

New National Utility Standards & Guidelines from AASHTO, ASCE, and FHWA  
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**Abstract**

New and emerging technologies allow for the cost effective collection and depiction of existing utility information. This convergence of technologies, and the systematic ways these data are used, is known as subsurface utility engineering (SUE). SUE has developed a broad definition over the last several decades. The American Society of Civil Engineers' (ASCE) current definition is "a branch of engineering practice that involves managing certain risks associated with: utility mapping at appropriate quality levels, utility coordination, utility relocation design and coordination, utility condition assessment, communication of utility data to concerned parties, utility relocation cost estimates, implementation of utility accommodation policies, and utility design." AASHTO, ASCE, and FHWA all have recently published standards and guidelines that directly relate to SUE. These standards and guidelines form a basis for defining standards of care, and by extension, allocations of risk between project owners, engineers, constructors, and other parties involved in transportation projects.

AASHTO's Highway Subcommittee on Right of Way and Utilities has recommended guidelines and best practices for the major functional work areas involved in the Right of Way and Utilities process. This information was developed as an assignment of the AASHTO Standing Committee on Highways Strategic Plan. That plan required the Subcommittee to take primary responsibility to "develop and advocate guidelines and best practices to assure timely procurement, clearance of rights of way and adjustment of utilities." Chapter 7 (Utilities) of this plan specifically recommends and outlines the ways that subsurface utility engineering should be incorporated into project planning, design, and construction.

The FHWA expanded on AASHTO's guidelines in a 2002 publication titled "Avoiding Utility Relocations." The purpose of the work was to develop a manual that encouraged highway designers to avoid unnecessary utility relocations in the designs for which they are responsible. This was accomplished by identifying both the value of avoiding relocations on highway construction projects, and the technologies and techniques that can be used to achieve this goal. To avoid utility relocations, we must first know all we can about the existing utilities. The proper and comprehensive use of SUE is one of the key conclusions and recommendations for avoiding relocations.

The ASCE published a national standard in 2002 titled *Standard Guidelines for the Collection and Depiction of Existing Subsurface Utility Data*. The intent of this standard is to present a system of classifying the quality of data associated with existing subsurface utilities. Such a classification will allow the project owner, engineer, constructor, and utility owner to develop strategies to reduce risk by improving the reliability of information on existing subsurface utilities in a defined manner. This document, as a reference or as part of a specification, will assist engineers, project and utility owners, and constructors in understanding utility data quality level classifications.

The integration of the concepts of these three documents into the project development process accrues significant benefit to transportation projects and more. Current project costs are reduced for the benefit of tax and rate payers. Future project costs are reduced by retaining and managing high quality utility location information. Project schedules are reduced. The potential for utility damages are reduced. There is a better defined allocation of risks for all stakeholders. There is even an increasing use of these documents' concepts in use for Homeland Security applications. Additional standards and guidelines are sure to be developed, but these three provide a great start for reducing the risks that existing utilities present to transportation projects, their owners, engineers, constructors, and the public.

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Chairman: ASCE C/I 38-02, *Standard Guidelines for the Collection and Depiction of Existing Subsurface Utility Data*.

## INTRODUCTION

Subsurface Utility Engineering (SUE) is a relatively new interdisciplinary approach to managing the risks that existing underground utilities create on projects involving excavation. Some of these risks are a direct result of inaccurate, incomplete, or imprecise information on the location or existence of existing utilities. Other risks come from not using or considering existing data, or not using it at the most opportune time. Subsurface utility engineering utilizes new and existing technology to collect and manage utility data, and uses or communicates this data, at the right times, in order to decrease project risks. SUE is now accepted and promoted by engineering organizations and federal and state agencies as a means of reducing overall project costs and liabilities.

Three national organizations that promote the profession of subsurface utility engineering are the American Society of Civil Engineers (ASCE), the American Association of State Highway and Transportation Officials (AASHTO), and the Federal Highway Administration (FHWA). The definition and understanding of SUE has become ever broader over the last several decades. ASCE's current definition is "a branch of engineering practice that involves managing certain risks associated with: utility mapping at appropriate quality levels, utility coordination, utility relocation design and coordination, utility condition assessment, communication of utility data to concerned parties, utility relocation cost estimates, implementation of utility accommodation policies, and utility design." This definition is now commonly accepted and infers a broad responsibility to the design professional and project owners. AASHTO, ASCE, and FHWA all have recently published standards and guidelines that directly relate to SUE. These standards and guidelines form a basis for defining standards of care, and by extension, allocations of risk between project owners, engineers, constructors, and other parties involved in transportation projects.

