Multifamily Stormwater Retrofit Manual

February 2018

Gresham Smith

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LEXINGTON

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Contents

Introduction

The Multifamily Stormwater Retrofit Manual is intended to highlight immediate opportunities for dramatically improving stormwater management on one of Lexington, Kentucky's, most prevalent land uses. This focus was chosen for several reasons:

1. Multifamily land uses exist throughout the county, many of which were developed prior to green infrastructure requirements, making them key contributors to the overall stormwater management challenge faced by Lexington.

2. Lexington continues to face challenges related to affordable housing and quality of life for its citizens. These two issues can be directly addressed through creative improvements to existing multifamily housing stock. Developing methods for improving existing multifamily properties is the most sustainable solution to these issues, which can be done in coordination with improving stormwater quality from these often large and predominantly impervious sites.

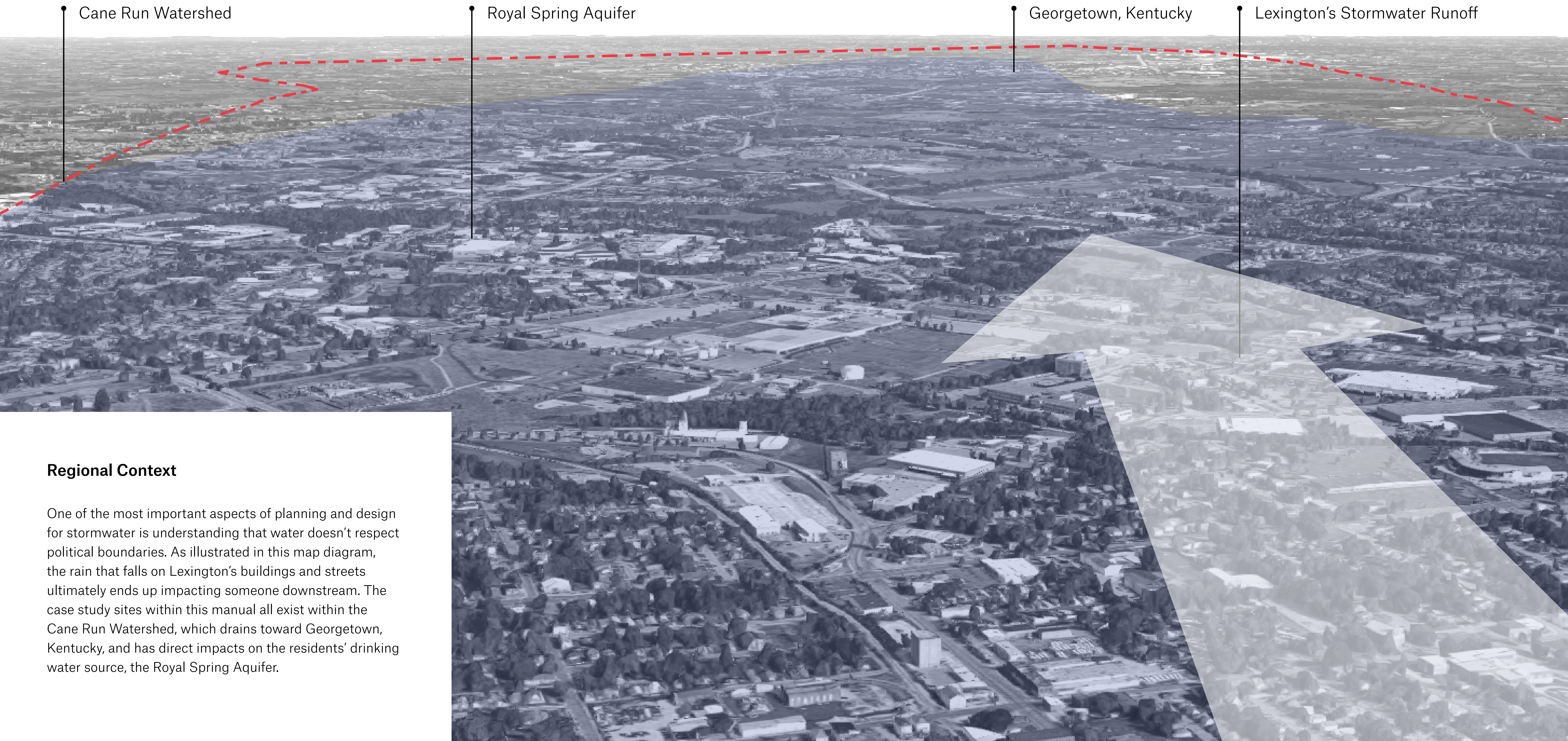
3. As Lexington faces mounting pressure to expand the Urban Services Boundary, multifamily housing will play an even more important role in increasing density, and providing a broader spectrum of housing types.

4. Stormwater quality and innovative management techniques are often difficult to quantify, making it difficult for a city to truly invest in innovative approaches to planning and designing these systems. multifamily properties are an ideal location for experimentation and education, because of the built-in visibility these properties offer.

The critical focus of this manual is to illustrate that sustainability does not require compromise.

Through case studies, this manual intends to showcase how multifamily properties can be designed to improve water quality and reduce flooding, while also creating better places to live, more environmentally resilient communities, and increasing value for our communities and property owners.

This manual takes a triple bottom line approach to sustainable design that looks beyond the natural resources typically associated with sustainability, and attempts to define how to measure and increase community sustainability: environmentally, socially and economically.



Regional Context

One of the most important aspects of planning and design for stormwater is understanding that water doesn't respect political boundaries. As illustrated in this map diagram, the rain that falls on Lexington's buildings and streets ultimately ends up impacting someone downstream. The case study sites within this manual all exist within the Cane Run Watershed, which drains toward Georgetown, Kentucky, and has direct impacts on the residents' drinking water source, the Royal Spring Aquifer.

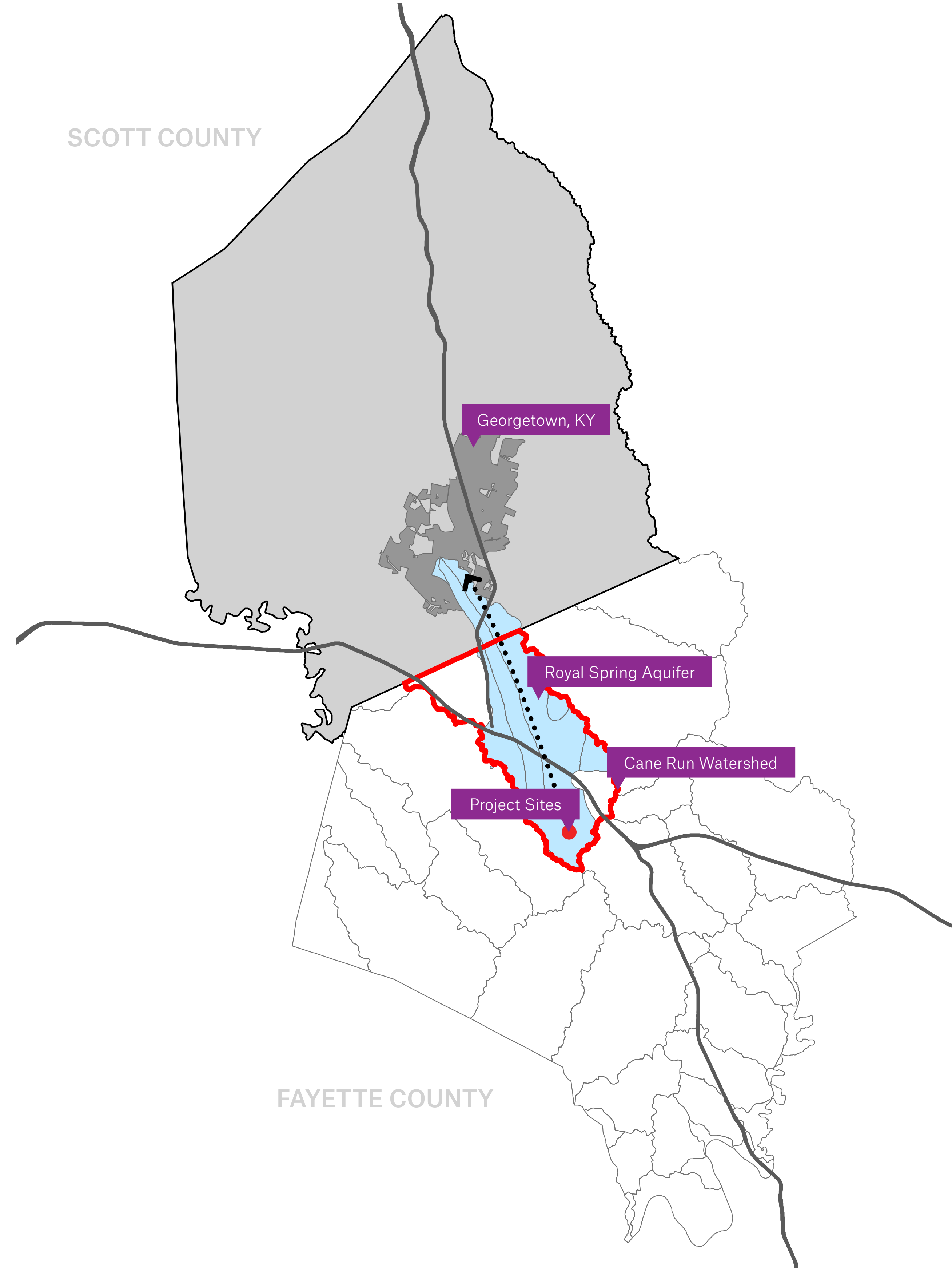
Understanding Watersheds

Watersheds can be complex systems with multiple layers. Watersheds are essentially areas of land where all the water goes to a common outlet. Watersheds can be small or large, and consist of rivers, lakes, streams wetlands and all the underlying groundwater— which in Central Kentucky is important because of the limestone geology.

Decisions made in one part of a watershed impact not only that watershed but also the adjacent watersheds that receive their water. For instance, the Royal Spring Aquifer (illustrated in blue on the adjacent map) is in the Cane Run Watershed and is an environmentally sensitive area in northern Fayette County and southern Scott County. As described in the following excerpt from the Rural Service Area Land Management Plan, the runoff on the Lexington side of this equation literally becomes drinking water in Georgetown, Kentucky.

"Unlike Lexington, which derives its water from the Kentucky River, Georgetown derives its drinking water from the Royal Spring Aquifer. Since 80% of the aquifer for that spring is located in Fayette County, rainwater that infiltrates the ground in Fayette County becomes the source of drinking water in Scott County. This is the largest spring-fed public water supply in the state, providing water to over 7,000 customers.

The Royal Spring Aquifer is particularly susceptible to pollution because it is located in an irregular limestone region with sinkholes, underground streams, and caverns. The sinkholes, streams and caverns allow pollutants to easily enter the water system. Within a matter of hours, groundwater, and pollutants can travel from Lexington to Georgetown. In order to ensure that the water supply in Georgetown remains viable, Lexington-Fayette County must take particular care to ensure that pollutants do not enter this system."



Stormwater and Multifamily Development

According to the Lexington Open Data Portal, as of 2005, there were over 2,050 acres of multifamily land uses countywide. The Cane Run Watershed alone had over 215 acres of multifamily land use within its boundaries.

Aging apartment complexes, like the three case studies focused on in this manual, exist all across Fayette County. These sites are major opportunities for stormwater improvement projects because they are typically highly impervious, and they represent some of Lexington's highest residential densities, which means more people can interact and learn about innovative stormwater approaches.

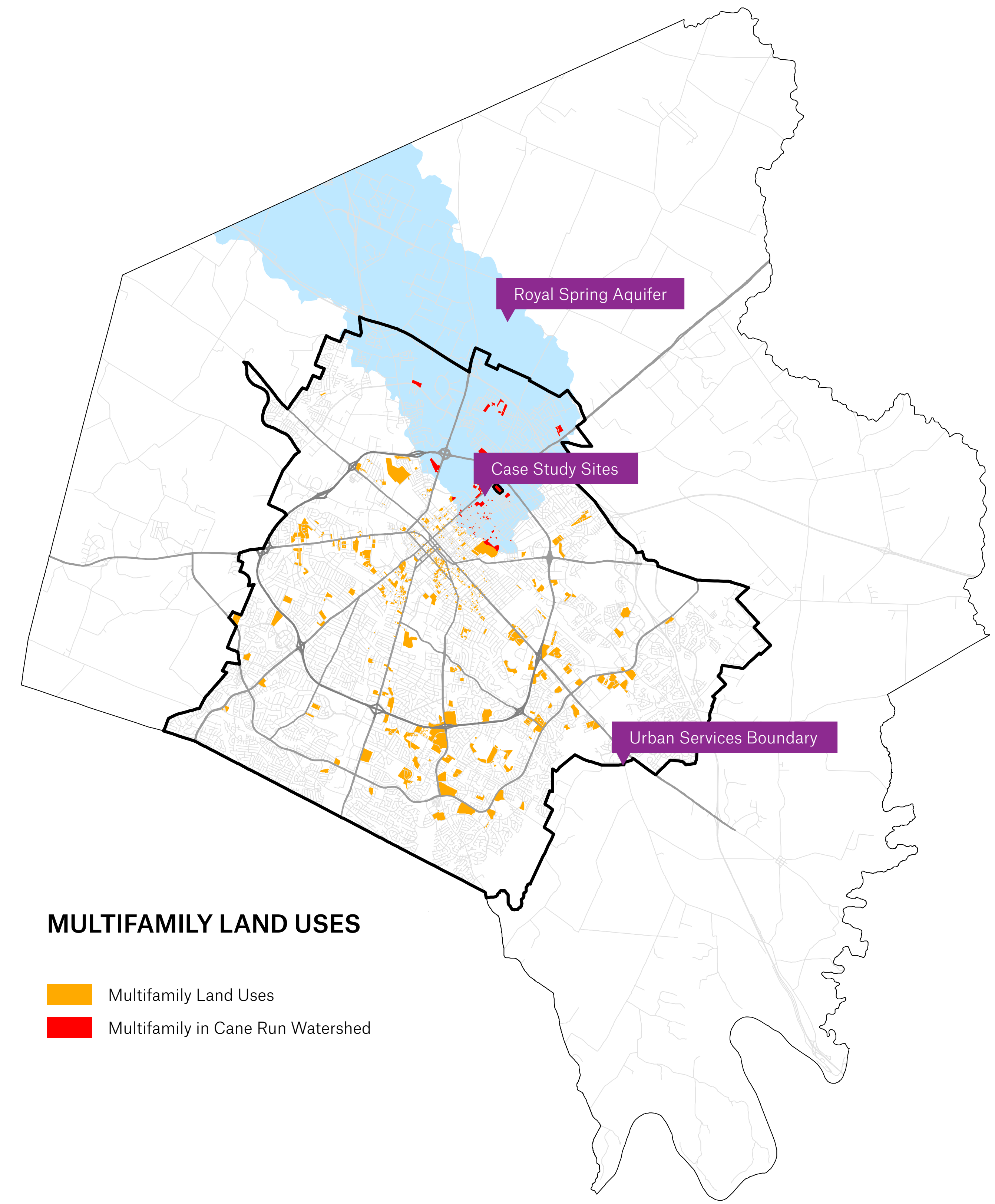
Additionally, local and national housing trends indicate that apartment lifestyles aren't slowing down anytime soon. As such, the thousands of acres of existing multifamily land use will become increasingly important in addressing stormwater quality issues through stormwater infrastructure retrofit projects. Using one of the case study sites as an example (150 Northland), the potential impacts are quite clear:

The Northland site is 66.3 percent impervious. In a single 1-inch rainfall event, just over 66,000 gallons of water would fall on this site and go directly into the storm system — along with every pollutant picked up along the way.

Assuming a 47-inch annual rainfall, that puts this single, 3-acre site at 3.14 million gallons of untreated water washing pollutants and sediment into the storm system, and eventually into the waterways, each year.

