California Air Resources Board

and the California Air Pollution Control Officers Association

Diesel Internal Combustion Engine Risk Tool User Guide

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1. Introduction

The development of the <u>Non-Vehicular Diesel Engine Risk Assessment Guidance</u> (Guidance) included a tool created to assist local Air Pollution Control Districts and Air Quality Management Districts (Districts) in performing screening health risk assessments (HRAs) of toxic emissions from diesel internal combustion engines (DICE). The Hotspots Analysis and Reporting Program 2 (HARP2) Diesel Internal Combustion Engine Risk Assessment Tool (DICE Risk Tool) follows this Guidance and allows users to perform customized screening health risk assessments (HRAs). Users of the DICE Risk Tool should refer to the Guidance for a complete technical understanding of the inputs to the tool, as well as its limitations.

2. Downloading the DICE Risk Tool

This section provides information for installing the program.

2.1 System Requirements

Before installing the DICE Risk Tool on your computer, please review the system requirements. The current version of the DICE Risk Tool is a Microsoft Windows based program and can be installed on any Windows operating system that supports the Microsoft .NET Framework 4.0 or later. Additional system requirements include:

- 2 GB of RAM
- 20 MB of free hard drive space for the DICE Risk Tool program files
- At least 1 GB of storage space for project files

2.2 Installing the DICE Risk Tool

The DICE Risk Tool installation files are available on the Internet at:

https://ww2.arb.ca.gov/resources/documents/non-vehicular-diesel-engine-risk-assessment-guidance

Click the **Download Software and User Guide** link. Follow the online instructions for complete details on how to download the installation software. Once the installation setup file has been downloaded and saved to your hard drive, double-click on it to begin the program setup. Follow the on-screen instructions to complete the setup.

The default destination folder is C:\DICE. It is recommended that you install to the default destination folder. In addition, the installer will create a DICE Risk Tool folder on your desktop. This folder will contain shortcuts to the program's executable file and the user guide.

2.3 Opening the Program

To launch the DICE Risk Tool, open the DICE folder found on your desktop. Double-click on the **DICE** icon.



2.4 Getting Familiar with the Program

The DICE Risk Tool is designed as a wizard to guide the user through the emissions calculation, air dispersion modeling and risk assessment process. It has been streamlined to require minimal user input, while still providing a robust assessment. The DICE Risk Tool is composed of the following main user screens:

- Title
- Project Information
- Engine Information
- Building Information
- Receptor Information
- Run and View Results

The sections that follow provide a step by step description of the use of the DICE Risk Tool.

3. Calculating Risk

3.1 Required Information for Performing an Assessment

The DICE Risk Tool uses the following information to perform a health risk assessment:

- Engine exhaust stack parameters: stack height, stack diameter, exhaust temperature and exhaust exit velocity or flow rate. If not known, the DICE Risk Tool provides defaults based on engine horsepower.
- Engine exhaust release type: vertical, horizontal or capped.
- Annual diesel PM₁₀ emissions (lbs/year). If not known, the DICE Risk Tool will calculate emissions given engine horsepower, engine load, diesel PM₁₀ emission factor (g/bhp-hr or g/kw-hr), and engine annual activity in hours or gallons.
- Building information (if applicable).
- Nearest resident and worker receptor distance (m).
- AERMOD ready meteorological data. A link is provided to data for California.
- Name of Agency with jurisdiction over the project (in order to select the appropriate pre-set default risk settings) or user-entered risk settings.

3.2 Opening the DICE Risk Tool

Launching the DICE Risk Tool will open the title screen as shown in Figure 1. On this screen, the user can start a new project by selecting the **Next** button on the bottom right, or open a previously saved project by selecting the **Open Project** option in the **File** drop-down menu. The **GoTo** drop-down menu allows the user to navigate to a specific screen in the DICE Risk Tool.

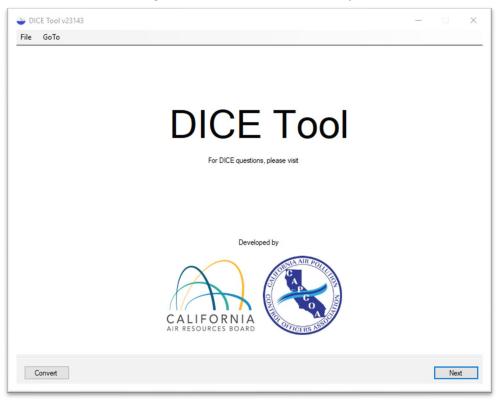


Figure 1 - DICE Risk Tool on Startup

A conversion tool, shown in Figure 2, is available to the user from most screens by selecting the **Convert** button located in the bottom left corner of the DICE Risk Tool.

The conversion tool allows the user to convert common units for the following measurements:

- Length Feet, inches, and miles to meters.
- Temperature Fahrenheit and Celsius to Kelvin.
- Velocity Feet per second and kilometers per hour to meters per second.
- Flow Rate Cubic Feet per second, minute, and hour to cubic meters per second.

To use the conversion tool, enter the desired numerical value in the white boxes under **Convert From**. The conversion tool will then automatically generate the converted value into the corresponding grey boxes located under **Convert To** as shown in Figure 3.

ile GoTo				
	Common Conversions		2	
	Convert From	Convert To		
	Length			
	ft		m	
	in		m	
	m	iles	m	
	Temperature			
	F		к	
	C		к	
	Exit Velocity			
	ft	/s	m/s	
	kr	n/hr	m/s	
	Flow Rate			
	ft	/s	m³/s	
		/min	m³/s	
		/hr	m ³ /s	
		L		

Figure 2 - Conversion Tool Page

Figure 3 – Conversion Tool Page with Entered Values

ile GoTo				
	Common Conversions			
	Convert From	Convert To		
	Length			
	1 ft 12 in	0.3048 m		
	1 miles	1609.344 m		
	Temperature	010 00777777777		
	100 F 36 C	<u>310.92777777778</u> к <u>309.15</u> к		
	Exit Velocity			
	10 ft/s	3.0480 m/s		
	10.95 km/h	r 3.041667 m/s		
	Flow Rate	0.2832 m³/s		
	600 ft³/mi			
	10 ft³/hr	7.86579072E-05 m³/s		
Convert			Nex	

