Chapter 2: Design Scope and Process

2.1 Design Philosophy

-- The UDOT 2017 Standard Specifications and Standard Drawings adapted a philosophy change in the approach to engineering design. In most cases, references to contractor discretion in locating or configuring installed infrastructure were deleted, with the idea that the designer should specify the precise locations of all above ground items. Contractor discretion often resulted in unsatisfactory placement of devices that were based on contractor's convenience rather that Department needs. Designers are now required to locate above ground ATMS Infrastructure on plans by station, offset, and (in most cases) elevation to eliminate such contractor discretion. This requires a greater level of design effort than has been exercised in the recent past. It also requires a greater level of knowledge and information about the proposed site, including survey and utility data.

2.2 Required Information

a. Project Area -- Detailed familiarity of the project area and proposed site(s) is essential to be able to design to the level of detail required. A site visit is required in the design process and should be documented in the project notes. The entire project area should be walked by the team, including all fiber backbone conduit running lines. Google Earth or other available photography is not adequate to fully evaluate site conditions as the photography may be dated and/or not show essential features in sufficient detail. Aerial photography certainly has its benefits but cannot replace a site walk. During the site walk, major geographical features to be avoided should be noted and flagged for use in the design process.

b. Utilities -- Designing to avoid utility conflicts is part of the designer's role, not the contractor's. To the extent possible, the designer should identify utilities on the plans and design around them to avoid conflicts. Utilities should be identified by collecting information from local providers and confirmed if necessary by a limited Bluestakes marking request and/or potholing. The process of locating utilities on the plans is not perfect (as there are often errors in the as-built and locating process), and some minor field adjustments may be necessary, but major conflicts should be avoided. During the site walk, look for evidence of utilities present (manholes, inlets, transformers, above grade switches and valves, etc.), and make sure that the information received from the utilities companies reconciles with the observations.

c. Terrain/Obstacles -- Terrain and physical obstacles should be accounted for in the design of ATMS infrastructure. The ATMS Standard Drawings and Standard Specifications require paths and flat areas of various configurations around cabinets and boxes for maintenance and access purposes (see Chapter 4). The design must meet these requirements, so slopes and other undesirable cross sections should be avoided (or mitigated, if not avoidable). Common obstacles that are often missed include irrigation canals, drainage structures, retaining walls, narrow right-of-way, and rocky

areas unsuitable for excavation. Low lying and poor drainage areas should be flagged, as ATMS infrastructure should not be placed in such areas.

d. Standalone or part of a roadway project -- ATMS projects can be either part of a larger roadway project or can be standalone. If the later, it is straightforward to determine what the terrain will look like after the project. If the roadway will be reconstructed and elevations/grades will change, more detailed information will be required. Roadway construction plans must be used to determine final terrain and hence suitable locations and elevations for ATMS infrastructure.

e. Survey -- Certain ATMS elements will require survey data for the design process. VMS signs, for example, always require a cross section of the roadway to design the structure to the correct height and orientation. Survey data is also required if grading, guardrail, barrier, or other elevation critical elements are being specified. Survey data, roadway plans, and/or a digital terrain model (DTM) may be required when designing ATMS infrastructure where reconstruction is occurring and ground elevations will change.

2.3 Project Delivery Network

-- The UDOT Project Delivery Network (PDN) is a summary of the activities and tasks followed by UDOT to deliver projects for advertising. The PDN should be followed for all ATMS design projects. The tasks that are applicable to specific Intelligent Transportation System (ITS) device design are listed below.

i. 1C1 -- Assess ITS (ATMS) Needs
ii. 3C1 -- Develop ITS (ATMS) Components Design
iii. 4C1 -- Complete ITS (ATMS) Plans and Documents

2.4 ATMS Design QC Checklist

-- UDOT has developed an ATMS Design QC Checklist which can be seen here. The checklist follows the UDOT Project Delivery Network tasks for ITS Design and provides a list of tasks and check points for the designer for each type of ATMS device. It also follows and is part of the UDOT QC/QA Procedures. This document should be followed closely and used as the primary design process and QC process resource.

