Risk Assessments
Off-Site Workers and Residential

Dr. Cathy Fitzgerald, PE

PLACEWORKS
creating great places

William Ruckelshaus – Former EPA Administrator

"Risk assessment data can be like the captured spy: If you torture it long enough, it will tell you anything you want to know."

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TITLE 5 RISK ASSESSMENTS

Guidance Documents

AIR QUALITY AND LAND USE HANDBOOK:
A COMMUNITY HEALTH PERSPECTIVE

April 2005

California Environmental Protection Agency
California Air Resources Board

Health Risk Assessments
for
Proposed Land Use Projects

CAPCOA Guidance Document

CAPCOA
CALIFORNIA AIR POLLUTION CONTROL OFFICERS ASSOCIATION

Prepared by:
CAPCOA Planning Managers

Approved for Release
July 2009

CARB – 2005
Air Quality and Land Use Handbook

- Freeways and high volume roadways – 500 feet
- Warehouse/distribution centers – 1,000 feet
- Rail yards – 1,000 feet
- Ports – Downwind
- Refineries - Downwind
- Chrome Platers – 1,000 feet
- Dry Cleaners – 300 feet
- Gasoline Stations – 300 feet

CACPOA – 2009
Health Risk Assessments for Proposed Land Use Projects

- Type A Projects – Impact on Emission Source on Surrounding Environment

- Type B Projects – Placing Sensitive Receptors Near Emission Sources

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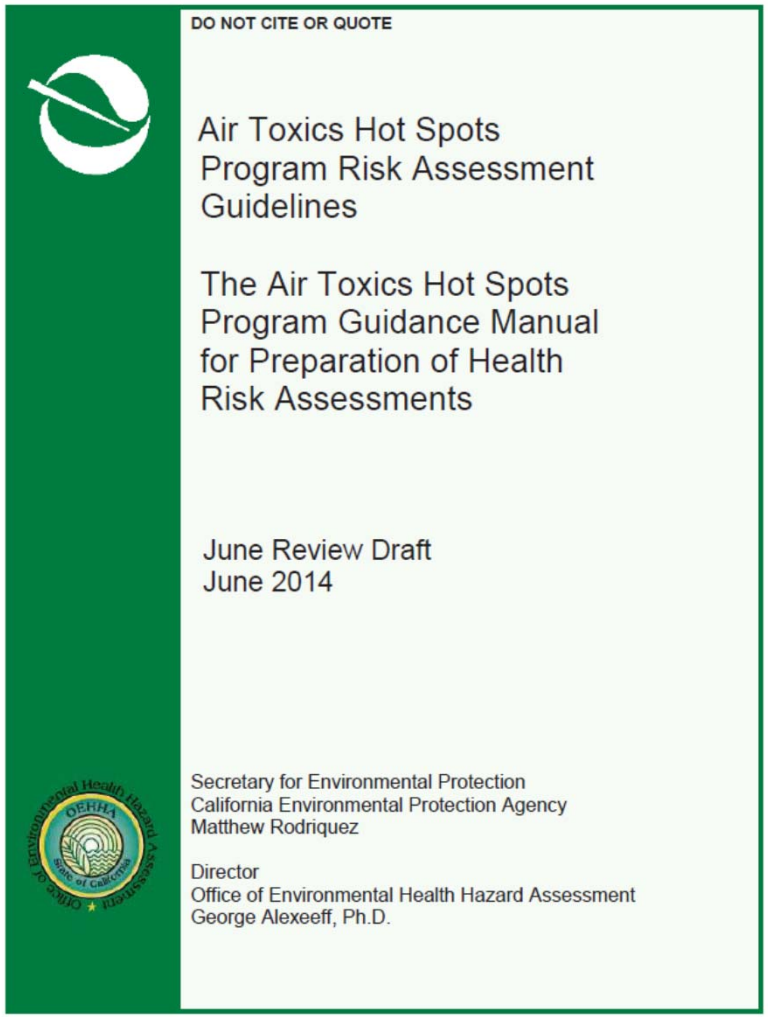
OEHHA GUIDELINES


DO NOT CITE OR QUOTE

Air Toxics Hot Spots Program Risk Assessment Guidelines

The Air Toxics Hot Spots Program Guidance Manual for Preparation of Health Risk Assessments

June Review Draft
June 2014

Secretary for Environmental Protection
California Environmental Protection Agency
Matthew Rodriquez

Director
Office of Environmental Health Hazard Assessment
George Alexeeff, Ph.D.

