Irrigation with Runoff: A Rainwater Paradigm

University of Illinois at Urbana-Champaign

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Abstract

Our goal for the master plan is to create a green stormwater infrastructure system for the University of Illinois at Urbana-Champaign, located in Champaign County, Illinois, and the surrounding site. In this presentation, we will explore different water collection methods and water purification methods. These new green stormwater infrastructure implementations will collect and utilize rainwater, save the water the university uses for irrigation, reduce energy and water consumption, reduce flood risk, and reduce the heat island effect by lowering the ground temperature.

1. Introduction

Champaign County has been dealing with an increase in development and changes over the years. A lot of this development is due to the university expanding its campus and the development of the Research Park. These changes have been carried out resulting in the loss of many acres of plant species which has significantly altered the heat island of the county. This also affects the various species of animals in the county. The county has a list of threatened and endangered species gathered by research carried out by the Department of Urban and Regional Planning. Therefore, our team’s research into stormwater purification and its correlation to land heat can not only save the university budget, reduce energy and water consumption but also help maintain and restore certain parts of Champaign County’s ecosystem.

Based on our Master Plan, the elevation decreases southward. And so, south of Curtis Rd., we are proposing to direct the stormwater into the purification ponds. These ponds would create marshy conditions as a wetland would be presented around the body of water. These conditions would be ideal to host many of the endangered (LE) and threatened (LT) species of Champaign County as listed in the table below.

Common names of Species	**State Status**
Slippershell	LT
Little Spectaclecase	LT
Salamander Mussel	LE
Sangamon Phlox	LE
Yellow-crowned Night-Heron	LE
Mudpuppy	LT
Wavy-rayed Lampmussel	LE
Least Bittern	LT
Bloodleaf	LE
Hedge Hyssop	LE
Arkansas Mannagrass	LE
Northern Riffleshell	LE
Blanding's Turtle	LE
Blue Jasmine	LE
Northern Harrier	LE
Smooth False Indigo	LE

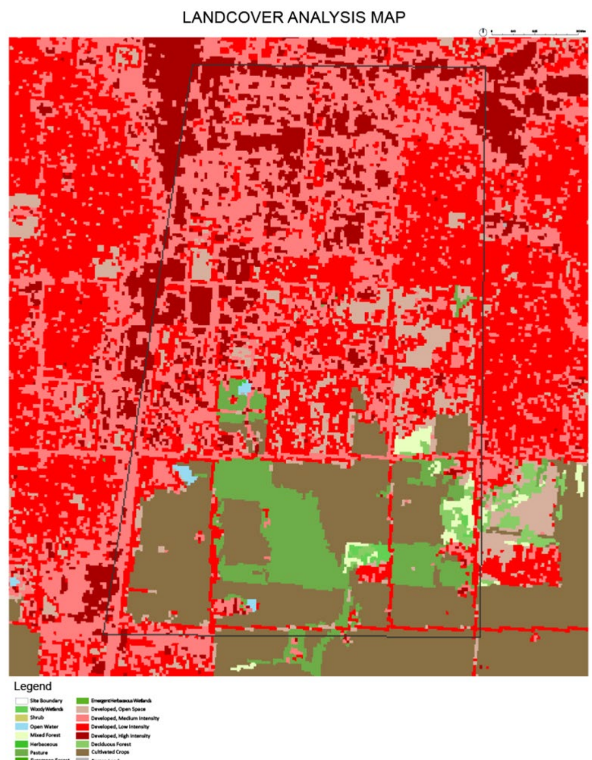
2.Site Condition

2.1 Background

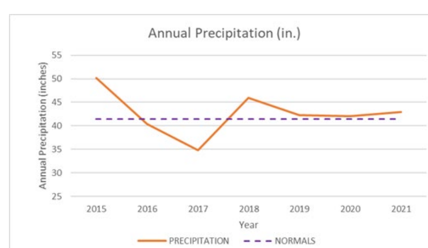
The University of Illinois sits at the Champaign County in central Illinois. University site contains the area between South Neil St and South Race Street bordered by University Ave and Curtis Road. This area encompasses the entire University campus, Research Park, and some neighboring communities.

2.1 Site Analysis

2.1.1 context



The campus site intersects with the City of Champaign, IL and the City of Urbana, IL, comprising the entire campus area, Research Park, commercial and residential areas. Most grey infrastructures are concentrated in the north, including commercial business districts, neighboring communities, education facilities, parking lots, and streets. The southern site generally consists of more green spaces, covered with agricultures. Buildings and facilities are less dense than the northern infrastructures. The entire campus site lies in the central area. To the northern west and northern east, commercial districts and neighboring communities embrace the campus. Beyond the campus site, a railway, parallel to Neil St., segregates the site from downtown champaign, while another railway, to the north of the site, segregates the campus from the northern commercial and residential districts. Highway I-74 and 150 offer access to transportation, leading to potential urban developments.

