Existing Catch Basin	Lump Sum	500
		~~$192,500~~ 161,000
10% Engineering		16,100
10% Contingency		16,100
TOTAL SYSTEM #1		$193,200

FUTURE STORM SEWER SYSTEM #2

Remove Existing Manhole	Lump Sum	$ 500
1 - Box Manhole	$3,500/Each	3,500
1 - Street Repairs	Lump Sum	10,000
200 LF - 42" RCP, Class III	$ 54/LF	10,800
1 - 30° Bend - 42" RCP	$ 600/Each	600
200 LF - 42" RCP, Class III	$ 54/LF	10,800
1 - 10' D-10-R Catch Basin	$2,500/Each	2.500
40 LF - 36" RCP, Class III	$ 48/LF	1,920
1 - 10' D-10-R Catch Basin	$2,500/Each	2,500
300 LF - 30" RCP, Class III	$ 36/LF	10,800
1 - 6' D-10-R Catch Basin	$1,800/Each	1,800
40 LF - 24" RCP, Class III	$ 30/LF	1,200
1 - 6' D-10-R Catch Basin	$1,800/Each	1,800
		$ 58,720
10% Engineering		5,872
10% Contingency		5,872
TOTAL SYSTEM #2		$ 70,464

FUTURE STORM SEWER SYSTEM #3

120' D-10-R Catch Basin	$ 250/LF	$ 30,000
Connection to Channel	Lump Sum	1,000
72' D-10-R Catch Basin	$ 300/LF	21,600
18' D-11 Catch Basin	$ 300/LF	5,400
50 LF - 36" RCP, Class III	$ 42/LF	2,100
Connection to Channel	Lump Sum	1,000
Asphalt Repairs	Lump Sum	2,000
		$ 63,100
10% Engineering		6,310
10% Contingency		6,310
TOTAL SYSTEM #3		$ 75,720

FUTURE STORM SEWER SYSTEM #4

Realign 300 LF Natural Channel	$ 100/LF	$30,000
Remove 500 LF Trickle Channel	$ 20/LF	10,000
Connection to Channel	Lump Sum	1,000
200 LF - 60" RCP, Class III	$ 72/LF	14,400
1 - Box Manhole	$3,500/Each	3,500
550 LF - 60" RCP, Class III	$ 72/LF	39,600
Replace 30' Concrete Chase With 30' D-10-R Catch Basin	$7,500/Each	7,500
100 LF - 60" RCP, Class III	$ 72/LF	7,200
1 - Street/Utility Crossing	Lump Sum	10,000
1 - Box Manhole - Junction	$3,500/Each	3,500
140 LF - 24" RCP, Class III	$ 30/LF	4,200
2 - 5' D-10-R Catch Basin	$1,500/Each	3,000
500 LF - 60" RCP, Class III	$ 72/LF	36,000
1 - Street/Utility Crossing	Lump Sum	20,000
165' D-10-R Catch Basin	$ 250/LF	41,250
		$231,150
10% Engineering		23,115
10% Contingency		23,115
TOTAL SYSTEM #2		$277,380

JR Engineering, Ltd. cannot and does not guarantee that the construction cost will not vary from these opinions of probable construction costs. These opinions represent our best judgement as a design professional familiar with the construction industry and this development.

PROPOSED DRAINAGE BASIN FEE REVISIONS:

FACILITIES	1992 MDDP	1981 DBPS	DEFICIT
Future Storm Sewer System #1	$193,200	$ 36,851	$156,349
Future Storm Sewer System #2	70,464	4,140	66,324
Future Storm Sewer System #3	75,720	2,070	73,650
Future Storm Sewer System #4	277,380	73,600	203,780
TOTAL	$616,764	$116,661	$500,103

Available Unplatted Acreage in 1981,
Entire Basin..... 3,339 Ac.

Available Unplatted Acreage in 1992,
Extrapolated from Basin "A"..... 2,401 Ac.

Net **Increase** in Drainage Fees = $\frac{\$500,103}{2,401 \text{ Ac}}$ = $208.29/Acre

SUMMARY:

Existing drainage facilities and patterns in the Oak Valley area do NOT adequately protect the development from flooding. Future upstream development will worsen the drainage problems and increase the potential for flooding. New drainage facilities must be constructed to direct runoff into the existing concrete channel as specified in the Douglas Creek Drainage Basin Planning Study. Four systems of drainage facilities have been shown on the plan and detailed in the enclosed construction cost estimates. Alternative and/or equivalent improvements will be permitted, provided they perform as specified in this MDDP. Preliminary and Final Drainage Reports will be necessary to evaluate alternative solutions, provide final hydrologic and hydraulic data for design, and preparation of construction plans. Of specific interest, with the plan for installation of upstream diversions, the proposed 42" RCP storm sewer along Centennial Boulevard from Allegheny Drive to Flying W Ranch Road will be adequate for anticipated runoff quantities.

Respectfully submitted,

Joseph W. DesJardin, Colorado P.E. #24207
For and on Behalf of JR Engineering, Ltd.

12/4/92
Date

APPENDIX

EXHIBIT "A"

DRAINAGE REPORTS FOR TRIBUTARY SUBDIVISIONS

OAK VALLEY MDDP

DRAINAGE REPORTS FROM LAND DEVELOPMENT

DOUGLAS MASTER BASIN

CASTLE HEIGHTS SUBDIVISION

LIVE OAKS STATION FILING NO. 1

LIVE OAKS STATION FILING NO. 2

OAK VALLEY RANCH FILING NO. 1

OAK VALLEY RANCH FILING NO. 2

OAK VALLEY RANCH FILING NO. 3

A REPLAT OF A PORTION OF OAK VALLEY RANCH FILING NO. 1

THE VALLEY

VALLEY RANCH

MOUNTAIN SHADOWS FILING NO. 8

MOUNTAIN SHADOWS FILING NO. 21

MOUNTAIN SHADOWS FILING NO. 23

CENTENNIAL BOULEVARD SUBDIVISION

OAK VALLEY MDDP

ADDITIONAL DRAINAGE REPORTS FROM LAND DEVELOPMENT

1. ALLEGHENY DRIVE SUBDIVISION

   STORM DRAINAGE PLAN & REPORT
   DATED JULY, 1982

2. SILENT RAIN DRIVE REPORT

   DATED JANUARY, 1985

3. "DRAINAGE REPORT - PLANNED CENTENNIAL BOULEVARD BETWEEN THE NORTH TERMINUS OF EXISTING IMPROVED CENTENNIAL BOULEVARD AND VINDICATOR DRIVE"

   REVISED JULY 27, 1983
   APPROVED OCTOBER 6, 1983
   PREPARED BY URS ENGINEERS

EXHIBIT "B"

HYDROLOGY
(EXISTING FLOWS WITHOUT DIVERSIONS)

JOB NO. 8503.00; 12/03/92

OAK VALLEY MDDP
(EXISTING FLOWS WITHOUT DIVERSIONS)

