What Policies Could Mitigation by Vegetation Affect?

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Overview

- What are the policies that influence air quality near roadways?
- How could mitigation fit in?
- What outstanding questions should be answered?
- What are the challenges to site-specific mitigation?

Which Policies May Be Relevant?

- Clean Air Act
  - NAAQS
  - Transportation conformity
  - State implementation plans (SIPs)
- National Environmental Policy Act
- Transportation policy
- State and local policies

CAA: National Ambient Air Quality Standards

- Six criteria pollutants
  - CO, NO_2, O_3, Pb, PM, SO_2
- Designed to protect public health and welfare with an adequate “margin of safety”
- State Implementation Plans (SIPs) for nonattainment areas to reach timely attainment

NAAQS

- Most recently, revisions to the NO_2 NAAQS
  - Based on 1-hour daily maximum concentration
  - 98^{th} percentile value of all days in a year
  - Averaged over 3 years
- Monitoring in
  - Sites of maximum expected concentration, focusing on highest traffic volume roads in metro areas
  - Sites of maximum areawide concentration (e.g. neighborhood / urban scale)
  - Sites oriented toward susceptible or vulnerable populations
- Near-road concentrations have come up in context of other recent NAAQS: CO, PM, Pb

Transportation Conformity

- Ensures that Federal funds in nonattainment and maintenance areas go to transportation activities that are consistent ("conforms") with an area's air quality goals (SIP)
- Encourages cooperation between state and local transportation and air quality officials
- Applies to:
  - Long-term regional transportation plans
  - Shorter-term transportation improvement programs
  - Highway and transit projects funded or approved by Federal Highway Administration or Federal Transit Administration

Project-level ("Hot Spot") Analysis

- Hot-spot analyses are used to meet CAA requirements that new projects not:
  - Create new NAAQS violations,
  - Worsen NAAQS violations, or
  - Delay timely attainment or achievement of RFP milestones
- A hot-spot analysis assesses air quality impacts in the local project area (not an entire nonattainment or maintenance area)
  - Transportation projects historically have required emissions and dispersion modeling in CO areas to address project impacts
  - PM modeling guidance to be released this year after public comment period
- For PM analyses, emphasis on "projects of local air quality concern," for example:
  - Expressways with significant diesel traffic
  - Highways and intersections for freight terminals
  - Large bus terminals

PM “Hot Spots” Guidance

- Analytical approach:

emission model →

dispersion model →

combine with background →

compare to NAAQS

- Guidance will include list of potential mitigation and control measures
  - Additional appropriate measures can be considered in consultation process over time

Mitigation Possibilities for Projects

- Site-specific mitigation through vegetation (or other means) might be possible, but there are hurdles
  - Verifiable reductions in concentrations
  - Approved tools for quantifying its impact
  - Relevant timing
    - Analysis years can focus on year project opens and consider long-term impacts

Possible (?) Routes and Challenges to Addressing Vegetation in Modeling

- Via emission modeling?
  - How would such an adjustment work?
  - Would a whole new model be needed?
- Via dispersion model?
  - Filter emissions prior to moving downwind?
    - Source characterization issue: what is the source?
  - Increase surface roughness?
    - May require onsite meteorology data to account for impacts on winds at the project site
- Via numerical modeling (e.g., wind flow around barriers)
  - Resource requirements: is magnitude of mitigation worth it?
- Other approaches?