- Age Sensitivity Factors (ASFs)
- Third trimester to 2 years – ASF of 10
- Age 2 to 16 – ASF of 3
- Lifetime risk – from 70 years to 30 years
- Worker risk – from 40 years to 25 years
- Fraction of time spent at home – 0.73 to 0.85

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UPCOMING CHANGES

- EMFAC 2014 – December 2014
- Revision of CalEEMod
- Truck traffic to and from facilities
- Siting residential near freeways
- HARP Revision – Incorporate OEHHA guidance

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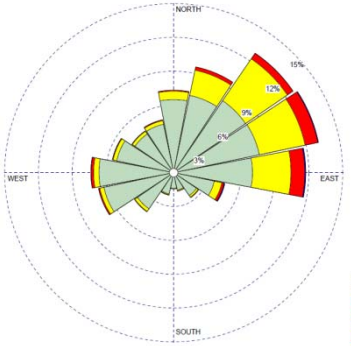
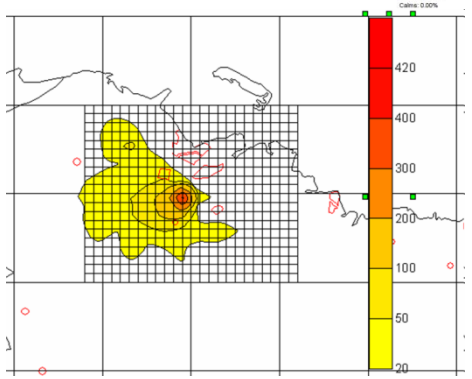
STEPS IN CONDUCTING AN HRA

- Source Identification
- Source Characterization
- Point, Area, or Volume Source
- Meteorology
- Model Concentrations at Receptors – AERMOD or ISCST3
- Calculate Risk and Compare to Levels of Significance





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SIGNIFICANCE THRESHOLDS

Significance Thresholds

- Excess Cancer Risk $\geq$ 10 in a million
- Chronic/Acute Hazard Index $\geq$ 1.0
- SCAQMD – Incremental increase in average annual $PM_{2.5}$ concentration of $\geq$ 2.5 ug/m^3

Inappropriate

- Compare risk as percentage of background from MATES study
- Compare risk to overall probability of cancer – 1 in 3-4 people will get cancer during lifetime

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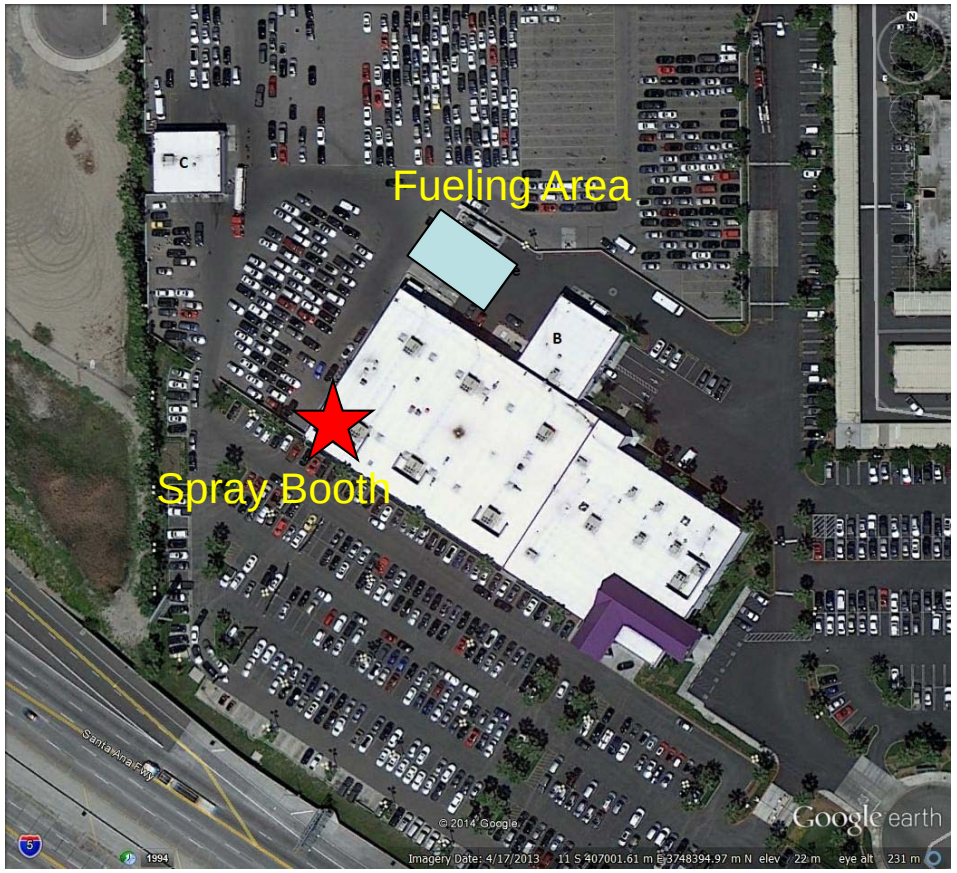
SOURCE CHARACTERIZATION

