Molybdenum in Biosolids Update



Rick Stevens / U.S. EPA

Presentation for the Massachusetts

Molybdenum-In-Biosolids Workshop

Wednesday, June 17, 2015

Today's Presentation

Takes a look at statute and regulations

Summarizes biosolids risk assessment methodology

Outlines next steps for molybdenum

…applying science & technology to protect water quality

EPA Statute and Regulations

…applying science & technology to protect water quality

Use of Rivers


Use of Rivers

Beach Closings

CWA Statute

EPA established December 2, 1970

CWA Enacted October 18, 1972 (PL 92-500)

Section 405 sets the framework for sewage sludge regulations (i.e., Part 503)

- Requires EPA to establish standards for proper treatment, use and disposal of sewage sludge
- Also requires EPA to conduct biennial reviews to determine if additional pollutants should be regulated

Part 503 Regulations

40 CFR Part 503
Standards for the Use or Disposal of Sewage Sludge
Enacted February 1993

Solid, semi-solid, or liquid residue generated during the treatment of domestic sewage in a treatment works

Specifies requirements for three management options and applies to a limited number of pollutants

- Land application
- Incineration
- Surface disposal

Rules and Standards

40 CFR Part 503

Self-implementing rule

- Federally enforceable without a permit

States have adopted Part 503 or something more restrictive

- Typically additional requirements address environmentally sensitive areas (e.g., shallow ground water)
- Eight states formally delegated (SD, UT, OK, WI, TX, AZ, OH, MI)

Choice of use or disposal practice is a local decision

Effective management practices help support the needs of local communities

- Renewable resource
- Too valuable to waste

40 CFR Part 503
Heavy Metals

Heavy Metals limits

- ✓ Risk based
- ✓ Arsenic, Cadmium, Chromium[1], Copper, Lead, Mercury, Molybdenum[2], Nickel, Selenium, Zinc

Regulatory limits

- ✓ Ceiling concentration limits (CCL)
- ✓ Pollutant concentration limits (PCL)
- ✓ Cumulative pollutant loading rate (CLPR)
- ✓ Annual pollutant loading rate (APLR)

[1] 1995 amendment deleted land application limits
[2] 1994 amendment only retained CCL

40 CFR Part 503
Molybdenum Limits

Promulgated Limits § 503.13 (1993)

- Table 1: Ceiling Concentration Limit — 75 mg / kg dw
- Table 2: Cum Pollutant Loading Rate — 18 kg / ha
- Table 3: Pollutant Concentration Limit — 18 mg / kg dw ma
- Table 4: Annual Pollutant Loading Rate — 0.9 kg / ha /365 d

Petition Seeking Review (1993)

- Questioned the use of certain data
- Overprotective MO limits

Amendment of MO Limits (1994)

- Deleted land application Table 2,3 & 4 of §503.13
- Only retained Table 1: CCL

Over the next few slides I will provide an overview of select EPA activities involving Molybdenum

- Response to the NRC Report

- Targeted National Sewage Sludge Survey

- Biosolids Core Risk Assessment Model (BCRAM)

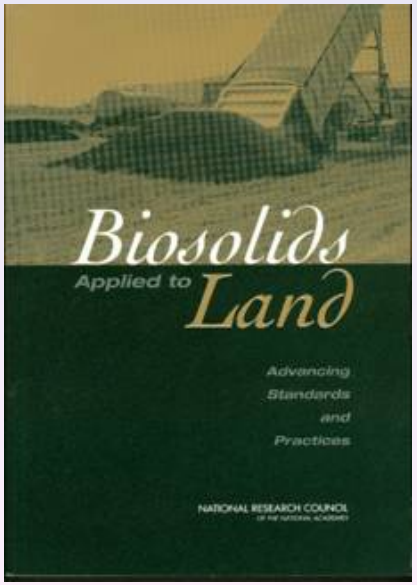
EPA's 2003 Action Plan

NAS Report (2002)

