

Using Consequence Modeling to Help Make Emergency Decisions

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CSCHE 2002 Conference
October 20-23, 2002
Vancouver B.C.

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If auto safety was like some emergency response & crisis management programs,

we'd be buying seat belts and air bags while our cars were skidding towards a wall at high speed.

If it happened today.....

- How would the impact zone be estimated?
- What would be a suitable staging area for the response team?
- Will the release reach populated areas?
- How much time do we have?
- How can we identify those affected?
- What concentrations will they be exposed to?
- How would you decide between a Shelter-In-Place vs Evacuation recommendation?

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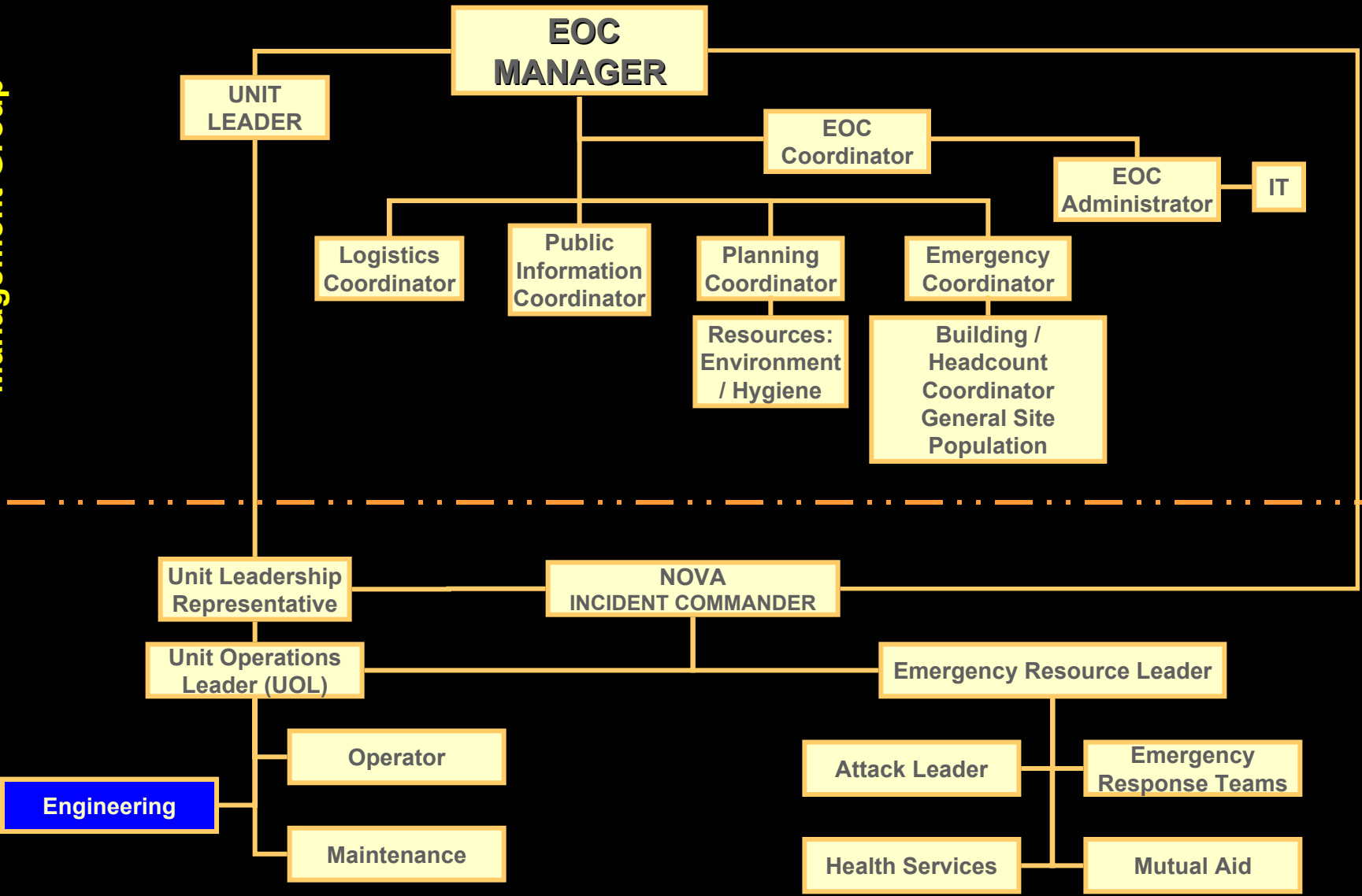
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EOC ORGANIZATION

Emergency Operation Centre
Management Group

Field Response Group



EOC FUNCTION

- **Direct support to the Field Command Structure**
- **Support to and management of unaffected areas**
- **Site communication & evacuation management**
- Long term incident response planning
- Manage outside influences
 - Media, public & investor relations, special interest groups
- External communications
 - Corporate, government
- Post incident recovery operations

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ENGINEERING FUNCTION

- Directs Capital Engineering group and construction technical support staff
- **Provides technical support (drawings, tech data, consequence modeling)**
- Maintain P&IDS and list of resources from within the engineering group
- Regulatory reporting and interfacing
- Environmental input monitoring
- Employee/public exposure monitoring (Ind. Hygiene)
- **Risk assessment services**
- Assists the post-emergency recovery stage
- Maintains a log of calls and activities relevant to this role

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SUPPORTING

- Industrial Rescue
- Natural Disasters
- Workplace Violence
- **Flammable Spill / Release**
- **Toxic Vapour / Liquid Release**

