Florida’s Turnpike Mainline (SR 91) from Florida’s Turnpike Extension (SR 821) to Johnson Street

Project Overview

WGI’s submitted project (Project) for the MAPPS 2019 Geospatial Products and Excellence Awards is Florida’s Turnpike Mainline (SR 91) from Florida’s Turnpike Extension (SR 821) to Johnson Street¹. The Project is a major highway design for a construction program that involves all the elements and criteria of the MAPPS Excellence Award’s Category B. for Surveying/Field Data Collection. While conducting the Project, WGI performed:

- Geodetic control for referencing all field observations, and surveys to a rigorously defined and accurate survey control network
- Made extensive use of ground-based (static, mobile, and backpack) LiDAR systems for 3D data collection (creating point clouds) containing the roadway and other required assets for mapping
- Acquisition of 360-degree imagery for use in asset collection, point cloud colorization, and visualizations
- Performed hydrographic surveys with a small drone vessel
- Asset data collection from the LiDAR point clouds while augmenting those LiDAR sources with GNSS RTK and total station surveys with automated data collection
- Ground penetrating radar (GPR) and electromagnetic surveys to designate subsurface utilities within the right-of-way and, thereafter, perform limited vacuum excavations to further verify presence and potential conflicts with the proposed design

Complexity

The Project possesses extraordinary requirements containing complex technical criteria and addresses significant problems associated with a major highway widening project on an active limited access tollway. WGI used unique approaches to solve many logistical and technical problems working within the Project’s right-of-way, which posed significant safety challenges related to the complete avoidance of high-speed traffic. No single technology could derive a solution for every Project need, so WGI used a variety of available technologies for a safe, programmatic, and integrated field data collection approach.

The Project consisted of performing surveys and collecting asset information to be used by the engineering consultant² for 100% updating of the then-current plans that were “on the shelf” since 2009 and migrating those plans to Bentley Open Roads Connect Edition 3D design. Those plans developed and completed for a 2009 objective were initially for a bilateral six to eight lane roadways widening of the Turnpike (Milepost 47.3) to north of Johnson Street (Milepost 50.7). The 2017 objectives reflect a widening from six to ten lanes with variable tolled express lanes plus modifications to the Hollywood Blvd interchange. A significant change is a proposed 33’ shift of the mainline alignment to the west and complete reconstruction of the mainline, to avoid two gas transmission facilities owned and operated by the Florida Gas Transmission Company. The Hollywood Blvd interchange is a major interchange for SR 858/Miramar Pkwy and SR 820/Hollywood Blvd. To complete this Project, WGI worked very closely with the engineering consultant and the Turnpike’s professional staff. A foremost expectation for Project performance is WGI’s familiarity with the engineering consultant to collect current information to support their preliminary review of the concepts and commitments (typical sections, alignments, etc.) developed from prior studies and/or activities for the current Project Development and Environmental (PD&E) study. The engineering consultant relies on those approved concepts and new survey data collected by WGI as a basis for the new design. The new design includes required drainage design and stormwater management services and all the associated tasks necessary to prepare the construction plans and documents, including permit applications for all work within the limits of this Project. Moreover, the complexity increases significantly with the Project stakeholders and their reliance on the accuracy and completeness of the WGI provided data. Project stakeholders include FDOT District 4 – six internal departments; Broward County – four internal departments; City of Hollywood, City of Miramar, South Florida Water Management District (SFWMD), the Florida Gas Transmission Company and other Utility Agency Owners (UAO’s), Metropolitan Planning Organizations each with two departments; and twenty-four (24) Homeowners Associations (HOA). All of WGI’s work had to support the Turnpike Design Manual (TDM) and resulting plan sheets in accordance with the FDOT Design Manual (FDM). Our efforts produced the data

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² Kimley-Horn and Associates, Inc. is the lead engineering consultant.
necessary for separate roadway plans and profile sheets that are updated for the 10-lane section, and supported 3D corridor modeling design in Open Roads Connect Edition. The following are the prepared sections:

- SR 91 mainline widening six (6) to ten (10) lanes with two (2) Express Lanes in each direction
- Bridge Typical Sections for Bridge No. 860361 CR 858/Miramar Pkwy over Turnpike, Bridge(s) No. 860394/860395 Turnpike over CR 824/Pembroke Rd, Bridge No. 860407/860408 Turnpike over CR 820/Hollywood Blvd, and Bridge No. 860403 Turnpike over Johnson St.
- SR 858/Miramar Pkwy roadway section
- SR 824/Pembroke Rd roadway section
- CSR 820/Hollywood Blvd Interchange ramps (Mainline offset of existing configuration)
- Johnson St roadway section

Original or Innovative Application/Development of Technologies or techniques

Amongst the foremost uses of technology and the development of new techniques was the requirement to use efficient methods for safety since traffic was maintained on all affected roadways throughout the duration of the Project’s work activity. Canals with 2:1 slope immediately adjoin the tollway, and the associated reduced shoulder width and guardrails limit the ability to safely remove parked vehicles and personnel from exposure to high-speed traffic. WGI used:

- Remotely piloted Teledyne Marine Z-Boat with R2 Sonic multibeam echosounder to collect bathymetric data to allow the design consultant to conduct analysis for drainage needs and provide enough plan details to ensure maintenance of flow for the work in the canals and wet treatment ponds. The Z-Boat was an ideal platform for use in surveying drainage ponds and canals in the right of way. Data included information for each pond siting report for evaluating a minimum of three facilities per basin and the right of way needs for stormwater management.
- Mobile LiDAR and 360-degree imagery to assist in the determination of what portions of prior data could be used for existing geometry and widening. WGI’s data collection and survey activities documented the need for variations and exceptions prepared by the engineering consultant and preparation of technical memorandums with recommendations.
- Static LiDAR to produce surveys for pipes for the seventeen cross drains within the Project area.
- Static LiDAR for the collection of precise bridge superstructure geometrics and details, supporting the preparation of Bridge Development Reports (BDR’s), and structural design for bridge widening or replacement at six bridge locations.
- Backpack LiDAR for collecting 3D data along and behind retaining and noise barrier walls where accessibility was challenging or in areas where vehicle-based Mobile LiDAR possessed occluded areas.
- GPR and electromagnetic designations (ASCE 38-02 Quality Level B) for identifying all existing subsurface utilities to prepare updated plans for utilities and their coordination during construction. WGI was tasked with determining the locations of Turnpike-owned utility facilities (i.e. power, telephone, water, sewer, roadway lighting, data, and internal communication lines), and for twenty-one (21) separate utility company stakeholders with facilities within the right-of-way. Each owner of a utility was provided with a copy of the plans.
- Vacuum excavation of existing 18-inch and 24-inch Florida Gas Transmission (FGT) facilities for accurate determination of FGT’s easement location. This aspect was critical to design and cost savings, ensuring no easement encroachment and to avoid an FGT relocation triggered by the designed improvements.
- More than 400 ASCE 38-02 Quality Level A utility test holes were performed to clear design conflicts with existing utilities. These included drainage structures, eight new mast arms, sign foundations, tolling structures, bridge piers/foundations/end bents, and FTE Intelligent Transportation Systems (ITS) fiber optic lines.
• Topographic and other surveys with total stations and RTK instrumentation for support of the necessary design plans for grading, staging, maintenance of traffic, storm water management, landscaping, signing, and lighting. WGI supported the identification of all locations and widths for any type of work that may require the use of the temporary construction space and associated easements or license agreements.

• Processing of 3D point clouds to support the design of 16 overhead sign structures and the other three dynamic message signs required for the express lanes. The signage design includes special foundations due to the specified roadway width. Special drainage structures are necessary to avoid excessive grading.

Future Value to the Geospatial Profession and the Public

By using 3D data collection (largely LiDAR surveys), WGI was able to safely and efficiently provide a design field survey to produce full 3D topography, cross-sections, drainage and outfalls, utility location, bridge surveys, and other surveys including field investigations for collection missions. WGI performed mobile scans of the Turnpike from MP 47.2 to MP 50.9 in the northbound and southbound lanes. We also scanned the ramps at Miramar Parkway going over the Turnpike, Pembroke Road going under the Turnpike, Hollywood Boulevard under the Turnpike and the interchange ramps, and Johnson Street under the Turnpike. All these data were related to established horizontal and vertical datums by recovering and/or re-establishing the existing geodetic control on the Florida State Plane Coordinate System and providing a combined overall adjusted network of control meeting the Turnpike’s specifications.

This Project advances our profession of surveying by producing complete 3D topography, digital terrain model (DTM), drainage and outfalls, bridge surveys, and other appropriate surveys, including field investigations with highly efficient and integrated technologies. Using the same data, we integrated utility designation, vacuum excavation to incorporate a subsurface and overhead 3D utility model for this Project, automating conflict and clash detection. These same data will be used for any subsequent right of way survey as may be needed in support of the design and preparation of legal descriptions to support the land acquisition process, including right of way maps and appraisal sketches. Finally, the data from this Project will be included within a GIS for integration with SunGuide3 software for the Turnpike’s GIS-based asset management applications like ITS Facility Maintenance (FM) software.

As with any highway program, every activity should create a positive public image. WGI’s approach facilitates such an experience with the engineering consultant, its interactions with the Turnpike and its customers, and community stakeholders. The focus on safety and efficiency reduces traffic interruptions and motorist inconvenience. The holistic approach demonstrates the advancement of 3D design, corridor modeling, survey, visualization, and geographic information systems for Project purposes and long-term asset management.

Client/Owner Satisfaction

Our ultimate client (The Florida Turnpike Enterprise) enthusiastically supported the submission of their Project, performed by WGI, for the MAPPS 2019 Geospatial Products and Excellence Awards. The engineering consultant is equally pleased with WGI’s work and products. We were cost-effective in delivering the project within the prescribed budget and on time. In every respect, WGI met the clients’ technical and financial expectations for all interim and final dates for services and products.

3 https://www.fdot.gov/traffic/ITS/Projects-Arch/SunGuide.shtml