INTERNATIONAL ROAD DYNAMICS INC.

LTPP WIM DATA COLLECTION SYSTEMS

INSTALLATION AND CALIBRATION FOR MINNESOTA SPS-5 LTPP ID 270500

November 16, 2006

CLIN 2004C TASK ORDER # 14

CONTRACT NO. DTFH61-05-D-00001

U.S. Department of Transportation
Federal Highway Administration

LONG TERM Pavement PERFORMANCE

TABLE OF CONTENTS

1.0 EXECUTIVE SUMMARY

This report details the installation and calibration of the Minnesota SPS-5 Weigh-in-Motion (WIM) site located on US-2 at mile post 91.8. The WIM site is instrumented with IRD's iSINC (Intelligent Sensor Interface Network Controller) WIM Electronic and Kistler Quartz Sensors.

All four lanes are instrumented for WIM data collection consisting of two inductive loops and eight Quartz Sensors per lane. The two outside driving lanes which includes the LTPP lane use one (1) 4 channel Kistler Sensor Module each. Four inputs per lane; right wheel path sensors leading, left wheel path sensors leading, right wheel path sensors trailing, left wheel path sensors trailing. The inside lanes share one (1) 4 channel Kistler Sensor Module. Two inputs per lane; one for the leading sensors combined and one for the trailing sensors combined.

The LTPP lane is in the west bound driving lane adjacent to the WIM Controller Cabinet. The WIM system uses a landline phone for communication and 120V A.C. to power the equipment.

The WIM equipment installation began on August 22, 2006 and was completed on October 6, 2006. The WIM system calibration was started on October 31, 2006 and was completed on November 1, 2006.

The results demonstrate the WIM system meets the LTPP performance requirements for weight and axle spacing as detailed in the *Data Collection Guide for SPS WIM Sites*. The system appeared to classify all vehicles correctly based on the latest ETG algorithm installed.

2.0 POINT OF CONTACTS

- Debbie Walker (COTR)
  FHWA LTPP
  ph: 202-493-3068
  e: deborah.walker@fhwa.dot.gov

- Basil Abukhater (RSC)
  Stantec
  ph: 716-632-0804

- Jean Wallace (Division Representative)
  FHWA
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- State of Minnesota DOT
  George Cepress ph: (651) 296-0217
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- International Road Dynamics (Phase 2 Contractor)
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- Landwehr
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3.0 SHEET 16 – SITE CALIBRATION SUMMARY

SITE CALIBRATION INFORMATION

1. DATE OF CALIBRATION (MONTH/DAY/YEAR): **October 31, 2006 thru November 1, 2006**

2. TYPE OF EQUIPMENT CALIBRATED:
   - ☒ WIM
   - ☐ CLASSIFIER
   - ☐ BOTH

3. REASON FOR CALIBRATION
   - ☐ REGULARLY SCHEDULED SITE VISIT
   - ☐ RESEARCH
   - ☐ EQUIPMENT REPLACEMENT
   - ☐ TRAINING
   - ☐ DATA TRIGGERED SYSTEM REVISION
   - ☒ NEW EQUIPMENT INSTALLATION
   - ☐ OTHER (SPECIFY) _____

4. SENSORS INSTALLED IN LTPP LANE AT THIS SITE (CHECK ALL THAT APPLY):
   - ☐ BARE ROUND PIEZO CERAMIC
   - ☐ BARE FLAT PIEZO
   - ☐ BENDING PLATES
   - ☐ CHANNELIZED ROUND PIEZO
   - ☐ LOAD CELLS
   - ☒ QUARTZ PIEZO
   - ☐ CHANNELIZED FLAT PIEZO
   - ☒ INDUCTANCE LOOPS
   - ☐ CAPACITANCE PADS
   - ☐ OTHER (SPECIFY) _____

5. EQUIPMENT MANUFACTURER: **International Road Dynamics Inc.**

WIM SYSTEM CALIBRATION SPECIFICS

6. CALIBRATION TECHNIQUE USED:
   - ☐ TRAFFIC STREAM:
     - NUMBER OF TRUCKS _____
     - ☐ STATIC SCALE
   - ☒ TEST TRUCKS:
     - NUMBER OF TEST TRUCKS **2**
     - PASSES PER TRUCK **20**

TRUCK#	TYPE	SUSPENSION
1	**9**	**1 & 2**
2	**9**	**1 & 2**
3	**X**	**X**
4	**X**	**X**
5	**X**	**X**

TYPE PER FHWA 13 BIN SYSTEM
SUSPENSION TYPES:
1 – AIR
2 – LEAF SPRING
3 – OTHER

7. SUMMARY CALIBRATION RESULTS (EXPRESSED AS A PERCENT)
   GVW MEAN DIFFERENCE -**0.5%** STANDARD DEVIATION **2.2%**
   SINGLE AXLE MEAN DIFFERENCE **-5.9%** STANDARD DEVIATION **2.9%**
   DOUBLE AXLES MEAN DIFFERENCE **0.4%** STANDARD DEVIATION **2.7%**

8. NUMBER OF SPEEDS AT WHICH CALIBRATION WAS PERFORMED: **3**

9. DEFINE THE SPEED RANGES USED (MPH): **45, 55, and 65**

10. CALIBRATION FACTOR (AT EXPECTED FREE FLOW SPEED) **See following sheets**

11. IS AUTO-CALIBRATION USED AT THIS SITE? ☐
    IF USED, LIST AND DEFINE AUTO-CALIBRATION VALUE _____

CLASSIFIER TEST SPECIFICS

12. METHOD FOR COLLECTING INDEPENDENT VOLUME MEASUREMENT BY VEHICLE CLASS:
    ☐ VIDEO
    ☒ MANUAL
    ☐ PARALLEL CLASSIFIERS

13. METHOD TO DETERMINE LENGTH OF COUNT:
    TIME
    NUMBER OF VEHICLES
    NUMBER OF TRUCKS

14. MEAN DIFFERENCE IN VOLUMES BY VEHICLES CLASSIFICATION:
    FHWA CLASS 2 **0%**
    FHWA CLASS 3 **30%**
    FHWA CLASS 4&5 **15%**
    FHWA CLASS 8 **0%**
    FHWA CLASS 9 **0%**
    FHWA CLASS 12 **0%**
    "UNCLASSIFIED" VEHICLES: **0%**