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EXAMPLES

- Vessel ruptures
- Explosions
- Process unit fires
 - requiring shutdown or isolation
 - requiring activation of deluge or Halon system dumps
- Tank truck / rail car fires and releases



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EXAMPLES

- Fire releasing significant quantities of toxic byproducts from combustion that requires monitoring
 - Large electrical or substation fires
- Large piping or pipeline releases and fires
- Any fire or release involving casualties



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ASSESSING RISK

- Location
 - Proximity of residents & public
 - Topography
- Weather
- Material(s) / containers involved
- Hazards present
 - Toxic
 - Flammable
 - Environmental



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ASSESSING RISK

- Scope of impact
- Numbers potentially affected – contact information
- Time release reaches offsite
- Shelter in place vs evacuation
- Staging areas
- Road closures



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Tools:

- Lookup Tables
- Software

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GUIDEBOOK

Table of Initial Isolation and Protective Action Distances

TABLE OF INITIAL ISOLATION AND PROTECTIVE ACTION DISTANCES

ID No.	Name of Material	SMALL SPILLS					
		First ISOLATE in all Directions	Then PROTECT persons Downwind during				Initial Isolation Direction
			DAY		NIGHT		
Meters (Feet)	Kms (Miles)	Kms (Miles)	Meters (Feet)	Kms (Miles)	Meters (Feet)	Meters (Feet)	
1026	Cyanogen, liquefied	30 (100)	0.3 (0.2)	1.1 (0.7)	305 (1000)	305 (1000)	
1040	Ethylene oxide	30 (100)	0.2 (0.1)	0.2 (0.1)	60 (200)	60 (200)	
1040	Ethylene oxide with Nitrogen	30 (100)	0.2 (0.1)	0.2 (0.1)	60 (200)	60 (200)	
1045	Fluorine	30 (100)	0.2 (0.1)	0.5 (0.3)	185 (600)	185 (600)	
1045	Fluorine, compressed	30 (100)	0.2 (0.1)	0.5 (0.3)	185 (600)	185 (600)	
1048	Hydrogen bromide, anhydrous	30 (100)	0.2 (0.1)	0.5 (0.3)	125 (400)	125 (400)	
1050	Hydrogen chloride, anhydrous	30 (100)	0.2 (0.1)	0.6 (0.4)	185 (600)	185 (600)	
1051	AC (when used as a weapon)	60 (200)	0.2 (0.1)	0.5 (0.3)	460 (1500)	460 (1500)	
1051	Hydrocyanic acid, aqueous solution	60 (200)	0.2 (0.1)	0.5 (0.3)	400 (1300)	400 (1300)	
1051	Hydrocyanic acid, liquefied	60 (200)	0.2 (0.1)	0.5 (0.3)	400 (1300)	400 (1300)	
1051	Hydrogen cyanide, anhydrous, stabilized	60 (200)	0.2 (0.1)	0.5 (0.3)	400 (1300)	400 (1300)	
1051	Hydrogen cyanide, stabilized	60 (200)	0.2 (0.1)	0.5 (0.3)	400 (1300)	400 (1300)	
1052	Hydrogen fluoride, anhydrous	30 (100)	0.2 (0.1)	0.6 (0.4)	125 (400)	125 (400)	
1053	Hydrogen sulfide	30 (100)	0.2 (0.1)	0.3 (0.2)	215 (700)	215 (700)	
1053	Hydrogen sulfide, liquefied	30 (100)	0.2 (0.1)	0.3 (0.2)	215 (700)	215 (700)	

2000 EMERGENCY RESPONSE GUIDEBOOK



A GUIDEBOOK FOR FIRST RESPONDERS DURING THE INITIAL PHASE OF A DANGEROUS GOODS/HAZARDOUS MATERIALS INCIDENT

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LOOKUP TABLES:

Technical Guidance for Hazards Analysis

Emergency Planning for Extremely Hazardous Substances

VULNERABLE ZONE DISTANCES FOR RATES OF RELEASE AND L

SCREENING - Rural, F Atmospheric Stability, Low Wind Speed (3.4 miles per hour)
For Quantities of Release up to 10,000 pounds

