



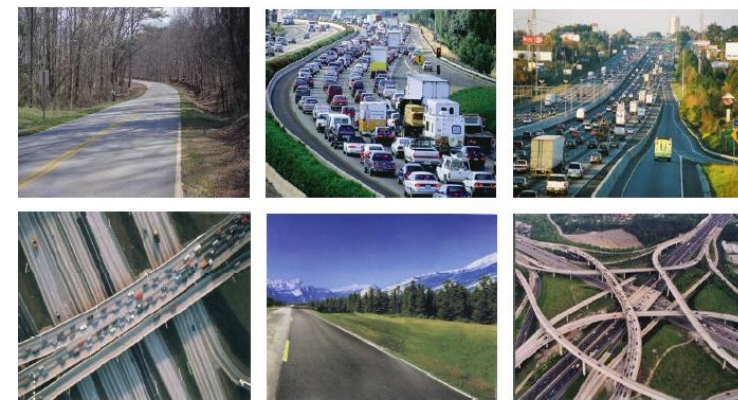
FHWA/TPF-5(299) Guidance for Quality Management of Pavement Surface Condition Data Collection and Analysis

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Guidance for Quality Management of Pavement Surface Condition Data Collection and Analysis

- 42 Months: 3/2019 to 8/2022
- FHWA COR: Andy Mergenmeier
- Project Team: Transtec Group + Wood
- To produce **Practical Guide for QMP**



U.S. Department of Transportation
Federal Highway Administration



TRANSPORTATION POOLED FUND PROGRAM

BENEFITS



Anticipated Benefits

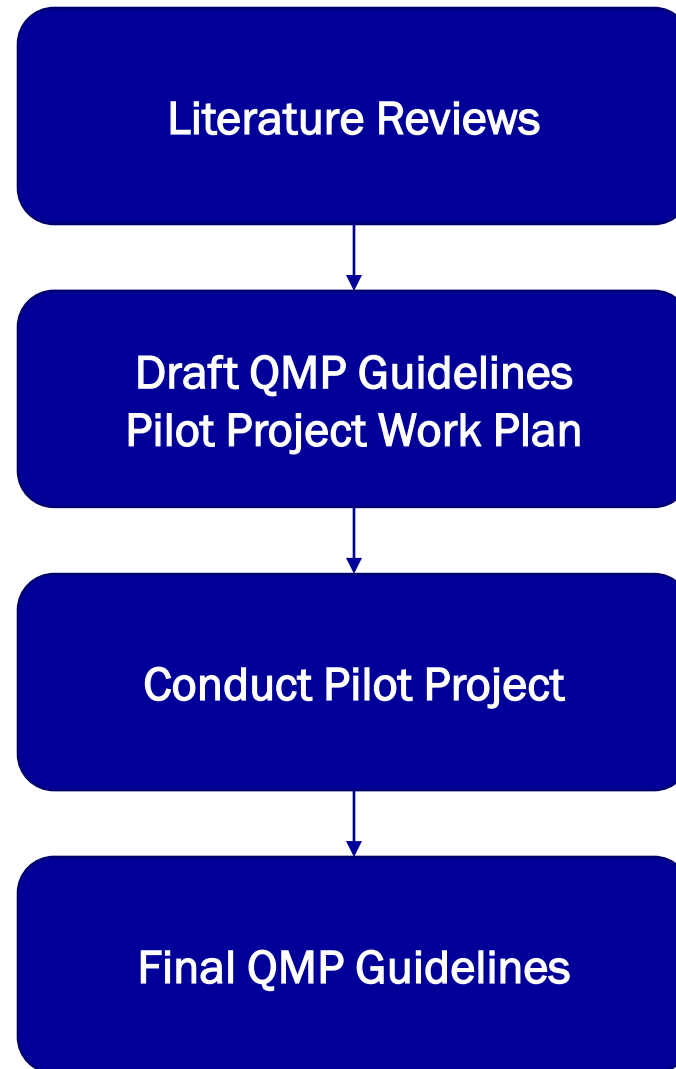
- Improve current **QM plan** and **Quality Management Plan (QMP) guidelines** by establishing standards that can be used by State and Local Transportation Agencies to develop their QMP;
- Improve the **accuracy**, **precision**, and **reliability** of pavement surface condition data; and
- Improve the **cost-effectiveness** of pavement surface condition data collection and analysis processes.

