New York City Urban Soils Institute: Soils to the People

by

Tatiana Morin, Director of NYC Urban Soils Institute and

Richard K Shaw, State Soil Scientist, NRCS-NJ
Soils in the City

1. Urban agriculture
2. Urban reforestation & restoration
3. Stormwater management
4. Heat island mitigation
5. Ecosystem establishment
6. Brownfield & soil remediation
7. Soil survey & mapping
8. Climate resiliency, coastal restoration
9. Invasives management
10. Green infrastructure
NYC Urban Soils Institute

USI serves as the clearing house for all soil-related resources through FIVE divisions:

- Soil Testing & Technical Services
- Education & Outreach
- Data Depository
- Research
- International collaboration

www.usi.nyc
THE MISSION

The mission of the Urban Soils Institute (USI) is to advance the scientific understanding and promote sustainable use of urban soils through research, education, conservation, and restoration.

The USI achieves these goals through partnerships, resource sharing and coordination of programs.
New York City Soil Survey 1995

A partnership was established between:

- NRCS
- NYCSWCD
- Cornell University

To address the complexities of urban needs with a multi-faceted soil survey program.
The NYC Soil Survey Program

a) Soil mapping & survey-related studies/special projects

b) Onsite Investigations

c) Soils training, workshops, lectures, conferences; outreach

d) Volunteer & internship opportunities
**USDA-NRCS**  
**NYC Soil Surveys**

<table>
<thead>
<tr>
<th>Park</th>
<th>Acres</th>
<th>Scale</th>
<th>MSD</th>
<th>Commentary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Central Park</td>
<td>843</td>
<td>1:4800</td>
<td>0.3 acres</td>
<td></td>
</tr>
<tr>
<td>South Latourette Park</td>
<td>320</td>
<td>1:6000</td>
<td>0.5 acres</td>
<td></td>
</tr>
<tr>
<td>Gateway Nat Rec Area</td>
<td>6300</td>
<td>1:4800</td>
<td>0.3 acres</td>
<td></td>
</tr>
<tr>
<td>Bronx River Watershed</td>
<td>6900</td>
<td>1:6000</td>
<td>0.5 acres</td>
<td></td>
</tr>
<tr>
<td>Reconnaissance</td>
<td>193,024</td>
<td>1:62,500</td>
<td>40 acres</td>
<td></td>
</tr>
</tbody>
</table>

**City-Wide Initial**  
190,764  
1:12,000  
1.5 acres  
*(Web Soil Survey available)*
NRCS survey-related projects, NYC

- 118 pedons sampled to date
- Atmospheric inputs of trace metals in woodland soils
- Manhattan trace metal/PAH background levels with Con-Edison
- Infiltration & Land Use
- Artifacts & trace metals
- Citywide soil organic carbon stocks
Onsite Investigations

Community Gardening  Restoration  Hydrology  Archaeology

Education, Outreach, Collaboration

Soils Training  Envirothon  Conferences  Soils & Art
Our NYC Cooperators

- NYC Department of Parks & Recreation
- NYC Department of Environmental Protection
- NYC Office of Environmental Remediation
- NYC Housing Authority
- NYC Department of Design and Construction
- New York State Department of Environmental Conservation
- New York State Department of Health
- USDA – National Park Service
- US EPA
- USDA Forest Service
- Cornell University
- Queens College
- Brooklyn College
- College of Staten Island
- Lehman College
- Columbia University
- New York University
- Pratt Institute
- Fashion Institute of Technology
- The Gaia Institute
- Sustainable South Bronx
- Central Park Conservancy
- New York Restoration Project
- Youth Ministries for Peace & Justice
- Rocking the Boat

Central Park soil sampling cadre, April 2009

- Con Edison
- NY Botanical Garden
- Hort. Soc. of NY
- RETEC
Soil-related needs, NYC
Urban ag & community gardens
Green Infrastructure
Composting
Restoration & revegetation
Soils based research
International collaboration
etc.

Soil-related partners, NYC
USDA-NRCS
NYCSWCD
Gaia Institute
Brooklyn College

www.usi.nyc

USI
Tatiana Morin, Director
What does NRCS provide to USI?

