

# Automated Pavement Data Collection – QC/QA Practices

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# Presentation Topics

- ◆ Importance of Quality Data
- ◆ Overview of QC/QA Activities
- ◆ Field Activities
- ◆ Data Processing Activities
- ◆ Data Acceptance Activities
- ◆ QA Tools in Oklahoma

# Importance of Quality Data

Pavement  
Condition Data

→ Calculation of  
Condition Indexes

→ Development of  
Deterioration Models

→ Prediction of Future  
Conditions

→ Development of  
Treatment  
Recommendations

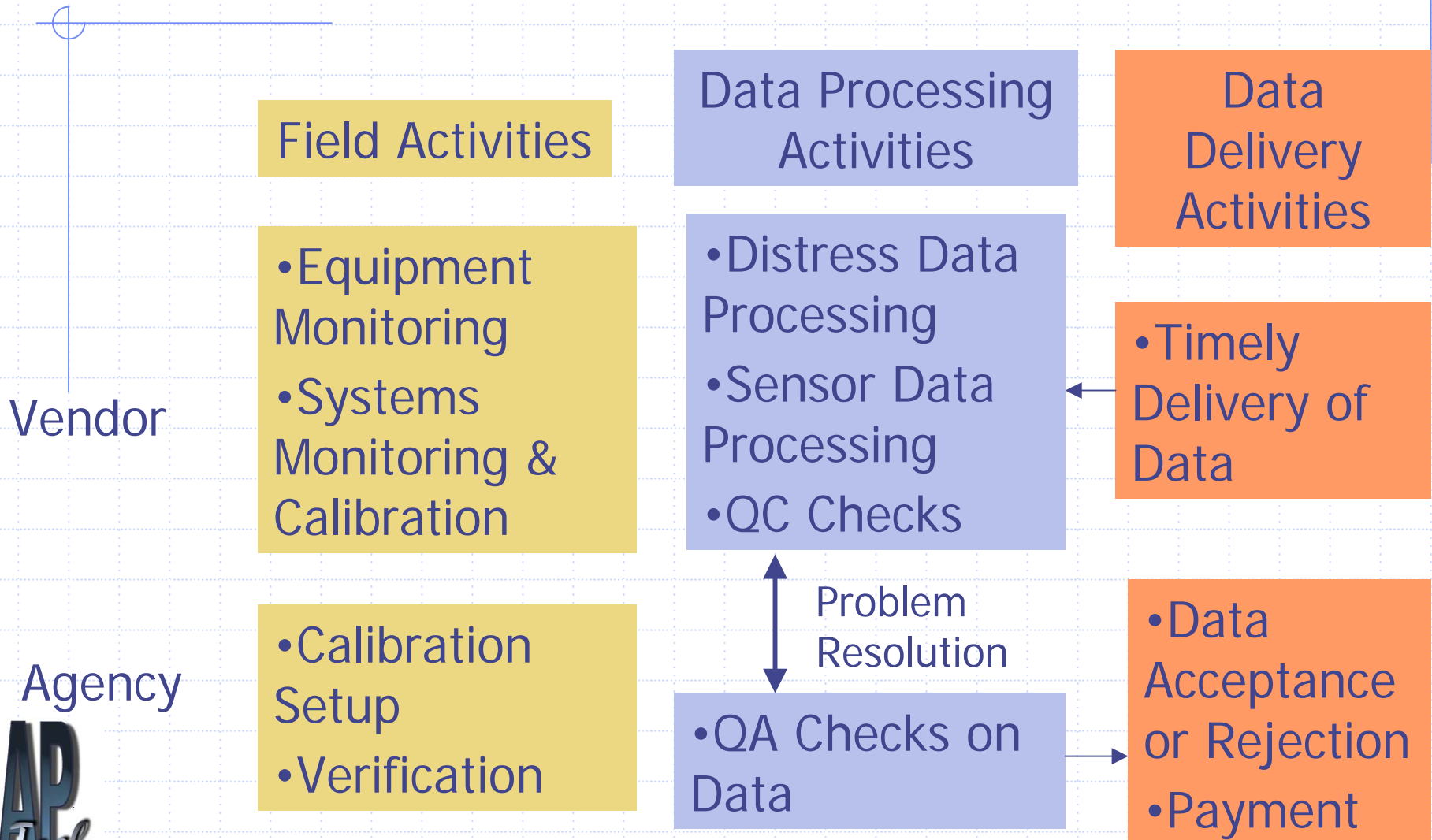
# Recognizing Variability

- ◆ Variability in pavement conditions
- ◆ Procedures used to collect pavement condition information
  - Subjectivity
  - Automated versus manual
  - Sampling rate
- ◆ Rater consistency
- ◆ Other factors

# What Level of Variability is Acceptable?

- ◆ How will the data be used?
  - Network level versus project level
- ◆ What level of variability is reasonable?

