



To: Mike Koerber

From: John F. Hillery

Subject: 1995 WDNR Aircraft Data Submittal*

Dear Mike:

Please find enclosed in this data submittal package the following items:

1. Flight log summary.
2. Flight patterns (changes from 1994).
3. VOC and Carbonyl sampling locations.
4. Flight Patterns and Waypoint documentation.
5. NO and NO2 line 3-D plots.
6. Quality control record for Ozone, NOX, RH and Temp.
7. Data file listing and column documentation.
8. Six data diskettes.
9. Listing of data caveats.
10. Internal and external audits.
11. Aloft to PAMS site intercomparison data.

* VOC and Carbonyl data to be submitted separately.

1995 PAMS SUPPLEMENTAL EFFORT
WDNR AIRCRAFT FLIGHT LOG SUMMARY

DATE	FLIGHT	MAX O3 CONC	REMARKS
6-06-95	am A,B pm C,D	N/A 107	No VOC's No VOC's/West Fork
6-07-95	am A,B pm C,D	111 -	Cancelled
6-15-95	am A,B pm C,D	95 148	No VOC's No VOC's/West Fork
6-16-95	am A,B pm C,D	111 181	West Fork
6-17-95	am A,B pm C,D	112 231(2)	East Fork
6-19-95	am A,B pm C,D	86 128	East Fork
7-12-95	am A,B pm C,D	132 243(15)	No VOC's No VOC's/West Fork
7-13-95	am A,B pm C,D	- 243(63)	Scrubbed (Fog) East Fork
7-14-95	am A,B pm C,D	123 173	East Fork
8-12-95	pm A,B pm C,D	99 161	West Fork

TOTAL DAYS: 10

TOTAL FLIGHT HOURS: 107

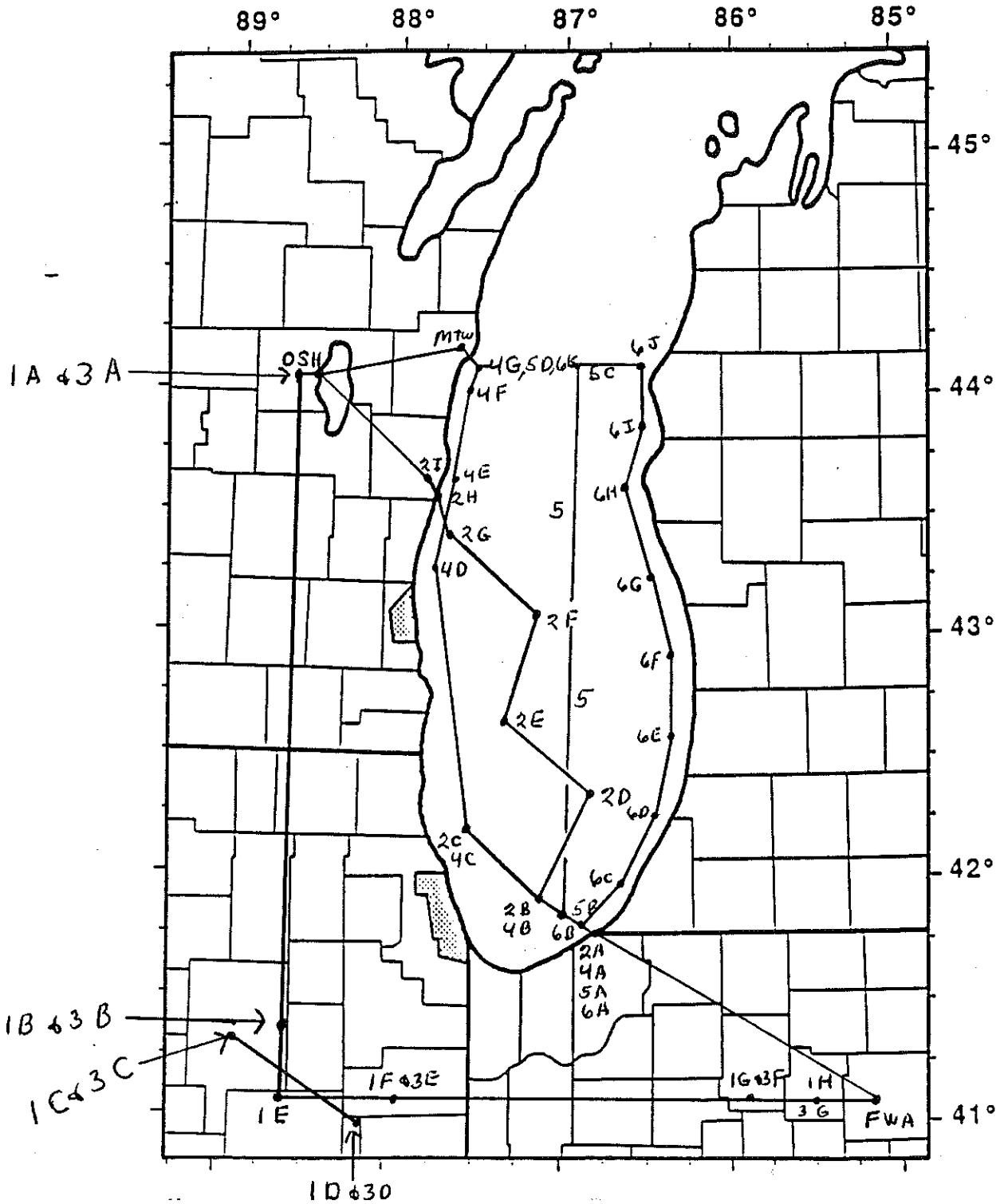
TOTAL CANISTERS (VOC): 64

TOTAL CARTRIDGES (CARBONYL): 60

(#) NUMBER OF PEAK OZONE CONCENTRATIONS > 200 PPB

1995 PAMS SUPPLEMENTAL EFFORT

AIRCRAFT MONITORING



WISCONSIN AIRCRAFT FLIGHT PATTERNS

- | | |
|------------------------------|--------------|
| 1. Western/Southern Boundary | 4. West Fork |
| 2. Lake Michigan | 5. Mid Lake |
| 3. Western/Southern Boundary | 6. East Fork |

1995 WDNR AIRCRAFT DATA CAVEATS

OZONE

The early flights contain some missing data due to a loss of voltage in the data logger system.

