ATTACHMENT 18

LDC
THE CIVIL ENGINEERING GROUP

Commercial
Infrastructure
Residential

Memo

To: Jeff Dendy, City of Redmond, Development Services

From: Matthew Merritt, P.E.; Mark Villwock, P.E.

CC: Kevin O'Brien; Craig Seers

Date: November 11, 2013

Re: Benjamin Estates: Offsite Storm Design / Analysis

11/12/2013

Dear Mr. Dendy,

The Benjamin Estates and Willow Hill Developments propose to discharge their stormwater releases to a proposed (new) underground pipe which will convey all developed flows directly into the existing public storm system within Willows Commerce Park. Though the drainage design for Benjamin Estates and Willow Hill allow for the collection of stormwater runoff from required frontage improvements within NE 100th St., the detention and water quality facilities proposed cannot manage flows from all upstream offsite acreage currently carried through roadside swales within the frontage lengths for the proposed developments. The NE 100th ST upstream offsite flows are collected by proposed catch basin and bypass the collection/detention systems for the proposed developments. The mitigated releases from proposed on-site detention join the upstream offsite by-passed flows and all are conveyed east down a significant slope to the existing Willows Commerce Park system.

The City of Redmond requested an analysis of the proposed bypass and off-site storm system and its integration into the existing Willows Commerce Park/Willow Road system. As the proposed detention system will release less than the existing condition for the developed areas, and the existing upstream offsite areas are only being piped/by-passed through the improvement area, there should be no increase in flows to threaten the existing downstream system. There are no records of complaints or drainage problems within Willows Commerce Park or Willow Road.

Existing Willows Commerce Park Storm System Design/Evaluation

Current surface drainage is such that runoff from the north NE 100th St. ROW flows into the Benjamin property, and then under (by culvert) a private drive east of the Benjamin property, to discharge onto private property. Similarly, the south roadside ditch of NE 100th St. is conveyed by a culvert at the intersection with 138th Ave SE northeast to discharge onto private property. From this private property stormwater flows down steep grades within rills and ravines to the base of the hill where it is collected by the storm system at Willows Commerce Park (WCP).

The Drainage Report approved as part of the WCP development (see Engineering Report, Willows Commerce Park Phase 3, prepared by Coughlin, Porter, Lundeen. 1998) identified an upstream tributary drainage area of which Willows Hill and Benjamin Estates proposed developed areas are a part. The basins, and land uses for the upstream areas were identified using USGS Quadrangle maps, per the 1992 DOE SWMM. Based on the WCP drainage report the upstream acreage was separated into three areas tributary to WCP; Basins A, B and C (see

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COUGHLIN PORTER LUNDEEN

A CONSULTING STRUCTURAL AND CIVIL ENGINEERING CORPORATION

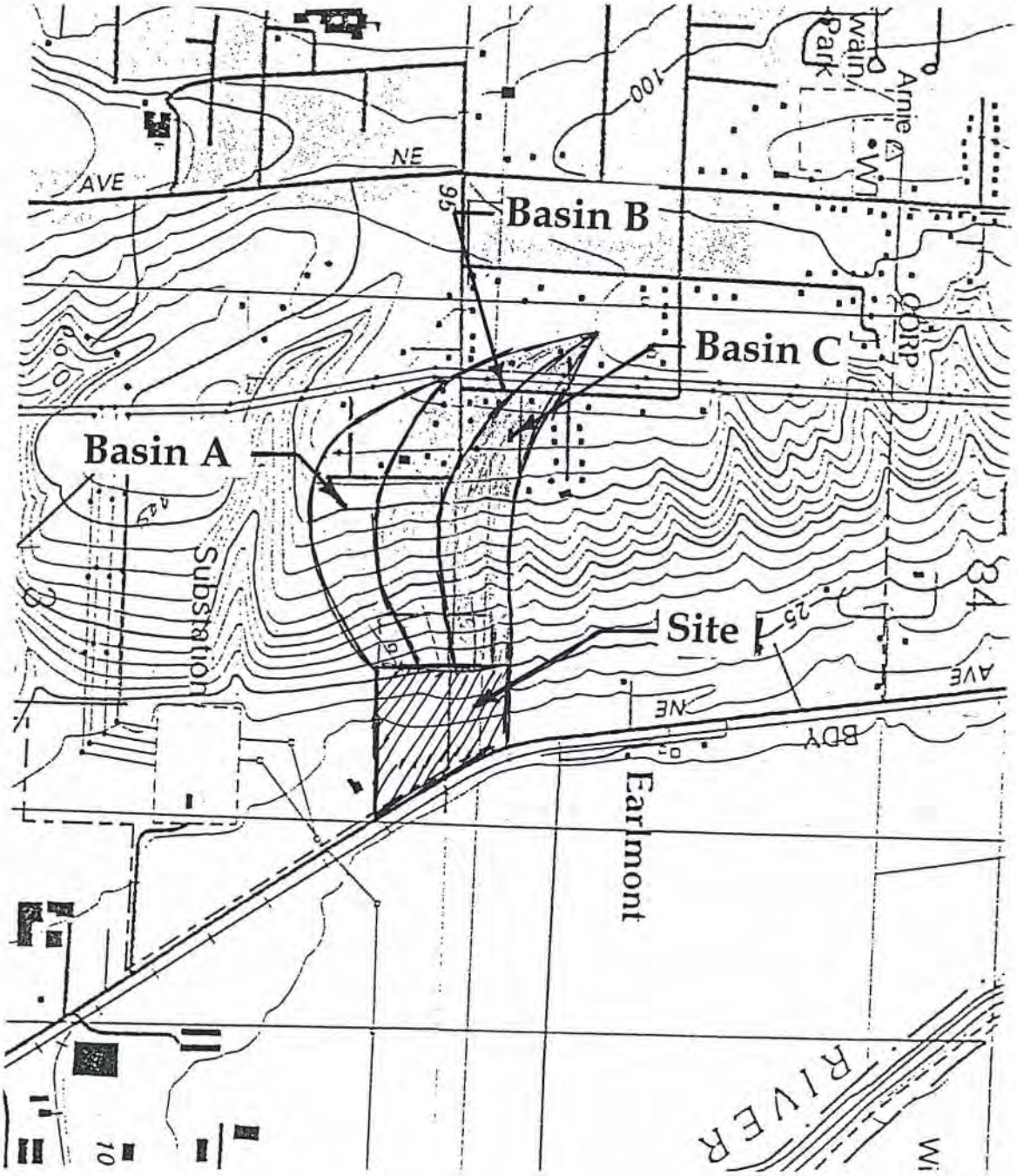

EXHIBIT 1 - WCP UPSTREAM BASIN DELINIATION

PROJECT Willows Commerce Park Phase III

PROJECT NO. 96-0632-02 CLIENT Opus Northwest

DESIGNED BY: JAS DATE: 6/12/98

CHECKED BY: LJP SHEET 4 of 7

217 PINE STREET SUITE 520 SEATTLE, WA 98101 P:206/343-0460 F:206/343-3691

Exhibit 1). Basin C, the most northerly basin, contains areas which are proposed to be developed as Benjamin Estates and Willow Hill developments.

Per WCP Drainage Report:

Basin C: **Area: 14.8 acres**
CN: 83 (81-Forest, and 98-impervious)

The WCP storm/conveyance design provided a bypass pipe/system around the north side of building D (north bypass) conveying Basin C flows directly into the Willows Road drainage system. No surface water from the Willows Commerce Park development is collected by the bypass system, until the connection to Willows Road. The system does collect flows from interflow and groundwater cutoffs, and retaining wall drain pipes, but this flow is considered to be inconsequential.

Because the scale and detail available on USGS quad maps does not allow as detailed a delineation of either landform or land use/cover, and more detailed LiDAR topography is and aerial image land cover assessments are available, an analysis of Existing conditions with more detailed current data is presented below.

Model Parameters

The analysis of the proposed downstream system has been completed based on parameters set by the City of Redmond through coordination with LDC, Inc. The parameters for the model are as follows:

Bluff Basin Area: Area (Based on Current/Existing Drainage/Flow Paths) draining to the NE 100th St. east terminus, just prior to the unimproved ROW (Total = 26.85acres).

Basin Composition: Basin Area modeled as "current" existing condition, with contribution from Benjamin Estates and Willow Hill Developments being modeled as release mitigated from required detention. (*As the detention facility is modeled in WWHM, and downstream conveyance model is based on SCS/SBUH, the drainage area tributary to the pond will be assigned a value of 81, which corresponds to the pre-developed release rates/durations against which WWHM is evaluating mitigated releases.)*

Conveyance Flow: The conveyance system will be evaluated per 2012 City of Redmond Technical Notebook criteria to ensure that the system into which the Benjamin Estates and Willow Hill mitigated release will discharge (proposed and existing), can convey the following:

- 25-year event: HGL's within the proposed/existing conveyance (no overtopping)
- 50-year event: Must show flows from 50-year event do not impact existing/proposed structures (in the event that HGL is above catch basin inlets, must show surface flow/conveyance does not impact structures)

Downstream Limit: As the purpose of this evaluation is not to establish modeling/hydrology for the entire basin tributary to the system in Willow Road, the City of Redmond established a downstream modeling parameter that limited

the flow evaluated in the system to only that flow originating from the Bluff Basin Area described above (the bluff area is the sole significant source of flow for Willows Commerce Park "north bypass pipe" by original design), with a downstream tailwater condition at the 36" "culvert" crossing Willows Road set at "full" (top of pipe).

Though there are other sources of runoff which are collected into the reach of the Willow Road system within the model boundaries, these flows (based on City GIS/Storm data) are likely minor compared with the flow capacity of a Willow Road system (24" pipe) and the 36" culvert crossing Willow Road. As the unknown area tributary to the Willow Road reach being modeled is likely much smaller than would outstrip the 24" pipe, modeling the 36" downstream segment as "full" is a conservative downstream parameter.

Modeled Basin

According to updated City of Redmond Road/Storm System GIS maps, on-site surface flow/ditch/culvert confirmation, current King County LiDAR topography, and current aerial imagery, the existing acreage upstream of the WCP Basin C bypass conveyance is as shown in Exhibit 2.

Current/Existing Basin C: Area: 26.85 acres (including Benjamin and Hill)
CN: 86.1 (Composite)

This acreage is divided into 2 basins for evaluation; Basin C1, and C2. Basin C1, is comprised of area which drains via historic drainage patters and existing roadside ditch conveyance to the eastern terminus of NE 100th St. This area also includes the entire Willows Hill and Benjamin Estates property among other "offsite" areas (See Offsite Conveyance spreadsheets below). This is the existing tributary area to the east terminus of NE 100th St.

Basin C1: Area: 17.97 Acres
CN: 87.5* (Composite CN)

*Hill and Benjamin properties accounted in the Composite CN as CN=81 or forested, as their runoff will be mitigated to match pre-developed "forested" rates.

It is proposed that Basin C1 will be collected into a piped-system at the east terminus of NE 100th St. and piped down the bluff to tie into the existing WCP system.

Basin C2 is the acreage which is east (the slope of the bluff) and slightly north of the proposed development of Benjamin Estates, and which will not be collected as part of proposed on-site or offsite development. These flows, though not part of or impacted by proposed development, are collected and conveyed after surface flow down the bluff, by the same "north-bypass" WCP system as Basin C-1, and so is evaluated as part of the existing watershed tributary to the WCP system. Basin C2 is collected in inlets at the top of an existing retaining wall constructed as part of WCP. Though there are 3 separate ravines which are collected independently, the entire acreage for Basin C2 has been routed into a single up-gradient location to achieve a conservative flow model (See Exhibit 2).

Basin C2: Area: 8.88Acres
CN: 83.2 (Composite CN)

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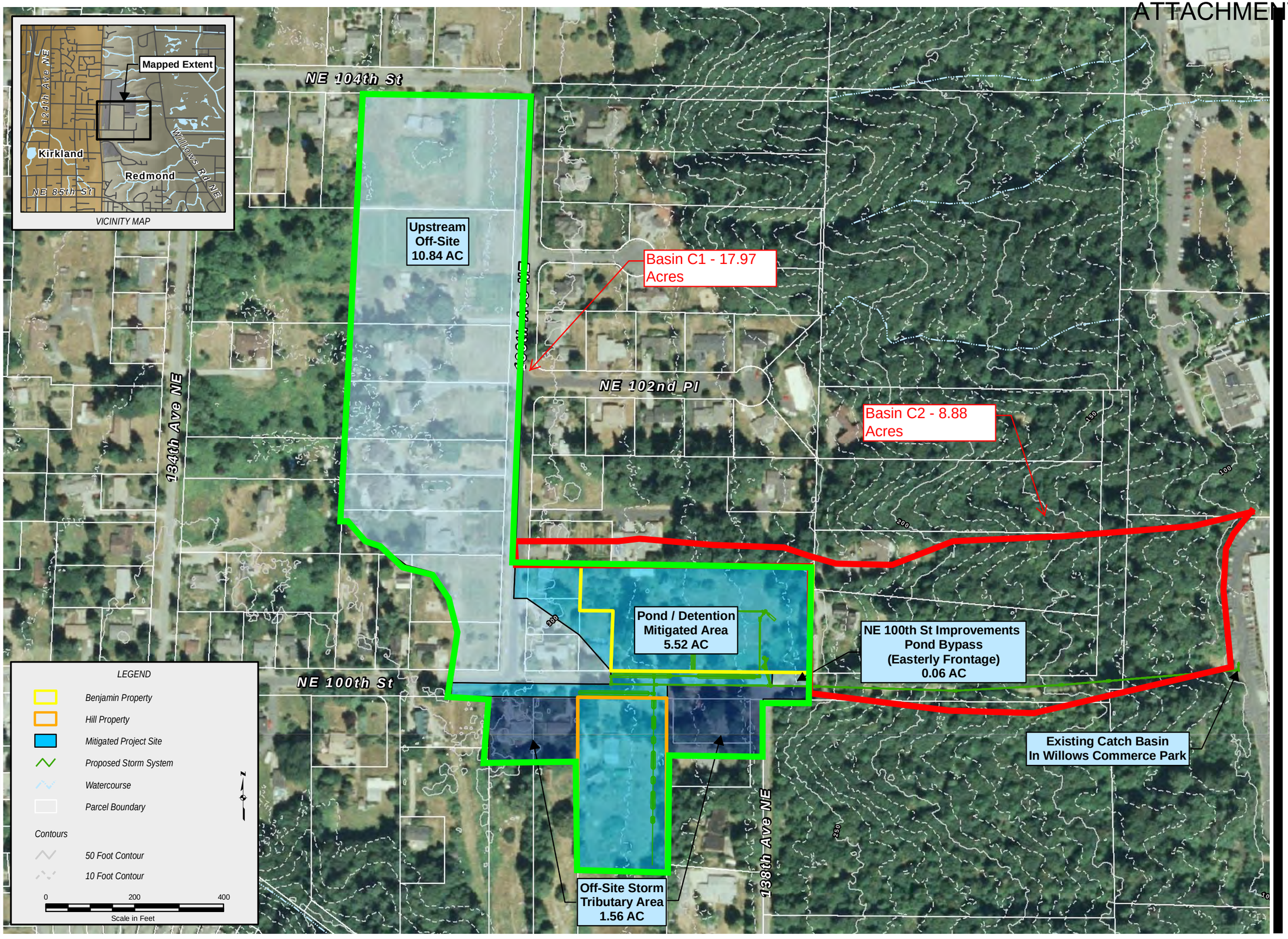

SOURCE INFORMATION

SOURCE AGENCY	DESCRIPTION
USDA	COLOR AERIAL PHOTOGRAPHY (2006)
KING COUNTY GIS	TEN FOOT CONTOUR - GENERATED FROM BARE EARTH LiDAR (KING COUNTY). THIS DATA HAS A STATED VERTICAL ACCURACY OF APPROXIMATELY 1 FOOT.
CITY OF REDMOND	HYDROLOGY
KING COUNTY GIS	PARCEL BOUNDARIES

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TAYLOR DEVELOPMENT, INC.