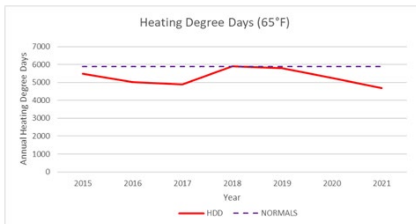


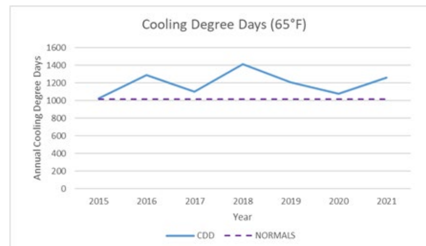
2.1.2 climate

As per Koppen climate zones, the campus site lies within Class C region, which is defined as warm and humid summers with mild winter (National Weather Service). Additionally, Illinois State Water Survey, Prairie Research Institute, and University of Illinois jointly conduct the weather observation for the campus site. As per the observation for the 1991-2020 average, the mean temperature is 52.3 degrees Fahrenheit with 5,657 heating and 1072.5 cooling degree days (based on 65 degrees Fahrenheit). The annual precipitation is 40.92 inches.

According to the records in the recent years, the precipitation within campus shows a stable value except 2017 when the precipitation dropped by 12.5%.

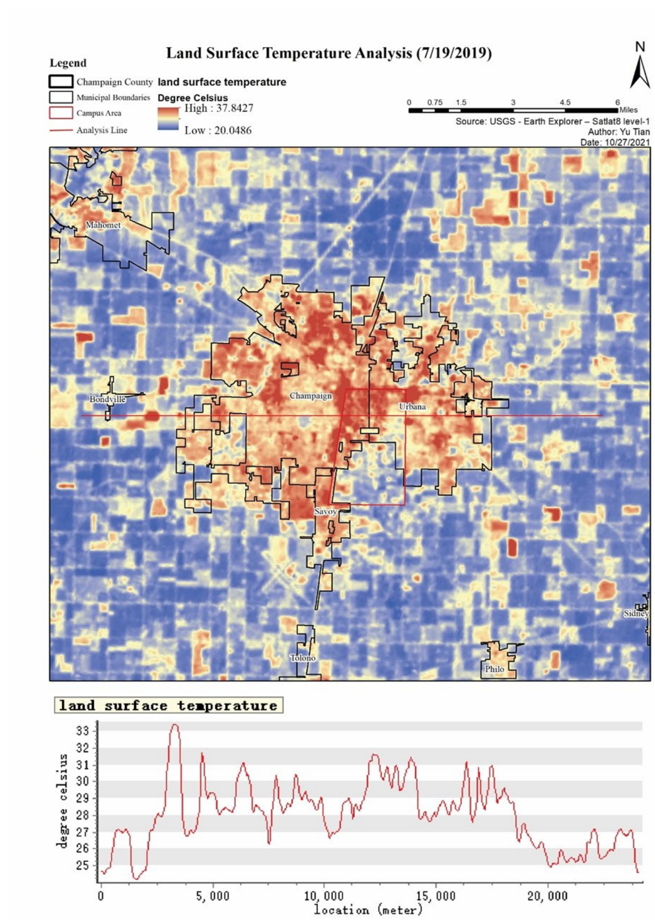
With the comparison between annual HDD/CDD and the average in 1991-2020, the annual cooling degree days since 2015 indicate constant higher than the average, while heating degree days indicate constant lower than the average, which reflects a potential influence from global warming and urban heat island.





- Urban Heat Island

Urban Heat Island (UHI) reflects the phenomenon of higher temperature in urban areas than in suburban and rural areas. Land use types can contribute to the UHI effect variably, where gray infrastructures, such as buildings, parking lots, and roads, will increase albedo and store more energy than green infrastructures, such as open spaces, parks, and green roofs. The higher population density in urban areas will generate more heat through human activities, such as commute, energy consumption, and food. Peng et al. (2012) analyzed surface urban heat island intensity (SUHII) in 419 global big cities in terms of daytime and nighttime by calculating surface temperature differences in urban and suburban areas.

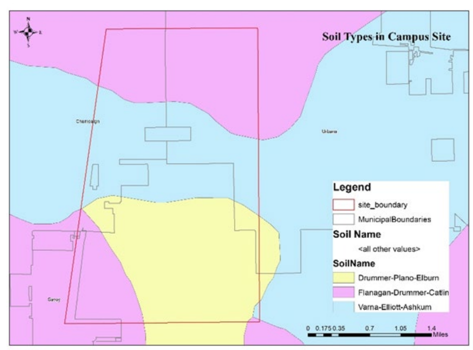


They obtained that, at nighttime, SUHII correlated positively with albedo and light, while in the daytime, SUHII correlated negatively with vegetation cover and activities, which meant more vegetation covers and activities in the daytime could mitigate the urban heat island effect. They suggested that increasing vegetation cover could be an effective way to mitigate the urban heat island effect. To mitigate the UHI effects, a green development through green infrastructure and sustainable development can reduce the negative impacts of urban heat island.

