



Innovative Solutions to Keep the Aging PM2.5 FRM QA Process Current

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NC Department of Environment and Natural Resources
Division of Air Quality

National Ambient Air Monitoring Conference
Atlanta, Georgia
August 13, 2014



Criticisms

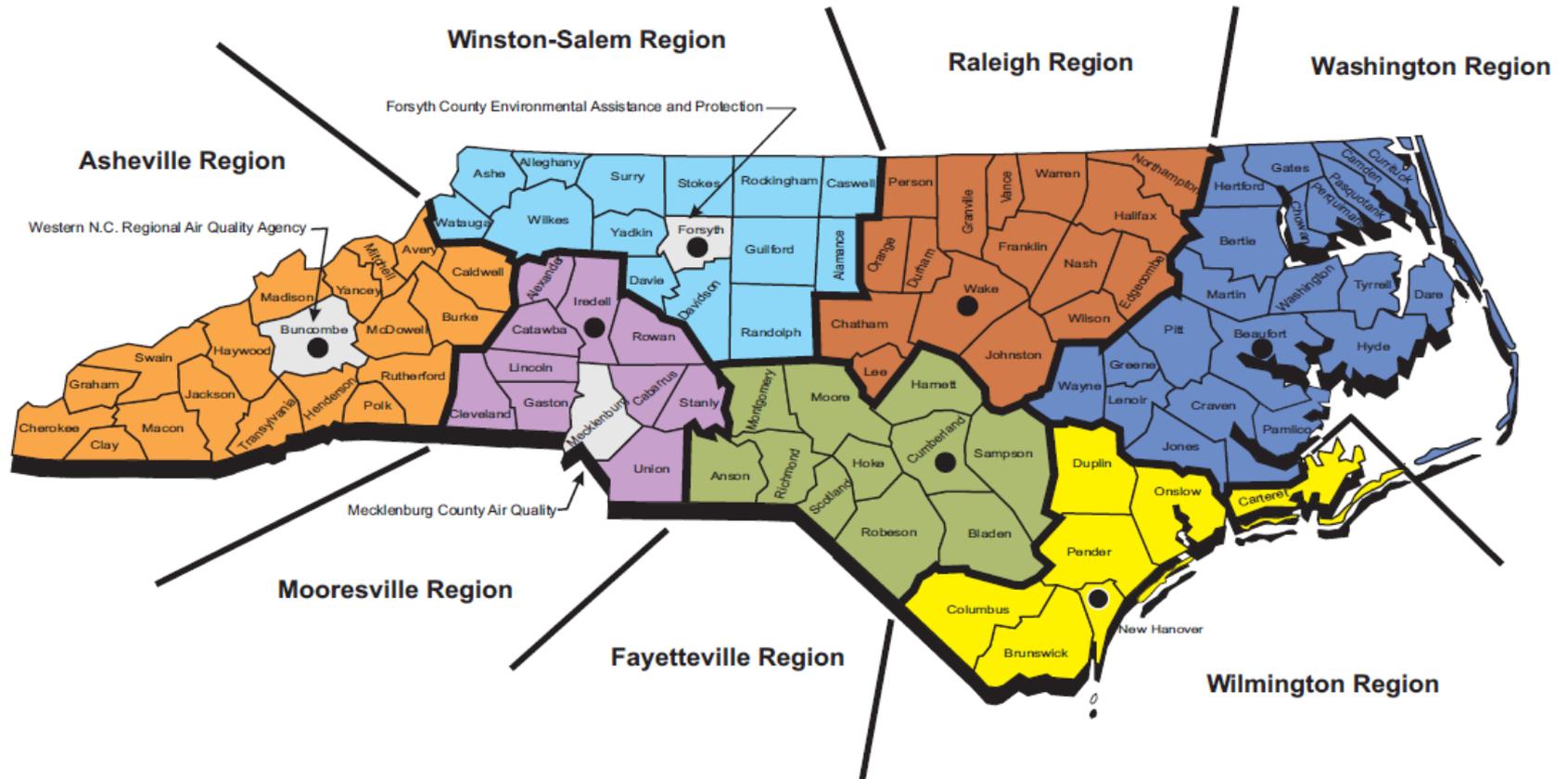
- **Question:** *My agency is replacing all of our manual PM2.5 samplers with BAMs. Why should I care about this presentation?*
- **Answer:** Even if you have one FRM within your agency, some of the following information might be helpful. If your agency has no FRMs, the information in this presentation can be extrapolated for other pollutants and methods.

Agenda

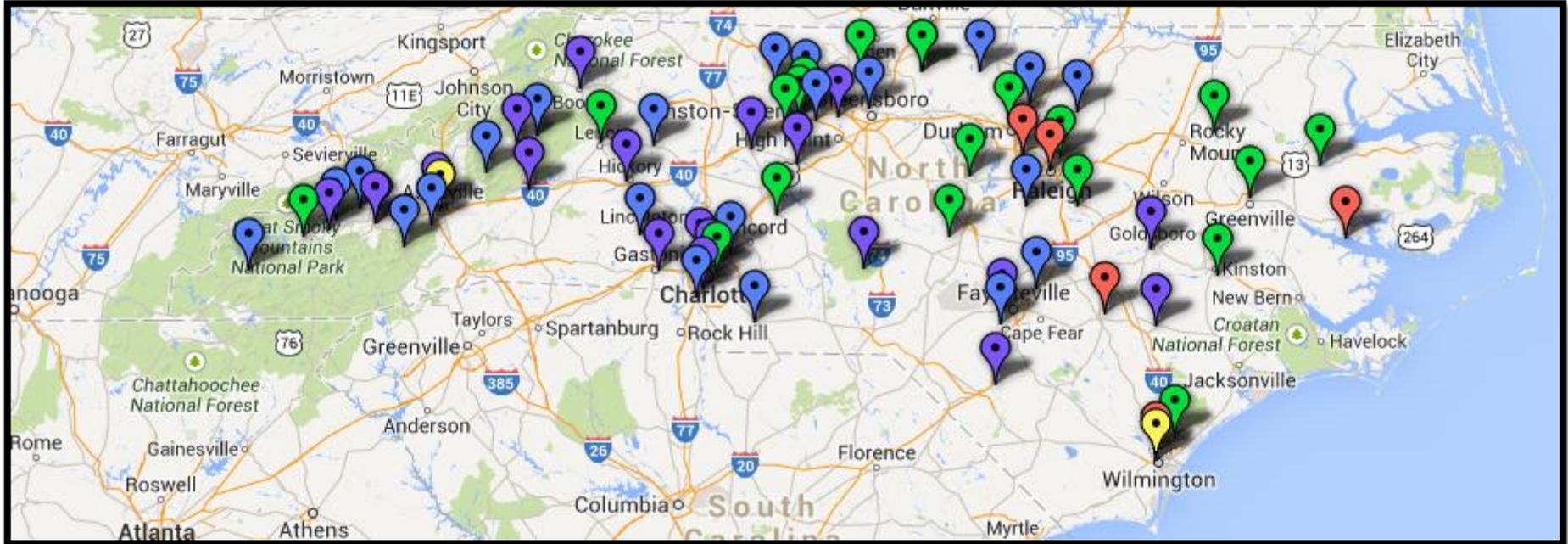
- NC DAQ Ambient Monitoring Background
- Review of EPA QA Requirements
- QA of PM2.5 Data
- Electronic Logbooks, Databases, Data Management
- “Updating” the R&P 2025 FRM
- Remote Connect, VPN, Helpful Hints
- Potential Criticisms

