Designing Underground Storm Water Management Systems For Water Quality

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Ohio EPA Storm Water Technical Assistance

2019 OHIO STORMWATER CONFERENCE 12th Annual

Ohio Environmental Protection Agency

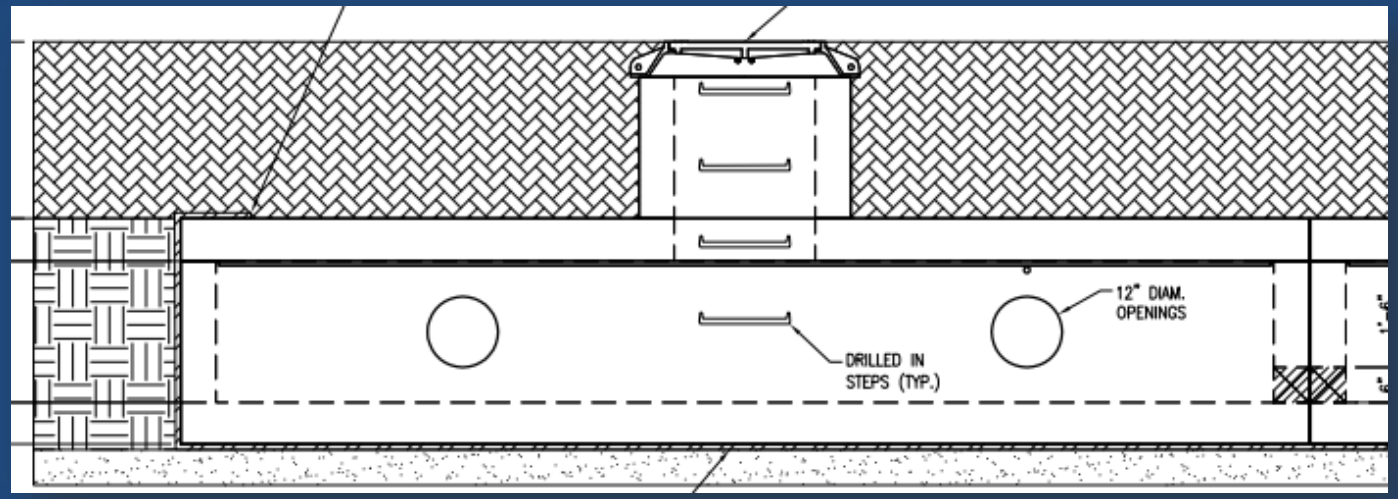

image credit: Oldcastle Infrastructure

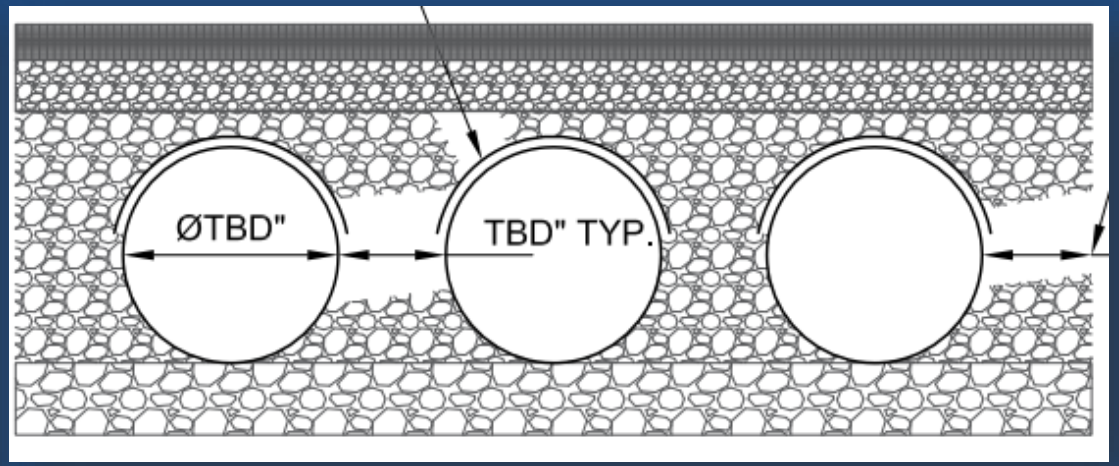

image credit: Contech Engineered Solutions

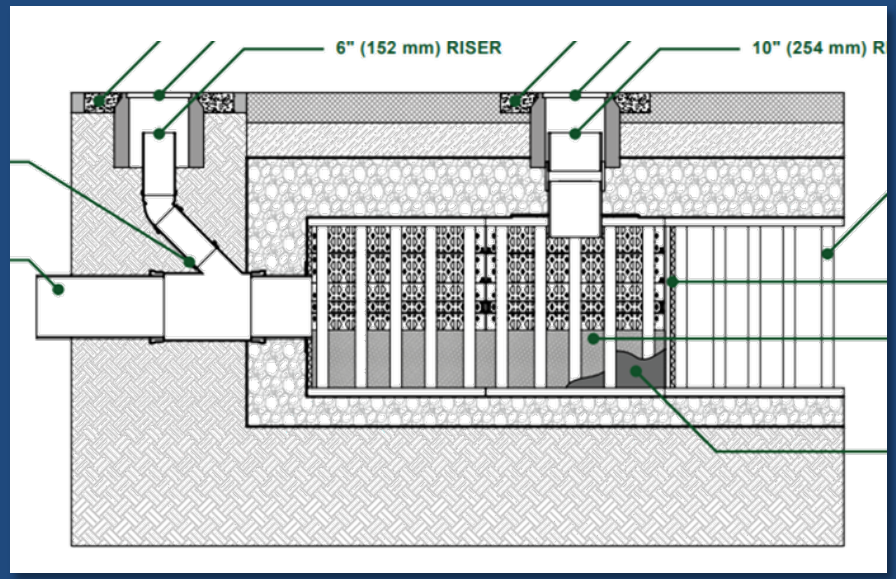

image credit: Brentwood Industries, Inc.

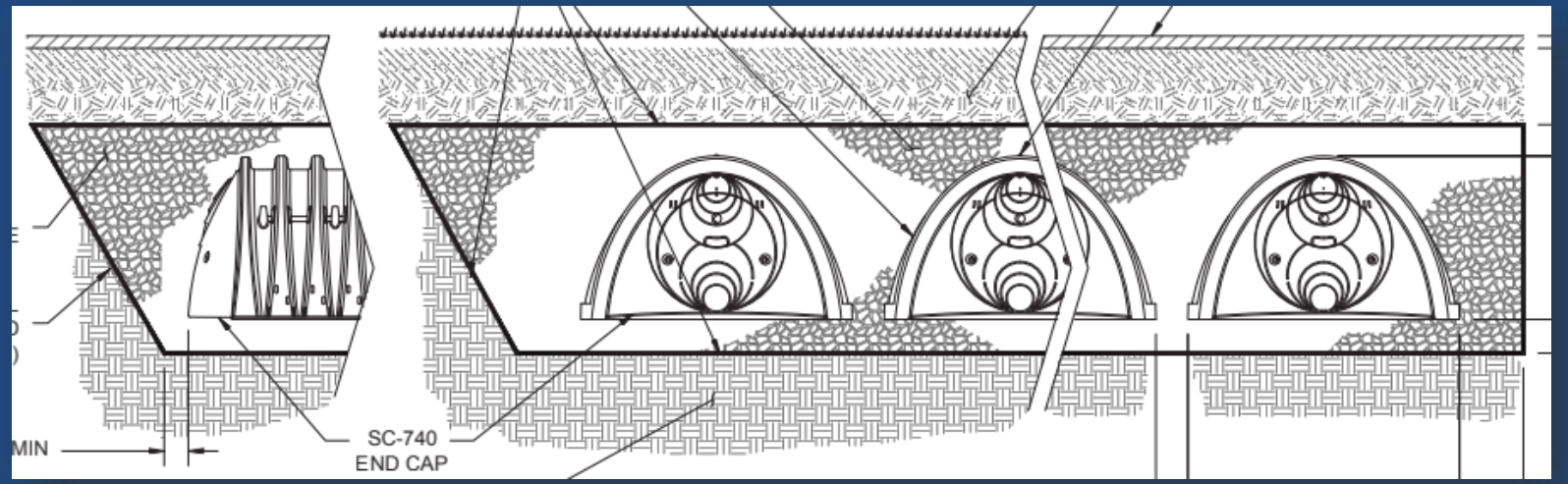

image credit: StormTech

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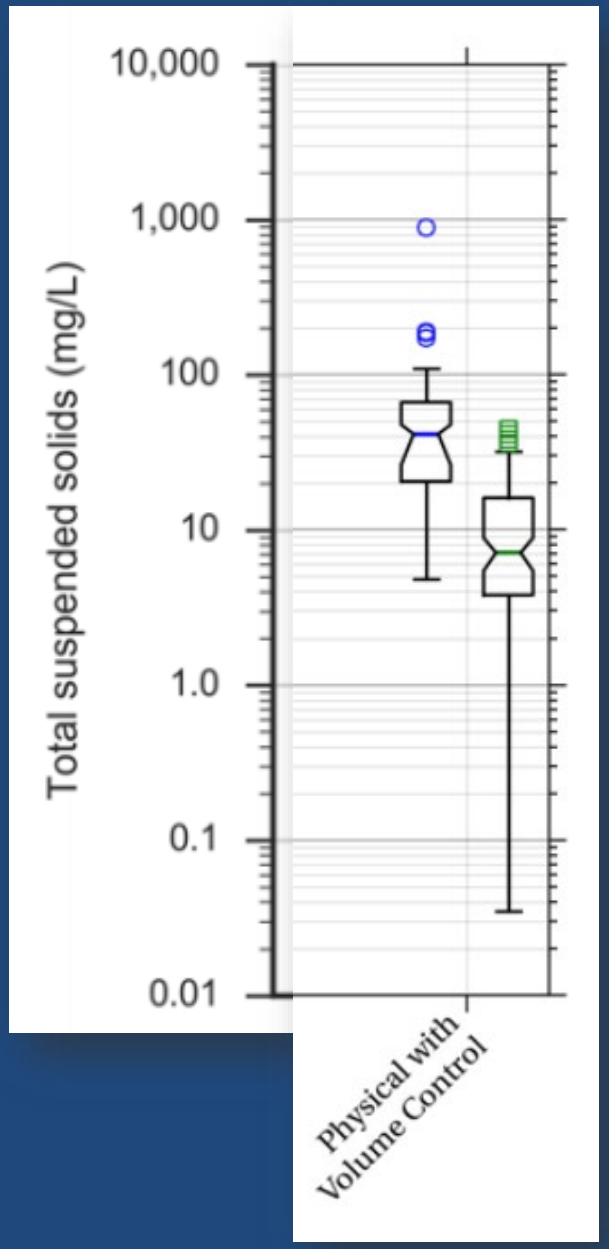
Table 6
Impact of separately reducing the contributions of individual removal processes on the ranked position of BMPs with respect to TSS removal

BMP	Default ranked order of preference	Highest and lowest ranked positions
Infiltration basin	1	1–2
Constructed wetland (SSF)	2.5	2–3.5
Porous paving	2.5	1–6[a]
Soakaways	4.5	4.5–9.5[a]
Infiltration trench	4.5	4.5–9.5[a]
Constructed wetland (SF)	6.5	6–8
Extended detention basin	6.5	2–11[a]
Filter drain	8	6.5–10
Retention ponds	9	3.5–13[a]
Detention basins	11	5–12[a]
Porous asphalt	11	6.5–15[a]
Swales	11	9–13
Lagoons	13	9.5–14
Filter strip	14	10–14
Sedimentation tank	15	12–15

[a]BMPs which show an overall change in ranked position of ⩾5 places.

Scholes, L. Et. Al. 2008. *A Systematic Approach for the Comparative Assessment of Stormwater Pollutant Removal Potentials*. J. Environ. Mgmt.