15. PICTURES: _____

16. NOTES:
    _____

PERSON LEADING CALIBRATION EFFORT: **Rino Quinones**
CONTACT INFORMATION: **416-540-43767**

3.1.1 SITE PARAMETERS MINNESOTA SPS-5 270500, US-2, MP 91.8

Select Lanes			1	2	3	4
Lane Name			EB	EB	WB	WB
Lane State			ENABLED	ENABLED	ENABLED	ENABLED
Upstream Loop >		Loop State	ENABLED	ENABLED	ENABLED	ENABLED
		Module UID	9	9	9	9
		Channel Num	0	2	4	6
		Polarity Active	LOW	LOW	LOW	LOW
		Width (cm)	183	183	184	185
Downstream Loop >		Loop State	ENABLED	ENABLED	ENABLED	ENABLED
		Module UID	9	9	9	9
		Channel Num	1	3	5	7
		Polarity Active	LOW	LOW	LOW	LOW
		Width (cm)	183	183	183	183
		Distance(cm)	914	914	914	914
Axle Sensors >		Select Axle	1	1	1	1
		Axle State	ENABLED	ENABLED	ENABLED	ENABLED
		Module UID	5	6	6	7
		Channel Num	0	0	2	0
		Polarity Active	HIGH	HIGH	HIGH	HIGH
		Type	KISTLER_DUAL	KISTLER_DUA	KISTLER_DUA	KISTLER_DUA
		Distance(cm)	360	360	360	360
		Temp State	ENABLED	ENABLED	ENABLED	ENABLED
		Temp Module UID	5	5	5	5
		Temp Channel Num	0	0	0	0
Axle Sensors >		Select Axle	2	2	2	2
		Axle State	ENABLED	ENABLED	ENABLED	ENABLED
		Module UID	5	6	6	7
		Channel Num	1	1	3	1
		Polarity Active	HIGH	HIGH	HIGH	HIGH
		Type	KISTLER_DUAL	KISTLER_DUA	KISTLER_DUA	KISTLER_DUA
		Distance(cm)	360	730	660	360
		Temp State	ENABLED	ENABLED	ENABLED	ENABLED
		Temp Module UID	5	5	5	5
		Temp Channel Num	0	0	0	0
Axle Sensors >		Select Axle	3	3	3	3
		Axle State	ENABLED	DISABLED	DISABLED	ENABLED
		Module UID	5	6	6	7
		Channel Num	2	2	2	2
		Polarity Active	HIGH	HIGH	HIGH	HIGH
		Type	KISTLER_DUAL	KISTLER_DUA	KISTLER_DUA	KISTLER_DUA
		Distance(cm)	730	660	661	730
		Temp State	ENABLED	DISABLED	DISABLED	ENABLED
		Temp Module UID	5	0	0	5
		Temp Channel Num	0	0	0	0
Axle Sensors >		Select Axle	4	4	4	4
		Axle State	ENABLED	DISABLED	DISABLED	ENABLED
		Module UID	5	6	6	7
		Channel Num	3	3	3	3
		Polarity Active	HIGH	HIGH	HIGH	HIGH
		Type	KISTLER_DUAL	KISTLER_DUA	KISTLER_DUA	KISTLER_DUA
		Distance(cm)	730	660	661	730
		Temp State	ENABLED	ENABLED	ENABLED	ENABLED
		Temp Module UID	5	5	5	5
		Temp Channel Num	0	0	0	0
Off Scale >	Offscale St		DISABLED	DISABLED	DISABLED	DISABLED
	Module UID		0	0	0	0
	Channel Num		1	1	1	1
	Polarity ACTIVE		HIGH	HIGH	HIGH	HIGH
Overheight >	Overhght St		DISABLED	DISABLED	DISABLED	DISABLED
	Module UID		0	0	0	0
	Channel Num		1	1	1	1
	Polarity ACTIVE		HIGH	HIGH	HIGH	HIGH
Processing >	MaxTimeout(ms)		3000	3000	5000	5000
	Dynamic Comp(%)		104	103	104	100
	Sig Wt Diff(%)		40	40	40	40
	Min Axle Wt(kg)		1360	1360	1360	1360
	Veh Rec Mode		NORMAL	NORMAL	NORMAL	NORMAL
	Axl Sep(cm)		363	365	365	365

3.1.2 SITE CORRECTION FACTORS MINNESOTA SPS-5, US-2, MP 91.8

Select Lane	**1**						
Select Axle Sensor	**1 to 4**						
Threshold	**16**						
WIM Calib Factors >	Select Speed Bin	**1**	**2**	**3**	4	5	
	Max Speed (kph)	**65**	**80**	**95**	110	125	
	Calib Factor	3900	**4000**	**4120**	**4140**	4220	LANE 1

Select Lane	**2**						
Select Axle Sensor	**1 to 2**						
Threshold	**16**						
WIM Calib Factors >	Select Speed Bin	**1**	**2**	**3**	4	5	
	Max Speed (kph)	**65**	**80**	**95**	110	125	
	Calib Factor	2530	**2600**	**2600**	**2650**	2550	LANE 2

Select Lane	**3**						
Select Axle Sensor	**1 to 2**						
Threshold	**16**						
WIM Calib Factors >	Select Speed Bin	**1**	**2**	**3**	4	5	
	Max Speed (kph)	65	**80**	**95**	**110**	125	
	Calib Factor	**2200**	**2260**	**2215**	2280	2215	LANE 3

Select Lane	**4 (LTPP Lane)**						
Select Axle Sensor	**1 to 4**						
Threshold	**16**						
WIM Calib Factors >	Select Speed Bin	**1**	**2**	**3**	4	5	
	Max Speed (kph)	65	**80**	**95**	**110**	125	
	Calib Factor	**3230**	**3320**	**3390**	3390	3300	LANE 4

4.0 WIM SITE INVENTORY

1. ROUTE US-2 Mile Post: **91.8** 39.7 LTPP DIRECTION: N S E **W**

2. SITE DESCRIPTION
   GRADE: <1%
   ☐ Sag vertical
   Nearest SPS section downstream of the site: 270503
   Distance from sensor to nearest downstream SPS Section: 5.4 Miles

3. LANE CONFIGURATION
   Number of lanes in LTPP direction: 2 lanes
   Lane width: 12 ft.
   ☐ Median painted
   ☐ Median physical barrier
   ☒ Median grass
   ☐ Median none
   ☐ Shoulder curb and gutter
   ☐ Shoulder paved AC
   ☒ Shoulder paved PCC
   ☐ Shoulder unpaved
   Shoulder width: 11 ft.

4. PAVEMENT TYPE: AC

5. CONDITION: (Surface distresses by type / severity within WIM section)

   The existing roadway is AC and appears to be in fair structural condition. However, both the traveled way and shoulders exhibit transverse cracking at approximately every 40'. The 400' "WIM Pavement" section is the same as the approaching and departing pavement.

6. SENSOR SEQUENCE: Loop – Quartz Sensors – Quartz Sensors - Loop

7. PAVEMENT REPLACEMENT AND/OR GRINDING:
   Straightedge check: Performed _____ Result: ☐ Pass / ☐ Marginal / ☐ Unsatisfactory
   Short wave check: Performed _____ Result: ☐ Pass / ☐ Marginal / ☐ Unsatisfactory
   Long wave check: Performed _____ Result: ☐ Pass / ☐ Marginal / ☐ Unsatisfactory

8. ANY EFFECTS FROM RAMPS OR LANE TRANSITIONS:
   ☐ Intersection/driveway within 300m upstream, distance: _____
   ☐ Intersection/driveway within 300m downstream, distance: _____
   ☐ LTPP lane used for passing by vehicles traveling in south bound lane

9. DRAINAGE:
   ☐ Open to ground
   ☐ Pipe to culvert or ditch
   ☒ None
   ☐ French drain
   Clearance under plates: N/A
   Clearance/access to flush lines from under system:

10. CABINET LOCATION:
    - ☒ Same side of road as LTPP lane
    - ☐ Median
    - ☐ Behind guard rail

    Distance from edge of travel lane to cabinet: 50 ft
    Distance from sensors: 50 ft
    Type: 336
    Access controlled by: ☐ LTPP / ☒ State / ☐ Joint
    Primary contact: George Cepress (651) 296-0217
    Alternate contact: Mark Novak (651) 296-2607

11. POWER:
    Power type: ☐ Overhead / ☒ Underground / ☐ Solar
    Distance from cabinet to drop: 2ft
    Service provider: A.C.