BASIN	AREA IN ACRES	Tc PATH OVERLAND/GUTTER	Tc (min)	I_{10}	I_{100}	% 1/8 Ac.	C_{10}	C_{100}	FLOW (cfs) Q_{10}	FLOW (cfs) Q_{100}
1	8.2	1000' @ 20%/ 1100' @ 10%	20	3.4	5.1	55%	0.41	0.51	11	21
2	54.2	1000' @ 16%/ 5100' @ 13%	21	3.3	5.0	11%	0.29	0.39	52	106
3	1.1	50' @ 2%/ 640' @ 7%	10	4.6	7.0	100%	0.60	0.70	3	5
4	31.2	1000' @ 15%/ 2900' @ 15%	24	3.1	4.6	16%	0.31	0.41	30	59
5	521.0	1000' @ 23%/ 7500' @ 23%	25	3.0	4.5	5%	0.25	0.35	391	821
6	6.4	300' @ 9%/ 1400' @ 9%	16	3.8	5.6	0%	0.25	0.35	6	13
7	37.8	300' @ 17%/ 2300' @ 17%	13	4.1	6.2	0%	0.25	0.35	39	82
8	34.3	300' @ 5%/ 3850' @ 5%	24	3.1	4.6	3%	0.26	0.36	28	57
9	13.8	300' @ 12%/ 1650' @ 12%	14	4.0	6.0	0%	0.25	0.35	14	29
10	12.4	60' @ 2%/ 2000' @ 5%	14	4.0	6.0	100%	0.60	0.70	30	52

BASIN	AREA IN ACRES	Tc PATH OVERLAND/GUTTER	Tc (min)	I_{10}	I_{100}	% 1/8 Ac.	C_{10}	C_{100}	FLOW (cfs) Q_{10}	FLOW (cfs) Q_{100}
11	10.7	300' @ 19%/ 1100' @ 19%	12	4.2	6.4	0%	0.25	0.35	11	24
11a	1.9	100' @ 20%/ 440' @ 5%	7	5.2	7.9	100%	0.60	0.70	6	11
12	35.3	300' @ 15%/ 2250' @ 15%	14	4.0	6.0	0%	0.25	0.35	35	74
13	2.3	50' @ 20%/ 1200' @ 7%	6	5.6	8.4	99%	0.89	0.94	11	18
14	12.5	300' @ 6%/ 1400' @ 9%	17	3.6	5.5	0%	0.25	0.35	11	24
15	9.3	100' @ 2%/ 1300' @ 5%	15	3.9	5.8	100%	0.60	0.70	22	38
16	2.8	160' @ 7%/ 600' @ 3%	12	4.2	6.4	100%	0.60	0.70	7	13
17	5.1	250' @ 5%/ 1000' @ 3%	18	3.5	5.3	100%	0.60	0.70	11	19
18	8.9	210' @ 8%/ 1500' @ 5%	15	3.9	5.8	100%	0.60	0.70	21	36
19	0.6	50' @ 2%/ 700' @ 3%	11	4.4	6.7	97%	0.58	0.68	2	3
20	14.9	110' @ 4%/ 1450' @ 6%	13	4.1	6.2	100%	0.60	0.70	37	65

BASIN	AREA IN ACRES	Tc PATH OVERLAND/GUTTER	Tc (min)	I_{10}	I_{100}	% 1/8 Ac.	C_{10}	C_{100}	FLOW (cfs) Q_{10}	FLOW (cfs) Q_{100}
21	7.3	300' @ 22%/ 1950' @ 6%	14	4.0	6.0	0%	0.25	0.35	7	15
22	31.3	1000' @ 6%/ 1600' @ 8%	31	2.7	4.0	0%	0.25	0.35	21	44
23	17.2	200' @ 7%/ 2200' @ 3%	18	3.5	5.3	100%	0.60	0.70	36	64
24	10.3	300' @ 4%/ 250' @ 4%	18	3.5	5.3	100%	0.60	0.70	22	38
25	5.6	300' @ 11%/ 600' @ 4%	14	4.0	6.0	100%	0.60	0.70	13	24
26	4.6	50' @ 2%/ 800' @ 3%	11	4.4	6.7	100%	0.60	0.70	12	22
27	3.8	170' @ 6%/ 800' @ 3%	14	4.0	6.0	100%	0.60	0.70	9	16
28	15.3	240' @ 8%/ 1350' @ 2%	17	3.6	5.5	100%	0.60	0.70	33	59
29	21.4	300' @ 23%/ 2350' @ 9%	14	4.0	6.0	10%	0.29	0.39	25	50
30	0.9	10' @ 2%/ 1200' @ 3%	7	5.2	7.9	67%	0.68	0.75	3	5

OAK VALLEY ROUTED FLOWS
(EXISTING FLOWS WITHOUT DIVERSIONS)

BASIN	Tc (min)	I_{10}	I_{100}	EQUIV. CA's 10-YEAR	EQUIV. CA's 100-YEAR	FLOW (cfs) Q_{10}	FLOW (cfs) Q_{100}
6	16	3.8	5.6	1.60	2.24	6	13
Assume 50/50 split each side of street (Each 4' Catch Basin #5 & #6 takes 1cfs/2cfs at 2% grade) Flowby (per side)				0.53	0.71	2	4
6, 4	24	3.1	4.6	10.21	13.54	32	62
(6' Catch Basin #4 takes 7cfs/10cfs at 0.80%) Flowby				8.06	11.30	25	52
6, 4, 3	24	3.1	4.6	8.72	12.01	27	56
(4' Catch Basin #3 takes 4cfs/6cfs @ 0.80%) Flowby				7.42	10.87	23	50
6, 4, 3, 2	26	3.0	4.4	23.14	32.01	69	141
(6' Catch Basin #2 takes 10cfs/15cfs @ 1.0%) Flowby				19.67	28.64	59	126
6, 4, 3, 2, 1	26	3.0	4.4	22.95	32.82	69	144
(20' Radial Inlet #1 takes 34cfs/51cfs @ 1%) Flowby				11.67	21.14	35	93
Summary of Pipe System: Q_{10}=55cfs, Q_{100}=82cfs; Existing 36" RCP: Need S min = 1.51%							
6, 4, 3, 2, 1, 11A	27	2.9	4.3	12.81	22.47	37	97

BASIN	Tc (min)	I_{10}	I_{100}	EQUIV. CA's 10-YEAR	EQUIV. CA's 100-YEAR	FLOW (cfs) Q_{10}	FLOW (cfs) Q_{100}
(8' Catch Basin #12 takes 7cfs/11cfs @ 4%)							
Flowby				10.34	20.00	30	86
6, 4, 3, 2, 1, 11A, 11	28	2.8	4.2	13.02	23.75	36	100
(10' Catch Basin #13 takes 8cfs/14cfs @ 4% slope)							
Flowby				10.00	20.48	28	86
6, 4, 3, 2, 1, 11A, 11, 12	28	2.8	4.2	18.83	32.84	53	138
(6' Catch Basin #14 takes 6cfs/10cfs @ 4% slope)							
Flowby				16.79	30.48	47	128
13	6	5.6	8.4	2.05	2.16	11	18
(6' Catch Basin #15 takes 2cfs/3cfs @ 4% slope)							
Flowby				1.61	1.79	9	15
6, 4, 3, 2, 1, 11A 11, 12, 13	28	2.8	4.2	18.40	32.27	52	136
(Design Point "A")							
DP "A" + 14	29	2.7	4.2	21.53	36.65	58	154
(10' Catch Basin #16 takes 9cfs/16cfs @ 6% slope)							
Flowby				18.15	32.86	49	138
Summary of Pipe System: Q_{10}=32cfs, Q_{100}=54cfs; Existing 36" RCP: Need S min = 0.66%							
DP "A" + 14, 22	32	2.6	3.9	25.98	43.82	68	171
(Design Point "B")							