Median TSS
In: 41.2 mg/L
Out: 7.1 mg/L
Removal: 82.7%

Stormwater BMP Database
2012 MTD Performance Study

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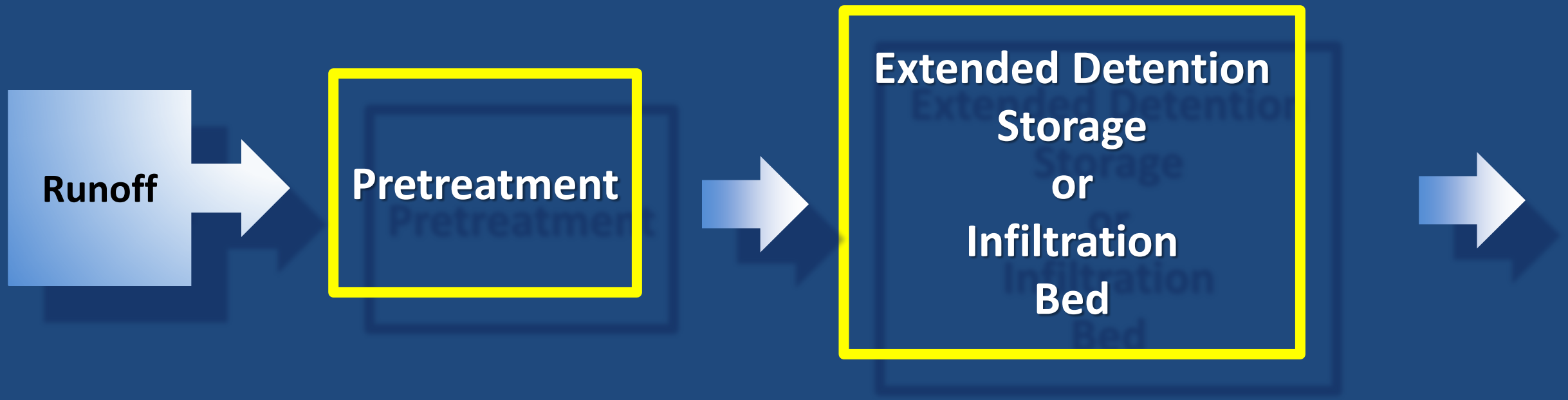
Underground Storm Water Management System



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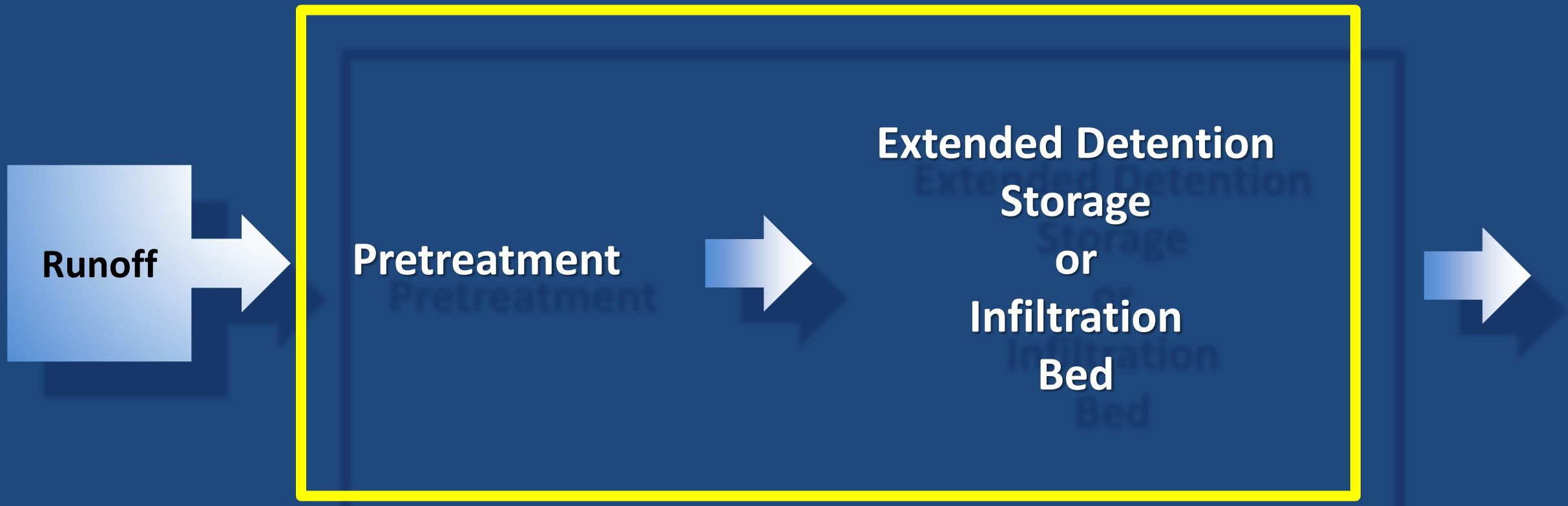
Underground Storm Water Management System



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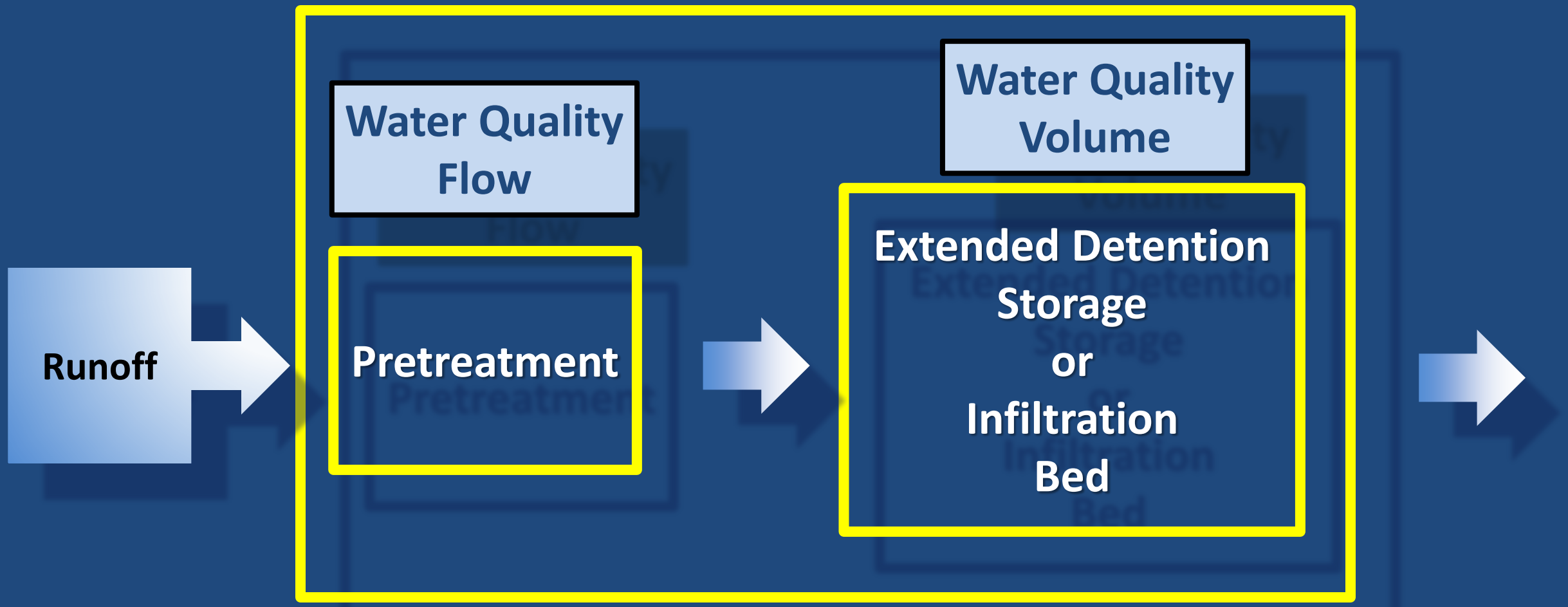

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Water Quality Flow

$WQf = C \times i \times A$

Where:

WQf = water quality flow rate (cfs)

C = runoff coefficient for use with rational method for estimating peak discharge

i = rainfall intensity (in/hr)

A = drainage area (ac)

Appendix CIntensity for Calculation of Water Quality Flow (WQF)

DURATION t_c (minutes)	WATER QUALITY INTENSITY [i_{wq}] (inches/hour)	DURATION t_c (minutes)	WATER QUALITY INTENSITY [i_{wq}] (inches/hour)
5	2.37	33	0.95
6	2.26	34	0.93
7	2.15	35	0.92
8	2.04	36	0.90
9	1.94	37	0.88
10	1.85	38	0.86
11	1.76	39	0.85
12	1.68	40	0.83
13	1.62	41	0.82

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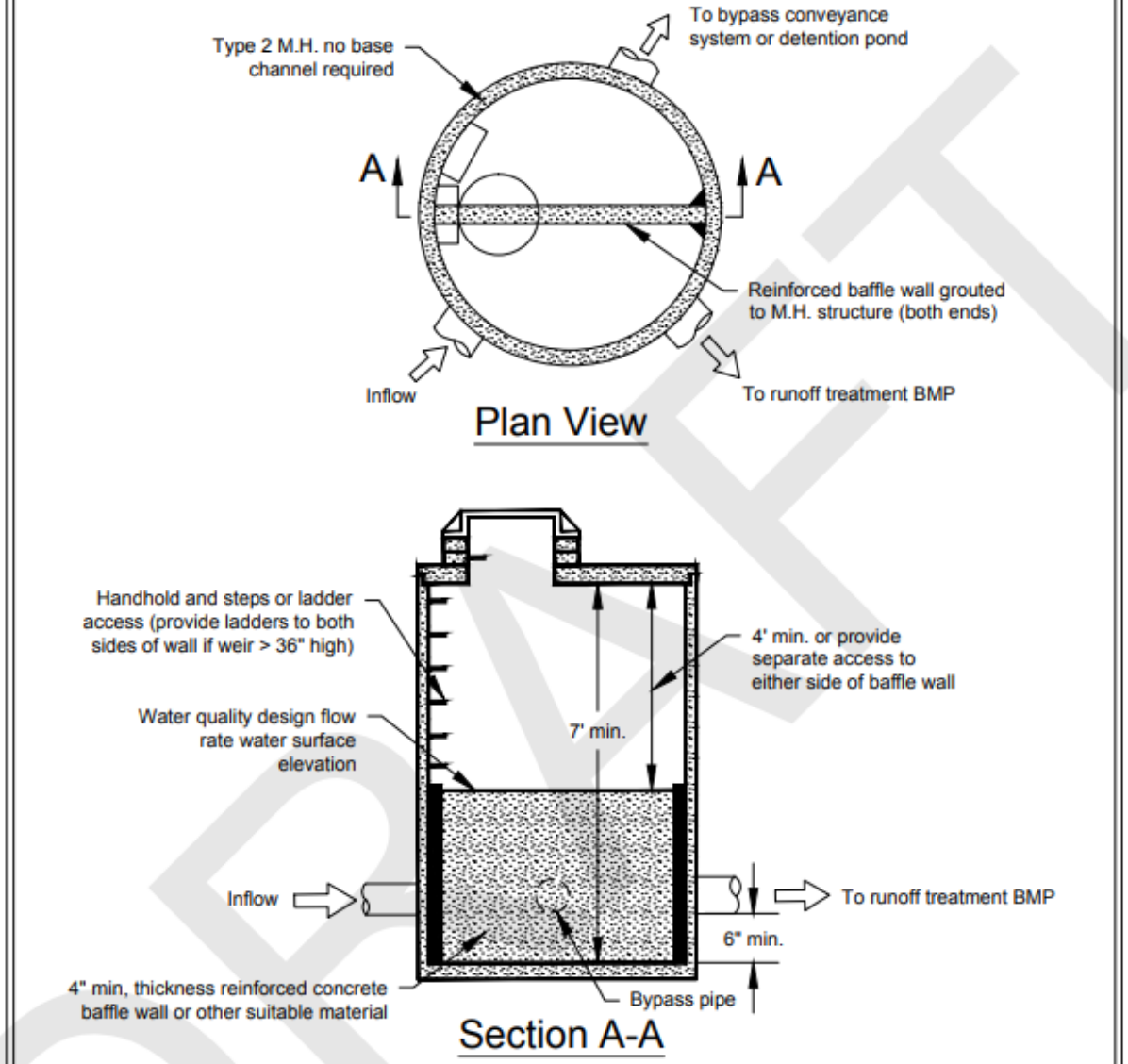
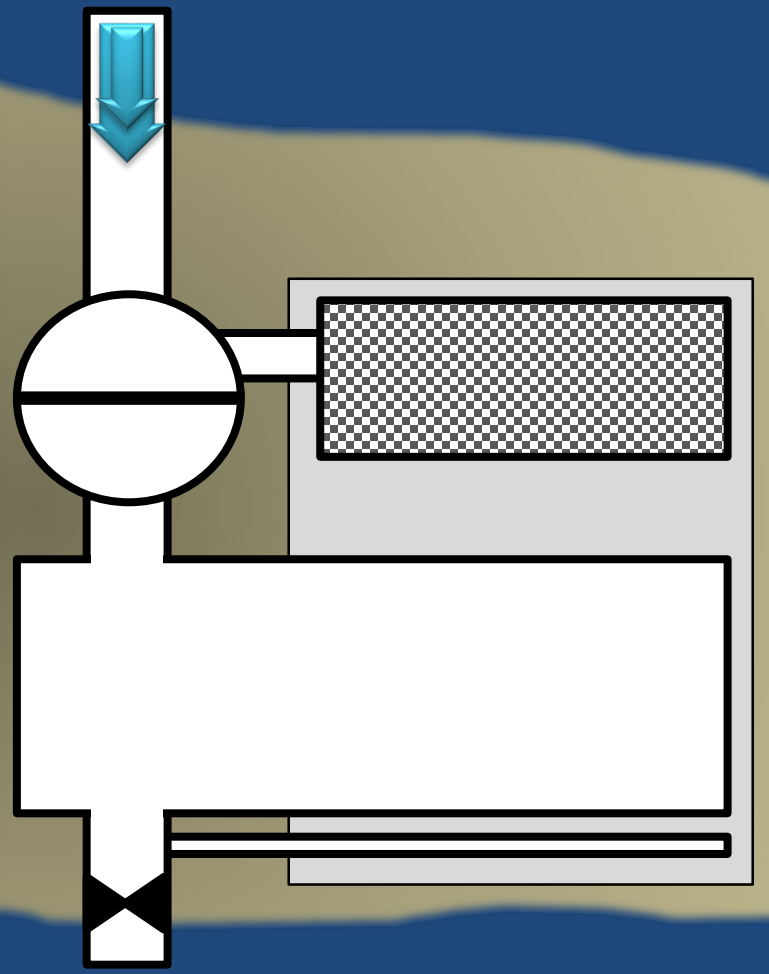
Flow Splitter