Imagine all of Lexington's multifamily land uses having a similar level of imperviousness. You could hypothesize that in a single 1-inch rain event across Lexington, well over 36 million gallons of water and associated pollutants are being put in pipes and potentially in waterways that are directly connected to aquifers across the region. And this is just for multifamily land use, not commercial, industrial or single-family.

These staggering numbers illustrate the importance of developing creative opportunities for stormwater quality improvements across the diverse range of multifamily development types in Lexington.



Stormwater Best Management Practices

As our communities continue into the 21st century, it is imperative that they are as efficient and thoughtful with land development as possible. Growth is continually on the rise, and as such, finding ways for necessary infrastructure to incorporate multiple societal benefits is a must.

Historically, stormwater has been seen as an engineering problem of excess water that should be removed as quickly as possible. For decades, stormwater systems have been designed to direct water to pipes and remove it from the site as quickly as possible to avoid potential flooding. This approach, often referred to as "gray" or "hard" infrastructure because of the use of pipes and impervious surfaces, has created unintended consequences for our communities.

At first glance, expedient removal of stormwater may make sense, but if left unchecked can cause unintended consequences downstream including: increased water velocities and erosion, depleted natural percolation, and reduced opportunity for biological water quality improvement. Untreated stormwater will carry pollutants with it that impact the health of natural water bodies, (rivers, streams and lakes), not to mention the effects on water quality for human consumption.

Finally, the dirtier the water supply, the more expensive it is to clean it. Municipal water companies expend massive amounts of funding to clean water, which also requires immense amounts of electrical energy. According to the Environmental Protection Agency (EPA) 3-4 percent of the nation's energy is used for treating and distributing potable water.

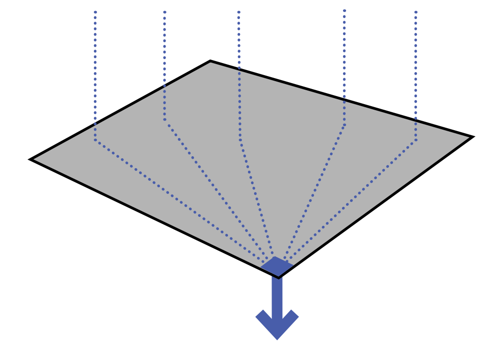
Increases in these types of gray infrastructure approaches also enable the continual increase of impervious surfaces. These surfaces increase urban heat island effects, and reduce the amount water that naturally infiltrates to groundwater systems.

As our communities head into the 21st century, we face numerous issues related to water quality, flooding and related negative environmental impacts. It is becoming increasingly apparent that gray infrastructure, must be balanced with "green" or "soft" infrastructure which focuses on working hand in hand with natural processes to slow water down, spread water out, and soak water in whenever possible. These approaches also bring with them a plethora of broader communal and ecological benefits, which make green infrastructure a necessary path forward for growing cities.

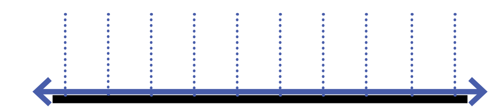
Green + Gray

TRADITIONAL APPROACHES

Traditional stormwater management removes water from a site as quickly as possible by directing it across impervious surfaces to gutters and then to pipes. This approach can decrease water quality and increase the likelihood of erosion downstream.

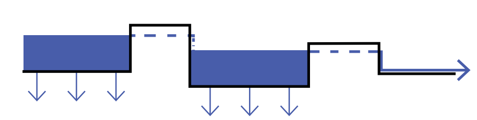


Traditional practices typically send runoff to as few outlets as possible as part of an efficiently designed system. This can increase flooding issues, and dramatically increase water velocities.

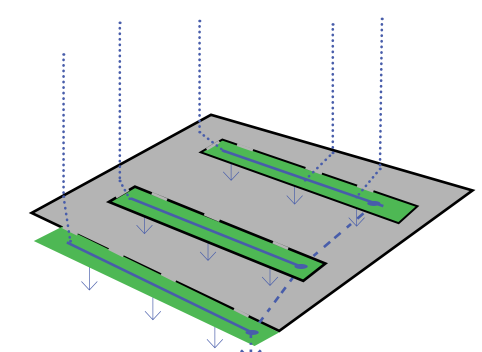


Traditional approaches rely on impervious surfaces to direct water away from a site. These approaches, however, reduce natural percolation, increase urban heat island effects and negatively impact soil health.

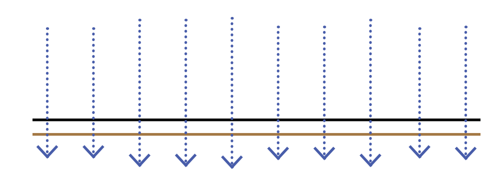
BMP APPROACHES



Green infrastructure can be designed to slow water down. This approach can be achieved through thoughtful control of site elevations, use of weirs and by developing systems which guide water to pervious surfaces that both slow water down, but also allow it to percolate naturally into the soil.



By spreading water out across a site, stormwater can be slowed down and given more opportunities to percolate naturally before entering the gray system, which should operate as a failsafe.



Finding ways for stormwater to naturally infiltrate is imperative for a healthy and balanced urban ecology. Replenishing groundwater systems, cleaning water through biological processes, and reducing the effects of downstream erosion and sedimentation are all benefits of absorbing water where it falls.

BMP Examples

There are many examples of how the previously mentioned BMPs have been put to use in cities across the world.

Often, the best approaches are diverse and are designed to decrease stormwater speeds, distribute stormwater around the site and allow the water to soak in naturally where possible.

Allowing for this overlap of strategies will help provide the best stormwater management and quality improvements. Understanding how these strategies can benefit broader communities is important. The following images are simple examples from around the United States that show how these diverse approaches are being put to use.

SLOW

Using pervious surface materials like native grasses and crushed stone instead of asphalt can provide social spaces while improving natural percolation.

Providing detention/retention features within landscapes will allow water to percolate naturally over longer periods. When not filled with water, these can serve as both open and functional spaces.

Features like bioretention basins along roadways can help slow water down in larger rain events by creating small pools with weirs, which overflow to the larger system.

SPREAD

Green-roof technology can help slow down and spread out stormwater runoff across large surfaces.

Linking stormwater collection points along green streets can create networks of stormwater features, providing multiple benefits to both the streetscape and the stormwater collection system.

Providing open spaces in mostly impervious environments can help disseminate stormwater runoff across a greater area.

SOAK

Where possible, larger features such as designed or natural wetlands can help absorb massive amounts of stormwater runoff.

Using topography like this designed basin will help capture and slow stormwater runoff while improving a community streetscape.

Pervious surface materials that allow the landscape to act more like a sponge, such as the materials used in this parking lot, can dramatically reduce runoff.

Making BMPs Add Value

Improving stormwater management on existing multifamily properties can be an uphill battle, as it can be considered a cost versus an investment. The most critical component of evaluating these strategies is their ability to add value. Added value for multifamily properties can come in a number of ways.

Lessening the Water Quality Management Fee

The most direct benefit of these strategies is a reduction of impervious surfaces, which will lessen a property owner's Water Quality Management Fee that is based on the total square footage of impervious surfaces for multifamily properties.

More Beautiful Landscapes That Can Be Sustainably Maintained

One way multifamily properties differentiate themselves is the look and feel of the property. There are many landscape solutions that are beneficial to stormwater quality and local ecological systems while remaining beautiful. If designed well, these native landscapes can require less long-term maintenance, less water and minimal chemical treatment.

Added Resident Amenities

Perhaps most importantly, these features can be designed to lessen impervious surfaces and improve drainage problems and water quality, while adding amenities that make a property stand out to prospective residents, and allowing the property owner to create more rental value on their respective property.

The Sustainability Market

While the sustainability and "green living" markets vary from region to region, there is absolutely a growing public interest, and even a market demand, for consumers who want to live a more sustainable lifestyle. Using these stormwater features in marketing is one more way to add value and elevate the status of a multifamily property when residents are choosing where to sign their lease.


Pervious Parking Lots


Dog Parks/Runs


Seating Areas


Play Areas


Rooftop Terraces


Community Gardens


Water Features


Trails/Boardwalks


Bike Storage

BMP-menities

BMP-menities is a new way of thinking creatively about how stormwater infrastructure can be used to add value to a multifamily property. It is extremely hard to differentiate properties based on infrastructure that is underground, as out of site is often out of mind. However, BMPs can be designed to act as site amenities that fit a number of different lifestyles and can improve the marketability of any multifamily site, regardless of scale.

These images represent just a few typical site amenities, which if designed thoughtfully, could also help improve overall stormwater quality and stormwater management.

How to Use the Manual

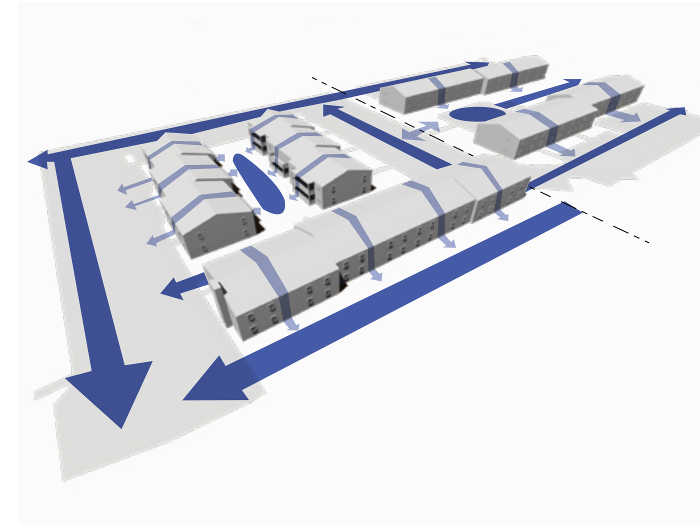
The following pages include three distinct case studies that describe the process of evaluating a site's stormwater issues, followed by developing strategies and designs for improving stormwater management and increasing site amenities.

Each case study addresses three phases of the design process: Site Analysis, Site-Appropriate Strategies and Conceptual Design.

The case studies are organized by the scale of the property. Multifamily properties come different shapes and sizes, and not all stormwater management solutions are appropriate for all sites. The manual includes a large, medium and small site to showcase how the solutions can be applied in multiple ways and be scaled up or down depending on the context.

This design process is imperative in order to develop solutions that not only improve stormwater management, but also increase the value of these properties for residents, neighbors and the owners.

SITE ANALYSIS



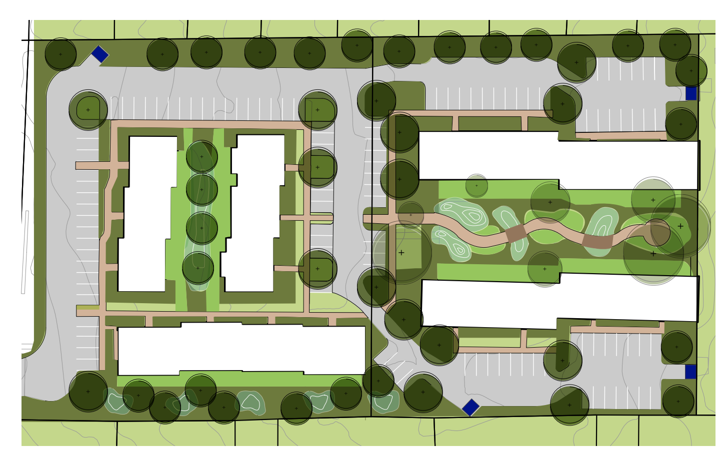
Site analysis begins with understanding the multifamily site and its existing stormwater patterns by answering questions such as:

- How big is the site?
- Who lives here?
- Where does stormwater runoff currently go?
- Are there current flooding issues?
- Where is there obvious room for improvement?
- How do residents currently use the outdoor space?
- What plants are on the site?
- Where does the site slope? How steep are the slopes?

STORMWATER STRATEGIES

After gaining a better understanding of the specific site, it is important to start thinking about ways that improved stormwater management can align with the issues and opportunities identified in the site analysis phase. For example, if you determine a site includes young families, and the current outdoor spaces are dominated by parking and turf grass areas, this may be an opportunity to create stormwater features that include both space for play and rain gardens that make the property more appealing to young families who want to spend time outside.

DESIGN



Although identifying the opportunities is important, the design is critical. Engaging a local landscape architect who understands stormwater management, plant materials and community design is key to the success of your retrofit. Professionals can help ensure the proper materials, slopes and plants are used so that your project is functional as well as safe and beautiful.

Three Case Studies

The three case studies are all situated on the north side of Lexington, Kentucky, and represent a diversity of multifamily property types and scales. Each property was developed prior to contemporary green infrastructure requirements and represent opportunities to develop a series of stormwater retrofits applicable to the thousands of acres of other multifamily properties throughout the city.

① Large

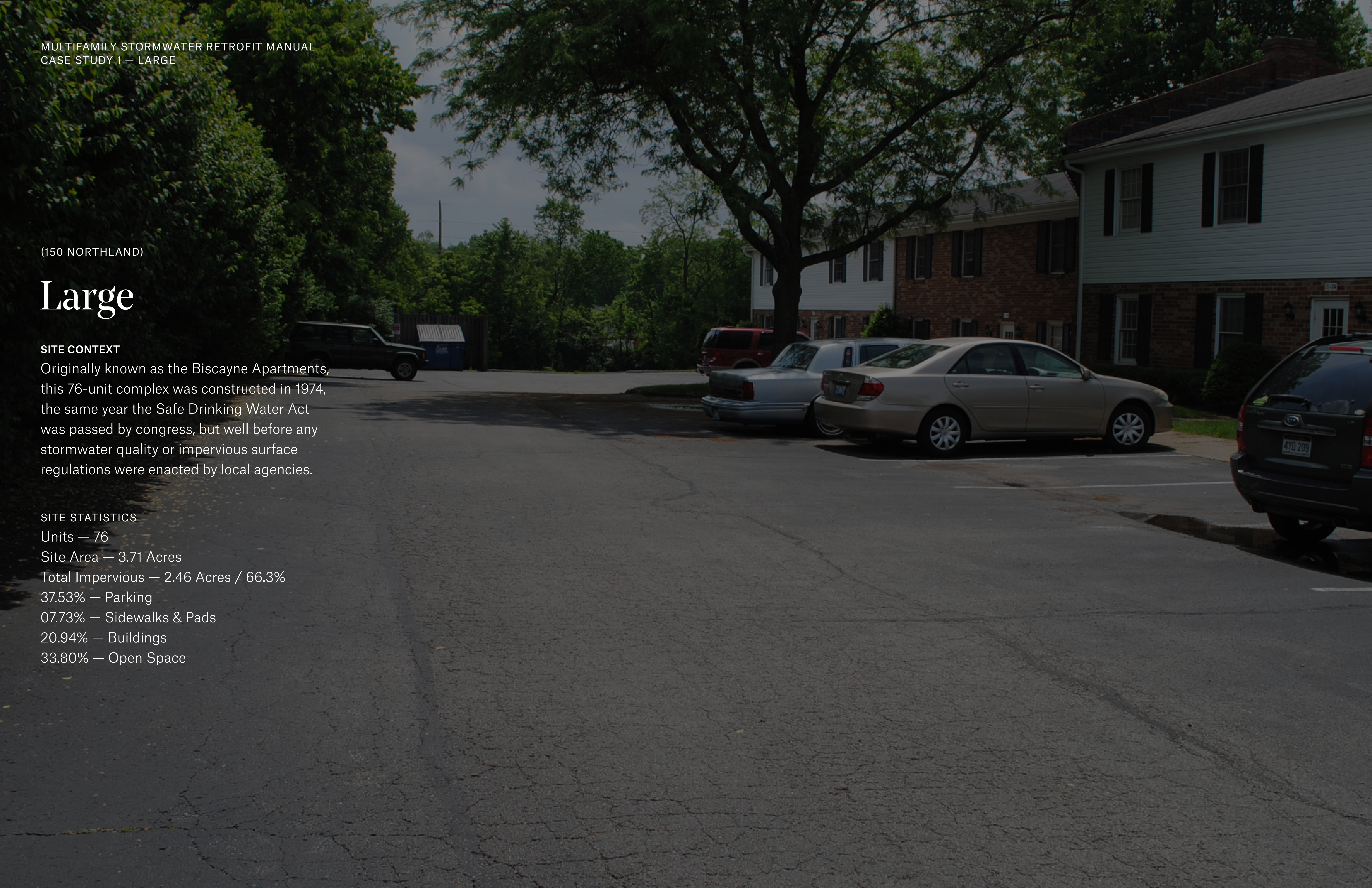
(150 NORTHLAND)

② Medium

(900 BLOCK)

③ Small

(525 LIMESTONE)



(150 NORTHLAND)

Large

SITE CONTEXT

Originally known as the Biscayne Apartments, this 76-unit complex was constructed in 1974, the same year the Safe Drinking Water Act was passed by congress, but well before any stormwater quality or impervious surface regulations were enacted by local agencies.

