# Curbside Collection Systems and Containers

## Case Study: GBB's Pasadena CA Project

**Metropolitan Washington Council of Governments**
**Recycling Committee**
**July 16, 2007**

**Prepared by:**
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**Gershman, Brickner & Bratton, Inc. (GBB)**
**In association with:**
**Kevin Callen, Chief Technology officer**
WasteBid. Com, Inc.

**City of Pasadena is in the process of implementing one of the most sophisticated routing and data collection / analysis systems installed by any municipality in the United States**

**Functionality Includes:**

- **Asset identification**
- **Collection route optimization**
- **Asset tracking**
- **GPS-based performance monitoring**
- **Customer Service Records management**

# City's Current Collection Situation

- Separate curbside collection of refuse, yard waste and recyclable materials
- Customers: 27,000 residential units
- 24 automated collection packers
- "Pay As You Throw" refuse program:
  - 100-gallon cart - $26.10
  - 60-gallon cart - $16.67
  - 32-gallon cart - $10.05
- Yard waste and recycling service at no additional charge.
- Current routes were created manually in the early 1980's

# One Trash Can per Unit

# City of Pasadena Waste Service Issues

- Excessive overtime of collection crews
  - estimated to be almost $300,000 / year
- Inaccurate inventory of carts on the field
  - 2004 spot audit indicated that 5%+ of residences have refuse containers for which they are not billed, or they are billed for a different size container
  - estimated loss of revenues of $250,000 / year due to services inaccurately billed
- Inadequate customer service
  - Lack of information
  - Inaccurate information

# *Asset Management in City of Pasadena with Integrated Waste Management Data Collection and Routing System Improvements*

- **GBB Project Team selected to perform the needed service**
  - **Project Team includes:**

GBB

PACIFICA SYSTEMS

wastebid.com

# GBB Project & Components

a. Field Audit
b. Route Optimization
c. Asset Tracking System
d. GIS Refuse Database
e. Training

# *Field Audit*

Three-pass City field audit was conducted to:

- Physically inspect each of the City's 27,000 residential units setouts three-times
- Inventory the serial numbers all existing carts set out in the field (initial est. was 81,000 carts in service)
- Install Radio Frequency Identification (RFID) tags on all current carts
- Provide GPS data for container setout locations to augment the City database.

# Step 1 - Audit Preparation

- Customized software on handheld PDA's and used by team of field waste cart auditors to:
  - Capture data in the field/on routes
  - Inventory RFID tags placed in the field
- GBB trained team of field waste auditors to use the PDA and managed the data collection process

# What does RFID Stand For?

# What does RFID Stand For?

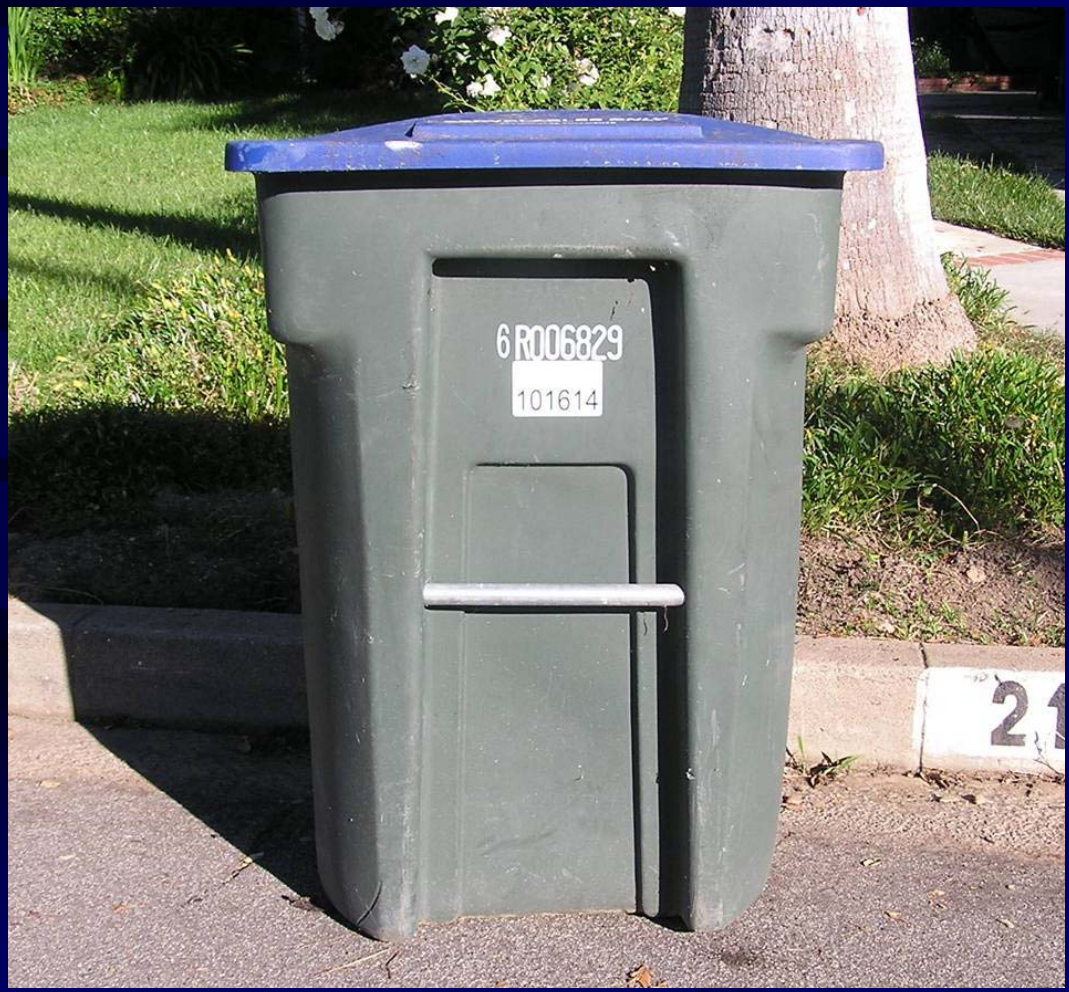
- Radio Frequency Identification (RFID)
- Examples:
  - Exxon/Mobil SpeedPass
  - Retailers with Electronic Article Surveillance (EAS) Tags
  - Prime Use: Tracking of High-Valued Assets
  - Major retailers initiatives for supply chain to store inventories
    - Wal-Mart, Best Buy, Target

# RFID is NOT Bar Codes

- Bar Codes – someone needs to take action of scanning the bar code label with a reader
- RFID tagging – the item is always on and available to be read, sometimes by multiple readers at the same time.

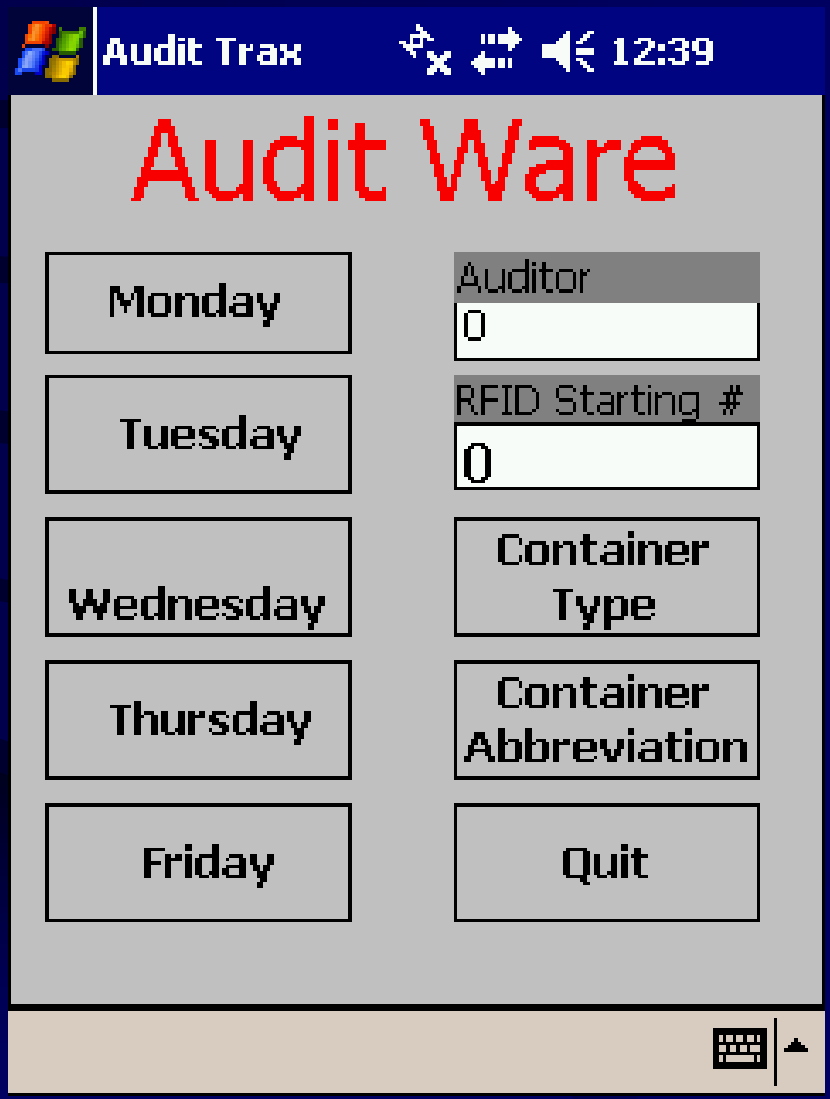
# What's an RFID tag look like? One Example Below!