BASIN	Tc (min)	I_{10}	I_{100}	EQUIV. CA's 10-YEAR	EQUIV. CA's 100-YEAR	FLOW (cfs) Q_{10}	FLOW (cfs) Q_{100}
Sump Condition $Q_{ea}=1.7\ (4+1.8x2)(1.5+0.33)^{1.85}=40$cfs: Ignore clogging factor since existing upstream facility All surface and piped flow eventually ends up in Basin 23							
DP "B" + 23	36	2.4	3.7	36.30	55.86	87	207
Since these inlets will be swamped, determine flow from opposite side of street & combine.							
Shift back to Basin 6 calculations on Page 1							
1/2 of 6 Flowby =	16	3.8	5.6	0.53	0.71	2	4
6,10	22	3.2	4.8	7.97	9.39	26	45
(10' Catch Basin #9 takes 6cfs/8cfs @ 5% slope) (10' Catch Basin #10 takes 5cfs/7cfs @ 5% slope) (30' Opening #11 takes 15cfs/30cfs based on Manning Therefore, flowby past Basin 10 is 0/0							
Shift to Basin 15							
15	15	3.9	5.8	5.58	6.51	22	38
(8' Catch Basin #18 takes 4cfs/6cfs @ 5% slope) (4' Catch Basin #17 takes 3cfs/4cfs @ 1% slope) Flowby				3.85	4.83	15	28
Route with Basin 23 & DP "B"							
DP "B", 23, 15	36	2.4	3.7	40.15	60.69	96	225
Route with Basin 24							

BASIN	Tc (min)	I_{10}	I_{100}	EQUIV. CA's 10-YEAR	EQUIV. CA's 100-YEAR	FLOW (cfs) Q_{10}	FLOW (cfs) Q_{100}
DP "B", 24, 23, 15	36	2.4	3.7	46.33	67.90	111	251
(Design Point "C")							
(Two 14' Catch Basins #23 & #24 in sump w/1' head take: $Q_{ea}=1.7(14+1.8x2)(1.0+0.33)^{1.85}=51cfs$)							
Flowby				3.75	40.27	9	149
DP "C" + 25	37	2.4	3.6	7.11	44.19	17	159
(4' Catch Basin #25 takes: $Q=1.7(4+3.6)(2+0.33)^{1.85}=62cfs$							
However, outfall for this system consists of 36" RCP @ 3% +/- which has a capacity of 115cfs. Therefore, Catch Basin may only take 115-102=13cfs.							
Flowby				1.67	40.56	4	146
DP "C" + 25, 26, 27, 29	38	2.3	3.5	12.92	54.79	30	192
(Design Point "D")							
Existing Catch Basins #26 & #27 already full (6' Catch Basin #28 takes 5cfs/14cfs @ 2%)							
Flowby				10.87	50.86	25	178
Summary of Pipe System: $Q_{10}=120cfs$, $Q_{100}=129cfs$; Existing 42" RCP: Need S min = 1.66%							
Calculate flow approaching Design Point "F" from Allegheny Drive							
Shift to Basin 5							
5	25	3.0	4.5	130.25	182.35	391	821
Route with flow from curb inlets from Basin 6							

BASIN	Tc (min)	I_{10}	I_{100}	EQUIV. CA's 10-YEAR	EQUIV. CA's 100-YEAR	FLOW (cfs) Q_{10}	FLOW (cfs) Q_{100}
5, 6	25	3.0	4.5	130.78	183.06	392	824
5, 6, 7	25	3.0	4.5	140.23	196.29	421	883
(Design Point "E")							
DP "E" + 8	34	2.5	3.8	149.15	208.64	373	793
Route with flows from Catch Basins 9, 10, 11, 17, 18, 20, 8, 1, 2, 3, 4, 12, 13, 14, 15, 16, 19, 31, 32, 33, 34, 35. First must calculate pickup from 20 in Basin 16							
Shift to Basin 16							
16	12	4.2	6.4	1.68	1.96	7	13
(4' Catch Basin #20 takes 2cfs/2cfs @ 2% slope) Flowby				1.19	1.72	5	11
16, 18	15	3.9	5.8	6.53	7.95	25	46
(6' Catch Basin #32 takes 4cfs/6cfs @ 3% slope) Flowby				5.38	6.90	21	40
16, 18, 19	17	3.6	5.5	5.73	7.31	21	40
(4' Catch Basin #33 $Q=1.7(4+1.8x3)(0.67+0.33)^{1.85}$= 16cfs Flowby				1.39	4.36	5	24
Shift to Basin 17							
17	18	3.5	5.3	3.06	3.57	11	19
(6' Catch Basin #31 takes 3cfs/4cfs @ 3% slope) Flowby				2.29	2.83	8	15

BASIN	Tc (min)	I_{10}	I_{100}	EQUIV. CA's 10-YEAR	EQUIV. CA's 100-YEAR	FLOW (cfs) Q_{10}	FLOW (cfs) Q_{100}
17, 28	23	3.1	4.7	11.47	13.54	36	64
12' Catch Basin #29 takes 36cfs/45cfs Flowby				0.00	4.04	0	19
16, 17, 18, 19, 28	23	3.1	4.7	1.39	8.40	4	39
Shift to Basin 9							
9	14	4.0	6.0	3.45	4.83	11	18
(10' Catch Basin #8 takes 3cfs/4cfs @ 10% slope) Flowby				2.00	2.33	8	14
9, 21	18	3.5	5.3	3.83	4.89	13	26
(8' Catch Basin #35 takes 4cfs/5cfs @ 4% slope) Flowby				2.57	3.96	9	21
9, 21, 30	21	3.3	5.0	3.18	4.64	10	23
Shift to Basin 20							
20	13	4.1	6.2	8.94	10.43	37	65
(8' Catch Basin #34 takes 6cfs/9cfs @ 4% slope) Flowby				7.56	9.03	31	56
Route with 16, 17, 18, 19, 28							
16, 17, 18, 19, 20, 28	23	3.1	4.7	8.95	17.43	28	82
Route with 9, 21, 30							

BASIN	Tc (min)	I_{10}	I_{100}	EQUIV. CA's 10-YEAR	EQUIV. CA's 100-YEAR	FLOW (cfs) Q_{10}	FLOW (cfs) Q_{100}
9, 16, 17, 18, 19, 20 21, 28, 30	23	3.1	4.7	12.13	22.07	38	104
(Design Point "F")							
(8' Catch Basin #30 takes 12cfs/17cfs @ 2% slope) Flowby				8.39	18.51	26	87
Summary of Pipe System: Q_{10}=163cfs, Q_{100}=177cfs; Existing 42" RCP: Need S min = 3.20%							
Route DP "F" & DP "D"	38	2.3	3.5	19.26	69.37	44	243
Shift to Calculations at Design Point "G"							
DP "E" + 8	34	2.5	3.8	149.15	208.64	373	793
Catch Basin #1	26	3.0	4.4	11.33	11.59	34	51
Catch Basin #2	26	3.0	4.4	3.33	3.41	10	15
Catch Basin #3	24	3.1	4.6	1.29	1.30	4	6
Catch Basin #4	24	3.1	4.6	2.26	2.17	7	10
Catch Basin #8	14	4.0	6.0	0.75	0.67	3	4
Catch Basin #9	22	3.2	4.8	1.88	1.67	6	8
Catch Basin #10	22	3.2	4.8	1.56	1.46	5	7
Catch Basin #11	22	3.2	4.8	4.69	6.25	15	30
Catch Basin #12	27	2.9	4.3	2.41	2.56	7	11
Catch Basin #13	28	2.8	4.2	2.86	3.33	8	14

