

# Designing and Constructing Around Utilities

## Design Alternatives Dynamic Source Document



Indiana Department of Transportation

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Anthony Gray

Governor Summer Intern, Purdue University

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## Preface

This document is intended to be a source of information to provide creative insight for the design process, specifically when dealing with potential utility conflicts, by providing a synopsis of possible implementations of designing around existing utility facilities. Previously used design alterations will be appended periodically to increase the usefulness and relevancy of the document. When possible, information will be provided concerning an exact origin, such as a Designation Number, but not all entries will have such information available. Any material included in the following pages is free to public use.

## Introduction

Different stages in the development of a highway project offer different opportunities for making decisions that can help avoid utility relocations. These stages are planning, design, and construction. The planning stage is started years ahead of actual construction and typically begins with the feasibility analysis of a project identified on a State's transportation master plan. The planning stage can last several years and generally ends with approval of a preliminary ROW map and authorization to begin topographic and utility surveys for design. The design stage, consisting of plans, specifications, and estimates (PS&E), is commonly broken into percentage completion such as 30 percent, 60 percent, and 90 percent. As the various design milestones are reached, the options available for avoiding relocations become fewer.

(Source 2).

Designing around utilities has saved many hours and cut significant costs to both the department of transportation and the customers that the utilities serve. It is for these reasons that avoiding conflicts that result in relocations is being emphasized as the primary option for designers, utilities, contractors, and coordinators.

## All Potential Conflicts – General Ideas

1. Obtain complete design information. Define the actual footprint of the new project and its construction.
2. Obtain accurate utility location and size.
  - a. Additional potholing may be necessary.
  - b. Subsurface Utility Engineering (SUE)
  - c. Contact utility representative
3. Pre-allocate “hot spots” where utility conflicts are very likely prior to design.
  - a. **Georgia Street, Indianapolis, Indiana** (Source 3)
    - i. Set corridors of “Do not disturb” in design to avoid clusters of utilities
    - ii. Designed after restrictions fully known
4. Speak with utility owners and discuss their needs first, then look to design changes.
  - a. Challenge utility’s needs if seemingly unreasonable
5. Challenge established design standards or approve nonstandard design changes. Ask why it can’t be done another way if the new method/design prevents conflicts.
6. Small changes in grade, centerline, road or sidewalk alignment, ramp/driveway locations or widening the alternate side along the section of roadway near the places of conflict can resolve conflicts fully with little to no change in functionality or cost.
  - a. **Highway widening project, MD 32 in Maryland** (Source 1)
    - i. Saved an estimated \$500,000 and 4-6 months by changing design and widening on other side of roadway.
7. Prevent designing around Utility A to cause conflicts with Utility B, unless a conflict is more desirable with Utility B and all design around options have been exhausted.

## Above-Ground Conflicts

### Pile Driving

1. Arc distance from electrical power line (safe distance determined by OSHA)
  - a. De-energize the lines
    - i. Can be difficult to schedule
  - b. Change in design methods
    - i. Use drilled piles
  - c. Change in construction methods
    - i. Use sonic side grip for pile driving
2. Communication Line
  - a. Change design methods
    - i. Consider drilled piles
  - b. Change construction methods
    - i. Use sonic side grip for pile driving
3. Change length of span between poles

### Small Structure Installation and Aerial Lines

1. Change design method
  - a. Cast in place vs. precast concrete
2. Change alignment of road
3. Change angle of wing wall

### Bridge Conflicts

1. Move bridge bents
2. Move bridge end that would conflict with pipeline
3. Consider alternative foundations
4. Move bridge ends
5. Make structural box modifications
6. Make abutment modifications to allow bridge occupancy
7. Move bridge pilings
8. Change bridge type
9. Slide beams in place laterally

10. Make alignment changes
11. Add an additional bridge span
  - a. Second span added to avoid gas lines. Estimated cost savings of over \$1 million.

