



Illinois Statewide



Intelligent Transportation
Systems (ITS) Strategic Plan

APPENDIX G

Communications Inventory and
Planning

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AECOM

PARSONS

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ILLINOIS DEPARTMENT
OF
TRANSPORTATION
(IDOT)



ITS PROGRAM OFFICE

Communications Fiber Inventory
Standard Operating Procedure (SOP)
for 3-GIS Web Tool

ITS Strategic Plan – Appendix G

Document Revision History

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1.0	October 2019	TranSmart/EJM	Final, “working draft”, version
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I. Introduction

The Illinois Department of Transportation (IDOT) has deployed a comprehensive web-based GIS system to help facilitate designing, documenting, maintaining, and managing the allocation of fiber optic assets throughout the State of Illinois. The IDOT 3-GIS web-based system has the ability to store and easily retrieve information regarding the location, type, and individual components of the fiber optic system, such as splice points and access points showing where the devices are connected. For more information and reference materials on the Fiber Management Software Project, visit the IDOT SharePoint site at: [<link 1>](#).

IDOT operates and maintains 2 different networks (Signal System and Surveillance) of thousands of miles of conduits, located alongside or across highways, many carrying fiber optic cables that must be located and marked to avoid damage from digging or boring resulting from construction. As the Department continues to build and develop its complex fiber network across the state, it is essential that data on the fiber assets be complete and reliable. This is particularly important as the Department seeks to expand Station One centralized operations and investigates statewide ATMS implementation. Similarly, the inventory database and related process will also support future CV/AV integration opportunities.

Each of the nine IDOT Districts has fiber installations ranging from short distances for traffic signal interconnects, to several miles along interstates to support communications across Districts. While existing records and documentation procedures may already exist for some Districts, the documentation is in multiple formats, limiting GIS mapping capabilities. This document presents a standard procedure for designing, installing, and documenting fiber assets for the Department.

Table 1 lists total miles of fiber installed between 2005 and 2017 by District, according to IDOT Letting and Contracting information. While IDOT continues to invest in the expansion of the statewide fiber optic network, sufficient data has not been captured to facilitate effective planning and management of fiber resources.

Table 1- Illinois Fiber Optic Cable Installations (miles)										
Letting Year	D1	D2	D3	D4	D5	D6	D7	D8	D9	Statewide
2005	29.46	0.37	0.00	6.96	0.68	7.97	0.00	5.65	0.00	51.09
2006	22.47	1.59	1.74	5.04	0.00	0.17	0.27	10.51	0.00	41.80
2007	23.57	84.41	3.19	0.43	0.31	2.84	0.00	10.13	0.00	124.89
2008	26.09	0.00	0.00	0.19	0.00	0.48	0.00	7.61	0.00	34.38
2009	39.40	0.00	2.33	4.72	3.10	0.12	0.00	0.00	0.00	49.65
2010	48.51	0.00	0.00	11.21	0.48	1.15	0.09	0.00	0.00	61.44
2011	77.38	0.02	1.07	58.74	13.14	5.52	0.00	10.25	0.00	166.12
2012	23.63	0.00	0.59	114.07	2.80	0.17	0.00	0.83	0.00	142.10
2013	44.82	0.00	2.79	0.84	0.00	0.00	0.00	8.78	0.00	57.23
2014	34.05	0.00	0.00	2.30	2.22	3.98	3.32	12.39	0.00	58.26
2015	32.26	1.87	1.23	44.01	7.81	1.29	0.00	9.17	0.00	97.64
2016	54.43	0.00	0.19	1.28	0.00	3.58	0.00	0.58	0.00	60.07
2017	9.27	0.63	0.00	0.00	0.00	3.09	0.00	0.00	0.00	13.00
Total	465.35	88.90	13.13	249.79	30.54	30.36	3.68	75.91	0.00	957.66

II. Purpose

IDOT seeks to implement a collaborative process to ensure all of the Department's fiber assets are contained within the 3-GIS central depository and database. Easy to obtain, accurate information is essential in order to disseminate that information to the appropriate entities during critical emergency situations, as well as routine operations.

The purpose of this SOP is to provide a common practice to maintain a fiber inventory that is both current and accurate, and also to increase the utilization of the fiber asset management tool. The system is being used to inventory fiber connected assets only. The goal is to develop a comprehensive database of infrastructure supporting ITS devices including conduits, handholes, junction boxes, and multiagency connection points, as well as cameras, message signs, ramp metering systems, and electrical facilities, etc.

IDOT plans to utilize standard templates that are scalable and share a common naming convention for consistency to facilitate planning, design, construction and maintenance of fiber optic facilities. The system inputs may include new and existing fiber inventories from a variety of sources.

This procedure is not intended to duplicate or replace the 3-GIS User Guide or Web User training tools. It is a supplement and procedural reference for use and distribution by the IDOT ITS Program office. The 3-GIS documentation and tools will be referenced throughout this SOP as a source of detailed instructions on completing inventory tasks or processes.

III. Stakeholders

The intended audience for this SOP constitutes authorized system users as defined by the IDOT System Administration. Users may include internal and external stakeholders, consisting of IDOT District and Regional staff, GIS and ITS Coordinators, partner agencies, contractors, and consultants. Maintaining a statewide database is an immense undertaking which requires coordination of tools and resources by each District and Central Bureau. Districts which may not have staff that are familiar with GIS, or where minimal fiber infrastructure exists, have established relationships with neighboring Districts with more subject matter expertise. For example, Districts 4, 5, 6, and 7 collaborate and share resources to manage existing fiber.

The ITS Program Office is the primary owner of the 3-GIS system, responsible for overall system administration, operation, maintenance and security. General roles and responsibilities for system users are summarized in Table 2. With the intent for fiber inventory data to be entered and updated in the 3-GIS system as projects are completed, consideration for such roles and responsibilities will serve to ensure the integrity of fiber inventory data over time.

The users and responsibilities listed in Table 2 may be applicable at different phases of project development including planning, design, construction, operations and maintenance. While this table does not present a comprehensive view of user roles, it offers a solid baseline for understanding the level of effort involved with establishing and maintaining a statewide fiber inventory.

Table 2	
3-GIS Users	Roles & Responsibilities
<ul style="list-style-type: none"> ➤ ITS Program Office ➤ District GIS Coordinators ➤ Designated Representative 	<ul style="list-style-type: none"> ➤ System administration and operation ➤ Maintain password access and compliance with system security requirements ➤ Data entry and validation ➤ Confirm accuracy of data ➤ Provide user training and guidance
<ul style="list-style-type: none"> ➤ District/Design Engineer ➤ District ITS Coordinator ➤ External/Proposing Entity 	<ul style="list-style-type: none"> ➤ Data entry and validation ➤ Endeavor to produce minimum documentation for each project as listed in this SOP and Appendix G-3
<ul style="list-style-type: none"> ➤ Project Stakeholders (DoIT, Illinois Tollway, county and municipal departments of transportation, and local agencies) ➤ Contractor/Consultant 	<ul style="list-style-type: none"> ➤ Contact ITS Program Office or designated representative for system access and use guidelines ➤ Confirm accuracy of data ➤ Include contract requirements for fiber inventory data such as listed in this SOP and Appendix G-3

IV. 3-GIS Overview

The 3-GIS Suite runs on Esri's ArcGIS Server 10.5.1 and 10.6.1. 3-GIS allows users to create geometry and track what happens along the geometry to simulate a telecommunication network. Many geometric features have tables related to them which store telecommunication information.

IDOT is using the 3-GIS system to document the fiber optic and raceway infrastructure systems that are, and will be, installed along hundreds of miles of the State of Illinois roadways. The system is web based with a user-friendly interface. Not all interface items, menus, and tools will be available to all users. Access depends on the configuration created in 3-GIS Admin. Toolsets are defined by your administrator and determine which tools are available on the 3-GIS interface. Different toolsets are assigned to different tasks so that only the tools you need are displayed, making it easier to find what you need.

The 3-GIS Web JS User Guide and User Training Guide shown in Figure 1 serve to help users better acquaint themselves with the system functions and tools available by providing step-by-step instructions. The instructions are made up of topics that are logically grouped by their positioning on the 3-GIS Web JS user interface. The documentation assumes that the user has familiarity with opening and closing browser windows, mouse actions such as Click, Right-Click, Double-Click, Move, Drag and Drop, drawing a bounding box, and keyboard keys including Backspace, Shift, and Control (Ctrl). Alternately, the User Training Guide provides an overview of system functions in a presentation format that is useful as a quick reference. Please refer to Appendices G-1 for Fiber Inventory Data Dictionary elements and G-2 for a brief glossary of fiber terms.

