THE VILLAGE SCHOOLYARD PROJECT

Final Report for the Audubon Elementary
Agreement Number IGIG 1701

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Prepared For

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1 Introduction

1.1 Pre-Construction Conditions

John James Audubon Elementary School is located at 3500 N Hoyne Avenue, Chicago, IL 60618. Bordered by N Hoyne Avenue to the east, W Cornelia Avenue to the South and N Hamilton Avenue to the West, the total site area within the Audubon Elementary property is approximately 53,376 square feet, with the project area consisting of 33,228 square feet on the north side and 20,148 square feet on the south side of the property. The site is bordered to the north by an alley, and to the east, south and west by low-rise single and multi-family residences and city streets. A map of the approximate area in Chicago and the pre-construction area is shown in Figure 1.

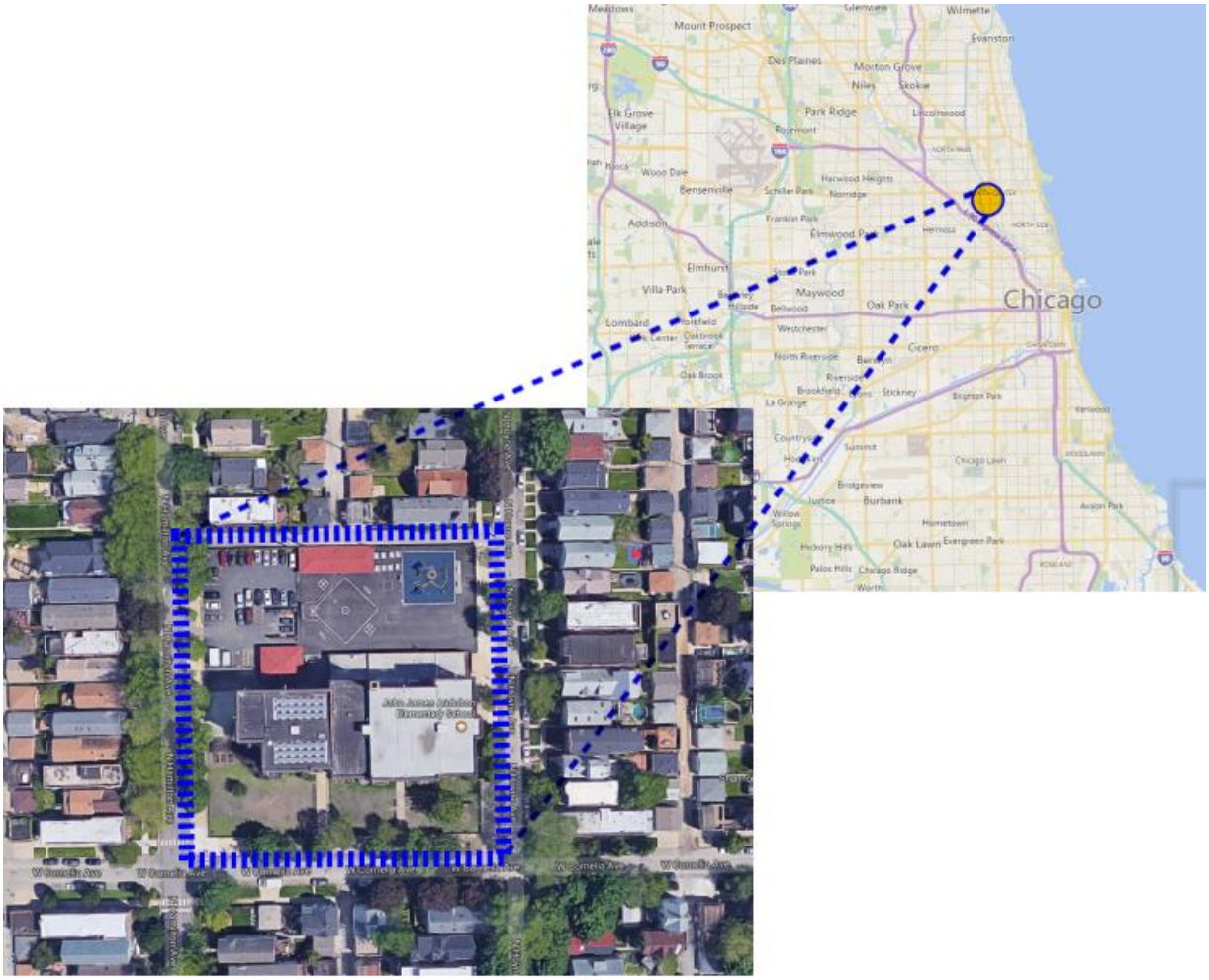


FIGURE 1 Map of Project Area in Chicago

The Village Schoolyard Project was initially proposed by Audubon Elementary School and the Friends of Audubon (FoA), a school-based community group. The intent of the project was to implement green infrastructure Best Management Practices to improve the stormwater drainage and increase the amount of surface runoff that drains naturally into the ground instead of entering the City of Chicago's combined sewer system. The objective of the Village Schoolyard project was to use green infrastructure BMP's to:

In the short term:

1) Reduce stormwater runoff quantity and improve quality by using BMP's.
2) Prevent CSO events by infiltrating surface runoff.
3) Maximize the impact of existing green infrastructure projects

Over the long term:

1) Create a sustainable play and educational spaces for the Audubon students and community members that address stormwater retention and infiltration.
2) Foster a culture of awareness and community involvement for green infrastructure projects on school grounds throughout the city.