National Environmental Policy Act (NEPA)

- Requires federal agencies to document and consider the environmental impacts of major projects and their alternatives
- Each federal agency responsible for its own NEPA implementation, under CEQ guidance
- DOTs generally conduct and document transportation conformity analyses via NEPA, though the laws are different
  - NEPA applies everywhere / conformity in NAA/MAs only
  - NEPA applies to all impacts / conformity to NAAQS
- Under CAA Section 109, EPA has responsibility to comment on adequacy of EIS/EA to project sponsor

NEPA and Roadways

- NEPA involves
  - Scoping the level of analysis
  - Description of purpose and need
  - Description of project and its alternatives
  - Description of existing population, land use, environmental conditions
  - Evaluation of impacts of project and alternatives
  - Mitigation of adverse impacts
    - Avoidance of impact by modifying or omitting actions
    - Minimization by limiting degree of impact of an action
    - Compensation for impact by substitution or replacement
- Air quality and health concerns near roadways has been issue in numerous recent NEPA documents and litigation
  - PM
  - Air toxics
  - Health in general

Possible Routes and Challenges for Vegetation within NEPA

- **Route 1**
  - Preserve and plan appropriate vegetation to avoid problems as part of facility design
  - NEPA is often a coda to the decision process
    - After corridor study, benefit/cost analysis, regional transportation plan, etc.
    - Need to deliver information in time for the key decisions
  - Highway agencies face challenges in preserving right-of-ways from other encroachments
    - But vegetation can also serve beneficial purposes for them

Possible Routes and Challenges for Vegetation within NEPA

(inclusive of dispersion model issues)

- **Route 2**
  - Use vegetation to minimize problems identified by the analysis
  - May require changes in basic design of roadway or right-of-way, if not incorporated up front
    - Justified by magnitude of mitigation?
    - Need to engage transportation professionals on when such cases would be suitable
  - Potential for perception of planting trees as an inadequate fix or “greenwashing”
    - Requires transparency in what vegetation can and can’t do

Examples of DOT Right-of-Way Policies

- “The Minnesota Department of Transportation reminds citizens that state law prohibits the placement of unauthorized signs and other objects on state highway right of way.”
  - News release, MN DOT, May 1, 2009

Examples of DOT ROW Policy

“The aesthetic quality of North Carolina's roadsides is influenced by a number of factors. Among these factors are right-of-way width, adjacent land use, topography, overhead utilities, signage, and existing vegetation.

In order to protect the public investment in highways the North Carolina Department of Transportation Division of Highways uses **grass and legume cover to prevent roadside erosion and shrubs, trees and wildflower plantings to reduce mowing areas and improve roadside aesthetics.**

Shrubs and trees within highway rights-of-way result by **retaining desirable vegetation during initial highway construction, allowing natural regeneration, or planting/reforesting selected areas**. Limited funding and manpower prevent the North Carolina Division of Highways from planting and maintaining shrubs and trees on all roadsides. Planting and maintenance of specific roadside areas is frequently undertaken by municipalities, garden clubs, or individuals after permission is granted from the Division of Highways.”

-NC DOT Guidelines for Planting within Highway Right-of-Way

GUILDELINES FOR PLANTING TREES, SHRUBS, AND GROUNDCOVERS WITHIN HIGHWAY RIGHT-OF-WAY

The following are cross sections for highways and streets with posted speed limits as indicated, and plan views of diamond and cloverleaf interchanges; showing guidelines for planting trees, shrubs, and groundcovers. Planting that involves exceptions to these criteria will be considered on an individual basis.

Distance from Travel Lane

The cross sections and plan views show the minimum distances from the curb or the edge of travel lanes for new plantings. Where existing tree distances have been established, replacement trees should conform with established set-back distances.

Vertical Clearance

A minimum clearance of 16 feet above the entire pavement width must be maintained at all times and a minimum clearance of 7 feet above sidewalks or pedestrian spaces.

Sight Distances

Shrubs must be kept low, and trees and large shrubs under-trimmed sufficiently to permit clear sight in the area between 2 feet and 6 feet above roadway elevations. Due to widely varying conditions of topography, highway alignment and grade, type and volume of vehicular and pedestrian traffic; necessary sight distances in excess of the minimums described on the following pages must be individual site determinations.

Selection of Plants

Tall-growing trees should not be selected for planting beneath utility lines and wide-spreading trees should not be used unless there is sufficient width of planting area to accommodate them without continued severe pruning. Small trees and large shrubs should be used which are adaptable to under-trimming without destroying their desired appearance.