To Meet State DOTs' Needs on QMP!

How can We Get There?

1. Develop a clear understanding of the current **state-of-the-practice** for QMPs and SHA's **challenges** for developing and maintaining data QMPs.
2. Develop a **living document of guidelines** that combines the best information available and recommendations for needed future improvements.
3. Conduct **pilot study** to test the proposed QMP guidelines and to revise those guidelines as needed.

Work Plan



QMP 101



- Quality Management Plan
- FHWA Notice of Proposed Rulemaking (NPRM) 2017
- Ensure **acceptable quality data** and **enhanced consistency** through documenting and formalizing the QC and quality assurance (QA) processes and methods already implemented by the agencies
- Provide more **reliable estimates for the performance measures** used to support and monitor strategies towards achieving the performance targets established in asset management plans for the NHS.

QMP Structure



- Data collection equipment
 - including procedures for calibration, certification or validation, verification and daily quality checks;
- Personnel involved in data collection
 - including procedures for training, validation, and verification; and
- Collected data
 - including procedures for periodic review during data collection and final review after data collection.

5 QMP Components



1. Data collection equipment calibration and certification,
2. Certification process for persons performing manual data collection,
3. Data quality control measures to be conducted before data collection begins and periodically during the data collection program,
4. Data sampling, review and checking processes, and
5. Error resolution procedures and data acceptance criteria.

5 QMP Components

RPUG 2018
QMP Workshop Survey

A blue box in the top right corner contains the text 'RPUG 2018 QMP Workshop Survey'. Two blue arrows originate from this box: one points to the first component of the list, and the other points to the fifth component.

1. Data collection equipment calibration and certification,
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5. Error resolution procedures and data acceptance criteria.

