Agenda Item IV.2

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Bristol Subsurface Infiltration Chamber Design Project

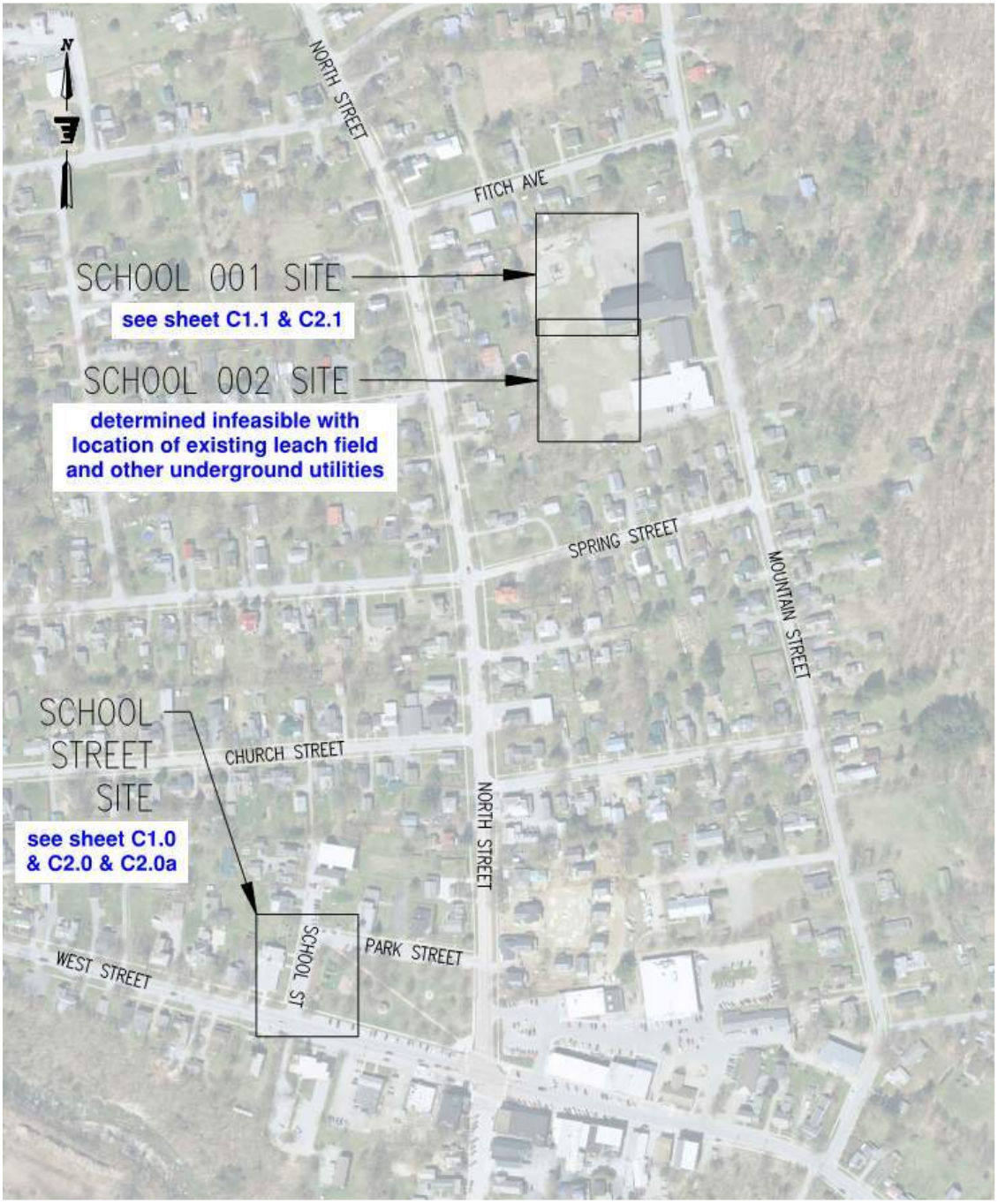
60% Design Narrative

11/19/2021

subsurface infiltration chamber system designed by EV during installation (March 2020)

Purpose

The purpose of this project is to advance the 30% conceptual design documents for the School Street Site and School 1 & 2 Sites. The goal of the project is to produce construction level documents for the Town of Bristol that can be used securing funding for installation of the chamber systems. These improvements are part of the Bristol stormwater master plan which targets reduction of stormwater runoff, sediment discharge, and nutrient (particularly phosphorus) loading.



Attachments

C1.0 Existing Conditions Plan – School Street Site

C1.1 Existing Conditions – School 001 Site

C2.0 Proposed Site Plan – School Street Site

C2.0a Proposed Site Plan Alternate – School Street Site

C2.1 Proposed Site Plan – School 001 Site

Work to Date

The following work has been completed for each of the two project sites:

Topographic site surveys were conducted by Latitudes Land Surveying, LLC for each of the potential sites locating existing features and visible utilities.