In curb and gutter areas, groundcover is permissible between curb and shrubs to avoid a narrow mowing strip.

Pavement Removal

When pavement remains beneath traffic channelization islands, such pavement may not be broken or removed without written permission.

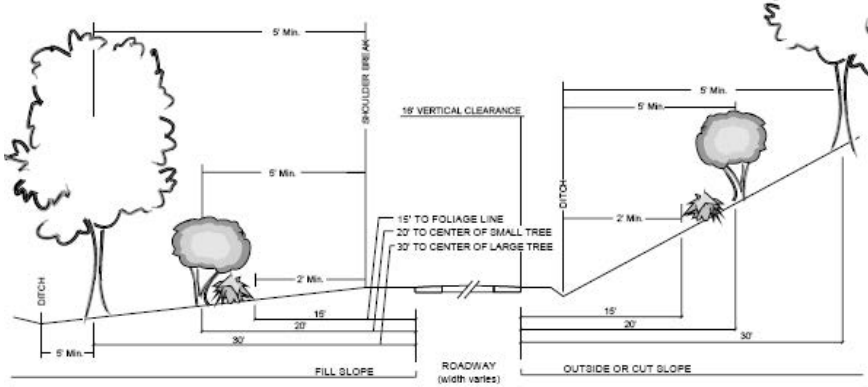
Effect on Mowing and Drainage

Trees should be placed sufficiently far apart, or grouped in shrub beds and mulched in a shape that will facilitate mower operation, avoid excessive mower maneuvering, or hand trimming.
Trees/large shrubs shall be minimum of 5 feet behind ditch line (in cut sections) and 5 feet outside shoulder break (in fill sections), or the minimum distance from edge of travel lanes as shown on Typical Sections, whichever is the greater.

Traffic Operation and Safety

All plantings shall be maintained in a condition that will not interfere nor endanger vehicular or pedestrian traffic.

SHOULDER SECTION



NOTE:
WHEN WIDTH OF SHOULDERS AND DITCHES DO NOT CONFORM WITH THESE TYPICAL SECTIONS, THE 2' MIN. DISTANCE BEHIND THE DITCH AND 2' MIN. DISTANCE OUTSIDE THE SHOULDER BREAK SHALL GOVERN.

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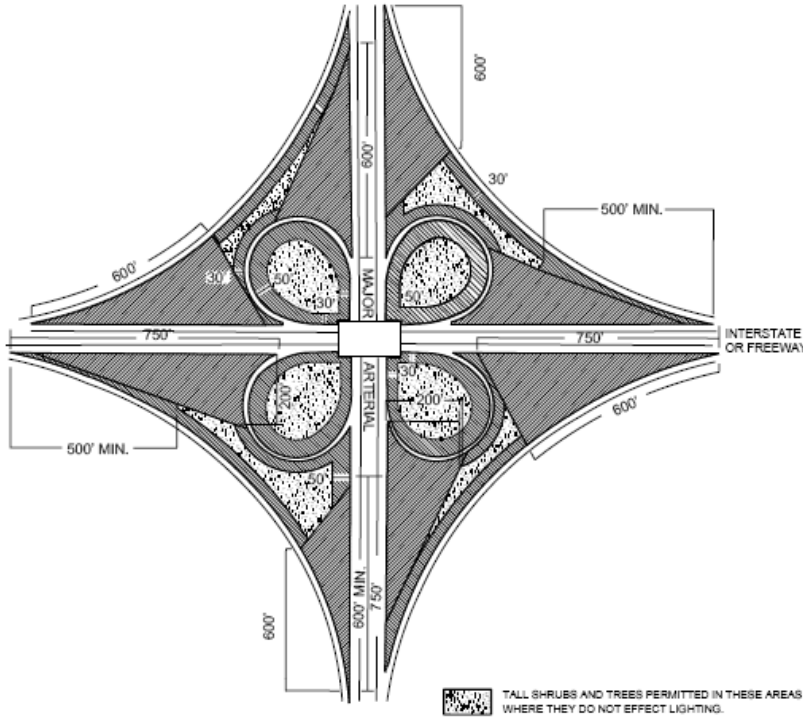