BASIN	Tc (min)	I_{10}	I_{100}	EQUIV. CA's 10-YEAR	EQUIV. CA's 100-YEAR	FLOW (cfs) Q_{10}	FLOW (cfs) Q_{100}
Catch Basin #14	17	3.6	5.5	1.67	1.82	6	10
Catch Basin #15	6	5.6	8.4	0.36	0.36	2	3
Catch Basin #16	29	2.7	4.2	3.33	3.81	9	16
Catch Basin #17	15	3.9	5.8	0.77	0.69	3	4
Catch Basin #18	15	3.9	5.8	1.03	1.03	4	6
Catch Basin #19	0	0.0	0.0	0.00	0.00	0	0
Catch Basin #20	12	4.2	6.4	0.48	0.31	2	2
Catch Basin #31	18	3.5	5.3	0.86	0.75	3	4
Catch Basin #32	15	3.9	5.8	1.03	1.03	4	6
Catch Basin #33	17	3.6	5.5	4.44	2.91	16	16
Catch Basin #34	13	4.1	6.2	1.46	1.45	6	9
Catch Basin #35	18	3.5	5.3	1.14	0.94	4	5
FLOW IN CHANNEL	34	2.5	3.8	196.60	257.16	491	977

EXHIBIT "C"

HYDROLOGY
(FULLY DEVELOPED FLOWS WITHOUT DIVERSIONS)

JOB NO. 8503.00; 12/03/92

OAK VALLEY MDDP
(FULLY DEVELOPED FLOWS WITHOUT DIVERSIONS)

BASIN	AREA IN ACRES	Tc PATH OVERLAND/GUTTER	Tc (min)	I_{10}	I_{100}	% 1/8 Ac.	C_{10}	C_{100}	FLOW (cfs) Q_{10}	FLOW (cfs) Q_{100}
1	8.2	1000' @ 20%/ 1100' @ 10%	20	3.4	5.1	70%	0.50	0.60	14	25
2	54.2	1000' @ 16%/ 5100' @ 13%	21	3.3	5.0	11%	0.29	0.39	52	106
3	1.1	50' @ 2%/ 640' @ 7%	10	4.6	7.0	100%	0.60	0.70	3	5
4	31.2	1000' @ 15%/ 2900' @ 15%	24	3.1	4.6	16%	0.31	0.41	30	59
5	521.0	1000' @ 23%/ 7500' @ 23%	25	3.0	4.5	5%	0.25	0.35	391	821
6	6.4	300' @ 9%/ 1400' @ 9%	16	3.8	5.6	0%	0.25	0.35	6	13
7	37.8	300' @ 17%/ 2300' @ 17%	13	4.1	6.2	45%	0.41	0.51	64	120
8	34.3	300' @ 5%/ 3850' @ 5%	24	3.1	4.6	3%	0.26	0.36	28	57
9	13.8	300' @ 12%/ 1650' @ 12%	14	4.0	6.0	0%	0.25	0.35	14	29
10	12.4	60' @ 2%/ 2000' @ 5%	14	4.0	6.0	100%	0.60	0.70	30	52
11	10.7	300' @ 19%/ 1100' @ 19%	12	4.2	6.4	50%	0.42	0.53	19	36

BASIN	AREA IN ACRES	Tc PATH OVERLAND/GUTTER	Tc (min)	I_{10}	I_{100}	% 1/8 Ac.	C_{10}	C_{100}	FLOW (cfs) Q_{10}	FLOW (cfs) Q_{100}
11a	1.9	100' @ 20%/ 440' @ 5%	7	5.2	7.9	50%	0.42	0.52	4	8
12	35.3	300' @ 15%/ 2250' @ 15%	14	4.0	6.0	70%	0.50	0.60	71	127
13	2.3	50' @ 20%/ 1200' @ 7%	6	5.6	8.4	99%	0.89	0.94	11	18
14	12.5	300' @ 6%/ 1400' @ 9%	17	3.6	5.5	80%	0.53	0.64	24	44
15	9.3	100' @ 2%/ 1300' @ 5%	15	3.9	5.8	100%	0.60	0.70	22	38
16	2.8	160' @ 7%/ 600' @ 3%	12	4.2	6.4	100%	0.60	0.70	7	13
17	5.1	250' @ 5%/ 1000' @ 3%	18	3.5	5.3	100%	0.60	0.70	11	19
18	8.9	210' @ 8%/ 1500' @ 5%	15	3.9	5.8	100%	0.60	0.70	21	36
19	0.6	50' @ 2%/ 700' @ 3%	11	4.4	6.7	97%	0.58	0.68	2	3
20	14.9	110' @ 4%/ 1450' @ 6%	13	4.1	6.2	100%	0.60	0.70	37	65
21	7.3	300' @ 22%/ 1950' @ 6%	14	4.0	6.0	100%	0.60	0.70	18	31
22	31.3	1000' @ 6%/ 1600' @ 8%	31	2.7	4.0	20%	0.32	0.42	27	53

BASIN	AREA IN ACRES	Tc PATH OVERLAND/GUTTER	Tc (min)	I_{10}	I_{100}	% 1/8 Ac.	C_{10}	C_{100}	FLOW (cfs) Q_{10}	FLOW (cfs) Q_{100}
23	17.2	200' @ 7%/ 2200' @ 3%	18	3.5	5.3	100%	0.60	0.70	36	64
24	10.3	300' @ 4%/ 250' @ 4%	18	3.5	5.3	100%	0.60	0.70	22	38
25	5.6	300' @ 11%/ 600' @ 4%	14	4.0	6.0	100%	0.60	0.70	13	24
26	4.6	50' @ 2%/ 800' @ 3%	11	4.4	6.7	100%	0.60	0.70	12	22
27	3.8	170' @ 6%/ 800' @ 3%	14	4.0	6.0	100%	0.60	0.70	9	16
28	15.3	240' @ 8%/ 1350' @ 2%	17	3.6	5.5	100%	0.60	0.70	33	59
29	21.4	300' @ 23%/ 2350' @ 9%	14	4.0	6.0	10%	0.29	0.39	25	50
30	0.9	10' @ 2%/ 1200' @ 3%	7	5.2	7.9	67%	0.68	0.75	3	5
31	13.1	100' @ 2%/ 1300' @ 4%	16	3.8	5.7	1/5 Ac.	0.52	0.62	26	46
32	14.4	100' @ 2%/ 1000' @ 3%	16	3.8	5.7	PBC	0.75	0.80	41	66
33	1.6	50' @ 2%/ 1100' @ 3%	12	4.3	6.5	50% Pave 50% Open	0.58	0.65	4	7
34	5.1	50' @ 2%/ 1000' @ 3%	12	4.3	6.5	25% Pave 75% Open	0.41	0.50	9	17

BASIN	AREA IN ACRES	Tc PATH OVERLAND/GUTTER	Tc (min)	I_{10}	I_{100}	% 1/8 Ac.	C_{10}	C_{100}	FLOW (cfs) Q_{10}	FLOW (cfs) Q_{100}
35	1.1	50' @ 2%/ 1000' @ 3%	12	4.3	6.5	75% Pave 25% Open	0.74	0.80	4	6
36	1.6	50' @ 2%/ 1000' @ 3%	12	4.3	6.5	50% Pave 50% Open	0.58	0.65	4	7
37	8.6	100' @ 2%/ 1000' @ 3%	16	3.8	5.7	1/8 Ac.	0.60	0.70	20	34
38	1.5	50' @ 2%/ 1000' @ 3%	12	4.3	6.5	50% Pave 50% Open	0.58	0.65	4	6

OAK VALLEY ROUTED FLOWS
(FULLY DEVELOPED FLOWS WITHOUT DIVERSIONS)