3.3 Enter Project Information Screen

To start the risk assessment, enter the project information as shown in Figure 4.

ile GoTo					 	_
Inter Project Inform	ation					
Project Information						
Projec	t Name:					
Agency Juri	sdiction:	<-Select->	~			
Project Output D	irectory:			Browse		
Invento	ry Year:					
Meteorological Data						
Surface Met Data File	e (*.SFC):			Browse		
Profile Met Data File	(*.PFL):			Browse		
Base Eleva	ation (m):					
Dispersion Coe	fficients: 🖲 Rura	I 🔿 Urban				
		Urban Population:	100000			
Building Downwash						
Include Building Dow	nwash					

Figure 4 – Project Information Page

3.3.1 Project Information

In the project information box, input a **Project Name** as shown in Figure 5. The **Project Name** will be displayed on the project's summary reports.

Figure 5 – Entering the Project Name

	E Tool v23143			×
File	GoTo			
Ente	er Project Information			
	ect Information			
	Project Name:	Enter Project Name Here!		
	Agency Jurisdiction:	<-Select-> V		
	Project Output Directory:	Browse		
	Inventory Year:			

Select the project's reviewing agency by using the **Agency Jurisdiction** drop down box as shown in Figure 6. This will load that agency's recommended HARP2 risk settings, which are

then used to perform the HRA. Risk settings are described in more detail in <u>Section 3.6.3</u> of this user guide, including a discussion of how to change from the default pre-set risk settings.

inter Project Name Here! <-Select-> County APCD Antelope Valley AQMD Bay Area AQMD Butte County APCD Calaveras County APCD Colusa County APCD Eastern Kern APCD	~		Brow	rse			
<-Select-> <-Select-> Amador County APCD Antelope Valley AQMD Bay Area AQMD Butte County AQMD Calaveras County APCD Colusa County APCD	~		Brow	rse			
<-Select-> <-Select-> Amador County APCD Antelope Valley AQMD Bay Area AQMD Butte County AQMD Calaveras County APCD Colusa County APCD	× ^		Brow	rse			
<-Select-> <-Select-> Amador County APCD Antelope Valley AQMD Bay Area AQMD Butte County AQMD Calaveras County APCD Colusa County APCD	✓▲		Brow	'se			
<-Select-> <-Select-> Amador County APCD Antelope Valley AQMD Bay Area AQMD Butte County AQMD Calaveras County APCD Colusa County APCD	✓		Brow	se			
Collect> Amador County APCD Antelope Valley AQMD Bay Area AQMD Butte County AQMD Calaveras County APCD Colusa County APCD	✓		Brow	rse			
Collect> Amador County APCD Antelope Valley AQMD Bay Area AQMD Butte County AQMD Calaveras County APCD Colusa County APCD	✓		Brow	se			
Amador County APCD Antelope Valley AQMD Bay Area AQMD Butte County AQMD Calaveras County APCD Colusa County APCD	^		Brow	se			
Amador County APCD Antelope Valley AQMD Bay Area AQMD Butte County AQMD Calaveras County APCD Colusa County APCD			Brow	se			
Antelope Valley AQMD Bay Area AQMD Butte County AQMD Calaveras County APCD Colusa County APCD							
Bay Area AQMD Butte County AQMD Calaveras County APCD Colusa County APCD							
Calaveras County APCD Colusa County APCD							
Colusa County APCD							
Eastern Kern APCD							
			Brow	se			
			Brow	se			
Mariposa County APCD							
Mendocino County AQMD							
Modoc County APCD		100000					
		100000					
San Joaquin Valley APCD							
San Luis Obispo County APCD				-			
Santa Barbara County APCD				Pre	evious	Nex	đ
	El Dorado County AQMD Feather River AQMD Glenn County APCD Great Basin Unified APCD Imperial County APCD Lake County APCD Mariposa County APCD Mariposa County APCD Modoc County APCD Modoc County APCD Modoc County APCD Monterey Bay Air Resources District North Coast Unified AQMD Northern Sionoma County APCD Placer County APCD Sacramento Metropolitan AQMD San Diego County APCD San Joaquin Valley APCD San Joaquin Valley APCD San Joaquin Valley APCD San Luis Obispo County APCD	El Dorado County AQMD Feather River AQMD Glenn County APCD Imperial County APCD Lake County APCD Manjoosa County APCD Manjoosa County APCD Mendocino County APCD Mendocino County APCD Mendocino County APCD Mendocino County APCD Monterey Bay Air Resources District North Coast Unified AQMD Northern Sierra AQMD Northern Sierra AQMD Northern Sierra AQMD Northern Sonoma County APCD Placer County APCD Sacramento Metropolitan AQMD San Diego County APCD San Luis Obispo County APCD San Luis Obispo County APCD Santa Batbara County APCD	El Dorado County AQMD Feather River AQMD Glenn County APCD Great Basin Unified APCD Impenial County APCD Lake County AQMD Lassen County APCD Mendocino County APCD Modoc County APCD Modoc County APCD Modoc County APCD Motherey Bay Ar Resources District North Coast Unified AQMD Northerey Say Ar Resources District North Coast Unified AQMD Northern Sierra AQMD Northern Sierra AQMD San Diego County APCD San Jaoguin VaIley APCD San Luis Obispo County APCD Santa Barbara County APCD	El Dorado County AQMD Brow Feather River AQMD Brow Gieno County APCD Brow Great Basin Unfied APCD Brow Imperial County APCD Brow Lake County APCD Brow Manjoosa County APCD Manjoosa County APCD Mendocino County APCD 100000 Modoc County APCD 100000 Morterey Bay Air Resources District Northern Sonia County APCD Norther Sonia County APCD Placer County APCD Placer County APCD San Diego County APCD San Luis Obispo County APCD San Luis Obispo County APCD San Luis Obispo County APCD San Lais Obispo County APCD	El Dorado County AQMD Feather River AQMD Glenn County APCD Great Basin Unfied APCD Imperial County APCD Lake County APCD Manjosa County APCD Mendocino County APCD Mendocino County APCD Modoc County APCD Modoc County APCD Mother Store AQMD Norther Store AQMD San Diego County APCD San Luis Obispo County APCD Santa Batbara County APCD Print Store ACC Print St	El Dorado County AQMD Browse Feather River AQMD Browse Gieno County APCD Browse Imperial County APCD Browse Imperial County APCD Browse Lake County APCD Marjoosa County APCD Mendocino County APCD Modoc County APCD Mendocino County APCD 100000 Mondoc County APCD 100000 Monterey Bay Air Resources District Northern Sierra AQMD Northern Sonia County APCD Previous San Liego County APCD San Lais Obispo County APCD San Luis Obispo County APCD Previous	El Dorado County AQMD Browse Feather River AQMD Browse Great Basin Unfied APCD Browse Imperial County APCD Browse Lake County APCD Marjoosa County APCD Mendocino County APCD Modoc County APCD Mendocino County APCD 100000 Modoc County APCD 100000 Monterrey Bay Air Resources District Northern Sonama County APCD Northern Sonama County APCD 100000 Placer County APCD San Diego County APCD San Luis Obispo County APCD San Luis Obispo County APCD San Luis Obispo County APCD Previous