NC Ambient Monitoring Background

Ambient Monitoring in North Carolina

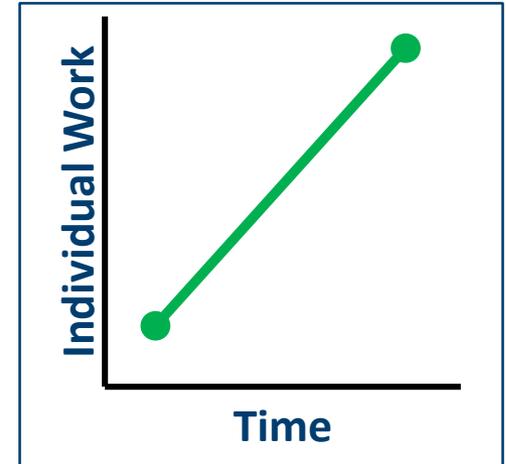
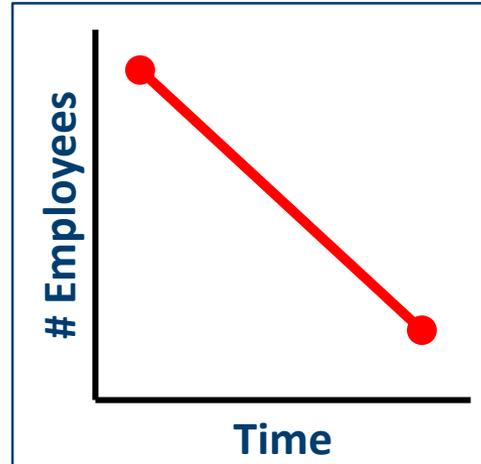
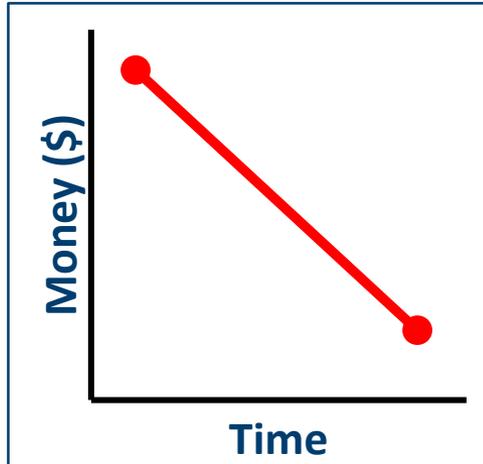


Ambient Monitoring in North Carolina



<http://www.ncair.org/monitor>

Let's face it....



**Disclaimer: Qualitative data. No necessarily scientific.
Just trust me.**

Innovative Methods for Data Analysis

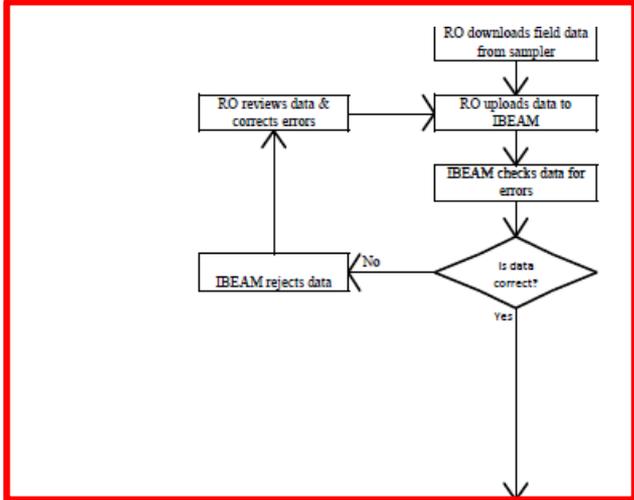
Ambient Monitoring in North Carolina (NCDAQ)

Pollutant	Number of DAQ Monitors
Ammonia	1
Low Volume PM10	2
High Volume PM10	5
Continuous PM2.5	17
Manual PM2.5	26
Nitrogen Dioxide	2
Ozone	32
Reactive Oxides of Nitrogen	1
Sulfur Dioxide	9
Trace Carbon Monoxide	1
Trace NO _y	2
Urban Air Toxics	4
Met Stations	9
TOTAL	111

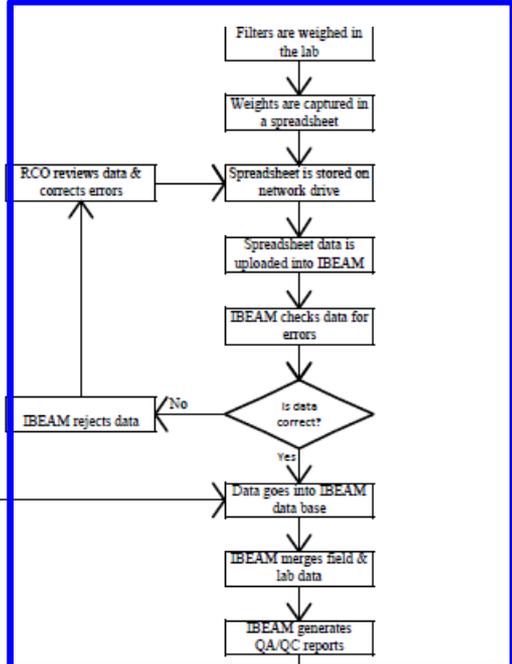
As of 8/4/14

NCDAQ PM2.5 FRM Network Concerns

1. Length of QA Feedback to Regional Operators
2. Cumbersome Regional Office QA
3. Documentation Issues
4. Technology Issues
 - Problems between regional offices
 - Compatibility problems with Office 2007, 2010, 365
5. Lengthy Quarterly QA Procedure
 - 3 different sets of data to QA

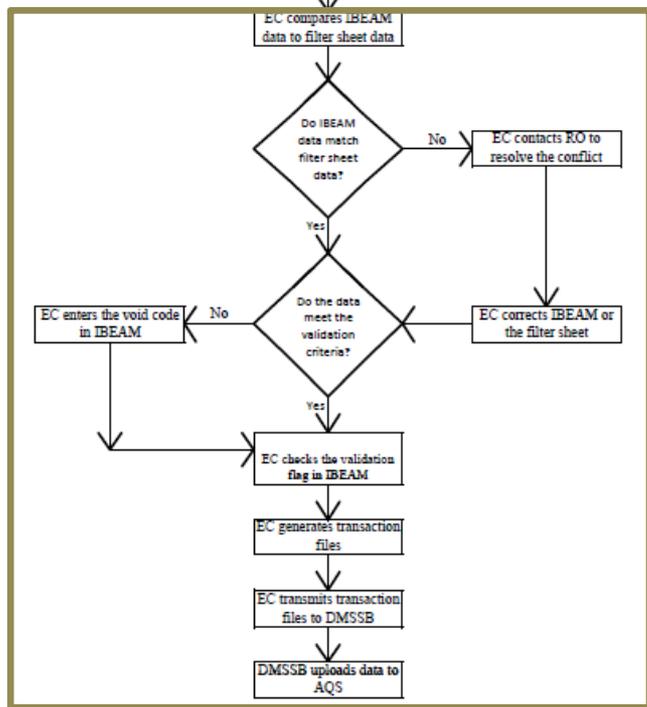


Regional Office



PM Laboratory

Central Office



Key to Abbreviations
 DMSSB = Data Management & Statistical Services Branch
 EC = Environmental Chemist
 RCO = Raleigh Central Office
 RO = Regional Office



Question: How many parameters need to be verified for each manual FRM sample?