Figure V-1.1: Flow Splitter, Option A



Note: The outlet pipe to the Runoff Treatment BMP may require an orifice plate installed on the outlet to control the water quality design flow rate water surface elevation (weir height). The water quality design flow rate water surface elevation should be set to provide a minimum headwater/diameter ratio of 2.0 on the outlet pipe.

NOT TO SCALE



DEPARTMENT OF ECOLOGY
State of Washington

Flow Splitter, Option A

Revised May 2017

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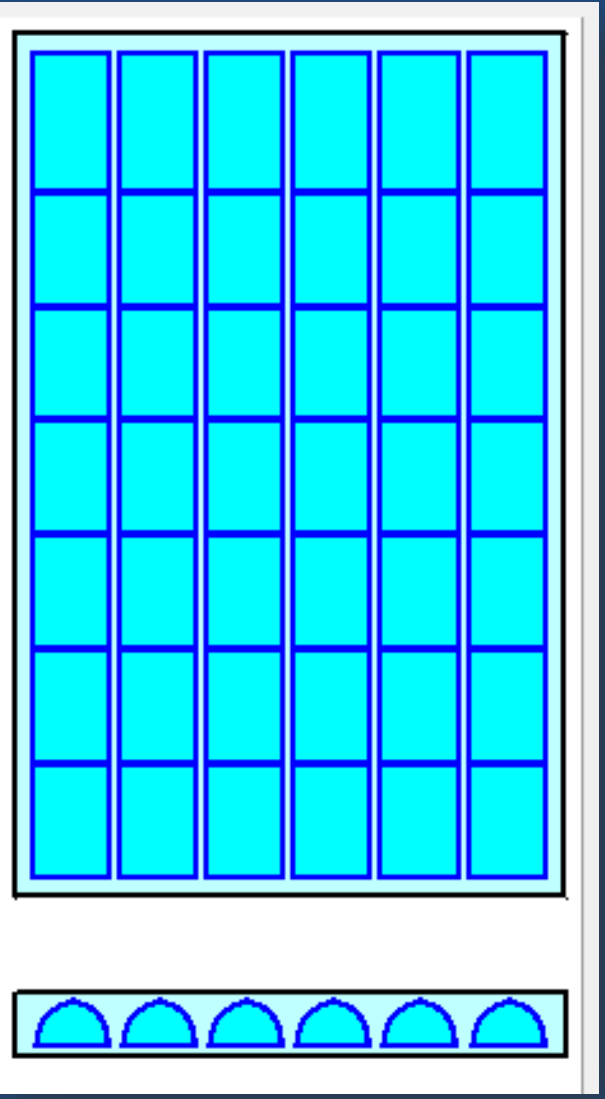
Water Quality Volume



Elevation (feet)	Storage (acre-feet)
0.00	0.000
0.10	0.001
0.20	0.003
0.30	0.004
0.40	0.005
0.50	0.007
0.60	0.009
0.70	0.012
0.80	0.015
0.90	0.018
1.00	0.020
1.10	0.023
1.20	0.026
1.30	0.028
1.40	0.031
1.50	0.034
1.60	0.036
1.70	0.039
1.80	0.042
1.90	0.044
2.00	0.047
2.10	0.049
2.20	0.051
2.30	0.054
2.40	0.056
2.50	0.058
2.60	0.060
2.70	0.062
2.80	0.064
2.90	0.066
3.00	0.067
3.10	0.068
3.20	0.070
3.30	0.071
3.40	0.072
3.50	**0.073**

Pond 1P: (new Pond) - OSWC USWMS ORIFICE SIZE

Summary | Wizards | Hydrograph | Discharge | Storage | Sizing

Time (hours)	Inflow (cfs)	Storage (acre-feet)	Elevation (feet)	Primary (cfs)
0.00	**0.00**	**0.071**	**3.30**	**0.05**
1.00	0.00	0.067	3.01	0.05
2.00	0.00	0.063	2.77	0.04
3.00	0.00	0.060	2.58	0.04
4.00	0.00	0.056	2.42	0.04
5.00	0.00	0.053	2.27	0.04
6.00	0.00	0.050	2.14	0.04
7.00	0.00	0.047	2.01	0.04
8.00	0.00	0.044	1.89	0.04
9.00	0.00	0.041	1.77	0.03
10.00	0.00	0.038	1.67	0.03
11.00	0.00	0.035	1.56	0.03
12.00	0.00	0.033	1.46	0.03
13.00	0.00	0.030	1.37	0.03
14.00	0.00	0.028	1.28	0.03
15.00	0.00	0.025	1.19	0.03
16.00	0.00	0.023	1.10	0.03
17.00	0.00	0.021	1.02	0.03
18.00	0.00	0.019	0.95	0.02
19.00	0.00	0.017	0.87	0.02
20.00	0.00	0.015	0.80	0.02
21.00	0.00	0.013	0.73	0.02
22.00	0.00	0.011	0.67	0.02
23.00	0.00	0.010	0.61	0.02
24.00	0.00	0.008	0.55	0.02
25.00	0.00	0.006	0.50	0.02
26.00	0.00	0.005	0.39	0.02
27.00	0.00	0.004	0.30	0.01

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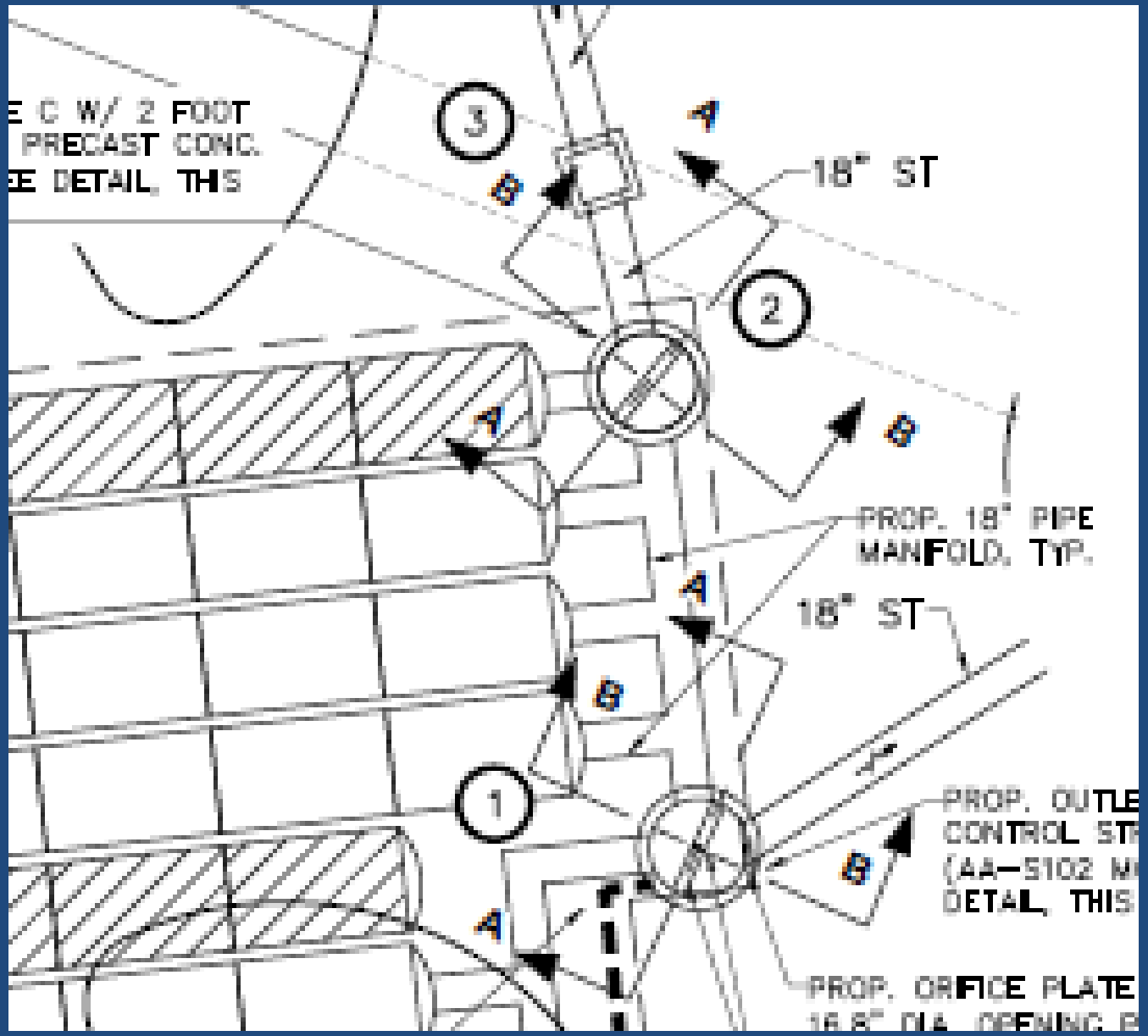

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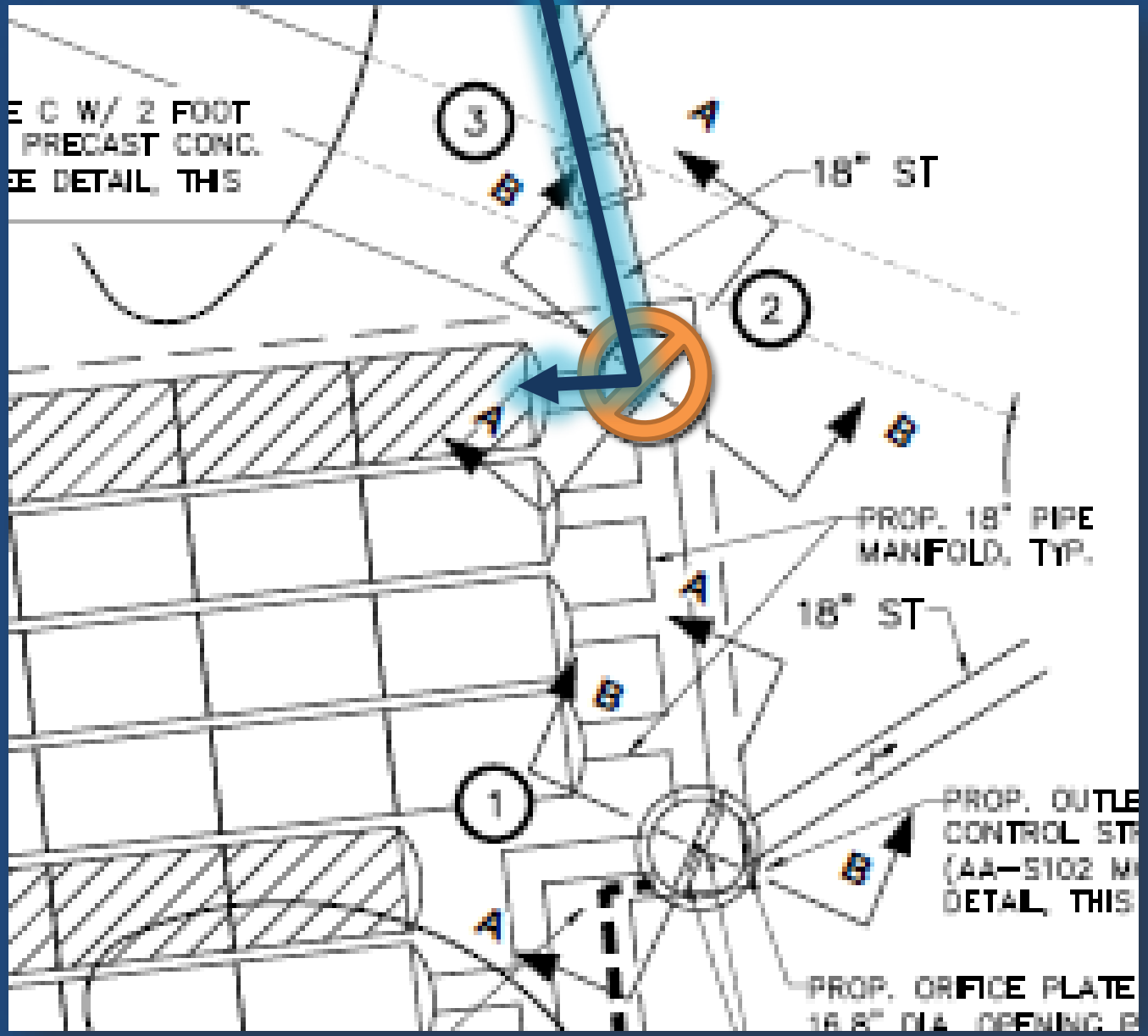