The 3-GIS web portal can be accessed at [<link2>](#). A Knowledge Base System is also available at <https://kb.3-gis.com/>. The 3-GIS Web 'Help' option takes you directly to this Knowledge Base. To access the wealth of information on system use, visit [How to use 3-GIS Knowledge Base](#).

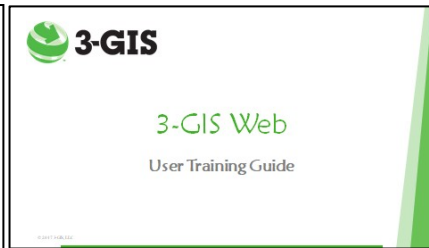
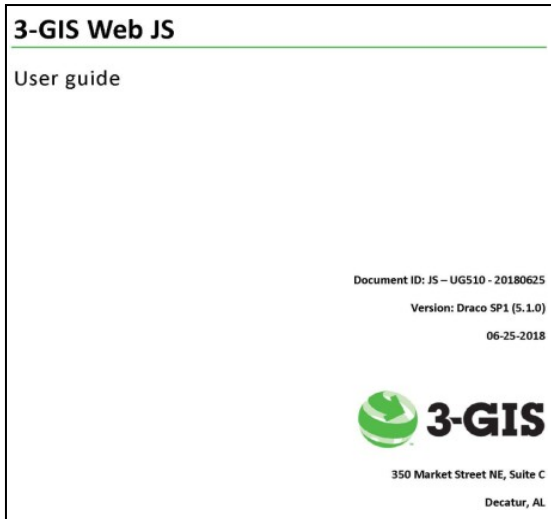


FIGURE 1 - Step-by-step instruction on tasks and processes in the 3-GIS system is provided in the User and Training Guides.

As previously stated, this SOP is not intended to duplicate the training and instruction reference materials. These documents will be referenced throughout this SOP as a source of detailed instructions. For an overview of the 3-GIS User Interface, refer to the screenshot in Figure 2.

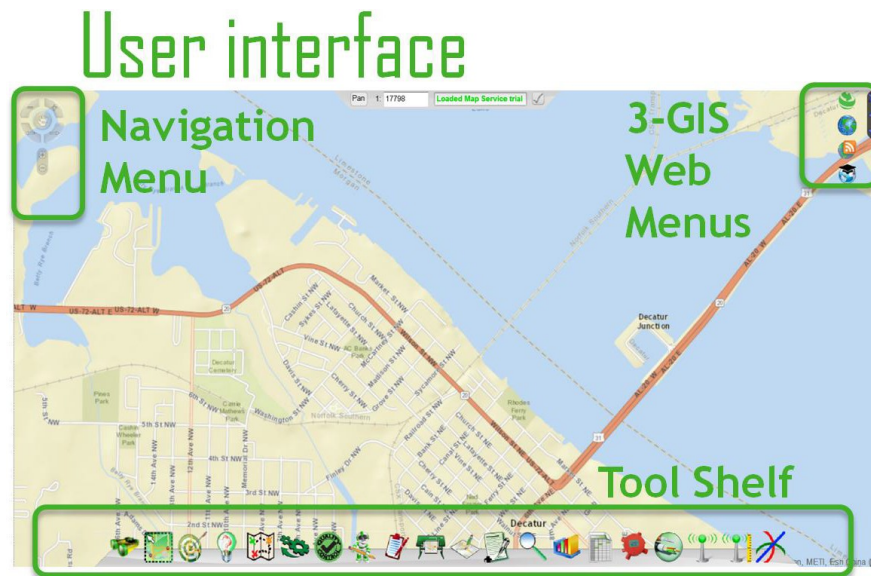
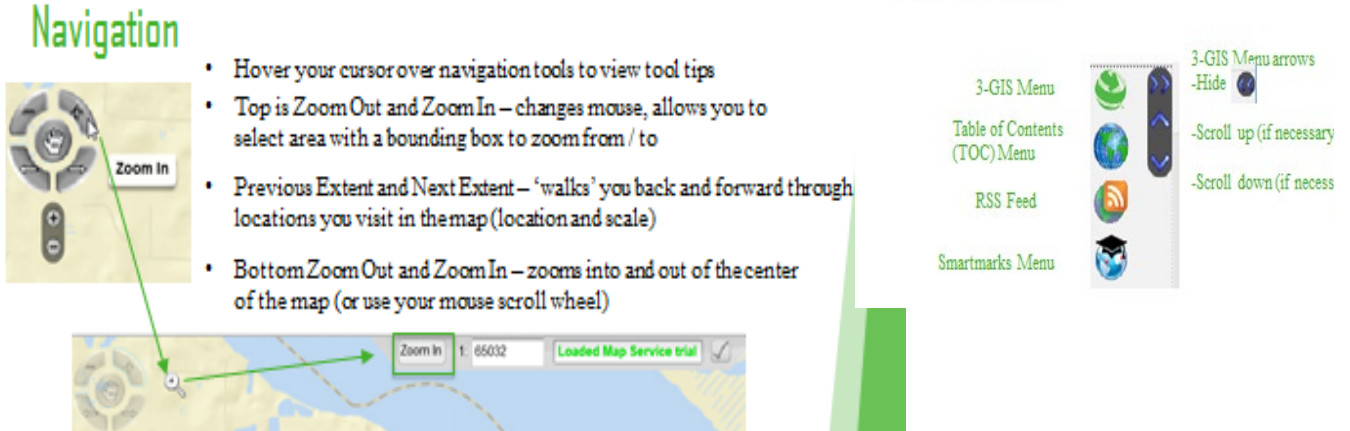


FIGURE 2 – 3-GIS User Interface

After logging into the 3-GIS system, Navigation Menu controls are available in the upper left corner of the screen, shown in Figure 3 below. The Tool Shelf at the bottom of the screen contains tools that can be used to make changes to fiber features and to analyze data.

FIGURE 3

Navigation instructions as shown on slides 10 and 11 of the User Training Guide. Refer to pages 39-44 of the User Guide for detailed instructions.



The 3-GIS processes and capabilities incorporated into this SOP are listed below with a brief description.

1. Data import
 - Spreadsheet data is imported from a spreadsheet
 - CADD data is imported from CADD file
 - As-Built Plans data is drawn or digitized from a set of as-built plans
 - GIS file data is imported from a GIS formatted data source, such as SHP, GDB, KML, KMZ.
 - GPS data is collected using a GPS Device in the field and then brought back to the office and imported. With a mobile cache, it is possible to use a tablet with a GPS antenna to the make edits.
 - Sketched data is hand drawn and uploaded as an attachment.
2. Attaching files
Feature types must be configured in 3-GIS Admin to allow attachments. Only features that have the 3-GIS settings will have the Attachments tab available.
3. Data export
The Export tool allows the user to export selected data in the following formats: File Geodatabase, CSV, KMZ or Shapefiles.
4. Querying data
Query data based on text and attribute searches using basic SQL syntax. Perform graphical selections to locate, identify and measure features and areas.
5. Creating fiber cable and equipment
Provides method for creating a fiber cable. Allows user to resize, split and merge fiber cables and place fiber equipment.
6. Editing data
The Editing Tool allows the user to select, create, delete, reshape, move coincident, rotate, split, merge, and commit features for structure and

equipment. Snapping, allows features to be created that have the same spatial location as another feature.

V. Communications Inventory Process

IDOT is using the 3-GIS system to document the fiber optic and raceway infrastructure systems that are, and will be, installed along hundreds of miles of the State of Illinois roadways.

The delivery and training for the 3-GIS tool has incurred some challenges that are typical for the broad implementations of systems. As part of the Statewide Architecture and Strategic Plan update, outreach to collect a wealth of data from the IDOT Districts has been initiated. While this approach ideally starts the process to complete a broad and complete statewide inventory, there are some challenges in play.

1. Not all Districts have the same depth of expertise in ITS communications systems.
2. To complete a statewide inventory initially, it appears a consistent effort to create and validate information is very labor intensive.
3. Recurring training and focus on collecting this data statewide will require substantial recurring efforts and support with the Districts.
4. Specifications and the role to update the 3-GIS by IDOT initially appears to exceed the staff availability of the Department.
5. Conversely to No. 4, providing contractors with access will require additional security and configuration management strategies to preserve the integrity of the database.
6. There is existing legacy paper and electronic inventories that have disparate levels of detail.