BENJAMIN & HILL PROPERTIES

OFF-SITE STORM TRIBUTARY AREA MAP

PROJECTION: WASHINGTON STATE PLANE, NORTH ZONE, NAD 83 HARN, FEET

REVISION:	
JOB NUMBER:	12-166
DRAWING NAME:	12-166F01
DESIGNER:	A. BENTON
DRAWING BY:	I. MIERAU
DATE:	11-01-12
SCALE:	AS SHOWN
JURISDICTION:	REDMOND

Exhibit 2

12-166F03.mxd | MOD 5/15/2013 | IGM

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BENJAMIN ESTATES **Offsite Conveyance -CN Calculations**	*LDC, Inc.*	
	142201 NE 200th St. # 100 Woodinville, WA 98072	Tel: (425) 806-1869 Fax: (425) 482-2893

Project Name: Benjamin and Hill
Description: Basin Calculations

Project No.: 12-166 & 12-169
Date: 11/8/2013
Calc. By: MWM

Composite CN

C-1: Top of Hill 17.97 Acres

Basin / Sub-Area Name				Upstream-Offsite / DS bypass
Basin/Subject Acreage				10.90
Land Use CN	**98.00**	**86.00**	**81**	
Land Type	Impervious	Lawn	Forested	Composite CN
Land Area	3.28	7.62	0.00	
Land Area Percent	30%	70%	0%	
Weighted CN's	29.49	60.12	0.00	89.61
				54.33

Basin / Sub-Area Name				Off-Site South of 100th
Basin/Subject Acreage				1.56
Land Use CN	**98.00**	**86.00**	**81**	
Land Type	Impervious	Lawn	Forested	Composite CN
Land Area (acres)	0.47	0.94	0.16	
Land Area Percent	30%	60%	10%	
Weighted CN's	29.40	51.60	8.10	89.10
				7.73

Basin / Sub-Area Name				Hill/Benjamin
Basin/Subject Acreage				5.52
Land Use CN	**98.00**	**86.00**	**81**	
Land Type	Impervious	Lawn	Forested	Composite CN*
Land Area (acres)	0.40	0.74	4.38	
Land Area Percent	7%	13%	79%	
Weighted CN's	7.07	11.50	64.32	**82.90**
				25.44

* As Benjamin and Hill developed flows will be mitigated to Forested condition - CN 81 used as part of composite calculation

Total Composite CN	**87.51**

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	142201 NE 200th St. # 100 Woodinville, WA 98072	Tel: (425) 806-1869 Fax: (425) 482-2893

Project Name: Benjamin and Hill
Description: Basin Calculations

Project No.: 12-166 & 12-169
Date: 11/8/2013
Calc. By: MWM

Composite CN

C-2: Slope/Downhill 8.88 Acres

Basin / Sub-Area Name			South of 100th	
Basin/Subject Acreage			8.88	
Land Use CN	**98.00**	**86.00**	**81**	
Land Type	Impervious	Lawn	Forested	Composite CN
Land Area (acres)	0.16	0.16	1.25	
Land Area Percent	10%	10%	80%	
Weighted CN's	**9.8**	**8.6**	**64.8**	**83.20**
				41.11

Resultant Flows

The upstream Basins as defined above generate the following peak flows:

25-year Event

Basin C1:	Peak 25yr Runoff = 3.87cfs
Basin C2:	Peak 25yr Runoff = 2.20cfs

50-year Event

Basin C1:	Peak 50yr Runoff = 4.59cfs
Basin C2:	Peak 50yr Runoff = 2.70cfs

The time of concentration generating the peak flows for these 2 basins differ however, and the peak Routed system flows are the following:

Peak System Routed 25yr: 5.95cfs
Peak System Routed 50yr: 7.16cfs

The WCP Basin C Bypass system caries both the 25 and 50 year events with the HGL within the system (all headwater elevations are below CB rim elevations). See StormShed output below.

Proposed Offsite Conveyance Sizing

Proposed Conveyance to carry storm runoff from the east terminus of NE 100th St. down the bluff to the existing WCP system is evaluated for conveyance as a 12" (ID) HDPE pipe. This pipe has an open-channel (gravity) capacity 7.74cfs at 4% slope (See open channel calculation sheet attached). The average slope down the bluff is 18.5%, and any low-slope length toward the bottom of the bluff will be subject to more than 50ft of hydraulic head. At 4% slope the proposed 12" HDPE storm pipe capacity is 157% of the 100yr runoff (4.91cfs) from the 17.97 acre C1 basin identified above, without considering head pressure. A 12" diameter is sufficient to carry modeled C1 Basin within the development frontage of NE 100th St. and down the bluff to the existing WCP system.

Existing WCP/Willows Road Conveyance Evaluation

The WCP system as-builts (See attached WCP north bypass line as-builts) were used as the basis for the corresponding portion of the system model within StormShed. As as-built plans are not available for the Willow Road reach, invert elevations as available from the City of Redmond GIS database were used with Adjusted Rim/grate elevations.

All HGL elevations are below surface grate elevations in both the 25-year and 50-year events, with a downstream tail-water elevation at the top of the 36" CAP "culvert". See StormShed output below.

If you have any questions or require additional data or information please don't hesitate contact me (mmerritt@LDCCorp.com, 425-806-1869). Thank you in advance for your review.

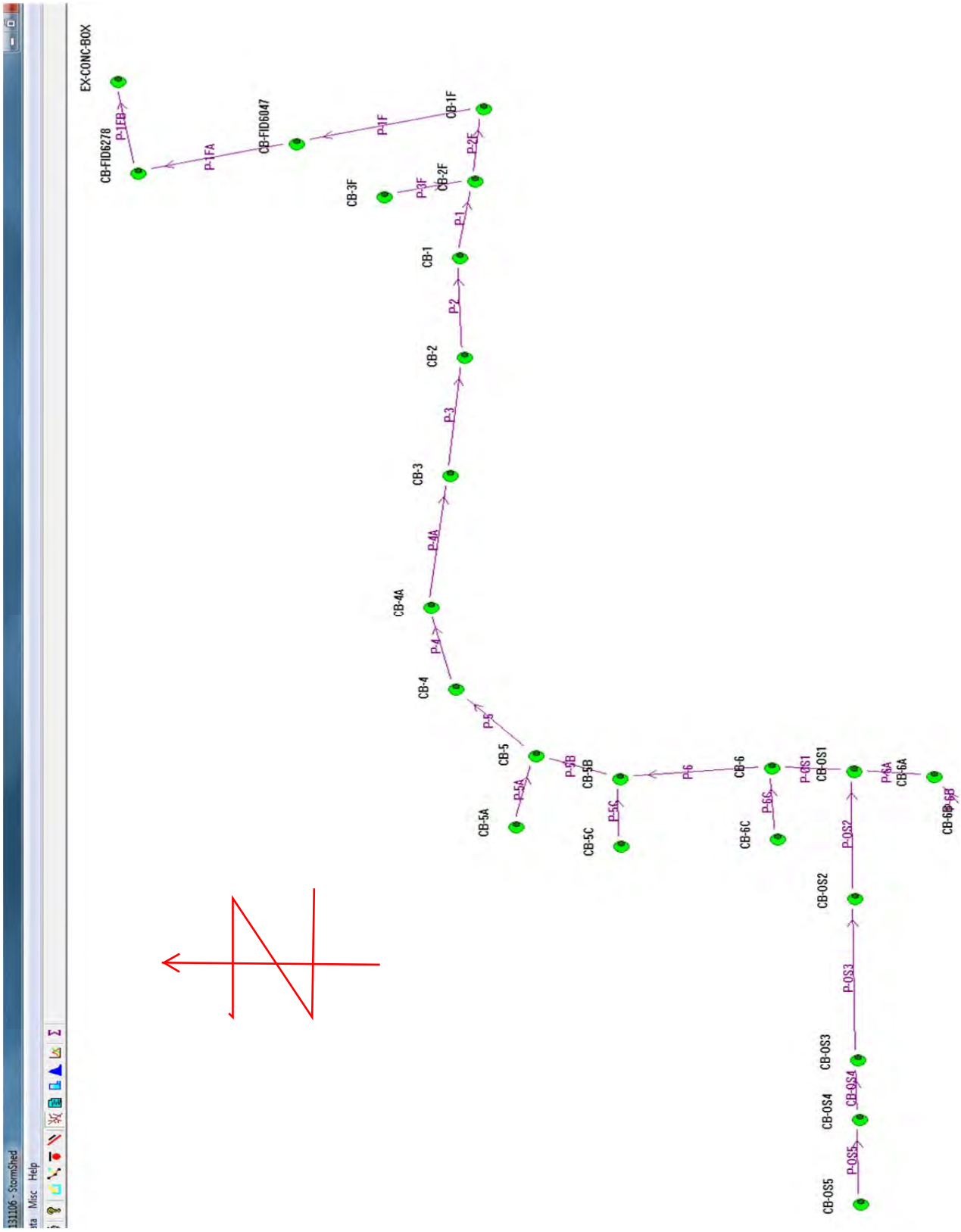
Sincerely,

Matthew Merritt, P.E.
Project Manager, LDC, Inc.

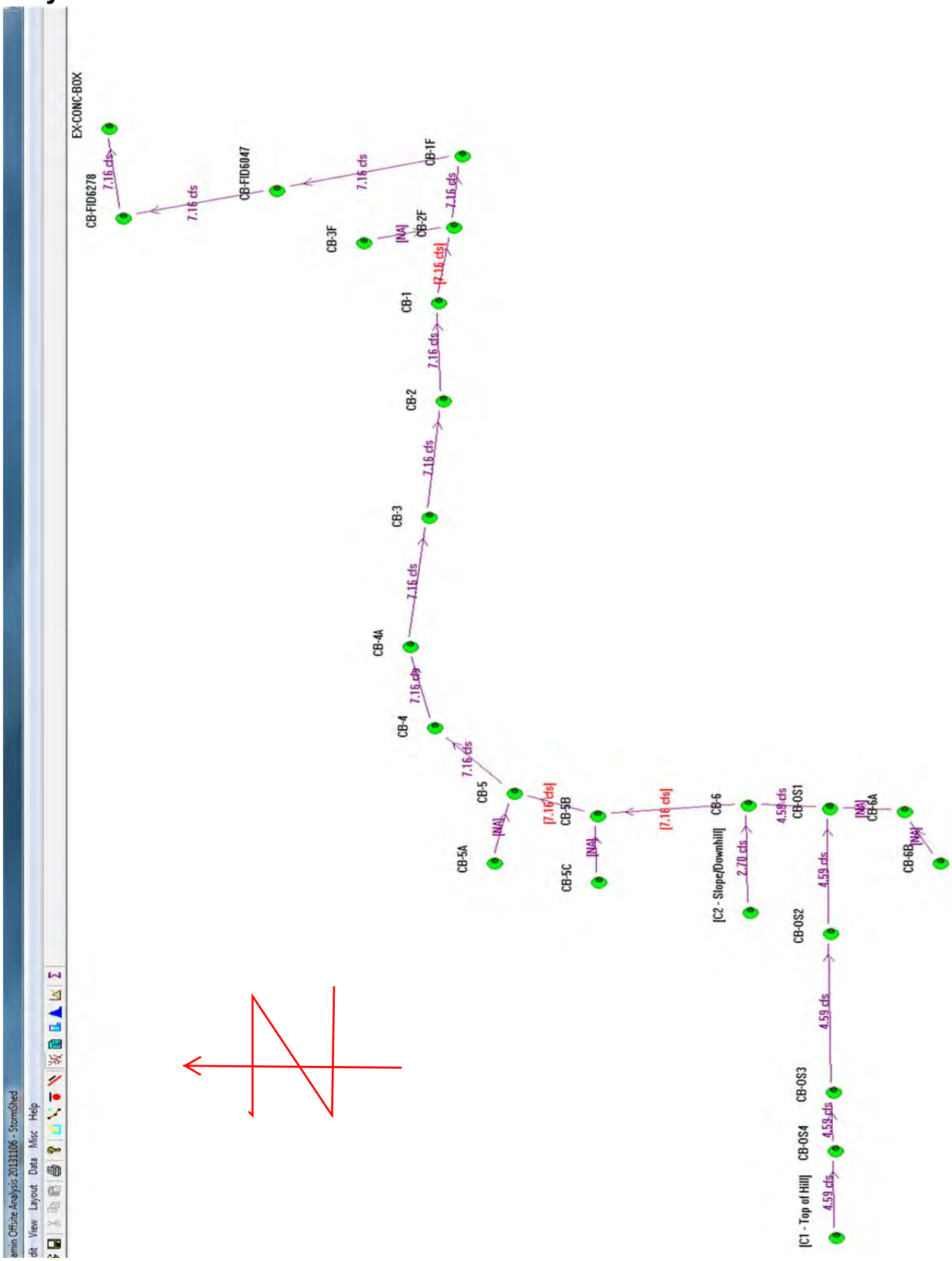
ATTACHMENT 18

Willows Commerce Park – Basin C Bypass Conveyance

Modeled System



50-year flows/Routed



C1 - Top of Hill Event Summary

Event	Peak Q (cfs)	Peak T (hrs)	Hyd Vol (acft)	Area (ac)	Method	Raintype
2 year	1.2908	9.00	1.1307	17.9400	SBUH	TYPE1A
10 year	2.9752	8.67	2.2676	17.9400	SBUH	TYPE1A
25 year	3.8698	8.50	2.8570	17.9400	SBUH	TYPE1A
50 year	4.5936	8.50	3.3267	17.9400	SBUH	TYPE1A
100 year	4.9081	8.50	3.5304	17.9400	SBUH	TYPE1A

Record Id: C1 - Top of Hill

Design Method	SBUH	**Rainfall type**	TYPE1A
Hyd Intv	10.00 min	**Peaking Factor**	484.00
		Abstraction Coeff	0.20
Pervious Area (AMC 2)	17.94 ac	**DCIA**	0.00 ac
Pervious CN	87.50	**DC CN**	0.00
Pervious TC	75.93 min	**DC TC**	0.00 min

Pervious CN Calc

Description	SubArea	Sub cn
Open spaces, lawns, parks (50-75% grass)	17.94 ac	87.50
Pervious Composited CN (AMC 2)		87.50

Pervious TC Calc

Type	Description	Length	Slope	Coeff	Misc	TT
Sheet	Short prairie grass and lawns.: 0.15	300.00 ft	0.50%	0.1500	1.77 in	55.24 min
SCS	Shallow Concentrated, pasture and lawns (n=0.030)	435.00 ft	0.50%	11.0000	0.50	9.32 min
SCS	Small roadside ditch w/grass (k=15.0)	675.00 ft	0.75%	15.0000	0.50	8.66 min
SCS	Small roadside ditch w/grass (k=15.0)	430.00 ft	5.60%	15.0000	0.50	2.02 min
SCS	Storm Sewers 24 in diam (k=78.333)	300.00 ft	9.80%	78.0000	0.50	0.20 min
SCS	Storm Sewers 24 in diam (k=78.333)	640.00 ft	18.50%	78.0000	0.50	0.32 min
SCS	Storm Sewers 24 in diam (k=78.333)	291.00 ft	13.60%	78.0000	0.50	0.17 min
Pervious TC						75.93 min

C2 - Slope/Downhill Event Summary

Event	Peak Q (cfs)	Peak T (hrs)	Hyd Vol (acft)	Area (ac)	Method	Raintype
2 year	0.5469	8.17	0.4079	8.8800	SBUH	TYPE1A
10 year	1.6196	8.17	0.9041	8.8800	SBUH	TYPE1A
25 year	2.2170	8.17	1.1711	8.8800	SBUH	TYPE1A
50 year	2.7045	8.17	1.3867	8.8800	SBUH	TYPE1A
100 year	2.9184	8.17	1.4809	8.8800	SBUH	TYPE1A

Record Id: C2 - Slope/Downhill

Design Method	SBUH	**Rainfall type**	TYPE1A
Hyd Intv	10.00 min	**Peaking Factor**	484.00
		Abstraction Coeff	0.20
Pervious Area (AMC 2)	8.88 ac	**DCIA**	0.00 ac
Pervious CN	83.20	**DC CN**	0.00
Pervious TC	27.73 min	**DC TC**	0.00 min

Pervious CN Calc

Description	SubArea	Sub cn
Open spaces, lawns, parks (50-75% grass)	8.88 ac	83.20
Pervious Composited CN (AMC 2)		83.20

Pervious TC Calc

Type	Description	Length	Slope	Coeff	Misc	TT
SCS	Concentrated / Channelized	70.00 ft	6.00%	11.0000	0.50	0.43 min
SCS	Forested drain crse/ravine w/defined bed (n=0.050)	640.00 ft	20.50%	10.0000	0.50	2.36 min
SCS	Forested drain crse/ravine w/defined bed (n=0.050)	280.00 ft	13.60%	10.0000	0.50	1.27 min
Sheet	Sheet	300.00 ft	5.00%	0.1500	1.77 in	21.99 min
SCS	Concentrated / Channelized / Forrested	320.00 ft	10.00%	10.0000	0.50	1.69 min
Pervious TC						27.73 min