- **Education & Outreach**
- **Partnerships**
- **Soil science technical expertise**
- **Credibility & connections in soil science community**
- **Knowledge of local soil patterns & characteristics**
“Urban soil pattern is unique for every city.”

- Geography & geology
- Land use history & disturbance
- Management practices
NYC - Geomorphic Setting

- 3 Physiographic Provinces
  1) New England Upland
  2) Triassic Lowland
  3) Atlantic Coastal Plain

- Glacial deposits
  - shallow & deep till
  - terminal moraine
  - meltwater deposits

- Postglacial deposits
  - alluvium
  - tidal marsh

- Anthropogenic disturbance
New York City, USA

- European settlement 1609

- Limited room for expansion - 3 islands & 1 peninsula

- Extensive filling of wetlands, expansion of shoreline; waste disposal needs (construction debris, dredge spoils, etc.)
NYC Survey methods

“Native” Soils in NDM
Naturally deposited materials (by ice, water, wind, etc.)
38 soil series* mapped

Soils in HA-HTM
Human-altered or human-transported mat’ls
32 soil series* mapped

Miscellaneous Areas
Urban land (sealed soils)
Also Beaches, Rock outcrop, Dune land, etc.

* Soils in a series have similar parent material, particle size & drainage class, sequence of horizons. We also differentiated HA-HTM soils by artifact type & content, and thickness of fill.
NYC Citywide totals
(USDA-NRCS Soil Survey)

<table>
<thead>
<tr>
<th>Type</th>
<th>% of land area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urban land (sealed soils)</td>
<td>62.7</td>
</tr>
<tr>
<td>HAHT* (fill) Soils</td>
<td>27.6</td>
</tr>
<tr>
<td>“Native” Soils</td>
<td>8.6</td>
</tr>
<tr>
<td>Other Misc. Areas**</td>
<td>1.1</td>
</tr>
</tbody>
</table>

* Human-altered & human-transported
** Rock outcrop, Beaches, etc.
“Anthropo sequence” for New York City soils, i.e., a continuum of human disturbance.

Wide range in physical, chemical, mineralogical properties
Local soils information

- What types of soils are out there?
- How much of each type?
- What are their properties?
- Suitabilities, plant preferences
- Limitations & potential problems
- Ecosystem service capacity
- Best use & management practices
- Research needs
NYC Pedodiversity

<table>
<thead>
<tr>
<th>Soil Type</th>
<th>% of land area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sealed soils</td>
<td>62.6</td>
</tr>
<tr>
<td>Clean fill</td>
<td>16.4</td>
</tr>
<tr>
<td>Artifactual fill</td>
<td>6.0</td>
</tr>
<tr>
<td>Dredge fill</td>
<td>2.9</td>
</tr>
<tr>
<td>Brown till</td>
<td>2.6</td>
</tr>
<tr>
<td>Red till</td>
<td>2.1</td>
</tr>
<tr>
<td>Tidal marsh</td>
<td>2.0</td>
</tr>
<tr>
<td>Landfill</td>
<td>1.6</td>
</tr>
<tr>
<td>Outwash</td>
<td>1.5</td>
</tr>
<tr>
<td>Sand dunes</td>
<td>0.3</td>
</tr>
<tr>
<td>Coal ash</td>
<td>0.1</td>
</tr>
<tr>
<td>Serpentine</td>
<td>0.1</td>
</tr>
</tbody>
</table>
### Soil Organic Carbon stocks, NYC

<table>
<thead>
<tr>
<th>Soil Type</th>
<th>kg C/m²</th>
<th>% of land area</th>
</tr>
</thead>
<tbody>
<tr>
<td>coal ash soils</td>
<td>242.24</td>
<td>0.1</td>
</tr>
<tr>
<td>tidal marsh</td>
<td>46.33</td>
<td>2.0</td>
</tr>
<tr>
<td>artifactual fill</td>
<td>30.82</td>
<td>5.9</td>
</tr>
<tr>
<td>outwash</td>
<td>17.21</td>
<td>1.4</td>
</tr>
<tr>
<td>clean fill</td>
<td>16.46</td>
<td>16.4</td>
</tr>
<tr>
<td>red till</td>
<td>13.99</td>
<td>2.2</td>
</tr>
<tr>
<td>brown till</td>
<td>12.04</td>
<td>2.5</td>
</tr>
<tr>
<td>sealed soils</td>
<td>5.96</td>
<td>62.6</td>
</tr>
</tbody>
</table>