These challenges are not explicitly difficult technically but do require a commitment to a process and substantial oversight and management over the next 2-5 years. The ITS Strategic Plan explicitly resulted in three directly correlated projects rising to the top of the prioritization scale (Table 6-1 of the Strategic ITS Plan)

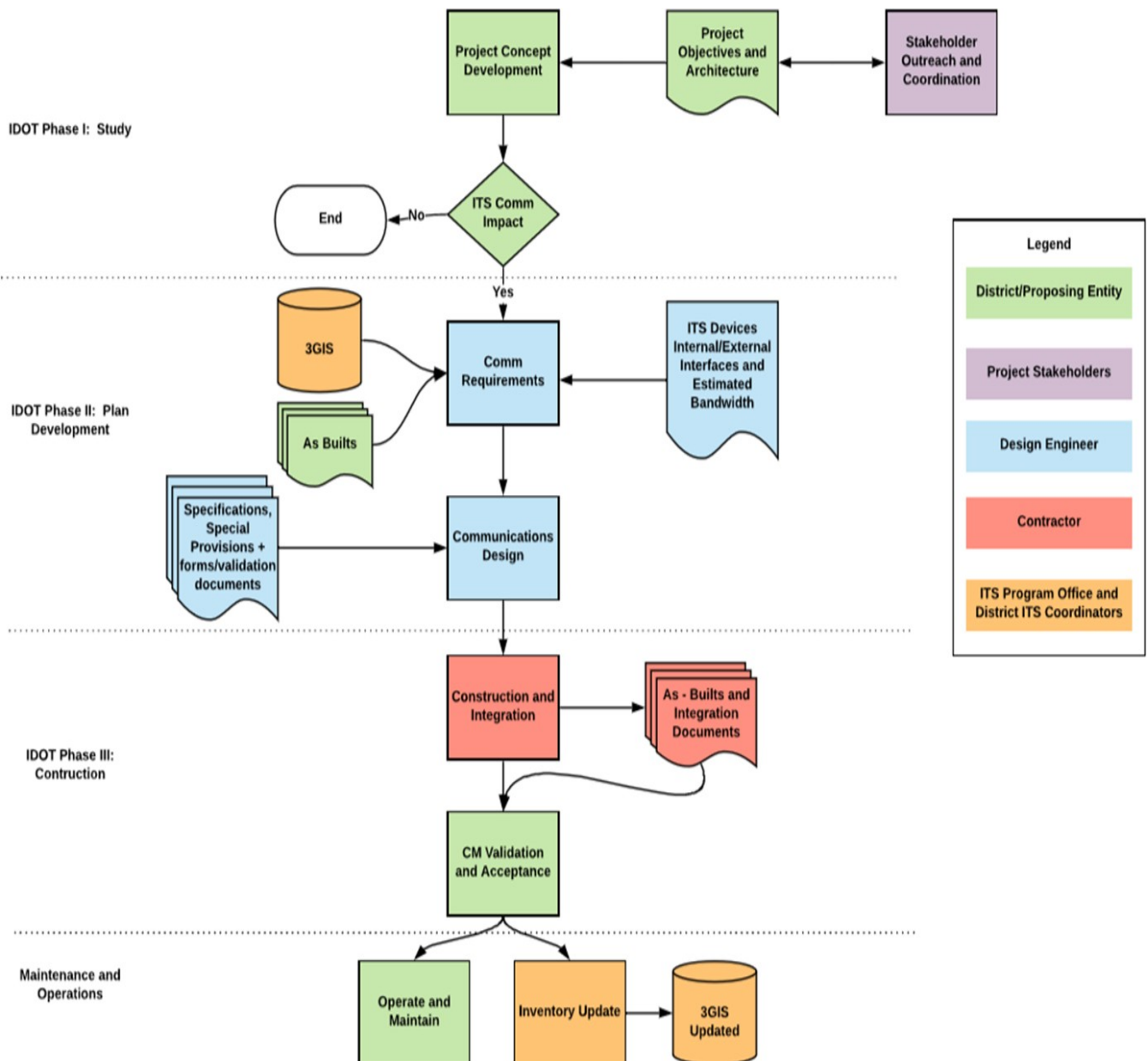
- ITS Data Collection Systems
- Enabling Backbone Communications Infrastructure
- Illinois Statewide Transportation Information Network (ISTIN)

These primary communications projects will ultimately engrain the roles, responsibilities, tools, supporting instructions and training into the IDOT District's use of the fiber management tool. As part of the ISTIN activities, ideally IDOT will wish to meet the additional challenge of overlaying network backbones from other regional, local and state agencies along with layering in backbones from private telecom and internet service providers will be performed to reveal the overarching connectivity opportunities.

Fiber inventory management involves existing, new and planned fiber installations and modifications. The proposed workflow presented in Figure 4 further identifies roles and responsibilities for users listed in Table 2.

The flowchart depicts the roles of the project owners and other stakeholders and the corresponding relationship to project planning, design, and construction management activities. Operations and maintenance processes are also reflected for inventory use and updates.

FIGURE 4 - IDOT PROPOSED FIBER INVENTORY WORKFLOW DIAGRAM



Appendix G-4 contains examples of data collected from Districts with outreach conducted during the development of this SOP. Some Districts reported that they currently do not have any fiber installed. As mentioned earlier, some Districts will need to set aside time and resources to collect and input years of fiber data.

For new and planned backbone installations, the consideration and implementation of inventory takes on differing roles, but should always remain part of the process as follows:

a. Phase I - Planning and Studies

- Project concept development
- Project objectives and architecture
- Stakeholders and outreach and coordination
- Assess ITS Comm impacts referenced from documented in statewide and regional ITS architectures

3-GIS tools are useful in this phase of project development. Executing the QAQC tool helps to discover potential problems with telecommunication networks.

b. Phase II - Fiber Design and Plan Development

- Develop communication requirements
- Identify ITS devices, internal and external interfaces, estimate bandwidth
- Inputs and references - existing documents, as-builts and 3-GIS and other inventories - link to D4 site
- Finalize design specs, special provisions, forms and validation documents
- Provide contract requirements and specifications for consultants and construction contractors to add the following to Article 801.16 of the Standard Specifications:

In addition to the specified record drawings, the Contactor shall record GPS coordinates of the following electrical and traffic signal components being installed, modified or being affected in other ways by the contract:

- i. All Mast Arm Poles and Posts
- ii. All light poles and light towers
- iii. Traffic Signal Wood Poles
- iv. Handholes and vaults
- v. Junction Boxes
- vi. Conduit roadway crossings
- vii. Controllers, Controller Cabinets
- viii. Communication Cabinets
- ix. Control Buildings
- x. Railroad Bungalow
- xi. Structures with electrical connections, i.e. DMS, lighted signs
- xii. Electric Service disconnect locations
- xiii. CCTV Camera installations
- xiv. Roadway Surveillance installations
- xv. UPS
- xvi. Fiber Optic Splice Locations

- xvii. Fiber Optic Cables. Coordinates shall be recorded along each fiber optic cable route at every Pole, Handhole, Vault, Cabinet and Controller location.
- xviii. All fiber optic slack locations shall be identified with quantity of slack cable included. When sequential cable markings are available, those markings shall be documented as cable marking into enclosure and marking out of enclosure.
- xix. Any device that can be programmed with an IP address

c. Phase III Construction and Installation of Fiber Communications

- Communications and integration
- As-Builts and project integration documents to understand connectivity needs and capacity impacts
- Construction methods, validation and acceptance based on examples of current specifications and special provisions used to define requirements for GIS deliverables and for how fiber documentation is provided post construction

When creating the fiber equipment, it must be placed or attached to certain features, known as Structure Layers. Equipment cannot sit in 'space.' Structure Layers are configurable and typically include Addresses, Poles, Buildings, Building Outlines, and Structures (Vaults, Handholds, and Manholes). Please refer to the 3-GIS User Guide section on Editing Data.

Creation of fiber cable and equipment assets in 3-GIS is based on best practices for appropriate placement of fiber equipment. In order to create a fiber cable, open the 'Editor' tool and select 'Fiber Cable' from the list of features as shown in Figure 5. Select the appropriate number of fibers the cable will contain. The Edit Tool allows the user to select, create, delete, reshape, move coincident, rotate, split, merge, and commit features.

