





Virginia Unified Risk Assessment Model (VURAM) Unleashed

Application for RCRA Programs

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What is VURAM ?

- Mathematical database model for:
 - 3 Modules- Screening, Human Health Quantitative Risk Assessment (QRA) and Background Comparison
- Developed in Microsoft Access for Win 2007 or later
- Uses data/updates from Regional Screening Levels (RSL) tables
- Accompanied by VURAM User Guide on Virginia DEQ web

What is not VURAM?

- Defaults cannot be edited to get to management decision process quicker
- VURAM does NOT include following important Risk Assessment steps:
 - CSM Development
 - Data Quality Assessment (QA/QC)
 - Statistical Analysis of Data
 - Calculate Uncertainties
 - Ecological QRA
 - Probabilistic Risk Assessment
 - Fate and Transport Evaluation

Why use VURAM?

- Complexity of the Excel Tables
- Better user-interface than EXCEL
- Consistency across all programs (Corrective Action, Brownfields, Voluntary Remediation, Solid Waste): Nuances built-in
- In-house support available for testing, update and questions
- Efficient report reviews and time saver

However..... Remember

- Risk Assessment approaches are the same : Use RAGS
- Site-specific scenarios are allowed
- “ Garbage In-Garbage Out ” : Good data vs. Bad data
- VURAM replaces REAMS (RA Module only) and Excel Tables

Starting VURAM

Download- DEQ Web (No Shared Drive, Unzip File/Save Copy)

Open w/ MS Access 2007 or later

Enable Macros & Launch

Select Module & Enter Site Name

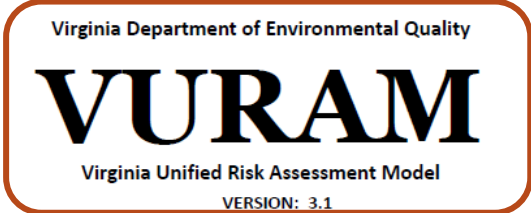
Select Program, COPCs/COCs, Study Area (QRA), Risk Thresholds


Enter Media and Concentration


Generate Report

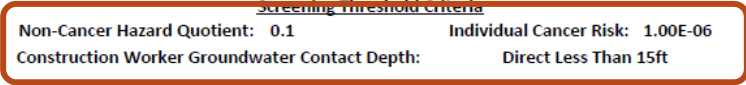



Report Interpretation: Screening

1. 

2. 

3. 

4. 

5. 

1. VURAM Header and Version Number: Check for the latest version before submittal
2. Module and Program
3. Site Name
4. Risk Thresholds and Construction Worker Scenario
5. Date and Page Number Stamp

Report Interpretation: Screening II

Detailed Screening Report

Site Name: ASTSWMO 2020
 Program: RCRA Corrective Action
 Non-Cancer Hazard Quotient: 0.1
 Screening Threshold Criteria
 Individual Cancer Risk: 1.00E-06
 Construction Worker Groundwater Contact Depth: Direct Less Than 15ft

6.

6. Site Name, Program, Risk Thresholds and Construction Worker Scenario

Surface water screening values are not applicable to ecological receptors.
 Physical and biological parameters are not screened in surface water.
 COPCs are listed as NE (not evaluated) where there is no screening level. A summary of NE analytes is provided at the end of the report.†

7.

7. Disclaimers about Surface Water and Not Evaluated COPCs

SOIL
mg/kg

Screening Type: Residential Soil

Analyte	CAS	VOC	Concentration	Screening Level	COPC
Benzene	71-43-2	Y	1.00E+02	1.20E+00	Y
Trichloroethylene	79-01-6	Y	1.00E+02	4.10E-01	Y

Screening Type: Industrial Soil

Analyte	CAS	VOC	Concentration	Screening Level	COPC
Benzene	71-43-2	Y	1.00E+02	5.10E+00	Y
Trichloroethylene	79-01-6	Y	1.00E+02	1.90E+00	Y

Screening Type: Risk-based SSL

Analyte	CAS	VOC	Concentration	Screening Level	COPC
Benzene	71-43-2	Y	1.00E+02	2.33E-04	Y
Trichloroethylene	79-01-6	Y	1.00E+02	1.01E-04	Y

Screening Type: MCL-based SSL

Analyte	CAS	VOC	Concentration	Screening Level	COPC
Benzene	71-43-2	Y	1.00E+02	2.56E-03	Y
Trichloroethylene	79-01-6	Y	1.00E+02	1.79E-03	Y

8.

