

Chicago Transit Authority (CTA) Climate Adaptation Pilot

Karl Peet

*CTA Strategic Planning & Policy
Chicago, Illinois*



**2012 SUSTAINABILITY AND PUBLIC
TRANSPORTATION WORKSHOP**



Climate Adaptation Pilot Overview Project Workplan

- Task I: Survey of System Vulnerabilities (35% of total effort)
 - Deliverable: Overview of key vulnerabilities (with level of risk) through survey of general asset classes (e.g. substations, ROW, viaducts)
- Task II: Adaptation Implementation Plans (45% of total effort)
 - Deliverable: In-depth analyses of three specific project areas for applying adaptation principles (e.g. traction power, right-of-way flooding)
- Task III: Integration into Standard Practices (20% of total effort)
 - Deliverable: Long-term strategies to integrate adaptation into standard CTA business practices (e.g. asset management; safety and operations planning)



Climate Adaptation Pilot Overview

Progress to Date

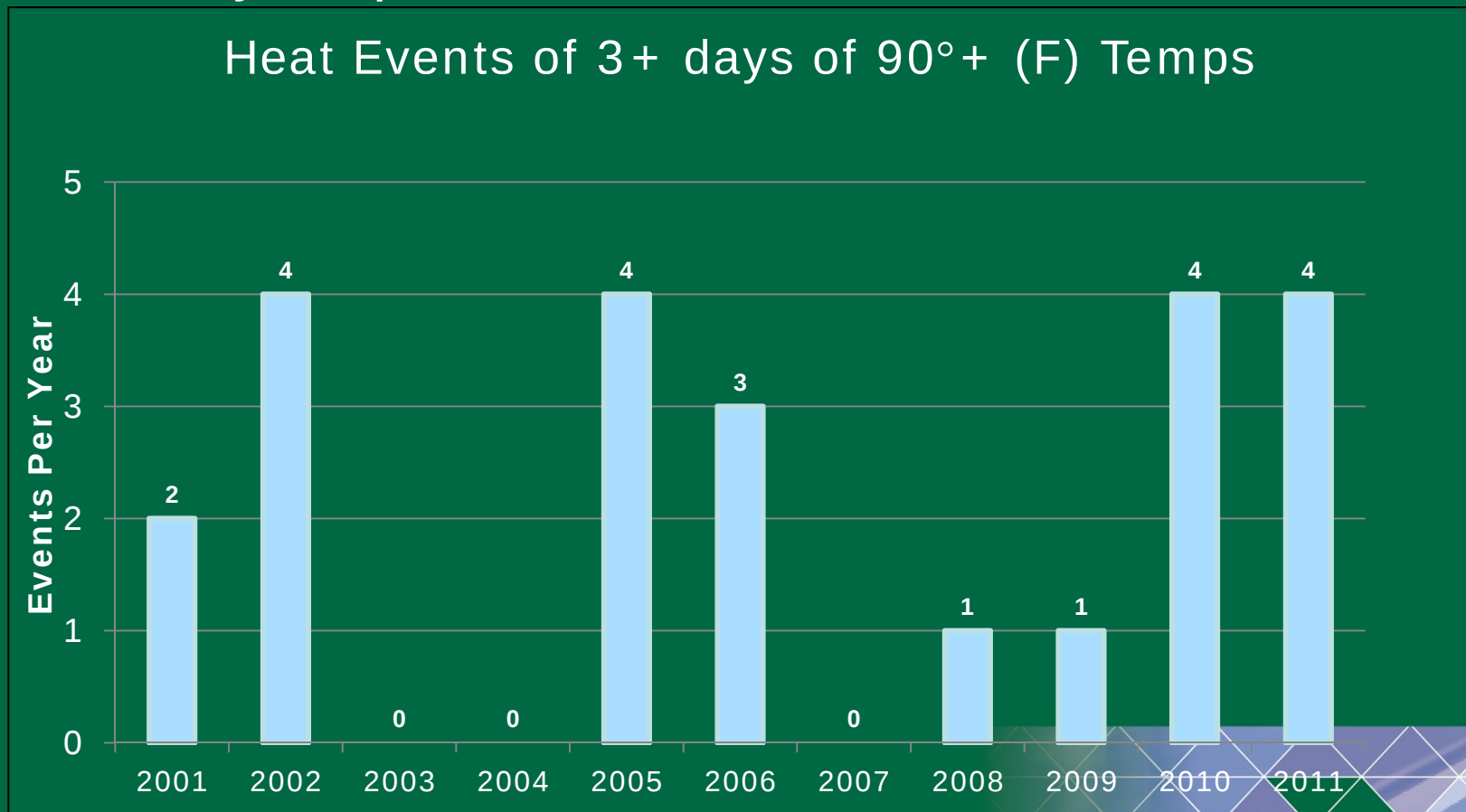
- Expert Interviews: Held interviews with 30 subject matter experts
 - CTA Infrastructure, Operations, Safety & Security, Planning, plus City of Chicago Sustainability, Transportation, and Emergency Management/Communications
- Data Collection: Compiled data from internal/external sources in these general categories:
 - Service Disruptions (e.g. flooding incidents, signal failures, MMIS)
 - Financial Costs (e.g. FEMA claims, traction power)
 - System Vulnerabilities (e.g. urban heat islands, viaduct flooding)
- Data Synthesis (ongoing)
 - Conducting initial analysis to correlate meteorological data with disruption, cost, and vulnerability data
 - Prioritize Task II/III study areas based on data synthesis and CTA stakeholder workshop