# What’s is an RFID tag look like once applied?



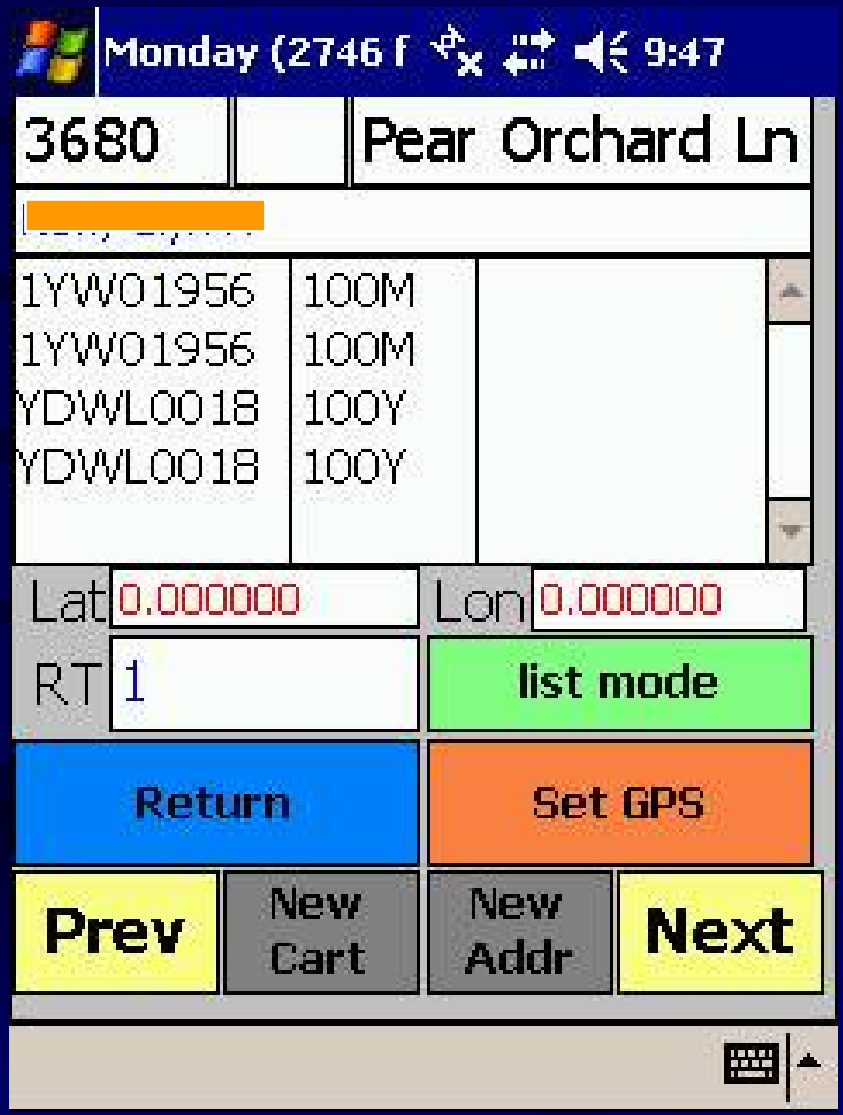
# PDA Interface & Power-up

# PDA Screenshot - Startup

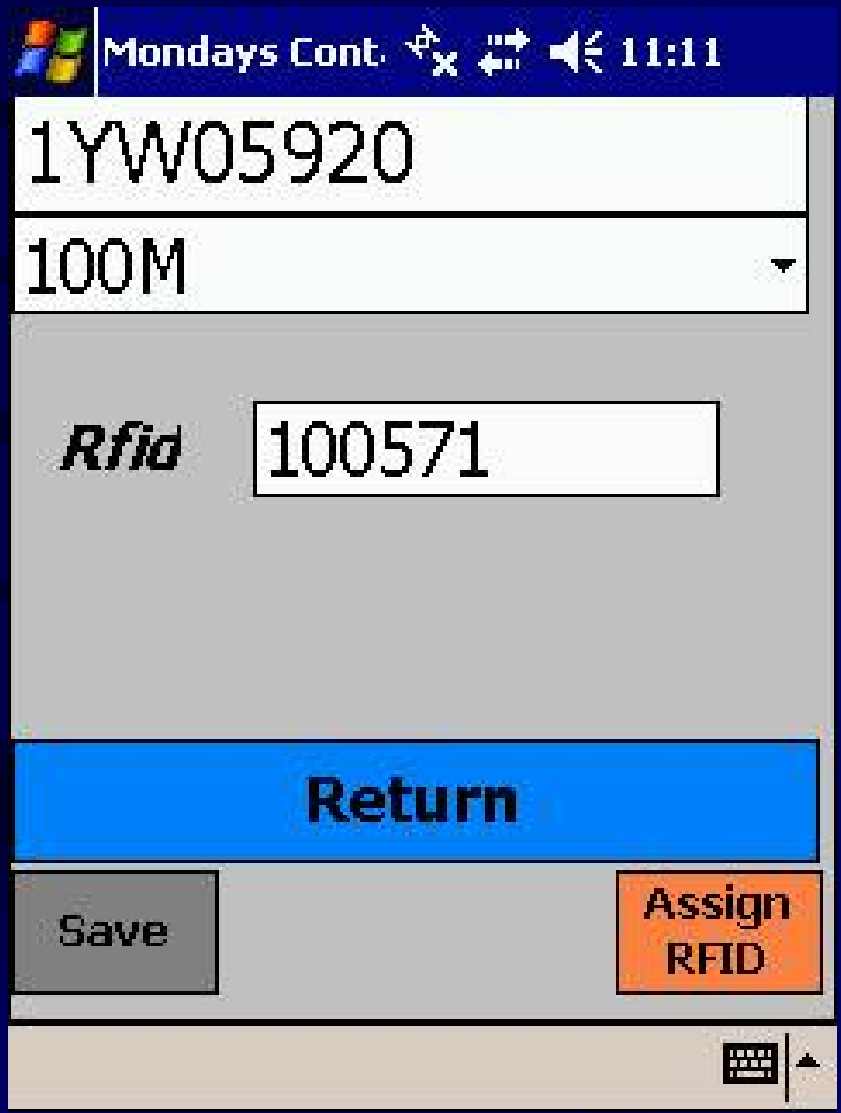


# PDA Screenshot – Route & Street Audit Selection

# PDA – Address/Can Info



# PDA - Cart Setting Screen



# GBB field audit team w / leader

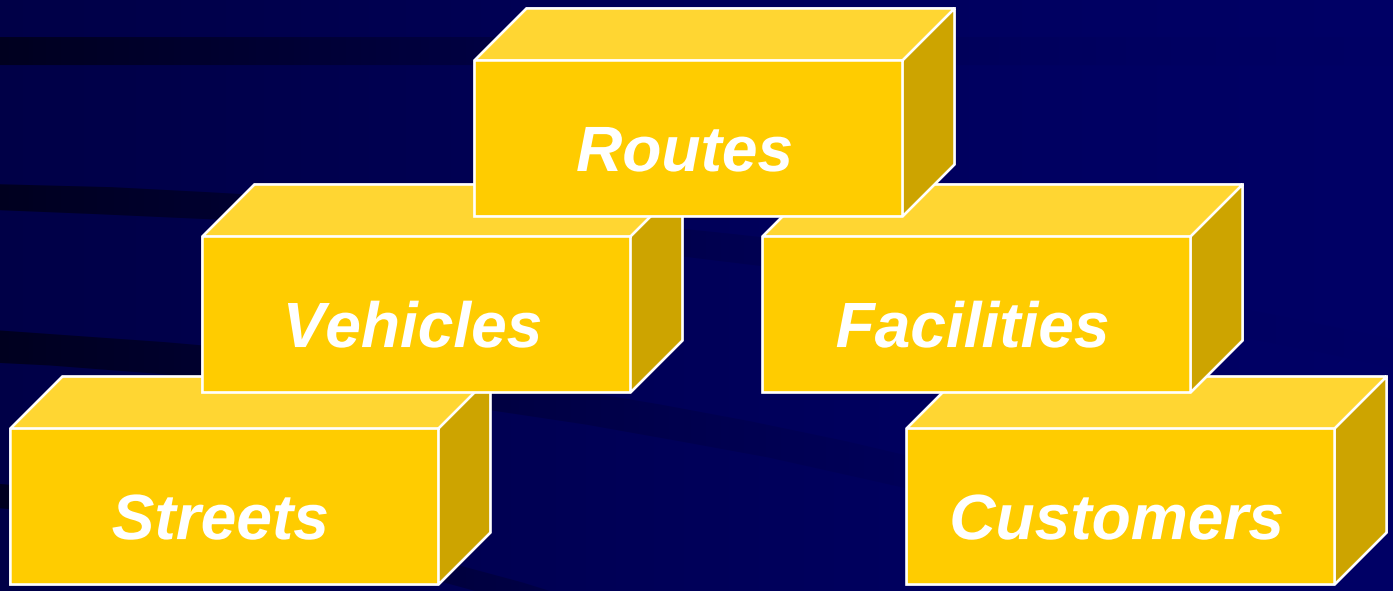
# GBB Field Auditor w/PDA

# RFID Tags on Containers

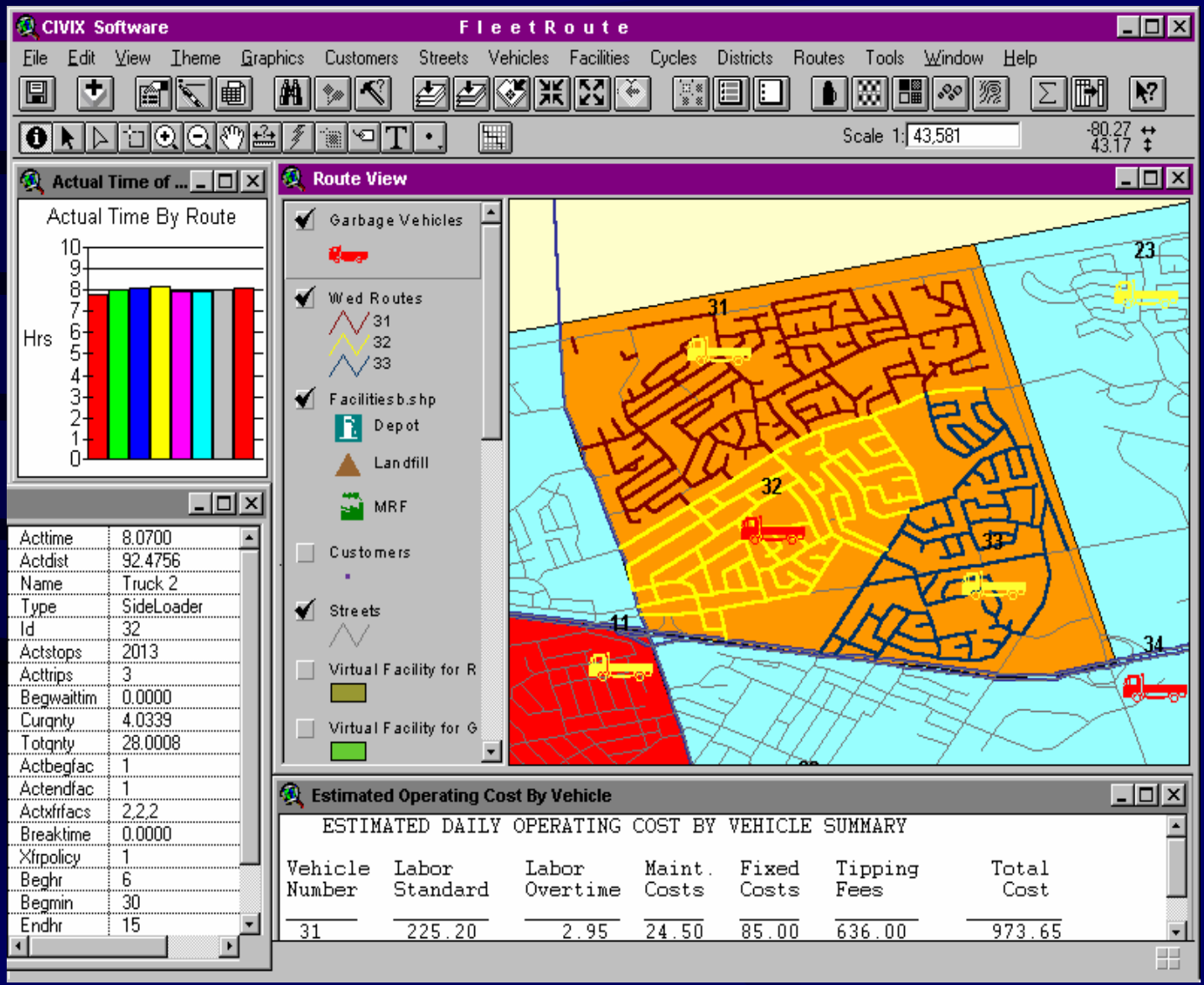
# 2. Route Optimization

- FleetRoute route optimization software was used on waste, recyclables and organics curbside collection
- FleetRoute™ determined number of collection days and individual routes to be performed
- Balanced route times, customers and service days
- Created routes using GIS and algorithms specifically written for the waste industry
- Integrated routes with customer service and billings
- Goal: reduce overall collection costs (by >10%)

# Flexible
# *Object Oriented Technology*

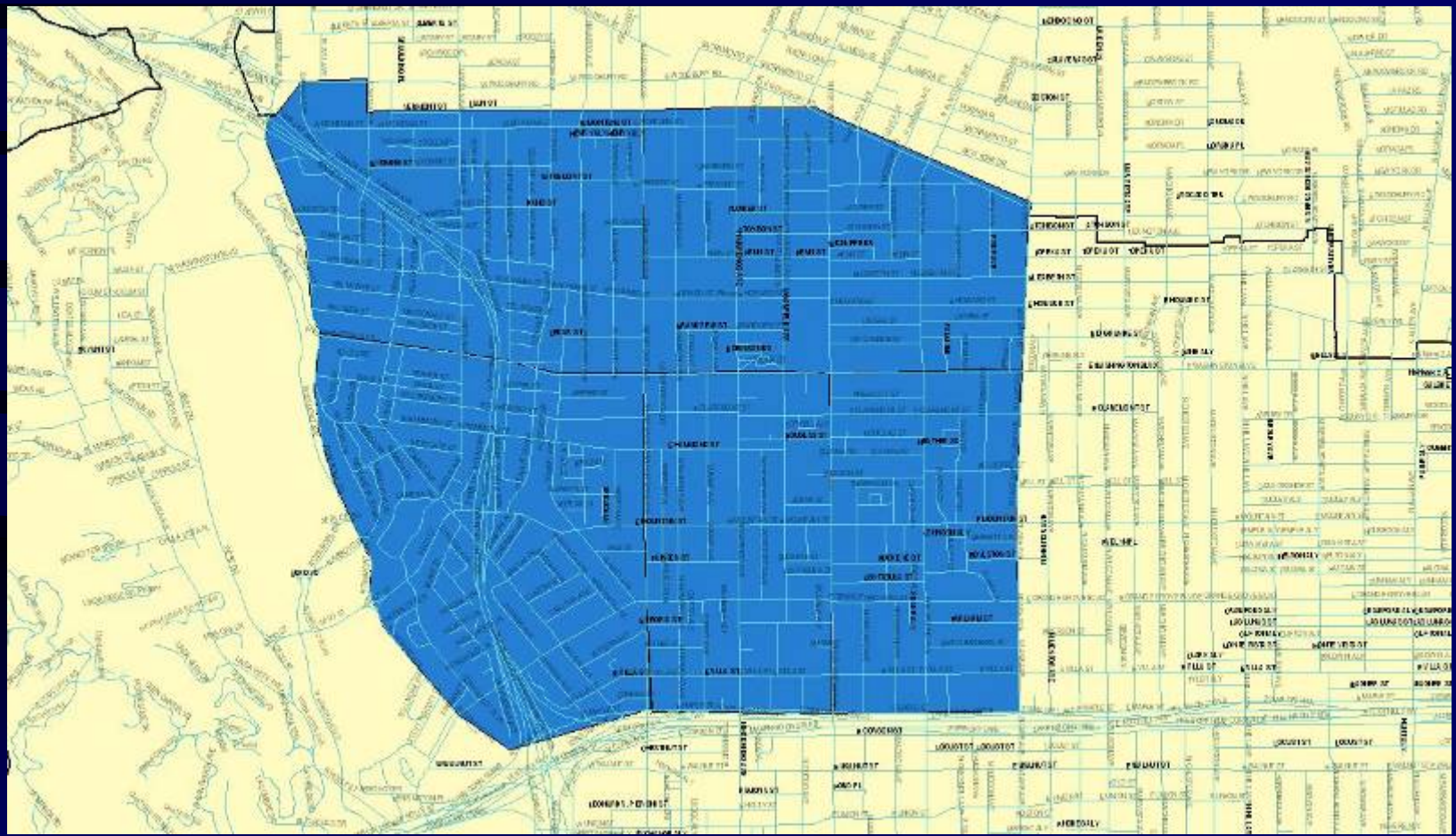


