TSI Link™
Spatial Analysis

Workbook Guide (US)

Contents

Overview

The Spatial Analysis workbook contains a set of worksheets for TSI Link™ Report Creator that support spatial visualization. In addition to traditional table-based data analysis, these worksheets allow you to overlay summary measurement data onto virtually any image, including:

- Building floorplan
- Hand sketch of a work area or building
- Photo
- Equipment diagram
- HVAC ductwork diagram
- Map

The templates in this workbook are designed to provide spatial context for your measurements. They allow you and your report recipients to clearly understand spatial context such as contaminant "hotspots', impact on surrounding areas, unsafe work areas, etc. You can also use Excel's annotation tools to further enhance your visualizations.

Check out the Report Creator Product Page *for guides, videos and more resources including: setting up an account, installing the application, using the study manager, using the layout view, customizing report creator templates, etc.* This guide builds upon and supplements those guides.

Worksheet Templates

The table below lists the worksheets available in the A-B comparison workbook.

Worksheet	Supported Measurements	Supported Instruments	Applications
General IAQ Assessment	CO (ppm) CO_2 (ppm) VOC (ppb) PM 2.5 (ug/m^3) PM 10 (ug/m^3)	OmniTrak™ Q-Trak™ XP	Air Quality testing around a public space, classroom, lab, commercial space, church, data center or other area. Helps to quickly analyze or troubleshoot situations
General Thermal Assessment	Temperature (C) Dew Point (C) Wet Bulb (C) rH (%) Barometric Pressure (inHg)	Q-Trak™ XP VelociCalc™	Optimize HVAC by measuring temperature gradient in an office, home, or manufacturing facility. Quickly analyze and report on energy efficiency assessments and working environments
PM & Sound Array	PM 2.5 (ug/m^3) NC 0.3 – 0.5 um (#/m^3) NC 0.5 – 1.0 um (#/m^3) NC 1.0 – 2.5 um (#/m^3) NC 2.5 – 4.0 um (#/m^3) NC 4.0 – 10 um (#/m^3)	OmniTrak™	Visualize the sounds and air quality on different points around a shop floor or around a construction site. Sound and IAQ in a concert hall or large meeting space
PM & VOC Array	VOC (ppb) NC 0.3 – 0.5 um (#/m^3) NC 0.5 – 1.0 um (#/m^3) NC 1.0 – 2.5 um (#/m^3) NC 2.5 – 4.0 um (#/m^3) NC 4.0 – 10 um (#/m^3)	OmniTrak™	Determine optimum placement of a portable air purifiers in a working area. Spot checking an garage, shop floor or production line. Checking a science lab area.
Sound Map	LCSmax (dB) LCpeak (dB)	OmniTrak™ Casella 620	Mapping sound levels in a park, urban area, school, or work place. Testing for noise complaints
Configurable Report	See Note 1		Visualize any one of 69 parameters around a floor plan, school, lab, product plant or other area.

NOTES:

1. The Configurable Report workbook allows you to select up to three measurements in a study from a large list. This configuration is made at the bottom of the Cover worksheet. See the Configurable Report section for more detail.
2. General IAQ and General Thermal Comfort Worksheets. The General IAQ worksheet is designed to display key indoor air quality gases and particulate matter measurements. The General Thermal Comfort does the same for temperature and humidity measurements. These two worksheet templates operate in a similar manner.

Worksheet Steps

Step 1 Select a Worksheet

The Trend Analysis Workbook is one of many that are available. An overview of the workbooks available is on the Report Creator product page.

The overview of worksheets in the prior section provides guidance on the A-B Comparison Worksheets.

Selecting Configurable Report Name and Parameters

The worksheets discussed above import specific measurement data. But the TSI® instrument portfolio can generate a wide range of measurements. It would be impractical to create templates for all possible permutations. The *Configurable Reports* provides a way for you to define a trend analysis for any three measurements you like.

The configuration is performed at the bottom of the *Cover* sheet.

You can give the Configurable Report a unique name, if desired. Then select up to two measurements. In the example below, we select three sound level measurements to check performance of an acoustic barrier.