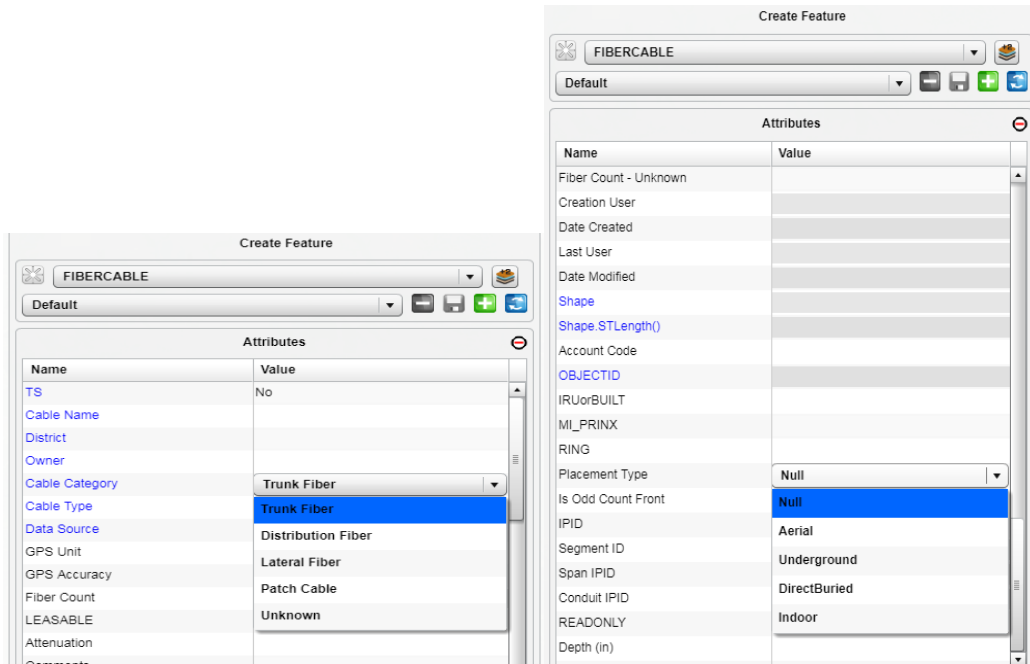


FIGURE 5 - EDITING TOOL

Once the asset is created, Click the 'Create Feature' button and Draw the fiber cable on the map. After placing the last point, right click and select 'Finish Creation' as shown in Figure 6.

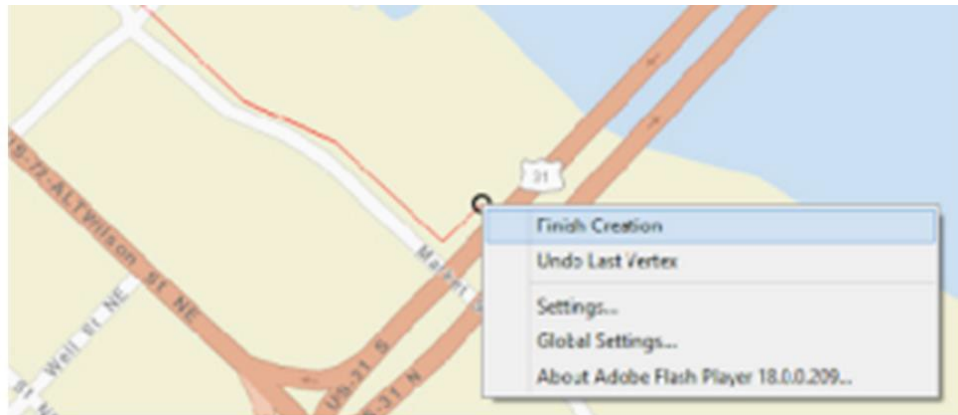


FIGURE 6 - MAPPING FIBER CABLE

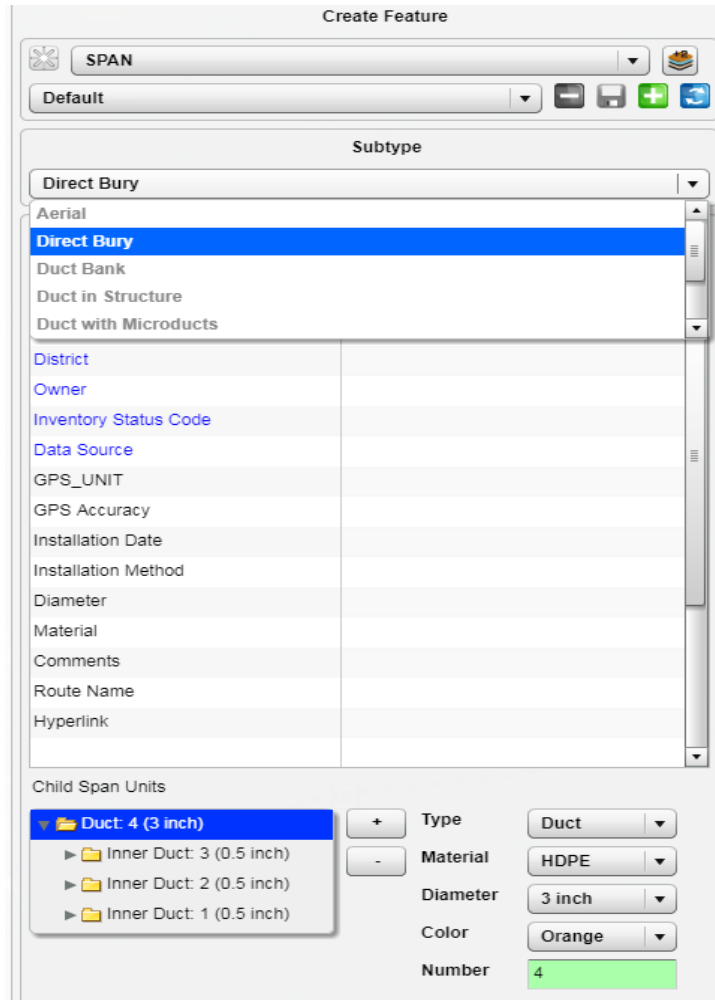


FIGURE 7 - Creating SPANS

It is important to emphasize that for mapping in 3-GIS, the best method is to draw structures/buildings first (point features) and then draw a Span feature that connects between all the points. While the most important thing to accomplish (in the short term) is to get fiber cable paths on a map, drawing a Span element first makes it all that easier to come back and draw Span Units (conduits) and Fiber Cable(s). The Span element is documenting the construction path. Adding other elements provides more details. Other elements that get added are (probably in this order):

- Span Unit (conduits)
- FiberCable
- Splice points
- SlackLoops
- PatchPanels
- Fiber strand details

Capabilities for import and export of inventory data include steps for creating new records and uploading files. Some basic features are listed below.

- Attachments can be uploaded for reference to assets and related historical documentation.

- Identify data sources that will be used to populate the fields
- Geocoding and/or spatial analysis
- Import from Esri
- CADD (MicroStation/Auto-CAD) format per record as-built drawings
- To import and prep KMZ file Google maps to be uploaded into 3-GIS
 - Attach a file instruction on page 77 of User Guide)
 - In the Info panel, select the feature you want to attach the file to
 - Enter a description of the file
 - Click Commit to save your attachment to the server.

VI. Fiber Data Structure and Configuration Management

This section provides the data structure for fiber, related assets, features and attributes. The 3-GIS Data structure for Fiber Cable features is summarized in the following tables. Fiber optic cable can be categorized into three (3) main categories: Backbone, Distribution and Lateral or Drop cable. They are defined as follows:

1. Backbone cable
Backbone fiber optic cable is the cable that runs aerial, direct bury or underground and is the main cable that a system runs on. Backbone fiber cable typically has a high count of fibers and can be singlemode or multimode.
2. Distribution cable
Distribution fiber optic cable is the cable that runs aerial, direct bury or underground and is a cable that connects to the backbone cable. This fiber cable can be singlemode or multimode.
3. Lateral cable
Lateral fiber optic cable is the cable that runs aerial, direct bury or underground and is a cable that connects backbone cable to a device cable. This fiber cable can be singlemode or multimode.

