Chicago's Sustainable Streets Pilot Project

Cool and Sustainable Pavements
U.S. EPA Heat Island Reduction Program

Richard M. Daley, Mayor
City of Chicago

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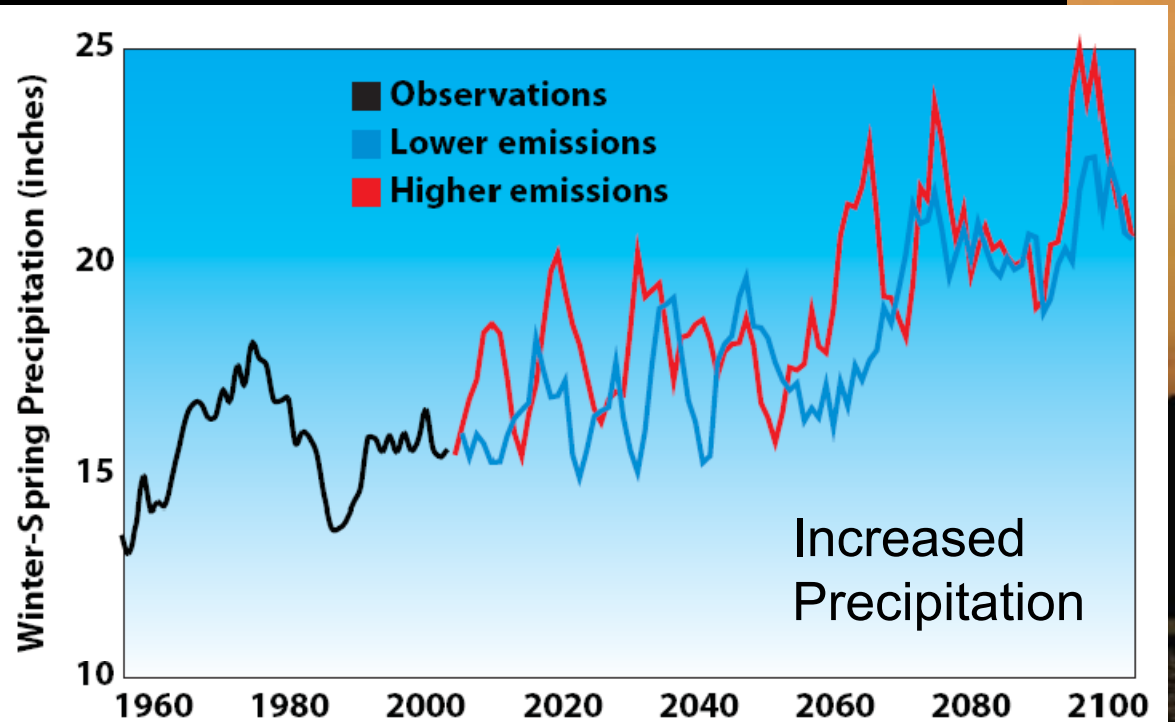
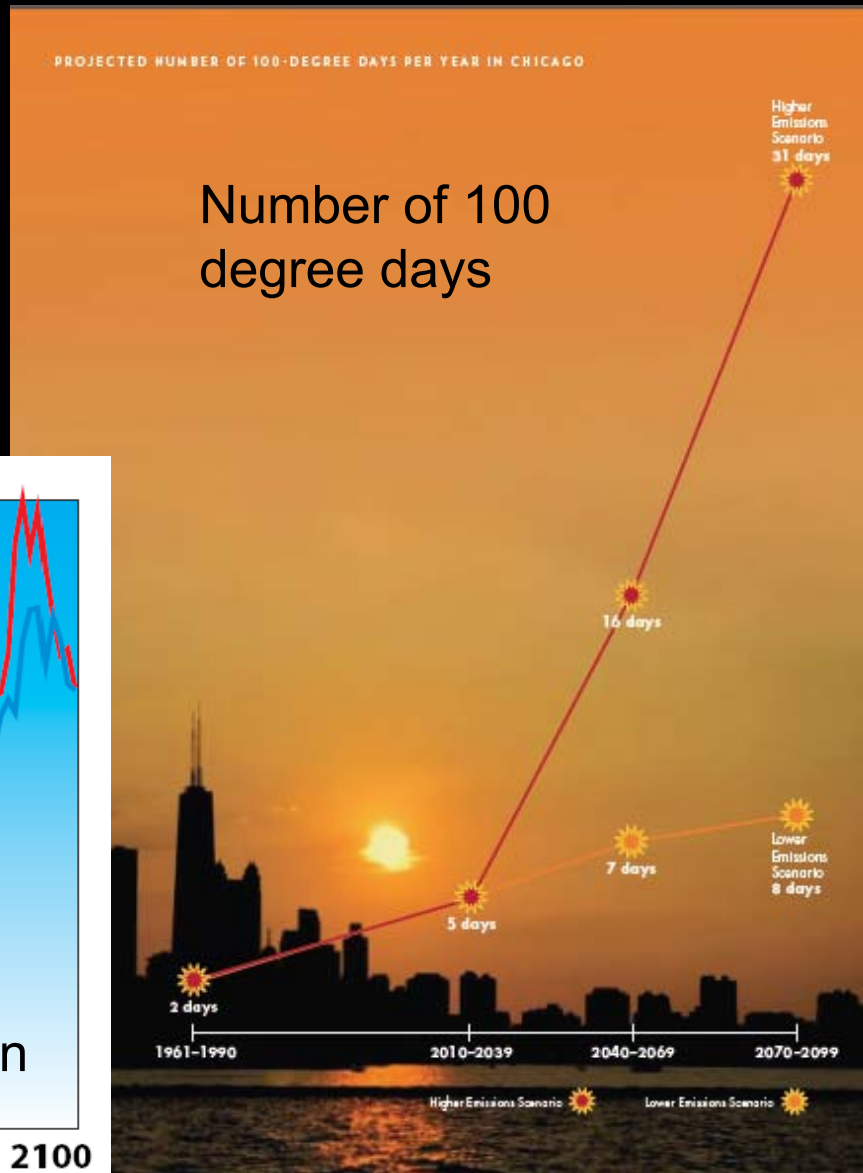
Streetscape and Sustainable Design Program

Chicago Climate Action Plan – Expected Meteorological Changes

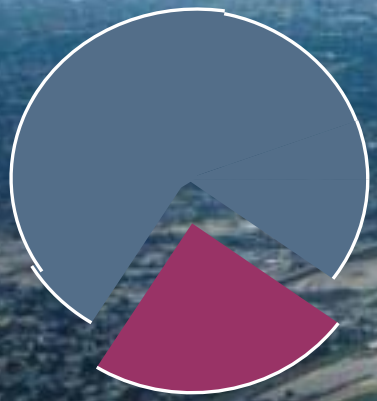
- Addressing the challenge of climate change with 5 strategies and 35 ways to ensure a resilient city.