QR Rate of Release (#/min)	Levels of Concern (grams per cubic meter)											
	(For LOC less than this, assume 10 mile distance)											
	0.0001	0.0004	0.0007	0.001	0.002	0.0035	0.005	0.0075	0.01	0.02	0.035	0.05
1	9.0	2.5	1.7	1.3	0.9	0.6	0.5	0.4	0.3	0.2	0.2	0
2	*	4.5	2.8	2.1	1.3	0.9	0.8	0.6	0.5	0.3	0.3	0
3	*	6.7	3.9	2.9	1.7	1.2	1.0	0.8	0.6	0.4	0.3	0
4	*	9.0	5.1	3.7	2.1	1.5	1.2	0.9	0.8	0.5	0.4	0
5	*	*	6.3	4.5	2.5	1.7	1.3	1.0	0.9	0.6	0.4	0
8	*	*	*	7.1	3.7	2.4	1.8	1.4	1.2	0.8	0.5	0
10	*	*	*	9.0	4.5	2.8	2.1	1.6	1.3	0.9	0.6	0
15	*	*	*	*	6.7	3.9	2.9	2.1	1.7	1.1	0.8	0
20	*	*	*	*	9.0	5.1	3.7	2.7	2.1	1.3	0.9	0
25	*	*	*	*	*	6.3	4.5	3.2	2.5	1.5	1.1	0
30	*	*	*	*	*	7.6	5.3	3.7	2.9	1.7	1.2	1
35	*	*	*	*	*	9.0	6.2	4.2	3.3	2.0	1.3	1
40	*	*	*	*	*	*	7.1	4.8	3.7	2.1	1.5	1
45	*	*	*	*	*	*	8.0	5.3	4.1	2.3	1.6	1.2
50	*	*	*	*	*	*	9.0	5.9	4.5	2.5	1.7	1.3
60	*	*	*	*	*	*	*	7.1	5.3	2.9	1.9	1.5
70	*	*	*	*	*	*	*	8.4	6.2	3.3	2.1	1.7
80	*	*	*	*	*	*	*	9.7	7.1	3.7	2.4	1.8
90	*	*	*	*	*	*	*	8.0	4.1	2.6	2.0	1.5
100	*	*	*	*	*	*	*	9.0	4.5	2.8	2.1	1.6
120	*	*	*	*	*	*	*	*	5.3	3.3	2.5	1.8
140	*	*	*	*	*	*	*	*	6.2	3.7	2.8	2.0
160	*	*	*	*	*	*	*	*	7.1	4.2	3.1	2.3
180	*	*	*	*	*	*	*	*	8.0	4.6	3.4	2.5
200	*	*	*	*	*	*	*	*	9.0	5.1	3.7	2.7
250	*	*	*	*	*	*	*	*	*	6.3	4.5	3.2
300	*	*	*	*	*	*	*	*	*	7.6	5.3	3.7
350	*	*	*	*	*	*	*	*	*	9.0	6.2	4.2
400	*	*	*	*	*	*	*	*	*	7.1	4.8	3.7
450	*	*	*	*	*	*	*	*	*	8.0	5.3	4.1
500	*	*	*	*	*	*	*	*	*	9.0	5.9	4.5

3-11

U.S. Environmental Protection Agency
Federal Emergency Management Agency
U.S. Department of Transportation

SEE NEXT PAGE FOR HIGHER QUANTITIES OF RELEASE (QR).

Multiply miles by 1.6 to get kilometers (km).

To find distance: Find nearest LOC across top. Use the lower LOC value for in-between numbers. This is a conservative approach.
Find nearest QR on left column.
Read across and down to find distance in miles.

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SOFTWARE:

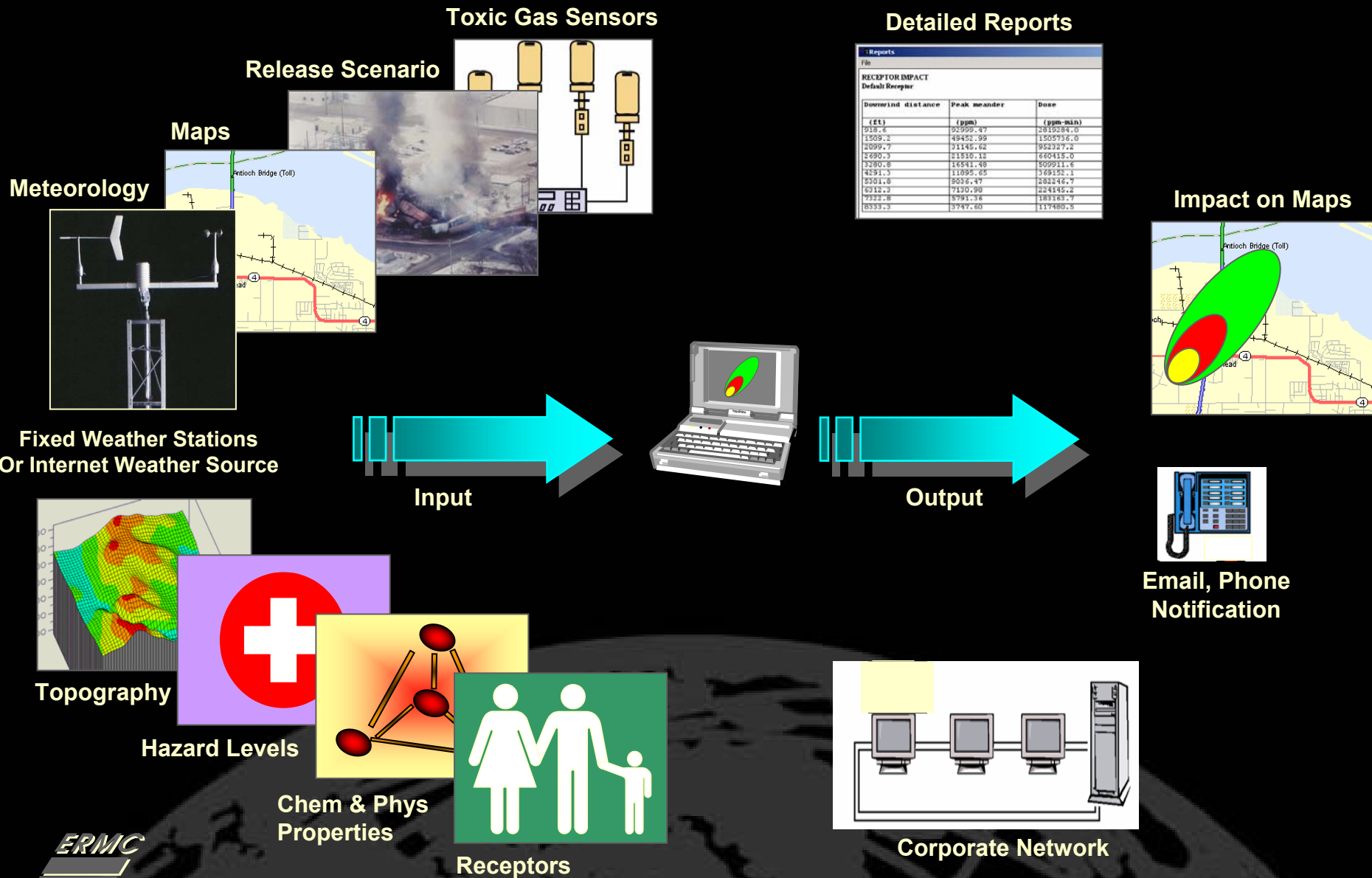
- Aloha
- Charm
- Effects
- PHAST
- SAFER TRACE, Real Time & STAR