Table 3 - Fiber Cable Data Structure – Attribute (Possible value(s)):

Table 3 - Fiber Cable Data Structure – Attribute (Possible value(s)):	
<u>Owner:</u> <i>Defines who owns the cable</i>	(IDOT, City of Peoria, AT&T, iFiber, Illinois Tollway, Illinois Century Network (ICN), DuPage County, Kane County, DoIT etc.)
<u>Cable Usage:</u>	<ul style="list-style-type: none"> • Backbone • Lateral • Distribution
<u>Characteristics:</u> <i>Defines the characteristics of the cable</i>	<ul style="list-style-type: none"> • Mode: (Singlemode, Multimode) • Total fiber count: (144 fibers, 96 fibers, 72 fibers, etc.) • Type: Ribbon, Loose Tube, Break Out, Hybrid Cable, Composite Cable • Attachment: (Datasheet, Manufacturer drawing, etc.) • Aerial, Direct Bury, Underground • Number of buffer tubes: (12, 6, etc.) • Number of fibers per buffer tube: (12, 6, 4, 2, etc.) • Part Number: (Manufacturer part number) • Manufacturer: (Manufacturer name)

<p><u>Location:</u> Defines the general location of the cable, start and end points and general use of the cable</p>	<ul style="list-style-type: none"> • System ID (TACTICs system ID, Surveillance) • Roadway (Roadway name Ex: IL 13) • Start Point (TOC, Intersection, etc.) • End Point (TOC, Intersection, etc.) • Notes (Additional notes)
<p><u>Path:</u> Defines path of fiber. This will include GPS points for the cable including all assets it goes through. Also contain information as to what the cable does here. Below is a table that can be uploaded as provided by the contractor.</p>	<ul style="list-style-type: none"> • ID (1,2,3,4, etc.) • Latitude (GPS value <format to be determined>) • Longitude (GPS value <format to be determined>) • Asset ID (Vault, Junction Box, Pole, GPS point) • Splice Location (Yes/No) <ul style="list-style-type: none"> • If Yes • Splice type (Lateral, Butt Splice, Type 1, Type 2, etc.) • Attachment (Plansheet, Detail Sheet) • Notes • Termination Location (Yes/No) <ul style="list-style-type: none"> • If Yes • Termination type (Type 1, Type 2, Coil, etc.) • Attachment (Plansheet, Detail Sheet) • Notes • Slack (Yes/No) <ul style="list-style-type: none"> • If Yes • Amount of slack in handhole (# of feet) • Attachment (Plansheet, Detail Sheet) • Notes <hr/> <ul style="list-style-type: none"> • Direction Change (Yes/No) <ul style="list-style-type: none"> • If Yes • Notes (Ex. Crosses from East side to West side, Attached to structure bridge crossing, etc.) • Final table to be completed by contractor

All Mast Arm Poles and Posts

Provide GPS points of asset only if fiber is present at location. If asset is already part of existing inventory, then add cable ID number or upload detail sheet.

Table 4 - All Mast Arm Poles and Posts – Attribute (Possible value(s)):	
<u>Asset ID:</u>	(Asset ID format to be determined)
<u>Owner:</u> <i>Defines who owns the asset</i>	(IDOT, Kane County, DoIT, CTA, etc.)
<u>Characteristics:</u> <i>Defines the characteristics of the cable</i>	<ul style="list-style-type: none"> • Type: (Mast Arm, Post, Light Pole, Light Tower, Traffic Signal Wood Pole)
<u>Location:</u> <i>Defines the general location of the cable, start and end points and general use of the cable</i>	<ul style="list-style-type: none"> • System ID (TACTICs system ID, CCTV, DMS) • Roadway (Roadway name Ex: IL 13) • Latitude (GPS value <format to be determined>) • Longitude (GPS value <format to be determined>) • Notes (Additional notes)
<u>Fiber Cable ID(s):</u> <i>Defines information about each cable present the cable</i>	<ul style="list-style-type: none"> • Cable ID (1,2,3,4, etc.) • Splice Location (Yes/No) <ul style="list-style-type: none"> ○ If Yes ○ Splice type (Lateral, Butt Splice, Type 1, Type 2, etc.) ○ Attachment (Plansheet, Detail Sheet) ○ Notes • Termination Location (Yes/No) <ul style="list-style-type: none"> ○ If Yes ○ Termination type (Type 1, Type 2, Coil, etc.) ○ Attachment (Plansheet, Detail Sheet) ○ Notes • Slack (Yes/No) <ul style="list-style-type: none"> ○ If Yes ○ Amount of slack (# of feet) ○ Attachment (Plansheet, Detail Sheet) ○ Notes • Direction Change (Yes/No) <ul style="list-style-type: none"> ○ If Yes ○ Notes (Ex. Crosses from East side to West side, Attached to structure bridge crossing, etc.)

All Handholes, Vaults, Junction Boxes, Controller Cabinets, Communication Cabinets, Control Buildings, Railroad Bungalow, Roadway Surveillance Installations
 Provide GPS points of device only if fiber is present at location. If asset is already part of existing inventory, then add cable ID number or upload detail sheet.

Table 5 - All Handholes, Vaults, Junction Boxes, Controller Cabinets, Communication Cabinets, Control Buildings, Railroad Bungalow, Roadway Surveillance Installations Attribute (Possible value(s)):	
<u>Asset ID:</u>	(Asset ID format to be determined)
<u>Owner:</u> <i>Defines who owns the asset</i>	(IDOT, Kane County etc.)
<u>Characteristics:</u> <i>Defines the characteristics of the cable</i>	<ul style="list-style-type: none"> • Type: (Handhole, Vault, Junction box, Controller Cabinet, Communication Cabinet, Control Building)
<u>Location:</u> <i>Defines the general location of the cable, start and end points and general use of the cable.</i>	<ul style="list-style-type: none"> • System ID (TACTICs system ID, CCTV, DMS) • Roadway (Roadway name Ex: IL 13) • Latitude (GPS value <format to be determined>) • Longitude (GPS value <format to be determined>) • Notes (Additional notes)
<u>Fiber Cable ID(s):</u> <i>Defines information about each cable present the cable.</i>	<ul style="list-style-type: none"> • Cable ID (1,2,3,4, etc.) • Splice Location (Yes/No) <ul style="list-style-type: none"> ○ If Yes ○ Splice type (Lateral, Butt Splice, Type 1, Type 2, etc.) ○ Attachment (Plansheet, Detail Sheet) ○ Notes • Termination Location (Yes/No) <ul style="list-style-type: none"> ○ If Yes ○ Termination type (Type 1, Type 2, Coil, etc.) ○ Attachment (Plansheet, Detail Sheet) ○ Notes • Slack (Yes/No) <ul style="list-style-type: none"> ○ If Yes ○ Amount of slack (# of feet) ○ Attachment (Plansheet, Detail Sheet) ○ Notes • Direction Change (Yes/No) <ul style="list-style-type: none"> ○ If Yes ○ Notes (Ex. Crosses from East side to West side, Attached to structure bridge crossing, etc.)

VII. Operations & Maintenance

Opportunities for interfaces and synergies with 3-GIS and other systems or processes may create the need to modify existing fiber configurations. This section provides an overview of the tasks users should be familiar with when updating the inventory. In general, best practices for inventory maintenance can be summarized as follows:

- Commit to changes often
- Clear Cache often
- Place Structure/cabinets, handholes, junction boxes, building first then fiber equipment
- Enforce Configuration Management practices

Table 6	
3-GIS Task	Process Description
Connect a Patch panel to Patch panel	<p>Patch Panel to Patch Panel is a connection of the inputs of two patch panels.</p> <ul style="list-style-type: none"> • Output – Fiber cable • Input – Patch Cable <p>Note: Make sure output of a patch panel is only available to fiber cable.</p>
Numbering Span Units and Child Span Units	<p>When using micro ducts or inner ducts, the outer most duct should be assigned the last “Span Unit ID” (number) of the duct package. For example: in a duct package comprising of a 4” conduit with four inner ducts the 4” conduit should be assigned Span Unit ID #5.</p>
Creating a Path	<ol style="list-style-type: none"> 1. Create structures – handholes, buildings, 2. Draw the Span – this includes defining any span units or child span units 3. Draw fiber cable
Documenting Leasable Fibers	<p>On Fiber cable feature class make field <i>Leasable</i> = yes if any fiber in the cable is leasable whether it is in use or not. All detailed information regarding the leased fiber strand will be filled out using the signal editor tool, fiber table and the documents table.</p> <p><u>If a fiber is leasable and not leased</u> Signal Table - <i>Signal/Status</i> = Available – Leasable</p> <p><u>If a fiber is leasable and leased</u></p> <ul style="list-style-type: none"> • Signal Table - <i>Signal/Status</i> = In Use - Leased • Enter Agreement # in the Fiber table = <i>Document Number</i> = Agreement # • Enter Information in the Document table • Select <i>Document Type</i> = Agreement • Enter <i>ACustomer</i> = (Name of entity leased to)