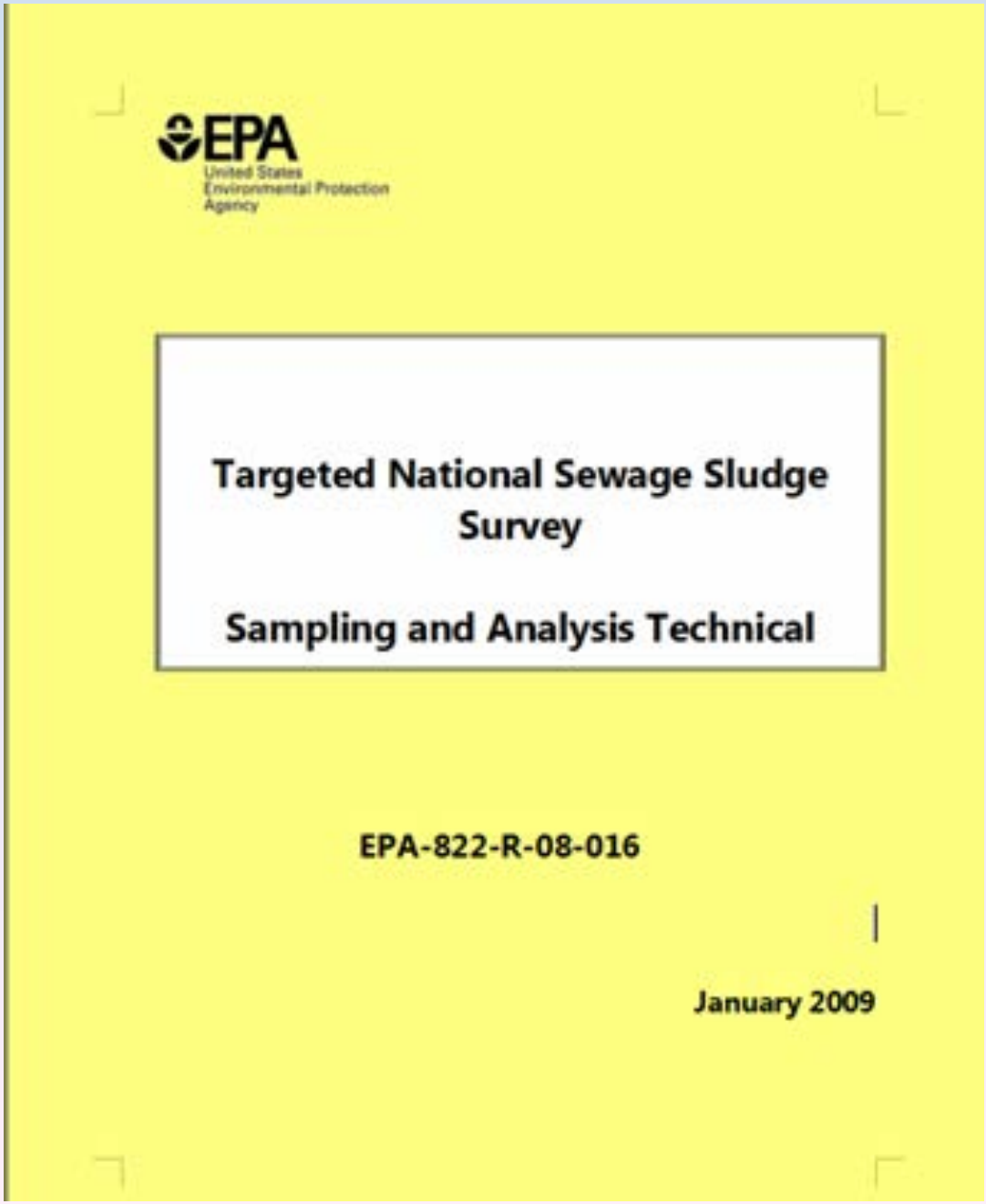
- 53+ recommendations
- Addressing public health concerns / scientific uncertainties

EPA response (2003)

- ✓ 14-point action plan
- ✓ Significant progress



NAS / NRC Report, July 2002



http://water.epa.gov/scitech/wastetech/biosolids/

TNSSS Design

Designed to provide nationally representative results

Statistically selected 74 POTWs to represent 3,337 POTWs that met the following criteria:

- Flow greater than 1 MGD
- Secondary treatment or better
- Located in the contiguous United States

Peer-reviewed both survey design and analytical methods

Sampled treated sewage sludge

TNSSS Design (cont)

Collected 84 samples at 74 POTWs in 35 states August 2006 – March 2007

Measured 145 analytes, including:

- 97 pharmaceuticals, steroids and hormones
  - ✓ 72 antibiotics and drugs (Rx and OTC)
  - ✓ 25 steroids and hormones
- 28 metals, including molybdenum
- 11 polybrominated diphenyl ethers (PBDEs)
- 4 polycyclic aromatic hydrocarbons (PAHs)
- 3 inorganic ions
- 2 semivolatile organics