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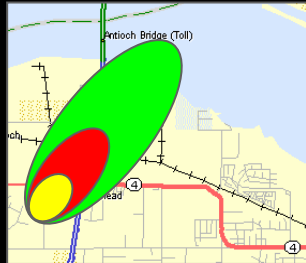
Reports

File

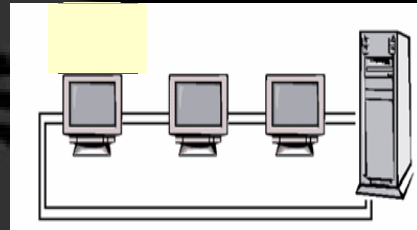
RECEPTOR IMPACT

Default Receptor

Downwind distance (ft)	Peak meander (ppm)	Dose (ppm-min)
918.6	92999.47	2819284.0
1509.2	49432.99	1505794.0
2099.7	31145.42	952387.2
2690.3	21810.12	640415.0
3280.8	16541.40	509911.6
4281.3	11095.65	369152.1
5001.8	8036.47	282246.7
6012.3	7170.90	224145.2
7022.8	5791.36	183163.7
8033.3	3747.60	117480.3



Email, Phone Notification



Corporate Network

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THE INCIDENT

- Truck / train collision – derailment - fire
- 50 kilometers east of a major city
- 14 cars derailed in yard
- 4 liquid aromatic hydrocarbons & 10 with polyethylene resin
- Two technical advisors onsite