ROUTEHYD [] THRU [Untitled] USING TYPE1A AND [25 year] SCS/SBUH

Reach ID	Area (ac)	Flow (cfs)	Full Q (cfs)	Full ratio	nDepth (ft)	Size	nVel (ft/s)	fVel (ft/s)	CBasin / Hyd
P-3F	0.0000	0.0000	3.6431	0.00	0.0000	12" Diam	0.0000	4.6386	
P-5A	0.0000	0.0000	11.2969	0.00	0.0000	12" Diam	0.0000	14.3837	
P-5C	0.0000	0.0000	13.8127	0.00	0.0000	12" Diam	0.0000	17.5868	
P-OS5	17.9400	3.8698	10.9097	0.35	0.4116	12" Diam	12.6968	13.8907	C1 - Top of Hill
CB-OS4	17.9400	3.8698	10.3203	0.37	0.4243	12" Diam	12.1957	13.1402	
P-OS3	17.9400	3.8698	15.2445	0.25	0.3433	12" Diam	16.2209	19.4100	
P-OS2	17.9400	3.8698	13.1404	0.29	0.3716	12" Diam	14.5640	16.7309	
P-6B	0.0000	0.0000	10.9227	0.00	0.0000	12" Diam	0.0000	13.9072	
P-6A	0.0000	0.0000	3.5286	0.00	0.0000	12" Diam	0.0000	4.4927	
P-OS1	17.9400	3.8698	4.9963	0.77	0.6606	12" Diam	7.0291	6.3614	
P-6C	8.8800	2.2170	23.3005	0.10	0.2085	12" Diam	18.6813	29.6671	C2 - Slope/Downhill
P-6	26.8200	5.9479	3.7566	1.58	-----	12" Diam	7.5731	4.7831	
P-5B	26.8200	5.9479	6.0397	0.98	0.8062	12" Diam	8.7667	7.6900	
P-5	26.8200	5.9479	8.8328	0.67	0.6011	12" Diam	12.0627	11.2462	
P-4	26.8200	5.9479	9.8412	0.60	0.5610	12" Diam	13.1132	12.5302	
P-4A	26.8200	5.9479	17.5196	0.34	0.4019	12" Diam	20.1495	22.3067	
P-3	26.8200	5.9479	14.1830	0.42	0.4517	12" Diam	17.2686	18.0584	
P-2	26.8200	5.9479	13.2034	0.45	0.4702	12" Diam	16.3885	16.8110	
P-1	26.8200	5.9479	5.4122	1.10	-----	12" Diam	7.5731	6.8910	
P-2F	26.8200	5.9479	11.2584	0.53	0.7753	18" Diam	6.4548	6.3709	

P-1F	26.8200	5.9479	37.3576	0.16	0.5396	24" Diam	8.7013	11.8913	
P-1FA	26.8200	5.9479	25.8833	0.23	0.6519	24" Diam	6.6917	8.2389	
P-1FB	26.8200	5.9479	29.5731	0.20	0.9122	36" Diam	3.2731	4.1837	

From Node	To Node	Rch Loss (ft)	App (ft)	Bend (ft)	Junct Loss (ft)	HW Loss Elev (ft)	Max El (ft)
							36.6500
CB-FID6278	EX-CONC-BOX	36.9750	0.0557	0.0813	------	37.0006	38.7500
CB-FID6047	CB-FID6278	37.1113	0.0557	0.0002	------	37.0558	38.7500
CB-1F	CB-FID6047	37.1615	0.6470	1.2473	------	37.7618	39.2900
CB-2F	CB-1F	39.4834	0.8906	0.0127	------	38.6055	39.3500
CB-3F	CB-2F	0.0000	------	------	------	0.0000	39.3600
CB-1	CB-2F	40.3591	0.8906	0.0413	------	39.5099	40.6400
CB-2	CB-1	45.3419	0.8906	0.0269	------	44.4783	48.9300
CB-3	CB-2	60.8769	0.8906	0.0055	------	59.9918	67.1600
CB-4A	CB-3	79.2170	0.8906	0.0901	------	78.4165	80.0700
CB-4	CB-4A	80.6165	0.8906	0.1710	------	79.8970	81.4100
CB-5	CB-4	82.5500	0.8906	0.1590	------	81.8185	83.1700
CB-5A	CB-5	0.0000	------	------	------	0.0000	88.5800
CB-5B	CB-5	83.9378	0.8906	0.1381	------	83.1853	86.4200
CB-5C	CB-5B	0.0000	------	------	------	0.0000	92.7000
CB-6	CB-5B	86.3925	0.3770	0.0139	0.1402	86.1696	92.4400
No approach losses at node CB-OS2 because inverts and/or crowns are offset.							
CB-OS1	CB-6	86.7120	------	------	------	86.7120	93.5000
CB-OS2	CB-OS1	130.6612	0.3770	0.0018	------	130.2861	134.2800
CB-OS3	CB-OS2	247.7278	0.3770	0.0019	------	247.3527	252.0000
CB-OS4	CB-OS3	248.7689	0.3770	0.0023	------	248.3942	255.6800
CB-OS5	CB-OS4	252.2565	------	------	------	252.2565	263.4300
No approach losses at node CB-6B because inverts and/or crowns are offset.							
CB-6A	CB-OS1	0.0000	------	------	------	0.0000	93.9100
CB-6B	CB-6A	0.0000	------	------	------	0.0000	93.1300
CB-6C	CB-6	87.8710	------	------	------	87.8710	92.7100

ROUTEHYD [] THRU [Untitled] USING TYPE1A AND [50 year] SCS/SBUH

Reach ID	Area (ac)	Flow (cfs)	Full Q (cfs)	Full ratio	nDepth (ft)	Size	nVel (ft/s)	fVel (ft/s)	CBasin / Hyd
P-3F	0.0000	0.0000	3.6431	0.00	0.0000	12" Diam	0.0000	4.6386	
P-5A	0.0000	0.0000	11.2969	0.00	0.0000	12" Diam	0.0000	14.3837	
P-5C	0.0000	0.0000	13.8127	0.00	0.0000	12" Diam	0.0000	17.5868	
P-OS5	17.9400	4.5936	10.9097	0.42	0.4526	12" Diam	13.2990	13.8907	C1 - Top of Hill
CB-OS4	17.9400	4.5936	10.3203	0.45	0.4673	12" Diam	12.7597	13.1402	
P-OS3	17.9400	4.5936	15.2445	0.30	0.3765	12" Diam	16.9860	19.4100	
P-OS2	17.9400	4.5936	13.1404	0.35	0.4077	12" Diam	15.2641	16.7309	
P-6B	0.0000	0.0000	10.9227	0.00	0.0000	12" Diam	0.0000	13.9072	
P-6A	0.0000	0.0000	3.5286	0.00	0.0000	12" Diam	0.0000	4.4927	
P-OS1	17.9400	4.5936	4.9963	0.92	0.7554	12" Diam	7.2171	6.3614	
P-6C	8.8800	2.7045	23.3005	0.12	0.2300	12" Diam	19.8209	29.6671	C2 - Slope/Downhill
P-6	26.8200	7.1592	3.7566	1.91	-----	12" Diam	9.1154	4.7831	
P-5B	26.8200	7.1592	6.0397	1.19	-----	12" Diam	9.1154	7.6900	
P-5	26.8200	7.1592	8.8328	0.81	0.6831	12" Diam	12.5243	11.2462	
P-4	26.8200	7.1592	9.8412	0.73	0.6323	12" Diam	13.6766	12.5302	
P-4A	26.8200	7.1592	17.5196	0.41	0.4448	12" Diam	21.2039	22.3067	
P-3	26.8200	7.1592	14.1830	0.50	0.5024	12" Diam	18.1181	18.0584	
P-2	26.8200	7.1592	13.2034	0.54	0.5249	12" Diam	17.1440	16.8110	
P-1	26.8200	7.1592	5.4122	1.32	-----	12" Diam	9.1154	6.8910	
P-2F	26.8200	7.1592	11.2584	0.64	0.8683	18" Diam	6.7523	6.3709	

P-1F	26.8200	7.1592	37.3576	0.19	0.5933	24" Diam	9.1744	11.8913	
P-1FA	26.8200	7.1592	25.8833	0.28	0.7192	24" Diam	7.0413	8.2389	
P-1FB	26.8200	7.1592	29.5731	0.24	1.0052	36" Diam	3.4462	4.1837	

From Node	To Node	Rch Loss (ft)	App (ft)	Bend (ft)	Junct Loss (ft)	HW Loss Elev (ft)	Max El (ft)
							36.6500
CB-FID6278	EX-CONC-BOX	37.0134	0.0806	0.1178	------	37.0505	38.7500
CB-FID6047	CB-FID6278	37.2108	0.0806	0.0003	------	37.1304	38.7500
CB-1F	CB-FID6047	37.2835	0.7080	1.3649	------	37.9405	39.2900
CB-2F	CB-1F	38.3393	1.2902	0.0184	------	37.0674	39.3500
CB-3F	CB-2F	0.0000	------	------	------	0.0000	39.3600
CB-1	CB-2F	40.1633	1.2902	0.0599	------	38.9330	40.6400
CB-2	CB-1	46.0935	1.2902	0.0390	------	44.8423	48.9300
CB-3	CB-2	61.6285	1.2902	0.0079	------	60.3462	67.1600
CB-4A	CB-3	79.9686	1.2902	0.1305	------	78.8089	80.0700
CB-4	CB-4A	81.3680	1.2902	0.2478	------	80.3256	81.4100
CB-5	CB-4	83.3016	1.2902	0.2303	------	82.2417	83.1700
CB-5A	CB-5	0.0000	------	------	------	0.0000	88.5800
CB-5B	CB-5	85.4507	1.2902	0.2000	------	84.3605	86.4200
CB-5C	CB-5B	0.0000	------	------	------	0.0000	92.7000
CB-6	CB-5B	89.0070	0.5312	0.0196	0.2016	88.6971	92.4400
No approach losses at node CB-OS2 because inverts and/or crowns are offset.							
CB-OS1	CB-6	89.4613	------	------	------	89.4613	93.5000
CB-OS2	CB-OS1	130.9512	0.5312	0.0026	------	130.4226	134.2800
CB-OS3	CB-OS2	248.0178	0.5312	0.0027	------	247.4893	252.0000
CB-OS4	CB-OS3	249.0589	0.5312	0.0033	------	248.5310	255.6800
CB-OS5	CB-OS4	252.5465	------	------	------	252.5465	263.4300
No approach losses at node CB-6B because inverts and/or crowns are offset.							
CB-6A	CB-OS1	0.0000	------	------	------	0.0000	93.9100
CB-6B	CB-6A	0.0000	------	------	------	0.0000	93.1300
CB-6C	CB-6	88.9815	------	------	------	88.9815	92.7100

Pipes and Catch Basin Data

Layout Report: Untitled

Event	Precip (in)
2 year	1.7700
10 year	2.7000
25 year	3.1500
50 year	3.5000
100 year	3.6500

Reach Records

Record Id: CB-OS4

Section Shape:	Circular		
Uniform Flow Method:	Manning's	Coefficient:	0.0090
Routing Method:	Travel Time Translation	Contributing Hyd	
DnNode	CB-OS3	UpNode	CB-OS4
Material	Plastic	Size	12" Diam
Ent Losses	Groove End w/Headwall		
Length	34.3000 ft	Slope	4.00%
Up Invert	247.3400 ft	Dn Invert	245.9680 ft

Conduit Constraints				
Min Vel	Max Vel	Min Slope	Max Slope	Min Cover
2.00 ft/s	15.00 ft/s	0.50%	21.00%	3.00 ft

Drop across MH	0.0000 ft	Ex/Infil Rate	0.0000 in/hr
Up Invert	245.9680 ft	Dn Invert	247.3400 ft
Match inverts.			

Record Id: P-1

Section Shape:	Circular		
Uniform Flow Method:	Manning's	Coefficient:	0.0090
Routing Method:	Travel Time Translation	Contributing Hyd	
DnNode	CB-2F	UpNode	CB-1
Material	Plastic	Size	12" Diam
Ent Losses	Groove End w/Headwall		
Length	51.5600 ft	Slope	1.10%
Up Invert	37.1900 ft	Dn Invert	36.6228 ft

Conduit Constraints				
Min Vel	Max Vel	Min Slope	Max Slope	Min Cover
2.00 ft/s	15.00 ft/s	0.50%	21.00%	3.00 ft

Drop across MH	0.0000 ft	Ex/Infil Rate	0.0000 in/hr
Up Invert	36.6228 ft	Dn Invert	37.1900 ft
Match inverts.			

Record Id: P-1F

Section Shape:	Circular		
Uniform Flow Method:	Manning's	Coefficient:	0.0090
Routing Method:	Travel Time Translation	Contributing Hyd	
DnNode	CB-FID6047	UpNode	CB-1F
Material	Plastic	Size	24" Diam
Ent Losses	Groove End w/Headwall		
Length	118.0000 ft	Slope	1.30%
Up Invert	35.8700 ft	Dn Invert	34.3360 ft

Conduit Constraints				
Min Vel	Max Vel	Min Slope	Max Slope	Min Cover
2.00 ft/s	15.00 ft/s	0.50%	21.00%	3.00 ft

Drop across MH	0.0000 ft	Ex/Infil Rate	0.0000 in/hr
Up Invert	34.3360 ft	Dn Invert	35.8700 ft
Match inverts.			

Record Id: P-1FA

Section Shape:	Circular		
Uniform Flow Method:	Manning's	Coefficient:	0.0090
Routing Method:	Travel Time Translation	Contributing Hyd	
DnNode	CB-FID6278	UpNode	CB-FID6047
Material	Plastic	Size	24" Diam
Ent Losses	Groove End w/Headwall		
Length	133.0000 ft	Slope	0.62%
Up Invert	34.2300 ft	Dn Invert	33.3999 ft

Conduit Constraints				
Min Vel	Max Vel	Min Slope	Max Slope	Min Cover
2.00 ft/s	15.00 ft/s	0.50%	21.00%	3.00 ft

Drop across MH	0.0000 ft	Ex/Infil Rate	0.0000 in/hr
Up Invert	33.3999 ft	Dn Invert	34.2300 ft
Match inverts.			

Record Id: P-1FB

Section Shape:	Circular		
Uniform Flow Method:	Manning's	Coefficient:	0.0220
Routing Method:	Travel Time Translation	Contributing Hyd	
DnNode	EX-CONC-BOX	UpNode	CB-FID6278
Material	Corr Metal - new	Size	36" Diam
Ent Losses	Projecting		
Length	50.0000 ft	Slope	0.56%
Up Invert	33.9300 ft	Dn Invert	33.6500 ft

Conduit Constraints				
Min Vel	Max Vel	Min Slope	Max Slope	Min Cover
2.00 ft/s	15.00 ft/s	0.50%	21.00%	3.00 ft

Drop across MH	0.0000 ft	Ex/Infil Rate	0.0000 in/hr
Up Invert	33.6500 ft	Dn Invert	33.9300 ft
Match inverts.			

Record Id: P-2

Section Shape:	Circular		
Uniform Flow Method:	Manning's	Coefficient:	0.0090
Routing Method:	Travel Time Translation	Contributing Hyd	
DnNode	CB-1	UpNode	CB-2
Material	Plastic	Size	12" Diam
Ent Losses	Groove End w/Headwall		
Length	89.2000 ft	Slope	6.55%
Up Invert	42.9600 ft	Dn Invert	37.1200 ft

Conduit Constraints				
Min Vel	Max Vel	Min Slope	Max Slope	Min Cover
2.00 ft/s	15.00 ft/s	0.50%	21.00%	3.00 ft

Drop across MH	0.0000 ft	Ex/Infil Rate	0.0000 in/hr
Up Invert	37.1200 ft	Dn Invert	42.9600 ft
Match inverts.			

Record Id: P-2F

Section Shape:	Circular		
Uniform Flow Method:	Manning's	Coefficient:	0.0090
Routing Method:	Travel Time Translation	Contributing Hyd	
DnNode	CB-1F	UpNode	CB-2F
Material	Plastic	Size	18" Diam
Ent Losses	Groove End w/Headwall		
Length	42.0000 ft	Slope	0.55%
Up Invert	36.5200 ft	Dn Invert	36.2900 ft

Conduit Constraints				
Min Vel	Max Vel	Min Slope	Max Slope	Min Cover
2.00 ft/s	15.00 ft/s	0.50%	21.00%	3.00 ft

Drop across MH	0.0000 ft	Ex/Infil Rate	0.0000 in/hr
Up Invert	36.2900 ft	Dn Invert	36.5200 ft
Match inverts.			

Record Id: P-3

Section Shape:	Circular		
Uniform Flow Method:	Manning's	Coefficient:	0.0090
Routing Method:	Travel Time Translation	Contributing Hyd	
DnNode	CB-2	UpNode	CB-3
Material	Plastic	Size	12" Diam
Ent Losses	Groove End w/Headwall		
Length	205.7000 ft	Slope	7.55%
Up Invert	58.5000 ft	Dn Invert	42.9600 ft

Conduit Constraints				
Min Vel	Max Vel	Min Slope	Max Slope	Min Cover
2.00 ft/s	15.00 ft/s	0.50%	21.00%	3.00 ft

Drop across MH	0.0000 ft	Ex/Infil Rate	0.0000 in/hr
Up Invert	42.9600 ft	Dn Invert	58.5000 ft
Match inverts.			

