Chicago Sustainable Industries
Green Infrastructure for Stormwater

City of Chicago
Department of Housing and Economic Development

A LEANER MEANER GREENER CHICAGO

Why stormwater? - Why now?

As part of the Chicago Sustainable Industries Initiative, stormwater conditions in the industrial corridors were studied. This guide outlines a set of green infrastructure strategies identified during that effort. The term Green Infrastructure is used to describe a set of landscape-based strategies for managing stormwater at the ground surface, keeping it out of the sewer system to provide multiple benefits for property owners. Specifically, green infrastructure addresses the problems of flooding, urban heat island effect, and combined sewer overflows. Green infrastructure is composed of simple technologies designed to manage stormwater while also providing significant economic, social, and ecological value.

Benefits include:

Protecting property & reducing clean-up costs through a broad-scale reduction of chronic stormwater problems, including street flooding and basement flooding.

Reducing energy usage through a reduction in heat island effect as well as reduced stormwater pumping.

Improving visual surroundings and worker conditions, and increasing Chicago's reputation as a home for green industry.

Protecting the Chicago River through the reduction of combined sewer overflows.

The primary findings of the study were that stormwater challenges exist throughout the corridors and that corridor-wide actions will have greater benefit than individual properties acting alone. While the need for action exists in all the corridors, the strategies used should be tailored to the varied conditions between and within corridors.

This guide is specifically intended for use by property owners and their associations in the Chicago industrial and manufacturing zones to aid in understanding the benefits of developing and implementing green infrastructure stormwater strategies for both retrofitting of existing properties and new construction.

Implementation of these recommendations may be undertaken in response to the Chicago stormwater ordinance requirements or initiated as a means to reduce flooding and property damage costs over time. In addition to the material presented, further information can be found in the References and Resources section on the back cover.

PROJECT TEAM

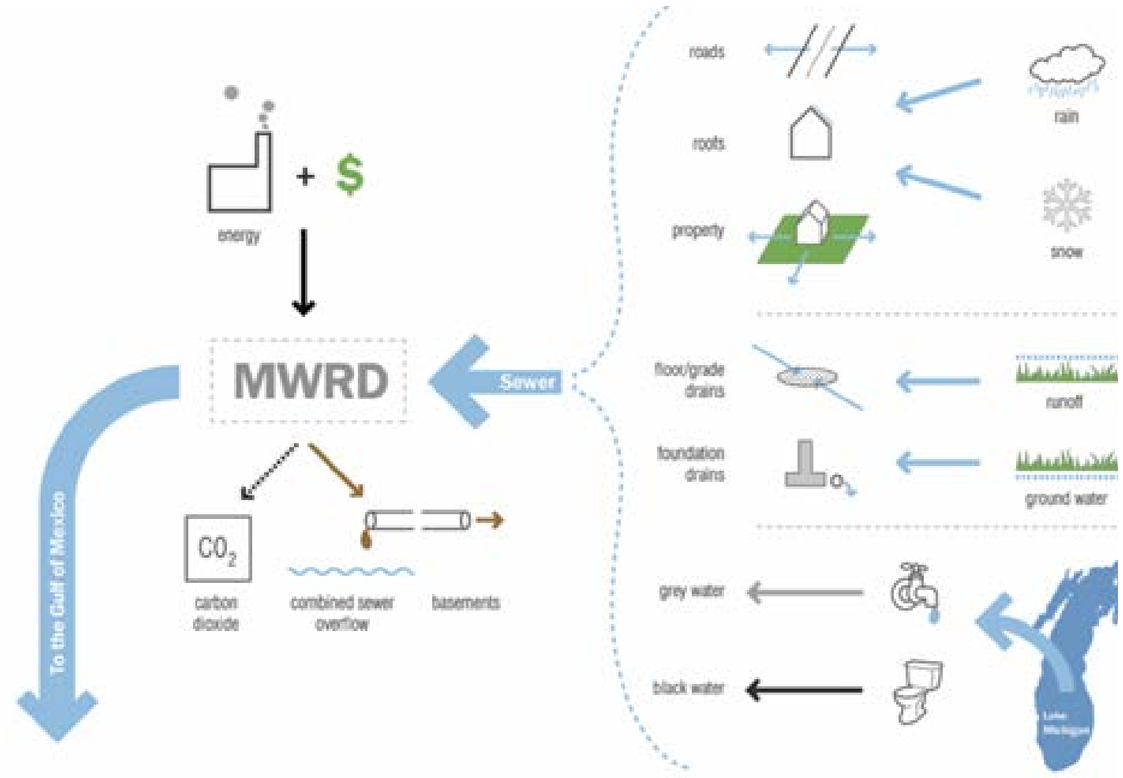
City of Chicago:
Department of Housing and Economic Development
Department of Water Management
Department of Transportation

