Growing Solutions

A Policy Brief Concerning Vegetative Landscaping's Ability to Address the Effects of Climate Change in Cedar Rapids, IA

Acknowledgements

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Special Thanks to: Kevin Griggs, Mary Beth Stevenson, Cara Matteson and Allen Bonini for their consultation in the creation of this brief.

Brief submitted Oct. 1, 2020

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I. Introduction

Extreme weather events linked to climate change have had catastrophic consequences for Cedar Rapids, Iowa, leaving the city vulnerable to repeated instances of intense natural disasters. On June 13, 2008, more than 7,198 parcels of land, 10 square miles, and 310 city facilities were damaged when the Cedar River rose to the highest level in Cedar Rapids' history, 31.12 feet.[1] In 2016, large flooding occurred again with the river cresting nearly 22 feet above its banks.[2] Since 1990, Cedar Rapids has been inundated with flood levels of 18 feet or more on five separate occasions.[3] Major flooding has put the city, located in a 500 year flood plain, into a persistent state of recovery.[4]

Only twelve years removed from the 2008 floods, Cedar Rapids became the target of yet another cataclysmic weather phenomenon: the 2020 Derecho. The powerful hurricane-force winds caused Cedar Rapids to sustain unimaginable, widespread damage to homes, businesses and other structures.[5] The storm left tens of thousands of people without power, isolated from food sources and possessing limited communicative resources.[6]

The severity of the storms and floods make addressing climate change paramount to the city's survival.[7] Part II of this brief discusses the legal framework for adopting provisions into

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[1] Cedar Rapids, *Flood of 2008 Facts & Statistics*, http://www.cedar-rapids.org/discover_cedar_rapids/flood_of_2008/2008_flood_facts.php (Visited September, 2020).
[2] Lauren Shotwell, *Facts and Figures: Cedar Rapids Flood 2016*,
[3] *Id*.
[4] Cedar Rapids, *Flood of 2008 Facts & Statistics*, *supra* note 1.
[5] National Weather Service, Midwest Derecho – August 10, 2020, (Aug., 20, 2020), https://www.weather.gov/dvn/summary_081020.
[6] *Id*.
[7] Cedar Rapids, *EnvisionCR: A Comprehensive Plan for Cedar Rapids, Iowa*, RDG Planning & Design HR Green, Inc., (Dec. 3, 2019), at 114, https://cms8.revize.com/revize/cedarrapids/EnvisionCR%20Update,%20Adopted%2012.3.19.pdf .

municipal codes both in general terms and with an Iowa specific lens. Part III gives a brief general overview of measures and provisions undertaken by Cedar Rapids. The recommended proposals in part IV demonstrate how ordinances pertaining to vegetative landscapes may be tailored to support more than the city's stormwater management, as demonstrated in part V which discusses how vegetative landscapes may be used to lessen the severity and frequency of natural disasters. In part VI, available state financial and technical resources are listed. Part VII then addresses potential conflicts between adaptation and mitigation.

II. The Legal Framework for Municipal Law

Local governments have many considerations to weigh when adopting regulations, one of which is that ordinances must comply with limitations set by federal and state constitutions, statutes and court rulings. The recommendations set forth in part IV of this brief are crafted to conform with the parameters established by state and federal law.

A. Federal Law: Zoning Authority, Preemption, the Takings Clause and Exactions

The Supreme Court has held that zoning regulations are a valid delegation of the state police power conferred to municipalities.[8] Such laws are unconstitutional only if they are "arbitrary and unreasonable, having no substantial relation to the public health, safety, morals, or general welfare."[9] However, state and local laws may not contravene legitimate exercises of federal lawmaking power.[10] The Fifth Amendment also states that "private property [shall not] be taken for public use, without just compensation."[11] The Supreme Court has ruled that land-use regulations made under the authority of the police power can cross a threshold that brings the

[8] *Village of Euclid, Ohio v. Ambler Realty Co.*, 272 U.S. 365, 386-87 (1926).
[9] *Id* at 395 (internal citations omitted).
[10] U.S. Const. Art. VI, § 2.
[11] *Id.* at amend. V.

government action into the ambit of takings jurisprudence.[12] Regulations may constitute a taking after reviewing courts weigh the interests of a developer's financial status and investment backed expectations, in addition to analyzing the character of the governmental restriction.[13] When local governments seek exactions from developers who apply for a permit, the governmental requirement must have a close connection and rough proportionality to the interest it seeks to further.[14]

B. State Authority: Home Rule, Zoning and Subdivisions

Iowa's constitutional "home rule" amendment affords cities and counties express authority to manage local affairs so long as their regulations are not inconsistent with state law.[15] Reviewing courts attempt to harmonize local and state laws as much as possible to avoid an inconsistent interpretation.[16] The caveat in the home rule amendment is that municipalities may not impose new taxes without a grant of authority from the state legislature.[17] The Iowa Supreme

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[12] *Penn. Coal v. Mahon*, 260 U.S. 393. 414-15 (1922).
[13] *Penn Cent. Transp. Co. v. City of New York*, 438 U.S. 104, 136 (1978).
[14] *Nollan v. California Coastal Commission*, 483 U.S. 825. 837 (1987) (holding that the government could not require a public-use easement across a beachfront property as a condition precedent to approve a building permit when the landowner's modifications did not affect the public's perception regarding beach access. This holds true even though the government could still deny the permit outright); *Dolan v. City of Tigard*, 512 U.S. 374, 391 (1994) (holding that the government could not require a business owner (who was seeking a permit that would increase the amount of impervious surface on site) to dedicate land for a public greenway as a condition precedent to permit approval because the greenway was a disproportionate means of offsetting the new development's harm when weighed against the expected negative impacts of the proposed improvements. This holds true even though the government could still deny the permit outright).
[15] Iowa Const. art III § 38A.
[16] *City of Des Moines v. Gruen*, 457 N.W.2d 340, 342 (Iowa 1990) (internal citations omitted) (holding that a city may issue citations for improper storage of an unlicensed vehicle even though state law permits ownership of unlicensed vehicles. The improper storage citation was not inconsistent with petitioner's statutory right to own the vehicle); Iowa Code § 364.2(3) (2017) (declaring that "[A]n exercise of a city power *is not inconsistent* with a state law *unless it is irreconcilable* with the state law) (emphasis added).
[17] Iowa Const. art III § 38A.

Court has held that irrespective of whether a monetary exaction is categorized as a "regulatory fee" or a "tax," it will be considered a tax under the home rule amendment if the revenue is spent for purposes other than covering administrative costs or providing services to developers and owners.[18] Thus, local governments in Iowa must take care to ensure owners and developers recognize a benefit when assessing impact fees if monies are put toward ends outside of administrative costs.[19]

Subdivision and city zoning regulations are governed by chapters 354 and 414 of the Iowa Code, respectively.[20] Iowa's state subdivision regulations contemplate a broad authority for municipalities to place public easements on lots when developers make dedications to cities and counties.[21] Chapter 414 gives cities the right to regulate building uses in addition to the right to impose conditions on owners seeking approval for site development.[22] The code requires municipalities to at least consider the state's Smart Planning Principles when adopting land use regulations, which include items such as "Natural Resources and Agricultural Protection" and "Sustainable Design."[23]

III. Existing Ordinances and Efforts

Cedar Rapids' current municipal code implements various vegetative landscape related ordinances. The city's current zoning chapter establishes agricultural, rural, public park, and

[18] *Home Builders Ass'n of Greater Des Moines v. City of West Des Moines*, 644 N.W.2d 339, 350 (2002) (holding that a city's ordinance requiring fees for off-site park dedication functioned as an excise tax with no authoritative basis from the legislature).
[19] *Id*.
[20] Iowa Code § 354 (1993); Iowa Code § 414 (2020).
[21] *See id.* at § 354.19(1) (stating that "[T]he recording of a subdivision plat shall dedicate to the public any utility, sewer, drainage, access, walkway, *or other public easement* shown on the plat) (emphasis added).
[22] *Id*. at §§ 414.1(1)(a), 414.5.
[23] *Id*. at §§ 18B.1, 18B.1(8-9).