Save the workbook template and open Report Creator. You will see your name appear in the worksheet selection list.

When you add the worksheet, you will see all the measurements you have selected.

NOTE: There is a limitation of Layout View in the Configurable Report. The display parameters only show the generic name, such as "Avg Meas 1". You will need to provide the actual label in the worksheet as shown here.

Step 2 Cover Sheet

This workbook contains a very simple Cover sheet that can be customized to suit your needs. See the *Customizing Report Creator Templates to learn how.* Other sheets can be added to your workbook, if desired.

The bottom of the Cover sheet includes a configuration tool for the **Configurable Report**. This report is discussed below. If the Cover sheet is deleted from the workbook, the Configurable Report will not be functional.

Step 3 Demographic Information

After you have created a blank worksheet, you can enter whatever demographic information you want into the report header. You may also change the "Location N" names to something more meaningful if desired.

You can also add or edit target maximum limits for each gas/PM in Row 12. (The Thermal worksheet includes *both* minimum and maximum targets.) If you do not want to display a target limit, simply leave the cell blank.

NOTE: You can also enter target limits into the worksheet templates if you want to make them static and avoid re-entering them. Refer to *Customizing Report Creator Templates.*

Step 4 Load Study Data

Import up to ten studies using the Study Manager or *File Import. Make sure the study names match the labels you added above. Swap them if necessary. When ready, click* **Add Data** to import data into the worksheet*. The measurement data is loaded further down the sheet and* the statistical summary table is compiled with the calculated maximum, average, and minimum values.

The Spatial Analysis workbook can load **up to 10 studies** in each worksheet. The two conditions can be described in the free text fields at the top of the sheet.

Step 5 Analyze Data

The data analysis sections differ between worksheets, as shown in the following examples.

Target Limits

Set Target limits as desired the maximum values, as highlighted below. These limits will be displayed on the chart to provide context. The different types of measurements have different target limits, of course, but they are all managed in similar ways. **Each measure and the target limit are displayed in a chart**, along with the target limits defined in the data summary table.

General IAQ, Thermal Comfort Analysis

The Test Results section includes a table to show key IAQ measurements. If you have added a target limit, the summary measurement will turn red if the target was exceeded.