**Average values**

- **“Native” soils**: 20.98 (8.6)
- **HAHT (fill) soils**: 17.73 (27.6)
- **Citywide**: 10.37 (100)

- **NJ woodland soils**: 14.53 (NRCS-NJ figures)
- **NJ agricultural soils**: 6.98
Some NYC Soil Survey-Related Research Needs

- Urban soil survey – use of geophysical methods
- Better Soil Survey Interpretations:
  - Urban Ag
  - Storm water management
- Contaminant assessment & management
- Carbon stocks & dynamics in urban soils
  - Black carbon – reactions, stability, pro vs con
  - CaCO$_3$ formation
- High pH soils in humid environments – chemistry, biology, plant communities, pedogenesis & evolution
- “Sealed” soils – relevance; characterization, classification & mapping
✓ Lab: Local soil testing services
✓ On-site technical services & assistance
✓ Soil survey
✓ Workshops & Urban soil courses
✓ Data Interpretation
SOIL TESTING: LAB AND FIELD VISITS


- **Basic Soil Quality Test**
- **Heavy Metal & pH Test (lead included)**
- **Advanced Soil Quality Test**
- **Plant Tissue Analysis: Heavy Metals**

**Audience and Customers:**
- Home gardens
- Community gardens
- Urban and Rural farms
- Green Infrastructure applications and research
- City agencies
- Industry
- Private companies
Demand for ON-SITE visits, assistance, and XRF heavy metals screening: community garden soils, urban farms, parks, vacant lots, etc.
New York City has the largest urban agriculture system in the United States.
Interacting with soils and plants through gardening, composting, harvesting, buying at farmers markets reconnects people to their food and its sourcing.

Urban Ag is a gateway to raise awareness about the significance of soil and soil health.

Increasing urban ag in the city, increases soil health, open space, and green infrastructure. Benefits are social, economic, environmental, and health.

Local sustainability and conscientious decisions lead to environmentally sustainable decisions locally, affecting climate change locally, then globally.
HOW WE WORK WITH URBAN AG

Soil testing, assistance & Education (training and instruction)
- for farms, future farms, and for governing agencies
- for entities that work with urban ag: farms, academic institutions, compost classes, certificate classes/continuing education, landscape architects, farm schools, government entities, and at events or other workshops

Support Urban Ag growth
- provide a database and road map for urban ag resources, promote urban ag in food desert areas by working with groups that affect policy and that claim vacant lots
- work with incubating farms

Build Connections
- connecting farms, existing organizations and experts to each other and other entities and disciplines
- creating a network for communication and resource-sharing.

Annual Urban Soils Symposium
acts as a conduit bringing all disciplines together to communicate, discuss, and share resources, research, policy, movements, awareness, and support
Eagle Street Roof Top Farm, NYC

The USI works with farms all over the City and Upstate
DEVELOPING A LIASON FOR URBAN & RURAL COMMUNITY SUPPORTED FARMS

Linking community-sized farming in rural areas outside the city with urban farms.

Blurring urban and rural “boundaries” to build sustainable small-scale high production farming = building soil health = city, ecological, climate health, expanding ag research
The USI is the only center providing courses, training, and workshops in urban soils.

Understanding your urban soils

How to Grow in the City

Urban Soils, Contamination, and (Re)Building Soil Health
Events, Hands-on workshops
Developing the Research Agenda for Urban Soils

- Mapping soil Pb and other contaminants in New York City and beyond
- Understanding the exposure and health risks associated with gardening
- Mitigation strategies and remediation technologies, such as reducing bioavailability, bioremediation, etc
- Supporting Green Infrastructure through soils research
- Work with EPA, ATSDR, CDC, USDA, Cornell, DOH, DPR, DEP, OER and community organizations
- Working with NYC Compost project to understand how to test compost, its ingredients, and how we can harness the power of compost for all New Yorkers
- Viability and complexity of phyto/myco/bio-remediation
What can we do to address lead contamination?