# Routes Maximize Each Vehicle's Productivity



# *Assessment of Set-out Variances*

## *Heavy Areas = ~40% more waste/HH from ~3 persons/HH vs. 2 persons/HH*



# Collection Day Changes

## Final Analysis of Proposed Collection Day Changes for the City of Pasadena

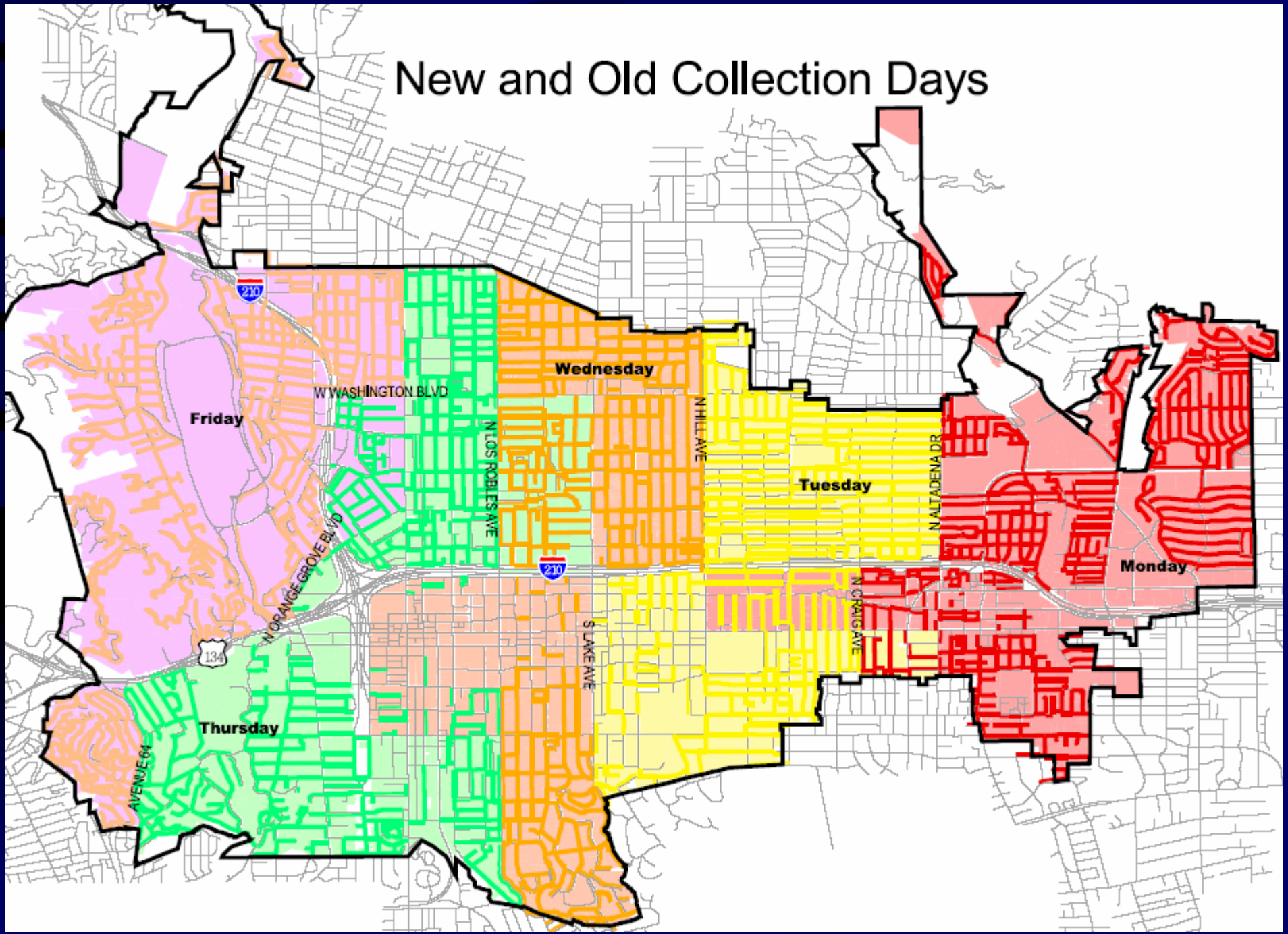
Date prepared: 8/9/2006

**Current Days (optimized routes, not using current routes)**

| Day | Number of Trucks | Total Hours Per Day | Average Hours Per Day | Tons | Carts | Miles | Dump Trips |
|---|---|---|---|---|---|---|---|
| Monday | 8 | 64.5 | 8.1 | 104.8 | 6303 | 303 | 16 |
| Tuesday | 8 | 58.7 | 7.3 | 107.3 | 5617 | 252 | 16 |
| Wednesday | 8 | 54.3 | 6.8 | 97.1 | 5204 | 212 | 16 |
| Thursday | 8 | 59.6 | 7.5 | 133.8 | 6105 | 254 | 16 |
| Friday | 8 | 63.4 | 7.9 | 125.3 | 6241 | 263 | 16 |
| **Average per Day** | **8** | **60.1** | 7.5 | **114** | **5894** | **257** | **16** |
| **Average per Truck** | **NA** | **7.5** | | **14.2** | **736.8** | **32** | **2.0** |
| **Total** | | **300** | | **568** | **29470** | **1284** | **80** |

