State of Wisconsin

HMA PWL Test Strip Spreadsheet Instruction Manual

2025 Edition

1. Disclaimer

This document is to be used as an instructive guide for the HMA PWL Test Strip Spreadsheet and to answer frequently asked questions of Regional Technical Services Section (TSS) and those acting as Department Representatives. It is not a substitute for reading and understanding HMA Pavement Percent Within Limits (PWL) specifications.

If there is a question about dispute resolution or data entry that is not covered in this document, please contact the Regional PWL Representative. If consulting BTS is recommended by this document or the HMA PWL Test Strip Spreadsheet, that contact should be made by TSS Staff.

The HMA PWL Test Strip Spreadsheet is designed to simplify the recording and analysis of contractor Quality Control (QC) and department Quality Verification (QV) data related to pavement density and air voids used for HMA test strip pay adjustment.

The Plans, Standard Specifications, and Special Provisions ALWAYS supersede this document, even in cases where this document may contradict those provisions.

2. Table of Contents

3. General

- A copy of this instruction manual is available within the PWL Test Strip Spreadsheet on the *Project Info & Instructions* worksheet. Simply double click the button "PWL Test Strip Manual" to access them from within the spreadsheet.

- The PWL Test Strip Spreadsheet should be filled out and completed by the Department Representative.

- The *Project Info & Instructions* worksheet must be filled out first prior to entering test results. Some worksheets will not appear until the required project information has been entered.

- Worksheets tab colors indicate the following:
    - Green – Worksheets that require test results to be entered.
    - Red – Worksheets that only present results; no data entry is required in these sheets.

- Cells that are canary/yellow colored are data entry fields.
    - It is essential that no blank spaces are entered in or after any of the information entered into the fields.
    - When copy/pasting, only use "Paste Values". If you use the hotkey combination, CTRL+V, values will be pasted automatically.

4. Project Info & Instructions

This is the main entry point for the PWL Test Strip Spreadsheet (Figure 1). It contains fields for information about the project as well as paving information such as the mix design and pavement layer and dimensions.

The canary/yellow fields on the *Project Info and Instructions* worksheet should be filled out completely by the Department Representative prior to beginning construction. Most of the fields in the *Project Info & Instructions* worksheet (i.e.: Contract Unit Price, Lane Width, Nominal Thickness, JMFs, etc.) are required for the worksheet to function correctly. The Test Strip Type (Combined Density and Volumetrics, Density-Only, and Volumetric-Only) must be selected to hide or reveal the correct worksheets for data entry. Project information used in all other worksheets within the spreadsheet are referenced from the *Project Info & Instructions* worksheet and can only be changed from this worksheet.

At the end of the Test Strip, the Department Representative must enter the Test Strip's Final Tonnage (cell C23) and Final Length (ft., cell C24). These final values are used for the pay adjustments.

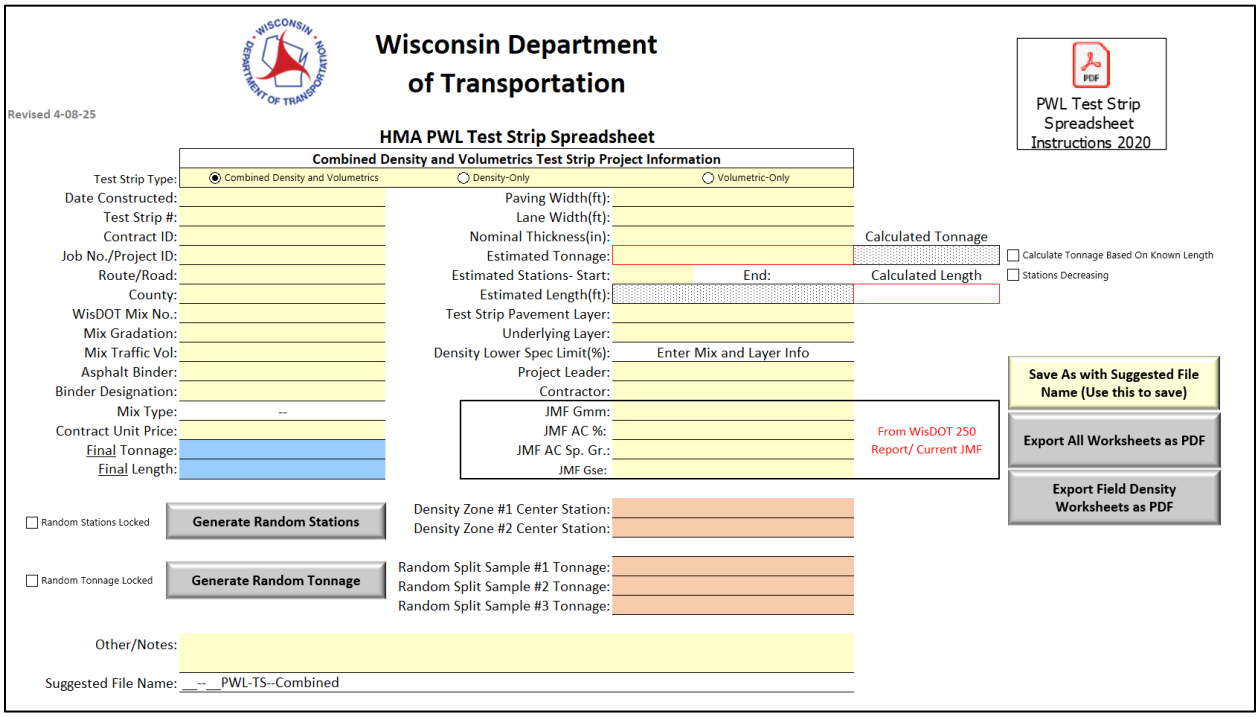
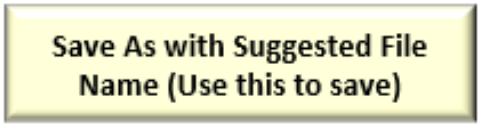


Figure 1: Project Info & Instructions Interface.

There are several buttons for worksheet functions found on the righthand side of the interface. The buttons perform the following functions:

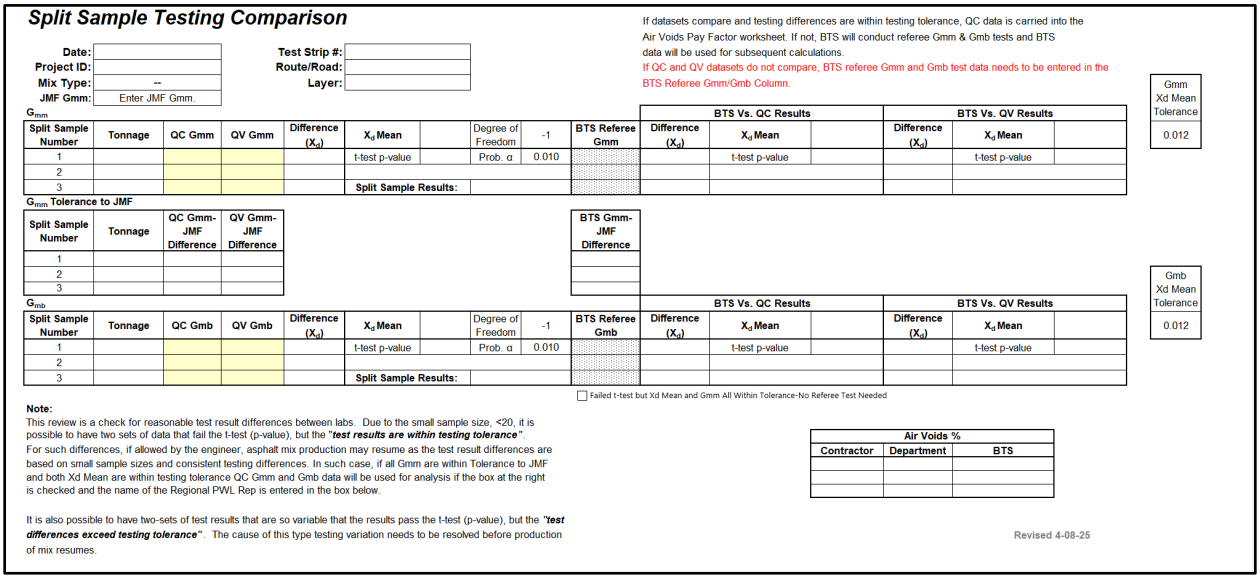
	• Saves the spreadsheet as a new Excel file (without overwriting old versions) with the suggested file name, including the date and time that the spreadsheet was saved. • This is the preferred method of saving the spreadsheet.
	• Exports the entire spreadsheet and its worksheets as a PDF.
	• Exports only the field density worksheets (QC-1, QC-2, QV-1, and QV-2 Density Worksheets) as a PDF. These can be printed and used in the field.

5. Split Sample Comparison

This worksheet only appears when either "Combined Density and Volumetrics" or "Volumetric-Only" is selected as the Test Strip Type on the *Project Info & Instruction* worksheet. This worksheet is used to enter the split samples' Gmm and Gmb results as well as the results of any dispute testing, if required. The split sample comparison is a check for reasonable test result differences between labs.

The Department Representative will enter the following information from the split sample comparison testing (Figure 2):

- QC Gmms
- QV Gmms
- QC Gmbs
- QV Gmbs
- BTS Referee Gmms (if required)
- BTS Referee Gmbs (if required)



Split Sample Testing Comparison

Date: | **Test Strip #:**
Project ID: | **Route/Road:**
Mix Type: -- | **Layer:**
JMF Gmm: Enter JMF Gmm.

If datasets compare and testing differences are within testing tolerance, QC data is carried into the Air Voids Pay Factor worksheet. If not, BTS will conduct referee Gmm & Gmb tests and BTS data will be used for subsequent calculations.
If QC and QV datasets do not compare, BTS referee Gmm and Gmb test data needs to be entered in the BTS Referee Gmm/Gmb Column.

G_{mm}

Split Sample Number	Tonnage	QC Gmm	QV Gmm	Difference (X_d)	X_d Mean		Degree of Freedom	-1	BTS Referee Gmm	BTS Vs. QC Results: Difference (X_d)	BTS Vs. QC Results: X_d Mean		BTS Vs. QV Results: Difference (X_d)	BTS Vs. QV Results: X_d Mean	
1					t-test p-value		Prob. α	0.010			t-test p-value			t-test p-value	
2															
3					Split Sample Results:										

Gmm Xd Mean Tolerance: 0.012

G_{mm} Tolerance to JMF

Split Sample Number	Tonnage	QC Gmm-JMF Difference	QV Gmm-JMF Difference	BTS Gmm-JMF Difference
1				
2				
3				

G_{mb}

Split Sample Number	Tonnage	QC Gmb	QV Gmb	Difference (X_d)	X_d Mean		Degree of Freedom	-1	BTS Referee Gmb	BTS Vs. QC Results: Difference (X_d)	BTS Vs. QC Results: X_d Mean		BTS Vs. QV Results: Difference (X_d)	BTS Vs. QV Results: X_d Mean	
1					t-test p-value		Prob. α	0.010			t-test p-value			t-test p-value	
2															
3					Split Sample Results:										

Gmb Xd Mean Tolerance: 0.012

☐ Failed t-test but Xd Mean and Gmm All Within Tolerance-No Referee Test Needed

Note:
This review is a check for reasonable test result differences between labs. Due to the small sample size, <20, it is possible to have two sets of data that fail the t-test (p-value), but the "***test results are within testing tolerance***". For such differences, if allowed by the engineer, asphalt mix production may resume as the test result differences are based on small sample sizes and consistent testing differences. In such case, if all Gmm are within Tolerance to JMF and both Xd Mean are within testing tolerance QC Gmm and Gmb data will be used for analysis if the box at the right is checked and the name of the Regional PWL Rep is entered in the box below.

It is also possible to have two-sets of test results that are so variable that the results pass the t-test (p-value), but the "***test differences exceed testing tolerance***". The cause of this type testing variation needs to be resolved before production of mix resumes.

Air Voids %		
Contractor	Department	BTS

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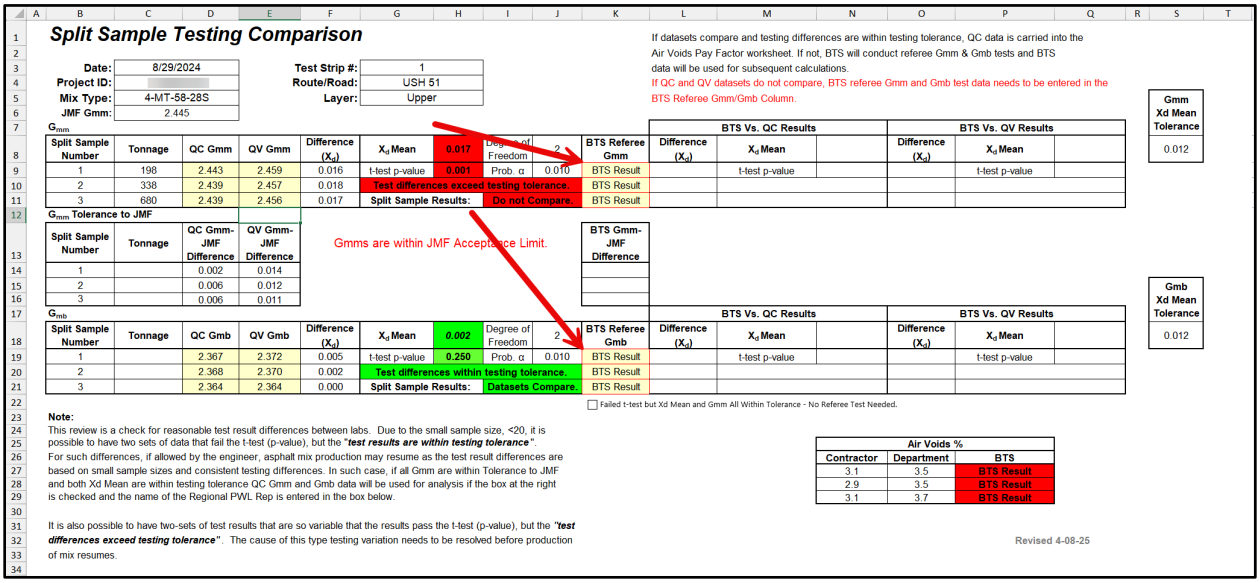
Figure 2: Split Sample Comparison data entry fields.