- WQf diversion

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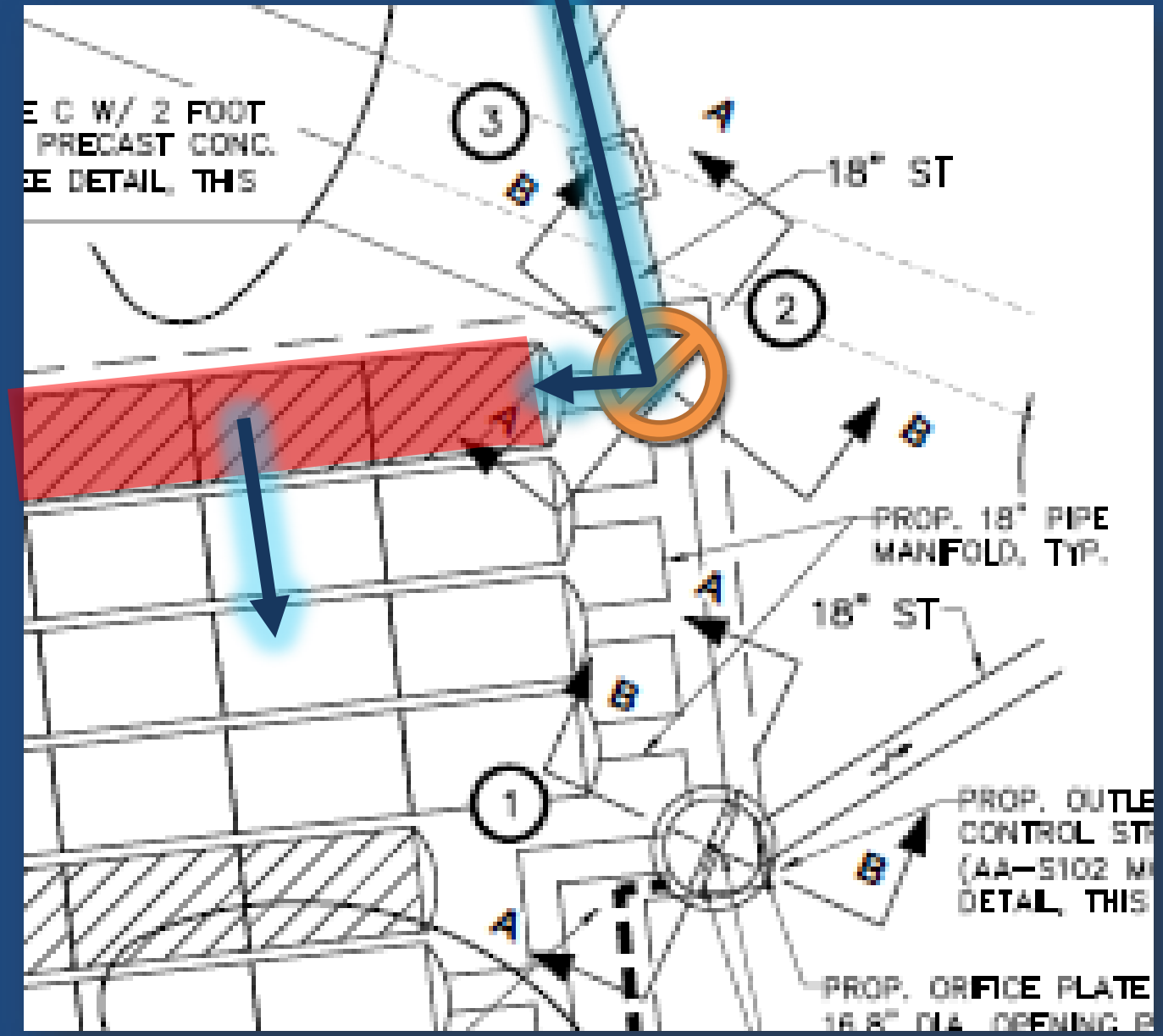

- WQf diversion
- Pretreatment unit

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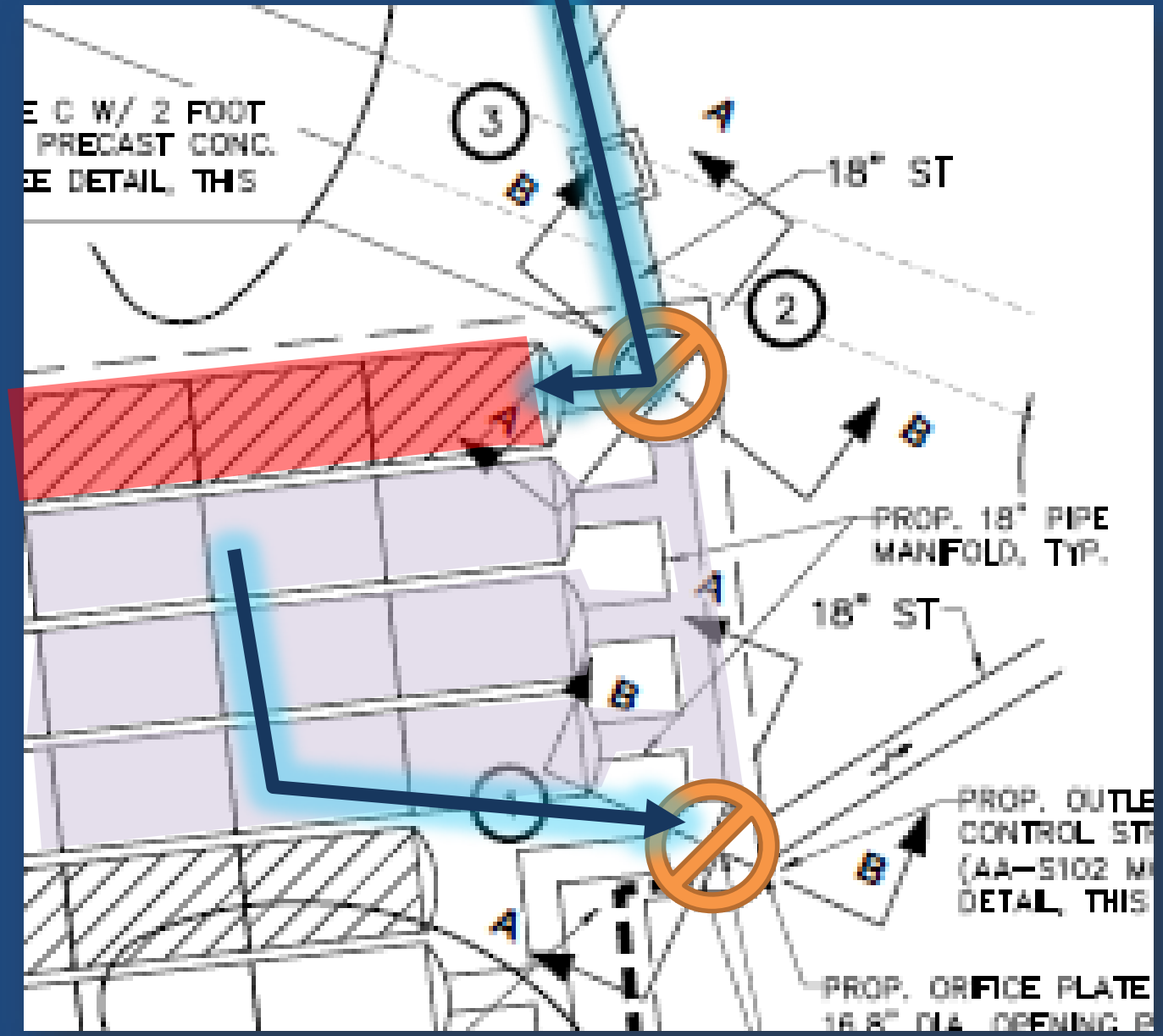

- WQf diversion
- Pretreatment unit
- WQv storage

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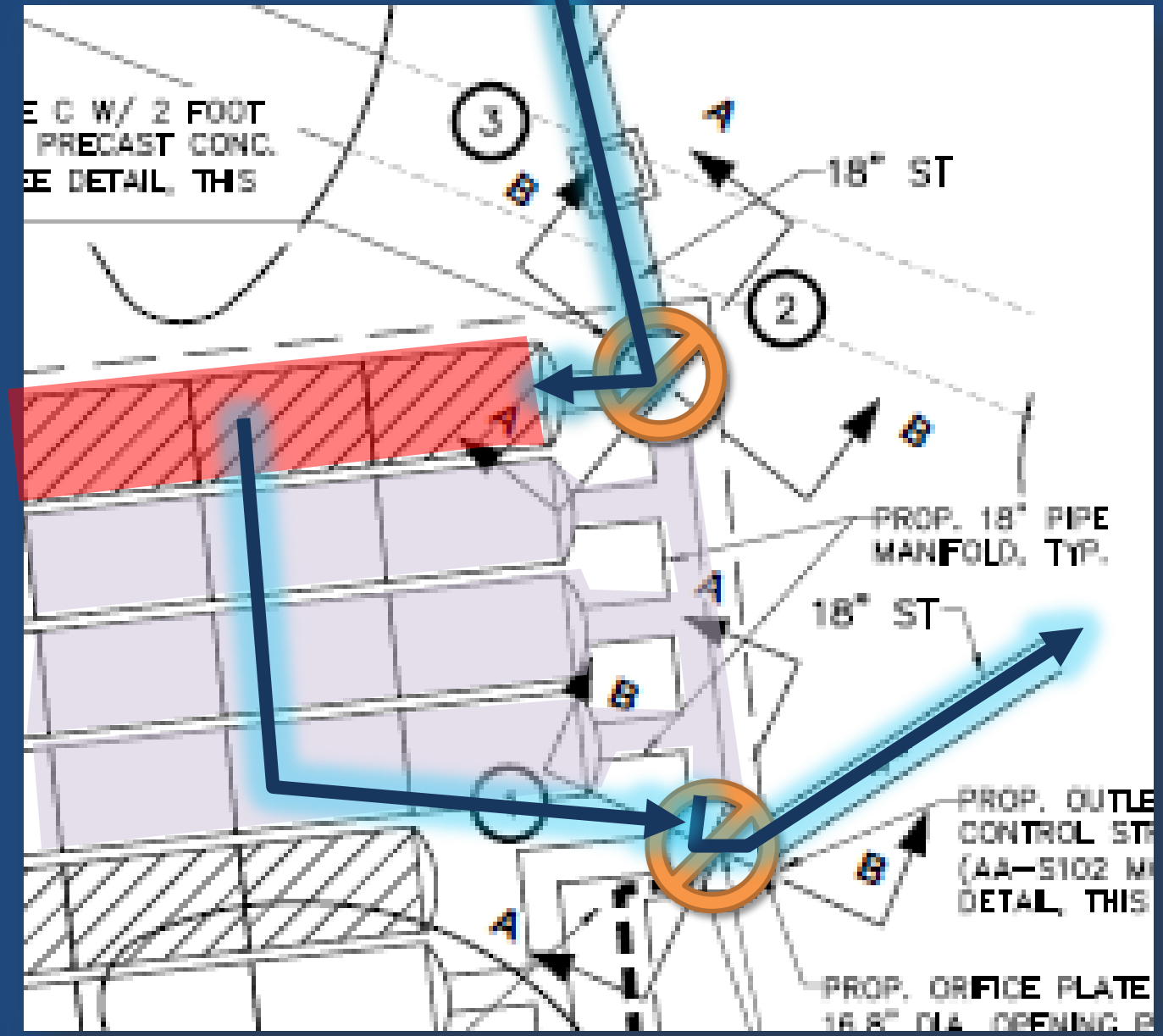
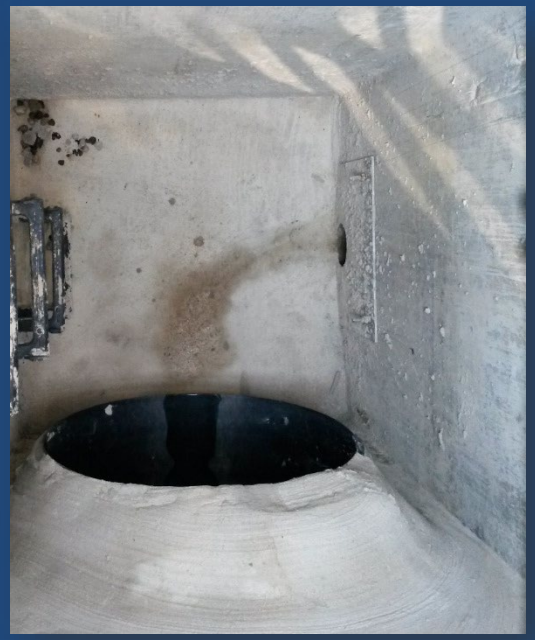