# Overview of QC/QA Activities



Agency

# Field Activities – Before Surveys

- ◆ Calibration of vendor to agency definitions
  - Calibration sites
- ◆ Test field procedures
  - Safety
  - Proper equipment operation
- ◆ Vendor must pass to proceed



# Establish Acceptability Requirements

| <b>DATA ELEMENT</b>           | <b>REQUIRED MINIMUM ACCURACY</b>                              | <b>REQUIRED RESOLUTION (Measure to the Nearest)</b> | <b>REQUIRED MINIMUM REPEATABILITY</b>            |
|-------------------------------|---|---|--|
| Rut Depth                     | +/- 0.08 inches compared to manual survey                     | 0.01 inch   | +/- 0.08 inches run to run for three repeat runs |
| International Roughness Index | +/- 5% compared to Rod & Level, Dipstick, or Class I profiler | 1 in/mi   | +/- 5% run to run for three repeat runs          |
| Faulting                      | +/- 0.04 inches compared to manual survey                     | 0.01 inch   | +/- 0.04 inches run to run for three repeat runs |

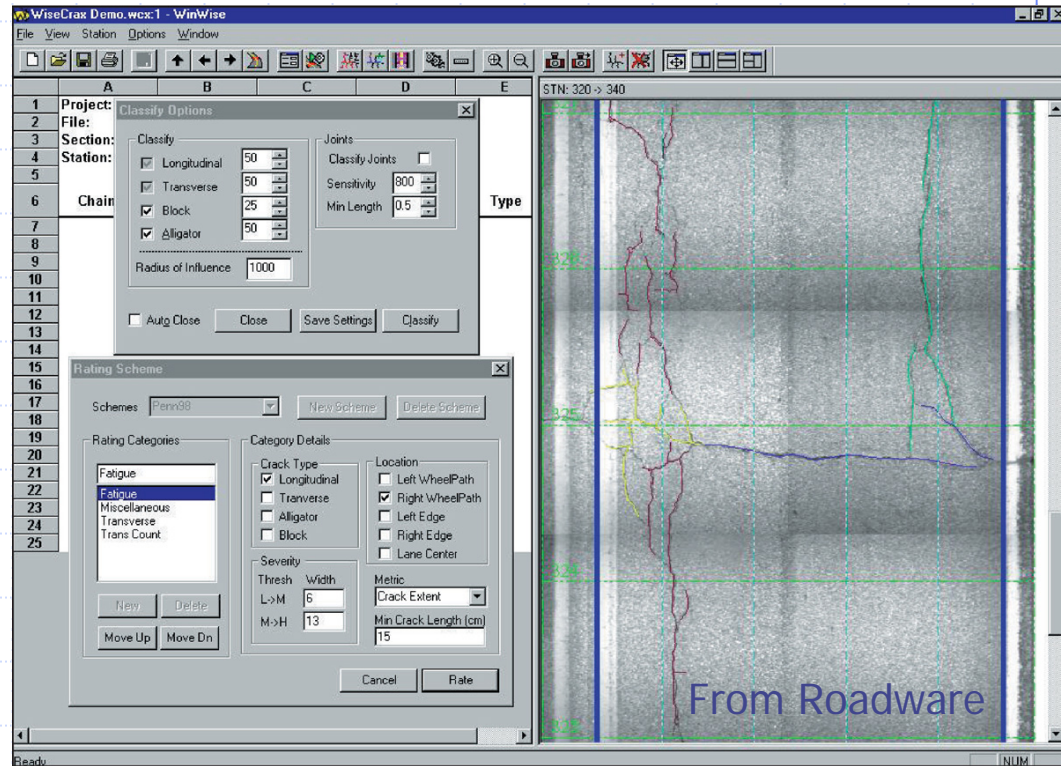


# Field Activities – During Surveys

- ◆ On-board verification and validation checks
  - Flag incorrect values
- ◆ Data continuity checks
  - Check for breaks in the data
  - Check for correct location references
- ◆ Periodic calibration checks

