Where are we in the Timeline?

**Remediation Program* Soil Reference Value (SRV) Revision Timeline**

- **2014**
  - October: Draft SRV Values & Technical Support Documents (TSD) Released
  - November: Stakeholder Review and Comments on Draft SRV and TSD (comments to MPCA by 12/15/14)

- **2015**
  - January: MPCA Review of Stakeholder Comments
  - February: MPCA Responses to Stakeholder Comments
  - March: Draft SRV and TSD Released
  - April: MPCA & Stakeholder Meeting
  - May: Draft SRV, TSD, & Background Values Released
  - June: Stakeholder Review and Comments on Draft SRV and TSD and Background Values Documents (comments to MPCA by 9/30/15)
  - July: MPCA Review of Stakeholder Comments on Draft SRV and TBT
  - August: MPCA Review of Stakeholder SRV and BTV Comments
  - September: Stakeholder Review and Comments on Program Specific Guidance Documents (comments to MPCA by 11/30/15)

- **2016**
  - October: Final SRV, TSD, Background Values, & Program Specific Guidance Released
  - November: MPCA Review of Stakeholder Program Specific Guidance Comments
  - December: All Final SRV, TSD, Background Values & Program Specific Guidance are in Effect Starting January 1, 2016

- **2017**
  - January: Additional MPCA & Stakeholder Meetings as Needed or Upon Request

*Superfund, Site Assessment, VIC, RCRA Cleanup*
Why are SRVs Revised?

• Periodically revised to incorporate new
  • Methodology
  • Exposure parameters
  • Toxicity values
  • Chemical specific parameters
• Not in response to any specific incident, project or occurrence
What Changed with this Revision?

- Methodology
  - EPA Superfund methodology
    - Addition of mass limit volatilization factor
- Exposure Parameters
  - 2014 EPA Superfund recommendations
    - Minnesota specific modifications
- Toxicity values
  - More recent values used if appropriate
- Chemical specific parameters
  - EPA Superfund hierarchy
What Documents Were Revised?

**SRV Technical Support Document (TSD)**
**DRAFT COMPLETED**
How the SRVs were derived and their intended use

**SRV Spreadsheet**
**DRAFT COMPLETED**
SRVs applicable to any site in Minnesota

**SRV Spreadsheet - Site Specific**
**DRAFT COMPLETED**
Used to derive SRVs applicable to a specific site

**Soil Investigation Guidance**
**TO BE DRAFTED**
VIC, Superfund, RCRA program Specific Guidance
SRVs are one of the tools used
Who Was involved?

- **SRV Revisions - MPCA**
  - Remediation Division
    - Staff participation in work groups
    - Consultation with other staff and staff review of documents
  - Environmental Outcomes & Analysis Division
    - Remediation risk assessor participation in work groups
    - Consultation with other staff and other risk assessors/toxicologist review of documents

- **Consultation and review of documents**
  - MDH
  - MDA
  - EPA
  - USGS (inorganics in BTV documents only)
How are SRVs Intended to Be Used?

- VIC, Superfund, RCRA cleanup sites
- SRVs are a screening tool
  - NOT intended to be used as Cleanup Values
- Responsible or voluntary parties can
  - Chose to derive site specific SRVs for clean up values
  - Chose to use state wide SRVs as cleanup values
How are SRVs Intended to Be Used?

EPA’s Superfund Program Provides Methodology used to Derive Soil Reference Values to States

MPCA’s EAO & Remediation Division derive SRVs based on EPA’s Superfund Methodology with Remediation’s Use in Mind

Minnesota specific exposures

Minnesota specific toxicity information

Remediation develops program specific guidance using SRVs as a screening tool to investigate soil contamination

Other MPCA programs chose to use SRVs when appropriate after consulting with EAO (Water Permitting, Stormwater, Solid Waste)

Other programs and EAO develop program specific spreadsheets when necessary

Other programs develop program specific guidance including the use of SRVs
What Do SRVs Evaluate?

- Human exposures to soil on land
  - NOT ecological
  - NOT sediments

- Soil Exposure Routes
  - Ingestion
  - Dermal Contact
  - Inhalation
    - Particulates in surface soil
      - Particulate Emission Factor
    - Volatilization from soil at depth
      - Volatilization Factor (standard and mass limit)
How Did Exposure Parameters Change?