Record Id: P-3F

Section Shape:	Circular		
Uniform Flow Method:	Manning's	Coefficient:	0.0130
Routing Method:	Travel Time Translation	Contributing Hyd	
DnNode	CB-2F	UpNode	CB-3F
Material	Plastic	Size	12" Diam
Ent Losses	Groove End w/Headwall		
Length	25.0000 ft	Slope	1.04%
Up Invert	36.7600 ft	Dn Invert	36.5000 ft

Conduit Constraints				
Min Vel	Max Vel	Min Slope	Max Slope	Min Cover
2.00 ft/s	15.00 ft/s	0.50%	21.00%	3.00 ft

Drop across MH	0.0000 ft	Ex/Infil Rate	0.0000 in/hr
Up Invert	36.5000 ft	Dn Invert	36.7600 ft
Match inverts.			

Record Id: P-4

Section Shape:	Circular		
Uniform Flow Method:	Manning's	Coefficient:	0.0090
Routing Method:	Travel Time Translation	Contributing Hyd	
DnNode	CB-4A	UpNode	CB-4
Material	Plastic	Size	12" Diam
Ent Losses	Groove End w/Headwall		
Length	40.1400 ft	Slope	3.64%
Up Invert	78.2200 ft	Dn Invert	76.7600 ft

Conduit Constraints				
Min Vel	Max Vel	Min Slope	Max Slope	Min Cover
2.00 ft/s	15.00 ft/s	0.50%	21.00%	3.00 ft

Drop across MH	0.0000 ft	Ex/Infil Rate	0.0000 in/hr
Up Invert	76.7600 ft	Dn Invert	78.2200 ft
Match inverts.			

Record Id: P-4A

Section Shape:	Circular		
Uniform Flow Method:	Manning's	Coefficient:	0.0090
Routing Method:	Travel Time Translation	Contributing Hyd	
DnNode	CB-3	UpNode	CB-4A
Material	Plastic	Size	12" Diam
Ent Losses	Groove End w/Headwall		
Length	159.1000 ft	Slope	11.53%
Up Invert	76.8600 ft	Dn Invert	58.5200 ft

Conduit Constraints				
Min Vel	Max Vel	Min Slope	Max Slope	Min Cover
2.00 ft/s	15.00 ft/s	0.50%	21.00%	3.00 ft

Drop across MH	0.0000 ft	Ex/Infil Rate	0.0000 in/hr
Up Invert	58.5200 ft	Dn Invert	76.8600 ft
Match inverts.			

Record Id: P-5

Section Shape:	Circular		
Uniform Flow Method:	Manning's	Coefficient:	0.0090
Routing Method:	Travel Time Translation	Contributing Hyd	
DnNode	CB-4	UpNode	CB-5
Material	Plastic	Size	12" Diam
Ent Losses	Groove End w/Headwall		
Length	62.7500 ft	Slope	2.93%
Up Invert	80.1500 ft	Dn Invert	78.3114 ft

Conduit Constraints				
Min Vel	Max Vel	Min Slope	Max Slope	Min Cover
2.00 ft/s	15.00 ft/s	0.50%	21.00%	3.00 ft

Drop across MH	0.0000 ft	Ex/Infil Rate	0.0000 in/hr
Up Invert	78.3114 ft	Dn Invert	80.1500 ft
Match inverts.			

Record Id: P-5A

Section Shape:	Circular		
Uniform Flow Method:	Manning's	Coefficient:	0.0130
Routing Method:	Travel Time Translation	Contributing Hyd	
DnNode	CB-5	UpNode	CB-5A
Material	Plastic	Size	12" Diam
Ent Losses	Groove End w/Headwall		
Length	22.0000 ft	Slope	10.00%
Up Invert	82.5200 ft	Dn Invert	80.3200 ft

Conduit Constraints				
Min Vel	Max Vel	Min Slope	Max Slope	Min Cover
2.00 ft/s	15.00 ft/s	0.50%	21.00%	3.00 ft

Drop across MH	0.0000 ft	Ex/Infil Rate	0.0000 in/hr
Up Invert	80.3200 ft	Dn Invert	82.5200 ft
Match inverts.			

Record Id: P-5B

Section Shape:	Circular		
Uniform Flow Method:	Manning's	Coefficient:	0.0090
Routing Method:	Travel Time Translation	Contributing Hyd	
DnNode	CB-5	UpNode	CB-5B
Material	Plastic	Size	12" Diam
Ent Losses	Groove End w/Headwall		
Length	86.3000 ft	Slope	1.37%
Up Invert	81.5300 ft	Dn Invert	80.3477 ft

Conduit Constraints				
Min Vel	Max Vel	Min Slope	Max Slope	Min Cover
2.00 ft/s	15.00 ft/s	0.50%	21.00%	3.00 ft

Drop across MH	0.0000 ft	Ex/Infil Rate	0.0000 in/hr
Up Invert	80.3477 ft	Dn Invert	81.5300 ft
Match inverts.			

Record Id: P-5C

Section Shape:	Circular		
Uniform Flow Method:	Manning's	Coefficient:	0.0130
Routing Method:	Travel Time Translation	Contributing Hyd	
DnNode	CB-5B	UpNode	CB-5C
Material	Plastic	Size	12" Diam
Ent Losses	Groove End w/Headwall		
Length	27.9000 ft	Slope	14.95%
Up Invert	85.5900 ft	Dn Invert	81.4190 ft

Conduit Constraints				
Min Vel	Max Vel	Min Slope	Max Slope	Min Cover
2.00 ft/s	15.00 ft/s	0.50%	21.00%	3.00 ft

Drop across MH	0.0000 ft	Ex/Infil Rate	0.0000 in/hr
Up Invert	81.4190 ft	Dn Invert	85.5900 ft
Match inverts.			

Record Id: P-6

Section Shape:	Circular		
Uniform Flow Method:	Manning's	Coefficient:	0.0090
Routing Method:	Travel Time Translation	Contributing Hyd	
DnNode	CB-5B	UpNode	CB-6
Material	Plastic	Size	12" Diam
Ent Losses	Groove End w/Headwall		
Length	161.0000 ft	Slope	0.53%
Up Invert	82.3900 ft	Dn Invert	81.5367 ft

Conduit Constraints				
Min Vel	Max Vel	Min Slope	Max Slope	Min Cover
2.00 ft/s	15.00 ft/s	0.50%	21.00%	3.00 ft

Drop across MH	0.0000 ft	Ex/Infil Rate	0.0000 in/hr
Up Invert	81.5367 ft	Dn Invert	82.3900 ft
Match inverts.			

Record Id: P-6A

Section Shape:	Circular		
Uniform Flow Method:	Manning's	Coefficient:	0.0130
Routing Method:	Travel Time Translation	Contributing Hyd	
DnNode	CB-OS1	UpNode	CB-6A
Material	Plastic	Size	12" Diam
Ent Losses	Groove End w/Headwall		
Length	16.4000 ft	Slope	0.98%
Up Invert	82.7000 ft	Dn Invert	82.5400 ft

Conduit Constraints				
Min Vel	Max Vel	Min Slope	Max Slope	Min Cover
2.00 ft/s	15.00 ft/s	0.50%	21.00%	3.00 ft

Drop across MH	0.0000 ft	Ex/Infil Rate	0.0000 in/hr
Up Invert	82.5400 ft	Dn Invert	82.7000 ft
Match inverts.			

Record Id: P-6B

Section Shape:	Circular		
Uniform Flow Method:	Manning's	Coefficient:	0.0090
Routing Method:	Travel Time Translation	Contributing Hyd	
DnNode	CB-6A	UpNode	CB-6B
Material	Plastic	Size	12" Diam
Ent Losses	Groove End w/Headwall		
Length	6.7000 ft	Slope	4.48%
Up Invert	87.9100 ft	Dn Invert	87.6098 ft

Conduit Constraints				
Min Vel	Max Vel	Min Slope	Max Slope	Min Cover
2.00 ft/s	15.00 ft/s	0.50%	21.00%	3.00 ft

Drop across MH	0.0000 ft	Ex/Infil Rate	0.0000 in/hr
Up Invert	87.6098 ft	Dn Invert	87.9100 ft
Match inverts.			

Record Id: P-6C

Section Shape:	Circular		
Uniform Flow Method:	Manning's	Coefficient:	0.0090
Routing Method:	Travel Time Translation	Contributing Hyd	
DnNode	CB-6	UpNode	CB-6C
Material	Plastic	Size	12" Diam
Ent Losses	Groove End w/Headwall		
Length	23.1000 ft	Slope	20.39%
Up Invert	87.0000 ft	Dn Invert	82.2900 ft

Conduit Constraints				
Min Vel	Max Vel	Min Slope	Max Slope	Min Cover
2.00 ft/s	15.00 ft/s	0.50%	21.00%	3.00 ft

Drop across MH	0.0000 ft	Ex/Infil Rate	0.0000 in/hr
Up Invert	82.2900 ft	Dn Invert	87.0000 ft
Match inverts.			

Record Id: P-OS1

Section Shape:	Circular		
Uniform Flow Method:	Manning's	Coefficient:	0.0090
Routing Method:	Travel Time Translation	Contributing Hyd	
DnNode	CB-6	UpNode	CB-OS1
Material	Plastic	Size	12" Diam
Ent Losses	Groove End w/Headwall		
Length	16.0000 ft	Slope	0.94%
Up Invert	82.5400 ft	Dn Invert	82.3900 ft

Conduit Constraints				
Min Vel	Max Vel	Min Slope	Max Slope	Min Cover
2.00 ft/s	15.00 ft/s	0.50%	21.00%	3.00 ft

Drop across MH	0.0000 ft	Ex/Infil Rate	0.0000 in/hr
Up Invert	82.3900 ft	Dn Invert	82.5400 ft
Match inverts.			

Record Id: P-OS2

Section Shape:	Circular		
Uniform Flow Method:	Manning's	Coefficient:	0.0130
Routing Method:	Travel Time Translation	Contributing Hyd	
DnNode	CB-OS1	UpNode	CB-OS2
Material	Plastic	Size	12" Diam
Ent Losses	Groove End w/Headwall		
Length	291.0000 ft	Slope	13.53%
Up Invert	129.2800 ft	Dn Invert	89.9077 ft

Conduit Constraints				
Min Vel	Max Vel	Min Slope	Max Slope	Min Cover
2.00 ft/s	15.00 ft/s	0.50%	21.00%	3.00 ft

Drop across MH	0.0000 ft	Ex/Infil Rate	0.0000 in/hr
Up Invert	89.9077 ft	Dn Invert	129.2800 ft
Match inverts.			

Record Id: P-OS3

Section Shape:	Circular		
Uniform Flow Method:	Manning's	Coefficient:	0.0130
Routing Method:	Travel Time Translation	Contributing Hyd	
DnNode	CB-OS2	UpNode	CB-OS3
Material	Plastic	Size	12" Diam
Ent Losses	Groove End w/Headwall		
Length	643.0000 ft	Slope	18.21%
Up Invert	246.3700 ft	Dn Invert	129.2797 ft

Conduit Constraints				
Min Vel	Max Vel	Min Slope	Max Slope	Min Cover
2.00 ft/s	15.00 ft/s	0.50%	21.00%	3.00 ft

Drop across MH	0.0000 ft	Ex/Infil Rate	0.0000 in/hr
Up Invert	129.2797 ft	Dn Invert	246.3700 ft
Match inverts.			

Record Id: P-OS5

Section Shape:	Circular		
Uniform Flow Method:	Manning's	Coefficient:	0.0090
Routing Method:	Travel Time Translation	Contributing Hyd	
DnNode	CB-OS4	UpNode	CB-OS5
Material	Plastic	Size	12" Diam
Ent Losses	Groove End w/Headwall		
Length	78.0000 ft	Slope	4.47%
Up Invert	250.8300 ft	Dn Invert	247.3434 ft

Conduit Constraints				
Min Vel	Max Vel	Min Slope	Max Slope	Min Cover
2.00 ft/s	15.00 ft/s	0.50%	21.00%	3.00 ft

Drop across MH	0.0000 ft	Ex/Infil Rate	0.0000 in/hr
Up Invert	247.3434 ft	Dn Invert	250.8300 ft
Match inverts.			

Node Records

Record Id: CB-1

Descrip:	Prototype Record	Increment	0.10 ft
Start El.	37.1900 ft	Max El.	40.6400 ft
Classification	Catch Basin	Structure Type	CB-TYPE 1
Ent Ke	Groove End w/Headwall (ke=0.20)	Channelization	Curved or Deflector
Catch	1.4160 ft	Bottom Area	3.9700 sf
Condition	Existing		

Record Id: CB-1F

Descrip:	Prototype Record	Increment	0.10 ft
Start El.	35.8700 ft	Max El.	39.2900 ft
Classification	Catch Basin	Structure Type	CB-TYPE 2-48
Ent Ke	Groove End w/Headwall (ke=0.20)	Channelization	Curved or Deflector
Catch	2.0000 ft	Bottom Area	12.5664 sf
Condition	Existing		

Record Id: CB-2

Descrip:	Prototype Record	Increment	0.10 ft
Start El.	42.9600 ft	Max El.	48.9300 ft
Classification	Catch Basin	Structure Type	CB-TYPE 2-48
Ent Ke	Groove End w/Headwall (ke=0.20)	Channelization	Curved or Deflector
Catch	2.0000 ft	Bottom Area	12.5664 sf
Condition	Existing		

Record Id: CB-2F

Descrip:	Prototype Record	Increment	0.10 ft
Start El.	36.5200 ft	Max El.	39.3500 ft
Classification	Catch Basin	Structure Type	CB-TYPE 1
Ent Ke	Groove End w/Headwall (ke=0.20)	Channelization	Curved or Deflector
Catch	1.4160 ft	Bottom Area	3.9700 sf
Condition	Existing		

Record Id: CB-3

Descrip:	Prototype Record	Increment	0.10 ft
Start El.	58.5000 ft	Max El.	67.1600 ft
Classification	Manhole	Structure Type	CB-TYPE 2-48
Ent Ke	Groove End w/Headwall (ke=0.20)	Channelization	Curved or Deflector
Catch	2.0000 ft	Bottom Area	12.5664 sf
Condition	Existing		

Record Id: CB-3F

Descrip:	Prototype Record	Increment	0.10 ft
Start El.	36.7600 ft	Max El.	39.3600 ft
Classification	Catch Basin	Structure Type	CB-TYPE 1
Ent Ke	Groove End w/Headwall (ke=0.20)	Channelization	Curved or Deflector
Catch	1.4160 ft	Bottom Area	3.9700 sf
Condition	Existing		

Record Id: CB-4

Descrip:	Prototype Record	Increment	0.10 ft
Start El.	78.2200 ft	Max El.	81.4100 ft
Classification	Manhole	Structure Type	CB-TYPE 1
Ent Ke	Groove End w/Headwall (ke=0.20)	Channelization	Curved or Deflector
Catch	1.4160 ft	Bottom Area	3.9700 sf
Condition	Existing		

Record Id: CB-4A

Descrip:	Prototype Record	Increment	0.10 ft
Start El.	76.8600 ft	Max El.	80.0700 ft
Classification	Catch Basin	Structure Type	CB-TYPE 1
Ent Ke	Groove End w/Headwall (ke=0.20)	Channelization	Curved or Deflector
Catch	1.4160 ft	Bottom Area	3.9700 sf
Condition	Existing		

Record Id: CB-5

Descrip:	Prototype Record	Increment	0.10 ft
Start El.	80.1500 ft	Max El.	83.1700 ft
Classification	Catch Basin	Structure Type	CB-TYPE 1
Ent Ke	Groove End w/Headwall (ke=0.20)	Channelization	Curved or Deflector
Catch	1.4160 ft	Bottom Area	3.9700 sf
Condition	Existing		

Record Id: CB-5A

Descrip:	Prototype Record	Increment	0.10 ft
Start El.	82.5200 ft	Max El.	88.5800 ft
Classification	Catch Basin	Structure Type	AREA INLET- 24
Ent Ke	Groove End w/Headwall (ke=0.20)	Channelization	Curved or Deflector
Catch	0.0000 ft	Bottom Area	3.1416 sf
Condition	Existing		

Record Id: CB-5B

Descrip:	Prototype Record	Increment	0.10 ft
Start El.	81.5300 ft	Max El.	86.4200 ft
Classification	Catch Basin	Structure Type	CB-TYPE 1
Ent Ke	Groove End w/Headwall (ke=0.20)	Channelization	Curved or Deflector
Catch	1.4160 ft	Bottom Area	3.9700 sf
Condition	Existing		

Record Id: CB-5C

Descrip:	Prototype Record	Increment	0.10 ft
Start El.	85.5900 ft	Max El.	92.7000 ft
Classification	Catch Basin	Structure Type	AREA INLET- 24
Ent Ke	Groove End w/Headwall (ke=0.20)	Channelization	Curved or Deflector
Catch	0.0000 ft	Bottom Area	3.1416 sf
Condition	Existing		

Record Id: CB-6

Descrip:	Prototype Record	Increment	0.10 ft
Start El.	82.3900 ft	Max El.	92.4400 ft
Classification	Catch Basin	Structure Type	CB-TYPE 2-48
Ent Ke	Groove End w/Headwall (ke=0.20)	Channelization	Curved or Deflector
Catch	2.0000 ft	Bottom Area	12.5664 sf
Condition	Existing		