SITE STATISTICS

Units — 76
Site Area — 3.71 Acres
Total Impervious — 2.46 Acres / 66.3%
37.53% — Parking
07.73% — Sidewalks & Pads
20.94% — Buildings
33.80% — Open Space

Site Context

The site consists of a series of five attached multifamily structures. Each structure has a front and a rear with balconies and porches. Many of the units face ambiguous open space, and most look onto oversized/underutilized parking lots. The existing landscape is made up of a handful of large shade trees, turf grass and overgrown foundation shrubs.

Ⓐ DILAPIDATED POOL

Central to the site is a dilapidated pool. The former apartment amenity is now out of service and sits as a liability, eyesore and impervious surface.

Ⓑ SOUTH PARKING

Parking lots on the "south" side of the site have no stormwater infrastructure and send all of their stormwater runoff to the adjacent, vacant parcel, which is now home to a small urban farm. These locations also house dumpsters.

Ⓒ STANDING WATER

Central to the three-building units is an unprogrammed open space that has three large White Pine trees, and is a low area that ponds when inundated with rain. This space offers little benefit to residents.

Ⓓ ENTRY PARKING

The entry parking lot is by today's standards 8 to 10 feet wider than necessary. This is a low point on the site and a distinct opportunity for improvement.

Ⓔ NORTH PARKING

The drive lanes along the "north" parking areas are wider than necessary and offer the opportunity for impervious surface reduction.

Ⓕ LOW-IMPACT LANDSCAPE

The "code minimum" landscape, a series of yews, turf and a handful of trees, do little to make the site interesting, and offer minimal environmental benefit.

Stormwater Analysis

The first step in stormwater analysis is understanding what impervious surfaces make up the site, followed by identifying rainwater flows during a storm event, and identifying key contributors to stormwater runoff as well as water-flow patterns across the site.

KEY CONTRIBUTORS

Parking Lots and Drive Aisles

The parking lots and drive aisles make up nearly 1.4 acres of impervious surfaces. These surfaces drain toward an inlet on Northland or to adjacent properties.

Rooftops

The rooftops of the five main structures account for over 33,000 square feet of impervious surfaces. These surfaces runoff toward landscape areas and parking lots.

Walkways and the Pool

The other impervious surfaces are made up of building pads, walkways and the dilapidated pool. These comprise over 12,000 square feet of impervious surfaces.

KEY FLOW PATTERNS

Main Parking Lot/Drive Aisle

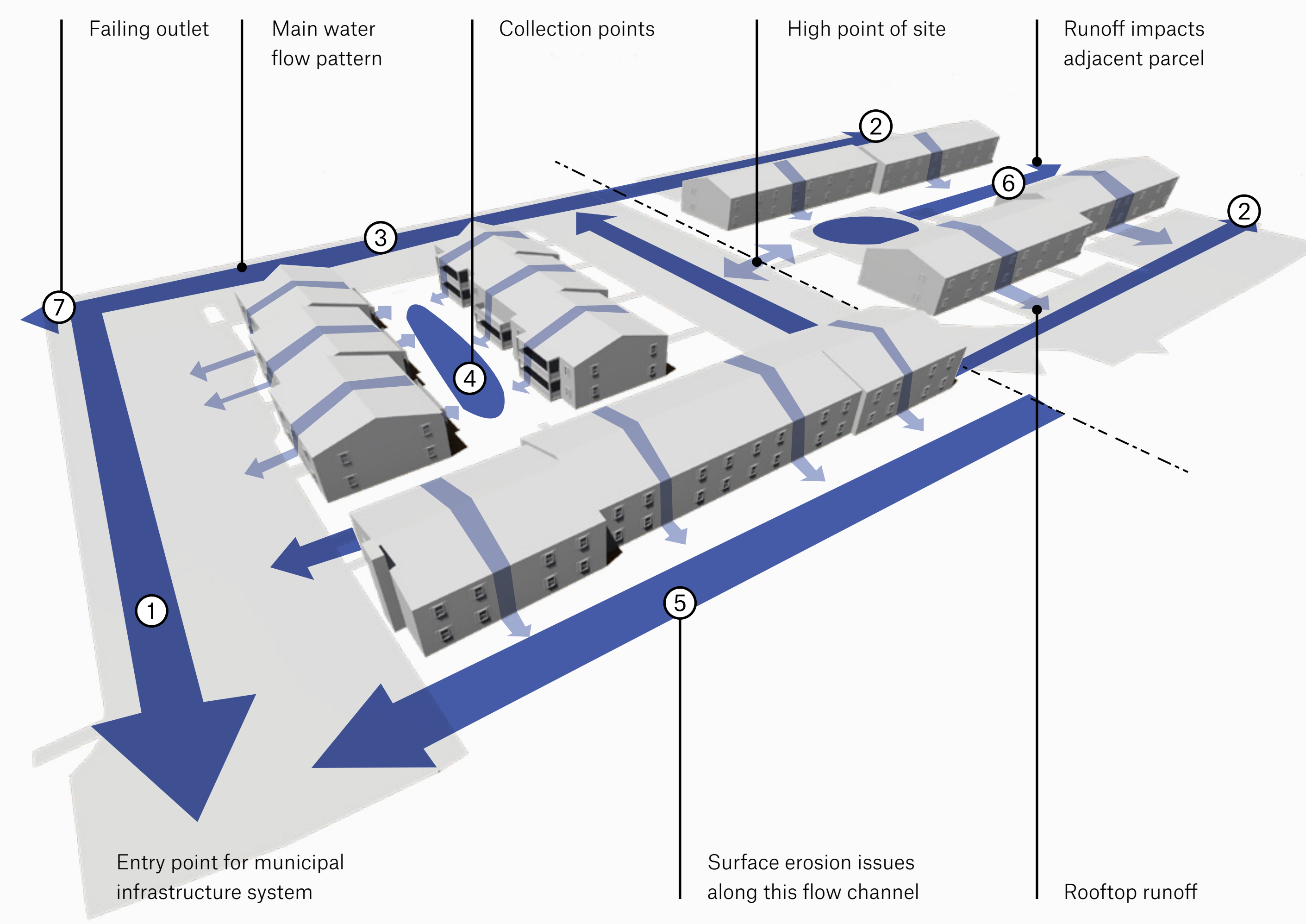
The main runoff channel is the parking lot and drive aisle, specifically nearest the main entryway 1, at the property edges 2 and the main drive 3.

Rooftop to Landscape Areas

Central landscape areas and the edges are encountering the totality of the rooftop runoff, but have nothing to protect them. These areas include central open spaces 4, the "southern" property edge 5 and foundation plantings.

Edge Runoff

Additionally, water runs off the "eastern" boundary to an adjacent parcel 6 and at a non-functioning collection inlet 7 which should runoff to an adjacent stormwater collection system to the west.



Site Analysis

Evaluation of Opportunities

In the case of the Northland property, there are three clear opportunities to retrofit the existing site so it can manage stormwater and provide opportunities to increase the value of the property from both an owner and resident standpoint. These opportunities include:

Parking Drive Aisles

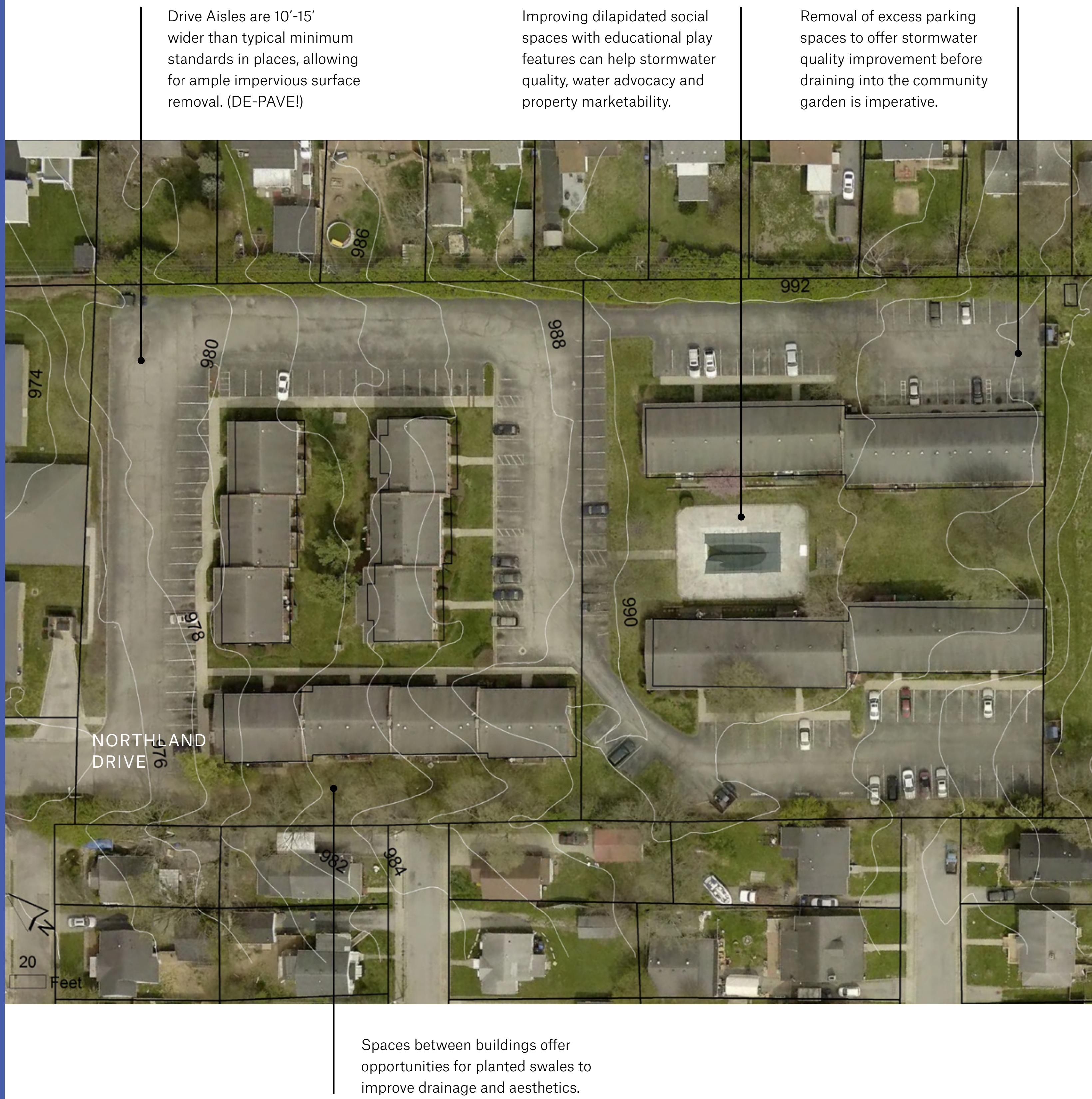
Typical dimensions of parking drive aisles are determined by traffic patterns and local agency requirements. Constructed in 1974, it is no surprise that many of the drive aisle dimensions at Northland are well in excess of what would be required today. Standard drive aisles vary, but typically a 20-24-foot drive aisle is required to allow for two-way traffic. Through cursory analysis, it was found that drive aisles, especially on the “west” and “north,” had excessive widths that could be reduced by as much as 10-15 feet across by nearly 200-400 feet allowing the site to replace thousands of square feet of impervious asphalt with native landscapes that are intended to handle stormwater runoff, improve water quality, improve the urban heat island effect and dramatically improve the site’s visual aesthetics.

The Site is Over-Parked

Typical of most developments, this site actually has more than the required amount of parking spaces. Standard multifamily developments typically seek out 1.5 parking spaces per unit, and in some cases less. Each parking space requires over 200 square feet of asphalt. This site has 10-15 more parking spaces than normally required, resulting in a very inefficient use of space, and a great opportunity to reduce impervious surfaces by thousands of square feet.

Inefficient Landscapes

Open space requirements associated with these types of developments typically result in unprogrammed, dysfunctional open lawns, which offer little value to residents and even less for stormwater. These spaces, such as around the pool, in between buildings and along building foundations, can be improved to not only look better, but to intentionally impact stormwater by slowing it down, allowing it to soak in and cleaning it. This opportunity allows for the use of native plant species that provide a new habitat and beautiful educational landscapes.



Strategy Identification

In the case of the Northland property, four main strategies were identified to decrease impervious surfaces, improve water quality, and make the property more attractive and valuable to the owner and the community.

Water + Play

Integrating social spaces like nature playgrounds and stormwater infrastructure such as bioretention can be a great way to blend education, functionality and valuable property amenities into one unique feature. Northland currently has no play spaces, which would make this a better place for young families.

DE-PAVE!

Northland has a plethora of asphalt allowing for multiple opportunities to narrow drive aisles and remove excess parking spots. These locations will be replaced with native landscapes that will further aid water quality, reduce runoff velocities, and decrease urban heat island effects.

Planted Swales and Native Landscapes

Planted swales can act both as vegetated filters and infiltration features because they slow runoff rates and allow for both particle settling and stormwater infiltration. Using native landscape strategies, former lawns can turn into sponges that require less invasive maintenance. Hardy plant materials also increase biodiversity and habitat.

[Park]ing

Because the site has more parking spaces than normally required, this strategy identifies parking stalls, which are in key locations to both improve the property's aesthetics, functionality and also achieve the greatest impact for stormwater quality/improvement.

WATER + PLAY

DE-PAVE!

