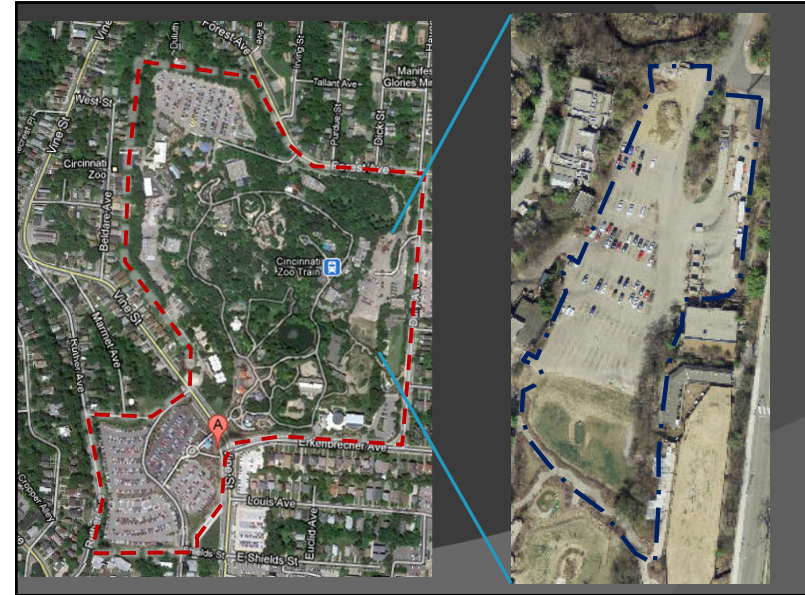


Leila Talebi (3/28/2012)

AFRICAN SAVANNAH ZOO

1



2

GENERAL INFORMATION

- The existing land use of Cincinnati Zoo consists of various types including parking lot, open space areas, and steep wooded hillsides.
- Stormwater runoff currently flows in a northeastern direction into catch basins and storm sewers which are directly rerouted to the Mitchell Avenue Regulator combined sewer system upstream from combined sewer overflow (CSO) 482.

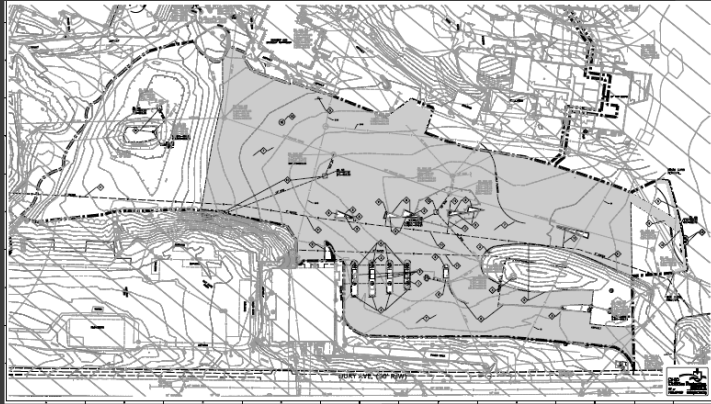
3

PROPOSED PROJECT FOR STORMWATER MANAGEMENT

- Replacement of Pavement with Pervious Pavers and Enhanced Turf and Vegetation
- Bioretention Areas and Tree Wells
- Rainwater Harvesting, Storage and Reuse System
- Storm Sewer Separation and Roof Leader Collection