Chicago Climate Change Projections

Periods of Extreme Heat / Precipitation

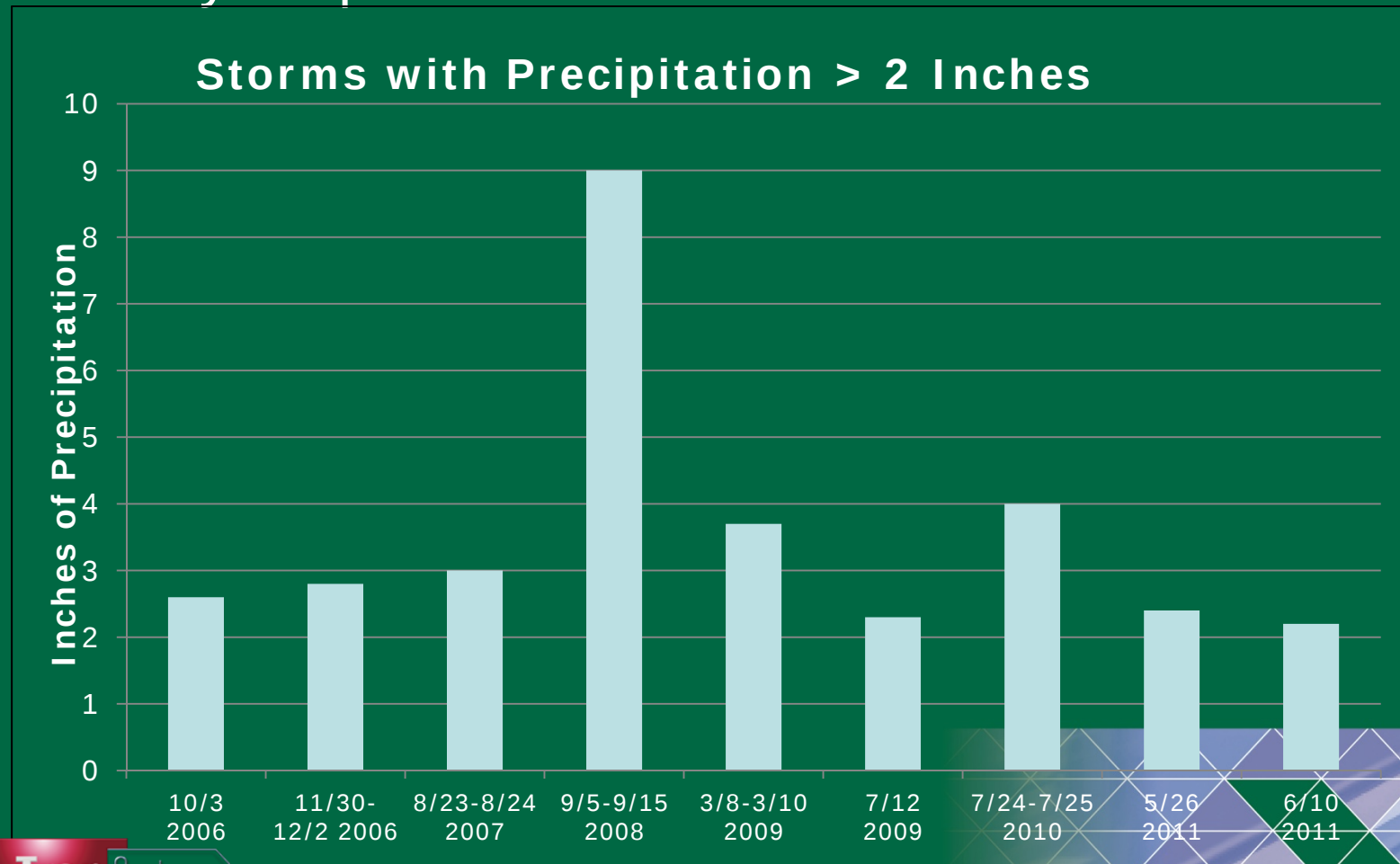
- Midway Airport Data 2001-2011



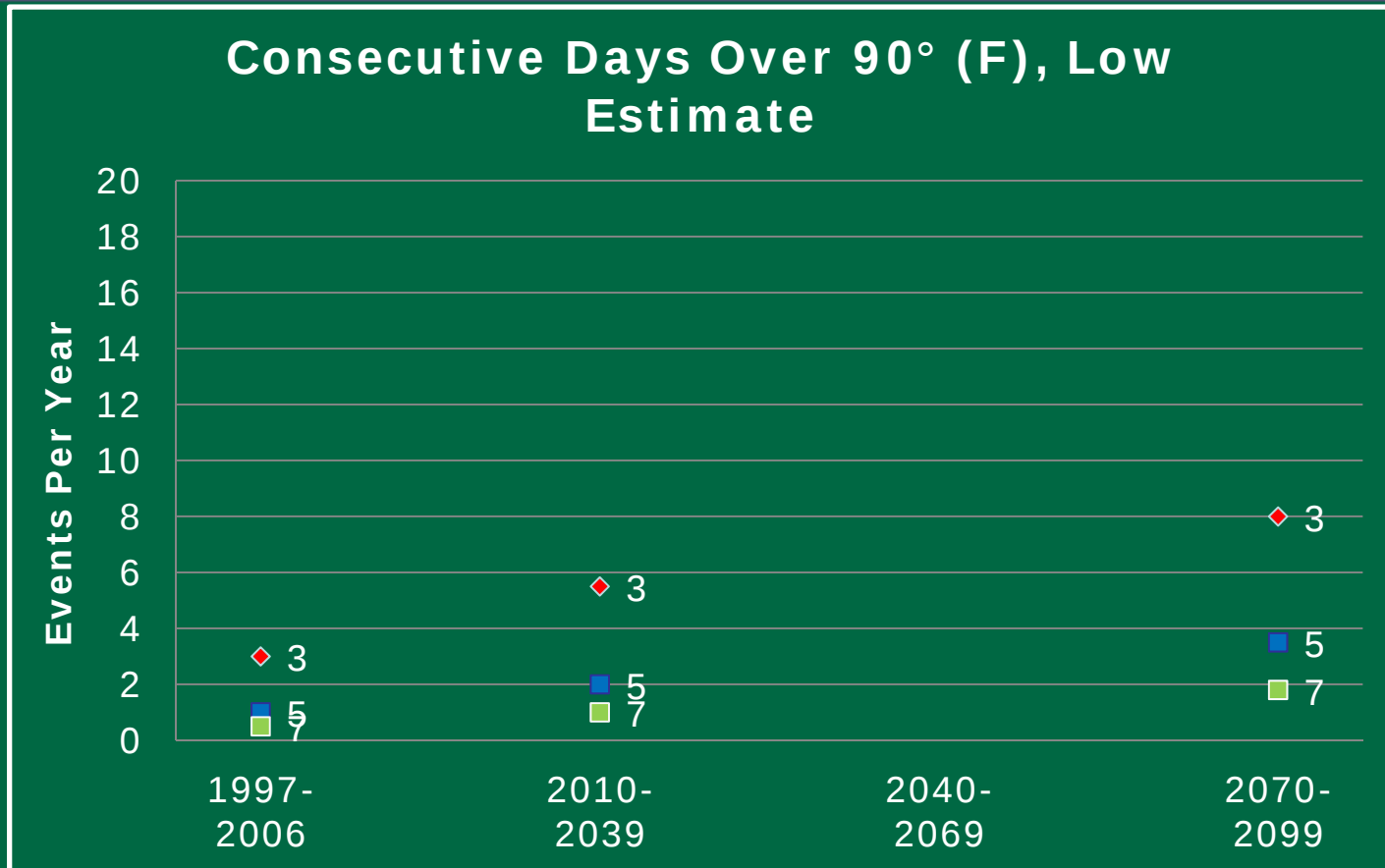