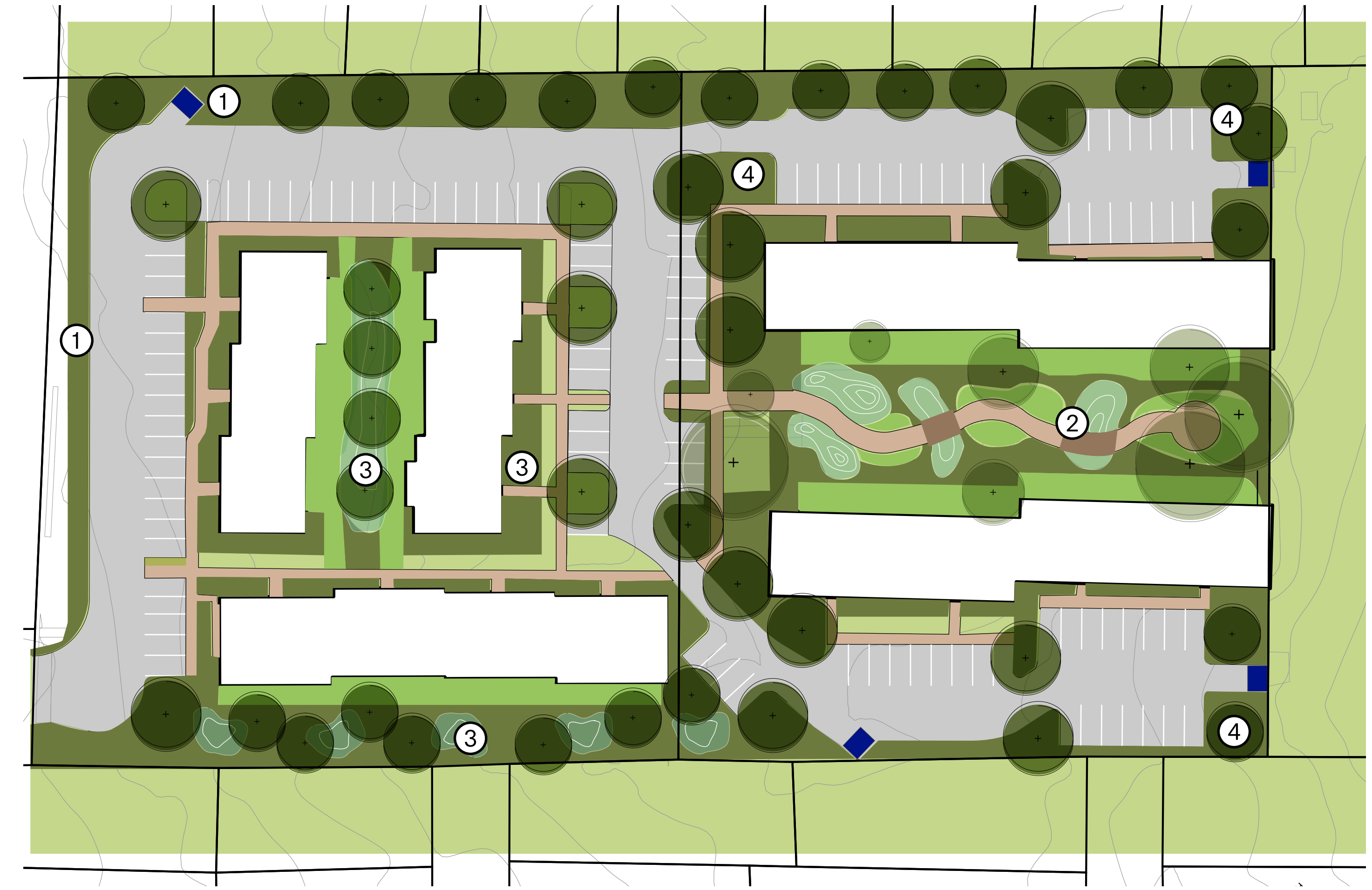
PLANTED SWALES

[PARK]ING

Conceptual Design

To address the issues and opportunities presented by the existing conditions, each strategy was then developed to explore how it would be utilized on the site. This step focused on a blend of landscape architecture and civil engineering to better understand the dimensional requirements and limitations of the site, and to better understand the overall feasibility, constructability and budget implications of each strategy.

One example of this is the De-pave Strategy. In order to understand how this strategy would be implemented, it was first necessary to understand how much pavement could be reduced, then explore what elements would be used in place of that pavement.



1 DE-PAVE!

Areas with excess asphalt will be "DE-PAVED" and replaced with native landscapes and planted swales. These features will require new curbs, soil amendments, a drainage strategy and native plantings.

2 WATER + PLAY

The bioretention play area integrates social amenity space with functional stormwater quality improvement infrastructure. Critical to this concept is the relationship of these features to the apartment units and an understanding of how each feature will function.

3 NATIVE SWALES

Areas already with ponding and erosion will be graded as swales and planted with native landscape materials. These features require evaluation of plant material, soil amendments and spatial limitations.

4 [PARK]ING

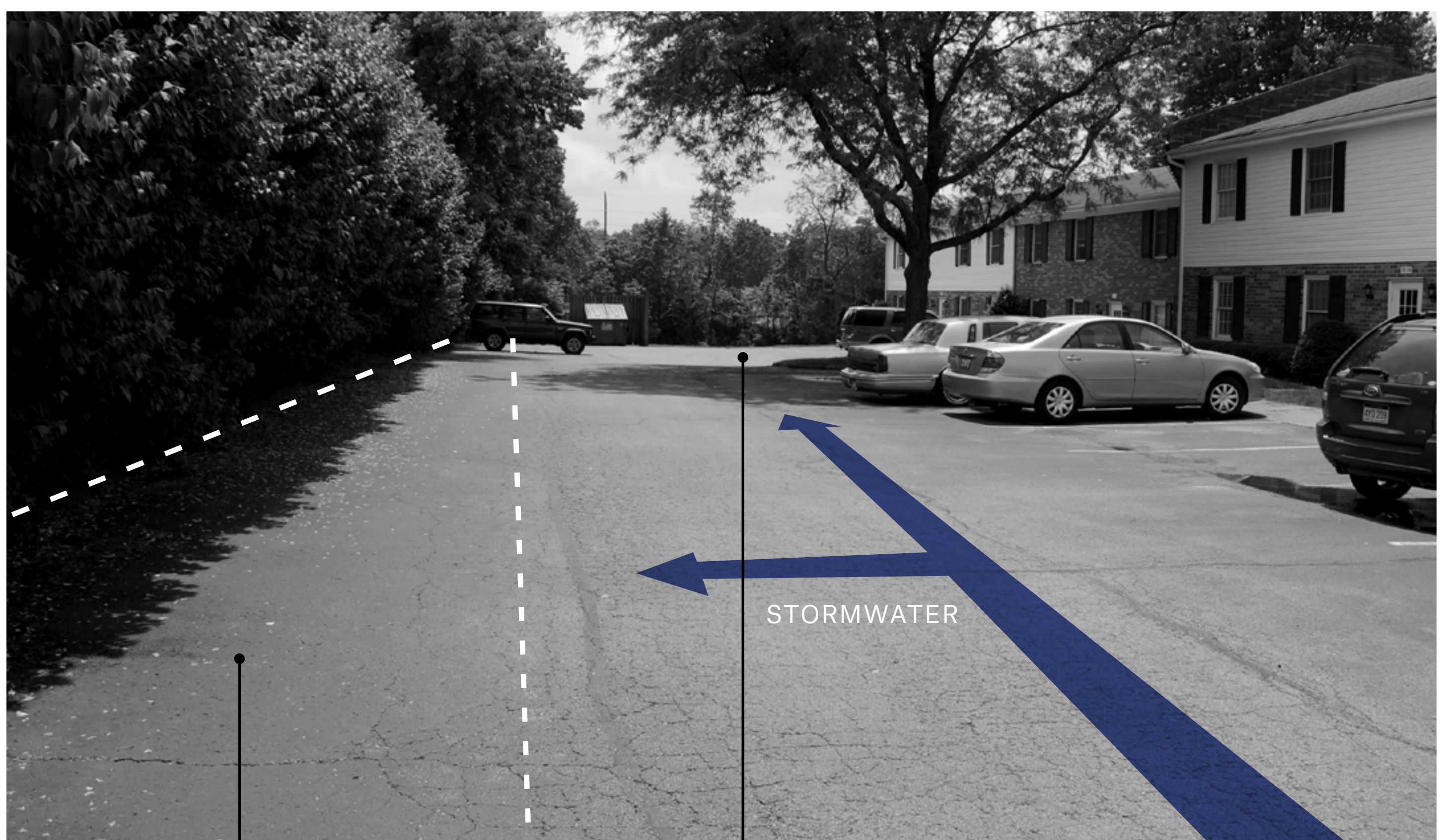
Identifying parking stalls that can be removed to give the property the most benefit is key. Asphalt removal paired with bioretention will help improve water that runs onto the urban garden adjacent to the property.

De-pave + [Park]ing

The De-paved landscape areas and bioswales will slow water down, allow water to percolate naturally and catch pollutants and sediment from the runoff helping improve water quality. These areas will also increase biodiversity and reduce urban heat island effects.

De-paving will lessen the site's municipal stormwater fee, replace asphalt with beautiful landscape treatments, making the property more attractive to prospective renters, and reduce ambient temperatures, which can positively impact utility rates for residents.

These features will provide community benefits, including a more visually pleasing landscape for residents and neighbors, while improving the site's biodiversity, providing critical native habitat, and reducing the amount of water that runs onto adjacent properties.



Excess pavement along the drive aisles can be removed and replanted with native landscape material.

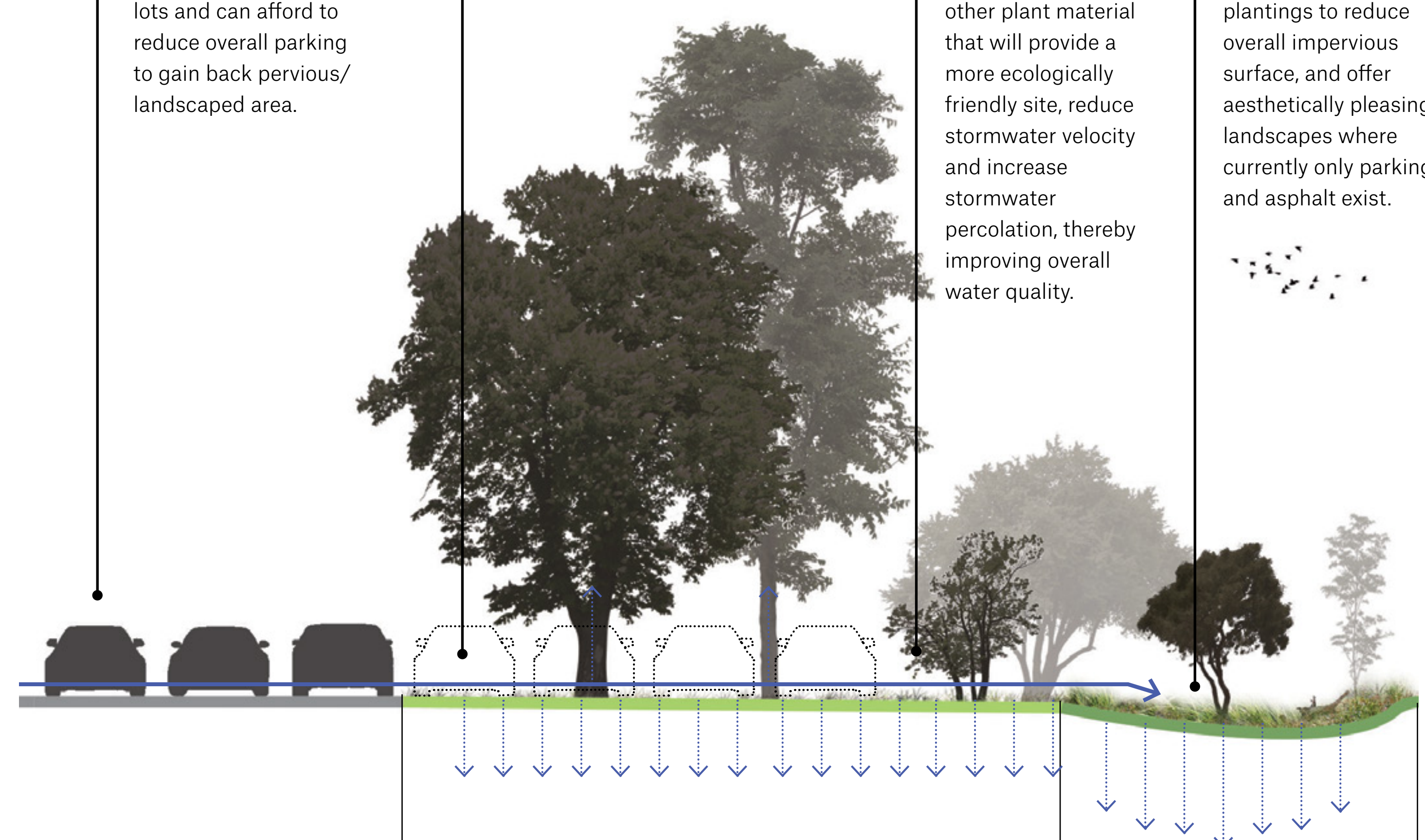
Excess parking spots can be removed and regraded as bioswales to clean and soak up runoff from the parking lot.

Like many suburban-style multifamily apartment complexes, the Northland Apartments have underutilized parking lots and can afford to reduce overall parking to gain back pervious/ landscaped area.

Existing parking would be removed for additional pervious landscape treatment.

These landscaped areas will increase overall site porosity and provide room for native plantings including trees and other plant material that will provide a more ecologically friendly site, reduce stormwater velocity and increase stormwater percolation, thereby improving overall water quality.

At the low points of the parking lots, bioretention facilities will be put in place. These facilities will include native plantings to reduce overall impervious surface, and offer aesthetically pleasing landscapes where currently only parking and asphalt exist.



Parking Lot

Former Parking Spaces Identified for Asphalt Removal and New Landscape Treatment

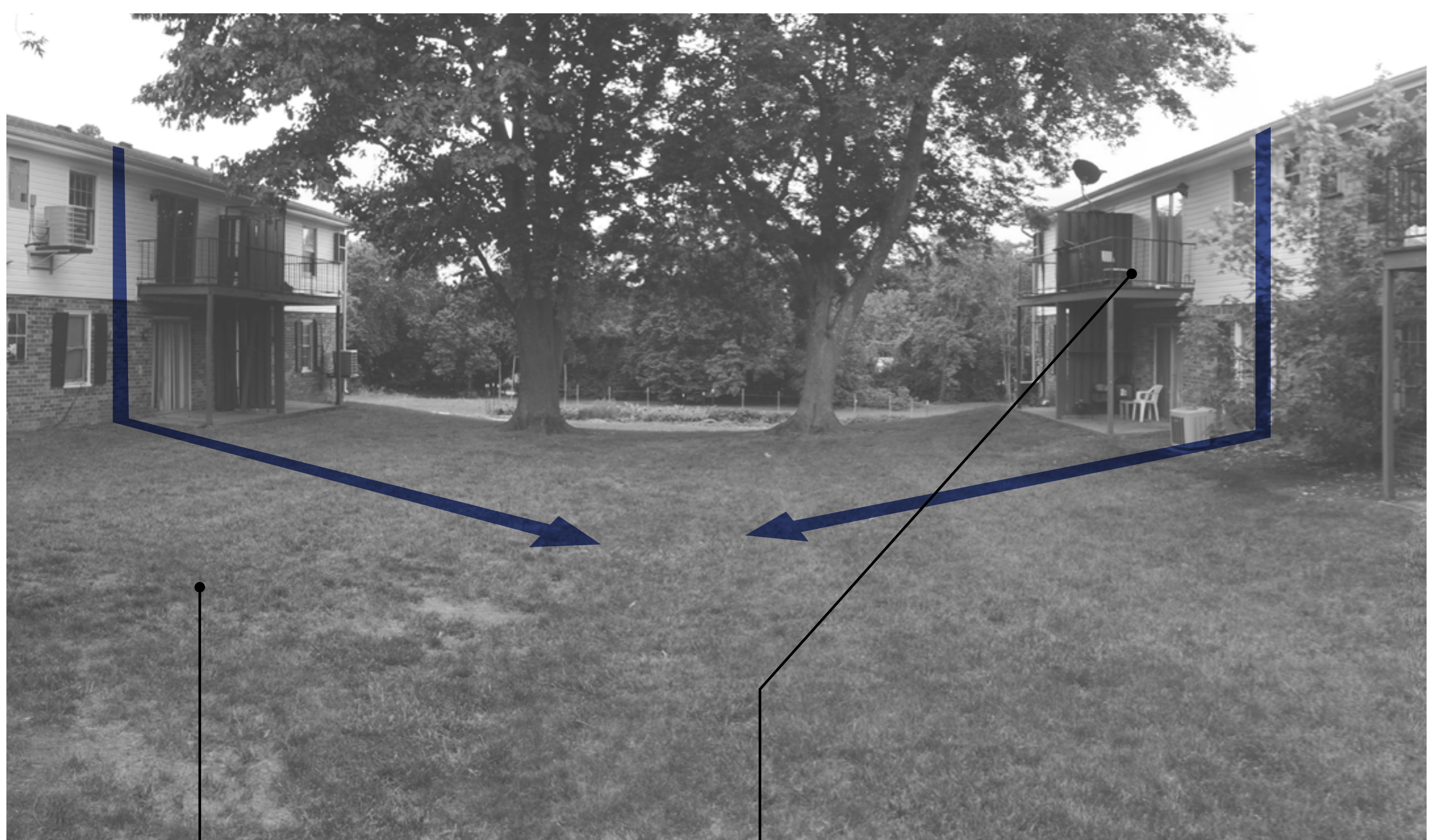
Parking Spaces Removed for New Bioretention Facility

Water + Play

Previously unprogrammed space will be retrofit as purposeful social space that integrates a bioswale as a central feature. This will capture and clean runoff, and provide for new native landscapes and stormwater educational opportunities.