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THE INCIDENT

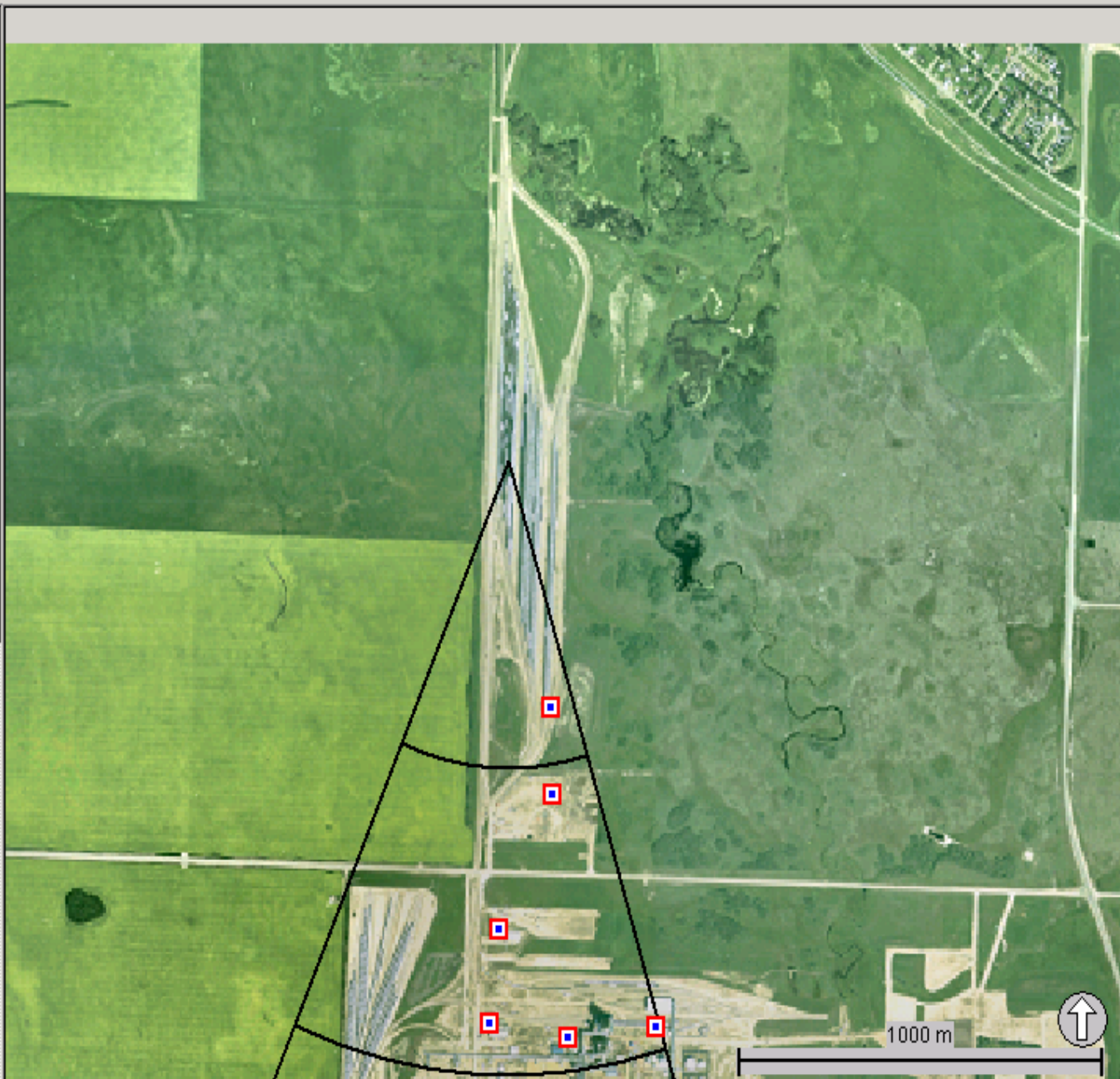


Manual Met

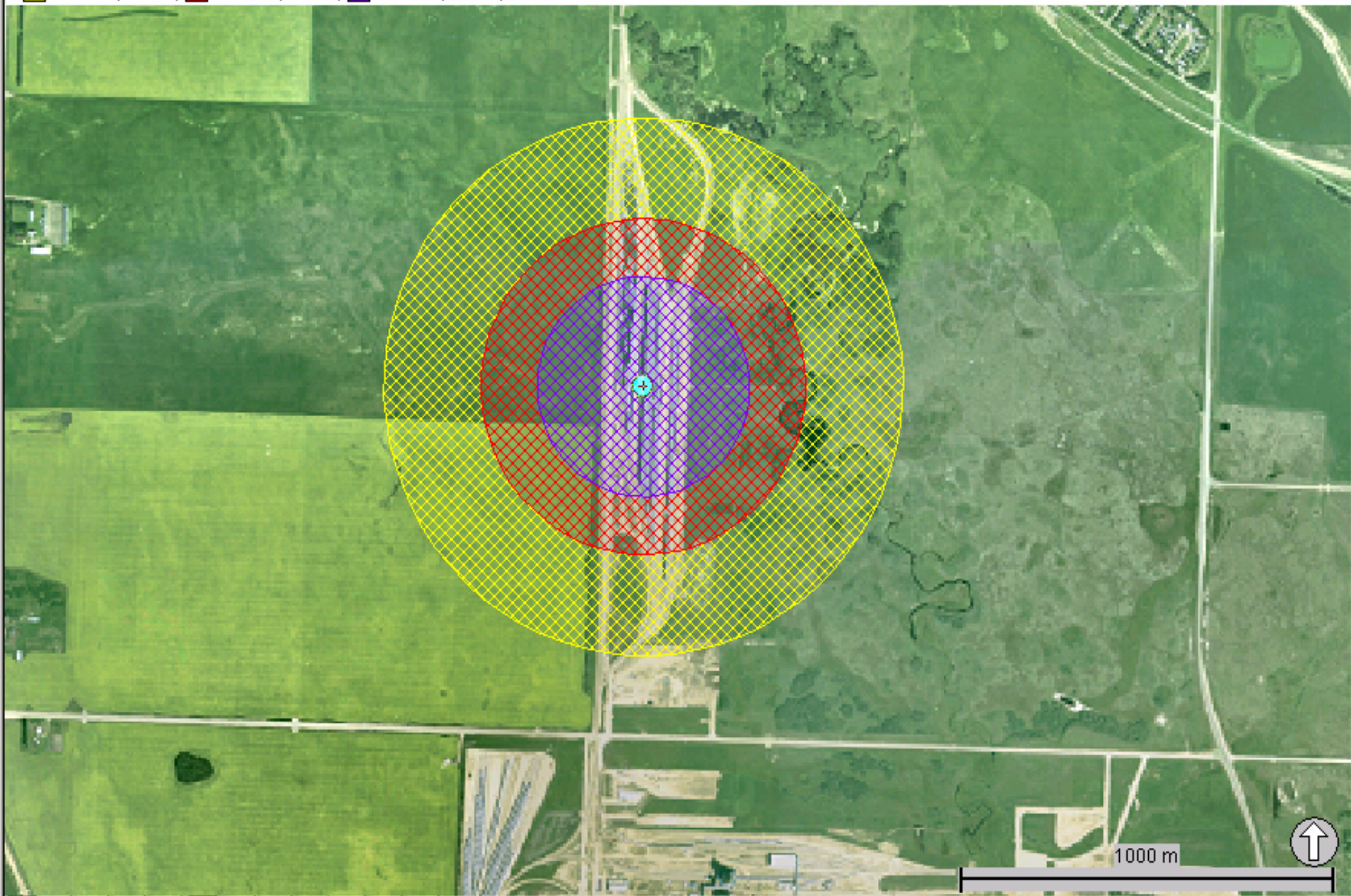
List of Impacted receptors

- NOVA - Bldg 21 - Poly Warehouse
- NOVA - Bldg 23 - Construction Shops
- NOVA - Bldg 20 - PE-1 Control Room
- NOVA - Bldg 26 - PE-1 Pelletizer Control
- NOVA - Bldg 15 - E2 Control Room
- NOVA - Bldg 14
- NOVA - Bldg 9 - Receiving/Stores
- NOVA - Bldg 7 - E-1 Control Room
- NOVA - Bldg 27
- NOVA - Bldg 34
- NOVA - Bldg 3 - Loss Prevention
- NOVA - Bldg 2 - Administration
- NOVA - Bldg 2A - MI Lab
- NOVA - Bldg 1
- NOVA - Bldg 8 - E1 Maintenance Services
- NOVA - Bldg 24 - Poly Rail Barn
- NOVA - Bldg 4
- NOVA - Bldg 10 - MI Control Room
- NOVA - Bldg 21b - Locomotive
- NOVA - Bldg 21a - Poly Bagging Line East
- NOVA - Bldg 21c - Rail Crew
- NOVA - Bldg 23A - Tech Services Construc
- NOVA - Bldg 77 - MI Maintenance
- K&C Silviculture (R17a)