Chicago Climate Change Projections

Periods of Extreme Heat/Precipitation

- Midway Airport Data 2005-2011

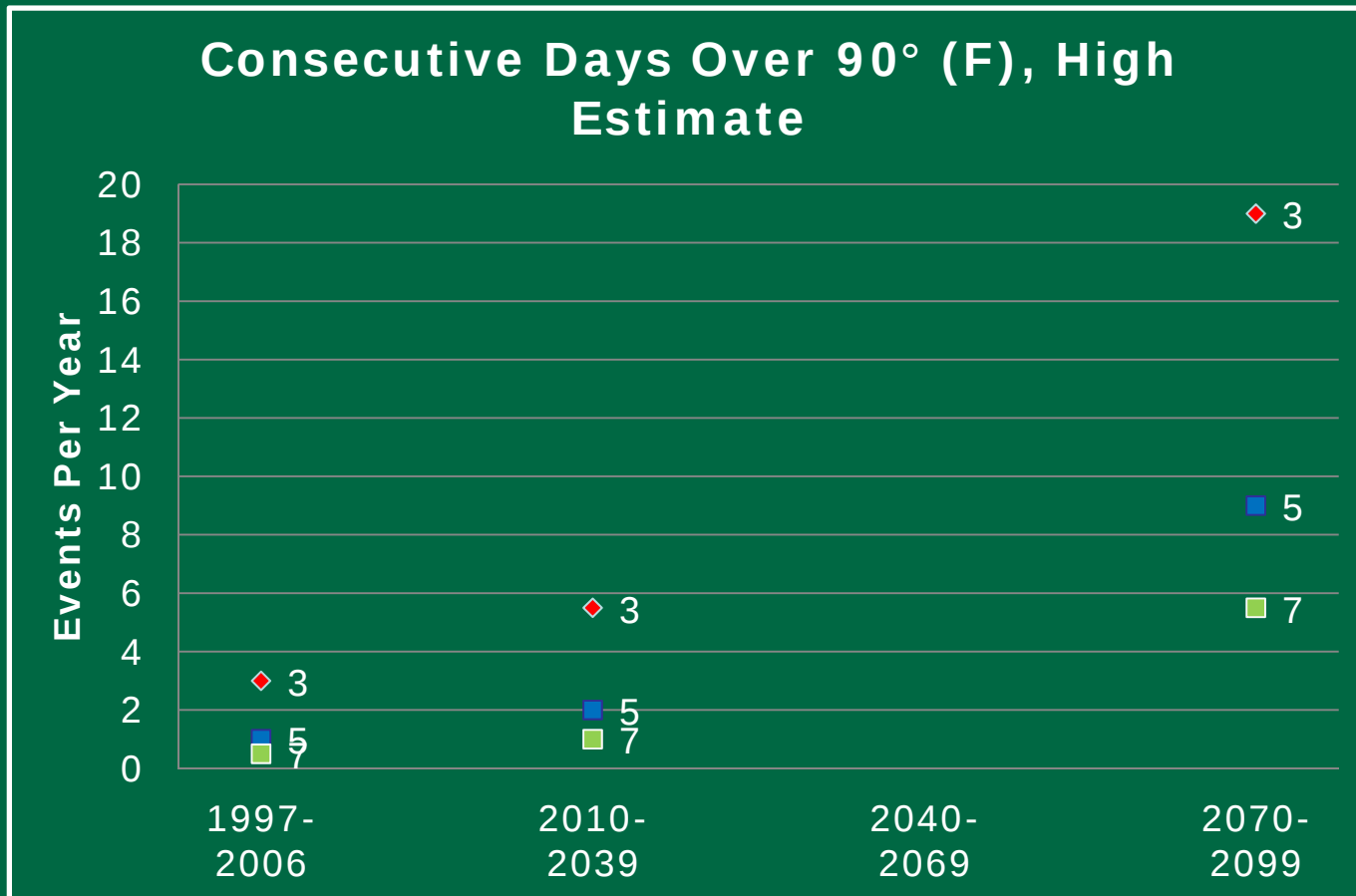


Chicago Climate Change Projections Extreme Heat (1)