open space districts to limit development and control urban sprawl in sensitive land areas.[24] Additionally, Cedar Rapids has enacted an ordinance pertaining to native and lost vegetation during the development process.[25] This particular section encourages, but does not require, planning native vegetation and replacing lost vegetation during the development process at new sites.[26]

Cedar Rapids has adopted measures to protect existing trees by implementing a "Tree Mitigation Plan."[27] Adherence to the provision's strong preference to protect existing trees is mandated at each phase of new site development and for any landscaping plan that requires a clearance permit described in the code section.[28] The City Arborist must give approval when replacement trees need to be planted for mitigation purposes.[29] If the City Arborist determines there is insufficient space for additional trees, the developer has the option to pay the City to plant the additional trees elsewhere.[30]

The Comprehensive Plan for Cedar Rapids, updated in 2019, highlights specific challenges facing the City as a result of climate change.[31] Recently, the City has faced catastrophic devastation from severe storms and floods.[32] The updated Comprehensive Plan addresses the importance of preparing for natural disasters and sets the framework for green

[24] Cedar Rapids, IA, Cedar Rapids Zoning Ordinance § 32.02 (2020) (establishes agricultural, rural, and public park/open space districts to limit and control development in sensitive areas.)
[25] d at § 32.04.06(A) (requiring a landscaping plan to encourage native vegetation and planting of lost vegetation during development at new sites.)
[26] *Id*.
[27] *Id*. at § 32.04.06(C)(2) (outlining the Tree Mitigation Plan).
[28] *Id*. at 32.04.06 (C) (2)(a).
[29] *Id*. at 32.04.06(C)(2)(d).
[30] *Id*.
[31] *EnvisionCR: A Comprehensive Plan for Cedar Rapids, supra* note 7, at 114.
[32] *Id*.

infrastructure, including vegetative landscape efforts.[33] The Plan includes opportunities for the City to convert selected areas of park turf grass to native prairie or woodland plantings.[34] Additionally, the City has discussed interest in incorporating parks and open spaces into new subdivisions.[35] This would require an updated subdivision code provision to encourage such vegetative spaces.[36]

Finally, the City's Comprehensive Plan states an overarching recommendation to minimize development within existing vegetative spaces and secure these areas for stormwater management, appropriate recreation, and native habitats.[37] However, few official ordinances or code provisions have been adopted to reinforce this recommendation.

IV. New Code Provisions for Cedar Rapids to Adopt

A. Subdivision Regulations

Subdivision regulations are an opportunity for municipalities to ensure vegetative landscapes are a predominant feature in new developments.[38] While Cedar Rapids gives developers some subdivision flexibility such as cluster conservation developments that can nominally ease some regulatory restrictions,[39] the city recognizes that an update to its subdivision ordinance is needed.[40] As currently constructed, Cedar Rapids' subdivision chapter requires a site approval process that must conform to the generalized standards in the city's

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[33] *Id*.
[34] *Id*. at 113.
[35] *Id*. at 114.
[36] *Id*. at 113.
[37] *Id*. at 106.
[38] *See generally* David Morley and Anna Read, *Supporting a Regional Green Infrastructure Network Through Local Policy and Action,* American Planning Association (Jan. 2016), https://www.vibrantcitieslab.com/wordpress/wp-content/uploads/2017/05/Supporting-a-Regional-GI-Plan-Through-Local-Policy.pdf.
[39] Cedar Rapids, IA, Zoning Ordinance § 32.04.05(E) (2020).
[40] *See, EnvisionCR: A Comprehensive Plan for Cedar Rapids, Iowa*, *supra* note 7, at 48.

comprehensive plan.[41] While these standards should prevent the removal of large swaths of vegetation during new development,[42] discrete criteria will serve as a better guide to developers and ensure the city will achieve the broad goals set forth in its comprehensive plan.[43] If adopted into Cedar Rapids' municipal code, the following proposals can turn those goals into a reality.

1. Design Streets and Sidewalks to Support Green Infrastructure

a. Utilize Bioswales in Lieu of Traditional Ditches to Mitigate Stormwater Runoff and Pollution

Bioswales are graded drainage systems that incorporate native vegetation to slow the pace of stormwater runoff, filter pollutants and foster ground infiltration.[44] They should be incorporated into street designs, running alongside streets and walkways, to mitigate the increased speed and volume of water flow over concrete surfaces.[45] Inlets are placed in curbs to direct flow into the swale.[46] Berms should be placed in a horizontal pattern along the bioswale's base, further slowing runoff by forming small pools which facilitate higher levels of infiltration and nutrient removal.[47] Soil profiles forming the bed of the swale need to be modified for optimal system performance and tile drainage should be installed beneath to provide for optimal

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[41] Cedar Rapids, IA, Code of Ordinances §§ 31.01(c), 31.03(b) (2010).
[42] *See*, *EnvisionCR: A Comprehensive Plan for Cedar Rapids, Iowa*,, *supra* note 7, 101-16.
[43] *Id*.
[44] Mark Clark and Glenn Acomb, *Florida Field Guide to Low Impact Development*, University of Florida IFAS Extension 2 (2008), http://buildgreen.ufl.edu/Fact_sheet_Bioswales_Vegetated_Swales.pdf.
[45] *Id* at 1.
[46] *See, e.g.* Park Forest, IL, Code of Ordinances App. A Art X § X-3(D)(1)(f)(Figure X-3-G. Bioswale Design) (2019).
[47] Mark Clark and Glenn Acomb, *supra* note 44, at 1; *Bioswales for Better Stormwater Management*, Rainscaping Iowa 4 (Mar. 2014), https://secureservercdn.net/166.62.110.232/e6d.7d8.myftpupload.com/wp-content/uploads/2018/10/Bioswale_Brochure.pdf.

infiltration.[48] Where practicable, downspouts should be disconnected from buildings to direct flow from gutters directly into the swale, relaxing the burden on traditional stormwater infrastructure and decreasing the pollutant load that washes off from the roofs and sides of structures.[49]

b. Incorporate Green Infrastructure Design into Public Rights-of-Way

Streets in new subdivisions should be designed at the narrowest feasible width.[50] Reducing the total area of a community's paved surfaces, such as roadways, reduces the runoff from precipitation.[51] Extra unpaved space should then be dedicated to vegetative landscapes that combat the effects of weather extremes.[52] In developments where narrow streets are impracticable, either a vegitative buffer should be planted in the median or stormwater curb extensions should be interspersed through the roadway to ameliorate the effects of the additional paved surface.[53] Wide sidewalks designed to encourage pedestrian use should incorporate bioretention planters or biofiltration planters[54] at regular intervals; the size, number and complexity of which should be proportionate to the needs of the site as determined by the site plan review authority.[55]

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[48] *Bioswales for Better Stormwater Management*, *supra* note 10, at 4.
[49] *Iowa Storm Water Management Manual: Design Standards Chapter 9 - Vegetated Swale Systems*, Iowa Department of Natural Resources 2 (Oct. 2009), https://www.iowadnr.gov/Environmental-Protection/Water-Quality/NPDES-Storm-Water/Storm-Water-Manual.
[50] *See generally* Lance Frazer, *Paving Paradise: The Peril of Impervious Surfaces*, 113 ENVIRONMENTAL HEALTH PERSPECTIVES 456 (Jul. 2005), https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1257665/pdf/ehp0113-a00456.pdf.
[51] *See id* at 457.
[52] *See id* at 462.
[53] *See, e.g.* National Association of City Transportation Officials, *Urban Street Stormwater Guide*, San Francisco: Island Press §§ 78, 94 (2017).
[54] Cedar Rapids, IA, Zoning Ordinance § 32.04.05(E).
[55] *Id* at 78-81.