**Proposed Days**

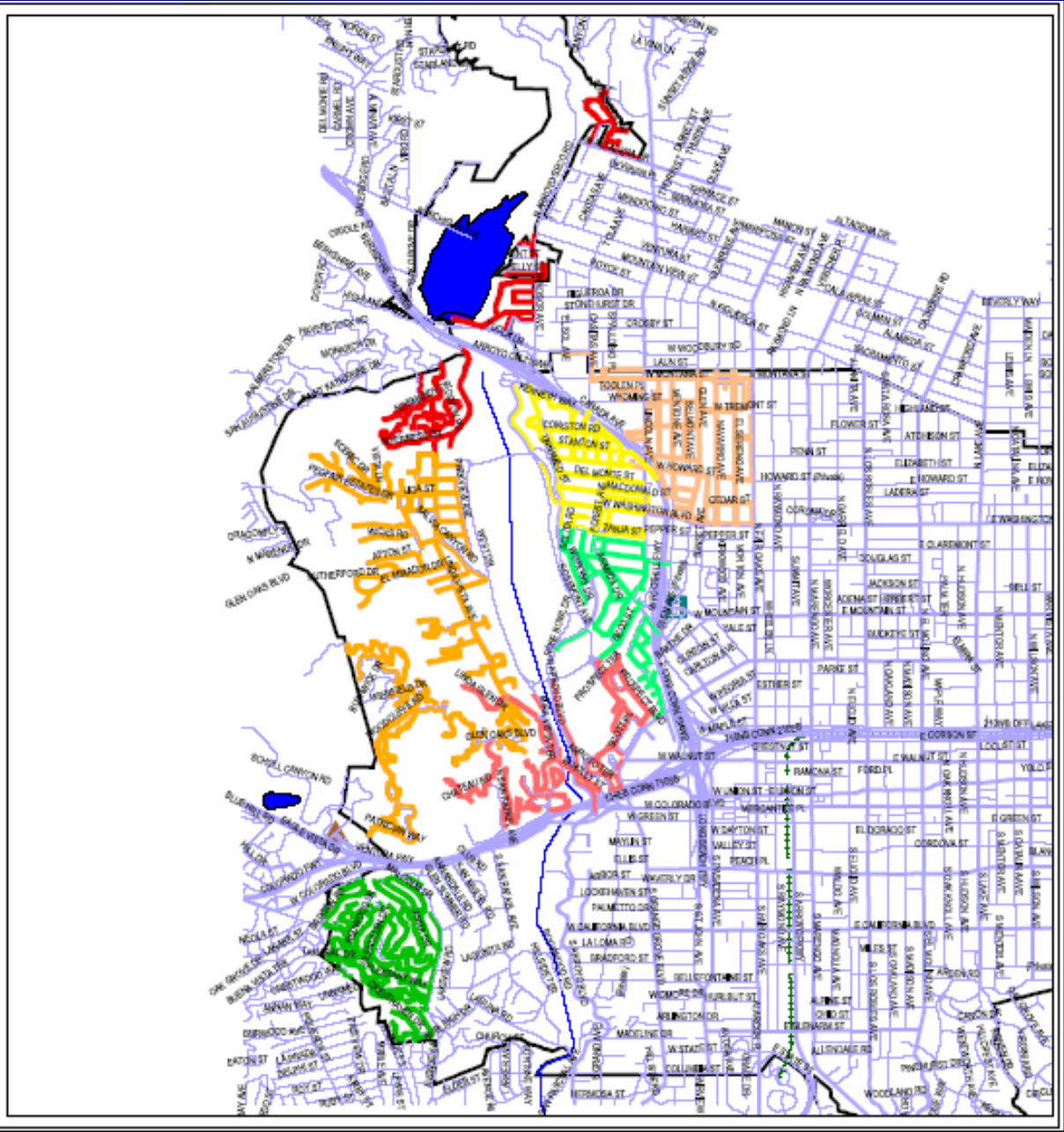
| Day | Number of Trucks | Total Hours Per Day | Average Hours Per Day | Tons | Carts | Miles | Dump Trips |
|---|---|---|---|---|---|---|---|
| Monday | 8 | 59.9 | 7.5 | 93.4 | 5582 | 279 | 16 |
| Tuesday | 8 | 61.3 | 7.7 | 118.7 | 6338 | 270 | 16 |
| Wednesday | 8 | 59.9 | 7.5 | 125.0 | 6407 | 251 | 16 |
| Thursday | 8 | 57.4 | 7.2 | 123.8 | 5705 | 239 | 16 |
| Friday | 8 | 58.8 | 7.3 | 107.4 | 5438 | 235 | 16 |
| **Average per Day** | **8** | **59.5** | 7.4 | **114** | **5894** | **255** | **16** |
| **Average per Truck** | **NA** | **7.4** | | **14.2** | **736.8** | **32** | **2.0** |
| **Total** | | **297** | | **568** | **29470** | **1274** | **80** |


New and Old Collection Days
Friday
Wednesday
Tuesday
Monday
Thursday
W WASHINGTON BLVD
N ORANGE GROVE BLVD
N LOS ROBLES AVE
N HILL AVE
N ALTADENA DR
N CRAIG AVE
S LAKE AVE
AVENUE 64
210
134