TNSSS Findings – Occurrence

Wide variation in minimum and maximum levels

Wide variation in detection frequency:

- 16 analytes (11%) not detected
- 129 analytes (89%) detected in at least one sample
- Most non-pharmaceuticals were detected in more than 50 of 84 samples
- Pharmaceuticals/steroids/hormones ranged from 0 to all 84 samples
- 42 analytes detected in 100% of samples (3 pharmaceuticals; 3 steroids & hormones; 28 metals, inorganic ions, organics)

Molybdenum Results

Analyte	# Detects (total=84)	Concentration Range Dry-Weight (mg/kg)	99th Percentile	95th Percentile	Mean	St. Deviation
Metals						
Molybdenum	84	2.51 – 86.4	68.7	40.5	15.3	13.8

TNSSS Next Steps

Characterizing risk where data are sufficient

- Evaluate exposure and effects to human and ecological receptors
  - 10 pollutants (barium, beryllium, manganese, **molybdenum**, silver, 4-choroaniline, fluoranthene, pyrene, nitrate, nitrite)
  - 135 pollutants
- Biosolids Core Risk Assessment Model

Biosolids Core Risk Assessment Model

BCRAM

…applying science & technology to protect water quality

BCRAM

Biosolids Core Risk Assessment Model

3MRA modeling system

- Multimedia
- Multipathway
- Multireceptor

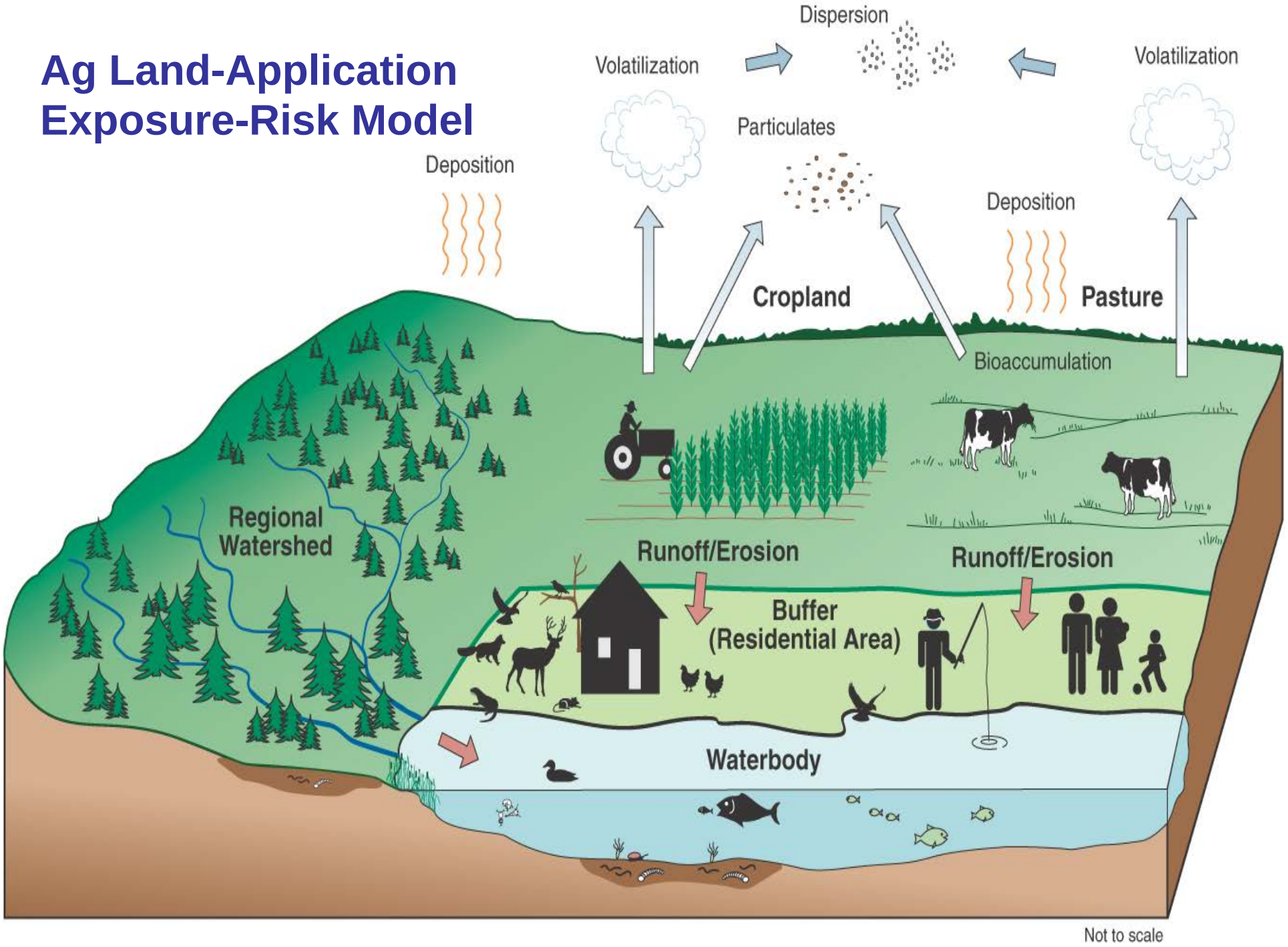
SAB reviewed core model also used by others