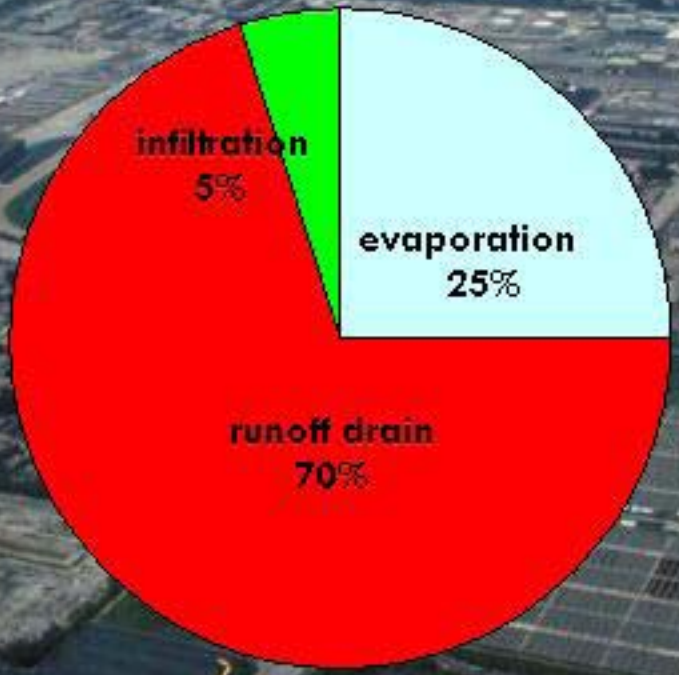




The Urban Form

- Chicago Land Area = 144,593 ac
  Public Right-of-Way (23%)





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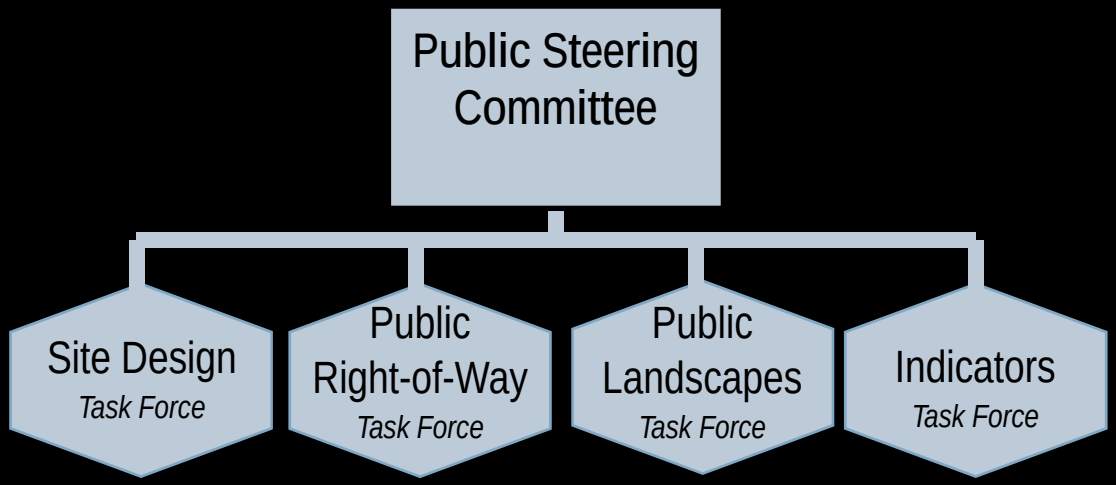
Adding Green to Urban Design Framework Plan



- Alternative Modes of Transportation
- Urban Heat Island Effect
- Light Pollution
- Construction Emissions
- Regional Materials