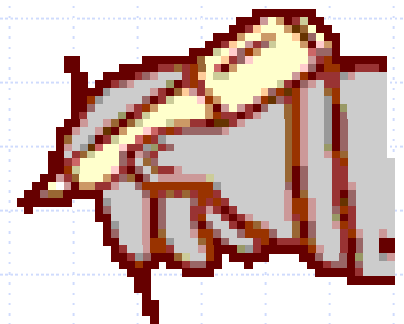
# Data Processing Activities - Vendor

- ◆ Training on distress ID
- ◆ Distress identification
- ◆ Sensor processing
- ◆ QC checks



# Data Processing Activities - Agency

- ◆ QA checks by agency
  - Sample size
- ◆ Resolution of differences with vendor



# Agency QA Checks


- ◆ Consistency
- ◆ Completeness
- ◆ Uniqueness of key fields
- ◆ Data reasonableness
- ◆ Acceptable data ranges

# Data Delivery Activities

- ◆ Vendor is responsible for timely delivery of data in the proper format
- ◆ Agency is responsible for accepting or rejecting the data

# Oklahoma DOT Pavement Data QA Tool

**ODOT QA Tool: Main Menu**



## Oklahoma Department of Transportation *PMS Data Quality Assurance (QA) Investigator*

This tool provides the Oklahoma Department of Transportation (ODOT) with a systematic approach for the conduct of their quality assurance (QA) procedures to check automated data collection results.

**Database Setup**

**Establish Table Links**

Prior to conducting QA checks, the database (DB) manager must format the condition DB on the server. Once complete, each user must first link to the database using the "Establish Table Links" button.

Database Link: `\\Cmisrv\projects\2001\01-074-RM06 Development of QC Procedures\QA Tool Development\NEW Development Files 05-05-05\MainDatabaseSample.mdb`

**QA Checks**

Note: 'Preliminary Checks' and the 'Sensor Data Checks' should be completed before Distress Checks.

**Set Valid Variable Data Ranges**

**Preliminary Checks**

**Conduct Preliminary Checks**

**Sensor Data Checks**

**Conduct Sensor Data Checks**

**Distress Checks**

**Division Selector**  
Select the division on which to run distress checks.

Division:

**Distress Check Type**

- AC or COMP Distress Data
- ICP Distress Data
- CRCP Distress Data
- Special Checks

**AC/Composite Pavement Distress Category**

- ALL AC/COMP DISTRESS GROUPS
- Transverse Cracking
- Alligator Cracking
- Miscellaneous Cracking
- Raveling
- Patching

Hide Ignored Values

**Generate Category Report**

**View Summary Report**

# Database Linking

**ODOT QA Tool: Establishing the Database Links**

## Establishing the Database Links

Establishing links to the main database is critical to ensure that data is properly retrieved from, and stored in, the main database. To setup the tool on your computer, please follow the steps below to link all needed tables. After establishing the links, click the 'Return to Main Page' button to return to the main page and begin the QA checks.

**Step 1:** Click the 'Establish Table Links' button to bring up the 'Access' interface that allows you to link to the master database on the server.

**Step 2:** Use the interface to navigate to the master database location and select "Link" on the dialog box. This will populate a list of tables within the database to which you can link.

**Step 3:** Link to the following tables by in the main database:  
'All Sections'; 'QC Documentation Data'; 'Structures'; 'Track Count'; 'Condition'; 'Ignored Values';  
'Corrected NLF\_ID GPS'

Click the "OK" box to establish the links between the QA tool and the main database.

**Step 4:** Select the specific table names from the provided lists of linked tables to ensure that the correct tables will be used in the analysis. Note: that during the linking process, 'Access' will add an integer to the end of a linked table name if you current database contains an existing table with the same name.

Database name: \\Cmisrv\projects\2001\01-074-RM06 Development of QC Procedures\QA Tool Development\NEW Development Files 05-05-05\MainDatabaseSample.mdb

'All Sections' table:

'QC Documentation' table:

'Structures' table:

'Track Count' table:

'Condition' table:

'Ignored Values' table:

'Corrected NLF\_ID GPS' table:


**Database Manager Utilities** To access the Database Manager utilities, click on the button to the left. Note: a password is required to gain access to these utilities.