State DOT QMP Reviews



<p>State of Alaska Highway Districts Data Collection Quality Management Plan</p> <p>AK</p>	<p>Alabama Quality Management Plan</p> <p>AL</p>	<p>Arkansas Department of Transportation Pavement Condition Survey DATA QUALITY MANAGEMENT PLAN</p> <p>AR</p>	<p>Arkansas Department of Transportation Pavement Condition Survey DATA QUALITY MANAGEMENT PLAN</p> <p>AR</p>	<p>Pavement Condition Survey DATA QUALITY MANAGEMENT PLAN</p> <p>CA</p>	<p>Connecticut Department of Transportation Pavement Condition Data Quality Management Plan</p> <p>CT</p>	<p>Delaware Department of Transportation Pavement Condition Data Quality Management Plan</p> <p>DE</p>	<p>Florida Department of Transportation Highway Performance Monitoring System Data Quality Management Plan for Pavement Condition Data Collection</p> <p>FL</p>	<p>Iowa Department of Transportation Pavement Condition Data Quality Management Plan</p> <p>IA</p>	<p>Illinois Department of Transportation Network-Level Performance Monitoring System Pavement Condition Data Collection Quality Management Plan</p> <p>IL</p>
<p>Indiana Department of Transportation Pavement Condition Data Quality Management Plan</p> <p>IN</p>	<p>Kansas Department of Transportation Pavement Condition Data Collection Quality Management Plan</p> <p>KS</p>	<p>Massachusetts Department of Transportation Network-Level Performance Monitoring System Data Quality Management Plan</p> <p>MA</p>	<p>Maryland Department of Transportation Pavement Data Quality Management Program</p> <p>MD</p>	<p>Maine Department of Transportation Pavement Condition Data Quality Management Plan</p> <p>ME</p>	<p>Michigan Department of Transportation Pavement Condition Data Quality Management Plan</p> <p>MI</p>	<p>Minnesota Department of Transportation Pavement Data Quality Management Plan</p> <p>MN</p>	<p>Mississippi Department of Transportation Pavement Data Quality Management Plan</p> <p>MS</p>	<p>Montana Department of Transportation Network-Level Pavement Condition Data Collection Quality Management Plan</p> <p>MT</p>	<p>North Carolina Department of Transportation Network-Level Pavement Condition Data Collection Quality Management Plan</p> <p>NC</p>
<p>North Dakota Department of Transportation Network-Level Pavement Condition Data Collection Quality Management Plan</p> <p>ND</p>	<p>Nebraska Department of Transportation Data Quality Management Program for Pavement Condition Data Collection</p> <p>NE</p>	<p>New Hampshire Department of Transportation Pavement Data Quality Management Program</p> <p>NH</p>	<p>New Mexico Department of Transportation Pavement Condition Data Quality Management Plan</p> <p>NM</p>	<p>Nevada Department of Transportation Pavement Data Quality Management Plan</p> <p>NV</p>	<p>New York Department of Transportation Highway Performance Monitoring System Quality Management Plan for Pavement Condition Data Collection</p> <p>NY</p>	<p>Ohio Department of Transportation Pavement Condition Data Quality Management Plan</p> <p>OH</p>	<p>Oklahoma Department of Transportation Pavement Condition Data Quality Management Plan</p> <p>OK</p>	<p>Oregon Department of Transportation Pavement Condition Data Quality Management Plan</p> <p>OR</p>	<p>Pennsylvania Department of Transportation Pavement Condition Data Quality Management Plan</p> <p>PA</p>
<p>Puerto Rico Department of Transportation Standard Operating Procedures Pavement Management System Procedures and Data Quality Management Plan</p> <p>PR</p>	<p>Rhode Island Department of Transportation DATA QUALITY MANAGEMENT PLAN FOR PAVEMENT CONDITION DATA September 2016</p> <p>RI</p>	<p>South Carolina Department of Transportation Pavement Management System DATA QUALITY MANAGEMENT PLAN</p> <p>SC</p>	<p>South Dakota Department of Transportation Pavement Condition Data Quality Management Plan</p> <p>SD</p>	<p>Tennessee Department of Transportation Guidelines on Quality Management of Pavement Condition Data</p> <p>TN</p>	<p>Texas Department of Transportation Quality Management Plan for Pavement Data Collection</p> <p>TX</p>	<p>Utah Department of Transportation Management Plan for Pavement Condition Data</p> <p>UT</p>	<p>Vermont Department of Transportation Pavement Condition Data Quality Management Plan</p> <p>VT</p>	<p>Wisconsin Department of Transportation Pavement Data Quality Management Plan</p> <p>WI</p>	<p>Washington Department of Transportation Pavement Condition Data Quality Management Plan</p> <p>WA</p>

QMP Review Cards



AutoSave Off | DQMP-ScoreCard-v13.xlsx - Excel

File Home Insert Draw Page Layout Formulas Data Review View Developer Add-ins Help AC

Clipboard Font Alignment Number Styles

E19

1	Orange cells must be completed by the rater using one of the options in the drop down menu.
2	Blue cells indicate required protocol that the DQMP must reference
3	Yellow cells are for page references, notes, and descriptions. It is critical to give a reference page to where the information was found for future review.
4	For consistency, use page document assigned by the pdf reader (adobe or other), as documents may have inconsistent page formats.
5	
6	
7	Score Scale: 2 - complete and thorough explanation of process, missing no critical component. Reference "definitions" for critical component definition.
8	1 - partial explanation of process, missing one critical component. If multiple critical components are missing, a score of unknown or 0 should be given. An explanation of what critical component is missing should be given in the notes section.
9	0 - no explanation or inadequate explanation of process, missing multiple critical components, does not meet required protocol - this score shall be received if no information is present. For example, if there is no faulting information in the DQMP, and the state does not clarify whether there are concrete pavements in that state, a score of 0 shall be assigned to all faulting metrics.
10	N/A - No information is required for this DQMP, if this score is chosen a description of why it does not apply must accompany the score in the notes section.
11	Unclear - not clear whether the DQMP meets required protocol - the reviewer is unsure if there are critical components missing - not scored, further information needed, explanation on what is unclear is required in the notes section.
12	
13	Responsibility: This section clarifies which party is responsible for the specific task. This will aid in evaluating current practices with Vendor or SHA self-collected data against the new guidelines.
14	1 - Agency - The SHA/agency
15	2 - Vendor - The vendor completed the task
16	3 - Third Party - A third party completed the task
17	4 - Unclear - The task is not clearly defined
18	
19	Referenced Protocol: Protocol that the State DQMP references - should match required protocol when applicable
20	AASHTO - conform with required AASHTO specification - note that AASHTO Provisionals have been updated as follows: AASHTO PP 70 is now R 88 AASHTO PP 69 is now R 87 AASHTO PP 68 is now R 86 AASHTO PP 67 is now R 85
21	States may reference either in the DQMP HPMS Field Manual - conform with the HPMS Field Manual
22	23 CFR Part 490
23	Practical Guide for Quality Management of Draft Condition Data Collection
24	NCHRP's Synthesis 401 Quality Management of Pavement Condition Data Distress Identification Manual for Long Term Pavement Performance Program
25	
26	State specific - State has developed their own protocol