12. TELEPHONE:
    Telephone type: ☐ Overhead / ☒ Underground / ☐ Cell
    Distance from cabinet to drop: 2ft
    Service provider: Land Line - Ph # (218) 694-5010

13. SYSTEM:
    Software: iSINC
    Version:
    Connection: ☒ RS232 / ☐ Parallel port / ☐ USB / ☐ Other

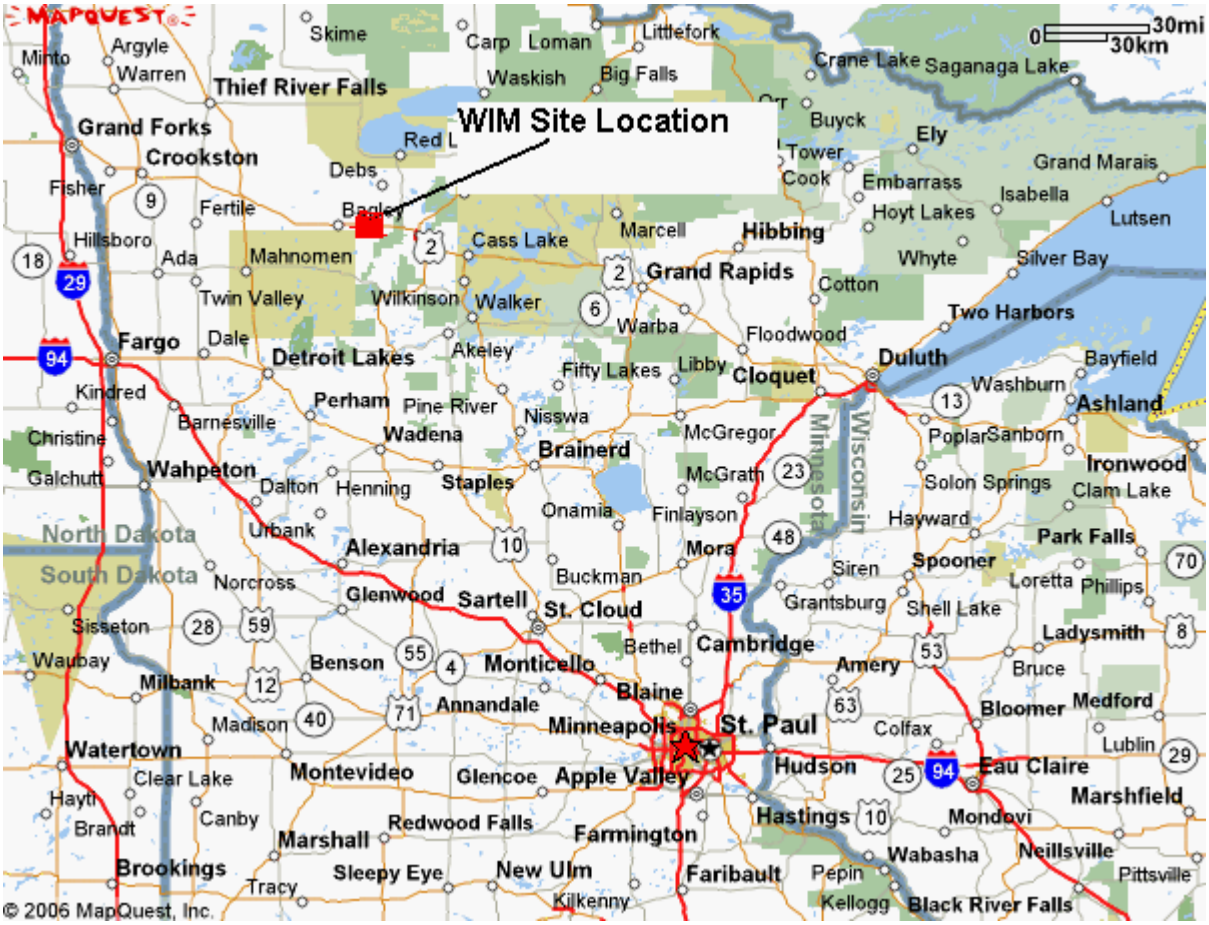
14. TEST TRUCK CYCLE:
    Turnaround time: 12 minutes
    Turnaround distance: 12 miles

15. PICTURES: See following pages, Site Map, WIM Site, Site layout drawings

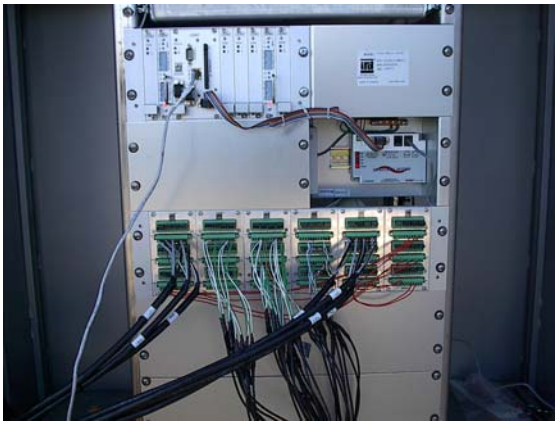
16. NOTES:

COMPLETED BY: **Bruce Myers**
CONTACT INFORMATION: **717-264-2077**

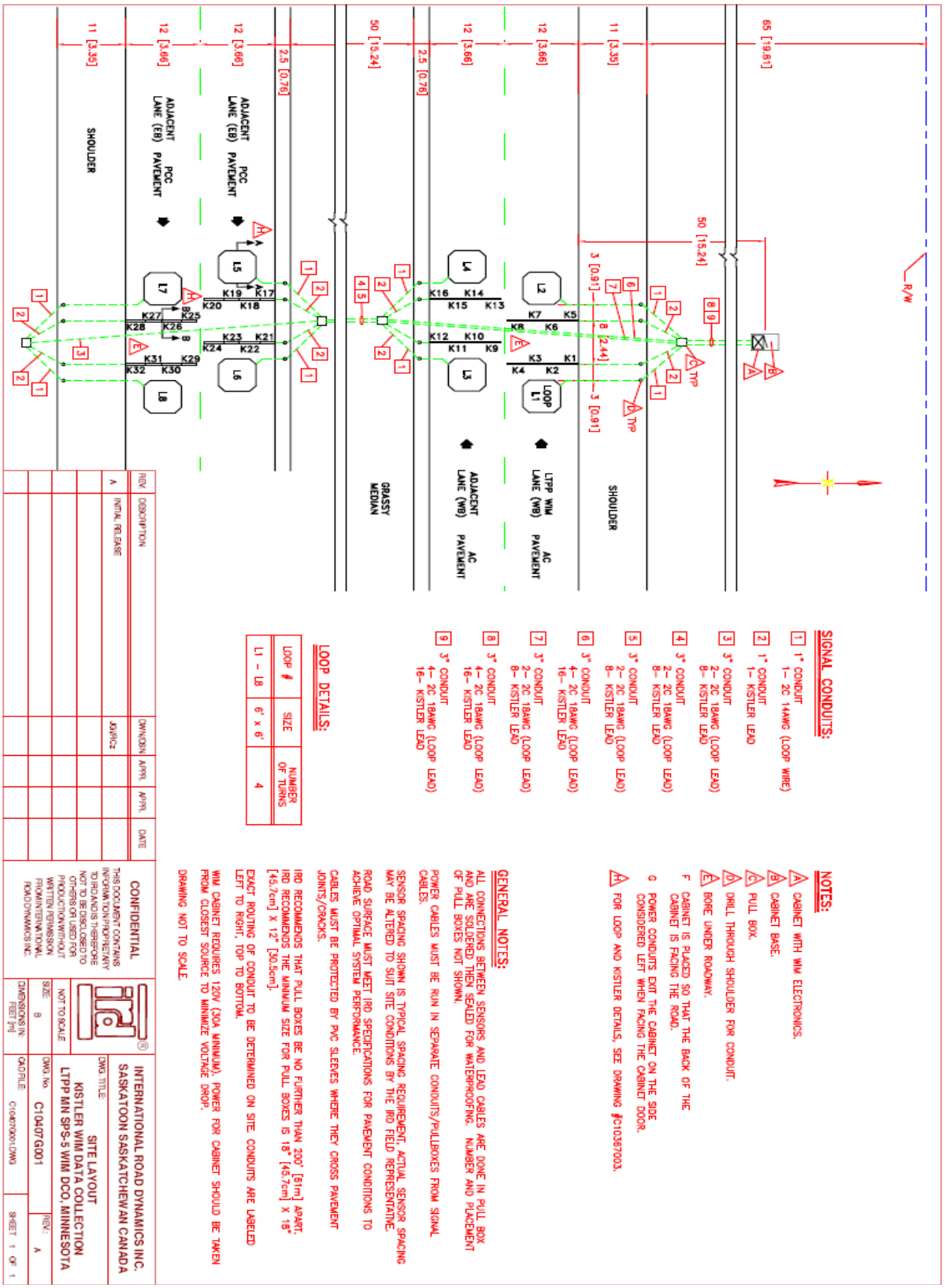
4.1.1 SITE MAP


MAPQUEST
WIM Site Location
Skime
Carp
Loman
Littlefork
Minto
Argyle
Warren
Thief River Falls
Waskish
Big Falls
Crane Lake
Saganaga Lake
Grand Forks
Red L
Buyck
Ely
Crookston
Debs
Tower
Cook
Grand Marais
Fisher
Embarrass
Isabella
Fertile
Bagley
Hoyt Lakes
Lutsen
Hillsboro
Marcell
Hibbing
Cass Lake
Ada
Mahnomen
Whyte
Silver Bay
Grand Rapids
Cotton
Twin Valley
Wilkinson
Walker
Two Harbors
Warba
Floodwood
Fargo
Dale
Detroit Lakes
Akeley
Duluth
Bayfield
Fifty Lakes
Libby
Cloquet
Kindred
Washburn
Perham
Pine River
Nisswa
Ashland
Barnesville
Wadena
McGregor
Poplar
Sanborn
Christine
Brainerd
Ironwood
Wahpeton
McGrath
Solon Springs
Galchutt
Dalton
Henning
Staples
Clam Lake
Onamia
Finlayson
Hayward
North Dakota
Urbank
Alexandria
Mora
Park Falls
South Dakota
Norcross
Buckman
Siren
Spooner
Glenwood
Sartell
St. Cloud
Grantsburg
Shell Lake
Loretta
Phillips
Sisseton
Bethel
Cambridge
Ladysmith
Waubay
Benson
Monticello
Amery
Bruce
Milbank
Blaine
Bloomer
Medford
Annandale
Madison
Minneapolis
St. Paul
Colfax
Watertown
Lublin
Clear Lake
Montevideo
Glencoe
Apple Valley
Hudson
Eau Claire
Hayti
Marshfield
Brandt
Canby
Redwood Falls
Hastings
Mondovi
Marshall
Farmington
Wabasha
Neillsville
Brookings
Sleepy Eye
New Ulm
Faribault
Pepin
Pittsville
Tracy
Kilkenny
Kellogg
Black River Falls
0
30mi
30km
© 2006 MapQuest, Inc.

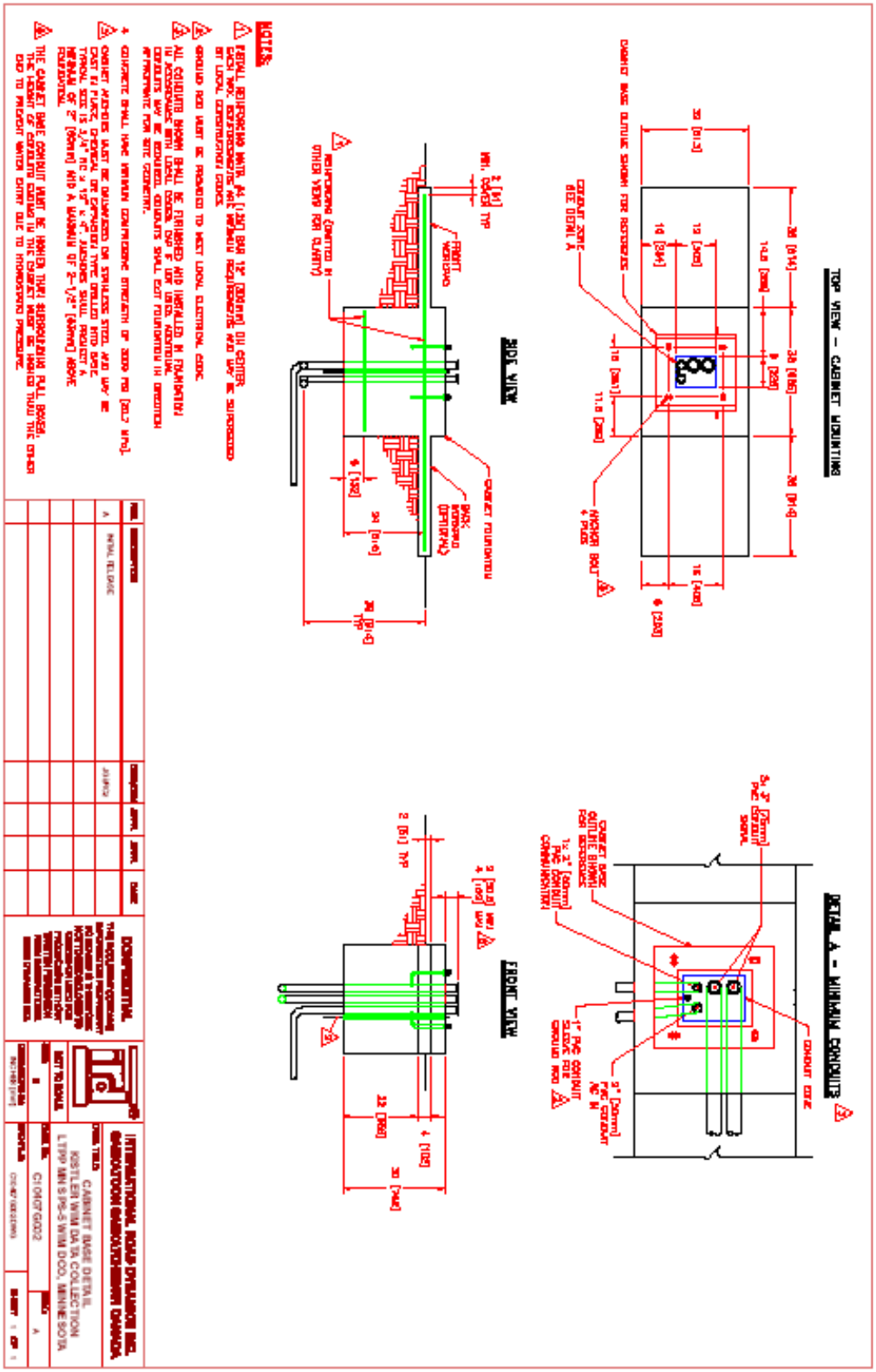
4.1.2 PICTURES, WIM SITE



4.1.3 SITE LAYOUT



4.1.4 WIM CABINET CONCRETE PEDESTAL



4.1.5 ELECTRICAL READINGS

IRD

Site Service Sheet

Clear

System Type: iSINC / Kistler Quartz

Date: 10/6/2006 **State: MN** **Location: Bemidji**
Job #: 10407G **Site #:** **Directions: US 2 Mile Post 91.8**

