RESULTS FROM OVERFLIGHTS OF THE HOUSTON SHIP CHANNEL USING THE HYPERSPECTRAL AISA+ SENSOR

JUNE 12 - 13, 2004

Larry B. York

CITY OF HOUSTON
ENVIRONMENTAL HEALTH DIVISION

THE SITUATION

- Facility inspection responsibilities, environmental monitoring needs, and costs have risen dramatically in recent years, which prompts responsible agencies to investigate alternative processes.

- The use of remote sensing will enable environmental agencies and local government officials to identify likely non-conforming facilities, and industrial or private processes that threaten the environment.

- Previously, multispectral or other remote sensing capabilities were limited to wide-area analyses using low-resolution data, a process ill-suited to the complex urban environment.

- Recent advances in hyperspectral collection yield more detailed information at higher resolutions, offering the capability of detection of illegal or unauthorized chemical releases or disposal on land, air, and water.

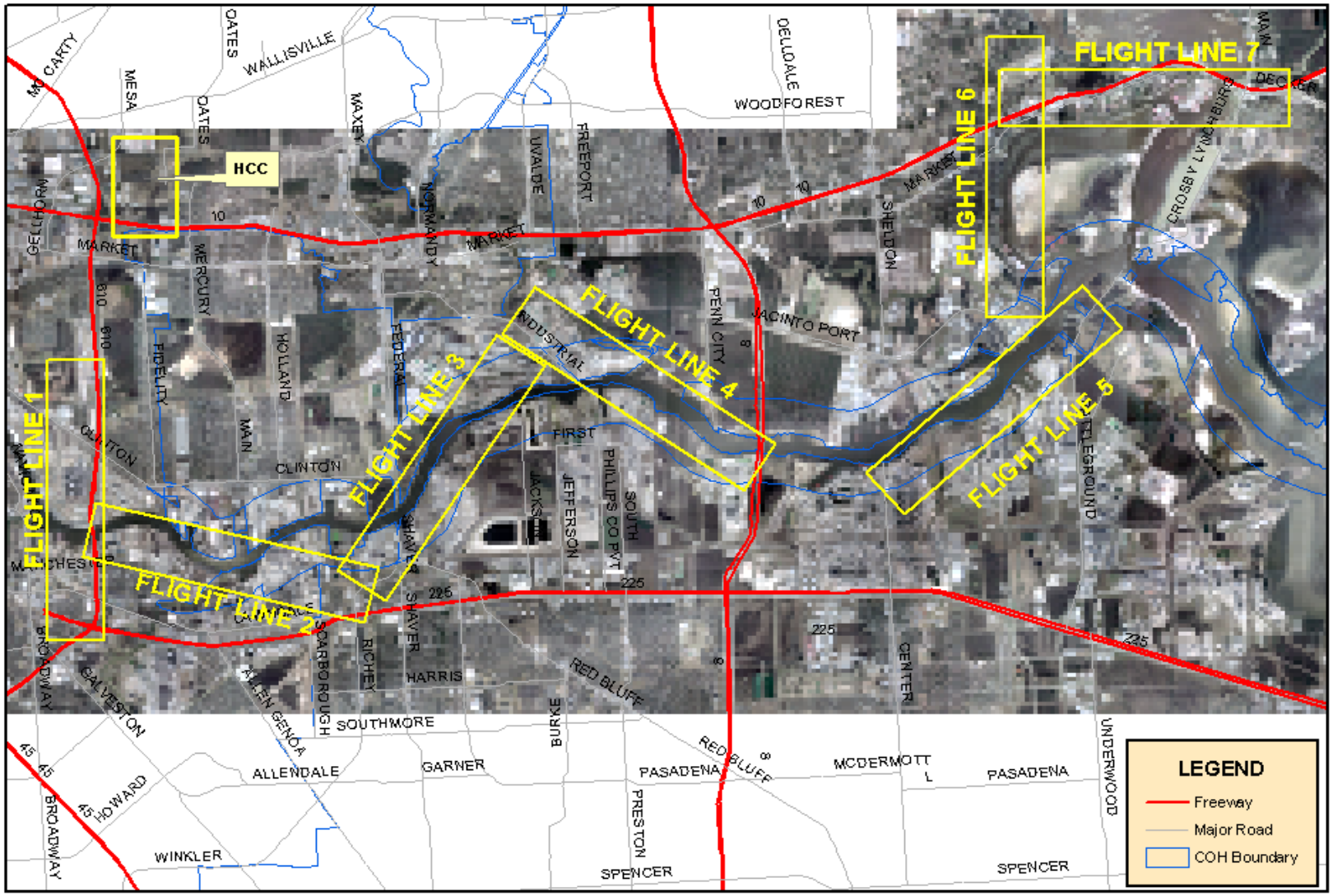
VISION AND MISSION

- Vision
  - Using hyperspectral imagery to detect, measure, and identify pollutant discharges and emissions.
- Mission
  - After identifying and sampling, to enforce local, state, and federal regulations and apply data as an enforcement tool.

HYPERSPECTRAL PROJECT

The Hyperspectral Project was developed by the Environmental Health Division in the City of Houston Department of Health and Human Services. The original concept was to lease a hyperspectral sensor and, using a COH police helicopter, fly the sensor over selected areas along the Houston Ship Channel. The EPA in Region 6 ultimately approved and funded the project, and contracted with Remote Measurement Services, LLC. to collect and analyze the data from the over-flights. The EPA and various departments of the COH jointly conducted the project.

PROPOSED FLIGHT LINES
HOUSTON SHIP CHANNEL AREA



HCC: Houston Community College

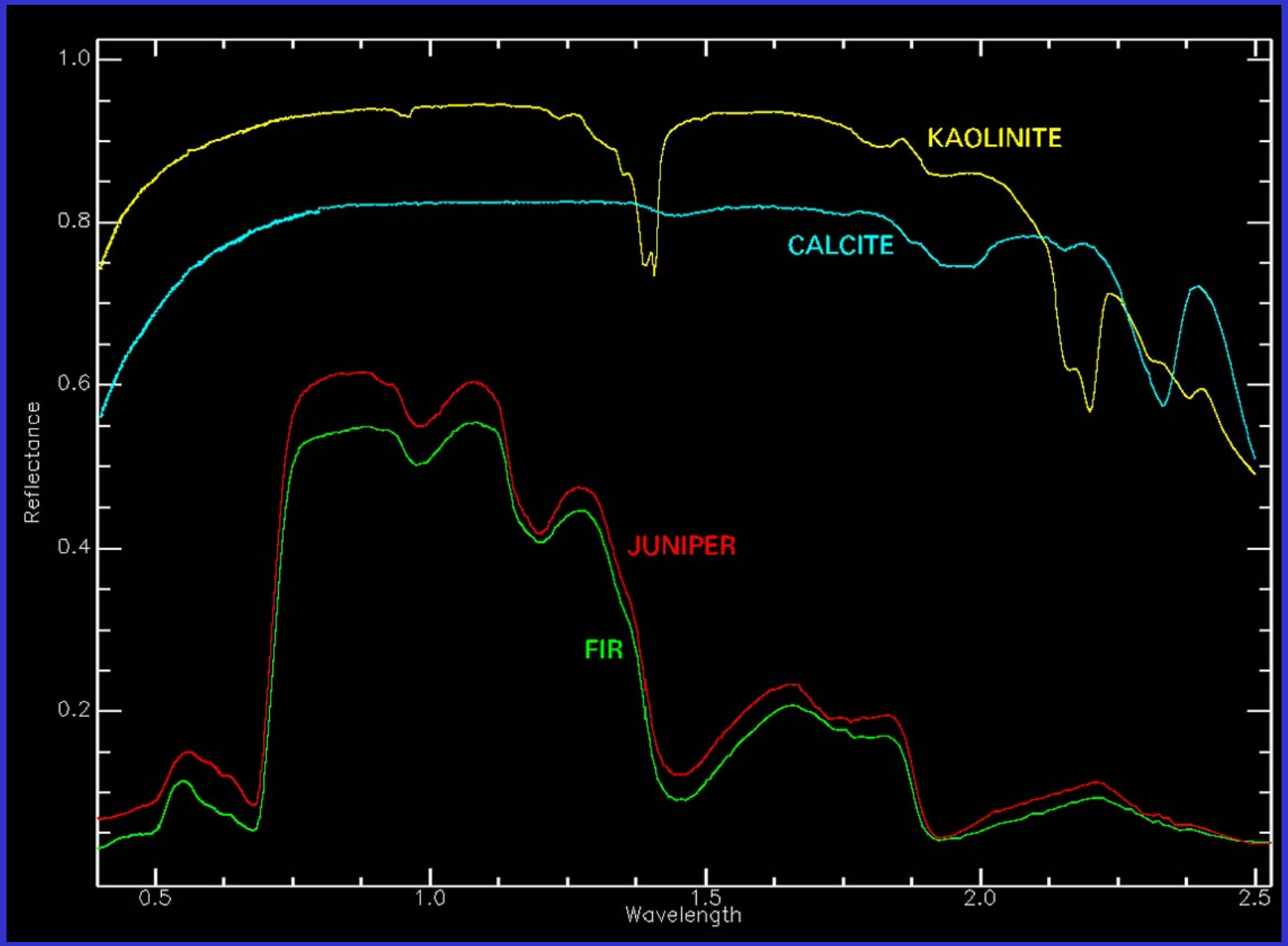
DATA SOURCE: H-GAC 2002 Color Digital Orthophoto, 1 foot
Over-Flight Date: January 2002
Vector Data: COH - COHGIS Rel. 9