2. Incentivize the Installation of Additional Green Infrastructure Features Using a Point System

Municipalities have the option of creating a menu of options for developers to incorporate, where each option corresponds to an allotment of points.[56] The total amount of points accrued can then qualify developers for various bonuses.[57] One option is to grant density bonuses, where development is either allowed on a larger percentage of the lot (horizontal) or structures are allowed to be built higher, adding additional floors (vertical).[58] Another is to reduce the minimum lot size when subdividing land, giving owners a greater number of parcels to sell than would be available without the incentive.[59] Cedar Rapids should adopt provisions spelling out procedures for developers and owners to qualify for one or both of these types of bonuses if the comprehensive plan's goals and policies for the underlying district are furthered by awarding them.

These provisions should apply to single family, multifamily, commercial and industrial land uses. Easements would be required to be placed on lots to ensure implementation of the infrastructure; such easements would be recorded on the subdivision plat before site design takes place and the city's reviewing authority would then have to approve the design and techniques used before development could commence.[60] The following options should be included on an

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[56] *See* North Las Vegas, NV, Code of Ordinances Ch. 17.24 § 140-1: Menu of Sustainability Options.
[57] *Id*.
[58] Douglas Miskowiak and Linda Stoll, *Planning Implementation Tools: Density Bonus*, University of Wisconsin Stevens Point Center for Land Use Education, at 1 (Nov. 2005), https://www.uwsp.edu/cnr-ap/clue/Documents/PlanImplementation/Density_Bonus.pdf.
[59] *See* Alec Lesher, *Cluster/Conservation Subdivision in Rural/Urban Area*, Sustainable Development Code (Jan. 2019), https://sustainablecitycode.org/brief/cluster-conservation-subdivision-in-rural-urban-area-9/.
[60] *See*, *e.g.* Kennett Square, PA Code of Ordinances App. A § A.2(1)(Step 1) (2014).

incentive menu offered by Cedar Rapids; each recommendation should require use of the cluster conservation subdivision method to qualify.[61]

a. Dedicating Space to Treeline Windbreaks

Municipalities can incentivize the planting of trees by offering bonuses when land is set aside for tree planting.[62] Cedar Rapids should offer a bonus to developers when they plant windbreaks according to specified criteria that will reduce heating and cooling costs. The minimum to receive points in this category should require one row of short shrubs, one row of medium sized trees and a final row of taller trees planted on the north and western portions of structures on the lot (conifers should be planted where conditions allow). The point total can be increased when additional rows are planted, up to a maximum point award at eight rows.[63] To qualify for the bonus, the shortest row of shrubs should be required to be planted furthest away from structures, followed by a layer of "medium" sized trees and at least one row of "tall" trees to direct wind over and around structures.[64] The row closest to the protected structure should be planted 50 to 100 feet from the building and, where conditions permit, should be located uphill

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[61] Cedar Rapids, IA, Zoning Ordinance § 32.04.05(E).
[62] *See, e.g.* Snohomish County, Wash., County Code § 30.25.016(5)(h) (2010) (reducing minimum lot sizes by 20 percent when tree line buffers are planted).
[63] *See* Iowa State University, *Windbreaks,* Iowa State University Extension and Outreach: Horticulture and Home Pest News (May 1996), https://hortnews.extension.iastate.edu/1996/5-3-1996/brkwind.html; Iowa State University, *Windbreaks,* Iowa State University Extension and Outreach: Natural Resource Stewardship, https://naturalresources.extension.iastate.edu/forestry/planning/windbreaks.html (last accessed Sep. 17, 2020).
[64] *See* Iowa State University, *Windbreaks*, Iowa State University Extension and Outreach: Horticulture and Home Pest News (May 1996), https://hortnews.extension.iastate.edu/1996/5-3-1996/brkwind.html; Iowa State University, *Windbreaks,* Iowa State University Extension and Outreach: Natural Resource Stewardship, https://naturalresources.extension.iastate.edu/forestry/planning/windbreaks.html (last accessed Sep. 17, 2020).

from the site.[65] The distance between the tree line and the structure should account for the expected height of the tree to lessen the potential for toppling damage.

b. Place Easements on Lots Requiring the Installation of Rain Gardens

Points ought to be awarded to developments that dedicate space on lots to the installation of rain gardens. To qualify, the city should mandate that rain gardens able to infiltrate site runoff from precipitation events of 1.25 inches or less[66] be installed on all structures when feasible.[67] Additional points should be awarded based on the size and complexity of the rain garden; for example, an easement that calls for the use of retaining walls and high quality soils should be awarded a higher total than sites that only require cut and fill methods.[68] Owners would be responsible for costs to maintain the rain garden, which would be assessed by the city in lieu of a stormwater impact fee. The city should form a partnership with one or more local businesses to negotiate a lower price for residents.

c. Place Easements on Lots Requiring the Installation of Green Roofs and/or Vertical Gardens

Cedar Rapids should assign points for development bonuses for lots that commit to the installation of green roofs and vertical gardens. Green roofs should be designed according to the

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[65] *See* Iowa State University, *Windbreaks*, Iowa State University Extension and Outreach: Horticulture and Home Pest News (May 1996), https://hortnews.extension.iastate.edu/1996/5-3-1996/brkwind.html; Iowa State University, *Windbreaks*, Iowa State University Extension and Outreach: Natural Resource Stewardship, https://naturalresources.extension.iastate.edu/forestry/planning/windbreaks.html (last accessed Sep. 17, 2020).

[66] *Rain Gardens: Iowa Rain Garden Design and Installation Manual*, Iowa Stormwater Partnership 7 (Oct. 2009), https://secureservercdn.net/166.62.110.232/e6d.7d8.myftpupload.com/wp-content/uploads/2018/10/RainGarden_InstallationManual.pdf.

[67] A minimum number of installations should be required, e.g. "85 percent of structures must contain the feature to qualify."

[68] *See id* at 15.

standards set forth in the Iowa Stormwater Management Manual,[69] such as the capacity to manage a typical Iowa rainfall total of 1.25 inches.[70] Likewise, points should be awarded for lots where easements are placed requiring the installation of "vertical gardens" or "green walls."[71] As with rain gardens, a greater number of points should be awarded based upon complexity and system capacity, such as the capability to infiltrate a larger amount of runoff than the 1.25 inch rain event. To accrue points, vertical gardens should be required to demonstrate the capacity to absorb a meaningful amount of runoff; for example, simple "green facade" designs such as ivy covered walls should account for very few or zero points due to their decreased capacity to mitigate runoff.[72] The highest point totals in this category should be awarded to lots with systems that incorporate both features and use runoff from rooftops to help irrigate the vegetation along the vertical gardens.[73] Once again, the onus would be on owners to pay for maintenance of the system in lieu of impact fees and the city should enter into a partnership with local business to negotiate lower costs.

d. Offer Bonuses for the Installation of Bioretention Basins

Cedar Rapids currently requires the installation of detention basins on residential lots as part of a Stormwater Management Plan that must conform with the city's Design Standards Manual;[74] In 2019, Cedar Rapids adopted the Statewide Urban Design and Specifications

[69] *See Iowa Storm Water Management Manual: Design Standards Chapter 17- Green Roof Systems*, Iowa Department of Natural Resources (Apr. 2015).
[70] *Id* at 12.
[71] *See* Mike Weinmaster, *Are Green Walls as "Green" as They Look? An Introduction to the Various Technologies and Ecological Benefits of Green Walls*, 4 Journal of Green Building 3, 11-16 (Nov. 2009).
[72] *See id* at 11.
[73] *See id* at 12-13 (noting that vertical gardens should be irrigated with rainwater whenever possible).
[74] Cedar Rapids, IA, Code of Ordinances Ch. 72 §§ 72.202(c), 72.203(a) (2013).