Save Links and Close

Establish Table Links

# Setting Data Ranges

ODOT QA Tool: Valid Data Ranges

 Oklahoma Department of Transportation  
**PMS Data Quality Assurance (QA) Investigator**  
Valid Variable Value Ranges

Save Values

General Fields | **Sensor Data Fields** | HMA Distress Fields | JCP Distress Fields | CRCP Distress Fields

| Data Element | Low Value | High Value | Data Element | Low Value | High Value |
|--------------|-----------|------------|--------------|-----------|------------|
| SURVEY DATE  | 3/1/2002  | 1/2/2005   | FAULT_AVG    | 0         | 1          |
| SENSORS      | 31        | 31         | FAULT_MAX    | 0         | 1          |
| IRI_RT       | 30        | 600        | FAULT_DEV    | 0         | 0.4        |
| IRI_LT       | 30        | 600        | FAULT_CNT    | 0         | 31         |
| IRI_AVG      | 30        | 600        | TEXTURE      | 0         | 2          |
| RUT_AVG      | 0         | 1.25       |              |           |            |
| RUT_MAX      | 0         | 2          |              |           |            |
| RUT_1        | 0         | 100        |              |           |            |
| RUT_2        | 0         | 100        |              |           |            |



# Checks for Duplicate Data

**Preliminary Check - GPS Duplicate Check** [Close]

GPS Duplicate Check

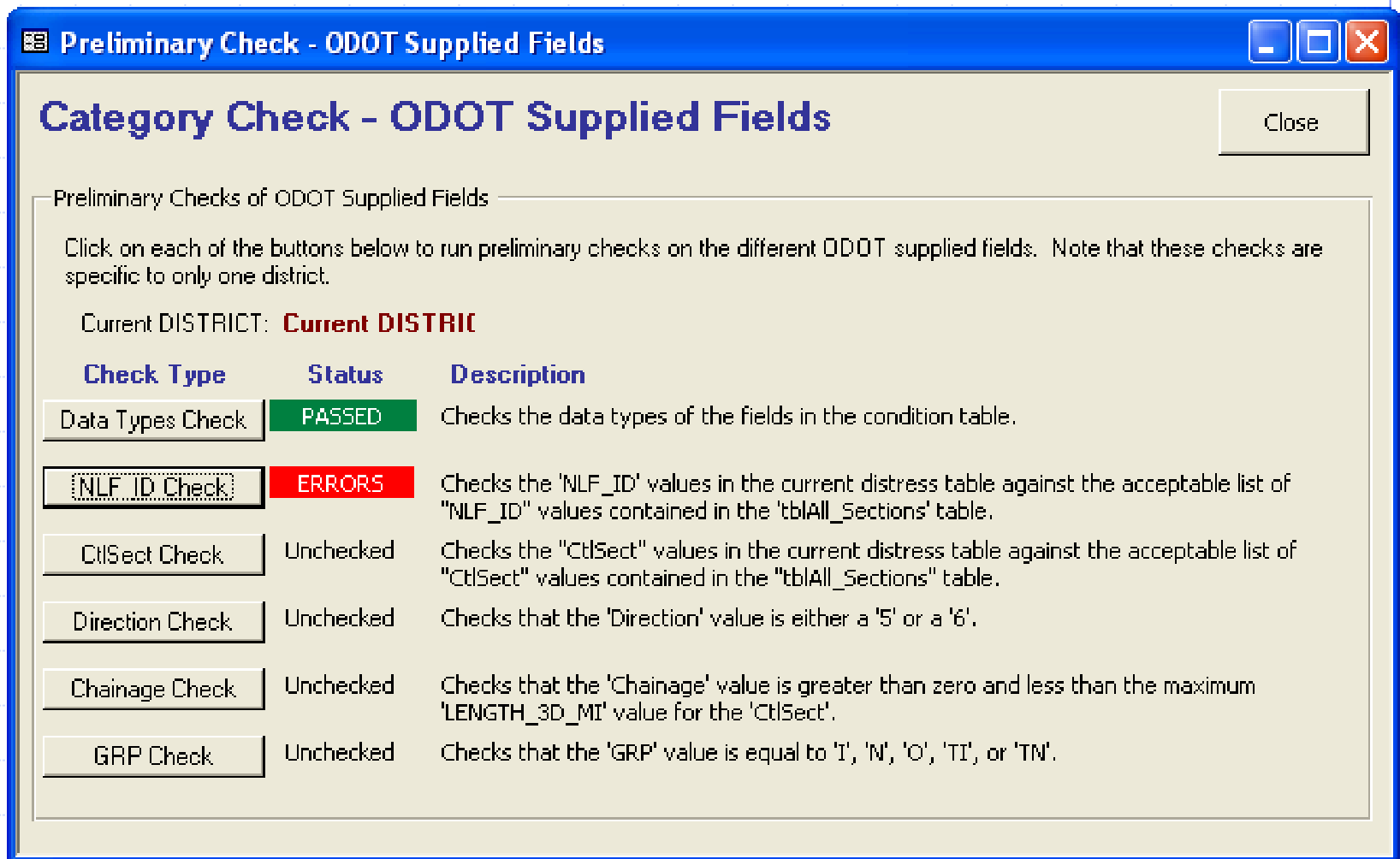
The following table contains groups of duplicate latitude or longitude values. The FKEY value is included as a reference to make these duplicate values more visible.