Generate Report



1500.0 (W/m²) 4000.0 (W/m²) 9500.0 (W/m²)



[13166, 9309]

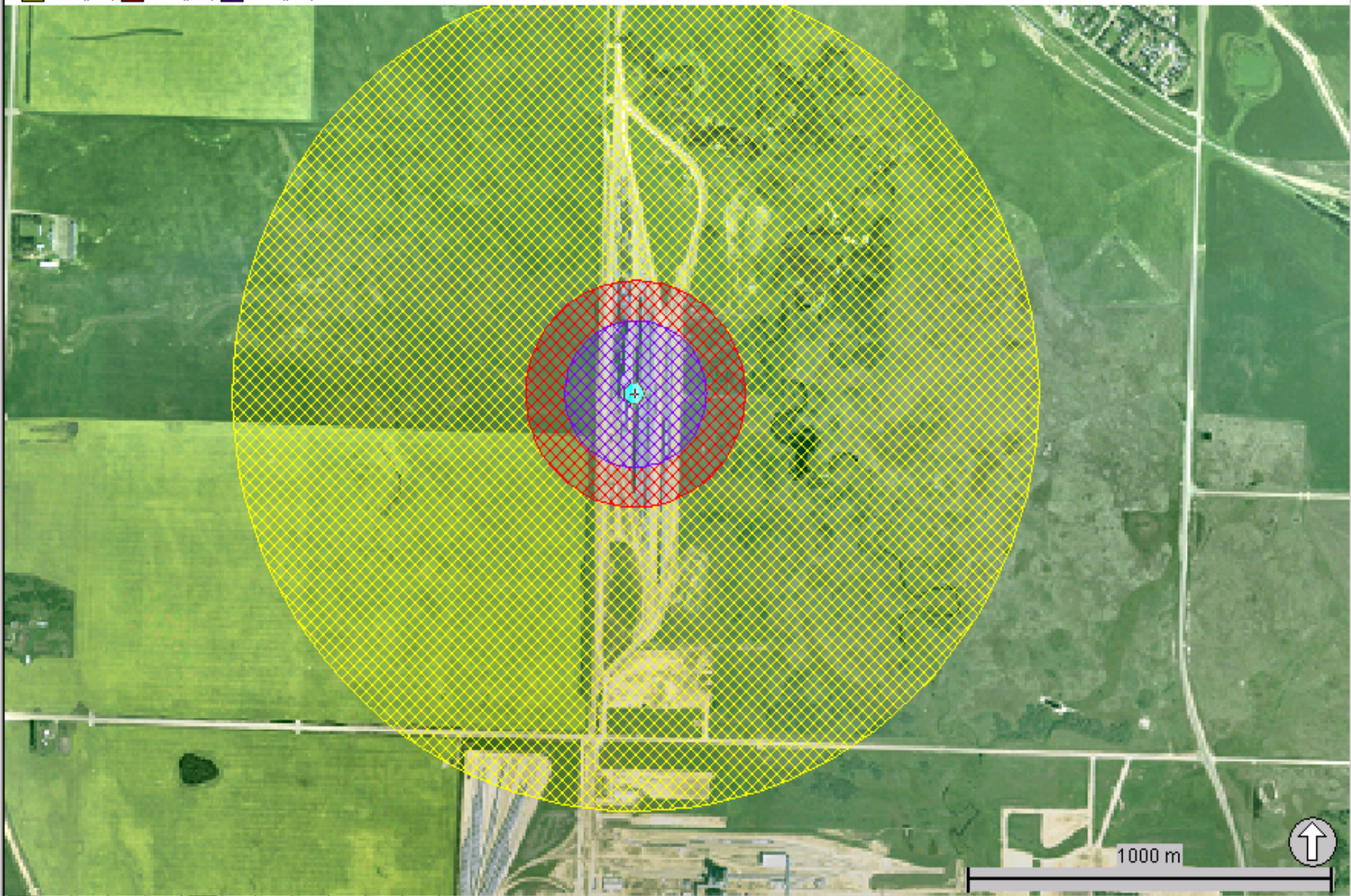
9.9 (km/h) North 12.2 (deg C) 1151.2 (W/m²)

Typical Values for Thermal Radiation

Watt m⁻²	Observed Effect
37500	Sufficient to cause damage to process equipment. Minimum energy required to ignite wood at indefinitely long exposures
12500	Minimum energy required for piloted ignition of wood, melting of plastic tubing
9500	Pain threshold reached after 8 seconds; second degree burns after 20 seconds
4000	Sufficient to cause pain to personnel if unable to reach cover within 20 seconds; however, blistering of the skin (second degree burns) is likely; 0% fatality
1600	Will cause no discomfort for long exposure

Effects of Thermal Radiation [CCPS 1994]

0.4 (psi) 1.5 (psi) 2.2 (psi)



Navigation icons: edit, home, back, forward, up, down, search, zoom in, zoom out, pan, and a close button. Coordinates: (13380, 8811)

7.7 (km/h) North 11.9 (deg C) 1150.2 (W/m²)