Consultants:
Conservation Design Forum
Urban Lab
EDI
Gingko Planning

Figure 1: "McCormick Works Factory, International Harvester Company, Chicago, USA, World's Largest Farm Machine Factory" H.M. Pettit. Chicago Historical Society (ICHi-16826)

Front and back cover: View to downtown Chicago along West Carroll Avenue in the Kinzie industrial corridor

Water in the "Wrong Place"



Historically stormwater has been managed as a waste product to be disposed of and was quickly conveyed to underground pipes leading to water reclamation plants or to our local rivers. This method depletes groundwater recharge, overloads the sewer system causing basement flooding and combined sewer over flows that pollute our streams and rivers. Further, significant energy is required to pump and treat stormwater runoff at the water reclamation plants.

Times have changed – water is considered a resource that should be managed on site or as close to on site as reasonable. Not only is this beneficial to our urban ecosystems, but new methods of managing stormwater on site are showing measurable short-and long-term economic benefits and savings.

This study examined the characteristics of the industrial corridors in order to identify a range of opportunities for applying green infrastructure strategies to capture, infiltrate, and/or re-use as much stormwater as possible through landscape-based, green infrastructure technologies. These technologies, ranging from permeable pavements to bioretention landscapes to stormwater parks, are cost effective relative to the long-term savings in site and property damage reduction. Within this guide, the strategies are linked to parcel size and configuration as well as to corridor infrastructure, such as roads, rail yards, and water ways. Tailoring strategies to the unique corridor characteristics and features will maximize effectiveness and enhance the conditions within the corridors and adjacent neighborhoods. This approach transforms a 'problem-solving' effort of managing stormwater into an effective, landscape-enhancing set of stormwater strategies.

Greening of Chicago Industrial Corridors

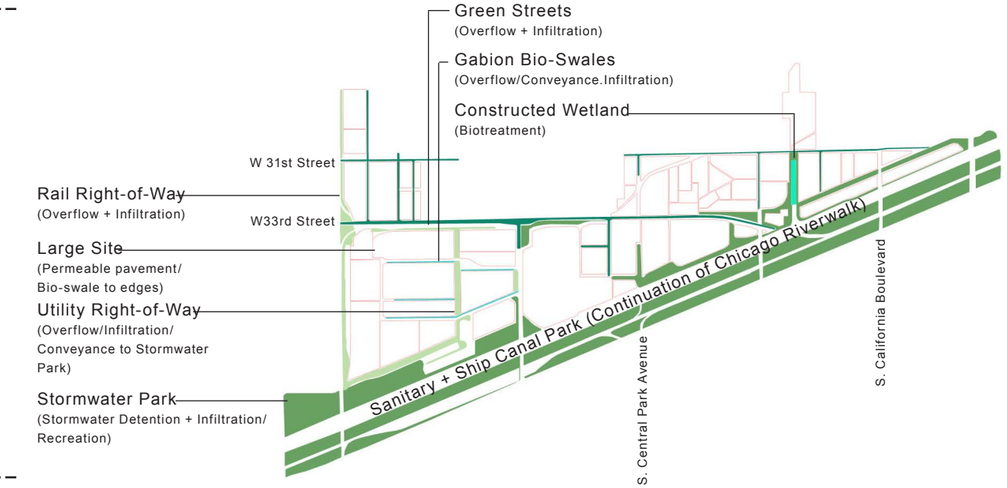
A once-in-a-lifetime opportunity

Chicago's industrial corridors comprise over 16,000 acres of land, many of them located adjacent to the Chicago River. We are poised at a point in time when storm intensity and energy costs are predicted to escalate and the need for upgrades to street and infrastructure has never been higher. This affords a unique opportunity to reduce stormwater runoff, improve environmental quality, and reduce energy consumption by integrating green infrastructure into necessary transportation, parking lot, and landscape infrastructure. Chicago's industrial corridors can play an important role in the economic and ecological future of Chicago.