- Hours of Operation
- Point, Area, Volume Source
- Chemical Usage
- MSDS
- VOC Content

PLACEWORKS

POINT SOURCE

- Emission Rate – gm/sec or lb/hr
- Stack Height
- Stack Diameter
- Stack Exit Velocity
- Stack Gas Temperature



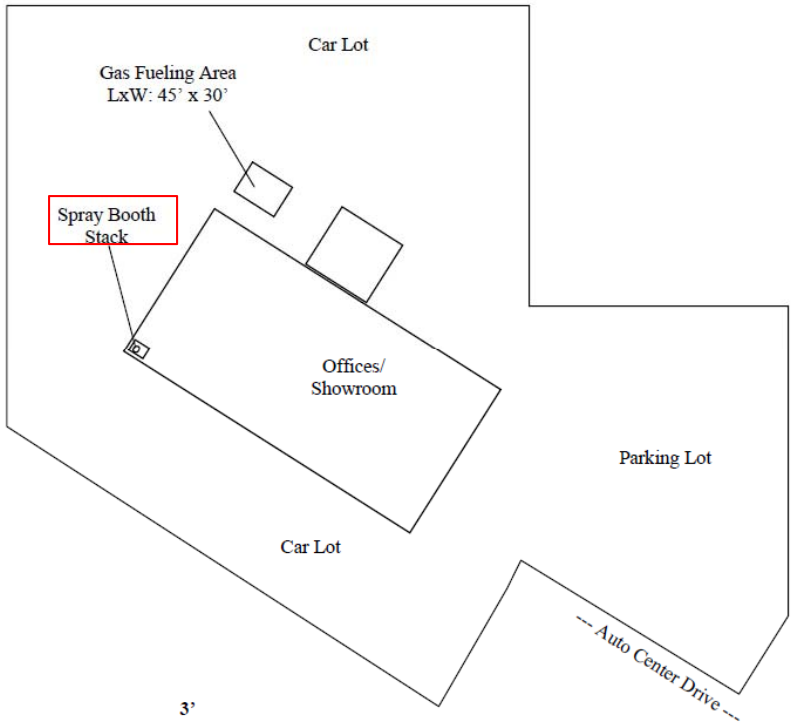
PLACEWORKS

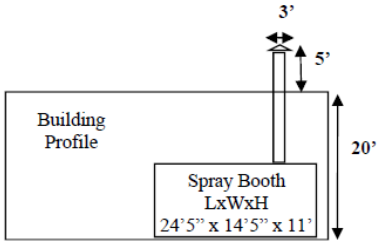
Source 2
CarMax Auto Superstore
6100 Auto Center Drive
Buena Park, CA 90621

N

Monday - Friday: 7:30AM - 6:00PM (service center)

Chemical and Use Rate
Gasoline Dispensing: 15,000 gallons per month
Automotive Refinishing (Spray Booth): 503.7 pounds per year
(SCAQMD 2012 Inspection Report)





- Lot area is based upon Google Earth, Version 6.1.
– δz of 1.86 m and release height of 1 m are based upon California Air Pollution Control Officers Association (CAPCOA) *Gasoline Service Station Industrywide Risk Assessment Guidelines* (1998).