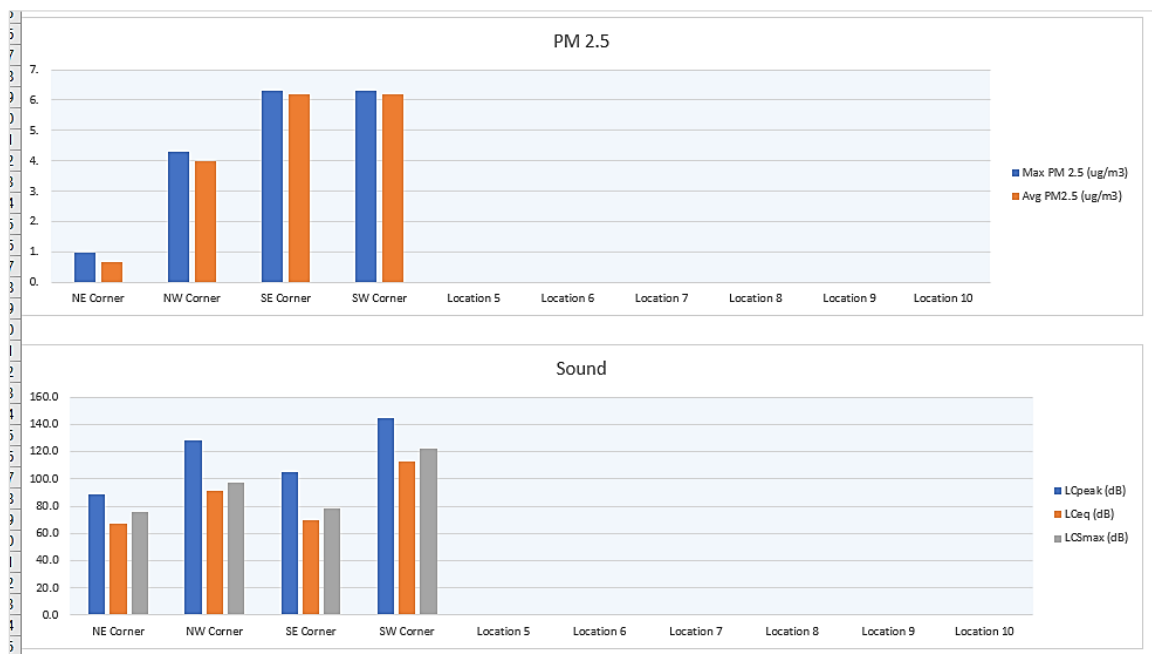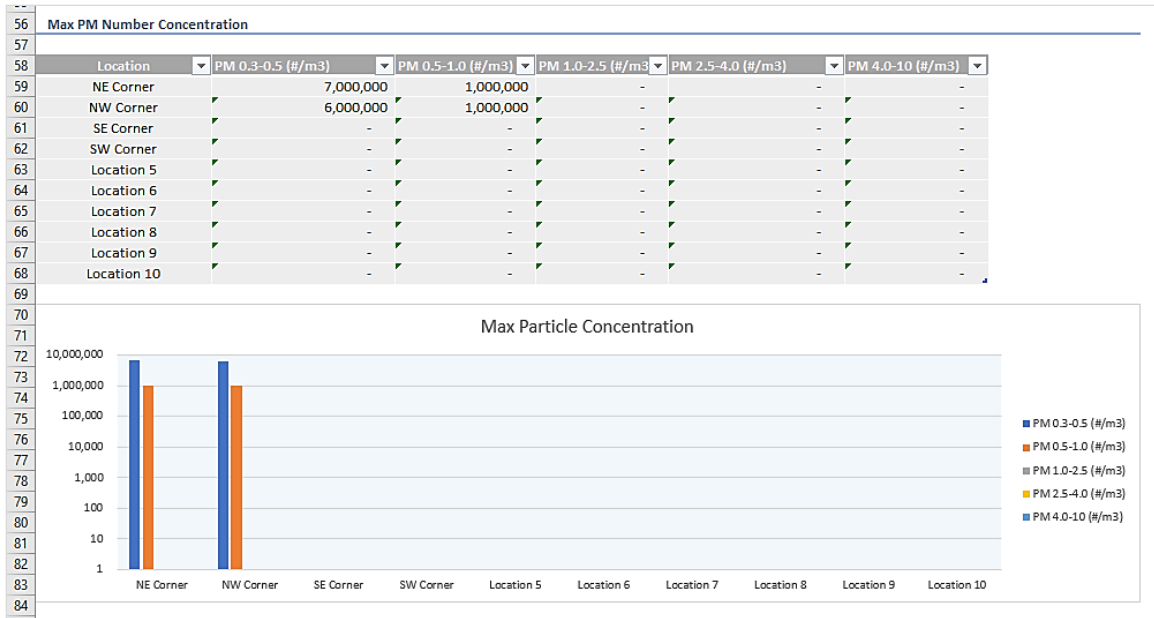| 9	Test Results						
10							
11	**Target Names**	**Max CO Limit**	**CO2 Limit**	**VOC Limit**	**PM2.5 Limit**	**Avg PM2.5 Limit**	**PM10 Limit**
12	Target Limits		1200		15		
13	**Location**	**Max CO (ppm)**	**Max CO2 (ppm)**	**Max VOC (ppb)**	**Max PM2.5 (ug/m3)**	**Avg PM2.5 (ug/m3)**	**Max PM10 (ug/m3)**
14	Break Room	2.	408.	0.	14.	14.	0.
15	Conference Room 3	1.	768.	100.	127.	127.	21.
16	Board Room	0.	1843.	0.	13.	13.	2.
17	East Stairwell	0.	553.	800.	64.	64.	14.
18	West Stairwell	6.	412.	0.	12.	12.	1.
19	Northeast Cubes	3.	1210.	200.	37.	37.	9.
20	North Cubes	3.	708.	0.	7.	7.	0.
21	Northwest Cubes	2.	817.	0.	6.	6.	0.
22	Team Room	1.	633.	0.	5.	5.	0.
23	Restrooms	0.	633.	0.	5.	5.	0.