103 Items!

Draft

Scores | ChangeLog

Why QMP Review Cards

- Objective review – independent of reviewer
- Efficient review –efficiently in defining what is required
- Allow for direct comparison – in spite of different QMP formats, layout, etc.
- Transparent reviewing
 - Tool for “QC” of review or to quickly find more information for literature
 - Tool to give back to SHA for revisions and track improvements/outstanding issues

Categories of QMP Review Cards

1. Data Collection Equipment Calibration and Certification:

2. Certification Process for Persons Performing Manual Data Collection:

3. Data Quality Control Measures to be Conducted Before Data Collection Begins and Periodically During the Data Collection Program:

4. Data Sampling, Review, and Checking Processes:

5. Error Resolution Procedures and Data Acceptance Criteria:

Part of Category 1

1. Data Collection Equipment Calibration and Certification		
PM2 Rule Pavement Condition Metrics Testing Protocols		
DQMP should include a description of how the State DOT is collecting the pavement condition metrics to be reported in HPMS - if required protocol is not met the state should re		
Metric	Does DQMP include the following regarding data collection and computation?	Required Protocol
IRI	IRI collection device in accordance with:	AASHTO M328-14
IRI	Collection of IRI data in accordance with:	AASHTO R57-14
IRI	Quantification of IRI data in accordance with:	AASHTO R43-13 MRI reported
Cracking	For asphalt: collection of pavement surface images in accordance with:	AASHTO PP68-14/R86 with modifications specified in the HPMS Field Manual
Cracking	For asphalt: quantification of cracking in accordance with:	AASHTO R55-10 with modifications specified in the HPMS Field Manual OR AASHTO PP67-14/R85 with modifications specified in the HPMS Field Manual
Cracking	For jointed concrete pavements: quantification of cracking in accordance with:	HPMS Field Manual
Cracking	For continuously reinforced concrete pavements: quantification of cracking in accordance with:	HPMS Field Manual
Cracking	For all pavements: Computation of cracking percent in accordance with:	HPMS Field Manual
Rutting	Collection and quantification of rut depth values conforming to:	AASHTO R48-10 with modifications specified in HPMS Field Manual
Rutting	OR (only one method is required to meet the PM2 rule - a score of N/A should be used for one of the methods) Collection of transverse pavement profiles in accordance with:	AASHTO PP70-14/R88 with modifications specified in HPMS Field Manual
Rutting	Quantification of rut depth values in accordance with:	AASHTO PP69-14/R87 with modifications specified in HPMS Field Manual
Calibration	Does DQMP include the following regarding equipment calibration?	
The DQMP should describe how each piece of equipment and its subsystems (DMI, GPS, Video, etc.) will be tested and calibrated. Control sites with known values are typically used. Calibrations involving equipment adjustments are typically performed by the equipment manufacturer. QC processes should include verification of original calibration through		
Metric	Does DQMP include the following regarding equipment calibration?	Required Protocol
IRI	Calibration of inertial profiling system in accordance with:	AASHTO R57-14
IRI	Complete explanation of calibration of data collection equipment subsystems - fill out matrix for subsystems →	
Cracking	Complete explanation of calibration of data collection equipment subsystems - fill out matrix for subsystems →	
Rutting	Complete explanation of calibration of data collection equipment subsystems - fill out matrix for subsystems →	
Faulting	Complete explanation of calibration of data collection equipment subsystems - fill out matrix for subsystems →	
All	Responsible person assigned to calibration procedure and providing State DOT with certificate or proof of calibration	
All	Identifies frequency of routine calibration	
All	Identifies number, length, type of pavement(s), and range of condition values of control sites	
All	Identifies the equipment and ground reference used for calibration/certification.	
All	State DOT reviews, approves, and keeps record of calibration documentation	
Certification	Does DQMP include the following regarding equipment certification?	