Figure 6 – Selecting Agency Jurisdiction from Dropdown Box

To enter a project folder name in the **Project Output Directory** box, first select the **Browse** button indicated by the red arrow in Figure 7. A **Browse for Folder** window will appear as shown in Figure 8.

Figure 7 – Selecting the Browse Button

File Go	То			
	Project Informatio	1		
Project Ir	nformation Project Nar	: Enter Project Name Here!		
	Agency Jurisdiction	n: San Joaquin Valley APCD 🗸		
	Project Output Directo	r: Browse		
	Inventory Ye	r		

Agency Project Outp Inv Meteorological Data Surface Met Data Profile Met Data Base B	entory Year: > This PC > This PC > Libraries > Petwork > Control Panel a File (".SFC A Recycle Bin HARP2
Building Downwash	

Figure 8 – Browse for Folder Window

Navigate through your computer's files and select the desired location of your output files. To make a new folder, select the **Make New Folder** button as indicated by the red arrow in Figure 9. After selecting the output folder location, click **OK** to finish.

Figure 9 – Making New Folder Location

Brow	vse For Folder)
Γ	🛛 Recycle Bin	^
	HARP2	
	Lakes Environmental	
>	2022 EI PROCESS	
>	AG and Waste Burning Project	
>	CEQA Met Site Runs	
>	Contruction Only HRA Screening	
~	DICE Tool Project	
	> 🔄 DICE Tool Guide Example	
	DICE Tool Invalid User Guide Drafts	
	Figures Captures	
	In entory Query Special Project	v
_		
M	Take New Folder OK Cancel	

Enter the year in which the engine's emissions occurred into the **Inventory Year** box as indicated by the red arrow in Figure 10. Otherwise, leave this box blank.

		-		×
Enter Project Name Here!				
San Joaquin Valley APCD \checkmark				
C:\Users\yeungn\Desktop\DICE Tool Project\DICE Tool Guide Exal	Browse			
2023				
	San Joaquin Valley APCD C:\Users\yeungn\Desktop\DICE Tool Project\DICE Tool Guide Exal	Enter Project Name Here! San Joaquin Valley APCD C:\Users\yeungn\Desktop\DICE Tool Project\DICE Tool Guide Exai Browse	Enter Project Name Here! San Joaquin Valley APCD C:\Users\yeungn\Desktop\DICE Tool Project\DICE Tool Guide Exal Browse	Enter Project Name Here! San Joaquin Valley APCD C:\Users\yeungn\Desktop\DICE Tool Project\DICE Tool Guide Exar Browse

Figure 10 – Entering Project's Inventory Year

3.3.2 Meteorological Data

Next, the meteorological data needed to run the air dispersion model must be loaded into the tool. These data can be obtained from the local air district or from the California Air Resources Board (CARB) website at:

https://ww2.arb.ca.gov/resources/documents/harp-aermod-meteorological-files

To enter the meteorological data, click the **Browse** buttons next to the Surface and Profile Met Data File boxes as shown in Figure 11 and select the .SFC and .PFL files of the selected meteorological site.

	Figure 11 - Im	porting the	Meteorological	Data
--	----------------	-------------	----------------	------

Surface Met Data File (*.SFC):		Browse
Profile Met Data File (*.PFL):		Browse
Base Elevation (m):		
Dispersion Coefficients:	ral 🔘 Urban	
	Urban Population: 100	0000

Next, enter the chosen site's **Base Elevation** and select the **Dispersion Coefficient** type. If the urban dispersion coefficient is selected, enter the **Urban Population** of the project's location. As an example, in Figure 12, the Fresno Met site was selected and its base elevation of 101.5 meters was entered. The urban dispersion coefficient was selected and the project location's population of 549,702 was entered.

Profile Met Data File (*.PF	L): T:\TOXIC\SCREEN\DATA\01 Meteorological_Data\AERMET v180 Browse
Base Elevation (r	m): 101.5
Dispersion Coefficien	ts: 🔿 Rural 💿 Urban

Figure 12 – Entered Meteorological Data

3.3.3 Building Downwash

If the DICE is located near a building and the exhaust stack is subjected to building downwash, the user can include building downwash in the air dispersion model by clicking the **Include Building Downwash** check box as shown in Figure 13. If the building downwash option is selected, the user will be prompted later to enter the building information. Click the **Next** button to continue to the next step.

Figure 13 - Specifying Building Downwash

Building Downwash	
Include Building Downwash	
Convert	Previous Next

3.4 Enter Engine Information Screen

The Enter Engine Information Screen collects engine emissions and exhaust information as shown in Figure 14.