### **American Association of State Highway and Transportation Officials**

AASHTO's Highway Subcommittee on Right of Way and Utilities has recommended guidelines and best practices for the major functional work areas involved in the Right of Way and Utilities process. This information was developed as an assignment of the AASHTO Standing Committee on Highways Strategic Plan. That plan required the Subcommittee to take primary responsibility to "develop and advocate guidelines and best practices to assure timely procurement, clearance of rights of way and adjustment of utilities." Chapter 7 (Utilities) of this plan specifically recommends and outlines the ways that subsurface utility engineering should be incorporated into project planning, design, and construction.

The first guideline stated in the document is to use current available technology to the greatest extent possible. This includes the use of Subsurface Utility Engineering mapping technologies for projects where underground utilities are present and high quality levels of information are needed for design purposes. It includes encouraging frequent coordination and communication with utility companies to reduce delivery time, reduce costs, and improve quality in the utilities process.

AASHTO encourages the FHWA to continue its support for Subsurface Utility Engineering. This has proved helpful to Departments of Transportation that are trying to establish a Subsurface Utility Engineering program. The Virginia Department of Transportation has been using Subsurface Utility Engineering since 1984. It is presently used, to some extent, on virtually every highway project. Some of the other states making extensive use of Subsurface Utility Engineering include North Carolina, Maryland, Texas, Ohio, New York, Florida, Montana, Arizona, Delaware, Pennsylvania, Utah, Illinois, Georgia, South Carolina, and Michigan. In addition, many local highway agencies use Subsurface Utility Engineering. States currently developing Subsurface Utility Engineering programs for imminent implementation are New Jersey, Maine, Missouri, Washington State, Colorado, and Arkansas. Some state transportation departments are prohibited by state law or policy from using out-of-state consultants (at least one state is prohibited from using any consultants at all, even in-state consultants). These states should consider developing in-house Subsurface Utility Engineering capabilities.

AASHTO recommends that state DOTs keep good records of cost and time savings. This information is often beneficial for justifying the continuation of Subsurface Utility Engineering programs to upper management. The

FHWA study, “Cost Savings on Highway Projects Utilizing Subsurface Utility Engineering” (2000), can serve as a guideline for evaluating Cost Savings.

AASHTO supports the efforts of ASCE in developing and promoting their national engineering standard, ASCE C/I 38-02, “Standard Guideline for the Collection and Depiction of Existing Subsurface Utility Data.” This document was developed to serve as the basis for a scope of work for utility mapping and the planning, design, and construction functions that benefit from the portrayal of utilities on documents. This standard should be referenced by transportation departments in their specifications and consultant contracts.

### **American Society of Civil Engineers**

An engineer has many sources of information on existing utilities. Utility owner records, public records, private records, interviews with knowledgeable sources, visual site indications, historical books and newspaper archives, surface geophysical information, test holes, and GIS systems are some examples.

Utility owners keep many different kinds of records. Large scale transmission/distribution system maps may show presence of utilities, but because of their scale they may not be horizontally accurate or show details of material type, size, etc. On the other end of the spectrum may be field notes, where accurate measurements to existing topographic features were made by field personnel during installation or maintenance activities (sometimes all those topographic references will be long gone, rendering these drawings less useful for location purposes). Service record cards, valve drawings, and circuit schematics are examples of other kinds of records. These utility records may exist on all kinds of formats, such as mylar, aperture cards, computer files, index cards, wall maps, paper sheets, and so on.

There is one obvious difference between these records. Quality! Different types of records have different quality. Some records have very high quality, and tell us everything we need to know about a particular utility at a known point. Other records may have a very low quality, and tell us next to nothing about the utility, other than its potential presence somewhere in the general area.

Until recently, there was no mechanism for engineers or surveyors to differentiate these differences in quality on design or construction plans, or in GIS databases. All utility information was depicted as being the same. The end result of low quality information being portrayed the same as high quality information resulted in all the information sinking to the lowest common denominator of quality, in other words, untrustworthy information. Engineers and surveyors recognized this and completely disclaimed responsibility for utility information that they depicted on documents. They attempted to push liability to the utility owner or the constructor. Some court rulings upheld these disclaimers. However, an increasing number of state supreme court decisions do not.

The ASCE published a national standard in 2002 titled *Standard Guidelines for the Collection and Depiction of Existing Subsurface Utility Data*. The intent of this standard is to present a system of classifying the quality of data associated with existing subsurface utilities, a key concept of subsurface utility engineering. Such classification allows the project owner, engineer, constructor, and utility owner to develop strategies to reduce risk by improving the reliability of information on existing subsurface utilities in a defined manner. This document, as a reference or as part of a specification, assists engineers, project and utility owners, and constructors in understanding utility data quality level classifications.