[Click to see example image](#)

### Bridge Demolition

1. Cranes and electrical OH line
  - a. De-energize line(s)
  - b. Temporarily relocate - may be able to remove line temporarily while retaining and guying poles
    - i. **I-65 at SR 26, Indiana, Tippecanoe County (DES # 1383339)**
2. Cranes and communication lines
  - a. Temporarily relocate

### Poles / Overhead Lines

1. Install guardrail around pole, but allow for room for deflection of the guardrail
  2. Adjust road alignment
    - a. **Power pole, Rapid City, South Dakota (Source 1)**
      - i. Used a new field approach to avoid pole, saved an estimated \$57,000.
- [Click to see images](#)
3. Temporarily relocate poles (construction conflicts)
  4. Tilt poles out of way temporarily with partial excavation at pole base (Source 4)
  5. Install temporary cross arms for overhead lines
    - a. 8ft on one side instead of 4ft on both sides of poles (Source 4)
  6. Install taller poles
    - a. Prevent ROW acquisition
    - b. Increase clearance
  7. Dig trench behind pole and temporarily push pole through trench (Source 3)

### Traffic Signals

1. Increase mast arm lengths
2. Move proposed signal locations

## Underground Conflicts

### Subgrade Treatment for Pavement and Sidewalks

1. Make alternate material selection, can allow for thinner subgrade or pavement (Source 2).
2. Use alternative proof rolling/compaction adjacent to/above a utility
  - a. Removable flowable fill
3. Raise elevation of pavement

### Structural Walls

1. Change length/locations of straps for MSE walls
2. Support utilities in conflict during construction
  - a. Utilities like fiber can be easily supported by contractor. Gas often prefers to support on their own instead of contractor. (Source 4)
  - b. **Des # 1298035, I-69 and 106<sup>th</sup> St. Fishers, Indiana** (Source 5)
    - i. Conduit in area of final MSE wall but excavated during construction.
    - ii. Supported during construction to prevent relocation
3. Change design to use alternate wall type
  - a. MSE wall, traditional retaining, dead man wall, soil nailing
4. Allow utility to pass through section of wall

[Click to see images](#)

### Small Drainage Structures

1. Change angle or length of wing wall
2. Move alignment of structures

### Storm Sewer / Drains

1. Move drain location
2. Use low head storm pipe
3. Use alternative type inlets
  - a. **Storm sewer, Aberdeen, South Dakota** (Source 1)
    - i. Communication ducts and vaults conflict with planned storm sewer.
    - ii. Changed inlet type and storm sewer location to avoid
    - iii. Saved an estimated \$712,730 (\$750,000 to relocate, \$37,270 to redesign)

[Click to see image](#)

4. Use alternative storm drain (oval, etc.)
5. Add flexibility to the design (i.e. inlet/drain spacing)
6. Adjust manhole locations
7. Extend storm pipe runs to avoid ditch cuts that impact utilities
8. Incorporate multiple trunklines
9. Install a manhole at the conflicting location, encase the utility and pass it through  
[Click to see example sketch](#)
10. Thread pipe through vault or manhole
  - a. Encase in sleeve and enlarge manhole to keep accessibility (Source 4).
  - b. Common for gravity sewer

## Footings

1. Customize foundation design
  - a. **Deadwood, South Dakota** (Source 1)
    - i. Pole to be placed in close proximity to existing utilities
    - ii. High cost to relocate existing utilities
    - iii. QL-A SUE utility investigation
    - iv. Recommendation: Reduce pole footing diameter from 36" to 30"
    - v. Relocate cost: \$95,000; Cost of alternative: \$5,785; Savings: \$89,215  
[Click to see image](#)
2. Use protective casings and/or encase utility
  - a. Concrete slab
  - b. Steel sleeve
3. Pre-bore and batter pile driving to miss utilities
4. Change wall/structure type above the footings to avoid utilities

## Noise Walls

1. Stagger posts around underground facilities
2. Use steel encasement for non-parallel conflict with lines and underground footing
3. Install sliding wall panels (for accessibility/construction issues)
  - a. **Noise Wall, I-69 Indiana** (Source 6)  
[Click to see image of plans](#)