Engine Horsepower:
Engine Horsenower
Engine Load Factor (%):
Engine Annual Usage: hours 🗸
Diesel PM10 Emission Factor: g/bhp-hr v
Diesel PM10 Emissions (b/yr): Calculate
Stack Height (m):
Stack Exhaust Temperature (K):
Stack Exit Velocity (m/s):
Stack Exit Flow Rate (m^3/s): Calculate
Stack Internal Diameter (m):

Figure 14 – Enter Engine Emissions Data

3.4.1 Engine Data

In the Engine Data Section, the user must enter or calculate the **Diesel PM10 Emissions**. The user is only required to enter the annual diesel PM10 emissions indicated by the red arrow in Figure 15.

Figure 15 - Entering Engine Specification Data	Figure	15 -	Entering	Engine	Specification	Data
--	--------	------	----------	--------	----------------------	------

File GoTo	
Enter Engine Information	
Engine Data	
Engine Horsepower:	
Engine Load Factor (%):	
Engine Annual Usage:	hours 🗸
Diesel PM10 Emission Factor:	g/bhp-hr V
	group in .
	10 Calculate

However, if the user would like the tool to calculate the annual diesel PM10 emission rate, the user may instead enter the Engine Horsepower, Engine Load Factor, Engine Annual Usage, and Diesel PM10 Emission Factor and then press the Calculate button to generate the annual diesel PM10 emission rate as shown in Figure 16.

DICE	E Tool v23143				-	
File	GoTo					
Ente	r Engine Information					
Engine	Data					
	Engine Horsepower:	300				
	Engine Load Factor (%):	100				
	Engine Annual Usage:	100	hours v	/		
	Diesel PM10 Emission Factor:	0.01	g/bhp-hr 🗸	/		
	Diesel PM10 Emissions (b/yr):	0.66	Calculate ┥			

Figure 16 – Generating Diesel PM10 Emissions from Engine Information

The **Engine Annual Usage** can be entered as hours operated or gallons of diesel fuel consumed. The **Diesel PM10 Emission Factor** can be entered as g/bhp-hr or g/kw-hr. To select which unit to use, click the drop down boxes shown in Figures 17 and 18.

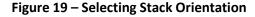
Figure 17 – Selecting Units for Engine Annual Usage

DICE Tool v23143				-	×
File GoTo					
Enter Engine Information					
Engine Data					
Engine Horsepower:	300				
Engine Load Factor (%):	100				
Engine Annual Usage:	100	hours ~			
Diesel PM10 Emission Factor:	0.01	gallons	l		
Diesel PM10 Emissions (b/yr):	0.66	Calculate			

300								
100								
100	hours	\sim						
0.01	g/bhp-hr	~						
0.66	g/bhp-hr g/kw-hr							
	100 100 0.01	100 100 hours 0.01 g/bhp-hr g/bhp-hr	100 100 hours ~ 0.01 g/bhp-hr ~ g/bhp-hr	100 100 hours ~ 0.01 g/bhp-trr ~	100 100 hours ~ 0.01 g/bhp-hr ~ g/bhp-hr	100 100 hours ~ 0.01 g/bhp-hr ~ g/bhp-hr	100 100 hours ✓ 0.01 g/bhp-hr ✓ g/bhp-hr	100 100 hours ~ 0.01 g/bhp-hr ~ g/bhp-hr

Figure 18 – Selecting Units for Diesel PM10 Emission Factor

The next step is to enter the exhaust stack parameters. First, select the stack orientation of the DICE by using the **Stack Orientation** drop down box as shown in Figure 19. The **Stack Orientation** drop down box gives the user three options to select from: vertical, capped, and horizontal. Vertical and horizontal refer to the direction of exhaust and capped is used when the exhaust has a fixed rain cap that obstructs the vertical momentum of the exhaust. Flappers are considered vertical.





Next, enter the Stack Height (meters), Stack Internal Diameter (meters), Stack Exhaust Temperature (Kelvin), and Stack Exit Velocity (meters/second) in the boxes shown in Figure 20. The user also has the option to calculate the Stack Exit Velocity if the Stack Exit Flow Rate is known by clicking the **Calculate** button.

Note: In order to use the **Stack Exit Velocity (m/s) Calculate** button, values must be entered for the Stack Internal Diameter (m) and the Stack Exit Flow Rate (m³/s). In order to use the **Stack Exit Flow Rate (m³/s) calculate button**, values must be entered for the Stack Internal Diameter (m) and the Stack Exit Velocity (m/s).

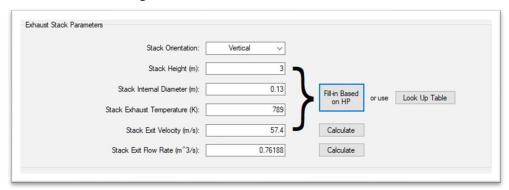


Figure 20 – Entered Stack Parameter Data

If the information for stack parameters is not available to the user, default parameters may be used instead. In order to use the default parameters, the engine's horsepower must be known. Once the engine horsepower has been entered, the user may click the **Fill-in Based on HP** button to autofill the exhaust stack parameters, or manually select parameters from the **Select Engine Stack Parameters** table. To access this table, shown in Figure 21, click the **Look Up Table** button. From the table, the user may select the brake-horsepower (BHP) range representing the engine, and then either click **Select** or double-click the row to copy the default values to the input form's exhaust stack parameter fields. When all of the fields are complete, click the **Next** button to go to the next screen in the DICE Risk Tool.