This worksheet checks for four (4) conditions to be met:

1. The paired t-test p-value for both Gmm and Gmb must be greater than alpha (0.010).
2. The Gmms for all parties must not be more than ± 0.024 from the JMF Gmm.
3. The Average Difference (X_d Mean) between both QC and QV Gmms and Gmbs must be less than or equal to 0.012.
4. Individual QC and QV air voids tests must meet the acceptance limits (1.5% ≤ Va ≤ 5.0%).

Notes:

- BTS Referee Testing is only required if Condition 1 AND 3 are NOT MET, OR Condition 4 is NOT MET.
    - In the event BTS Referee testing is required, the BTS Referee cells (column K) will change to a canary/yellow color and say “BTS Result”. Enter the results of the BTS Referee testing in these cells (Figure 3).
- If Condition 1 is NOT MET but Condition 3 IS MET, then no BTS referee testing is required.
    - In the event this situation occurs. Select the checkbox next to *Failed t-test but Xd Mean and Gmm All Within Tolerance – No Referee Test Needed* and enter the Regional PWL Representative Name that reviewed and approved the results in the field that appears below the check box (Figure 4).



Split Sample Testing Comparison

Date: 8/29/2024 | Test Strip #: 1
Project ID: | Route/Road: USH 51
Mix Type: 4-MT-58-28S | Layer: Upper
JMF Gmm: 2.445

If datasets compare and testing differences are within testing tolerance, QC data is carried into the Air Voids Pay Factor worksheet. If not, BTS will conduct referee Gmm & Gmb tests and BTS data will be used for subsequent calculations.
If QC and QV datasets do not compare, BTS referee Gmm and Gmb test data needs to be entered in the BTS Referee Gmm/Gmb Column.

G_{mm}

Split Sample Number	Tonnage	QC Gmm	QV Gmm	Difference (X_d)	X_d Mean	0.017	Degree of Freedom	2	BTS Referee Gmm	BTS Vs. QC Results: Difference (X_d)	BTS Vs. QC Results: X_d Mean	BTS Vs. QV Results: Difference (X_d)	BTS Vs. QV Results: X_d Mean
1	198	2.443	2.459	0.016	t-test p-value	0.001	Prob. α	0.010	BTS Result		t-test p-value		t-test p-value
2	338	2.439	2.457	0.018	Test differences exceed testing tolerance.				BTS Result				
3	680	2.439	2.456	0.017	Split Sample Results:	Do Not Compare.			BTS Result				

Gmm Xd Mean Tolerance: 0.012

G_{mm} Tolerance to JMF

Split Sample Number	Tonnage	QC Gmm-JMF Difference	QV Gmm-JMF Difference
1		0.002	0.014
2		0.006	0.012
3		0.006	0.011

Gmms are within JMF Acceptance Limit.

BTS Gmm-JMF Difference

G_{mb}

Split Sample Number	Tonnage	QC Gmb	QV Gmb	Difference (X_d)	X_d Mean	0.002	Degree of Freedom	2	BTS Referee Gmb	BTS Vs. QC Results: Difference (X_d)	BTS Vs. QC Results: X_d Mean	BTS Vs. QV Results: Difference (X_d)	BTS Vs. QV Results: X_d Mean
1		2.367	2.372	0.005	t-test p-value	0.250	Prob. α	0.010	BTS Result		t-test p-value		t-test p-value
2		2.368	2.370	0.002	Test differences within testing tolerance.				BTS Result				
3		2.364	2.364	0.000	Split Sample Results:	Datasets Compare.			BTS Result				

Gmb Xd Mean Tolerance: 0.012

☐ Failed t-test but Xd Mean and Gmm All Within Tolerance - No Referee Test Needed.

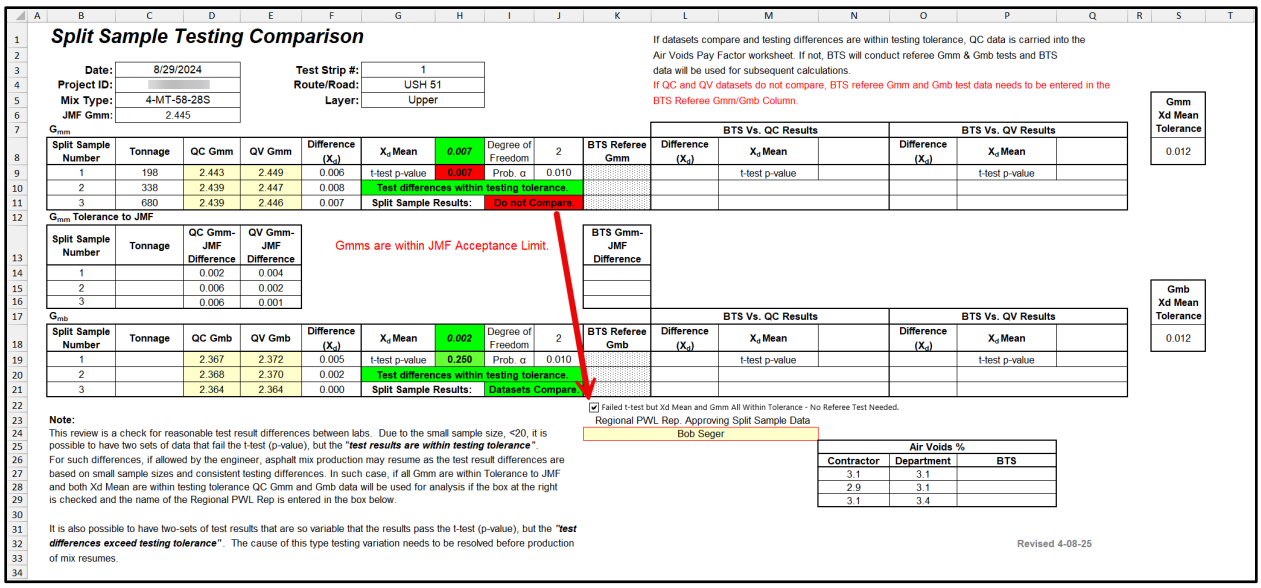
Note:
This review is a check for reasonable test result differences between labs. Due to the small sample size, <20, it is possible to have two sets of data that fail the t-test (p-value), but the ***"test results are within testing tolerance"***. For such differences, if allowed by the engineer, asphalt mix production may resume as the test result differences are based on small sample sizes and consistent testing differences. In such case, if all Gmm are within Tolerance to JMF and both Xd Mean are within testing tolerance QC Gmm and Gmb data will be used for analysis if the box at the right is checked and the name of the Regional PWL Rep is entered in the box below.

It is also possible to have two-sets of test results that are so variable that the results pass the t-test (p-value), but the ***"test differences exceed testing tolerance"***. The cause of this type testing variation needs to be resolved before production of mix resumes.

Air Voids %		
Contractor	Department	BTS
3.1	3.5	BTS Result
2.9	3.5	BTS Result
3.1	3.7	BTS Result

Revised 4-08-25

Figure 3: Failed t-test and Xd Mean.



Split Sample Testing Comparison

Date:	8/29/2024
Project ID:	
Mix Type:	4-MT-58-28S
JMF Gmm:	2.445
Test Strip #:	1
Route/Road:	USH 51
Layer:	Upper

If datasets compare and testing differences are within testing tolerance, QC data is carried into the Air Voids Pay Factor worksheet. If not, BTS will conduct referee Gmm & Gmb tests and BTS data will be used for subsequent calculations.
If QC and QV datasets do not compare, BTS referee Gmm and Gmb test data needs to be entered in the BTS Referee Gmm/Gmb Column.

G_{mm}

Split Sample Number	Tonnage	QC Gmm	QV Gmm	Difference (X_d)	X_d Mean	0.007	Degree of Freedom	2	BTS Referee Gmm	BTS Vs. QC Results: Difference (X_d)	BTS Vs. QC Results: X_d Mean	BTS Vs. QC Results	BTS Vs. QV Results: Difference (X_d)	BTS Vs. QV Results: X_d Mean	BTS Vs. QV Results
1	198	2.443	2.449	0.006	t-test p-value	0.007	Prob. α	0.010			t-test p-value			t-test p-value	
2	338	2.439	2.447	0.008	Test differences within testing tolerance.										
3	680	2.439	2.446	0.007	Split Sample Results:	Do not Compare.									

Gmm Xd Mean Tolerance: 0.012

G_{mm} Tolerance to JMF

Split Sample Number	Tonnage	QC Gmm-JMF Difference	QV Gmm-JMF Difference
1		0.002	0.004
2		0.006	0.002
3		0.006	0.001

Gmms are within JMF Acceptance Limit.

BTS Gmm-JMF Difference

G_{mb}

Split Sample Number	Tonnage	QC Gmb	QV Gmb	Difference (X_d)	X_d Mean	0.002	Degree of Freedom	2	BTS Referee Gmb	BTS Vs. QC Results: Difference (X_d)	BTS Vs. QC Results: X_d Mean	BTS Vs. QC Results	BTS Vs. QV Results: Difference (X_d)	BTS Vs. QV Results: X_d Mean	BTS Vs. QV Results
1		2.367	2.372	0.005	t-test p-value	0.250	Prob. α	0.010			t-test p-value			t-test p-value	
2		2.368	2.370	0.002	Test differences within testing tolerance.										
3		2.364	2.364	0.000	Split Sample Results:	Datasets Compare.									

Gmb Xd Mean Tolerance: 0.012

☑ Failed t-test but Xd Mean and Gmm All Within Tolerance - No Referee Test Needed.

Regional PWL Rep. Approving Split Sample Data: Bob Seger

Air Voids %		
Contractor	Department	BTS
3.1	3.1	
2.9	3.1	
3.1	3.4	

Note:
This review is a check for reasonable test result differences between labs. Due to the small sample size, <20, it is possible to have two sets of data that fail the t-test (p-value), but the ***"test results are within testing tolerance"***. For such differences, if allowed by the engineer, asphalt mix production may resume as the test result differences are based on small sample sizes and consistent testing differences. In such case, if all Gmm are within Tolerance to JMF and both Xd Mean are within testing tolerance QC Gmm and Gmb data will be used for analysis if the box at the right is checked and the name of the Regional PWL Rep is entered in the box below.

It is also possible to have two-sets of test results that are so variable that the results pass the t-test (p-value), but the ***"test differences exceed testing tolerance"***. The cause of this type testing variation needs to be resolved before production of mix resumes.

Revised 4-08-25

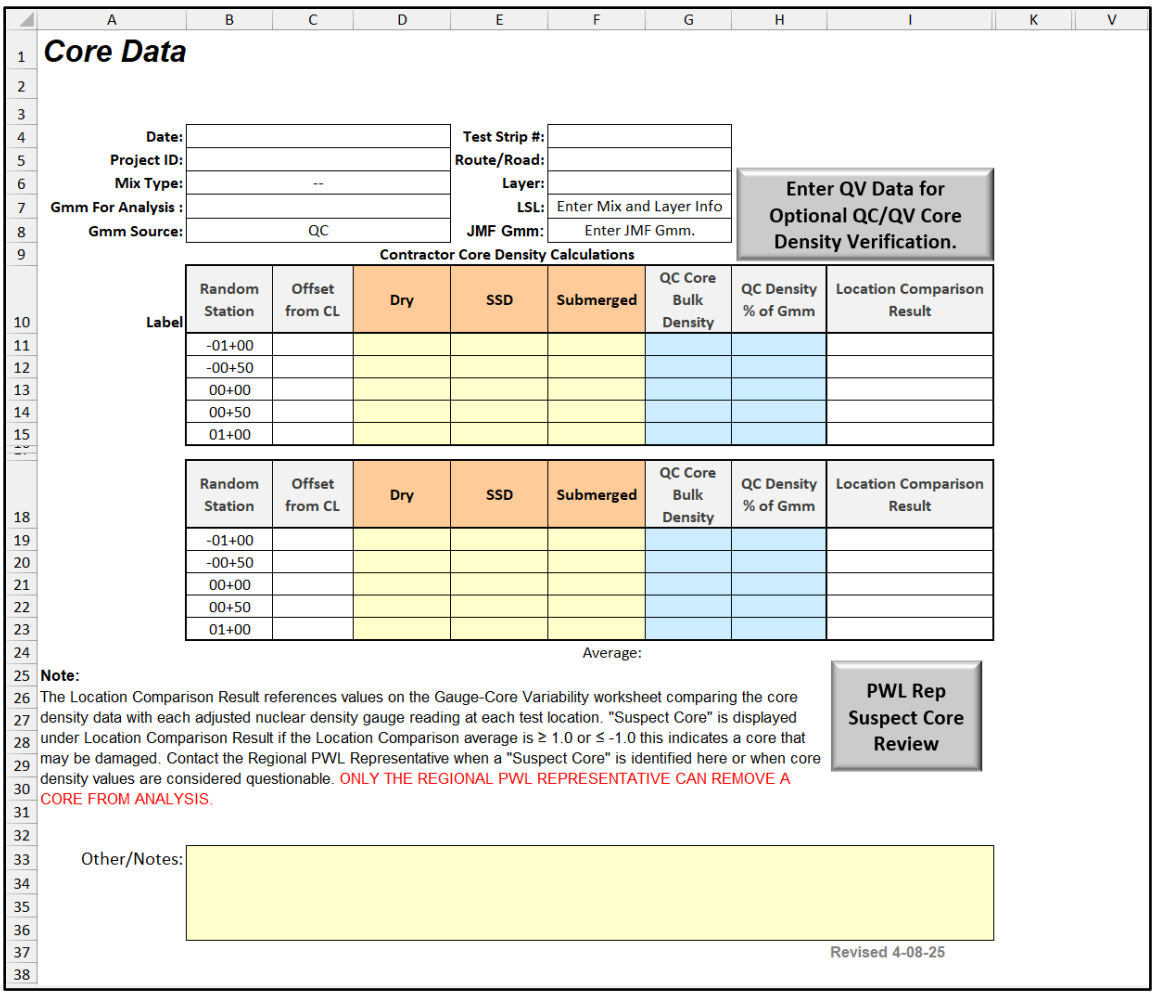
Figure 4: Failed t-test but Xd Mean and Gmm All Within Tolerance.