NOX

NO - After reviewing the graphs from the NO channel, it appears that a 20 - 40 minute ramp-down response occurred after departure. Since we do not know how much of this is real or an artifact in the channel, the early portion of the NO flight data was left unedited. All users of the data should be aware of this caveat. Likewise it affected the descriptive statistics calculated for this parameter.

NO2 - No problems discovered in this parameter. Since this is the predominant parameter aloft, line 3-D plots are provided for this and for the NO channel instead of NOX.

NOX - This channel experienced intermittent partial voltage losses throughout the operational period. Most of the data points that did not agree within 3 ppb of the sum of the NO and NO2 channel were deleted from the data base.

GPS ALTITUDE

GPS altitude is accurate to within 140 meters (95%) or + or - 230 ft. GPS altitude is actual altitude above mean sea level and is not equivalent to altitude measured by pressure altimeters. Furthermore, due to the arrangement of the satellite constellation and implementation of Selective Availability (purposeful degradation of the GPS signal accuracy by the Department of Defense), GPS altitude may vary significantly even when maintaining constant altitude. For these reasons, the GPS altitude may show the aircraft below the surface waters of Lake Michigan when flight level 100 ft AGL is maintained.

CAVEAT ADDENDUM dated 1-31-96

During the Advanced Pollution Instrumentation (API) workshop held in Milwaukee on January 23-26, 1996, the data from the API NOX analyzer used on the aircraft was reviewed regarding the 20-40 minute ramp-down response which occurred after departure. It was determined that the PMT voltage was undergoing restabilization after its brief shutdown prior to departure. Therefore all NO, NO2 & NOX data are not representative for at least the first 30 minutes after any departure.

1995 PAMS SUPPLEMENTAL EFFORT

AIRCRAFT MONITORING

WISCONSIN AIRCRAFT FLIGHT PATTERNS

- | | |
|------------------------------|--------------|
| 1. Western/Southern Boundary | 4. West Fork |
| 2. Lake Michigan | 5. Mid Lake |
| 3. Western/Southern Boundary | 6. East Fork |

Drafted by: Larry Waskow & Bob Clark

Approved by: Cyril Griesbach

Complied by: John F. Hillery

WISCONSIN AIRCRAFT FLIGHT PATTERN NO. 1

WESTERN/SOUTHERN BOUNDARY

ENROUTE "A" FLIGHT DESCRIPTION - This flight is executed along the western and southern boundaries of Lake Michigan's UAM-V grid "B" domain. Samples for VOC's and Carbonyls are collected in the southwest corner and along the southern boundary. The aircraft departs Oshkosh at 0330 CDT for a 3 1/2 hour flight to Fort Wayne, Ind.

GPS WAYPOINT POSITION: (N. Latitude & W. Longitude in Degrees/Minutes)

Oshkosh Airport: 43 59 88 33

After departure:

Initiate 500 - 2000 ft AGL Dolphin maneuver to points 1A & 1B.

1. 1A - 44 00 88 46
2. 1B - 41 16 88 40
Transition to 1C for VOC & Carbonyl collection run.
3. 1C - 41 14 88 50
Location 1
Begin 500 ft AGL VOC & Carbonyl sample collection.
4. 1D - 40 50 88 10
End sample collection.
Transition for 2000 ft AGL VOC & Carbonyl sample collection run.
(Backcourse along same flight track at Location 1).
5. 1C - 41 14 88 50
End sample collection.
Transition to 1E.
6. 1E - 41 02 88 40
Southwest corner of UAM -V grid "B"
Initiate 500 - 2000 ft AGL Dolphin maneuver to points 1F, 1G & 1H.
7. 1F - 41 02 88 00
Location 2
Begin VOC & Carbonyl sample collection run (performed during Dolphin maneuver - 90 nm ground track and 30 minute collection time).
8. 1G - 41 02 85 59
End sample collection.
9. 1H - 41 02 85 25
Class C Airspace
Transition for landing at Fort Wayne, Ind.
10. FWA 40 58 85 11
"A" Flight termination.

WISCONSIN AIRCRAFT FLIGHT PATTERN NO. 2

LAKE MICHIGAN

ENROUTE "B" FLIGHT DESCRIPTION - This flight returns the aircraft back to Oshkosh for recycling for the afternoon boundary operation. The mission profile is a sawtooth flight track with sample collections northeast of Chicago, Southeastern Wisconsin and Milwaukee. The aircraft departs Fort Wayne, Ind. between 0715 and 0745 CDT for a 3 hour flight.

GPS WAYPOINT POSITION: (N. Latitude & W. Longitude in Degrees/Minutes)

Fort Wayne Airport: 40 58 85 11

After departure:

Initiate 500 - 2000 ft AGL Dolphin maneuver to position 2A.

