WHAT STORMWATER PROFESSIONALS NEED TO KNOW ABOUT WASTE SITE CLEANUP

NEWMOA: Stormwater & Redevelopment of Contaminated Properties

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September 25, 26 and November 6, 2019

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OUTLINE OF TOPICS

- **Brownfields & Site Contamination**
  - What are Brownfields
  - Common Contaminants & Common Sites
- **Is my Site Contaminated?**
  - The Developer/Owner Knows, Doesn't Know, Doesn't Want to Know
  - The Site is Listed or Not Listed
  - Clean Doesn't Exist but Compliant Does
- **Design Considerations for Contaminated Sites**
  - Soil & Groundwater Management During Construction
  - Contaminant Migration Caused or Worsened by Design
- **Contaminant Migration & Receptors**
  - What are Receptors?
  - What is Migration? Is it Coming or Going?
- **Resiliency/Sustainability**
  - Green Infrastructure

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BROWNFIELD SITES & CONTAMINATION

A Brownfield is a property, the expansion, redevelopment or reuse of which may be complicated by the presence, **or potential presence**, of a hazardous substance, pollutant or contaminant.

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BROWNFIELD SITES

Obvious:

- **Abandoned Mills**
- **Gasoline & Service Stations**
- **Manufacturing Companies**
- **Dry Cleaners**

Less Obvious:

- **Commercial/Strip Malls**
  - Hair & Nail Salons
  - Home Improvement/Paint Store
- **Doctor, Dentist, Veterinary**
- **Hospitals & Universities**

Not Obvious:

- **Residential**
- **Farms & Orchards**
- **Parks**

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COMMON CHEMICAL CONTAMINANTS

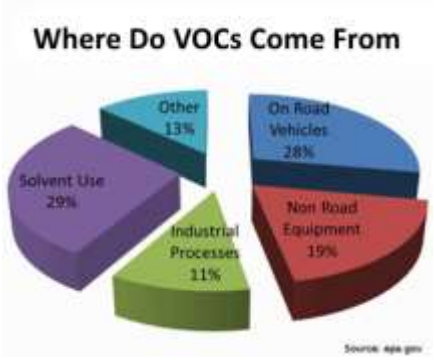
Volatile Organic Compounds (VOCs) Benzene, Toluene, Ethyl Benzene & Xylene (BTEX), Tetrachloroethylene (PCE), Trichloroethylene (TCE), Acetone, Methyl Ethyl Ketone (MEK)

Semi-Volatile Organic Compounds (SVOCs)

Chlorobenzenes, Phenols, Phthalates, Naphthalene and Polycyclic Aromatic Hydrocarbons (PAHs: Naphthalene, Benzo(a)Pyrene, Chrysene, Fluorene, etc.)

Petroleum Hydrocarbons

Total Petroleum Hydrocarbons (TPH), Extractable Petroleum Hydrocarbons (EPH), Volatile Petroleum Hydrocarbons (VPH)



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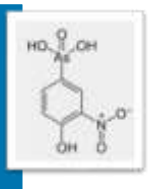
COMMON CHEMICAL CONTAMINANTS

Heavy Metals

13 Priority Pollutant Metals (PP13): Antimony, Arsenic, Beryllium, Cadmium, Chromium, Copper, Mercury, Lead, Nickel Selenium, Silver, Thallium & Zinc

Massachusetts Contingency Plan 14 Metals (MCP 14): Removes Copper and Adds Barium & Vanadium

RCRA Hazardous Waste Metals (RCRA 8): Arsenic, Barium, Cadmium, Chromium, Lead, Mercury, Selenium & Silver



Polychlorinated Biphenyls (PCBs)

Mixtures of chlorinated compounds, known as "Aroclors"

Pesticides & Herbicides

Aldrin, Chlordane, DDD, DDT, DDE, Endrin, Lead Arsenate

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OTHER CONTAMINANTS

Biological (Medical & Hospital)

Radiological

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"TYPICAL" CONTAMINANTS & PROPERTY TYPES