		Lead	Trail	Lead	Trail	Lead	Trail	Lead	Trail
Loops	**Lane**	**1 EB**	**1 EB**	**2 EB**	**2 EB**	**3 WB**	**3 WB**	**4 WB**	**4 WB**
Resistance		2.8 Ω	2.8Ω	2.5Ω	2.4Ω	2Ω	2.2Ω	1.8Ω	1.7Ω
Leakage		inf	inf	inf	inf	inf	inf	inf	inf
Inductance uH		265.0	260.0	258.0	250.0	211.0	208.0	160.0	160.0
Frequency		High	Low	High	Low	High	Low	High	Low

Piezos	**Lane - 1**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Amplitude		OK	OK	OK	OK	OK	OK	OK	OK
Capacitance		11.3 nF	11.3 nF	11.2 nF	11.2 nF	11.3 nF	11.2 nF	10.4 nF	10.5 nF
Resistance		inf	inf	inf	inf	inf	inf	inf	inf

Piezos	**Lane - 2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Amplitude		OK	OK	OK	OK	OK	OK	OK	OK
Capacitance		9.3 nF	9.4 nF	9.3 nF	9.3 nF	9.3 nF	9.2 nF	9.2 nF	9 nF
Resistance		inf	inf	inf	inf	inf	inf	inf	inf

Piezos	**Lane - 3**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Amplitude		OK	OK	OK	OK	OK	OK	OK	OK
Capacitance		8.9 nF	8.9 nF	8.8 nF	8.8 nF	8.7 nF	8.6 nF	8.6 nF	8.4 nF
Resistance		inf	inf	inf	inf	inf	inf	inf	inf

Piezos	**Lane - 4**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Amplitude		OK	OK	OK	OK	OK	OK	OK	OK
Capacitance		11.3 nF	11.2 nF	11.2 nF	11.2 nF	11.1 nF	11 nF	10.9 nF	10.8 nF
Resistance		inf	inf	inf	inf	inf	inf	inf	inf

System

A/C Service	120 VAC
Power Supply	12 Volt
Solar Panel	n/a
Back-Up	12 Volt
System Input	
Modem Power	
Phone off	
Phone on	

Temp Sensor

White+	
Red +	

Software

System	

Site Full Operating Capacity **Pass** √
Fail

Technician: **Rino Quinones** **Date:** **10/6/2006**

5.0 WIM CALIBRATION

5.1.1 TEST TRUCK #1 INFORMATION

DATE OF CALIBRATION: **October 31, 2006 thru November 1, 2006**

1. TEST TRUCK NUMBER: 1 2. FHWA CLASS: 9 3. Number of axles: 5

Axle	Empty Truck Axle Weights (lb)	4. Pre-Test Loaded Axle Weights (lb)	5. Post-Test Loaded Axle Weights (lb)	6. Measured Directly or Calculated
A		10,000		D
B		33,900		D (B&C combined)
C				
D		33,400		D (D&E combined)
E				

7. CALCULATIONS:

Empty Truck Gross Weight (lb)	Pre-Test Loaded Gross Weight (lb)	Post-Test Loaded Gross Weight (lb)	Pre to Post Difference (lb)
	77,300		

8. TRACTOR CAB STYLE: ☐ Cab over engine / ☒ Conventional ☐ With sleeper

9. TRACTOR MANUFACTURER:
   Make: Mack
   Model:

10. TRAILER LOAD DESCRIPTION: Concrete Barriers

11. TRAILER TARE WEIGHT (lb): _____

12. AXLE SPACINGS

Axle	Spacing (feet & inches)
A-B	15’
B-C	4.2’
C-D	32.8’
D-E	4.1’

KINGPIN OFFSET FROM AXLE B (ft, + towards rear): +1 ft

SUSPENSSION:

Axle	17. Tire Size	18. Suspension description (leaf, air, # of leaves, taper or flat leaf, etc.)
A	11R24	Leaf spring – two leaves
B	11R24	air
C	11R24	air
D	11R24	air
E	11R24	air

5.1.2 PICTURES, TEST TRUCK 1

5.1.3 TEST TRUCK #2 INFORMATION

DATE OF CALIBRATION: **October 31, 2006 thru November 1, 2006**

1. TEST TRUCK NUMBER: 2 2. FHWA CLASS: 9 3. Number of axles: 5

Axle	Empty Truck Axle Weights (lb)	4. Pre-Test Loaded Axle Weights (lb)	5. Post-Test Loaded Axle Weights (lb)	6. Measured Directly or Calculated
A		9,600		D
B		30,700		D (B&C combined)
C				
D		22,400		D (D&E combined)
E				

7. CALCULATIONS:

Empty Truck Gross Weight (lb)	Pre-Test Loaded Gross Weight (lb)	Post-Test Loaded Gross Weight (lb)	Pre to Post Difference (lb)
	62,700		500

8. TRACTOR CAB STYLE: ☐ Cab over engine / ☒ Conventional ☐ With sleeper

9. TRACTOR MANUFACTURER:
   Make: Mack
   Model:

10. TRAILER LOAD DESCRIPTION: Concrete Barriers

11. TRAILER TARE WEIGHT (lb): _____

12. AXLE SPACINGS

Axle	Spacing (feet & inches)
A-B	13.5’
B-C	4.3’
C-D	33.2’
D-E	4.1’

KINGPIN OFFSET FROM AXLE B (ft, + towards rear): +2 ft

SUSPENSSION:

Axle	17. Tire Size	18. Suspension description (leaf, air, # of leaves, taper or flat leaf, etc.)
A	11R24	Leaf spring – two leaves
B	11R24	air
C	11R24	air
D	11R24	air
E	11R24	air

5.1.4 PICTURES, TEST TRUCK 2

6.0 SHEET 20 – SPEED AND CLASSIFICATION CHECKS

7.0 SHEET 21 TEST TRUCK RECORDS

7.1.1 VALIDATION RUNS 10/31/200 TO 11/1/2006

International Road Dynamics Inc.