PM & Sound Array Analysis

NOTE: The *PM & Sound Array* worksheet combines data files from two different instruments. Each location name has two prefixes – "PM:" and "Sound:". When you import studies, it is important that you select the proper prefix with the location.

The Test Results section includes a summary table that combines both the sound and PM measurements for each location. If you have added a target limit, the summary measurement will turn red if the target was exceeded. A column chart helps visually compares these measurements.

9	PM2.5 & Sound Level						
10							
11		**LCSmax Limit**	**Lcpeak Limit**	**Lceq Limit**		**Max PM2.5 Limit**	**Avg PM2.5 Limit**
12	**Upper Limits**						
13	**Location**	**LCSmax (dB)**	**LCpeak (dB)**	**LCeq (dB)**	**PM 2.5 Study**	**Max PM 2.5 (ug/m3)**	**Avg PM2.5 (ug/m3)**
14	NE Corner	75.6	88.5	67.3		1.	0.7
15	NW Corner	97.0	128.0	91.0		4.3	4.0
16	SE Corner	78.6	104.8	69.4		6.3	6.2
17	SW Corner	122.2	144.5	112.8		6.3	6.2
	Location 5	0.0	0.0	0.0		0.	

The particle number concentration is also shown in both tabular form and log-scale column chart.

56	**Max PM Number Concentration**

| Location	PM 0.3-0.5 (#/m3)	PM 0.5-1.0 (#/m3)	PM 1.0-2.5 (#/m3)	PM 2.5-4.0 (#/m3)	PM 4.0-10 (#/m3)
NE Corner	7,000,000	1,000,000	-	-	-
NW Corner	6,000,000	1,000,000	-	-	-
SE Corner	-	-	-	-	-
SW Corner	-	-	-	-	-
Location 5	-	-	-	-	-
Location 6	-	-	-	-	-
Location 7	-	-	-	-	-
Location 8	-	-	-	-	-
Location 9	-	-	-	-	-
Location 10	-	-	-	-	-

Max Particle Concentration

PM & VOC Array Analysis

The Test Results section includes a summary table that displays both Particulate Matter and VOC measurements. If you have added a target limit, the summary measurement will turn red if the target was exceeded. A column chart helps visually compares these measurements.

9	**VOC & PM2.5**						
	Target Names		Peak VOC Limit	Avg VOC Limit		Peak PM2.5 Limit	Avg PM2.5 Limit
	Target Limits		10			30	15
	Location	VOC Study	Max VOC (ppb)	Avg VOC (ppb)	PM 2.5 Study	Max PM 2.5 (ug/m3)	Avg PM2.5 (ug/m3)
14	Assembly		9.6	8.9		19.	3.5
15	Soldering Station		19.4	10.5		196.	47.7
16	Hallway		8.4	8.3		0.	0.0
17	Outdoor		8.3	8.3		0.	0.0
18	Location 5		0.			0.	

The particle number concentration is also shown in both tabular form and log-scale column chart.

56	**Max PM Number Concentration**					
57						
58	Location	PM 0.3-0.5 (#/m3)	PM 0.5-1.0 (#/m3)	PM 1.0-2.5 (#/m3)	PM 2.5-4.0 (#/m3)	PM 4.0-10 (#/m3)
59	Assembly	125,000,000	19,000,000	-	-	-
60	Soldering Station	1,264,000,000	202,000,000	26,000,000	5,000,000	1,000,000
61	Hallway	5,000,000	-	-	-	-
62	Outdoor	4,000,000	-	-	-	-
63	Location 5	-	-	-	-	-
64	Location 6	-	-	-	-	-
65	Location 7	-	-	-	-	-
66	Location 8	-	-	-	-	-
67	Location 9	-	-	-	-	-
68	Location 10	-	-	-	-	-