Property Type	Contaminant Sources	Contaminant Types	Chemical Category
Gas Stations	Underground Tanks, Dispenser Islands & Piping	Gasoline (leaded & unleaded) & Oil	VOC, SVOC, Metal, Petroleum
Service Stations Body Shops	Paint Booths, Degreasing, Floor Drains, Tanks, Fuels	Oil, Grease, Gasoline, Paint, Thinners, Strippers	VOC, SVOC, Metal, Petroleum
Old Mills Manufacturing	Tanks, Floor Drains, Drywells, Painting, Metal Finishing, Machining, Degreasing, On-Site Disposal, Spills, Electrical Equipment, Lifts/Elevators	Acids, Alkalis, Metals, Cleaning Solvents, Paints, Cyanides, Thinners, Oils, Fuels	VOC, SVOC, Metal, Petroleum, Corrosives, Cyanide, PCB
Hair & Nail Salons	Hair Dyes, Bleaches, Nail Polish & Remover, Laundering	Metals, Solvents (in polish & remover), Acids/Alkalis, Peroxide	Metal, VOC, Corrosive
Medical & Veterinary (Hospital & Offices)	Drugs, Labs, Disinfecting & Cleaning, Blood/Tissue	Metals, Solvents, Corrosives	Metal, VOC, Corrosive
K-12 & Higher Ed	Science Labs, Art (paint, ceramics), Shop & Trade Rooms (wood, automotive), Athletic Complexes (rinks, fields, pools), Fuel Tanks, Transformers	Oil, Metals, Paints & Thinners, Pesticides & Herbicides, Ammonia, Ethylene Glycol	Metal, VOC, SVOC, Pesticide/Herbicide, Refrigerants, PCBs, Petroleum
Farms & Orchards	Barns & Garages, Maintenance, Pest Management, Fueling, Tanks, Animal Waste Management Areas	Gasoline, Oils, Metals, Paint, Pesticides/Herbicides,	VOC, Petroleum, Metal, Pesticide/Herbicide, Nitrogen, Phosphorus
Railroad/Rail Lines	Petroleum, Pest & Weed Control	Oil, Pesticides/Herbicides	PAHs, Petroleum, Metal, Pesticides/Herbicides, PCB
Residential	Property and Vehicle Maintenance, Lead Paint, Historical Uses	Cleaners, Paint, Thinner, Oil, Pesticides/Herbicides, Gasoline	SVOC, Petroleum, Metal, VOC, Pesticide/Herbicide

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IS MY SITE CONTAMINATED?

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IS MY SITE CONTAMINATED?

Ask Owner/ Developer:

- Get information from them if they know;
- Do research or assessment if they don't know;
- Not evaluating is not the answer.

Research/ Assessment:

- Conduct Targeted Research
- Conduct Phase I Environmental Site Assessment

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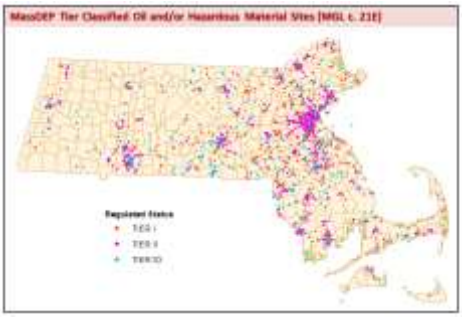
IS MY SITE CONTAMINATED?

- **Limited Targeted Research**
  - Inspect the Site: Any activities of concern?
  - Is the Site Listed: State Listings, Federal Listing
    - If Listed, Contact State/Federal Agency to Review Files
  - Closed/Inactive ≠ Not Contaminated
    - Could have activity/use limitation, engineered cap or other remedial system in place
    - Request files
  - Not Listed ≠ Not Contaminated
    - May not have been investigated
    - May not have been reported
    - Additional Research