As per the satellite 8 images, the detected land surface temperature on July 19th, 2019, within the site boundary reflects an urban heat island. Within the municipal boundary, temperature is higher than outsides, showing yellow and red on the map. The greatest temperature difference can reach 17 degrees Celsius. The graph shows the temperature on the red analysis line, which also indicates a higher temperature in central city. Additionally, for the campus site, temperatures on the northwest are the highest, followed by the northeastern residential areas and the southern side.

2.1.3 Soils

Soil, as a type of ecological landform, constitutes the foundation of the whole ecological region, which supports loads of structures, provides ecosystems, offers developments and hazard as well. The components of soils impact the attributes in terms of fineness, drainage, and strength. The characteristics of soil, such as permeability, water holding capacity, erosion, will influence the runoff depth and water collection methods. The soil type for the entire campus site is type C.



2.1.4 Slopes

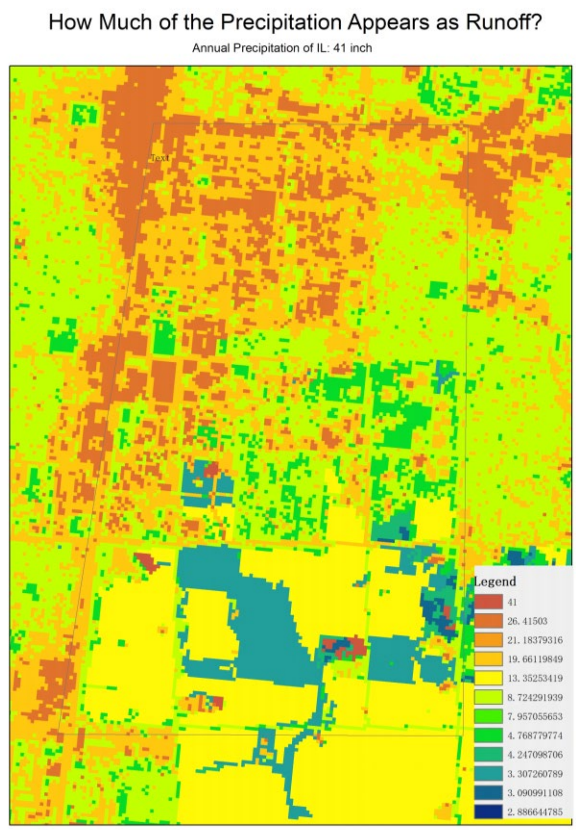
Rather than the soil through geology lens, the topography of lands describes the slope of soil, which has impacts on development plans as well. The contour of lands describes the slope, defined as the percentage, ratio, or degrees of the soil layers. The elevation and distance of contour express the slop of the land. Slope with zero to three degree is defined as flat, three to 10 as moderately sloping, and 10 to 15 as hillside. Different slopes influence development

variously. As for the campus site, it is relatively flat according to contour map.

The slope analysis map indicates two patterns. The northern side contains a north-south direction higher land in the middle. This pattern allows water to flow to the east and west side of the campus. The southern side has a lower land in the middle, which concentrates water in the southern middle of the site.

3.Water Quantity and Quality

3.1 Design description



Reducing and treating runoff are the two main functions of green infrastructures. Among all the green infrastructures designed, the ponds systems collect and treat most of the runoff while the stormwater pipe system recollect the treated water and convey it to other places. Thus, determining the quantity and quality of water collected, treated, and redistributed by the ponds-and-pipes system become significant. Given the fact that the northern part of the campus has a high risk of flooding while the southern part of the campus has available space to store water, the design plan is the made that part of the water from the detention basin near the Boneyard Creek is conveyed to the stormwater management pond in the southern part of the campus. The stormwater management pond is then adjusted to an aquatic plants (in this design, aquatic peanut is chosen to remove nitrogen and phosphor) pond for treating Nitrogen, Phosphor and BOD. Part of the water treated is then conveyed to the water tower at the highest point of the campus and the water can be distributed for irrigation purpose through flow driven by gravity. The bypass flow consists of two parts. One part is the weir flow which can be used for landscape later. The other part is the untreated water that continues flowing downstream. At the lowest point of the campus, which is the outlet of the watershed covering the campus, a larger aquatic pond is proposed to be constructed. Like the aquatic peanut pond upstream, part of the treated water will be conveyed the water tower while the bypass flow contains the weir flow for landscape use and the residual flow to the adjacent watershed. Along the flow path, runoff from the contributing area of the watershed and the concentrated flow (streamflow and pipe flow) will be included for water quantity calculation. Specifically, for the redistributed pipe flow, design is based on pertinent protocols. For water quantity calculation, since the parameters of the existing ponds are known, the outflow concentration of pollutants can be directly calculated. For the pond downstream, the design plan of the pond will be determined first after striking a balance between runoff reduction goal and available space for placing the pond. Once the size of the pond is settled, the outflow concentration of the pollutants can be calculated.