# Pasadena

Mixed Waste
Friday

Date: Aug 14, 2006
Scale: 1:50000



Routes for Streets7262006.shp
- 1501
- 1502
- 1503
- 1504
- 1505
- 1506
- 1507

Streets7262006.shp
- 1
- 3
- 4
- 5
- 6

Street Names
Railroads

Facilities
- DEPOT
- LANDFILL
- MRF
- TS

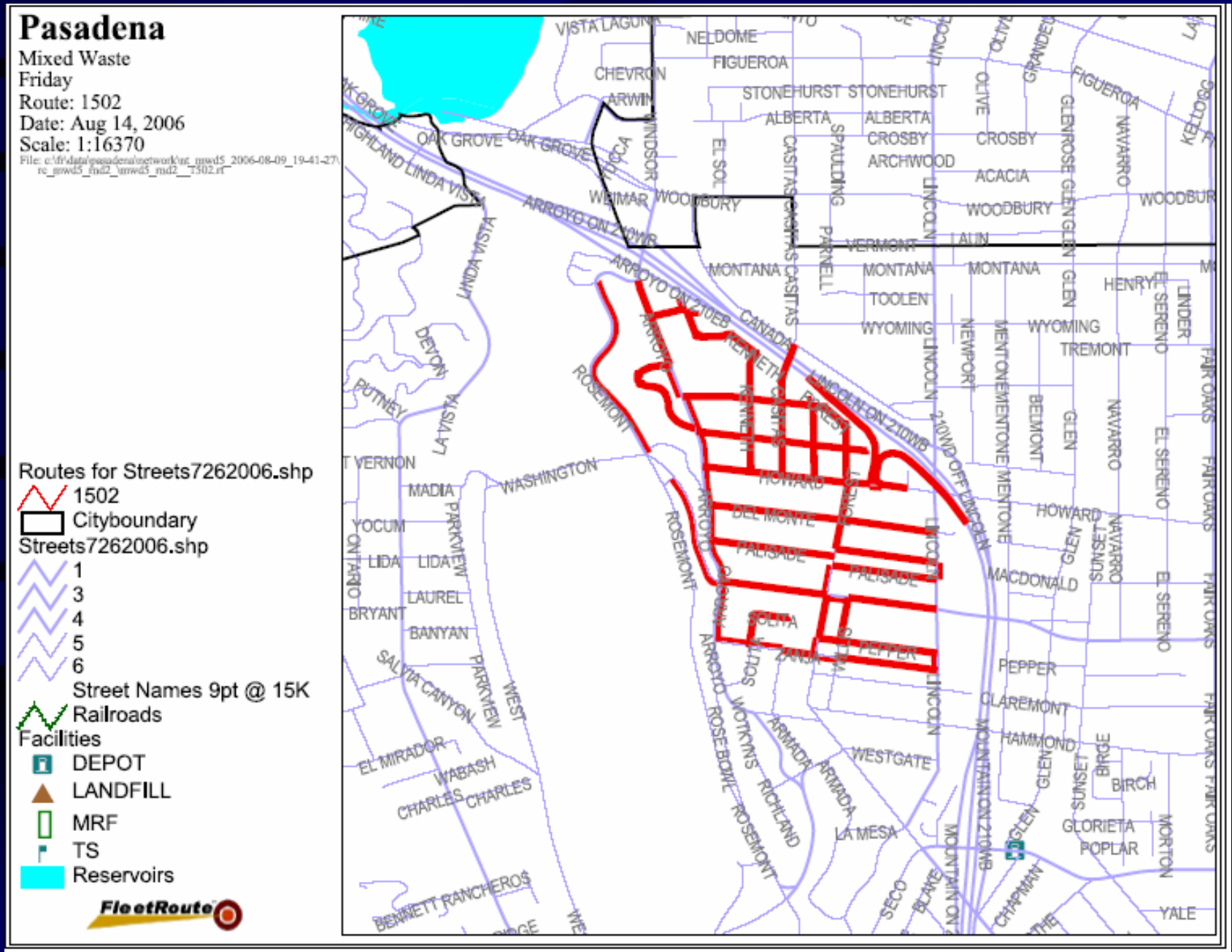
Rivers
Reservoirs
Cityboundary

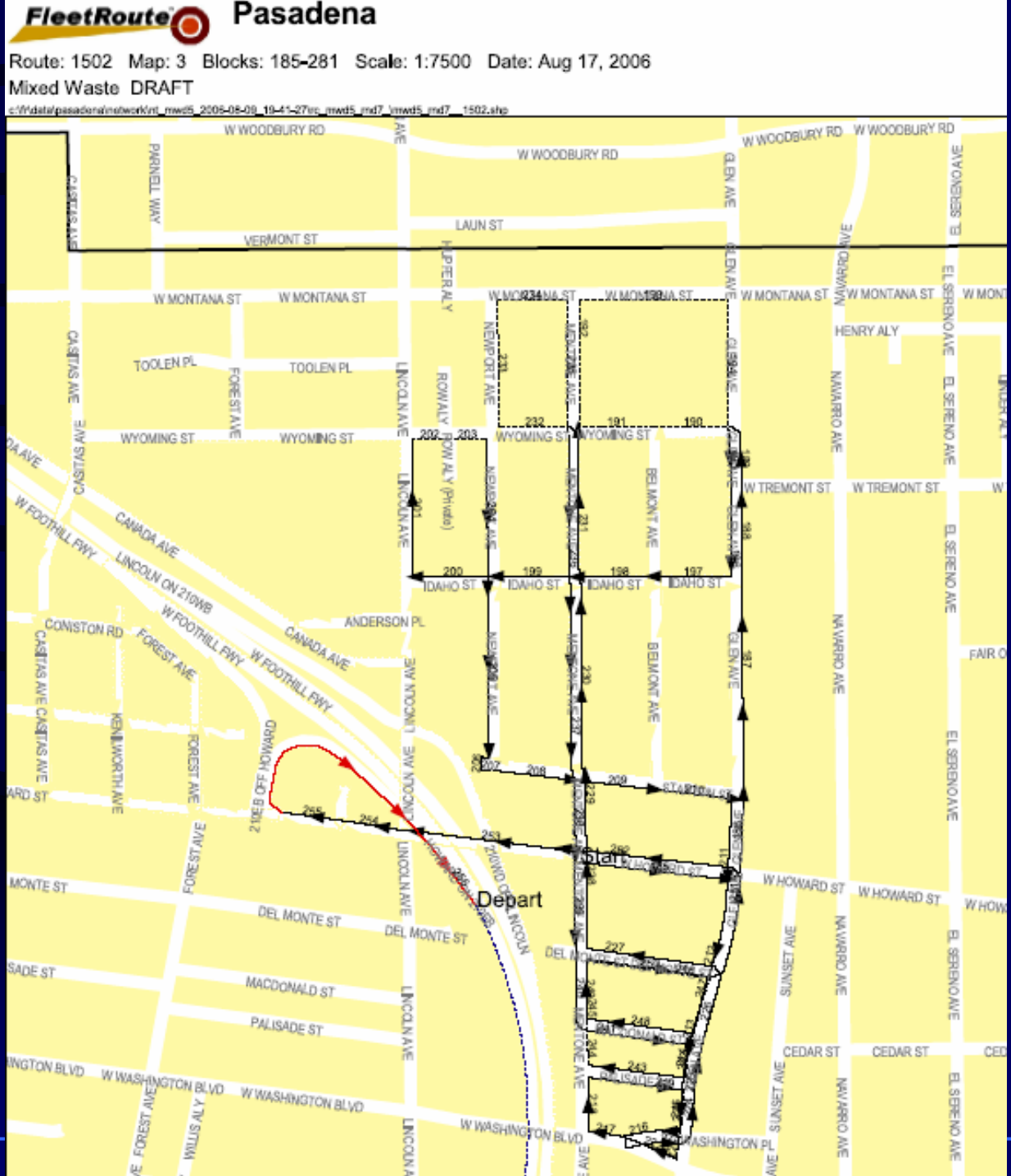
FleetRoute

# Pasadena

Mixed Waste
Friday
Route: 1502
Date: Aug 14, 2006
Scale: 1:16370

File: c:\fr\data\pasadena\network\nt_mwd5_2006-08-09_19-41-27\rc_mwd5_md2_\mwd5_md2__1502.rt




FleetRoute
Pasadena
Route: 1502 Map: 3 Blocks: 185-281 Scale: 1:7500 Date: Aug 17, 2006
Mixed Waste DRAFT
Start
Depart
W WOODBURY RD
VERMONT ST
LAUN ST
W MONTANA ST
TOOLEN PL
WYOMING ST
IDAHO ST
W TREMONT ST
HENRY ALY
CANADA AVE
W FOOTHILL FWY
LINCOLN ON 210WB
CONISTON RD
ANDERSON PL
FOREST AVE
LINCOLN AVE
CASTAS AVE
NEWPORT AVE
BELMONT AVE
NAVARRO AVE
EL SERENO AVE
GLEN AVE
W HOWARD ST
DEL MONTE ST
MACDONALD ST
PALISADE ST
W WASHINGTON BLVD
CEDAR ST
SUNSET AVE
MONTE ST
WASHINGTON PL

# Travel Directions Report
# Route No. 1502

FleetRoute

| Driver: | | Vehicle: | |
|---|---|---|---|
| Valid Days: | | | |

| Remarks: |
|---|
| |

| Route computed on | Wednesday, August 9, 2006 9:07 PM |
|---|---|
| Route File: | c:\fr\data\pasadena\network\nt_mwd5_2006-08-09_19-41-27\rc_mwd5_rnd7_\mwd5_rnd7__1502.rt |

Begin at DPW at 6:30.
Prep in vehicle for 15:00 min.

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Start route | | on W MOUNTAIN ST | (1) | at | 6:45 | Drive from facility | 2 blks | 9 sec | 0.05 mi |
| Turn right | (N) | on MOUNTAIN ON 210WB | (3) | at | 6:45 | Drive from facility | 1 blk | 15 sec | 0.24 mi |
| Straight | (N) | on W FOOTHILL FWY | (4) | at | 6:45 | Drive from facility | 1 blk | 23 sec | 0.37 mi |
| Straight | (N) | on 210WD OFF LINCOLN | (5) | at | 6:46 | Service both sides | 1 blk | 1:30 min | 0.30 mi |
| | | | | | | | 2 units | 2 custs | 93.12 lbs |
| Turn right | (N) | on LINCOLN AVE | (6) | at | 6:47 | Service right side | 1 blk | 1:41 min | 0.06 mi |
| | | | | | | | 5 units | 5 custs | 250.26 lbs |
| Turn left | (W) | on CANADA AVE | (7) | at | 6:49 | Service right side | 1 blk | 43 sec | 0.10 mi |
| | | | | | | | 1 unit | 1 cust | 52.38 lbs |
| Turn right | (NE) | on ANDERSON PL | (8) | at | 6:50 | Service right side | 1 blk | 2:24 min | 0.09 mi |
| | | | | | | | 7 units | 7 custs | 320.10 lbs |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | 11 units | 11 custs | 434.56 lbs | |
| Turn right | (W) | on WASHINGTON PL | (216) at 11:25 Service right side | 1 blk | 33 sec | 0.05 mi | |
| | | | | 1 unit | 1 cust | 40.74 lbs | |
| Straight | (W) | on W WASHINGTON BLVD | (217) at 11:25 Service right side | 1 blk | 1:19 min | 0.03 mi | |
| | | | | 4 units | 4 custs | 209.52 lbs | |
| Turn right | (N) | on MENTONE AVE | (218) at 11:27 Service right side | 1 blk | 53 sec | 0.06 mi | |
| | | | | 2 units | 2 custs | 93.12 lbs | |
| Turn right | (E) | on PALISADE ST | (219) at 11:28 Service right side | 1 blk | 2:06 min | 0.08 mi | |
| | | | | 6 units | 6 custs | 212.43 lbs | |
| Turn right | (S) | on GLEN AVE | (220) at 11:30 Drive deadhead | 2 blks | 17 sec | 0.08 mi | |
| Turn right | (NW) | on W WASHINGTON BLVD | (222) at 11:30 Service right side | 1 blk | 1:06 min | 0.05 mi | |
| | | | | 3 units | 3 custs | 133.86 lbs | |
| Turn right | (E) | on WASHINGTON PL | (223) at 11:31 Service right side | 1 blk | 33 sec | 0.05 mi | |
| | | | | 1 unit | 1 cust | 40.74 lbs | |
| Turn left | (N) | on GLEN AVE | (224) at 11:32 Service right side | 3 blks | 6:14 min | 0.16 mi | |
| | | | | 19 units | 19 custs | 818.68 lbs | |
| Turn left | (W) | on DEL MONTE ST | (227) at 11:38 Service right side | 1 blk | 4:09 min | 0.11 mi | |
| | | | | 13 units | 13 custs | 534.47 lbs | |
| Turn right | (N) | on MENTONE AVE | (228) at 11:42 Service right side | 4 blks | 12:36 min | 0.49 mi | |
| | | | | 37 units | 37 custs | 0.83 t | |
| Turn left | (W) | on WYOMING ST | (232) at 11:55 To avoid U-turn | 1 blk | 13 sec | 0.06 mi | |
| Turn right | (N) | on NEWPORT AVE | (233) at 11:55 To avoid U-turn | 1 blk | 27 sec | 0.13 mi | |
| Turn right | (E) | on W MONTANA ST | (234) at 11:55 To avoid U-turn | 1 blk | 13 sec | 0.06 mi | |
| Turn right | (S) | on MENTONE AVE | (235) at 11:56 To avoid U-turn | 1 blk | 27 sec | 0.13 mi | |
| Straight | (S) | on MENTONE AVE | (236) at 11:56 Service right side | 5 blks | 11:30 min | 0.55 mi | |
| | | | | 32 units | 32 custs | 0.69 t | |
| Turn left | (E) | on MACDONALD ST | (241) at 12:07 Service right side | 1 blk | 3:32 min | 0.09 mi | |
| | | | | 11 units | 11 custs | 494.70 lbs | |
| Turn right | (S) | on GLEN AVE | (242) at 12:11 Drive deadhead | 1 blk | 9 sec | 0.04 mi | |
| Turn right | (W) | on PALISADE ST | (243) at 12:11 Service right side | 1 blk | 2:23 min | 0.08 mi | |
| | | | | 7 units | 7 custs | 331.74 lbs | |
| Turn right | (N) | on MENTONE AVE | (244) at 12:14 Drive deadhead | 2 blks | 23 sec | 0.11 mi | |
| Turn right | (E) | on DEL MONTE ST | (246) at 12:14 Drive deadhead | 1 blk | 22 sec | 0.11 mi | |
| Turn right | (S) | on GLEN AVE | (247) at 12:14 Drive deadhead | 1 blk | 14 sec | 0.06 mi | |
| Turn right | (W) | on MACDONALD ST | (248) at 12:15 Service right side | 1 blk | 4:57 min | 0.09 mi | |