1. 2A - 41 44 86 52
Michigan City, Ind.
Transition to 2B.
2. 2B - 42 00 87 08
Location 5
Begin 100 ft AGL VOC & Carbonyl sample collection run.
3. 2C - 42 27 87 42
End sample collection.
Transition for 1000 ft AGL VOC & Carbonyl sample collection run.
(Backcourse along same flight track at Location 5).
4. 2B - 42 00 87 08
End 1000 ft AGL VOC & Carbonyl sample collection.
Transition to 2D.
5. 2D - 42 27 87 04
Location 6
Begin 100 ft AGL VOC & Carbonyl sample collection run.
6. 2E - 42 53 87 39
End sample collection.
Transition to 2F.
7. 2F - 42 59 87 14
Location 7
Begin 100 ft AGL VOC & Carbonyl sample collection.
8. 2G - 43 24 87 50
End sample collection.
Transition to 2H AND 2I
9. 2H - 43 29 87 47
10. 2I - 43 30 87 49
HARRINGTON BEACH PAMS SITE
Continue 500 - 2000 ft AGL dolphin maneuver to Oshkosh, Wi.
11. OSH 43 59 88 33
"B" Flight Termination

WISCONSIN AIRCRAFT FLIGHT PATTERN NO. 3

WESTERN/SOUTHERN BOUNDARY

ENROUTE "C" FLIGHT DESCRIPTION: This afternoon flight is executed along the western and southern boundaries of Lake Michigan's UAM-V grid "B" domain. Samples for VOC's and Carbonyls are collected in the southwest corner and along the southern boundary. The aircraft departs Oshkosh around 1100 hrs CDT for a 3 1/4 hour flight to Fort Wayne, Ind.

GPS WAYPOINT POSITION: (N. Latitude & W. Longitude in Degrees/Minutes)

Oshkosh Airport: 43 59 88 33

After departure:

Initiate 500 - 2000 ft AGL Dolphin maneuver to positions 3A & B.

1. 3A - 44 00 88 46

2. 3B - 41 16 88 40
Transition to 3C.

3. 3C - 41 14 88 50
Location 1
Begin 500 ft AGL VOC & Carbonyl sample collection.

4. 3D - 40 50 88 10
End sample collection.
Transition to 3E.

5. 3E - 41 02 88 00
Location 2
Begin 500 to 2000 ft AGL VOC & Carbonyl sample collection (90 nm distance and 30 minute sample)

6. 3F - 41 02 85 59
End sample collection.

7. 3G - 41 02 85 26
Class C airspace.

8. FWA 40 58 85 11
" C" Flight Termination

WISCONSIN AIRCRAFT FLIGHT PATTERN NO. 4

WEST FORK

ENROUTE "D" FLIGHT DESCRIPTION: This flight, one of three options for the return back to Oshkosh, Wis., is executed based on a weather forecast for Ozone conducive conditions along the western shores of Lake Michigan. The mission profile for the aircraft is a track which keeps it within 5 - 10 statute miles from the shore. A dolphin maneuver from 100 - 800 ft AGL is performed over the lake with one VOC and Carbonyl collected off shore between Harrington Beach State Park and Woodland Dunes (PAMS site). The aircraft departs Fort Wayne, Ind. around 1430 CDT for a 3 hour flight to Oshkosh, Wi.

GPS WAYPOINT POSITION: (N. Latitude & W. Longitude in Degrees/Minutes)

Fort Wayne Airport: 40 58 85 11

After departure:

Initiate 500 - 2000 ft AGL Dolphin maneuver to 4A.

1. 4A - 41 44 86 52
Michigan City, Ind.
Initiate 100 - 800 ft Dolphin maneuver over Lake Michigan to 4B, 4C, 4D & 4E.
2. 4B - 42 00 87 08
3. 4C - 42 27 87 42
4. 4D - 43 19 87 44
5. 4E - 43 28 87 42
Location 3 W
Begin 100 ft AGL VOC & Carbonyl sample collection.
6. 4F - 44 04 87 33
End sample collection.
7. 4G - 44 07 87 32
Transition to Woodland Dunes PAMS site.
8. MTW 44 08 87 36
Woodland Dunes PAMS site.
9. OSH 43 59 88 33
"D" Flight Termination

WISCONSIN AIRCRAFT FLIGHT PATTERN NO. 5

MID LAKE

ENROUTE "D" FLIGHT DESCRIPTION: This flight, one of three options for the return back to Oshkosh, Wi., is executed based on a weather forecast for Ozone conducive conditions to exist over the center of Lake Michigan. The flight over the 87th parallel of longitude takes the aircraft on a track over the center of Lake Michigan. No VOC or Carbonyl samples are collected on this flight. The aircraft departs Fort Wayne, Ind around 1430 CDT for a 2 3/4 hour flight to Oshkosh, Wi.

GPS WAYPOINT POSITION: (N. Latitude & W. Longitude in Degrees/Minutes).

Fort Wayne, Ind. 40 58 . 85 11

After Departure:

Initiate 500 - 2000 ft Dolphin maneuver to 5A.

1. 5A - 41 44 86 52

Michigan City, Ind.

Initiate 100 - 800 ft AGL Dolphin maneuver over Lake Michigan to points 5B, 5C & 5D.

2. 5B - 41 52 87 00

3. 5C - 44 05 87 00

4. 5D - 44 07 87 32

Transition to Woodland Dunes PAMS site.

5. MTW 44 08 87 36

Woodland Dunes PAMS site.