AREA SOURCE

- Emission Rate – gm/sec/m^2
- Long Side of Area
- Short Side of Area
- Release Height

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VOLUME SOURCE

- Emission Rate – gm/sec or lb/hr
- Release Height
- Initial Lateral Dimension – Building Length/4.3
- Initial Vertical Dimension – Building Height/2.15

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Source 2
Insurance Collision Centers
3415 West 2nd Street

Operation: Automotive Refinishing

Temporal Profile: 10 6 52
0 0 0

Materials:

Primer	3.0	gal/mo	2.10 VOC lbs/gal	MSDS:
Basecoat/Reducer	5.0	gal/mo	5.50 VOC lbs/gal	MSDS:
Clearcoat/Reducer	5.0	gal/mo	2.10 VOC lbs/gal	MSDS:

Emissions: Average Monthly

Primer	6.30	lbs/mo
Basecoat/Reducer	27.50	lbs/mo
Clearcoat/Reducer	10.50	lbs/mo
Total	44.300	lbs/mo
	0.172	lbs/hr

Speciation:

		Compound Wt Fraction	Compound Emissions	Adjusted Wt Fraction
Primer	Butyl Alcohol	0.23	1.4490	0.0327
	Ethylbenzene	0.001	0.0063	0.0001
	Methyl Isobutyl Ketone	0.04	0.2520	0.0057
	Toluene	0.10	0.6300	0.0142
	Other (NOS)	0.63	3.9627	0.0895
Basecoat/Reducer	Ethylbenzene	0.05	1.375	0.0310
	n-Hexane	0.01	0.275	0.0062
	Toluene	0.19	5.225	0.1179
	1,2,4-Trimethylbenzene	0.01	0.275	0.0062
	Other (NOS)	0.74	20.350	0.4594
Clearcoat/Reducer	Methyl Isobutyl Ketone	0.02	0.210	0.0047
	Toluene	0.10	1.050	0.0237
	Xylene	0.07	0.735	0.0166
	Other (NOS)	0.81	8.505	0.1920
	Total		44.300	1.000

CALCULATE VOC EMISSION RATES

CALCULATE PM2.5 EMISSION RATES

Source 2
Insurance Collision Centers
3415 West 2nd Street

Operation: Automotive Refinishing

Temporal Profile: 10 6 52
0 0 0

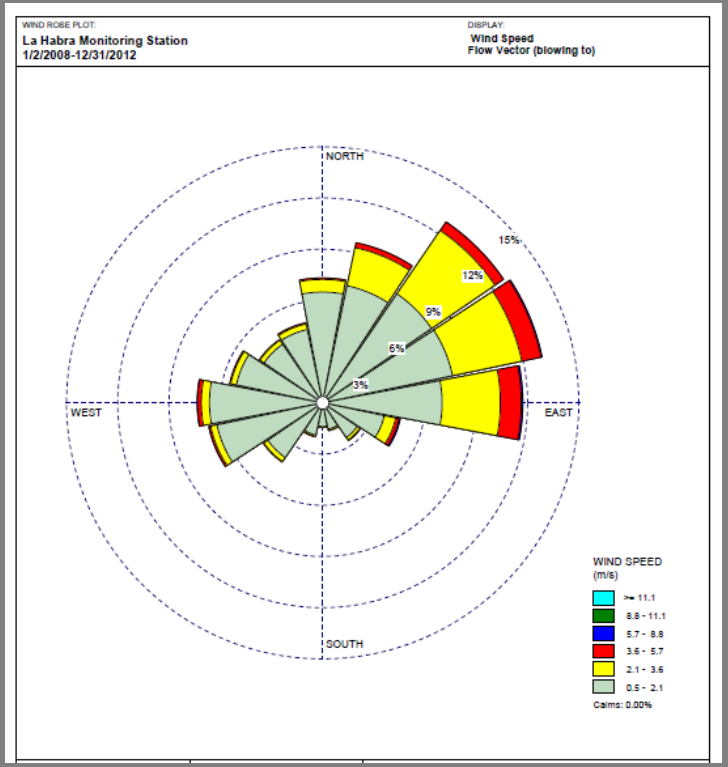
Spray Booth Specifications:

Transfer Efficiency	0.65
Control Efficiency	0.90

Pariculate Matter Emissions:

	Product	Use Rate (gal/mo)	Density (lbs/gal)	Solids Fraction	PM EF (lbs/mo)	
Primer	Dupont Variprime	3.0	8.30	0.24	0.209	
Basecoat/Reducer	Dupont Chromabase	5.0	7.28	0.15	0.191	
Clearcoat/Reducer	Dupont Chromaclear	5.0	8.17	0.45	0.643	
				Total	1.044	lbs/mo
					4.05E-03	lbs/hr