- WQf diversion
- Pretreatment unit
- WQv storage
- WQv drawdown control (orifice)



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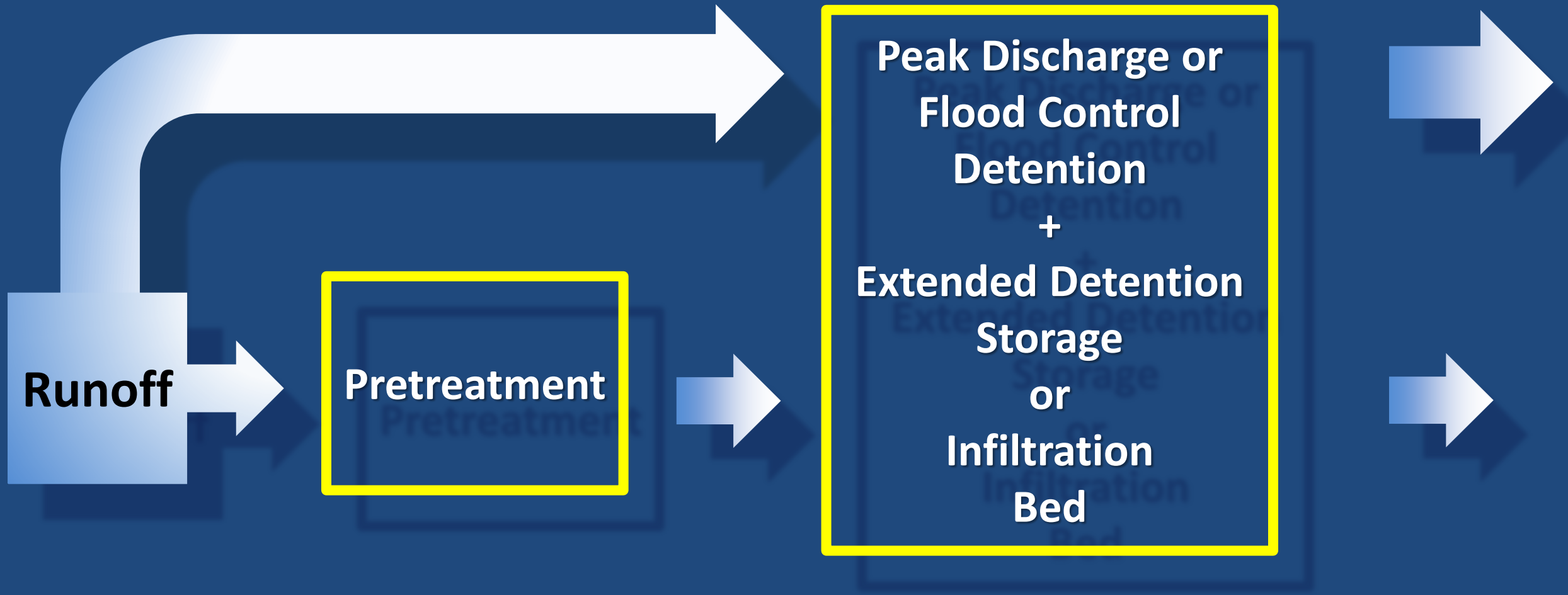

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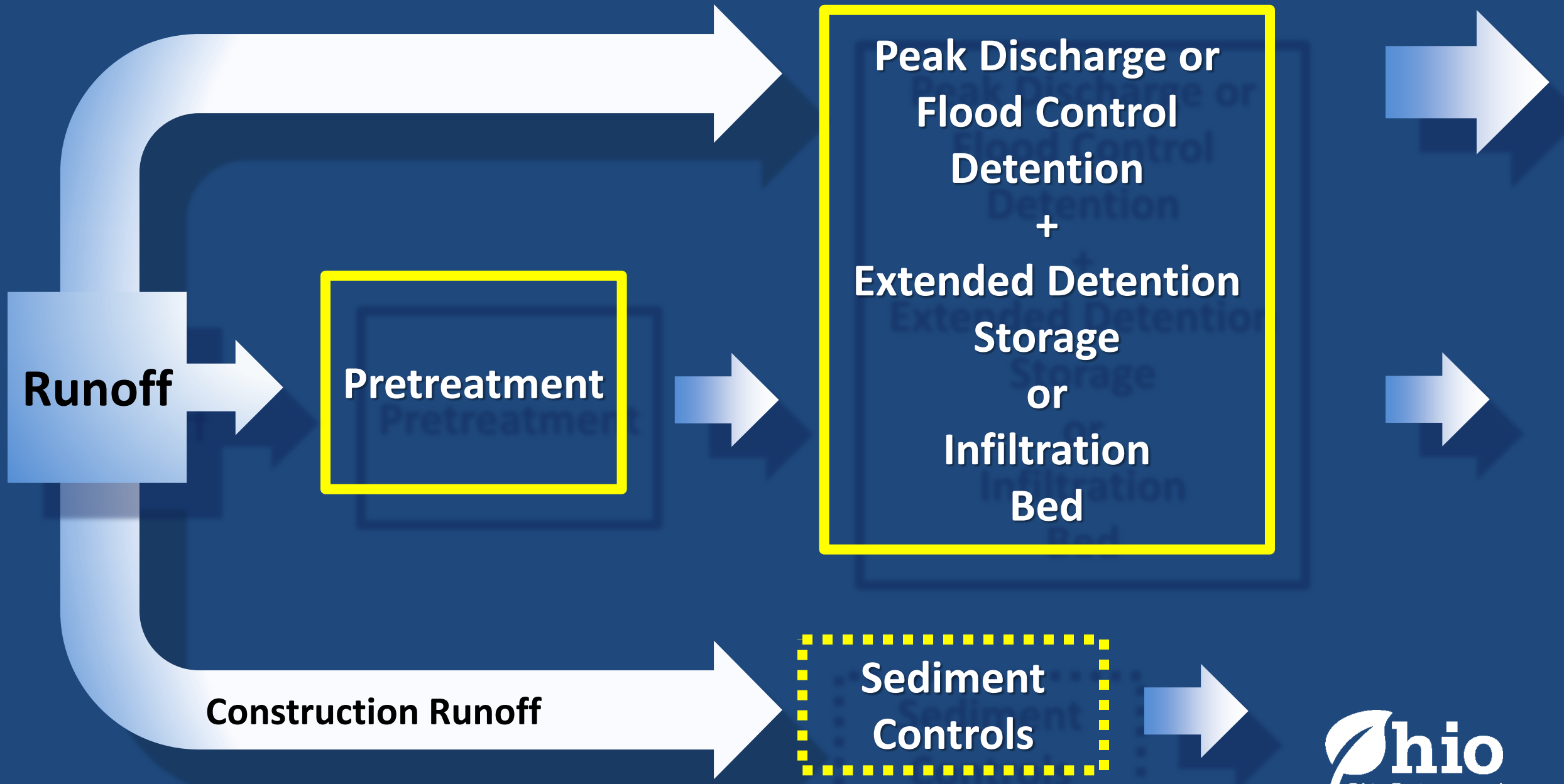

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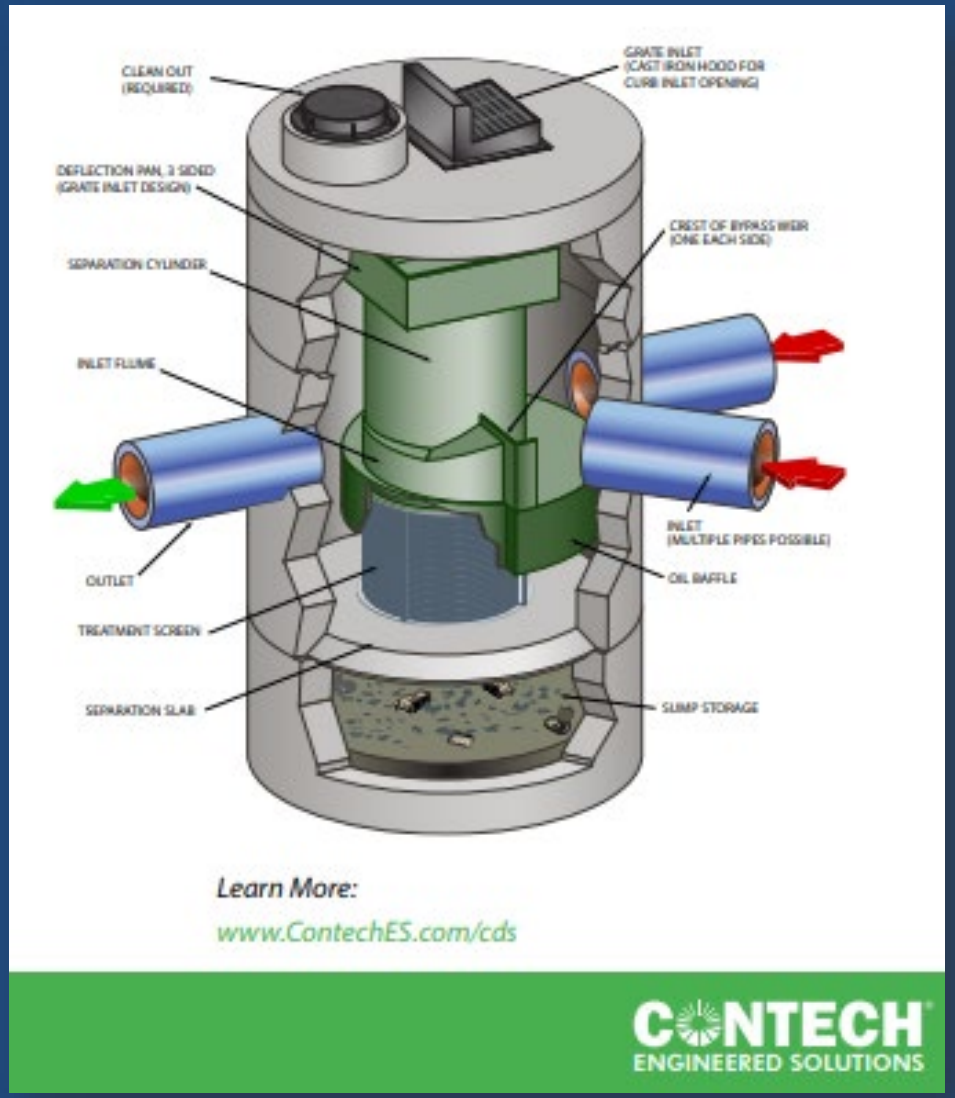
Pretreatment

1. Manufactured Treatment Device (MTD)
   - NJDEP or TAPE certified hydrodynamic separator



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Pretreatment

1. Manufactured Treatment Device (MTD)
   - NJDEP or TAPE certified hydrodynamic separator
   - NJDEP or TAPE certified media filter