6. OSH 43 59 88 33

"D" Flight Termination

WISCONSIN AIRCRAFT FLIGHT PATTERN NO. 6

EAST FORK

ENROUTE "D" FLIGHT DESCRIPTION: This flight, one of three options for the return back to Oshkosh, Wis. is executed based on a weather forecast for Ozone conducive conditions along the eastern shores of Lake Michigan. The mission profile for the aircraft is a track which keeps it within 5 - 10 statute miles from the shore. A dolphin maneuver from 100 - 800 ft AGL is performed over the lake with one VOC and Carbonyl sample collected off shore centered on Muskegon, MI.

GPS WAYPOINT POSITION: (N. Latitude & W. Longitude in Degrees/Minutes).

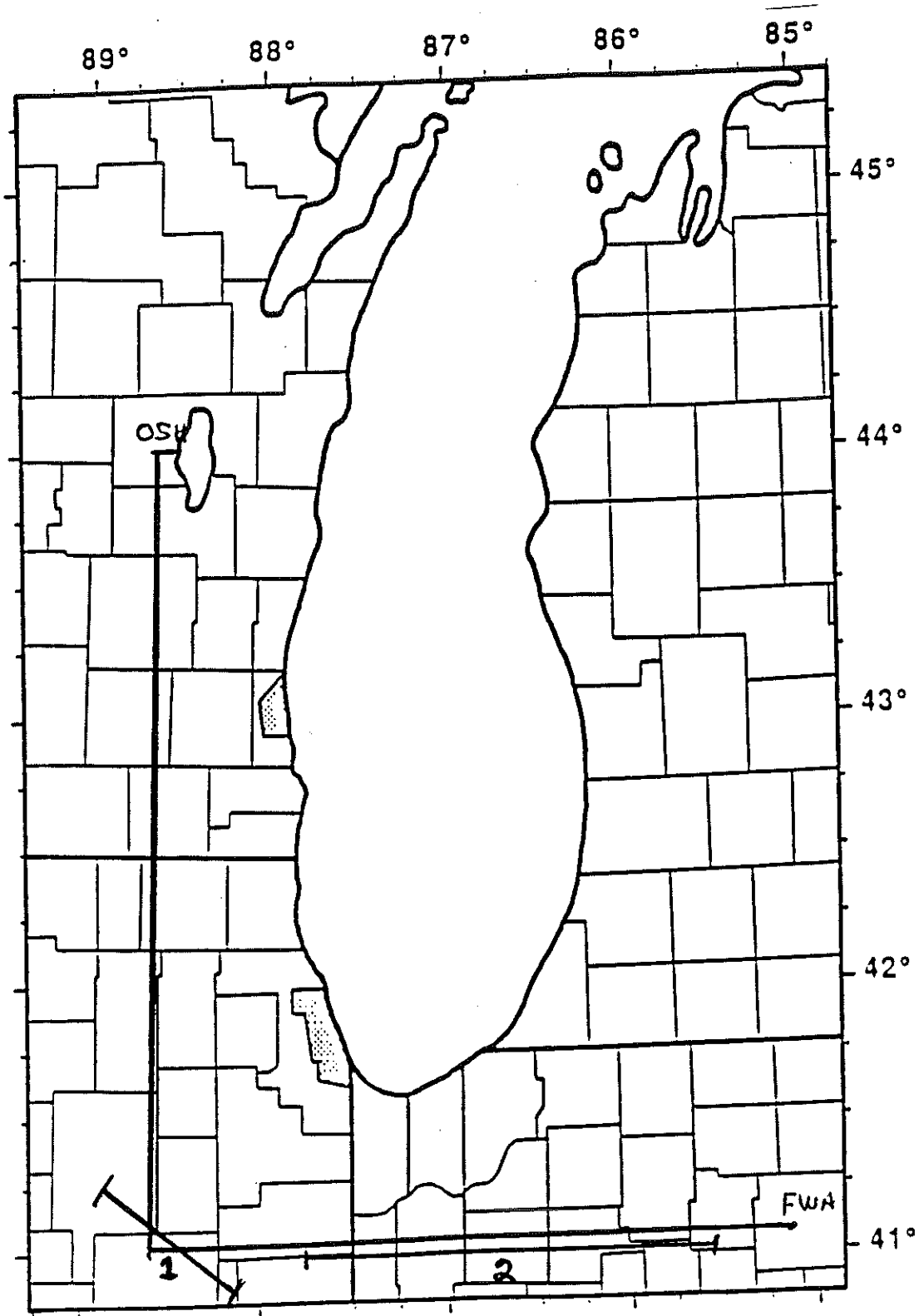
Fort Wayne, Ind. 40 58 85 11

After departure:

Initiate 500 - 2000 ft Dolphin maneuver to position 6A.

1. 6A - 41 44 86 52
Michigan City, Ind.
Initiate 100 - 800 ft AGL Dolphin maneuver over Lake Michigan to points 6B, 6C, 6D, 6E & 6F.
2. 6B - 41 48 86 56
3. 6C - 41 55 86 45
4. 6D - 42 21 86 25
5. 6E - 42 34 86 21
6. 6F - 42 57 86 20
Location 3 E
Begin 100 ft AGL VOC & Carbonyl sample collection.
7. 6G - 43 31 86 37
End sample collection.
Reinitiate 100 to 800 ft AGL Dolphin maneuver to points 6H, 6I, 6J & 6K.
8. 6H - 43 35 86 39
9. 6I - 43 49 86 34
10. 6J - 44 03 86 38
11. 6K - 44 07 87 32
Transition to Woodland Dunes PAMS site.
12. MTW 44 08 87 36
Woodland dunes PAMS site.
13. OSH 43 59 88 33
"D" Flight Termination