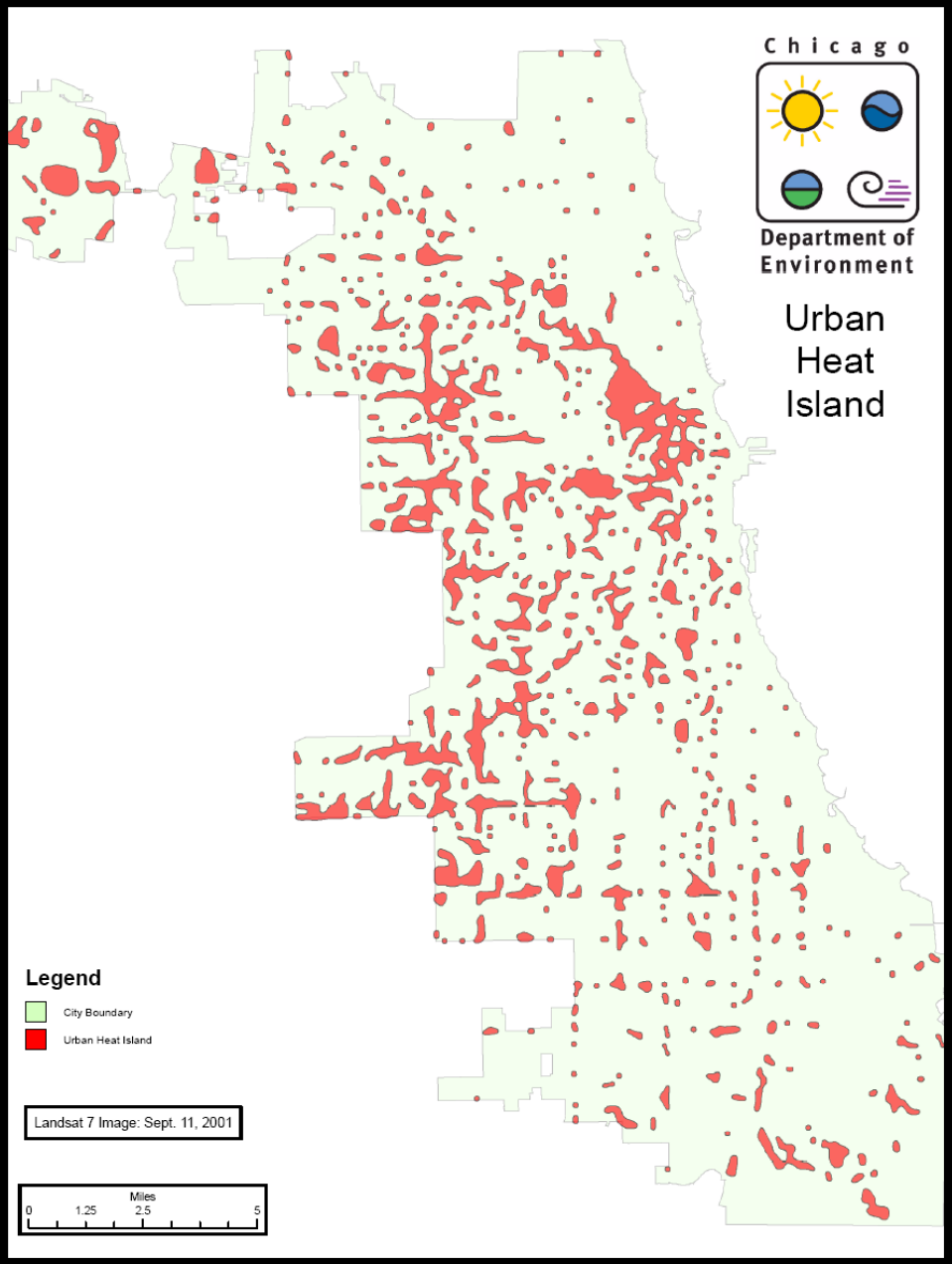
Air Principles

Land Principles

Water Principles

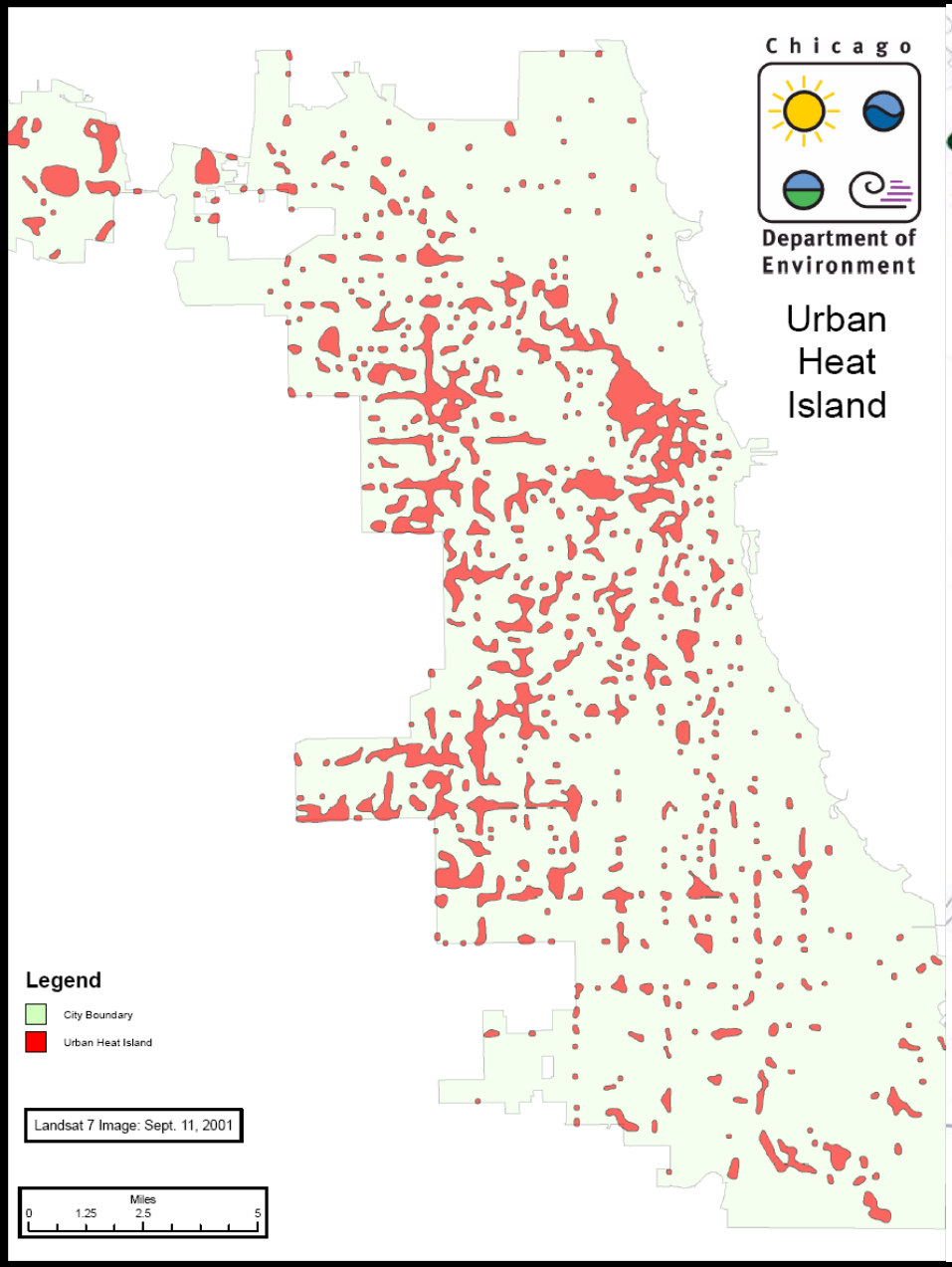
Quality of Life Principles

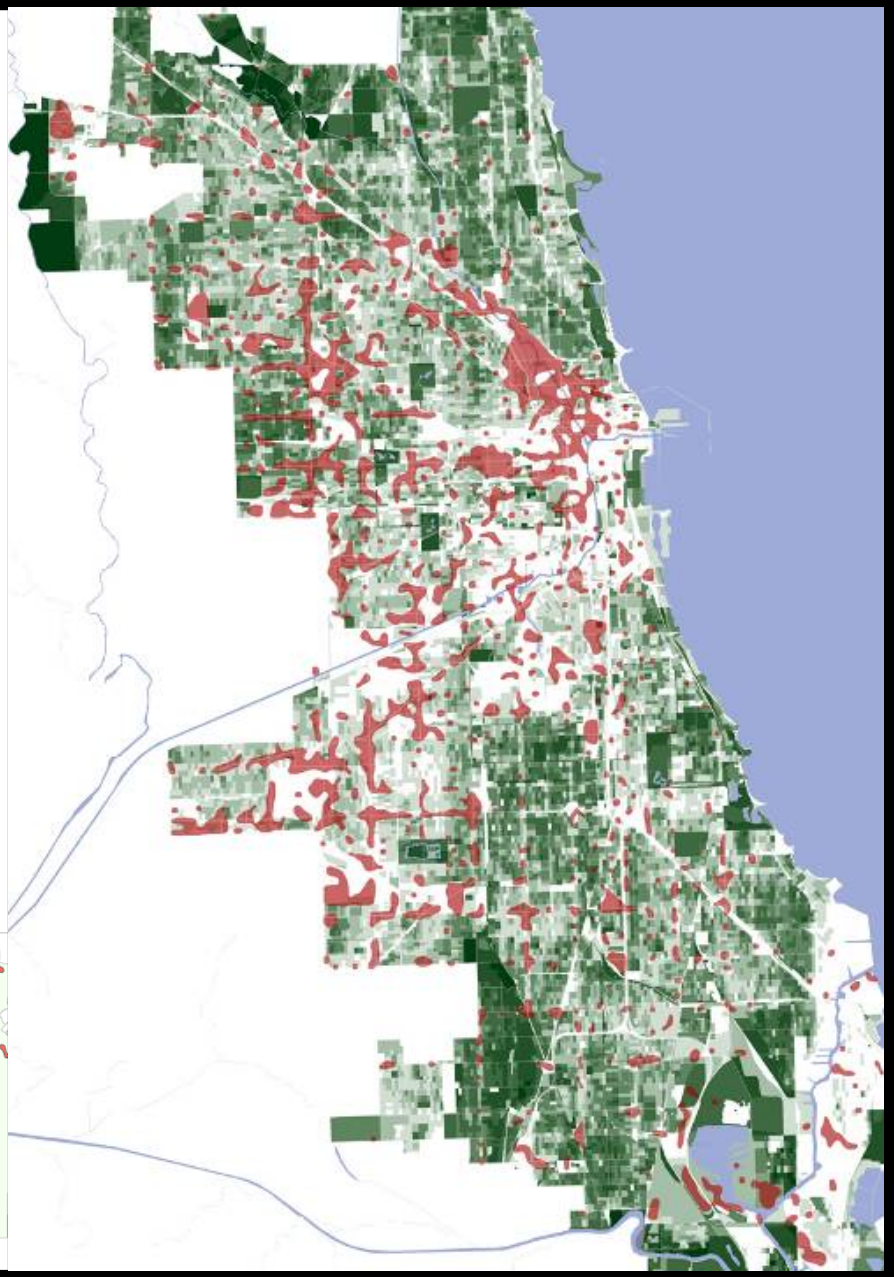
Urban Heat Island



- Roadways
- Industrial Areas
- Parking lots

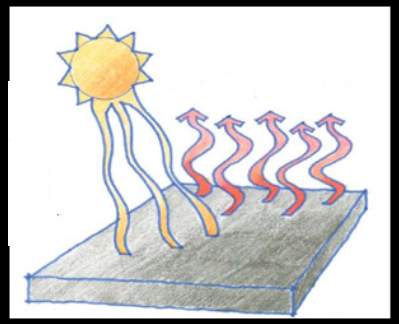
Urban Heat Island





How Complete is your Street?

- Energy Efficiency
- Waste Management
- Air Quality
- Site Selection
- Beauty and Community
- Urban Heat Island
- Stormwater Management
- Water Efficiency
- Alternative Transportation
- Education



Green Alley Program

- 1,900 miles of public alleyways in Chicago, the largest of any city in the world.
- Total of 3,500 acres of impermeable surface, the equivalent area of over 5 Midway Airports.