|   | Fkey | CtlSect | Direction | Chainage | Latitude | Longitude |
|---|------|---------|-----------|----------|----------|-----------|
| ▶ | 5    | 03-02   | 5         | 0.04     | 34.15775 | 1800      |
|   | 6    | 03-02   | 5         | 0.05     | 34.15788 | 1800      |

Record: [Navigation icons] 1 of 2

Record: [Navigation icons] 1 of 2

# Checks of Supplied Data



**Preliminary Check - ODOT Supplied Fields**

**Category Check - ODOT Supplied Fields** Close

Preliminary Checks of ODOT Supplied Fields

Click on each of the buttons below to run preliminary checks on the different ODOT supplied fields. Note that these checks are specific to only one district.

Current DISTRICT: **Current DISTRICT**

| Check Type          | Status        | Description   |
|---------------------|---------------|---|
| Data Types Check    | PASSED        | Checks the data types of the fields in the condition table.   |
| <b>NLF_ID Check</b> | <b>ERRORS</b> | Checks the 'NLF_ID' values in the current distress table against the acceptable list of "NLF_ID" values contained in the 'tblAll_Sections' table.   |
| CtlSect Check       | Unchecked     | Checks the "CtlSect" values in the current distress table against the acceptable list of "CtlSect" values contained in the "tblAll_Sections" table. |
| Direction Check     | Unchecked     | Checks that the 'Direction' value is either a '5' or a '6'.   |
| Chainage Check      | Unchecked     | Checks that the 'Chainage' value is greater than zero and less than the maximum 'LENGTH_3D_MI' value for the 'CtlSect'.                             |
| GRP Check           | Unchecked     | Checks that the 'GRP' value is equal to 'I', 'N', 'O', 'TI', or 'TN'.   |

# QA Interface

frm01a\_DetailedOutputCategoryReportGenerator : Form

Oklahoma Department of Transportation  
**PMS Data Quality Assurance Investigator**  
Detailed Report Generator for Data Categories

Produce Detailed Report

Return to Main Page

Use the controls below to 1) select the type of checks you wish to run, and 2) select the data items on which you wish to run. The combination of the two will determine the report that will be created.

Quality Check Types

- Data format
- Data acceptability
- Data completeness
- Data duplication
- Data range
- Data relationship

Data Element Categories

General Elements

- Pavement Type
- Geometrics
- Section/Sample ID
- Number of Slabs Joints
- Section Lengths

Sensor Data

- IRI
- Rutting
- Faulting
- Macrotexture

Distress Data Elements

- Transverse Cracking (AC, COMP, CRCP)
- Alligator Cracking (AC or COMP)
- Miscellaneous Cracking (AC or COMP)
- Patching
- Raveling (AC or COMP)
- Transverse Slab Cracking (JCP)
- Longitudinal Slab Cracking (JCP)
- Slabs w/ Multiple Cracks (JCP)
- Shattered Slabs (JCP)
- Corner Breaks (JCP)
- Spalling (JCP)
- D-Cracking (JCP)
- Longitudinal Cracking (CRCP)
- Punchouts (CRCP)

# Sensor Data Range Checks

**Sensor Data - Data Range Checks** Close

Section ID Information

CtlSect  Direction  Chainage

Date

| Var  | Value                                   | Valid Range          | Status        | Ignore?                  |
|------|---|----------------------|---------------|--------------------------|
| DATE | <input type="text" value="12/31/2003"/> | 3/1/2002 to 1/2/2005 | <b>Passed</b> | <input type="checkbox"/> |

Number of Sensors

| Variable | Value                           | Valid Range | Status        | Ignore?                  |
|----------|---------------------------------|-------------|---------------|--------------------------|
| SENSORS  | <input type="text" value="31"/> | 31 to 31    | <b>Passed</b> | <input type="checkbox"/> |