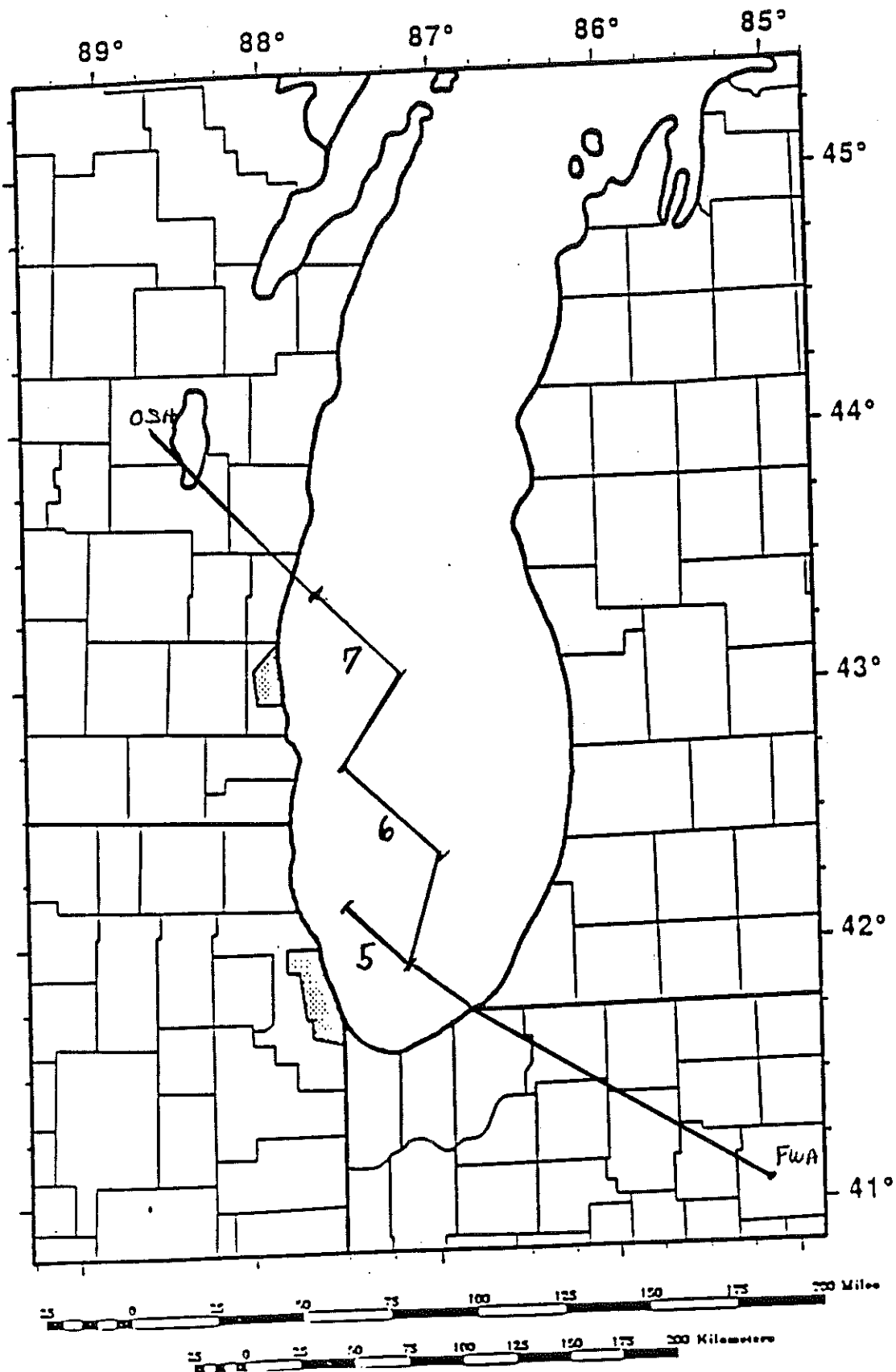
FLIGHT A



- LOCATION 1 - 500 FT AGL - VOC AND CARBONYL (VOC FLOW 185)
- 2000 FT AGL - VOC AND CARBONYL (VOC FLOW 185)
- LOCATION 2 - DOLPHIN
- 500 - 2000 FT AGL - VOC AND CARBONYL (VOC FLOW 75)