BASIN	Tc (min)	I_{10}	I_{100}	EQUIV. CA's 10-YEAR	EQUIV. CA's 100-YEAR	FLOW (cfs) Q_{10}	FLOW (cfs) Q_{100}
6	16	3.8	5.6	1.60	2.24	6	13
Assume 50/50 split each side of street (Each 4' Catch Basin #5 & #6 takes 1cfs/2cfs at 2% grade) Flowby (per side)				0.53	0.71	2	4
6, 4	24	3.1	4.6	10.21	13.54	32	62
(6' Catch Basin #4 takes 7cfs/10cfs at 0.80%) Flowby				8.06	11.30	25	52
6, 4, 3	24	3.1	4.6	8.72	12.01	27	56
(4' Catch Basin #3 takes 4cfs/6cfs @ 0.80%) Flowby				7.42	10.87	23	50
6, 4, 3, 2	26	3.0	4.4	23.14	32.01	69	141
(6' Catch Basin #2 takes 10cfs/15cfs @ 1.0%) Flowby				19.67	28.64	59	126
6, 4, 3, 2, 1	26	3.0	4.4	23.77	33.56	71	148
(20' Radial Inlet #1 takes 34cfs/51cfs @ 1%) Flowby				12.33	22.05	37	97
Summary of Pipe System: Q_{10}=55cfs, Q_{100}=82cfs; Existing 36" RCP: Need S min. = 1.51%							
6, 4, 3, 2, 1, 11A	27	2.9	4.3	13.47	23.38	39	101

BASIN	Tc (min)	I_{10}	I_{100}	EQUIV. CA's 10-YEAR	EQUIV. CA's 100-YEAR	FLOW (cfs) Q_{10}	FLOW (cfs) Q_{100}
(8' Catch Basin #12 takes 7cfs/11cfs @ 4%) Flowby				11.03	20.93	32	90
6, 4, 3, 2, 1, 11A, 11	28	2.8	4.2	15.63	26.60	44	112
(10' Catch Basin #13 takes 9cfs/15cfs @ 4% slope) Flowby				12.50	23.10	35	97
6, 4, 3, 2, 1, 11A, 11, 12	28	2.8	4.2	30.15	44.28	84	186
(6' Catch Basin #14 takes 7cfs/10cfs @ 4% slope) Flowby				27.50	41.90	77	176
13	6	5.6	8.4	2.05	2.16	11	18
(6' Catch Basin #15 takes 2cfs/3cfs @ 4% slope) Flowby				1.61	1.79	9	15
6, 4, 3, 2, 1, 11A 11, 12, 13	28	2.8	4.2	29.11	43.69	82	184
(Design Point "A")							
DP "A" + 14	29	2.7	4.2	35.86	51.69	97	217
(10' Catch Basin #16 takes 13cfs/20cfs @ 6% slope) Flowby				31.11	46.91	84	197
Summary of Pipe System: Q_{10}=38cfs, Q_{100}=59cfs; Existing 36" RCP: Need 5 min. = 0.78%							
DP "A" + 14, 22	32	2.6	3.9	41.07	60.06	107	234
(Design Point "B")							

BASIN	Tc (min)	I_{10}	I_{100}	EQUIV. CA's 10-YEAR	EQUIV. CA's 100-YEAR	FLOW (cfs) Q_{10}	FLOW (cfs) Q_{100}
Sump Condition $Q_{ea}=1.7\ (4+1.8x2)(1.5+0.33)^{1.85}=40cfs$: Ignore clogging factor since existing upstream facility All surface and piped flow eventually ends up in Basin 23							
DP "B" + 23	36	2.4	3.7	51.39	72.10	123	267
Since these inlets will be swamped, determine flow from opposite side of street & combine.							
Shift back to Basin 6 calculations on Page 1							
1/2 of 6 Flowby =	16	3.8	5.6	0.53	0.71	2	4
6,10	22	3.2	4.8	7.97	9.39	26	45
(10' Catch Basin #9 takes 6cfs/8cfs @ 5% slope) (10' Catch Basin #10 takes 5cfs/7cfs @ 5% slope) (30' Opening #11 takes 15cfs/30cfs based on Manning Therefore, flowby past Basin 10 is 0/0							
Shift to Basin 15							
15	15	3.9	5.8	5.58	6.51	22	38
(8' Catch Basin #18 takes 4cfs/6cfs @ 5% slope) (4' Catch Basin #17 takes 3cfs/4cfs @ 1% slope)							
Flowby				3.85	4.83	15	28
Route with Basin 23 & DP "B"							
DP "B", 23, 15	36	2.4	3.7	55.24	76.93	133	285
Route with Basin 24							
DP "B", 24, 23, 15	36	2.4	3.7	61.42	84.14	147	311
(Design Point "C")							

BASIN	Tc (min)	I_{10}	I_{100}	EQUIV. CA's 10-YEAR	EQUIV. CA's 100-YEAR	FLOW (cfs) Q_{10}	FLOW (cfs) Q_{100}
(Two 14' Catch Basins #23 & #24 in sump w/1' head take: $Q_{ea}=1.7(14+1.8x2)(1.0+0.33)^{1.85}=51cfs$)							
Flowby				19.02	56.54	46	209
DP "C" + 25	37	2.4	3.6	22.38	60.46	54	218
(4' Catch Basin #25 takes: $Q=1.7(4+3.6)(2+0.33)^{1.85}=62cfs$ However, outfall for this system consists of 36" RCP @ 3% +/- which has a capacity of 115cfs. Therefore, Catch Basin may only take 115-102=13cfs.							
Flowby				16.93	56.79	41	204
DP "C" + 25, 26, 27, 29	38	2.3	3.5	28.18	71.02	65	249
(Design Point "D")							
Existing Catch Basins #26 & #27 already full							
(6' Catch Basin #28 takes 3cfs/5cfs @ 2%)							
Flowby				26.96	69.71	62	244
Summary of Pipe System: Q_{10}=118cfs, Q_{100}=120cfs; Existing 42" RCP: Need S min. = 1.42%							
Calculate flow approaching Design Point "F" from Allegheny Drive							
Shift to Basin 5							
5	25	3.0	4.5	130.25	182.35	391	821
Route with flow from curb inlets from Basin 6							
5, 6	25	3.0	4.5	130.78	183.06	392	824

BASIN	Tc (min)	I_{10}	I_{100}	EQUIV. CA's 10-YEAR	EQUIV. CA's 100-YEAR	FLOW (cfs) Q_{10}	FLOW (cfs) Q_{100}
5, 6, 7	25	3.0	4.5	146.28	202.34	439	911
(Design Point "E")							
DP "E" + 8	34	2.5	3.8	155.20	214.69	388	816
Route with flows from Catch Basins 9, 10, 11, 17, 18, 20, 8, 1, 2, 3, 4, 12, 13, 14, 15, 16, 19, 31, 32, 33, 34, 35. First must calculate pickup from 20 in Basin 16							
Shift to Basin 16							
16	12	4.2	6.4	1.68	1.96	7	13
(4' Catch Basin #20 takes 2cfs/2cfs @ 2% slope) Flowby				1.19	1.72	5	11
16, 18	15	3.9	5.8	6.53	7.95	25	46
(6' Catch Basin #32 takes 4cfs/6cfs @ 3% slope) Flowby				5.38	6.90	21	40
16, 18, 19	17	3.6	5.5	5.73	7.31	21	40
(4' Catch Basin #33 takes $Q=1.7(4+1.8x3)(0.67+0.33)^{1.85}= 16$ Flowby				1.39	4.36	5	24
Shift to Basin 17							
17	18	3.5	5.3	3.06	3.57	11	19
(6' Catch Basin #31 takes 3cfs/4cfs @ 3% slope) Flowby				2.29	2.83	8	15
17, 28	23	3.1	4.7	11.47	13.54	36	64