Alley Summary

Total: 13,000 Alleys

- 20% Currently Unimproved
- 20% in Need of Repairs

Chicago Examples: Green Alley Program

- Six pilot locations, and over forty planned locations citywide
- Program includes use of permeable pavements, recycled materials, high-albedo pavements, and dark-sky lighting.
- Improves stormwater management and energy use through infrastructure improvements

High Albedo Pavement

- Slag in Pervious PCC is 100 lbs/yd3. Total cementious material cannot be less than 525 pounds per cubic yard (lbs/yd3)
- Fly ash not allowed

Location	Air Temp, F	Pavement Temp, F[1]	Pavement Type	Albedo[2]	SRI 5 (0-5 mph)[3]	SRI 12 (5-13 mph)[4]	SRI 30 (13-25 mph)[5]
1700 W. 106th Street	81	121	Pervious HMA	0.04	1.17	1.01	22.34
10300 S. Avenue G	88	116	Pervious PCC	0.18	19.20	18.81	37.01
2100 N. Rockwell Ave	83	93	Pavers	0.19	20.70	20.34	38.29
5300 N. Glenwood Ave	85	107	Pervious PCC Strip	0.18	18.63	18.27	41.08
	85	90	PCC Edge	0.26	29.41	29.08	45.59
2400 N. Harding Blvd	90	98.5	High Albedo PCC	0.26	29.52	29.19	45.68

Wider Implementation

Permeable Ward Yard

Permeable Parkways

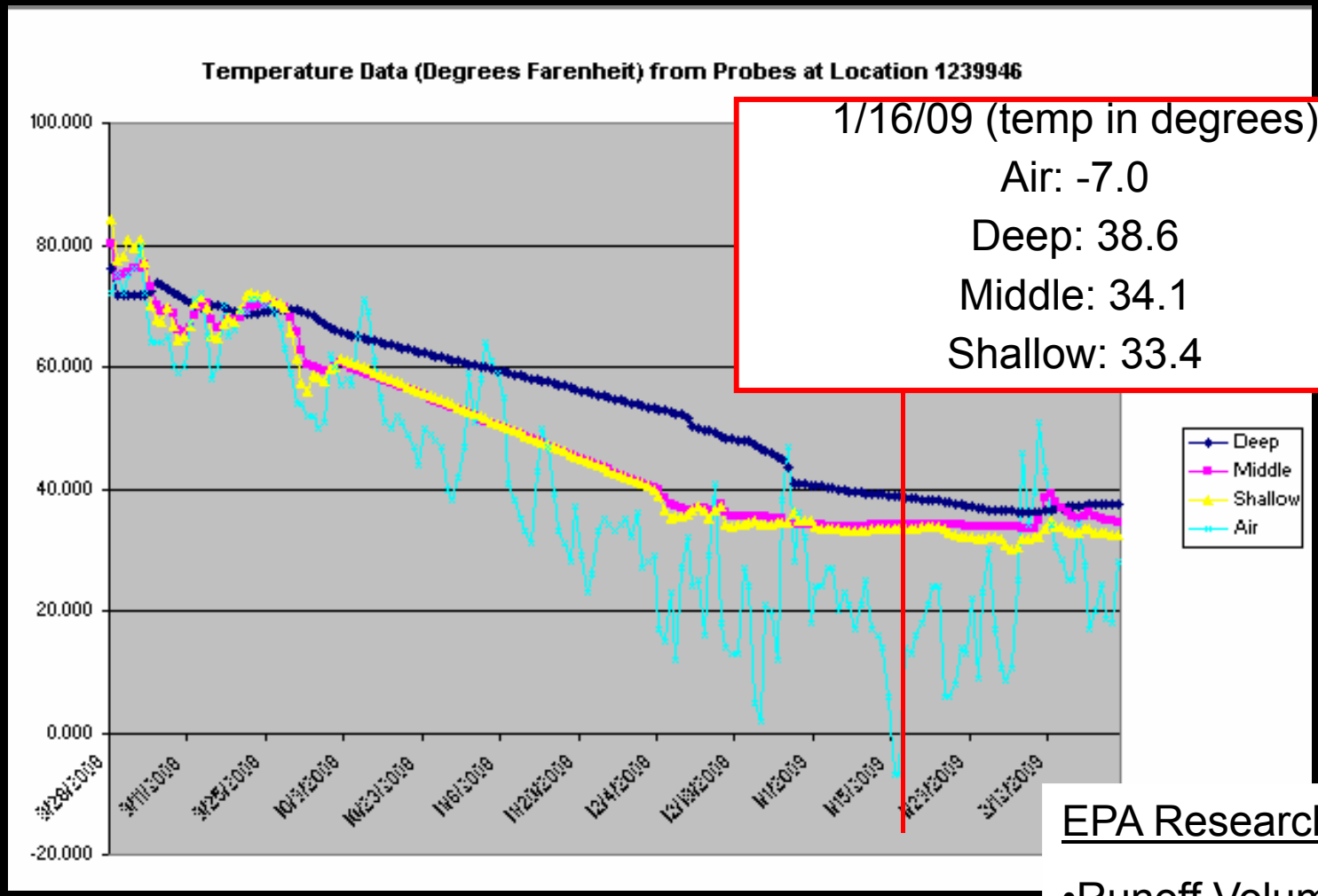
Permeable Pocket Parks

Permeable Parking Lanes

Maxwell Street Permeable Market Plaza

- .89 acres of permeable, high albedo pavers
- Pavers have initial SRI of .30 or 32%
- .19 acres of adjacent bioswale

Market Plaza: Preliminary Monitoring Results



1/16/09 (temp in degrees)
Air: -7.0
Deep: 38.6
Middle: 34.1
Shallow: 33.4

Sept 2008- Feb 2009

EPA Research Questions

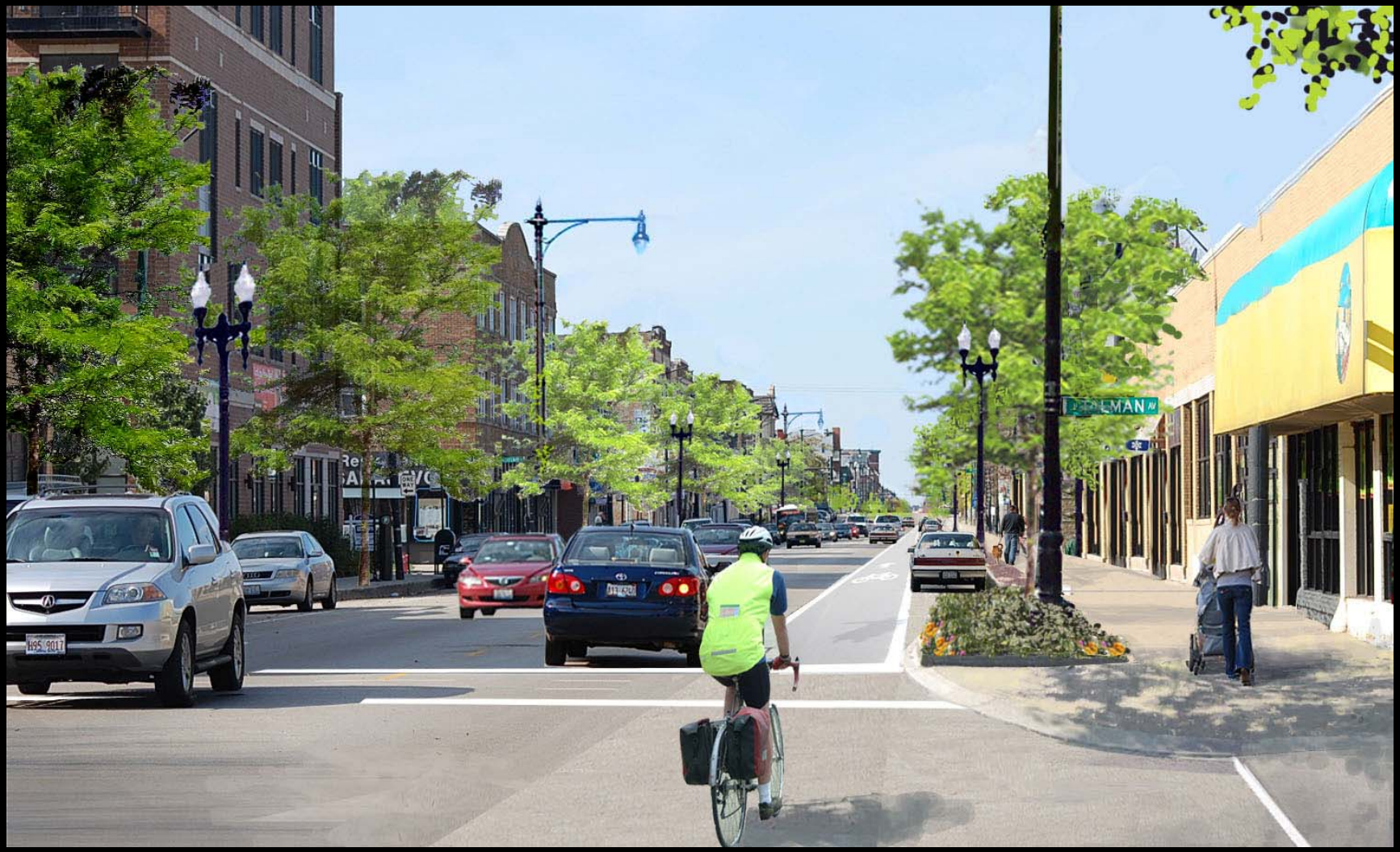
- Runoff Volume and Rate
- Surface Water Quality
- Ground Water Quality
- Freeze/Thaw Performance