Other Key Feature - Responsibility

Clarify which party is responsible for the specific task. This will aid in evaluating current practices with Vendor or SHA self-collection and data quality control, acceptance, and assurance

- 1 - Agency - The SHA/agency completes the task
- 2 - Vendor - The vendor completes the task
- 3 - Third Party - A third party completes the task
- 4 - Unclear - The task is not clearly assigned

Other Key Feature – Matrix of Subsystems

- Consider different possible subsystems for data collection equipment and required calibrations.

Equipment Subsystem Calibration

The following matrix shows the different possible subsystems for data collection equipment and required calibrations. An overall score of 2 shall be applied if the DQMP references calibrations for all required subsystems for the metric. An overall score of 1 shall be applied if only one subsystem calibration receives a score of "No" for the metric. An overall score of 0 shall be applied if more than 1 subsystem calibration receives a score of "No" for the metric. An overall score of "unclear" may be applied if all subsystems receive "yes" or "unclear", with up to one "No" for the metric. An overall score of N/A may be applicable for faulting if the DQMP states there are no PCC pavements.

Subsystem:	IRI	Cracking	Rutting	Faulting
Inertial Profiler				
Height Sensor				
Accelerometer				
3D camera/sensor				
Calibration of distance measurements (range checks)				
Calibration image (optical checks)				
DMI				
GPS				
2D camera/sensor				
Calibration image (optical checks)				
Other (e.g., rut bar)				
Overall score (copied to main scorecard automatically)				

Referenced Protocol

- AASHTO Specs
- HPMS Field Manual
- 23 CFR Part 490
- Practical Guide for Quality Management of Pavement Condition Data Collection
- NCHRP's Synthesis 401 Quality Management of Pavement Condition Data
- Distress Identification Manual for Long Term Pavement Performance Program
- State-Specific
- Others (Explain)

Usage of QMP Review Cards

Orange cells must be completed by the rater using one of the options in the drop down menu.

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Yellow cells are for page references, notes, and descriptions. It is critical to give a reference page to where the information was found for future review.

For consistency, use page document assigned by the pdf reader (adobe or other), as documents may have inconsistent page formats.

Required Protocol	Referenced Protocol
AASHTO M328-14	AASHTO M328-14
AASHTO R57-14	AASHTO M328-14
AASHTO R43-13 MRI reported	State specific
AASHTO PP68-14/R86 with modifications specified in the HPMS Field Manual	Other (explain)
	State specific

Potential Usage of QMP Reviews

- Show areas that FHWA can provide support/training to improve QMP.
- Shared during Peer Exchanges to obtain further feedback from SHAs and to identify common issues/opportunities and potential resolutions.

Review Relevant Projects



RESEARCH PROJECT

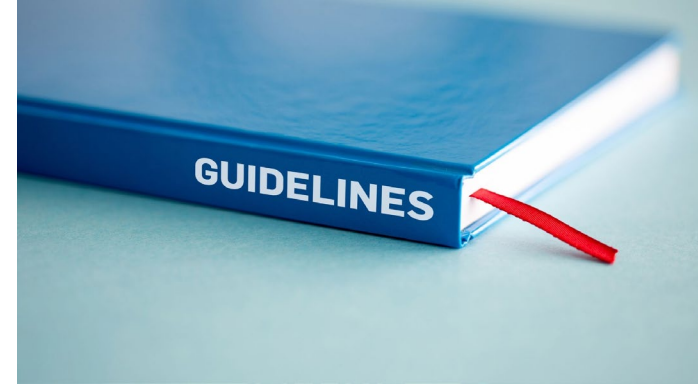
- TPF-5(299)/FHWA: Development of Standard Data Format for 2-Dimensional and 3-Dimensional (2D/3D) Pavement Image Data used to determine Pavement Surface Condition and Profiles,
- TPF-5(299)/FHWA: Following Contract for Independent Evaluation of Standard Data Format for 2-Dimensional and 3-Dimensional (2D/3D) Pavement Image Data used to determine Pavement Surface Condition and Profiles,
- TPF-5(299)/FHWA: Developing Guidelines for Cracking Assessment for Use in Vendor Selection Process for Pavement Crack Data Collection/Analysis Systems and/or Services,
- NCHRP 01-57A: Standard Definitions for Comparable Pavement Cracking Data (AASHTO R 85),
- NCHRP Project 20-05/Topic 49-15 Synthesis: Automated Pavement Condition