CITY OF HOUSTON
ENVIRONMENTAL HEALTH DIVISION
MAP DATE: MAY 12, 2004

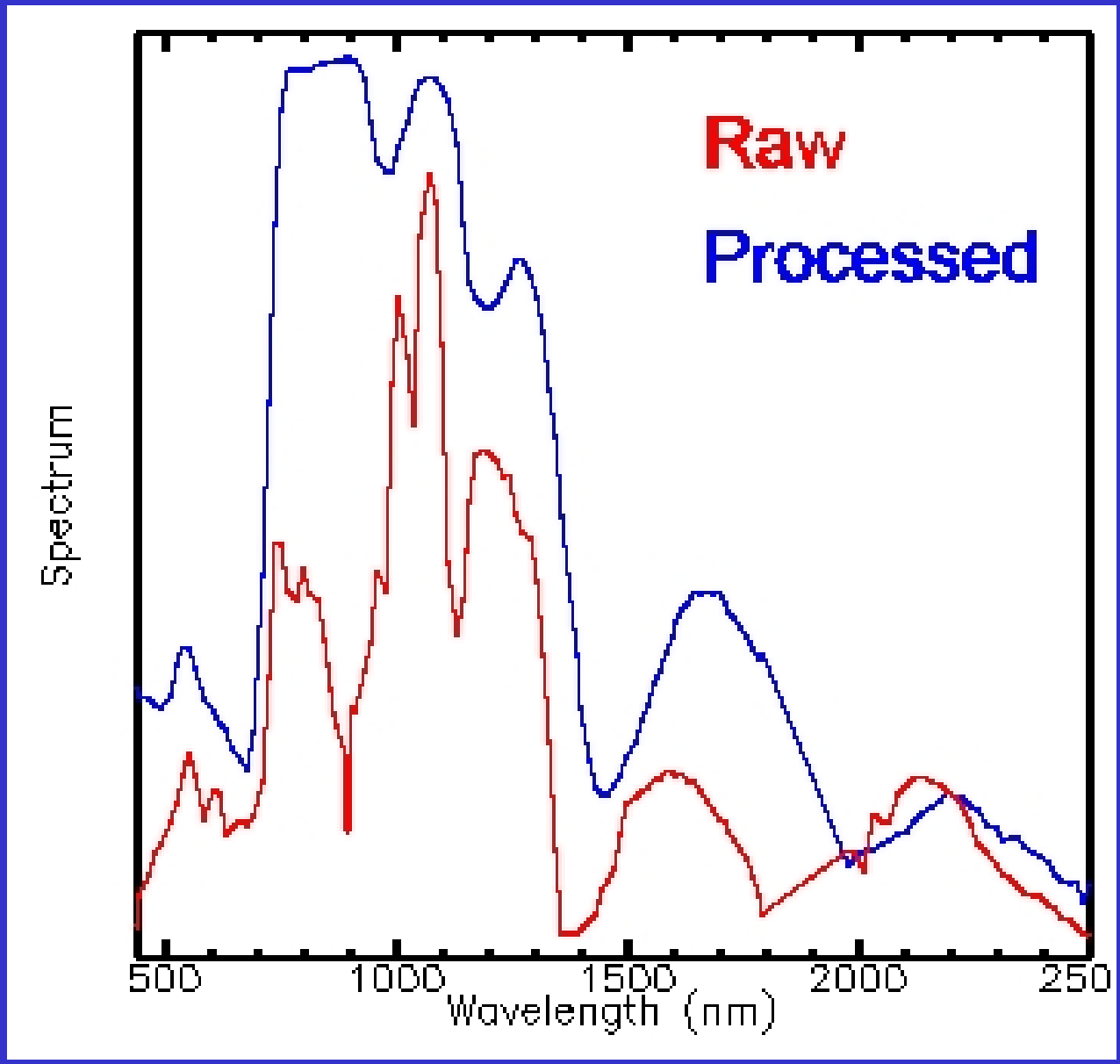
Helicopter MD 500

ASIA+ Sensor

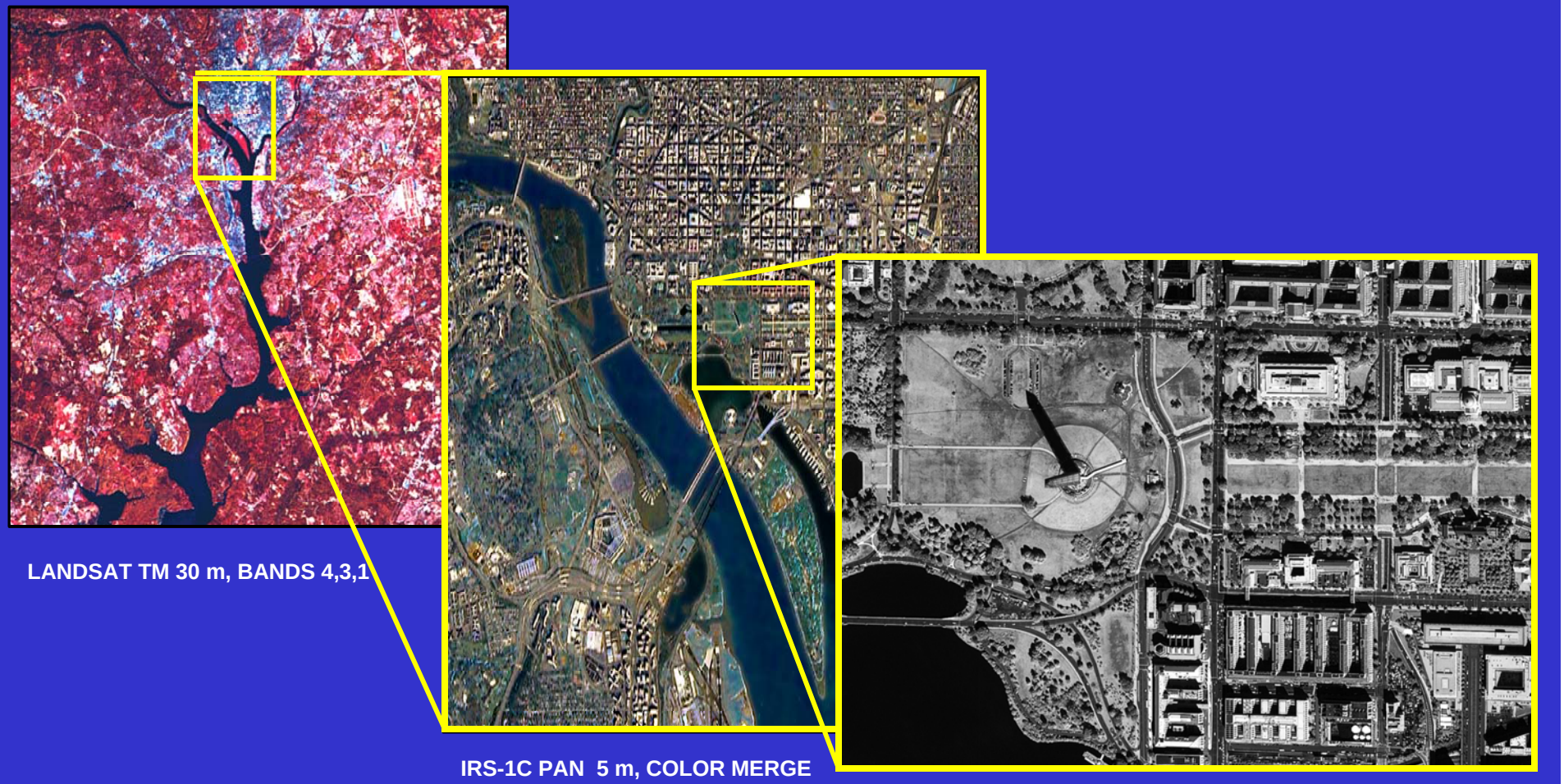
Spectra From Different Materials



Raw Vs Processed Data



Pixel Size And Image Resolution

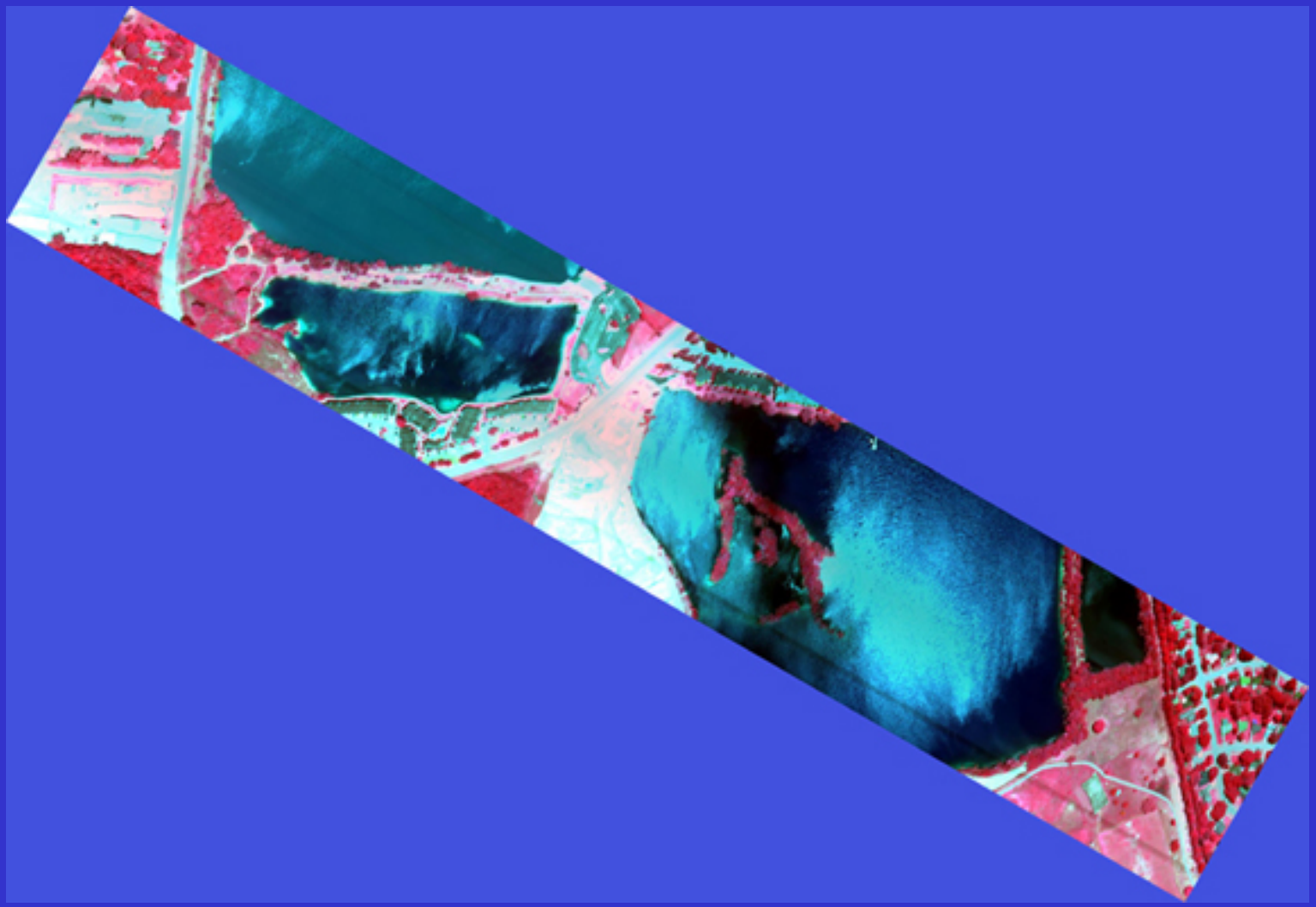


LANDSAT TM 30 m, BANDS 4,3,1

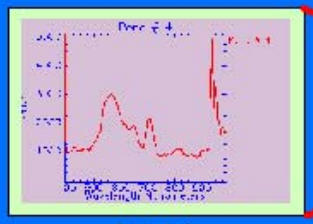
IRS-1C PAN 5 m, COLOR MERGE

IKONOS 1m PAN

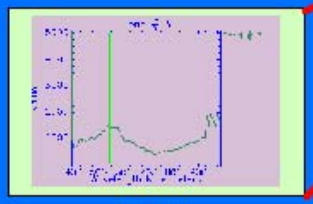
ASIA+ Sensor – 2.1 Foot Spatial Resolution



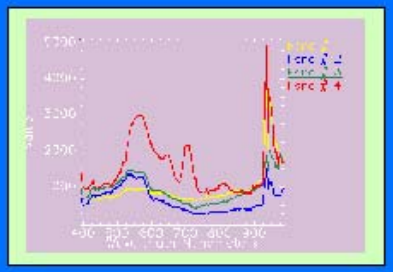
Hyperspectral Imagery in Support of Suspect Amebic Meningo Encephalitis Case Over Flight Date: June 12, 2004