8. Screening Separated According to Media, Receptors and Various Screening Levels

Groundwater
ug/L

Screening Type: Residential Tapwater

Analyte	CAS	VOC	Concentration	Screening Level	COPC
Benzene	71-43-2	Y	1.00E+02	4.60E-01	Y
Trichloroethylene	79-01-6	Y	1.00E+02	2.80E-01	Y

9.

9. Date and Page Number Stamp

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Report Interpretation: Screening III

10.

Air
µg/m³

Screening Type: Residential Deep Soil Gas

Analyte	CAS	VOC	Concentration	Screening Level	COPC
Benzene	71-43-2	Y		3.60E+01	
Trichloroethylene	79-01-6	Y		2.10E+01	

Screening Type: Industrial Shallow/Sub-Slab Soil Gas

Analyte	CAS	VOC	Concentration	Screening Level	COPC
Benzene	71-43-2	Y	1.00E+02	5.33E+01	Y
Trichloroethylene	79-01-6	Y	1.00E+02	2.93E+01	Y

Screening Type: Industrial Deep Soil Gas

Analyte	CAS	VOC	Concentration	Screening Level	COPC
Benzene	71-43-2	Y		1.60E+02	
Trichloroethylene	79-01-6	Y		8.80E+01	

Screening Type: Construction Worker Soil Gas

Analyte	CAS	VOC	Concentration	Screening Level	COPC
Benzene	71-43-2	Y	1.00E+02	7.50E+03	
Trichloroethylene	79-01-6	Y	1.00E+02	2.63E+02	

10. Screening Separated by Media, Receptor, Sample Type (Shallow, Deep, Construction Worker); Indicates Screening Level and if a COPC or NE

Surface Water
ug/L

Screening Type: Surface Water Fresh

Analyte	CAS	VOC	Concentration	Screening Level	COPC
Benzene	71-43-2	Y	1.00E+02	5.80E-01	Y
Trichloroethylene	79-01-6	Y	1.00E+02	6.00E-01	Y

Report Interpretation: Screening IV

Summary of COPCs

Summarized by Residential and Industrial receptor screening for all screened media. Construction Worker screening results are included under the Industrial summary. Risk-based SSL, MCL-based SSL, and MCL results are included under the Residential summary.

Residential

Analyte	CAS
Benzene	71-43-2
Trichloroethylene	79-01-6

Industrial

Analyte	CAS
Benzene	71-43-2
Trichloroethylene	79-01-6

11.

11. Summary combined based on Residential and Industrial only. All Medias Combined

No NE Analytes in Screening Level Risk Assessment

†Not Evaluated (NE): COPCs are listed as NE (not evaluated) where there is no screening level. Some analytes have screening levels for some, but not all, screened media. An analyte may be in both the COPC and NE summary lists, e.g. analyte has screening values available in soil but not air.

12.

12. Not Evaluated COPCs Denoted

END OF REPORT

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13.

13. End of Report, Date and Page Number Stamp

Report Interpretation: QRA I

1. **Virginia Department of Environmental Quality**
VURAM
Virginia Unified Risk Assessment Model
VERSION: 3.1

2. **Residential Quantitative Risk Assessment Report**

3. **Total Hazard Index/Risk for All Media**
Program: RCRA Corrective Action
Site Name: ASTSWMO 2020

Non-Cancer Adult	Non-Cancer Child	Cancer
Total: 1.66E+03 <i>Exceeds Hazard Index!</i>	Total: 1.66E+03 <i>Exceeds Hazard Index!</i>	Total: 2.75E-02 <i>Exceeds Cumulative Risk!</i>