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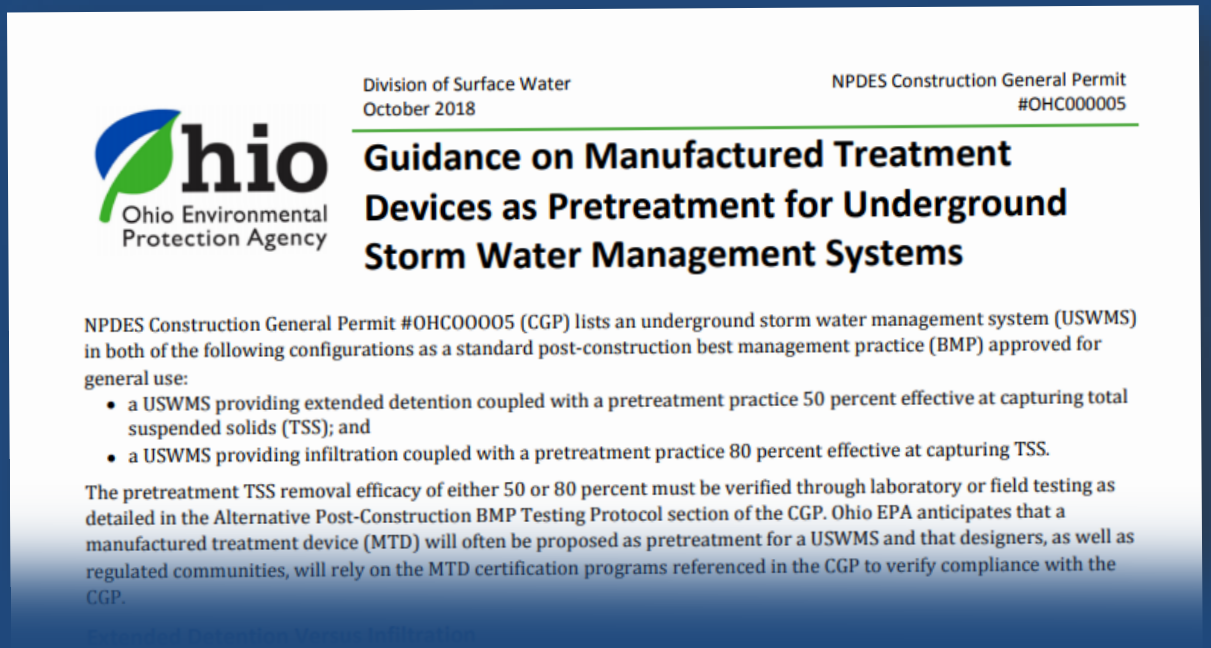
Manufactured Treatment Device

Guidance on certified practices

- ✓Navigating NJDEP & Washington TAPE Certifications
- ✓50% and 80% requirements
- ✓Maximum Treatment Flow Rate



Division of Surface Water
October 2018

NPDES Construction General Permit
#OHC000005

Ohio Environmental Protection Agency

Guidance on Manufactured Treatment Devices as Pretreatment for Underground Storm Water Management Systems

NPDES Construction General Permit #OHCOOOO5 (CGP) lists an underground storm water management system (USWMS) in both of the following configurations as a standard post-construction best management practice (BMP) approved for general use:

- a USWMS providing extended detention coupled with a pretreatment practice 50 percent effective at capturing total suspended solids (TSS); and
- a USWMS providing infiltration coupled with a pretreatment practice 80 percent effective at capturing TSS.

The pretreatment TSS removal efficacy of either 50 or 80 percent must be verified through laboratory or field testing as detailed in the Alternative Post-Construction BMP Testing Protocol section of the CGP. Ohio EPA anticipates that a manufactured treatment device (MTD) will often be proposed as pretreatment for a USWMS and that designers, as well as regulated communities, will rely on the MTD certification programs referenced in the CGP to verify compliance with the CGP.

Extended Detention Versus Infiltration

www.epa.ohio.gov/dsw/storm/index

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Pretreatment

2. Subsurface Geotextile Filter System
   - Provisional practice standard (pretreatment)

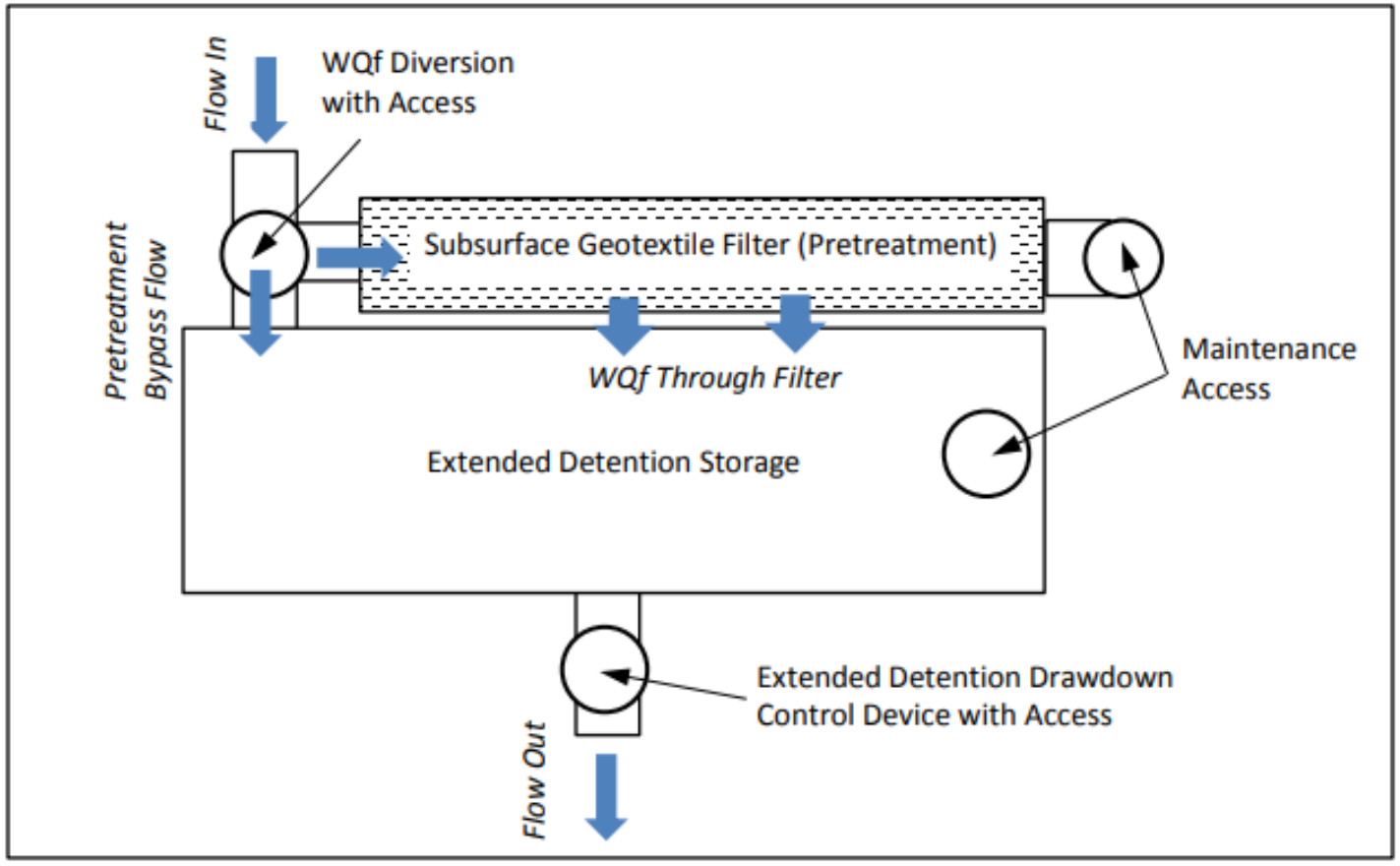

Figure 1: Schematic plan view of a subsurface media filter pretreatment system with a USWMS providing extended detention (after Maine DEP, 2016)

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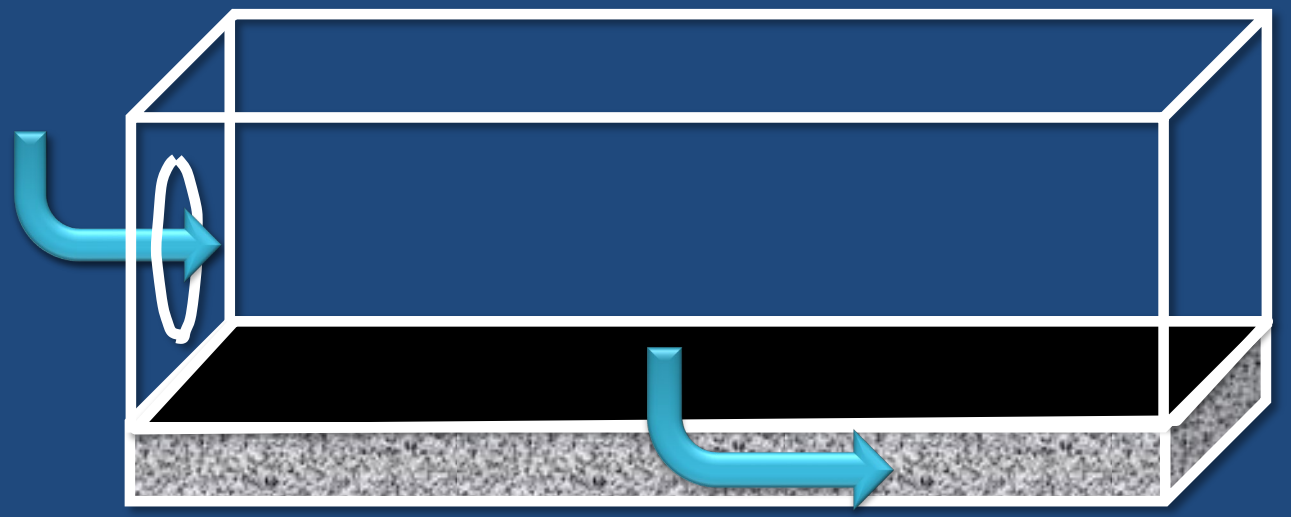
Geotextile Filter Systems

- ✓ Required hydraulic capacity is the WQf
- ✓ Size geotextile with hydraulic loading rate provide in *Rainwater* (1.0 gpm/sf)
- ✓ Specifications for woven fabric provided
- ✓ Surface access for maintenance



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Geotextile Filter Systems

WQf calculated as 1.5 cfs (673 gpm)