IRI Data

| Variable | Value                            | Valid Range | Status        | Ignore?                  |
|----------|----------------------------------|-------------|---------------|--------------------------|
| IRI_RT   | <input type="text" value=""/>    | 30 to 600   | <b>Blank</b>  | <input type="checkbox"/> |
| IRI_LT   | <input type="text" value="600"/> | 30 to 600   | <b>Passed</b> | <input type="checkbox"/> |
| IRI_AVG  | <input type="text" value="128"/> | 30 to 600   | <b>Passed</b> | <input type="checkbox"/> |

Faulting Data

| Variable  | Value                          | Valid Range | Status        | Ignore?                  |
|-----------|--------------------------------|-------------|---------------|--------------------------|
| FAULT_AVG | <input type="text" value="0"/> | 0 to 1      | <b>Passed</b> | <input type="checkbox"/> |
| FAULT_MAX | <input type="text" value="0"/> | 0 to 1      | <b>Passed</b> | <input type="checkbox"/> |
| FAULT_DEV | <input type="text" value="0"/> | 0 to 0.4    | <b>Passed</b> | <input type="checkbox"/> |
| FAULT_CNT | <input type="text" value="0"/> | 0 to 31     | <b>Passed</b> | <input type="checkbox"/> |

Rutting Data

| Variable | Value                             | Valid Range | Status        | Ignore?                  |
|----------|-----------------------------------|-------------|---------------|--------------------------|
| RUT_AVG  | <input type="text" value="0.21"/> | 0 to 1.25   | <b>Passed</b> | <input type="checkbox"/> |
| RUT_MAX  | <input type="text" value="0.29"/> | 0 to 2      | <b>Passed</b> | <input type="checkbox"/> |
| RUT_1    | <input type="text" value="100"/>  | 0 to 100    | <b>Passed</b> | <input type="checkbox"/> |
| RUT_2    | <input type="text" value="0"/>    | 0 to 100    | <b>Passed</b> | <input type="checkbox"/> |

Macrotexture Data

| Variable | Value                              | Valid Range | Status        | Ignore?                  |
|----------|------------------------------------|-------------|---------------|--------------------------|
| TEXTURE  | <input type="text" value="0.843"/> | 0 to 2      | <b>Passed</b> | <input type="checkbox"/> |

Record:       of 1

# Distress Data Range Checks

Distress Data - ALL AC and Composite Pavement Distress
X

Return to Main Page

## Category Check - AC and Composite Pavement Distress

Section ID Information

CtSect  Direction  Chainage

Transverse Cracking

| Variable | Value   | Valid Range | Status | Ignore?                  |
|----------|---|-------------|--------|--------------------------|
| TRANSV_1 | <span style="background-color: red; color: black;"> </span> | 0 to 10     | Blank  | <input type="checkbox"/> |
| TRANSV_2 | <span style="background-color: red; color: black;"> </span> | 0 to 10     | Blank  | <input type="checkbox"/> |
| TRANSV_3 | <span style="background-color: red; color: black;"> </span> | 0 to 8      | Blank  | <input type="checkbox"/> |
| TRANSV_4 | <span style="background-color: red; color: black;"> </span> | 0 to 5      | Blank  | <input type="checkbox"/> |

Miscellaneous Cracking

| Variable   | Value   | Valid Range | Status | Ignore?                  |
|------------|---|-------------|--------|--------------------------|
| MISC_1     | <span style="background-color: red; color: black;"> </span> | 0 to 52.8   | Blank  | <input type="checkbox"/> |
| MISC_2     | <span style="background-color: red; color: black;"> </span> | 0 to 52.8   | Blank  | <input type="checkbox"/> |
| MISC_3     | <span style="background-color: red; color: black;"> </span> | 0 to 52.8   | Blank  | <input type="checkbox"/> |
| Total MISC | <span style="background-color: red; color: black;"> </span> | 0 to 52.8   | Blank  | <input type="checkbox"/> |

Alligator Cracking

| Variable    | Value   | Valid Range | Status | Ignore?                  |
|-------------|---|-------------|--------|--------------------------|
| ALLIG_1     | <span style="background-color: red; color: black;"> </span> | 0 to 52.8   | Blank  | <input type="checkbox"/> |
| ALLIG_2     | <span style="background-color: red; color: black;"> </span> | 0 to 52.8   | Blank  | <input type="checkbox"/> |
| ALLIG_3     | <span style="background-color: red; color: black;"> </span> | 0 to 52.8   | Blank  | <input type="checkbox"/> |
| Total ALLIG | <span style="background-color: red; color: black;"> </span> | 0 to 52.8   | Blank  | <input type="checkbox"/> |