3.2 Water Quantity Calculation

3.2.1 Watershed Analysis

Since the runoff is directly generated from the watershed, determining the runoff volume for each catchment is the prerequisite for following design process.

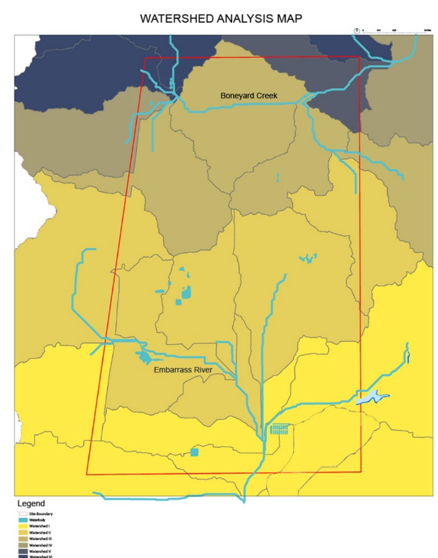


Figure 1. Annual Runoff Depth Distribution Map

An ARC-GIS based watershed analysis is performed to prepare for the runoff calculation. Based on the DEM file of the campus, a filled DEM file is generated. Based on the filled DEM file, several analyses are conducted to obtain the delineated watershed, including flow direction analysis, flow accumulation analyses and stream link analyses.

For runoff depth calculation, the SCS-CN method is applied. From statistical data, the annual average precipitation for Champaign is 41in..To determine the curve number, hydrological soil group data, NLCD land type data is added to the base map.

The soil group for the whole campus is type C. The curve number for C soil for each NLCD land type is then added to the attribute table of the land type data, thus the annual runoff depth is calculated, and the annual runoff depth distribution map is generated (Figure 1).

Based on the runoff depth map, the catchment area weighted average annual runoff depth, annual runoff volume and runoff flow rate for the 12 catchments related to later design processes are calculated. The catchment area weighted average annual runoff depth distribution map is shown in Figure 2. The catchment area weighted average annual runoff depth distribution map Figure 2.

The runoff depth, volume and flow rate values for each catchment are shown in Table 1. for each catchment.

Table 1. Annual Runoff Depth, Volume and Flow Rate

	Annual Runoff Depth (in.)	Annual Runoff Volume (m^3)	Flow rate (cms)
1	8	7700165	0.2442
2	23	9026749	0.2862
3	13	5914432	0.1875
4	3	1030157	0.03267
5	13	9261002	0.2937
6	3	614970	0.01950
7	13	4223702	0.1339
8	8	8833494	0.2801
9	27	14685065	0.4657
10	27	18257259	0.5789
11	4	66002135	2.093
12	19	18013505	0.5712

3.2.2 Original annual runoff volume calculation

The runoff under analysis the total runoff generated in the southern part of the campus and the runoff leaves the detention pond without the two ponds in the southern part of the campus. The total runoff volume is calculated as follows:

$$V_T=\Sigma V_i \quad (1)$$

(1) Where V_i is the annual runoff volume for catchment i.
The total annual runoff volume is calculated to be 117978668 m^3.

3.2.3 Annual runoff volume calculation after placing aquatic plants ponds

- Design variables

Table 2: Design variables
Pipe flow
Weir flow
Size of pond 3
Runoff volume at outlets
Runoff reduction rate

Pollutant's concentration in the outflow

- Description of the ponds-pipes system

The ponds-pipes system is designed to collect, treat, and redistribute the runoff water. Part of the runoff generated in the northern part of the campus is conveyed to the aquatic pond P2, from the detention basin P1 with a flow rate Q_{PL1}. For pond P2, the influent flows except Q_{PL1} are Q1, Q2, 0.5*Q3 from catchment 1,2 and 3 respectively. Since the pond P2 is placed approximately halfway the principal flow path of catchment 3, the contribute area of catchment 3 for inflow to P2 is approximate half of the total area, thus the flow is also a half correspondingly. The effluent flow out of pond P2 includes weir flow Q_{po2} and bypass flow Q_{p2}. The difference between the influent and effluent flow the design flow for treatment. Part or all the treated runoff is then conveyed to water tower at a rate of Q_{PL2}. The outflow from the pond P2 then flows into pond P3 with the join of flow 0.5*Q3, Q4, Q5, Q6, Q7 and Q8. The outflow from the pond P3 includes weir flow Q_{po3} and the bypass flow to the adjacent watershed Q_{p3}. The difference between the influent and effluent flow the design flow for treatment. Part or all the treated runoff is then conveyed to water tower at a rate of Q_{PL3}. Flow balance for each pond is demonstrated below. Assume negligible evaporation.