A key concept in corridor-wide stormwater management is to treat each corridor as a landscape system. When each corridor is specifically designed to capture and manage its own stormwater, each corridor functions as a mini-watershed, with all of the environmental benefits of a healthy ecosystem. This translates into economic value as our urban lands continue to be tested by heavier rainfall and increased average temperatures. When stormwater methods are applied and constructed throughout a corridor, individual parcel owner costs can be reduced significantly.

Below is an example of designing corridors as continuous landscapes, creating networks of infiltration and storage opportunities based on existing parcel types, infrastructure networks, and adjacent land conditions. The diagrams illustrate how a variety of stormwater features and systems can be located throughout the corridor, each integrated with existing infrastructure. Each parcel has the option to manage stormwater on site where there is capacity, or to direct its stormwater into the corridor-wide system, implementing enough retrofit on site to convey water to the shared system.

EXAMPLE: Little Village Corridor



EXAMPLE: Stockyards Corridor

What are Green Infrastructure Technologies?

The term green infrastructure refers to a set of landscape-based design tools for capturing and retaining stormwater to reduce runoff volumes and slow the rate it enters the municipal system. These tools and features include green roofs, bioswales, permeable pavements, rain gardens, and detention ponds.

This incredibly valuable service of slowing water down, of holding it, and/or treating it with soils and vegetation has the effect of improving water quality, significantly reducing the rate of stormwater flow, and helps fulfill the long-term vision for mitigating the environmental impact of industrial areas within the urban core

City-wide Stormwater Goals

- Reduce combined-sewer over flow (CSO) events, through a reduction in discharge rates and quantity to the CS system, and to divert stormwater away from the CS system altogether
- Reduce flooding events
- Improve stormwater quality, prior to entering local waterways
- Identify and implement a range of green infrastructure stormwater management strategies that can be applied to prototypical conditions within the industrial corridors
- Improve environmental and economic opportunities for industrial and manufacturing customers

Corridor-wide Stormwater Goals

- Reduce flooding of property and buildings
- Implement stormwater practices that will satisfy potential future stormwater utility fees
- For water-intensive manufacturing businesses, develop rainwater capture, storage, and re-use technology to reduce water and sewer fees
- Create better places to work and conduct business
- Use innovative site development practices that are more cost effective and have long-lasting impact on the bottom line

Why Green Infrastructure is Ideal for Addressing BOTH

- Green infrastructure is a low-cost, high-benefit regenerative method of managing stormwater that improves soil conditions, recharges ground water, promotes plant growth, improves water quality, and enhances environment conditions.
- Green infrastructure is an integrated stormwater approach capable of being designed specifically to the existing urban infrastructure pattern and spatial characteristics and needs of each corridor and parcel site within the corridor.
- Green infrastructure is space efficient and can be readily integrated into street right-of-ways, parking lots, landscape zones, and other urban spaces, avoiding displacement of other urban uses.
- Green infrastructure can be implemented over a period of time, allowing for phased planning, yet will achieve immediate results at an individual project scale.
- Chicago is joining small, medium, and large cities across the country that are planning for, designing, and implementing green infrastructure at a range of scales in order to address these same issues.

What are the direct and indirect benefits?

Figure 2: Stormwater street retrofit at Cermak/Blue Island

Figure 3: Railroad Park, Birmingham, Alabama, public park on 19 acres of abandoned industrial land, that provides overflow stormwater and flooding zones. Image: Tom Leader Studio

ECONOMIC

- Reduction of on site flooding reduces clean-up and maintenance cost
- Reduction of heat island effect saves money on energy costs, lowering overall operating costs
- Less expensive to implement and maintain than gray infrastructure when constructed as part of other infrastructure improvements and development projects
- Creates opportunity for re-using water on site, or for creating a shared water re-use district
- May provide economic incentives for existing and future manufacturing businesses, e.g. through a future reduction of utility fees
- Stormwater ordinance compliance costs may be lower when simultaneously meeting stormwater and landscape ordinance requirements using green infrastructure

SOCIAL

- Healthier landscapes encourage workers to spend more break time outdoors, leading to healthier workers and fewer sick days
- Recreational and social spaces for workers and adjacent neighbors
- Creation of buffers between industrial corridors and adjacent residential and commercial areas
- Recast industrial areas as environmentally responsive to the city and adjacent neighborhoods

ENVIRONMENTAL

- Reduces heat island effect through vegetated surfaces
- Provides urban forestation opportunities
- Creation of habitat and wildlife corridors through the design of stormwater garden and park areas
- Reduction in stormwater overflow events

AESTHETIC

- Visual and environmental enhancement of sites
- Beauty and environmental benefit to adjacent neighborhoods
- Better social atmosphere

Chicago Industrial Corridors:

Three Corridor Typologies based on Parcel Size and Pattern

A key aspect of managing stormwater is to understand 1) the various patterns of parcel types along with 2) the adjacent infrastructure of roads, railroads, and riverways. Linking these will determine the best physical design strategies for managing stormwater.