BASIN	Tc (min)	I_{10}	I_{100}	EQUIV. CA's 10-YEAR	EQUIV. CA's 100-YEAR	FLOW (cfs) Q_{10}	FLOW (cfs) Q_{100}
(12' Catch Basin #29 takes $Q=1.7(12+1.8x2)(1+0.33)^{1.85}=45$: Actually takes 36/45							
Flowby				.00	4.04	0	19
16, 17, 18, 19, 28	23	3.1	4.7	1.39	8.40	4	39
Shift to Basin 9							
9	14	4.0	6.0	3.45	4.83	14	29
(10' Catch Basin #8 takes 3cfs/4cfs @ 10% slope) Flowby				2.75	4.17	11	25
9, 21	18	3.5	5.3	7.13	9.28	25	49
(8' Catch Basin #35 takes 5cfs/7cfs @ 4% slope) Flowby				5.71	7.92	20	42
9, 21, 30	21	3.3	5.0	6.32	8.60	21	43
Shift to Basin 20							
20	13	4.1	6.2	8.94	10.43	37	65
(8' Catch Basin #34 takes 6cfs/9cfs @ 4% slope) Flowby				7.56	9.03	31	56
Route with 16, 17, 18, 19, 28							
16, 17, 18, 19, 20, 28	23	3.1	4.7	8.95	17.43	28	82
Route with 9, 21, 30							

BASIN	Tc (min)	I_{10}	I_{100}	EQUIV. CA's 10-YEAR	EQUIV. CA's 100-YEAR	FLOW (cfs) Q_{10}	FLOW (cfs) Q_{100}
9, 16, 17, 18, 19, 20 21, 28, 30	23	3.1	4.7	14.42	24.15	45	114
(Design Point "F")							
(8' Catch Basin #30 takes $Q=1.7(8+3.6)(1.33)^{1.84}$= 33cfs (Pickup = 26/15cfs)							
Flowby				6.13	21.70	19	102
Summary of Pipe System: Q_{10}=180cfs, Q_{100}=180cfs; Existing 42" RCP: Need S min. = 3.20%							
Route DP "F" & DP "D"	38	2.3	3.5	33.09	91.41	76	320
Shift to Calculations at Design Point "G"							
DP "E" + 8	34	2.5	3.8	155.20	214.69		
Catch Basin #1	26	3.0	4.4	11.33	11.59	34	51
Catch Basin #2	26	3.0	4.4	3.33	3.41	10	15
Catch Basin #3	24	3.1	4.6	1.29	1.30	4	6
Catch Basin #4	24	3.1	4.6	2.26	2.17	7	10
Catch Basin #8	14	4.0	6.0	0.75	0.67	3	4
Catch Basin #9	22	3.2	4.8	1.88	1.67	6	8
Catch Basin #10	22	3.2	4.8	1.56	1.46	5	7
Catch Basin #11	22	3.2	4.8	4.69	6.25	15	30
Catch Basin #12	27	2.9	4.3	2.41	2.56	7	11
Catch Basin #13	28	2.8	4.2	3.21	3.57	9	15

BASIN	Tc (min)	I_{10}	I_{100}	EQUIV. CA's 10-YEAR	EQUIV. CA's 100-YEAR	FLOW (cfs) Q_{10}	FLOW (cfs) Q_{100}
Catch Basin #14	17	3.6	5.5	1.94	1.82	7	10
Catch Basin #15	6	5.6	8.4	0.36	0.36	2	3
Catch Basin #16	29	2.7	4.2	4.81	4.76	13	20
Catch Basin #17	15	3.9	5.8	0.77	0.69	3	4
Catch Basin #18	15	3.9	5.8	1.03	1.03	4	6
Catch Basin #19	0	.0	.0	.00	.00	0	0
Catch Basin #20	12	4.2	6.4	0.48	0.31	2	2
Catch Basin #31	18	3.5	5.3	0.86	0.75	3	4
Catch Basin #32	15	3.9	5.8	1.03	1.03	4	6
Catch Basin #33	17	3.6	5.5	4.44	2.91	16	16
Catch Basin #34	13	4.1	6.2	1.46	1.45	6	9
Catch Basin #35	18	3.5	5.3	1.43	1.32	5	7
FLOW IN CHANNEL	34	2.5	3.8	204.58	263.95	511	1003

EXHIBIT "D"

HYDROLOGY
(FULLY DEVELOPED FLOWS WITH DIVERSIONS)

OAK VALLEY MDDP
(FULLY DEVELOPED FLOWS WITH DIVERSIONS)

BASIN	AREA IN ACRES	Tc PATH OVERLAND/GUTTER	Tc (min)	I_{10}	I_{100}	% 1/8 Ac.	C_{10}	C_{100}	FLOW (cfs) Q_{10}	FLOW (cfs) Q_{100}
1	8.2	1000' @ 20%/ 1100' @ 10%	20	3.4	5.1	70%	0.50	0.60	14	25
2	54.2	1000' @ 16%/ 5100' @ 13%	21	3.3	5.0	11%	0.29	0.39	52	106
3	1.1	50' @ 2%/ 640' @ 7%	10	4.6	7.0	100%	0.60	0.70	3	5
4	31.2	1000' @ 15%/ 2900' @ 15%	24	3.1	4.6	16%	0.31	0.41	30	59
5	521.0	1000' @ 23%/ 7500' @ 23%	25	3.0	4.5	5%	0.25	0.35	391	821
6	6.4	300' @ 9%/ 1400' @ 9%	16	3.8	5.6	0%	0.25	0.35	6	13
7	37.8	300' @ 17%/ 2300' @ 17%	13	4.1	6.2	45%	0.41	0.51	64	120
8	34.3	300' @ 5%/ 3850' @ 5%	24	3.1	4.6	3%	0.26	0.36	28	57
9	13.8	300' @ 12%/ 1650' @ 12%	14	4.0	6.0	0%	0.25	0.35	14	29
10	12.4	60' @ 2%/ 2000' @ 5%	14	4.0	6.0	100%	0.60	0.70	30	52
11	10.7	300' @ 19%/ 1100' @ 19%	12	4.2	6.4	50%	0.42	0.53	19	36

BASIN	AREA IN ACRES	Tc PATH OVERLAND/GUTTER	Tc (min)	I_{10}	I_{100}	% 1/8 Ac.	C_{10}	C_{100}	FLOW (cfs) Q_{10}	FLOW (cfs) Q_{100}
11a	1.9	100' @ 20%/ 440' @ 5%	7	5.2	7.9	50%	0.42	0.52	4	8
12	35.3	300' @ 15%/ 2250' @ 15%	14	4.0	6.0	70%	0.50	0.60	71	127
13	2.3	50' @ 20%/ 1200' @ 7%	6	5.6	8.4	99%	0.89	0.94	11	18
14	12.5	300' @ 6%/ 1400' @ 9%	17	3.6	5.5	80%	0.53	0.64	24	44
15	9.3	100' @ 2%/ 1300' @ 5%	15	3.9	5.8	100%	0.60	0.70	22	38
16	2.8	160' @ 7%/ 600' @ 3%	12	4.2	6.4	100%	0.60	0.70	7	13
17	5.1	250' @ 5%/ 1000' @ 3%	18	3.5	5.3	100%	0.60	0.70	11	19
18	8.9	210' @ 8%/ 1500' @ 5%	15	3.9	5.8	100%	0.60	0.70	21	36
19	0.6	50' @ 2%/ 700' @ 3%	11	4.4	6.7	97%	0.58	0.68	2	3
20	14.9	110' @ 4%/ 1450' @ 6%	13	4.1	6.2	100%	0.60	0.70	37	65
21	7.3	300' @ 22%/ 1950' @ 6%	14	4.0	6.0	100%	0.60	0.70	18	31
22	31.3	1000' @ 6%/ 1600' @ 8%	31	2.7	4.0	20%	0.32	0.42	27	53