Chicago Climate Change Projections

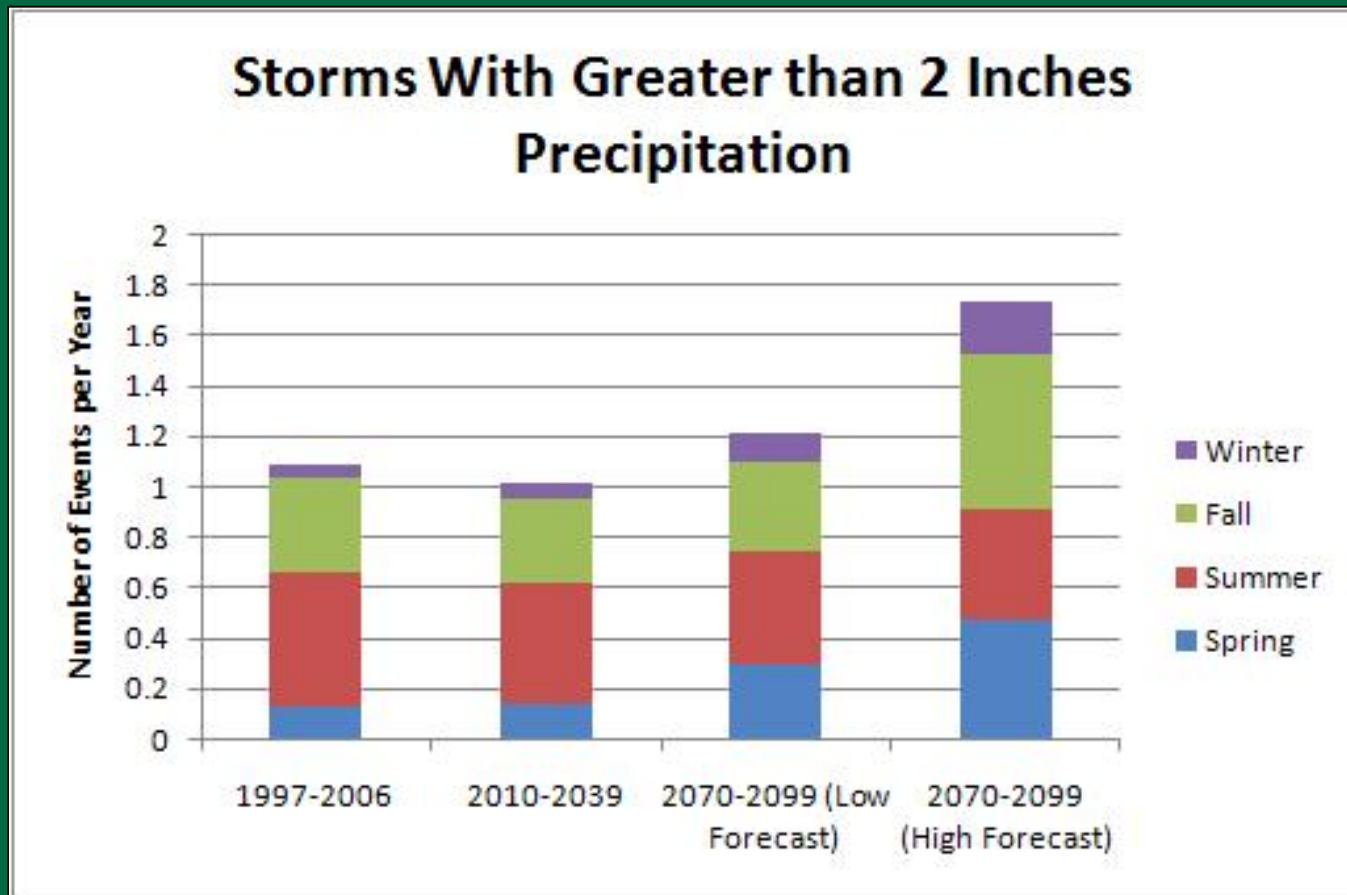
Extreme Heat (2)