Dense-Urban Corridor

Physical Description

Predemominance of small urban parcels organized along city street and block system

High-building density, with small percentage of open unoccupied or vacant land

Dense system of roads and rail

Often adjacent to residential neighborhood

Stormwater Opportunity

Grid of streets and alleys provide linear water collection and mangement system for parcels

Small vacant lots can provide stormwater storage and infilration areas integrated as pocket parks

Proximity of many parcels can provide a shared water re-use district

Corridors

Armitage
Greater southwest
Kinzie
Knox
Ravenswood

Large-Lot Corridor

Primarily large, low building-density parcels

Large percentage of surfaces are paved parking lots, and storage and transfer areas

Presence of large open areas such as rail and utility rights-of-way and river banks

Low density road network

Large open land areas provide space for on site management of stormwater

Portions of large, unused right-of-way areas can be allocated for overflow collection from large paved areas

High potential for stormwater storage and re-use by both individual and shared sites

Brighton Park
Burnside
Elston/Armstrong
Harlem
Kennedy
Little Village
Pullman
West Pullman

Hybrid Corridor: a variety of parcel types

Variety of parcel types and densities; pattern of buildings and lot sizes varies greatly

Various infrastructure present, often influenced by adjacent neighborhood conditions

Usually influenced by a strong rail and/or river corridor.

Multiple conditions and existing infrastructure provide for countless creative solutions

Large sites may develop on site treatment or coordinate with adjacent owners to develop shared systems

Opportunities for shared systems in street or rail rights-of way that can collect from both small and large parcels

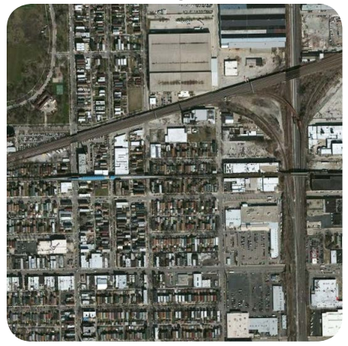
Possible system of stormwater parks and gardens

Addison
Calumet
North Branch
Northwest
Petersen
Pilsen
Pulaski
Roosevelt/Cicero
Stevenson

Adjacencies

A key benefit to developing corridor-wide features is that urban areas immediately adjacent to the corridor will be greener, cooler, and more beautiful.

Residential neighborhoods



Forests and waterways

Commercial areas

Parcel Types:

Why do we care about the shape, size, and density of parcels? Because this is where some of the initial decision-making will begin. Property owners may be confronted with stormwater challenges, and need to consider an alternate method for managing stormwater that is less expensive, more effective, and better looking.

Because parcels are characterized based on various scale and spatial arrangements, they guide the initial decision-making process about the options for managing stormwater. This is not a one-size fits all process. The suggestions within this brochure are intended to create an awareness about the big picture, and to lead to further resources.

Design and coordination of green infrastructure implementation will be supported by city agencies along with consultation by local stormwater design firms. For all parcel types, stormwater features will be specifically designed to meet the stormwater collection, infiltration and/or re-use needs for that parcels or group of parcels. A list of resources is located on the back cover.

What parcel type am I?

Typically a parcel type is characterized by three conditions:

Parcel size and density: the physical relationship of buildings to land area

Other parcels around it: the density and size distribution of parcels within a given area

Infrastructure network: the proximity and condition of adjacent roads, railways, and riverway

The parcels most capable of managing their own storm water on site will be large parcels that will have a small building to site-area ratio. Parcels of modest size and/or with a high building density will typically need to participate in a shared system due to space constraints.