# Route Statistics

| Route Statistics | | | | | | |
|---|---|---|---|---|---|---|
| Time | Customers | Units | Distance | Quantity | Transfer Trips | Blocks |
| 07:12:25 hr(s) | 853 | 855 | 35.24 miles | 18.87 tons | 2 | 280 |

| Turn Analysis | | |
|---|---|---|
| | Count | Relative Turn Penalties |
| Straight 'turns': | 163 | 0 sec |
| Right Turns | 69 | 2 sec |
| Left Turns | 41 | 30 sec |
| Non-deadend U-Turns | 0 | 600 sec |
| Deadend U-Turns | 8 | 12 sec |

| | |
|---|---|
| U-Turn Avoidence by Class: | 9 |

| Time Analysis | |
|---|---|
| | hh:mm:ss |
| Time from Beginning Facility: | 00:00:48 |
| Time to/from Transfer Facilities: | 00:16:16 |
| Time to Ending Facility: | 00:04:12 |
| Intra-Route Deadhead Time: | 00:11:50 |
| U-Turn Avoidance Time: | 00:07:50 |
| Service Time: | 05:01:39 |
| Other Time: | 01:29:51 |
| **Total Time:** | **07:12:25** |

**Notes:**

1. A 'block' is defined as one side of a street between two intersections. The block number shown in parentheses after the street name is the first block of that street and will correlate to the path sequence numbers on the route's path maps.
2. All times and quantities are estimates.
3. Breaks should be taken at appropriate times and report clock times adjusted accordingly.
4. The information contained herein is based on a computer model of these streets and are provided as a guide only - they should not be taken for reality. All traffic laws take precedence over these directions and should be obeyed.

Report created by *FleetRoute™*

End of Report

# *3. Asset Tracking System*

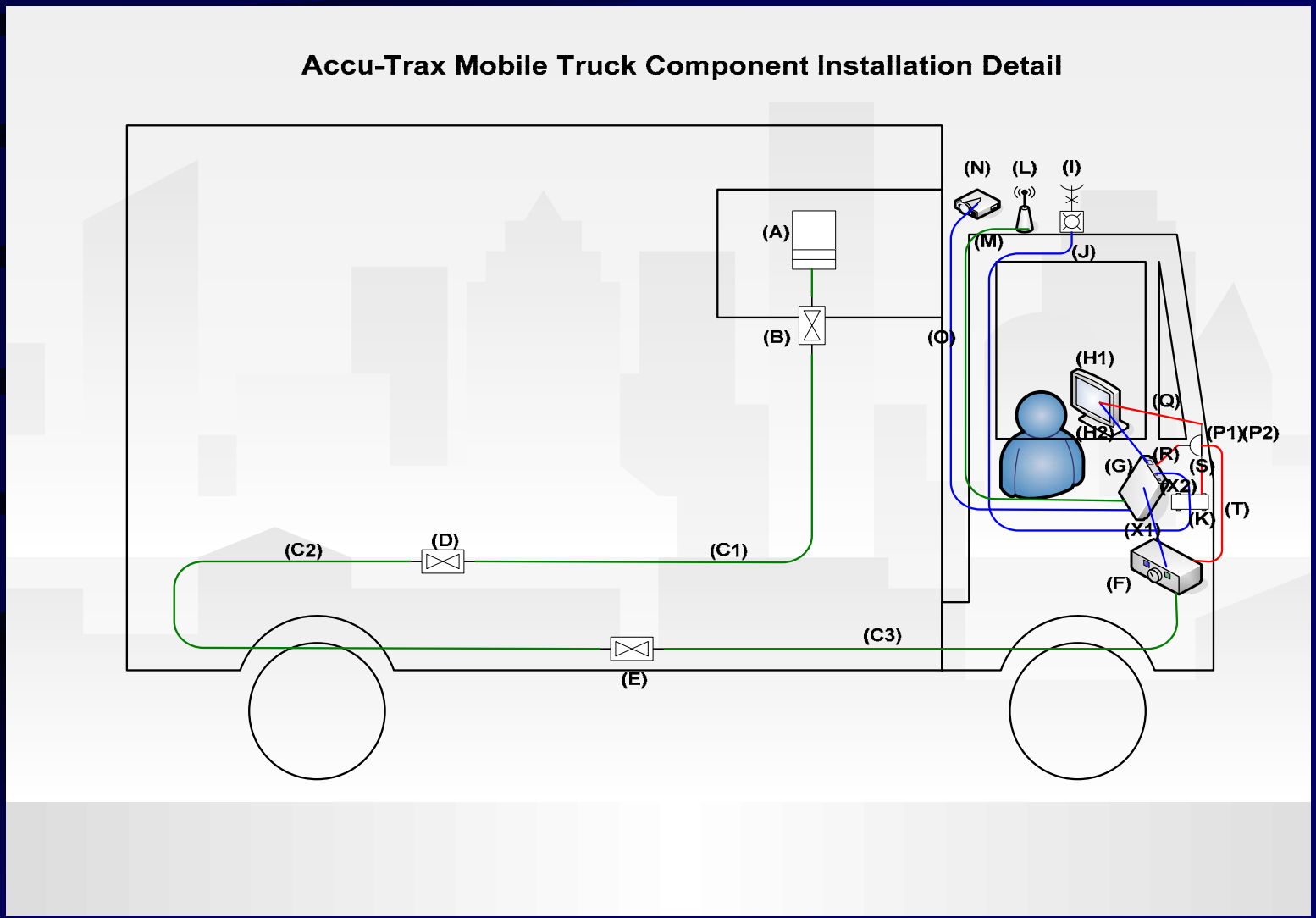
Purpose:

Used to optimize the interface between the waste collection truck cab and the dispatcher/office

# *Accu-Trax Mobile Features*

- Route Information transferred through WiFi -- replacing printed route books
- Real time GPS and cellular communication
- GPS truck tracking for accurate accounting of driver daily activity
- Container inventory and Tracking via RFID technology
- Camera Systems to capture “No cart out” or Extra’s
- Truck Mounted In-Cab touch screen for driver input and control center messaging