The proposed improvements will reduce the burden on the combined sewers as well as provide phosphorus, nitrogen and Total Suspended Solids (TSS) reductions. The permeable asphalt, permeable paver, underground stone infiltration system and native and drought tolerant gardens provide a variety of beneficial sustainable BMP's for this site, along with meeting the Chicago Stormwater Ordinance for detention requirements. The improvements are detailed in the Table 1 below.

TABLE 1 Original Projected Environmental Benefits

Project Element	Pollutant Load Reduction*			Flow Reduction (gals/1" rain)**	BMP Capacity (gallons)
	Total P (grams/1" rain)	Total Nitrogen (grans/1" rain)	Total Suspended Solids (grams/1" rain)		
Underground Stone Infiltration System	19.96	153.5	4183.5	20,254	40,072
Permeable Paver Parking Area	1.88	14.46	394.01	1,908	13,374
Native Vegetation Demonstration Garden	0.26	2.02	55.01	266	600

*Pollutant load reduction totals are from the EPA Region 5 Load Reduction worksheet.
**Flow reduction calculations are from the Center for Neighborhood Technology's Green Values National Stormwater Management Calculator and additional runoff calculations are based on 2011 Chicago rainfall data.

2 Discussion

2.1 Post-Construction Conditions

With the construction of the site improvements, the stormwater runoff will be significantly reduced, as will the impervious area of the site. The water quality leaving the site will also improve because of the filtering through the permeable asphalt, CA-7 stone in the detention areas, and permeable paver areas. The underground detention facility will be capable of collecting 890,000 gallons of water per year and releases it into the combined sewer system causing an overburden on these sewers and some instances flooding local residences. The construction of this facility will greatly reduce these instances.

The project tasks will start will with the removal of the existing conditions of impervious paving and flooded grass and dirt field and proceed with the installation of the project components outlined in the next section. The installation of the project components will begin with excavation to reach the design subbase depths of storage stone and the installation of utilities. After installation of utility runs and structures, the storage stone and other subbase will be installed and all concrete work will commence to create the required edge conditions needed for installation of each project component. Lastly, all equipment and final surfacing will be installed to complete the project.

The construction of the green infrastructure was completed in September, 2017. Below are several images of the project throughout construction.

After removal of the existing impervious paving and associated subbase on the north site (Figure 2), excavation for BMP subbase depths and utility run installation began (Figure 3).

FIGURE 2 Construction Progress as of July 7, 2017

FIGURE 3 Construction Progress as of July 20, 2017

Once desired subgrades were achieved, subbase (CA-7) for BMP's was installed and formwork was erected to form curbs for the separate BMP's (Figures 4 and 5).

FIGURE 4 Construction Progress as of July 26, 2017

FIGURE 5 Construction Progress as of August 2, 2017

Underground utilities were continued to the south portion of the site, and excavation began on the south site (Figure 6 and 7).

FIGURE 6 Construction Progress as of August 2, 2017

FIGURE 7 Construction Progress as of August 2, 2017

Sidewalks and curbs were poured on the north site, and excavation continued for subgrade on the south site (Figures 8 and 9).

FIGURE 8 Construction Progress as of August 9, 2017

FIGURE 9 Construction Progress as of August 9, 2017

The permeable asphalt track was poured to ring the future artificial turf field, utilities were extended to the south portion of the site, and excavation began on the south portion of the site (Figures 10 and 11).

FIGURE 10 Construction Progress as of August 23, 2017

FIGURE 11 Construction Progress as of August 23, 2017

The artificial turf assembly was installed over the infiltration basin on the north site, as were the permeable pavers at parking areas in 2 locations on the north site (Figures 12 and 13).

FIGURE 12 Construction Progress as of August 30, 2017

FIGURE 13 Construction Progress as of August 31, 2017

Trees, shrubs and native plants were placed and planted; landscape accessories including benches were installed (Figures 14 and 15).

FIGURE 14 Construction Progress as of September 6, 2017

FIGURE 15 Construction Progress as of September 6, 2017

Construction was completed in the Fall of 2017 after mulch, sod and various site elements were finished thereafter (Figures 16 and 17).

FIGURE 16 Construction Progress as of September 13, 2017

FIGURE 17 Construction Progress as of September 26, 2017

The project's ribbon cutting ceremony took place on September 29th (Figures 18 and 19).