1995 AIRCRAFT SAMPLING LOCATIONS

FLIGHT B



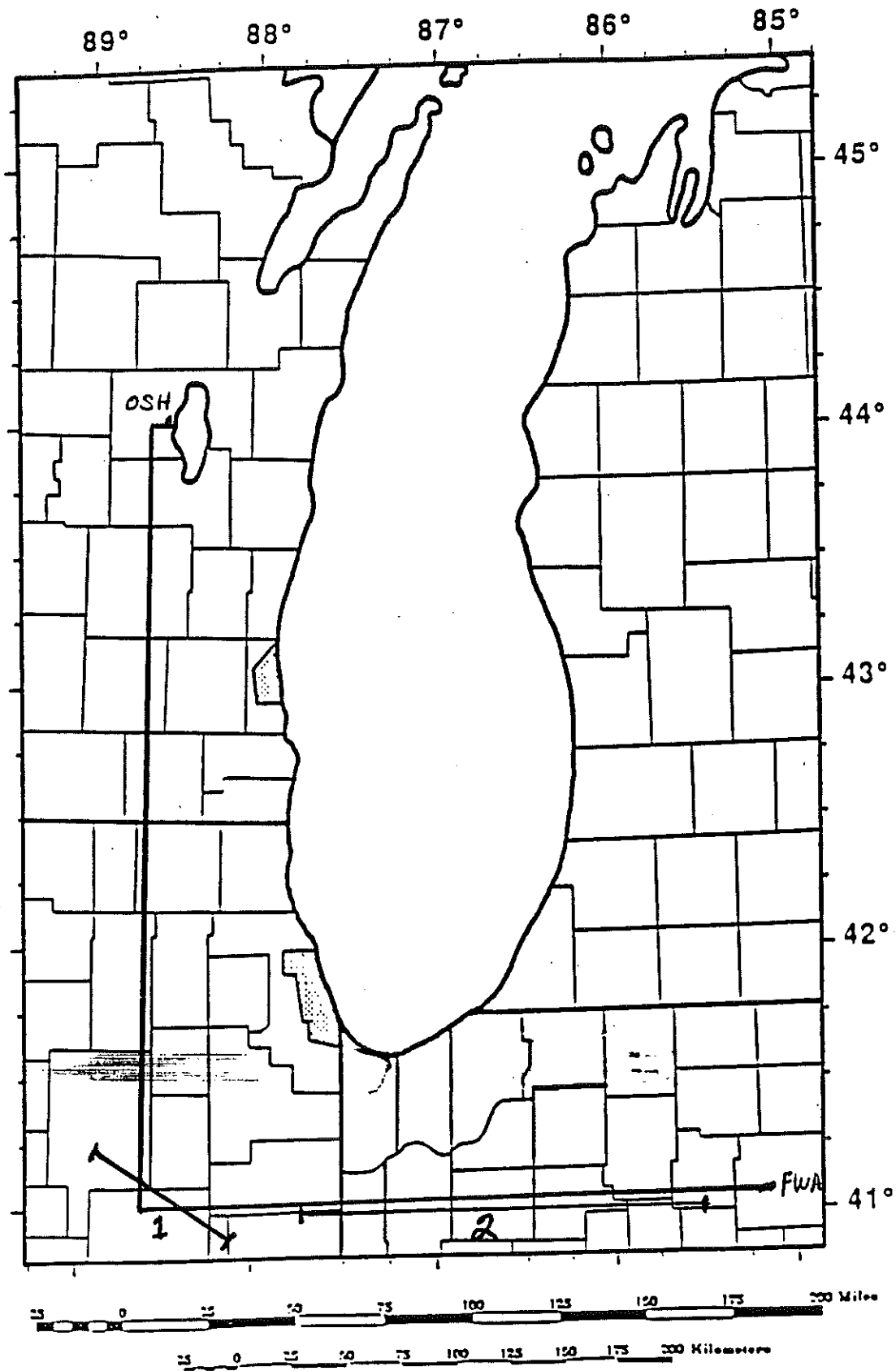
LOCATION 5 - 100 & 1000 FT AGL - VOC & CARBONYL (VOC FLOW 185)

LOCATION 6 - 100 FT AGL - VOC & CARBONYL (VOC FLOW 185)

LOCATION 7 - 100 FT AGL - VOC & CARBONYL (VOC FLOW 185)

1995 AIRCRAFT SAMPLING LOCATIONS

FLIGHT C



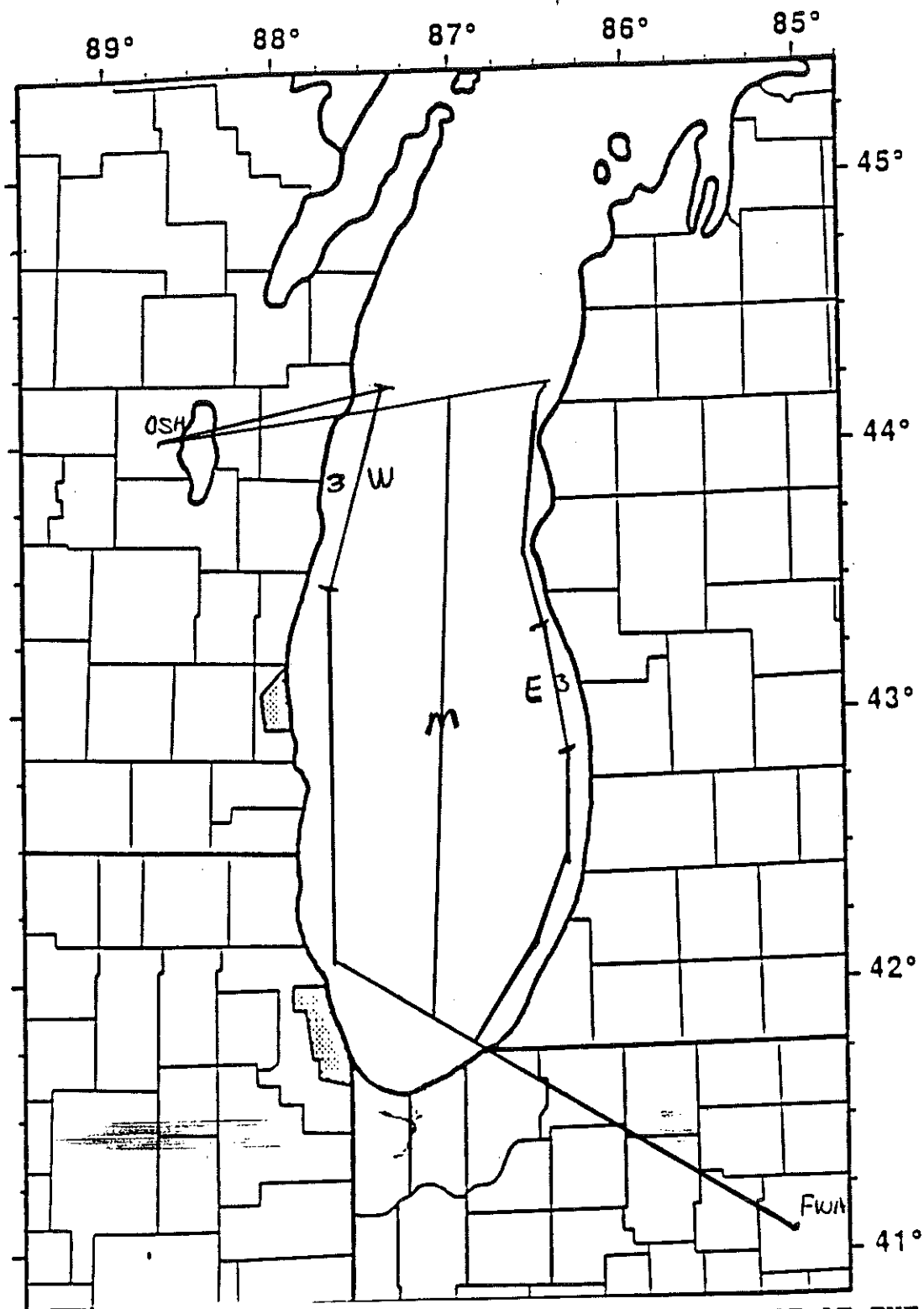
LOCATION 1 - 500 FT AGL - VOC & CARBONYL (VOC FLOW 185)