Source: K. Hayhoe et al. Journal
of Great Lakes Research, 2010

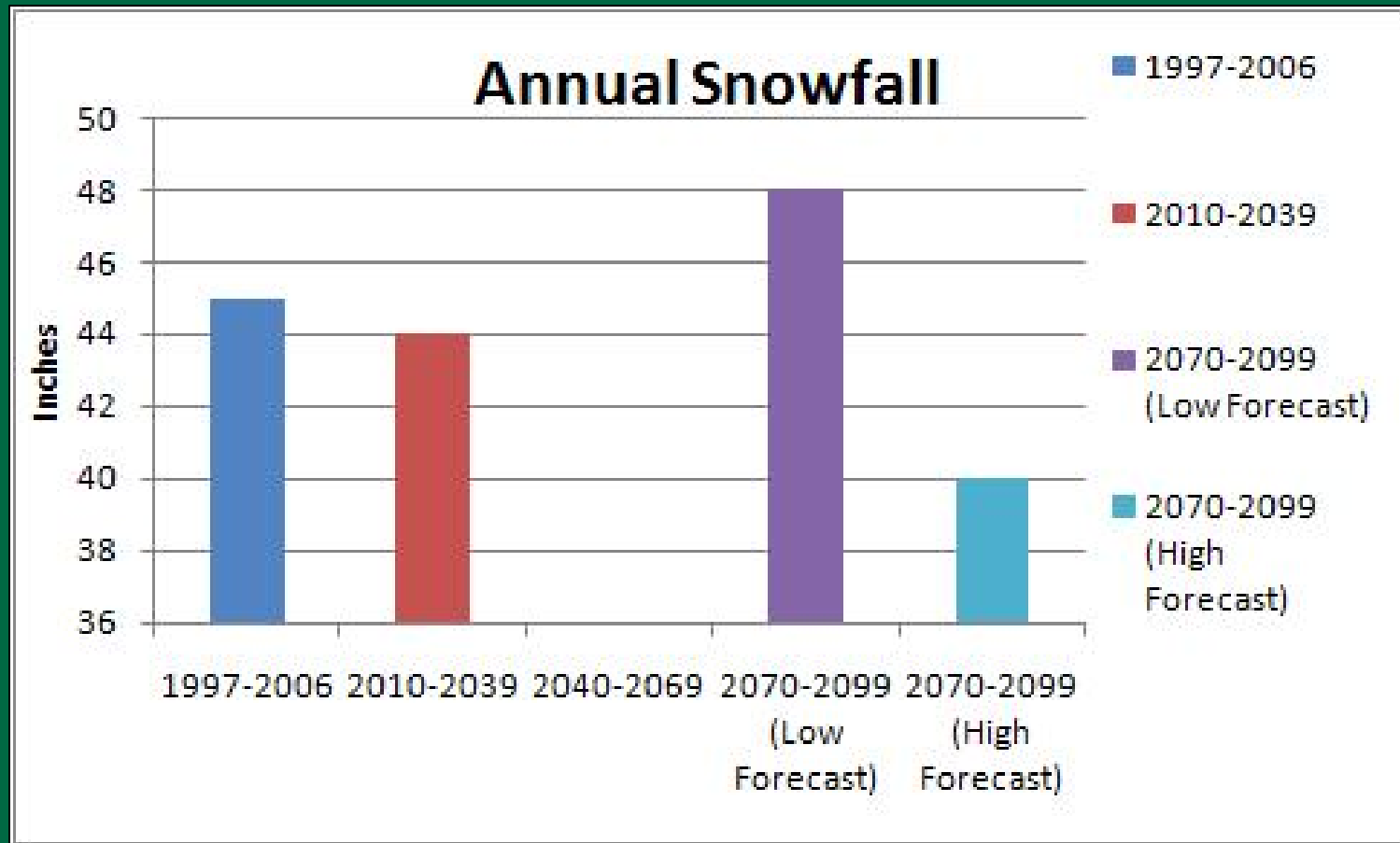


Chicago Climate Change Projections Extreme Precipitation (1)



Source: K. Hayhoe et al. Journal
of Great Lakes Research, 2010

Chicago Climate Change Projections Extreme Precipitation (2)



Source: K. Hayhoe et al. Journal
of Great Lakes Research, 2010

CTA Severe Weather Impacts

Extreme Heat: Daily Rail Traction Power Consumption (kWh)