## Ditches / Slopes

1. Steepen slope, but make certain clear zone hazard is not created
2. Change backslope rate
3. Narrow ditch widths
4. Redesign ditches from flat bottom to “V” bottom
5. Adjust flow lines
6. Make ditch grade changes
7. Use paved ditches
8. Change from ditch cross section to gutter
9. Pour concrete slabs over utilities in ditch bottom
10. Revise or eliminate portions of the drainage design
11. Install closed drainage and curbing
12. Use rock shield with geotech fabric (Source 4)
13. Add curb and gutter
14. Design alternative curb and gutter
15. Add retaining walls to the design to reduce slope encroachment
  - a. **Drainage ditch, Rapid City, South Dakota**
    - i. Typical concrete lined ditch would have conflicted with electrical cabinet.  
Changed to one vertical wall to avoid.
    - ii. Side benefit: additional property acquisition no longer required  
[Click to see images](#)
16. Remove slope rounding
17. Install protective shielding (revetment material)

## Underground Lines

1. Change size and/or type of inlet
2. Change lateral position of inlets, drainage lines, and/or underdrains
3. Install insulation over water pipe
4. Pour concrete slab over electric
5. Splay (spread out) duct bank
6. Create a utility cradle
7. Place steel plates over line and underneath outrigging for cranes (demolition)

8. Use water safe storm sewer pipe to allow < 18" clearance above/below water pipe (10 state standards) (Source 4).
9. Adjust portion of utility instead of complete relocation
  - a. **Worthsville Road, Greenwood, Indiana** (Source 3)
    - i. 2 locations of large diameter gas transmission line lowered to accommodate ramps. Cost of \$500,000.
    - ii. Complete relocation cost estimated near \$1.8 million, fully reimbursable.
10. Require the contractor to submit a vehicle crossing plan where equipment may traverse underground utilities. The utilities must approve the submittal.
  - a. Use ramps/pads to alleviate pressure from machinery (Source 7)  
[Click to see example images](#)