1. Sampling to final weighing less than 30 days
2. Initial weighing to sampling less than 30 days
3. Filter removed from sampler less than 7 days 9 hrs after sampling
4. Filter temp upon arrival at the lab less than 25 degrees
5. Samples on scheduled dates (1 in 3 or 1 in 6)
6. Filter number on data sheet agrees with field download file
7. Run time 0:00 to 0:00; 23 to 25 hours
8. CV less than 2.0
9. Average flow rate between 15.9 to 17.5
10. Volume 23 to 25 m³
11. Max temp differential less than 5 degrees for no more than 30 mins
12. Temp/RH average between min and max
13. Site ID1 and Site ID2 agree
14. WINS cycle no more than 12
15. Field blanks 1/month/sampler
16. Field and Trip blanks net mass $\pm 30 \mu\text{g}$
17. Trip Blanks 1/month

Question: How many parameters need to be verified for checks, calibrations, verifications (per quarter)?

1. Monthly Maintenance completed
2. Quarterly maintenance completed
3. 12 run maintenance completed
4. Leak Checks (3)*
5. Flow Check %A (3)*
6. Flow Check %AD (3)*
7. Audit devices different than verification devices
8. Devices within certification period (2-4 devices, 3 checks)
9. Ambient temp ± 2 (3)
10. Filter compartment temperature ± 2 (3)
11. Ambient pressure ± 10 (3)

*NCDAQ has a mid-month flow check

Let's Crunch the numbers...

PM2.5 Sampler Data	
Items to verify per sample	17
Number of samples per Year	122
Number of Samplers	28
TOTAL DATA POINTS TO QA	10472

PM2.5 Checks, Verifications, Calibrations	
Items to verify per quarter	31
Items to verify per Year	124
Number of Samplers	28
TOTAL DATA POINTS TO QA	3472

Total Data Points: 13944

FRM data are ready for a database!

- Filter ID
- Cass ID
- Set Start Date
- Set Start Time
- Act Start Date
- Act Start Time
- Set Stop Date
- Set Stop Time
- Total
- Average Flow
- Flow cv
- Volume
- Amb Temp Min
- Amb Temp Ave
- Amb Temp Max
- Filt Temp Min
- Filt Temp Ave
- Filt Temp Max
- Pres Min
- Pres Ave
- Pres Max
- Max Diff Temp
- Date
- Time
- Site ID1
- Site ID2
- Status Codes
- Valid
- Min Flow
- Max Flow
- Ave Wind Speed
- Ave Wind Vel
- Ave Wind Dir
- RH Min
- RH Ave
- RH Max
- Ave A1
- Ave A2
- Ave A3
- total(min)
- valid(min)

Filter ID	Cass ID	Set Start Date	Set Start Time	Act Start Date	Act Start Time	Set Stop Date	Set Stop Time	Total
T2670509	RP000000	3/6/2014	0:00	3/6/2014	0:00	3/7/2014	0:00	024:00
T2670510	RP000000	3/9/2014	0:00	3/9/2014	0:00	3/10/2014	0:00	024:00
T2670511	RP000000	3/12/2014	0:00	3/12/2014	0:00	3/13/2014	0:00	024:00
T2670981	RP000000	3/13/2014	0:00	3/13/2014	0:00	3/15/2014	0:00	000:00
T2670982	RP000000	3/15/2014	0:00	3/15/2014	0:00	3/16/2014	0:00	024:00



NCDAQ Sample Database

PM 2.5 FRM Site Data - Windows Internet Explorer
 http://ibeamaq.ncdenr.org/aq/PM25FRM/SiteModify.do

Air Quality: **PM 2.5 FRM** Site Data--View or Modify Records

Site: Start Act Start Date: Jan 1
 Site Id2: 305 End Act Start Date: Mar 31 2014 Records: All