• Exposure Frequency
  • Receptor type based on soil land use category
    • Residential/Recreational
    • Commercial/Industrial
  • Soil exposure route
    • Ingestion
    • Dermal
    • Inhalation via fugitive dust
    • Inhalation via vapors
  • Type of contamination present
    • VOCs
    • Non-VOCs
  • 100 frozen and snow covered days per year eliminated from some exposure routes
### How Did Exposure Parameters Change?

<table>
<thead>
<tr>
<th>Exposure Route</th>
<th>VOC</th>
<th>Non-VOC</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ingestion</strong></td>
<td>Eliminate 100 days/year</td>
<td>Do NOT eliminate 100 days/year</td>
</tr>
<tr>
<td></td>
<td>Although ingestion exposure will occur both indoor and outdoor, VOCs will not be present in indoor dust due to their volatile nature</td>
<td>Ingestion exposure will occur both indoor and outdoor and non-VOCs will be present in indoor dust</td>
</tr>
<tr>
<td><strong>Dermal Contact</strong></td>
<td>NOT included for VOCs</td>
<td>Eliminate 100 days/year</td>
</tr>
<tr>
<td></td>
<td>Dermal contact is not considered to be a significant route of exposure for VOCs due to their volatile nature</td>
<td>Dermal contact is considered to only be a significant route of exposure outdoors and will not occur when the ground is frozen and snow covered greater than 1 inch</td>
</tr>
<tr>
<td><strong>Inhalation – Fugitive Dust</strong></td>
<td>NOT included for VOCs</td>
<td>Eliminate 100 days/year</td>
</tr>
<tr>
<td></td>
<td>Inhalation of fugitive dust is not considered to be a significant route for exposure for VOCs due to their volatile nature</td>
<td>Fugitive dust is not expected to be present outdoors when the ground is frozen and snow covered greater than 1 inch</td>
</tr>
<tr>
<td><strong>Inhalation – Vapors</strong></td>
<td>Eliminate 100 days/year</td>
<td>Eliminate 100 days/year</td>
</tr>
<tr>
<td></td>
<td>Vapors are not expected to be present outdoors when the ground is frozen and snow covered greater than 1 inch</td>
<td>Vapors are not expected to be present outdoors when the ground is frozen and snow covered greater than 1 inch</td>
</tr>
</tbody>
</table>
How Did Exposure Parameters Change?

• Ingestion Rate
  • Previous ingestion adjusted to account for frozen days and snow covered days
  • New ingestion rate does not consider frozen and snow covered days since this is considered in exposure frequency
How Did Exposure Parameters Change?

- **Standard volatilization factor**
  - Contamination right below ground surface
  - Infinite source – may violate mass balance considerations
  - Uniform rate of volatilization based on
    - Infinite source
    - Henry’s Law specific to a contaminant
How Did Exposure Parameters Change?

- Mass limit volatilization factor
  - Contamination right below ground surface
  - Finite source based on thickness of contamination
  - Uniform rate of volatilization based on
    - Finite source size
Volatilization Factors

- Eliminate violation of mass balance considerations
  - 2 SRVs derived
    - 1 using standard volatilization factor
    - 1 using mass limit volatilization factor
  - SRV with highest value used
- Example
  - Chemical X SRV using standard VF = 100 mg/kg
  - Chemical X SRV using mass limit VF = 200 mg/kg
  - SRV is set at 200 mg/kg
How did Revisions Change SRVs?

- Mass limit volatilization factor
  - Net increase for impacted VOCs
- Exposure parameters
  - Residential/Recreational SRVs
    - Net slight decrease
  - Commercial/Industrial SRVs
    - Net increase
- Toxicity Values & chemical specific parameters
  - Contaminant specific
How did Revisions Change SRVs?

- SRVs potentially below soil background levels?
  - Aluminum
  - Arsenic
  - Barium
  - Chromium
  - Cobalt
  - Iron
  - Thallium
  - Vanadium
  - Benzo[a]pyrene (BaP) equivalents
  - TCDD (2,3,7,8-Tetrachlorodibenzo-p-dioxin) equivalents
Any SRVs Below Soil Background Levels?

- Evaluation to determine if SRVs are below soil background levels
- Establish a Background Threshold Value (BTV)
  - Estimate of the background level in soil
  - Background
    - Amount of a chemical that is present in soil that is NOT due to local anthropogenic sources such as a release
Any SRVs Below Soil Background Levels?