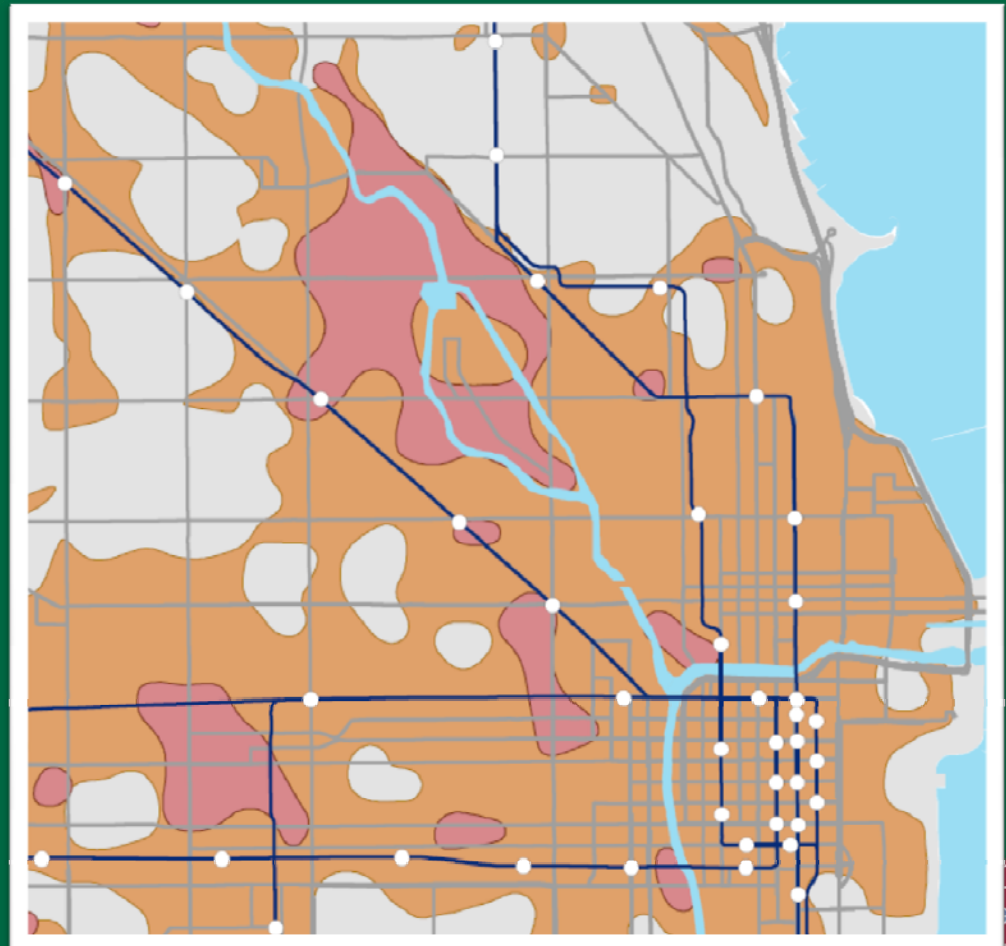
Year	3+ days 90+ degrees	Baseline days ~65 degrees	% Difference
2001	537,864	470,643	14.3%
2002	547,465	462,326	18.4%
2003	--	466,655	--
2004	--	531,413	--
2005	595,921	558,343	6.7%
2006	570,945	580,481	-1.6%
2007	--	573,249	--
2008	--	582,826	--
2009	1,216,889	1,011,761	20.3%
2010	1,060,557	912,387	16.2%
2011	1,083,957	1,018,733	6.4%
Average	801,942	716,382	11.9 %