Lawrence Ave. Streetscape

Existing Streetscape Conditions

- **West of Western Ave.**

Lawrence Ave. Streetscape



Proposed Streetscape Conditions

- **West of Western Ave.**

Cermak/Blue Island Sustainable Streetscape

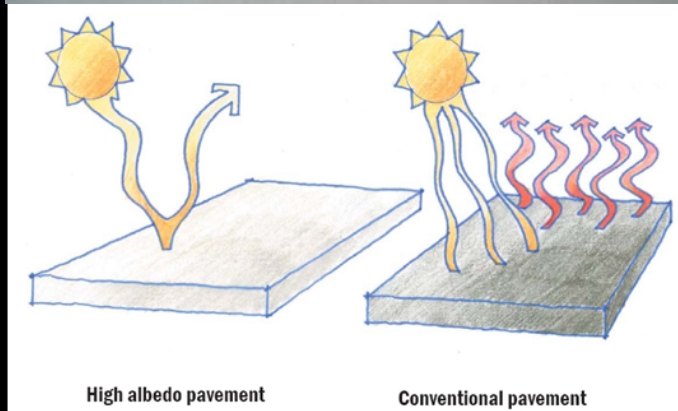
Project Sustainable Goals

Stormwater Management	Divert 80% of the typical average annual rainfall and at least 2/3 of rainwater falling within catchment area into stormwater best management practices.
Water Efficiency	Eliminate use of potable water for irrigation, specify native or climate adapted, drought tolerant plants for all landscape material.
Transportation	Improve bus stops with signage, shelters and lighting where possible, promote cycling with new bike lanes, improve pedestrian mobility with accessible sidewalks.
Energy Efficiency	Reduce energy use by min. 40% below a typical streetscape baseline, use reflective surfaces on roads/sidewalks, use dark sky-friendly fixtures. Min. 40% of total materials will be extracted, harvested, recovered, and/or manufactured within 500 miles of the project site.
Recycling	Recycle at least 90% of construction waste based on LEED NC criteria, Post/Pre- Consumer recycled content must be min. 10% of total materials value.
Urban Heat Island	Reduce ambient summer temperatures on streets and sidewalks through use of high albedo pavements, roadway coatings, landscaping, and permeable pavements
Education, Beauty & Community	Provide public outreach materials/self-guided tour brochure to highlight innovative, sustainable design features of streetscape. Create places that celebrate community, provide gathering space, allow for interaction and observation of people and the natural world.
Commissioning	Model Stormwater BMP's in Infoworks to analyze and refine design. Monitor stormwater BMP's to ensure predicted performance and determine maintenance practices.

Urban Heat Island

Maximize landscape opportunities and streetscape surface area in roadway, sidewalks, and plazas with minimum .29 Solar Reflective Index.

- Sidewalk Concrete with slag
- Microthin Concrete Overlay
- Permeable high albedo pavers
  - Photocatalytic Cement
- Increase tree canopy cover
- Increase landscaped surfaces



Pavement Technology - Asphalt

- Pre-2006: Maximum RAP allowable within IDOT Specification, N30
- 2006: Pilot use of N30LC, using 45% RAP + 15% Recycled Concrete + 10% GTR in the AC Liquid
- 2006: Permeable asphalt with GTR
- 2007: Pilot use GTR in N90 arterial application
- 2008: Pilot 4.75 binder course with GTR with SMA surface
- 2008: Piloted two Evotherm warm mix asphalt projects
- 2009: Pilot use of 5% post-consumer asphalt shingles + 23% RAP, N30, reducing amount of virgin asphalt concrete
- 2010: Warm mix asphalt with 15% RAP + 10% GTR with high albedo micro-thin concrete overlay

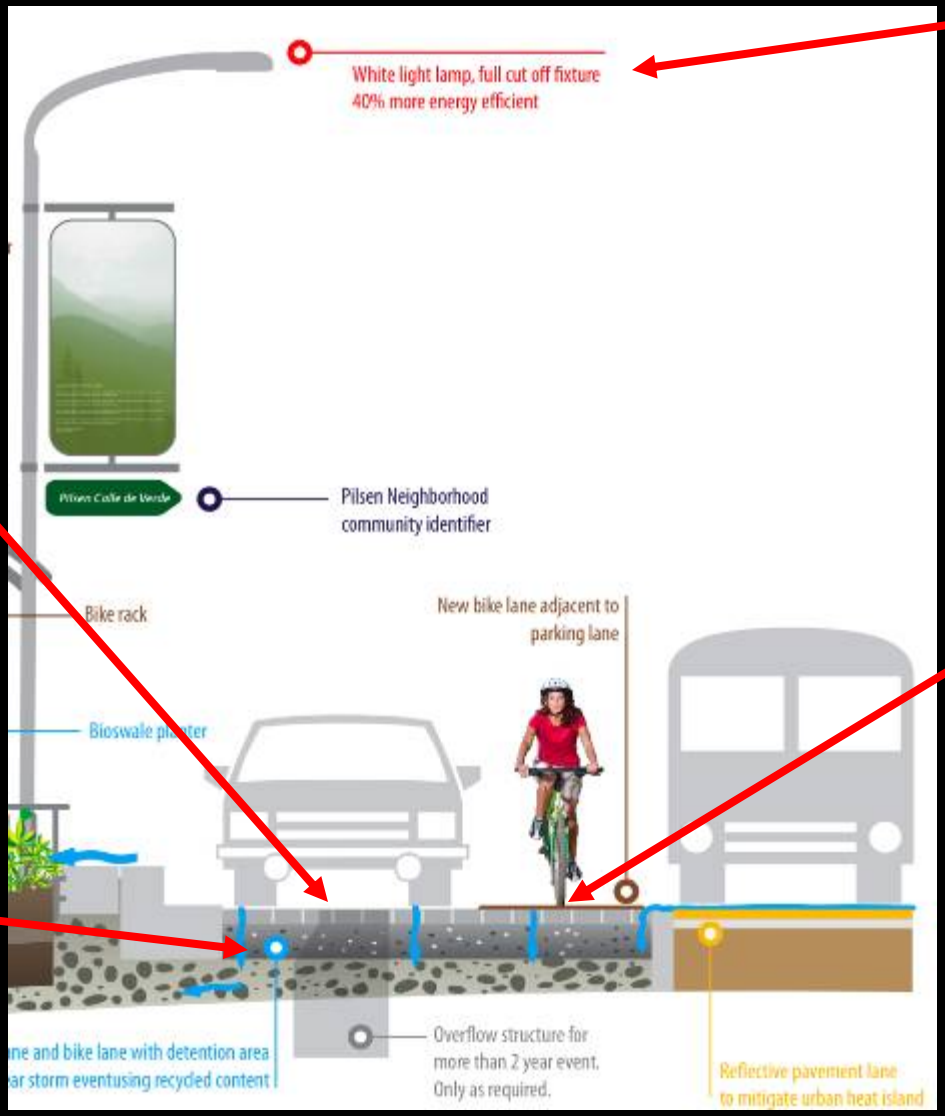
Pavement Technology - Concrete

- 2006: Permeable Concrete with slag
- 2006: High Albedo Concrete with slag
- 2009: Concrete with recycled wash water
- 2009: Refined permeable concrete mix design to accommodate new maintenance protocol and tested asphalt paver installation method
- 2010: Concrete with 30% recycled aggregate, recycled wash water and slag