4. **Risk Based Performance Criteria**

Default Hazard Index 1	Default Cumulative Risk-All Chemicals 1.00E-04
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5. **All Report Pages are Required for Risk Assessment Submission
DETAILED REPORT FOLLOWS**

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1. **VURAM Header and Version Number:** Check for the latest version before submittal
2. **Module and Study Area**
3. **Program, Site Name, Total Media Risk Estimates (Site-Wide Results; sum of hazard/risk from ALL chemicals and ALL exposure pathways across ALL media), Risk/Hazard Exceedances Message**
4. **Risk Thresholds**
5. **Date and Page Number Stamp**

Report Interpretation: QRA II

6.

Site Name: ASTSWMO 2020	Residential	
Program: RCRA Corrective Action		
<u>Risk Based Performance Criteria</u>		
Default Hazard Index	Default Risk for Individual Chemical	Default Cumulative Risk (All Chemicals)
1	1.00E-06	1.00E-04

7.

Air	
Analyte: Benzene	
CAS: 71-43-2	
Concentration ug/m3:	3.00E+00
RfDo (mg/kg-day):	4.00E-03
RfCi (mg/m3):	3.00E-02
SFO (mg/kg-day)-1:	5.50E-02
IUR (ug/m3)-1:	7.80E-06
Mutagen:	
VOC:	Y

8.

Calculated Hazard Index/Risk					
Non-Cancer Adult		Non-Cancer Child		Cancer	
Ingestion:		Ingestion:		Ingestion:	
Dermal:		Dermal:		Dermal:	
Inhalation:	9.59E-02	Inhalation:	9.59E-02	Inhalation:	8.33E-06
Total:	9.59E-02	Total:	9.59E-02	Total:	8.33E-06

% Contribution to Media Hazard/Risk	6.25%	6.25%	57.06%
Exceeds Risk!	ug/m3 Non-Cancer Adult	Non-Cancer Child	Cancer
Recommended Acceptable Concentration	N/A	N/A	3.60E-01

Analyte: Trichloroethylene
CAS: 79-01-6

Concentration ug/m3:	3.00E+00
RfDo (mg/kg-day):	5.00E-04
RfCi (mg/m3):	2.00E-03
SFO (mg/kg-day)-1:	4.60E-02
IUR (ug/m3)-1:	4.10E-06
Mutagen:	Y
VOC:	Y

Calculated Hazard Index/Risk					
Non-Cancer Adult		Non-Cancer Child		Cancer	
Ingestion:		Ingestion:		Ingestion:	
Dermal:		Dermal:		Dermal:	
Inhalation:	1.44E+00	Inhalation:	1.44E+00	Inhalation:	6.27E-06
Total:	1.44E+00	Total:	1.44E+00	Total:	6.27E-06

% Contribution to Media Hazard/Risk	93.75%	93.75%	42.94%
Exceeds Hazard!	ug/m3 Non-Cancer Adult	Non-Cancer Child	Cancer
Recommended Acceptable Concentration	2.09E+00	2.09E+00	4.78E-01

Total Calculated Hazard Index/Risk For Media:

Air		
Non-Cancer Adult	Non-Cancer Child	Cancer
Ingestion: 0.00E+00	Ingestion: 0.00E+00	Ingestion: 0.00E+00
Dermal: 0.00E+00	Dermal: 0.00E+00	Dermal: 0.00E+00
Inhalation: 1.53E+00	Inhalation: 1.53E+00	Inhalation: 1.46E-05
Total: 1.53E+00	Total: 1.53E+00	Total: 1.46E-05

6. Site Name, Study Area, Program and Risk Thresholds

7. Media, Analyte, CAS #, Concentration/EPC (User Entered), Toxicity Parameters (Chemical Specific, Latest RSL Update) and Units