FIGURE 18 Ribbon Cutting Ceremony, September 29, 2017

FIGURE 19 Ribbon Cutting Ceremony September, 29, 2017

3 Best Management Practices

Overview

Three Best Management Practice's (BMP's) were used in the design for the Audubon Elementary School. The BMP's include: Underground Storm Filtration System (Synthetic Turf Field); Permeable Pavers (Plaza/Sidewalks and Parking Lots), and Landscape Buffers (Deep Rooted Native Vegetation). The BMPs utilized provided additional stormwater retention, reducing the volume of runoff from and improving the quality returning to storm drains. Below describes the description and the logic for selection of each BMP, advantages and disadvantages, location, design, installation and construction, materials and cost effectiveness. Total area gained for stormwater management is 905 cubic yards.

TABLE 2 BMP Components & Capacity

BMP Components	Depth	Total Square Feet (SF) Cubic Yards (Cu Yds)
Underground Storm Filtration System (Synthetic Turf Field)	10"	9,303 SF 287 Cu Yds
Permeable Pavers (Parking Lot)	12"	3,963 SF 147 Cu Yds
Permeable Pavers (Plaza/Sidewalks)	12"	1,559 SF 58 Cu Yds
Landscape Buffers (North & South Combined)	~24"	5,570 SF 413 Cu Yds

BMP Project Elements

1 - Underground Storm Filtration System

2 - Permeable Paver Parking Area & Plaza

3 - Native Vegetation Buffer Area

4 - Landscape Buffer

FIGURE 20 Project Components

3.1 BMP 1: Underground Storm Infiltration System

Overview

An underground stone infiltration system was installed under a new permeable synthetic turf field covering an area of approximately 9,303 square feet. Surface runoff infiltrates through the synthetic turf field and into the infiltration stone layer, which consists of a layer of CA-7 type gravel. Surface runoff from the field and surrounding surfaces is directed into the infiltration stone layer through catch basins. The runoff filters through and is stored in the stone layer giving it a chance to infiltrate into the native soils. Soil borings indicate soft to stiff silty clays and loose silty sands exist below the surface to a depth of approximately 6 feet. Excess runoff that cannot infiltrate is stored in the stone layer and released slowly to the City's combined system through a 3-inch restrictor. Any runoff released to the City's combined system is released after the peak of the storm has passed and combined overflows have occurred.

Advantages/Disadvantages

The Synthetic Turf Filed acts as a retention basin during rain events which provides storage area for stormwater, slowly releasing captured water afterwards. Unlike natural turf, a synthetic turf field eliminates the need to water and use pesticides to maintain the surface entirely. The Synthetic Turf Council estimates that utilizing synthetic turf field conserves 500,000 gallons of water annually for a standard size field. Some disadvantages however include the systems inability to breakdown organic compounds such as bird droppings or bodily fluids. Synthetic turf absorbs and stores heat and does not disperse heat which makes the surface unplayable on days hotter than 95 degrees (ASBA, 2017).

Location

Synthetic Turf Field - Northwest corner of the site, just north of the basketball court.

Design

The design included 2” of field turf over 4” of Vulcan P201 over compacted CA-7.

Installation & Construction

The field was constructed as designed.

Materials

The synthetic turf that was installed was Noland Sports Turf.

Cost Effectiveness

The synthetic field provides cost savings by not requiring ongoing maintenance, and savings due to unused irrigation. The initial cost of installation is higher than typical turf, however.

TABLE 3 BMP Component Construction Costs

BMP Components	Total*
Demolition and Haul-Out of Existing Asphalt, Concrete, Fencing & Signs	$43,308
Excavation and Haul-Out	$112,360
Geotextile Fabric	$4,211
CA-7 Stone Under Fabric	$57,744
210 Turf Stone Cap	$8,814
Fine Grading by Hand	$10,827
Sewer Work	$102,014
Concrete Curb Work	$43,308
Stone Work	$9,624
Asphalt Track	$18,665
Total	**$410,875**

*Total cost per practice component is a lump sum value. Costs include contractor's general conditions, insurance and bonds, overhead and profit.

3.2 BMP 2: Permeable Paver Parking Area & Plaza

Overview

There are two parking areas on the site: the northern perimeter of the property and eastern side of the site/north of the school. These areas consist of permeable interlocking concrete pavers (PICP). PICP is an extremely effective Best Management Practice (BMP) for stormwater management in low-volume areas such as access streets and parking lots. The pavement consists of manufactured pavers that reduce the volume and rate of stormwater runoff as well as pollutant concentrations. The pavers are separated by joints filled with highly permeable small stones. Water enters these joints and flows through a crushed stone base layer that stores and filters the runoff reducing pollutants as it infiltrates back into the soil. The PICP parking areas at Audubon School is approximately 3,920 square feet in size. In addition, a permeable paver plaza on the west side and new entry area on the east side provide an additional 1,548 square feet of permeable pavers.