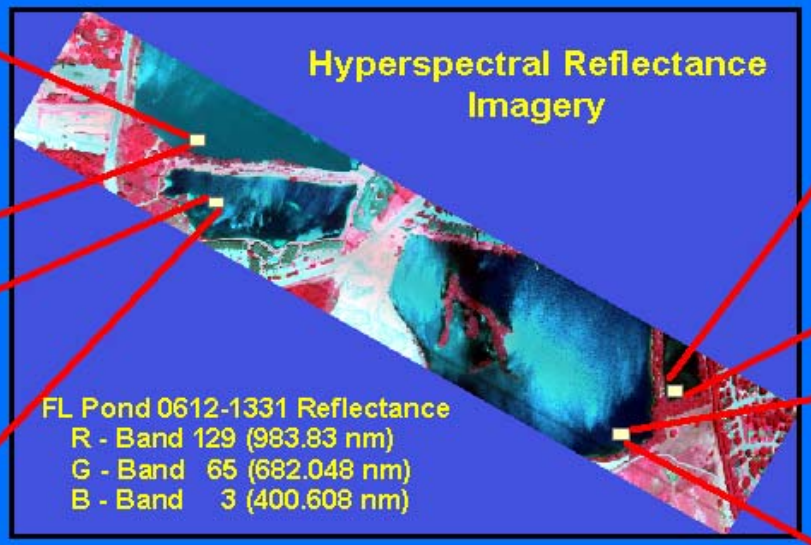
Plot # 4

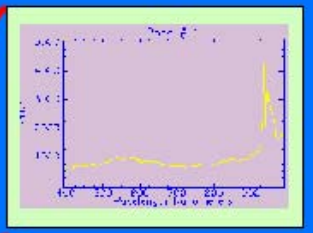


Plot #3

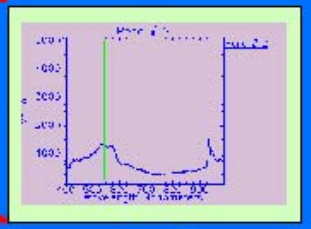


Four Spectral Plots





Plot #1



Plot #2

Color Digital Orthophoto
NAD83, 1 ft Resolution
Lambert Square: 5751
Overflight Date: January 2002

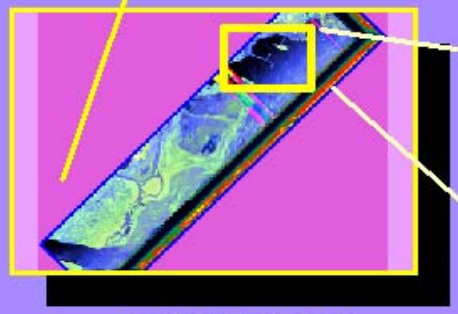
Key Map: 576 N & S

CITY OF HOUSTON
ENVIRONMENTAL HEALTH DIVISION
MAP DATE: JUNE 14, 2004

Prepared By: Larry B. York
pj Bevery Hill Hyperspectral 2

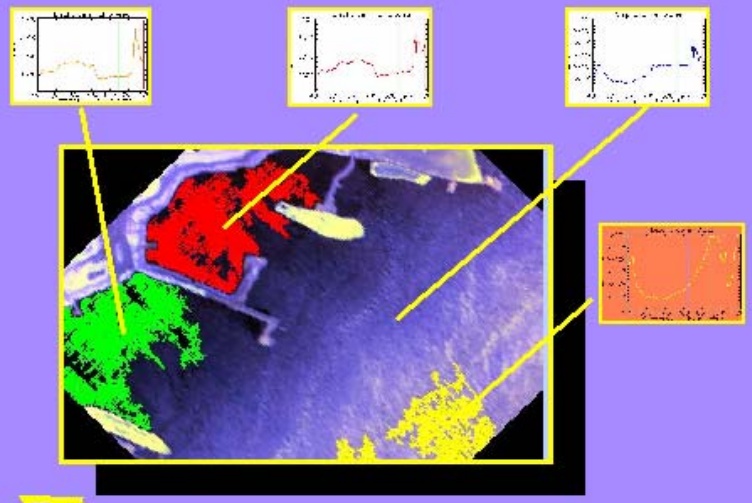
MONITORING HOUSTON SHIP CHANNEL AREA USING HYPERSPECTRAL REMOTE SENSING

Study Site Location

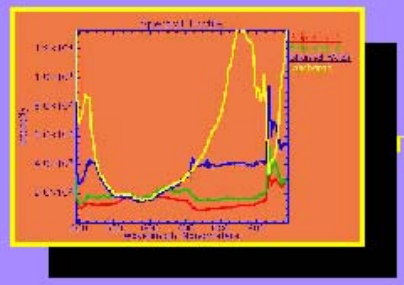


AISA + IMAGE CUBE
FLIGHT LINE 3

SUSPECT DISCHARGE AREA
SUBSET OF FLIGHT LINE 3



FL3 -0612-1358 REFLECTANCE
R - BAND 129 (983.8280 nm)
G - BAND 100 (846.9480 nm)
B - BAND 75 (728.9480 nm)

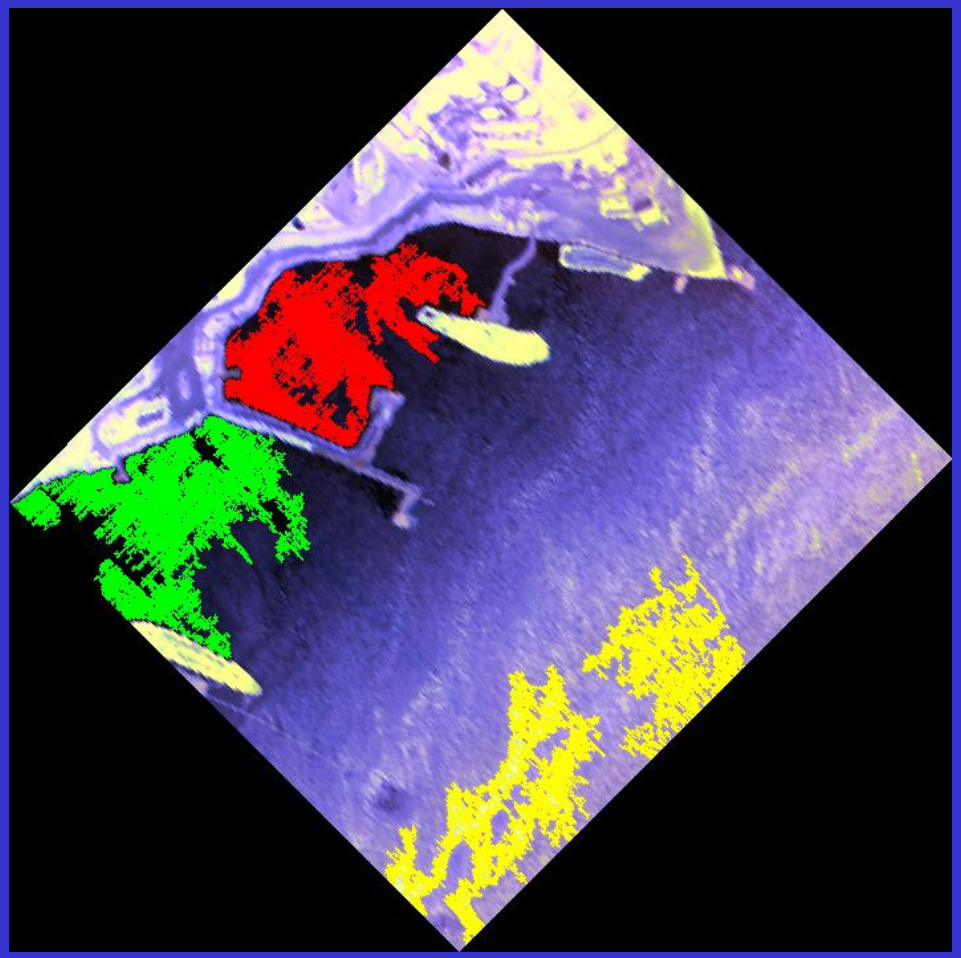


SPECTRA PROFILE
THREE SUSPECT AREAS

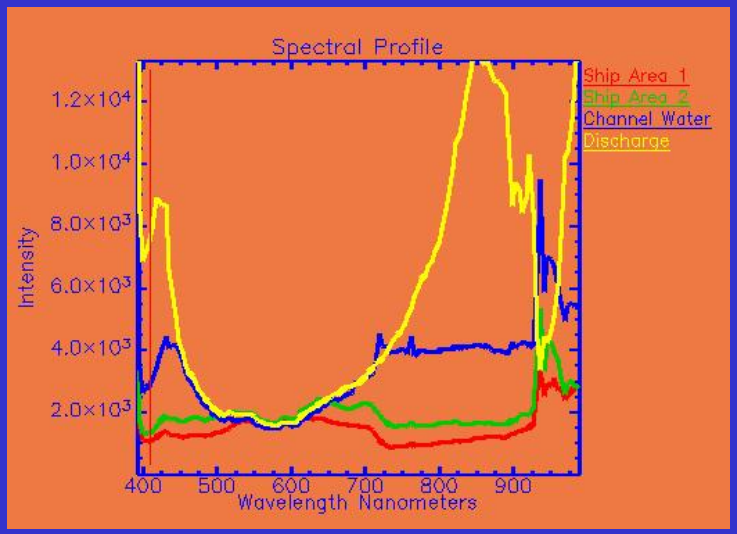
Prepared By: Larry B. York
pj FL 3 0612-1358 Ref 2

CITY OF HOUSTON
ENVIRONMENTAL HEALTH DIVISION
MAP DATE: AUGUST 3, 2004

Close-up Of Discharge Areas With Spectral Profiles



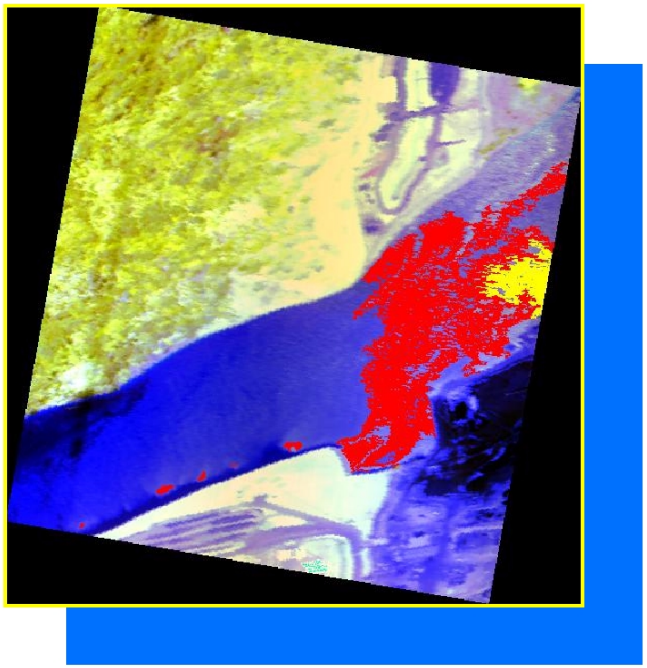
Flight Line 3 – 0612-1358 Ref
June 12, 2004