8. Risk Estimates (C/NC) for the Selected Media (Totals are Sums of All Routes; Only Reported when Calculated)

Report Interpretation: QRA III

Site Name: ASTSWMO 2020 Residential
 Program: RCRA Corrective Action

Risk Based Performance Criteria

Default Hazard Index	Default Risk for Individual Chemical	Default Cumulative Risk (All Chemicals)
1	1.00E-06	1.00E-04

Air
 Analyte: Benzene
 CAS: 71-43-2

	Calculated Hazard Index/Risk		
	Non-Cancer Adult	Non-Cancer Child	Cancer
Concentration ug/m3:	3.00E+00		
RfDo (mg/kg-day):	4.00E-03		
RfCi (mg/m3):	3.00E-02		
SFO (mg/kg-day)-1:	5.50E-02		
IUR (ug/m3)-1:	7.80E-06		
Mutagen:			
VOC:	Y		
Ingestion:			
Dermal:			
Inhalation:	9.59E-02	9.59E-02	8.33E-06
Total:	9.59E-02	9.59E-02	8.33E-06
% Contribution to Media Hazard/Risk	6.25%	6.25%	57.06%

	ug/m3 Non-Cancer Adult	Non-Cancer Child	Cancer
Exceeds Risk!	N/A	N/A	3.60E-01
Recommended Acceptable Concentration			

Analyte: Trichloroethylene
 CAS: 79-01-6

	Calculated Hazard Index/Risk		
	Non-Cancer Adult	Non-Cancer Child	Cancer
Concentration ug/m3:	3.00E+00		
RfDo (mg/kg-day):	5.00E-04		
RfCi (mg/m3):	2.00E-03		
SFO (mg/kg-day)-1:	4.60E-02		
IUR (ug/m3)-1:	4.10E-06		
Mutagen:	Y		
VOC:	Y		
Ingestion:			
Dermal:			
Inhalation:	1.44E+00	1.44E+00	6.27E-06
Total:	1.44E+00	1.44E+00	6.27E-06
% Contribution to Media Hazard/Risk	93.75%	93.75%	42.94%

	ug/m3 Non-Cancer Adult	Non-Cancer Child	Cancer
Exceeds Hazard! Exceeds Risk!	2.09E+00	2.09E+00	4.78E-01
Recommended Acceptable Concentration			

Total Calculated Hazard Index/Risk For Media: Air

	Non-Cancer Adult	Non-Cancer Child	Cancer
Ingestion:	0.00E+00	0.00E+00	0.00E+00
Dermal:	0.00E+00	0.00E+00	0.00E+00
Inhalation:	1.53E+00	1.53E+00	1.46E-05
Total:	1.53E+00	1.53E+00	1.46E-05

9. % Contribution of a chemical to the overall media hazard/risk (Identifies Risk driver(s)), Exceedances Message, Recommended Acceptable Concentrations (Only in Residential and Industrial Reports; N/A displayed when if hazard/risk do not exceed risk thresholds; Performance Criteria for remediation/decision making)

10. Media Totals (Selected Media: Sum of All COCs and exposure pathways)

11. Date and Page Number Stamp

10.

11.

Report Interpretation: Food QRA I

Site Name: ASTSWMO 2020	Residential	
Program: RCRA Corrective Action	Risk Based Performance Criteria	
Default Hazard Index	Default Risk for Individual Chemical	Default Cumulative Risk (All Chemicals)
1	1.00E-06	1.00E-04

12.

12. Site Name, Study Area, Program, Risk Thresholds

Food			
Analyte: Benzene			
CAS: 71-43-2			
Concentration mg/kg:	Calculated Hazard Index/Risk		
RfDo (mg/kg-day): 4.00E-03	Non-Cancer Adult	Non-Cancer Child	Cancer
RfCi (mg/m3): 3.00E-02	Ingestion: 1.82E+02	Ingestion: 1.82E+02	Ingestion: 1.48E-02
SFO (mg/kg-day)-1: 5.50E-02	Dermal:	Dermal:	Dermal:
IUR (µg/m3)-1: 7.80E-06	Inhalation:	Inhalation:	Inhalation:
Mutagen: Y	Total: 1.82E+02	Total: 1.82E+02	Total: 1.48E-02
VOC: Y			
% Contribution to Media Hazard/Risk	11.11%	11.11%	54.46%
Exceeds Hazard! Exceeds Risk!	mg/kg Non-Cancer Adult	Non-Cancer Child	Cancer
Recommended Acceptable Concentration	See Detailed Food Report	See Detailed Food Report	See Detailed Food Report