What have we learned?

What do we know? Not know?
Research

Centre of Urban Soils Research

Collaborative Opportunities

2018
USI Core Research Group
Develops Research Agenda

Established Collaborative Research Network
Members are local, national, international experts and practitioners in various fields

SUITMA 9, Moscow 2017
EXPANDING THE FUTURE IN CITIES ACROSS THE GLOBE

Expanding:

**International urban soils courses**

Offered locally and via distance studies
In partnership with universities throughout the world
Soil field excursions offered in each city once-twice a year

**Research “vehicle”**

coordinator of urban soils-based research networks and funds collaborations, dissemination, coordination of efforts, locally and internationally.
USI works with farms and organizations that work with /building partnerships with

Organizations that incubate farmers, network farmers and markets

**Government**
- GrowNYC
- Learn to Grow
- NYC Parks Department
- GreenThumb
- US Department of Agriculture, NRCS
- NYC Department of Sanitation, NYC Compost Project
- NY State Department of Environmental Conservation
- US Environmental Protection Agency
- NYC Soil & Water Conservation Districts for all counties
- NYC Housing Authority
- NYS Department of Health

**Non government**
- Square Roots
- NYC Farm School
- Food Network

Research/Demonstration (academic and non)
- Smiling Hogshead Ranch
- Urban Forage Demonstration Park
- Cornell University
- Brooklyn College
- Columbia University
- New York University
- Pratt Institute
- Rutgers University
- Drexel University
- Russian University of People’s Friendship
- USI Collaborative Research Network
Urban Ag Advocacy and Policy groups
Just Food
Slow FoodNY
596 Acres
Human Impact
Newtown Creek Alliance
Neighbourhoods Allied for Good Growth

Urban Farms (Community Supported Agriculture) & Urban Farm Institutes
Eagle Street Rooftop Farm
Prospect Farms
Harlem Grown
Brooklyn Grange
Smiling Hogshead Ranch
Rise & Root Farm
Downing Park Urban Farm (Newburgh, NY)
Brooklyn Queens Land Trust
All community Gardens

Orgs specializing in Urban Farm/Food Education
City Growers
Butterbeans

Resource-based and educational based organizations to which we supply soil courses and training
The Horticultural Society
NY Botanical Gardens
NYC Compost Project Snug Harbor
BIG Reuse
Earth Matters
Common Ground
Lower East Side Ecology

Rural Farms supported by urban CSA and farmers markets, and Farm Institutes
Essex Farm Institute (CSA and farm training)
Harlem Grown
Fishkill Farms
Glynwood
Sprout Creek Farm
In the Works

USI Scientific Collaborative Research Network & USI Collaborative Development Group

for collaborating on research, and reviewing and verifying recommendations and development of standards. For developing network and platform for soliciting needs and developing resources through various groups and entities in the city and around the globe

Satellite Soils Resource Hubs throughout the City

Potential for 2018: Green-wood Cemetery, Governor’s Island, Floyd Bennet Field, McCarren Park

a community resource center in each borough, equipped with a field lab, materials and resources for urban farming and gardening, demonstration gardens, research plots, restoration projects, school programming, soils museum, soil mapping, field courses, workshops & curriculum for urban soils, GI and urban agriculture support
Green-Wood Cemetery

Soil Art Museum
Soil Mapping
Urban Soils Research
Workshops, Lab
Urban Soils Curriculum
Inter-disciplinary Programs
Soil & Art communicate, translate, disseminate, collaborate
Larger, diverse participation