Micro-thin Concrete Overlay

- Over 100,000sq. Feet of micro-thin concrete overlay
- Minimum SRI of .36
- Installed on outer lanes of Cermak Road and intersection of Cermak Road, Ashland Avenue and Blue Island Avenue

Integrated Infrastructure Design Example: Blue Island Cross-section



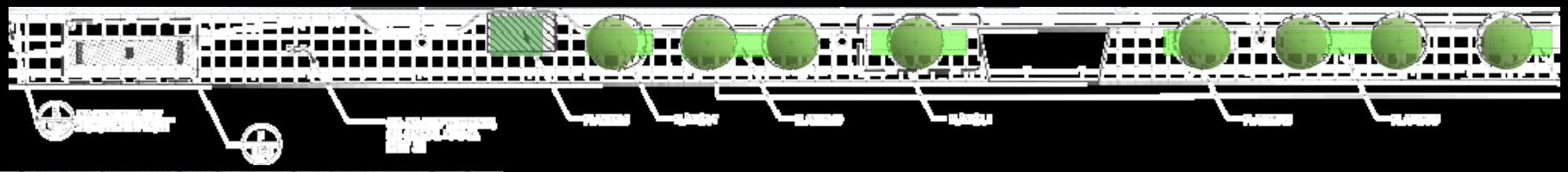
High SRI for Lighting and UHI

Photocatalytic for Air Quality

Bike/ Parking Lane

Permeable Pavement for Stormwater Management

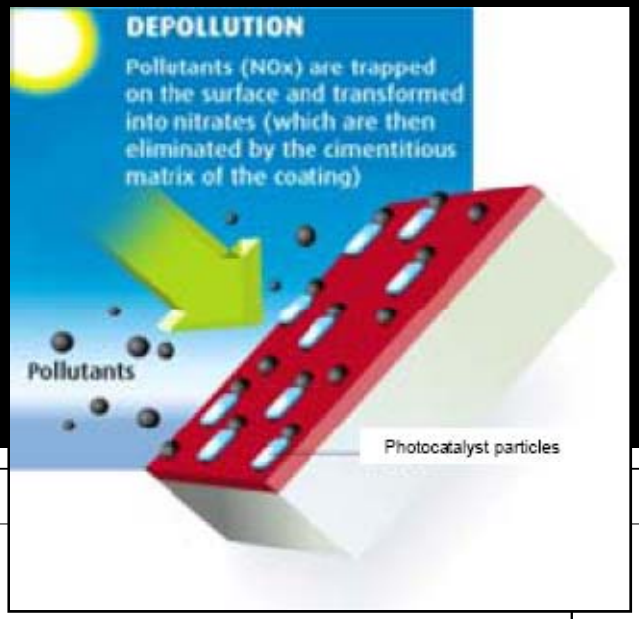
Photocatalytic Permeable Pavers

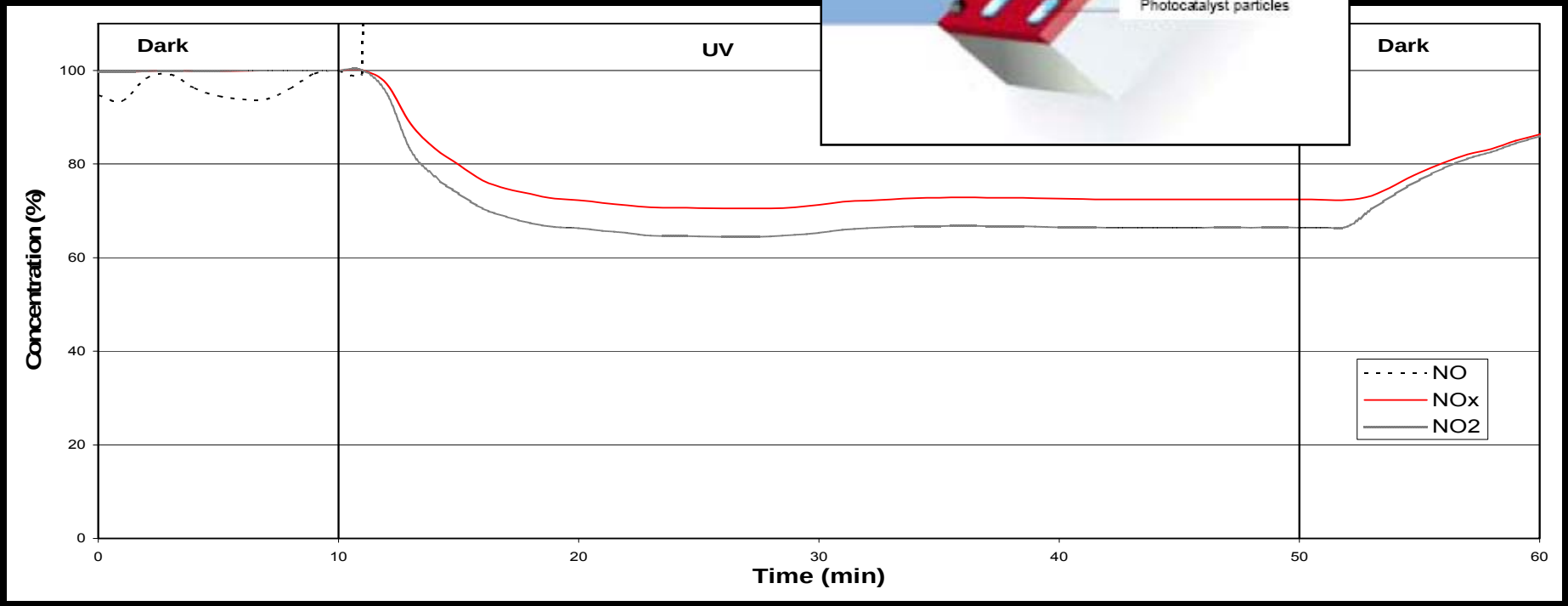


½ Inch Paver Facemix

- Permeable pavers with photocatalytic cement face mix will have a minimum SRI of .45
- Pavers should maintain their SRI better due to “self-cleaning” aspect
- Over 50,000sqft of permeable pavers

Photocatalytic Cement in Pavements





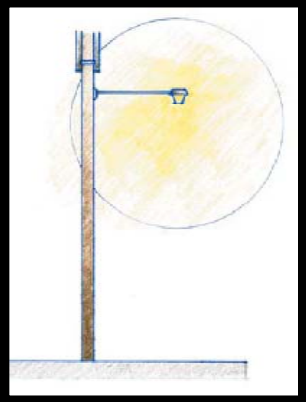
Depollution Process on Tested Paver Samples