Design hydraulic loading rate = 1.0 gpm/sf

$$\frac{673\ gpm}{1.0\ {}^{gpm}/_{SF}} = 673\ SF$$

$$\frac{673\ gpm}{70\ {}^{SF}/_{chamber}} = 9.6\ , use\ 10\ chambers$$

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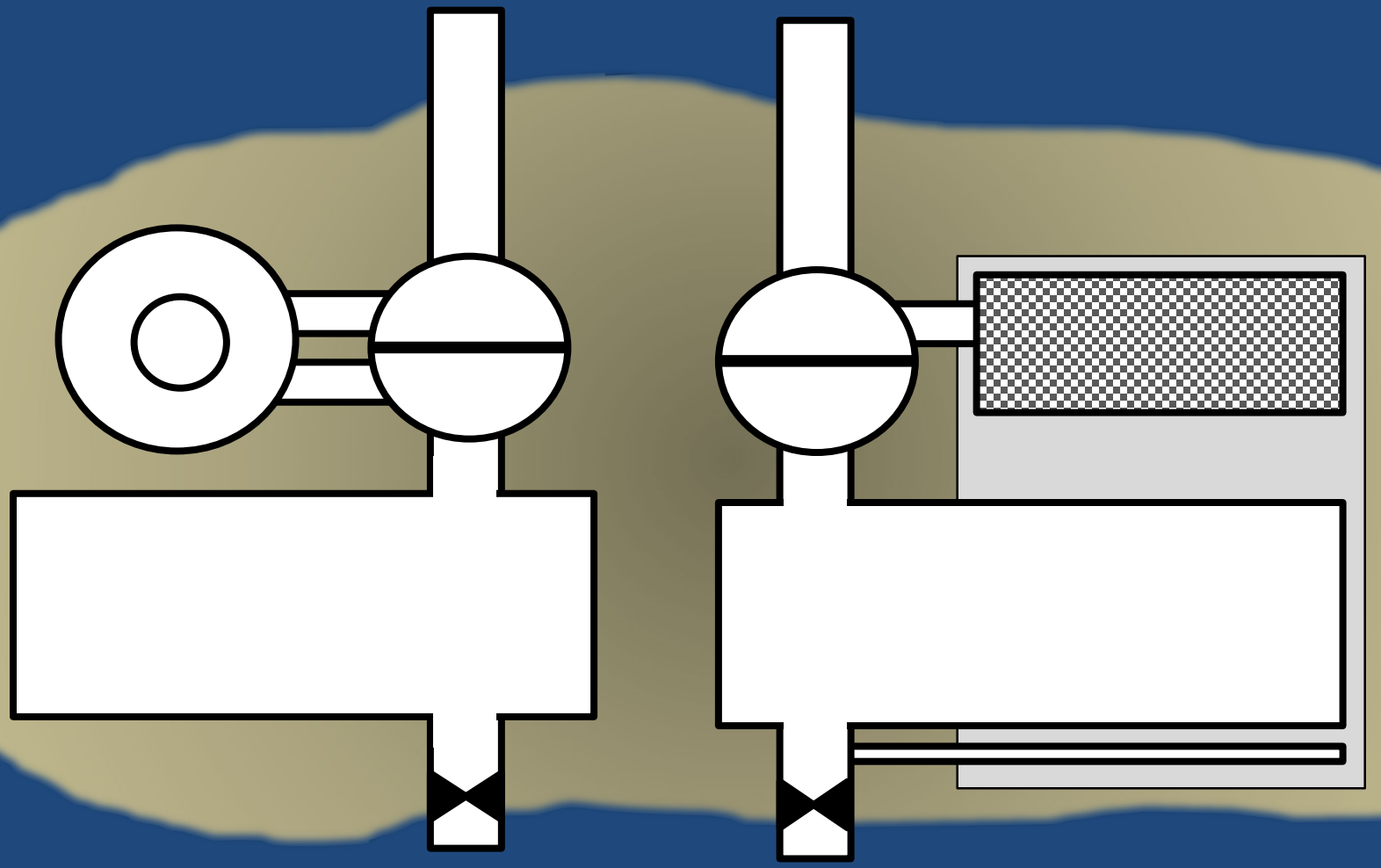
Offline



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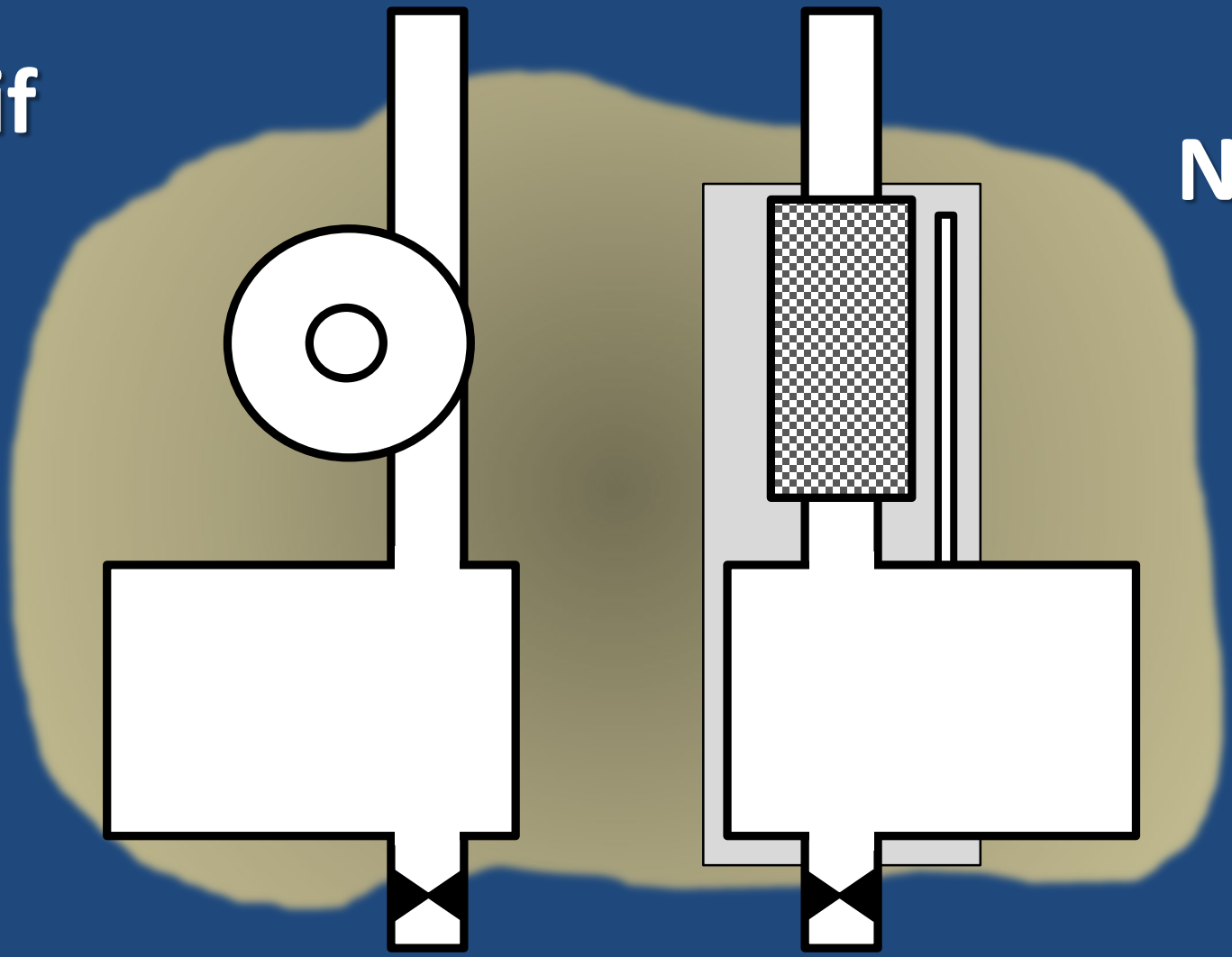
Online ?

Maybe, if internal bypass



No

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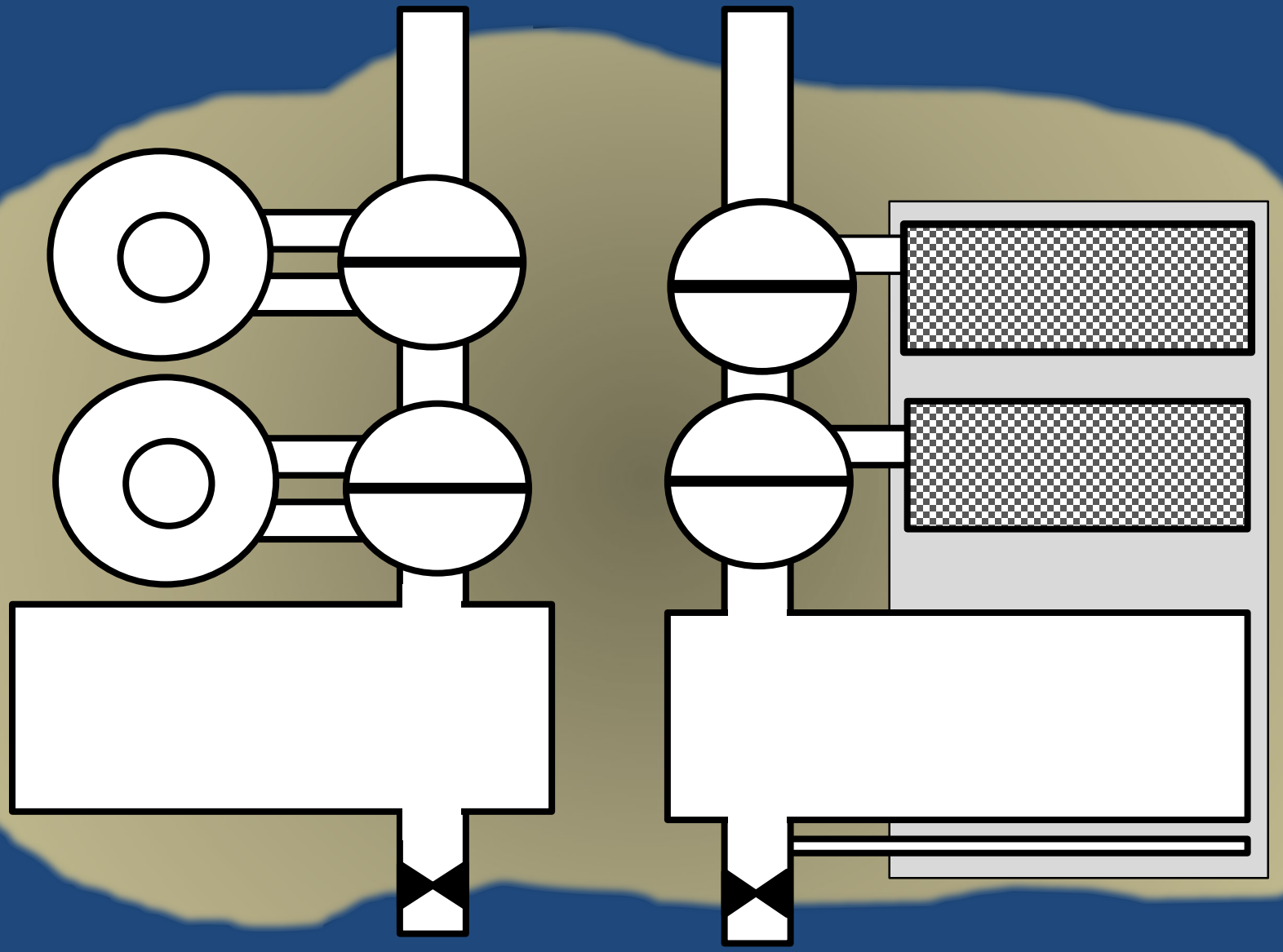
In Series ?



No

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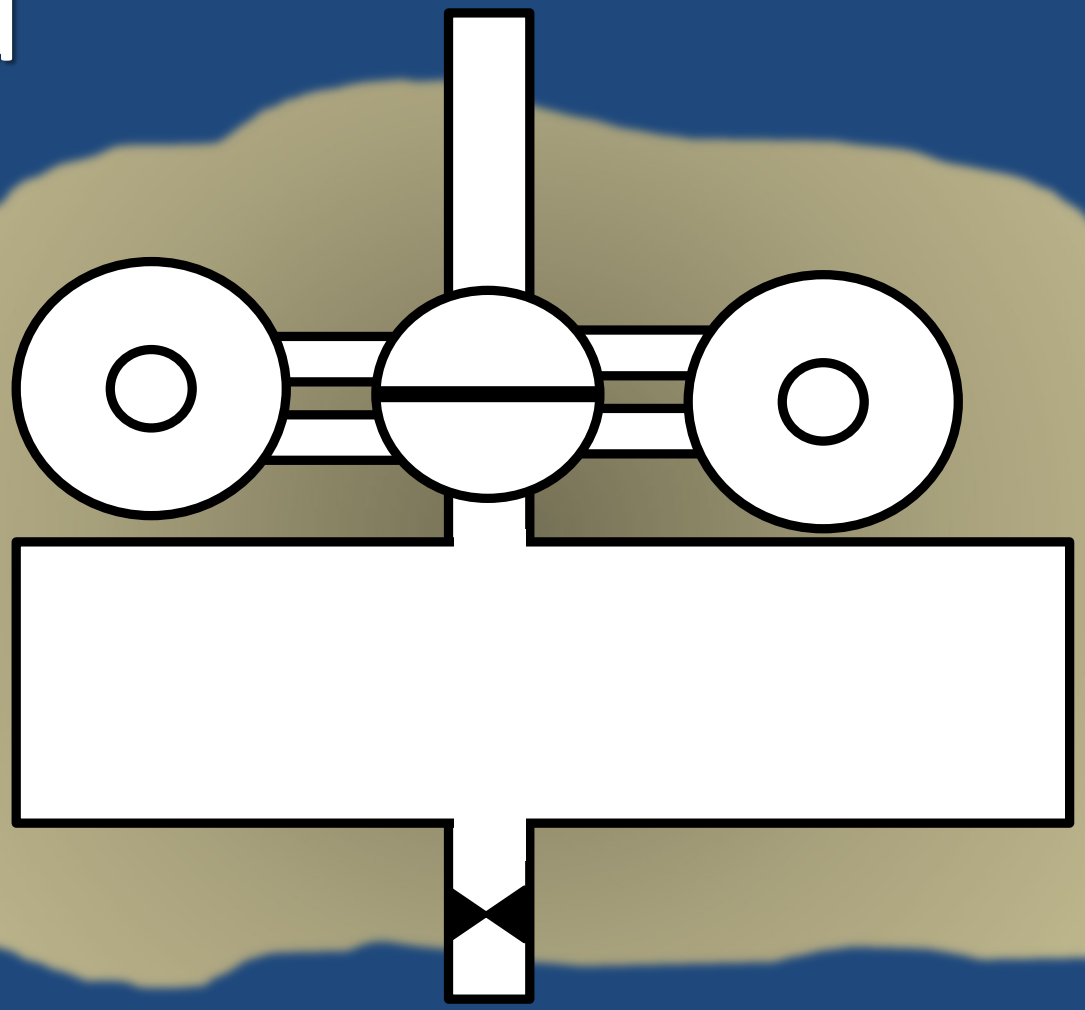
Parallel ?