6. Core Data

This worksheet only appears when either "Combined Density and Volumetrics" (Figure 5) or "Density-Only" is selected as the Test Strip Type on the *Project Info & Instruction* worksheet. This worksheet is used to enter the mainline density test results obtained by cores.

The Department Representative will enter the following information from the core density testing:

- Contractor Dry Weight (g)
- Contractor SSD Weight (g)
- Contractor Submerged Weight (g)
- Department Dry Weight (g) (if performed)
- Department SSD Weight (g) (if performed)
- Department Submerged Weight (g) (if performed)
- QC or QV Core Data Used For Analysis (option available when Department enters optional core verification results)
- Suspect Core Removal (if needed)
- Daily Average Gmm for Density-Only Test Strip Analysis (Density-Only Test Strip, Figure 6)
- PWL Production Gmm OR Non-Random Dept. Gmm collected during Density-Only Test Strip (Density-Only Test Strip, Figure 6)



Core Data

Date:		Test Strip #:		
Project ID:		Route/Road:		
Mix Type:	--	Layer:		
Gmm For Analysis :		LSL:	Enter Mix and Layer Info	
Gmm Source:	QC	JMF Gmm:	Enter JMF Gmm.	

Enter QV Data for Optional QC/QV Core Density Verification.

Contractor Core Density Calculations

Label	Random Station	Offset from CL	Dry	SSD	Submerged	QC Core Bulk Density	QC Density % of Gmm	Location Comparison Result
	-01+00							
	-00+50							
	00+00							
	00+50							
	01+00							

Random Station	Offset from CL	Dry	SSD	Submerged	QC Core Bulk Density	QC Density % of Gmm	Location Comparison Result
-01+00							
-00+50							
00+00							
00+50							
01+00							

Average:

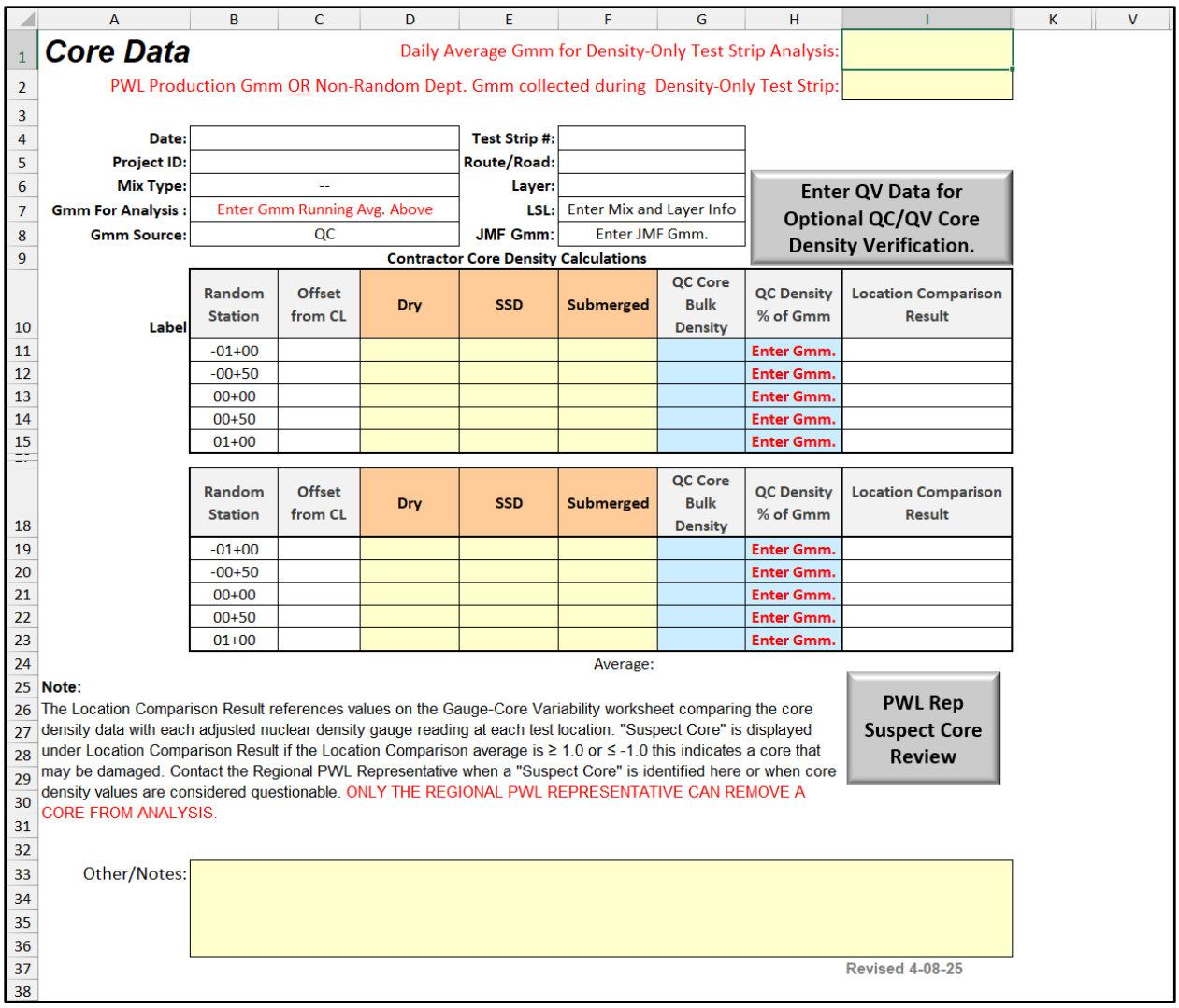
Note:
The Location Comparison Result references values on the Gauge-Core Variability worksheet comparing the core density data with each adjusted nuclear density gauge reading at each test location. "Suspect Core" is displayed under Location Comparison Result if the Location Comparison average is ≥ 1.0 or ≤ -1.0 this indicates a core that may be damaged. Contact the Regional PWL Representative when a "Suspect Core" is identified here or when core density values are considered questionable. ONLY THE REGIONAL PWL REPRESENTATIVE CAN REMOVE A CORE FROM ANALYSIS.

PWL Rep Suspect Core Review

Other/Notes:

Revised 4-08-25

Figure 5: Core Data Fields for a Combined Volumetric and Density Test Strip.



Core Data

Daily Average Gmm for Density-Only Test Strip Analysis:

PWL Production Gmm OR Non-Random Dept. Gmm collected during Density-Only Test Strip:

Date:		Test Strip #:	
Project ID:		Route/Road:	
Mix Type:	--	Layer:	
Gmm For Analysis :	Enter Gmm Running Avg. Above	LSL:	Enter Mix and Layer Info
Gmm Source:	QC	JMF Gmm:	Enter JMF Gmm.

Enter QV Data for Optional QC/QV Core Density Verification.

Contractor Core Density Calculations

Label	Random Station	Offset from CL	Dry	SSD	Submerged	QC Core Bulk Density	QC Density % of Gmm	Location Comparison Result
	-01+00						Enter Gmm.	
	-00+50						Enter Gmm.	
	00+00						Enter Gmm.	
	00+50						Enter Gmm.	
	01+00						Enter Gmm.	

Random Station	Offset from CL	Dry	SSD	Submerged	QC Core Bulk Density	QC Density % of Gmm	Location Comparison Result
-01+00						Enter Gmm.	
-00+50						Enter Gmm.	
00+00						Enter Gmm.	
00+50						Enter Gmm.	
01+00						Enter Gmm.	

Average:

Note:
The Location Comparison Result references values on the Gauge-Core Variability worksheet comparing the core density data with each adjusted nuclear density gauge reading at each test location. "Suspect Core" is displayed under Location Comparison Result if the Location Comparison average is ≥ 1.0 or ≤ -1.0 this indicates a core that may be damaged. Contact the Regional PWL Representative when a "Suspect Core" is identified here or when core density values are considered questionable. ONLY THE REGIONAL PWL REPRESENTATIVE CAN REMOVE A CORE FROM ANALYSIS.

PWL Rep Suspect Core Review

Other/Notes:

Revised 4-08-25

Figure 6: Core Data Fields for a Density-Only Test Strip.

The department may decide to perform optional density verification of the contractor's results. If the department performs this testing, the results can be entered by pressing the

button to reveal the data entry fields (Figure 7). Additionally, the Department Representative, at their discretion, can select which data set, QC or QV, to use for acceptance, pay adjustment, and nuclear gauge correlation.

Notes:

- It is recommended to use QV results for analysis if the *Difference in Average % Density* (cell U24) is more than 0.5%.

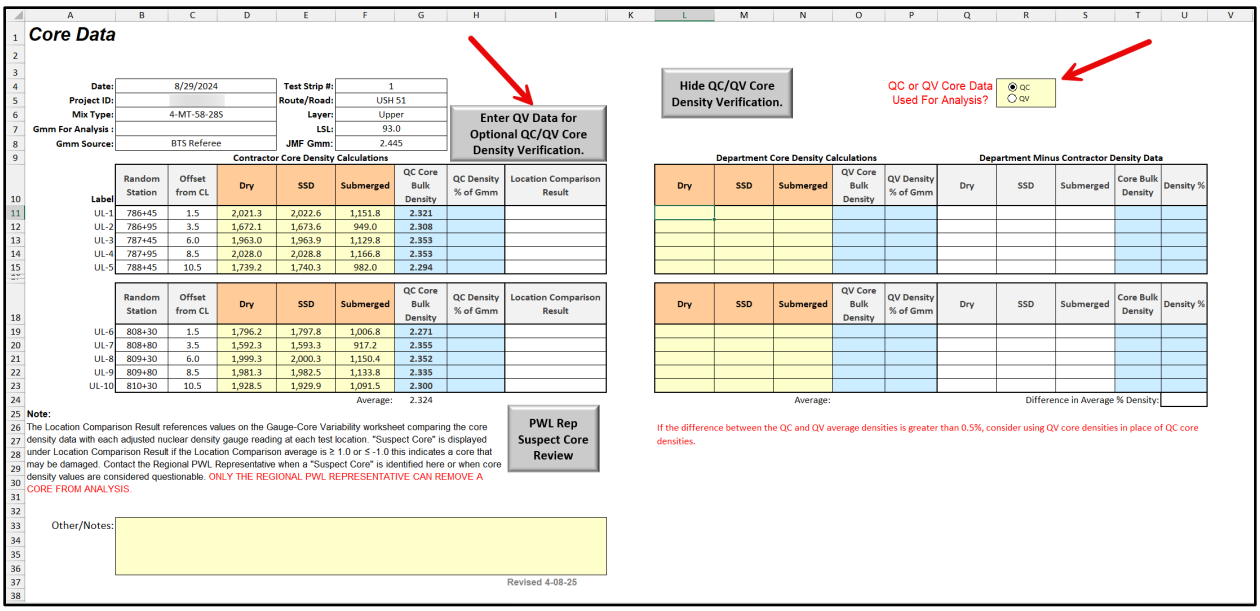
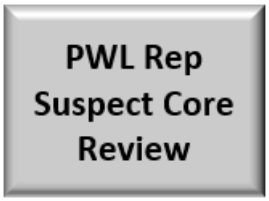


Figure 7: Optional Department Verification of Cores.

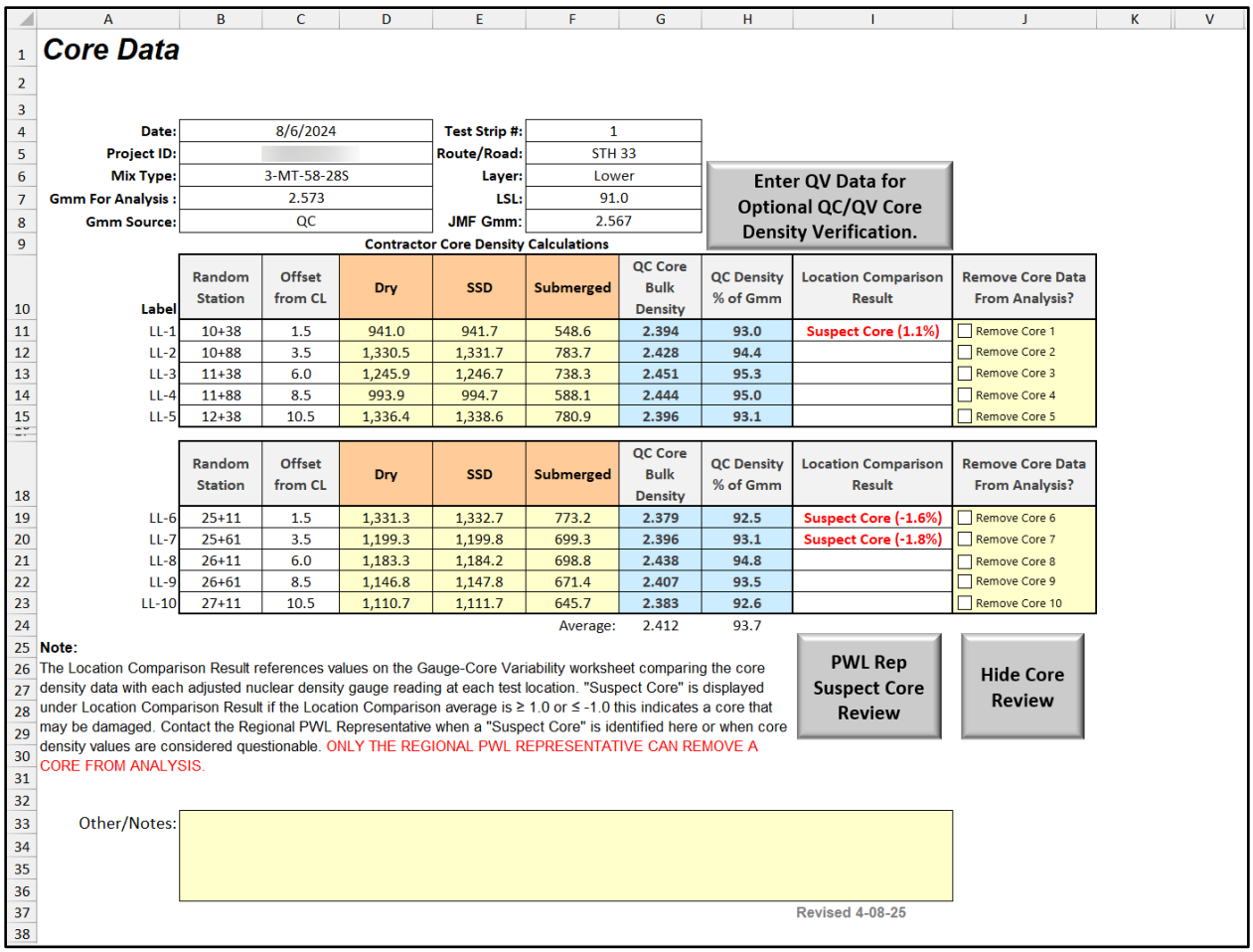
Notes regarding the testing can be entered at the bottom of the worksheet in the provided field found in the range of cells (B33:I36).