AERMOD MODEL



Concentration [ug/m^3] - Source Group: 2A

Averaging Period	Rank	Peak	X (m)	Y (m)	ZELEV (m)	ZFLAG (m)	ZHILL (m)	Peak Date, Start Hour
ANNUAL		0.03386	407017.84	3748670.76	21.50	0.00	21.50	

Concentration [ug/m^3] - Source Group: 2B

Averaging Period	Rank	Peak	X (m)	Y (m)	ZELEV (m)	ZFLAG (m)	ZHILL (m)	Peak Date, Start Hour
ANNUAL		0.03943	407017.84	3748670.76	21.50	0.00	21.50	

EXPOSURE PARAMETERS

RESIDENT

- 24 hours/day
- 7 days/week
- 350 days/year
- 70 year duration
- DBR – 302 l/kg-day
- 30 years
- Fraction of time at home
- ASFs for children

OFF-SITE WORKER

- 8-12 hours/day
- 5 days/week
- 245-250 days/year
- 40 year duration
- DBR – 149 l/kg-day
- 25 years

PLACEWORKS

Risk Calculations- Resident

Concentration from AERMOD

Table 1
Carcinogenic Risks and Noncarcinogenic Hazards
70-Year Resident Exposure Scenario

Source Number*	Source	Mass GLC	Weight Fraction	Contaminant	Carcinogenic Risk				Noncarcinogenic Hazards/ Toxicological Endpoints*									
					URF	CPF	DOSE **	RISK	REL	RfD	RESP	CNS/PNS	CV/BL	IMMUN	KIDN	GI/LV	REPRO	EYES
		(µg/m³)			(µg/m³)⁻¹	(mg/kg/day)⁻¹	(mg/kg-day)		(µg/m³)	(mg/kg/day)								
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)	(s)
2	CarMax (gasoline dispensing)	3.39E-02	1.00E-02	Benzene	2.9E-05	1.0E-01	9.8E-08	1.7E-08	6.0E+01	1.7E-02		5.6E-06	5.6E-06				5.6E-06	
	(spray booth)	3.94E-02	1.09E-02	Ammonia					2.0E+02	5.7E-02	2.2E-06							
			6.78E-04	Benzene	2.9E-05	1.0E-01	7.7E-09	1.3E-09	6.0E+01	1.7E-02		4.5E-07	4.5E-07				4.5E-07	
			1.02E-05	Formaldehyde	6.0E-06	2.1E-02	1.2E-10	4.1E-12	9.0E+00	2.6E-03	4.5E-08							4.5E-08
TOTAL								1.8E-08			2.2E-06	6.1E-06	6.1E-06	0.0E+00	0.0E+00	0.0E+00	6.1E-06	4.5E-08

* Key to Toxicological Endpoints

RESP	Respiratory System
CNS/PNS	Central/Peripheral Nervous System
CV/BL	Cardiovascular/Blood System
IMMUN	Immune System
KIDN	Kidney
REPRO	Reproductive System
EYES	Eye irritation and/or other effects

** Exposure factors used to calculate dose

exposure frequency (days/year)	350
exposure duration (years)	70
inhalation rate (L/kg-day))	302
inhalation absorption factor	1
averaging time (days)	25550
fraction of time at home	1.00
age sensitivity factor - 70 year	1.7

Risk Value

Hazard Indices

Exposure Parameters

Risk Calculations - Worker

Concentration from AERMOD

Table 2
Carcinogenic Risks and Noncarcinogenic Hazards
40-Year Worker Exposure Scenario