Larger Scale Issues

- Vegetation and land cover play a role in emissions, weather, and climate
  - Air pollution sources and sinks
  - Urban heat island
  - Carbon sources and sinks
- These can be one way that microscale mitigation strategies may also contribute to policy goals at larger scales

Regional Emissions

- Vegetation as source: certain biogenic VOCs are precursors to ozone and PM (e.g, isoprene)
- As regional sink: Does vegetation reduce primary emissions from on-road or other low-level sources?
- Likely seasonal variations in both
- What types of information are available to quantify vegetation impacts for regional air quality planning?

Urban Heat Island

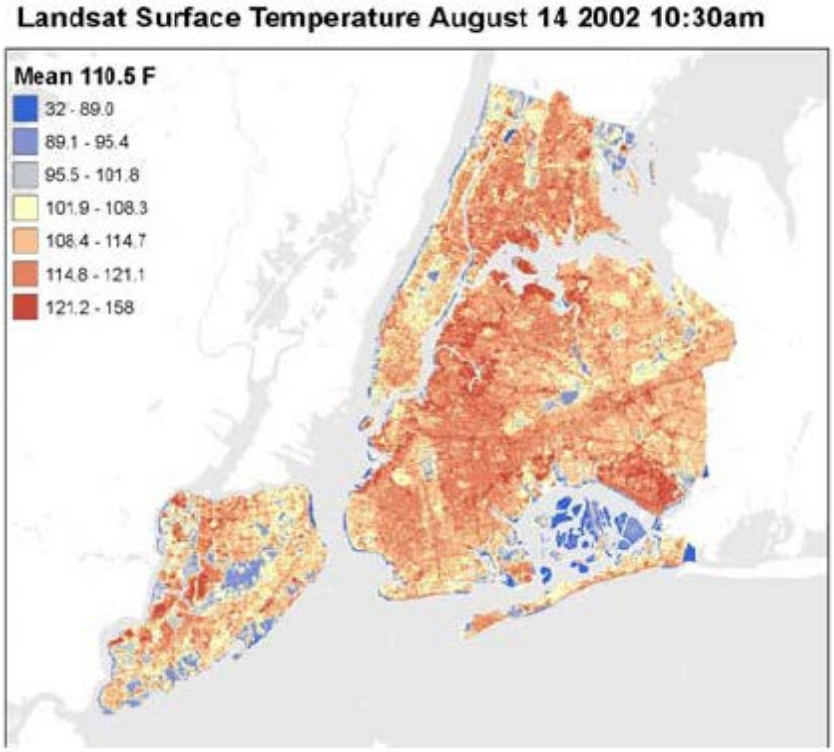


Figure 2. Remotely sensed thermal satellite data. Landsat ETM, August 14, 2002 at 10:30 AM, Band 6, resolution is 60 meters.

Vegetation may be associated with:

•Cooling via evapotranspiration

•Retention of rainwater in soil (evaporative cooling)

•Changes in material heat capacity

•Shading of impermeable surfaces

The urban heat island is one area where microscale mitigation may influence regional temperature trends.

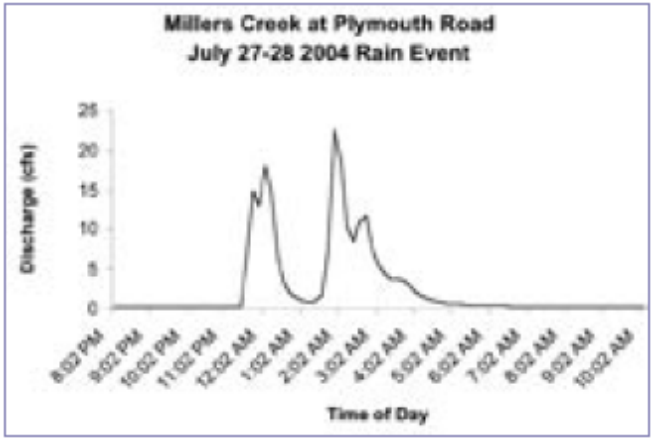
Rosenzweig et al. (2007) AMS Sixth Symposium on the Urban Environment