Typical Values for Overpressure

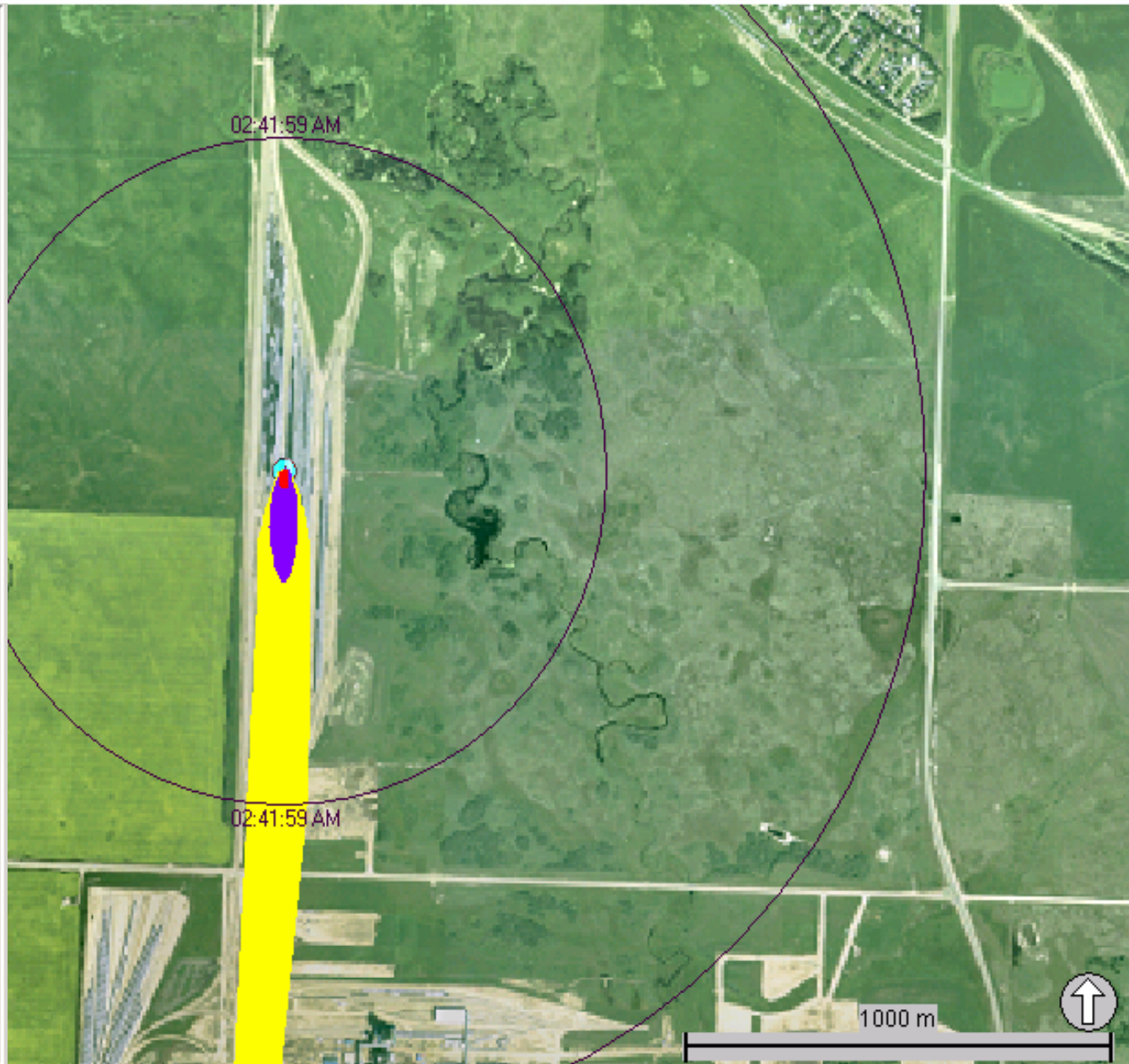
Structural Element	Failure	Side-on Overpressure (bar)	Side-on Overpressure (psi)
Glass windows	Usually shattering, occasional frame failure	0.03 - 0.07	0.5 - 1
Corrugated asbestos siding	Shattering	0.07 - 0.14	1 - 2
Wood siding panels standard house construction	Failure, usually at main connections, allowing a whole panel to be blown-in	0.07 - 0.14	1 - 2
Concrete or cinder-block wall panels 8 or 12 inch thick (not reinforced)	Shattering of wall	0.14 - 0.20	2 - 3
Self-framing steel panel building	Collapse	0.20 - 0.28	3 - 4
Oil storage tank	Rupture	0.20 - 0.28	3 - 4
Wooden utility poles	Snapping failure	0.34	5
Loaded rail cars	Overturned	0.48	7
Brick wall panel 8 or 12 inch thick (not reinforced)	Shearing, flexible failure	0.55	7 - 8

50.0 (ppm) 500.0 (ppm) 14000.0 (ppm)

Return

List of Impacted receptors

- Neighbour Notification Zone 4
- Neighbour Notification Zone 1
- NOVA - Bldg 35 - Tech Services
- NOVA - Bldg 44 - PE-2 Admin Bldg
- NOVA - Bldg 33 - E-3 Control Room
- Residence 25a -
- Residence 25b -
- Neighbour Notification Zone 6
- Neighbour Notification Zone 7



(12937, 9586)

9.4 (km/h)

North

12.8 (deg C)

1151.9 (W/m²)

Update Run..