Advantages/Disadvantages

The advantage of permeable pavers is their ability to absorb stormwater and the resulting reduction of heat island effect by dispersing trapped heat. The pavers are made from recycled materials reducing the amount of waste created from new construction. Permeable pavers can store pollutants from vehicles away from the users of the site – in this case – the children utilizing the site for recess. Permeable pavers reduce the formation of ice on paved surfaces because water can seep into the joint openings. The permeable pavers increase the hydrologic runoff capability from impervious paving by allowing water to

infiltrate into the subgrade. Disadvantages including increased maintenance necessary for cleaning clogged joints to maintain the effectiveness of the system.

Location

The permeable pavers in the vehicular parking areas are in the northwest and northeast portions of the site. The permeable pavers in the sidewalks are located on the east and west entrances to the school.

Design

The original detail called for a concrete paver with 2” of CA-16 and a 12” CA-7 fabric wrapped drainage layer.

Installation & Construction

Based on the contractor’s local experience, changes were made to the permeable paving system during the construction submittal phase. The geotextile fabric was removed from the detail due to the potential for premature clogging of the permeable system, as well as the potential for the fabric to tear when placing the aggregate during construction. The bedding material was also changed during construction.

Materials

The permeable pavers are concrete – Unilock Eco-Priora 5x10. The pattern in vehicular area is a 45-degree herringbone with a single soldier course border. This layout maintains its strength due to the pressures applied from vehicle turn movements. In pedestrian areas the pattern was running-bond with a single soldier course border. The joint filler is a Kafka granite chip (1/16”-3/16”). A replacement was made for the permeable paver bedding during the construction submittal process. McCook 210 product was considered an equal and preferred for permeable paver bedding and artificial turf. It contains more of a mix of sizes than CA16 while remaining free draining and is able to be rolled flat more readily.

Cost Effectiveness

The additional excavation needed for water filtration adds to the initial construction cost. However, the concrete paver cost itself is comparable to non-permeable concrete pavers. There is cost savings due to the lessened impact to sewer systems.

TABLE 4 BMP Component Construction Costs

BMP Component	Total*
Demolition and Haul-Out of Existing Asphalt, Concrete, Fencing & Signs	$15,038
Excavation and Haul-Out	$26,346
Stone	$19,248
Sewer Work	$32,481
Pavers	$80,421
Concrete Curbs	$23,218
Total	**$196,751**

*Total cost per practice component is a lump sum value. Costs include contractor’s general conditions, insurance and bonds, overhead and profit.

3.3 BMPs 3&4: Deep-Rooted Native Vegetation & Landscape Buffers

Overview

A native vegetation buffer area was planted in front of the school on the south side. This garden is equivalent to a vegetated filter strip and contains native plants specifically selected for site appropriateness. Vegetated filter strips slow the velocity of stormwater runoff and filter out pollutants. Native vegetation enhances the removal of nutrients and pollutants in stormwater runoff. The runoff also cools in temperature as it travels through the garden and the soil column. It provides a buffer between the school and the organic vegetable garden.

The strip of land between the proposed parking lots and play areas was landscaped to provide a visual break between the two areas. In addition to providing a safety feature and break between the areas, the permeable surface promotes infiltration of runoff to a much greater degree than the current asphalt surface at these locations. In addition, the soil profile within all native planting areas was modified for improved infiltration and plant performance. Total native planting totals 6,182 square feet.

Advantages/Disadvantages

Advantages of using deep rooted native vegetation include recharge of underground aquifers. This redistribution of water allow water to be transferred down during rainy periods and transferred to the levels closer to the surface when the rains have gone away (Sanders, 2006). Benefiting the process of carbon sequestration in the long term.

Location

The areas with deep rooted native vegetation line the south and north sides of the building, in the constructed garden on the south side and throughout the parking lots and playgrounds to the north.

Design

Planting locations were selected to provide the maximum amount of infiltration capability. Large tree locations were selected to allow shade in play areas and the garden space

Installation & Construction

Key to the success of the native vegetation is the specification calling for 15” of imported top soil and scarifying the existing subgrade.

Materials

See Plant List, Appendix A, for materials used.

Cost Effectiveness

The cost to purchase and install native vegetation of this kind is comparable to other perennial mixes commonly used in the region. There is cost savings in reduced maintenance and irrigation costs.

TABLE 4 BMP Component Construction Costs

BMP Component	Total*
Demolition and Haul-Out of Existing Asphalt, Concrete, Fencing & Signs	$3,008
Excavation and Haul-Out	$23,098
Landscaping	$85,413
Mulch and Soil Work	$29,594
Sewer & Concrete Curbs	$18,045
Total	**$159,157**

4 Results

Operation and Maintenance

As with most stormwater management practices, permeable pavement systems require regular maintenance to ensure a prolonged lifespan. The synthetic turf field requires regular maintenance to ensure no weeds or mold grow, the infill does not become compacted, and no damage occurs due to chemicals or fire. If not properly maintained, the infill may become contaminated and could lead to the hardening of the surface and decrease drainage. Similarly, care must be taken to ensure the permeability of the porous asphalt remains intact. Sand must not be used during winter months. Salt should not be used on permeable pavement surfaces. Shovels with appropriate edges should only be used for snow removal on the permeable asphalt. Adjacent surfaces that drain towards the permeable asphalt must be maintained to ensure sediment does not wash onto the permeable pavement and clog the voids. Scheduled cleanings and vacuuming/power washing will help ensure sediments do not affect drainage. See the Operation and Maintenance Plan in Appendix A.