Existing Available Mapping available either online from the Vermont Center for Geographic Information, by School Facilities Staff or on the ANR Wastewater Permit database, was reviewed for each of the sites. Original design plans for the school indicate three existing leach fields; one of which is located near the proposed chamber system for the 'School 002' site. Given this information, this site has been rendered unsuitable for siting a proposed stormwater treatment practice. A second leach field is failing (west of the central portion of the building) and the school is in the process of permitting a replacement system with Green Mountain Engineering. The location of this replacement system has been taken into consideration and does not interfere with the location of the proposed chamber system for the 'School 001' site.

Estimated Leach Fields at Bristol Elementary School, provided by Green Mountain Engineering

Soil Borings and Soil Infiltration Testing was performed by Randy Rhodes, PE of M&W Soils Engineering, Inc. This consisted of (2) borings at each site to a depth of 12-feet below grade and a series of infiltration tests approximately 10-ft below existing grade. Material gradations were performed for samples retrieved from B-1 at the School Street site at the 8-9-ft depth, 9-9.5-ft depth and 10.5-12-ft depth. For the School Street site gradations were performed at the 8-10-ft depth and 10-12-ft depth.

Results for the School Site indicate 4-5ft of fill with sands and gravelly native material below. Evidence of seasonal high groundwater table was noted at a depth of 10.25-ft for Boring B1. Material gradations differ between the depths sampled. Finer material was found at the 9-9.5-ft depth than depth below 10.5-ft which indicates the presence of tighter soil layers that would produce a lower infiltration rate. Given these findings if during installation of the chamber system a tighter soil layer is encountered near the bottom of the system, this layer will need to be excavated and replaced with suitable native or imported backfill.

Results for the School Street Site indicate clean gravel native material approximately 1-ft below existing grade. There was no evidence of seasonal high water table.

Infiltration rates for both sites varied between testing locations. The lowest of the infiltration field rates would be used for design. This rate of 9 inches per hour varies only slightly from the 6 inches per hour applied for the 30% design iteration.

LOCATION OF BORING: Elementary School, northerly of 2 locations B1

Sample Depths From/To (Feet)	Blows per 6" on Sampler	Moisture Density or Consist.	Strata Change Elev.	Soil Identification	Sample No.	Pen. Inches	Rec. Inches
0-2	4/6/9/6			Loamy to brown loamy sand	1	24	24
			16"	Old crushed stone			
		Dry	20"	Brown sand fill			
2-4	5/7/4/3			Same, some concrete rubble around 3'	2	24	10
		Dry	40"	Brown sand fill, trace brick			
4-6	2/2/2/4	Loose, Dry	5.5'	Dark brown fine gravel	3	24	16
6-8	5/5/4/3				4	24	3
8-10*	4/2/3/3		8'	Lt brown clean brown sand, 2.5Y 5/6	5	24	22
			9'	Very fine light brown sand, 2.5Y 6/4			
			9.5'	Brown gravelly sand, 10YR 4/6			
10-12	6/5/4/4		10.25'	Lt brown very fine sand, 2.5Y 6/4, trace darker brown mottling	6	24	24
				Moved 5' South to drill infiltration point, set 4" open pipe to 10' bgs			
				Found pine roots, some rock, from 5-8'			
8-10'	30/26/9/5			Took a sample 8-10', found silty sand to 9.25' and then cleaner sand			

Ground Surface to 10' Used: 4.25" ID auger, then drove SS 24" to 12'

Sample Boring Log from Infiltration Testing Field Report by M&W Soils Engineering, Inc.

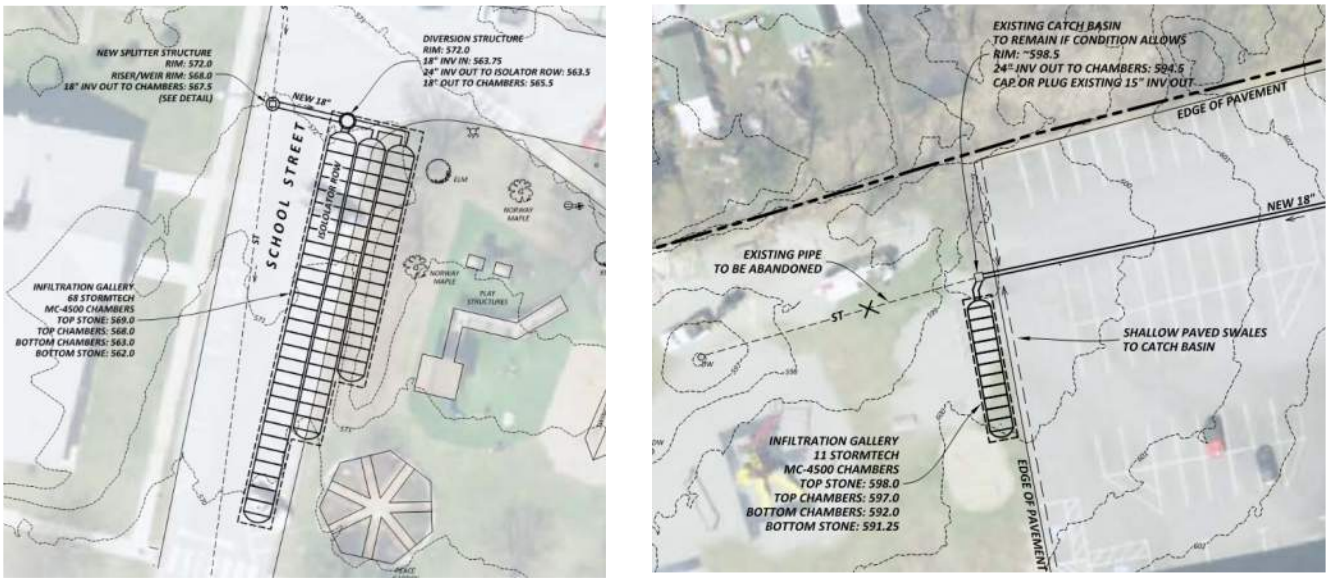
Existing Conditions plans have been developed, depicting the information described above. *Refer to attached plan sheets C1.0 and C1.1.*