FHWA VERIFICATION

Static Test Vehicle Measurements

ID				GVW	F/A	T1	T2	1>2	2>3	3>4	4>5
1				77.3	10.0	33.9	33.4	15.0	4.2	32.8	4.1
2				62.8	9.6	30.7	22.4	13.5	4.3	33.2	4.1

Dynamic Test Vehicle Measurements

ID	V#	Speed	Temp	GVW	F/A	T1	T2	1>2	2>3	3>4	4>5
1	3552	44	15	73.8	8.7	32.6	32.4	15.0	4.1	32.9	4.1
2	3555	45	15	61.1	9.4	29.9	21.9	13.4	4.3	33.3	4.0
1	3571	44	14	75.2	9.6	32.4	33.1	15.0	4.2	32.9	4.1
2	3574	45	14	61.0	9.0	30.3	21.8	13.5	4.3	33.3	4.1
1	3592	44	18	77.2	9.2	34.4	33.6	15.0	4.2	33.0	4.1
2	3593	45	18	60.5	8.8	29.6	22.1	13.4	4.3	33.3	4.1
1	3608	45	12	74.4	8.8	32.4	33.3	14.9	4.1	32.9	4.1
2	3609	45	12	59.8	8.7	29.2	21.8	13.4	4.3	33.2	4.1
1	3621	44	14	76.0	9.5	33.3	33.2	15.0	4.2	32.9	4.1
2	3622	45	14	61.1	9.0	30.2	21.8	13.5	4.3	33.4	4.1
1	3641	45	15	76.0	9.3	33.4	33.3	15.0	4.1	33.0	4.1
2	3645	45	15	60.8	9.1	30.1	21.6	13.4	4.3	33.3	4.1
1	3745	56	14	79.1	9.4	36.1	33.6	15.0	4.1	32.9	4.1
2	3746	55	14	62.2	8.8	30.7	22.7	13.5	4.3	33.3	4.1
1	3802	55	15	76.2	9.0	34.3	33.0	15.0	4.1	33.0	4.1
2	3804	55	15	61.9	8.8	30.9	22.2	13.4	4.3	33.3	4.1
1	3850	55	14	76.7	9.2	34.7	32.8	15.0	4.1	33.1	4.1
2	3854	55	14	61.8	8.9	30.5	22.4	13.4	4.3	33.3	4.1
1	3890	55	19	78.1	9.5	34.6	34.0	15.0	4.2	33.0	4.1
2	3894	55	19	62.6	9.1	31.1	22.5	13.5	4.3	33.3	4.0
1	3942	55	14	79.3	9.7	35.8	33.8	15.0	4.2	32.9	4.0
2	3946	55	14	62.7	8.9	31.5	22.3	13.4	4.3	33.3	4.0
1	3990	56	15	77.7	9.2	35.1	33.4	15.0	4.2	33.0	4.1
2	3991	55	15	62.8	9.5	30.9	22.4	13.5	4.3	33.3	4.1
1	4025	53	19	76.7	9.0	34.3	33.4	15.0	4.2	32.9	4.0
2	4028	55	19	62.9	9.0	31.0	22.8	13.4	4.3	33.2	4.1
1	6057	65	16	80.4	9.9	36.0	34.5	15.0	4.2	33.0	4.0
2	6058	64	16	64.8	9.4	32.2	23.1	13.4	4.3	33.3	4.0
1	2347	65	20	76.7	9.3	34.5	33.0	15.0	4.1	33.0	4.1
2	2348	65	20	61.8	8.9	30.4	22.6	13.4	4.3	33.3	4.0
1	2418	65	20	77.2	9.4	34.8	32.9	14.9	4.1	32.9	4.0
2	2419	65	20	63.0	9.5	31.0	22.5	13.5	4.3	33.4	4.1
2	2482	64	20	63.7	9.1	32.3	22.2	13.4	4.3	33.2	4.0
1	2540	65	20	79.3	9.7	35.8	33.9	15.0	4.2	33.0	4.1
2	2542	65	17	62.1	8.9	31.0	22.2	13.4	4.3	33.2	4.0
1	2582	65	17	78.8	9.5	35.6	33.7	15.0	4.1	32.9	4.1
2	2583	64	20	64.7	9.3	32.5	23.0	13.5	4.3	33.4	4.1
2	2636	65	20	62.9	9.4	30.9	22.6	13.4	4.3	33.2	4.0
1	2685	63	19	79.1	9.8	35.7	33.7	15.0	4.2	32.9	4.1
2	2688	64	19	63.9	9.2	32.1	22.6	13.5	4.3	33.4	4.1

Date:	10/31/2005 to 11/1/2006
Technician:	Rino Quinones
Location:	Bemidji MN

8.0 PERFORMANCE EVALUATION

8.1.1 ERROR CALCULATIONS – VALIDATION 10/31/200 TO 11/1/2006

Truck	V#	Speed	Temp	GVW	F/A	T1	T2	1>2	2>3	3>4	4>5
1	3552	44	15	4.6%	12.8%	3.9%	-3.1%	0.0	-0.1	0.1	0.0
2	3555	45	15	2.7%	-2.3%	2.7%	2.4%	-0.1	0.0	0.1	-0.1
1	3571	44	14	2.7%	-3.8%	4.5%	-1.0%	0.0	0.0	0.1	0.0
2	3574	45	14	2.9%	-6.4%	1.4%	2.9%	0.0	0.0	0.1	0.0
1	3592	44	18	0.2%	-7.8%	1.4%	0.5%	0.0	0.0	0.2	0.0
2	3593	45	18	3.7%	-8.5%	3.7%	-1.5%	-0.1	0.0	0.1	0.0
1	3608	45	12	3.8%	11.8%	4.5%	0.4%	-0.1	-0.1	0.1	0.0
2	3609	45	12	4.8%	-9.6%	5.0%	2.9%	-0.1	0.0	0.0	0.0
1	3621	44	14	1.7%	-4.8%	1.8%	0.7%	0.0	0.0	0.1	0.0
2	3622	45	14	2.7%	-6.4%	1.8%	2.9%	0.0	0.0	0.2	0.0
1	3641	45	15	1.7%	-6.8%	1.5%	0.4%	0.0	-0.1	0.2	0.0
2	3645	45	15	3.2%	-5.4%	2.1%	-3.7%	-0.1	0.0	0.1	0.0
1	3745	56	14	2.3%	-5.8%	6.4%	0.5%	0.0	-0.1	0.1	0.0
2	3746	55	14	1.0%	-8.5%	0.1%	1.2%	0.0	0.0	0.1	0.0
1	3802	55	15	1.4%	-9.8%	1.1%	-1.3%	0.0	-0.1	0.2	0.0
2	3804	55	15	1.4%	-8.5%	0.5%	-1.1%	-0.1	0.0	0.1	0.0
1	3850	55	14	0.8%	-7.8%	2.3%	-1.9%	0.0	-0.1	0.3	0.0
2	3854	55	14	1.6%	-7.5%	0.8%	0.2%	-0.1	0.0	0.1	0.0
1	3890	55	19	1.0%	-4.8%	2.0%	1.7%	0.0	0.0	0.2	0.0
2	3894	55	19	0.3%	-5.4%	1.2%	0.3%	0.0	0.0	0.1	-0.1
1	3942	55	14	2.6%	-2.8%	5.5%	1.1%	0.0	0.0	0.1	-0.1
2	3946	55	14	0.2%	-7.5%	2.5%	0.6%	-0.1	0.0	0.1	-0.1
1	3990	56	15	0.5%	-7.8%	3.5%	-0.1%	0.0	0.0	0.2	0.0
2	3991	55	15	0.0%	-1.2%	0.5%	0.2%	0.0	0.0	0.1	0.0
1	4025	53	19	0.8%	-9.8%	1.1%	-0.1%	0.0	0.0	0.1	-0.1
2	4028	55	19	0.2%	-6.4%	0.8%	1.6%	-0.1	0.0	0.0	0.0
1	6057	65	16	4.0%	-0.8%	6.1%	3.2%	0.0	0.0	0.2	-0.1
2	6058	64	16	3.2%	-2.3%	4.7%	2.9%	-0.1	0.0	0.1	-0.1
1	2347	65	20	0.8%	-6.8%	1.7%	-1.3%	0.0	-0.1	0.2	0.0
2	2348	65	20	1.6%	-7.5%	1.1%	0.7%	-0.1	0.0	0.1	-0.1
1	2418	65	20	0.2%	-5.8%	2.6%	-1.6%	-0.1	-0.1	0.1	-0.1
2	2419	65	20	0.3%	-1.2%	0.8%	0.3%	0.0	0.0	0.2	0.0
2	2482	64	20	1.4%	-5.4%	5.1%	-1.1%	-0.1	0.0	0.0	-0.1
1	2540	65	20	2.6%	-2.8%	5.5%	1.4%	0.0	0.0	0.2	0.0
2	2542	65	17	-1.1%	-7.5%	0.8%	-1.1%	-0.1	0.0	0.0	-0.1
1	2582	65	17	1.9%	-4.8%	5.0%	0.8%	0.0	-0.1	0.1	0.0
2	2583	64	20	3.0%	-3.3%	5.7%	2.5%	0.0	0.0	0.2	0.0
2	2636	65	20	0.2%	-2.3%	0.5%	0.7%	-0.1	0.0	0.0	-0.1
1	2685	63	19	2.3%	-1.8%	5.2%	0.8%	0.0	0.0	0.1	0.0
2	2688	64	19	1.8%	-4.4%	4.4%	0.7%	0.0	0.0	0.2	0.0