Source Number*	Source	Mass GLC	Weight Fraction	Contaminant	Carcinogenic Risk				Noncarcinogenic Hazards/ Toxicological Endpoints*									
					URF	CPF	DOSE **	RISK	REL	RfD	RESP	CNS/PNS	CV/BL	IMMUN	KIDN	GI/LV	REPRO	EYES
		($\mu g/m^3$)			($\mu g/m^3$)$^{-1}$	(mg/kg/day)$^{-1}$	(mg/kg-day)		($\mu g/m^3$)	(mg/kg/day)								
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)	(s)
2	CarMax (gasoline dispensing)	4.50E-02	1.00E-02	Benzene	2.9E-05	1.0E-01	2.6E-08	2.7E-09	6.0E+01	1.7E-02		7.5E-06	7.5E-06				7.5E-06	
	(spray booth)	5.60E-02	1.09E-02	Ammonia					2.0E+02	5.7E-02	3.1E-06							
			6.78E-04	Benzene	2.9E-05	1.0E-01	2.2E-09	2.2E-10	6.0E+01	1.7E-02		6.3E-07	6.3E-07				6.3E-07	
			1.02E-05	Formaldehyde	6.0E-06	2.1E-02	3.3E-11	7.0E-13	9.0E+00	2.6E-03	6.3E-08							6.3E-08
TOTAL								2.9E-09			3.1E-06	8.1E-06	8.1E-06	0.0E+00	0.0E+00	0.0E+00	8.1E-06	6.3E-08

* Key to Toxicological Endpoints

RESP	Respiratory System
CNS/PNS	Central/Peripheral Nervous System
CV/BL	Cardiovascular/Blood System
IMMUN	Immune System
KIDN	Kidney
REPRO	Reproductive System
EYES	Eye irritation and/or other effects

** Exposure factors used to calculate dose

exposure frequency (days/year)	250
exposure duration (years)	40
inhalation rate (L/kg-day))	149
inhalation absorption factor	1
averaging time (days)	25550
fraction of time at work	1.00
no age sensitivity factor - worker	1.0

Risk Value

Hazard Indices

Exposure Parameters

CANCER BURDEN

- If Risk is > 1 in a million
- Define Zone of Impact (ZOI)
- Population within ZOI
- Calculate Cancer Burden – Population x Risk Value
- Threshold of Significance - cancer burden >0.5