Table 6	
3-GIS Task	Process Description
Calculating Costs for Statewide Report	<p>Added two fields to contract table</p> <ul style="list-style-type: none"> • Cost per linear mile - Fiber • Cost per linear mile – Span <p>Use for estimating cost per linear mile of fiber and span unit (conduit)</p> <ol style="list-style-type: none"> 1. Pay Items – Material <ol style="list-style-type: none"> 1.1. Fiber 1.2. Fiber in duct 1.3. Handholes\communications vault (add to conduit cost only) 1.4. Junction boxes (add to conduit costs only) 1.5. Spare duct 2. Pay Items – Service/Work (use the % of the <ol style="list-style-type: none"> 2.1. Traffic Control 2.2. Mobilization 2.3. RR protection 3. Design & contract maintenance <ol style="list-style-type: none"> 3.1. 15 – 20% of construction Cost <p>Total Contract Cost = TCC Fiber Pay Items = F Conduit pay Items = C</p> <p>Fiber % of total contract = F/TCC Conduit % of total contract = C/TCC</p> <p>Costs Per Linear Mile (CPLM) CPLMF = [F + F%(TC+MOB+RR)] X 1.15 CPLMC = [C + C%(TC+MOB+RR)] X 1.15</p>

APPENDIX G-1: FIBER INVENTORY DATA DICTIONARY

Table G-1A - FIBER INVENTORY ELEMENTS	
LOCATION	<ul style="list-style-type: none"> • Latitude • Longitude • Elevation • Offset
INFRASTRUCTURE	Underground <ul style="list-style-type: none"> • Duct Bank • Number • Configuration • Material • Assignments Aerial • Messenger • Storage • Attachment method
NETWORK ARCHITECTURE CABLE	Fiber Optic <ul style="list-style-type: none"> • Fiber Type • Number of fibers • Sheath <ul style="list-style-type: none"> ○ Material ○ Armored • Cable Identification • Fiber usage • Fiber Assignment Copper/twisted-pair <ul style="list-style-type: none"> • Number of conductors • Conductor size • Sheath <ul style="list-style-type: none"> ○ Material ○ Configuration Coaxial <ul style="list-style-type: none"> • Type • Sheath

Table G-1B - Feature Classes Buildings, Structures, Fiber Cable, Span (conduit), Pole, Fiber Equipment	
CABINET	Type - 332, 334, ITS (if defined) Purpose <ul style="list-style-type: none"> • Traffic Signal • Video • Communications • Roadway Weather Information System (RWIS) • Traveler Information System (TIS) • Multipurpose • Dynamic Message Sign (DMS) • Power Source Identifier • Highway • Post Mile • Street Address • Direction (side of road) • Serial Number Maintenance History • Date Installed • Date/maintenance action
POLE	<ul style="list-style-type: none"> • Function • Height • Diameter • Material • Anchor • Power Source • Use
VAULT	Type <ul style="list-style-type: none"> • Splice Vault • Hand Hole • Junction Box • Maintenance Hole Size • Length • Width • Depth Miscellaneous • Material • Traffic Rating • Grounding • Cable racks

Table G-1B - Feature Classes Buildings, Structures, Fiber Cable, Span (conduit), Pole, Fiber Equipment	
SIGN	Type <ul style="list-style-type: none"> • Fixed Message (Static) • Changeable Message Sign (CMS) • Variable Message Sign (VMS) Size • Length • Width • Height
EVENT	Change of Direction for Duct Bank or Conduit Change or direction for communications or electrical cable direct buried Type of Marker Direct buried cable splice Communications <ul style="list-style-type: none"> • Splice Closure • Splice conductors/type • Splice Diagram Electrical • Splice Closure • Splice conductors/method • Splice Diagram
SENSOR	Type <ul style="list-style-type: none"> • Inductive Loop • RTMS • Microwave • Magnetic Field Detector (puck) • Video Image Processor • ID Reader Coverage • Roadway • Post Mile/Intersection/Address • Lane • Function Miscellaneous • Manufacturer • Date installed Maintenance Actions • Date • Complaint • Action Taken
SPAN CONDUIT	<ul style="list-style-type: none"> • Size • Number • Material • Use • Fill

Table G-1C: Building and Structures Subtypes and Codes			
Buildings		Structures	
Code	Description	Code	Description
0	Unknown	0	Unknown
1	Communications Hut	1	Manhole
2	District HQ Building	2	Handhole
3	Pump Station	3	Communications Vault
4	Rest Area	4	Tower
5	Maintenance Yard	5	Pedestal
6	Sign Shop	6	Cabinet
7	Bridge Office	7	Cabinet and UPS
8	TSC	8	Double Handhole
9	Weigh Station	9	Post
10	Laboratory	29	HAR Cabinet
11	School	30	RWIS Cabinet
12	Municipality / County	31	FIBER OPTIC INTERCONNECT CABINET
13	Hospital	32	Junction Box
14	Storage Facility	33	Pull Box
15	Transit Agency	34	CCTV Cabinet
16	Telecommunications Company	35	Lighting Controller Cabinet
17	Other State Agency	36	Traffic Signal Cabinet
18	Library	37	Surveillance Cabinet

APPENDIX G-3: SAMPLE CONTRACT REQUIREMENTS

I. As-Built Documentation

The Contractor shall locate all proposed conduit, every 100 feet using a GIS locating device that is accurate within a maximum of five (5) meters.

The Contractor shall locate all proposed communication vaults, and camera poles using a GIS locating device that is accurate within a maximum of five (5) meters.

The Contractor shall provide a GIS based map of the conduit route and a complete listing of all map coordinates in an electronic format (Google Earth KML or KMZ shape file).

II. Operation and Maintenance Documentation:

After the fiber optic cable plant has been installed, two (2) complete sets of Operation and Maintenance Documentation shall be provided. The documentation shall, as a minimum, include the following:

- Complete and accurate as-built diagrams showing the entire fiber optic cable plant including locations of all splices.
- Final copies of all approved test procedures.
- Complete performance data of the cable plant showing the losses at each terminal connector.
- Complete parts list including names of vendors.
- Electronic Testing Files (with both OTDR traces, and end to end power meter data)

III. GPS Documentation

In addition to the specified record drawings, the Contractor shall record GPS coordinates of the following electrical components being installed, modified or being affected in other ways by this contract:

- All light poles and light towers
- Handholes and vaults
- Junction Boxes
- Conduit roadway crossings
- Controllers
- Control Buildings
- Structures with electrical connections, i.e. DMS, lighted signs
- Electric Service locations
- CCTV Camera installations
- Roadway Surveillance installations
- Fiber Optic Splice Locations
- Fiber Optic Cables. Coordinates shall be recorded along each fiber optic cable route every 100 feet
- All fiber optic slack locations shall be identified with quantity of slack cable included. When sequential cable markings are available, those markings shall be documented as cable marking into enclosure and marking out of enclosure.
- Any device that can be programmed with an IP address
- Datum to be used shall be North American 1983.