Size	+	Building Density	=	Parcel Type ---------->	Stand-alone or Shared Features
Large		High		**Type 1 Large-Dense LD**	Shared
		Med		**Type 2 Large-flexible LF**	Shared or On site
		Low		**Type 3 Large-open LO**	On site
		Vacant		**Type 6 Large-vacant LV**	On site, or Shared, provide management for nearby dense parcels
Small		High		**Type 4 Small-dense SD**	Shared
		Low		**Type 5 Small-open SO**	On site (primary) or Shared (secondary)
		Vacant		**Type 7 Small-vacant SV**	Shared, provide management for nearby parcels

Stormwater TOOLBOX: Go it alone.....

There are two primary approaches for managing stormwater:

Stand-alone : direct capture and storage of water on site, and
Shared : conveying stormwater to features shared by two or more parcels

Stand-alone features are for parcels that have the space to capture and manage water within their site.

STAND-ALONE FEATURES

Parcel Types 2, 3, 5

Examples of features located within sample parcels types

Bioswales in property setbacks

Type 2 - LF

Type 3 - LO

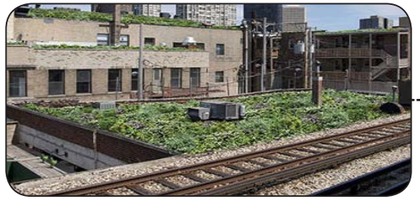
Type 5 - SO

Bioinfiltration gardens in rights-of-way

Bioswales in parking lots

Permeable pavement

Green roofs



Stormwater TOOLBOX: .....team up!

The organization of streets, rail corridors, and vacant parcels provides an infrastructure network of horizontal surfaces throughout the corridors for managing stormwater. These spaces can be designed to capture and convey stormwater as a system-wide shared strategy. The features within a shared system will take advantage of these infrastructures which often run through or alongside a set of parcels and therefore allow each parcel access or frontage to convey storm-water to it. Below are four examples of how parcels can direct their stormwater to a series of shared features in their corridor.

SHARED FEATURES

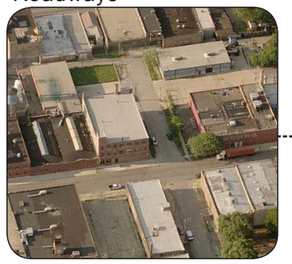
Parcel Type 1, 4, 6, 7

FEATURES - designed for collecting and treating stormwater from a group of parcels

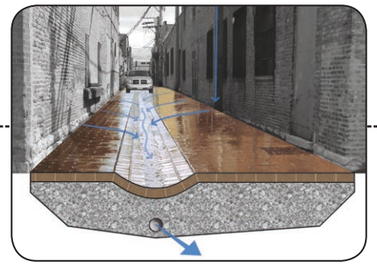
WHERE is stormwater managed? (Four examples)

HOW is stormwater collected?

Roadways

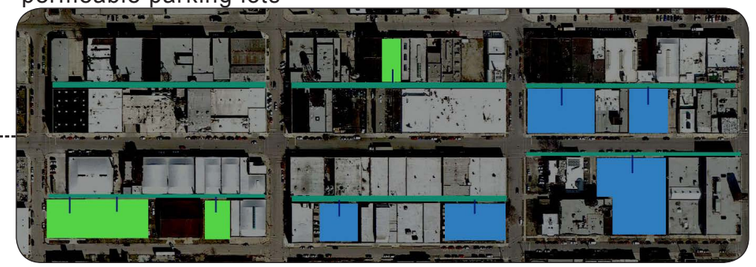


Permeable alleys



Stormwater gardens

Alleys and roads direct stormwater to small vacant lots and permeable parking lots



Type 4 (SD) parcels, with a dense network of streets and alleys, can direct water into **PERMEABLE ALLEYS AND STREETS**, **STORMWATER GARDENS IN SMALL VACANT LOTS**, and **PERMEABLE PARKING LOTS** through disconnected downspouts, existing street gutters, and alley channels.