Review Relevant Projects (cont'd)

RESEARCH PROJECT

- NCHRP 20-07/Task 411: Determine Pavement Deformation Parameters and Cross Slope from Collected Transverse Profiles (Reviewing and Updating AASHTO R87)
- TPF-5(299)/FHWA Calibration, Certification, and Verification of Transverse Pavement Profile Measurements,
- NCHRP 01-60 Measuring the Characteristics of Pavement Surface Images and Developing Standard Practices for Calibration, Certification, and Verification of Imaging Systems,
- TPF-5(299)/FHWA Joint Concrete Pavement Faulting Collection and Analysis Standards (AASHTO R36)

Draft QMP Guidelines



- A living document that is easy to update as data collection practices evolves;
- Improve current QM practices by establishing standards for developing data QMPs;
- Improve the accuracy, precision, and reliability of data collection by agencies; and
- Improve agency's cost-effectiveness of data collection and analysis processes.

Develop QMP Guidelines

1. **Establishing basic criteria** used to identify pavement surface condition data to collect and analyze in support of the SHA's decision-making processes and recommended data elements as a function of intended uses.
2. Identifying and documenting **standards** used to establish QC, QA, acceptance criteria, and independent verification procedures for each of the pavement surface condition data items from step 1.
3. Documenting **testing and analysis procedures** used to select and set-up reference or certification test sites, verification sites, blind test sites, equipment and operators training and certification.

Develop QMP Guidelines (continue)

4. Detailing development of other methods and procedures, as appropriate, for pavement surface condition data collection and analysis, meeting the following characteristics: They are **traceable, objective, practical, and transparent**, and Developed in an open and transparent manner to ensure results are independent and do not include a commercial bias.
5. Supporting implementation of clear and proactive measures to **mitigate or remove bias or favoritism** that may exist, or be perceived to exist, in the outcomes.
6. Documenting and recommending **effective statistical analysis** procedures to analyze the data and verify that test results are within the allowed tolerances.

Develop QMP Guidelines (continue)