These new landscapes can positively impact utility fees, and the addition of the social space will make this property more attractive to prospective and current residents, helping increase occupancy and making the units more desirable.

Integrating quality social spaces within a development that is geared toward lower market-rate renters helps create more equitable housing conditions while solving stormwater quality issues.



Lack of intentional programming and spatial definition results in this open lawn being underutilized.

Stormwater from rooftops will be directed to a bioswale in the center of this open space.

Nature play spaces near rain gardens will offer places for kids to play that don't currently exist. Their proximity to the BMPs will allow children to look, see and touch those features, as well as interact with the other educational components of the space.

Features like a small bridge over the bioretention basin allow residents to get up close and personal with this stormwater feature.

Featuring native landscape material, the bioretention feature will aid in collecting and cleaning stormwater on-site, while blending seamlessly into the surroundings.

Native landscape materials will help define "public versus private" spaces as well as reduce lawn sizes, lessen mowing, improve soil quality and absorb more stormwater.

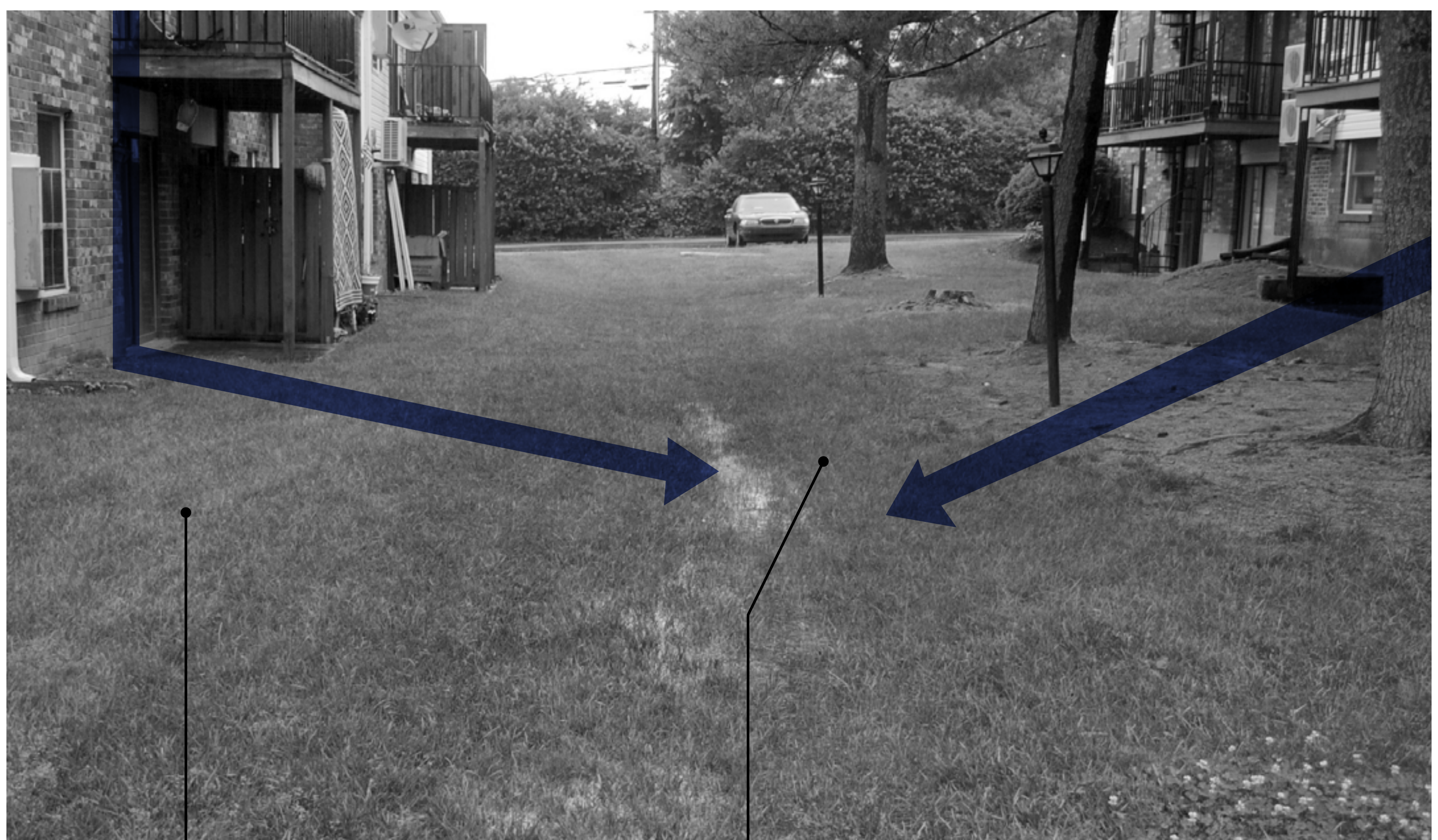
Features such as seating will be integrated throughout the space, providing residents with a place to gather that just happens to be adjacent to beautiful stormwater infrastructure.

Native Swales

Areas that already pond in rain events illustrate low points that would make ideal stormwater infrastructure. These swales will help improve soil and clean water through biological processes.

Adding more definition to the landscape will offer units more privacy while improving site aesthetics, and the plant materials will help cool ambient temperatures with shade allowing for utility fee benefits. Once established, these landscapes can also lessen long-term maintenance costs.

Improving the site's biodiversity benefits larger ecological systems as well as the watershed. These spaces will better define public versus private space allowing residents more usefulness and comfort in their respective homes.



All units are open to the lawn space with very little privacy or delineation of "public" and "private space."

As the site exists, during rain events water ponds in low spots and makes the lawn too wet for resident recreational use.

Trees should be incorporated within the swale to help increase stormwater take-up, provide shade, and benefit microclimates.

The swale will be planted with native perennial plant materials. Native plants are more well adapted to the climate zone, hardier, and lower maintenance long term. In addition, these native landscapes provide both biodiversity and aesthetic benefits for residents.

Resident spaces are better delineated with the use of the swale and planting as buffers.

The swale will feature river stone as an aesthetic element that also slows water down and helps provide a limited amount of short-term storage capacity in void spaces.

(900 BLOCK)

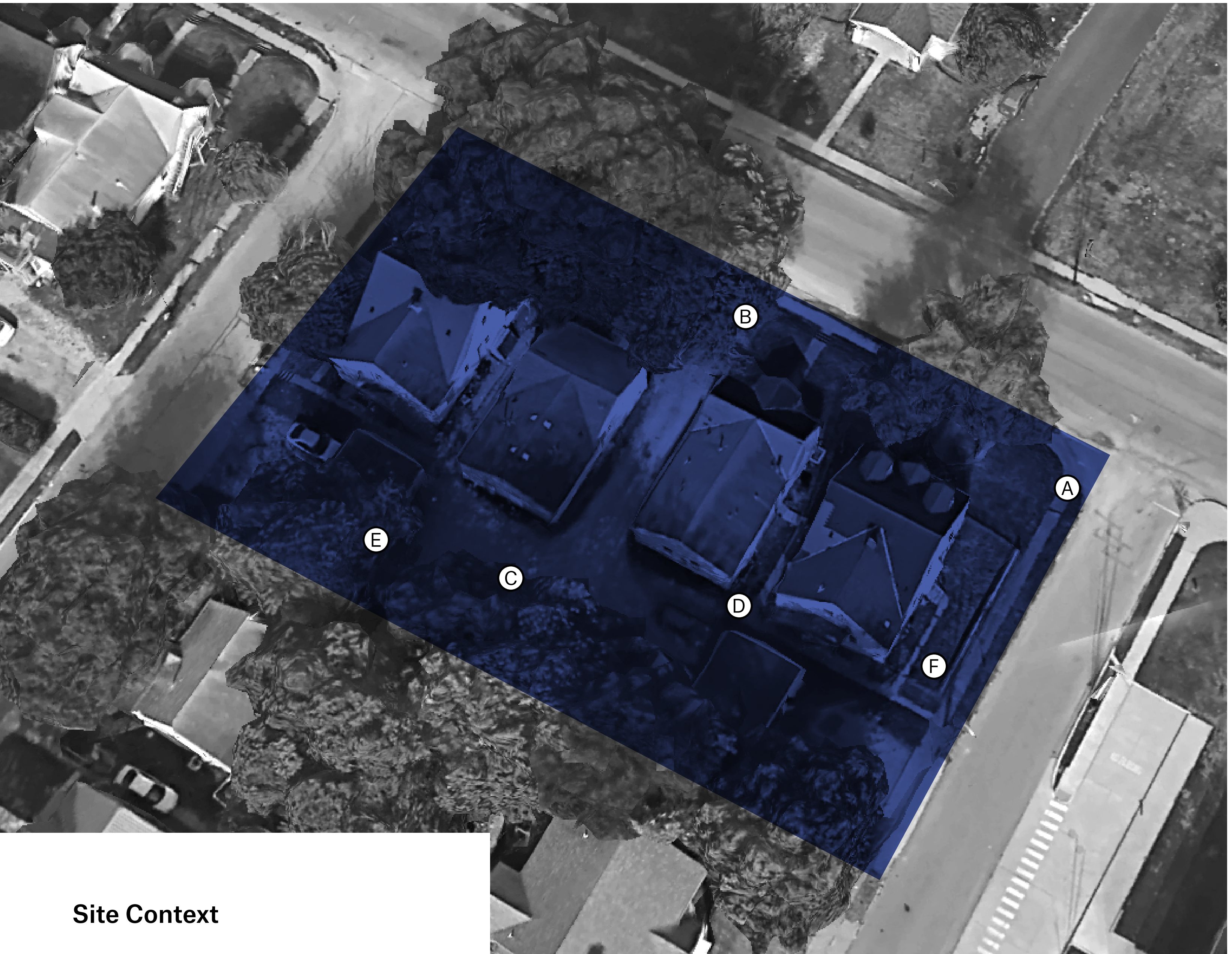
Medium

SITE CONTEXT

The 900-block property is made up of four distinct structures (two duplexes and two triplexes) originally constructed between 1949 and 1961. The owner is renovating the properties as one distinct property featuring 10 units, shared parking, and shared open spaces.

SITE STATISTICS

Units — 10
Site Area — 0.5 Acres
Total Impervious — 0.35 Acres / 69.9%
35.12% — Parking
04.51% — Sidewalks & Pads
30.26% — Buildings
30.11% — Open Space



Site Context

The 900 block represents four properties that are being re-imagined as one multifamily complex. The block sits across the street from an elementary school that is + 90-percent walk-up, and this property contributes to flooding issues along the main corridor, making the sidewalks impassible during rain events.

Ⓐ ELEVATED FRONTYARD

The front yard across the entire block has a 2- to 3-foot elevation difference from the sidewalk as well as large canopy trees.

Ⓑ CENTRAL CORRIDOR

Due to the original development of the block, each property required driveway access. This central drive is completely dilapidated and a main source of stormwater runoff that floods the street.

Ⓒ REAR PARKING

The entire rear yard of each property consists of dilapidated parking lots that offer little benefit to the residents beyond parking.

Ⓓ NARROW SPACES

Narrow spaces between the structures currently have sidewalks and totally eroded landscape areas where downspouts have made plantings difficult to maintain.

Ⓔ PARKING STRUCTURES

Remaining parking structures exist for the two triplex buildings. In a singular redevelopment, these structures would be removed and the property circulation altered to reduce total imperviousness.

Ⓕ SIDE YARDS

Opportunities for new landscape strategies and reprogramming exterior space exist in the rear and side yards.

Stormwater Analysis

The 900 block is a key contributor to well-documented flooding issues that directly impact the public right-of-way. Stormwater from adjacent streets and the 900 block's impervious surfaces greatly impact the flood conditions along the frontage road. Key areas of concern have been identified along the sidewalk, in addition to overall water quality.

KEY CONTRIBUTORS

Rear Parking

The parking lots make up more than 7,600 square feet of this small half acre site and is the main source of stormwater runoff, which impacts the public right-of-way.

Rooftops

The rooftops from the four structures pitch in a variety of directions, with downspouts that drain to the parking areas or yards. This roof top runoff is exacerbated by poor soil and landscape conditions.

Compacted Soil

The soil conditions throughout the site are compacted and eroded, making it difficult for any meaningful landscape material to establish and help absorb water. Beyond the handful of trees on the site, the landscape does very little to impact stormwater volume, velocity or quality.

KEY FLOW PATTERNS

Rear Parking Through the Site

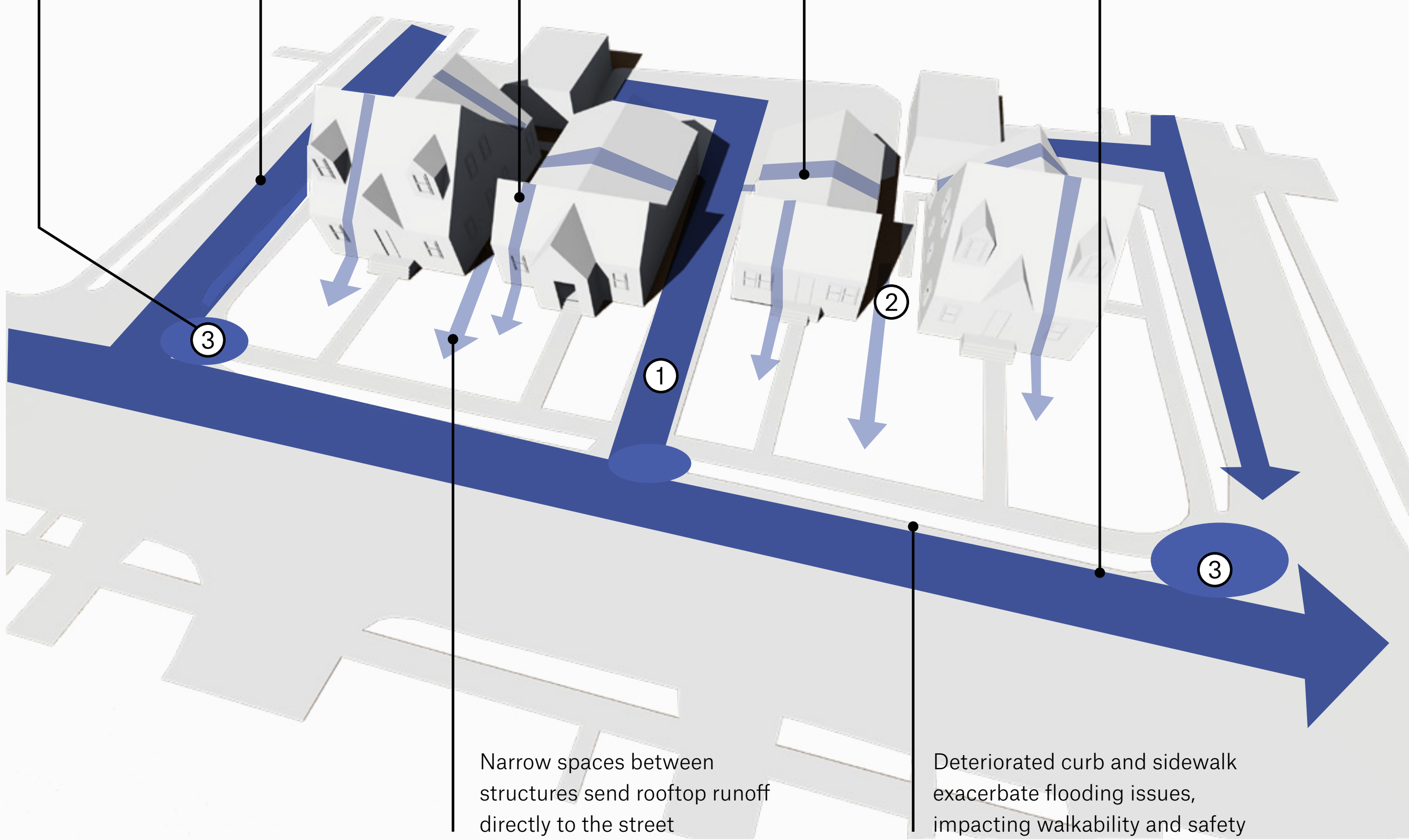
The main on-site runoff occurs from the parking lot through the central corridor 1 as evidenced by its erosion and deterioration.