CTA Severe Weather Impacts

Extreme Heat: Urban Heat Islands (1)

- Urban Heat Islands (UHIs) refer to elevated temperatures due to intense urban development.
- Ambient air temperature can be elevated 2-8° F in UHI areas
- Two Landsat 7 satellite images were used to capture both day and night images in Chicago
 - Tier 1 areas are in the warmest 10% in both the day and night images
 - Tier 2 areas are in the top 10% of either of the day or night images



CTA Severe Weather Impacts

Extreme Heat: Urban Heat Islands (2)

Rail Branch Name	UHI Tier 1	UHI Tier 2	Total	2012 Heat-Related Signal Disruptions
Loop Elevated	0%	100%	100%	0
Red Line Dan Ryan	0%	87%	87%	7
Blue Line O'Hare	12%	72%	83%	1
Blue Line Forest Park	5%	71%	75%	5
Pink Line	5%	59%	64%	11
Orange Line	10%	48%	58%	0
Green Line Lake Street	8%	50%	58%	1
Green Line South	0%	36%	36%	1
Red Line North Side	1%	30%	32%	5
Brown Line	0%	27%	27%	0
Purple Line	0%	0%	0%	2



CTA Severe Weather Impacts

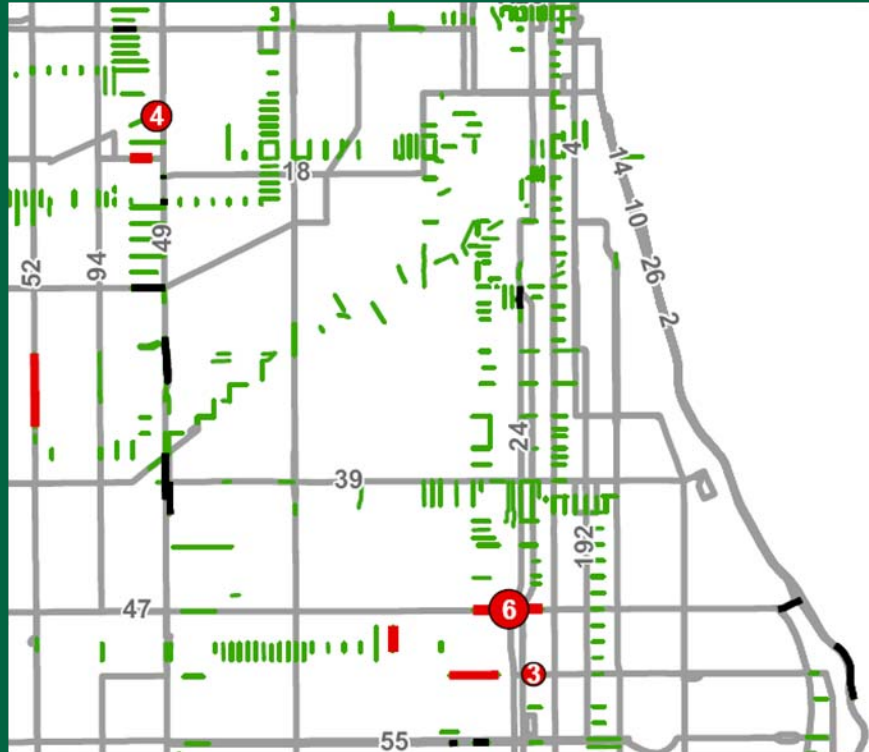
Extreme Heat: Heat Kinks

Date	Daily High Temp(F)	Branch	Location
4/26/10	61	Blue (FP)	Lathrop
7/6/10	91	Yellow	Skokie
7/12/10	84	Red (DR)	76th
8/18/10	83	Red (DR)	69th
8/18/10	83	Red (DR)	71st
10/10/10	84	Yellow	Hamlin
5/12/11	87	Orange	35th/Archer
6/7/11	96	Blue(FP)	Racine
7/21/11	101	Red (DR)	Cermak to 35th
7/21/11	101	Red (DR)	Cermak



CTA Severe Weather Impacts

Extreme Precipitation: ROW Flooding (1)



- normal viaduct
- troubled (CDOT)
- troubled (CTA)
- 4 frequency of CTA reroutes

Viaduct Location	Frequency	Bus Routes Affected
W. 47th / Shields	6	47, 24
W. Ogden / Claremont	4	18, 49
N. Sacramento / Carroll	4	65
W. 51st / Dan Ryan	3	192, 24
S. State / 63rd	3	29, 63
E. 79th / Avalon	3	79, 28
E. 95th / Cottage Grove	3	100, 111, 4

Viaduct Flooding, 2010-2012



CTA Severe Weather Impacts

Extreme Precipitation: ROW Flooding (2)