BASIN	AREA IN ACRES	Tc PATH OVERLAND/GUTTER	Tc (min)	I_{10}	I_{100}	% 1/8 Ac.	C_{10}	C_{100}	FLOW (cfs) Q_{10}	FLOW (cfs) Q_{100}
23	17.2	200' @ 7%/ 2200' @ 3%	18	3.5	5.3	100%	0.60	0.70	36	64
24	10.3	300' @ 4%/ 250' @ 4%	18	3.5	5.3	100%	0.60	0.70	22	38
25	5.6	300' @ 11%/ 600' @ 4%	14	4.0	6.0	100%	0.60	0.70	13	24
26	4.6	50' @ 2%/ 800' @ 3%	11	4.4	6.7	100%	0.60	0.70	12	22
27	3.8	170' @ 6%/ 800' @ 3%	14	4.0	6.0	100%	0.60	0.70	9	16
28	15.3	240' @ 8%/ 1350' @ 2%	17	3.6	5.5	100%	0.60	0.70	33	59
29	21.4	300' @ 23%/ 2350' @ 9%	14	4.0	6.0	10%	0.29	0.39	25	50
30	0.9	10' @ 2%/ 1200' @ 3%	7	5.2	7.9	67%	0.68	0.75	3	5
31	13.1	100' @ 2%/ 1300' @ 4%	16	3.8	5.7	1/5 Ac.	0.52	0.62	26	46
32	14.4	100' @ 2%/ 1000' @ 3%	16	3.8	5.7	PBC	0.75	0.80	41	66
33	1.6	50' @ 2%/ 1100' @ 3%	12	4.3	6.5	50% Pave 50% Open	0.58	0.65	4	7
34	5.1	50' @ 2%/ 1000' @ 3%	12	4.3	6.5	25% Pave 75% Open	0.41	0.50	9	17

BASIN	AREA IN ACRES	Tc PATH OVERLAND/GUTTER	Tc (min)	I_{10}	I_{100}	% 1/8 Ac.	C_{10}	C_{100}	FLOW (cfs) Q_{10}	FLOW (cfs) Q_{100}
35	1.1	50' @ 2%/ 1000' @ 3%	12	4.3	6.5	75% Pave 25% Open	0.74	0.80	4	6
36	1.6	50' @ 2%/ 1000' @ 3%	12	4.3	6.5	50% Pave 50% Open	0.58	0.65	4	7
37	8.6	100' @ 2%/ 1000' @ 3%	16	3.8	5.7	1/8 Ac.	0.60	0.70	20	34
38	1.5	50' @ 2%/ 1000' @ 3%	12	4.3	6.5	50% Pave 50% Open	0.58	0.65	4	6

OAK VALLEY MDDP
(FULLY DEVELOPED FLOWS WITH DIVERSIONS)

BASIN	Tc	SURFACE Q_{10}	SURFACE Q_{100}	SURFACE CA_{10}	SURFACE CA_{100}	PIPE/CHANNEL Q_{10}	PIPE/CHANNEL Q_{100}	PIPE/CHANNEL CA_{10}	PIPE/CHANNEL CA_{100}
5	25					391	821	130.25	182.35
6	16	6	13	1.60	2.24				
4' C.B. #6		-1	-2	-0.26	-0.36	+1	+2	+0.26	+0.36
4' C.B. #5		-1	-2	-0.26	-0.36	+1	+2	+0.26	+0.36
½ Flowby		2	4	0.53	0.71				
7						+64	+120	+15.50	+19.28
Summary of Channel Flow:						439	911	146.27	202.35
4	24	+30	+59	+9.67	+12.79				
Route	24	32	62	10.20	13.50				
6' C.B. #4		-7	-10	-2.14	-2.20	+7	+10	+2.14	+2.20
Flowby		25	52	8.06	11.30				
3	10	+3	+5	+0.66	+0.77				
Route	24	27	56	8.72	12.07				
4' C.B. #3		-4	-6	-1.30	-1.20	+4	+6	+1.30	+1.20
Flowby		23	50	7.42	10.87				
2	21	+52	+106	+15.72	+21.14				
Route	26	69	141	23.14	32.01				
6' C.B. #2		-10	-15	-3.47	-3.37	+10	+15	+3.47	+3.37
Flowby		59	126	19.67	28.64				
1	20	+14	+25	+4.10	+4.92				
Route	26	71	148	23.77	33.56				
20' C.B. #1		-34	-51	-11.44	-11.51	+34	+51	+11.44	+11.51
Flowby		37	97	12.33	22.05	55	80	18.35	18.28
Summary of Pipe System:						Existing 36" RCP - Need S min=1.51%			
Design Point "E" Summary of Channel Flow:						494	971	164.52	220.63
11A	7	+4	+8	+0.82	+1.01				
Route	27	38	99	13.15	23.06				
8' C.B. #12		-7	-11	-2.46	-2.59	+7	+11	+2.46	+2.59
Flowby		31	88	10.69	20.47				
11	12	+19	+36	+4.60	+5.67				
Route	28	43	110	15.29	26.14				
10' C.B. #13		-9	-15	-3.15	-3.52	+9	+15	+3.15	+3.52
Flowby		34	95	12.14	22.62				
12	14	+71	+127	+17.65	+21.18				
Route	28	83	184	29.79	43.80				
6' C.B. #14		-7	-10	-2.65	-2.37	+7	+10	+2.65	+2.37

Flowby		76	174	27.14	41.43				
13	6	11	18	2.05	2.16				
6' C.B. #15		-2	-3	-0.44	-0.37	+2	+3	+0.44	+0.37
Flowby		9	15	1.61	1.79				
Design Point "A"		81	182	28.75	43.22				
14	17	+24	+44	+6.75	+8.00				
Route	29	96	215	35.50	51.22				
10' C.B. #16		-1	-20	-4.76	-4.79	+13	+20	+4.76	+4.79
Flowby		83	195	30.74	46.43	36	57	13.46	13.64
Summary of Pipe System:						Existing 36" RCP - Need S min=0.78%			
Future									
165' C.B.	29	-83	-195	-30.74	-46.43	+83	+195	+30.74	+46.73
Summary of Pipe System:						Future 60"RCP @ S min=0.56% hW=7.5'			
15	15	22	38	5.58	6.51				
8' C.B. #18		-4	-6	-1.03	-1.03	+4	+6	+1.03	+1.03
4' C.B. #17		-3	-4	-0.70	-0.65	+3	+4	+0.70	+0.65
6' C.B. #19		-0	-0	-0.00	-0.00	-	-	-	-
Flowby		15	28	3.85	4.83				
Future Pair 5'									
Sump Onsite		-15	-28	-3.85	-4.83	+15	+28	+3.85	+4.83
	29	-	-	-	-	100	217	34.59	51.56
Flowby		0	0	0.00	0.00				
Summary of Pipe System:						Future 60" RCP @ S min - 0.69%			
22	31	27	53	10.02	13.15				
23	18	36	64	10.32	12.04				
24	18	22	38	6.18	7.21				
Design Point "C"	35	66	123	26.52	32.40				
14' C.B. #23		-33	-51	-13.26	-13.44	+33	+51	+13.26	+13.44
14' C.B. #24		-33	-51	-13.26	-13.44	+33	+51	+13.26	+13.44
Flowby		0	21	0.00	5.53				
+25	14	+13	+24	+3.36	+3.92				
Route	36	8	35	3.36	9.45				
4' C.B. #25		-8	-16	-3.36	-4.31	+8	+16	+3.36	+4.31
Flowby		0	19	0.00	5.14	72	115	29.88	31.19
+26	11	+12	+22	+2.76	+3.22				
Route	37	7	30	2.76	8.36				
6' C.B. #26		-7	-3	-2.76	-0.86	+7	+3	+2.76	+0.86
Flowby		0	27	0.00	7.50	78	115	32.64	32.05
+27	14	+ 9	+16	+2.28	+2.66				
Route	37	5	37	2.28	10.16				
6' C.B. #27		-5	-0	-2.28	-0.00	+5	+0	+2.28	+0.00
Flowby		0	37	0.00	10.16	84	115	34.92	32.05