Rooftop to Landscape Areas

The landscape areas have been eroded by rooftop runoff, which comes from a series of downspouts from each of the four structures 2.

Ponding Along Sidewalk

Each of these elements, along with off-site stormwater, adds to flooding issues along the main frontage road, which can make the sidewalks nearly impassible and unsafe for children and families who walk to school 3.



Site Analysis

Evaluation of Opportunities

In the case of the 900 block property, there are three clear opportunities to retrofit the existing site so it can manage stormwater and provide opportunities to increase the value of the property from both an owner and resident standpoint. These opportunities include:

Remove Central Driveway

The central drive aisle was necessary to provide parking to the central duplexes because there is no off-street parking. However, this alignment creates a conflict point with the sidewalk and is a key contributor to runoff. Removal of this central area and replacement with thoughtful, open space for residents that simultaneously handles stormwater would be a key feature in improving water quality and this property.

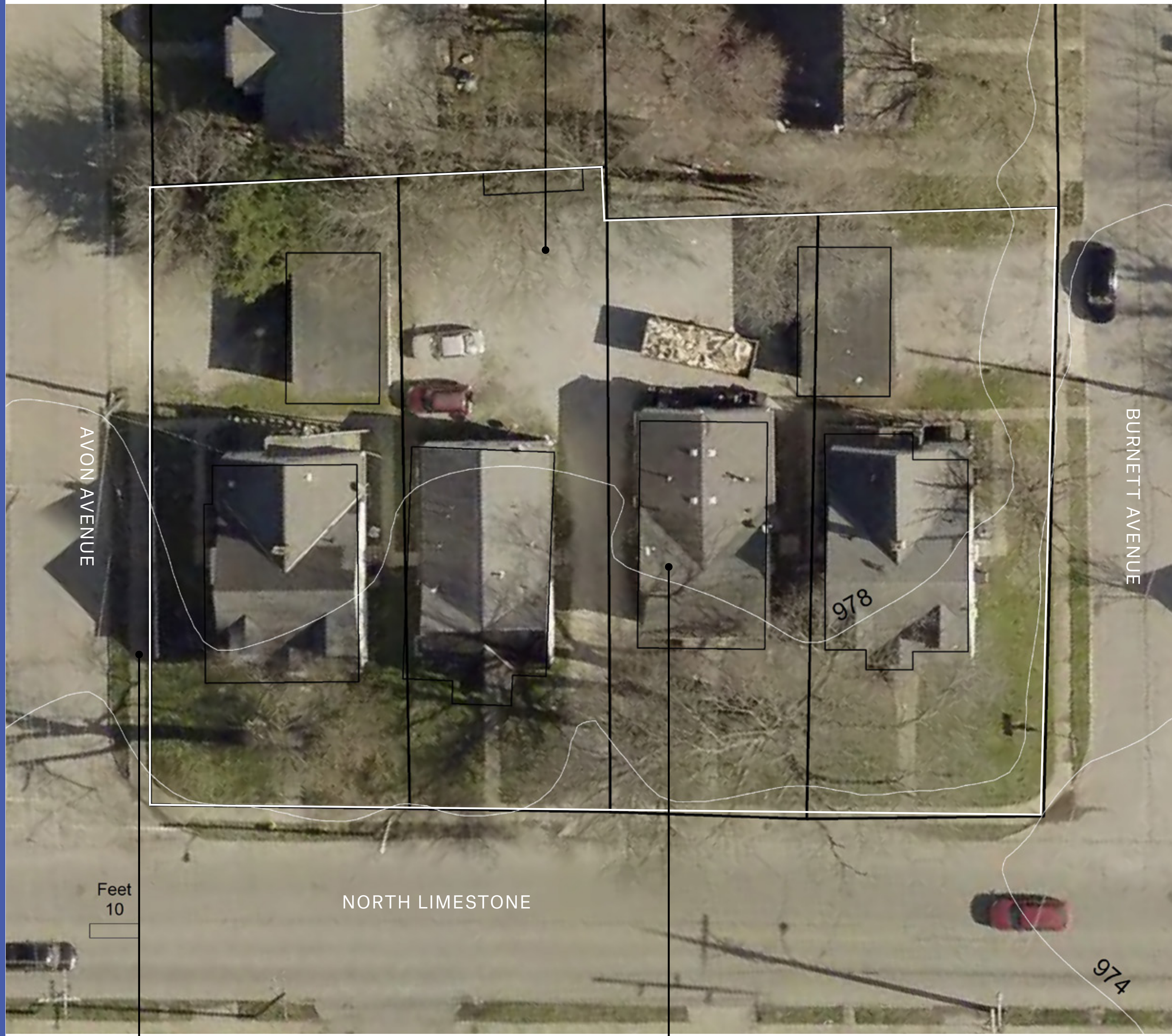
Rethink Parking

Due to the way the 900 block was parceled in the 1950s, the parking strategy became highly fragmented. For this reason, a singular, shared parking strategy is imagined; an approach that treats the property as one complex and allows significant space to be opened up to new landscape treatment. This strategy also involves transforming the parking area into a pervious lot.

Inefficient Landscapes

As is the case with most homes in America, these properties have front lawns and side yards made up of turf grass and a few trees. This landscape does very little for stormwater or for residents. New strategies that focus on native landscape, thoughtful grading to control the flow of water, and soil amendments that allow more natural percolation will be key elements of the design. These features will make the 900 block a more beautiful place to live while improving stormwater quality, decreasing stormwater runoff velocities, increasing site biodiversity and helping reduce overall flooding issues.

Impervious parking areas and drive aisles; Surface drain to North Limestone causing flooding



Runoff creates flooding/ponding issues along public sidewalk

Rooftop runoff contributes to flooding and runoff issues on limestone

Strategy Identification

In the case of the 900 block property, four main strategies rose to the top. These strategies would decrease impervious surfaces, improve water quality, and make the property more attractive and useful to current and prospective residents.

Planted Swales

Planted swales can act as vegetated filters and provide infiltration opportunities because they slow runoff rates and allow for both sediment settling and stormwater infiltration.

Rain Gardens

Rain gardens along North Limestone will serve as highly visible landscape features that capture runoff from the buildings and surrounding walkways as well as yard areas. The gardens will support educational opportunities while providing a plethora of ecological benefits to the site.

Immersive Infrastructure

Making sure that educational features are both immersive and interactive is critical when it comes to understanding the importance of water quality and regional watersheds. At the 900 block, seating features could be designed to capture rooftop runoff while providing a beautiful amenity that offers educational elements through simple, strategic signage and interactive components.

[Park]ing

Where feasible, pervious parking could be utilized for further treatment of stormwater runoff. The site has a significant amount of paved area in the rear, which runs off to the main frontage road (North Limestone). This area will play a large part in reducing the overall impact this site has on flooding, water quality, and the velocity of stormwater runoff.

PLANTED SWALES

RAIN GARDENS

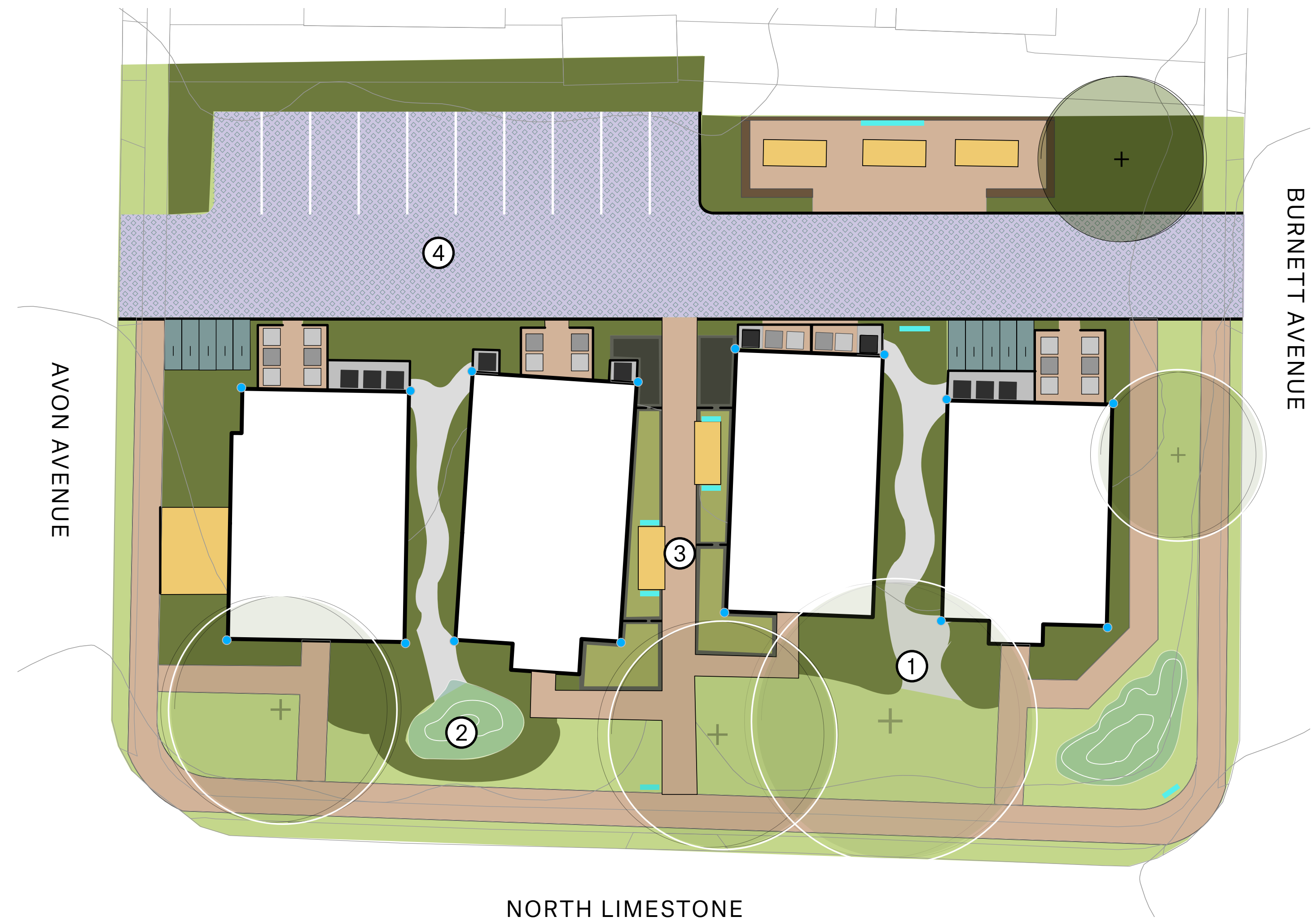
IMMERSIVE INFRASTRUCTURE

[PARK]ING

Conceptual Design

To address the issues and opportunities presented by the existing conditions of the site, each strategy was developed to explore how it would be utilized on-site. This step focused on the blend of landscape architecture and civil engineering to better understand the dimensional requirements and limitations of the site, and to better understand the overall feasibility, constructability and budget implications of each strategy.

One example of this is the [Park]ing strategy. In order to understand how this strategy would be implemented, it was first necessary to understand how much parking was needed on this site, the dimensional requirements, and feasible circulation paths. Once this was developed, it became clear that a strategy that unified four separate properties into one would allow for the consolidation of parking. It would also permit the expansion of open space and opportunities for new landscape strategies that would offer residents more amenity space, a more ecologically friendly habitat, and more beautiful landscapes for residents and passersby.



1 SWALES

In narrower areas between buildings, native plantings and river rock make up swales that will not only look great but also improve water quality while reducing runoff velocities, These swales will turn small, excess spaces into efficient stormwater features that will slow and clean stormwater.

2 ALT LAWNS

As an alternative to traditional turf lawns, rain gardens will be installed to handle small rain events. While providing aesthetic benefits, these gardens will also improve water quality microclimates, biodiversity and the ecological habitat.

3 WATER PATH

In order to fully capitalize on the on-site educational opportunities. immersive infrastructure will be used to integrate social spaces and infrastructure so that residents can see, hear and touch the features while learning about their benefits.

4 [PARK]ING

The consolidated parking strategy will utilize pervious parking to improve water quality and reduce urban heat island effects, while improving parking-lot functionality and accessibility. This strategy will also free up prime, open spacesfor resident amenities.

Alternative Lawns

The rain gardens will slow water down, allow water to percolate naturally, and catch pollutants and sediment from the runoff helping improve water quality. These areas will also increase biodiversity and reduce urban heat island effects.

Once established, rain gardens will require less invasive maintenance. Additionally, the native plants will require less water and less chemical treatment, helping save in long-term maintenance costs. Potential value will be added through improved curb appeal.

These features will provide a more visually pleasing landscape for residents while improving the site's biodiversity and helping to mitigate flooding issues on the public sidewalk.

Stormwater runs directly off the steep lawns into the adjacent sidewalks, eroding the yard and flooding the right-of-way.

Stormwater runoff is channeled through multiple downspouts to the compacted lawns and adjacent sidewalks.

In an effort to effectively mitigate stormwater, runoff, the grounds are envisioned to transition from traditional turf lawns to a mixture of rain gardens and low-to no-mow turf solutions to reduce chemical applications, improve soil structure through biological processes, and reduce the impacts of maintenance equipment.

The site has ideal locations for rain gardens that will function well and be highly visible to the public from the street. These gardens will be integrated within the educational strategy of the site.

Downspouts on each structure will be directed to planted swales and rain gardens.

Simple and effective educational signage will be placed along the sidewalk along North Limestone. This location is highly visible and easily accessible to the public.

Water Path

The water path will reduce overall imperviousness and handle stormwater from the rooftops of the two central buildings. These features will slow water down, allow it to soak in, and offer unique water-quality educational features.

The water path will add much-needed outdoor amenity space that will provide seating and beautiful landscapes for residents of the central duplexes to enjoy. This area will also help reduce impervious surface fees.

These features will provide social benefits through the added open and functional space that will encourage social interaction. Additionally, this will be a visible and educational feature that will explain the impacts of stormwater runoff and the benefits of BMPs.

Stormwater runoff from downspouts adds to overflow along the central drive, playing a key role in flooding issues along the main frontage road.

Runoff from the parking lot picks up, sediment and pollutants as well as speed as it runs down the central drive of the 900 block and heads toward the frontage road.

Raised planter beds featuring river rocks and native plantings will capture rooftop runoff at seat height, allowing residents to see, hear and touch the features.

Heavily planted beds will include educational information about the benefits of native landscapes in regard to water quality and the local region.