Area Carbon Flux

- Photosynthesis can result in net CO_2 sinks during daylight hours
- Plants that accrue biomass and soil carbon can be long-term carbon sinks
- Could enough vegetation be planted to affect regional (and higher scale) impacts?

Watershed Management

- Management of municipal stormwater is a challenge for many cities and states
  - In combined storm/sanitary sewer systems, wastewater plants end up treating high volumes of stormwater
  - In separated sewer systems, NPDES permits may be required
- A partnership between EPA Region 3, FHWA, and Maryland's state highway administration is seeking to develop best practices for improving highway stormwater performance



Transportation Policy Issues

Caveat

- I’m not a transportation policy expert.
- These are thoughts on how and where mitigation with vegetation may intersect with day-to-day operations in transportation agencies.

Different Levels of Planning

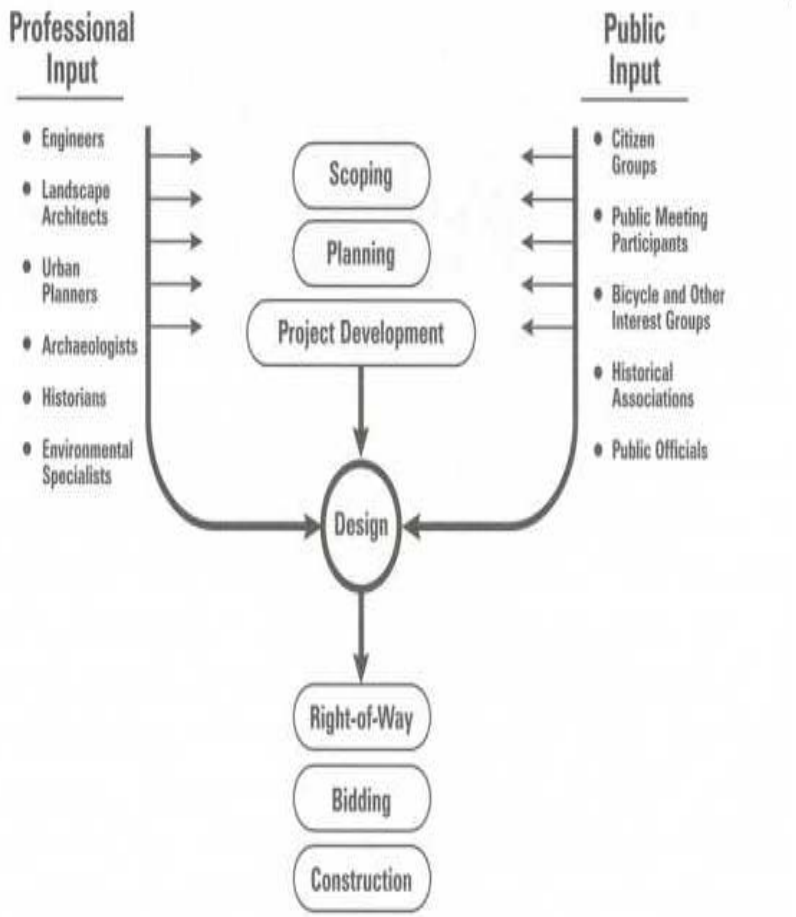
- State DOTs
  - Statewide multimodal long-range plan
  - Assesses current and projected conditions
  - Selects improvement projects periodically
  - “Sponsor” of many projects
- Metropolitan planning organizations
  - Develop long-range regional plans in larger urbanized areas
  - Prioritizes projects
  - Develops transportation improvement programs every few years
- City/county government
  - Various practices