Review of the 30% Design Information provided in the RFP was completed by our office once the existing conditions and soil investigation work concluded. Our review found areas where we believe the 30% design to be overly optimistic in terms of capacity and performance. We also found underground infrastructure at both locations that would interfere with installation of the chamber systems as outlined in the 30% plans.

The 'School 002 System' was shown in an area in use for wastewater disposal by the school. This area was abandoned for stormwater and the 30% concept not advanced further.

For the 'School 001' site the 30% design included directing nearly 50-acres of upland wooded area to the proposed chamber system. In our opinion, this is too large of a collection area for the chamber system proposed, and would be regularly overloaded. It should also be noted that the school site is considerably lower than the elevation of Mountain Street and the school does not have a defined outfall from the site. This means that any runoff reaching the school parcel that does not infiltrate into the ground would continue across school property to adjacent residential properties. It is our opinion that directing additional runoff to the site is not warranted and could result in the need for a much larger system, or exacerbate drainage issues for the school and/or neighboring residences.

For the 'School Street' site, the roughly 30-ac drainage area consisting primarily of the residential neighborhood to the northwest, remains unchanged from the 30% design iteration.



30% designs for the School Street Site (left) and School 001 Site (right).

60% Design has been completed largely based on the 30% design targets while also taking into consideration the additional information made available by the topographic survey and soils investigation.

The 'School 001' chamber system design has been modified to a series of (9) stormtech MC-3500 chambers arranged in (3) rows (*refer to attached plan sheet C2.1*). A single MC-3500 chamber provides a larger storage volume than the MC-4500 chamber which was initially proposed. The 3500 units boasts a larger footprint, but a shorter vertical dimension. The MC-3500 chambers were chosen for the 60% design to provide adequate separation to seasonal high water table, as identified during the geotechnical investigation.

Pretreatment is typically provided for stormwater system that treat non-rooftop runoff to remove sediment and pollutants prior to entering the treatment system. The Vermont Stormwater Management Manual (VSMM), specifies pretreatment be provided for 50% of the water quality volume. For this site, pretreatment is proposed as (2) below grade pre-cast concrete tanks as well as a deep sump catch basin which will replace the existing drywell structure.

The orientation of this system is largely based on providing the required 35-ft horizontal separation to adjacent leach field systems, both on the school property and adjacent residential properties. The chamber system layout avoids impact to existing playground features and minimizes impact to the paved parking area. There will likely be some amount of pavement replacement required to enable installation of the pretreatment tanks which will require excavations roughly 13-ft below existing grade.

It is recommended that this 60% design be reviewed with school facilities staff prior to advancing the design.

The 'School Street' chamber system design has been modified to a series of (78) stormtech MC-4500 chambers arranged in (3) rows (*refer to attached plan sheet C2.0*).

Although 50% pretreatment is required per the VSMM, it would require a significant increase in the treatment area footprint due to the large size of the contributing drainage area. It is likely that some amount of pretreatment is provided upstream by the existing stormwater conveyance system and sheet flow over vegetated areas. Furthermore, an isolation row can be incorporated in this design which adds a layer of geotextile fabric below the chambers to prevent suspended sediments from migrating into the filtering stone layer.

The orientation of this systems is largely unchanged from the 30% design aside from shifting the entire system to within the paved roadway and parking area. The chamber system layout minimizes impact to the existing park features and will provide a uniform area of pavement replacement.

One factor that will impact the final design of the system is the location of existing underground utilities. During our review of existing available mapping, a wastewater permit plan for an adjacent property was discovered which shows existing water and sewer lines in proximity to the project area. It is likely that the system will need to be reduced or reoriented to avoid impact to existing utility lines.

Another option is to relocate any existing underground utilities which would add cost and scope to the project. Cyrus Marsano of Vermont Utility Management Services field-located the waterlines in vicinity to the project. Based on the approximate location of the water lines, an alternate 60% design has been developed (*refer to attached plan sheet C2.0a.* The water line is estimated to be nearly 100-years old. Excavation near a water line of that age risks damage to the water line itself and raises the level of risk to the excavation crew. Note that the alternate plan does not take into consideration a possible sewer line that may exist to the east of the water line.