Max Particle Concentration

PM 2.5

VOC
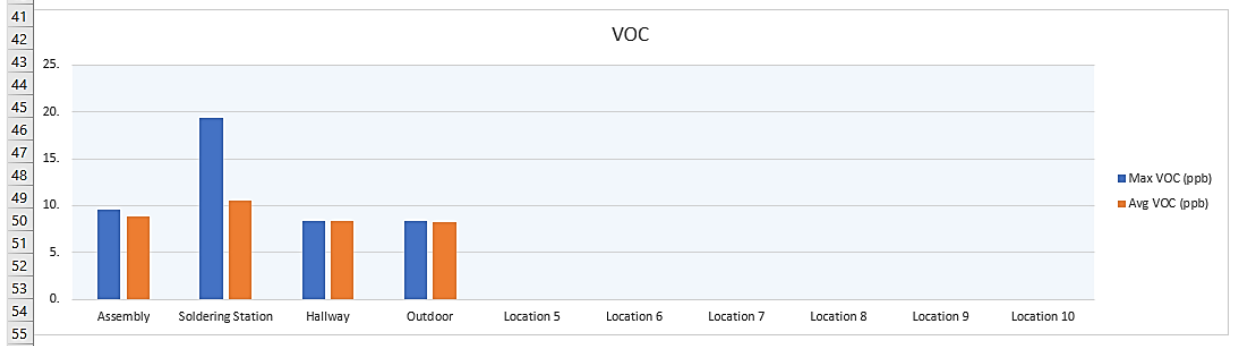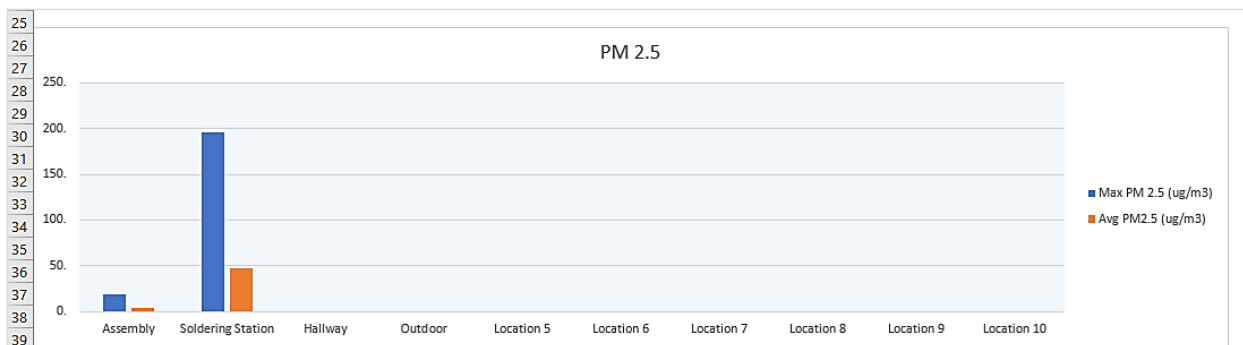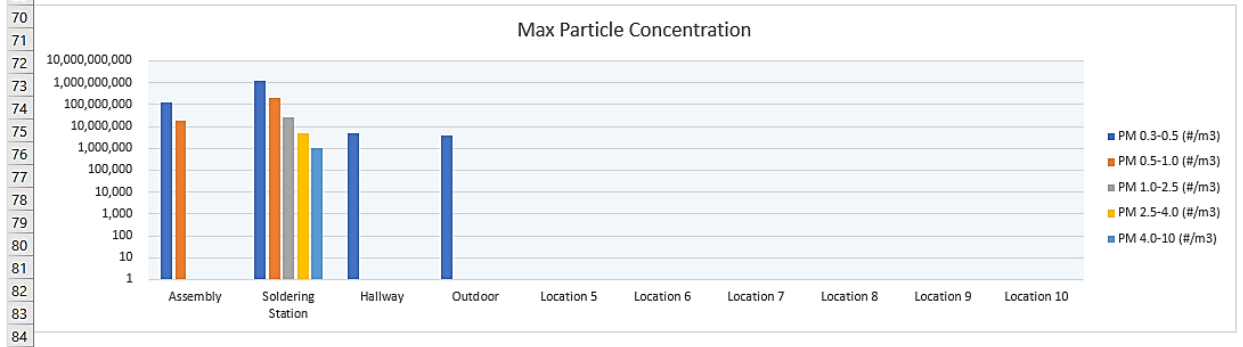
Sound Map Analysis