Highway Projects

- Different types of projects
  - New construction
  - Reconstruction (major change to existing highway)
  - 3R (resurfacing, restoration, rehabilitation – extends service life)
  - Maintenance (repainting lanes, pavement repair, minor lane widening, etc.)
- Design criteria apply mostly to first two
  - AASHTO Green Book
  - State-specific standards

Project Planning

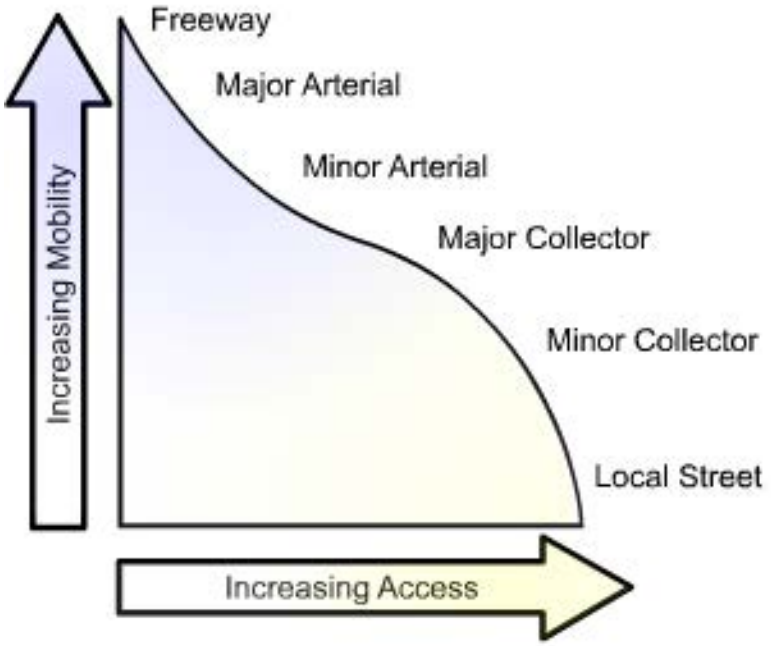
- Many places within project planning where information on vegetation's effects may be useful
  - Project design
  - Selection of alignment
  - Right-of-way
  - Property acquisition
- Transportation agencies often use the term "context sensitive design" to incorporate other stakeholders' values



FHWA, Flexibility in Highway Design. http://www.fhwa.dot.gov/environment/flex/index.htm

Access Management

- Management of vehicular access points to land parcels adjacent to roadways, promotes safer, more efficient use of existing network
  - Preserves road hierarchy
  - Signal and driveway spacing
  - Turning lanes and medians
  - Right-of-way management
    - Reservation for future widening
    - Preserve sight distance and access points
- These practices are critical to understanding the context for air quality mitigation using vegetation