BHP Range	Count	BHP	Stack Height (m)	Stack Diameter (m)	Exhaust Temperature (K)	Exit Velocity (m/s)
0-50	59	48	2.1	0.06	813	47.1
51-100	616	86	2.4	0.07	797	56.9
101-150	406	131	2.4	0.09	755	53
151-175	301	166	2.4	0.1	795	46.9
176-200	107	197	2.9	0.1	761	55.5
201-275	413	237	3	0.11	780	56.4
276-300	121	279	3	0.13	789	57.4
301-400	582	355	3	0.13	780	63.9
401-500	275	464	3.1	0.15	770	59.4
501-600	187	539	3.4	0.15	786	69.8
601-750	195	680	3.7	0.2	764	57.8
751-825	313	755	3.7	0.2	755	55.8
826-1150	310	954	3.8	0.25	775	53.5
1151-1500	292	1474	4.3	0.25	750	52.2
1501-1850	128	1800	4.9	0.3	751	57.4
1851-2500	259	2220	5.3	0.36	750	51.8
2501-3500	429	2923	6.1	0.46	747	45.1
3501-4500	175	3705	7.6	0.51	753	45.6
>4500	22	4680	7.6	0.58	786	40

Figure 21 - Engine Stack Parameters Look-Up Table

3.5 Building Information Screen

If the **Include Building Downwash** option was checked on the Enter Project Information screen, the user will be prompted to provide information required for the program to calculate downwash. In Figure 22, the red circled cross represents the stack, and the numbered grey boxes represents the different potential building locations relative to the stack. Only one building may be included in the screening model.

DICE Tool v23143 File GoTo		- 🗆 X
Building Information		
	1 2 3	
	Y ⁴ ⁵ ⊕ ⁶	
	7 8 9	
	X	
Building	Position Relative to Stack: <-Select-> <>	
Buid	dling Distance to Stack (m):	
	Building Height (m):	
	Building X Dimension (m):	
	Building Y Dimension (m):	
Convert		Previous Next

Figure 22 – Building Information Page

To select the building's relative position, click the **Building Position Relative to Stack** dropdown box. From the dropdown box shown in Figure 23, choose a number from 1 to 9 to match the building's relative position to the stack. For example, if the building is north of the stack, the user should select the number 2. Stack position 5 should be used if the stack is exhausting through the roof of a building.

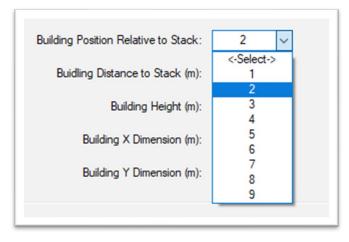
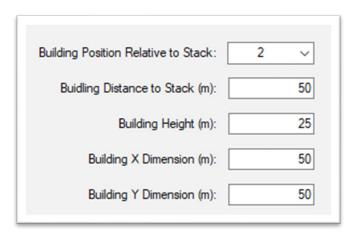


Figure 23 – Selecting Building Relative Position

The next step is to enter the desired **Building Distance to Stack (m)**, the **Building Height (m)**, the **Building X Dimension (m)** (east-west) and **Building Y Dimension (m)** (north-south), as shown in Figure 24. The **Building Distance to Stack** should be measured from the stack to the nearest edge of the building. Click **Next** when finished.

Figure 24 – Entering Building Dimensions



3.6 Enter Receptor Information Screen

The Enter Receptor Information screen requires the user to input receptor distances, select either the default air dispersion modeling grid or custom grid spacing, and customize the risk settings, as shown in Figure 25.

	Resident (m):		
Receptor Grid			
Use Default Grid Spacing			
O Use Custom Grid Spacing			
Distances (m)			
Distance 1	Distance 2	Distance 3	
Distance 4	Distance 5	Distance 6	
Risk Settings			
sk Settings			

Figure 25 – Enter Receptor Information Screen

3.6.1 Receptor Distances

The distance to the nearest **Resident (m)** and **Worker (m)** must be entered, as shown in Figure 26. Risk will be calculated at these distances using the exposure assumptions selected in the next screen in the DICE Risk Tool.

Figure 26 – Entering Receptor Information

3.6.2 Receptor Grid

Selecting the **Use Default Grid Spacing** setting will calculate the risk results using a telescoping polar grid with varying receptor spacing from 10 meters out to 4,850 meters from the diesel engine (located at the grid's origin point).

Figure 27 –	Use	Default	Grid	Spacing
-------------	-----	---------	------	---------

O Use Custom Grid Spacing		
Distances (m)		
Distance 1	Distance 2	Distance 3
Distance 4	Distance 5	Distance 6

Selecting the **Use Custom Grid Spacing** setting will calculate the risk results using a polar grid with up to six receptor rings at the distances specified. These are in addition to the worker and resident receptor distances previously identified.

In Figure 28, the **Use Custom Grid Spacing** setting was selected and values were entered into the boxes **Distance 1** through **Distance 6**. The user has the option to use up to six receptor ring distances by checking or unchecking the **Distance** number boxes. Compared to the **Use Default Grid Spacing** setting, a custom grid allows the user to decrease the number of receptors used in the risk assessment.

Use Custom C	arid Spacing				
Distances (m)					
Distance 1	50	Distance 2	75	Distance 3	100
Distance 4	150	Distance 5	250	Distance 6	500

Figure 28 – Use Custom Grid Spacing Selected and Distances Entered

3.6.3 Risk Settings

As shown in Figure 29, the **Use District Defaults** risk settings box is automatically checked. The default risk settings are determined the agency selected in <u>Section 3.3.1</u> of this user guide.

Figure 29 - Using District Defaults Risk Setting

Risk Settings			
Use District Defaults	New/Edit Settings		

In order to edit the risk settings, the user must uncheck the **Use District Defaults** box and click the **View/Edit Settings** button to open the **Risk Settings** window, shown in Figure 29.

Note: It is recommended that the user consult with the project's reviewing agency before making any changes to the default risk settings.

The risk settings shown in Figure 30 are the default options used by the San Joaquin Valley Air Pollution Control District (SJVAPCD); however, the risk settings will change depending on the agency that was selected.