International Road Dynamics Inc.

FHWA VERIFICATION

Specifications						
Confidence	95%	Speed range low	40	to	46
	(1.96)	Speed range medium	46	to	57
Gross vehicle weight	10%	Speed range high	57	to	76
Tandem group weight	15%	Temperature range low	10	to	13
Single axle weight	20%	Temperature range medium	13	to	17
Axle spacings	0.5	Temperature range high	17	to	20

Overall

Characteristic	Error	StdDev	Specification	Calculated	Pass/Fail
Gross vehicle weight	-0.5%	2.2%	10%	4.8%	pass
Tandem group weight	0.4%	2.7%	15%	5.6%	pass
Single axle weight	-5.9%	2.9%	20%	11.7%	pass
Axle spacings	0.0	0.1	0.5	0.2	pass

Speed range 40 to 46 (11 runs)

Characteristic	Error	StdDev	Specification	Calculated
Gross vehicle weight	-2.9%	1.3%	10%	5.6%
Tandem group weight	-2.2%	1.7%	15%	5.6%
Single axle weight	-7.3%	3.3%	20%	5.6%
Axle spacings	0.0	0.1	0.5	0.2

Speed range 46 to 57 (14 runs)

Characteristic	Error	StdDev	Specification	Calculated
Gross vehicle weight	-0.1%	1.3%	10%	2.7%
Tandem group weight	1.0%	1.9%	15%	4.7%
Single axle weight	-6.7%	2.5%	20%	11.7%
Axle spacings	0.0	0.1	0.5	0.2

Speed range 57 to 76 (15 runs)

Characteristic	Error	StdDev	Specification	Calculated
Gross vehicle weight	0.9%	2.0%	10%	5.0%
Tandem group weight	1.7%	2.6%	15%	6.8%
Single axle weight	-4.2%	2.3%	20%	8.9%
Axle spacings	0.0	0.1	0.5	0.2

Temperature range 10 to 13 (2 runs)

Characteristic	Error	StdDev	Specification	Calculated
Gross vehicle weight	-4.3%	0.7%	10%	5.7%
Tandem group weight	-3.2%	2.1%	15%	7.3%
Single axle weight	-10.7%	1.6%	20%	13.9%

Temperature range 13 to 17 (22 runs)

Characteristic	Error	StdDev	Specification	Calculated
Gross vehicle weight	-0.7%	2.3%	10%	5.3%
Tandem group weight	0.1%	2.7%	15%	5.5%
Single axle weight	-6.0%	3.0%	20%	12.0%

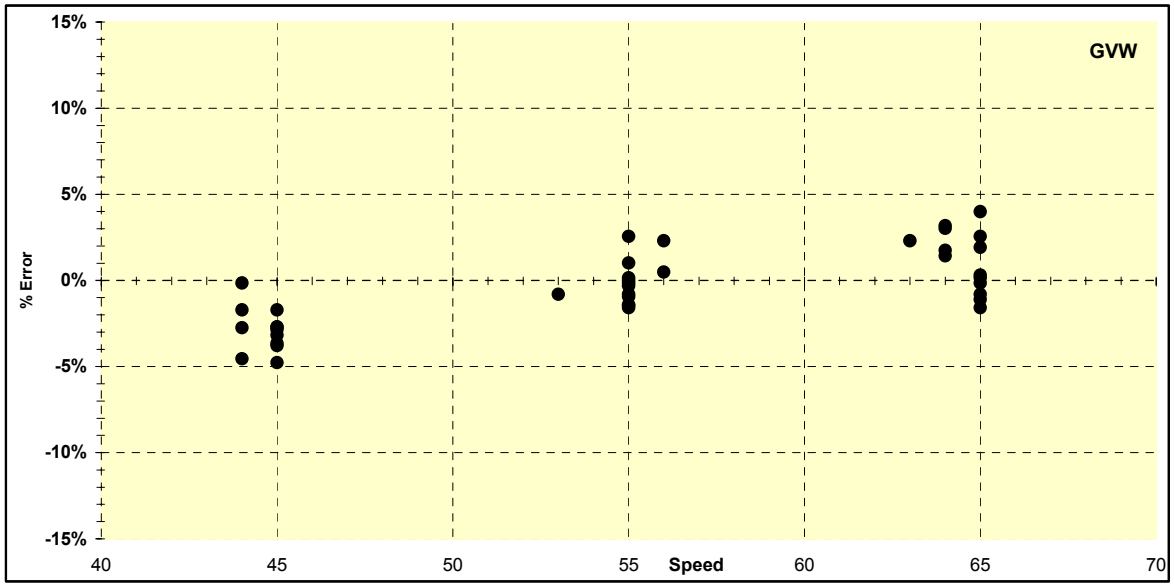
Temperature range 17 to 20 (16 runs)

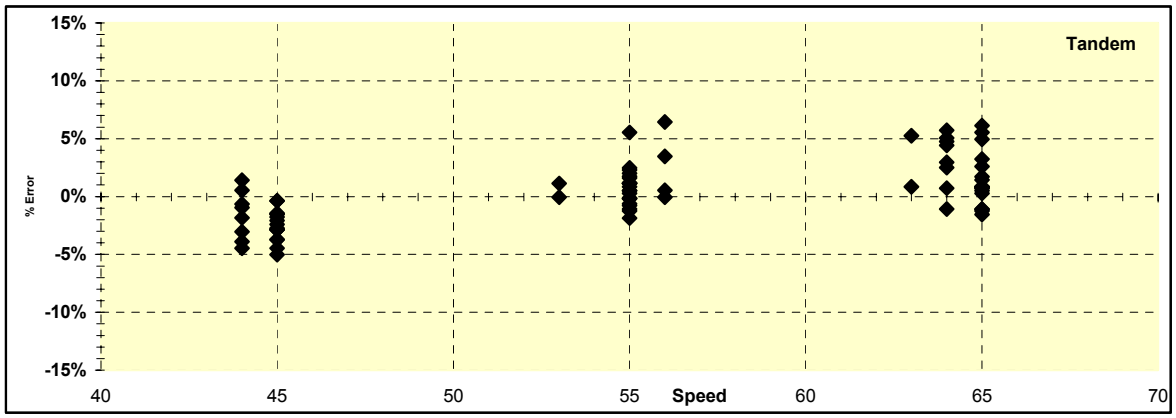
Characteristic	Error	StdDev	Specification	Calculated
Gross vehicle weight	0.3%	1.7%	10%	3.7%
Tandem group weight	1.2%	2.2%	15%	5.6%
Single axle weight	-5.3%	2.5%	20%	10.3%