4

PLAN OF EXISTING ASPHALT TO BE REMOVED

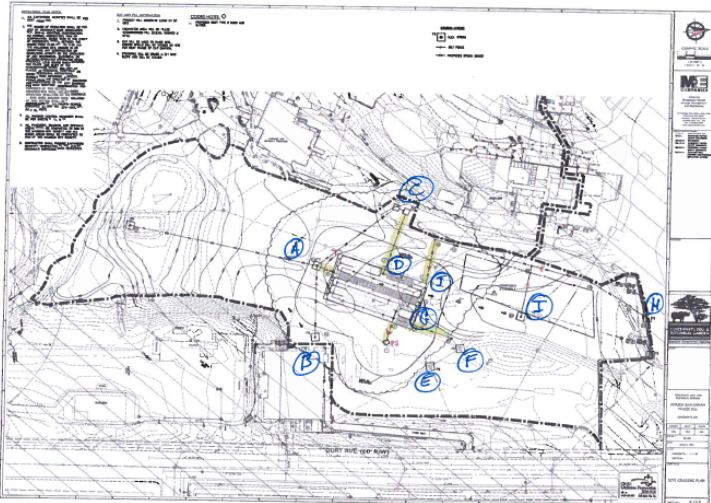


5



6

$A = 13.62 \text{ ac}$ $C = \text{re-filter } \phi \text{ ac}$ $e = 0.56$ $g = e + f$ $h = 1.06$ $j = h + i \text{ enter tank}$
 $B = 0.46 \text{ ac}$ $D = A + B + C \text{ enter tank}$ $f = 0.83$ enter tank $i = 0.80$



7

WATER REUSE OPTIONS

- Irrigation; (4,240,000 gallons annually)
 - The Zoo is a heavy irrigator (close to 2"/week) due to high display quality. The industry standard is 1"/week. Within the Africa Savannah project there will be 4 acres of irrigated area.
- Providing water for filling Swan Lake; (10 months each year and will be able to accept 8,000,000 gallons annually)
 - Swan Lake has a surface area of 50,000 sf. It is generally at the highest elevation of the Zoo and actually receives very little surface water. The lake is currently filled with a 2" domestic water line. The pond requires 6-9" of make-up water 12 months out of the year.
- Providing water for the bear ponds; (5,230,000 gallons each year)
 - The existing bear moat requires between 400 000 to 500 000 gallons of "make-up" domestic water on a monthly basis. This translates to 13,350 to 16,600 cf per week. The Zoo will construct a pump and filtration system that directs 10 gpm of water to the moat (24/7).

8

WINSLamm MODELING

WINSLamm v10 Data File [C:\Leila\Classes\Experimental design\zoo.mdb] - Land Use Model

Source Area #	Source Area	Area (acres)	First Control	Second Control
5	Roofs 5			
6	Roofs 6			
7	Roofs 7			
8	Roofs 8			
9	Roofs 9			
10	Roofs 10			
11	Roofs 11			
12	Roofs 12			
13	Parking	17.330	Entered	
14	Paved Parking 1	17.330	Entered	
15	Paved Parking 2			
16	Paved Parking 3			
17	Paved Parking 4			
18	Paved Parking 5			
19	Paved Parking 6			

9

WINSLamm MODELING

WINSLamm v10 Data File [C:\Leila\Classes\Experimental design\zoo.mdb] - WINSLamm Model Output

Runoff Volume (cu-ft)	Percent Runoff Reduction	Runoff Coefficient (Cp)	Particulate Solids Conc. (mg/L)	Particulate Solids Yield (Btu)	Percent Particulate Solids Reduction
743842	0.00%	0.42	1300	6037	
743842	0.00%	0.42	1300	6037	0.00%

Current File Output: Annualized Total After Outfall Controls: 771313 Years in Model Run: 0.96 6263

10

WINSLamm MODELING

WINSLamm v10 Data File [C:\Leila\Classes\Experimental design\zoo.mdb] - Land Use Model

Porous Pavement Control Device

Fast Source Area Control Practice: Porous Pavement Number 1

Land Use: Institutional 1

Source Area: Paved Parking 1

Total Area: 17.330

Flow Hydrograph Peak to Average Flow Ratio: 3.8

Pavement Geometry and Properties

- 1- Pavement Thickness (in): 1.5
- 2- Aggregate Bedding Thickness (in): 1.5
- 3- Aggregate Base Reservoir Porosity (D1): 0.30
- 4- Aggregate Base Reservoir Thickness (in): 24.0
- Aggregate Base Reservoir Porosity (D1): 0.25