Museum of Arts & Design
Manhattan, 2012
TO THE
REMEMBRANCE ROCK
HAS BEEN BROUGHT PRECIOUS EARTH
FROM THE BATTLEFIELDS OF GETTYSBURG,
SAN JUAN HILL, ARBROON FOREST,
NORMANDY BEACH AND KOREA TO
MEMORIALIZE THE GALLANT BOYS OF
ALMA MATER WHO DIED IN OUR WARS.
HERE ALSO HAS BEEN PLACED SOIL
FROM CITY HALL, THE OLD 23rd STREET
BUILDING AND THE CROWDED TENEMENTS
OF OUR CITY TO SYMBOLIZE THE
GRATITUDE OF ALL THOSE STUDENTS
WHO HERE RECEIVED A FREE COLLEGE
EDUCATION. MAY REMEMBRANCE ROCK
EVER SERVE AS A PLACE FOR ALUMNI
OF THE CITY COLLEGE TO COME TO,
PAUSE AND REMEMBER.
1859
PRESENTED BY THE ALUMNI ASSOCIATION OF
THE CITY COLLEGE AND THE CLASS OF 1859.
A Map-able Soils Database

= one-stop interactive map and data analysis application

Organize, Collaborate, Centralize

A Tool for Everyone
Soil Quality Certificate
A standard soil quality grading system for mixes of topsoil and compost for various applications in urban gardening/farming and soil remediation (namely for the excavated native NYC sediments and compost mixes).

Soil Health Certificate
Just like the nutritional labels, this certificate will allow farmers to show that they test their soil regularly. This will not only encourage and promote the farmers who test and care for their soils, but will also educate the consumer.

Soil Grading
Developing a standard grading menu for engineered soils for various applications: ground, rooftop, and vertical farming, gardens, stormwater management systems.
Recycling Soil and Waste for Soil Needs in the City

NYC Clean Soils Bank-Mayor’s Office of Environmental Remediation
• pure native sediments excavated during construction are used for other projects in the city
• before this program, 99% of excavated sediments used to be trucked out of the city at a huge cost
• USI will be working with this program to establish soil mixes using local organic amendments and sediments and providing the educational tools for the end-user.

Compost
• the city and community groups have developed city-wide composting programs.
• Compost is being researched as not only a viable management tool for maintaining productive Green infrastructure and urban farms, but for its remediation potential of contaminated soils in the city. USI is working with several groups to establish research needs, compost grades, and effective end-uses for various grades of compost
3MUGIS Summer School will be held in Moscow, Russia on May 21-30 2018. The Summer School will be hosted by the RUDN University and Urban Soils Institute of New York under umbrella of International Union of Soil Science.

The summer school will include 7 days of lectures, seminars, lab and field practical, art and design master classes as well as a rich social program. The practice will involve field survey and in situ measurement, working in research laboratories and landscape architecture studies.

Experts with different background, including but not limited to, environmental conservation, soil science, climate change, civil engineering and policy-making, will be invited to give lectures or seminars. For the preliminary program and registration visit 3MUGIS.org

<table>
<thead>
<tr>
<th>REGISTRATION FEES</th>
<th>Summer school (May 21-26)</th>
<th>Field tour (May 26-31)</th>
<th>SSC conference (May 23-26)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foreign participants</td>
<td>400$</td>
<td>400$</td>
<td>0$</td>
</tr>
<tr>
<td>Russian participants</td>
<td>10000 RUB</td>
<td>20000 RUB</td>
<td>0 RUB</td>
</tr>
</tbody>
</table>

The International Union of Soil Sciences
People's Friendship University of Russia (RUDN University)
Lomonosov Moscow State University
Russian State Agrarian University –
Moscow Timiryazev Agricultural Academy
Institute of Geography, Russian Academy of Sciences

Supported by
Moscow City Government
Project of Competitiveness Enhancement of Leading Russian Universities among Global Research and Educational Centers «5-100»
Erasmus+ Jean Monnet Program

Information letter #1
on the Smart and Sustainable Cities Conference
to be held on May 23 - 26 2018 in Moscow, Russia
1ST ANNUAL URBAN SOILS SYMPOSIUM
SOILS OF OUR CITY
FEATURES & APPLICATIONS
2016
3rd Annual Symposium
Coming this fall!
Save the Date – end of November 2018
Theme: Remediation