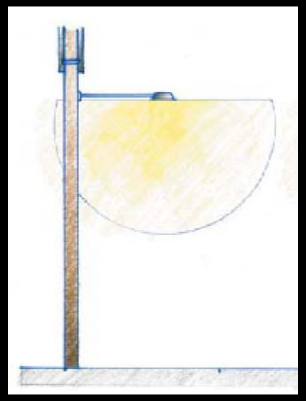
Reduction in NO, NOx, NO2 Gases

Source: Axim Technology Center

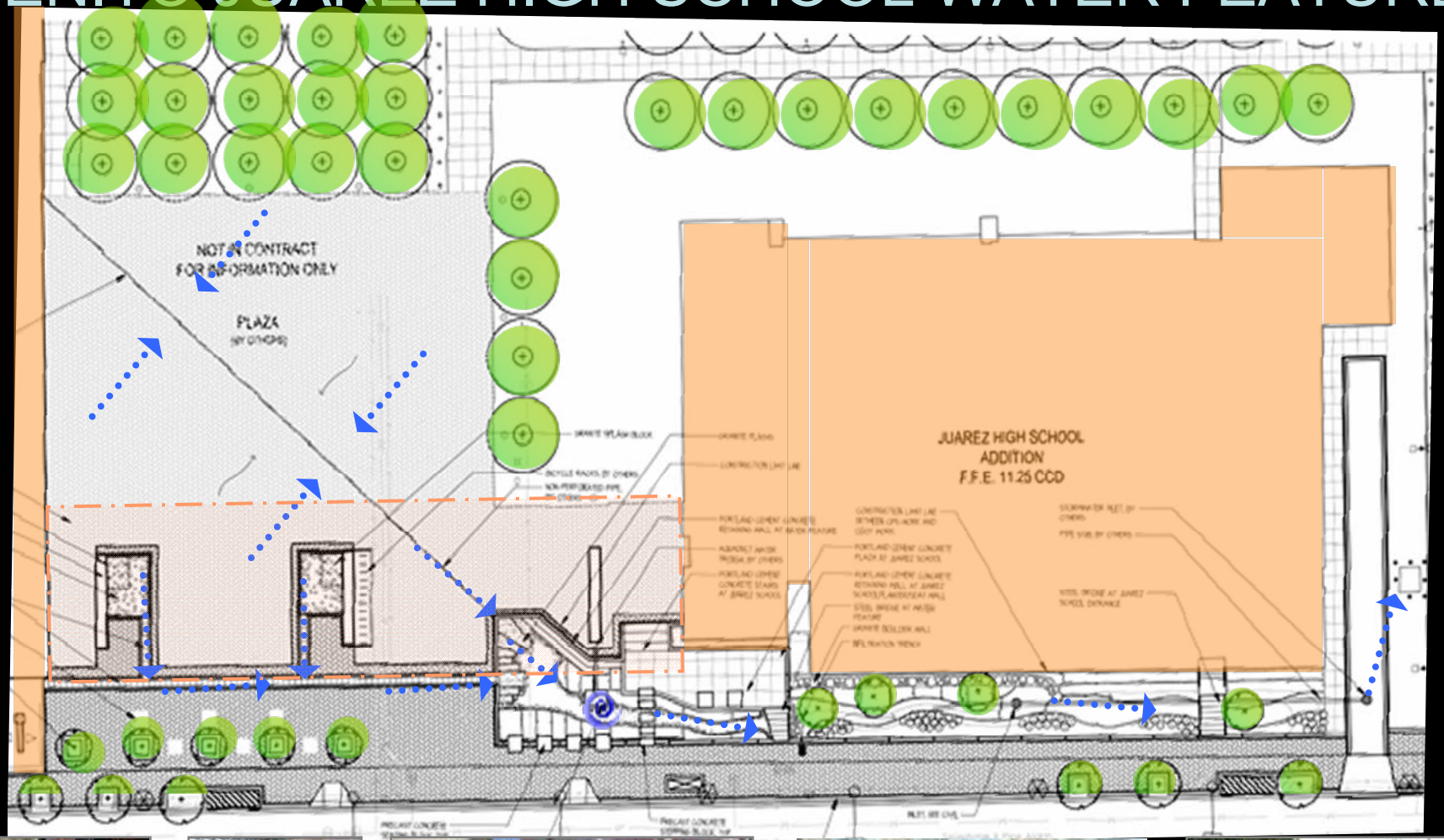
Energy Efficiency:

- Streetlamps will be white LED and metal halide
- Reduced lighting levels
- Use reflective pavement to improve uniformity



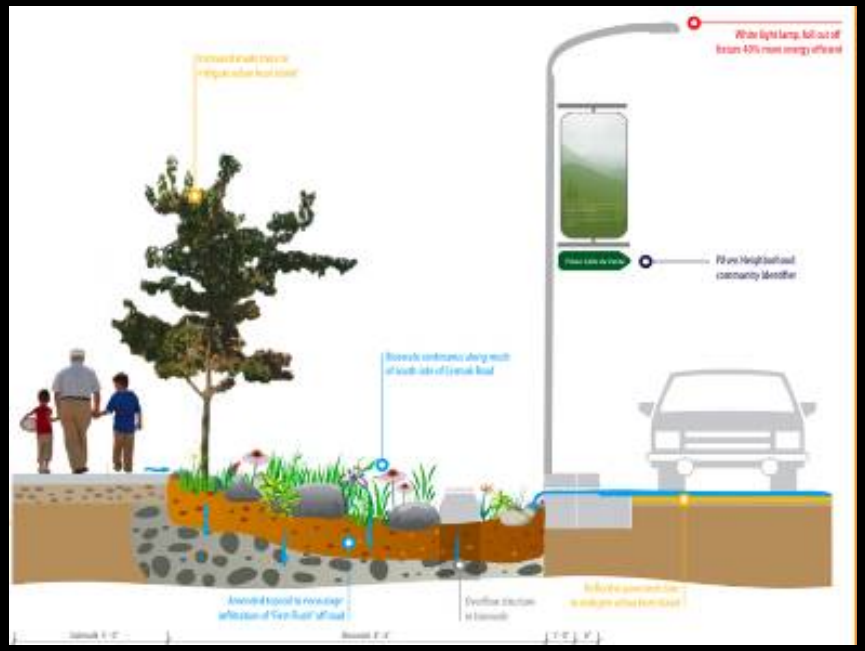


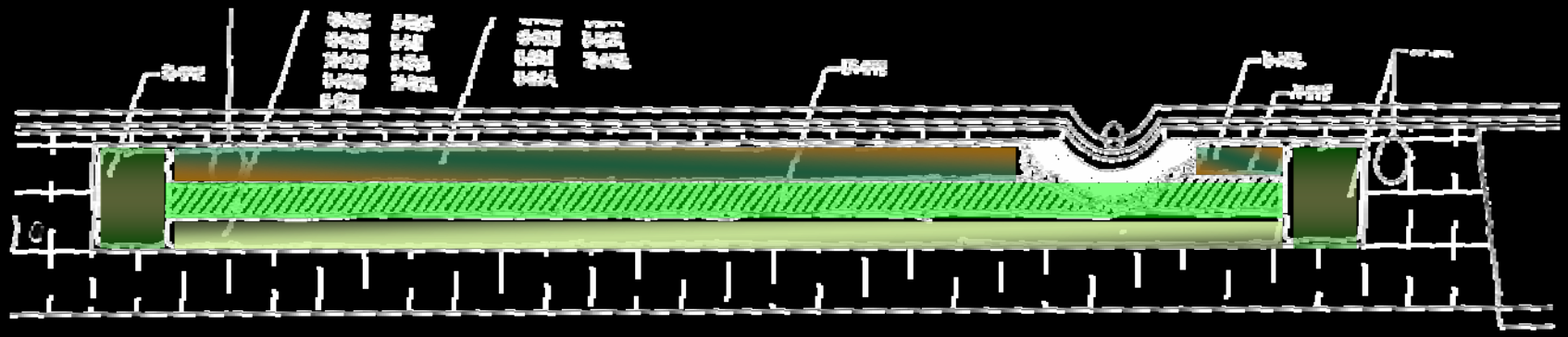
BENITO JUAREZ HIGH SCHOOL WATER FEATURE



Integrated Infrastructure Design Example: Parkway Bioswale

- Stormwater Management
- Pedestrian Buffer
- Landscaped beautification
- Urban Heat Island Reduction
- Water quality
- Reduction in potable water use





Asclepias tuberosa
butterflyweed

Andropogon scoparius
little bluestem

Echinacea pallida
pale purple coneflower

Spartina pectinata
rice cut grass

Aster novae-angliae
New England aster

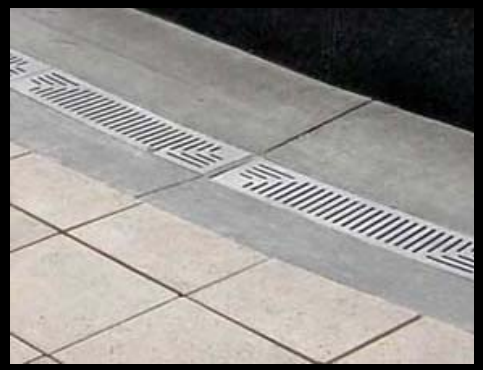
Solidago rigida
stiff goldenrod

Beauty and Community

Human Scale

Allow for interaction and observation of both people and the natural world

Celebrate culture, history, spirit and place



Education

- Partnership with Benito Juarez High School on the project site
- Education Seminar
- Self-guided walking tour brochure
- Informational kiosks/identifiers with interpretive graphics
- Daylight stormwater where possible