Data shall be provided electronically and in print form. The electronic format shall be

compatible with MS Excel. Latitude and Longitude shall be in decimal degrees with a minimum of 6 decimal places. Each coordinate shall have the following information:

- File shall be named: TSXXX-YY-MM-DD (i.e. TS22157_15-01-01)
- Each intersection shall have its own file
- Row 1 should have the location name (i.e. IL 31 @ Klausen)
- Row 2 is blank
- Row 3 is the headers for the columns
- Row 4 starts the data
- Column A (Date) – should be in the following format: MM/DD/YYYY
- Column B (Item) – as shown in the table below
- Column C (Description) – as shown in the table below
- Column D and E (GPS Data) – should be in decimal form, per the IDOT special provisions

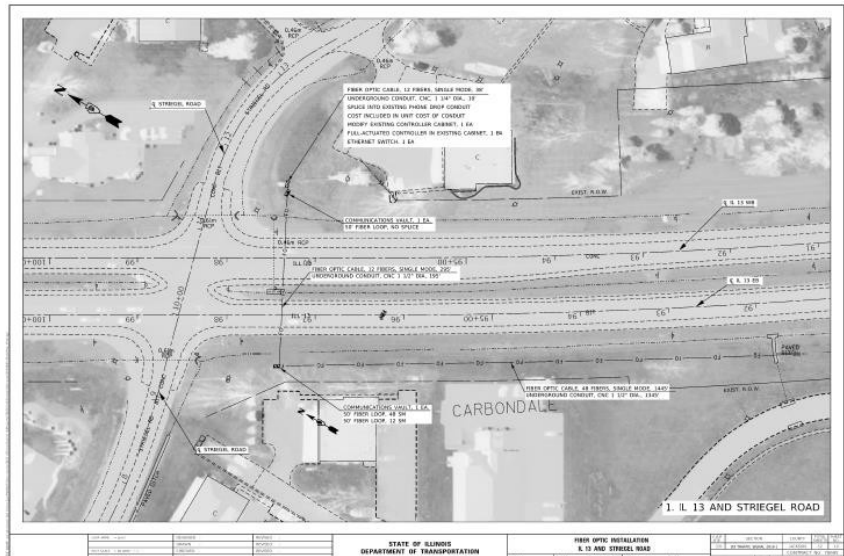
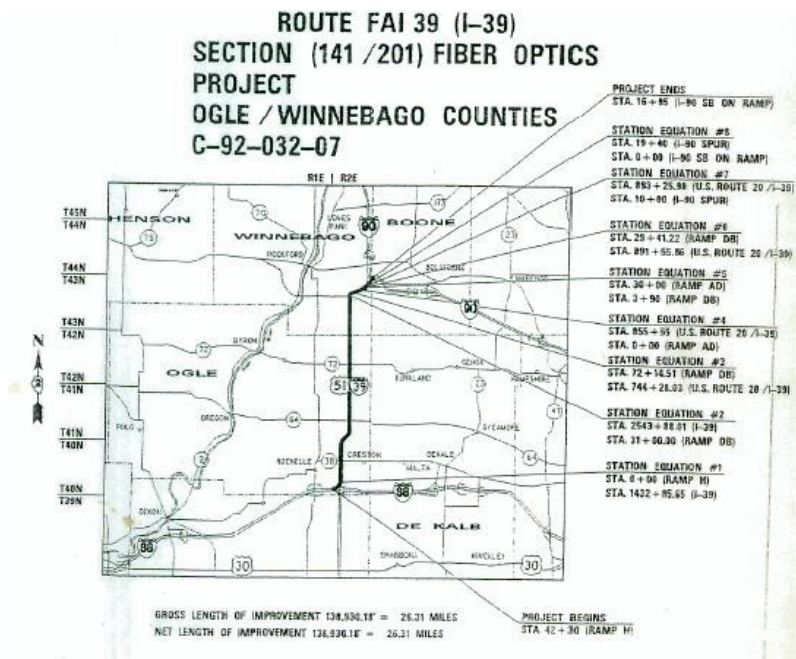
Prior to the collection of data, the contractor shall provide a sample data collection of at least six data points of known locations to be reviewed and verified by the Engineer to be accurate within five (5) meters. Upon verification, data collection can begin. Data collection can be made as construction progresses or can be collected after all items are installed. If the data is unacceptable the contractor shall make corrections to the data collection equipment and or process and submit the data for review and approval as specified.

APPENDIX G-4: Examples of Fiber Data

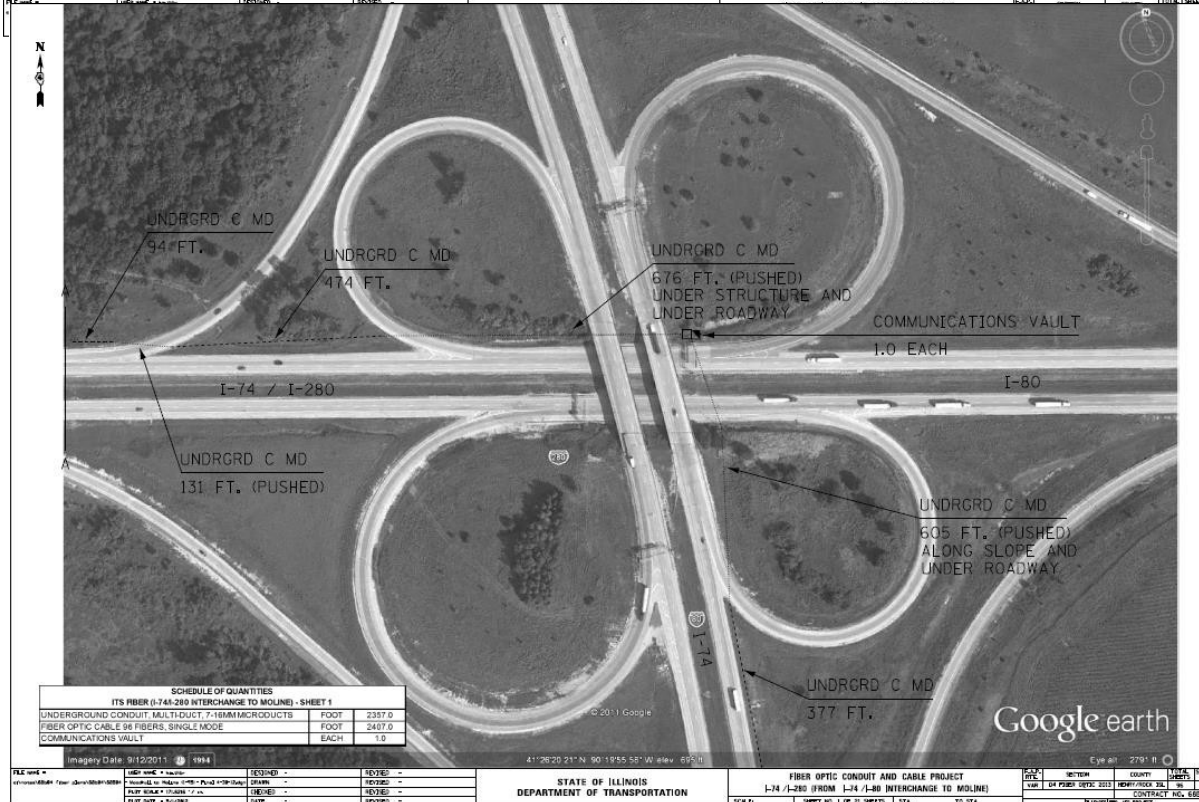
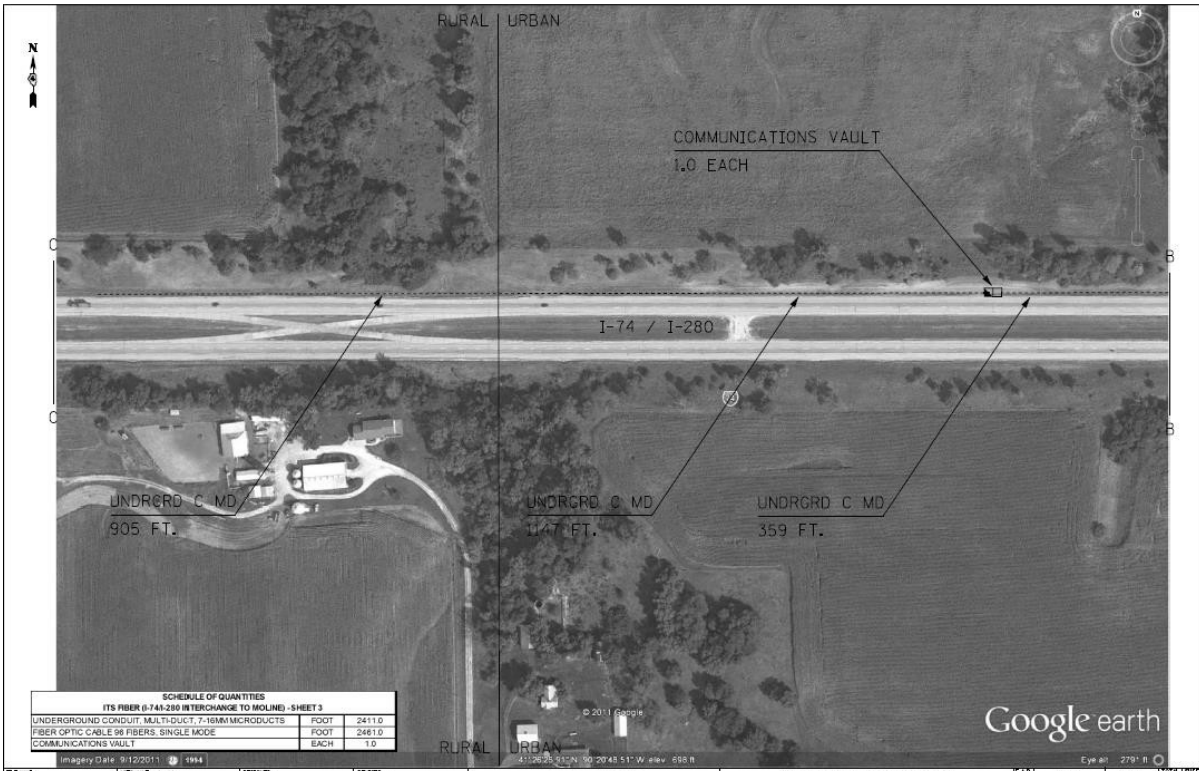
The outreach effort was able to collect examples of fiber inventory data various Districts. Project Specifications documentation adopted in 2019 were also collected and potentially be used as a template. The data is available in formats such as Google KMZ files, plan sheets that contain Google Earth layout and details of installation or scanned version of old plan sets.