Conclusion

In summary, progressing the chamber systems from 30% to 60% designs has required an increasingly pragmatic approach. It is our recommendation that the 60% School site be advanced after reviewing the proposed plan with the school. There are a few items for consideration before advancing the School Street design; EV presents the following options:

1. Replace and relocate existing aging infrastructure within school street to enable the installation of the underground chamber system. We anticipate this will require the Town to seek additional funding for the design and installation of the relocated utilities.
2. Further pursue the alternate chamber system design which reduces the size of the treatment area in order to avoid impact to the existing water line. The alternate design would likely result in increased impact to the park area. This option would also require the Town hire a private utility locating company to identify existing underground utilities within School Street, with sanitary infrastructure being the primary concern.
3. Abandon this site as a location for underground infiltration chambers. Investigate relocating the system elsewhere within the park. Note that geotechnical soils investigation and topographic survey work will need to be performed to verify the suitability of a potential site for relocation.

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LOCATION MAP

SCALE: 1" = 1,000'

EXISTING CONDITIONS LEGEND

- APPROXIMATE PROPERTY LINE
- 769 1-FT CONTOUR INTERVAL
- 770 5-FT CONTOUR INTERVAL
- EDGE OF PAVEMENT/CURB
- APPROXIMATE LINE STRIPING
- SD STORMLINE/CATCH BASIN/DRAINAGE MANHOLE
- S SEWERLINE/SANITARY MANHOLE
- W WATERLINE/VALVE/HYDRANT
- OHE OVERHEAD POWERLINE/POWERPOLE/LIGHTPOLE
- EXISTING TREE
- EXISTING SIGN
- B1 SOIL BORING LOCATION

SURVEY NOTES

1. EXISTING PHYSICAL FEATURES AND TOPOGRAPHY SHOWN HERE HAS BEEN TAKEN FROM A SURVEY PERFORMED BY LATITUDES LAND SURVEYING, LLC IN JUNE/JULY OF 2021.
2. PROPERTY LINES ARE BASED ON INFORMATION PROVIDED BY VERMONT CENTER FOR GEOGRAPHIC INFORMATION AND ARE APPROXIMATE ONLY.
3. UTILITIES SHOWN DO NOT PURPORT TO CONSTITUTE OR REPRESENT ALL UTILITIES LOCATED UPON OR ADJACENT TO THE SURVEYED PREMISES.
4. NORTH ORIENTATION IS REFERENCED TO APPROXIMATE VERMONT GRID NORTH DERIVED FROM GPS READINGS OBSERVED BY OTHERS.
5. ELEVATIONS ARE REFERENCED TO APPROXIMATE NAVD 88 DERIVED FROM GPS READINGS OBSERVED BY OTHERS.
6. EXISTING UTILITIES SHOWN ON PLANS WERE TAKEN FROM FIELD OBSERVATIONS OF VISIBLE UTILITIES AND PAINTED MARKINGS. CONTRACTOR SHALL BE RESPONSIBLE FOR FIELD VERIFYING UTILITY LOCATIONS PRIOR TO COMMENCING WORK. NOTIFY ENGINEER OF ANY DISCREPANCY BETWEEN UTILITIES AS SHOWN AND AS FOUND. THE CONTRACTOR SHALL CONTACT DIG SAFE (811 or 888-344-7233) A MINIMUM OF 72 HOURS, BUT NOT INCLUDING SATURDAYS, SUNDAYS AND LEGAL HOLIDAYS, PRIOR TO ANY CONSTRUCTION.

GRAPHIC SCALE

10 0 5 10 20 40

1 inch = 10 ft.
for sheet size 24" x 36"

Stamp

No.	Description	Date

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208 Flynn Avenue, Suite 2A, Burlington, VT 05401 s 802-863-6225
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Addison County
Regional Planning Commission
Maddison Shropshire, Water Quality Planner
14 Seminary Street, Middlebury, VT 05753
mshropshire@acrpc.org

Sheet Title: Existing Conditions Plan
School Street Site

Project Title: School Street and School 1 & 2
Surbsurface Infiltration Chamber Project
Town of Bristol, Addison County, Vermont

EV Project #	21230
Drawn By:	HKW
Checked By:	PB
Scale:	1" = 10'
Date:	09/24/2021 - 60% CDs

C1.0

S:\PROJECTS\H-2021\21230 (BRISTOL SUB-SURFACE INFILTRATION CHAMBERS)\PW\SHEET FILES\21230 C1.0 EXISTING CONDITIONS PLAN.DWG