After this worksheet and the QC and QV density worksheets have been filled out, the *Gauge-Core Variability* worksheet may flag some cores as suspect (further discussed in section 12. Gauge-Core Variability). In the event cores have been flagged suspect, the *Location Comparison Result* next to the applicable core will say "Suspect Core (X.X%)" (where X.X will be the average location comparison result). The Department Representative may remove suspect cores from the analysis by clicking the 

button. This will reveal the options to remove the suspect cores (Figure 8). Simply click the checkbox next to the suspect cores to remove them from the analysis.

Notes:

- Remove suspect cores starting with the core with the largest *Location Comparison Average*. Sometimes not all the cores that were originally flagged will remain flagged once the core with the largest *Location Comparison Average* is removed. This information will also appear in a pop-up when the PWL Rep Suspect Core Review button is pressed.



Core Data

Date:	8/6/2024	**Test Strip #:**	1	
Project ID:		**Route/Road:**	STH 33	
Mix Type:	3-MT-58-28S	**Layer:**	Lower	Enter QV Data for Optional QC/QV Core Density Verification.
Gmm For Analysis :	2.573	**LSL:**	91.0	
Gmm Source:	QC	**JMF Gmm:**	2.567	

Contractor Core Density Calculations

Label	Random Station	Offset from CL	Dry	SSD	Submerged	QC Core Bulk Density	QC Density % of Gmm	Location Comparison Result	Remove Core Data From Analysis?
LL-1	10+38	1.5	941.0	941.7	548.6	2.394	93.0	Suspect Core (1.1%)	☐ Remove Core 1
LL-2	10+88	3.5	1,330.5	1,331.7	783.7	2.428	94.4		☐ Remove Core 2
LL-3	11+38	6.0	1,245.9	1,246.7	738.3	2.451	95.3		☐ Remove Core 3
LL-4	11+88	8.5	993.9	994.7	588.1	2.444	95.0		☐ Remove Core 4
LL-5	12+38	10.5	1,336.4	1,338.6	780.9	2.396	93.1		☐ Remove Core 5

Label	Random Station	Offset from CL	Dry	SSD	Submerged	QC Core Bulk Density	QC Density % of Gmm	Location Comparison Result	Remove Core Data From Analysis?
LL-6	25+11	1.5	1,331.3	1,332.7	773.2	2.379	92.5	Suspect Core (-1.6%)	☐ Remove Core 6
LL-7	25+61	3.5	1,199.3	1,199.8	699.3	2.396	93.1	Suspect Core (-1.8%)	☐ Remove Core 7
LL-8	26+11	6.0	1,183.3	1,184.2	698.8	2.438	94.8		☐ Remove Core 8
LL-9	26+61	8.5	1,146.8	1,147.8	671.4	2.407	93.5		☐ Remove Core 9
LL-10	27+11	10.5	1,110.7	1,111.7	645.7	2.383	92.6		☐ Remove Core 10
					Average:	2.412	93.7		

Note:
The Location Comparison Result references values on the Gauge-Core Variability worksheet comparing the core density data with each adjusted nuclear density gauge reading at each test location. "Suspect Core" is displayed under Location Comparison Result if the Location Comparison average is ≥ 1.0 or ≤ -1.0 this indicates a core that may be damaged. Contact the Regional PWL Representative when a "Suspect Core" is identified here or when core density values are considered questionable. ONLY THE REGIONAL PWL REPRESENTATIVE CAN REMOVE A CORE FROM ANALYSIS.

PWL Rep Suspect Core Review

Hide Core Review

Other/Notes:

Revised 4-08-25

Figure 8: Suspect Core Review Interface.

7. AC % Data

This worksheet only appears when either "Combined Density and Volumetrics" or "Volumetric-Only" is selected as the Test Strip Type on the *Project Info & Instruction* worksheet. This worksheet is used to enter the results of the asphalt content testing.

The Department Representative will enter the following information from the asphalt content testing ():

- QC AC%
- QV AC%
- BTS Referee AC% (if required)

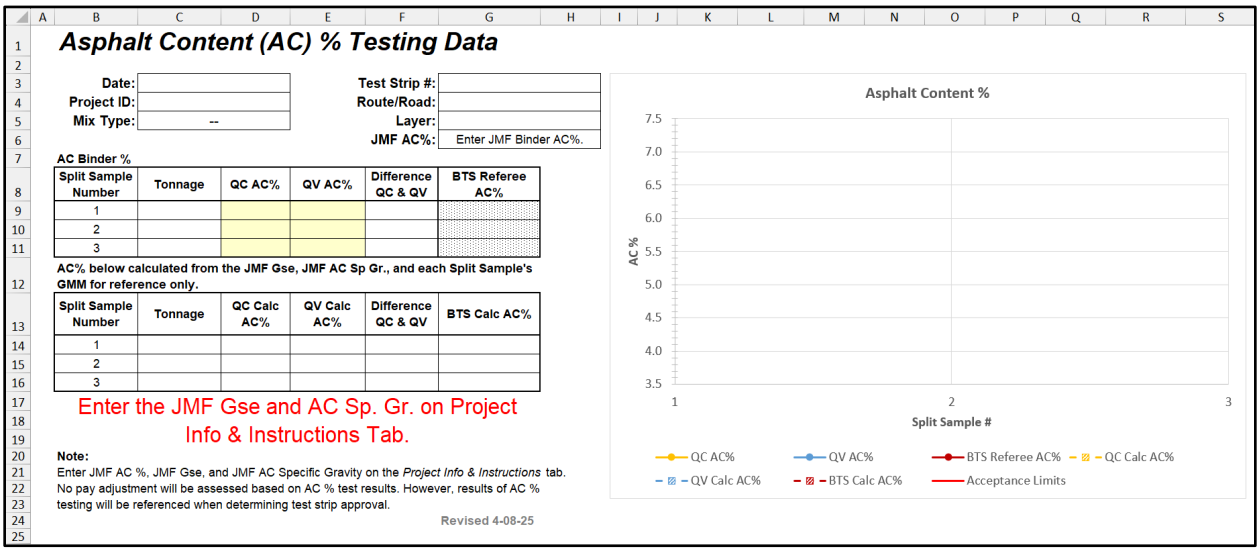
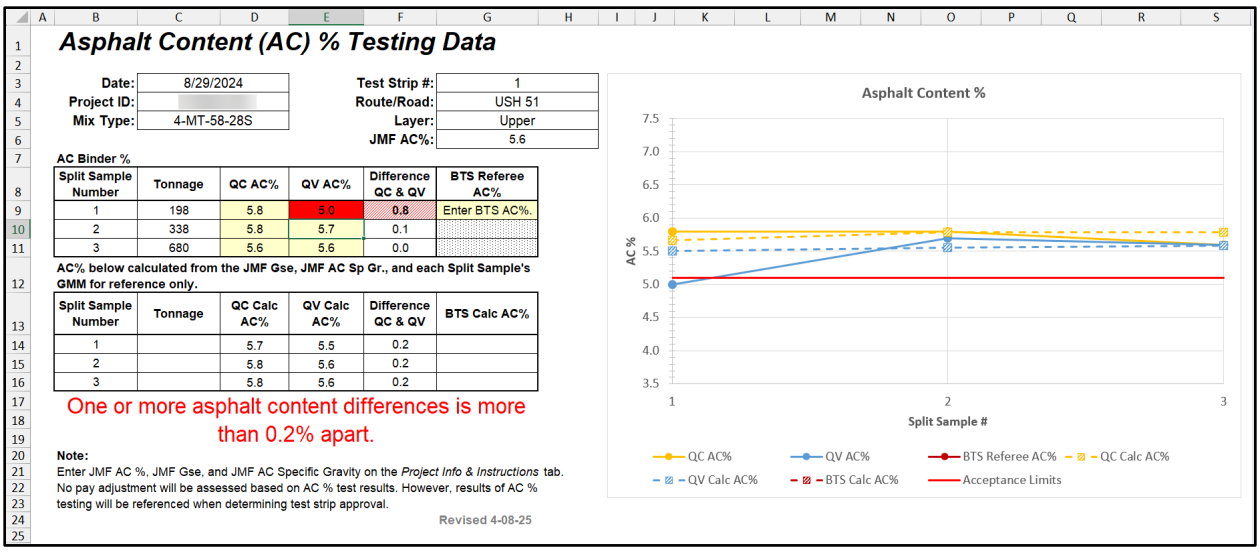


Figure 9: AC% Data Fields.

In the event there are unacceptable individual asphalt contents, then the corresponding BTS Referee AC% cell(s) will turn canary/yellow and will say "Enter BTS AC%." Enter the results of the BTS Referee Testing in the corresponding cell(s). (Figure 10)

In the event the *Split Sample Comparison* requires BTS Referee Testing, all of the BTS Referee AC% cells will turn canary/yellow and will say "Enter BTS AC%." Enter the results of the BTS Referee Testing in the corresponding cells. (Figure 11)



Asphalt Content (AC) % Testing Data

Date:	8/29/2024
Project ID:	
Mix Type:	4-MT-58-28S
Test Strip #:	1
Route/Road:	USH 51
Layer:	Upper
JMF AC%:	5.6

AC Binder %

Split Sample Number	Tonnage	QC AC%	QV AC%	Difference QC & QV	BTS Referee AC%
1	198	5.8	5.0	0.8	Enter BTS AC%.
2	338	5.8	5.7	0.1	
3	680	5.6	5.6	0.0	

AC% below calculated from the JMF Gse, JMF AC Sp Gr., and each Split Sample's GMM for reference only.

Split Sample Number	Tonnage	QC Calc AC%	QV Calc AC%	Difference QC & QV	BTS Calc AC%
1		5.7	5.5	0.2	
2		5.8	5.6	0.2	
3		5.8	5.6	0.2	

One or more asphalt content differences is more than 0.2% apart.

Note:
Enter JMF AC %, JMF Gse, and JMF AC Specific Gravity on the *Project Info & Instructions* tab.
No pay adjustment will be assessed based on AC % test results. However, results of AC % testing will be referenced when determining test strip approval.

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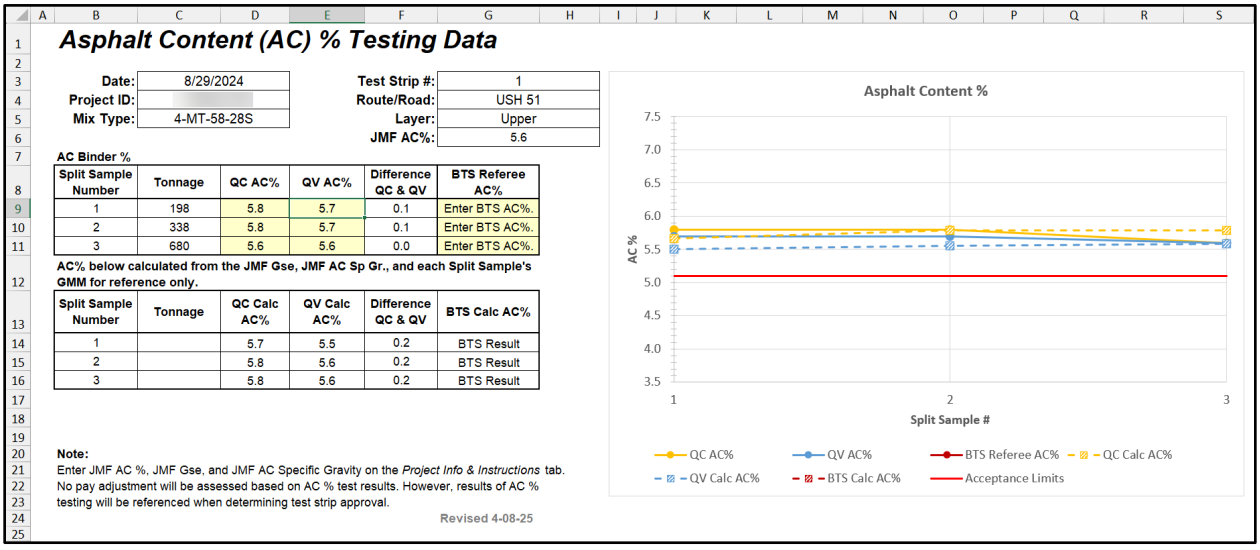
Figure 10: Individual Unacceptable Asphalt Contents.