AC Patching

| Variable | Value  | Valid Range | Status       | Ignore?                  |
|----------|--|-------------|--------------|--------------------------|
| ACPATCH  | <span style="background-color: red; color: black;">6000</span> | 100 to 636  | Out of Range | <input type="checkbox"/> |

Raveling

| Variable | Value   | Valid Range | Status | Ignore?                  |
|----------|---|-------------|--------|--------------------------|
| RAVEL    | <span style="background-color: red; color: black;"> </span> | 0 to 0      | Blank  | <input type="checkbox"/> |

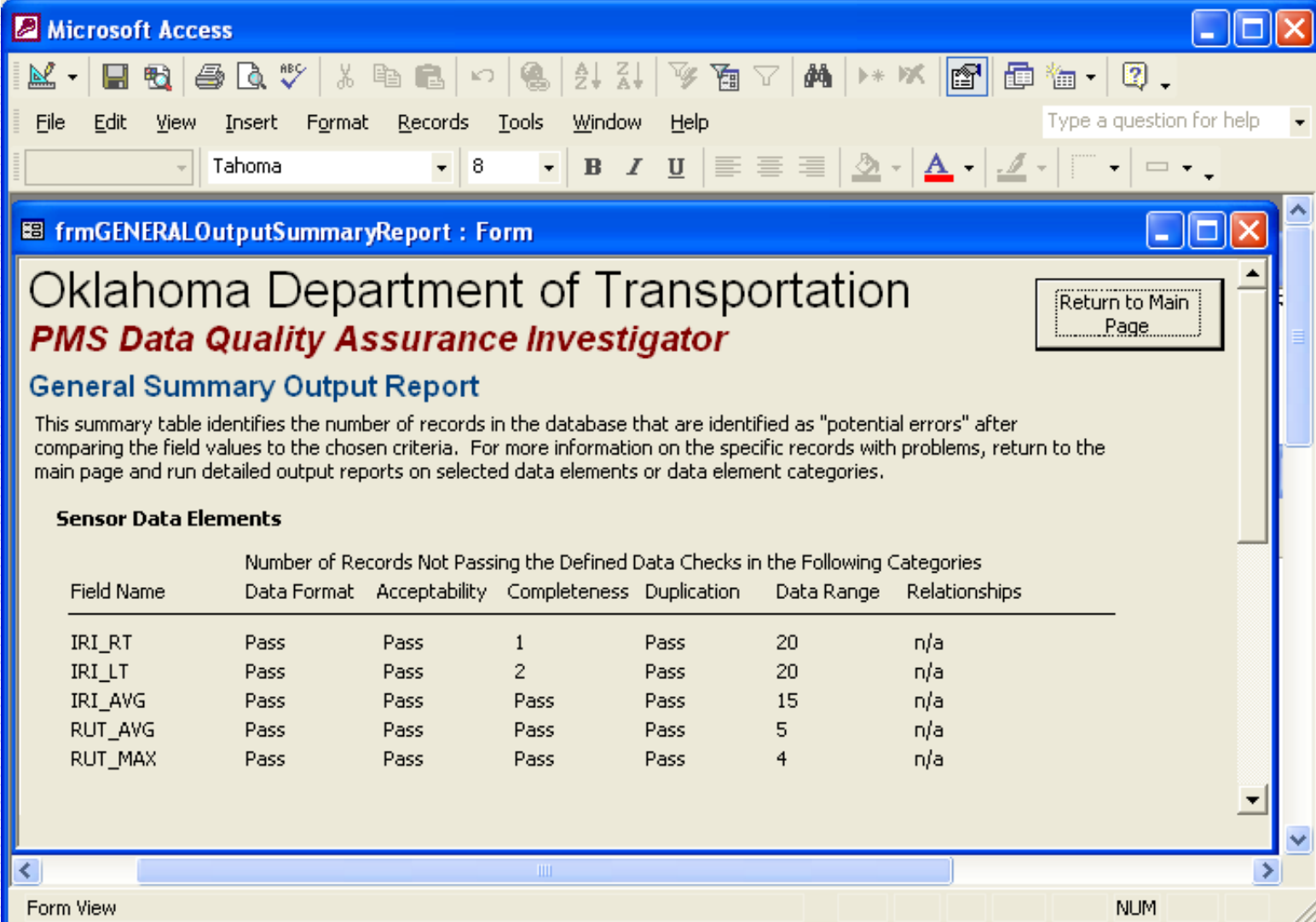
When 'TEXTURE' < 0.75, valid value for 'RAVEL' = 0  
 When 'TEXTURE' ≥ 0.75, valid range for 'RAVEL' = 0 to 53