Railroad corridors

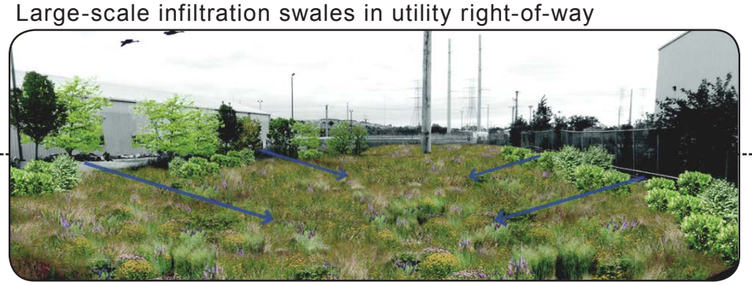
Shallow swales and filter strips in railroad right-of-way

Rail rights-of-way manage water from adjacent parcels

Parcel types 1 (LD), 4 (SD), and 5 (SO) can convey and treat water within **RAIL AND UTILITY RIGHTS-OF-WAY** and **VACANT PARCEL STORMWATER GARDENS** through a series of **STREET BIOSWALES AND PAVEMENT CHANNELS**.The rail rights-of-way could be designed as recreational trails or local paths for residents and workers.

Utility rights-of-way

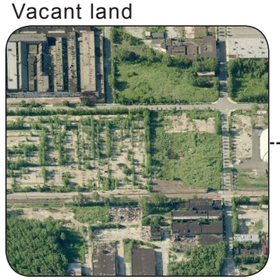
Large-scale infiltration swales in utility right-of-way



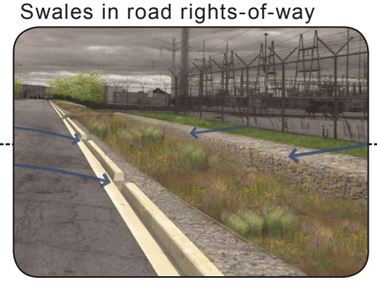
Road and utility rights-of-way manage water from large lots

Parcel types 2 (LF) and 3 (LO) can convey and treat stormwater through a series of **ON SITE BIOSWALES** and channels to the larger stormwater landscapes located in **UTILITY RIGHTS-OF-WAY** and **OPEN SPACE CORRIDORS.**

Vacant land



Swales in road rights-of-way



City-owned stormwater parks

Vacant land (city-owned) designed to receive stormwater

Parcel Types 6 (LV) and 7 (SV) can be designed as a series of **LARGER STORMWATER PARKS** to which stormwater from the corridor is directed via **STREET GUTTERS AND BIOSWALES**. These provide a system-wide detention and infiltration system and double as a visual and recreational asset to the entire community.

Planning for the Future

This stormwater guide is aimed at the long-term transformation of the Chicago Industrial Corridors into increasingly profitable and healthful centers of economic progress for the City of Chicago. The following statements summarize the stormwater goals for the industrial corridors. The City of Chicago will continue to seek ways to improve the opportunities for implementation of the recommendations within.

Focus on the long-term best management and use of stormwater.

Don't be limited by short-term thinking, planning , or design.

Implement **green infrastructure over grey infrastructure** whenever possible.

Consider this a **multi-decade approach** to greening our industrial corridors.

The goals and plan are aspirational, and sets out **a strategy for achieving those aspirations**.

Don't try to solve every problem or issue at a site scale, all at once.

These are long-term, large-scale, ecological and economic transformations.

References and Resources

Adding Green to Urban Design - City of Chicago
http://www.cityofchicago.org/dam/city/depts/zlup/Sustainable_Development/Publications/Green_Urban_Design/GUD_booklet.pdf

A Guide to Stormwater Best Management Practices - City of Chicago
http://www.cityofchicago.org/dam/city/depts/doe/general/NaturalResourcesAndWaterConservation_PDFs/Water/guideToStormwaterBMP.pdf

Chicago Climate Action Plan
http://www.chicagoclimateaction.org/pages/adaptation/11.php

CMAP Chicago Metropolitan Area Plan - GO TO 2040
http://www.cmap.illinois.gov/strategy-papers/stormwater-best-management-practices/stormwater-management

EPA Green Infrastructure for Stormwater
Overview: http://water.epa.gov/infrastructure/greeninfrastructure/index.cfm
Tools: http://water.epa.gov/infrastructure/greeninfrastructure/index.cfm

IL EPA Green Infrastructure Plan for Illinois
http://www.epa.state.il.us/green-infrastructure/index.html

Image Credits

Figure 1: "McCormick Works Factory, International Harvester Company, Chicago, USA, World's Largest Farm Machine Factory" H.M. Pettit. Chicago Historical Society (ICHi-16826)
Figure 2: City of Chicago, Department of Transportation
Figure 3: http://minnesota.publicradio.org/display/web/2010/11/08/minneapolis-park-design-competition-finalists-announced/

Notes

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