Record Id: CB-6A

Descrip:	Prototype Record	Increment	0.10 ft
Start El.	82.7000 ft	Max El.	93.9100 ft
Classification	Catch Basin	Structure Type	CB-TYPE 2-48
Ent Ke	Groove End w/Headwall (ke=0.20)	Channelization	Curved or Deflector
Catch	2.0000 ft	Bottom Area	12.5664 sf
Condition	Existing		

Record Id: CB-6B

Descrip:	Prototype Record	Increment	0.10 ft
Start El.	87.9100 ft	Max El.	93.1300 ft
Classification	Catch Basin	Structure Type	CB-TYPE 1
Ent Ke	Groove End w/Headwall (ke=0.20)	Channelization	Curved or Deflector
Catch	1.4160 ft	Bottom Area	3.9700 sf
Condition	Existing		

Record Id: CB-6C

Descrip:	Prototype Record	Increment	0.10 ft
Start El.	87.0000 ft	Max El.	92.7100 ft
Classification	Catch Basin	Structure Type	AREA INLET- 24
Ent Ke	Groove End w/Headwall (ke=0.20)	Channelization	Curved or Deflector
Catch	0.0000 ft	Bottom Area	3.1416 sf
Condition	Existing		

Record Id: CB-FID6047

Descrip:	Prototype Record	Increment	0.10 ft
Start El.	34.2300 ft	Max El.	38.7500 ft
Classification	Catch Basin	Structure Type	CB-TYPE 2-48
Ent Ke	Groove End w/Headwall (ke=0.20)	Channelization	Curved or Deflector
Catch	2.0000 ft	Bottom Area	12.5664 sf
Condition	Existing		

Record Id: CB-FID6278

Descrip:	Prototype Record	Increment	0.10 ft
Start El.	33.9300 ft	Max El.	38.7500 ft
Classification	Catch Basin	Structure Type	CB-TYPE 2-54
Ent Ke	Groove End w/Headwall (ke=0.20)	Channelization	Curved or Deflector
Catch	2.0000 ft	Bottom Area	15.9040 sf
Condition	Existing		

Record Id: CB-OS1

Descrip:	Prototype Record	Increment	0.10 ft
Start El.	82.5400 ft	Max El.	93.5000 ft
Classification	Catch Basin	Structure Type	CB-TYPE 2-48
Ent Ke	Groove End w/Headwall (ke=0.20)	Channelization	Curved or Deflector
Catch	2.0000 ft	Bottom Area	12.5664 sf
Condition	Existing		

Record Id: CB-OS2

Descrip:	Prototype Record	Increment	0.10 ft
Start El.	129.2800 ft	Max El.	134.2800 ft
Classification	Manhole	Structure Type	CB-TYPE 1-48
Ent Ke	Groove End w/Headwall (ke=0.20)	Channelization	Curved or Deflector
Catch	1.5000 ft	Bottom Area	19.6350 sf
Condition	Existing		

Record Id: CB-OS3

Descrip:	Prototype Record	Increment	0.10 ft
Start El.	246.3700 ft	Max El.	252.0000 ft
Classification	Manhole	Structure Type	CB-TYPE 1-48
Ent Ke	Groove End w/Headwall (ke=0.20)	Channelization	Curved or Deflector
Catch	1.5000 ft	Bottom Area	19.6350 sf
Condition	Existing		

Record Id: CB-OS4

Descrip:	Prototype Record	Increment	0.10 ft
Start El.	247.3400 ft	Max El.	255.6800 ft
Classification	Manhole	Structure Type	CB-TYPE 1-48
Ent Ke	Groove End w/Headwall (ke=0.20)	Channelization	Curved or Deflector
Catch	1.5000 ft	Bottom Area	19.6350 sf
Condition	Existing		

Record Id: CB-OS5

Descrip:	Prototype Record	Increment	0.10 ft
Start El.	250.8300 ft	Max El.	263.4300 ft
Classification	Manhole	Structure Type	CB-TYPE 1-48
Ent Ke	Groove End w/Headwall (ke=0.20)	Channelization	Curved or Deflector
Catch	1.5000 ft	Bottom Area	19.6350 sf
Condition	Existing		

Record Id: EX-CONC-BOX

Descrip:	Prototype Record	Increment	0.10 ft
Start El.	33.6500 ft	Max El.	38.7500 ft
Classification	Manhole	Structure Type	CONCRETE INLET
Ent Ke	Groove End w/Headwall (ke=0.20)	Channelization	Curved or Deflector
Catch	0.0000 ft	Bottom Area	17.4000 sf
Condition	Existing		

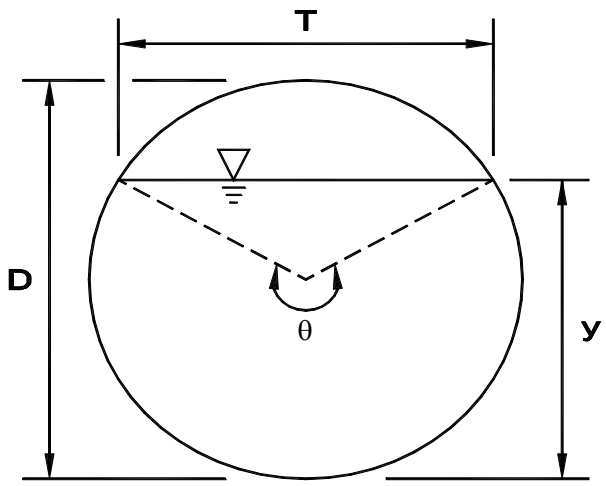
ATTACHMENT 18

Open Channel Flow Calculator For Circular Pipes	*Land Development Consultants, Inc.*	
	14201 NE 200th St. Ste. 100 Woodinville, WA 98072	Tel: (425) 806-1869 Fax: (425) 482-2893

Project Name: Benjamin
Description: Conveyance Calculation

Project No.: 12-166
Date: 11/8/2013
Calc. By: MEV

Pipe Diameter (D) =	12	in
Pipe Slope (S) =	4.00	%
Flow Depth (y) =	1.00	ft
Flowrate (Q) =	**7.74**	**cfs**
Mannings Coeff. (n) =	0.012	
Theta Angle (θ) =	6.28	rad
Wetted Area (A) =	0.79	ft^2
Wet. Perimeter (P) =	3.14	ft
Hydraulic Radius (R) =	0.25	ft
Top Width (T) =	0.00	ft
Flow Velocity =	9.86	fps



Formulas:

Theta Angle (θ): If y ≥ r : $\theta = 2\pi - 2a\cos(\frac{y-r}{r})$ where: r = Pipe Radius

If y ≤ r : $\theta = 2a\cos(\frac{r-y}{r})$ where: r = Pipe Radius

Wetted Area (A): $A = \frac{1}{8}(\theta - \sin\theta)d^2$

Wetted Perimeter (P): $P = \frac{1}{2}\theta d$

Hydraulic Radius (R): $R = \frac{A}{P}$

Top Width (T): $T = \sin\left(\theta/2\right)d$

ATTACHMENT 18

Willows Commerce Park
North Bypass Line
As Builts

ATTACHMENT 18

APPROVED FOR CONSTRUCTION
DATE: 8/20/98
DIRECTOR OF PUBLIC WORKS
CITY OF REDMOND

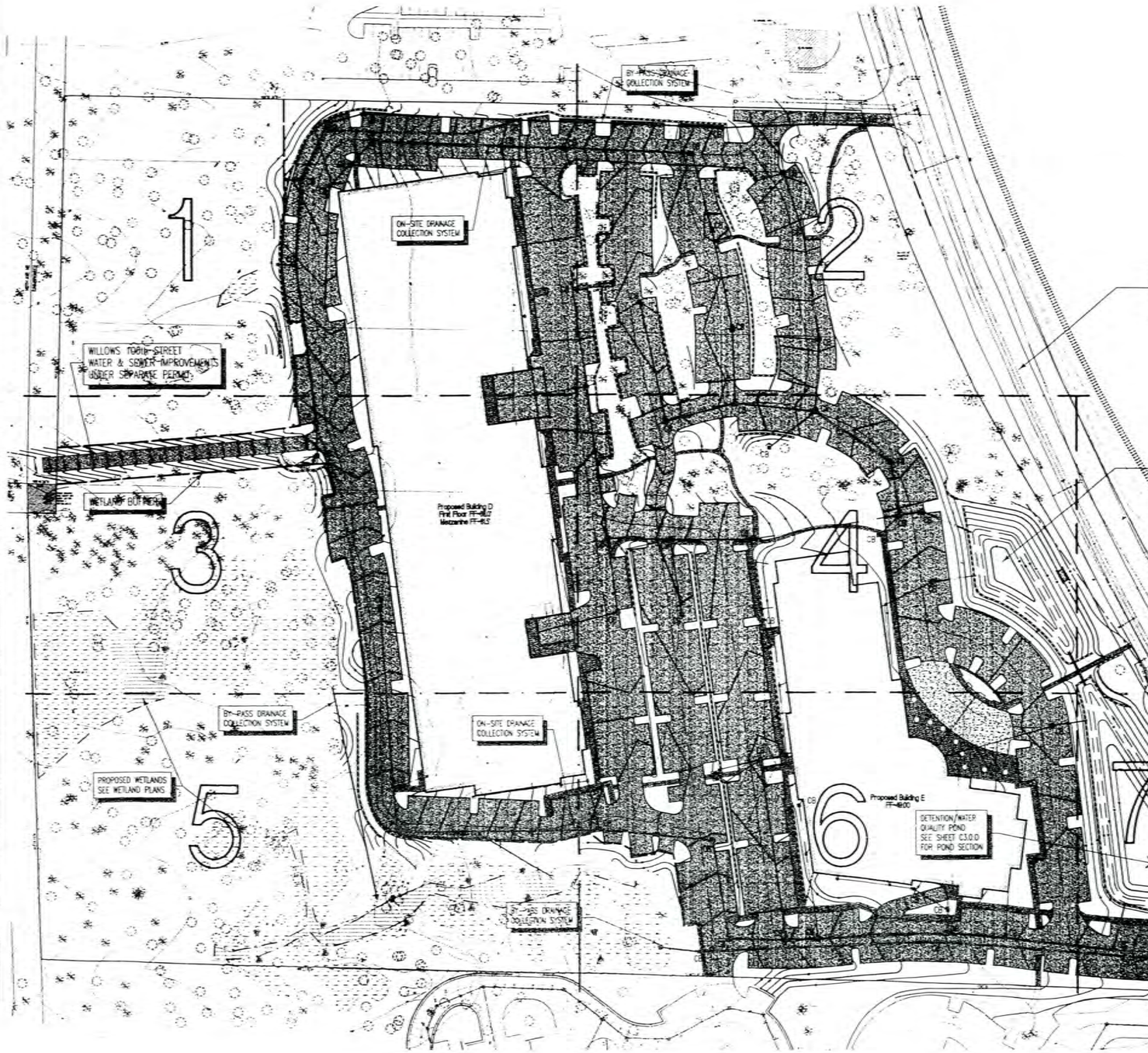
DRAINAGE ENGR: Sept 8/24/98
FOR SHEET(S)
STRUCTURAL ENGR: mkf 8/28/98
SITE ENGR: n/a
FIRE DEPT: 8/28/98
TRANS. ENGR: 8/28/98 & 9/24/98
PLANNING DEPT:

THIS APPROVAL IS FOR THE DESIGN CONCEPT ONLY. THESE PLANS APPEAR TO BE IN CONFORMANCE WITH THE CITY OF REDMOND DESIGN STANDARDS FOR CONSTRUCTION. THIS APPROVAL SHALL NOT BE CONSTRUED AS AUTHORIZING CONSTRUCTION NOT IN ACCEPTANCE WITH APPLICABLE CITY STANDARDS. THE CITY RESERVES THE RIGHT TO REQUIRE REVISIONS TO THE APPROVED PLANS TO ASSURE CONFORMANCE WITH CITY OF REDMOND DESIGN STANDARDS FOR CONSTRUCTION AT ANY TIME THAT IT IS DISCOVERED THAT THE PROPOSED CONSTRUCTION DOES NOT OTHERWISE MEET THE APPLICABLE CONSTRUCTION STANDARDS. THE OWNER IS REQUIRED TO PROVIDE DESIGNS AND PLANS IN ACCORDANCE WITH APPLICABLE CITY STANDARDS AND ASSURES THAT CONSTRUCTION IS ACCOMPLISHED IN ACCORDANCE WITH THOSE STANDARDS. THE OWNER AND/OR DESIGN ENGINEER AND/OR CONSULTANTS MAY BE REQUIRED TO MAKE NECESSARY APPROVED FIELD REVISIONS TO CORRECT ANY ERRORS OR OMISSIONS FOUND ON THE APPROVED PLAN

0 30 60 120
SCALE 1"=60'

ISSUED TO: CITY OF REDMOND
FOR: REVISED BUILDING PERMIT
DATE: 8-26-98

CALL UTILITIES BEFORE YOU DIG 1-800-424-5555



STORM DRAINAGE CONSTRUCTION

1. THE FOLLOWING MATERIALS ARE ACCEPTABLE FOR STORM DRAINAGE PIPE:

   A) CONCRETE

   8" (MINIMUM) – 24" DIAMETER SHALL BE UNREINFORCED AND SHALL CONFORM TO ASTM C-14 TABLE II, EXTRA STRENGTH, RUBBER GASKETED, AND IS REQUIRED TO PASS AIR TEST.
   LARGER THAN 24" SHALL BE REINFORCED. CLASS SHALL BE DETERMINED BY THE DESIGN ENGINEER. MINIMUM CLASS SHALL BE CL2, RUBBER GASKETED, AND IS REQUIRED TO PASS AIR TEST.
   MINIMUM COVER OVER THE PIPE FROM OUTSIDE TOP OF PIPE TO FINISHED GRADE IS 18 INCHES.

   B) PVC

   6" AND LARGER DIAMETERS SHALL MEET ASTM 3034, BE RUBBER GASKETED, AND IS REQUIRED TO PASS AIR TEST AND A MANDREL TEST.
   MINIMUM COVER OVER THE PIPE FROM OUTSIDE TOP OF PIPE TO FINISHED GRADE IS 18 INCHES AND THE MAXIMUM COVER IS 12 FEET.

   C) DUCTILE IRON

   6" AND LARGER DIAMETERS SHALL BE CLASS 52, AND IS REQUIRED TO PASS AIR TEST.
   MINIMUM COVER OVER THE PIPE FROM OUTSIDE TOP OF PIPE TO FINISHED GRADE IS 12 INCHES.

   D) CORRUGATED POLYETHYLENE PIPE (DOUBLE-WALLED HDPE)

   4" – 10" DIAMETER SHALL MEET THE REQUIREMENTS OF AASHTO M-252 TYPE S. 12"-14" DIAMETERS SHALL MEET THE REQUIREMENTS OF AASHTO M-294 TYPE S. SIZES GREATER THAN 24" DIAMETER SHALL BE SUBJECT TO PROJECT APPROVAL BY CITY OF REDMOND ENGINEERING DIVISION.
   ALL PIPE SHALL BE SUBJECT TO MANDREL TESTING (SIZE – 90" OF NOMINAL DIAMETER) AND MAY BE REQUIRED TO PASS AN AIR TEST IN ACCORDANCE WITH SECTION 7-04.3(4)D OF THE WSDOT STANDARD SPECIFICATIONS.
   ON SITE STORAGE REQUIRES A FLAT LEVEL SURFACE. PIPE SHALL BE STORED IN SHIPPING BUNKS AND NOT EXPOSED TO NATURAL LIGHT FOR EXTENDED PERIODS.
   MINIMUM COVER OVER THE PIPE FROM OUTSIDE TOP OF PIPE TO FINISH GRADE IS 18 INCHES.

2. ALL BACKFILL WITHIN EXISTING IMPROVED RIGHTS-OF-WAY SHALL BE CONTROL DENSITY FILL, SEE STANDARD DETAIL #201. IF CONTROL DENSITY FILL IS NOT REQUIRED, BACKFILL SHALL BE CRUSHED SURFACING AS PER SECTION 9-03.9(3) OF THE STANDARD SPECIFICATIONS.