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STATE & FEDERAL CONTAMINATED SITE INFORMATION

State/Federal	Resource Name	Website
U.S. EPA	Envirofacts: One Stop Source for Environmental Information	https://enviro.epa.gov/
Connecticut Department of Energy & Environmental Protection (CTDEEP)	List of Contaminated or Potentially Contaminated Sites	https://www.ct.gov/deep/cwp/view.asp?a=2715&q=325018&deepNav_GID=1626
Maine Department of Environmental Protection (MEDEP)	File Room, Reports and Lists	https://www.maine.gov/dep/maps-data/data.html
Massachusetts Department of Environmental Protection (MassDEP)	Energy & Environmental Affairs Data Portal: Waste Site and Reportable Releases Search	https://eeaonline.eea.state.ma.us/portal#!/search/wastesite
New Hampshire Department of Environmental Services (NHDES)	OneStop Data and Information	https://www.des.nh.gov/onestop/index.htm
Rhode Island Department of Environmental Management (RIDEM)	RIDEM Environmental Resource Map	http://ridemgis.maps.arcgis.com/apps/webappviewer/index.html?id=87e104c8adb449eb9f905e5f18020de5
Vermont Department of Environmental Conservation (VTDEC)	Contaminated Sites Search	https://dec.vermont.gov/waste-management/contaminated-sites

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IS MY SITE CONTAMINATED?

- **Conduct Phase I Environmental Site Assessment (ESA)**
  - American Society for Testing and Materials (ASTM) E1527-13 Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process
- **Phase I ESA Process**
  - Objective: Identify "Recognized Environmental Conditions" or RECs
  - Four Components:
    1. Records Review: State/Federal Environmental Database Review, Municipal Research, Physical Setting Sources, Historical Research, Maps and Aerial Photographs, City Directories
    2. Site Reconnaissance: Interior & Exterior Site Inspections, Abutter Uses and Observations,
    3. Interviews: Past & Present Owners & Operators, State & Local Officials,
    4. Report: Written Report, Summary of Work, Pictures, Figures, Findings (RECs/No RECs), Opinion of Impact on Property from the RECs.

Sites aren't "clean," they are compliant.

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DESIGN CONSIDERATIONS FOR CONTAMINATED SITES

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DESIGN CONSIDERATIONS FOR CONTAMINATED SITES

- **Surplus Contaminated Soil Management**
  - **HazMat Trained Contractors**
  - **Stockpile Management**
  - **Additional Cost**
- **Contaminated Groundwater Management**
  - **Discharge Permits**
    - Treatment Prior to Discharge
    - Decontaminate/Dismantle System
  - **Off-Site Disposal**
    - Cost Implications
- **Contaminant Migration**
  - **Caused by Stormwater Infiltration**
  - **Worsened by Stormwater Infiltration**
  - **Effect on Receptors**

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CONTAMINANT MIGRATION

- **Pathway**
  - Routes of transport for contaminants to travel from a contaminated Site, through environmental media, to Receptors;
- **Receptor**
  - A population, community, or ecosystem that is exposed to a contaminant or other stressor (EPA Terminology Services, https://iaspub.epa.gov/sor_internet/registry/termreg/searchandretrieve/termsandacronyms/search.do, 9/2019)

Direct infiltration on Brownfield Sites may introduce additional pollutants/loads to groundwater, surface water, wetlands and abutters. Careful research, engineering design, and regulatory approval are needed.

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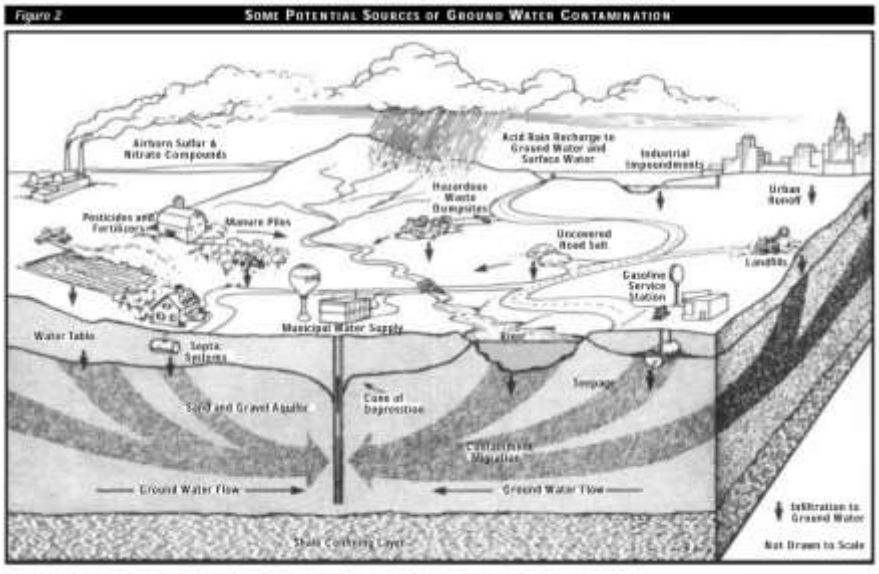
CONTAMINANT MIGRATION