13. Media, Analyte, CAS #, Concentration/EPC (User Entered), Toxicity Parameters (Chemical Specific), Units, Risk/Hazard Message, % Contribution (See Detailed Report)

Analyte: Trichloroethylene			
CAS: 79-01-6			
Concentration mg/kg:	Calculated Hazard Index/Risk		
RfDo (mg/kg-day): 5.00E-04	Non-Cancer Adult	Non-Cancer Child	Cancer
RfCi (mg/m3): 2.00E-03	Ingestion: 1.45E+03	Ingestion: 1.45E+03	Ingestion: 1.24E-02
SFO (mg/kg-day)-1: 4.60E-02	Dermal:	Dermal:	Dermal:
IUR (µg/m3)-1: 4.10E-06	Inhalation:	Inhalation:	Inhalation:
Mutagen: Y	Total: 1.45E+03	Total: 1.45E+03	Total: 1.24E-02
VOC: Y			
% Contribution to Media Hazard/Risk	88.89%	88.89%	45.54%
Exceeds Hazard! Exceeds Risk!	mg/kg Non-Cancer Adult	Non-Cancer Child	Cancer
Recommended Acceptable Concentration	See Detailed Food Report	See Detailed Food Report	See Detailed Food Report

13.

14. Food Media Totals (Sum of hazard/risk for ALL selected food media- fish and shellfish, eggs, meat and dairy, and/or fruits and vegetables- for ALL chemicals in Food media)

Total Calculated Hazard Index/Risk For Media: Food			
Non-Cancer Adult	Non-Cancer Child	Cancer	
Ingestion: 1.63E+03	Ingestion: 1.63E+03	Ingestion: 2.72E-02	
Dermal: 0.00E+00	Dermal: 0.00E+00	Dermal: 0.00E+00	
Inhalation: 0.00E+00	Inhalation: 0.00E+00	Inhalation: 0.00E+00	
Total: 1.63E+03	Total: 1.63E+03	Total: 2.72E-02	

14.

Report Interpretation: Food QRA II

Site Name: ASTSWMO 2020 Residential
 Program: RCRA Corrective Action

Risk Based Performance Criteria
 Default Hazard Index 1
 Default Risk for Individual Chemical 1.00E-06
 Default Cumulative Risk (All Chemicals) 1.00E-04

Detailed Residential Food Report

Analyte: Benzene
 CAS: 71-43-2

Concentrations (mg/kg)	Calculated Hazard/Risk Values			
	Non-Cancer		Cancer	
Meat/Dairy: 100	Meat/Dairy: 8.39E+01	Meat/Dairy: 6.86E-03		
Eggs: 100	Eggs: 4.49E+01	Eggs: 3.67E-03		
Fish/Shellfish: 100	Fish/Shellfish: 1.62E+01	Fish/Shellfish: 1.32E-03		
Fruits/Vegetables: 100	Fruits/Vegetables: 3.66E+01	Fruits/Vegetables: 2.99E-03		
	Total: 1.82E+02	Total: 1.48E-02		

15.