3. CATCH BASINS SHALL BE CONSTRUCTED IN ACCORDANCE WITH THE STANDARD DETAILS UNLESS OTHERWISE SHOWN ON PLANS OR NOTED IN THE STANDARD SPECIFICATIONS.
   HANDHOLDS ON RISER OR ADJUSTMENT SECTION SHALL HAVE 3" MINIMUM CLEARANCE. STEPS IN STRUCTURE SHALL HAVE 6" MINIMUM CLEARANCE.
   ALL REINFORCED CAST IN PLACE CONCRETE SHALL BE CLASS 4000. ALL PRECAST CONCRETE SHALL OBTAIN A MINIMUM OF 4000 PSI @ 28 DAYS.
   PRECAST BASES SHALL BE FURNISHED WITH CUTOUTS OR KNOCKOUTS. KNOCKOUTS SHALL HAVE A WALL THICKNESS OF 2" MINIMUM.
   ALL STORM STRUCTURES SHALL BE GROUTED WATER TIGHT, INCLUDING UNDER FRAMES, MANHOLE BARREL AND RISER SECTIONS, AND PIPE COLLARS.
   ALL CAST IN PLACE STRUCTURES REQUIRE CITY APPROVAL OF STRUCTURAL DESIGN.
   CONCRETE INLETS SHALL CONFORM TO SECTION 8-04 OF THE STANDARD SPECIFICATIONS AND AS SHOWN IN THE STANDARD DETAILS.
   MATCH CROWNS ON ALL INLET AND OUTLET PIPES, AS A MINIMUM.

4. GRATES SHALL BE DUCTILE IRON AND CONFORM TO OLYMPIC FOUNDRY CO. #SM50C OR EQUAL FOR SLOPES LESS THAN 5%. WHERE SLOPES EXCEED 5%, USE OLYMPIC FOUNDRY CO. #SM50VG, OR APPROVED EQUAL, IN ACCORDANCE WITH THE STANDARD DETAIL.
   FRAMES FOR CATCH BASINS AND INLETS SHALL BE OF CAST IRON OR DUCTILE IRON CONFORMING TO OLYMPIC FOUNDRY CO. SM50, OR APPROVED EQUAL, EXCEPT THROUGH-CURB INLET FRAMES WHICH SHALL CONFORM TO OLYMPIC FOUNDRY CO. SM52, OR APPROVED EQUAL.
   SOLID COVERS FOR STRUCTURES, WHERE PERMITTED, SHALL BE 24" DIAMETER, WITH "DRAIN" CAST IN THE COVER IN 2" LETTERS, CONFORMING TO OLYMPIC FOUNDRY CO. M44-3, OR APPROVED EQUAL.
   DRAINAGE STRUCTURES NOT WITHIN PAVED AREAS SHALL HAVE LOCKING LIDS.
   FRAMES, GRATES AND COVERS SHALL NOT REFERENCE ANY JURISDICTION EXCEPT THE CITY OF REDMOND.
   RAISED DESIGNS OTHER THAN THE DIAMOND DESIGN MAY BE USED IF APPROVED BY THE ENGINEER.

5. CONNECT FOOTING DRAINS AS SHOWN ON PLANS. PROVIDE CLEANOUT PER COR STD PLAN 6210N LINE AT ALL BENDS, ENDS AND AT NO POINT GREATER THAN 100' SPACING. THE FOOTING DRAINAGE SYSTEM AND THE DOWNSPOUT SYSTEM SHALL NOT BE INTERCONNECTED UNLESS SUCH CONNECTION IS AT LEAST 1 FOOT BELOW THE FOOTING DRAINAGE SYSTEM AND DOWN SLOPE OF THE BUILDING FOUNDATION.

6. PROVIDE AND MAINTAIN TEMPORARY SEDIMENTATION COLLECTION FACILITIES TO ENSURE SEDIMENT OR OTHER HAZARDOUS MATERIAL DOES NOT ENTER THE STORM DRAINAGE SYSTEM.

7. PRIOR TO FINAL INSPECTION AND ACCEPTANCE OF STORM DRAINAGE WORK, PIPES AND STORM DRAINAGE STRUCTURES SHALL BE CLEANED AND FLUSHED. ANY OBSTRUCTIONS TO FLOW WITHIN THE STORM DRAINAGE SYSTEM, (SUCH AS RUBBLE, MORTAR AND WEDGED DEBRIS), SHALL BE REMOVED AT THE NEAREST STRUCTURE. WASH WATER OF ANY SORT SHALL NOT BE DISCHARGED TO THE STORM DRAIN SYSTEM OR SURFACE WATERS.

8. VEGETATIVE/LANDSCAPING IN THE DETENTION POND AND/OR DRAINAGE SWALE(S) IS AN INTEGRAL PART OF THE RUNOFF TREATMENT SYSTEM FOR THE PROJECT. SUCH DRAINAGE FACILITIES WILL NOT BE ACCEPTED UNTIL PLANTING IS COMPLETE.

9. INSTALL TRACER WIRE WITH ALL ROCKERY TIGHTLINES, DOWNSPOUT DRAIN LINES, AND FOOTING DRAIN TIGHTLINES.

10. PROVIDE DUCTILE IRON SLEEVE FOR ALL STORM AND SEWER PIPE EXTENDING UNDER ROCKERIES PER DETAIL 10/C5.0.0.

11. ROOF DRAIN LINES FOR BUILDING 'E' ARE INTERNAL. CONNECT PER ARCH'L, MECH'L PLANS TO ROOF DRAIN TIGHTLINE SYSTEM. ROOF DRAINS FOR BUILDING 'D' SHALL BE CONNECTED PER DETAIL 1/C5.2.0.

12. PROVIDE SAFETY RAILING AT ROCKERIES AND RETAINING WALLS ADJACENT TO PEDESTRIAN WALKWAYS WHERE GRADE DIFFERENCE IS GREATER THAN 30".

98-1709

OPUS
OPUS NORTHWEST, L.L.C.
200 – 112TH AVENUE NE, SUITE 205
BELLEVUE, WASHINGTON 98004
(206) 453-4100

A CONSULTING STRUCTURAL AND CIVIL ENGINEERING CORPORATION
217 PINE STREET - SUITE 300
SEATTLE, WA 98101
206.343.0460
FAX 206.343.0461

KEY MAP
N.T.S.

WILLOWS COMMERCE PARK
PHASE III
Redmond, Washington

STEPHEN C. PORTER
STATE OF WASHINGTON
PROFESSIONAL ENGINEER
8-26-98
EXPIRES 07/23/2000

NO	DATE	REVISION

SHEET TITLE
GRADING & DRAINAGE PLAN

97-0326-02
JOB NO.
DR
DRAWN
UP
CHECKED
8-26-98
DATE

SHEET NUMBER
C1.1.0

COUGHLIN PORTER LUNDEEN

EMERIE J. PEARL
REGISTERED PROFESSIONAL ENGINEER
8-26-98
EXPIRES 10/16/2000

ATTACHMENT 18

ISSUED TO: CITY OF REDMOND
FOR: REVISED BUILDING PERMIT
DATE: 8-26-98

CALL UTILITIES BEFORE YOU DIG 1-800-424-5555

SCALE 1"=20'

MATCHLINE - SEE SHEET C11.1

MATCHLINE - SEE SHEET C11.5

MATCHLINE - SEE SHEET C11.4

LEGEND

	EXISTING	REMOVE	PROPOSED
ASPHALT PAVING			
CEMENT CONCRETE			
BUILDINGS			
CURBING			
CONTOUR (INDEX)	120		100
CONTOUR	97		98
ROCKERY			
TREE			

	EXISTING	PROPOSED
ELECTRIC LINE	PWR	
GAS LINE	G	
OVERHEAD POWER	OHP	OHP
SANITARY SEWER LINE	SS	
STORM DRAINAGE LINE	SD	
TELEPHONE LINE	T	
WATER LINE	W	
INTERCEPTOR TRENCH		

	EXISTING	PROPOSED
FIRE HYDRANT / FDC / PIV		
VALVE / BLOWOFF		
FITTINGS		
THRUST BLOCKING		
SS MH / CLEANOUT		
GAS METER		
STREET LIGHT ASSEMBLY		
STRUCTURAL RETAINING WALL		

	EXISTING	REMOVE	PROPOSED
CONSTRUCTION ENTRANCE			
SILT FENCE			
SHORING			
CB TYPE I, TYPE II-48"			
STORM MANHOLE			
CONSTRUCTION LIMITS			
TREE PROTECTION			
DIFFUSER PAD			

AS-BUILT INFORMATION SHOWN HEREON WAS PREPARED BY HUGH G. GOLDSMITH AND ASSOCIATES.
98-1712

APPROVED FOR CONSTRUCTION
CAPITAL PROJECTS MANAGER
DIRECTOR OF PUBLIC WORKS
CITY OF REDMOND
DATE: 8/28/98

PLAN THE ENGR: TMP 8/24/98
FOR SPECIES: N/A
TRA SPN ENGR: N/A 8/28/98
UTIL ENGR: N/A
FIRE DEPT: N/A 8/28/98
PARKS ENGR: N/A
PLANNING DEPT: 8/28/98

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LAURIE J. PEARS, STATE OF WASHINGTON, PROFESSIONAL ENGINEER, 8-26-98
EXPIRES 06/04/2000

OPUS
OPUS NORTHWEST L.L.C.
200 - 112TH AVENUE NE, SUITE 205
BELLEVUE, WASHINGTON 98004
(206) 453-4100

KEY MAP N.T.S.

WILLOWS COMMERCE PARK PHASE III
Redmond, Washington

STEPHEN C. PORTER, STATE OF WASHINGTON, 19577, REGISTERED PROFESSIONAL ENGINEER, 8-26-98
EXPIRES 09/23/2000

NO.	DATE	REVISION

SHEET TITLE
GRADING & DRAINAGE PLAN

97-0326-02
JOB NO.
LPL
DRAWN
LJP
CHECKED
8-26-98
DATE

SHEET NUMBER
C11.3

COUGHLIN PORTER LUNDEEN
A CONSULTING STRUCTURAL AND CIVIL ENGINEERING CORPORATION
217 PINE STREET - SUITE 300
SEATTLE, WA 98101
206.343.0460
FAX 206.343.0461

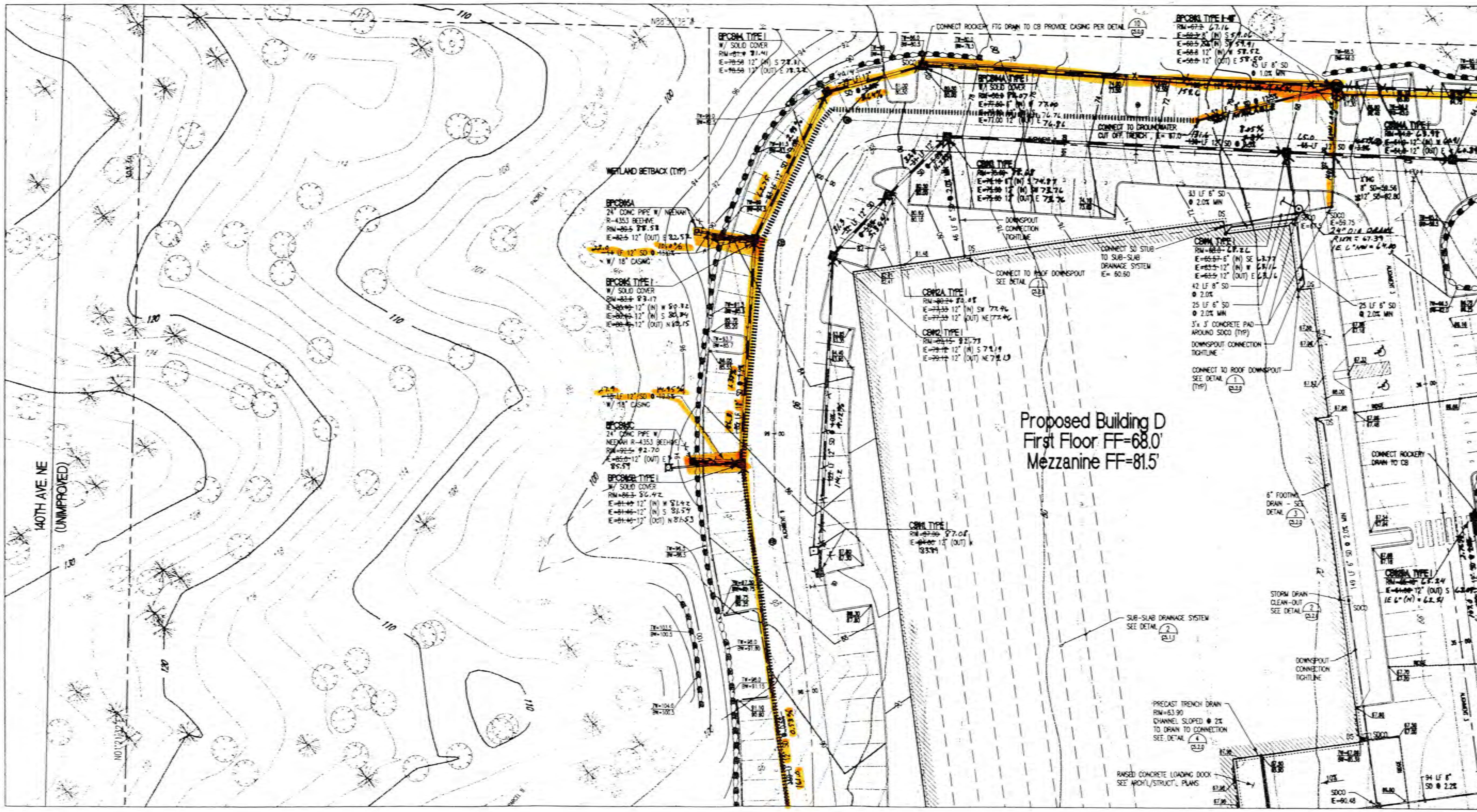
ATTACHMENT 18

ISSUED TO: CITY OF REDMOND
FOR: REVISED BUILDING PERMIT
DATE: 8-26-98

CALL 2 DAYS BEFORE YOU DIG
1-800-424-5555

OPUS
OPUS NORTHWEST L.L.C.
200 - 112TH AVENUE NE, SUITE 205
BELLEVUE, WASHINGTON 98004
(206) 453-4100

SCALE 1"=20'



MATCHLINE - SEE SHEET C1.1.3

LEGEND

	EXISTING	REMOVE	PROPOSED
ASPHALT PAVING			
CEMENT CONCRETE			
BUILDINGS			
CURBING			
CONTOUR (INDEX)	100		100
CONTOUR	98		98
ROCKERY			
TREE			

	EXISTING	PROPOSED
ELECTRIC LINE	PWR	
GAS LINE	G	
OVERHEAD POWER	OHP	OHP
SANITARY SEWER LINE	SS	
STORM DRAINAGE LINE	SD	
TELEPHONE LINE	T	
WATER LINE	W	
INTERCEPTOR TRENCH		

	EXISTING	PROPOSED
FIRE HYDRANT / FDC / PIV		
VALVE / BLOWOFF		
FITTINGS		
THRUST BLOCKING		
SS MH / CLEANOUT		
GAS METER		
STREET LIGHT ASSEMBLY		
STRUCTURAL RETAINING WALL		

	EXISTING	REMOVE	PROPOSED
CONSTRUCTION ENTRANCE			
SILT FENCE			
SHORING			
CB TYPE I, TYPE II-48"			
STORM MANHOLE			
CONSTRUCTION LIMITS			
TREE PROTECTION			
DIFFUSER PAD			

AS-BUILT INFORMATION SHOWN HEREON WAS PREPARED BY HUGH G. GOLDSMITH AND ASSOCIATES.

98-1710

EXPIRES 7/17/2000

LAURIE J. PFAFF — STATE OF WASHINGTON — PROFESSIONAL ENGINEER — 8-26-98
EXPIRES 06/16/2000

APPROVED FOR CONSTRUCTION
CAROL OSBORNE
DIRECTOR OF PUBLIC WORKS
CITY OF REDMOND
DATE 8/28/98

PLAN CHK ENGR: 8/26/98
FOR SHEET(S):
STM DRN ENGR: 8/28/98
UTIL ENGR: n/a
FIRE DEPT: n/a
TRANS ENGR: 8/28/98
PLANNING DEPT: 8/26/98

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KEY MAP N.T.S.

WILLOWS COMMERCE PARK PHASE III

Redmond, Washington

STEPHEN C. PORTER — STATE OF WASHINGTON — 26577 — REGISTERED PROFESSIONAL ENGINEER — 8-26-98
EXPIRES 01/22/2000

NO.	DATE	REVISION

SHEET TITLE

GRADING & DRAINAGE PLAN

97-0326-02
JOB NO.
LPL
DRAWN
LJP
CHECKED
8-26-98
DATE

SHEET NUMBER
C1.1.1

COUGHLIN PORTER LUNDEEN
A CONSULTING STRUCTURAL AND CIVIL ENGINEERING CORPORATION
217 PINE STREET, SUITE 300
SEATTLE, WA 98101
206.343.0460
FAX 206.343.5691

ISSUED TO: CITY OF REDMOND
FOR: REVISED BUILDING PERMIT
DATE: 8-26-98

CALL 2 DAYS BEFORE YOU DIG 1-800-424-5555

0 10 20 40
SCALE 1"=20'

WILLOWS ROADWAY FRONTAGE IMPROVEMENTS BY OTHERS. CONTRACTOR TO COORDINATE ALL CONNECTIONS.

AS-BUILT INFORMATION SHOWN HEREON WAS PREPARED BY HUGH G. GOLDSMITH AND ASSOCIATES.