**Quality Level D** utility data is that information that is collected and depicted on documents that comes solely from utility owner records, or conversations, or visual indications. It is the lowest quality level and everyone should be very careful when using it for any purpose. The only aspect the engineer can be held accountable for is investigating all sources of information and interpreting the records as best as can be done. It has a good application for project planning/route selection, where the planner needs to get an overall “feel” for the utility congestion. An example of its use and pitfalls is as follows: A water record from 1960 shows the water line two feet off the edge of the road, with one valve on the main. The road in 1960 was two narrow lanes; now it is two wider lanes with a turn lane. The engineer plots the water line two feet off the edge of the road, but is not known whether i) the edge of the road is at the same place now as in 1960, ii) the water record was correct as far as its geometry, iii) the water line is still in service or abandoned, or iv) the water line underwent changes in conjunction with road improvements or other events.

**Quality Level C** utility data is somewhat better. It addresses the problem of where the old road edge might be by using the water valve as a survey point. All visible utility structures that indicate a utility below the surface are surveyed to project control and placed on the plans at the right spot. Then, the utility record's geometry can be used to place it on the plans. The water line that would have been plotted two feet off the edge of the road is now plotted through the surveyed water valve. If the water valve is six feet inside the turn lane, then the water line is plotted parallel to the road (following the record geometry) but six feet inside the turn lane. Of course, if the water valve can't be found, this utility can only be plotted to quality level D standards. Quality level C data still does not address utilities for which there are no records, utilities for which the records are wrong or incomplete or not updated, or utilities which have no visible features that can be surveyed. The survey of the visible utility feature is "sealed" and certified. Liability revolves around the comprehensive utility records search, the certification of the survey, and the best interpretation of the records information.

**Quality Level B** utility data provides a significant upgrade in quality from QL C data. It involves the use of surface geophysics to identify, interpret, and field-mark underground utilities, combined with a survey of the field markings, and subsequent reduction onto plans or into the digital database. There are many different types of surface geophysics that will work under certain conditions to identify underground utilities. The key to liability here is that the "appropriate" methods be used. Appropriateness of method is part of the professional's role, along with interpretation (or the training thereof) of the data, and education of the client for budgetary purposes. The key is to pick those techniques that, given the environmental and site conditions, will give the educated client the best value in identifying the most, or the most critical, utilities for the project mission. Not all utilities may be found through surface geophysics.

After utilities' approximate locations are marked on the ground surface, the surveyor references them to project control and reduces them onto plans or into the database. Other information might be interpreted from the surface geophysics, such as approximate depth and utility type. Utilities for which records exist, but which could not be found through the surface geophysics, are depicted at a lower quality level.

In the water record example, if the water line had bends in it that the records did not reflect, the surface geophysics would detect them. If the valve was paved over, the surface geophysics would detect it; survey would place it on the plans correctly. If the water line was abandoned and was in poor condition, the surface geophysics might detect the new waterline and give clues as to the condition of the abandoned one.

Liability for quality level B data is confined to surface geophysics method selection, education of the client, correct interpretation of the surface geophysics, correct marking of the utility on the ground surface, survey of those markings, depiction on the plans or in the database, and evaluation of all records to see if utilities must be depicted at a lower quality level. The engineer or surveyor "seals" the survey work; insurance covers all aspects of the end work product. QL B data is most useful in the preliminary design stage of projects.

**Quality Level A** data is the highest quality. No matter how good the surface geophysics is applied and interpreted, precise information on elevation, size, material type, condition, configuration and so forth of the utility cannot be verified without exposure. So QL A data is that data that is gathered, surveyed, and depicted through excavation or exposure of the utility. It takes all interpretation out of the utility information at that point. In our water line example, the exact horizontal location, depth, condition and other data at the point where it is needed is gathered. Excavation technologies such as air/vacuum methods protect the utility from damage during exposure, limit the work zone, and reduce costs. Quality Level A measurement data is "sealed" by the professional.

The standard is organized into eight chapters and one appendix. The chapters cover such topics as definitions, engineers' responsibilities, project owners' responsibilities, deliverables, costs and savings, and information sources. The appendix covers available surface geophysical methods for utility imaging.

In general the standard says the following. The engineer should have enough knowledge about utilities (e.g. costs to move, installation practices, design considerations, safety issues) to consider risk factors for a particular project. The engineer should have knowledge of federal, state, and local accommodation policies so that cost responsibilities can be estimated since cost is certainly a risk. The engineer should be able to put together a

preliminary cost estimate, based upon utility prior rights and likely adjustment schemes. The engineer should be able to assist the project owner in negotiating a scope of work that fits the project's needs, rather than just regurgitating the standard mapping scope ("designating" and "locating") in existence since the 1980s. Such a scope might include what quality levels to use, when to use them, when and how to communicate data to others in the design process and so forth. The engineer should be able to produce that mapping. The engineer should be able to identify potential conflicts with the design footprint and offer sensible and practical avoidance alternatives to the designers. When avoidance is not practical, the engineer should be able to offer up detailed relocation plans and their costs. The engineer should be able to communicate information to the constructors through unambiguous mapping deliverables, written reports, and/or verbal briefings. The engineer will be responsible for negligent errors and/or omissions in the utility data for the certified utility quality level.