Asphalt Content (AC) % Testing Data

Date:	8/29/2024
Project ID:	
Mix Type:	4-MT-58-28S
Test Strip #:	1
Route/Road:	USH 51
Layer:	Upper
JMF AC%:	5.6

AC Binder %

Split Sample Number	Tonnage	QC AC%	QV AC%	Difference QC & QV	BTS Referee AC%
1	198	5.8	5.7	0.1	Enter BTS AC%.
2	338	5.8	5.7	0.1	Enter BTS AC%.
3	680	5.6	5.6	0.0	Enter BTS AC%.

AC% below calculated from the JMF Gse, JMF AC Sp Gr., and each Split Sample's GMM for reference only.

Split Sample Number	Tonnage	QC Calc AC%	QV Calc AC%	Difference QC & QV	BTS Calc AC%
1		5.7	5.5	0.2	BTS Result
2		5.8	5.6	0.2	BTS Result
3		5.8	5.6	0.2	BTS Result

Note:
Enter JMF AC %, JMF Gse, and JMF AC Specific Gravity on the *Project Info & Instructions* tab.
No pay adjustment will be assessed based on AC % test results. However, results of AC % testing will be referenced when determining test strip approval.

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Figure 11: Split Sample Comparison Requires BTS Referee Testing.

Additionally, the table below the data entry table shows calculated asphalt contents that are calculated using each party's Gmm in the following equation:

$$Calculated\ AC\ (\%) = 100 * \frac{G_{AC,JMF}}{G_{mm,x}} * \frac{G_{se,JMF} - G_{mm,x}}{G_{se,JMF} - G_{AC,JMF}}$$

Where:

$$G_{AC,JMF} = Asphalt\ Cement\ JMF\ Specific\ Gravity$$

$$G_{se,JMF} = JMF\ Effective\ Stone\ Specific\ Gravity$$

$$G_{mm,x} = Measured\ Gmm\ for\ Split\ Sample\ X\ (QC\ or\ QV)$$

Individually measured asphalt contents and calculated asphalted contents for both parties as well as the acceptance limits are drawn on the chart to the right of the data entry fields. Measured values are shown in solid-colored lines and markers, where QC values are yellow, QV values are blue, and BTS Referee values are Red. Calculated values for each party are also plotted using the same colors as measured values but using dashed lines and hashed markers instead.

8. Mix Acceptance

This worksheet only appears when either "Combined Density and Volumetrics" or "Volumetric-Only" is selected as the Test Strip Type on the *Project Info & Instruction* worksheet. This worksheet is used to accept the mixture split sample gradations and VMAs.

The Department Representative will check the box for each measured property that meets the acceptance limits for each split sample (Figure 12).

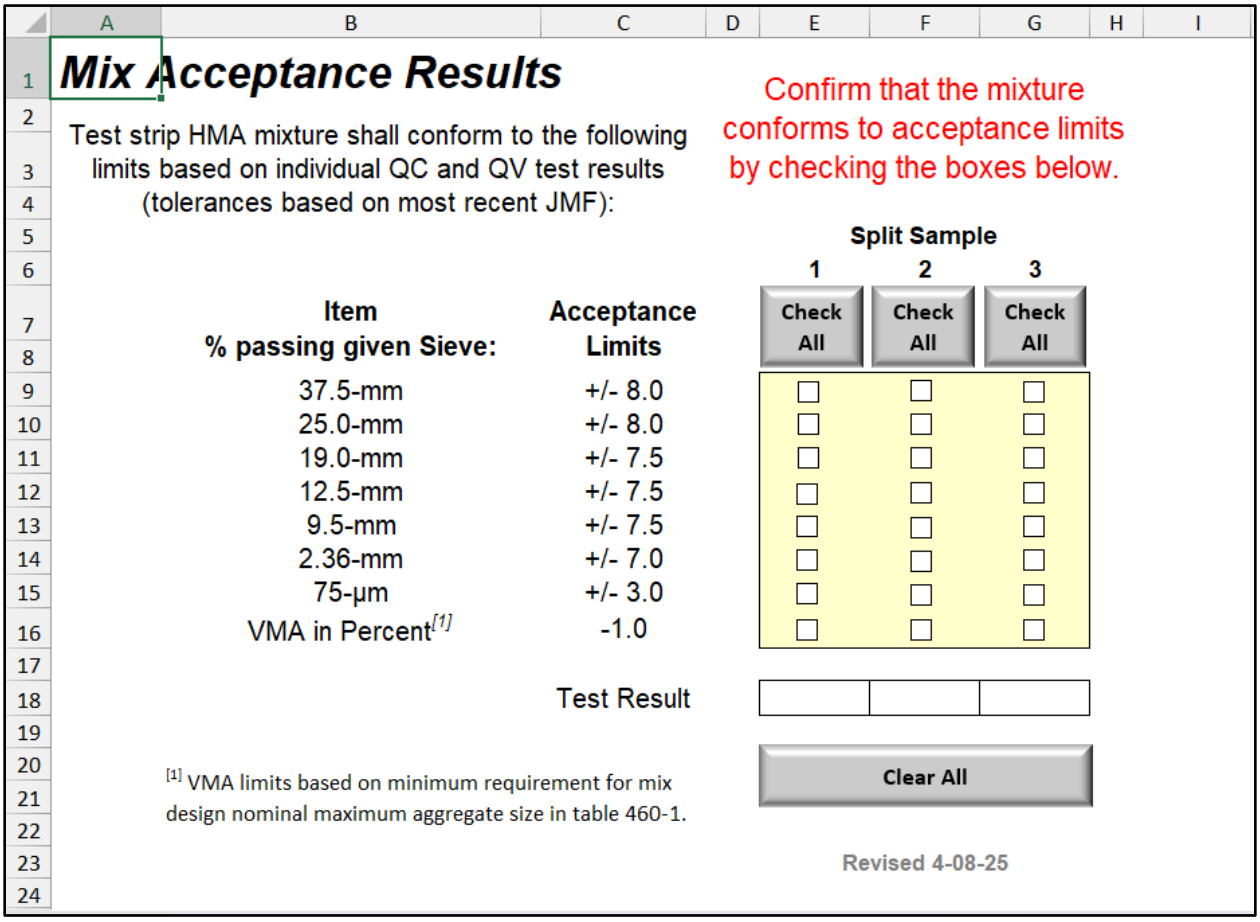

Figure 12: Mix Acceptance Checklist

Notes:

- The checklist applies to QC and QV/BTS results. If any party does not meet the acceptance limit for a property in the list, the checkbox should not be marked.
    - QV/BTS may optionally test the gradation.

If any of the requirements are not met, the split sample not meeting the requirement will be flagged with "Fail", otherwise it will be flagged with "Pass" (Figure 13).

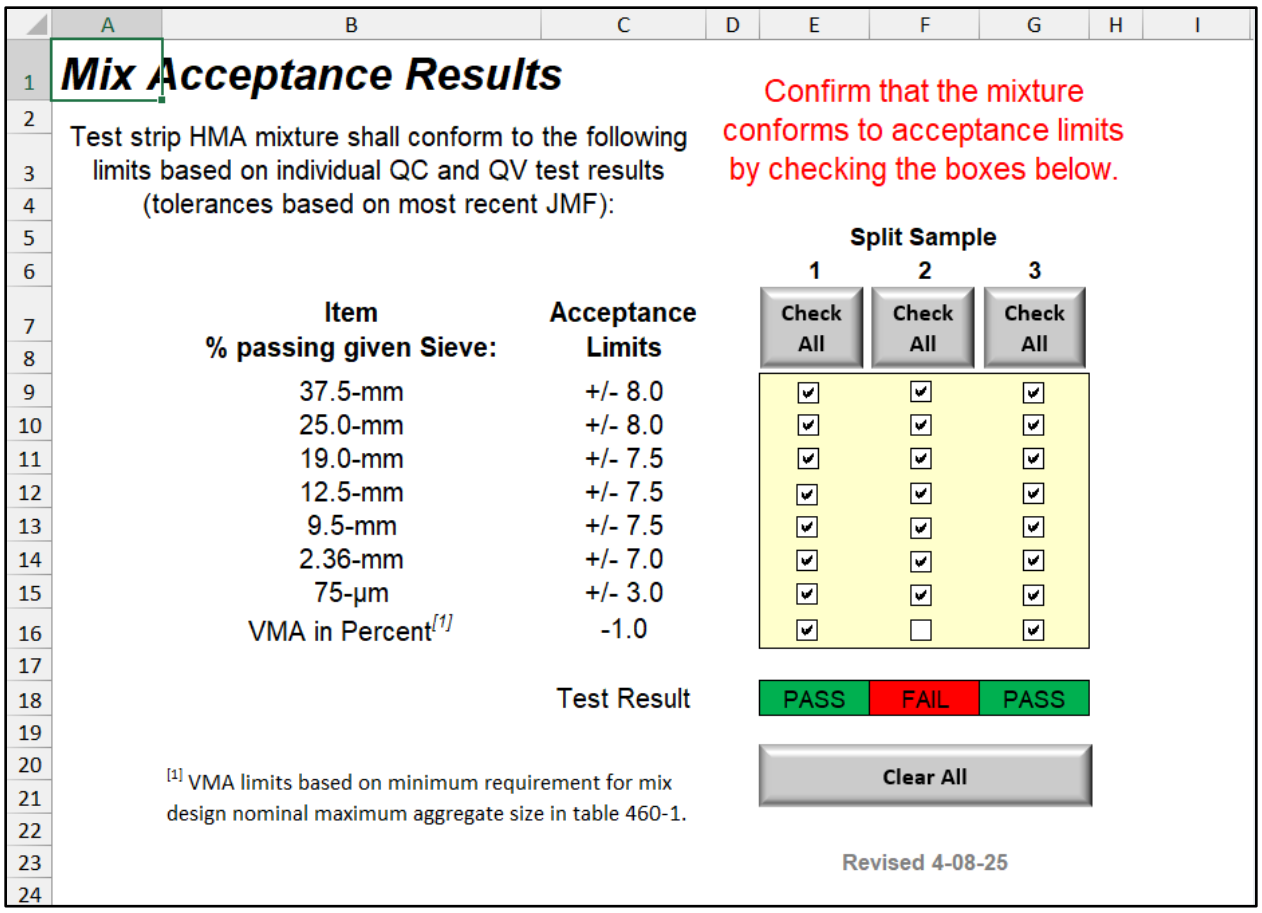

Figure 13: Passing/Failing Mixture Properties.

There are several buttons for worksheet functions found above each split sample and below the results of the analysis. The buttons perform the following functions:

Check All	• Checks all properties as passing for the split sample below the button.
Clear All	• Clears all checkboxes (Resets the worksheet).

9. Air Voids Pay Factor

This worksheet only appears when either "Combined Density and Volumetrics" or "Volumetric-Only" is selected as the Test Strip Type on the *Project Info & Instruction* worksheet. This worksheet is used to review the test strip's air voids results and the associated pay adjustments (Figure 14).

No information is to be entered into this worksheet.

Depending on the results of the t- and Xd Mean testing performed on the *Split Sample Comparison* worksheet, the QC or BTS test results will be used to calculate the air voids used to calculate the PWL_{VA} and Air Voids Pay Adjustment. Additionally, that party's Gmm values will be used to calculate the Average Gmm (cell D11) used to calculate the Target Max Density (PCF) for the density portion of the test strip. The party whose results are used for the analysis is identified by the Gmm Source (cell D12).

Air Voids Pay Factor

Date:	8/29/2024		Test Strip #:	1							$Target_{Va}$:	3.0						
Project ID:			Route/Road:	USH 51							LSL_{Va}:	2.0						
Mix Type:	4-MT-58-28S		Layer:	Upper							USL_{Va}:	4.3						
						Air Voids												
Lot	Split Sample No.	Date	Gmm	Gmb	Air Voids	Standard Deviation	Mean	Number of Tests in Lot	PWL_{UL}	PWL_{LL}	PWL_{Va}	PF_{Va}	Lot Size (Ton)	Air Voids Pay Adjustment				
	1		2.443	2.367	3.1											PWL Default Unit Price	Contract Unit Price	
TS-1	2	8/29/2024	2.439	2.368	2.9											$ 65.00	$ 71.45	
	3		2.439	2.364	3.1	0.107	3.0	3	100.00	100.00	100.00	104.00	844.88	$ 1,098.34	460.2010 Incentive Air Voids HMA Pavement			
Average Gmm:	2.440																	
Gmm Source:	QC																	

Acceptable Gmm & Gmb values carried in as determined from the *Split Sample Comparison* worksheet.

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Figure 14: Air Voids Pay Adjustment Example.

10. Density Pay Factor

This worksheet only appears when either "Combined Density and Volumetrics" or "Density-Only" is selected as the Test Strip Type on the *Project Info & Instruction* worksheet. This worksheet is used to review the test strip's density results and the associated pay adjustments (Figure 15).

No information is to be entered into this worksheet.

Notes:

- For a Combined Volumetric and Density Test Strip, depending on the results of the split sample comparison testing, the QC or BTS test results will be used for the Average Gmm (cell D19) for the Target Max Density (PCF) of the cores and nuclear gauge readings.
- For a Density-Only Test Strip, the Daily Average Gmm for the Density-Only Test Strip Analysis (cell I1 in *Core Data*), will be used as the Average Gmm (cell D19) to calculate density.
- The Gmm source is identified in cell D20.
- The Department Representative will determine which party's core density results will be used for acceptance, pay adjustment, and nuclear gauge correlation on the *Core Data* worksheet if verification testing is performed (otherwise the default is QC). The source of the data selected by the representative is identified in cell D21.