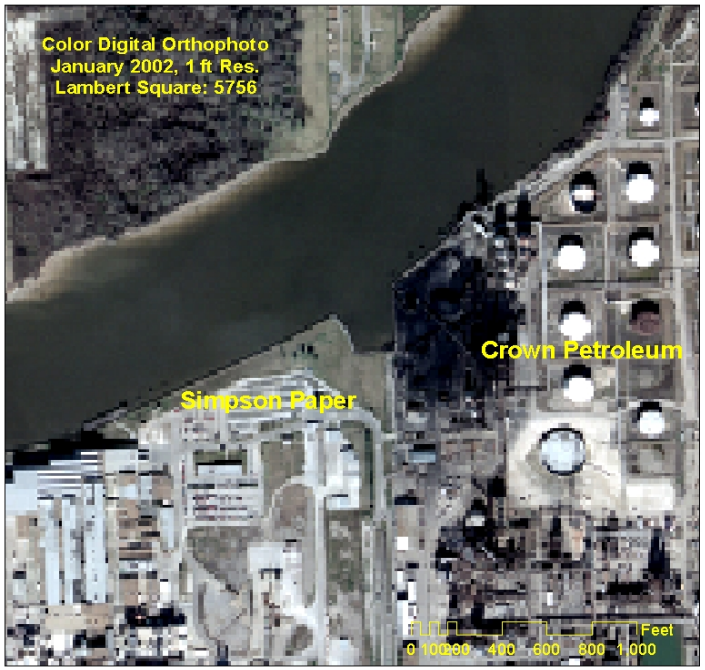


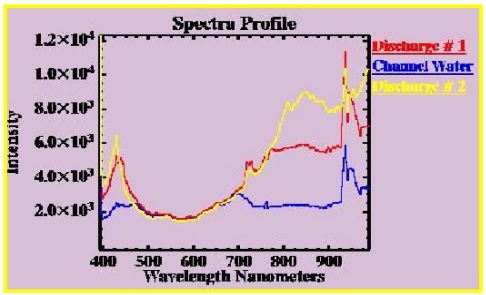
HYPERSPECTRAL IMAGERY
DISCHARGES IN HOUSTON SHIP CHANNEL
SIMPSON PAPER & CROWN PETROLEUM AREAS