Filter Id	Site	Site Id1	Site Id2	Poll	Cassette Id	Set Start Date	Set Start Time	Act Start Date	Act Start Time	Set Stop Date	Set Stop Time	Total	Avg Flow	Flow cv	Vol	Amb Temp Min	Amb Temp Ave	Amb Temp Max	Filt Temp Min	Filt Temp Ave	Filt Temp Max	Pres Min	Pres Ave	Pres Max	Max Diff Temp	Date	Time
T2669629	GM	370710016	305	PM2.5	000000	01/05/2014	0:00	01/05/2014	0:00	01/06/2014	0:00	024:00	16.7	.1	24	-4	2.9	5.4	1.3	4.7	7.5	734	742	747	2.3	01/05/2014	4:40
T2669630	GM	370710016	305	PM2.5	000000	01/11/2014	0:00	01/11/2014	0:00	01/12/2014	0:00	023:59	16.7	0	24	5.1	10.6	17.7	6.2	10.7	16	730	735	743	2.1	01/11/2014	11:05
T2669890	GM	370710016	305	PM2.5	000000	01/17/2014	0:00	01/17/2014	0:00	01/18/2014	0:00	024:00	16.7	.2	24	-2	4.6	12	-1.4	5.1	12.7	736	739	741	2.4	01/17/2014	11:50
T2669891	GM	370710016	305	PM2.5	000000	01/18/2014	0:00	01/18/2014	0:00	01/18/2014	0:00	000:00	0	0	0	0	0	0	0	0	0	0	0	0	0	01/01/1980	0:00
T2670030	GM	370710016	305	PM2.5	000000	01/23/2014	0:00	01/23/2014	0:00	01/24/2014	0:00	024:00	16.7	.3	24	-7.2	-1.8	5.1	-5.4	-5	6.2	741	746	751	3.4	01/23/2014	10:25
T2670032	GM	370710016	305	PM2.5	000000	01/29/2014	0:00	01/29/2014	0:00	01/30/2014	0:00	024:00	16.7	0	24	-9.5	-5.2	.6	-7.6	-3.2	1.1	744	747	750	2.8	01/29/2014	11:20
T2670033	GM	370710016	305	PM2.5	000000	02/04/2014	0:00	02/04/2014	0:00	02/05/2014	0:00	024:00	16.7	0	24	2.5	4.2	8	3.7	5	7.6	742	746	750	1.7	02/04/2014	11:15
T2670034	GM	370710016	305	PM2.5	000000	02/05/2014	0:00	02/05/2014	0:00	02/05/2014	0:00	000:00	0	0	0	0	0	0	0	0	0	0	0	0	0	01/01/1980	0:00
T2670339	GM	370710016	305	PM2.5	000000	02/10/2014	0:00	02/10/2014	0:00	02/11/2014	0:00	024:00	16.7	0	24	1.4	4	9.4	2.1	5	10.8	740	743	747	2.3	02/10/2014	13:20
T2670340	GM	370710016	305	PM2.5	000000	02/16/2014	0:00	02/16/2014	0:00	02/17/2014	0:00	024:00	16.7	0	24	-1.9	5.4	15.2	-6	6.8	16.1	740	742	744	2.6	02/16/2014	13:15
T2670341	GM	370710016	305	PM2.5	000000	02/25/2014	0:00	02/25/2014	0:00	02/26/2014	0:00	023:59	16.7	0	24	2	9.2	18.4	3.4	10	19	737	740	743	2.6	02/25/2014	11:20
T2670652	GM	370710016	305	PM2.5	000000	02/28/2014	0:00	02/28/2014	0:00	03/01/2014	0:00	024:00	16.7	0	24	-2.9	3.3	10.7	-3.3	3.8	12.1	739	745	747	2.6	02/28/2014	11:35
T2670653	GM	370710016	305	PM2.5	000000	03/06/2014	0:00	03/06/2014	0:00	03/07/2014	0:00	023:59	16.7	0	24	-2	1.9	5	-6	2.1	6.1	740	746	750	1.7	03/06/2014	13:05
T2670654	GM	370710016	305	PM2.5	000000	03/07/2014	0:00	03/07/2014	0:00	03/07/2014	0:00	000:00	0	0	0	0	0	0	0	0	0	0	0	0	0	01/01/1980	0:00
T2670655	GM	370710016	305	PM2.5	000000	03/13/2014	0:00	03/13/2014	0:00	03/14/2014	0:00	023:59	16.7	0	24	-1	4.6	11.1	-6	5.4	12.3	734	741	747	2.7	03/13/2014	13:10
T2670864	GM	370710016	305	PM2.5	000000	03/18/2014	0:00	03/18/2014	0:00	03/19/2014	0:00	023:59	16.7	0	24	-1	2.3	6	.1	3.9	7.9	737	742	745	2.3	03/18/2014	11:25

100%



In Development: Centralized Logbooks

Air Quality ▾		PM 2.5 FRM ▾	E Logs - Sample Log ▾
Site Information			
Site Name	<input type="text"/>		
Site ID (XX-XXX-XXXX)	<input type="text"/>		
Site ID2 (XXX)	<input type="text"/>		
Setup and Post Sample Information			
Sample Setup Date	Aug ▾	13 ▾	2014 ▾
Sample Setup Time (HH:MM)	<input type="text"/>	:	<input type="text"/> AM ▾
Setup Operators Initials	<input type="text"/>		
Post Sample Date	Aug ▾	13 ▾	2014 ▾
Post Sample Time (HH:MM)	<input type="text"/>	:	<input type="text"/> AM ▾
Post Sample Operators Initials	<input type="text"/>		
Sample Information			
Filter Weigh Date	Aug ▾	13 ▾	2014 ▾
Sample Date	Aug ▾	13 ▾	2014 ▾
Wins Run #	<input type="text"/>		
Status Code	<input type="text" value="0"/>		
Sample Run as Scheduled?	Yes ▾		
Data Download	No ▾		
Sample Comments	<input type="text"/>		
Help		Logoff	Save Sample Log

In Development: Centralized Logbooks

Air Quality	PM 2.5 FRM	E Logs - Maintenance Log
Region	ARO	
Site Name		
Site ID (XX-XXX-XXXX)		
Maintenance Date	Aug 13 2014	
Maintenance Activity	12 Run Maintenance	
Maintenance Comments		
Help	Logoff	Save Maintenance Log

NCDAQ Logbook Database

PM 2.5 FRM Elogs Data - Windows Internet Explorer
 http://ibeamaq.ncdenr.org/daq/PM25FRM/ElogsModify.do

Air Quality: PM 2.5 FRM E Logs--View or QA

Site Id2: 305 Quarter: 2nd 2014 Site Activity: All

Site Id2	Site	Date of Activity	Site Activity	Leak Check	Flow Std Device	Flow Std Exp Date	Barometer	Barometer Exp Date	Thermometer	Thermometer Exp Date	Manometer	Manometer Exp Date	Filter Temp Sampler	Filter Temp Std	Filter Temp Diff	Filter Comp Temp Sampler	Filter Comp Temp Std	Filter Comp Temp Diff
305	GM	04/01/2014	Annual Cal	23	1170	12/05/2014	D539	03/03/2015	WHT-74	09/30/2014	8	04/12/2014	28	28.1	.1	27.5	29	1.5
305	GM	04/14/2014	Monthly Verifi.	4	1170	12/05/2014	D539	03/03/2015	WHT-74	09/30/2014	16	08/29/2014	23	23	0	23	22.5	-.5
305	GM	04/24/2014	Mid-Month Verif*	13	1170	12/05/2014												
305	GM	05/07/2014	Monthly Verifi.	13	1170	12/05/2014	D539	03/03/2015	WHT-79	09/30/2014	8	04/16/2015	28.5	28.3	-.2	27.5	26.7	-.8
305	GM	05/14/2014	Quarterly Audit	10	1051	12/20/2014	D528	05/30/2014	WHT-81	09/30/2014	16	08/29/2014	25	25.1	.1	26	24.9	-1.1
305	GM	06/06/2014	Monthly Verifi.	5	1170	12/05/2014	D539	03/03/2015	WHT-79	09/30/2014	8	04/16/2015	29	28.9	-.1	28.5	28	-.5
305	GM	06/24/2014	Mid-Month Verif*	7	1170	12/05/2014												

User Comment: Clock within 1 minute of Atomic Clock. Reviewed by RCM 5/14/14

Audit Comment: Quarterly audit manometer was the same manometer (#16) that was used for the Monthly Verification on 4/14/14.

100%



E-Log Report for Audits, Verifications, Cals

Region	SITE ID1	SITE NAME	SITE ACTIVITY	DATE OF ACTIVITY	FILTER TEMP DIFF PF	FILTER COMP TEMP DIFF PF	AMBT TEMP DIFF PF	AMBT PRESS DIFF PF	POST CAL FLOW VERIF A PF	POST CAL FLOW VERIF AD PF	RCO AUDIT COMMENTS	RCO AUDIT
MRO	370710016	Grier	Annual Cal	4/1/2014	PASS	PASS	PASS	PASS	PASS	PASS		Pass
MRO	370710016	Grier	Monthly Verifi.	4/14/2014	PASS	PASS	PASS	PASS	PASS	PASS		Pass
MRO	370710016	Grier	Mid-Month Verifi.	4/24/2014					PASS	PASS		Pass
MRO	370710016	Grier	Monthly Verifi.	5/7/2014	PASS	PASS	PASS	PASS	PASS	PASS		Pass
MRO	370710016	Grier	Quarterly Audit	5/14/2014	PASS	PASS	PASS	PASS	PASS	PASS	Audit manometer the same as verification	Pass
MRO	370710016	Grier	Monthly Verifi.	6/6/2014	PASS	PASS	PASS	PASS	PASS	PASS		Pass
MRO	370710016	Greir	Mid-Month Verifi.	6/24/2014					PASS	PASS		Pass

Hey, Corey. That's all great, but our Agency does not have computer programmers like DAQ.