# Accu-Trax Components



# Cab over…Evening/Weekend Installation

# Samsys Antenna – Final Location

# *Accu-Trax Mobile System Protection w / additional fan*

# Samsys RFID Transmitter

# *Roof Mounted Antenna, GPS Unit & External Camera*

# WiFi Antenna Mounted on DPW Bldg.

# Equipment Installation in Cab

# Screen with Driver Log In Page

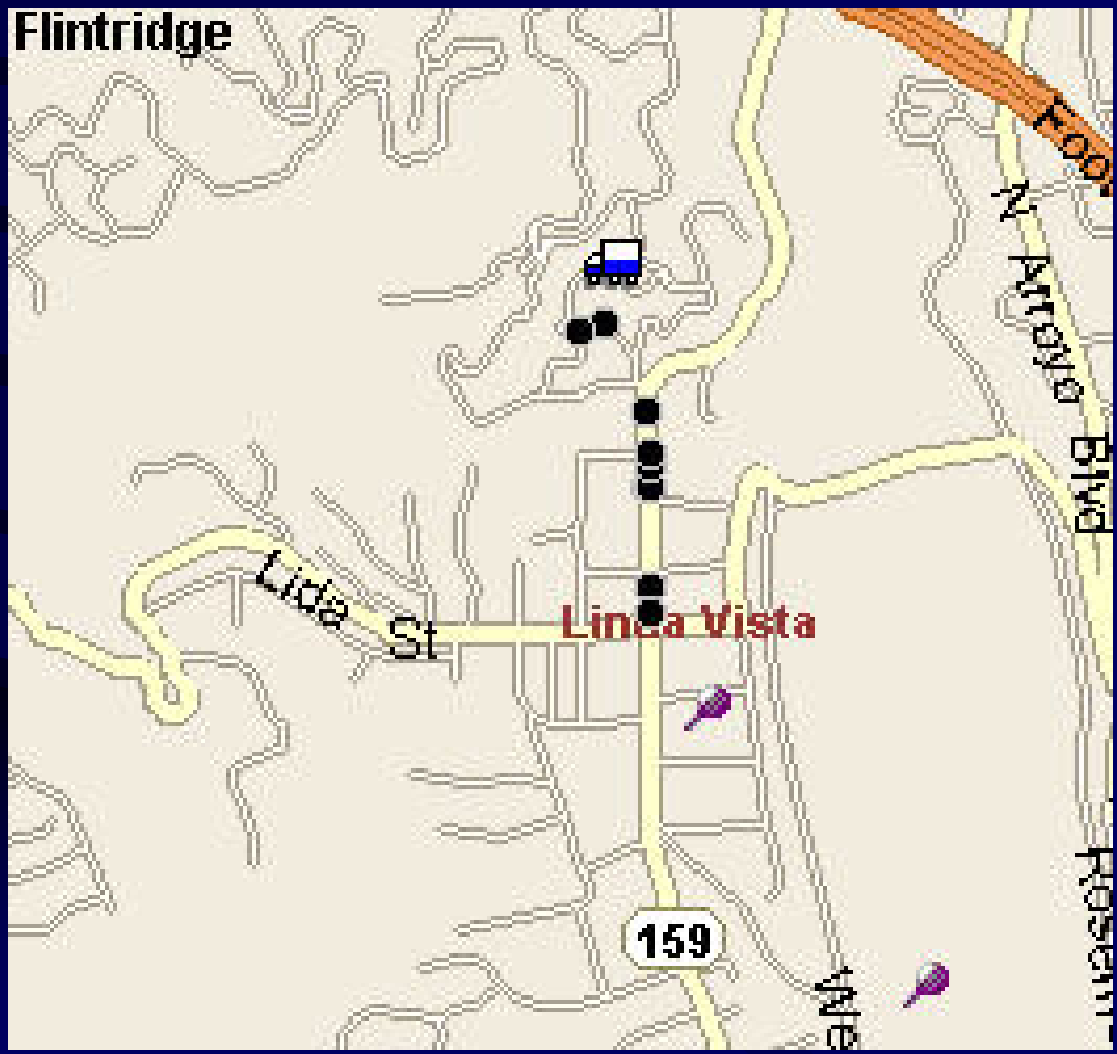
# Touch Screen w/Camera Picture

# *4. GIS Waste Database*

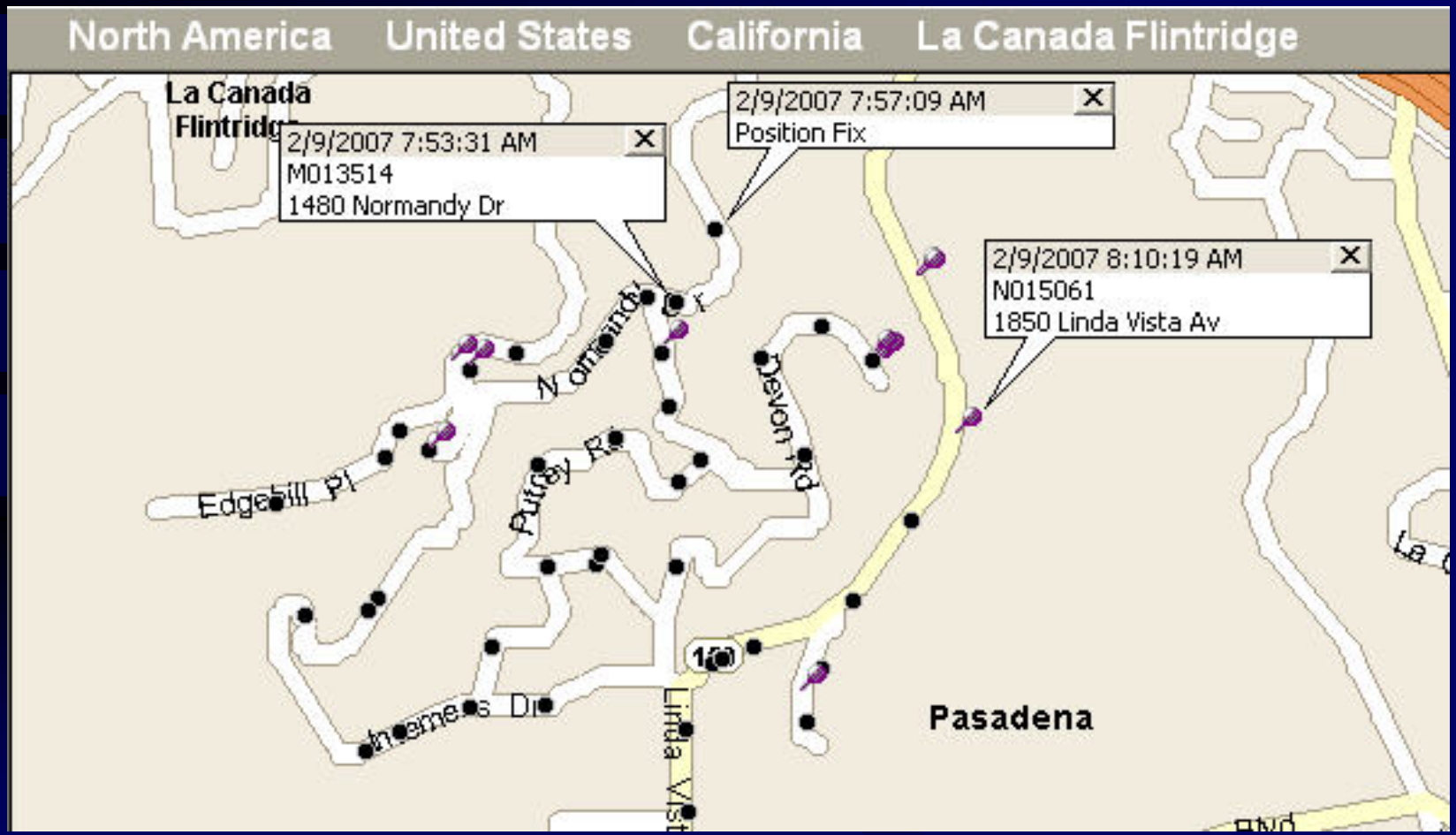
- Started field audits based on existing customer database system
- As audits were conducted, added GPS coordinated for container locations
- Cart GPS coordinates were added to the customer information
- Results: Customer – Carts – Locations – Invoicing  are all integrated and linked together into the City system

# *Breadcrumbs 1 – Dots are RFID cart tips*

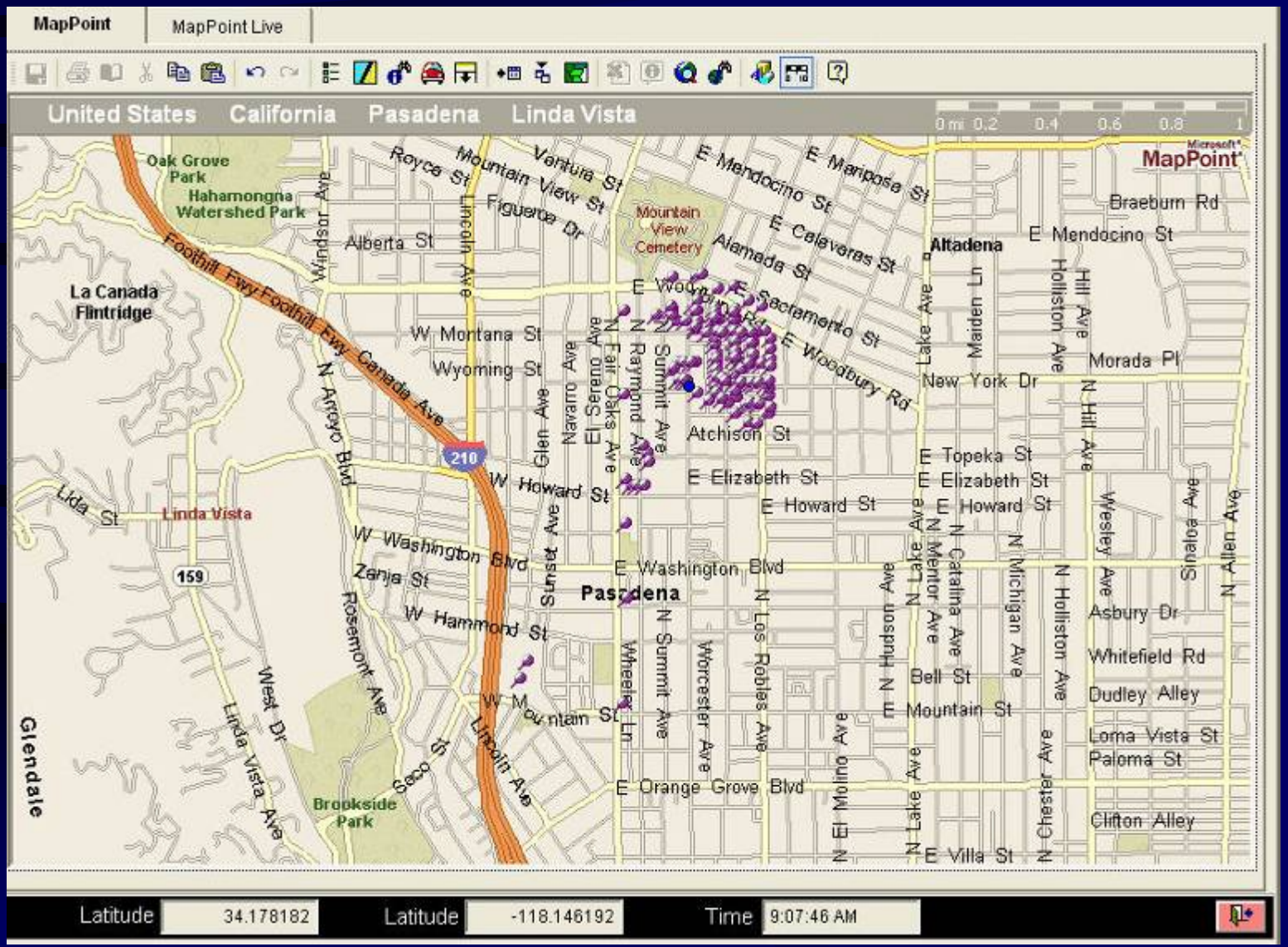
*(pins are GPS fixes set, 2-120 seconds w/o tips occurring )*