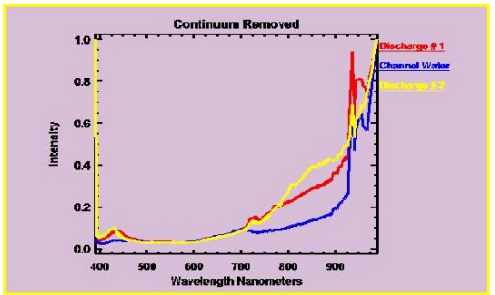
N
W E
S

Hyperspectral Data
Flight Line 3 0612-1358 Ref
JUNE 12, 2004







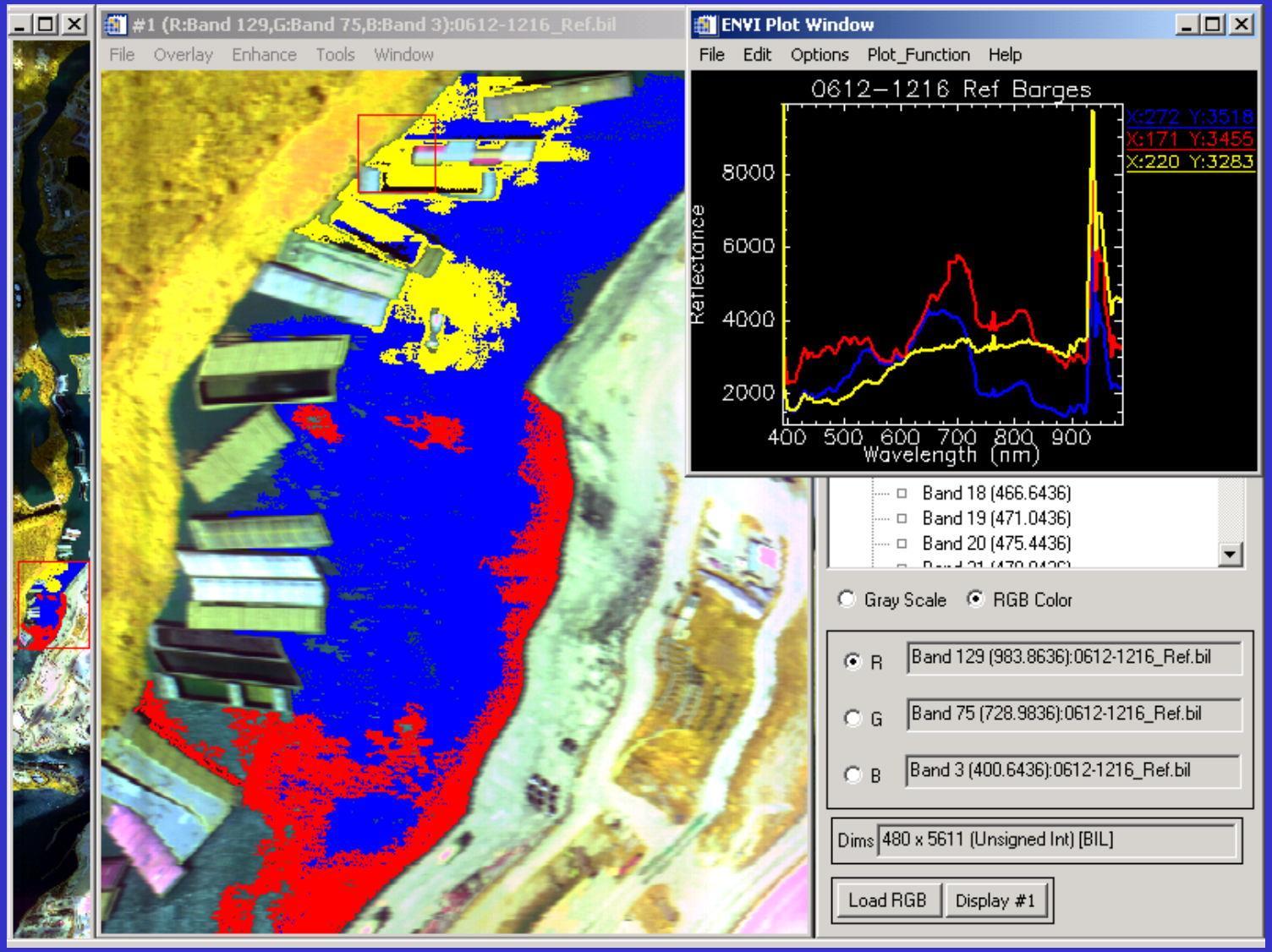


CITY OF HOUSTON
ENVIRONMENTAL HEALTH DIVISION
MAP DATE: SEPTEMBER 1, 2004

PJ 0612-1358 Simpson Crown

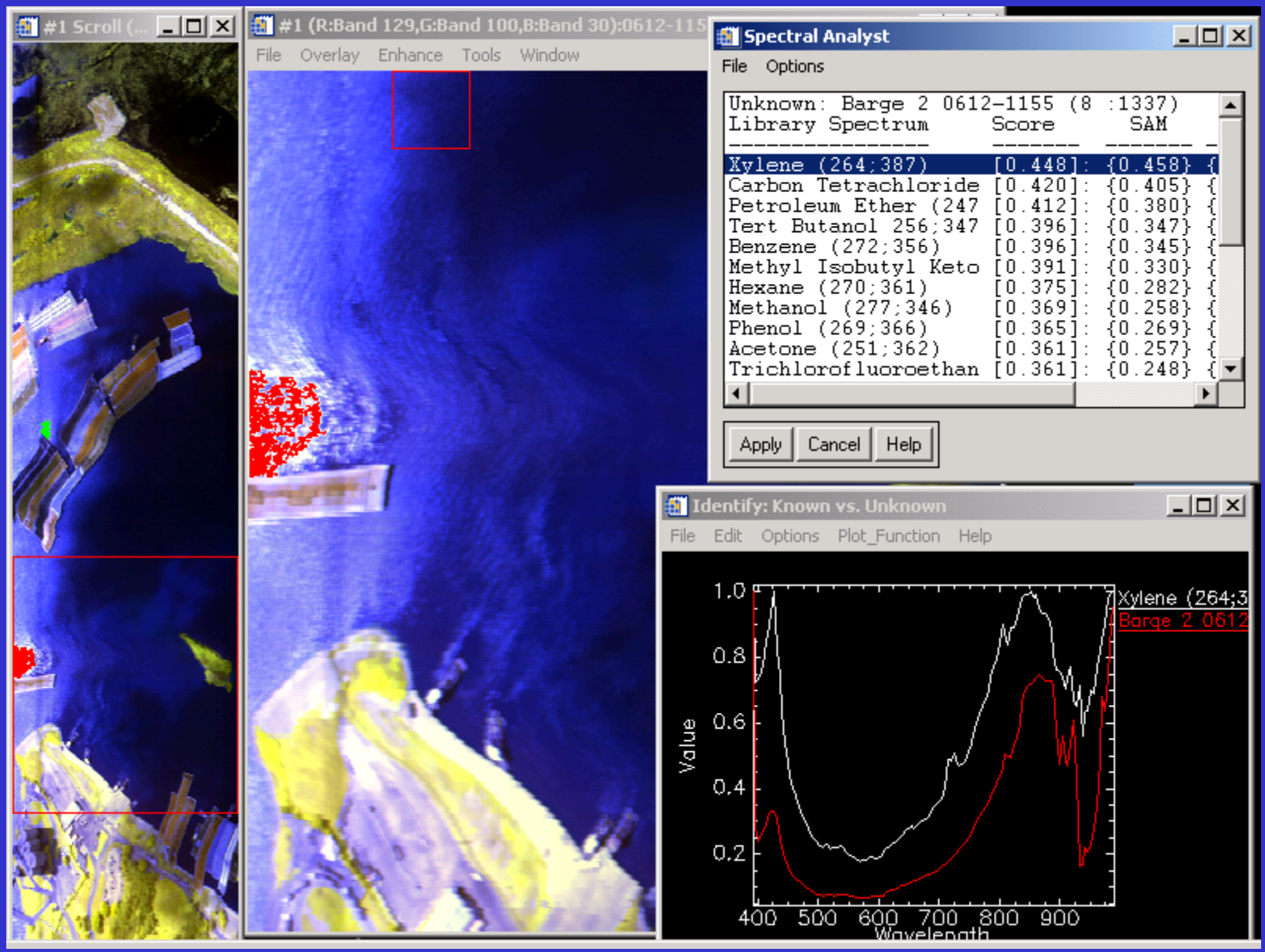
Prepared By: Larry B. York

Barge Area Greens Bayou
Flight Line 4 – June 12, 2004

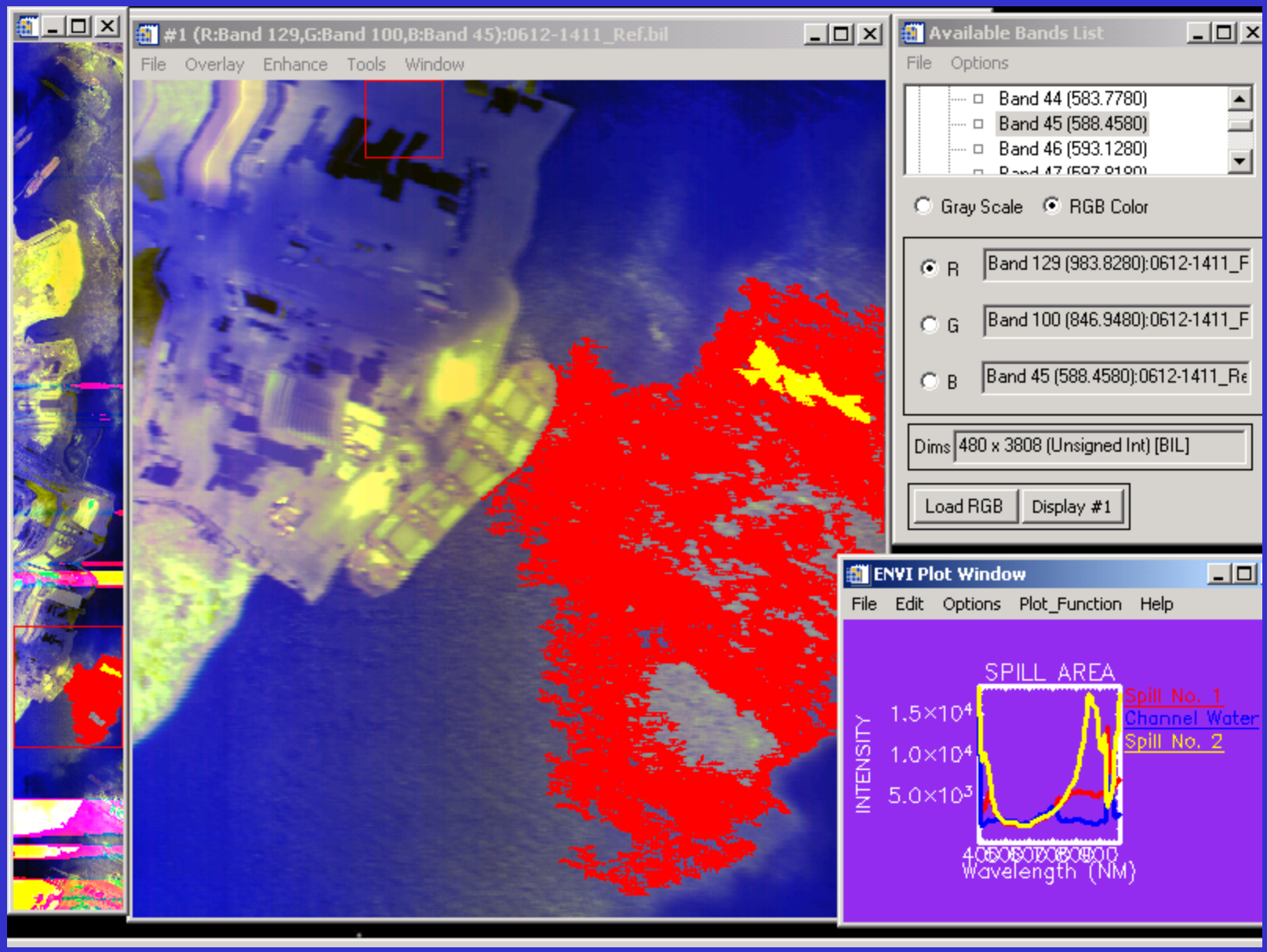


0612-1216 Ref

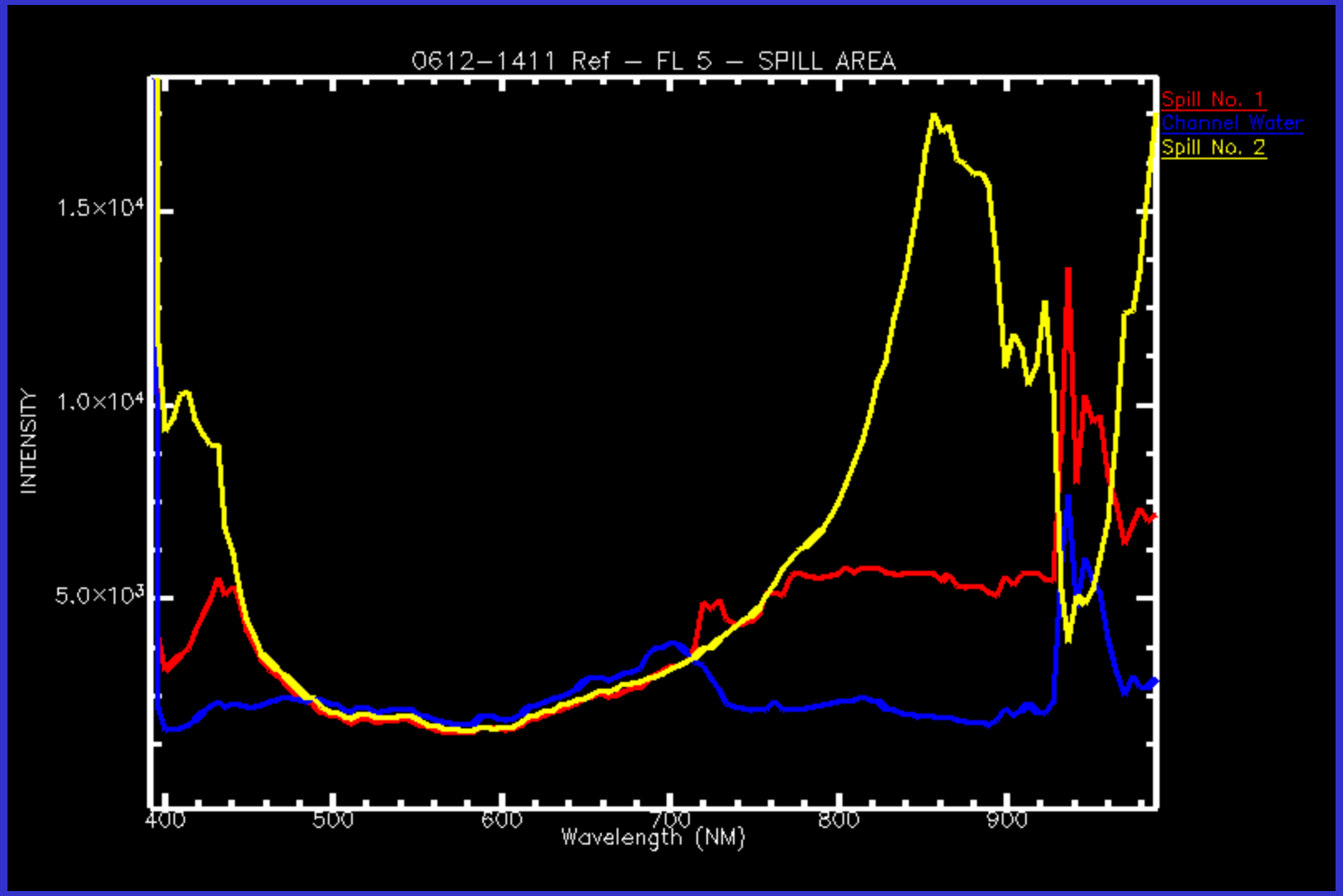
Flight Line 6 – 0612-1155 Ref



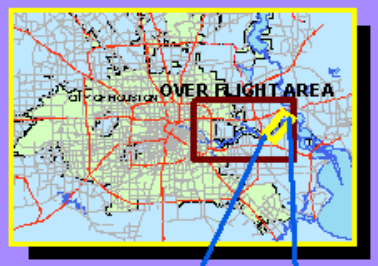
Flight Line 5 - 0612-1411 Ref



Spectra Plots

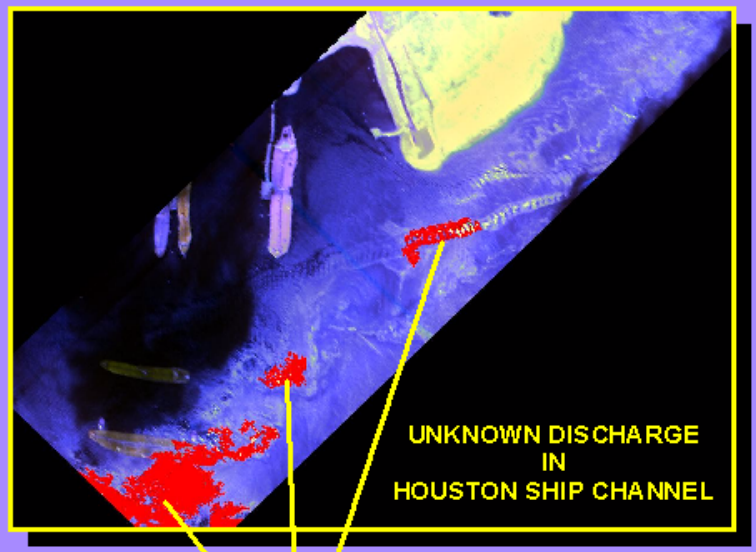


AISA+ SENSOR HYPERSPECTRAL DATA
HOUSTON SHIP CHANNEL AREA
FLIGHT LINE 5 -0612-1411 - JUNE 12, 2004



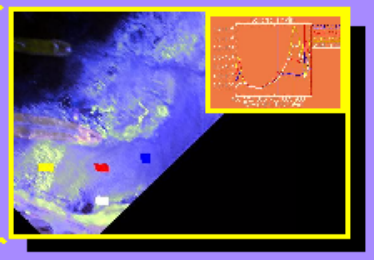
OVER FLIGHT AREA
HOUSTON SHIP CHANNEL

FLIGHT LINE 5
0612-1411

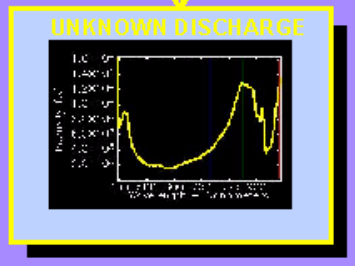


HYPERSPECTRAL IMAGERY
FL5 -0612-1411 REFLECTANCE
R - BAND 129 (983.8280 nm)
G - BAND 100 (846.9480 nm)
B - BAND 75 (728.9480 nm)