Outlet/Discharge Options

- Perforated Pipe Underdrain Diameter (in): 12.00
- Number of Perforated Pipe Underdrains: 6.0
- Elevation (inches above Datum):
- Number of Perforated Pipe Underdrains: 3
- Seepage Rate (in/hr) - select below or enter: 0.000
- Use Random Number Generation to Account for Uncertainty in Seepage Rate:
- Subgrade Seepage Rate (in/hr):

Surface Pavement Layer Infiltration Rate Data

- Initial Infiltration Rate (in/hr): 0.000
- Percent of Infiltration Rate After 3 Years (0-100):
- Percent of Infiltration Rate After 15 Years (0-100):
- Time Period Until Complete Clogging Occurs (yr):
- Percent of Original Infiltration Rate Upon Cleaning (0-100):
- Surface Clogging Load (lb/ft²): 6.0

Restorative Cleaning Frequency

- Never Cleaned
- Three Times per Year
- Semi-Annually
- Annually
- Every Two Years
- Every Three Years
- Every Four Years
- Every Five Years
- Every Seven Years
- Every Ten Years

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WINSLamm MODELING

WINSLamm v10 Data File [C:\Leila\Classes\Experimental design\zoo.mdb] - WINSLamm Model Output

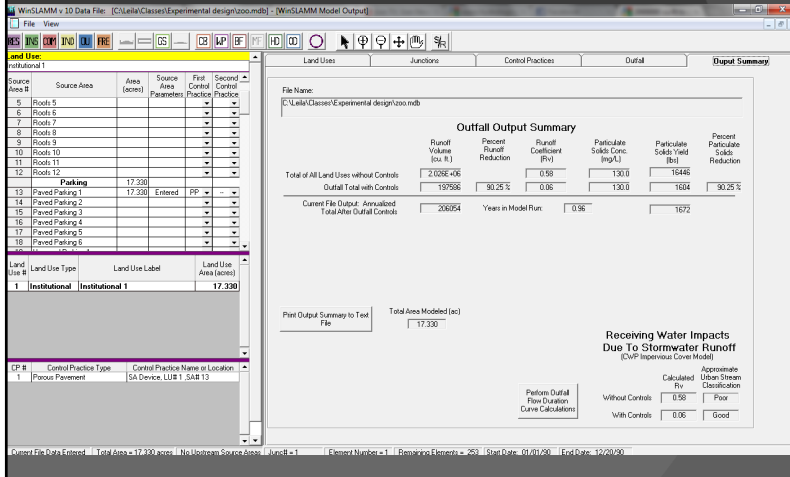
Runoff Volume (cu-ft)	Percent Runoff Reduction	Runoff Coefficient (Cp)	Particulate Solids Conc. (mg/L)	Particulate Solids Yield (Btu)	Percent Particulate Solids Reduction
743842		0.42	1300	6037	
48468	93.48%	0.03	1300	393.6	93.48%

Current File Output: Annualized Total After Outfall Controls: 50280 Years in Model Run: 0.96 428.1

Percent Runoff Volume Reduction: 93.48%

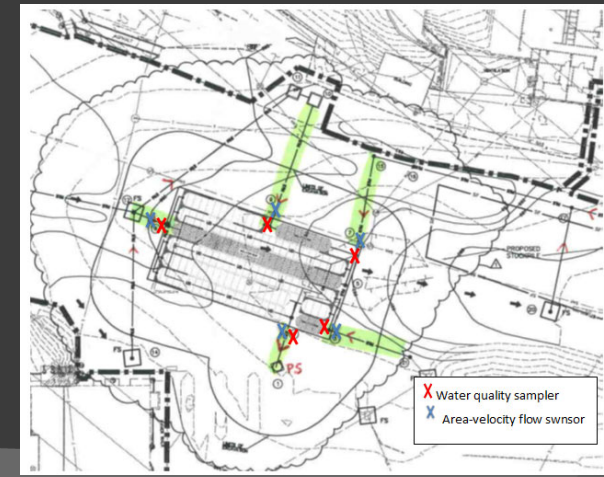
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WINSLAMM MODELING (1990)