Stormwater Runoff

With the installation of the BMPs included in the project, the stormwater runoff will be reduced and attenuated. The majority of the site redeveloped was impervious; accordingly, most of the runoff previously was directly tributary to the City of Chicago's combined sewer system. Given the City's approximate rainfall of 27.1 inches per year approximately 0.67 million gallons of stormwater per year will now be reduced and attenuated prior to release to the City's combined sewer system. This will result in a minor incremental decrease in Combined Sewer Overflow (CSO) release volumes.

Pollutant Removal Efficiency

In order to determine pollutant reduction for the proposed BMPs the implementation of urban BMPs based on reduction efficiencies and calculations developed by Illinois EPA was used. The annual pollutant load reductions are summarized in Table 5.

TABLE 5 Pollutant Reductions

BMP	Infiltration Basin	Porous Pavement	Vegetated Filter Strips	Total (lbs/yr)
BOD			1	**1**
COD	58	32	5	**95**
TSS	277	150	40	**457**
Lead				
Copper				
Zinc				
TDS				
TN	2	1		**3**
TKN				
DP				
TP				
Cadmium				

This treatment train process will maximize stormwater infiltration and pollutant removal by treating stormwater runoff by several different BMPs prior to discharging downstream.

5 Bibliography

ASBA. (2017, October 17). *Natural Grass or Synthetic Turf?* Retrieved from American Sports Builders Association: https://www.sportsbuilders.org/press/LandscapeArchBusinessNaturalGrassSynthTurf.pdf

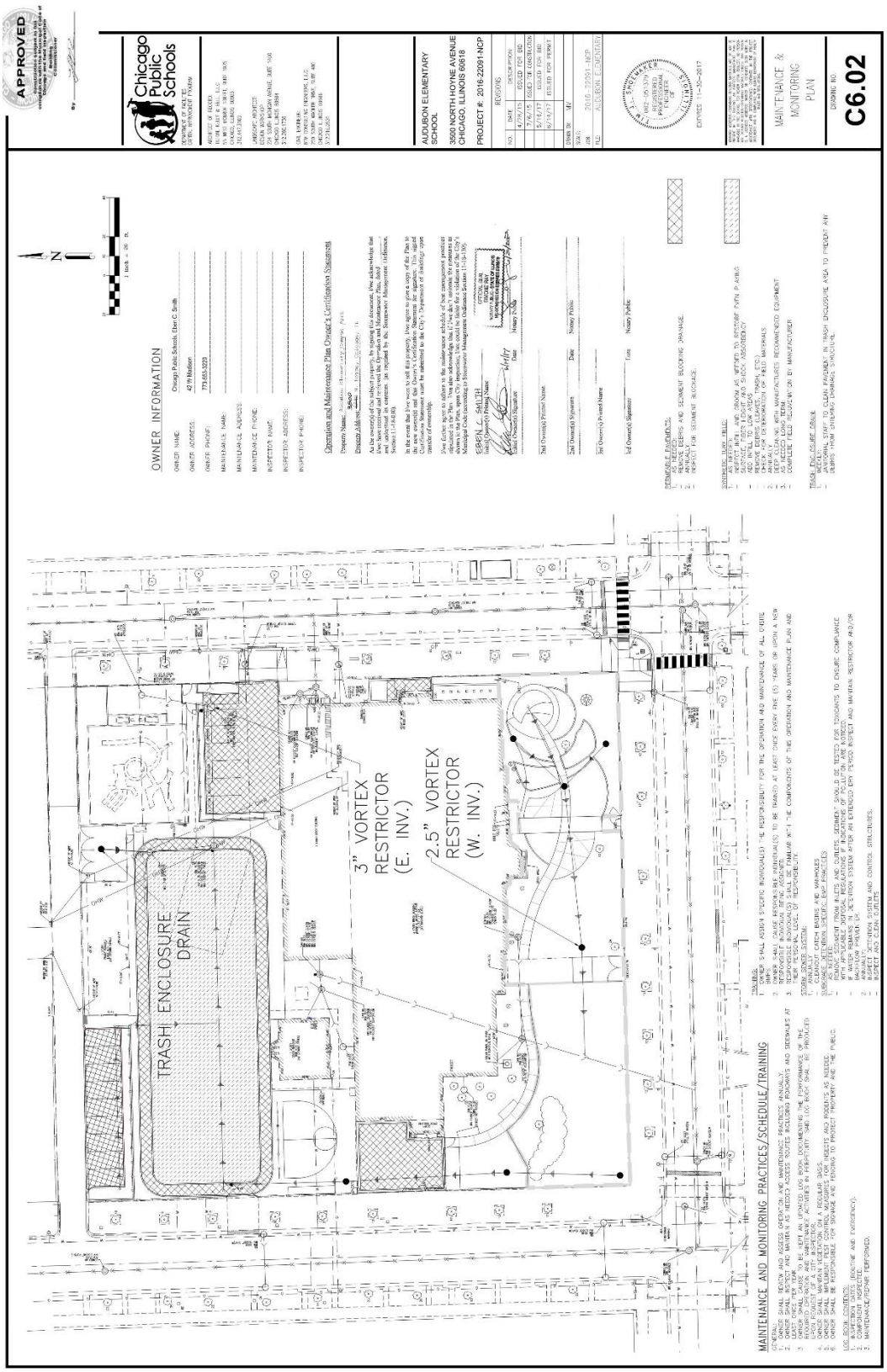
Sanders, R. (2006, January 11). Deep-Rooted Plants Have Much Greater Impact on Climate Than Experts Thought. *UC Berkley News*.