(SUDAS) as its authority to guide the design of detention basins.[75] The city should offer bonuses on lots that dedicate space to retention strategies which exceed the standards set forth in the SUDAS, such as bioretention basins. Bioretention basins are areas designed to allow runoff to settle and infiltrate while removing pollutants.[76] Communities in the American midwest have implemented bioretention basins that can serve as design standards for Cedar Rapids.[77]

To receive points toward a bonus, the city should set minimum standards for bioretention basins at new development sites. The basin's size should be at least half an acre with a buffer strip of native grass leading in.[78] Vegetation should be planted in mulch and engineered soils to treat the water as it moves through the system.[79] A sand bed should be placed beneath the soil to aid filtration.[80] The grade of the basin should be shallow to allow water to pool and an underdrain system should be installed so any surpluses of treated water can flow to the storm sewer.[81] A storm drain connected to the sewer system should be installed above grade to prevent overflow.[82] Due to the high cost of installation and complicated maintenance schedule,[83] the city should assume management of these spaces after installation to ensure the system delivers the maximum benefit.

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[75] Public Works, *SUDAS*, Cedar Rapids SUDAS (last accessed Sep. 20, 2020).
[76] Isri R. Mangangka et al., *Enhancing the Storm Water Treatment Performance of Constructed Wetlands and Bioretention Basins*, Springer 8 (2016).
[77] *See Site Design Toolkit: Tools for Stormwater Management - Bioretention Basins*, Lake Superior Duluth Streams (Jul. 2020), https://www.lakesuperiorstreams.org/stormwater/toolkit/bioretention.html.
[78] *Id*.
[79] *Id*.
[80] *Id*
[81] *Id*.
[82] *Id*.
[83] *Id.* (noting that factors such as special winter treatments and high up front costs might deter consideration for bioretention basins, but despite these potentially prohibitive barriers, the benefits of bioretention basins outweigh the costs if installed and managed properly).

e. Variances

Terms associated with green infrastructure are guided by general principles, but exact definitions vary depending on the source; for example, the language and emphasis used to define bioswales in one jurisdiction may differ from that of another.[84] As such, the term "should" is used intentionally throughout these subdivision proposals. If the proposals are adopted, the techniques above ought to be implemented as recommended guidelines and not strict "letter of the law" mandates to qualify for point totals. Whether or not the proposals listed above can be implemented may depend on factors out of the control of developers, such as geography, soil and available space.[85] Developers and engineers should be encouraged to innovate other solutions that comport with the intent of the regulations, such as infiltration capacity and nutrient filtration. The awarding of points under such circumstances would then be at the discretion of the reviewing authority, who must be presented with evidence that the proposed alternative techniques have succeeded elsewhere under similar conditions or are very likely to succeed at the individual site.

f. Maximum Bonuses

[84] *See* Lexington-Fayette County, KY, Code of Ordinances Ch. 17 § 17C-29(c) (2020) (defining bioswales as "landscape elements designed to concentrate or remove debris and pollution out of surface runoff water. Bioswales consist of a swaled drainage course with sloped sides and filled with vegetation"); *but see* Tuscaloosa, AL, Code of Ordinances Ch. 24 § 24-252 (2020) (defining bioswales as "vegetated surfaces that are designed to treat sheet flow from adjacent surfaces. Bioswales function by slowing runoff velocities, filtering out sediment and other pollutants and by providing some infiltration into underlying soils").

[85] Kristyn Abhold, Lorraine Loken & Ben Grumbles, *Barriers and Gateways to Green Infrastructure*, Clean Water America Alliance 13 (2011), http://uswateralliance.org/sites/uswateralliance.org/files/publications/Barriers-and-Gateways-to-Green-Infrastructure.pdf.

Maximum bonuses should be established for subdivisions in each district and ought to be reserved for lots that are expected to meet exceptional standards. One approach could award the maximum bonus to sites that are reasonably certain to contribute zero or close to zero runoff during an average rainfall event. Another could award the maximum bonus on lots with easements that guarantee a "treatment train" for its runoff, where treatment train could be defined as a process that treats rainwater starting on a green roof, moving through either a vertical garden or rain garden and then entering a bioretention basin before any runoff reaches the traditional gray infrastructure system. The maximum bonus could carry additional benefits not otherwise available, such as a relaxation of setback or frontage requirements.

B. Zoning Regulations: Require Pollinator Habitats to Be Planted at Sites where Solar Arrays Are a Primary Use

Cedar Rapids recognizes the need to support pollinators through habitat restoration projects.[86] One method taken by municipalities to ameliorate the stresses of pollinator habitat loss is to require the planting of pollinator friendly habitat as a vegetative buffer when a site is being used for solar energy harvesting.[87] Cedar Rapids should add a provision to its Zoning Ordinance's Alternative Energy Systems section requiring the planting of pollinator friendly habitat at sites where solar arrays are a primary use.[88] The city should set standards for what types of vegetation may be used, when it should be planted, height and width of the buffer and a

[86] *See* Parks and Recreation, *Pollinator and Natural Resource Initiatives*, Cedar Rapids, http://www.cedar-rapids.org/residents/parks_and_recreation/pollinator_and_natural_resources_initiatives.php (last accessed Sep. 21, 2020).
[87] *See, e.g.* Halifax County, VA, Code of Ordinances §§ 53-153 – 53-159 (2017).
[88] Cedar Rapids, IA, Cedar Rapids Zoning Ordinance § 32.03(D)(1)(a) (2020) (defining primary use solar arrays as those sites where the array is the principal use or when the array setup covers 50 percent or more of the site's surface).

maintenance schedule to ensure the health of the plant life; a site plan approval process should be utilized before the start of construction to verify that the developer's plan will comport with the regulations.[89]

C. Cemeteries: Require the Use of Non-Toxic Burial Materials and the Installation of Vegetation to Improve Soil Quality

A growing concern is emerging over traditional burial practices in the United States.[90] Byproducts from the burial process include the possible release of compounds such as methane, carbon dioxide, carbon monoxide, nitrates, ammonia and heavy metals and others from both corpses and the coffin or casket in which they are placed.[91] The full impact of these chemicals on soil and water health is not well understood and can vary from site to site due to the variance in soil conditions and the soil's ability to filter pollutants; however, troubling data has been linked to cemeteries, such as a study that found elevated levels of arsenic, zinc, lead and copper downstream from Iowa cemeteries founded in the late 1800s.[92] Though rates of burial are receding in favor of cremation,[93] some of those gains may be offset by local population increases; additionally, that fact does not address the substances already in the ground. Climate change poses a potentially devastating threat to sites containing toxic waste through heavy

[89] *See, e.g.* Halifax County, VA, Code of Ordinances §§ 53-153 – 53-159.
[90] *See generally* S. Fiedler et. al., *Graveyards — Special Landfills*, 419 The Science of the Total Environment 90 (2012).
[91] *Id* at 90.
[92] *Id*.
[93] Media Center, *Statistics*, National Funeral Directors Association https://nfda.org/news/statistics (last accessed Sep. 22, 2020) (reporting a current rate of 37.5 percent for burials and 56.8 percent for cremation).

rainfall and flooding events;[94] action should be taken to mitigate and prevent further degradation of these sites.

Cedar Rapids should enact regulations that ban toxics from entering the ground at cemeteries. A ban-list should be populated naming all hazardous chemicals, heavy metals and other harmful materials associated with embalming and burials; alternatively, the city could incorporate the state definition of "hazardous substance" by reference.[95] Where soils have been compromised as a result of traditional burial practices, Cedar Rapids should require existing cemeteries looking to expand onto land not previously sited for cemetery uses to obtain a landscaping permit mandating the installation of mitigative vegetation appropriate to offset the impact of the site's unique contaminated conditions. Sites that demonstrate no significant contamination should be exempt from the provisions. Careful consideration should be given when drafting these regulations not to interfere with established religious practices[96] or require the planting of vegetation to such a magnitude as might trigger negative exactions jurisprudence.[97]

V. Expected Impacts of Adopting the Provisions

A. Climate Change

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[94] *See generally Superfund: EPA Should Take Additional Actions to Manage Risks from Climate Change*, United States Government Accountability Office (Oct. 2019), https://www.gao.gov/assets/710/702158.pdf.