Two key sound level measurements are displayed in the table. These same measurements are displayed in a column chart below it. To help educate the work staff, a CDC-developed sound level guide is also shown.

Location	LCSmax (dB)	LCpeak (dB)
Drill Press	75.6	88.5
Stamping Machine	97.0	128.0
Lathe	78.6	104.8
Shredder	122.2	144.5
Location 5		
Location 6		
Location 7		
Location 8		
Location 9		
Location 10		
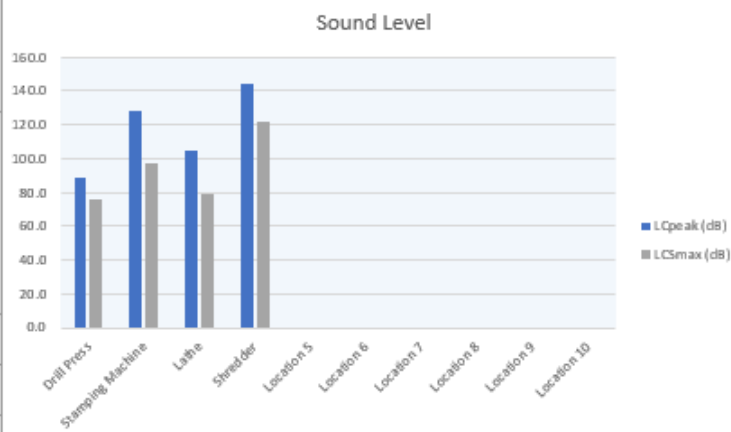
CDC Reference

Everyday Sounds	Average Sound Level (dB)	Typical Response (after routine or repeated exposure)
Softest sound that can be heard	0	Sounds at these dB levels typically don't cause any hearing damage
Normal breathing	10	
Ticking watch	20	
Soft whisper	30	
Refrigerator hum	40	
Normal conversation, air conditioner	60	
Washing machine, dishwasher	70	You may feel annoyed by the noise
City traffic (inside the car)	80–85	You may feel very annoyed
Gas-powered lawnmowers and leaf blowers	80–85	Damage to hearing possible after 2 hours of exposure
Motorcycle	95	Damage to hearing possible after about 50 minutes of exposure
Approaching subway train, car horn at 16 feet (5 meters), and sporting events (such as hockey playoffs and football games)	100	Hearing loss possible after 15 minutes
The maximum volume level for personal listening devices; a very loud radio, stereo, or television; and loud entertainment venues (such as nightclubs, bars, and rock concerts)	105–110	Hearing loss possible in less than 5 minutes
Shouting or barking in the ear	110	Hearing loss possible in less than 2 minutes
Standing beside or near sirens	120	Pain and ear injury
Firecrackers	140–150	Pain and ear injury

Sound Level

Layout View

You can now use the summary data created above and provide a spatial visualization of it. You can overlay any desired measurements onto a floorplan, photo, or other image. Click Layout View in Report Creator. Then click the **Add** icon.

The Layout View tool then opens. If you wish, you can change the default name of the picture. Then click **Import Image**. Navigate to the folder that contains your image and select it.

You now have to mark the measurement locations on your image. The first location in the list is automatically highlighted in blue. Click this location on the map. The Layout Tool advances to the next location. Repeat the location marking process until all locations are placed.

If you need to change a marked location, click the bubble annotation and drag it to the correct spot. (If you click the red X, that location will become unmarked.)

Now select which measurement you would like to display in your report. Also, if you wish to display the location names along with the measurement, check that box.