6 Appendix A: Plant List

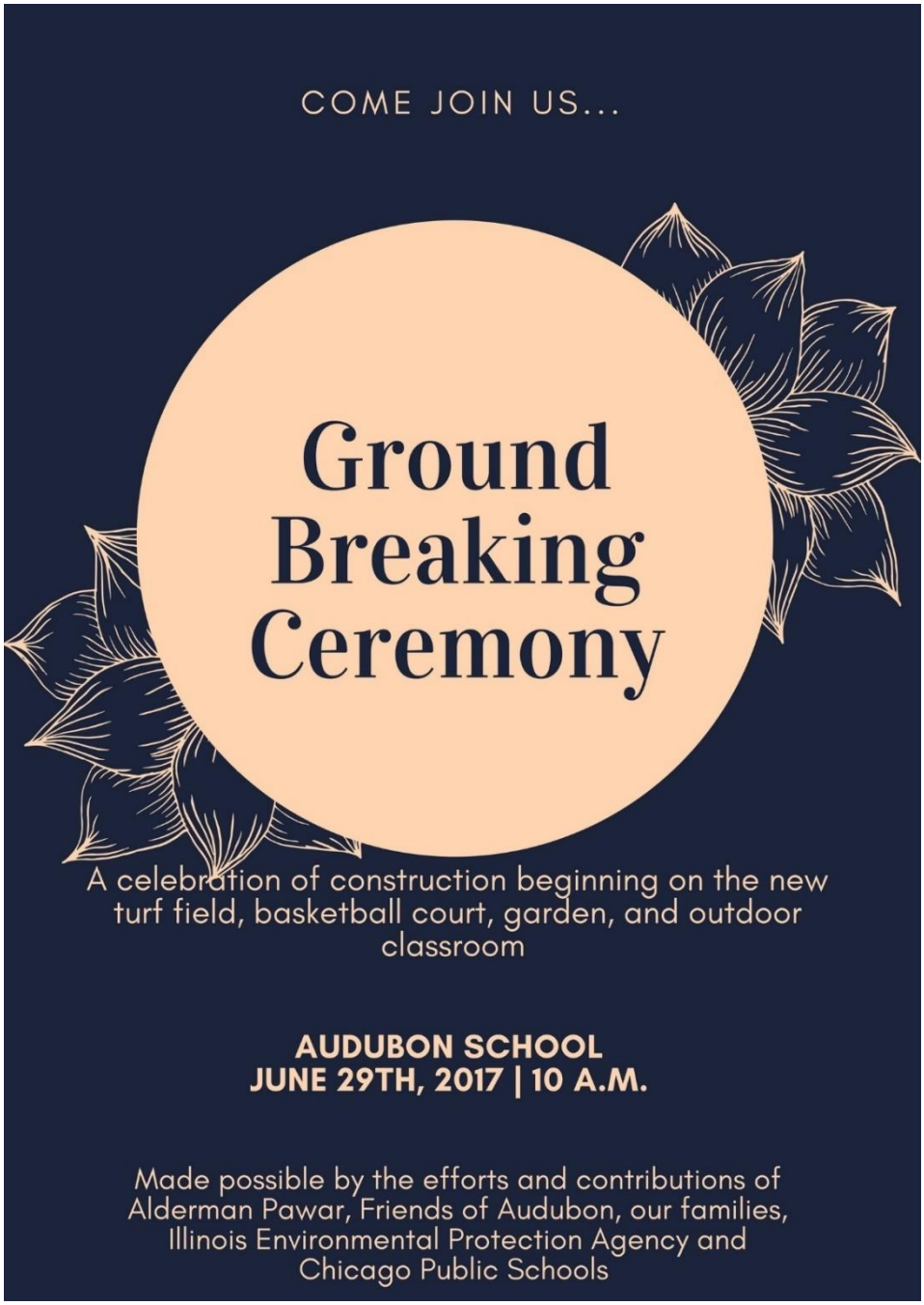