Commissioning

- Making the case for sustainable design
- Determining actual maintenance needs
- Continuous learning and improvement
- Critical link for turning pilots to programs

- Green Alleys: Permeability, Albedo, Surface Temperature, Strength
- Maxwell Street Market Permeable Plaza: Partnership with EPA to measure suitability of stormwater BMPs on brownfield sites.
- Sustainable Streetscape: Monitoring Partnership with MWRD / Essroc
    - Infoworks modeling of BMP's within City model

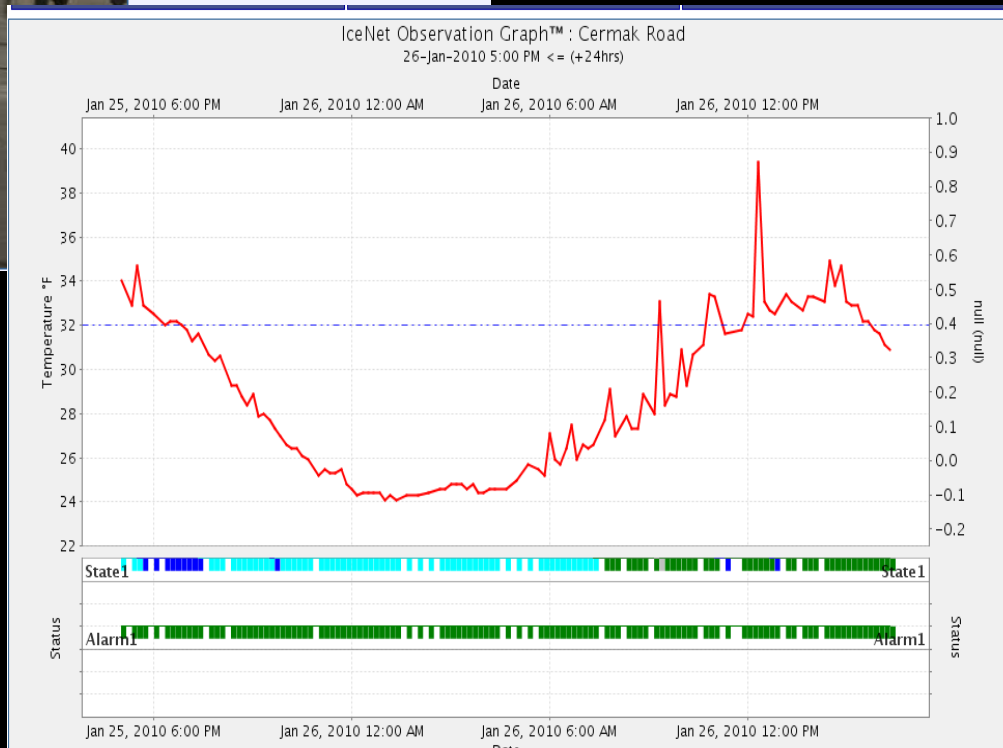
Meteorological Station

Cermak Road

camera 1

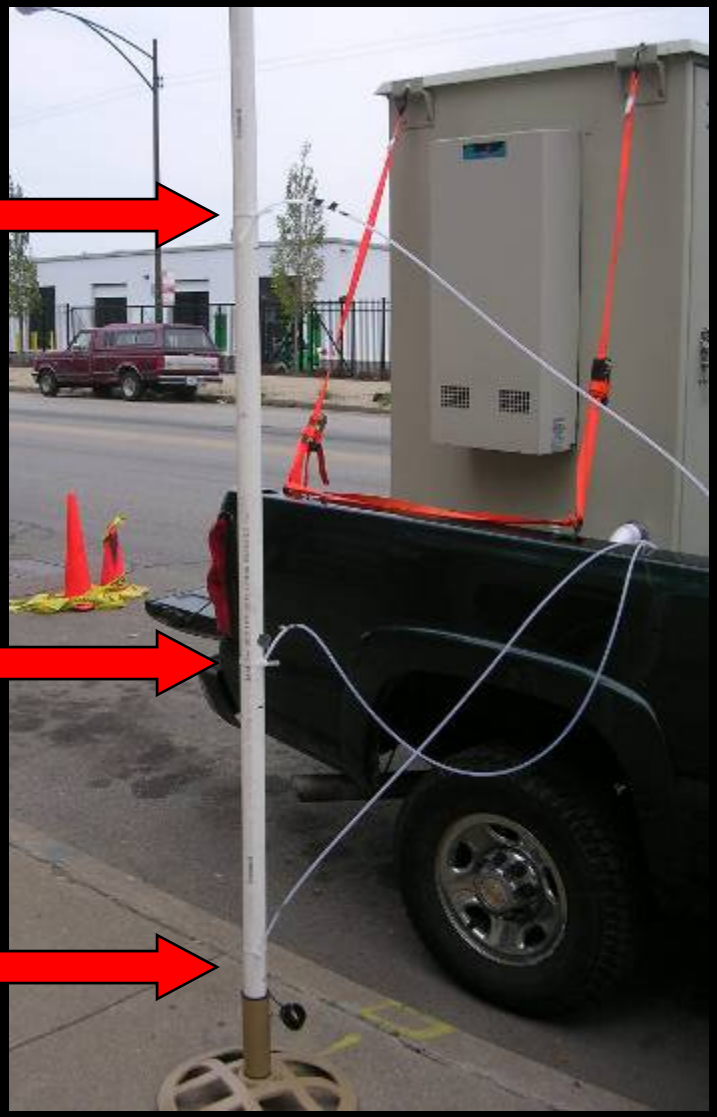
Observation @ 26.01.2010 16:20	
Air Temp	21.9 °F
Dew Point Temp	12.7 °F
Rel Humidity	67 %
Surf Temp	30.9 °F
Surf State	dry
Alarm	none
Grip Level	0.82
Water Layer	0.0 in
Ice Layer	0.0 in
Snow Layer	0.0 in

Can compare air temperature and surface temperature in real time



Intersection of Cermak Raod, Blue Island Avenue and Ashland Avenue will be coated with micro-thin concrete overlay

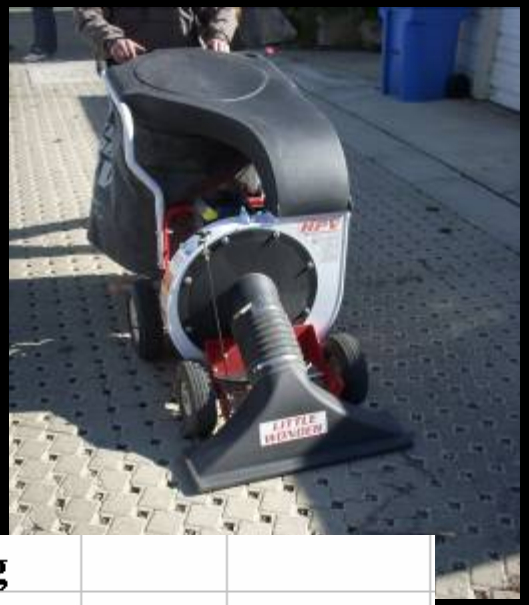
Air Quality Pre-Data Collection



Data Points Include: NO, NO2, NOx, Wind Speed, UV

Maintenance

- Determining Owner Needs
- Evaluating Life Cycle Costs
- Specification Development



May 2008 Green Alleys Monitoring

#	Location	Description	Albedo	Cores	Infiltration	Sweep?
1	1700 W. 106th St.	Pervious HMA alley	Y	Y	Y	3 methods
2	103rd & Avenue G	Pervious concrete alley	Y	Y	Y	3 methods
3	2100 N. Rockwell	Block pavers	Y	N	Y	~~Y~~N
4	5300 N. Glenwood	Pervious concrete strip w/high-albedo panels	Y	Y	Y	Power-wash
5	2400 N. Harding	High-albedo pavement	Y	N	N	N

How complete is your street?

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