Figure 30 – Risk Setting Page with San Joaquin Valley Air Pollution Control District Risk Settings

	Resident Receptors	Worker Rec	ceptors
Exposure Duration (years):	70 ~	40 \	~
Intake Rate Percentile:	OEHHA Derived	V OEHHA Deriv	ved 🗸
Time Away From Home <16 Years Old:			
Time Away From Home =>16 Years Old:			
	Rates for Resident Receptors:		
		tensity (Recommended)	
Adata	tment Factor:	1	
		050	
Exposure Frequency		250	
Exposure Frequency		250	
Exposure Frequenc	y (days/year): Rates for Worker Receptors:	250	
Exposure Frequency Use 8-Hour Breathing 8-Hour Ty	y (days/year): Rates for Worker Receptors: pe of Activity: Moderate Inte tment Factor:		

If the user wants to perform a refined analysis, they may edit the values in the **Risk Settings** window. The user may assign a **Flagpole Receptor Height (m)**, change the **Exposure Duration** (years) for the resident and worker receptors, apply **Time Away from Home <16 Years Old** or **Time Away from Home =>16 Years Old** factors to the resident receptors, or **Use 8-hour Breathing Rates** for Resident and/or Worker Receptors.

The user should consult with the reviewing agency before changing these values. For a technical understanding of these inputs, please refer to the HARP2 User Guide¹ and the OEHHA Health Risk Assessment Guidelines².

To restore the risk settings to the selected agency's district defaults, click the **Reset** button on the top of the **Risk Settings** page shown in Figure 30.

3.7 Run and View Results Screen

After all user inputs are entered, the final step of the DICE Risk Tool generates the risk screening results. Figure 31 shows the **Run and View Results** screen where the air dispersion modeling is performed and the health risk is calculated.

¹ California Air Resources Board. 2015. User Manual for the Hotspots Analysis and Reporting Program Air Dispersion Modeling and Risk Assessment Tool Version 2. Available online at: <u>https://ww2.arb.ca.gov/resources/documents/harp-air-dispersion-modeling-and-risk-tool.</u>

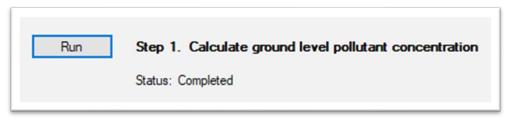
² Office of Environmental Health Hazard Assessment. 2015. Air Toxics Hot Spots Program Risk Assessment Guidelines: Guidance Manual for Preparation of Health Risk Assessments. Available online at: <u>https://oehha.ca.gov/air/crnr/notice-adoption-air-toxics-hot-spots-program-guidance-manual-preparation-health-risk-0</u>.

DICE Tool v23143		- 0	×
File GoTo			
Run and View R	sults		
	Run Step 1. Calculate ground leve Status: Not completed	el pollutant concentration	
	Run Step 2. Calculate health risk Status: Not completed		
	View Step 3. View screening risk m	esults	
		Finished	
Convert		Previous	ot

Figure 31 - Run and View Results Page

Click the **Run** button next to **Step 1. Calculate ground level pollutant concentration** as shown in Figure 32.



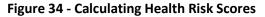


A new window will appear, as shown in Figure 33, tracking the progress of the air dispersion model's calculation of the ground level pollutant concentrations. Once the model is finished, the status under Step 1 will change to Completed.

C:\DICE\AERMOD.exe			100		1
ow Processing Data For		of			
ow Processing Data For		of			
ow Processing Data For		of			
ow Processing Data For		of			
ow Processing Data For		of			
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Figure 33 - Ground Level Pollutant Concentration Being Calculated

After the ground level pollutant concentrations have been calculated, a message box asking the user if they would like to calculate the health risks will appear, as shown in Figure 34. Select **Yes** to continue with the health risk calculations and another progress window will appear similar to that shown in Figure 33.



Finished	
GLCs have been calculated. Would you like to calculate health risks now (Step 2)?	
Yes No	

The user may also initiate the health risk calculations by clicking the **Run** button next to **Step 2. Calculate health risk** as shown in Figure 35. Once the health risk calculation is finished, the status under Step 2 will change to Completed.

Run	Step 2. Calculate health risk	
	Status: Completed	

Figure 35 - Calculating Health Risk Scores

Once the health risk calculations are finished, a report will open in the user's web browser. An example report is shown in Figure 36.

In order to view the most recent HRA report created by the DICE Risk Tool after closing out the report, click the **View** button next to **Step 3. View screening risk results** as shown in Figure 37.

Note: The HRA report is saved as a HTML file in the project folder. This type of file may be viewed in a web browser or word processing program. Word processing programs can convert the HTML HRA report to other types of files.

Figure 36 – DICE Risk Tool Results Report

	Table 1. Results Summary								
	Car	ncer	Chr	onic	Acute				
Receptor	Risk (in a million)	Receptor Distance (m)	Hazard Index (HI)	Receptor Distance (m)	Hazard Index (HI)	Receptor Distance (m)			
Resident (MEIR)	0.5	100	0	100	-	-			
Worker (MEIW)	0.1	25	0	25	-	-			
Maximum (PMI)	0.8	50	0	50	-	-			

Non-Vehicular Diesel Engine Risk Screening Tool Results

	Table 2. Inputs	
Project Information		
Project Name:	Enter Project Name Here!	
Agency Jurisdiction:	San Joaquin Valley APCD	
Project Output Directory:	C:\Users\yeungn\Desktop\DICE Too Tool Example Project	ol Project\DICE Tool Guide Example\DICE
Date Assessment Conducted:	9/7/2023 8:50:01 AM	
Inventory Year:	2023	
Tool Version:	23143	
Meteorological Data		
Surface Met Data File (*.SFC):	T:\TOXIC\SCREEN\DATA\01 Meteon v18081_UStar\Fresno_93193\Fresr	
Profile Met Data File (*.PFL):	T:\TOXIC\SCREEN\DATA\01 Meteor v18081_UStar\Fresno_93193\Fresr	- ·
Base Elevation (m):	101.5	
Dispersion Coefficients:	Urban	
Building Downwash:		el. Position from Stack: 2 Distance from Idg X Dim (m): 50 Bldg Y Dim (m): 50
Engine Information		
Engine Horsepower:	300	
Engine Load Factor (%):	100	
Engine Annual Usage:	100	hours
Diesel PM10 Emission Factor:	0.01	g/bhp-hr
Diesel PM10 Emissions (Ib/yr):	0.66	
Stack Height (m):	3	
Stack Diameter (m):	0.13	
Stack Temperature (K):	789	
Stack Exit Velocity (m/s):	57.4	
Risk Settings		
Use District Defaults:	Yes	
Flagpole Receptor Height (m):	0	
Deposition Rate (g/s):	NA	
Receptor Type:	Resident	Worker
Exposure Duration (yrs):	70	40
Intake Rate Percentile:	OEHHA Derived	OEHHA Derived
Time Away from Home <16:	No	-
Time Away from Home =>16:	No	-
Use 8-Hour Breathing Rate:	No	No
Enabled Pathways:	Inhalation Only	Inhalation Only