MATCHLINE - SEE SHEET C11.1

MATCHLINE - SEE SHEET C11.4

LEGEND

	EXISTING	REMOVE	PROPOSED
ASPHALT PAVING			
CEMENT CONCRETE			
BUILDINGS			
CURBING			
CONTOUR (INDEX)	50		100
CONTOUR	49		98
ROCKERY			
TREE			

	EXISTING	PROPOSED
ELECTRIC LINE	PWR	
GAS LINE	G	
OVERHEAD POWER	OHP	OHP
SANITARY SEWER LINE	SS	
STORM DRAINAGE LINE	SD	
TELEPHONE LINE	T	
WATER LINE	W	
INTERCEPTOR TRENCH		

	EXISTING	PROPOSED
FIRE HYDRANT / FDC / PIV		
VALVE / BLOWOFF		
FITTINGS		
THRUST BLOCKING		
SS MH / CLEANOUT		
GAS METER		
STREET LIGHT ASSEMBLY		
STRUCTURAL RETAINING WALL		

	EXISTING	REMOVE	PROPOSED
CONSTRUCTION ENTRANCE			
SILT FENCE			
SHORING			
DB TYPE I, TYPE II-48"			
STORM MANHOLE			
CONSTRUCTION LIMITS			
TREE PROTECTION			
DIFFUSER PAD			

98-1711

APPROVED FOR CONSTRUCTION
CARL DISORA
DIRECTOR OF PUBLIC WORKS
CITY OF REDMOND
DATE: 8/28/98

PLAN CHK ENGR: 8/24/98
FOR SHEET(S):
STM DRN ENGR: 8/28/98
STR. ENGR:
FIRE DEPT: 8/27/98
TRANS ENGR: 8/27/98
PLANNING DEPT: 8/24/98

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MAURIE J. FRASER — STATE OF WASHINGTON — 10766 — REGISTERED PROFESSIONAL ENGINEER — 8-24-98
EXPIRES 06/14/2000

STEPHEN C. PORTER — STATE OF WASHINGTON — 26377 — REGISTERED PROFESSIONAL ENGINEER — 8-26-98
EXPIRES 04/13/2000

OPUS
OPUS NORTHWEST L.L.C.
200 - 112TH AVENUE NE, SUITE 205
BELLEVUE, WASHINGTON 98004
(206) 453-4100

A CONSULTING STRUCTURAL AND CIVIL ENGINEERING CORPORATION
FAX 206.453.4111

KEY MAP
N.T.S.

WILLOWS COMMERCE PARK PHASE III
Redmond, Washington

NO. DATE REVISION

SHEET TITLE
GRADING & DRAINAGE PLAN

97-0326-02
JOB NO.
LPL
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LJP
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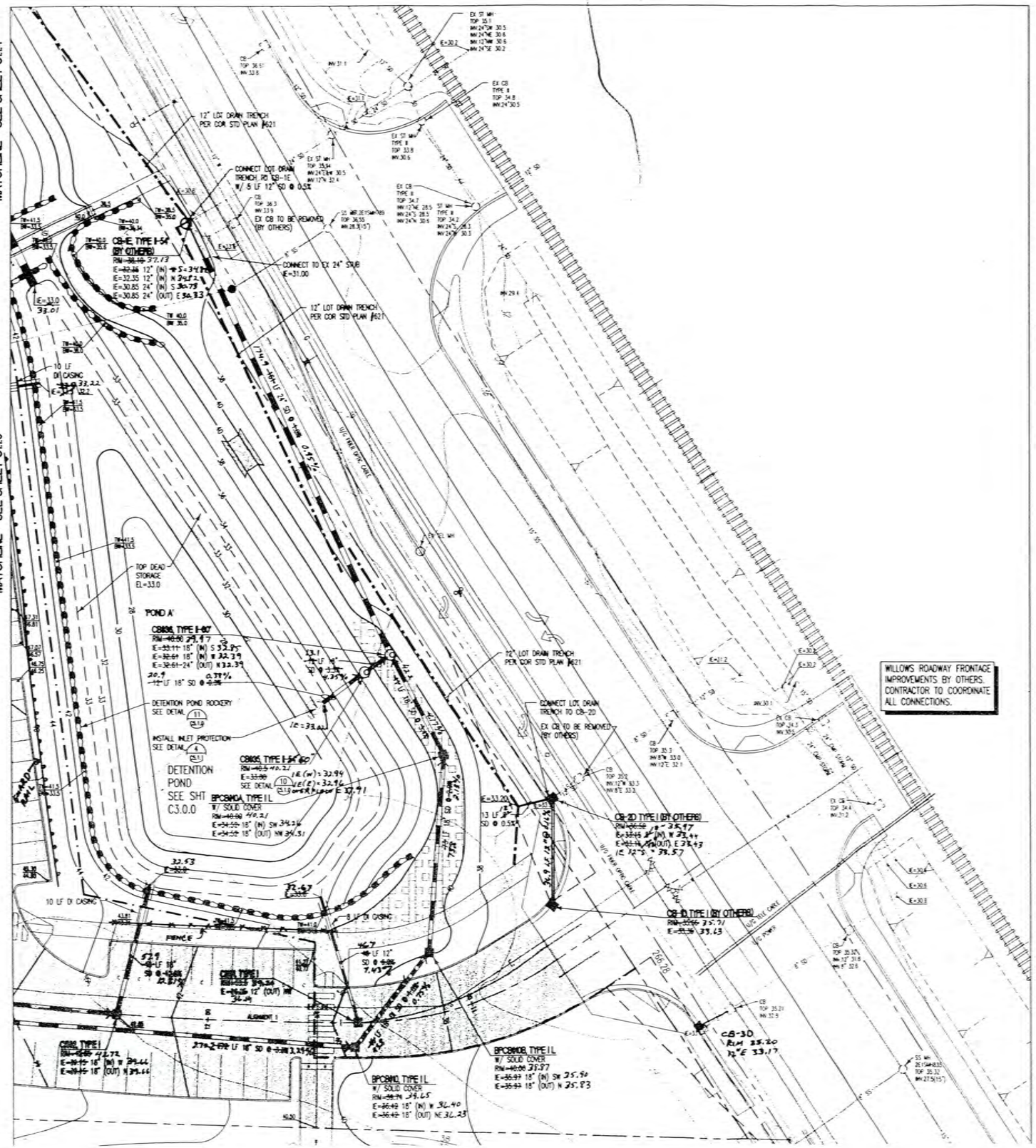
8-26-98
DATE

SHEET NUMBER
C11.2

COUGHLIN PORTER LUNDEEN

MATCHLINE - SEE SHEET C1.4

MATCHLINE - SEE SHEET C1.6



SCALE 1"=20'

ISSUED TO: CITY OF REDMOND
FOR: REVISED BUILDING PERMIT
DATE: 8-26-98

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LEGEND

	EXISTING	REMOVE	PROPOSED
ASPHALT PAVING			
CEMENT CONCRETE			
BUILDINGS			
CURBING			
CONTOUR (INDEX)	100		100
CONTOUR	99		98
ROCKERY			
TREE			
CONSTRUCTION ENTRANCE			
SILT FENCE			
SHORING			
CB TYPE I, TYPE II-48"			
STORM MANHOLE			G
CONSTRUCTION LIMITS			
TREE PROTECTION			
DIFFUSER PAD			
ELECTRIC LINE	PWR		
GAS LINE	G		
OVERHEAD POWER	OHP		OHP
SANITARY SEWER LINE	SS		
STORM DRAINAGE LINE	SD		
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WATER LINE	W		
INTERCEPTOR TRENCH			
FIRE HYDRANT / FDC / PIV			
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FITTINGS			
THRUST BLOCKING			
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GAS METER			
STREET LIGHT ASSEMBLY			
STORMWATER DETAINING WALL			

AS-BUILT INFORMATION SHOWN HEREON WAS PREPARED BY HUGH G. GOLDSMITH AND ASSOCIATES.

APPROVED FOR CONSTRUCTION
CAROL SIMONE
DIRECTOR OF PUBLIC WORKS
CITY OF REDMOND
DATE: 8/26/98

PLAN CHK ENGR: RP 8/26/98
FOR SHEET(S):
STM DRN ENGR:
UTIL ENGR: N/A
FIRE DEPT:
TRANS ENGR:
PLANNING DEPT:

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98-1716

OPUS
OPUS NORTHWEST, L.L.C.
200 - 112TH AVENUE NE, SUITE 205
BELLEVUE, WASHINGTON 98004
(206) 453-4100

KEY MAP N.T.S.

WILLOWS COMMERCE PARK PHASE III
Redmond, Washington

STEPHEN C. POWELL — STATE OF WASHINGTON — 20577 — REGISTERED PROFESSIONAL ENGINEER
EXPIRES 09/23/2000

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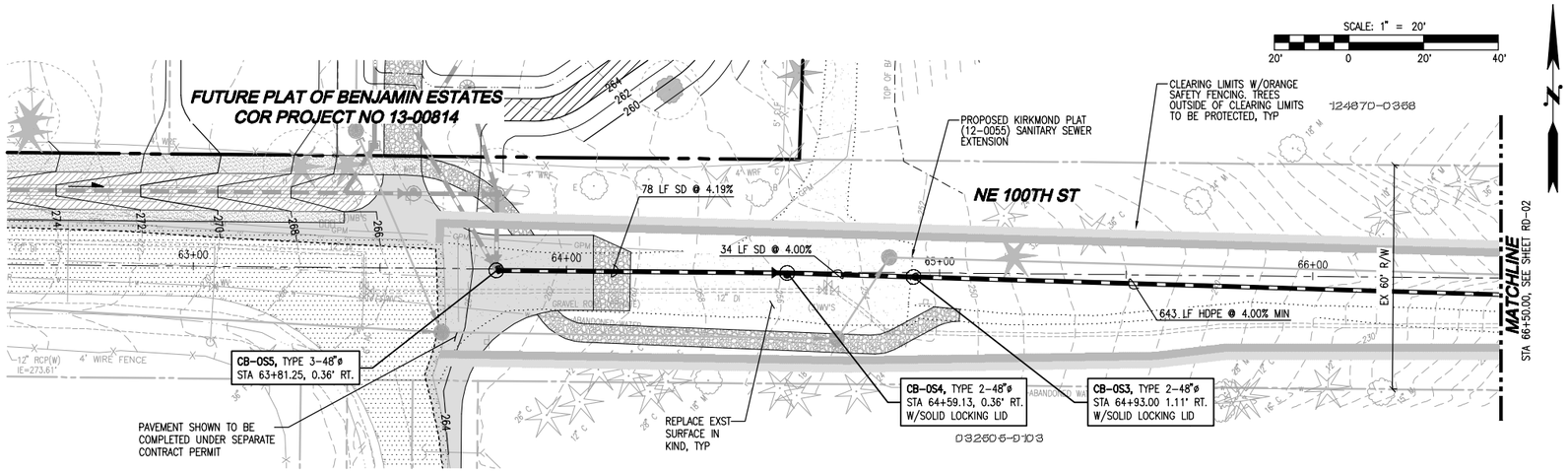
A CONSULTING STRUCTURAL AND CIVIL ENGINEERING CORPORATION
217 PINE STREET, SUITE 300
SEATTLE, WA 98101
206.343.0460
FAX 206.343.0461

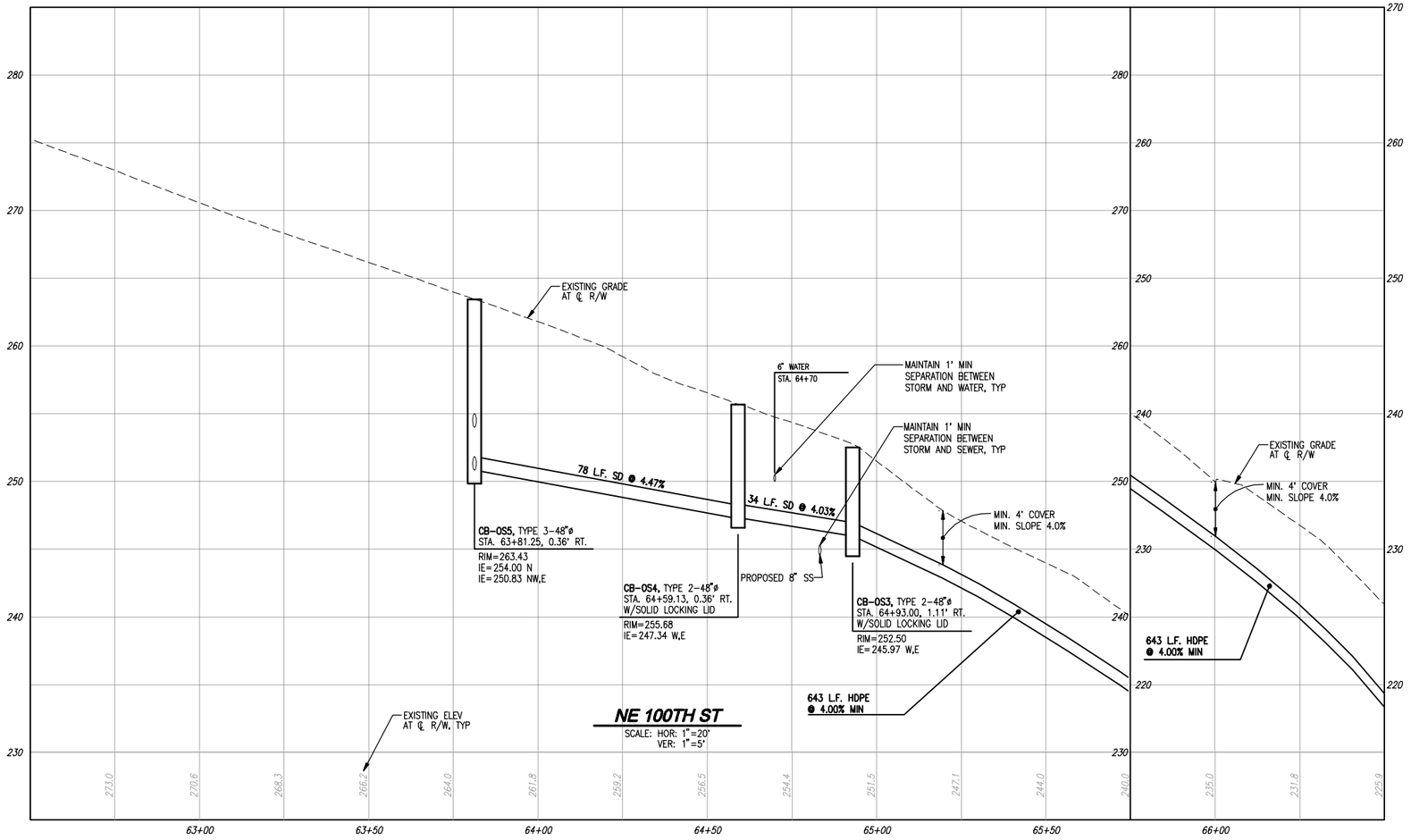
ATTACHMENT 18

Proposed Benjamin Offsite Storm Sewer Extension

ATTACHMENT 18

SW 1/4, SW 1/4 OF SEC 34, TWN 26 N, RGE 5 E, W.M., CITY OF REDMOND, KING COUNTY, WASHINGTON





LEGEND

SYMBOL	DESCRIPTION
	TYPE 1 CATCH BASIN, GRATED LID
	TYPE 1 CATCH BASIN, SOLID LID
	TYPE 2 CATCH BASIN, GRATED LID
	TYPE 2 CATCH BASIN, SOLID LID
	STORM PIPE
	SEWER MANHOLE
	WATER METER
	HYDRANT
	SEWER PIPE
	WATER PIPE
CLEARING AREA / PROTECTED AREA	CLEARING LIMITS W/ORANGE SAFETY FENCE
	CATCH BASIN PROTECTION
	INSTALL CHECK DAM EVERY 100 FEET
SD	STORM DRAIN (PVC)

TREE LEGEND

	TREE CONIFEROUS
	TREE DECIDUOUS
CW	COTTON WOOD TREE
F	FIR TREE
M	MAPLE TREE
A	ALDER TREE
S	SPRUCE TREE
C	CEDAR TREE
P	PINE TREE
	REMOVED TREE

NOTES

1. SEE SHEET DT-01 FOR GENERAL NOTES AND DETAILS.
2. ALL TREES SHOWN AS REMOVED ON THESE PLANS HAVE BEEN REMOVED OR WILL BE REMOVED AS PART OF OTHER APPROVED CONSTRUCTION. NO TREES WILL BE REMOVED WITHIN THIS CONSTRUCTION.

TOPOGRAPHIC DISCLAIMER

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Call 2 Business Days Before You Dig
811 or 1-800-424-5555
Utilities Underground Location Center

THIS DEVELOPMENT SHALL BE CONSTRUCTED IN ACCORDANCE WITH THE 2012 CITY OF REDMOND STANDARD SPECIFICATION AND DETAILS.