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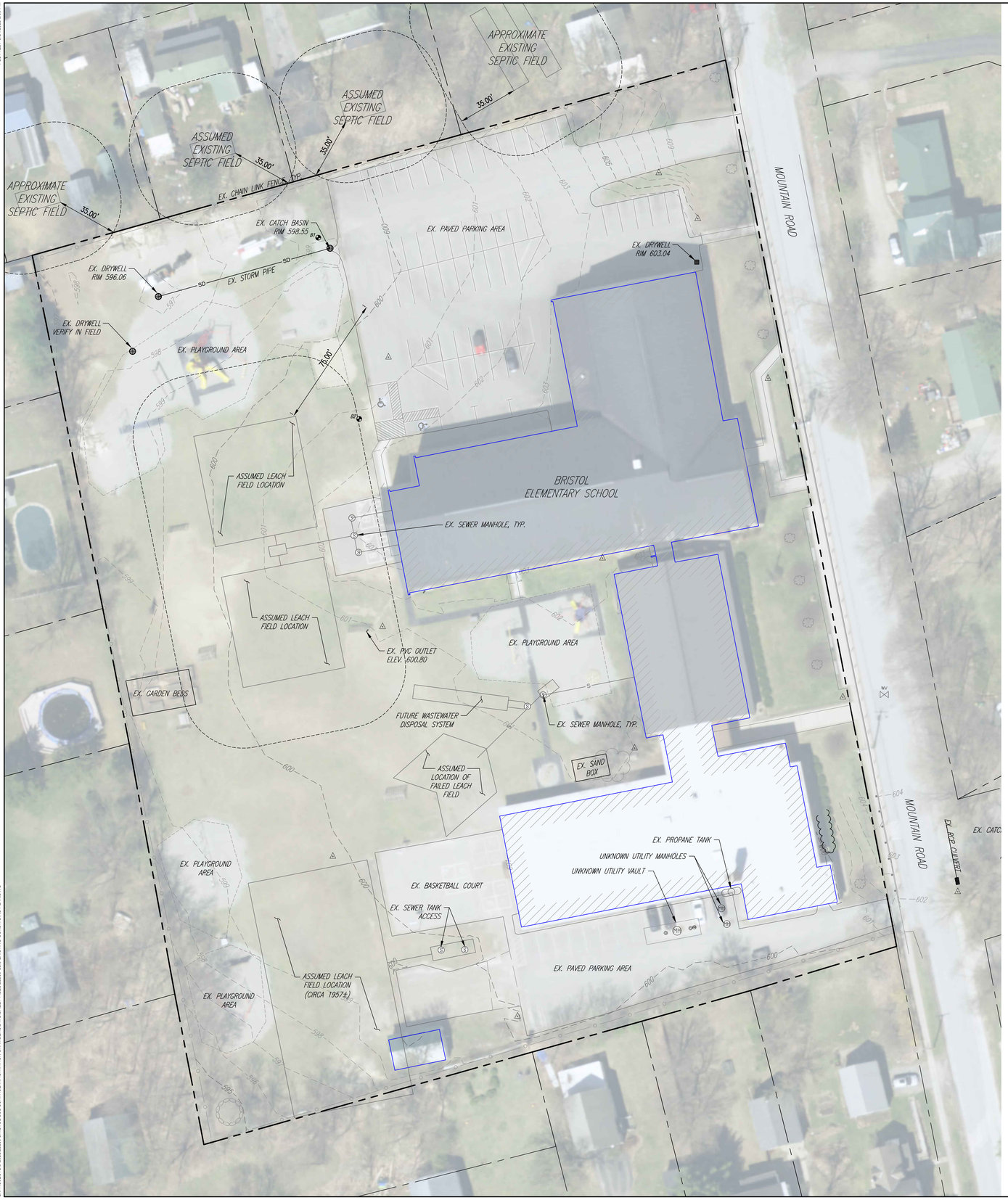

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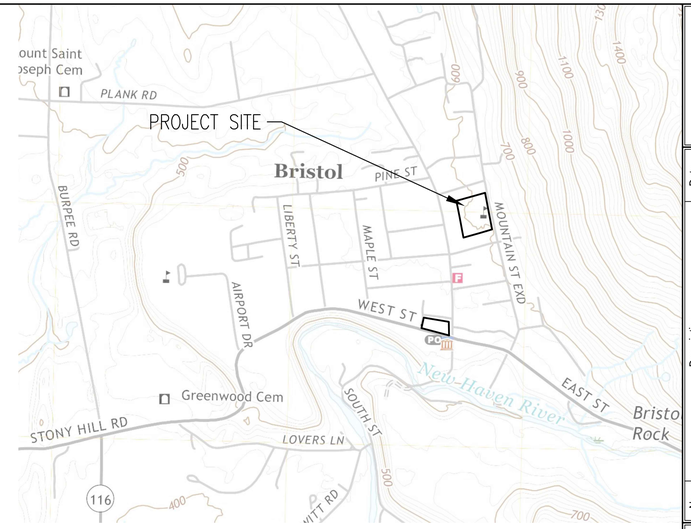

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GRAPHIC SCALE

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School 1 & 2 Sites

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Town of Bristol, Addison County, Vermont