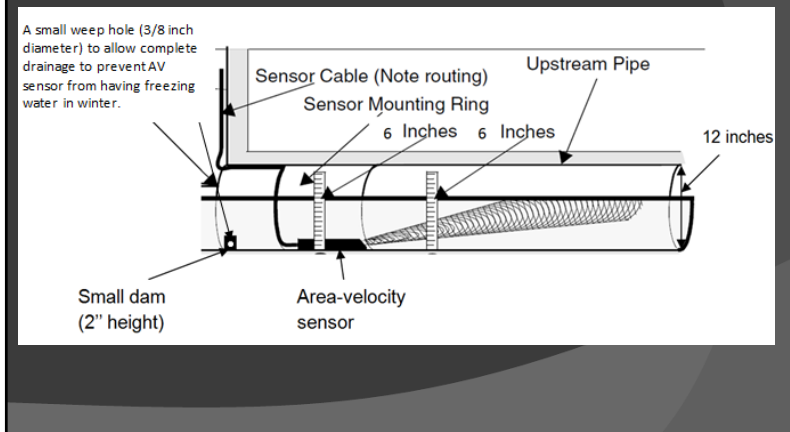
13

SCHEMATIC OF MONITORING COMPONENTS FOR PIPES



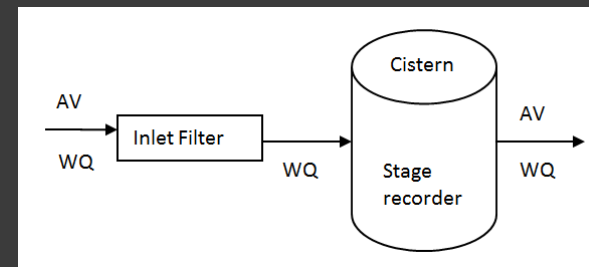
14

SCHEMATIC OF AREA-VELOCITY IN A 12" PIPE



15

SCHEMATIC OF MONITORING COMPONENTS FOR CISTERN



16

SUMMARY OF SAMPLING AND MONITORING LOCATIONS AT CINCINNATI ZOO

- Inlet pipes
 - 4 inlet automatic water sampler and 4 inlet flow monitor (one for each pipe)
- Outlet pipe
 - 1 outlet automatic water sampler and 1 outlet flow monitor
- Cistern
 - 1 water level recorder in the cistern
 - 4 inlet automatic water sampler after filter and before tank (because we have four inlet pipes)
- Therefore, a total of 9 automatic samplers (\$27k), 5 flow monitors (\$17k), and 1 water level recorders (\$0.65k) will be needed at this location.

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Some other examples from;

CINCINNATI STATE TECHNICAL AND COMMUNITY COLLEGE

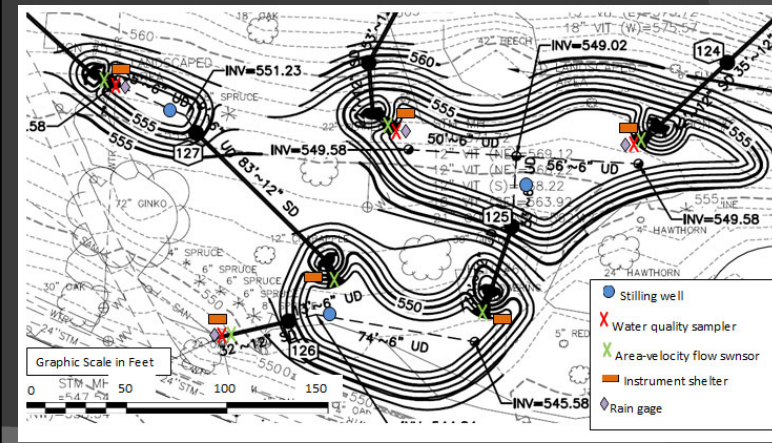
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- ✓ The site is located along Ludlow Avenue east of the intersection of Ludlow Avenue and Central Parkway.
- ✓ Total Drainage Area: 11.7 acre
- ✓ Located in two combined sewer areas. Runoff from the southern half of campus flows south into CSO 12, runoff from the northern half of campus flows north into CSO 21.