Rail Station Standing Water Events, 2010-2012	
Line	Number of Events
Red	66 *
Blue	45
Green	17
Brown	10
Loop	10
Pink	5
Orange	4
Purple	1

Rail Station Standing Water Events, 2010-2012		
Line	Station	Frequency
Red	Harrison	9
Red	Grand	8
Red	Jackson	6
Loop	Lasalle	5
Red	Howard	4
Brown	Irving Park	4
Blue	Irving Park	4

*45 of these events occurred on Red Line subway



CTA Severe Weather Impacts

Extreme Precipitation: Financial Impacts

- Financial Impacts of Select Severe Weather Events

Date	Weather Event	Weather Specifics	Cost
Sep-Nov 2008	Flood	9" of rain (9/5-9/15)	\$3,058,145
Jan-Feb 2011	Blizzard	20" of snow (1/31-2/1))	\$670,610
Aug 2007	Heavy Rainstorm	3" of rain (8/23-8/24)	\$50,207
Aug-Sep 2005	Hurricane Katrina	CTA Evacuee Assistance	\$448,173



CTA Severe Weather Impacts

Extreme Weather and Ridership (1)

- Methodology:
 - Build on 2007 study
 - Focus on extreme weather events
 - 2001-2011 NOAA data
 - Heat Index
 - Rainfall
 - Snowfall
 - 2001-2012 CTA ridership data



CTA Severe Weather Impacts

Extreme Weather and Ridership (2)

- Output:
 - Extreme Heat: Decline in ridership at high range
 - Extreme Cold: Decline in ridership for all periods
 - Heavy Rainfall: Decline in ridership on weekends
 - Heavy Snowfall: Insufficient observations

	Rail Ridership			Bus Ridership		
<i>Day Type</i>	<i>80+ Days</i>	<i>90+ Days</i>	<i>100+ Days</i>	<i>80+ Days</i>	<i>90+ Days</i>	<i>100+ Days</i>
Weekday	-5.50%	-7.70%	-12.70%	-3.80%	-4.10%	-4.90%
Saturday	15.10%	6.50%	-14.40%	-8.00%	-10.00%	-33.20%
Sunday	1.70%	-2.70%	-8.90%	-19.40%	-19.10%	-37.30%



CTA Stakeholder Workshop

July 2012

- Rank Catalog of Impacts
- Create Risk Matrix
- Define Task II/III Selection Criteria

TASK II (Implementation)

Severity (over frequency)
Capital (over operating)
Safety (over comfort)
Pervasiveness (A to B to C)
Expected future frequency increase
Complement ongoing projects
Availability of supporting data

TASK III (Integration)

Frequency (over severity)
Operating (over capital)
Coordination issues (cooling buses)
Process over infrastructure
Complement ongoing projects
Availability of supporting data



Climate Adaptation Pilot Overview: Next Steps

- Complete Task I Data Synthesis
 - Correlate observed costs/impacts with CCAP climate data
 - Integrate additional CTA data sets
- Develop Task II/III Priorities
 - Identify areas of greatest risk to be explored further in Task II, prioritized based on quantitative/qualitative criteria
- Complete Task I (August 2012)
 - Complete final memorandum of prioritization strategies and prepare launch of Task II analysis.
- Complete Task II (late 2012/early 2013)
 - Complete benefit-cost analyses to prepare shovel-ready projects for future implementation funding



Transit Asset Management Initiative

- CTA received \$5.4 million grant through the US Dept. of Transportation State of Good Repair Initiative (SGR) 2010
- Focus on Bus Maintenance Facility Assets:
 - Goal is to establish baseline structure for future expansion into other asset categories
 - Project Efficiencies lead to scope expansion to include some rail maintenance facilities
- Four phases of work:
 1. Phase A: Software Enhancement and Data Migration
 2. Phase B: Facility Asset Inventory and Assessment
 3. Phase C: Reporting and Prioritization
 4. Phase D: Process Evaluation and Training



Asset Attribute Inventory

Critical asset information collection including the following attributes:

- Type
- Size
- Replacement Value
- Condition
- Expected Life
- **Vulnerability to climate**
- Install Year
- Location
- Deficiency Type(s)
- Deficiency Quantity



Data Collection Methodology

- Two multi-disciplinary teams of engineers perform the survey: 7 garages, 3 maintenance shops and 10 rail maintenance facilities
- Collect key inventory and perform condition assessments on over 3 million sf of facilities
- Develop cost estimates for identified deficiencies
- Involvement of organization personnel to observe contractor assessment to promote learning with the ultimate goal of self-performance



Long Term Inspection Approach

- Routine assessments completed by trained in-house staff
- Prioritized inspections based on asset criticality and condition
- Inspections treated as required work orders within EAM
- Utilize available technology to streamline deficiency tracking and reporting
- LTI approach allows for continued migration to proactive versus reactive maintenance utilizing updated inventory and assessment data