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C1.1

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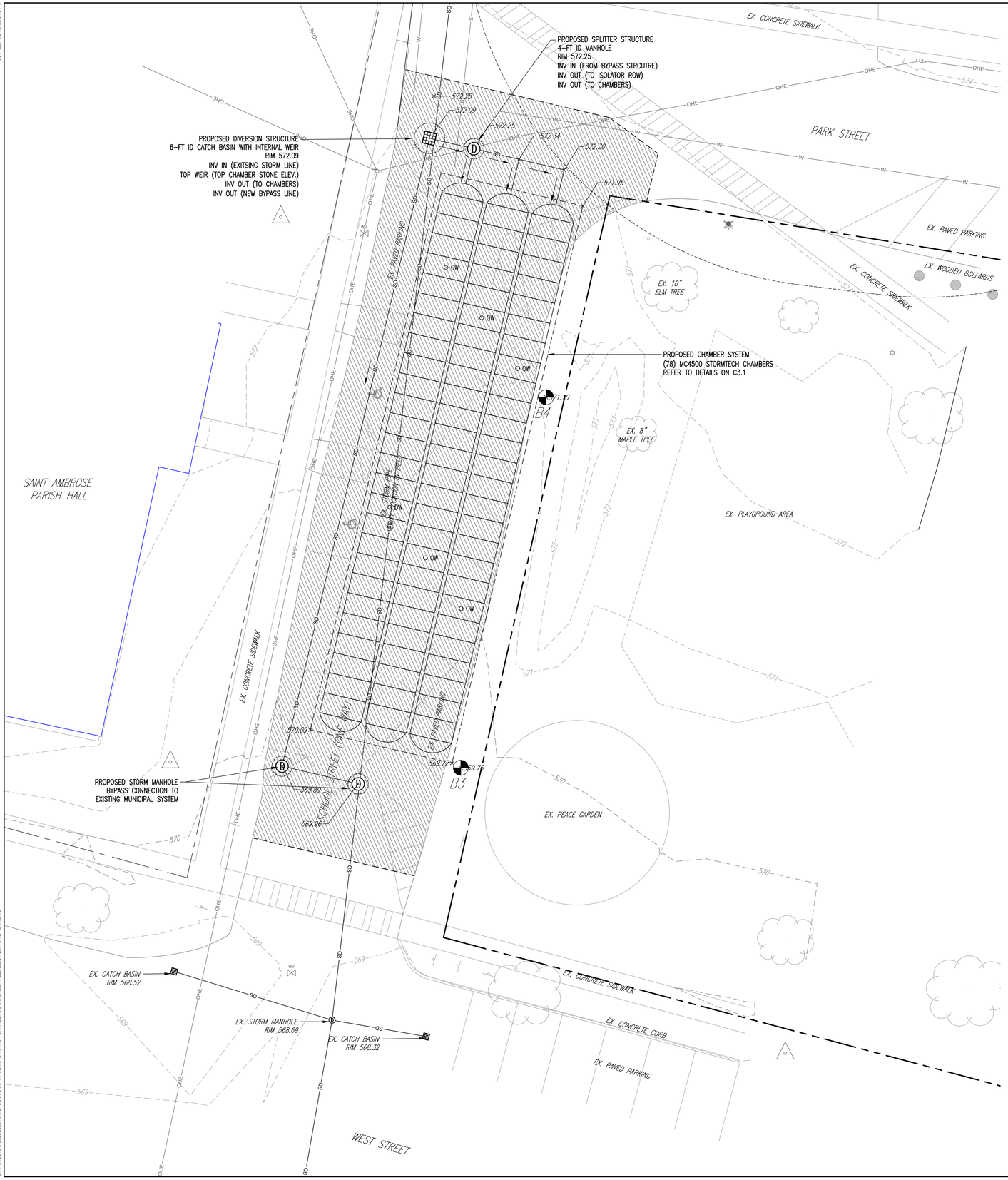

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PROPOSED CONDITIONS LEGEND

- 670 — 5-FT CONTOUR INTERVAL
- 671 — 1-FT CONTOUR INTERVAL
- SD — STORM LINE
- CATCH BASIN/MANHOLE
- INFILTRATION CHAMBER SYSTEM
- OW — OBSERVATION WELL LOCATION
- DIRECTION OF PIPE FLOW
- \+ — PROPOSED SPOT GRADE ELEVATION
- ×—667.40 — EXISTING SPOT GRADE ELEVATION
- PROPOSED PAVEMENT PATCH
- PROPOSED CONCRETE SIDWEALK REPLACEMEI

BASIS OF DESIGN

from 30% design iteration

Park Site, School Street		
Drain Area	65183 sf	32.120 ac
Impervious	37428 sf	10.230 ac
Pervious		21.890 ac
1-ft Contour Interval Length		37175 ft
Hydraulic Length		2412 ft
Tc		81.5 min

Water Quality Sizing

Precipitation	1 in
Rv	0.34
% Impervious	31.8 %
WQv =	**39251 cubic feet**

PEAK FLOW COMPARISON

(78) MC4500 Infiltration Chambers

	Peak Flows		
	Pre Development	Post Development	% Reduction
1" WQ	3.41 cfs	0.67 cfs	80%
1-year	7.95 cfs	7.28 cfs	8%
5-year	11.83 cfs	9.48 cfs	20%
10-year	13.82 cfs	10.48 cfs	24%
25-year	16.58 cfs	10.90 cfs	34%
50-year	18.65 cfs	11.21 cfs	40%
100-year	20.80 cfs	11.53 cfs	45%