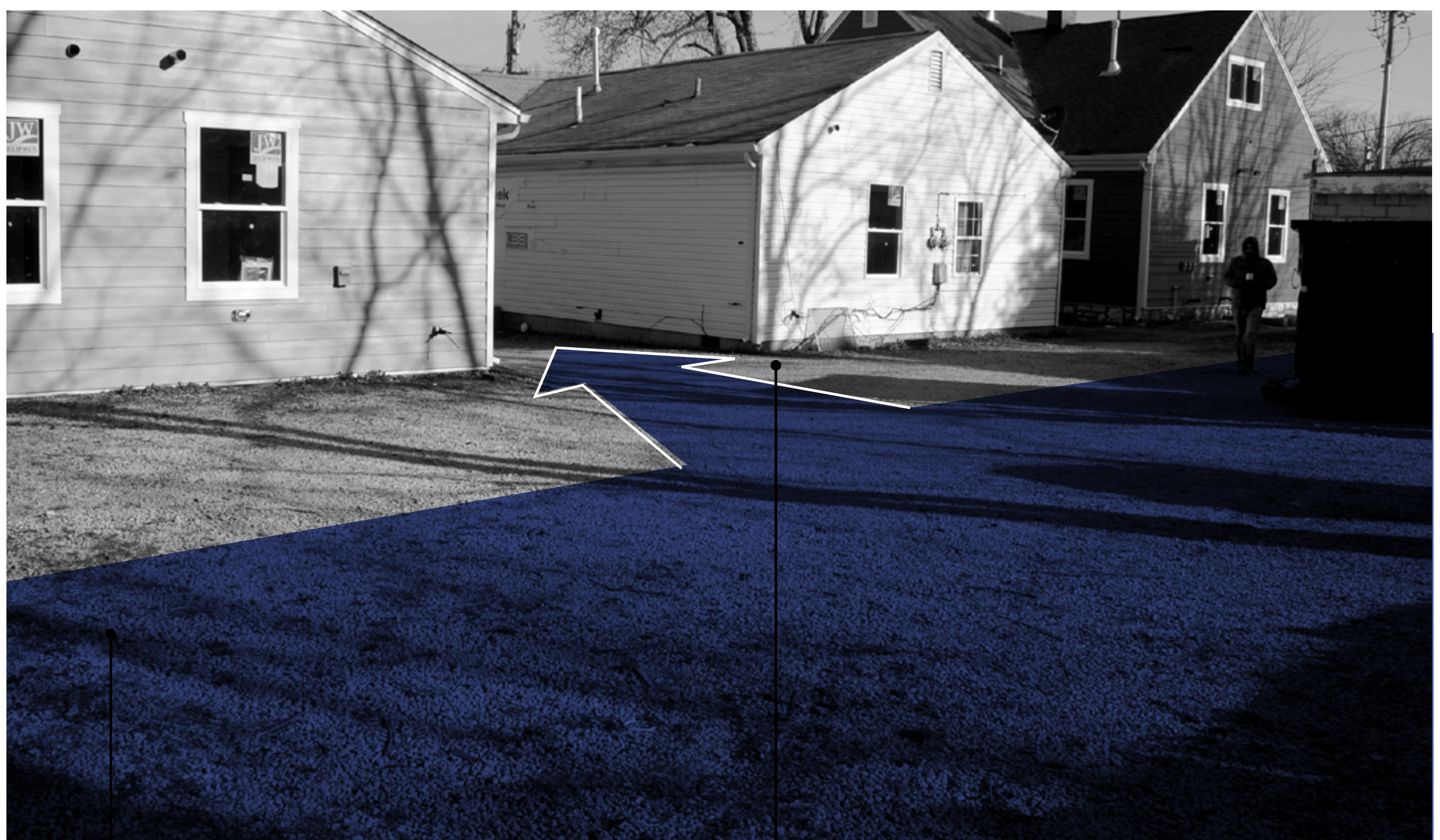
Benches built into the planters will allow residents to lounge “within” the BMP. This is also an excellent opportunity for passive learning.

[Park]ing + Swales

As the parking lot accounts for a significant amount of the site's total impervious surface, retrofitting this area as a large BMP will yield immense quality and quantity benefits.

The reorganization of the back lot will significantly benefit curb appeal while freeing up important open spaces for added amenities such as gathering areas, dog runs and community gardens, and reducing the overall impervious surface-fee impacts.

The improvements in the back lot will also go a long way toward managing the flooding issues along the main frontage road, which will help improve walkability in a community where access to sidewalks is a vital safety issue.



The parking lot makes up 35 percent of the site's total impervious surface. During rain events, the lot drains toward the main frontage road, carrying sediment and pollutants from vehicles and other debris.

The existing organization of the parking lot meant that every available surface needed to be impervious so that drivers could maneuver their vehicles in the space, making for a harsh environment both aesthetically and environmentally.

PERVIOUS PARKING
Replacing the impervious parking lot with pervious pavers will dramatically reduce stormwater runoff while providing multiple water-quality and aesthetic benefits.

NATIVE LANDSCAPES
Native landscape materials will help improve soil quality and absorb more water than traditional turf lawns. Additionally, native landscapes require less long-term maintenance, and can reduce chemical usage and the need for lawn-care equipment.

WATER PATH
Raised planters will be used to collect stormwater and will also serve as an interactive educational feature.

PLANTED SWALES
Landscaped swales will help collect roof runoff and provide even more space for native landscape materials.

(525 LIMESTONE)

Small

SITE CONTEXT

Built in 1962, the 525 building is a four-unit structure featuring two upstairs units that front a main corridor, and two downstairs units that are on the parking level. Although this is a small, mostly impervious site, it is situated in a high-visibility residential location that experiences a large amount of foot traffic.

SITE STATISTICS

Units — 4
Site Area — 0.12 Acres
Total Impervious — 0.10 Acres / 83.5%
47.29% — Gravel Parking
06.12% — Sidewalks & Pads
30.11% — Buildings
16.48% — Open Space

Site Context

The 525 building is difficult to see because of dense tree coverage. In this aerial view, however, the site context becomes clear, revealing a neighborhood mostly made up of histoaric buildings built at the turn of the 20th century. The lots in this area are small, and were built with alley access in the rear.

RECENT RENOVATIONS

The building was recently placed under new ownership and was renovated to bring the unit standard up and improve landscape features.

FRONT YARD

A front-yard landscape featuring native plants was installed on a steep hillside; a good early investment by the owner and a savvy tenant.

LOWER LEVEL

The lower-level units have issues with standing water on the concrete pad, which creates slippery conditions.

REAR PARKING

Nearly 50 percent of the site is occupied by this gravel parking lot. Gravel is considered an impervious surface, especially in this instance, due to the compaction caused by vehicular traffic, which would reduce/eliminate any potential natural percolation.

EXISTING STORM SEWER

All of the existing runoff from the rooftop and parking lot goes directly to the storm system in the rear alley without any water quality, velocity or other BMP controls.

Stormwater Analysis

The first step in stormwater analysis is understanding what impervious surfaces make up the site, followed by identifying rainwater flows during a storm event.

KEY CONTRIBUTORS

Parking Lot

The parking lot and drive aisle make up nearly 50 percent of the total impervious surface on this parcel. These surfaces drain toward an existing storm sewer in the rear alley.

Rooftop

The rooftop makes up just over 30 percent of the site's total impervious surface. The existing gabled roof runs off into a gutter and pipe system that drains directly into the storm sewer, never offering any opportunity to reduce velocity, percolate naturally or improve water quality.

KEY FLOW PATTERNS

Rooftop to Pipe System

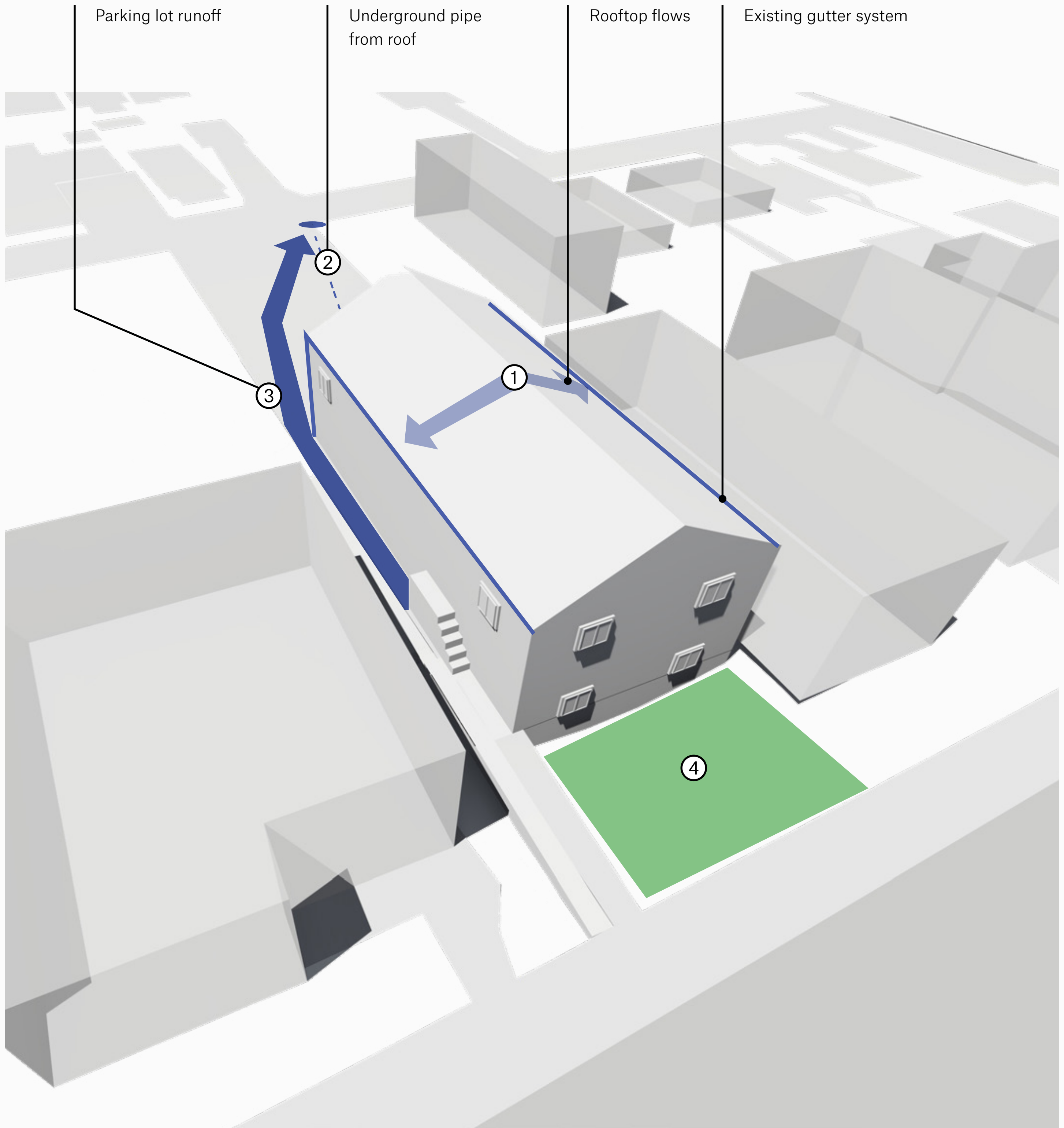
The main runoff from this site comes from the roof directly into the storm system 1. The pipes from the roof connect to a pipe that runs under the parking lot 2, which empties directly into the storm sewer.

Parking Lot to Alley

The Parking Lot 3 surface flows to the back alley, which then directs stormwater either further down the alley or into the storm system.

Front Yard

The front yard, which is on a steep hill that slopes toward the building, was recently replanted with native landscape materials 4, and allows water to soak in natural. When there is too much water, it is directed to an overflow pipe that is connected to the storm system.



Site Analysis

Evaluation of Opportunities

In the case of the 525 building, there are three clear opportunities to retrofit the existing site so it can manage stormwater and provide opportunities to increase the value of the property from both an owner and resident standpoint. These opportunities include:

Downspout Disconnect

Like many similar buildings, the 525 building's gutter system is directly connected to the storm system. By rethinking the rear parking lot, a two-stage bioretention system and downspout disconnect could provide site benefits as well as water quality and velocity improvement opportunities.

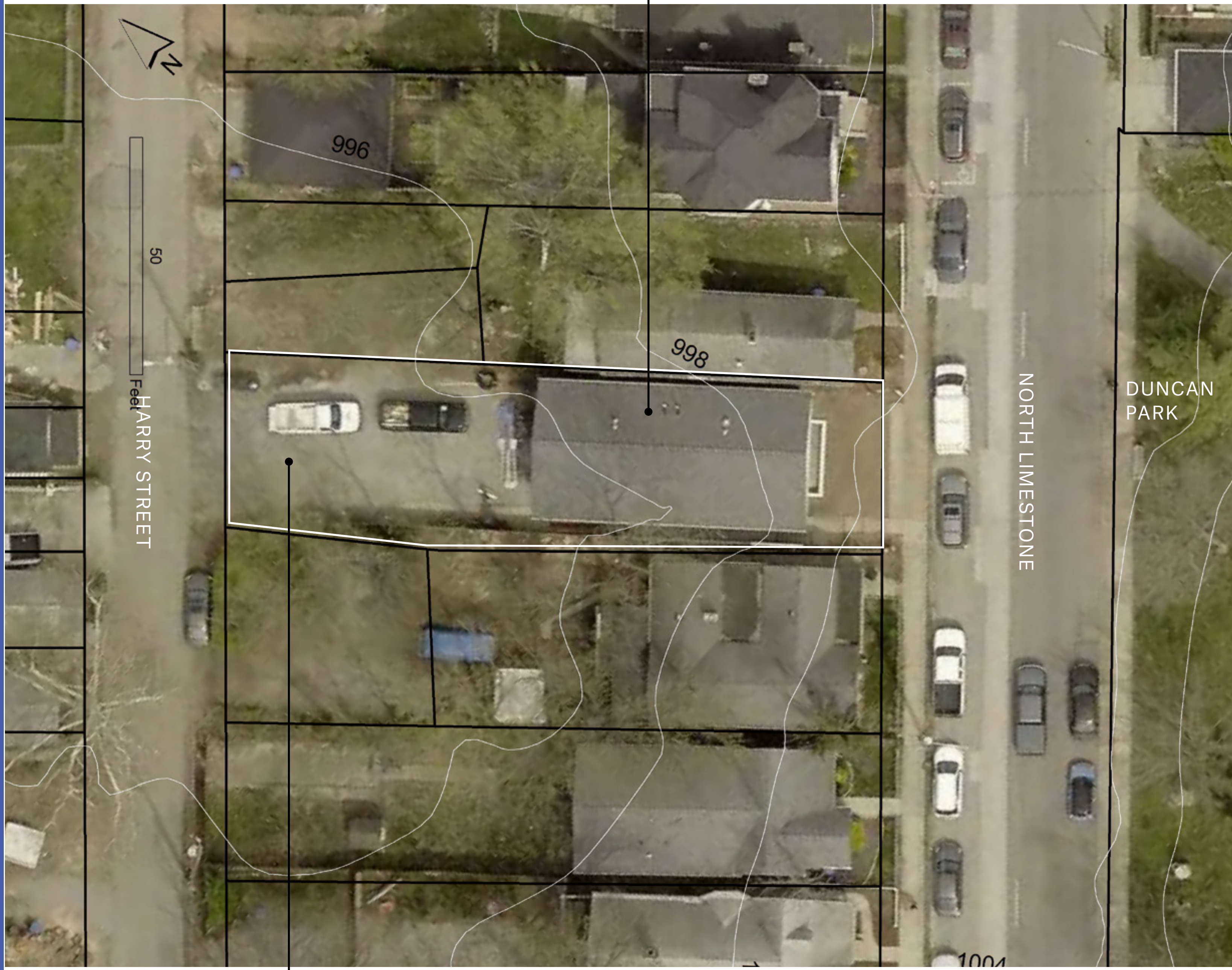
Pervious Parking

Given that most of the site is a parking lot, using a pervious parking system will allow water to percolate naturally, and in larger rain events overflow into the storm system. This will improve site aesthetics, accessibility issues related to gravel parking, functionality of the parking lot and overall water quality while reducing runoff velocities.