[95] Iowa Code § 455B.381(5) (defining "hazardous substance" broadly in addition to referencing federal standards that may apply, such as the definitions promulgated by the EPA under various federal statutes).

[96] *See generally* Rachel Scall, note, *Bring Out Your Dead: an Examination of the Possibilities for Zoning Out Cemeteries Under RLUIPA*, 24 N.Y.U. Envtl. L.J. 111 (2016) (discussing the complex interactions between the 1st Amendment's Free Exercise clause, the Religious Land Use and Institutionalized Persons Act and a city attempting to restrict a local church's ability to expand a cemetery).

[97] *See Nollan* 483 U.S. at 837; *Dolan* 512 U.S. 374 at 391.

1. Stormwater Management

a. Pollution Removal

Bioretention (practices involving modified soils and underdrain systems) removes a variety of pollutants from stormwater runoff,[98] thereby improving local water quality, and has been shown to be an effective tool in practice.[99] If built and managed according to research guidelines, bioretention can be very effective initially and improve its performance over time. For example, a bioretention cell[100] in North Carolina was measured to remove 40 percent of the nitrogen and 65 percent of the phosphorous from runoff shortly after construction; when measured again in the seventeenth year of its use, the numbers increased to 72 and 79 percent, respectively.[101] Care must be taken, however, to follow best management practices during installation and management of bioretention areas, as cold climates present unique challenges to the systems.[102] Green roofs have the potential to filter pollutants; setups that are built into the structure where the soil bed is placed over a waterproof membrane have been shown to reduce nitrates, turbidity and total suspended solids.[103]

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[98] *New Jersey Stormwater Best Management Practices Manual Chapter 9.1: Bioretention Systems*, State of New Jersey Department of Environmental Protection, at 1, (Feb. 2016) (stating that bioretention removes " suspended solids, nutrients, metals, hydrocarbons and bacteria" from stormwater).

[99] Jeffrey P. Johnson and William F. Hunt, *A Retrospective Comparison of Water Quality Treatment in a Bioretention Cell 16 Years Following Initial Analysis*, 11(7) Sustainability, Apr. 2019, at 1-2, https://doi.org/10.3390/su11071945.

[100] *Id*. at 2-3 (describing "biocell" as a bioretention method similar in form and function to those discussed in part II).

[101] *Id.* at 4-5.

[102] *See* Hannah Kratky et. al., *A critical literature review of bioretention research for stormwater management in cold climate and future research recommendations*, 11(4) Front. Environ. Sci. Eng., Aug 2017, 10, https://doi-org.cowles-proxy.drake.edu/10.1007/s11783-017-0982-y (noting that conditions such as roadway salt and vegetation tolerance must be considered during design).

[103] Susan Morgan, Serdar Celik & William Retzlaff, *Green Roof Storm-Water Runoff Quantity and Quality*, 139(4) Journal of Environmental Engineering 471, 478 (2013).

b. Flood Mitigation

Vegetative landscaping reduces stress on traditional gray infrastructure through infiltration, evapotranspiration and storage of stormwater, adding channels which runoff must travel through before being deposited into receiving waters.[104] Implementation of green infrastructure over large swaths of watersheds reduce peak flow volume and could lower the high water mark during flooding.[105] Green roofs in the midwest have the capacity to significantly reduce runoff; simpler systems added to existing rooftops absorb approximately 38 to 43 percent of water, while complex systems with soil covering a waterproof membrane (often installed during construction) traps approximately 51 to 55 percent.[106] In addition to alleviating pressure on sewer systems, water stored in bioretention areas can be put to non-potable uses such as landscape irrigation.[107]

2. Carbon Sequestration

Vegetation stores carbon in soil and as biomass (e.g. leaves, stems and wood) through photosynthesis.[108] While forests undoubtedly play an important role in climate change mitigation by sequestering carbon annually and in the long term,[109] the ability of trees to significantly

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[104] Atkins, *Flood Loss Avoidance Benefits of Green Infrastructure for Stormwater Management*, United States Environmental Protection Agency, at 1-2 (Dec. 2015), https://www.epa.gov/sites/production/files/2016-05/documents/flood-avoidance-green-infrastructure-12-14-2015.pdf

[105] *Id* at 1-3.

[106] Morgan, *supra* note 82, at 473.

[107] Atkins, *supra* note 83, at ix.

[108] National Academies of Sciences, Engineering, and Medicine, *Negative Emissions Technologies and Reliable Sequestration: A Research Agenda*, 87 The National Academies Press (2019).

[109] Borys Tkacz et al., *National Roadmap for Responding to Climate Change*, United States Department of Agriculture Forest Service at 6 (Feb. 2011), https://www.fs.fed.us/climatechange/pdf/Roadmapfinal.pdf (stating that forests sequester 11 percent of carbon emissions every year).

sequester carbon in urban landscapes is not completely understood and therefore, in this narrow context, it is difficult to inform policymakers as to the extent of their impact.[110] Smaller, non-woody plants may not be a significant source of carbon sequestration insofar as their above ground biomass because their ephemeral nature does not lend itself to long term carbon storage.[111]

One area of promise lies in bioretention (e.g. swales and basins).[112] Research indicates that bioretention methods are a net carbon sink that can help offset emissions through both plant life and the soil media used to create them, though to what extent is uncertain.[113] Other factors may enhance bioretention areas carbon sequestering capabilities, such as: planting vegetation that achieves a greater level of above and below ground biomass, limiting the amount of organic matter used in the filter media (such as that found in compost), increasing filter media depth and selecting plants that shed less material.[114] A generalization extrapolated from the available information is that, whether the extent is great or small, urban vegetation and soil can sequester

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[110] *See* David J. Nowak et. al., *Assessing Urban Forest Effects and Values: Minneapolis' Urban Forest*, United States Department of Agriculture Forest Service 8 (2006), https://permanent.fdlp.gov/websites/fsfedus/www.fs.fed.us/pdf/ne_rb166.pdf (touting urban trees as a viable measure to mitigate climate change through carbon sequestration in Minneapolis); *but see* Chang Zhao and Heather A. Sander, *Quantifying and Mapping the Supply of and Demand for Carbon Storage and Sequestration Service from Urban Trees*, PLOS ONE 23 (2015), https://doi.org/10.1371/journal.pone.0136392 (finding that trees only offset one percent of carbon emissions in Minneapolis, though the authors noted the low number could be a factor of tree placement within the study area as opposed to efficacy. The authors also mention that trees have other benefits not significantly addressed in their work).

[111] National Academies of Sciences, Engineering, and Medicine, *supra* note 108, at 87.

[112] *See generally* Paliza Shrestha, Stephanie E. Hurley & E. Carol Adair, *Soil Media CO2 and N2O Fluxes Dynamics from Sand-Based Roadside Bioretention Systems*, 10(2)(185) WATER, Feb. 2018, https://www.mdpi.com/2073-4441/10/2/185/htm.

[113] *Id*. at 16.

[114] *Id*. (adding that vegetation which sheds less can also reduce management costs).

carbon if managed properly; therefore, urban vegetative spaces can, at a minimum, be one piece of a greater whole in offsetting emissions. The only matter left open is one of degree.

3. Urban Heat Island Effect

Unlike carbon sequestration, trees and other vegetation have a verified impact concerning their ability to mitigate the heat island effect.[115] Trees and vegetation lower temperatures by either absorbing and reflecting heat, or by using heat to turn liquid water into gas (evapotranspiration).[116] Though variables such as geography, local weather and season prevent a "one size fits all" description of vegetation's effect on heat islands,[117] vegetative landscapes and green infrastructure have been shown to have a significant positive impact across a broad spectrum of geographical locations.[118] Locations with at least 40 percent canopy coverage over a given radius recognize the greatest benefit, with escalating returns over larger distances.[119] One study found a simple facade of vines reduced wall temperatures by 36ºF.[120] Green roofs can lower rooftop temperatures in some locations by up to 40ºF.[121] Reducing the heat island effect has collateral impacts as well, such as reducing the energy costs for buildings.