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School Street Site

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Subsurface Infiltration Chamber Project
Town of Bristol, Addison County, Vermont

EV Project #	21230
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Scale:	1" = 10'
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C2.0

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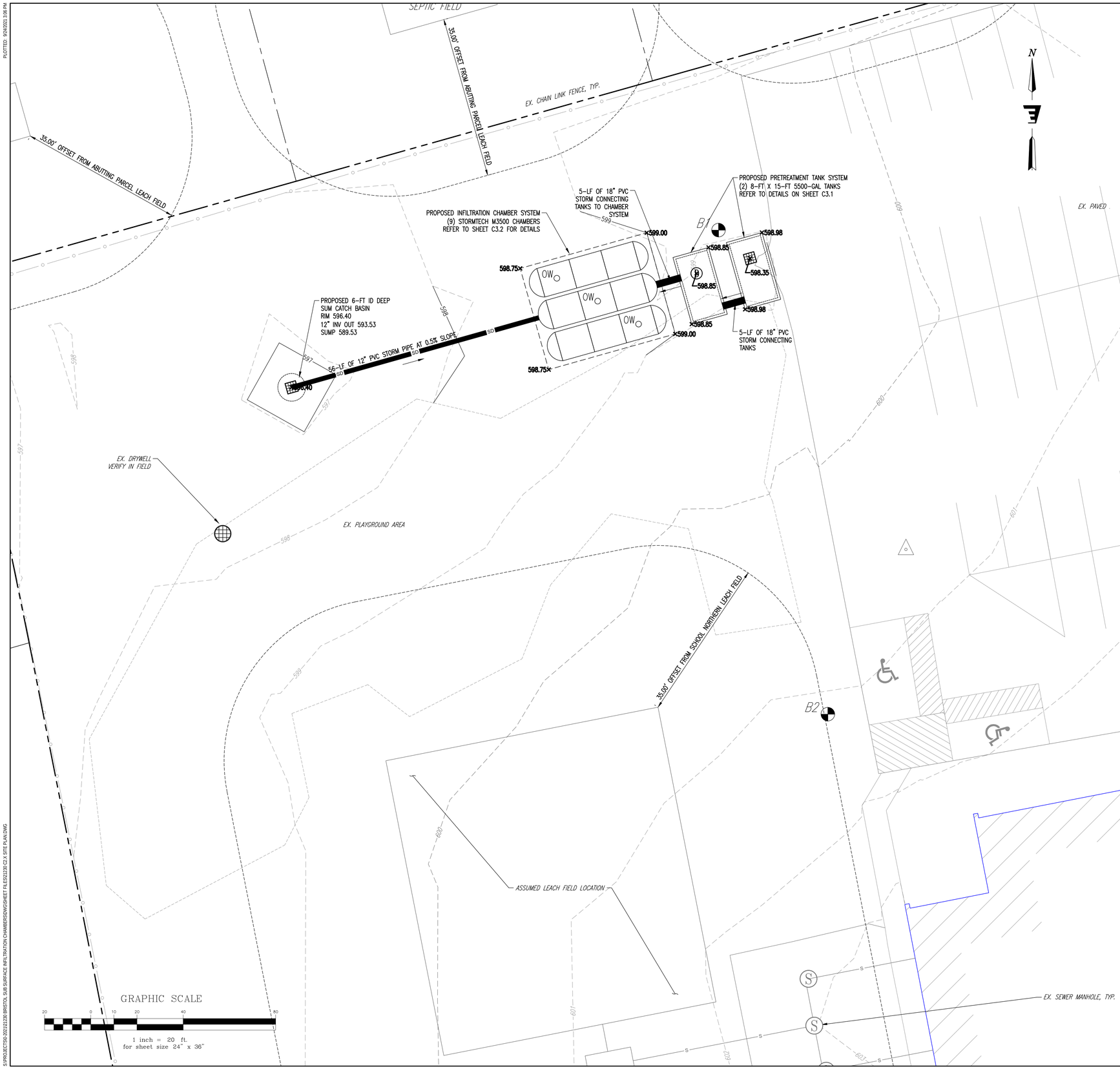

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- OW — OBSERVATION WELL LOCATION
- DIRECTION OF PIPE FLOW
- PROPOSED SPOT GRADE ELEVATION
- 667.40 — EXISTING SPOT GRADE ELEVATION

BASIS OF DESIGN

School Site Mountain Road

Drainage Area	65183 sf	1.496 ac
Impervious	37428 sf	0.859 ac
Grass HSG A		0.637 ac

Water Quality Sizing

Precipitation	1 in
Rv	0.57
% Impervious	57.4 %
WQv =	**3079 cubic feet**

Sub Drainage Area to Parking Lot Tanks

Drainage Area	46915 sf	1.077 ac
Impervious	36772 sf	0.844 ac
Grass HSG A		0.233 ac
Average DA Slope	5.0%	
Hydraulic Length	328 ft	
Tc	11.4 min	