Table	e 3. DPM Conce	entration and R	isk by Rece	eptor Distance			
DDM		Resident		Worker			
Concentration (µg/m ³)	Cancer Risk (in a million)	Chronic HI	Acute HI	Cancer Risk (in a million)	Chronic HI	Acute HI	
0.0007826806	0.8	0	-	0.1	0	-	
0.0006100829	0.6	0	-	0.1	0	-	
0.0004612601	0.5	0	-	0.1	0	-	
0.0002897588	0.3	0	-	0	0	-	
0.0001513462	0.2	0	-	0	0	-	
5.861246E-05	0.1	0	-	0	0	-	
	DPM Concentration (μg/m ³) 0.0007826806 0.0006100829 0.0004612601 0.0002897588 0.0001513462	DPM Cancer Risk (in a million) 0.0007826806 0.8 0.0006100829 0.6 0.0004612601 0.5 0.0002897588 0.3 0.0001513462 0.2	DPM Resident Concentration (μg/m³) Cancer Risk (in a million) Chronic HI 0.0007826806 0.8 0 0.0006100829 0.6 0 0.0004612601 0.5 0 0.0002897588 0.3 0 0.0001513462 0.2 0	DPM Concentration (μg/m ³) Cancer Risk (in a million) Chronic HI Acute HI 0.0007826806 0.8 0 - 0.0006100829 0.6 0 - 0.0004612601 0.5 0 - 0.0002897588 0.3 0 - 0.0001513462 0.2 0 -	DPM Concentration (μg/m³) Cancer Risk (in a million) Chronic HI Acute HI Cancer Risk (in a million) 0.0007826806 0.8 0 - 0.1 0.0006100829 0.6 0 - 0.1 0.0004612601 0.5 0 - 0.1 0.0002897588 0.3 0 - 0 0.0001513462 0.2 0 - 0	DPM Concentration (μg/m ³) Resident Worker Cancer Risk (in a million) Chronic HI Acute HI Cancer Risk (in a million) Chronic HI 0.0007826806 0.8 0 - 0.1 0 0.0006100829 0.6 0 - 0.1 0 0.0002897588 0.3 0 - 0.1 0 0.0001513462 0.2 0 - 0 0	





3.8 DICE Risk Tool Results Report

The DICE Risk Tool's results report is divided into three tables: *Results Summary, Inputs,* and *DPM Concentration and Risk by Receptor Distance*. The information provided in each table is presented below.

3.8.1 Table 1. Results Summary

Figure 38 presents a summary of the results for the project. This table contains the maximally exposed individual resident and worker (MEIR and MEIW) cancer risk and chronic hazard index (HI) at the distances specified by the user. The Maximum (PMI) is the point of maximum impact, and the cancer risk presented uses residential exposure assumptions. The Maximum (PMI) provides the project's maximum calculated cancer risk and chronic HI and is dependent on the receptor grid spacing. In the example below, the Maximally Exposed Individual Resident cancer risk is 0.5 in a million (5 x 10^{-7}) at a distance of 100 meters. The acute hazard index values are not populated, as the state has not published acute non-cancer risk factors for diesel particulate matter.

Table 1. Results Summary						
	Cancer		Chr	onic	Acute	
Receptor	Risk (in a million)	Receptor Distance (m)	Hazard Index (HI)	Receptor Distance (m)	Hazard Index (HI)	Receptor Distance (m)
Resident (MEIR)	0.5	100	0	100	-	-
Worker (MEIW)	0.1	25	0	25	-	-
Maximum (PMI)	0.8	50	0	50	-	-

Figure 38 – Results Summary Tab

3.8.2 Table 2. Inputs

Figure 39 summarizes all user inputs to the DICE Risk Tool. This table allows reviewing agencies to view the meteorological data, dispersion coefficient, building information, engine information, and risk settings used in the project without having to open the DICE Risk Tool.

	Table 2. Inputs			
Project Information				
Project Name:	Enter Project Name Here!			
Agency Jurisdiction:	San Joaquin Valley APCD			
Project Output Directory:	C:\Users\yeungn\Desktop\DICE Tool Project\DICE Tool Guide Example\DICE Tool Example Project			
Date Assessment Conducted:	9/7/2023 8:50:01 AM			
Inventory Year:	2023			
Tool Version:	23143			
Meteorological Data				
Surface Met Data File (*.SFC):	T:\TOXIC\SCREEN\DATA\01 Meteorological_Data\AERMET v18081_UStar\Fresno_93193\Fresno_2013-2017.SFC			
Profile Met Data File (*.PFL):	T:\TOXIC\SCREEN\DATA\01 Meteorological_Data\AERMET v18081_UStar\Fresno_93193\Fresno_2013-2017.PFL			
Base Elevation (m):	101.5			
Dispersion Coefficients:	Urban			
Building Downwash:	Yes **Building Information** Rel. Position from Stack: 2 Distance from Stack (m): 50 Bldg Hgt (m): 25 Bldg X Dim (m): 50 Bldg Y Dim (m): 50			
Engine Information				
Engine Horsepower:	300			
Engine Load Factor (%):	100			
Engine Annual Usage:	100 hours			
Diesel PM10 Emission Factor:	0.01	g/bhp-hr		
Diesel PM10 Emissions (Ib/yr):	0.66			
Stack Height (m):	3			
Stack Diameter (m):	0.13			
Stack Temperature (K):	789			
Stack Exit Velocity (m/s):	57.4			
Risk Settings				
Use District Defaults:	Yes			
Flagpole Receptor Height (m):	0			
Deposition Rate (g/s):	NA			
Receptor Type:	Resident	Worker		
Exposure Duration (yrs):	70	40		
Intake Rate Percentile:	OEHHA Derived	OEHHA Derived		
Time Away from Home <16:	No	-		
Time Away from Home =>16:	No	-		
Use 8-Hour Breathing Rate:	No	No		
Enabled Pathways:	Inhalation Only	Inhalation Only		

