GPS and DOT

The Circle of Usage

Or

Who’s Doing What Where and Why

Presented By Charles W. Brown, PE, PLS
NC Dept. of Transportation
email: charliebrown@dot.state.nc.us
Technology Implementation Group
GPS Implementation Committee

GPS and DOT
Technology Implementation Group
GPS Implementation Committee

Len Sanderson, PE  NCDOT, Chair
Alan Blair - Central Fed Lands Hwy Div (FLHD)
Charlie Brown  NCDOT
Leo Dario  Eastern FLHD
Brian Dolman-Jersey  MDOT (Mich)
Sean Fernandez  UDOT
Larry Goble  Western FLHD
John McCracken  FHWA R&D
Jeff Place  Western FLHD
Dan Streett  NYDOT

GPS and DOT
Technology Implementation Group
Two-Fold Implementation Plan

GPS Workshop - Today
Nationwide Workshops - Locally if Possible
At GPS Users’ Requests
For Survey Grade Users
Who Is Using GPS For What
Contacts
Technology Implementation Group
Two-Fold Implementation Plan

Multiple Uses of GPS in DOTs
AASHTO Regional Meetings
For Upper Management
Who Is Using GPS For What
What Benefits
What Shortcomings
What this workshop is not:

A Sales Pitch for any particular Vendor
A Training Session in GPS
A Solution to All of Your GPS Woes
What this workshop is:

A Brief Discussion of GPS Applications in DOT/FHWA Operations
Concentration on Design and Construction
Discussion of What To Do
and What Not To Do
A Starting Point for a National Discussion on GPS Standards in Highway Planning, Design, Construction
TIG
Nationwide Survey

Fall, 2003
Utah DOT Website
http://www.udot.utah.gov/ets/GPS/default.htm
32 States and Federal Lands - Highways responded
Individual results can be accessed thru TIG website
www.aashtotig.org
TIG Nationwide Survey
Different Applications of GPS:
- GPS and DOT
- Planning
- Design
- Construction
- Maintenance
- Asset Management
- GIS and DOT
- Technology Implementation Group
Planning the Project - Corridor Studies

Natural Environment Mapping
Wetland Boundaries/PETS Habitat
Historic Property Locations
Archaeological Sites - Points or Boundaries
Major Utility Locations
Things To Avoid
Planning the Project - Corridor Studies

Mapping or Recreational Grade GPS
Accuracy Relative to Need for
Feasibility Studies/ Initial Cost Estimates
Planning Purposes
Fast and Inexpensive
More Data with Fewer Personnel
Common Coordinate System
(Usually State Plane or Similar)

GPS and DOT
Planning the Project - Corridor Studies

Mapping or Recreational Grade GPS
Accuracy Only Relative to Need
Uneducated Users Unfamiliar with:
Coordinate Systems
Accuracy of Different Types of GPS
Application of Mapping Grade (or Recreational) to Actual Design Needs
Controlling the Project - NDGPS Networks

12/03- All contiguous 48 states receive the signal from at least two transmitting sites.
Planning the Project - Corridor Studies

Ground Control for Photogrammetry Over Multiple Corridor Area

GPS-IMU for Aerial Photography Mapping For Preliminary Roadway Alignments and Grades

GPS Combined with LIDAR for Preliminary Earthwork Quantities
Planning the Project - Corridor Studies

Survey Grade GPS
Post Processed or RTK
Highly Accurate Control
Utilized Throughout Project
Better Data / Fewer Personnel

Accuracy Determined by Photogrammetric Process
(Altitude of Plane Usually)
Knowledgeable Users
Designing the Project - Route/Property Location

Recreational/Mapping Grade
Locating Known Coordinates
Lost Control Corners
Property Reconnaissance
Low Cost = Low Accuracy
Easy Use

GPS and DOT
Designing the Project - Route/Property Location

Survey Grade GPS
Post Processed or RTK
Highly Accurate Control - Photogrammetry or Ground Surveys
Property Corner Locations
Utilities
DTM Collection
Hydraulic Data - Rivers, Lakes, Bays

GPS and DOT
Designing the Project - Route/Property Location

Faster Data Collection
More Accurate Data
Fewer Personnel
Knowledgeable Users - Usually
Limited Usage
Staking Right of Way
Setting Known Points

GPS and DOT
Designing the Project - Route/Property Location

Canopy A Problem
Urban Canyons
Equipment Costs
Coordinate Issues - Different Datums
Tying Grid To Ground
Who’s On The Right Point?
How Do We Know What’s Right?

GPS and DOT
Controlling the Project - NDGPS Networks

Post Processing
Common Points - Common Coordinates
Multiple Users - Multiple Benefits
Numerous State DOTs
Maintaining NDGPS Networks
Cost Included in Operational Budget or Thru Projects (FHWA)
Building the Project - Construction Estimate for Bid

Paper Plans and Electronic Alignment on a Mapping Grade GPS Receiver

OR

Electronic Plans on a Mapping Grade GPS Receiver

No Need to Stake the Project for Estimation Purposes

GPS and DOT
So - You’ve Got Good Data

Typical Construction Phasing:

Electronic Plans Printed and Provided to Contractor
Construction Surveyor Computes Coordinates
Construction Surveyor Establishes Project Control
Construction Surveyor Stakes Project
Grader Tears Up Stakes
Construction Surveyor Stakes Project
Grader Tears Up Stakes
Construction Surveyor Stakes Project...
Building the Project - Construction Stakeout

Canopy - What Canopy?