http://ops.fhwa.dot.gov/access_mgmt/index.htm

Airspace Leases

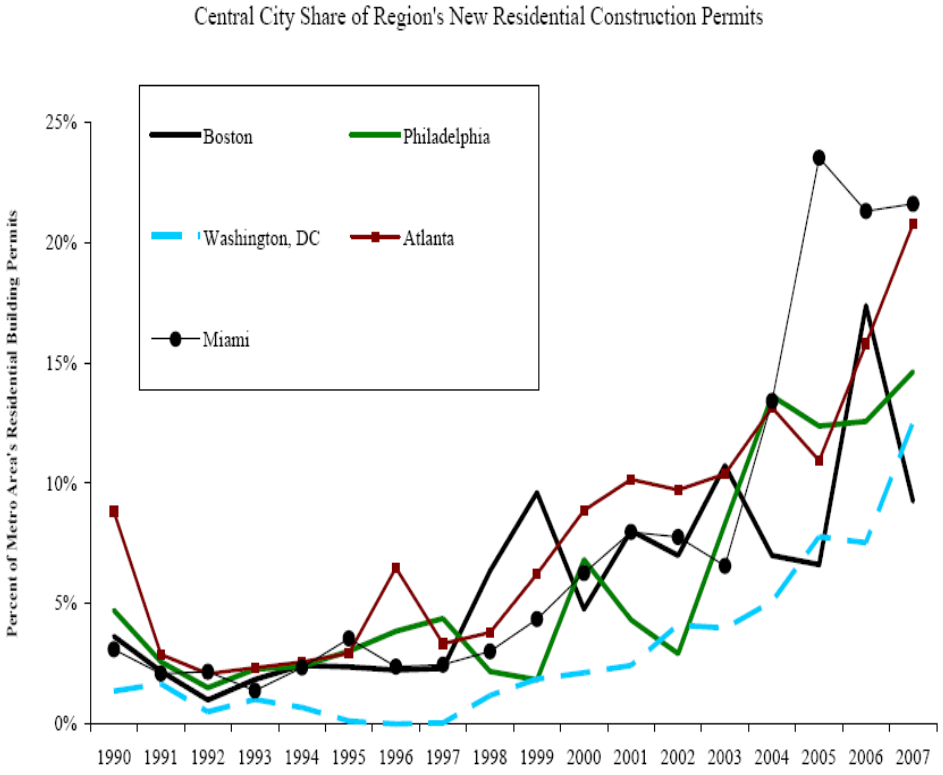
- FHWA has final approval on leases of airspace on Interstate systems, and is an interested party on other roads in the National Highway System
  - "*Available airspace may be leased to a public agency for interim uses such as green strips, small parks, play areas, parking, public or quasi-public use which would integrate the highway into the local environment and enhance other publicly supported programs.* "
  - "*Airspace cannot be leased if it is required currently or in the foreseeable future for safe operation and maintenance of the highway facility*"
- Could such spaces be locations for vegetation?

http://www.fhwa.dot.gov/realestate/airguide.htm

State and Local Policies

Land Use

- Many cities have dense urban cores or are encouraging “smart growth” (i.e., compact or in-fill development)
- However, such development may bring people into greater proximity of sources
  - Contrary to “buffer zone” policies?
- No easy answers, but vegetation research may help to resolve density-proximity conflicts
  - Better explain existing conditions
  - Help to resolve future conflicts



www.epa.gov/smartgrowth

Zoning & Other Municipal Policies

- Zoning requirements interact with other transportation issues (walkability, safety, transit) related to vegetation siting. For example:
  - Minimum setbacks from roads for new structures
  - Parking lot capacity, location, design (e.g., islands)
  - Pedestrian and bike access requirements
- Other municipal policies can also mesh with mitigation-oriented vegetation
  - Energy efficiency (trees for shade & windbreaks)
  - Stormwater management
  - LEED standards for neighborhood development