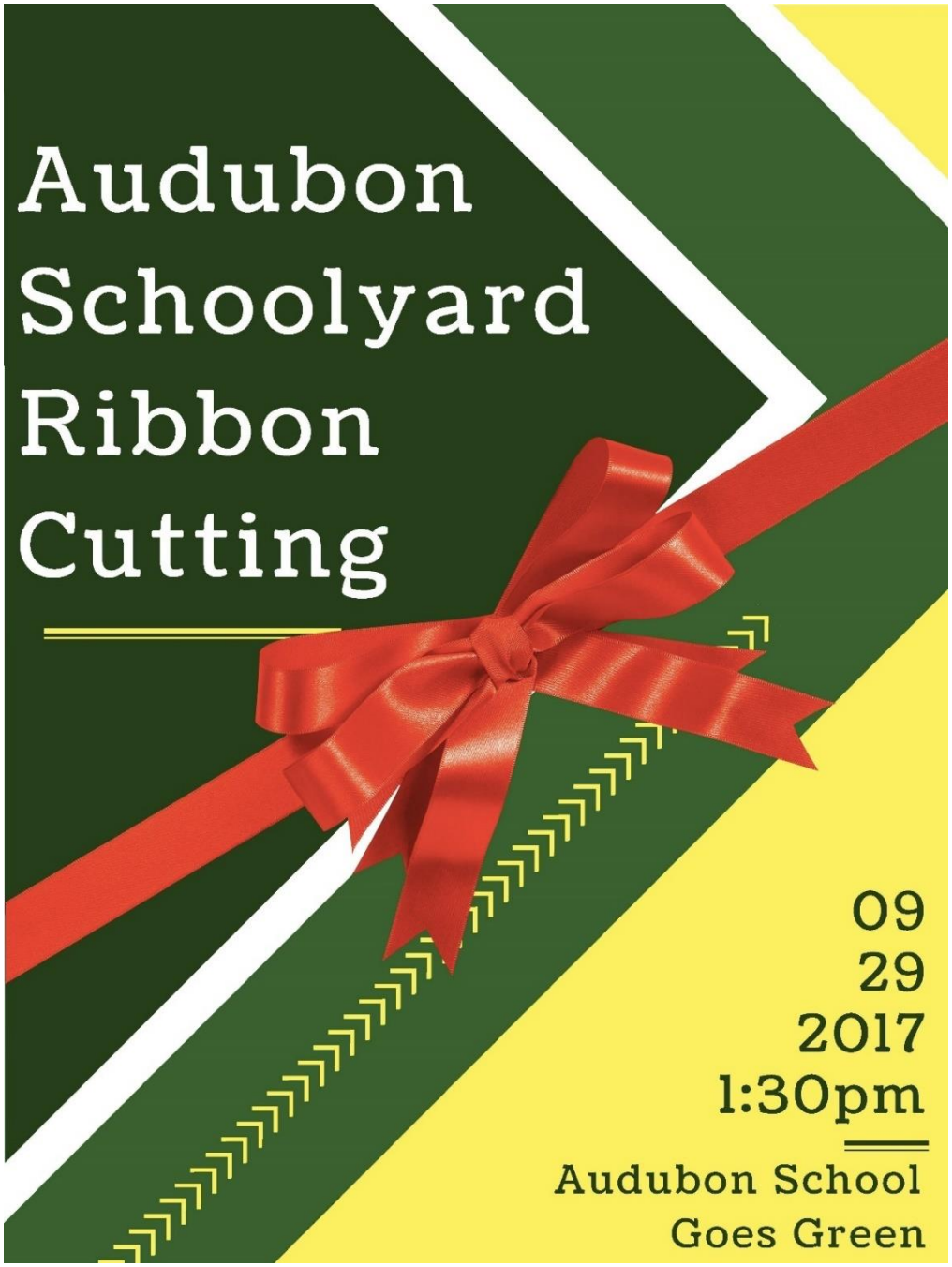
PLANT LIST