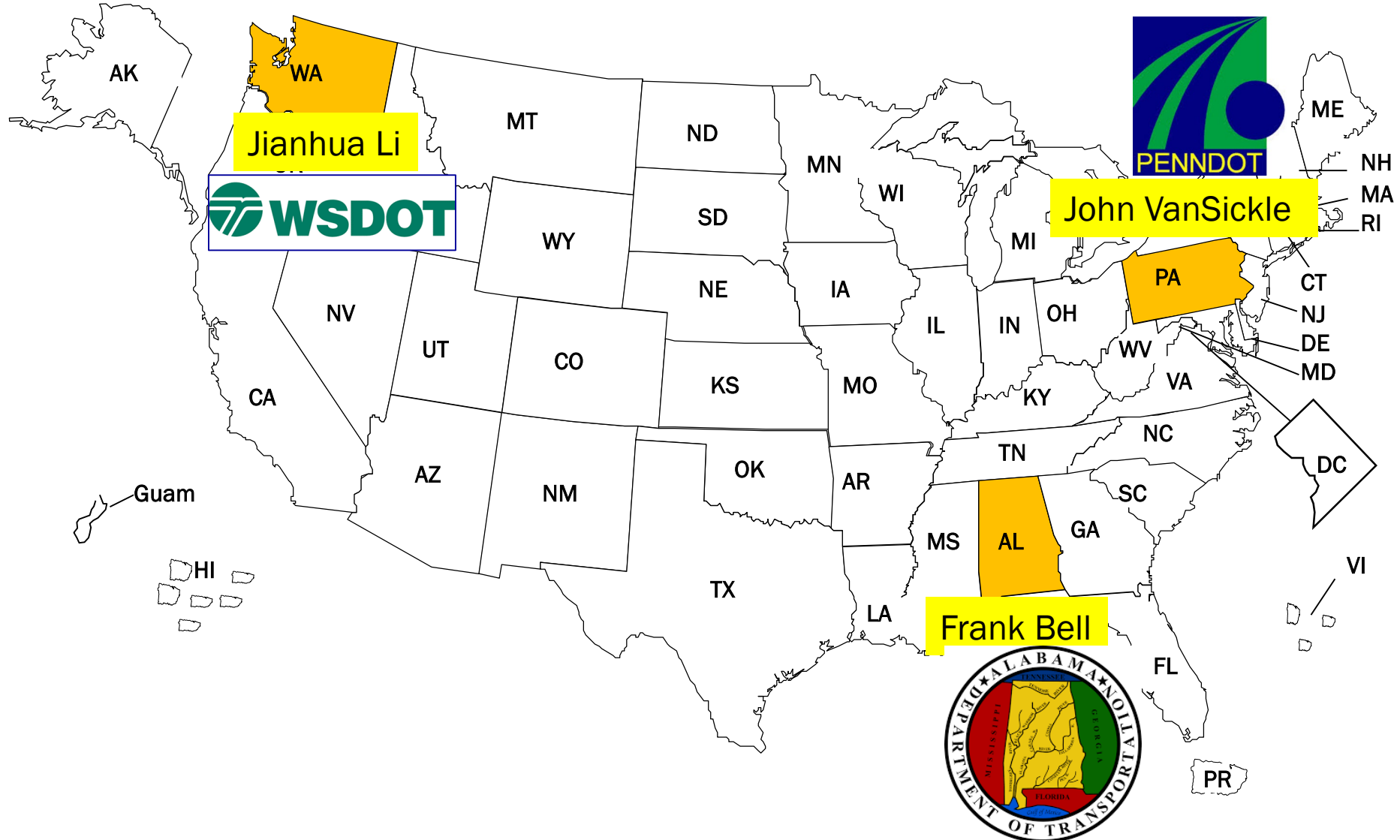
7. Providing **case scenarios and other examples** to further support understanding and implementation of the guidelines contained in steps 1 through 6.



Develop Work Plan for Pilot Projects

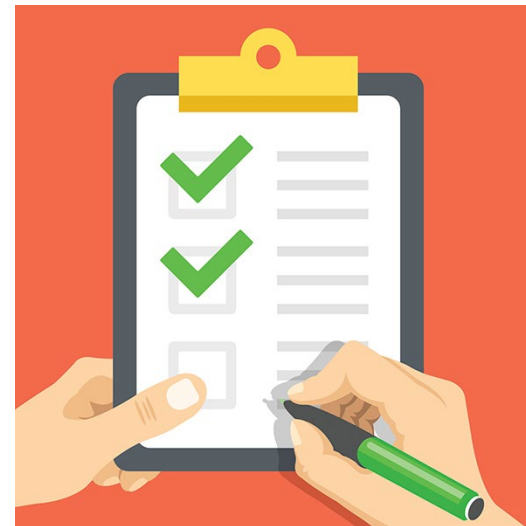
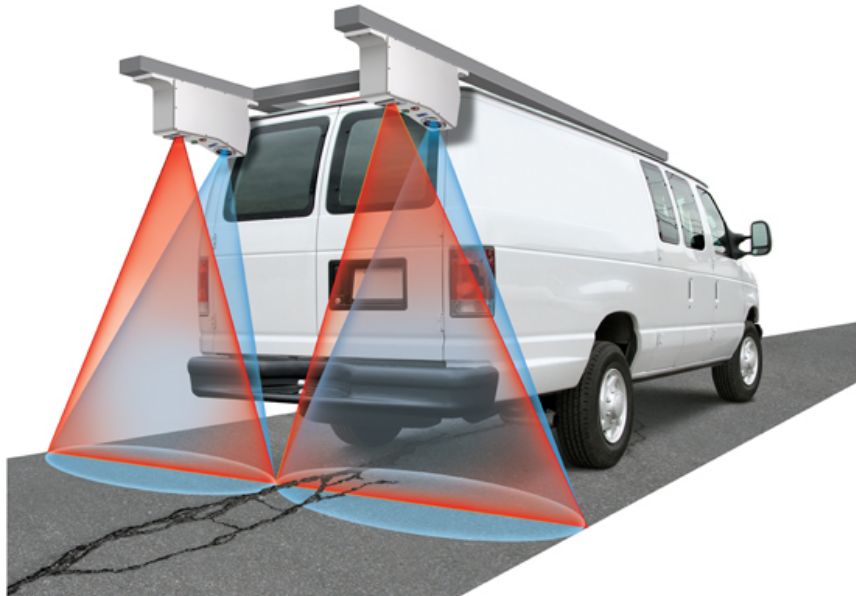
- Communications and coordination with all parties involved.
- Establishment of field experimental design.
- Selection of adequate equipment or personnel for collection of reference pavement surface condition data and actual collection of reference data.
- Collection of pavement surface condition data by the DCC.
- Analysis/comparison of reference and vendor pavement surface condition data and, as appropriate, issue resolution.