Should Use Existing GPS Control Network

Plans Should Contain GPS Data

Electronic Data Sent To Construction Surveyor

Reduces Error/Increases Time

Reduces Cost

GPS and DOT
Building the Project - Construction Stakeout

Stakeout Error Not As Critical In Construction As In Right Of Way
Smaller Survey Parties - More Crews in Different Directions
One Base On Project Can Serve Several Different Surveyors
Reduces Need For Multiple Project Controls

GPS and DOT
So - You’ve Got Great Data and It’s Really Staked Well

Still Typical Construction Phasing:
- Construction Surveyor Computes Coordinates
- Construction Surveyor Establishes Project Control
- Construction Surveyor Stakes Project
- Grader Tears Up Stakes
- Construction Surveyor Stakes Project
- Grader Tears Up Stakes
- Construction Surveyor Stakes Project...
Solution -
Put GPS On The Grader!

GPS and DOT
Building the Project - Vehicle Guidance

Tied To Electronic DTM File
Provides Cut/Fill As The Grader Moves Dirt
Tied To Project Control Thru Base Station
In Most Cases, Good Down (or Up) to Near Final Grade

GPS and DOT
Building the Project - Vehicle Guidance

Reduces Repetitive Need For Construction Stakeout
Reduces Time
Reduces Cost
Operators Are Already Visualizing - This Gives Them Something To See

GPS and DOT
Building the Project - Vehicle Guidance

Western Mining Operations Have Been Using GPS Vehicle Guidance For Years
Contractors Are Using GPS Vehicle Guidance on DOT Projects In Several States

GPS and DOT
What Controls Are In Place To Put The Bridge In The Right Place?
Solution

Common Coordinate System
- Predetermined Base Station Network
- Project Control as Part of Plans
- Any Required Adjustment Factors
- OPUS
- Network RTK
- Local Base Stations
Controlling the Project - OPUS Networks

On-line Positioning User Service
Product of NGS/NOAA
Utilizes NCORS
NGS Home Page
(http://www.ngs.noaa.gov)
Controlling the Project - Networks

OPUS - Reduces Time for Establishing Controls
Cuts Occupation and Travel Time
Good For Stand-Alone Projects - Accurate Within Itself
Free from NGS

GPS and DOT
Controlling the Project -
VRS* Networks

Virtual Reference System
(Trimble)
RTK Network Using Multiple
Base Stations
Transmits One Correction
Factor to Multiple Rovers
Utilizes Cell Phone Technology

GPS and DOT
Controlling the Project - VRS* Networks

Reduces/Removes Need For Individual Bases
As Accurate As Individual Bases
No Set-Up Time
No Additional Equipment
Not Inexpensive
Limited to 50 Users Per License
Cost v Benefits?
Funding - Equipment or Networks

Different Sources of Funds - NC
Charge Equipment & Partial Funding of Network RTK via Federal Projects - FHWA
Approval of Shared Funds
Additional Funding from NCDENR and User Fees
Funding - Equipment or Networks

Different Sources of Funds - NY
Leasing CORS Base Stations on 6 year interval, through IT Budget, with option for 2nd 6 year interval renewal or re-bid
Not a Lease-To-Own

GPS and DOT
Funding - Equipment or Networks

Different Sources of Funds -
TN - State DOT Equipment Budget
FL - Legislative Funds approved over Multi-Year plan
Maintaining the Project - Asset Management

Pavement Analysis Mapped With GPS
Roads Mapped For GIS
Structures Located
Highway Assets:
Signs
Utilities
Pipes

GPS and DOT
Maintaining the Project - Asset Management

GPS Used To Monitor
Bridge Deflections in FL
Dam Deformation in TN
Earth Movement in CA
Subsidence in Houston, TX
Maintaining the Project - Incident Management

GPS and DOT

GPS Used to locate accidents for E-911 routing
Maintaining the Project - Incident Management

Congestion Points Easily Added To GIS Congestion Management Database

GPS and DOT
Maintaining the Project - Incident Management

10 Accidents

Vehicular Accident Investigations and Tracking

GPS and DOT
Project Records

GIS

GPS Places GIS Data In The Correct Location, Geographically
Where Are The Assets?
Where Are The Wetlands?

With A Well-Built GIS, Based on Good Data, Planning For Future Projects Becomes Easier
We’ve Come Full Circle

Construction

Design

Planning

GIS

Asset Management

Maintenance

What Now?

GPS and DOT
After Lunch:
Panel Discussion

• Obstructions to GPS Implementation
• Need for GPS Standards
• How Much? What Type?

Begin A Nationwide Discussion on Data, Metadata, and Methods of Collecting Data
Thank You.