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[115] *See generally* Carly D. Ziter et. al., *Scale-dependent interactions between tree canopy cover and impervious surfaces reduce daytime urban heat during summer*, 116 PNAS 7575 (2019), https://www.pnas.org/content/pnas/116/15/7575.full.pdf.
[116] *Reducing Urban Heat Islands: Compendium of Strategies - Trees and Vegetation*, United States Environmental Protection Agency at 2-3 (2008), https://www.epa.gov/sites/production/files/2017-05/documents/reducing_urban_heat_islands_ch_2.pdf.
[117] *Reducing Urban Heat Islands: Compendium of Strategies - Urban Heat Island Basics,* United States Environmental Protection Agency, at 6 (2008), https://www.epa.gov/sites/production/files/2017-05/documents/reducing_urban_heat_islands_ch_1.pdf.
[118] *See id.* at 1.
[119] Carly D. Ziter et. al., *supra* note 115, at 7576.
[120] *Reducing Urban Heat Islands: Compendium of Strategies - Trees and Vegetation*, *supra* note 117, at 3.
[121] *Using Green Roofs to Reduce Heat Islands*, United States Environmental Protection Agency (Jun. 11, 2019), https://bit.ly/30g3Bjk.

4. Energy Costs

Vegitative landscapes have the potential to provide considerable reductions in heating and cooling costs. Notwithstanding variables such as location, local weather, building type and installation methods, complex green wall designs can reduce energy consumption in buildings by up to 58 percent while simpler green facade designs can achieve up to a 33 percent energy use reduction.[122] One study monitoring the effects of treeline windbreaks on converted office buildings found the structures' heating costs were reduced by 20-27 percent, which equated to a reduction in carbon dioxide emissions of 1.8 to 2.7 kg over the winter.[123] The proper placement of trees and smaller vegetation that provide building shade can reduce energy costs during the summer by fifty percent.[124]

5. Wildlife Habitat

The warming climate is causing changes in plant behavior; annually, species have been flowering earlier and earlier.[125] This effect can have devastating effects on pollinator species and their habitats that rely on a synchronous arrival and blooming schedule.[126] This increases pressure on species already suffering from a myriad of stressors such as habitat loss and

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[122] Julia Coma et. al., *Vertical greenery systems for energy savings in buildings: A comparative study between green walls and green facades*, 111 BUILDING AND ENVIRONMENT 228, 236 (2017).
[123] Fan Wang, *Modelling Sheltering Effects of Trees on Reducing Space Heating in Office Buildings in a Windy City*, 38(12) ENERGY AND BUILDINGS 1443, 1450 (2006).
[124] Tivon E. Feely, *Forestry Extension Notes: Landscaping for Energy Conservation*, Iowa State University Extension Service Forestry Extension at 1 (Dec. 2001) (describing that trees are most beneficial when planted on the east and west side of structures in Iowa).
[125] William R. L. Anderegg and Terry L. Root, *Climatic Influences on Ecosystems*, in Terry L. Root et. al., *Biodiversity in a Changing Climate: Linking Science and Management in Conservation* 27, 29 (2015).
[126] *Id*.

chemical exposure.[127] These effects are particularly troubling for agricultural purposes, which derive billions of dollars of value from pollinators each growing season.[128] Requiring the planting of pollinator friendly vegetation at solar facilities can be one step along the path to ensure pollinators enjoy a robust and healthy habitat.[129]

B. Ancillary Benefits

1. Economic

a. Costs of Green vs. Gray Infrastructure

Performing a cost/benefit analysis on whether to develop gray or green infrastructure to address flooding is a complicated and inexact process.[130] The same can be said for nutrient removal.[131] In any given narrow context, it can be argued that gray infrastructure is an economically preferable alternative to green infrastructure.[132] However, when viewed

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[127] *See generally* Bradley Adams, *Protection of Pollinators from Habitat Loss and Chemical Exposure*, Sustainable Development Code (Aug. 2020), https://sustainablecitycode.org/brief/protection-of-pollinators-from-habitat-loss-and-chemical-exposure-6/.

[128] *See generally* Nick Hanley et al., *Measuring the Economic Value of Pollination Services: Principles, Evidence and Knowledge Gaps*, 14 ECOSYSTEM SERVICES 124, (2014).

[129] *See* Jodi Helmer, *Solar Farms Shine a Ray of Hope on Bees and Butterflies*, Scientific American (Jan. 14, 2019), https://www.scientificamerican.com/article/solar-farms-shine-a-ray-of-hope-on-bees-and-butterflies/.

[130] *See generally* Eastern Research Group, *A Guide to Assessing Green Infrastructure Costs and Benefits for Flood Reduction*, National Oceanic and Atmospheric Administration Office for Coastal Management (Apr. 2015), https://coast.noaa.gov/data/docs/digitalcoast/gi-cost-benefit.pdf.

[131] *See generally* Erik E. Nordman, *Benefit-cost analysis of stormwater green infrastructure practices for Grand Rapids, Michigan, USA*, 200 JOURNAL OF CLEANER PRODUCTION 501 (2018).

[132] Ioannis M. Kourtis, Vassilios A. Tsihrintzis & Evangelos Baltas, *A robust approach for comparing conventional and sustainable flood mitigation measures in urban basins*, 269 JOURNAL OF ENVIRONMENTAL MANAGEMENT, May 2020, at 1, 12, https://doi.org/10.1016/j.jenvman.2020.110822 (finding that sewer enlargement and detention tanks were a better economic alternative to green roofs and permeable pavement to address flooding issues. The study did not include analysis of bioretention areas outside of green roofs).

holistically, research indicates that the total value provided to communities by green infrastructure outweighs the building and maintenance costs attendant to its installation.[133] Although gray infrastructure may be a better alternative with regard to flood mitigation, the money spent to upgrade sewers and detention tanks only addresses that single issue and does nothing to ameliorate water pollution, heat island effects, energy costs or habitat restoration. Expensive systems separate from flood control must be installed to address nutrient runoff.[134] Additionally, gray infrastructure methods that do not include retention practices merely pass problems downstream.

It is not debatable to assert that green roofs, vertical gardens and bioretention methods are generally expensive to build and maintain, and costs vary from site to site based on factors such as complexity of the system, local weather and the desired level of aesthetic appeal.[135] But while maintenance costs for practices such as bioretention are considered very high compared to traditional methods, the cost effectiveness becomes much more palatable when considering the amount of impermeable surface runoff that receives treatment as a result.[136] Thus, when analyzing costs of green infrastructure installation and care, the entire package of benefits must be considered and will often come down in favor of vegetative landscapes.[137]

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[133] *Id*. (finding that the co-benefits associated with low impact development tipped the scale in favor of green roofs and permeable pavements).
[134] *A Compilation of Cost Data Associated with the Impacts and Control of Nutrient Pollution*, United States Environmental Protection Agency Office of Water, at III-11 (noting that Ohio incurred over $13 million in costs to treat an outbreak of blue-green algae in a single lake).
[135] Stormwater Report, *The Real Cost of Green Infrastructure*, Water Environment Federation (Dec. 2, 2015), https://stormwater.wef.org/2015/12/real-cost-green-infrastructure/#:~:text=Construction%20on%20the%20green%20infrastructure,other%20cost%2Deffective%20implementation%20programs (quoting Andrew Potts, senior watershed services technologist at CH2M, as saying "[Y]ou cannot simply assume a certain practice will cost $10 per square foot" in reference to the exact dollar figure attached to green infrastructure).
[136] *Id*.
[137] *See* Ioannis M. Kourtis, Vassilios A. Tsihrintzis & Evangelos Baltas, *supra* note 132, at 12.