2.5 AT Series Drawings and Specifications

-- UDOT has developed a series of Standard Drawings and Standard Specifications for ATMS (AT series) that describe how to build and install ATMS infrastructure. They show typical arrangement and relative position of devices. In general, these documents are intended for the contractor and are included by default in the project requirements (unless modified by special provisions or supplemental drawings). It is important to note that these drawings and specifications do not imply project scope. Designers must specify which devices and project elements are included in the project. The drawings and specifications then apply if the item is required. The designer cannot assume that the standard drawings and specifications cover all possible scenarios. A review and comparison of the plans with the drawings and specifications should be part of the QC process to ensure there are not conflicts or omissions. AT Series drawings should not be reproduced in plan sets.

2.6 TMD Involvement

-- Even though the designer is responsible for the ATMS design and getting the plan package through the bid process, there are several sub-processes that involve the TMD or other groups. It is important for designers to understand the scope and scale of these issues.

a. State-Furnished Material Process -- Certain ATMS devices and infrastructure are furnished to the contactor by UDOT, rather than having the contractor supply them. The reason for this is to ensure consistency across projects for maintenance and operational purposes, as well as to reduce purchasing lead times. It also allows for some cost savings due to the use of competitive materials contracts and purchasing in bulk. State-furnished items include most electrically powered ATMS equipment and the associated cabinets, as well as standard Non-Intrusive Detectors (NIDs) and camera poles. A complete list of State-furnished items can be found on the ATMS State-Furnished Materials form. State-furnished items must be tabulated on the plans by the designer during the PDN 4C1 stage so it is understood which items the contractor will supply and which items will be provided. After project award, the ATMS Project Manager will fill in the form based on the plan quantities, order the State-furnished materials, and provide to the contractor.

b. ATMS Communication -- Several groups in the TMD play a significant role in designing and maintaining the communication system that transmits data from each ATMS device to the TOC. This includes the TMD Fiber Group and the TMD Technology Services Group. The designer will detail the physical communication infrastructure that is placed in the field, including conduit, junction boxes, and fiber optic backbone cables, and drops. The TMD groups will specify the electronic "pathways" that the data will take. It is the designer's responsibility to ensure that the required coordination happens at the correct time. Fiber usage considerations may impact the design of the physical infrastructure, for instance if physical strands are not available to accommodate the devices being added.

    1. Splice Details -- ATMS devices are connected to the ATMS backbone fiber via a splice to a specific strand(s) on the backbone. The strand usage and splice patterns are determined by the UDOT Fiber Group and provided to the contractor after award. Splice details are not included in the plan set. The designer's responsibility is to coordinate with the TMD Fiber Group as detailed in Section 3.2 below.
    2. Channel Diagrams – The assignment of ATMS devices to physical fiber channels is part of the splice detail process. Channel assignments are invisible in the field and are not the responsibility of the designer. A separate document called a channel diagram is generated along with the splice charts and is provided to the integrator after contract award. The designer's responsibility is to coordinate with the TMD Fiber Group as detailed in Section 3.2 below
    3. IP Plans -- Similar to the splice details and channel diagrams, IP plans are developed by the TMD staff. They define the physical addressing that identifies Ethernet switches and ATMS devices. IP addressing is programmed into devices and switches by a System Integrator, generally hired separately by UDOT and not a part of the contractor's team. IP plan

generation is not the responsibility of the designer. Rather the plan development process should include coordination with TMD staff, especially on large projects with many devices, so they have sufficient notice to plan their work, as well as work out any conflicts caused by the addition of new devices.

4. Fiber Optic Network -- UDOT has a Fiber Group at the TMD that manages the UDOT-owned fiber optic network that connects ATMS devices. The Fiber Group must be involved in all projects that involves connecting to the communication network. See section 3.2 below for a more extensive discussion of the fiber network and design requirements.
5. Integration -- After the contractor has completed constructing the ATMS elements in the plans, the Department initiates a process called integration. In this step, the newly installed ATMS devices are configured to collect data and communicate back to the TOC. This integration process is completed jointly by a third-party consultant retained separately by UDOT as well as TMD Technology Services staff at the TOC. It is not part of the contractor's scope of work, but the integration process may reveal punch list items in the contractor's scope that need to be completed before the new devices are fully operational.

c. Construction Inspection -- Inspection of the ATMS devices and the contractor's work is completed by the Department, generally by third party consultant inspectors. The designer is not involved in this process but may be approached with questions regarding the intent of the design. All contact with construction staff should be referred to the UDOT ATMS Project Manager for coordination.