29	14	25	50	6.21	8.35				
6' C.B. #28		-14	-14	-3.50	-2.33	+14	+14	+3.50	+2.33
Flowby		11	36	2.71	6.02			.	.
Design Point "D"	38	6	57	2.71	16.18	88	120	38.42	34.38
17	18	11	19	3.06	3.57				
6' C.B. #31		-3	-4	-0.77	-0.74	3	4	0.77	0.74
Flowby		8	15	2.29	2.83				
+28	17	+33	+59	+9.18	+10.71				
Route	23	36	64	11.47	13.54				
Combine	38	26	83	11.47	23.70				
12' C.B. #29		-26	-28	-11.47	-7.99	+26	+28	+11.47	+7.99
Flowby		0	55	0.00	15.71				
+30	7	+3	+5	+0.61	+0.68				
Design Point "F"	38	1	57	0.61	16.39				
8' C.B. #30		-1	-15	-0.61	-4.39	+1	+15	+0.61	+4.39
Flowby		0	42	0.00	12.00	116	164	50.50	46.76
+33	12	+4	+7	0.93	1.04				
Route	41	2	44	0.93	13.04				
10' C.B. #36		-2	-21	-0.93	-6.18	+2	+12	+0.93	6.18
Flowby		0	23	0.00	6.86				
+35	12	+4	+6	+0.81	+0.88	113	180	51.43	52.94
+36	12	+4	+7	+0.93	+1.04				
Route	43	4	29	1.74	8.78				
Future 10'									
Sump C.B. @ Box		-4	-29	-1.74	-8.78				
Flowby (West Side)		0	0	0.00	0.00				
29 Flowby	14	11	36	2.71	6.02				
+34	12	9	17	2.09	2.55				
Route	17	17	47	4.80	8.57				
+38	12	+4	+6	+0.87	+0.98				
Route	20	19	49	5.67	9.55				
Future 20'									
Sump C.B. @ Box		-19	-49	-5.67	-9.55				
Flowby (East Side)		0	0	0.00	0.00				
Design Point "E"						494	971	164.62	220.63
+ 8	24					28	57	+8.92	+12.35
Route	34					434	885	173.54	232.98
½ 6 Flowby		2	4	0.53	0.71				
+10	14	+30	+51	+7.44	+8.68				
Route	22	26	45	7.97	9.39				
10' C.B. #9		-6	-8	-1.88	-1.67	+6	+8	+1.88	+1.67
10' C.B. #10		-5	-7	-1.56	-1.46	+5	+7	+1.56	+1.56

30' Open #11		-15	-30	-4.53	-6.26	+15	+30	+4.53	+6.26
Flowby		0	0	0.00	0.00	26	45	7.97	9.39
+60" Diversion						+100	+217	+34.59	+51.56
Route	29					115	256	42.56	60.95
Summary of Pipe System:						Future 60" RCP @ S min=0.97%			
Route	34					540	1117	216.10	293.93
9	14	14	29	3.45	4.83				
10' C.B. #8		-3	-4	-0.70	-0.66	+3	+4	+0.70	+0.66
Flowby		11	25	2.75	4.17				
C.B. #12, 13, 14, 15, 16									
	29					36	57	13.46	13.64
C.B. #17, 18, 19									
	15					+7	+10	+1.73	+1.68
Route	29					41	64	15.19	15.32
						Existing 36" RCP - need S min=0.92%			
16	12	7	13	1.68	1.96				
4' C.B. #20		-2	-2	-0.49	-0.24	+2	+2	+0.49	+0.24
Flowby	29	5	11	1.19	1.72	42	65	15.68	15.56
	34					581	1179	232.48	310.15
18		+21	+36	+5.34	+6.23				
Route	15	25	46	6.53	7.95				
6' C.B. #32		-4	-6	-1.15	-1.05	4	6	1.15	1.05
Flowby		21	40	5.38	6.90				
C.B. #31						+3	+4	+0.77	+0.74
Route	18					7	9	1.92	1.79
	34					586	1185	234.40	311.94
+19		+2	+3	+0.35	+0.41				
Route	17	21	40	5.73	7.31				
4' C.B. #33		-16	-16	-4.34	-2.95	+16	+16	+4.34	+2.95
Flowby		5	24	1.39	4.36				
Future 30' Sump		-5	-24	-1.39	-4.36	+5	+24	+1.39	+4.36
Flowby		0	0	0.00	0.00				
20	13	37	65	8.94	10.43				
8' C.B. #34		-6	-9	-1.33	-1.40	+6	+9	+1.33	+1.40
Flowby		31	56	7.56	9.03				
Future 30' Sump		-31	-56	-7.56	-9.03	+31	+56	+7.56	+9.03
Flowby		0	0	0.00	0.00				
9 Flowby	14	11	25	2.75	4.17				
+21	14	+18	+31	+4.38	+5.11				
Route	18	25	49	7.13	9.28				
8' C.B. #35		-5	-7	-1.42	-1.36	+5	+7	+1.42	+1.36
Flowby		20	42	5.71	7.92				

Future 120′ C.B.		-20	-42	-5.71	-7.92	+20	+42	+5.71	+7.92
Flowby	34	0	0	0.00	0.00	640	1288	256.15	338.96

EXHIBIT "E"

HYDRAULIC CALCULATIONS

COMPUTATIONS FOR CURB OPENING INLETS

1. $L_1 = 2.49\, S_x\, 0.3\, F_{WT}$
2. $L_2 = 3.27\, S_x\, 0.5\, F_{WT}$
3. $L_3 = 1.65\, F_{WT}$
4. $F_W = 16.4\,[(T-2)\,S_x]^{1/6}\, S_o^{1/2}$
5. $\frac{Q_i}{Q} = \frac{L_i}{L_i}$
6. $\frac{Q_i}{Q} = \left(\frac{L_i}{L_3}\right)^{0.4}$

LOCATION	DESIGN POINT	INLET #	Q (CFS)	S_o (%)	S_x (%)	T (FT.)	F_W	F_{WT}	L_1 (FT.)	L_2 (FT.)	L_3 (FT.)	$\frac{Q_i}{Q}$ (%)	Q_i (CFS)
CENTENNIAL	A+14	1	195	5.5	4.2	26	3.85	100	80	67	165		
			83			18'	3.60	65			107		
SILENTRAIN	15	2	28	5.7	2.5	17	3.33	57.			93		
			15			14	3.22	46			74		
WHITE BARN	19	3	24	2.0	2.0	22.	1.99	44			72		
			5			8							
ALLEGHENY	20	4	56	4.5	2.0	29	2.95	86			141		
			31			20.5							
ALLEGHENY	21	5	42	4.5	2.0	24	3.03	73			120		
			20			13							

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FIMS MAP DRAINAGE PLAN

SHEET 1 OF 2 - FULLY DEVELOPED WITH NO DIVERSION

SHEET 2 OF 2 - FULLY DEVELOPED WITH DIVERSION