APPROVED FOR CONSTRUCTION:

FOR:
DIRECTOR OF PUBLIC WORKS CITY OF REDMOND
DATE:
PLAN CHK ENGR:
STORM:
UTILITY:
FIRE DEPT:
TRANS / ENGR:
PLANNING DEPT:

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13-

NO.	DATE	DESCRIPTION	BY
1	8-21-13	3RD PREP SUBMITTAL	MEV

REVISIONS

LDC
THE CIVIL ENGINEERING GROUP
Engineering
Structural
Planning
Survey
14201 NE 200th St. #100
Woodinville, WA 98072
Ph. 425.806.1869
Fx. 425.482.2893
www.LDCcorp.com

THE BENJAMIN TRUST

BENJAMIN ESTATES OFFSITE STORM
NE 100TH ST

STORM DRAINAGE PLAN AND PROFILE

MARK B. VILLWOCK
STATE OF WASHINGTON
40908
REGISTERED
PROFESSIONAL ENGINEER

JOB NUMBER:	12-166
DRAWING NAME:	21660-RD-PL
DESIGNER:	MEV
DRAFTING BY:	MCH
DATE:	7-23-13
SCALE:	1"=20'
JURISDICTION:	REDMOND

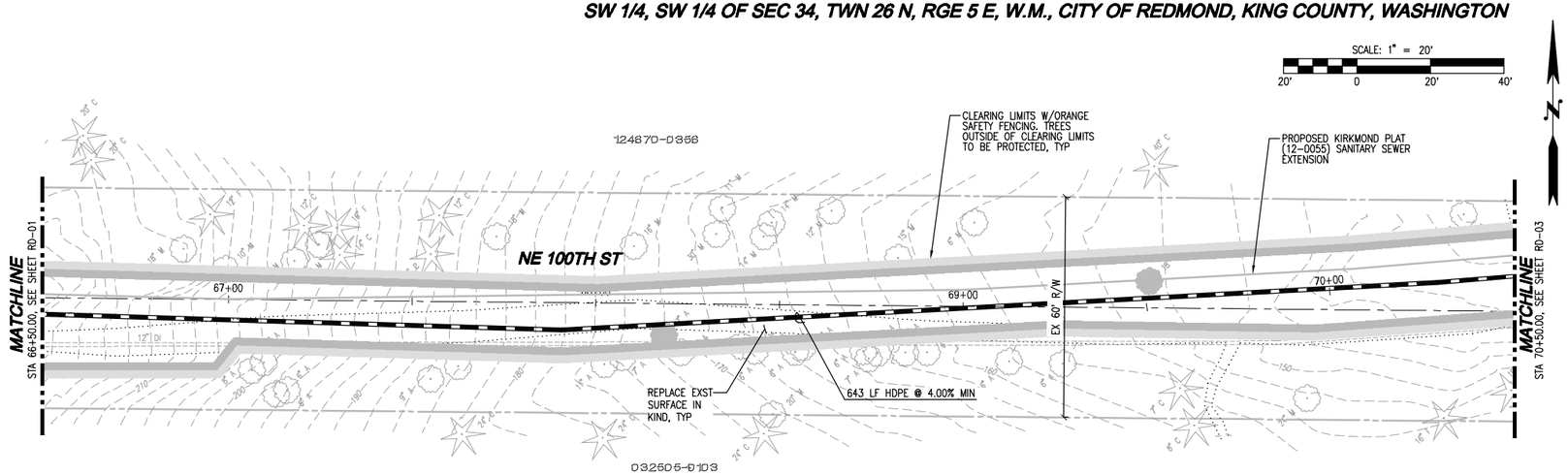
RD-01

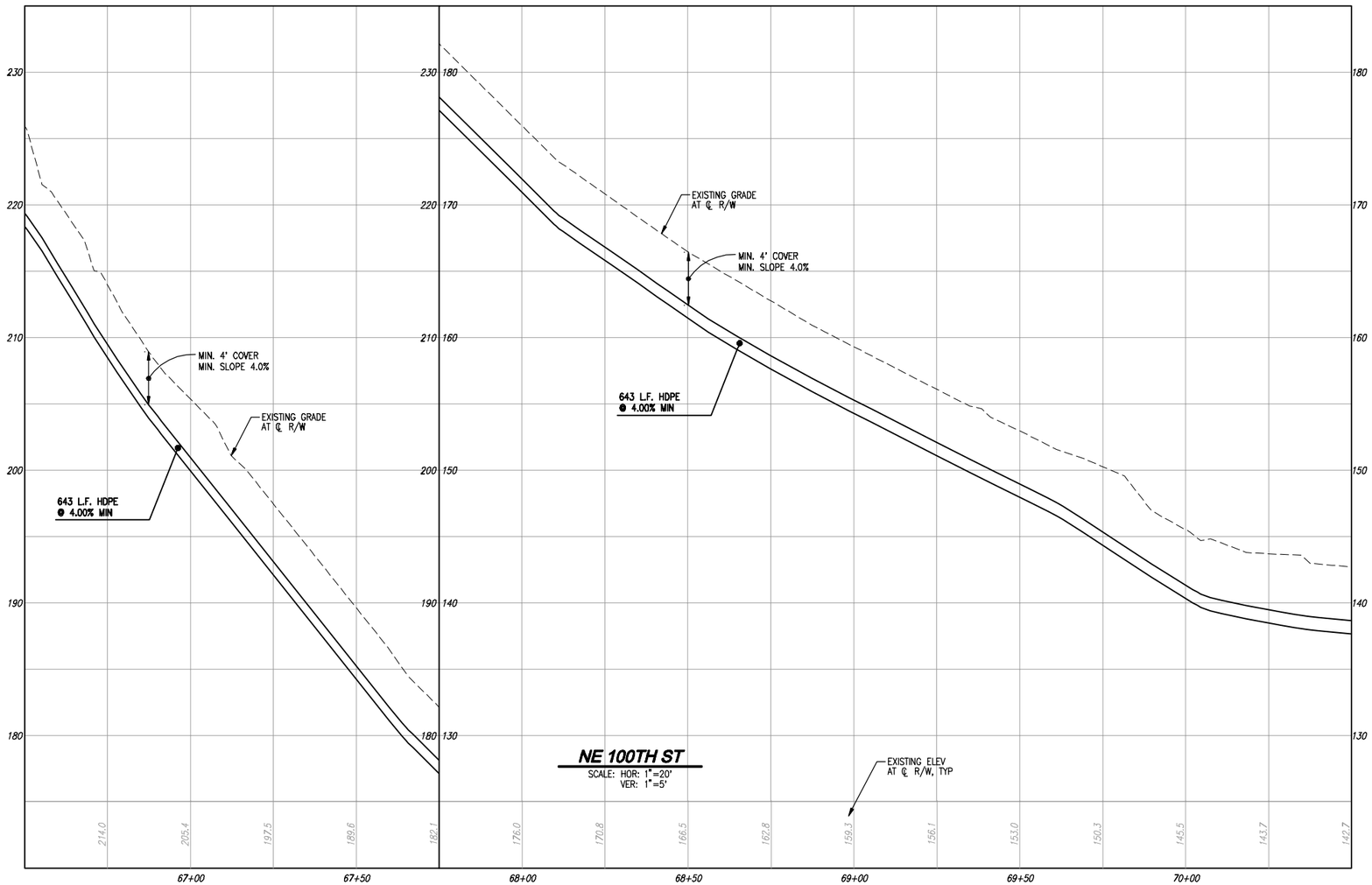
SHEET 3 OF 5

Drawing: P:\2012\12-166 Benjamin Trust Property\Drawings\Offsite\121660-RD-PL.dwg Plotted: Nov 12, 2013 - 10:43am

ATTACHMENT 18

SW 1/4, SW 1/4 OF SEC 34, TWN 26 N, RGE 5 E, W.M., CITY OF REDMOND, KING COUNTY, WASHINGTON





LEGEND

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SD	STORM DRAIN (PVC)

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	TREE DECIDUOUS
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F	FIR TREE
M	MAPLE TREE
A	ALDER TREE
S	SPRUCE TREE
C	CEDAR TREE
P	PINE TREE
	REMOVED TREE

NOTES

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APPROVED FOR CONSTRUCTION:

FOR: DIRECTOR OF PUBLIC WORKS CITY OF REDMOND

DATE: _____

PLAN CHK ENGR: _____

STORM: _____

UTILITY: _____

FIRE DEPT: _____

TRANS / ENGR: _____

PLANNING DEPT: _____

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13-

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Utilities Underground Location Center

REVISIONS

NO.	DATE	DESCRIPTION	BY
1	8-21-13	3RD PREP SUBMITTAL	MEV

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www.LDCcorp.com

THE BENJAMIN TRUST

BENJAMIN ESTATES OFFSITE STORM
NE 100TH ST

STORM DRAINAGE PLAN AND PROFILE

MARK E. VILLWOCK
STATE OF WASHINGTON
40906
REGISTERED
PROFESSIONAL ENGINEER

JOB NUMBER:	12-166
DRAWING NAME:	21660-RD-PL
DESIGNER:	MEV
DRAFTING BY:	MCH
DATE:	7-23-13
SCALE:	1"=20'
JURISDICTION:	REDMOND

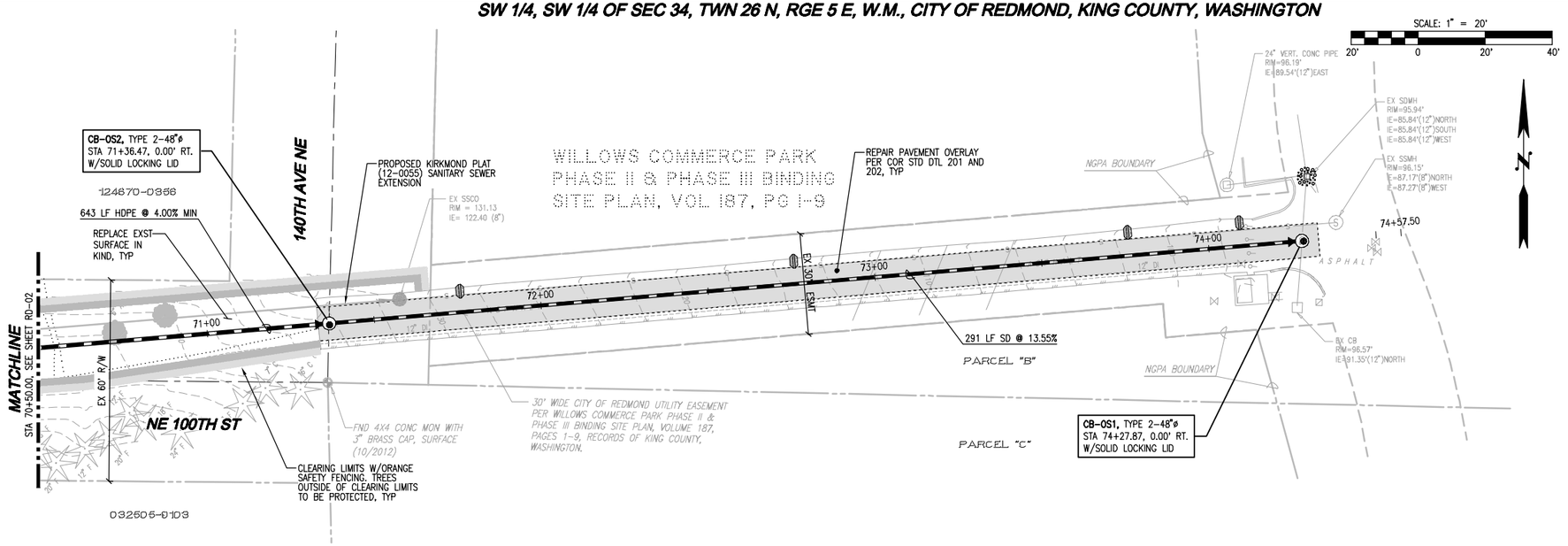
RD-02

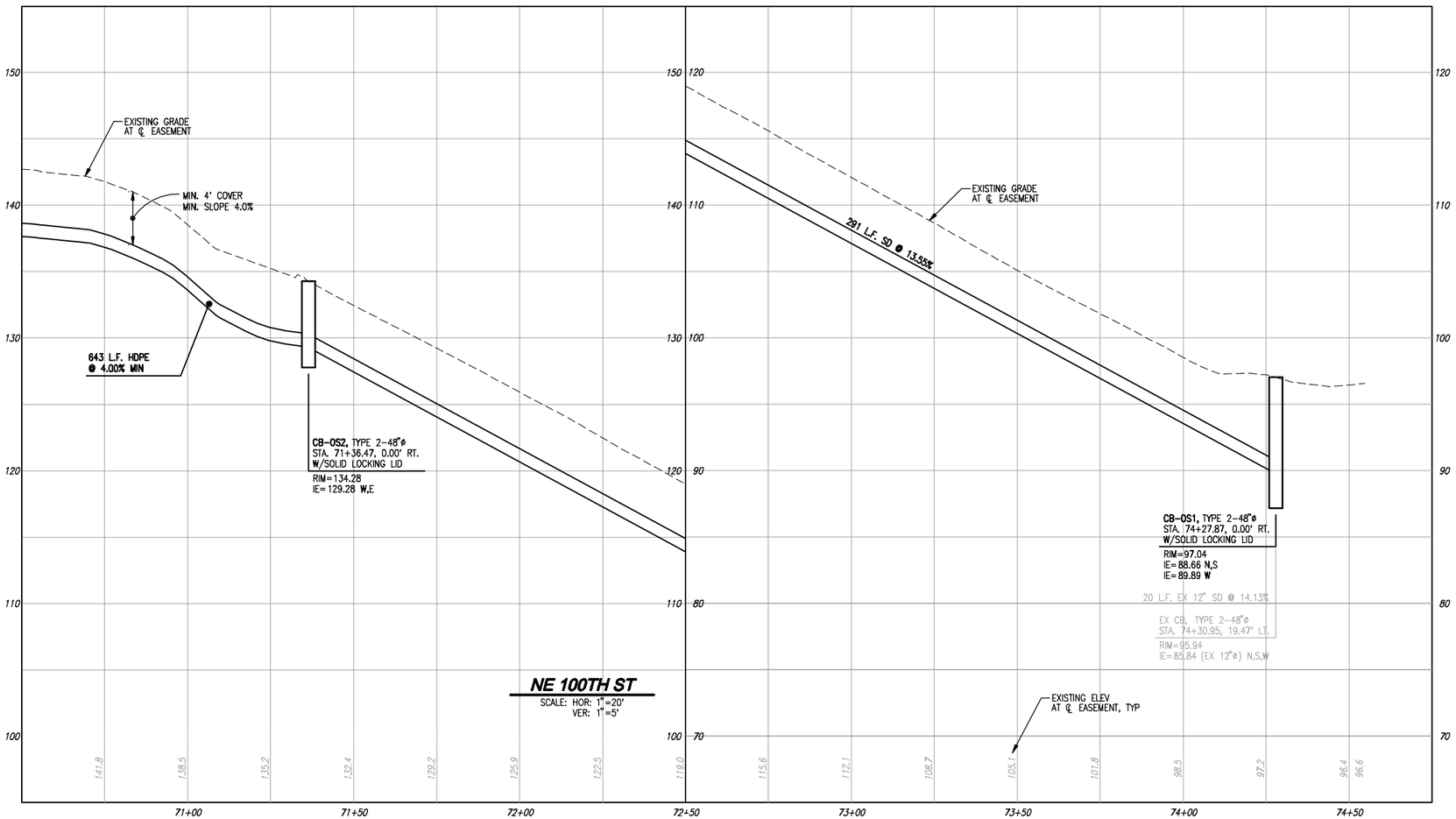
SHEET 4 OF 5

Drawing: P:\2012\12-166 Benjamin Trust Property\Drawings\Offsite\121660-RD-PL.dwg Plotted: Nov 12, 2013 - 10:43am

ATTACHMENT 18

SW 1/4, SW 1/4 OF SEC 34, TWN 26 N, RGE 5 E, W.M., CITY OF REDMOND, KING COUNTY, WASHINGTON





NE 100TH ST
SCALE: HOR: 1"=20'
VER: 1"=5'

LEGEND

SYMBOL	DESCRIPTION
	TYPE 1 CATCH BASIN, GRATED LID
	TYPE 1 CATCH BASIN, SOLID LID
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	SEWER PIPE
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	TREE DECIDUOUS
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C	CEDAR TREE
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	REMOVED TREE

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APPROVED FOR CONSTRUCTION:

FOR:
DIRECTOR OF PUBLIC WORKS CITY OF REDMOND

DATE: _____
PLAN CHK ENGR: _____
STORM: _____
UTILITY: _____
FIRE DEPT: _____
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JURISDICTION:	REDMOND

RD-03

SHEET 5 OF 5

Drawing: P:\2012\12-166 Benjamin Trust Property\Drawings\Offsite\121660-RD-PL.dwg Plotted: Nov 12, 2013 - 10:43am