15. Food Media Concentration (EPC/User Specified), Calculated Hazard/Risk Values Reported when all necessary values are available; Totals are sums of all Media

Recommended Acceptable Concentrations	Meat/Dairy	Eggs	Fish/Shellfish	Fruits/Vegetables
Exceeds Hazard!	Non-Cancer 1.19E+00	2.22E+00	6.18E+00	2.74E+00
Exceeds Risk!	Cancer 1.46E-02	2.72E-02	7.56E-02	3.35E-02

Analyte: Trichloroethylene
 CAS: 79-01-6

Concentrations (mg/kg)	Calculated Hazard/Risk Values			
	Non-Cancer		Cancer	
Meat/Dairy: 100	Meat/Dairy: 6.71E+02	Meat/Dairy: 5.73E-03		
Eggs: 100	Eggs: 3.60E+02	Eggs: 3.07E-03		
Fish/Shellfish: 100	Fish/Shellfish: 1.29E+02	Fish/Shellfish: 1.11E-03		
Fruits/Vegetables: 100	Fruits/Vegetables: 2.92E+02	Fruits/Vegetables: 2.50E-03		
	Total: 1.45E+03	Total: 1.24E-02		

16.

16. % Contribution to Hazard/Risk (Identify hazard/risk driver(s) for each media), Recommended Acceptable Concentration (Select the lowest value for decision making), Risk/Hazard Message

Recommended Acceptable Concentrations	Meat/Dairy	Eggs	Fish/Shellfish	Fruits/Vegetables
Exceeds Hazard!	Non-Cancer 1.49E-01	2.78E-01	7.72E-01	3.42E-01
Exceeds Risk!	Cancer 1.74E-02	3.26E-02	9.04E-02	4.00E-02

17.

Total Hazard/Risk For Media: Detailed Food

Non-Cancer		Cancer	
Meat and Dairy: 7.55E+02		Meat and Dairy: 1.26E-02	
Eggs: 4.05E+02		Eggs: 6.74E-03	
Fish and Shellfish: 1.46E+02		Fish and Shellfish: 2.43E-03	
Fruits and Vegetables: 3.29E+02		Fruits and Vegetables: 5.49E-03	
Total: 1.63E+03		Total: 2.72E-02	

17. Total Hazard/Risk Food (Sum of hazard/risk from ALL chemicals for ALL food media)

Report Interpretation- Last

Site Name: ASTSWMO 2020

Residential

Program: RCRA Corrective Action

Risk Based Performance Criteria

Default Hazard Index

Default Risk for Individual Chemical

Default Cumulative Risk (All Chemicals)

1

1.00E-06

1.00E-04

Residential Exposure Default Values

Symbol	Description	Value	Units
AF0-02	Soil Adherence Factor - age segment 0-2	0.2	(mg/cm ²)
AF02-06	Soil Adherence Factor - age segment 2-6	0.2	(mg/cm ²)

SA _s 16-26	Surface Area Soil/Sediment - age segment 16-26	6032	(cm ² /day)
SA _w 0-02	Surface Area Water - age segment 0-2	6365	(cm ²)
SA _w 02-06	Surface Area Water - age segment 2-6	6365	(cm ²)
SA _w 06-16	Surface Area Water - age segment 6- 16	19652	(cm ²)
SA _w 16-26	Surface Area Water - age segment 16- 26	19652	(cm ²)

END OF REPORT

[Exposure Defaults Last Page](#) (List of exposure defaults used for the calculations displayed for specified study area, information purposes and documenting input assumptions for QRA)
[Submit Report in Entirety](#)

Wrap Up...

- Exposure Defaults are non-editable to avoid wrangling on math/risk assessment inputs; Helps get to risk management decision process quicker
- Calculations using site-specific defaults require pre-approval from DEQ and should be calculated outside VURAM
- Report submission in entirety

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Virginia Department of Environmental Quality
Mailing Address:
P.O. Box 1105
Richmond, VA 23218

Risk Assessment - Virginia Unified Risk Assessment Model

Thank you for your interest in VURAM. Click on the "Sign Up Now" Button below to get added on the notification list. Click on the "Leave feedback" Button below to fill out the survey.

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DEQ strives to provide the regulated community with risk assessment tools for several regulatory programs. These tools help with overall efficiency of review of risk assessments. However, maintenance and update of several different tools has been challenging due to staff and funding limitations. In order to improve the efficiency of information maintenance and transfer, Virginia DEQ has developed a Microsoft Access based mathematical model for risk assessment called Virginia Unified Risk Assessment Model

Questions ???



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