LOCATION 2 - DOLPHIN

- 500 - 2000 FT AGL - VOC & CARBONYL (VOC FLOW 75)

1995 AIRCRAFT SAMPLING LOCATIONS

FLIGHT D



FLIGHT OVER LAKE - 100 TO 800 FT AGL DOLPHIN EXCEPT AT THE SAMPLING LOCATIONS

LOCATION 3 - WEST FORK

- 100 FT AGL - VOC & CARBONYL (VOC FLOW 185)

LOCATION 3 - EAST FORK

- 100 FT AGL - VOC & CARBONYL (VOC FLOW 185)

1995 PAMS SUPPLEMENTAL EFFORT

WDNR AIRCRAFT FLIGHT PATTERNS
(CHANGES FROM 1994)

"A" FLIGHT

ELIMINATE: 500,2000 & 500 ft AGL CARBONYL SAMPLE ON THE SOUTHERN BOUNDARY

PERFORM: 30 MIN/90 NM VOC & CARBONYL SAMPLE DURING 500 - 2000 ft AGL
DOLPHIN MANEUVER

"B" FLIGHT

REDUCE TURNAROUND TIME AND DEPART EARLIER
(AVERAGE DEPARTURE TIME,0730 CDT)

"C" FLIGHT

REDUCE TURNAROUND TIME AND DEPART EARLIER
(AVERAGE DEPARTURE TIME,1130 CDT)

ELIMINATE: 2000 ft AGL VOC & CARBONYL SAMPLE AT THE SOUTHWEST CORNER
& 500,2000 & 500 ft AGL CARBONYL SAMPLE ON THE SOUTHERN BOUNDARY

PERFORM: 30 MIN/90 NM VOC & CARBONYL SAMPLE DURING 500 - 2000 ft AGL
DOLPHIN MANEUVER

"D" FLIGHT

REDUCE TURNAROUND TIME AND DEPART EARLIER
(AVERAGE DEPARTURE TIME,1430 CDT)

ELIMINATE: ENTIRE 1994 FLIGHT PATTERN

PERFORM: WEST,EAST OR MID-LAKE DOLPHIN MANEUVER

100 - 800 ft AGL OVER THE LAKE

WEST & EAST - WITHIN 10 SM OF SHORELINE

100 ft AGL VOC & CARBONYL SAMPLE COLLECTION AT:

1) WEST - HARRINGTON BEACH TO MANITOWOC,WI.

2) EAST - TRACK CENTERED OFF OF MUSKEGON,MI.

1995 WDNR AIRCRAFT DATA FILES

C6695.WK1 Each data file has the following 17 columns:
D6695.WK1

	UNITS OF MEASUREMENT	
	MONTH	
A6795.WK1	DAY	
B6795.WK1		
A61595.WK1	YEAR	
B61595.WK1		
C61595.WK1	HOUR	CDT
D61595.WK1	MINUTE	
A61695.WK1	SECOND	
B61695.WK1		
C61695.WK1	NORTH LATITUDE	DEGREE.TENTHS OF DEGREES
D61695.WK1	WEST LONGITUDE	DEGREE.TENTHS OF DEGREES
A61795.WK1	OZONE	PPB
B61795.WK1	NITROGEN OXIDE	PPB
C61795.WK1	NITROGEN DIOXIDE	PPB
D61795.WK1	OXIDES OF NITROGEN	PPB
A61995.WK1	RELATIVE HUMIDITY	%
B61995.WK1	TEMPERATURE	CELSIUS
C61995.WK1	AMBIENT PRESSURE	mm HG
D61995.WK1	GPS ALTITUDE	ft MSL
A71495.WK1	COMMENTS	
B71495.WK1		
C71495.WK1		
D71495.WK1		
A81295.WK1		
B81295.WK1		
C81295.WK1		
D81295.WK1		