Pilot Projects

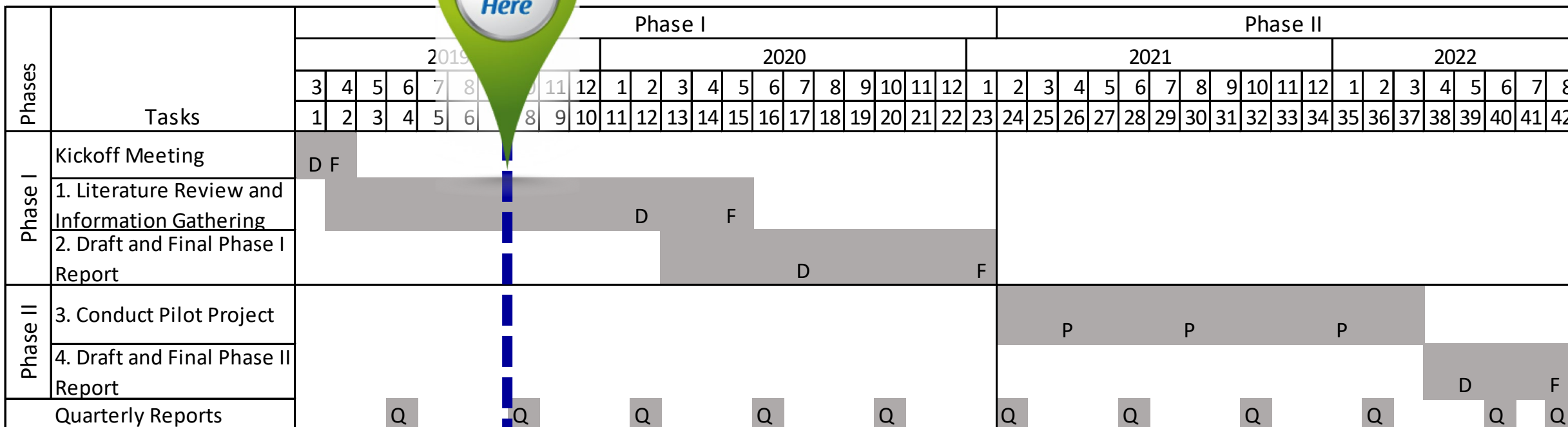


Conduct Pilot Projects

1. Selection of Test Sections
2. Field Data Collection and Certification
3. Quality Monitoring and Data Analysis
4. Recommend Modifications to QMP Guidelines

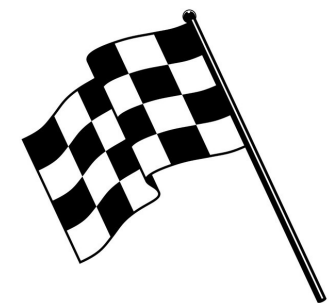


Next Steps?



Legends:

- [Grey square] Research team effort
- D Draft project deliverables
- F Final project deliverables
- P Pilot projects (actual schedule depends on SHA's arrangement)
- Q Quaterly reports



To Meet State DOTs' Needs on QMP!

Thank You!





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