- Not a problem.
- If you have a domain, you can create your own SQL database.
- Google is your friend.
- Before bringing my idea to the developers at DAQ, I made my own SQL database online. Let's take a look...

“Non-Technical” Cloud Based E-Log

FRM E-Log Version 1.0 x

← Used my wedding domain

FRM E-Log Version 1.0

Maintenance Log

Region:

Site Name:

Site ID: (XX-XXX-XXXX)

Maintenance Date:

Maintenance Activity:

Maintenance Comments:

Add Records Page

“Non-Technical” Cloud Based E-Log



FRM E-Log Version 1.0

Maintenance Log

id	Region	Site	Site ID	Maintenance Date	Maintenance Activity	Maintenance Comment	Edit
26	WSRO	Boone	37-189-0003	2014-05-07	Quarterly	check 1, 2, 3	Edit
27	WSRO	Boone	37-189-0003	2014-05-07	Monthly	check again	Edit

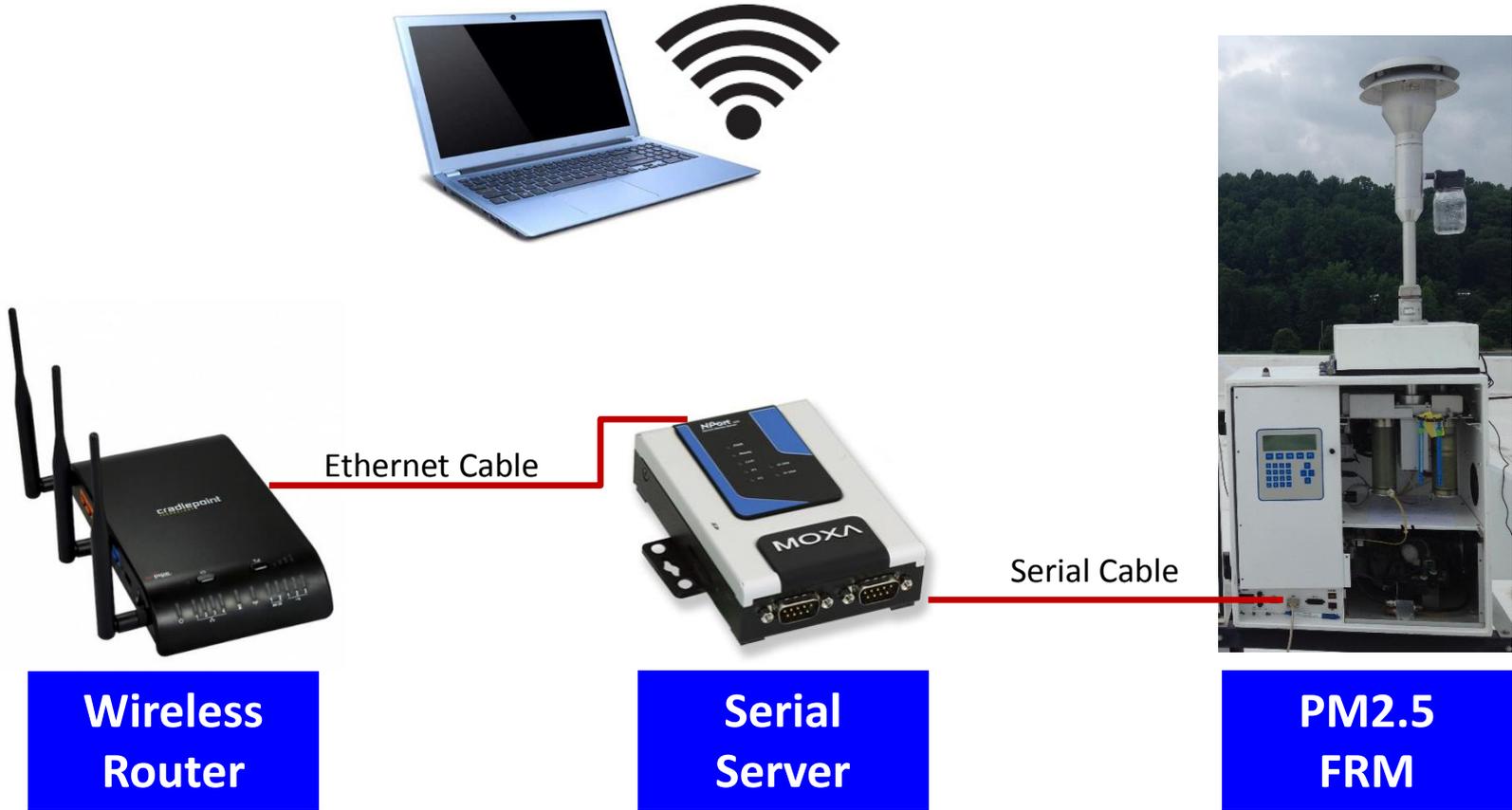
View/Edit Records Page

Final thoughts on interactive databases....

- Faster, more efficient method to analyze data.
- Many options for data reduction, reports, graphs, etc.
- Significantly improves feedback times.
- Condenses all of the logbooks and data files into one location.
- Can be developed without much expertise.