Pop. Size

Approx 5,285 people

Pop. Density

Approx. 13,638 people per sq. mile

Land Area

Approx 0.4 sq. miles

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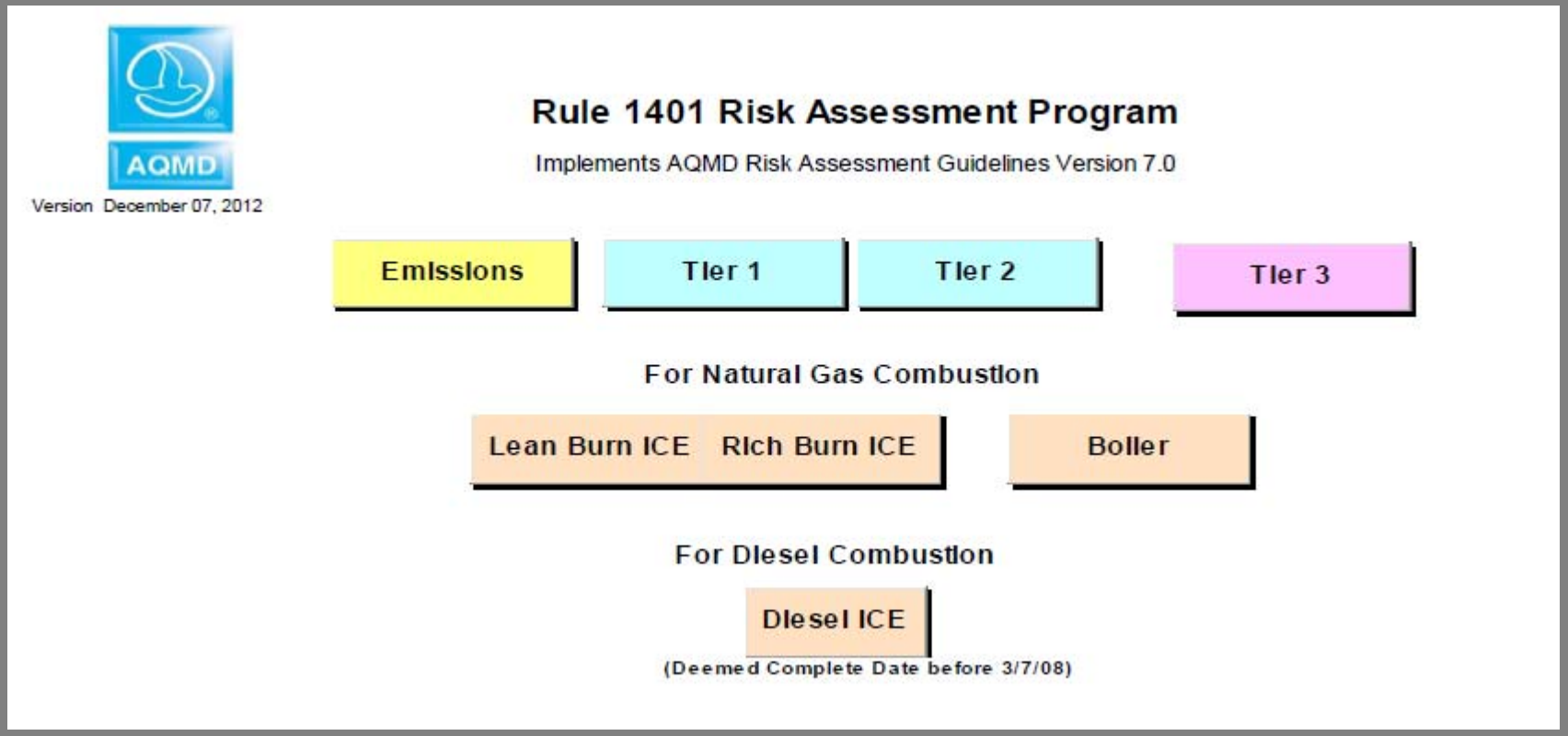
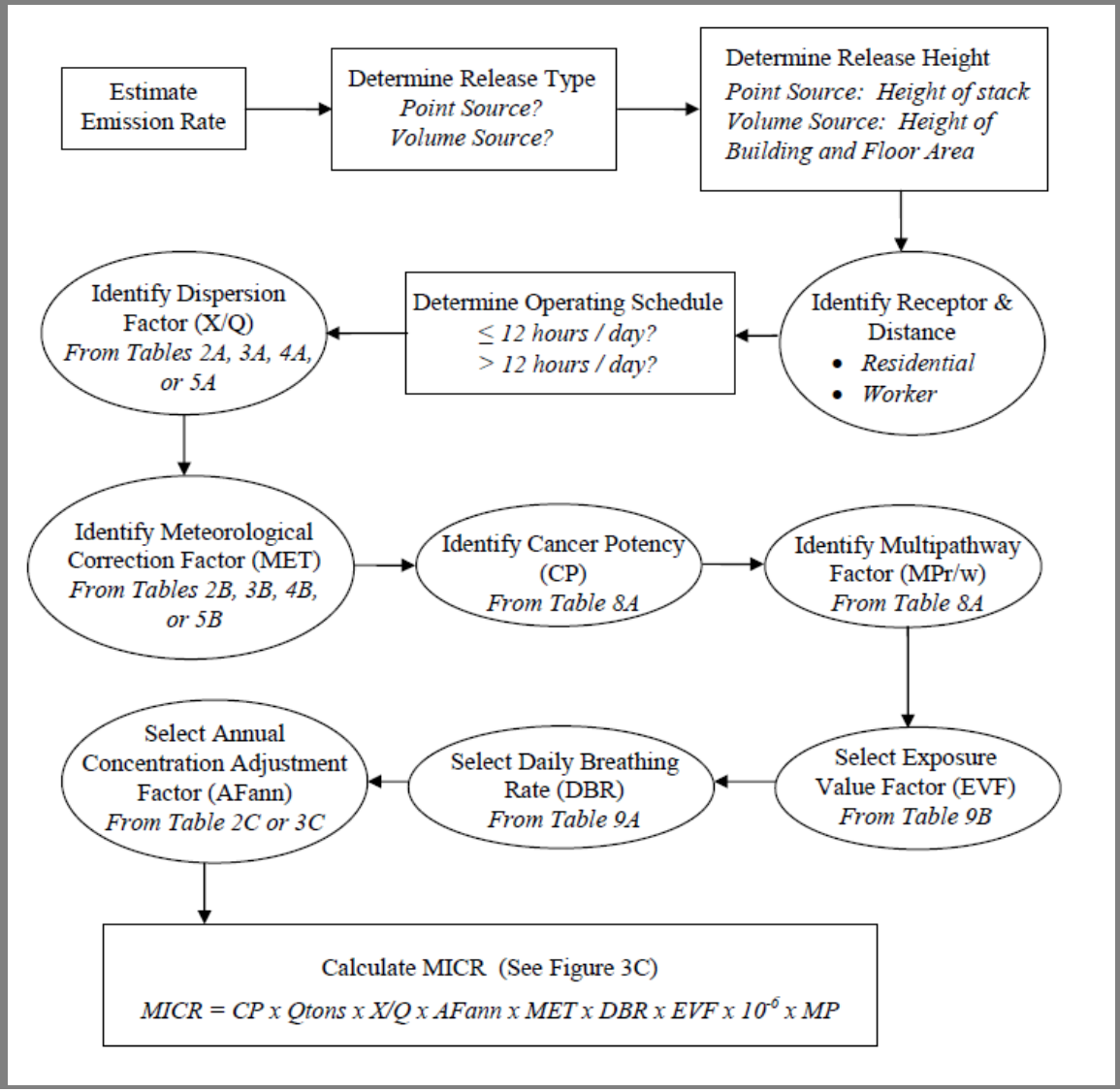
SCAQMD RISK CALCULATOR