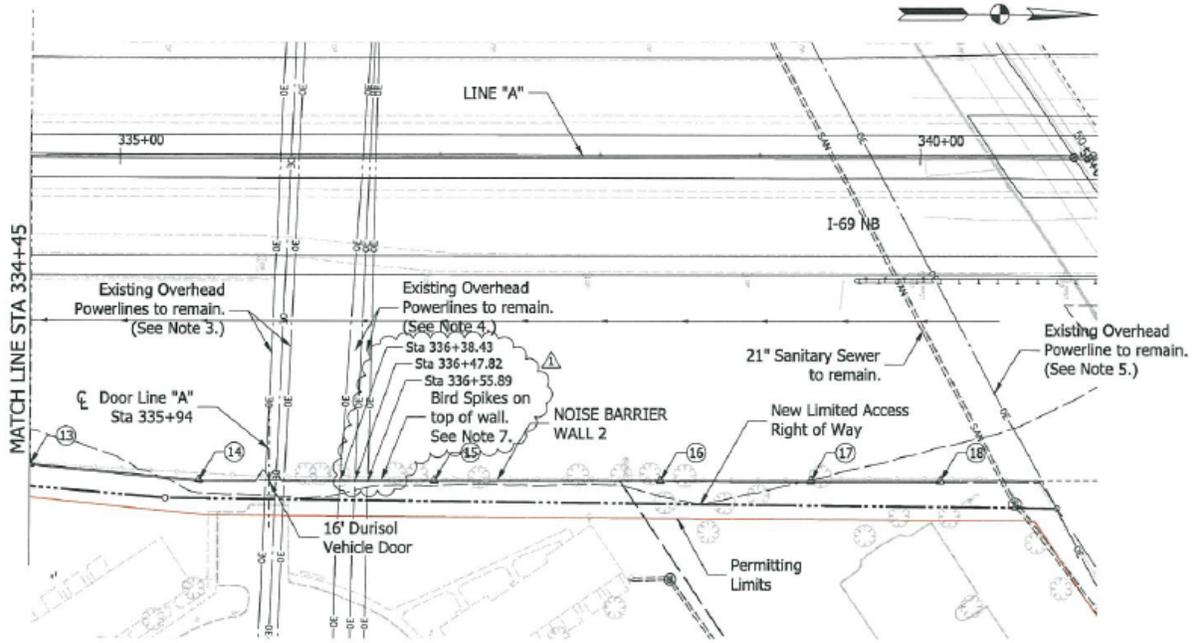
## Appendix

### Additional Bridge Span Example

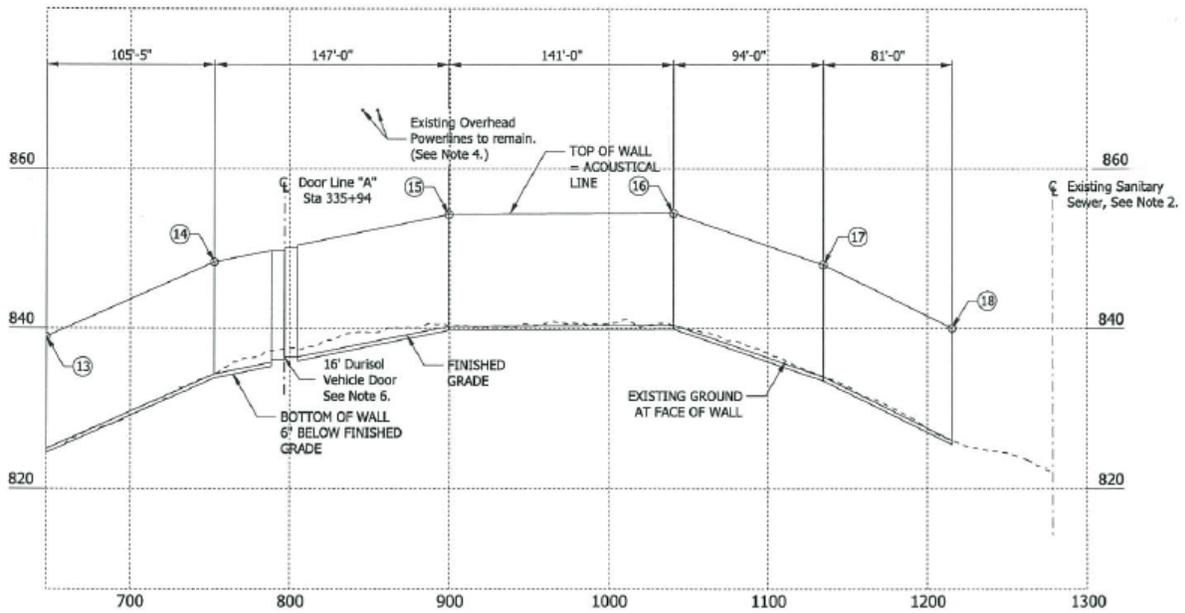


[Click to return to Bridge Conflicts](#)

Sliding Noise Barrier Wall Plans



**NOISE BARRIER WALL 2 PLAN VIEW**  
SCALE 1" = 50'



**NOISE BARRIER WALL 2 ELEVATION VIEW**  
SCALE HORIZONTAL 1" = 50'  
SCALE VERTICAL 1" = 10'

**NOISE BARRIER WALL 2 SUMMARY**

Segment	Point No.	Line "A" Stationing	Offset	Bottom (Z)	Top (Z)
13	13	334+45.00	190.23 RT	824.45	838.95
	14	335+50.00	199.94 RT	833.78	848.26
14	14	335+50.00	199.94 RT	833.78	848.26
	15	336+97.00	200.10 RT	839.74	854.24
15	15	336+97.00	200.10 RT	839.74	854.24
	16	338+38.00	200.02 RT	839.90	854.40
16	16	338+38.00	200.02 RT	839.90	854.40
	17	339+32.00	200.13 RT	833.44	847.94
17	17	339+32.00	200.13 RT	833.44	847.94
	18	340+13.00	200.01 RT	825.53	840.03

(Z) Denotes Elevations in Feet.