You can also add a label to any of the measurements by clicking the bubble annotation and expanding the location in the left column. Type in the label text.

When finished, click **DONE**.

A thumbnail of your image will now be displayed in Report Creator. To add it to the report, first click the destination cell in the worksheet that you want to place the image. Then hover over the thumbnail image in Report Creator and click **Insert**.

If you want to show additional measurement diagrams in your report, hover over the thumbnail and click **Edit**. Change the display value and click **DONE**. Click the destination cell in the worksheet and repeat the insertion process.
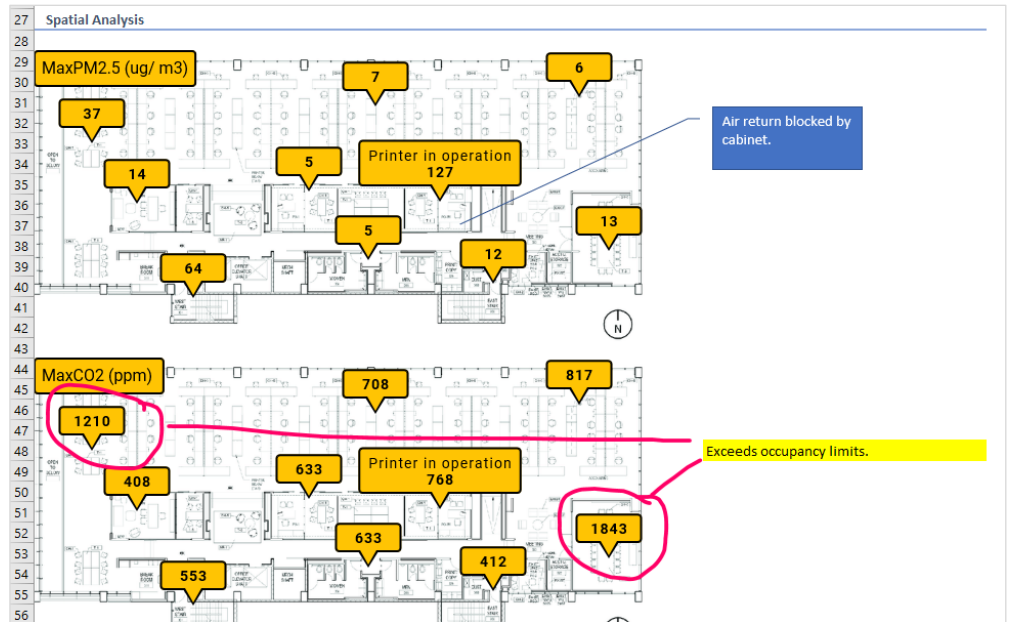
With your images inserted into the report, you can now add additional annotations using Excel's tools. You may find either of these tools useful:

1. Click **Insert** in the Excel® ribbon. Click the **Shapes** icon and select a callout. Drag and size the callout block. Move the pointer as desired and enter in the text.
2. Click **Draw** in the Excel® ribbon. Select the desired pen color. Circle areas of the image and draw lines to a cell. Add comments in the cell.

This is what the drawing tools produce:

Step 6 Complete the Assessment

To complete the report, you can add recommendations under the Conclusions section.

The print layout for this sheet does not include the measurement data in the blue tables at the bottom of the sheet. They will not appear in a PDF export either.

Appendix A – Configuration Sheet Parameters

Below is a list of the 69 parameters available for the configuration template. This large set of options provide extraordinary flexibility for your A-B analysis.