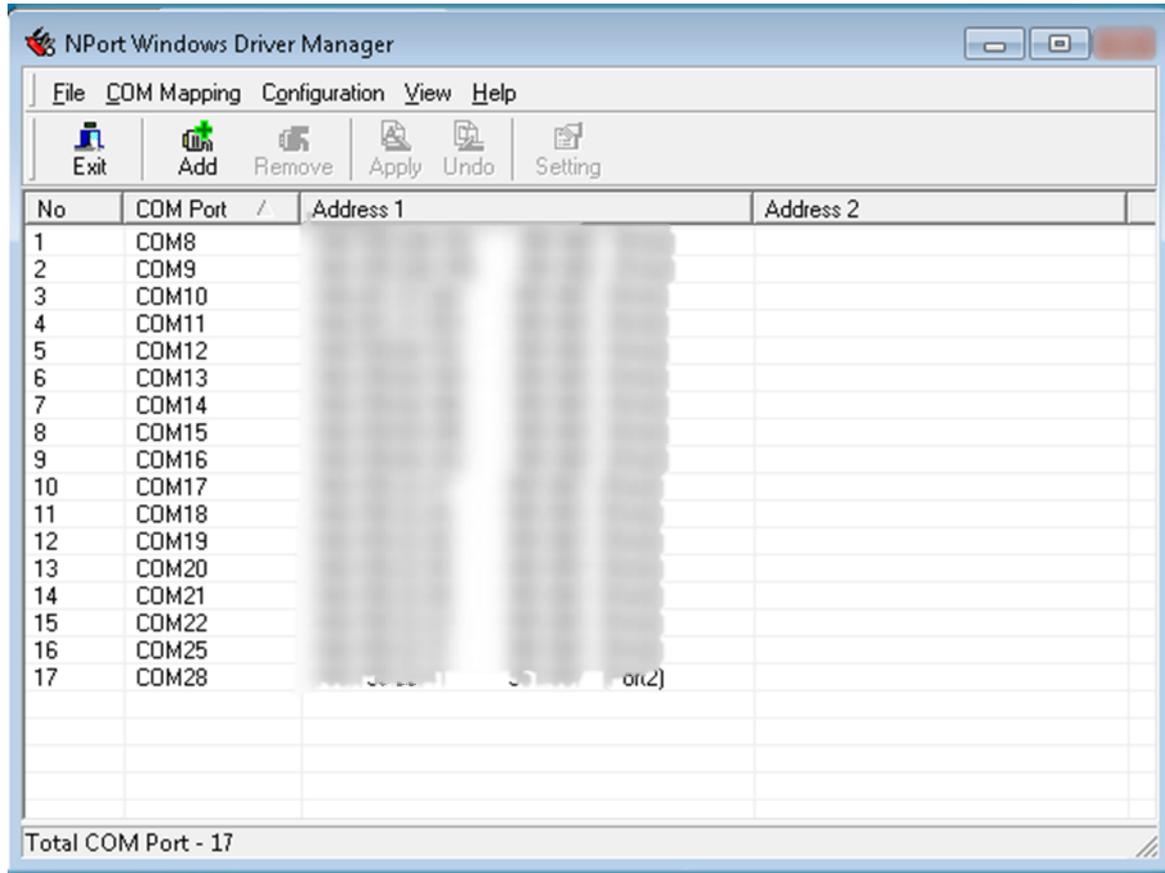
Innovative Methods for Updating Instrumentation