National standards such as this one are used in case law to assist in establishing standard of care issues. Engineers will need to find a way to perform to this standard. They can develop resources in-house or they can contract with sub-consultant. Using a subconsultant, they can contractually shift some risk, however, since the risk of tort liability remains with Prime Consultant, it is to their advantage to be careful in their selection process due to increasing costs for utility errors / omissions.

## **FHWA**

This manual describes the problems common to highway designers and utility owners, the available tools to detect, image, and map utilities, and the mitigation measures that have been implemented to avoid relocation. It describes successful processes being used in the planning, design, and construction phases of highway projects that support coordination and reduce conflict among owners. The document, Manual on Avoiding Utility Relocations, was prepared for the Federal Highway Administration in accordance with Utilities Research Development and Technology Transfer Contract Order DTFH61-01-P-00237, Avoiding Utility Relocations. The European Scanning Team -Right-of-Way and Utilities - recommended the work in March of 2000.

The purpose of the work was to develop a manual identifying technologies and techniques that have been used to avoid the need to relocate utilities to accommodate highway construction.

The work was accomplished through research that included:

- A mail survey of current practices, policies, and strategies to State and municipal highway agencies (utility divisions), and private utility companies across the country.
- Review of State DOT's published utility accommodation policy and procedure manuals.
- Investigation into state-of-the-practice technologies for detecting and mapping utility facilities.
- Review of related publications and internet information sponsored by the Federal Highway Administration (FHWA), the United States Department of Transportation (USDOT), and the American Association of State Highway and Transportation Officials (AASHTO).
- Review of related publications and internet information from the private sector.
- Telephone interviews with DOT and utility personnel and private sector "utility locators."
- Personal interviews with leaders in the field of subsurface utility engineering.

Utility owners and operators have been constructing, operating, and maintaining utility facilities within and adjacent to the public rights-of-way (ROW) of streets and highways since the early 1900s. Many of these roads have insufficient ROW for the expansion needed to satisfy the tremendous growth of traffic and the proliferation of basic and increasingly sophisticated utility services. As demand for the finite space in existing ROW increases, the difficulty and cost of adding new utility facilities and relocating existing facilities also increases. The cost of any relocation is borne by the public as the taxpayer or the ratepayer. Since they are the same person, it is imperative to have a partnership between the entities representing this person; that is, the project owner (DOT or Municipality) and the utility owner. This partnership must address and implement strategies to avoid utility relocations when feasible. However, due to reimbursement policies and departmental budgets, the incentives for partnership are sometimes obscured.

The costs of utility relocations can be extremely high. The NJDOT utility department estimates utility relocation reimbursement at approximately 10% of the State's annual highway budget, with additional costs for coordination. This does not include user costs: difficult to quantify, but very real. Fuel costs while idling in traffic or detours, lost business revenue, and public opinion problems due to delays are just a few of these user costs.

Many mechanisms and practices exist to assist in avoiding or minimizing utility relocations. These include knowing where all existing utilities are located, the comprehensive nature of these utilities, educating the designer of utility impacts and risks and motivating them to avoid utility relocations when prudent, designing new utility installations with life-cycle costs in mind, early and frequent communications, and so forth.

A branch of civil engineering practice has evolved that addresses many of these issues. Subsurface utility engineering is recognized by many organizations, such as FHWA, AASHTO, ASCE, AGC, APWA, and others, as a means to better manage the risks that existing subsurface utilities present to a project. Incorporating comprehensive subsurface utility engineering into the project planning, design, and construction goes a long way towards avoiding utility relocations. It should become a standard part of the project development team, much as environmental engineering, highway design, structure design, hydraulics, and survey are now.

Although engineering can play perhaps the largest role in avoiding utility relocations, construction also has a significant place. Construction techniques such as common (joint) trenching, trenchless technology, and GPS record drawings of new or relocated installations can all play a role in avoiding relocations.

## **SUMMARY**

The common theme of these three new utility standard documents is that use of subsurface utility engineering, in its broadest definition, should be an integral part of any project in order to reduce the risks of existing underground utilities. There is an emerging standard of care for project owners and engineers in this regard. The impacts of utilities on a project must be considered during planning, design, and construction. These three documents set forth standards and guidelines for that consideration.