- Biosolids environmental settings
- Exposure to individuals on lifestyle farms

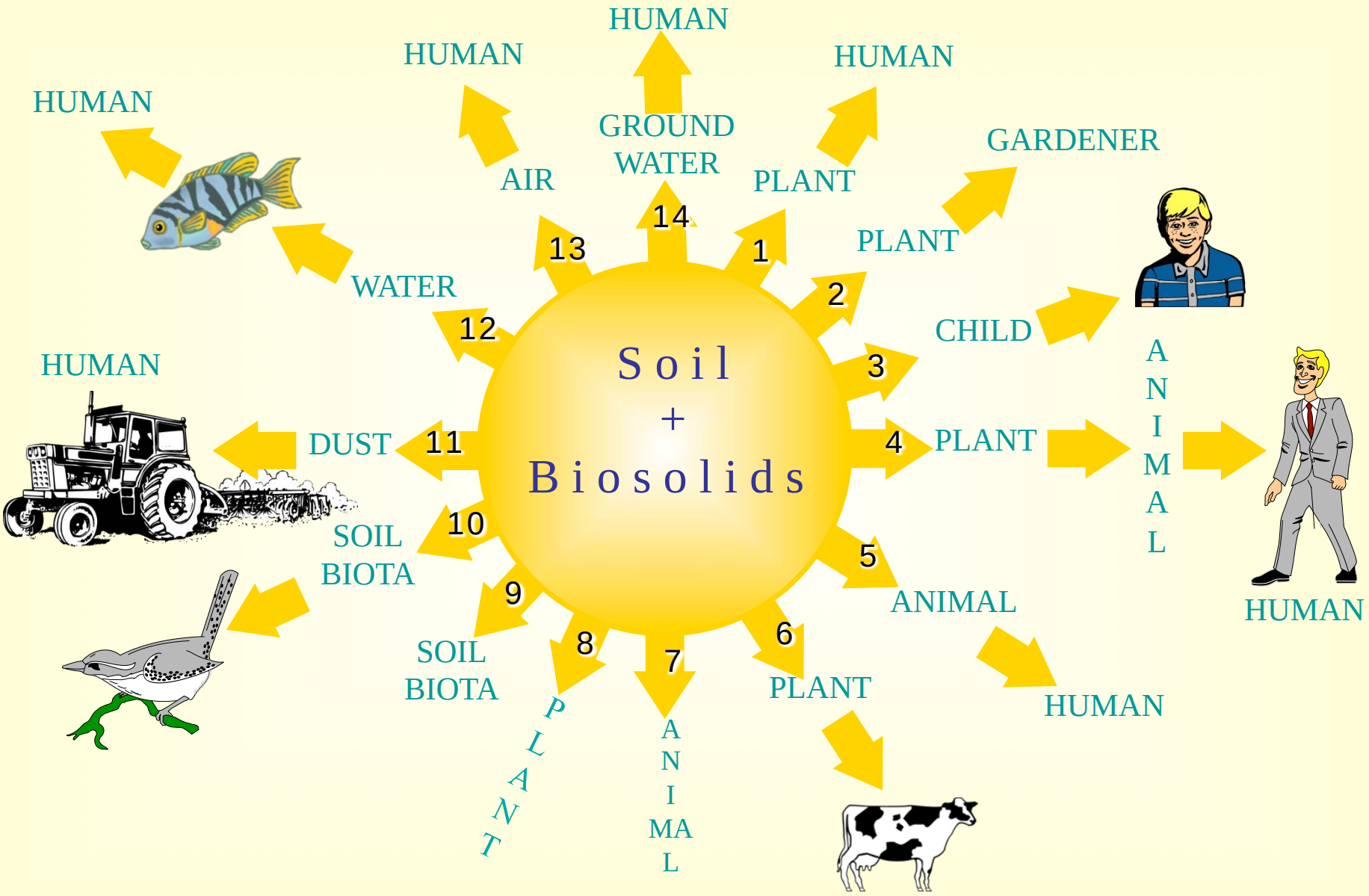
Recent methodology and data updates

- Human Health Risk Assessment Protocol (2005)
- Exposure Factors Handbook (2011)
- Child Specific EFH (2008)