Figure 39 – Project Input Information Table

3.8.3 Table 3. DPM Concentration and Risk by Receptor Distance

Figure 40 presents the diesel particulate matter (DPM) concentration as well as the cancer risk and chronic HI results for residents and workers at each ring distance in the receptor grid. In the example below, the results were calculated for six user specified distances using the **Use Custom Grid Spacing** option (see <u>Section 3.6.2</u> of this user guide). If the **Use Default Grid Spacing** option were selected, Table 3 would have generated results at 60 discrete distances from 10 meters to 4,850 meters.

Table 3. DPM Concentration and Risk by Receptor Distance							
Decenter	DPM	Resident			Worker		
Receptor Distance (m)	Concentration (µg/m ³)	Cancer Risk (in a million)	Chronic HI	Acute HI	Cancer Risk (in a million)	Chronic HI	Acute HI
50	0.0007826806	0.8	0	-	0.1	0	-
75	0.0006100829	0.6	0	-	0.1	0	-
100	0.0004612601	0.5	0	-	0.1	0	-
150	0.0002897588	0.3	0	-	0	0	-
250	0.0001513462	0.2	0	-	0	0	-
500	5.861246E-05	0.1	0	-	0	0	-

Figure 40 – Receptor Grid DPM Concentration and Risk Score Table

4. Output Files

4.1 DICE Risk Tool Output File Summary

After the user calculates the ground level pollution concentrations and health risk results, the DICE Risk Tool will generate AERMOD and HARP files into the **Project Output Directory** folder location. Table 1 summarizes these output files.

File Name	File Description			
DICE Tool Files	•			
ProjectName.dice	DICE Risk Tool project file containing all project inputs. Replace 'ProjectName' with the Project Nam entry from Enter Project Information page.			
Air Dispersion Modeling Files				
AERMOD.inp	AERMOD input file			
AERMOD.out	AERMOD output file			
BPIP.inp	Building Profile Input Program (BPIP) input file (only created when building downwash option is used)			
BPIP.out	Building Profile Input Program (BPIP) output file (only created when building downwash option is used)			
BPIP.sum	Building Profile Input Program (BPIP) summary file (only created when building downwash option is used)			
STK01.PLT	AERMOD period plot file for the project engine			
Risk Assessment Files				
9901AnnualConc.txt	Diesel Particulate Matter (DPM) ground level concentration (GLC) file for use with HARP2			
Res1CancerRisk.csv	HARP2 residential cancer risk output file. Contains detailed cancer risk results by receptor and pollutant.			
Res1CancerRiskSumByRec.csv	HARP2 residential cancer risk output file. Contains summed cancer risk results by receptor for all sources and pollutants.			
Res1Output.txt	HARP2 residential cancer risk output file. Contains a summary of settings used in HARP2 analysis.			
Res2NCChronicRisk.csv	HARP2 residential chronic non-cancer risk output file. Contains detailed chronic HI results by receptor, pollutant, and affected pathways.			
Res2NCChronicRiskSumByRec.csv	HARP2 residential chronic non-cancer risk output file. Contains summed chronic HI results by receptor for all sources, pollutants, and affected pathways.			
Res2Output.txt	HARP2 residential chronic non-cancer risk output file. Contains a summary of settings used in HARP2 analysis.			

File Name	File Description				
	HARP2 input file. Contains all inputs for use in				
ResCancerHRAInput.hra	performing residential cancer risk analysis using HARP2.				
	HARP2 input file. Contains all inputs for use in				
ResChronicHRAInput.hra	performing residential chronic non-cancer risk analysis using HARP2.				
Worker1CancerRisk.csv	HARP2 worker cancer risk output file. Contains				
	detailed cancer risk results by receptor and pollutant.				
	HARP2 worker cancer risk output file. Contains				
Worker1CancerRiskSumByRec.csv	summed cancer risk results by receptor for all				
	sources and pollutants.				
Worker1Output.txt	HARP2 worker cancer risk output file. Contains a				
	summary of settings used in HARP2 analysis.				
	HARP2 worker chronic non-cancer risk output file.				
Worker2NCChronicRisk.csv	Contains detailed chronic HI results by receptor,				
	pollutant, and affected pathways.				
	HARP2 worker chronic non-cancer risk output file.				
Worker2NCChronicRiskSumByRec.csv	Contains summed chronic HI results by receptor for				
	all sources, pollutants, and affected pathways.				
	HARP2 worker chronic non-cancer risk output file.				
Worker2Output.txt	Contains a summary of settings used in HARP2				
	analysis.				
WorkerCancerHRAInput.hra	HARP2 input file. Contains all inputs for use in				
	performing worker cancer risk analysis using HARP2.				
	HARP2 input file. Contains all inputs for use in				
WorkerChronicHRAInput.hra	performing worker chronic non-cancer risk analysis				
	using HARP2.				
Risk Results Report					
	Summarizes results from DICE Risk Tool. Provides				
	detailed information of inputs used in the tool as well				
DICESummaryReport.htm	as cancer risk and chronic HI for maximally exposed				
	resident (MEIR), maximally exposed worker (MEIW),				
	and point of maximum impact (PMI).				