- Inorganics: aluminum, arsenic, barium, chromium, cobalt, iron, thallium, vanadium
  - USGS’s 2013 Soil Survey
    - 137 samples from Minnesota
  - USGS vs. EPA analytical methods
    - USGS - aggressive digestion
    - EPA - less aggressive digestion
    - Results in different concentrations
      - Specific chemical
      - Geological characteristics of the soil
      - Differences NOT consistent across Minnesota
Any SRVs Below Soil Background Levels?

- Difference between USGS and EPA’s method?
  - Re-analyze 45 samples using EPA’ method

- Data
  - USGS complete 137 sample dataset
  - EPA reanalyzed 45 sample dataset

- BTV Evaluation
  - Differences in concentrations across Minnesota
  - Outliers using USGS’s full 137 sample dataset
  - Are background concentrations higher than SRV?
  - Differences between results of 2 methods
  - Establish BTV if necessary
Any SRVs Below Soil Background Levels?

- How was a BTV established?
  - Complete USGS 137 sample dataset
  - EPA’s ProUCL software
  - Upper Tolerance Limit (UTL)
- What is a UTL95-95?
  - 95% confidence limit of the 95th percentile of the dataset
- Why a UTL?
  - Large number of comparisons to BTV
  - False positive and negative errors rates minimized
- Some BTVs were established using a lower percentile
  - All BTVs used a 95% confidence limit
Any SRVs Below Soil Background Levels?

- Difference between USGS & EPA methods varies by
  - Specific inorganic
  - Geology at sample site

<table>
<thead>
<tr>
<th>Inorganic</th>
<th>Minimum Difference</th>
<th>Maximum Difference</th>
<th>Upper Percentile Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aluminum</td>
<td>-95%</td>
<td>-67%</td>
<td>-70%</td>
</tr>
<tr>
<td>Arsenic</td>
<td>-75%</td>
<td>39%</td>
<td>-1%</td>
</tr>
<tr>
<td>Barium</td>
<td>-95%</td>
<td>-65%</td>
<td>-71%</td>
</tr>
<tr>
<td>Chromium</td>
<td>-84%</td>
<td>-48%</td>
<td>-63%</td>
</tr>
<tr>
<td>Cobalt</td>
<td>-56%</td>
<td>21%</td>
<td>-19%</td>
</tr>
<tr>
<td>Iron</td>
<td>-65%</td>
<td>-2%</td>
<td>-32%</td>
</tr>
<tr>
<td>Thallium</td>
<td>-79%</td>
<td>-35%</td>
<td>-55%</td>
</tr>
<tr>
<td>Vanadium</td>
<td>-76%</td>
<td>-11%</td>
<td>-52%</td>
</tr>
<tr>
<td>Inorganic</td>
<td>Soil Land Use Category</td>
<td>EPA Method Value mg/kg</td>
<td>Source</td>
</tr>
<tr>
<td>-----------</td>
<td>------------------------</td>
<td>------------------------</td>
<td>--------</td>
</tr>
<tr>
<td>Aluminum</td>
<td>Res/Rec Chronic</td>
<td>59,000</td>
<td>BTV, UTL95-95 from USGS dataset</td>
</tr>
<tr>
<td></td>
<td>Com/Ind Chronic</td>
<td>100,000</td>
<td>Com/Ind chronic SRV</td>
</tr>
<tr>
<td>Arsenic</td>
<td>Res/Rec Acute</td>
<td>9</td>
<td>BTV, UTL95-95 from USGS dataset</td>
</tr>
<tr>
<td></td>
<td>Res/Rec Chronic</td>
<td>9</td>
<td>BTV, UTL95-95 from USGS dataset</td>
</tr>
<tr>
<td></td>
<td>Com/Ind Chronic</td>
<td>9</td>
<td>BTV, UTL95-95 from USGS dataset</td>
</tr>
<tr>
<td>Barium</td>
<td>Res/Rec Acute</td>
<td>250</td>
<td>Res/Rec acute SRV</td>
</tr>
<tr>
<td></td>
<td>Res/Rec Chronic</td>
<td>3,000</td>
<td>Res/Rec chronic SRV</td>
</tr>
<tr>
<td></td>
<td>Com/Ind Chronic</td>
<td>35,000</td>
<td>Com/Ind chronic SRV</td>
</tr>
<tr>
<td>Chromium III</td>
<td>Res/Rec Chronic</td>
<td>23,000</td>
<td>Res/Rec chronic SRV</td>
</tr>
<tr>
<td></td>
<td>Com/Ind Chronic</td>
<td>100,000</td>
<td>Com/Ind chronic SRV</td>
</tr>
<tr>
<td>Chromium VI</td>
<td>Res/Rec Chronic</td>
<td>11</td>
<td>Res/Rec chronic SRV</td>
</tr>
<tr>
<td></td>
<td>Com/Ind Chronic</td>
<td>57</td>
<td>Com/Ind chronic SRV</td>
</tr>
<tr>
<td>Cobalt</td>
<td>Res/Rec Chronic</td>
<td>13</td>
<td>BTV, UTL95-95 from USGS dataset</td>
</tr>
<tr>
<td></td>
<td>Com/Ind Chronic</td>
<td>67</td>
<td>Com/Ind chronic SRV</td>
</tr>
<tr>
<td>Iron</td>
<td>Res/Rec Chronic</td>
<td>30,000</td>
<td>BTV, UTL95-90 from USGS dataset</td>
</tr>
<tr>
<td></td>
<td>Com/Ind Chronic</td>
<td>100,000</td>
<td>Com/Ind chronic SRV</td>
</tr>
<tr>
<td>Thallium</td>
<td>Res/Rec Chronic</td>
<td>Site specific BTV</td>
<td>Site specific BTV</td>
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<tr>
<td></td>
<td>Com/Ind Chronic</td>
<td>2.3</td>
<td>Com/Ind chronic SRV</td>
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<tr>
<td>Vanadium</td>
<td>Res/Rec Chronic</td>
<td>121</td>
<td>BTV, UTL95-95 from USGS dataset</td>
</tr>
<tr>
<td></td>
<td>Com/Ind Chronic</td>
<td>121</td>
<td>BTV, UTL95-95 from USGS dataset</td>
</tr>
</tbody>
</table>