Ag Land-Application Exposure-Risk Model



14 - Pathway Risk Assessment



POLLUTANT	CONTROLLING PATHWAY	PATHWAY SCENARIO
Arsenic Cadmium Lead Mercury Selenium	3	Child Eating Biosolids
Molybdenum	6	Animal Eating Plants
Copper Nickel Zinc	8	Plant Phytotoxicity

BCRAM - Land Application

- Biosolids applied by a “lifestyle” farmer to either pasture or cropland
  - once every two years
  - agronomic rates
- Data help characterize toxicity, environmental settings and exposure
  - Pollutant behavior
  - Climate / meteorologic (41 climate regions)
  - Soil (9 farm “resource regions”)

41 Climate Regions

Figure 1.1 Map of 41 climatic regions.

9 Resource Regions

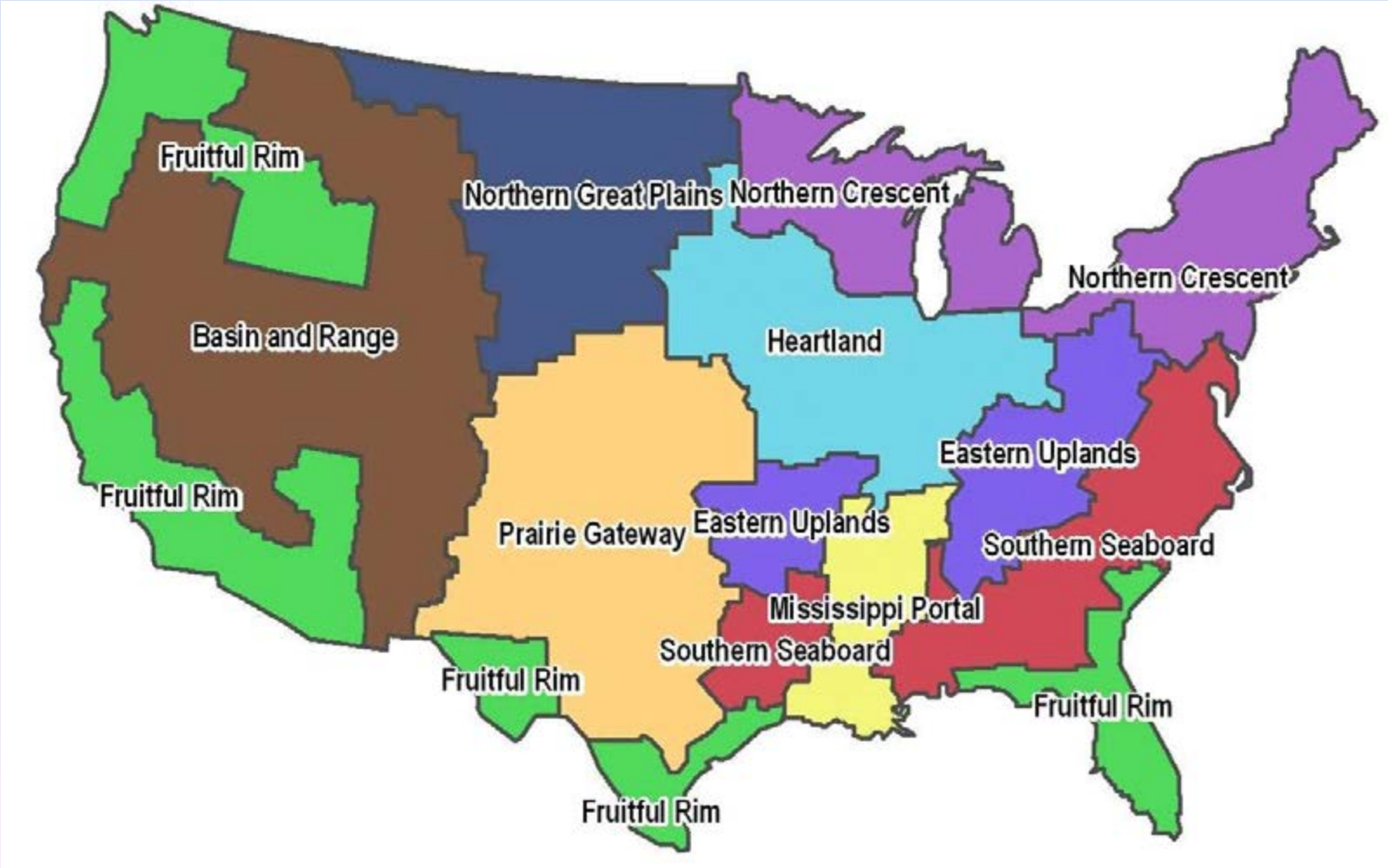
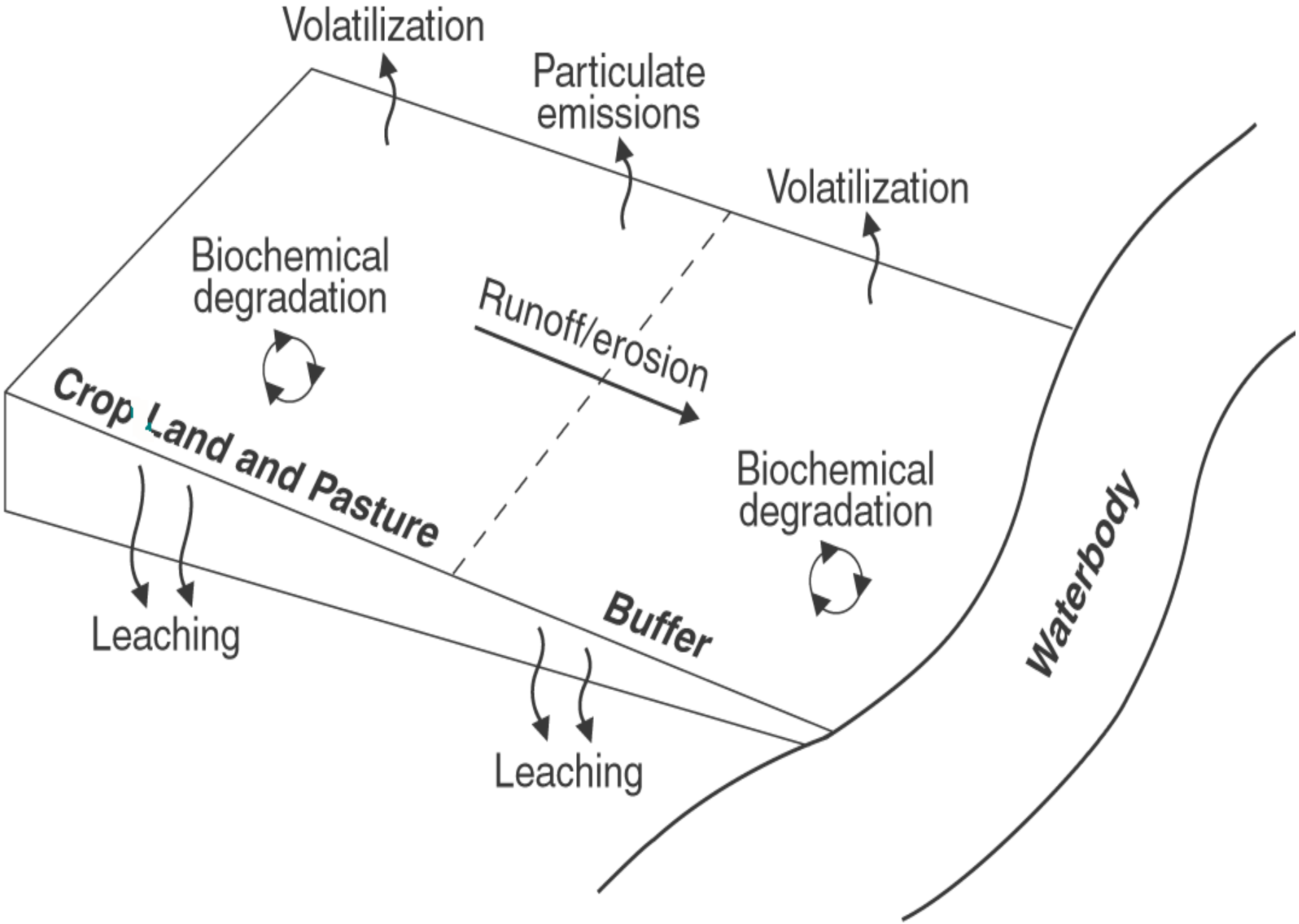
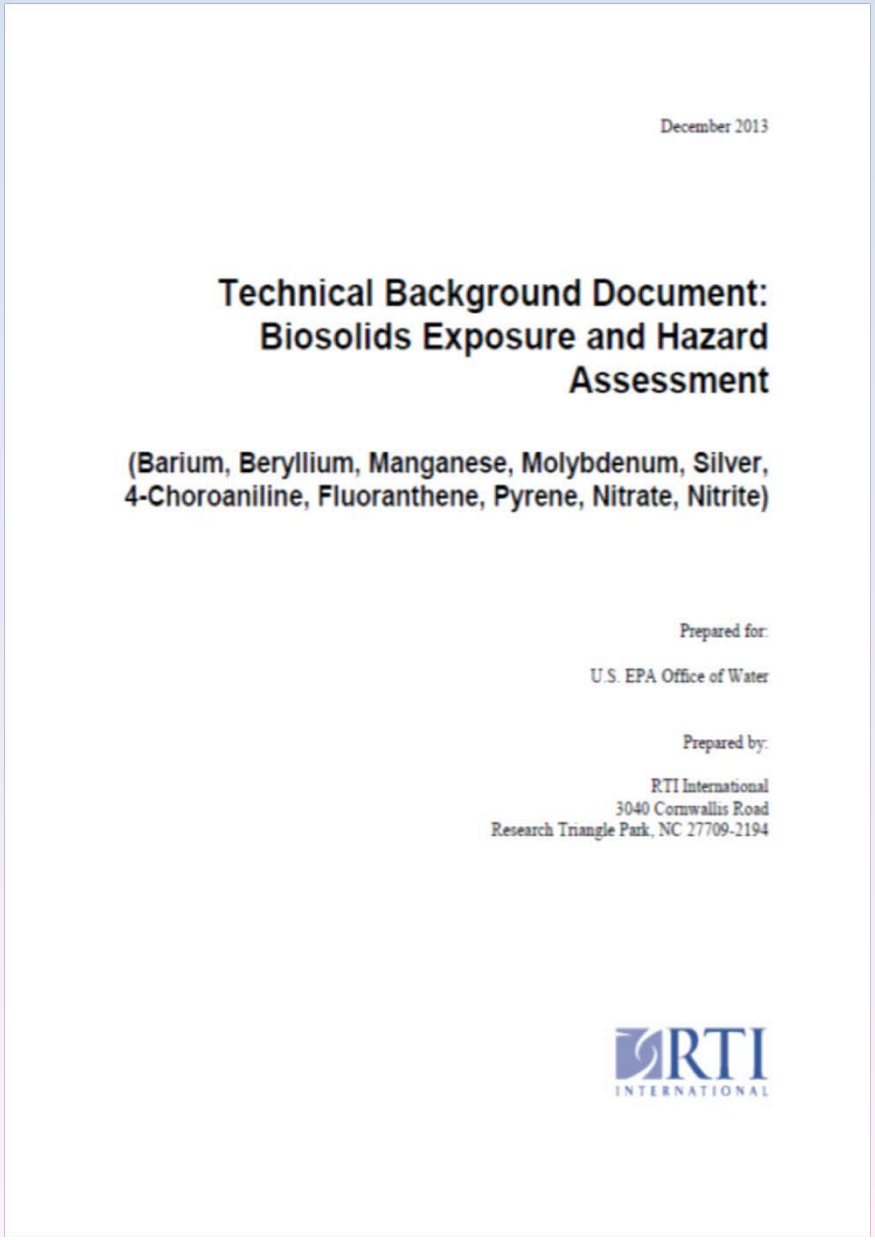