$$Q9+Q10+Q11+Q12= Q_{PL1} + Qpn \quad (2)$$

$$Q_{po2} +Q_{p2} = Q1+Q2+0.5*Q3-Q_{PL1}-Qdesign \quad (3)$$

$$Qinp3=Q_{p2}+0.5*Q3+Q4+Q5+Q6+Q7+Q8= Q\ designp3+ Q_{po3}+ Q_{po3}Q_{p3} \quad (4)$$

- Calculation of flows in redistribution pipes & design of pond P3

From ARC-GIS, the areas of the detention basin P1 and pond P2 are determined as 1696 and 24097 m^2 respectively, the depths are 8 ft and 2.5 m. According to protocols for pond design in Champaign, if the area of the pond is smaller than 5 ac, the maximum outflow rate should be below 0.9 cfs. Since the area of the detention basin is below 5 ac and the outflow rate should be as large as possible to reduce the flooding risk in the northern part of the campus, the outflow rate Q_{PL1} from the detention pond is designed to be 0.9 cfs, or 0.02549 cms.

From the flow balance equation for P2, $Q_{po2} +Q_{p2} = Q1+Q2+0.5*Q3-Q_{PL1}-Qdesign$

According to the water-treatment unit process principles, Q designp2 = Vp2/ trp2 (5)

Where Vp2 is the volume of pond P2, calculated to be 60242.5 m^3, trp2 is the hydraulic retention time in P3. According to papers on the design of aquatic peanuts ponds, the recommended hydraulic retention time is 20 days. Q designp2 is thus calculated to be 0.03486 cms.According to protocols for pond design in Champaign, if the area of the pond is larger than 5 ac, the maximum pipe outflow is 0.18 cfs / ac, weir flow Q_{po2} is set according to the protocol, while the pipe outflow Q_{PL2} is set to be the min {Q_{po2}, Q designp2} .Thus, Q_{po2} is 0.03035 cms, Q_{PL2}= *0.03035* cms.From the flow balance equation, Q_{p2}=*0.5654* cms. From the flow balance equation for P3, *Qinp3=*Q_{p2}*+0.5*Q3+Q4+Q5+Q6+Q7+Q8= Q designp3+* Q_{po3}+ $Q_{po3}Q_{p3}$

An ideal runoff reduction rate compared to inflow to P3 is proposed to determine the size of pond P3. The calculated size is then compared to the available space for construction according to the map. If the size is not reasonable, it is set according to the map, the runoff reduction rate for the northern and the whole southern part of the campus are back calculated. When the runoff reduction from upstream is set to be 20%, *Q designp3=0.2 Qinp3=0.4878cms.* According to the water-treatment unit process principles, *Q designp3 = Vp3/ trp3 (6), trp3=trp2=20days, Vp3=842918.4* m^3.

Assuming the shape of the pond is irregular but with the same area of a rectangular pond. The calculation is thus based on the effective width and length of the pond.

According to papers on the design of aquatic peanuts ponds, the recommended depth d is 1.5 m. Ap3=Vp3/ d= 561945.6 m^2.According to protocols for pond design in Champaign, if the area of the pond is larger than 5 ac, the maximum pipe outflow is 0.18 cfs / ac, weir flow Q_{po3} is set according to the protocol, while the pipe outflow Q_{PL3} is set to be the min *{*Q_{po3}*, Q designp3}* ,Q_{po3}= *24.99cfs=0.7076 cms*. Outflow from P3 Q_{p3} is thus calculated by Q_{p3}*=0.8 Qinp3-* Q_{po3}*=1.2436cms.*

Annual runoff volume at the southern part of the campus *Vp3=39218169.6* m^3.

Annual runoff volume at the southern part of the campus *Vpn=V9+V10+V11+V12-QPL1*(1yr) =71170144.36* m^3. Total annual runoff volume *VT1=Vp3+Vpn=110388314* m^3.

Percentage of runoff reduction in the northern part of campus=11.17%

Percentage of runoff reduction in the northern part of campus=6.43%

The runoff reduction rate for the whole campus seems to be small.