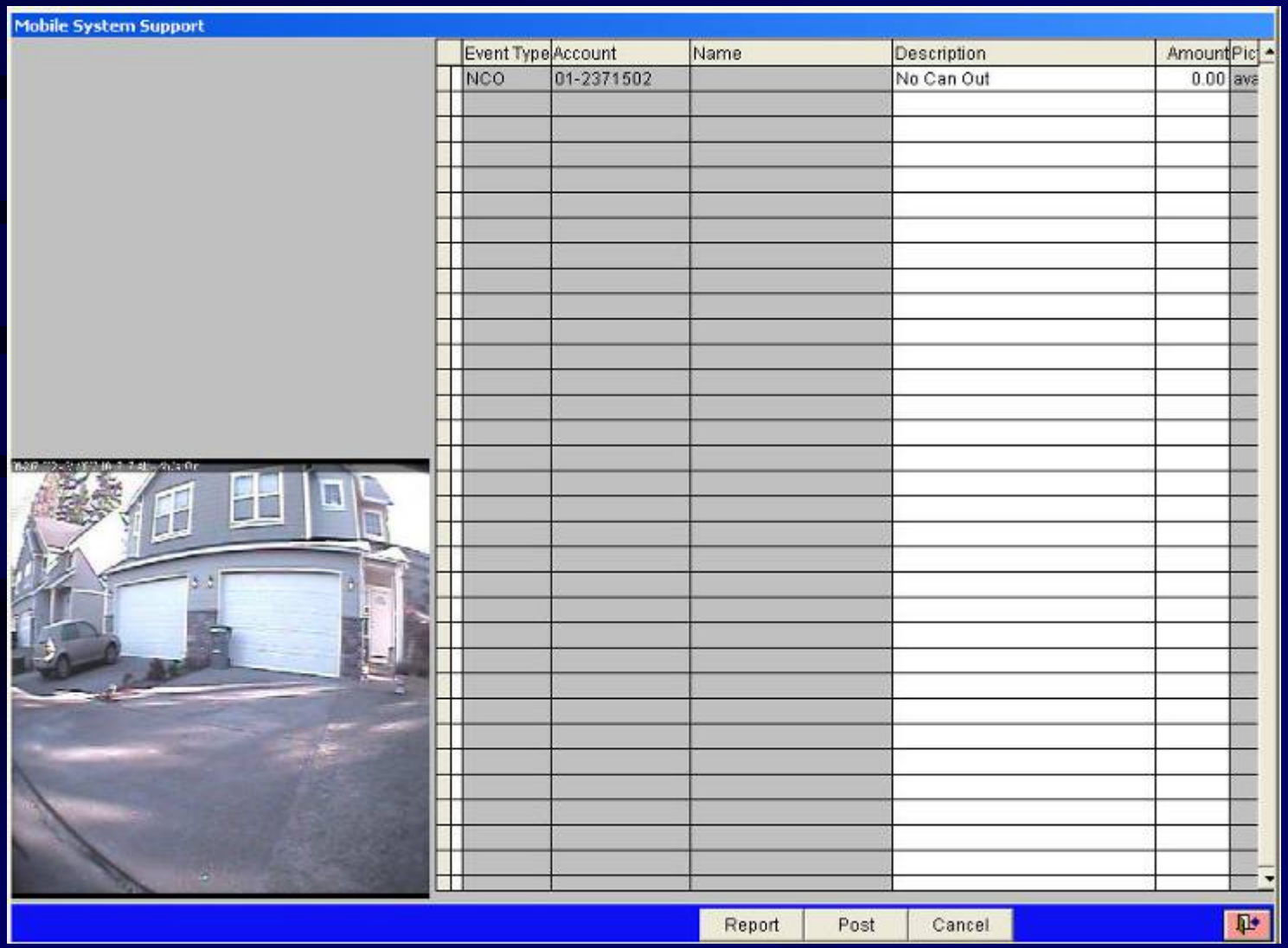
# *Breadcrumbs-w/time & locations listed (pins are GPS fixes w/o tips occurring)*



# Mapping Breadcrumbs on Time Interval

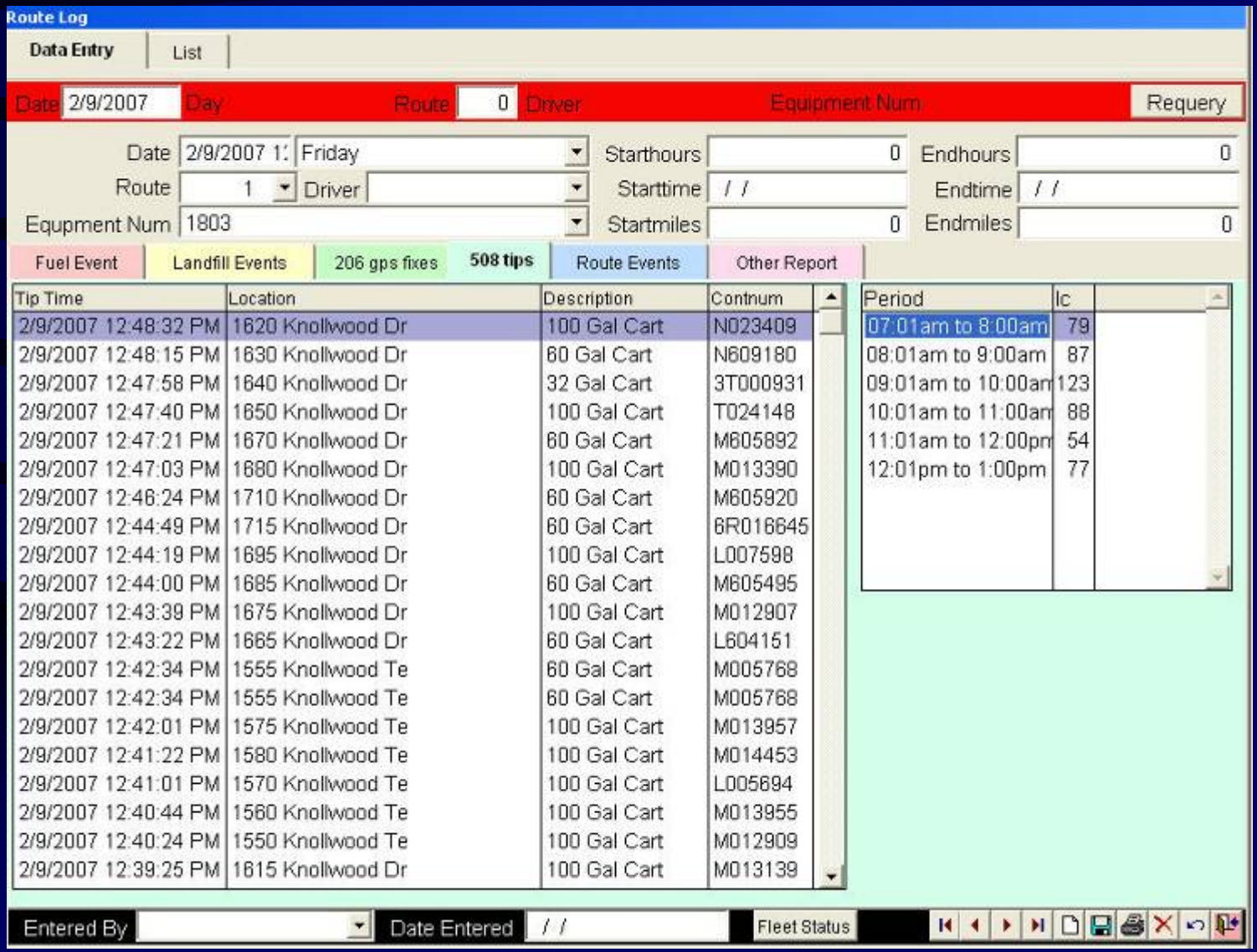


# NO CAN OUT…Picture on Truck Monitor (all photo's downloaded end of day)

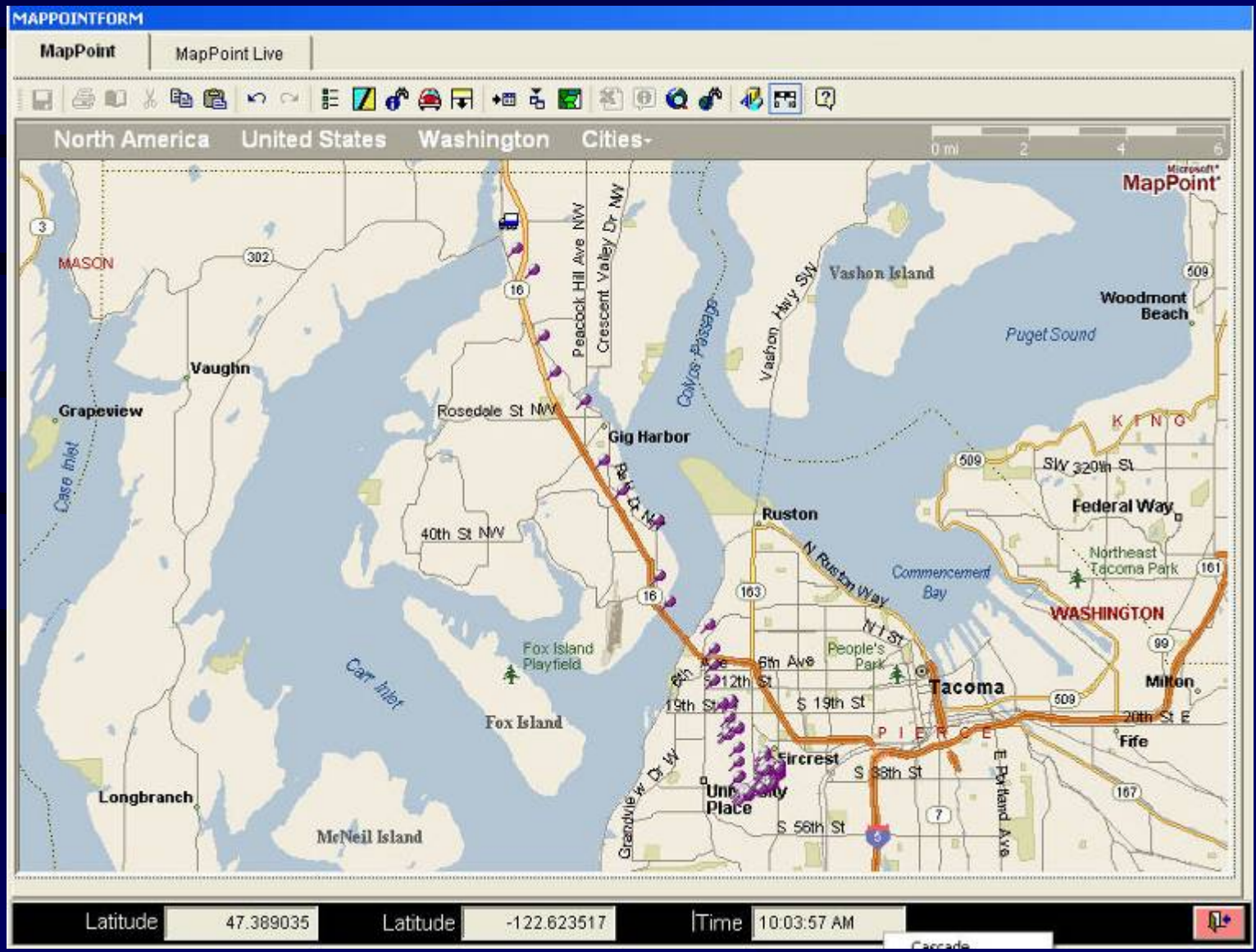


# Route 1 Log -Customers & Service Times

## (Periods on Right --- Productivity w/Tips/Hr. log)



# Route w/Collection vehicle now at Landfill



Thank You for your attention