Auto Run



INFILTRATION

INDOOR/OUTDOOR

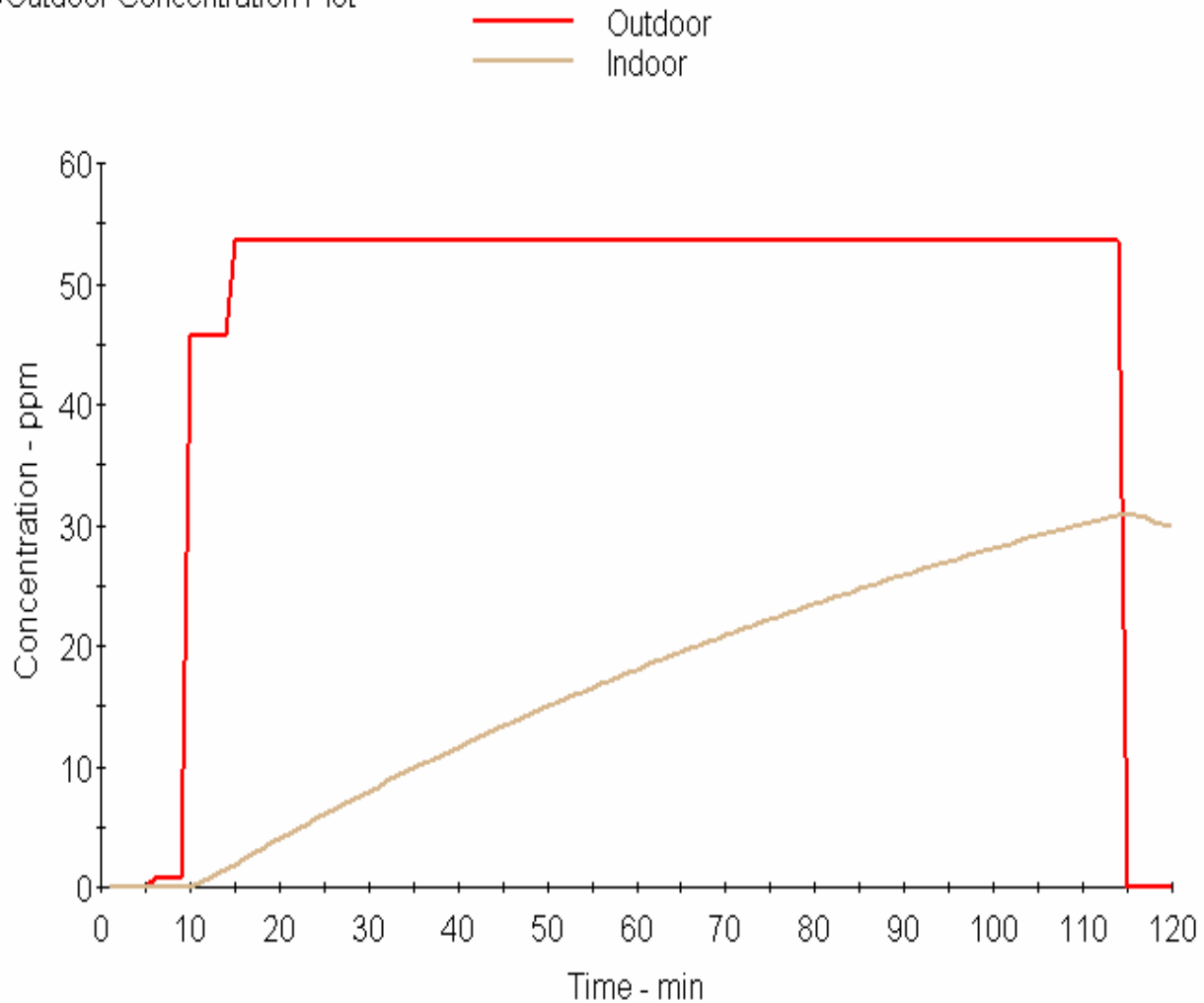
- OUTDOOR CONC.
- INDOOR CONC.
- LOG Y-SCALE
- LIN Y-SCALE
- UPDATE ACH
- PICK MAP SITE
- RETURN



Menu Selection History

- 0.5 (ACH VALUES)
- PICK MAP SITE (INFILTRATION)
- RETURN (INFILTRATION)
- 0.5 (ACH VALUES)
- PICK MAP SITE (INFILTRATION)
- RETURN (INFILTRATION)
- 0.25000 (ACH VALUES)

Indoor/Outdoor Concentration Plot



Map Site Selection
Receptor coordinates : (14710,6787,0)
ACH = 0.50
10/21/2002 2:36:59 AM Release of AC1-Benzene Isopleths

REPORTS

- Scenario
- Meteorology
- Downwind Distance
- Receptor Dosage
- Toxicity
- Infiltration
- Chemical Properties
- Isopleth Limits

Summary

- Tools can
 - Be used for training & education
 - Guide improved emergency response planning
 - Help develop operational approaches for reducing hazards
 - Demonstrate how inventory, release rate & elevation, topography, wind speed & stability can affect downwind concentrations, arrival times, etc.

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ISSUES TO CONSIDER

- Track and Predict the Impact of
 - Fires & Explosions
 - Concentrations of Gases
 - Weather
 - Topography
 - Population Exposure
 - Relative to Time

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ISSUES TO CONSIDER

- Established entity
- Sound operating platform
- Extensive field testing and experience
- Subject matter expertise
- Meets government / industry guidelines
- User support & recognition
- Ease of use
- Customizable - turn key set up & integration
- Regular updates / upgrades
- 24 hour expert assistance

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