b. Benefits to Residents and Business

On site vegetation can confer economic benefits to property owners. One study analyzing the effect of trees on property values in Dakota and Ramsey Counties in Minnesota found trees planted within 100 meters of single-family residences increased sale price by an average of $1,373, while trees within 250 meters increased sale price by an average of $836.[138] Apartment complexes, office spaces and retail locations garner higher rent values and occupancy rates when attractive landscaping features are on site.[139] Retail sales also improve with attractive vegetation, as patrons are willing to spend more, travel further and make more trips to shop at locations containing green features.[140] Green roofs can have double the lifespan of conventional roofs, which can lead to significant savings; a retail structure with a 40,000 square foot green roof can save more than $600,000 over a 40 year period on roof repairs.[141]

2. Social

a. Public Health

Green infrastructure enhances the health and well being of residents in areas it is implemented. In addition to mitigating the energy costs associated with cooling buildings in urban heat islands, green infrastructure's temperature reducing effects can provide refuge for vulnerable individuals during heat waves.[142] Individuals living close to green spaces are more

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[138] Heather Sander, Stephen Polasky & Robert G. Haight, *The value of urban tree cover: A hedonic property price model in Ramsey and Dakota Counties, Minnesota, USA*, 69 ECOLOGICAL ECONOMICS 1646, 1654-55 (2010).
[139] Janet Clements and Alexis St. Juliana, *The Green Edge: How Commercial Property Investment in Green Infrastructure Creates Value*, National Resource Defense Council, at 17, https://www.nrdc.org/sites/default/files/commercial-value-green-infrastructure-report.pdf.
[140] *Id*. at 9.
[141] *Id*. at 10.
[142] Kathryn J. Bowen and Yvonne Lynch, *The Public Health Benefits of Green Infrastructure: the Potential of Economic Framing for Enhanced Decision-Making*, 25 CURRENT OPINION IN ENVIRONMENTAL SUSTAINABILITY 90, 91 (2017).

likely to engage in physical activity; research has found green space reduces the number and severity of "chronic heart disease, upper respiratory tract infection, asthma [and] chronic obstructive pulmonary disease."[143] Stress levels are reported to be lower where vegetative landscapes are present.[144] Trees and vegetation also significantly increase air quality, improving health by filtering out pollutants such as "particulate matter, ozone, nitrogen dioxide, and sulphur dioxide."[145]

b. A Note on Equity

It is well established that the negative effects of climate change disproportionately impact poor communities and communities of color.[146] Green infrastructure and open space projects too often have the effect of pricing out disadvantaged people from their communities.[147] Municipalities place heavy amounts of effort into maximizing the real estate potential when incorporating vegetative landscapes while ignoring the voices of community stakeholders concerned about gentrification.[148] A collaborative effort to bridge this gap should include interest groups dedicated to transportation and affordable housing in the planning stage.[149] Within the context of the proposals in this policy brief, additional benefits should be granted to developers who commit to building affordable housing. This could come in the form of property tax breaks

[143] *Id*.
[144] *Id*.
[145] Beth Anne Currie and Brad Bass, *Estimates of air pollution mitigation with green plants and green roofs using the UFORE model*, 11 URBAN ECOSYST. 409, 420 (2008).
[146] S. Nazrul Islam and John Winkel, *Climate Change and Social Inequality*, United Nations Department of Economic and Social Affairs, at 21-22 (Oct. 2017).
[147] *See generally* Alessandro Rigolona and Jeremy Németh, *"We're not in the business of housing:" Environmental gentrification and the nonprofitization of green infrastructure projects*, 81 CITIES 71 (2018).
[148] *Id*. at 78.
[149] *Id*.

or lessening the threshold for affordable housing sites to qualify for maximum bonuses, a full discussion of which is beyond the purview of this work.

VI. Available State Assistance

A. Financial Assistance

Iowa provides a multitude of resources for municipalities, soil and water conservation districts (SWCDs), and landowners to implement vegetative landscapes. SWCDs are eligible for funding from the Iowa Department of Agriculture and Land Stewardship (IDALS) which can be put toward the planting of trees and vegetation to enhance water quality and advancing stormwater practices.[150] Funding through IDALS is also available for SWCDs to implement urban stormwater management projects, which includes bioretention systems.[151] The State Revolving Fund's Clean Water program (administered by the Iowa Finance Authority, Iowa Department of Natural Resources (IDNR) and IDALS) provides financing for municipalities, SWCDs and developers for stormwater management practices.[152]

These grants and loans are part and parcel of larger federal and state initiatives designed to improve water quality. The Clean Water Act authorizes federal grants to states to improve water quality from nonpoint source pollutants; the grants are awarded at the state's discretion but must conform to a nonpoint source management plan.[153] Nonpoint source grant money may not

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[150] *Water Quality Protection Practices*, Iowa Department of Agriculture and Land Stewardship Field Services Bureau, https://www.iowaagriculture.gov/FieldServices/waterQualityProtectionPractices.asp (last accessed Sep. 30, 2020).
[151] *Water Quality Protection Projects*, Iowa Department of Agriculture and Land Stewardship Field Services Bureau, https://www.iowaagriculture.gov/FieldServices/waterQualityProtectionPractices.asp (last accessed Sep. 30, 2020).
[152] Investing in Iowa's Water: FY 2021 Intended Use Plans, Iowa State Revolving Fund at 12 (Jun. 2020), www.iowaagriculture.gov/FieldServices/ waterQualityProtectionPractices.asp.
[153] 33 U.S.C. § 1329(h) (1998).

be spent to implement the requirements of an MS4 permit,[154] but does provide flexibility for practices that "may support but do not *directly* implement activities required by [MS4 permits], as well as activities that go above and beyond permit requirements" (emphasis added).[155] EPA guidance specifically carves out room for states to help fund green infrastructure for MS4 permit holders.[156]

Iowa statutory authority allows conservation grants to be allocated for soil and water enhancement which is to be spent on a non-exhaustive list of items that includes reforestation and clean water programs.[157] The State Revolving Fund establishes two classes of funding; the first for water quality protection projects that protect both surface and ground water from point source and nonpoint source pollution, and the second for landowners to create water protection measures such as planting native grasses.[158] Authority for application requirements and disbursement of funds is delegated to state agencies.[159] Applications for funding from these sources must address issues of water quality and need to be grounded in the goals of Iowa's Nonpoint Source Management Plan.[160]

B. Technical Assistance

[154] Cedar Rapids is currently operating with an MS4 permit, available for viewing at https://cms8.revize.com/revize/cedarrapids/document_center/PublicWorks/LTR%20DNR%20&%20NPDES%20PERMIT%2057-15-0-05_RCVD%20012516.pdf.
[155] Nonpoint Source Program and Grants Guidelines for States and Territories, Guidance Document, United States Environmental Protection Agency, at 24-25 (Apr. 2013), https://www.epa.gov/sites/production/files/2015-09/documents/319-guidelines-fy14.pdf.
[156] *Id*. at 25.
[157] Iowa Code § 455A.19(c) (2015).
[158] Iowa Code § 161C.4(2) (2017).
[159] *See, e.g. id* (delegating authority for disbursement of funds to IDALS).
[160] *See* Planning for Water Quality: Iowa's Nonpoint Source Management Plan, Iowa Department of Natural Resources (Jul.2012); Iowa Nonpoint Source Management Program Plan Objectives and Action Steps 2018 Plan Update, Iowa Department of Natural Resources (2018).