SUSPECT DISCHARGE AREA
SUBSET OF FLIGHT LINE 5



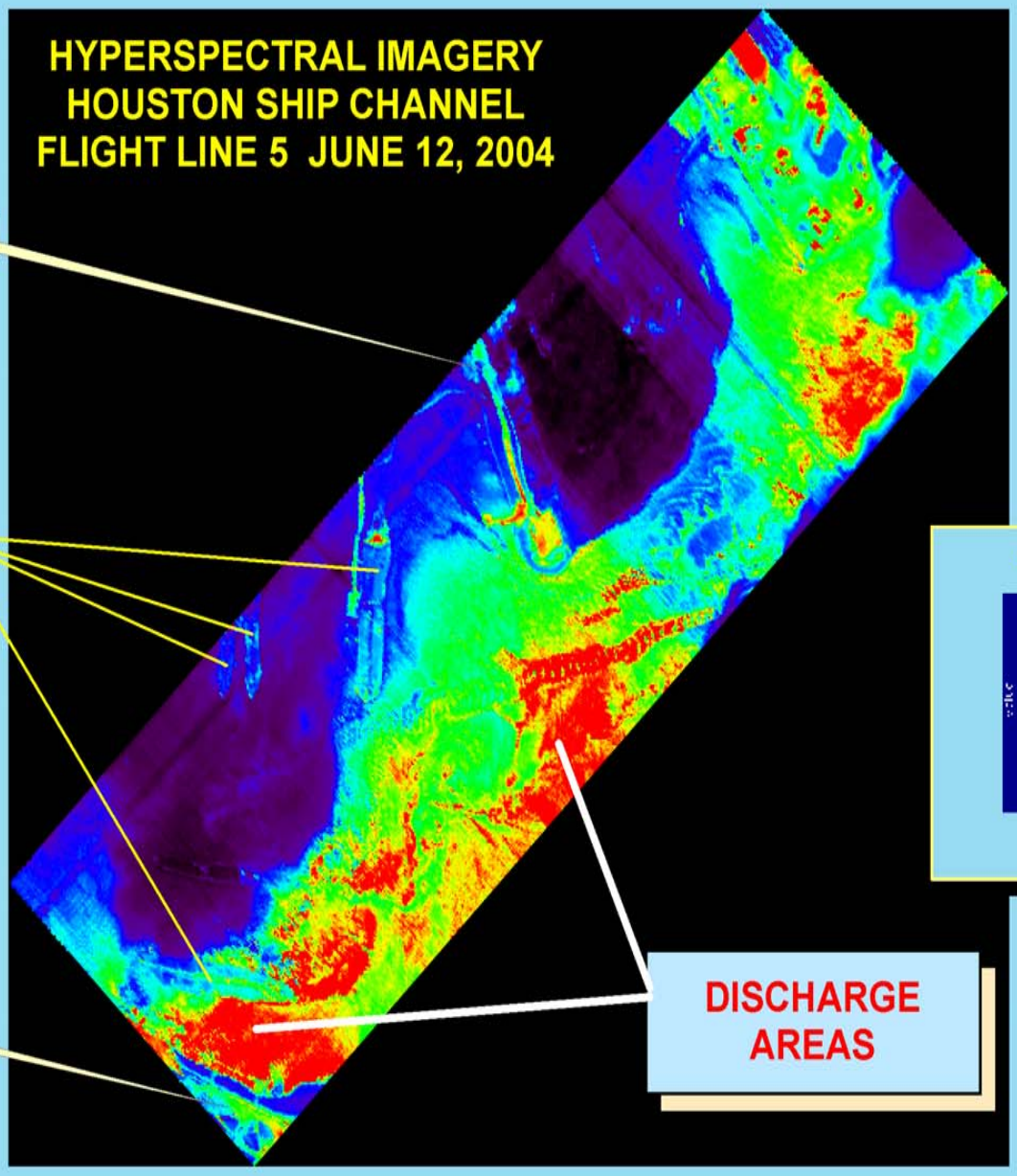
SPECTRA PROFILE
FROM SUSPECT AREAS



Prepared By: Larry B. York

CITY OF HOUSTON
ENVIRONMENTAL HEALTH DIVISION
MAP DATE: AUGUST 3, 2004

HYPERSPECTRAL IMAGERY
HOUSTON SHIP CHANNEL
FLIGHT LINE 5 JUNE 12, 2004



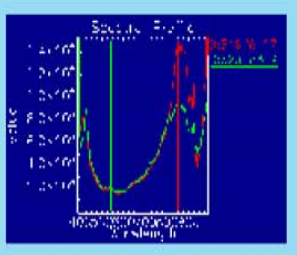
OILTANKING HOUSTON

TANKERS

SHELL OIL CO.