Source: "Getting up to Speed" for Section C, "Ground Water Contamination" adapted from US EPA Seminar Publication *Wellhead Protection: A Guide for Small Communities*, Chapter 3. EPA/625/R-93/002.

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CONTAMINANT MIGRATION

- **Infiltration**
  - Infiltrating stormwater in contaminated areas can mobilize contaminants from soil into groundwater and increase groundwater contamination;
  - Contamination can migrate with groundwater and affect on-Site and off-Site receptors;
  - Stormwater management and infiltration at Brownfield Sites requires careful planning and design that considers and includes:
    - Research and Environmental Assessments to identify known/potential contamination areas;
    - Coordination with, and approval by, state environmental agencies where infiltration is sought in a contaminated area;
    - Proper design and engineering to avoid infiltration in contaminated areas, or mitigate impacts to the satisfaction of the regulators;
    - Consultation with remediation system designers to avoid interfering with remediation system effectiveness.

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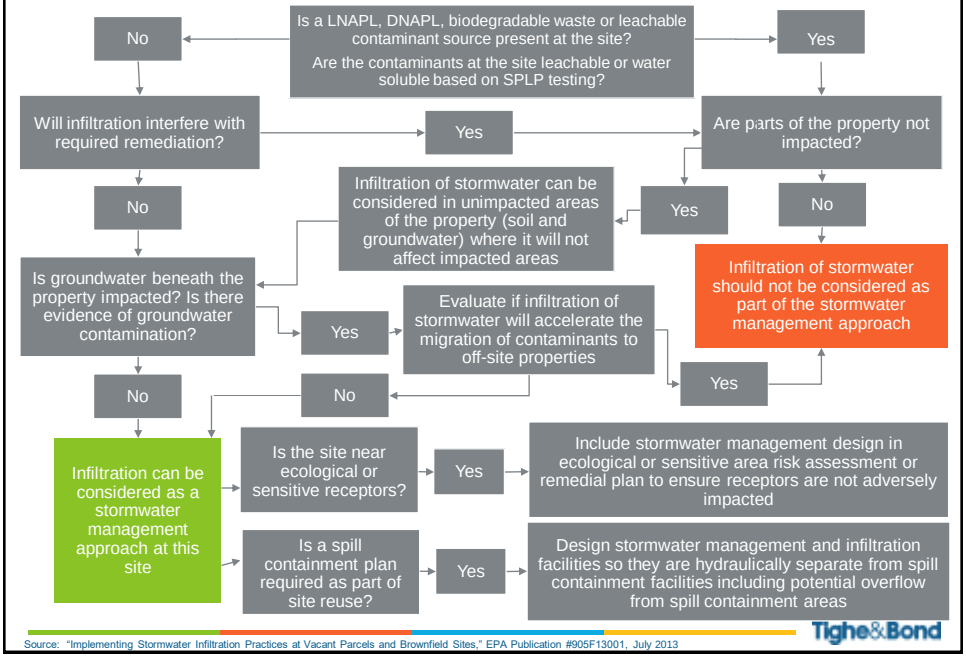
Is Infiltration Appropriate?
Decision Flowchart for the Use of Stormwater Infiltration at Brownfield Sites



Source: "Implementing Stormwater Infiltration Practices at Vacant Parcels and Brownfield Sites," EPA Publication #905F13001, July 2013