IDNR provides an elaborate design manual for stormwater infrastructure entitled "Iowa Stormwater Management Manual."[161] The manual provides detailed installation guidelines for methods such as infiltration and filtration practices, detention practices, bioswales, stormwater easements and green roof systems.[162] In a separate document, IDNR provides guidelines for the design and installation of rain gardens.[163] The state also provides educational materials on stormwater management that includes a primer on green infrastructure.[164]

VII. Potential Conflicts Between Mitigation and Adaptation

Climate change presents humanity with a myriad of complex challenges and uncertain forecasts. Tension exists between notions of climate adaptation and mitigation. Adaptive measures include more open space and fewer paved surfaces, while mitigation calls for denser human environments to cut down on vehicle traffic and energy costs.[165] Bringing vegetative landscapes into dense populations alleviates the stress between adaptation and mitigation, but has its own attendant concerns.[166]

Balancing interests must be accounted for when planting trees. Future use planning should be considered when planting trees or other adaptive vegetation to minimize negative effects on adjacent areas where mitigation measures such as solar energy sites might be

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[161] *Available at* Storm Water Manual, Iowa Department of Natural Resources, https://www.iowadnr.gov/Environmental-Protection/Water-Quality/NPDES-Storm-Water/Storm-Water-Manual (last accessed Sep. 30, 2020).
[162] *Id*.
[163] *See Rain Gardens: supra* note 66.
[164] *Green Infrastructure*, Iowa Stormwater Education Partnership, https://iowastormwater.org/green-infrastructure/ (last accessed Sep. 30, 2020).
[165] Elisabeth M. Hamin and Nicole Gurran, *Urban Form and Climate Change: Balancing Adaptation and Mitigation in the U.S.. and Australia*, 33 HABITAT INTERNATIONAL 238, 242 (2009).
[166] *Id*.

utilized.[167] Soil condition and distance from nearby structures need to be accounted for when planting trees; trees planted in the right soil have stronger root systems that can better withstand violent winds and accounting for factors like tree height and crown size lessens the likelihood that the trunk or branches will impact buildings during storms.[168]

Vegetative systems can offer many benefits to communities in the western United states, but care needs to be taken to ensure these systems are not lost to wildfire.[169] Coastal communities benefit from vegetation that reduces coast erosion,[170] but hurricane impacts can severely damage landscapes,[171] thereby releasing carbon from decaying vegetation into the atmosphere. Cold weather and varying flowering schedules for plants can severely limit and damage the effectiveness of green infrastructure. These tensions and complexities further highlight the need for policy makers to consult with the scientific community to ensure the best decisions are made.

VIII. Conclusion

Cedar Rapids is immensely vulnerable to the destructive consequences of climate change. The city has seen irreparable damages to their community and preparing for future strong storms

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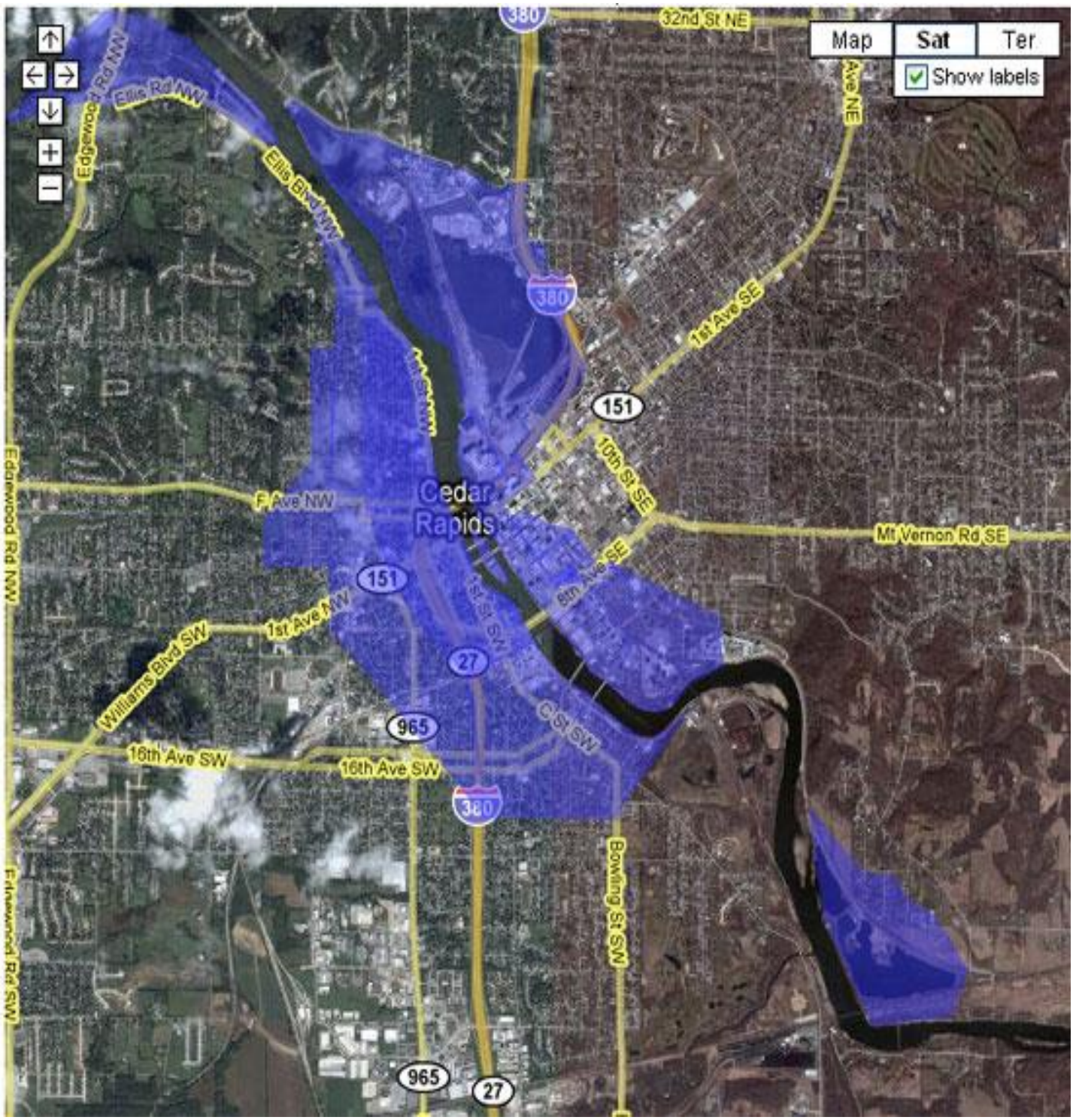
[167] Erin Musiol et. al., *Solar Briefing Papers: Balancing Solar Energy Use with Potential Competing Interests*, American Planning Association, at 8 (2012).
[168] Donna C. Fare and Wayne K. Clatterbuck, *Planting the Right Tree in the Right Place*, Texas A&M Agrilife Extension Tree Care Kit, https://agrilife.org/treecarekit/planting-tree-maintenance/planting-the-right-tree-in-the-right-place/ (last accessed Sep. 30, 2020).
[169] Almut Arneth et. al., *Climate Change and Land: An IPCC Special Report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems*, Intergovernmental Panel on Climate Change, at 20 (2019), https://www.ipcc.ch/site/assets/uploads/2019/08/4.-SPM_Approved_Microsite_FINAL.pdf.
[170] *Adaptation Strategies and Actions: Restore Natural Coastal Buffers: Native Vegetation Buffers and Plantings*, Massachusetts Wildlife Climate Action Tool (2017), https://bit.ly/3n370Me.
[171] *Hurricane Impacts on the Coastal Environment*, United States Geological Survey, https://pubs.usgs.gov/fs/hurricane-impacts/ (last accessed Sep. 30, 2020).

and floods is paramount to the survival of their community. The proposals set forth in this brief address the susceptibility of the city in conjunction with vegetative landscape ordinances, but more research is needed to maximize their effectiveness. Residents and community stakeholders need to be engaged so equitable communities arise from the proposed ordinances. Developers must be brought into the fold to determine the breadth of bonuses necessary to encourage their use. Experts from state and local agencies as well as from the scientific community are necessary to ensure the success of the vegetative systems. Together with Cedar Rapids officials, these groups can strengthen themselves and each other while ensuring the long-term viability of the city.

Appendix A: Map Showing Extent of 2008 Flood – Areas in blue highlight where the river was over its banks.



Source: https://www.dailykos.com/stories/2008/6/13/535293/-

Appendix B: Aerial Image Showing Damage from the 2020 Derecho

On behalf of the Drake University School of Law team participating in the Elisabeth Haub School of Law Environmental Law and Policy Hack Competition, I certify this policy brief reflects the work product of our team in accordance with the official rules of the competition.

Bradley Adams
J.D. Candidate 2020
Drake University School of Law