The integration and workflow from plan development to installation as-built collection, and file formats for requests and future work need to be coordinated in the process. Keep in mind that design plans, as-built data collection and common requests and common useful formats should be considered in the workflow.

Example of scanned plan sheets:

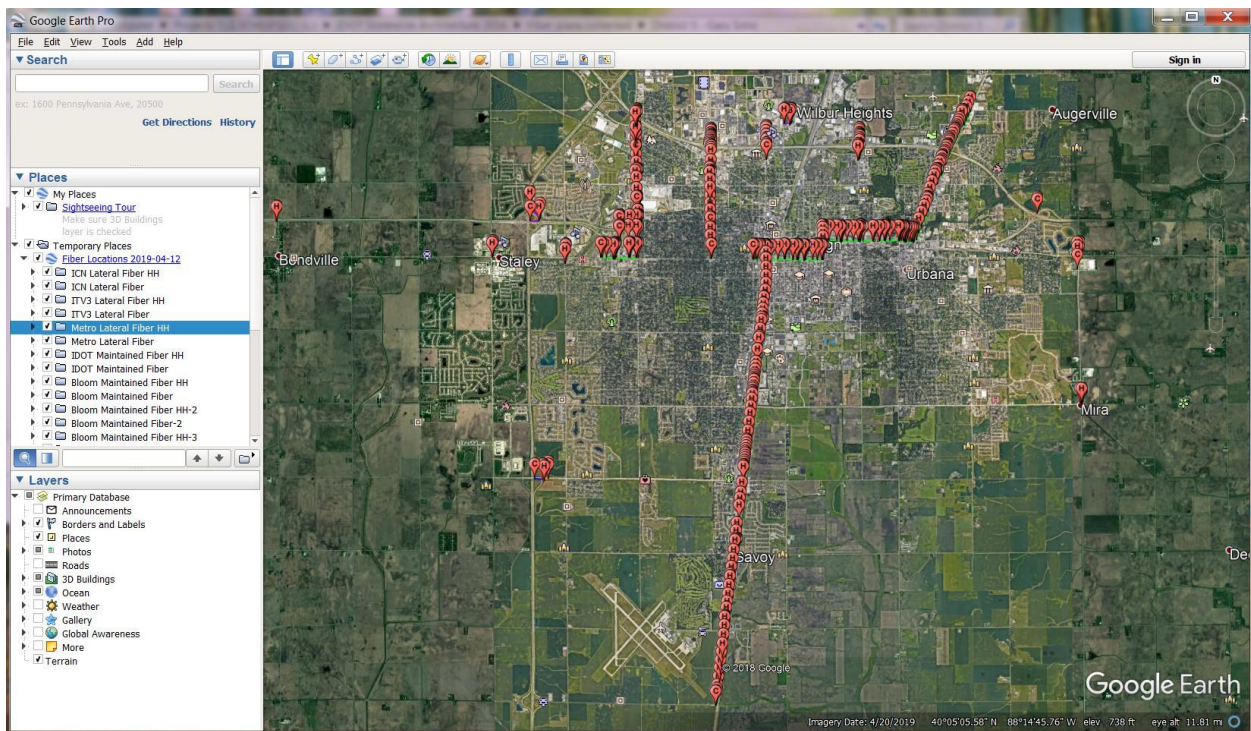
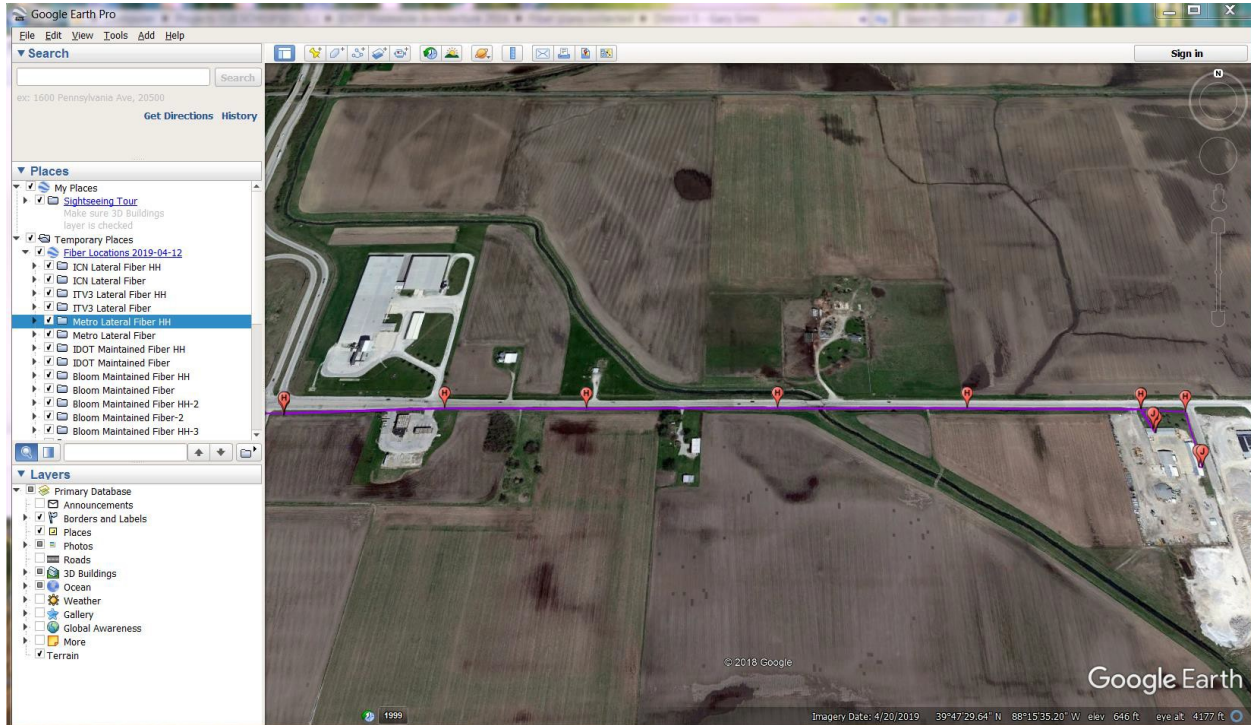


Examples of plan sheets that contain Google Earth layout and details of installation



STATE OF ILLINOIS	DEPARTMENT OF TRANSPORTATION	FIBER OPTIC CONDUIT AND CABLE PROJECT	DATE	SECTION	COUNTY	PROJECT NO.
		I-74 / I-280 (FROM I-74 / I-80 INTERCHANGE TO MOLINE)				
		SHEET NO. 1 OF 21 SHEETS	STA.	TO STA.		

Backbone fiber, Lateral Fiber, Cabinet Locations and Handholes are marked on Google Earth (KMZ) file maintained in this case by District 5.



Zooming in using Google Earth, the user can obtain details of fiber layout.