Water Quality Volume

Precipitation	1 in
Rv	0.76
% Impervious	78.4 %
WQv =	**2953 cubic feet**

Pretreatment

50% WQv required with infiltration rate > 2in/hr per VSSM

50% WQv	1477 cubic feet
	11046 gallons
2	5523 gal tanks

Pretreatment Tank Sizing

length	7 ft
width	14 ft
req. depth	7.50 ft

Sub Drainage Area to Playground Basin

Drainage Area	18268 sf	0.419 ac
Impervious	656 sf	0.015 ac
Grass HSG A		0.404 ac
Average DA Slope	4.1%	
Hydraulic Length	208 ft	
Tc	12.6 min	

Water Quality Volume

Precipitation	1 in
Rv	0.08
% Impervious	3.6 %
WQv =	**125 cubic feet**

Pretreatment

50% WQv required with infiltration rate > 2in/hr per VSSM

50% WQv	63 cubic feet

Pretreatment Deep Sump Basin Sizing

inner dia	5 ft
sump	4 ft
volume	79 cf

PEAK FLOW COMPARISON

(9) MC3500 Infiltration Chambers

Storm Event	Peak Flows: Pre Development	Post Development	Percent Reduced
1" WQ	0.94 cfs	0.13 cfs	86%
1-year	2.16 cfs	1.44 cfs	33%
5-year	3.20 cfs	3.07 cfs	4%
10-year	3.74 cfs	3.73 cfs	0%
25-year	4.48 cfs	4.47 cfs	0%
50-year	5.03 cfs	5.02 cfs	0%
100-year	5.70 cfs	5.69 cfs	0%

100% WATER QUALITY TREATMENT OUTFLOW IS 100% INFILTRATED

MINIMAL FLOW REDUCTION PONDING AREA IN PLAYGROUND SIGNIFICATLY REDUCED: PEAK ELEVATION FOR 100-YEAR EVENT IS ESTIMATED AS 596.73'

Stamp

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Town of Bristol, Addison County, Vermont

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Scale:	1" = 10'
Date:	09/24/2021 - 60% CDs

C2.1

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PROPOSED DIVERSION STRUCTURE
6-FT ID CATCH BASIN
WITH INTERNAL WEIR

PROPOSED SPLITTER STRUCTURE
4-FT ID MANHOLE

EX. CONCRETE SIDEWALK

PARK STREET

Approximate
waterline location

EX. PAVED PARKING

EX. WOODEN BOLLARDS

EX. CONCRETE SIDEWALK

EX. 18"
ELM TREE

EX. 8"
MAPLE TREE

EX. PAVED PARKING

10.0 ft

PROPOSED CHAMBER SYSTEM
(54) MC4500 STORMTECH CHAMBERS

for infiltration of an estimated 75%
of the water quality volume

EX. PLAYGROUND AREA

SAINT AMBROSE
PARISH HALL

EX. CONCRETE SIDEWALK

SCHOOL STREET (ONE WAY)

EX. PAVED PARKING

Approximate
location of blue
painted dots...

deep excavations
for installation will
likely impact peace
garden

EX. PEACE GARDEN

may need
geomembrane here

PROPOSED STORM MANHOLE
BYPASS CONNECTION TO
EXISTING MUNICIPAL SYSTEM

6 ft

optional area for
chamber system?

EX. CATCH BASIN
RIM 568.52

EX. STORM MANHOLE
RIM 568.69

EX. CATCH BASIN
RIM 568.32

EX. CONCRETE SIDEWALK

EX. CONCRETE CURB

EX. PAVED PARKING

WEST STREET

N

PROPOSED CONDITIONS LEGEND

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(54) MC4500 Infiltration Chambers Park Site, School Street Peak Flows				
	Pre Development		Post Development	% Reduction
1" WQ	3.41	cfs	2.54 cfs	26%
1-year	7.95	cfs	7.95 cfs	0%
5-year	11.83	cfs	10.00 cfs	15%
10-year	13.82	cfs	10.31 cfs	25%
25-year	16.58	cfs	10.73 cfs	35%
50-year	18.65	cfs	11.05 cfs	41%
100-year	20.80	cfs	11.37 cfs	45%

GRAPHIC SCALE

10 0 5 10 20 40

1 inch = 10 ft.
for sheet size 24" x 36"

Stamp

No.	Description	Date

ENGINEERING VENTURES PC
208 Flynn Avenue, Suite 2A, Burlington, VT 05401 s 802-863-6225
85 Mechanic Street, Suite E2-3, Lebanon, NH 03766 s 603-442-9333
414 Union Street, Schenectady, NY 12305 s 518-830-9614
www.engineeringventures.com

Addison County
Regional Planning Commission
Maddison Shropshire, Water Quality Planner
14 Seminary Street, Middlebury, VT 05753
mshropshire@acrpc.org

Sheet Title: Proposed Site Plan - Alternate
School Street Site

Project Title: School Street and School 1 & 2
Subsurface Infiltration Chamber Project
Town of Bristol, Addison County, Vermont

EV Project #	21230
Drawn By:	HKW
Checked By:	PB
Scale:	1" = 10'
Date:	10/18/2021

C2.0a