Density Pay Factor

Date:	8/29/2024	Test Strip #:	1	Lane Width(ft):	12.0	PWL Default Unit Price: $ 65.00
Project ID:		Route/Road:	USH 51	Nominal Thickness(in):	2.00	Contract Unit Price: $ 71.45
Mix Type:	4-MT-58-28S	Layer:	Upper	LSL(%):	93.0	

Density

Zone	Core No.	Date	Core Data (%Gmm)	Standard Deviation	Mean	Number of Tests in Lot	PWL_D	PF_D	Lot Size (Ton)	Density Pay Adjustment
1	UL-1	8/29/2024	95.1							
	UL-2		94.6							
	UL-3		96.4							
	UL-4		96.4							
	UL-5		94.0							
2	UL-6		93.1							
	UL-7		96.5							
	UL-8		96.4							
	UL-9		95.7							
	UL-10		94.2							
				1.22	95.2	10	97.76	103.11	850.01	$ 858.02

460.2005 Incentive Density PWL HMA Pavement

Average Gmm:	2.440
Gmm Source:	QC
Core Density Source:	QC

Core data calculated from Contractor measured Gmb under Dept. supervision, and Gmm values determined acceptable in accordance with the paired t-test

Final Length: 5,692.00 Feet

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Figure 15: Density Pay Adjustment Example.

11. Test Strip Summary

This worksheet is used to display the acceptance results of the Test Strip as well as the Nuclear Density Gauge Correlation, if performed (Figure 16). The Nuclear Density Gauge Correlation will only appear when either "Combined Density and Volumetrics" or "Density-Only" is selected as the Test Strip Type on the *Project Info & Instruction* worksheet.

Each portion of the test strip is broken down into the various acceptance requirements:

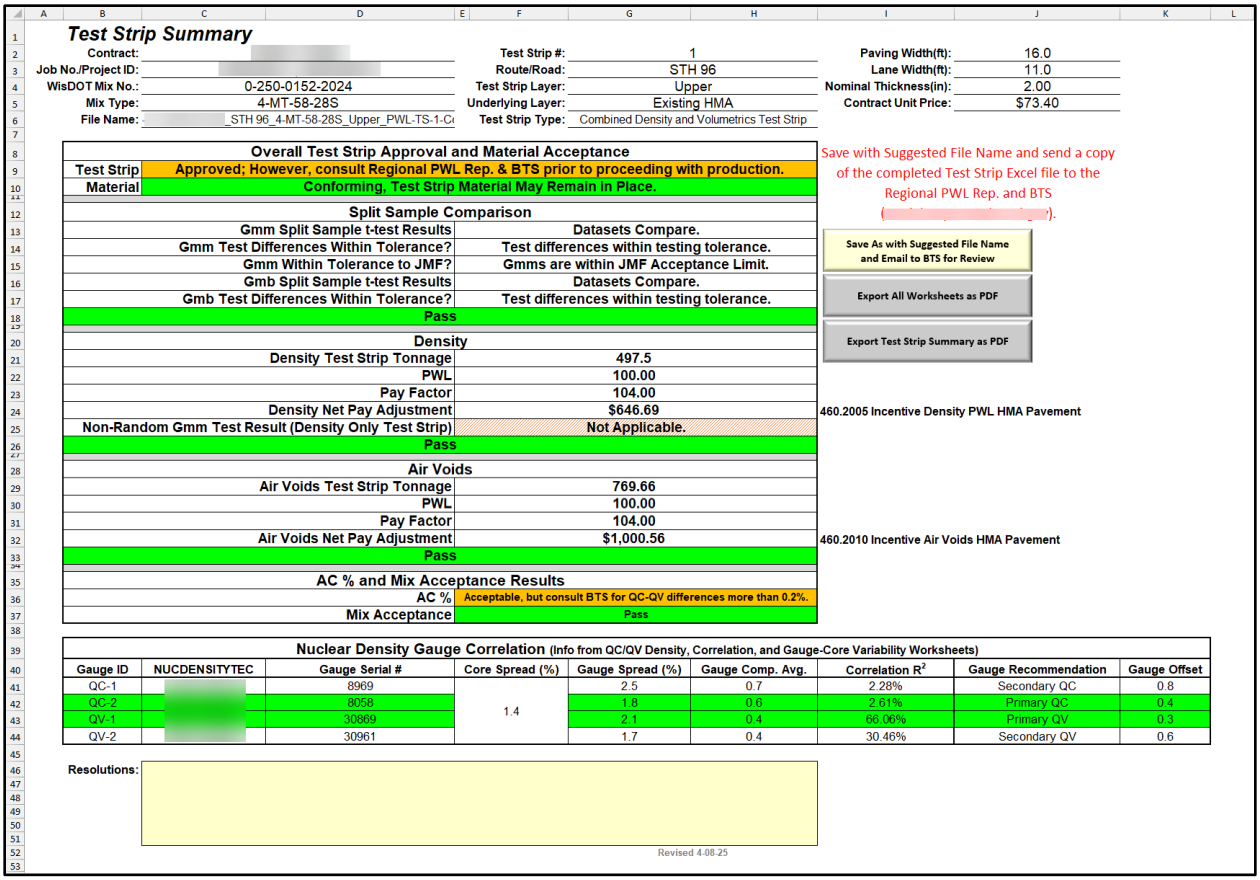
- Split Sample Comparison
  - Gmm/Gmb t-test comparison.
  - Gmm within tolerance of JMF.
  - Test differences between parties are within tolerance.
- Density
  - PWL.
- Air Voids
  - PWL.
- AC % and Mix
  - Acceptable asphalt contents.
  - Acceptable Gradation and VMA.

Any agreed upon resolutions to any issues that occurred during the test strip should be entered in the Resolutions space at the bottom of this worksheet (range C46:H51). Examples of resolutions include, but are not limited to:

- Test Strip left in place but required the construction of another test strip prior to continuing to production.
- Test Strip removed and replaced.
- Contractor will make an adjustment to some process to bring some parameter back into acceptable limits.
- Contractor will reheat mixture during production to account for testing differences between parties.
- Etc.

This worksheet will decide based on the results of the test strip whether the material is acceptable (shown in ranges C9:H9 and C10:H10). It also determines the following outcomes of the test strip:

- Approved, proceed with production.
- Approved; However, consult Regional PWL Rep. & BTS prior to proceeding with production.
- Not approved. Consult Regional PWL Rep. & BTS.



Test Strip Summary

Contract:		Test Strip #:	1	Paving Width(ft):	16.0
Job No./Project ID:		Route/Road:	STH 96	Lane Width(ft):	11.0
WisDOT Mix No.:	0-250-0152-2024	Test Strip Layer:	Upper	Nominal Thickness(in):	2.00
Mix Type:	4-MT-58-28S	Underlying Layer:	Existing HMA	Contract Unit Price:	$73.40
File Name:	_STH 96_4-MT-58-28S_Upper_PWL-TS-1-C	Test Strip Type:	Combined Density and Volumetrics Test Strip		

Overall Test Strip Approval and Material Acceptance	
Test Strip	Approved; However, consult Regional PWL Rep. & BTS prior to proceeding with production.
Material	Conforming, Test Strip Material May Remain in Place.

Split Sample Comparison	
Gmm Split Sample t-test Results	Datasets Compare.
Gmm Test Differences Within Tolerance?	Test differences within testing tolerance.
Gmm Within Tolerance to JMF?	Gmms are within JMF Acceptance Limit.
Gmb Split Sample t-test Results	Datasets Compare.
Gmb Test Differences Within Tolerance?	Test differences within testing tolerance.
Pass	

Density	
Density Test Strip Tonnage	497.5
PWL	100.00
Pay Factor	104.00
Density Net Pay Adjustment	$646.69
Non-Random Gmm Test Result (Density Only Test Strip)	Not Applicable.
Pass	

460.2005 Incentive Density PWL HMA Pavement

Air Voids	
Air Voids Test Strip Tonnage	769.66
PWL	100.00
Pay Factor	104.00
Air Voids Net Pay Adjustment	$1,000.56
Pass	

460.2010 Incentive Air Voids HMA Pavement

AC % and Mix Acceptance Results	
AC %	Acceptable, but consult BTS for QC-QV differences more than 0.2%.
Mix Acceptance	Pass

Save with Suggested File Name and send a copy of the completed Test Strip Excel file to the Regional PWL Rep. and BTS ( ).

Save As with Suggested File Name and Email to BTS for Review

Export All Worksheets as PDF

Export Test Strip Summary as PDF

Nuclear Density Gauge Correlation (Info from QC/QV Density, Correlation, and Gauge-Core Variability Worksheets)

Gauge ID	NUCDENSITYTEC	Gauge Serial #	Core Spread (%)	Gauge Spread (%)	Gauge Comp. Avg.	Correlation R^2	Gauge Recommendation	Gauge Offset
QC-1		8969	1.4	2.5	0.7	2.28%	Secondary QC	0.8
QC-2		8058		1.8	0.6	2.61%	Primary QC	0.4
QV-1		30869		2.1	0.4	66.06%	Primary QV	0.3
QV-2		30961		1.7	0.4	30.46%	Secondary QV	0.6

Resolutions:

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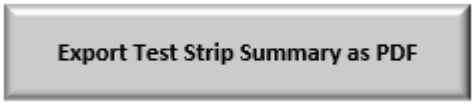
Figure 16: Test Strip Summary Example.

There are several buttons for worksheet functions found on the righthand side of the interface. The buttons perform the following functions:

	• Saves the spreadsheet as a new Excel file (without overwriting old versions) with the suggested file name, including the date and time that the spreadsheet was saved. • Creates a new email to send the test strip file to BTS. (Note: This function only works with Outlook.) • You will be able to edit the email before it sends.
	• Exports the entire spreadsheet and its worksheets as a PDF.
	• Exports only the Test Strip Summary worksheet.

12. Gauge-Core Variability

This worksheet only appears when either "Combined Density and Volumetrics" or "Density-Only" is selected as the Test Strip Type on the *Project Info & Instruction* worksheet. This worksheet is used to review the Location Comparison Averages and the Gauge Comparison for nuclear gauge correlation portion of the test strip (Figure 17).

No information is to be entered into this worksheet.

The tables on the left half of the worksheet reflect the comparisons which may or may not have suspect cores removed from the analysis. The tables on the right half of the worksheet reflect the comparisons using all of the original data with no removed suspect cores.

Notes:

- The Location Comparison table is used to determine whether a core is deemed suspect. A core is deemed suspect when the Average of the Adjusted Differences (cells G12-G21) from all the gauges is either greater than or equal to 1.0 or less than or equal to 1.0 for a specific core. Suspect cores will be flagged in the table automatically with a red background Location Comparison Average and "Suspect Core" appearing in the third column (Figure 18). Cores deemed suspect may only be removed from the analysis by the Department Representative. Removing cores can be done in the *Core Data* worksheet. Refer to section 6 Core Data for additional information on removing cores (Figure 19).
- The Gauge Comparison table is used to determine whether a nuclear gauge is deemed suspect. A nuclear gauge is deemed suspect when the Average Absolute Adjusted Difference (Cells B36, C36, D36, and E36) for a particular gauge is greater than or equal to 1.0%. Suspect gauges will be flagged in the table automatically with a red background showing on the testing party, gauge ID, and Gauge Comparison Average (Figure 18). Gauges deemed suspect should be removed from the project and further diagnostics should be performed in coordination with the WisDOT Radiation Safety Officer.

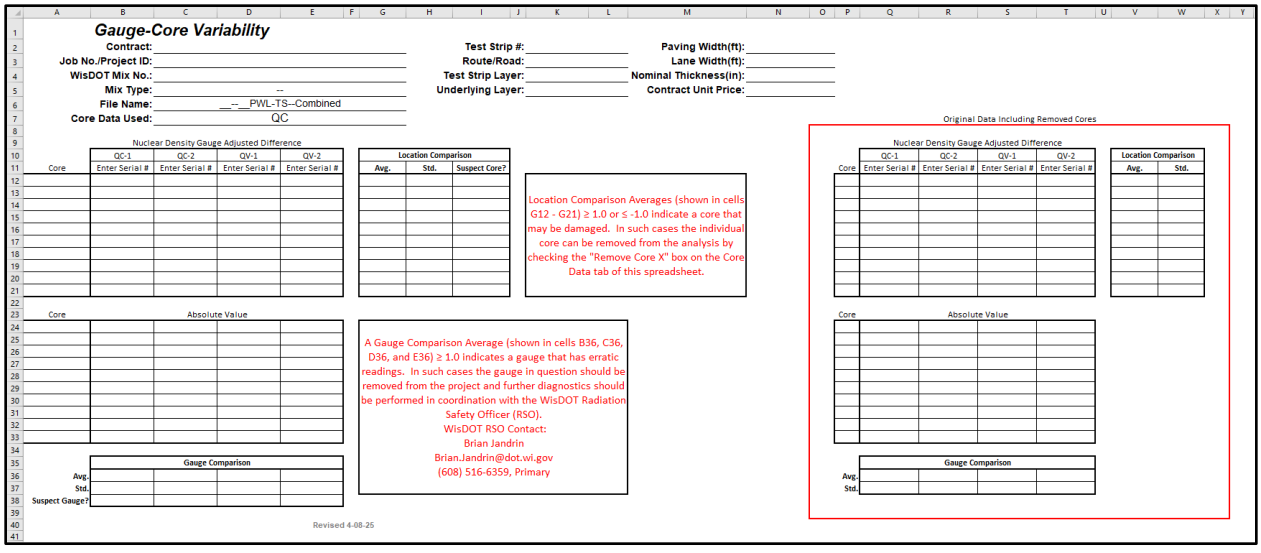
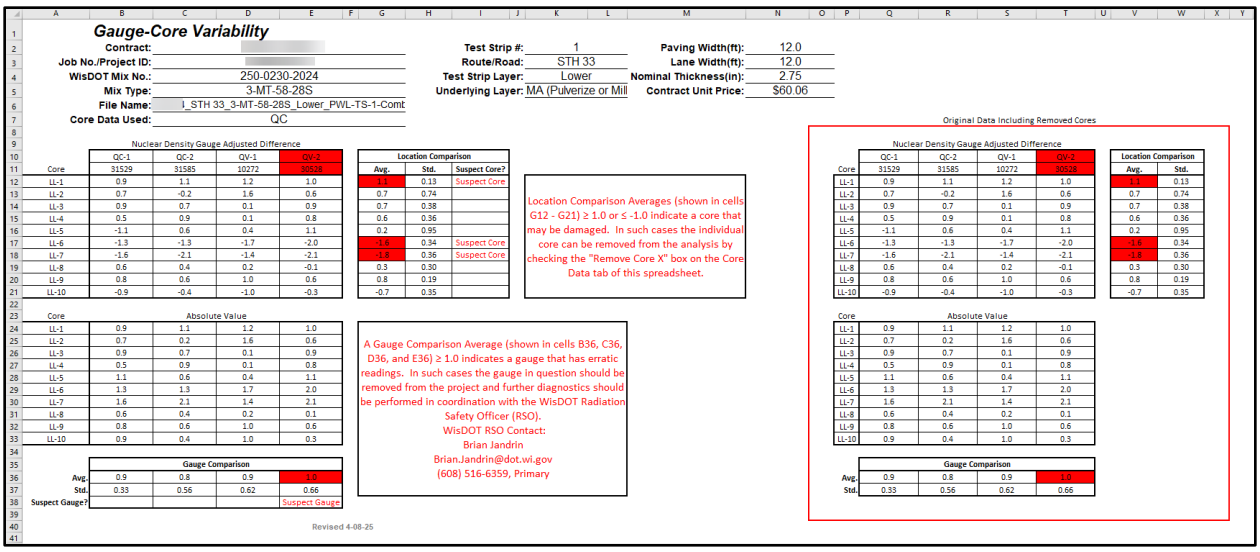