Wireless Setup of FRM



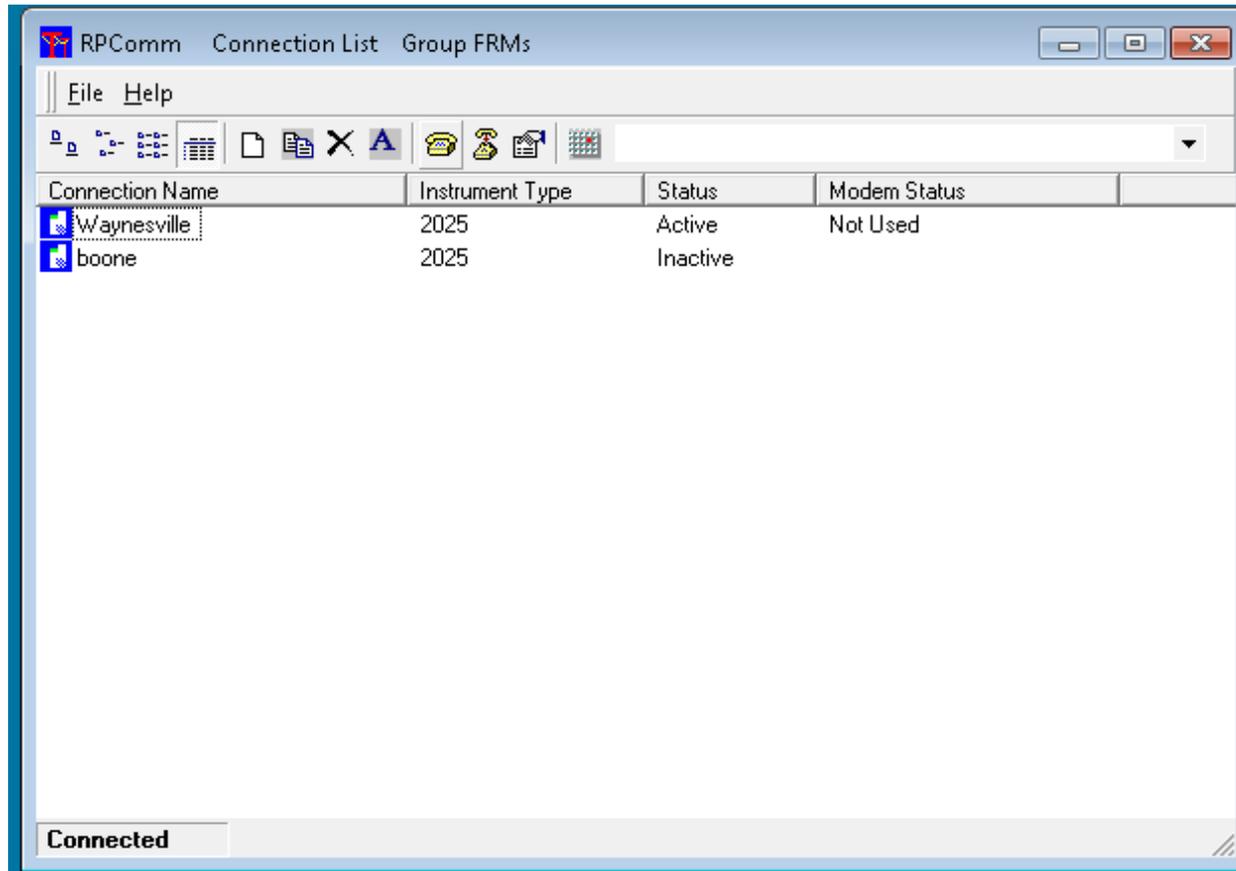
Setting up wireless for the FRM

Step 1: Establish COM Port for Serial Server



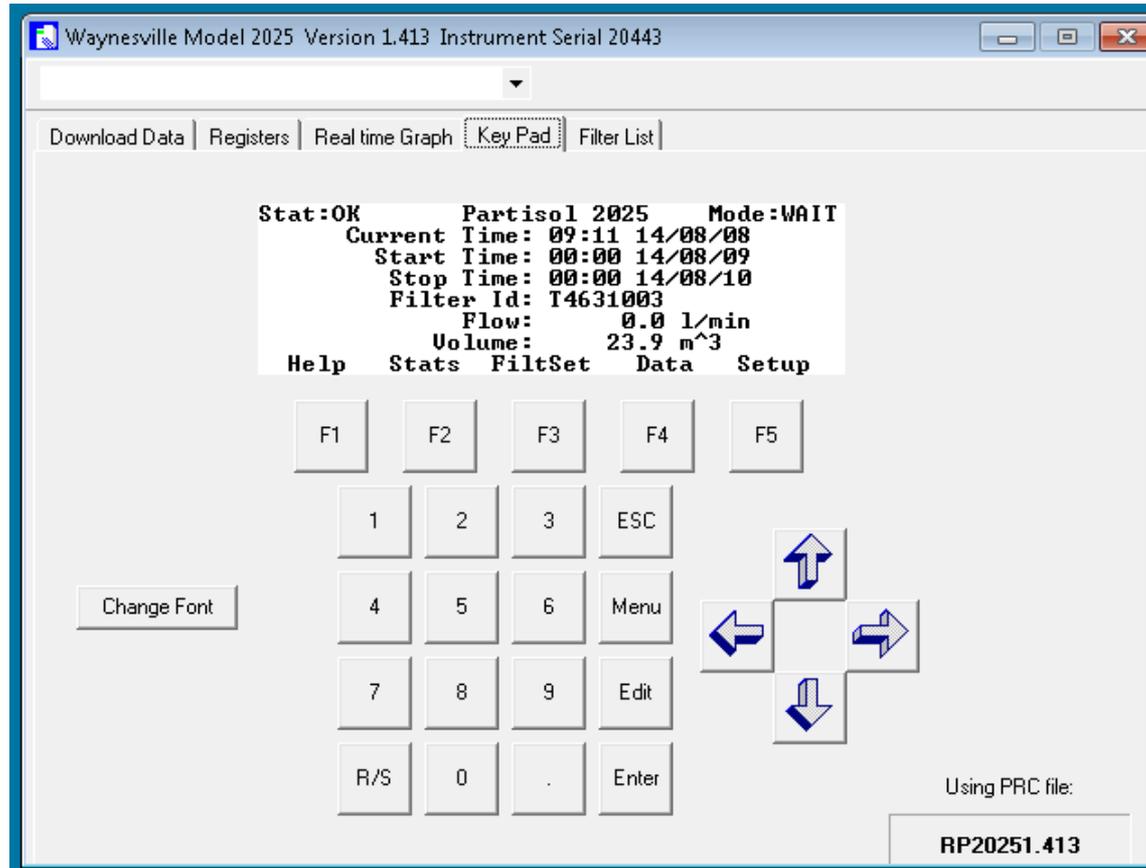
Setting up Wireless for the FRM

Step 2: Configure RPComm



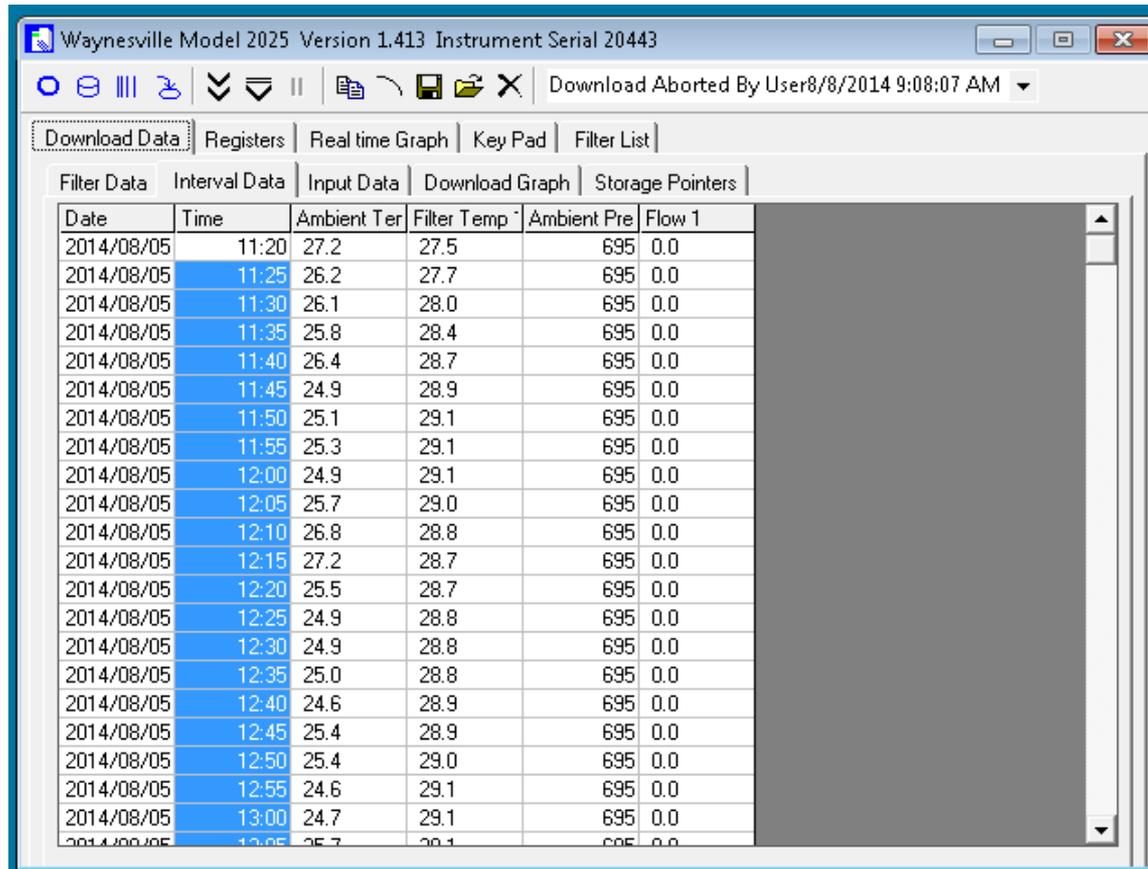
Setting up Wireless for the FRM

Step 3: Connect to the Instrument (Key Pad)



Setting up Wireless for the FRM

Step 3: Connect to the Instrument (Access Interval Data)