DISCHARGE AREAS

SPECTRA OF DISCHARGE

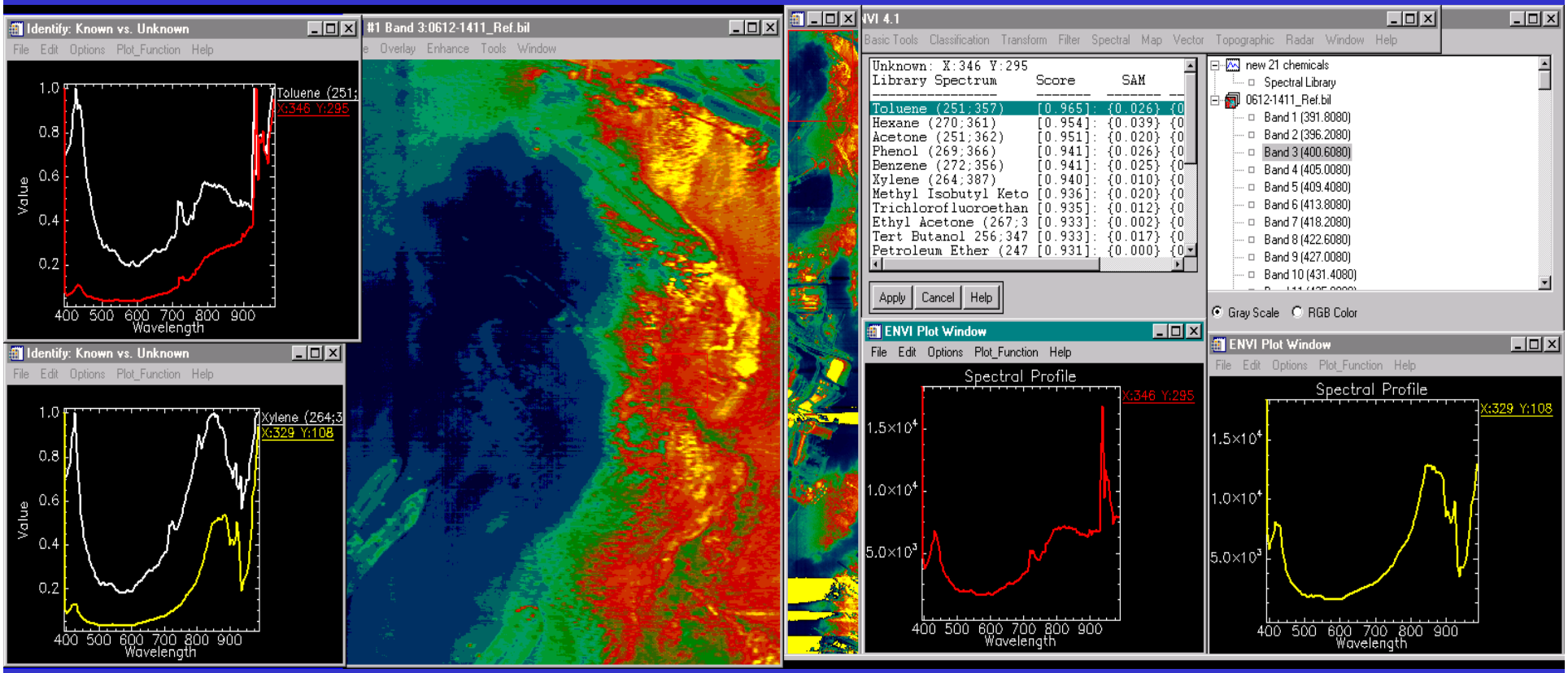


pj 1436

Prepared By: Larry B. York

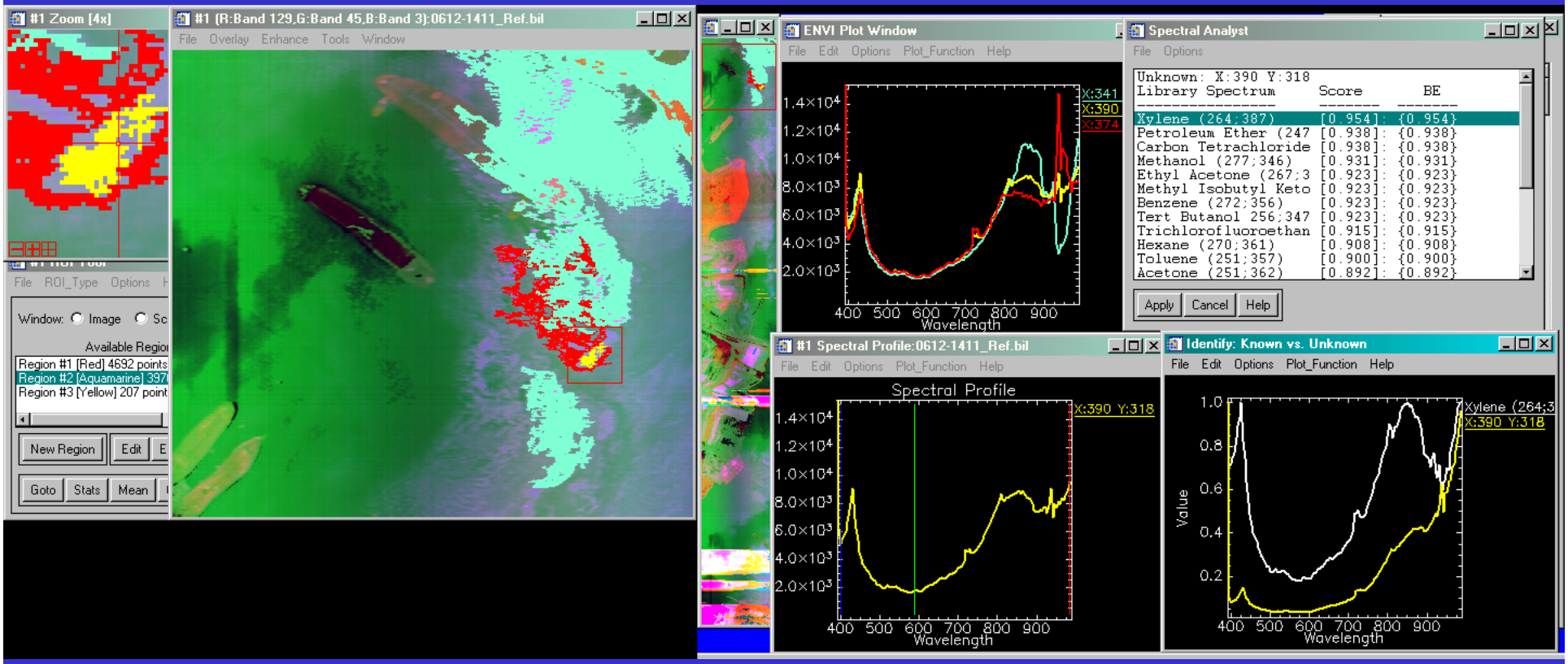
CITY OF HOUSTON
ENVIRONMENTAL HEALTH DIVISION
MAP DATE: NOVEMBER 19, 2004

IDENTIFICATION OF DISCHARGES
FLIGHT LINE 5 – 0612-1411



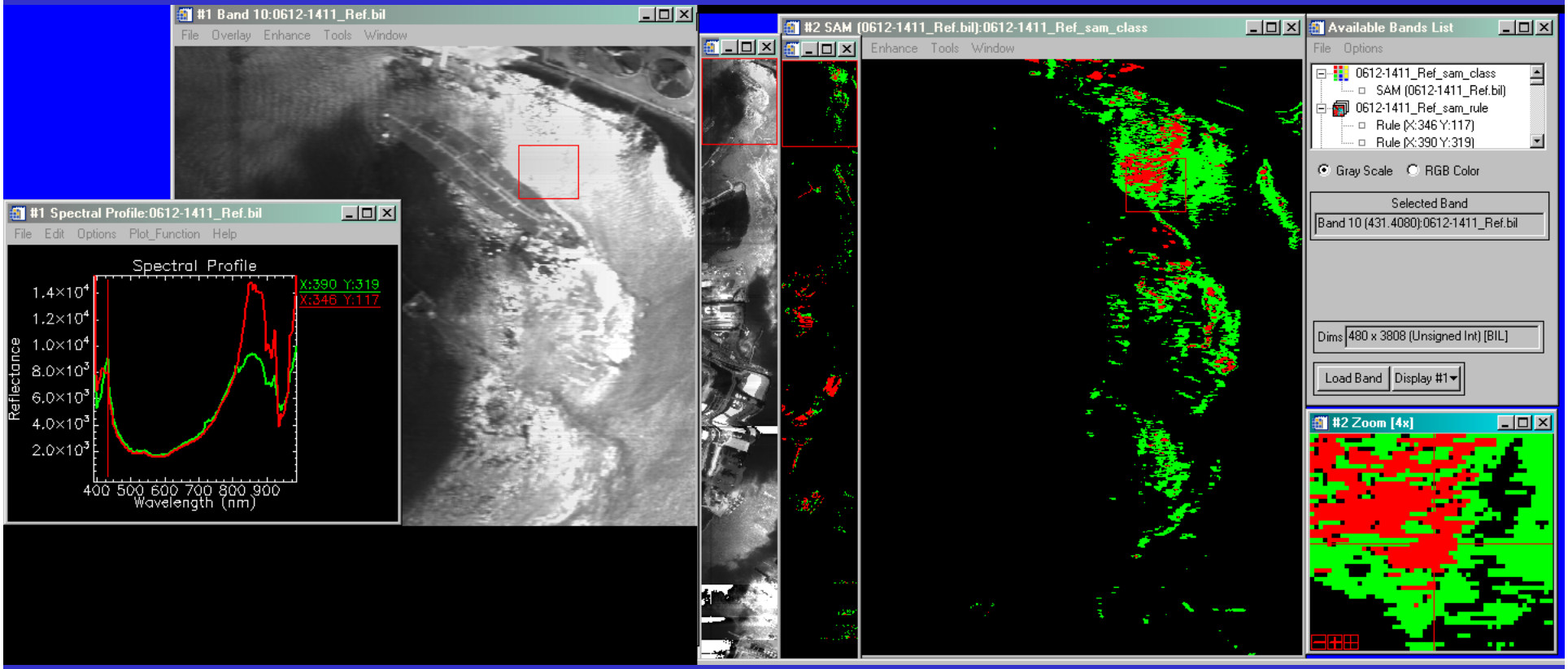
TOLUENE & XYLENE

DISCHARGE OF TWO DIFFERENT MATERIALS



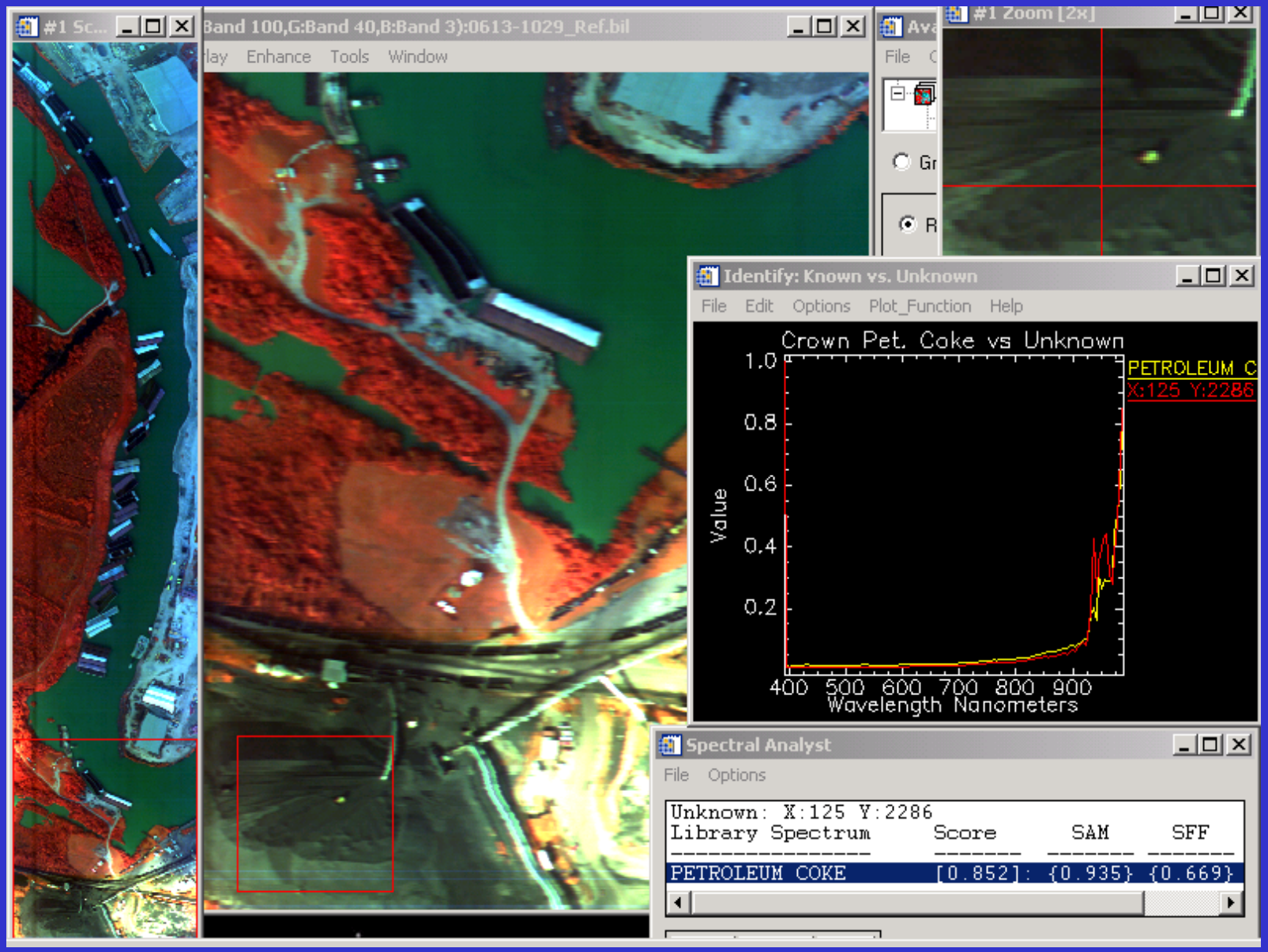
Flight Line 5 0612-1411 Reflectance

DISCHARGE OF TWO DIFFERENT MATERIALS USING TARGET SPECTRA

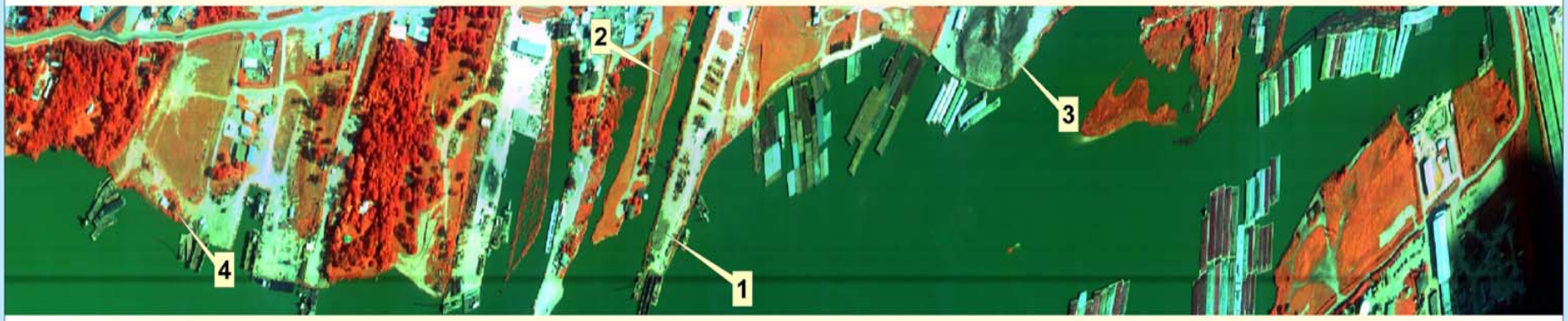


Flight Line 5 0612-1411
Reflectance

CROWN PETROLEUM COKE Vs UNKNOWN



HYPERSPECTRAL SENSOR DATA
OLD RIVER AND SAN JACINTO RIVER AREA



Flight Line 7 0613-0959 Refectance June 13, 2004

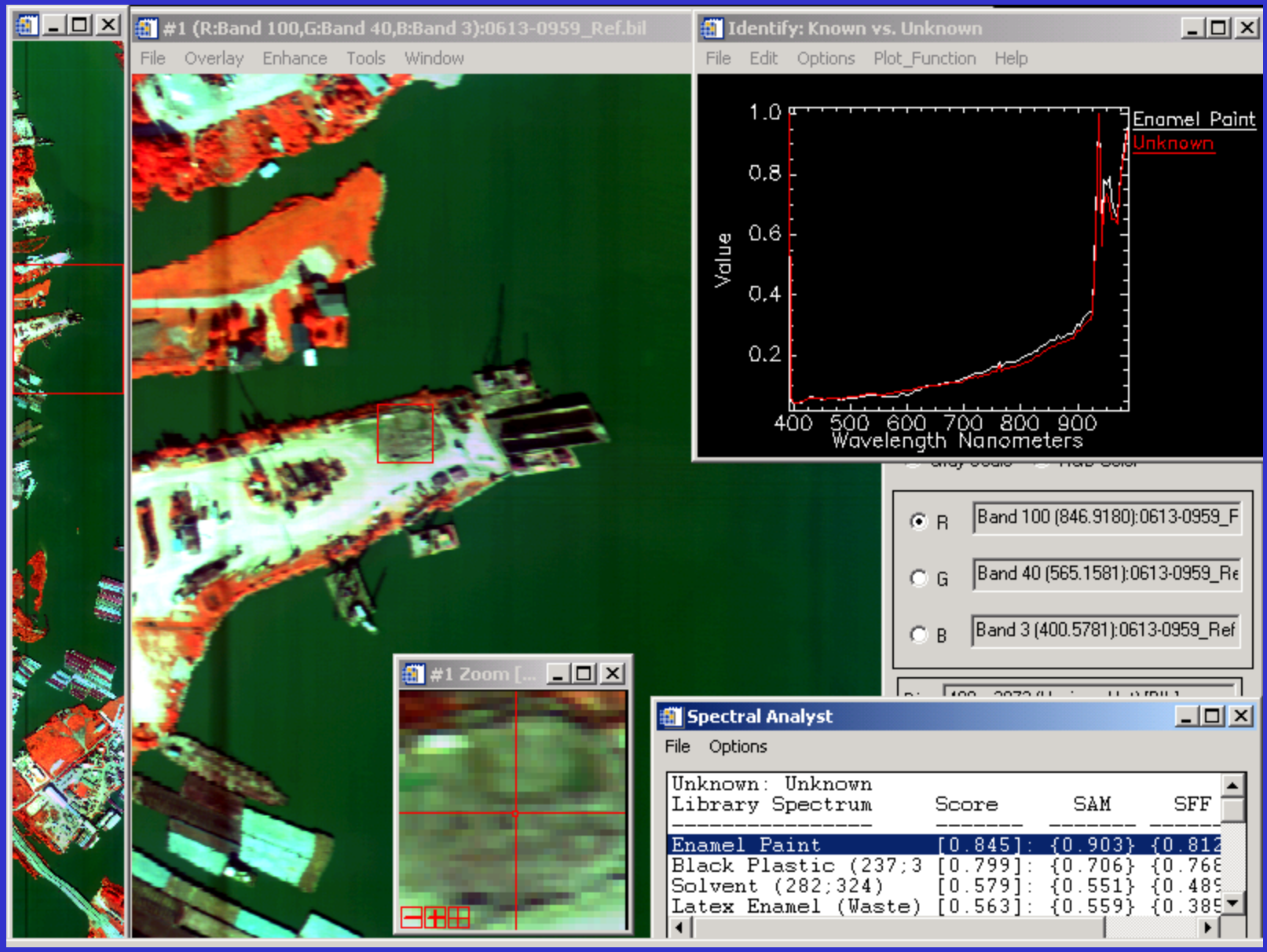
1, 2, 3, 4: SUSPECT DISCHARGE AREAS

Prepared By: Larry B. york

pj FL 7 0613-0959

CITY OF HOUSTON
ENVIRONMENTAL HEALTH DIVISION
MAP DATE: AUGUST 27, 2004

Suspect Discharge Area No. 1

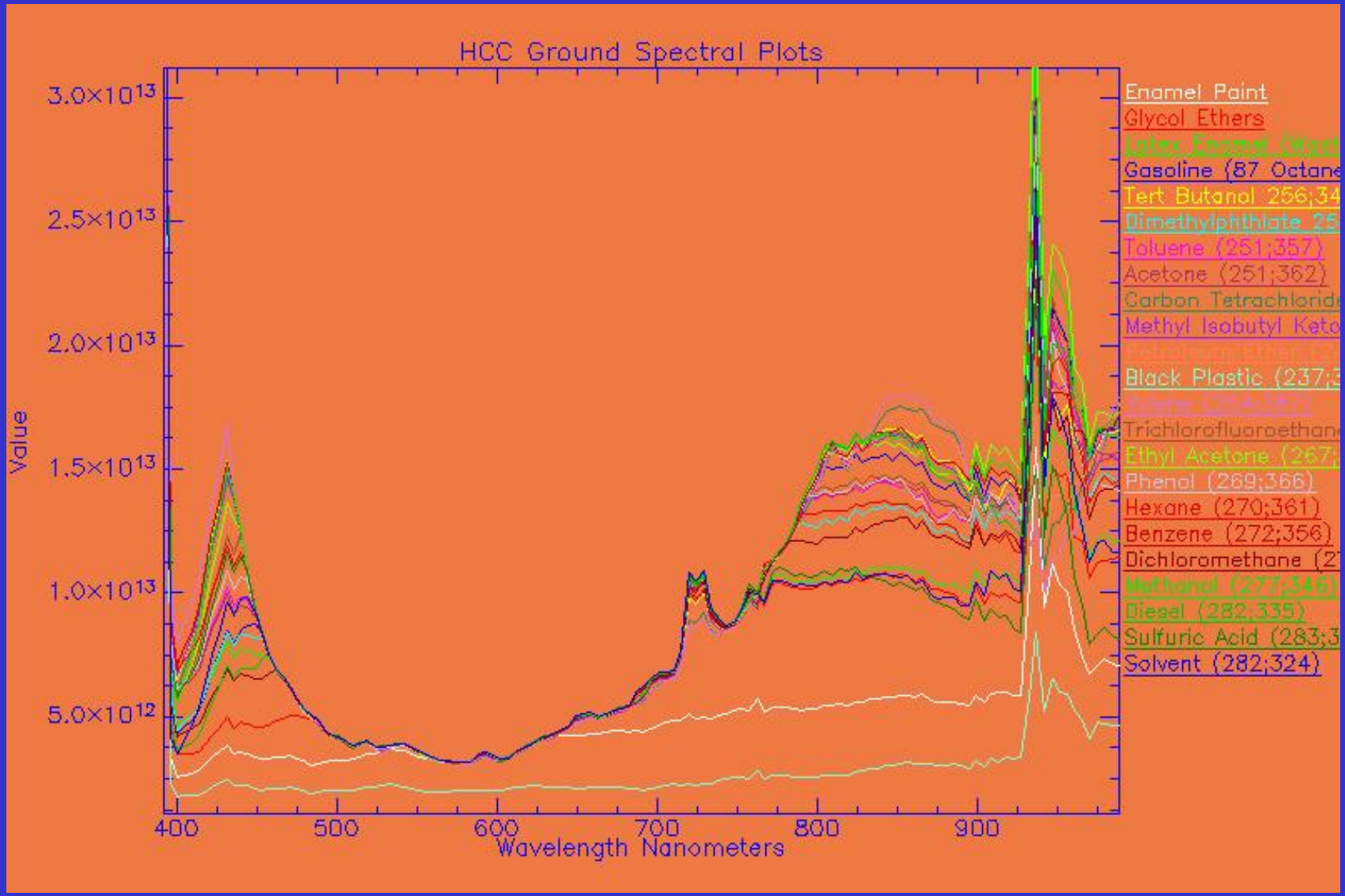


Ground Targets And Chemical List

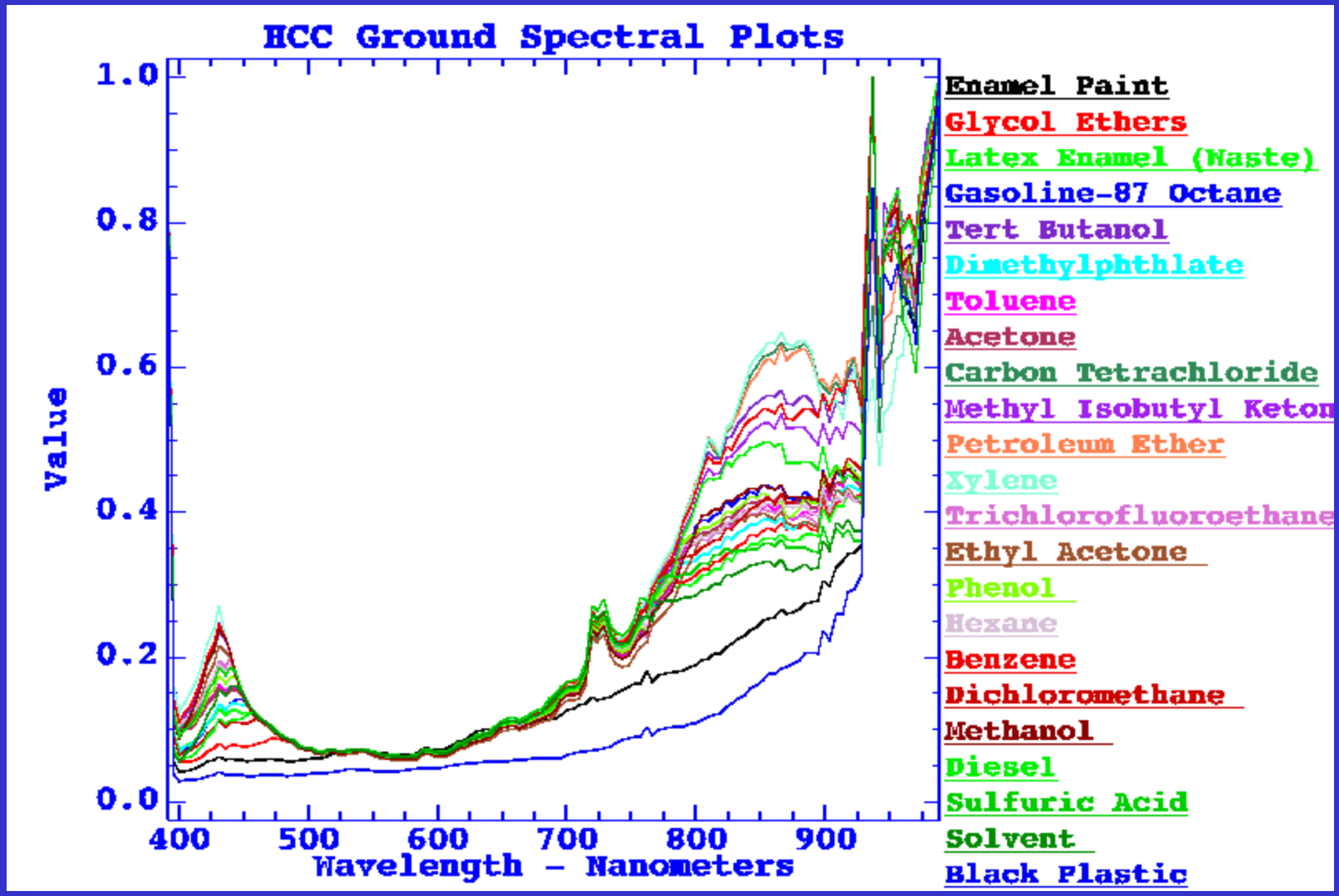
1. Solvent	2. Enamel Paint
3. Sulfuric Acid	4. Glycol Ethers
5. Diesel	6. Latex Enamel Paint waste
7. Latex Paint	8. Gasoline, 87 Octane
9. Methanol	10 Tert butanol
11.Dichloromethane	12.Dimethylphthlate
13. Benzene	14. Toluene
15. Hexane	16. Acetone