The dimensions of P3 is then set to be 1489m and 914m according to available space shown on the map. *Ap3=1362608* m^2, *Vp3= 2043912* m^3*, Q designp3 = Vp3/ trp3=1.183cms*

According to protocols for pond design in Champaign, if the area of the pond is larger than 5 ac, the maximum pipe outflow is 0.18 cfs / ac, weir flow Q_{po3} is set to be 1cms, while the pipe outflow Q_{PL3} is set to be the min *{*Q_{po3}*, Q designp3}*,Q_{po3}*= 1cms ,* Q_{PL3}*=1cms.*

Outflow from P3 Q_{p3} is thus calculated by Q_{p3}*=Qinp3-Qdesignp3-*Q_{po3}*=0.256cms.* Annual runoff volume at the southern part of the campus *Vp3=8073216* m^3. Annual runoff volume at the southern part of the campus *Vpn=V9+V10+V11+V12-QPL1*(1yr) =71170144.36* m^3.

Total annual runoff volume *VT2= Vp3+Vpn=79243360* m^3.

% runoff reduction in the northern part of campus=11.17%

% runoff reduction in the northern part of campus=33.00%

Since the design of the pond is feasible while total runoff reduction rate is ideal, the design is regarded completed.

The summary of calculated output parameters are in Table 2, Table 3 and Table 4.

Table 2. Annual Runoff volume in m3, reduction rate in percentage

North original	North after	Reduction rate	Total original	Total after	Reduction Rate
71973997	71170144	11.17	117978668	79243360	33.00

Table 3. Pipe flows in cm^s

QPL1	QPL2	QPL3
0.02549	0.03035	1

Table 4. Effective dimensions of Pond P3 in m

L	W	d
1489	914	1.5

Water Quality Calculation

- **Major pollutants in runoff on campus and original concentrations of them**

The major pollutants in the runoff include TSS, BOD, COD, Nitrogen, Phosphor, total organic compound, and metal ions. The designed aquatic plants pond, to be specific, the aquatic peanut pond aims to remove BOD, Nitrogen and Phosphor. According to the report, the peak values of some pollutants' concentration in runoff from the south east john street watershed is listed below in Table 5. These values are picked to become the design concentrations that need to be reduced.

Table 5. Peak values of some pollutants' concentration in runoff from the south east john street watershed

Pollutants	Original concentration in runoff (mg/L)
TKN	98
NH4+	6
NO2-/NO3-	10
P	110
COD	370
TOC	0

It is generally accepted that the value of BOD/COD is within 0.2 to 0.8. According to the data, the total organic compound peak concentration is 0. It can be assumed that the biodegradable compound's concentration is at a relatively low value, thus BOD is assumed to 0.2 COD=74mg/L.

- **Outflow pollution concentration calculation for aquatic peanut ponds P2 and P3**

Assume same k -correction for all the pollutants for simplicity.
According to paper on aquatic peanut ponds' design, the outflow concentrations of pollutants in the ponds are calculated by

(7) $$D=\frac{0.184w^{1.511}[tr(w+2d)]^{0.489}}{L/w^{1.489}}$$

(8) $$k = 0.15 * 1.05^{T-20}$$

$$a = (1+4ktrD)/2$$ (9)

(10) $$\frac{c}{c_0} = 4a\exp\left[\frac{1-a}{2D}\right]/(1+a)^2$$

Where tr is the hydraulic retention time for the aquatic peanut ponds in days
L, w, d are the dimensions of the ponds in m
T is the temperature of the pond in degree Celsius
C is the outflow concentration of a pollutant, C_0 is the original concentration

According to papers on the design of aquatic peanuts ponds, the recommended hydraulic retention time is 20 days. The average temperature on campus in summer is 21 degree Celsius while in winter the value becomes -1.11 degree Celsius.
For pond P2, the dimensions are determined from ARC-GIS

L=219.53 m w=109.76 m d= 2.5m

For pond P3, the dimensions are designed to be

L=1489 m w=914m d=1.5m

The outflow concentrations for both ponds in summer and winter are thus calculated. The results are shown in Table 6.