http://www.aqmd.gov/home/permits/risk-assessment/risk-assessment-calculator

TIER 2 RISK ASSESSMENT FLOWCHART



TIER 2 SCREENING RISK ASSESSMENT REPORT

A/N:
Fac:

Application deemed complete date: 12/07/12

2. Tier 2 Data

MET Factor	1.00
4 hr	0.89
6 or 7 hrs	0.73

Dispersion Factors table:

3	For Chronic X/Q
6	For Acute X/Q

Dilution Factors (ug/m3)/(tons/yr)

Receptor	X/Q	X/Qmax
Residential	1.445	83.35
Commercial	8.756	462.84

Adjustment and Intake Factors

	AFann	DBR	EVF
Residential	1	302	0.96
Worker	1	149	0.38

3. Rule 1401 Compound Data

Code	Compound	R1 - uncontrolled (lbs/hr)	R2 - controlled (lbs/hr)	CP	MP MICR Resident	MP MICR Worker	MP Chronic Resident	MP Chronic Worker	REL Chronic	REL Acute
B1	Benzene (including benzene from gasoline)	8.40E-05	8.40E-05	1.00E-01	1.0000	1.0000	1.0000	1.0000	60	1300
T3	Toluene (methyl benzene)	8.40E-05	8.40E-05		1	1	1	1	300	37000
X1	Xylenes (isomers and mixtures)	1.35E-05	1.35E-05		1	1	1	1.0000	700	22000
E4	Ethyl benzene	8.10E-07	8.10E-07	8.70E-03	1	1	1	1	2000	

5a. MICR

MICR = CP (mg/(kg-day))^-1 * Q (ton/yr) * (X/Q) * AFann * MET * DBR * EVF * 1E-6* MP

Compound	Residential	Commercial
Benzene (including benzene from gasoline)	1.54E-08	1.82E-08
Toluene (methyl benzene)		
Xylenes (isomers and mixtures)		
Ethyl benzene	1.29E-11	1.53E-11
Total	**1.54E-08**	**1.82E-08**

No Cancer Burden, MICR<1.0E-6

5b. Cancer Burden	NO
X/Q for one-in-a-million:	
Distance (meter)	
Area (km2):	
Population:	-
Cancer Burden:	

CHRONIC AND ACUTE HAZARD INDICES

6. Hazard Index

HIA = [Q(lb/hr) * (X/Q)max] * AF / Acute REL

HIC = [Q(ton/yr) * (X/Q) * MET * MP] / Chronic REL

Target Organs	Acute	Chronic	Acute Pass/Fail	Chronic Pass/Fail
Alimentary system (liver) - AL		1.55E-08	Pass	Pass
Bones and teeth - BN			Pass	Pass
Cardiovascular system - CV			Pass	Pass
Developmental - DEV	3.10E-05	6.43E-05	Pass	Pass
Endocrine system - END		1.55E-08	Pass	Pass
Eye	1.33E-06		Pass	Pass
Hematopoietic system - HEM	2.99E-05	5.35E-05	Pass	Pass
Immune system - IMM	2.99E-05		Pass	Pass
Kidney - KID		1.55E-08	Pass	Pass
Nervous system - NS	1.05E-06	6.50E-05	Pass	Pass
Reproductive system - REP	3.10E-05		Pass	Pass
Respiratory system - RES	1.33E-06	1.14E-05	Pass	Pass
Skin			Pass	Pass

CONTACT INFORMATION

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