TEXTURE  (for the current section)

Note: The 'Total ALLIG' will be blank if one of the corresponding individual values (e.g., ALLIG\_1) is blank. This is also the case for the 'Total MISC' value.

Record: 1 of 2

# Sensor Summary Report



Microsoft Access

File Edit View Insert Format Records Tools Window Help

Tahoma 8 B I U

frmGENERALOutputSummaryReport : Form

## Oklahoma Department of Transportation

### *PMS Data Quality Assurance Investigator*

#### General Summary Output Report

This summary table identifies the number of records in the database that are identified as "potential errors" after comparing the field values to the chosen criteria. For more information on the specific records with problems, return to the main page and run detailed output reports on selected data elements or data element categories.

[Return to Main Page](#)

#### Sensor Data Elements

Number of Records Not Passing the Defined Data Checks in the Following Categories

| Field Name | Data Format | Acceptability | Completeness | Duplication | Data Range | Relationships |
|------------|-------------|---------------|--------------|-------------|------------|---------------|
| IRI_RT     | Pass        | Pass          | 1            | Pass        | 20         | n/a           |
| IRI_LT     | Pass        | Pass          | 2            | Pass        | 20         | n/a           |
| IRI_AVG    | Pass        | Pass          | Pass         | Pass        | 15         | n/a           |
| RUT_AVG    | Pass        | Pass          | Pass         | Pass        | 5          | n/a           |
| RUT_MAX    | Pass        | Pass          | Pass         | Pass        | 4          | n/a           |

Form View NUM

# Detailed Outputs

Microsoft Access

frm00\_Introduction : Form

Detailed Output Form

Oklahoma Department of Transportation  
**PMS Data Quality Assurance Investigator**  
Detailed Category Output Report

Return to Detailed Report Generator

| CtlSect | Chainage | Direction | Field Name | Problem ID          | IRI_Rt | Valid Criteria    |
|---------|----------|-----------|------------|---------------------|--------|-------------------|
| 03-02   | 3.85     | 5         | IRI_RT     | Out of Range - HIGH | 566    | Range = 60 to 400 |
| 03-02   | 4.68     | 5         | IRI_RT     | Out of Range - HIGH | 587    | Range = 60 to 400 |
| 03-02   | 10.78    | 5         | IRI_RT     | Out of Range - LOW  | -1     | Range = 60 to 400 |
| 03-02   | 10.79    | 5         | IRI_RT     | Out of Range - LOW  | -1     | Range = 60 to 400 |
| 03-02   | 10.8     | 5         | IRI_RT     | Out of Range - LOW  | -1     | Range = 60 to 400 |
| 03-02   | 10.81    | 5         | IRI_RT     | Out of Range - LOW  | -1     | Range = 60 to 400 |
| 03-02   | 10.82    | 5         | IRI_RT     | Out of Range - LOW  | -1     | Range = 60 to 400 |
| 03-02   | 10.83    | 5         | IRI_RT     | Out of Range - LOW  | -1     | Range = 60 to 400 |
| 03-02   | 10.84    | 5         | IRI_RT     | Out of Range - LOW  | -1     | Range = 60 to 400 |
| 03-02   | 6.2      | 5         | IRI_RT     | Out of Range - LOW  | -1     | Range = 60 to 400 |
| 03-02   | 6.21     | 5         | IRI_RT     | Out of Range - LOW  | -1     | Range = 60 to 400 |
| 03-02   | 6.22     | 5         | IRI_RT     | Out of Range - LOW  | -1     | Range = 60 to 400 |

Record: 1 of 1

County-Control Section NUM

# Automated Data Collection QC/QA Recommendations

- ◆ Provide data quality requirements in the RFP
  - make vendor responsible for quality of data
- ◆ Verify that the vendor is following its QC plan
- ◆ Get distress data in batches
- ◆ Require an early submittal of the data
- ◆ Check any data delivered by vendor
- ◆ Avoid second party relationships to vendor