17. Phenol	18.Carbon Tetrachloride
19. Ethyl Acetone	20. Petroleum Ether
21. St. Augustine sod	22. Methyl Isobutyl Ketone
23.Trichlorotrifluoroethane	24. Pentane
25. Xylene	

pj targets

21 Chemicals & Solvents



21 Chemicals and Solvents



RESULTS FROM EPA OVERFLIGHT USING THE ASIA+ SENSOR

I. COVERED AREAS HAVING HIGH POTENTIAL FOR ILLEGAL DISCHARGES

1. Seven flight lines in the Houston Ship Channel area were over flown

2. Flights were repeat over several flight lines on different days

3. Data was collected on a weekend of suspect areas

II. COLLECT OVERFLIGHT DATA AND PROCESS IN A TIMELY MANNER

1. Up on landing – time was determine to transfer data to computers

2. Time was determined to look at raw data for ground personnel

III. SUSPECT AREAS AND RELAY INFORMATION TO GROUND DATA PERSONEL

1. The over flight data was analyzed for illegal discharges

2. Information was relayed to ground personnel

IV. COLLECT GROUND TRUTH TO BE USED AS ENFORCEMENT PURPOSES

1. Spectral for twenty-five different chemicals and materials was collected

2. A spectral library of the the materials was produced

V. PRODUCE MAPS OF THE OVER-FLIGHT AND TARGET AREAS

1. Maps were developed covering suspect discharges areas

2. Ground truth sampling of suspect discharges was attempted

VI. REPORTS

1. A Final Report of Project was produced

2. A Ground Truth Report was produced