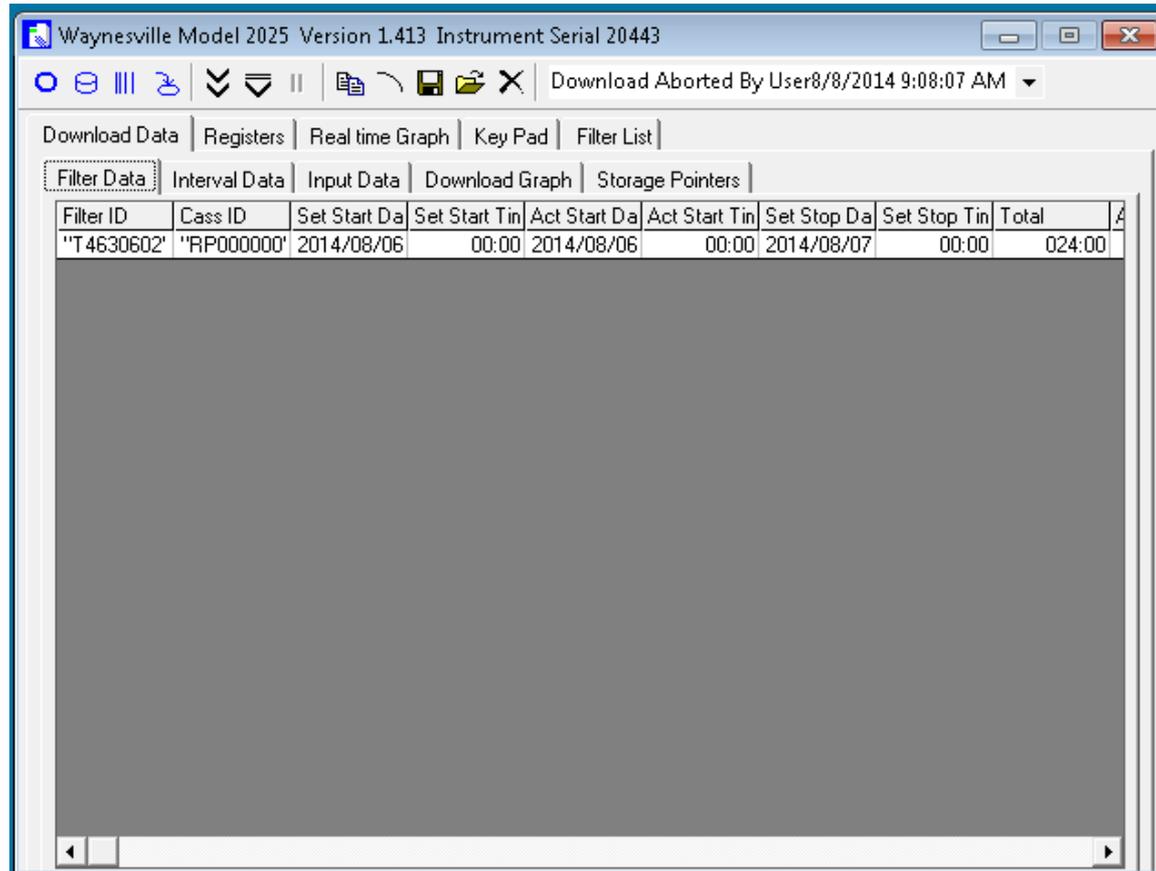


The screenshot shows the 'Waynesville Model 2025' software interface. The title bar indicates 'Version 1.413 Instrument Serial 20443'. The main window has a menu bar with 'Download Data', 'Registers', 'Real time Graph', 'Key Pad', and 'Filter List'. Below the menu bar, there are tabs for 'Filter Data', 'Interval Data', 'Input Data', 'Download Graph', and 'Storage Pointers'. The 'Interval Data' tab is active, displaying a table of data for August 5, 2014. The table has columns for Date, Time, Ambient Ter, Filter Temp, Ambient Pre, and Flow 1. The data is as follows:

Date	Time	Ambient Ter	Filter Temp	Ambient Pre	Flow 1
2014/08/05	11:20	27.2	27.5	695	0.0
2014/08/05	11:25	26.2	27.7	695	0.0
2014/08/05	11:30	26.1	28.0	695	0.0
2014/08/05	11:35	25.8	28.4	695	0.0
2014/08/05	11:40	26.4	28.7	695	0.0
2014/08/05	11:45	24.9	28.9	695	0.0
2014/08/05	11:50	25.1	29.1	695	0.0
2014/08/05	11:55	25.3	29.1	695	0.0
2014/08/05	12:00	24.9	29.1	695	0.0
2014/08/05	12:05	25.7	29.0	695	0.0
2014/08/05	12:10	26.8	28.8	695	0.0
2014/08/05	12:15	27.2	28.7	695	0.0
2014/08/05	12:20	25.5	28.7	695	0.0
2014/08/05	12:25	24.9	28.8	695	0.0
2014/08/05	12:30	24.9	28.8	695	0.0
2014/08/05	12:35	25.0	28.8	695	0.0
2014/08/05	12:40	24.6	28.9	695	0.0
2014/08/05	12:45	25.4	28.9	695	0.0
2014/08/05	12:50	25.4	29.0	695	0.0
2014/08/05	12:55	24.6	29.1	695	0.0
2014/08/05	13:00	24.7	29.1	695	0.0
2014/08/05	13:05	25.7	29.1	695	0.0

Setting up Wireless for the FRM

Step 3: Connect to the Instrument (Access Sample Data)



The screenshot shows the 'Waynesville Model 2025' software interface. The title bar indicates 'Version 1.413 Instrument Serial 20443'. The main window has a menu bar with options: Download Data, Registers, Real time Graph, Key Pad, and Filter List. Below the menu bar, there are several tabs: Filter Data (selected), Interval Data, Input Data, Download Graph, and Storage Pointers. The 'Filter Data' tab displays a table with the following data:

Filter ID	Cass ID	Set Start Da	Set Start Tin	Act Start Da	Act Start Tin	Set Stop Da	Set Stop Tin	Total	A
"T4630602"	"RP000000"	2014/08/06	00:00	2014/08/06	00:00	2014/08/07	00:00	024:00	

Setting up Wireless for the FRM

Step 3: Connect to the Instrument (Access Filter List)

Waynesville Model 2025 Version 1.413 Instrument Serial 20443

16 Filter list retrieved 8/8/2014 9:10:51 AM

Download Data | Registers | Real time Graph | Key Pad | Filter List

	Type	Filt ID	Cassette ID	Blank
1	T	4631004	000000	No
2	T	4631005	000000	No
3	T	4631006	000000	No
4	T	4631007	000000	No
5	T	4631008	000000	No
6	T	4631009	000000	No
7	T	0000000	000000	No
8	T	0000000	000000	No
9	T	0000000	000000	No
10	T	0000000	000000	No
11	T	0000000	000000	No
12	T	0000000	000000	No
13	T	0000000	000000	No
14	T	0000000	000000	No
15	T	0000000	000000	No
16	T	0000000	000000	No

Is it worth the money?

- Depends on your agency: number of techs, distance to site, workload, etc.
- Quick calculation that assumes a wireless network already established:

Item	Price
Gas (\$3.25/gallon; 25 mpg; 180 miles RT)	\$23.40
Personnel (\$19.23/hr; 1 hr site; 3 hr driving)	\$76.92
One Trip Total:	\$100.32

Cost of NPort 6250 Serial Server: \$265-\$335

Remote Desktop Connections, Databases, and VPN

E-Logs, Reports, Database



Laboratory Computer (RH, Temp)



PM2.5 FRM



Ahoy!

Quick Note on Windows XP Remediation

- Microsoft is no longer providing support for Windows XP.
***** This is a security issue. *****
- Opened a SOP the other day that said to use the “Briefcase”
- Most older monitoring technology is formatted for XP.
- NCDAQ can confirm that they have all monitors working with Windows 7. (Except Wedding PM10s because...)
- Try to avoid MS Access or electronic documents with macros.

Addressing Potential Criticisms

Criticisms

- **Question:** *Are you worried that if you make everything electronic that you will not have a job?*
- **Answer:** No.

Criticisms

- **Question:** *The way we have been doing it for the past 15 years works. Why should we change?*
- **Answer:** The goal is to have the produce the highest quality data possible. At the same time, methods should be modernized to improve organization, efficiency, and accessibility.

Recap

- Manual PM2.5 FRMs are going to stick around for a while .
- Interactive databases are a great way to organize data.
- Consider adding wireless connections to PM2.5 FRMs.
- Plan to get rid of Windows 95....and Windows XP.
- Utilize technology: remote desktop connections, VPN, etc.



Questions?

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