Figure 17:Gauge-Core Variability Tables



Gauge-Core Variability

Contract:
Job No./Project ID:
WisDOT Mix No.: 250-0230-2024
Mix Type: 3-MT-58-28S
File Name: i_STH 33_3-MT-58-28S_Lower_PWL-TS-1-Comt
Core Data Used: QC

Test Strip #: 1
Route/Road: STH 33
Test Strip Layer: Lower
Underlying Layer: MA (Pulverize or Mill

Paving Width(ft): 12.0
Lane Width(ft): 12.0
Nominal Thickness(in): 2.75
Contract Unit Price: $60.06

Nuclear Density Gauge Adjusted Difference

Core	QC-1	QC-2	QV-1	QV-2
	31529	31585	10272	30528
LL-1	0.9	1.1	1.2	1.0
LL-2	0.7	-0.2	1.6	0.6
LL-3	0.9	0.7	0.1	0.9
LL-4	0.5	0.9	0.1	0.8
LL-5	-1.1	0.6	0.4	1.1
LL-6	-1.3	-1.3	-1.7	-2.0
LL-7	-1.6	-2.1	-1.4	-2.1
LL-8	0.6	0.4	0.2	-0.1
LL-9	0.8	0.6	1.0	0.6
LL-10	-0.9	-0.4	-1.0	-0.3

Location Comparison

Avg.	Std.	Suspect Core?
1.1	0.13	Suspect Core
0.7	0.74	
0.7	0.38	
0.6	0.36	
0.2	0.95	
-1.6	0.34	Suspect Core
-1.8	0.36	Suspect Core
0.3	0.30	
0.8	0.19	
-0.7	0.35	

Location Comparison Averages (shown in cells G12 - G21) ≥ 1.0 or ≤ -1.0 indicate a core that may be damaged. In such cases the individual core can be removed from the analysis by checking the "Remove Core X" box on the Core Data tab of this spreadsheet.

Absolute Value

Core	
LL-1	0.9
LL-2	0.7
LL-3	0.9
LL-4	0.5
LL-5	1.1
LL-6	1.3
LL-7	1.6
LL-8	0.6
LL-9	0.8
LL-10	0.9

A Gauge Comparison Average (shown in cells B36, C36, D36, and E36) ≥ 1.0 indicates a gauge that has erratic readings. In such cases the gauge in question should be removed from the project and further diagnostics should be performed in coordination with the WisDOT Radiation Safety Officer (RSO).
WisDOT RSO Contact:
Brian Jandrin
Brian.Jandrin@dot.wi.gov
(608) 516-6359, Primary

Gauge Comparison

Avg.	0.9	0.8	0.9	1.0
Std.	0.33	0.56	0.62	0.66
Suspect Gauge?				Suspect Gauge

Revised 4-08-25

Original Data Including Removed Cores

Nuclear Density Gauge Adjusted Difference

Core	QC-1	QC-2	QV-1	QV-2
	31529	31585	10272	30528
LL-1	0.9	1.1	1.2	1.0
LL-2	0.7	-0.2	1.6	0.6
LL-3	0.9	0.7	0.1	0.9
LL-4	0.5	0.9	0.1	0.8
LL-5	-1.1	0.6	0.4	1.1
LL-6	-1.3	-1.3	-1.7	-2.0
LL-7	-1.6	-2.1	-1.4	-2.1
LL-8	0.6	0.4	0.2	-0.1
LL-9	0.8	0.6	1.0	0.6
LL-10	-0.9	-0.4	-1.0	-0.3

Location Comparison

Avg.	Std.
1.1	0.13
0.7	0.74
0.7	0.38
0.6	0.36
0.2	0.95
-1.6	0.34
-1.8	0.36
0.3	0.30
0.8	0.19
-0.7	0.35

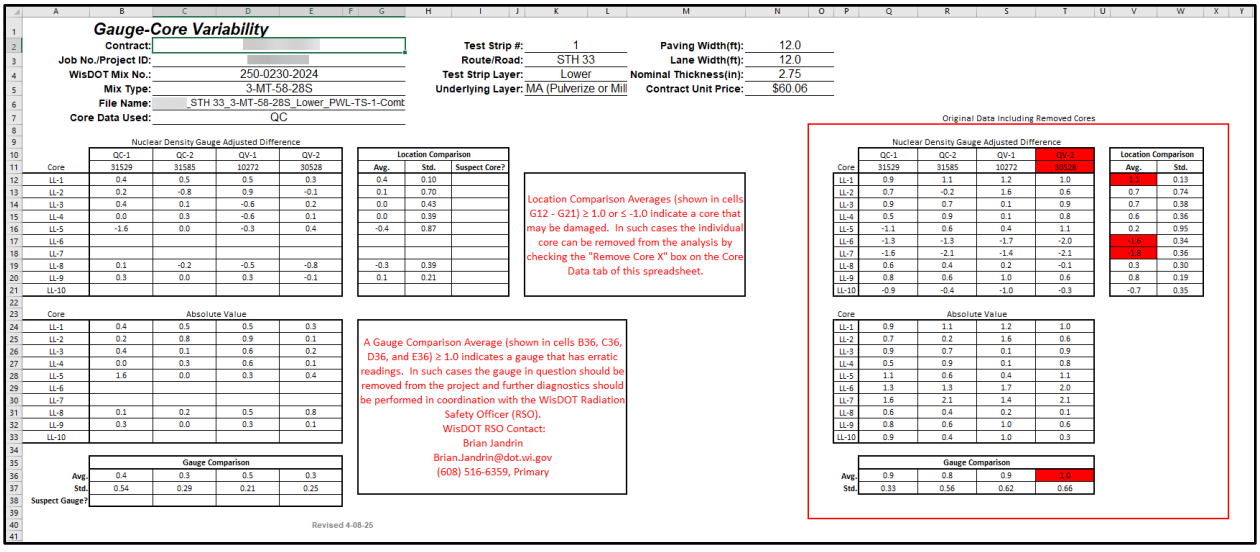
Absolute Value

Core	
LL-1	0.9
LL-2	0.7
LL-3	0.9
LL-4	0.5
LL-5	1.1
LL-6	1.3
LL-7	1.6
LL-8	0.6
LL-9	0.8
LL-10	0.9

Gauge Comparison

Avg.	0.9	0.8	0.9	1.0
Std.	0.33	0.56	0.62	0.66

Figure 18: Suspect Cores/Gauges Example.



Gauge-Core Variability

Contract:
Job No./Project ID:
WisDOT Mix No.: 250-0230-2024
Mix Type: 3-MT-58-28S
File Name: _STH 33_3-MT-58-28S_Lower_PWL-TS-1-Comt
Core Data Used: QC

Test Strip #: 1
Route/Road: STH 33
Test Strip Layer: Lower
Underlying Layer: MA (Pulverize or Mill

Paving Width(ft): 12.0
Lane Width(ft): 12.0
Nominal Thickness(in): 2.75
Contract Unit Price: $60.06

Nuclear Density Gauge Adjusted Difference

Core	QC-1	QC-2	QV-1	QV-2
	31529	31585	10272	30528
LL-1	0.4	0.5	0.5	0.3
LL-2	0.2	-0.8	0.9	-0.1
LL-3	0.4	0.1	-0.6	0.2
LL-4	0.0	0.3	-0.6	0.1
LL-5	-1.6	0.0	-0.3	0.4
LL-6				
LL-7				
LL-8	0.1	-0.2	-0.5	-0.8
LL-9	0.3	0.0	0.3	-0.1
LL-10				

Location Comparison

Avg.	Std.	Suspect Core?
0.4	0.10	
0.1	0.70	
0.0	0.43	
0.0	0.39	
-0.4	0.87	
-0.3	0.39	
0.1	0.21	

Location Comparison Averages (shown in cells G12 - G21) ≥ 1.0 or ≤ -1.0 indicate a core that may be damaged. In such cases the individual core can be removed from the analysis by checking the "Remove Core X" box on the Core Data tab of this spreadsheet.

Absolute Value

Core	
LL-1	0.4
LL-2	0.2
LL-3	0.4
LL-4	0.0
LL-5	1.6
LL-6	
LL-7	
LL-8	0.1
LL-9	0.3
LL-10	

A Gauge Comparison Average (shown in cells B36, C36, D36, and E36) ≥ 1.0 indicates a gauge that has erratic readings. In such cases the gauge in question should be removed from the project and further diagnostics should be performed in coordination with the WisDOT Radiation Safety Officer (RSO).
WisDOT RSO Contact:
Brian Jandrin
Brian.Jandrin@dot.wi.gov
(608) 516-6359, Primary

Gauge Comparison

Avg.	0.4	0.3	0.5	0.3
Std.	0.54	0.29	0.21	0.25
Suspect Gauge?				

Revised 4-08-25

Original Data Including Removed Cores

Nuclear Density Gauge Adjusted Difference

Core	QC-1	QC-2	QV-1	QV-2
	31529	31585	10272	30528
LL-1	0.9	1.1	1.2	1.0
LL-2	0.7	-0.2	1.6	0.6
LL-3	0.9	0.7	0.1	0.9
LL-4	0.5	0.9	0.1	0.8
LL-5	-1.1	0.6	0.4	1.1
LL-6	-1.3	-1.3	-1.7	-2.0
LL-7	-1.6	-2.1	-1.4	-2.1
LL-8	0.6	0.4	0.2	-0.1
LL-9	0.8	0.6	1.0	0.6
LL-10	-0.9	-0.4	-1.0	-0.3

Location Comparison

Avg.	Std.
1.1	0.13
0.7	0.74
0.7	0.38
0.6	0.36
0.2	0.95
-1.6	0.34
-1.8	0.36
0.3	0.30
0.8	0.19
-0.7	0.35

Absolute Value

Core	
LL-1	0.9
LL-2	0.7
LL-3	0.9
LL-4	0.5
LL-5	1.1
LL-6	1.3
LL-7	1.6
LL-8	0.6
LL-9	0.8
LL-10	0.9

Gauge Comparison

Avg.	0.9	0.8	0.9	1.0
Std.	0.33	0.56	0.62	0.66

Figure 19: Removed Suspect Cores Example.

13. QC-X / QV-X Density Worksheets

These worksheets only appears when either "Combined Density and Volumetrics" or "Density-Only" is selected as the Test Strip Type on the *Project Info & Instructions* worksheet. These are the field density worksheets that should be used for the test strip by the density technicians. These worksheets can be saved as PDFs and printed from the *Project Info & Instructions* worksheet if desired. These worksheets must be filled out to complete the nuclear gauge correlation.

The Department Representative will enter the following information into the worksheet received from the density technicians:

- Density and Moisture Standards
- Gauge Serial Number
- QC/QV Technician Name
- M Counts / D Counts for Reading 1
- Wet Density 1 (PCF)
- M Counts / D Counts for Reading 2
- Wet Density 2 (PCF)
- M Counts / D Counts for Reading 3 (if required)
- Wet Density 3 (PCF) (if required)
- Test Remarks

PWL DENSITY DATA FORM (LANE FOOT) — Revised 4-08-25

Nuclear HMA Density QC/QV Testing Records

TEST STRIP #1 | QC-1 | LAYER: Lower

Station Decreasing: FALSE

Project ID:		Road Name:	STH 33	Contractor:		Density Standard:	4012
Project Leader:		County:	Columbia	QC NUCDENSITYTEC:		Moisture Standard:	997
				QV NUCDENSITYTEC:	N/A	Gauge Serial #:	31529
				Start:	02+74 End: 39+27	WisDOT Mix #:	250-0230-2024
				Length (ft):	3,653	Mix Type:	3-MT-58-28S
				Lane Width (ft):	12.0	Target Gmm:	2.573
				Nominal Thickness(in):	2.75	Target Max Density (PCF):	160.1
				Gauge Offset	ZERO	Required Density %:	91.0
						Date Placed:	8/6/2024
						Date Tested:	8/6/2024

TEST STRIP - Field Density Worksheet

- Offsets are predetermined according to the test strip layout in WisDOT's Manual of Test Procedures WTP H-002.
- Gauge offset is set to ZERO since offsets will be determined from the test strip.
- The Target Max Gmm is the average from the 3 split samples, except for a density only test strip, then it is the daily average Gmm from production.
- Calculated per WisDOT's Manual of Test Procedures WTM T355.