TOTAL 34 AIRCRAFT DATA FILES

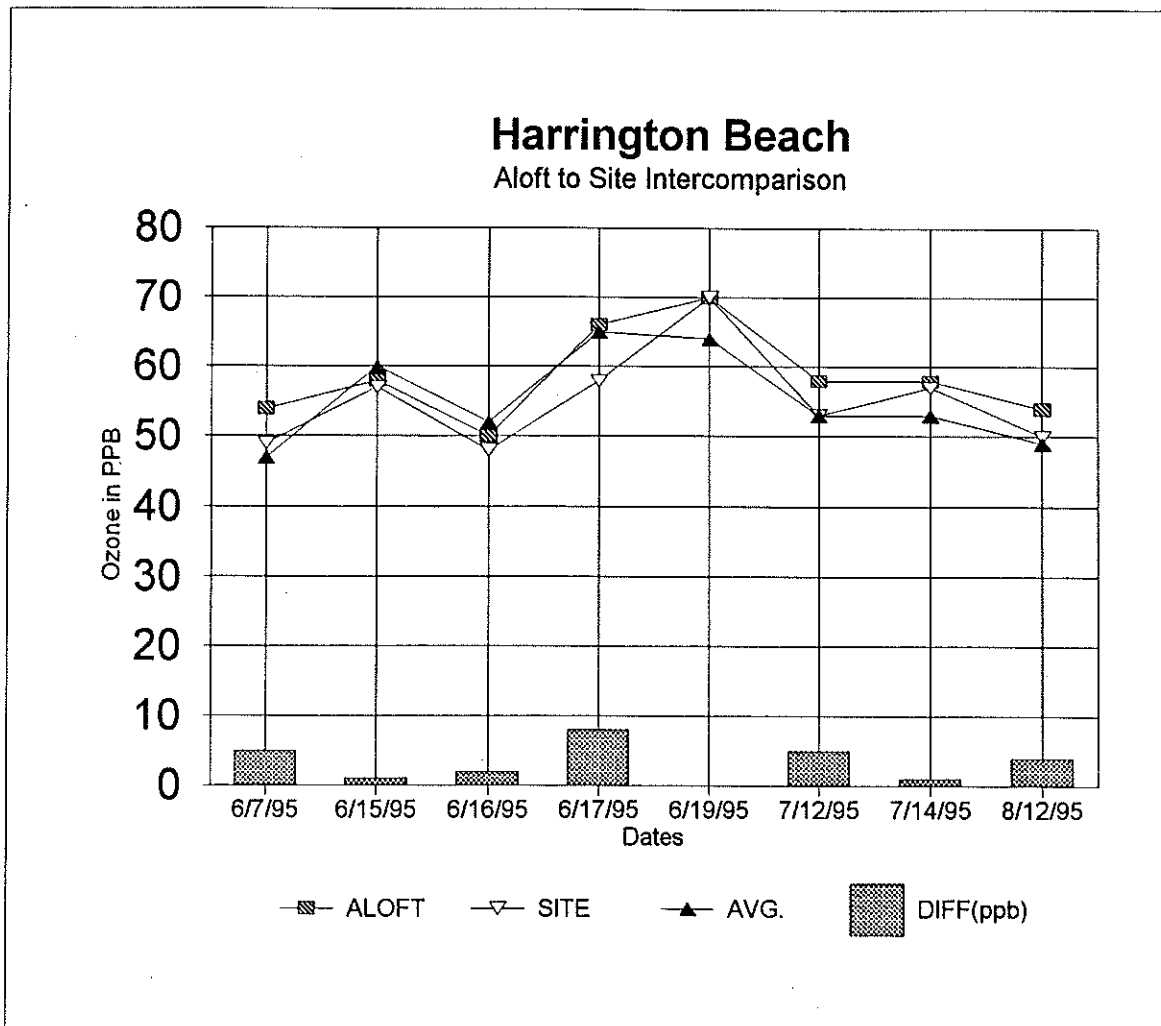
These are Quattro/Lotus files. The comments field contains the start and end times for the VOC and Carbonyl sample collections along with the location and sample numbers.

WDNR Aircraft Flight DATA

Aloft to Pams Site Ozone Intercomparison

HARRINGTON BEACH

DATE	TIME(CST)	Ozone Readings				% DIFF	SITE HRLY
		ALOFT	SITE	DIFF(ppb)	AVG.		
6/7/95	09:13	54	49	5	9%	47	
6/15/95	08:40	58	57	1	2%	60	
6/16/95	09:06	50	48	2	4%	52	
6/17/95	09:02	66	58	8	12%	65	
6/19/95	08:57	70	70	0	0%	64	
7/12/95	08:41	58	53	5	9%	53	
7/14/95	08:41	58	57	1	2%	53	
8/12/95	08:35	54	50	4	7%	49	



WDNR Aircraft Flight DATA

Aloft to Pams Site Ozone Intercomparison

WOODLAND DUNES

DATE	TIME(CST)	Ozone Readings				SITE HRLY	
		ALOFT	SITE	DIFF(ppb)	% DIFF	AVG.	
6/6/95	16:11	108	100	8	7%	94	
6/15/95	15:17	83	74	9	11%	73	
6/16/95	15:58	153	100	53	35%	100	
6/17/95	15:23	132	117	15	11%	119	
6/19/95	15:44	83	62	21	25%	57	
7/12/95	15:18	107	92	15	14%	98	
7/13/95	15:30	132	100	32	24%	95	
7/14/95	15:26	99	107	-8	-8%	102	
8/12/95	15:38	45	44	1	2%	38	