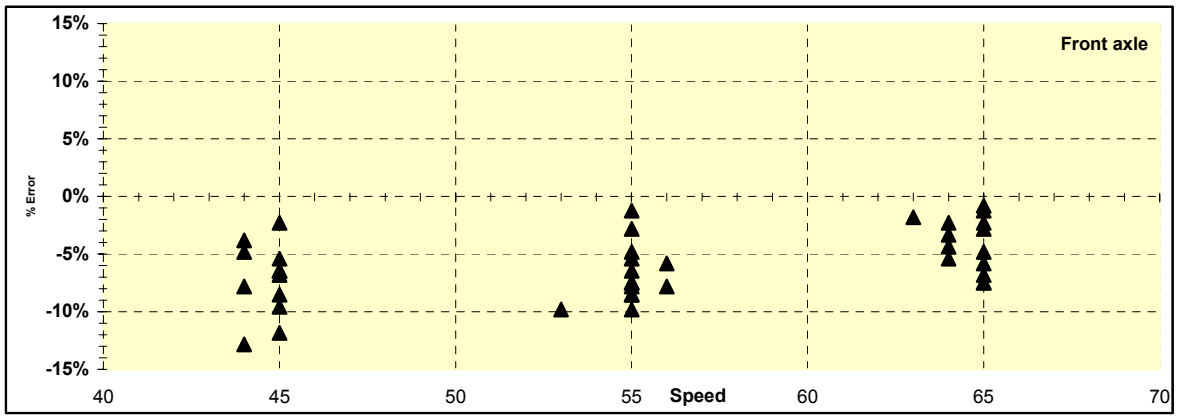
Bemidji MN Rino Quinones 10/31/2005 to 11/1/2006

International Road Dynamics Inc.

FHWA VERIFICATION







Bemidji MN Rino Quinones 10/31/2005 to 11/1/2006

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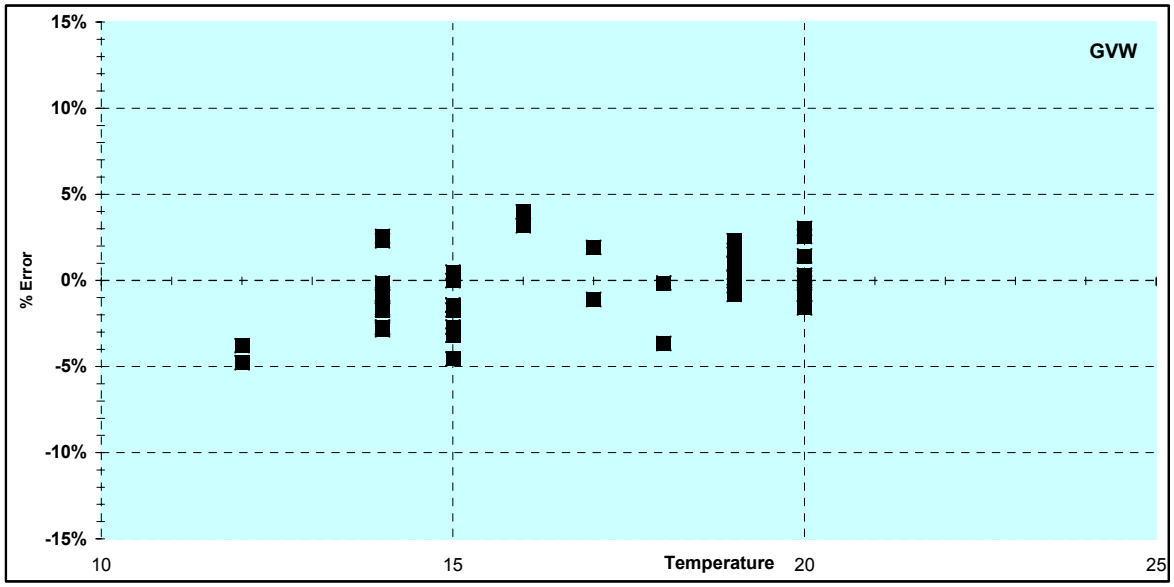

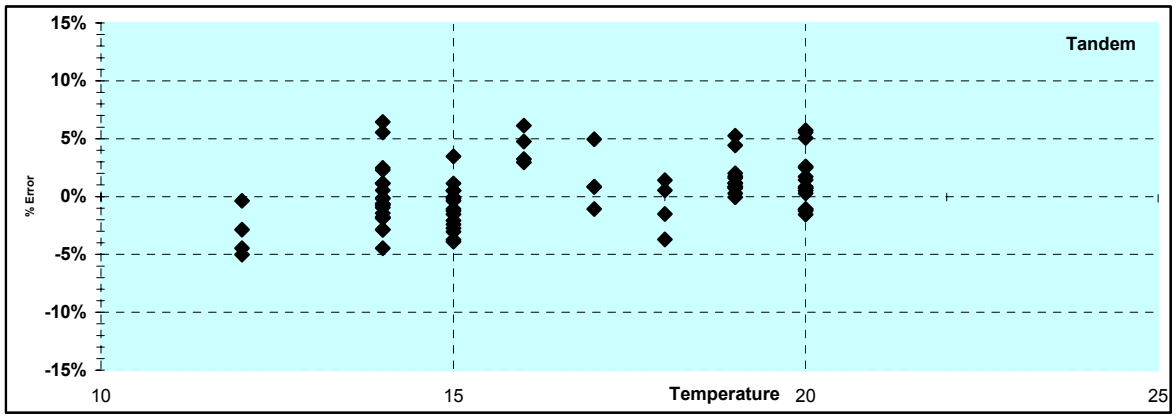

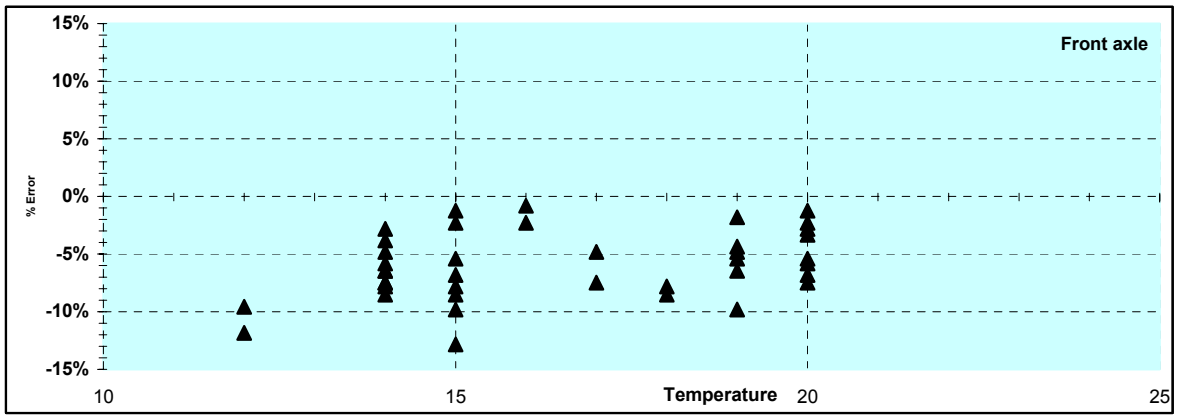

Bemidji MN Rino Quinones 10/31/2005 to 11/1/2006