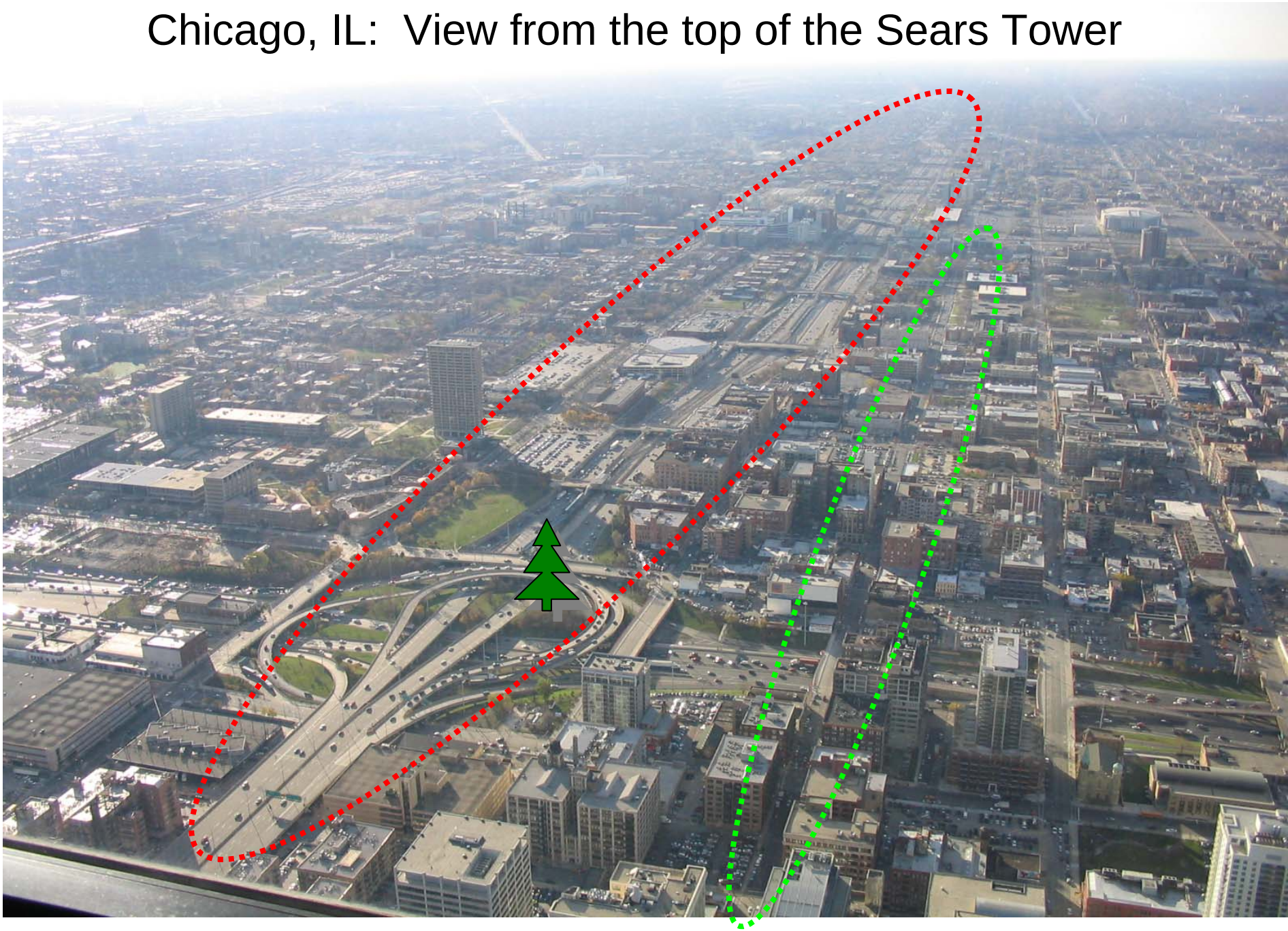
Rating Systems

- U.S. Green Building Council has developed a certification system (LEED) for neighborhood design
- The EPA/FHWA/Maryland DOT “Green Highways Partnership” is developing rating systems for highways
- Integrating air quality considerations into these systems could help identify best practices

Other Resources

- EPA Smart Growth Team
  - www.epa.gov/smartgrowth
- FHWA guidance, *Flexibility in Highway Design*
  - www.fhwa.dot.gov/environment/flex/index.htm
- U.S. Green Building Council, LEED certification for neighborhood design
  - http://www.usgbc.org/
- Green Highways Partnership
  - www.greenhighwayspartnership.org/

Chicago, IL: View from the top of the Sears Tower



Conclusions

- Mitigation of near-roadway pollution by vegetation may have roles in
  - Federal environmental regulations
  - Highway engineering practice
  - Larger-scale environmental issues
  - Local decision making
- Several hurdles (science and policy questions) still remain to integrate vegetation into routine policy use
- There are opportunities for outreach
  - DOTs have long history with design issues
  - Potential for integration with larger-geography issues
  - Local officials promoting compact growth
  - Voluntary rating systems