Yes, if flow proportioned 50/50



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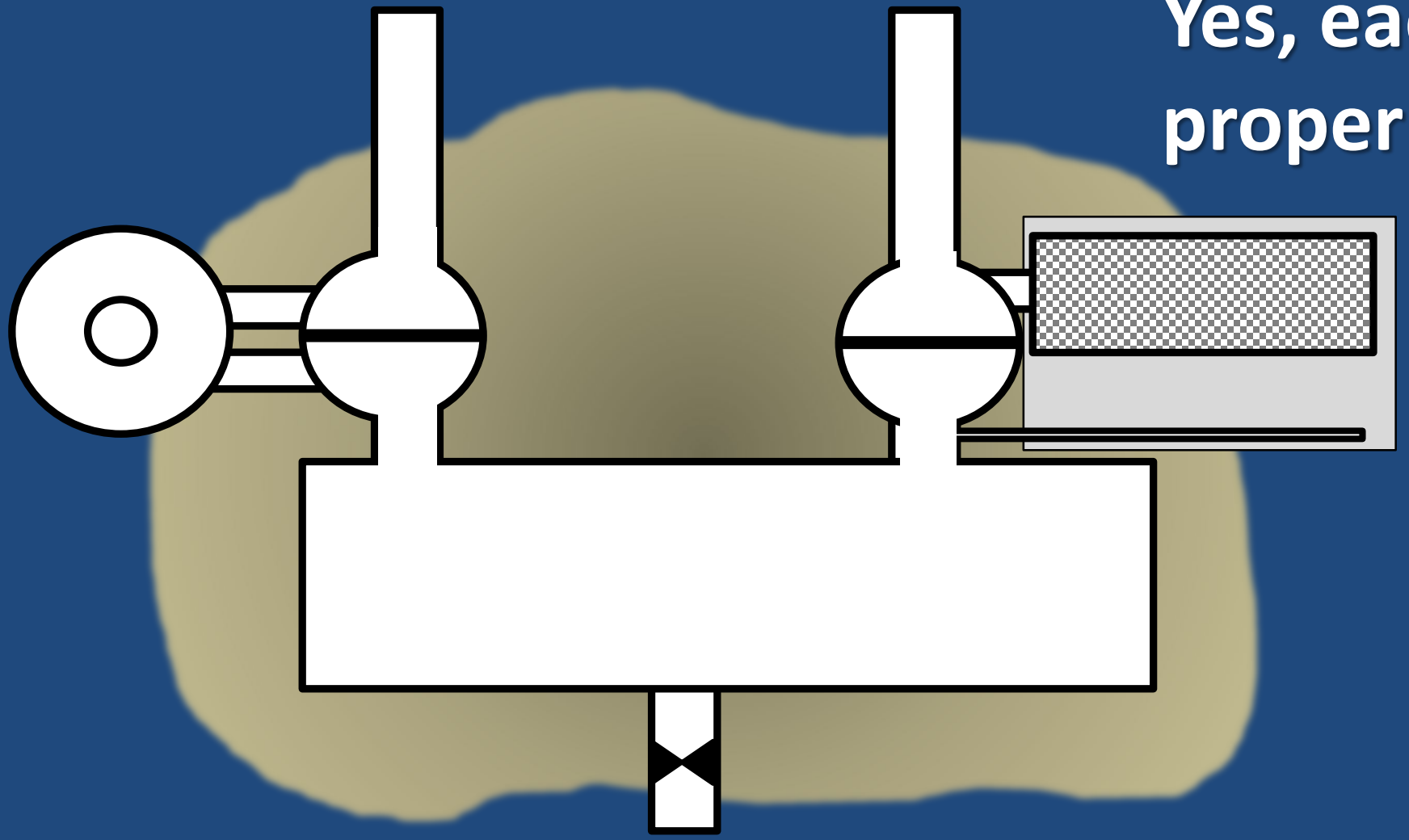
Combination ?



Yes, each with proper WQf

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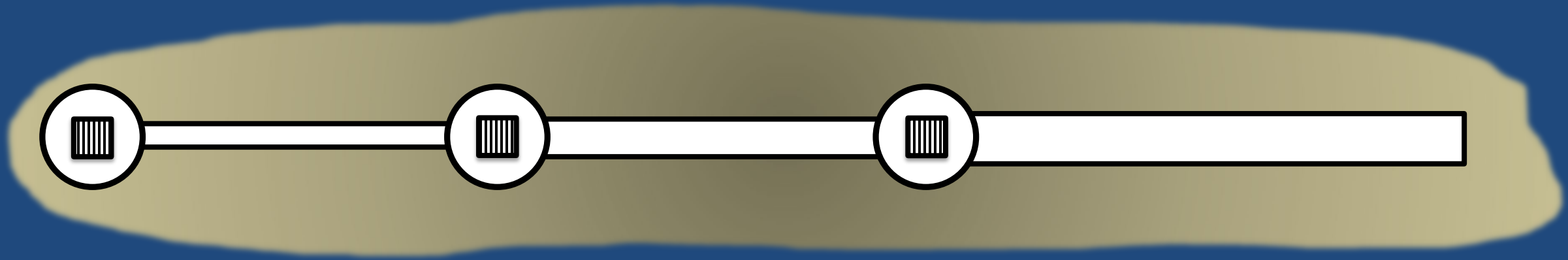
Linear ?



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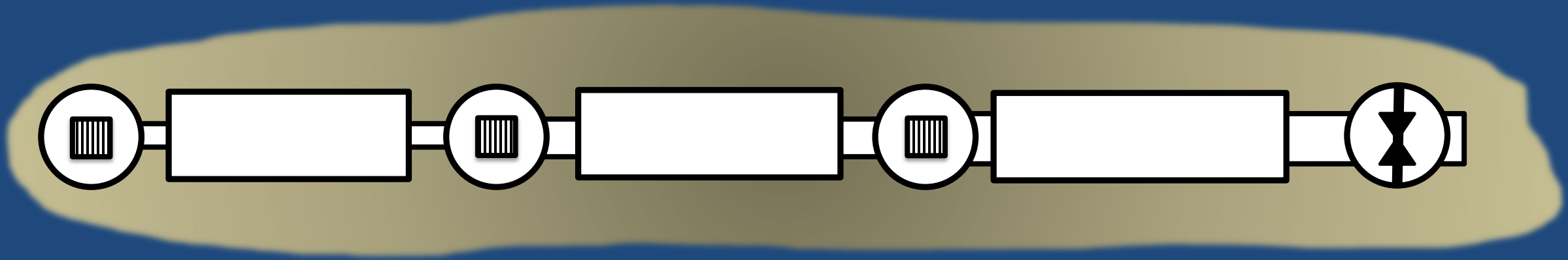
Linear ?



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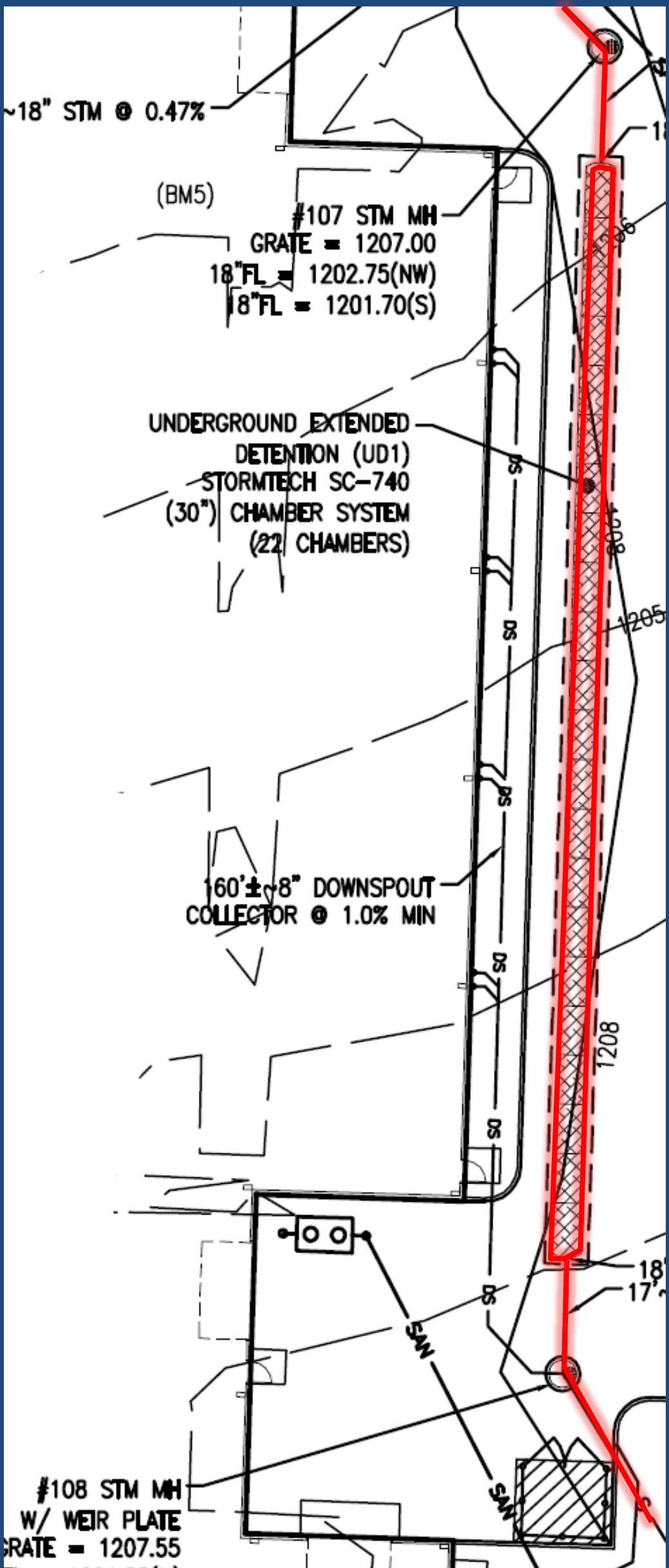

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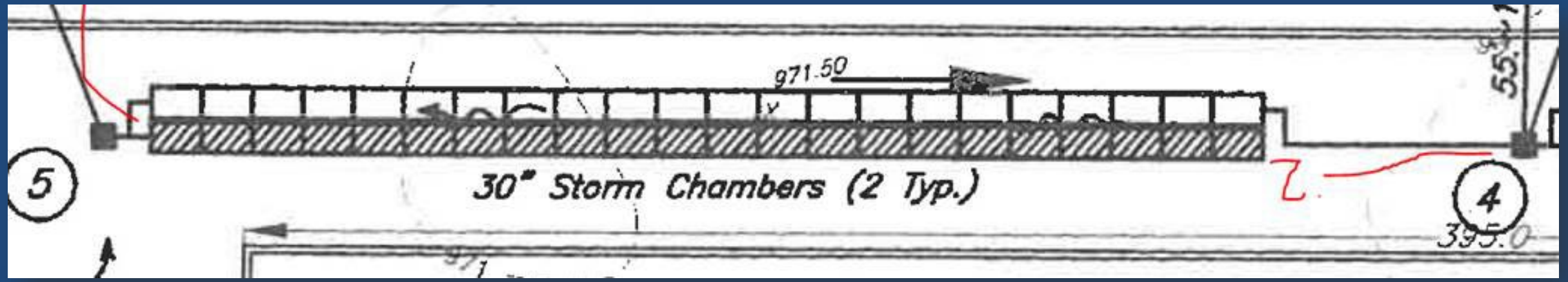
Linear Pretreatment



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Provisional Practice Standard

Criteria covered:

- Pretreatment
- Placement into service
- Outlet
- Storage volume
- Drain time
- Configuration
- Resuspension
- Excavation lining
- Access

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Thank You

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