Parameter	Description	Units
PM1.0	PM 1.0 (ug/m^3)	MICROGRAMS_PER_CUBIC_METER
PM2.5	PM 2.5 (ug/m^3)	MICROGRAMS_PER_CUBIC_METER
PM4.0	PM 4.0 (ug/m^3)	MICROGRAMS_PER_CUBIC_METER
PM10	PM 10 (ug/m^3)	MICROGRAMS_PER_CUBIC_METER
PN0.5	NC 0.3 - 0.5 (#/m^3)	COUNT_PER_CUBIC_METER
PN1.0	NC 0.5 - 1.0 (#/m^3)	COUNT_PER_CUBIC_METER
PN2.5	NC 1.0 - 2.5 (#/m^3)	COUNT_PER_CUBIC_METER
PN4.0	NC 2.5 - 4.0 (#/m^3)	COUNT_PER_CUBIC_METER
PN10	NC 4.0 - 10 (#/m^3)	COUNT_PER_CUBIC_METER
CO_2	CO_2 (ppm)	PARTS_PER_MILLION
CH_2O	CH_2O (ppb)	PARTS_PER_BILLION
CO	CO (ppm)	PARTS_PER_MILLION
SO_2	SO_2 (ppb)	PARTS_PER_BILLION
Ozone	Ozone (ppb)	PARTS_PER_BILLION
NO_2	NO_2 (ppb)	PARTS_PER_BILLION
CL	CL (ppm)	PARTS_PER_MILLION
NH^3	NH^3 (ppm)	PARTS_PER_MILLION
VOC	VOC (ppb)	PARTS_PER_BILLION
LZSmax	LZSmax (dB)	DECIBELS
LZFmax	LZFmax (dB)	DECIBELS
LZImax	LZImax (dB)	DECIBELS
LZSmin	LZSmin (dB)	DECIBELS
LZFmin	LZFmin (dB)	DECIBELS
LZImin	LZImin (dB)	DECIBELS
LASmax	LASmax (dB)	DECIBELS
LAFmax	LAFmax (dB)	DECIBELS
LAImax	LAImax (dB)	DECIBELS
LASmin	LASmin (dB)	DECIBELS
LAFmin	LAFmin (dB)	DECIBELS
LAImin	LAImin (dB)	DECIBELS
LCSmax	LCSmax (dB)	DECIBELS
LCFmax	LCFmax (dB)	DECIBELS
LCImax	LCImax (dB)	DECIBELS
LCSmin	LCSmin (dB)	DECIBELS
LCFmin	LCFmin (dB)	DECIBELS
LCImin	LCImin (dB)	DECIBELS
LZeq	LZeq (dB)	DECIBELS
LZpeak	LZpeak (dB)	DECIBELS
LCeq	LCeq (dB)	DECIBELS
LCpeak	LCpeak (dB)	DECIBELS

Parameter	Description	Units
LAeq	LAeq (dB)	DECIBELS
LApeak	LApeak (dB)	DECIBELS
LZS	LZS (dB)	DECIBELS
LZF	LZF (dB)	DECIBELS
LZI	LZI (dB)	DECIBELS
LCS	LCS (dB)	DECIBELS
LCF	LCF (dB)	DECIBELS
LCI	LCI (dB)	DECIBELS
LAS	LAS (dB)	DECIBELS
LAF	LAF (dB)	DECIBELS
LAI	LAI (dB)	DECIBELS
LAIeq	LAIeq (dB)	DECIBELS
LAe	LAe (dB)	DECIBELS
LAeq t80	Laeq t80 (dB)	DECIBELS
LAft m3	LAft m3 (dB)	DECIBELS
LAft m5	LAft m5 (dB)	DECIBELS
LAit m3	LAit m3 (dB)	DECIBELS
LAit m5	LAit m5 (dB)	DECIBELS
Lavg1 t1nn q1n	Lavg1 t1nn q1n (dB)	DECIBELS
Lavg2 t2nn q2n	Lavg2 t2nn q2n (dB)	DECIBELS
LCeq-LAeq	LCeq-LAeq (dB)	DECIBELS
Lex 8hr	Lex 8hr (dB)	DECIBELS
Lep d	Lep d (dB)	DECIBELS
Proj Lex 8hr	Proj Lex 8hr (dB)	DECIBELS
Lroj lep d	Lroj lep d (dB)	DECIBELS
TWA 8hr	TWA 8hr (dB)	DECIBELS
Proj TWA 8hr	Proj TWA 8hr (dB)	DECIBELS
Dose %	Dose % (dB)	DECIBELS
Proj Dose %	Proj Dose % (dB)	DECIBELS