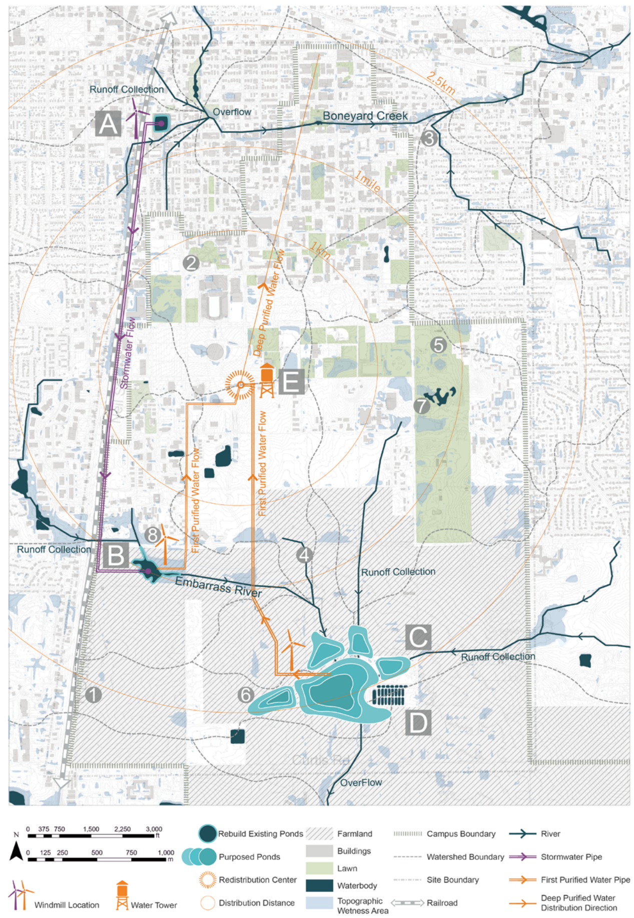
Table 6. Summary of water quality calculation: Pollutants concentration in mg/L

Pollutants	Original Concentration	PL2 outflow summer	PL2 Outflow winter	PL2 c/c0 summer	PL2 c/c0 winter	PL3 Outflow summer	PL3 outflow winter	PL3 c/c0 summer	PL3 c/c0 winter
TKN	98	2.9155	38.8700	0.02975	0.3966	0.392	7.84	0.004	0.08
NH4+	6	0.1785	2.3796	0.02975	0.3966	0.024	0.48	0.004	0.08
NO2-/NO3-	10	0.2975	3.9660	0.02975	0.3966	0.04	0.8	0.004	0.08
P	110	3.3725	43.6300	0.02975	0.3966	0.44	8.8	0.004	0.08
BOD	74	2.2015	29.3500	0.02975	0.3966	0.296	5.92	0.004	0.08

4. Master plan Design

Three groups of ponds were included in the whole process of water collection and purification— a detention pond on the corner of 1st Street and Green Street (As [A] shown in the map), an existing ‘lake’ on the Embarrass River [B], and a group of proposed purification ponds [C] along with a large reservoir [D].

UIUC Rain Water Management Master Plan



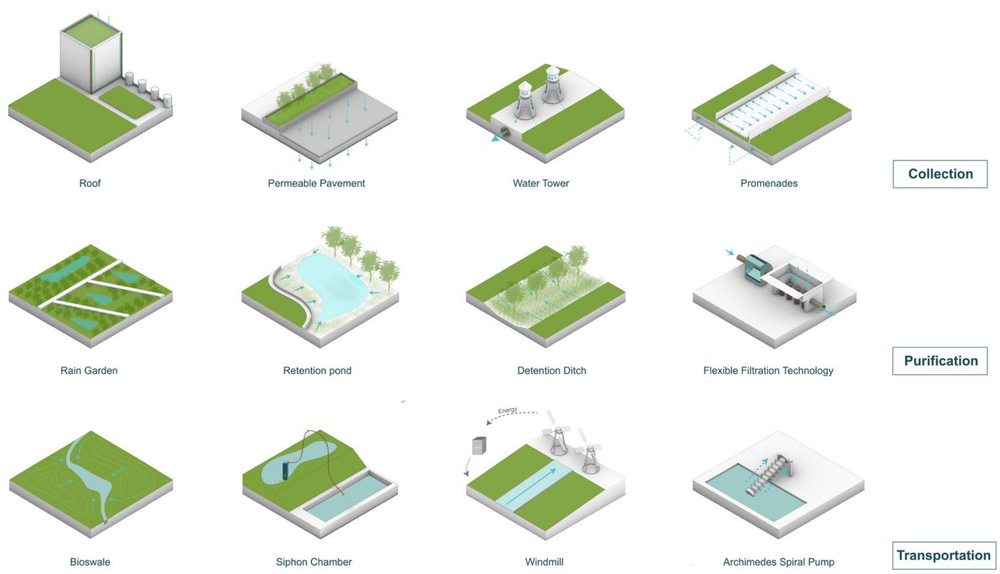
In the short term, the major responsibility of rainwater gathering is on the lake on the Embarrass River [B]. In order to reduce the risk of flooding in Boneyard Creek, which runs horizontally through the UIUC campus, water from the detention pond [A] on the north side of the campus will be transited to the lake [B] to be purified. The lake will be rebuilt into a vegetated wetland to assume more functions on purification. Then, water from the lake will be pumped up to the water tower, the old silo [E], where deep purification, the redistribution will be carried out.