ABBR.	BOTANICAL NAME	COMMON NAME	QTY.	SIZE		COMMENTS
DECIDUOUS TREES						
AM	Acer miyabei 'Morton'	State Street Maple	5	4.5" CAL		
AS	Acer saccharum 'Green Mountain'	Green Mountain Sugar Maple	1	4" CAL		
AG	Amelanchier x grandiflora "Autumn Brilliance'	Apple Serviceberry	2	10' ,10'		Multi-stem (3 + stems). 1 of 22' trees to be single stem
AG	Amelanchier x grandiflora "Autumn Brilliance'	Apple Serviceberry	1	8'		
AG	Amelanchier x grandiflora "Autumn Brilliance'	Apple Serviceberry	2	12' ,12'		Multi-stem (3 + stems)
CC	Cercis canadensis	Eastern Redbud	1	10'		
CA	Corylus americana	American Hazelnut	1	48" HT		
MH	Malus pumila 'Honeycrisp'	Dwarf Apple	1	2" CAL		
MB	Malus 'Braeburn'	Semi-Dwarf Apple	1	8' HT		
QB	Quercus bicolor	Swamp White Oak	1	4" CAL		
VO	Viburnum Dentatum	Red Regal	1	6' HT		
SHRUBS			QTY	SIZE	SPACING	
CPt	Comptonia peregrina	Lady Fern	29	3 Gal.	24" OC	
IV	Ilex verticillata "Nana Red Sprite"	Winterberry	125	3 Gal.	30" OC	
RC	Rhus copallinum var. latifolia 'Morton'	Gro-Low Sumac	61	5 Gal.	30" OC	
HQ	Hydrangea quercifolia	Oakleaf Hydrangea	12	5 Gal.	30" OC	
CS	Redtwig Dogwood	Cornus sericea	33	7"	30" OC	
SC	Symphoricarpos x chenaultii 'Hancock'	Snowberry	66	5 Gal.	30" OC	
VM	Vaccinium macrocarpon 'Peach Sorbet'	Cranberry	68	1 Gal.	30" OC	
GROUNDCOVERS/ PERENNIALS			QTY	SIZE	SPACING	
AT	Aesclepias tuberosa	Butterfly milkweed	122	1 Gal	18" OC	Interplanted with Sporobolus
ACn	Allium cernuum	Wild onion	55	1 Qt.	12" OC	Interplanted with Heuchera
AH	Amsonia hubrichtii "Blue Ice"	Bluestar	308	1 Gal.	15" OC	
ACd	Asarum canadense	Canadian Wild Ginger	77	1 Qt.	18" OC	
AF	Athyrium filix-femina	Lady Fern	60	1 Qt.	18" OC	Interplanted with Carex
DE	Dicentra exima	Bleeding Heart	20	1 Qt.	12" OC	
EP	Echinacea purpurea "Magnus"	Purple Coneflower	149	1 Gal.	18" OC	Interplanted with Panicum
EY	Eryngium yuccifolium	Rattlesnake Master	165	1 Gal.	9" OC	
EA	Dodecatheon Meadia	Shooting Star	16	6" POT	9" OC	
HC	Heuchera "Fire Alarm"	Coral Bells	22	1 Gal.	9" OC	
LS	Liatris spicata "Kobold"	Blazing Star	83	1 Qt.	15" OC	
HM	Helenium "Moerheim Beauty"	Sneezeweed	93	1 Gal.	15" OC	
MV	Mertensia virginica	Virginia Bluebells	61	D Qt.	9" OC	
RF	Rudbeckia fulgida "Goldsturm"	Black-eyed Susan	160	1 Gal.	9" OC	Interplanted with Panicum
TC	Tiarella cordifolia	Foamflower	26	1 Qt.	24" OC	Interplanted with Carex
ORNAMENTAL GRASSES			QTY	SIZE	SPACING	
CP	Carex pennsylvanica	Sedge	136	1 Gal.	24" OC	
DC	Deschampsia caespitosa "Goldscheir"	Wavy Hairgrass	46	1 Gal.	24" OC	
PV	Panicum virgatum "Rotstrahlbusch"	Switchgrass	219	3 Gal.	24" OC	
SH	Sporobolus heterolepsis	Prairie Dropseed	164	3 Gal.	24" OC	
PRAIRIE PLANTING MIX			QTY	SIZE	SPACING	
20%	Carex cristatella	Crested Oval Sedge	111	Plug	12" OC	
10%	Helicotrichon sempervirens	Blue Oat Grass	56	Plug	12" OC	
20%	Koeleria cristata	June Grass	111	Plug	12" OC	
15%	Panicum virgatum	Switchgrass	83	Plug	12" OC	
20%	Bouteloua curtipendula	Side-Oats Grama	111	Plug	12" OC	
2%	Aesclepias tuberosa	Butterfly Milkweed	12	Plug	12" OC	
2%	Coreopsis palmata	Prairie Coreopsis	12	Plug	12" OC	
2%	Geum triflorum	Prairie Smoke	12	Plug	12" OC	
2%	Monarda fistulosa	Wild Bergamot	12	Plug	12" OC	
2%	Echinacea purpurea	Purple Coneflower	12	Plug	12" OC	
2%	Penstemon hirsutus	Hairy Beardtongue	12	Plug	12" OC	
2%	Verbena stricta	Hoary Vervain	12	Plug	12" OC	
2%	Zizea aurea	Golden Alexanders	12	Plug	12" OC	
LAWN SOD			QTY			
	RTF "Water Saver"	Drought tolerant tall fescue sod	9,092 SF			
BULBS			QTY			
NA	Narcissus	Daffodil	160	Bulb	12" OC	
MU	Muscari armeniacum	Grape Hyacinth	85	Bulb	8" OC	

7 Appendix B: Operation and Maintenance Plan



8 Appendix C: Ground Breaking Media Release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