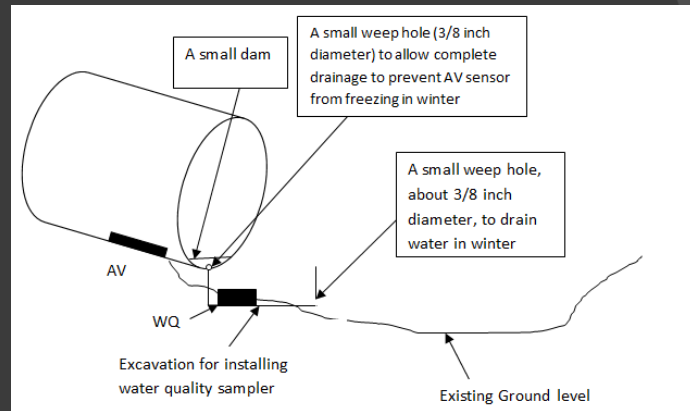
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RAIN GARDENS



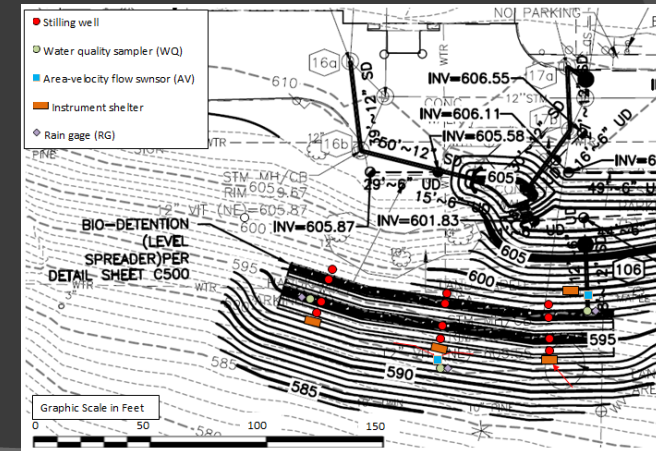
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SCHEMATIC OF WATER QUALITY SAMPLING IN THREE INLETS



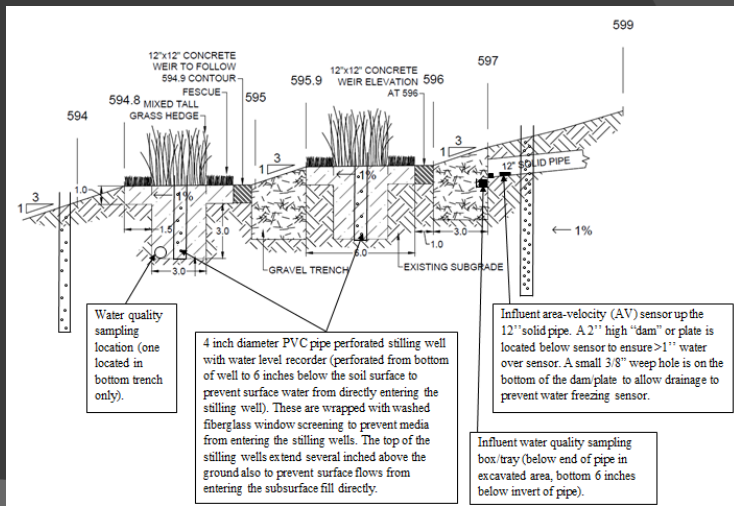
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INFILTRATION TRENCHES



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CROSS SECTION OF INFILTRATION TRENCHES



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THANK YOU

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