Determining site specific background is always an option
Any SRVs Below Soil Background Levels?

Map of arsenic background concentrations in Minnesota from USGS dataset

Determining site specific background is always an option
Any SRVs Below Soil Background Levels?

- **Organics:** BaP equivalents, TCDD equivalents
- **Other states data**
  - Data specific to other states reflecting ambient levels

<table>
<thead>
<tr>
<th>Inorganic</th>
<th>Soil Land Use Category</th>
<th>EPA Method Value (mg/kg)</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>BaP Equivalents</td>
<td>Res/Rec Chronic</td>
<td>1</td>
<td>BTV, available data</td>
</tr>
<tr>
<td></td>
<td>Com/Ind Chronic</td>
<td>14</td>
<td>Com/Ind chronic SRV</td>
</tr>
<tr>
<td>TCDD Equivalents</td>
<td>Res/Rec Chronic</td>
<td>4.0E-06</td>
<td>Res/Rec chronic SRV</td>
</tr>
<tr>
<td></td>
<td>Com/Ind Chronic</td>
<td>2.0E-05</td>
<td>Com/Ind chronic SRV</td>
</tr>
</tbody>
</table>
## How did Revisions Change SRVs?

### Residential/Recreational

<table>
<thead>
<tr>
<th>Change Type</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Decrease</td>
<td>89</td>
</tr>
<tr>
<td>Increase</td>
<td>59</td>
</tr>
<tr>
<td>No Change</td>
<td>1</td>
</tr>
<tr>
<td>No Previous SRV</td>
<td>7</td>
</tr>
<tr>
<td>Set at BTV</td>
<td>7</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>163</strong></td>
</tr>
</tbody>
</table>

### Commercial/Industrial

<table>
<thead>
<tr>
<th>Change Type</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Decrease</td>
<td>58</td>
</tr>
<tr>
<td>Increase</td>
<td>88</td>
</tr>
<tr>
<td>No Change</td>
<td>8</td>
</tr>
<tr>
<td>No Previous SRV</td>
<td>7</td>
</tr>
<tr>
<td>Set at BTV</td>
<td>2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>163</strong></td>
</tr>
</tbody>
</table>
What are site specific SRVs?

- Applicable to VIC, RCRA & Superfund sites only
- Derived using SRV Spreadsheet – Site Specific
  - Requires approval of project manager & risk assessor
- Ability to modify exposure parameters
  - Example: Hazard Quotient (HQ)
    - Purpose – present a range of potential risks
  - Example: Exposure frequency
    - Purpose – reflect site specific conditions
- Site Specific SRV Exposure Parameter Modifications
  Table in SRV TSD, Table B-1
Soil Reference Value Revisions

Questions?