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INFILTRATION CONSIDERATIONS AT BROWNFIELD SITES

- **Will stormwater likely mobilize contaminants in soil?**
  - Leachable or Water Soluble Contaminants
    - State-Specific Soil Leachability Standards
    - Test to determine leachability:
      - TCLP: Toxicity Characteristic Leaching Procedure; and
      - SPLP: Synthetic Precipitation Leaching Procedure
- **Is Site groundwater contaminated by an off-Site source?**
  - Additional stormwater infiltration could accelerate groundwater migration across the Site and affect other on-Site or off-Site receptors
  - Effects of comingling on-Site contamination with off-Site contamination must be carefully evaluated
- **Could it interfere with remedial actions?**
  - Vertical migration barriers (increased pressure and leakage)
  - Soil Vapor Extraction (raise groundwater table, increase moisture content in vadose zone)
- **Unimpacted or Easily Remediated Area on-Site?**
  - Evaluate other on-Site areas that may initially seem less attractive

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RESILIENCY AND SUSTAINABILITY

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CHALLENGES

- **Development & Redevelopment Can:**
  - Create large impervious surfaces
  - Prevent stormwater from soaking into the ground
- **Brownfield Sites Can Have:**
  - Impervious cap requirements
  - Remediation systems that are negatively impacted by infiltration
  - Contamination exacerbated by infiltration

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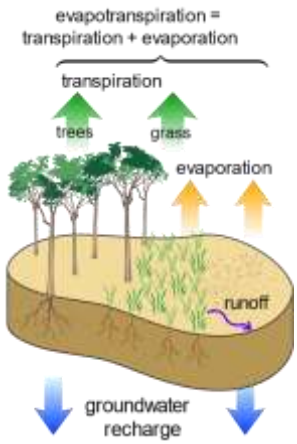
GREEN INFRASTRUCTURE

- **Stormwater reduced, or diverted from, sewer systems to areas where it can be:**
  - Infiltrated;
  - Reused; or
  - Evapotranspiration can occur.

Process where water transfers from the land to the atmosphere by evaporation from soil or other surfaces, and by transpiration from plants.



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GREEN INFRASTRUCTURE

- **Soil and vegetation are used in lieu of, or in conjunction with, traditional drains, gutters, pipes and centralized treatment areas.**
- **Used to manage or mitigate polluted runoff.**

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GREEN INFRASTRUCTURE

Key Components

Treatment and Storage vs Complete Infiltration

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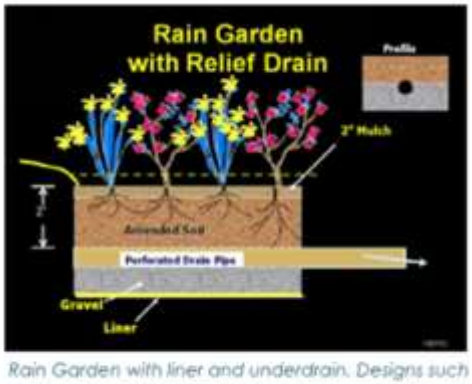
GREEN INFRASTRUCTURE

Key Components

- **Rain Garden with Relief Drain**



Rain Garden with liner and underdrain. Designs such as this allow for filtration and evapotranspiration, but prevent infiltration into subsoils.

Source: "Implementing Stormwater Infiltration Practices at Vacant Parcels and Brownfield Sites," EPA Publication #905F13001, July 2013

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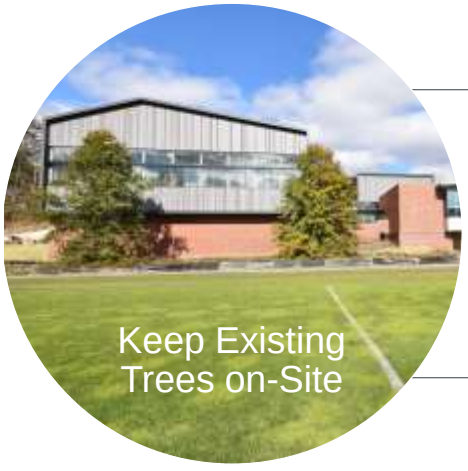
GREEN INFRASTRUCTURE
Key Components



Put buildings over contamination to serve as caps instead of over uncontaminated areas

Green roofs to reduce runoff and encourage evapotranspiration

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GREEN INFRASTRUCTURE
Key Components

Capture and reuse rainwater for non-potable uses: rain barrels and cisterns

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