Figure 2-11. Map of the 9 resource regions.


Volatilization
Particulate emissions
Volatilization
Biochemical degradation
Runoff/erosion
Crop Land and Pasture
Biochemical degradation
Waterbody
Leaching
Buffer
Leaching

What It Means for Molybdenum



December 2013

Technical Background Document: Biosolids Exposure and Hazard Assessment

(Barium, Beryllium, Manganese, Molybdenum, Silver, 4-Choroaniline, Fluoranthene, Pyrene, Nitrate, Nitrite)

Prepared for:

U.S. EPA Office of Water

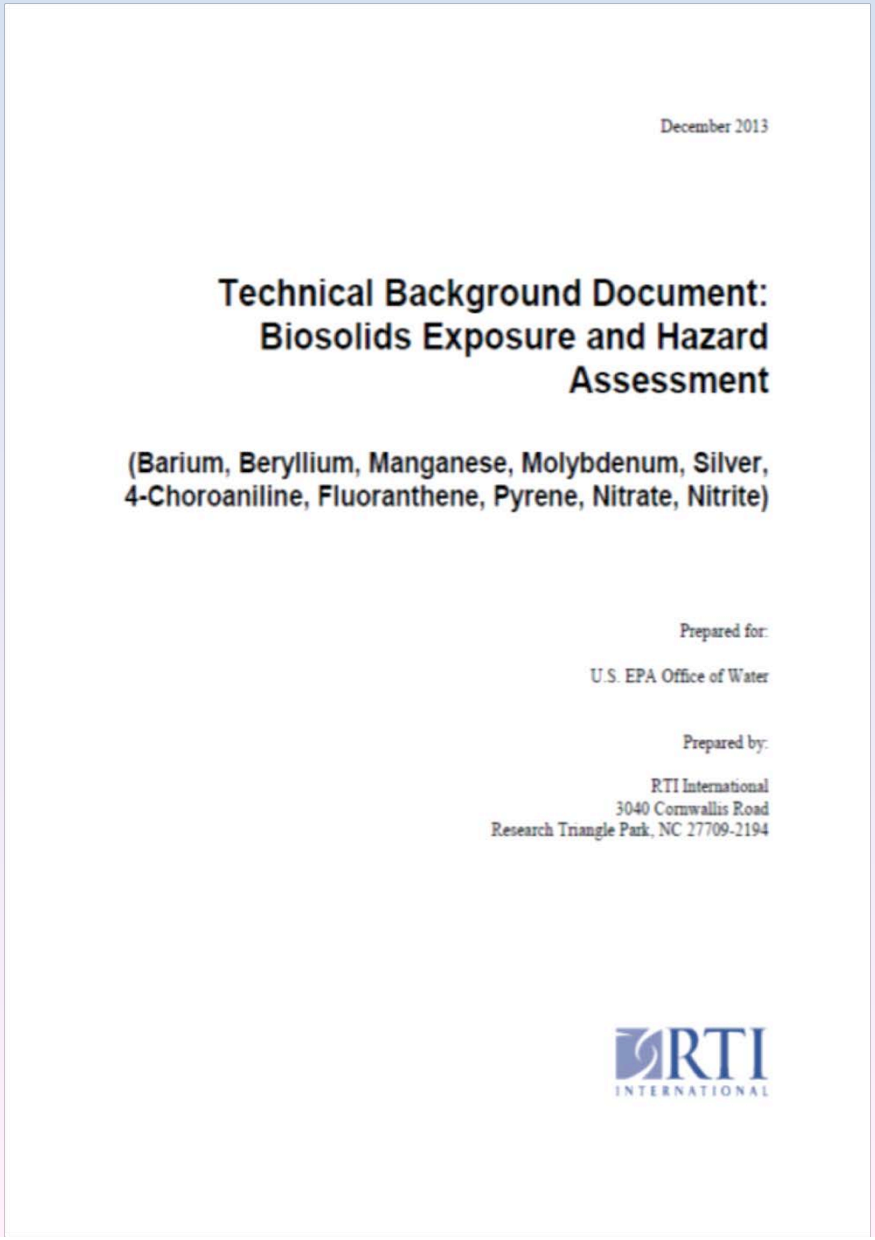
Prepared by:

RTI International
3040 Cornwallis Road
Research Triangle Park, NC 27709-2194

RTI INTERNATIONAL

- Evaluated exposure and hazards for molybdenum using BCRAM
- Characterized 95th percentile risk (cancer risk or Hazard Quotients from RfD / RfC / other endpoints)

Molybdenum Exposure to Grazing Cattle



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RTI INTERNATIONAL

- Use BCRAM to evaluated exposure to beef and dairy cattle for molybdenum under the pasture scenario
- Further characterized potential hazards associated with Pathway 6
- Risk Assessment was peer reviewed

Next Steps for Molybdenum

- Address Comments (July 2015)
  - Peer Review
  - W3170 Committee
  - NACWA
- Revise the risk assessment (July 2015)
- Publish the RA for public comment (Sept. 2015)
- Consider risk management options (2-3QFY2016)

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http://water.epa.gov/scitech/wastetech/biosolids/