In the long term, an additional group of ponds [C&D] will be added on the south side of the campus, in the farmland area on the north of Curtis Road. Water from the Embarrass River as well as the overflow from the 'lake' will be first gathered into four vegetated wetlands [C], in which various aquatic plants play an important role in absorbing extra nutrients in the water. Then, the water purified will flow into a large reservoir [D] that gathers all the first purified water waiting for further usage. Water then will be pumped to the old silo [E] to be further purified to meet the higher standard of irrigation.

From the silo [E], water after deep purification can flow to the target turf area by gravity as irrigation water. There aren’t clear standards for irrigation water on campus right now, which is a gap in stormwater purification and reuse. We sincerely hope that EPA and relevant departments will consider this.

Water collection facilities include (1) Permeable pavements, (2) green roofs, and (3) promenades. Run off is slowed down here and it will then be directed to (4) bioswales and (5) detention ditches. From here, water is sent for purification. This occurs later where water is filtered by mimicking natural sand filtration methods afforded by (6) retention ponds and with additional help of (7) rain gardens. We propose using (8) windmills as a source of clean energy to help with the transportation of water. And the purified water is then transported to redistributions centers –the water towers [E]. From here this water will be delivered for irrigation and other desired usages.

The facilities are listed in the scenario catalog here.



Collection Methods:

A. Roof
The roof is usually the first step in rainwater collection. With good storage capacity, the roof could be collecting and holding water for the better portion of the year, cutting down on water bills during the plants growing season.

B. Permeable pavement
Permeable pavement is a porous urban surface which absorbs rainfall and surface runoff, storing it in the reservoir while allowing it to infiltrate slowly into the soil below.

C Water tower
Water towers often operate in conjunction with underground or surface service reservoirs, which store treated water close to where it will be used. The water pump transports the treated water to the water tower. Here it will be uniformly distributed by the water tower to meet the needs of lawn irrigation.

D Promenades
The rainwater falling on the surface of the promenade is transported to the pipelines buried on both sides through the slope, and the water will flow into the underground reservoirs by gravity. The promenades can meet the demands of both tourism and water storage.

Purification Method:

A Retention Pond
By capturing and retaining stormwater runoff, the retention ponds control stormwater quantity and quality. The natural process in the ponds will reduce pollutants.

B Rain Garden
Rain garden is a type of water capture facility in landscape architecture that helps slow down and absorb runoff from storms. It recreates the natural function of the land, which includes capturing rainwater, filtering pollutants, and recharging groundwater.

C Detention Ditch
Detention ditch is an effective stormwater management practice that can prevent general flood and can also control extreme floods. The ditch helps manage the excess urban runoff caused by new-constructed impervious surfaces such as roads, parking lots and rooftops.

D Flexible filtration technology
During the purification process, first, the runoff enters the system and accumulates in a cartridge. Once it fills to the top, the valve will open and let clean water flows through to the underdrain. After the cartridge is drained, the air will be pushed through to dislodge and clear the filter media. The device can be flexibly adjusted in size and place locations.

Transportation Method:
A Bioswales
Bioswale is the most effective type of green infrastructure facility in slowing down runoff velocity and cleansing water while recharging the underlying groundwater table.

B Siphon Chamber

Siphon Chamber uses air pressure to push water upward. It doesn’t need additional energy.

C Windmill
Windmills use natural wind power to generate electricity, which is pollution-free and Inexhaustible. It provides electricity for the water pump.

D Archimedes Spiral Pump
It has a long turbine that pumps water from a lower lying area towards a higher elevation, which is powered by windmill or something to spin.

5. Public Engagement

Although the design itself does not involve the parts directly relating to public activities, the southern pool can purify sufficient and clean water sources during the rain season, which can not only provide wildlife and plants with resting and preying places but also can provide irrigation and clean water for residents' gardens. In addition, some of these water collection facilities themselves are interactive, such as Archimedes water traps, so that the public can deepen their understanding of rainwater collection and purification. From a long-term perspective, the overall Master plan is reproducible, and the success of the project promotes the popularization of rainwater reuse planning, thereby prompting more public participation.

6. Landscape Performance and Benefits

Our proposal can be an extension of the County’s existing green infrastructure plans – the Boneyard Creek can help contribute with our campus’ efforts to this endeavor. Our project also follows to the Campus Climate Action Plan to reduce the carbon emissions under its current irrigation methods. Short term benefits include reducing water-wasting by using runoff for irrigation. Long term benefits will contain new habitats to endangered species of Champaign County provided by our design. The purposed ponds will tightly connect human beings and other species in the natural environment. The large area of open water surface and various local vegetation species will not only support local species, but also provide shelter for migratory species. The purposed waterbodies can provide recreational ecosystem services, such as fishing, kayaking, and other aquatic outdoor activities. This is also a new destination for wildlife lovers to observe, learn, and protect various species, which contributes to educational services in public science.

This project delivers a perspective of altering the waste to utility and saving water. It is significant for meaningful for both human and the entire ecosystem.

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