Underground Detention

Given the small site, using every square foot as efficiently as possible is critical. Ultimately, the amount of anticipated stormwater will determine the size of the detention features. An underground detention system will help increase the amount of water treated and stored on-site, which will potentially allow for a dramatic reduction in the amount of water that leaves the site untreated.

Rooftop drainage is currently piped directly into the storm system



The impervious gravel parking lot in the back yard surface drains to the alley and storm system

Strategy Identification

In the case of the 525 building, four main strategies rose to the top. These strategies would decrease impervious surfaces, improve water quality, and make the property more attractive and useful to current and prospective residents.

Water Education

The property is situated along the North Limestone corridor, a very popular retail and entertainment corridor approximately half a mile from Lexington's downtown core. The front yard adjacent to the sidewalk is a prime location for stormwater educational materials, which should be interactive and easy to follow.

Bioretention Garden

The rear parking lot is currently inefficient and could allow for a retrofit that offers enough space for a bioretention feature; one that could handle small rain events from the rooftop, while also providing a beautiful landscape that simultaneously buffers the lower-level apartment from the parking lot.

Underground Detention

In restrictive sites such as this, where space is often at a premium, underground detention could help amplify the amount of water stored and treated.

[Park]ing

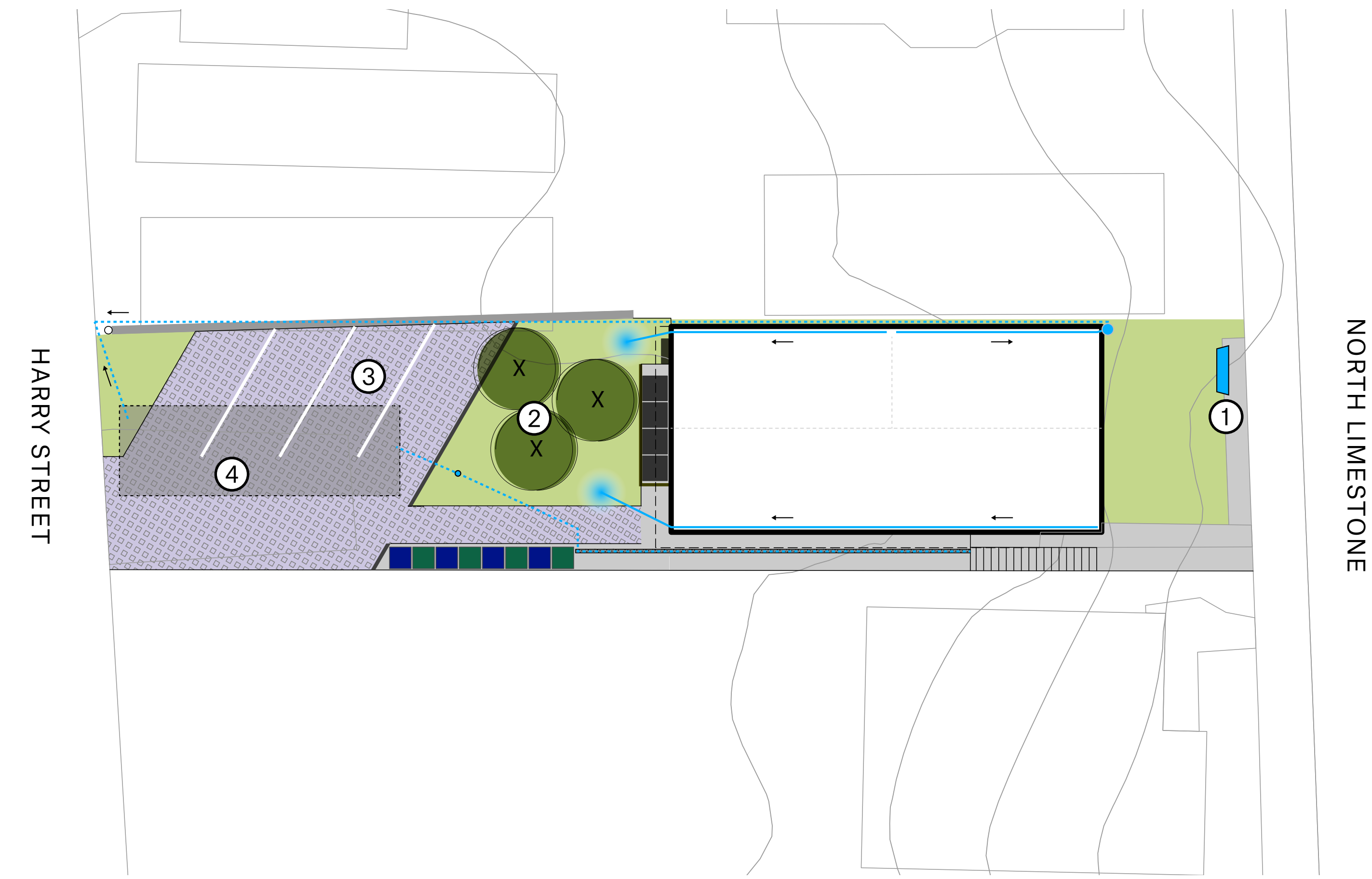
Pervious parking could be utilized in the rear parking lot to offer new opportunities for stormwater infiltration, potential water-quality benefits from the stone and sand layers acting as filters, ambient temperature benefits, and overall aesthetic and functionality benefits.

WATER EDUCATION

BIORETENTION

DETENTION

[PARK]ING



Conceptual Design

To address the issues and opportunities presented by the existing site conditions, each strategy was developed to explore how it would be utilized on the site. This step focused on the blend of landscape architecture and civil engineering to better understand the dimensional requirements and limitations of the site, and to better understand the overall feasibility, constructability and budget implications of each strategy.

One example of this is the Bio-Buffer strategy. In order to understand how this strategy would be implemented, it was first necessary to understand how the parking lot could be laid out, and how much area would be available for a bioretention feature. The location behind the building was chosen because of its proximity to the downspout system, and the added benefit of providing a landscape buffer between the lower-level residential units and the parking lot.

① EDUCATION

The sidewalk along North Limestone is an ideal opportunity for educational signage. To further enhance this opportunity, seating and bike parking are imagined adjacent to the interpretive signage.

② BIO-BUFFER

The Bio-buffer requires disconnecting downspouts and redirecting rooftop runoff to rear bioretention and detention areas. The bioretention facility will improve water quailty, microclimates, biodiversity, and the ecological habitat while providing aesthetic benefits.

③ [PARK]ING

To address the parking lot, pervious parking will be used to improve water quality, reduce urban heat island impacts, and improve parking lot functionality.

④ DETENTION

The use of underground detention will help capture high water volumes during major rain events, slow water velocities to reduce downstream erosion and ensure this small site maximizes its value.

Bio-Buffer

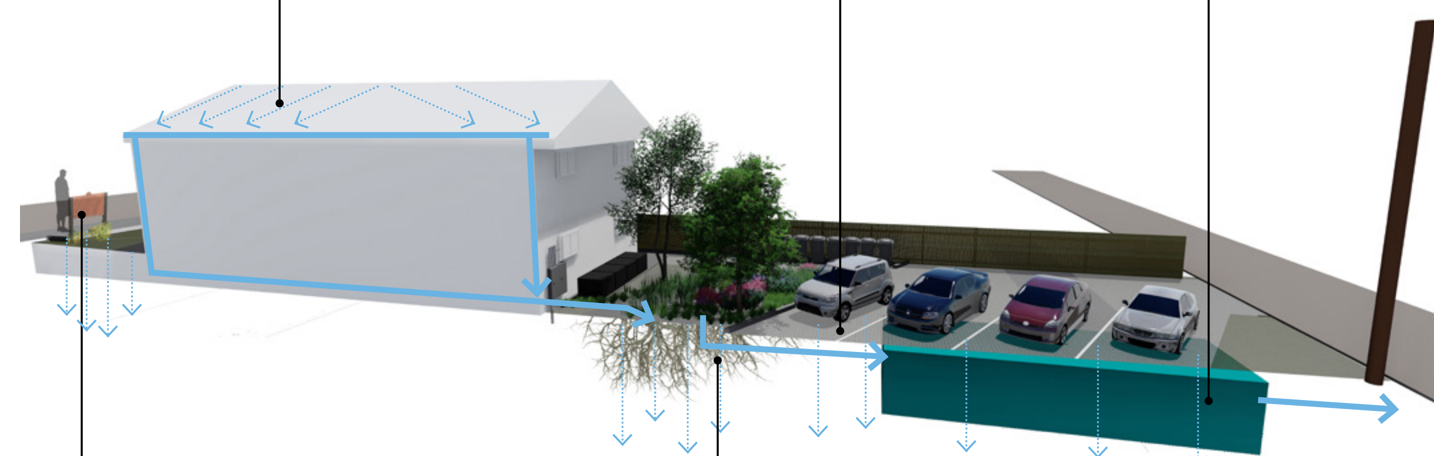
The two-stage stormwater system allows smaller rain events to be handled within the bioretention feature behind the building. This feature will allow water from the rooftop and adjacent walkways to percolate naturally and be cleaned through biological processes.

Reduction in the overall impervious surface will lessen impervious surface fees for the property. The new landscape features will improve the parking lot along with marketability of the lower units. Additionally, this property will be marketed as a sustainable property, thereby expanding its potential market share.

The site's improved bio-diversity, public education materials along the sidewalk, and overall reduction in urban heat island impacts will provide community benefits.

Rooftop runoff makes its way to an underground pipe, offering no opportunity for water-quality improvements.

The overall gravel parking lot results in sheet-flow runoff, which carries sediment, pollutants from vehicles and other debris to the rear alley and existing storm system.



ROOFTOP RUNOFF COLLECTION
By disconnecting existing downspouts, the rooftop runoff can be directed into the bioretention facility.

PERVIOUS PARKING AND DETENTION
Pervious parking will allow stormwater to percolate through sand and stone layers and either enter the detention facility and storm system or naturally percolate.

CLEAN WATER
Water that doesn't naturally percolate will go into the storm system after going through multiple filtration systems.

PUBLIC EDUCATIONAL OPPORTUNITY
Signage along the North Limestone sidewalk will be highly visible.

BIORETENTION OVERFLOW
During large storm events, the bioretention will overflow into the underground detention facility in the parking area.

Education

Providing clear, innovative illustrations to educate passersby on the stormwater features at the 525 building will raise awareness for stormwater issues, and help showcase what can be achieved on small sites.

Showcasing the sustainable attributes of the 525 building will make this a more marketable property that appeals to residents who want to live in a building that provides benefits to the greater community. The improved parking lot should improve microclimates and benefit utility fees.

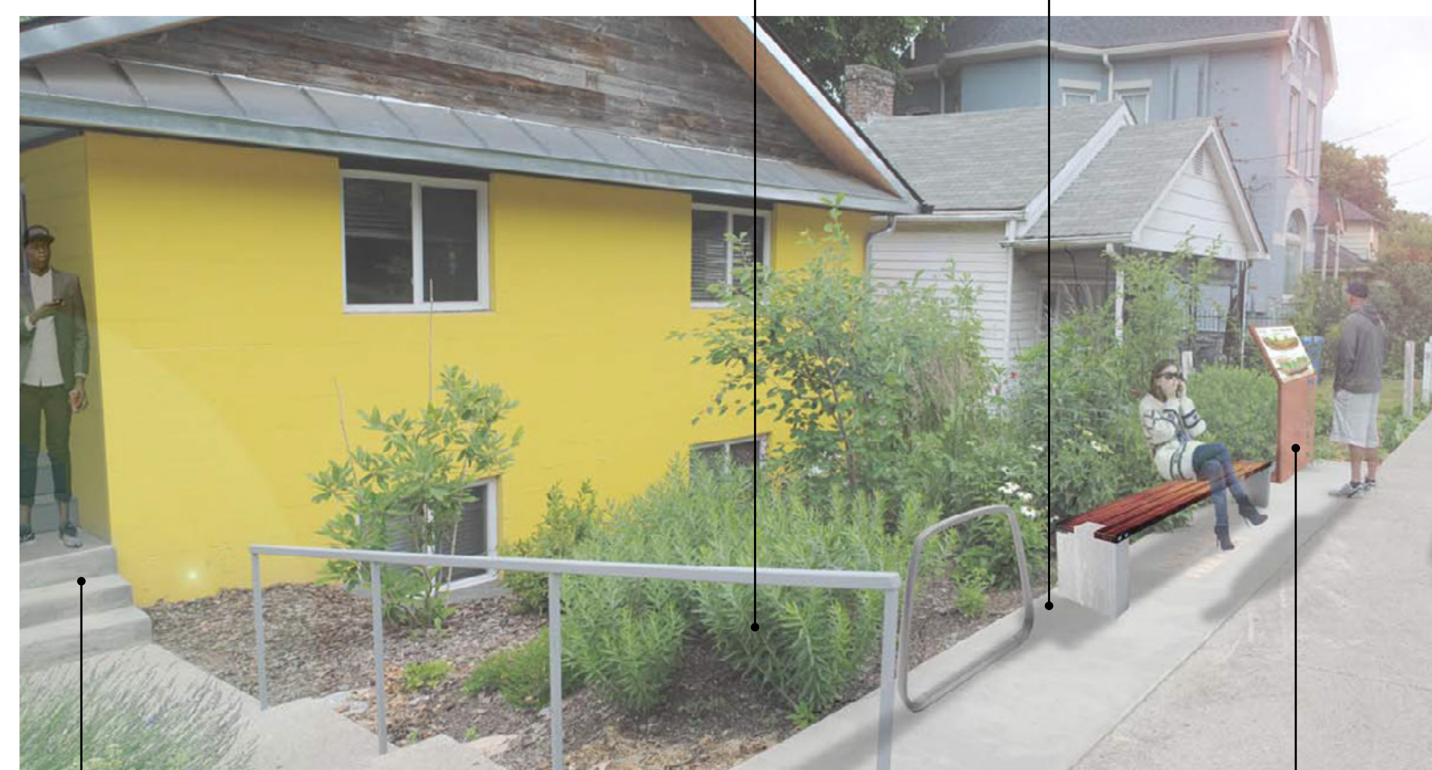
The seating and educational materials will serve as a precedent for these types of small-scale multifamily projects, and help raise awareness for the potential that exists to improve the environment around us.

This concrete pad offers a perfect opportunity for publicly accessible stormwater education, seating and bike parking.

This is a highly used pedestrian corridor that connects a retail/entertainment node to downtown Lexington and many residential districts.

Existing native landscape along North Limestone was implemented by the owner, and is a great example of biological water quality improvement opportunities and highly visible moments for stormwater/ environmental education.

This feature will include a bench and a bike rack for residents and passersby. Both amenities will be located near the educational feature and existing native landscape to ensure maximum visibility.



The educational signage is near the main entrance to the 525 building, just off the North Limestone corridor.

Simple and effective educational signage will be placed along the sidewalk next to North Limestone. This location has high visibility and will be easily accessible to the public.

References

Environmental Protection Agency (2017, May 1) Healthy Watersheds Protection
https://www.epa.gov/hwp/basic-information-and-answers-frequent-questions

Lexington-Fayette County (1999, April 8) Rural Land Management Plan
https://www.lexingtonky.gov/plans-studies-and-surveys

University of Arkansas (2010) LID Low Impact Development: A Design Manual for Urban Areas

Lexington Fayette Urban County Government (2017) Multiple GIS Data Sets,
Lexington Open Data Portal, https://data.lexingtonky.gov/group

Photography: Louis Johnson, Jared Kaelin and Google

Gresham Smith

Genuine Ingenuity