Gauge/Core Spacing (ft): 50

			Reading 1			Reading 2 (rotate 180)			Reading 3 (if needed, original orientation)			Final Density	
Lot / Sub Lot ID	Station	Offset from CL	M Count / D Count	Wet Density 1	% Max Density 1	M Count / D Count	Wet Density 2	% Max Density 2	M Count / D Count	Wet Density 3	% Max Density 3	Average PCF	% Max Density
LL-1	09+94	1.5	203/1976	146.2	91.3%	201/1968	146.7	91.6%				146.5	91.5%
LL-2	10+44	3.5	189/1929	148.8	92.9%	206/1918	149.4	93.3%				149.1	93.1%
LL-3	10+94	6.0	207/1897	150.5	94.0%	197/1912	149.7	93.5%				150.1	93.8%
LL-4	11+44	8.5	187/1892	150.8	94.2%	195/1909	149.9	93.6%				150.4	93.9%
LL-5	11+94	10.5	192/1910	149.8	93.6%	192/1975	146.3	91.4%	188/1912	149.7	93.5%	149.8	93.6%
LL-6	30+75	1.5	193/1915	149.5	93.4%	201/1927	148.9	93.0%				149.2	93.2%
LL-7	31+25	3.5	206/1899	150.4	93.9%	199/1889	151.0	94.3%				150.7	94.1%
LL-8	31+75	6.0	196/1905	150.1	93.8%	200/1913	149.7	93.5%				149.9	93.6%
LL-9	32+25	8.5	204/1958	147.2	91.9%	204/1911	149.8	93.6%	200/1950	147.6	92.2%	147.4	92.1%
LL-10	32+75	10.5	193/1937	148.3	92.6%	201/1922	149.2	93.2%				148.8	92.9%

Target Max Density = Gmm x 62.24

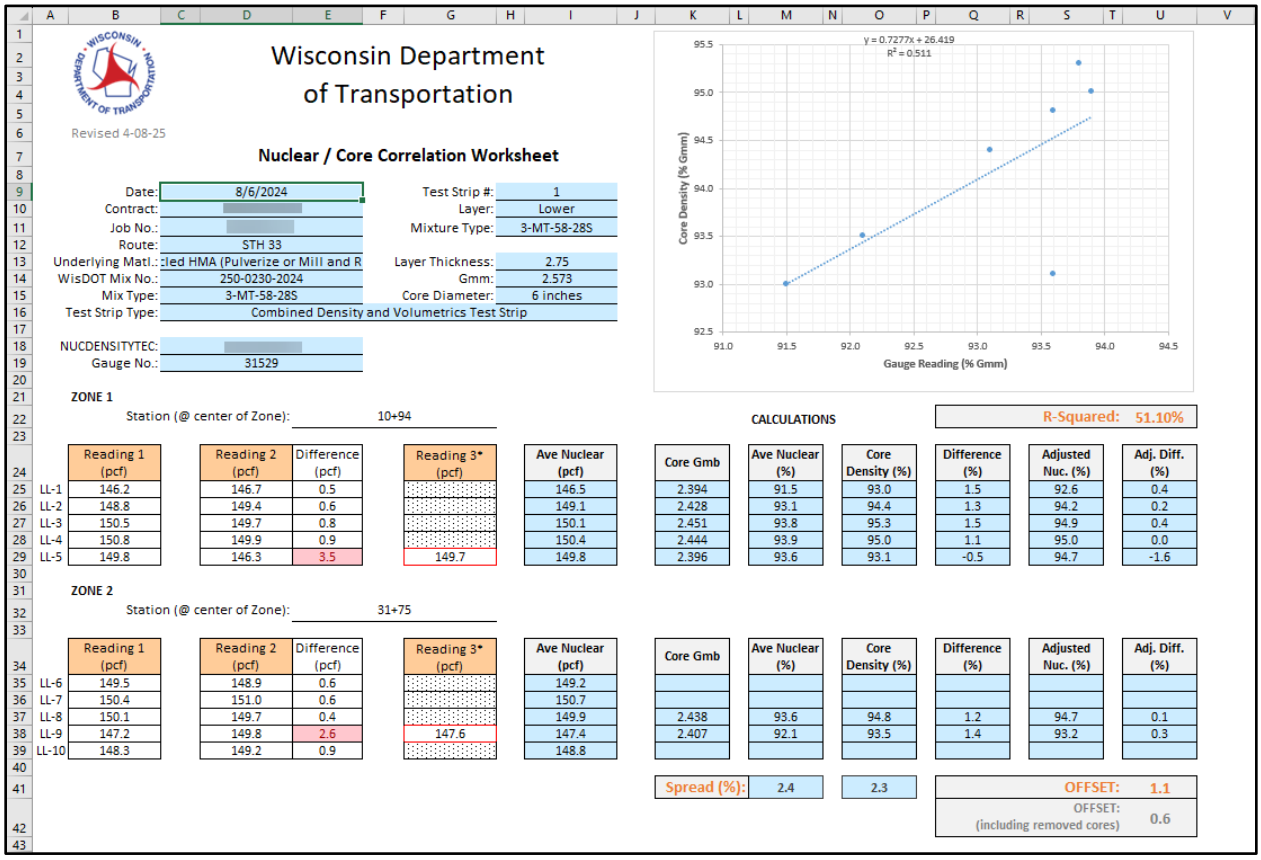
Test Remarks

Figure 20: QC-X / QV-X Field Density Worksheet Example.

14. QC-X / QV-X Correlation

These worksheets only appears when either “Combined Density and Volumetrics” or “Density-Only” is selected as the Test Strip Type on the *Project Info & Instructions* worksheet. These worksheets are used to review the correlation of each nuclear gauge.

No information is to be entered into this worksheet.



Wisconsin Department of Transportation

Revised 4-08-25

Nuclear / Core Correlation Worksheet

Date:	8/6/2024	Test Strip #:	1
Contract:	[redacted]	Layer:	Lower
Job No.:	[redacted]	Mixture Type:	3-MT-58-28S
Route:	STH 33		
Underlying Matl.:	tled HMA (Pulverize or Mill and R	Layer Thickness:	2.75
WisDOT Mix No.:	250-0230-2024	Gmm:	2.573
Mix Type:	3-MT-58-28S	Core Diameter:	6 inches
Test Strip Type:	Combined Density and Volumetrics Test Strip		
NUCDENSITYTEC:	[redacted]		
Gauge No.:	31529		

ZONE 1

Station (@ center of Zone): 10+94

CALCULATIONS

R-Squared: 51.10%

	Reading 1 (pcf)	Reading 2 (pcf)	Difference (pcf)	Reading 3* (pcf)	Ave Nuclear (pcf)	Core Gmb	Ave Nuclear (%)	Core Density (%)	Difference (%)	Adjusted Nuc. (%)	Adj. Diff. (%)
LL-1	146.2	146.7	0.5		146.5	2.394	91.5	93.0	1.5	92.6	0.4
LL-2	148.8	149.4	0.6		149.1	2.428	93.1	94.4	1.3	94.2	0.2
LL-3	150.5	149.7	0.8		150.1	2.451	93.8	95.3	1.5	94.9	0.4
LL-4	150.8	149.9	0.9		150.4	2.444	93.9	95.0	1.1	95.0	0.0
LL-5	149.8	146.3	3.5	149.7	149.8	2.396	93.6	93.1	-0.5	94.7	-1.6

ZONE 2

Station (@ center of Zone): 31+75

	Reading 1 (pcf)	Reading 2 (pcf)	Difference (pcf)	Reading 3* (pcf)	Ave Nuclear (pcf)	Core Gmb	Ave Nuclear (%)	Core Density (%)	Difference (%)	Adjusted Nuc. (%)	Adj. Diff. (%)
LL-6	149.5	148.9	0.6		149.2						
LL-7	150.4	151.0	0.6		150.7						
LL-8	150.1	149.7	0.4		149.9	2.438	93.6	94.8	1.2	94.7	0.1
LL-9	147.2	149.8	2.6	147.6	147.4	2.407	92.1	93.5	1.4	93.2	0.3
LL-10	148.3	149.2	0.9		148.8						

Spread (%):	2.4	2.3	OFFSET:	1.1
			OFFSET: (including removed cores)	0.6

Figure 21: QC-X / QV-X Correlation Example.

Notes:

- Cores that were removed from the analysis on the *Core Data* worksheet will not appear in the tables nor will they affect the correlation.

15. Appendix

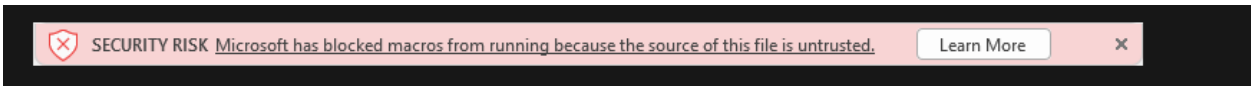
15.1 t-Testing

The spreadsheet adheres to the specifications for determining whether QC and QV data compare by conducting paired t-tests on *Split Sample Comparison* data.

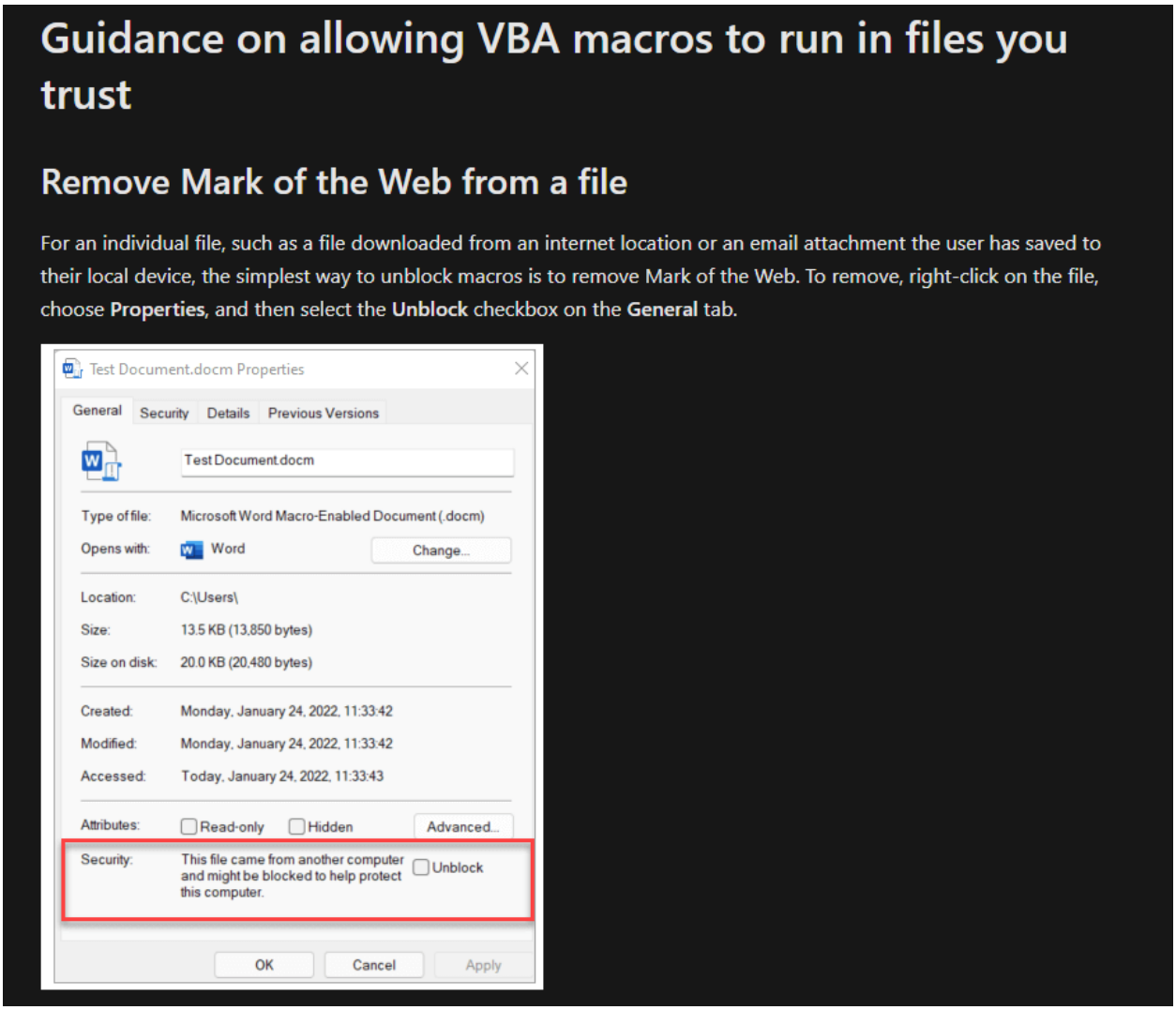
The t-tests during the test strip use an alpha value of 0.01. The alpha value determines the likelihood of a "false flag" or a failed comparison due to factors other than an actual difference in the population (or material source). Using an alpha value of 0.01, the t-test will fail 1 in 10 times (or about 10% of the time) when the two datasets are actually from the same population. The t-tests "pass" or compare when the p-value from either test is greater than alpha.

15.2 Enabling Macros (Red Banner)

As of February 23, 2023, Microsoft has blocked macros by default from spreadsheets downloaded from the internet (i.e.: Pantry) to provide additional protection from malicious macros. When this occurs, you will see an error like this at the top of the spreadsheet:



When this error is presented, you will be unable to enable macros using old methods where you could simply click the button in the banner to enable macros. Additional steps are required to enable the macros. Perform the following steps to enable macros:



Additional information about this change can be found on Microsoft's website at:
https://learn.microsoft.com/en-us/deployoffice/security/internet-macros-blocked