**NOTES:**

1. For General Notes. See Dwg No. BR-WD-01.
2. Invert elevation of Sanitary Sewer Line at Noise Barrier Wall is 800.58 Ft.
3. Elevation of Overhead Powerlines above Noise Barrier Wall are approximately 886.1 and 886.5.
4. Elevation of Overhead Powerlines above Noise Barrier Wall are approximately 865.9 and 867.3.
5. Elevation of Overhead Powerlines above Noise Barrier Wall are approximately 868.7.
6. Elevation of top of Vehicle Door to match adjacent Noise Barrier wall panels. Approx Eley. 851.25

△ 7. Bird spikes shall be attached to the top of the Noise Barrier wall panels below the overhead power lines. The limits of application shall be from approximate Line "A" Sta 336+22 to approximate Line "A" Sta 336+72. Bird spikes shall be 4" tall, minimum, 6" tall, maximum, stainless steel and affixed to the top panel with an epoxy adhesive.

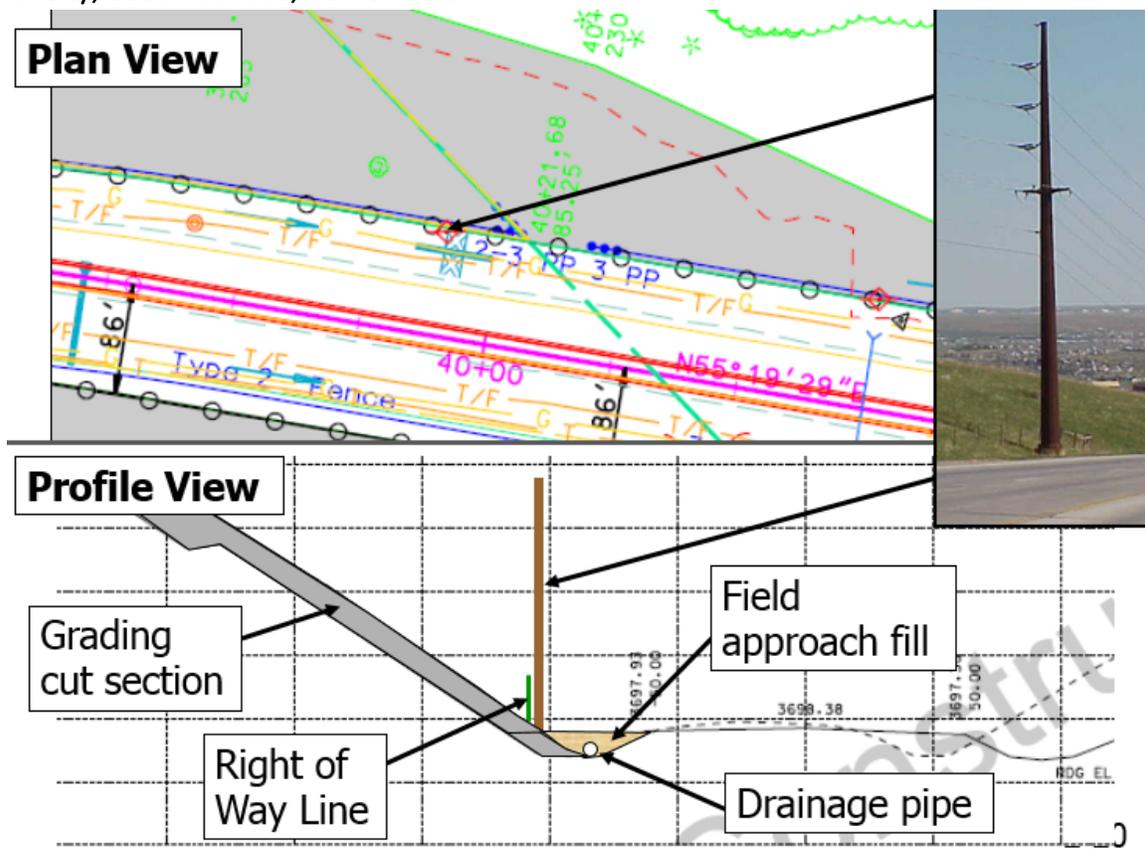
**LEGEND:**

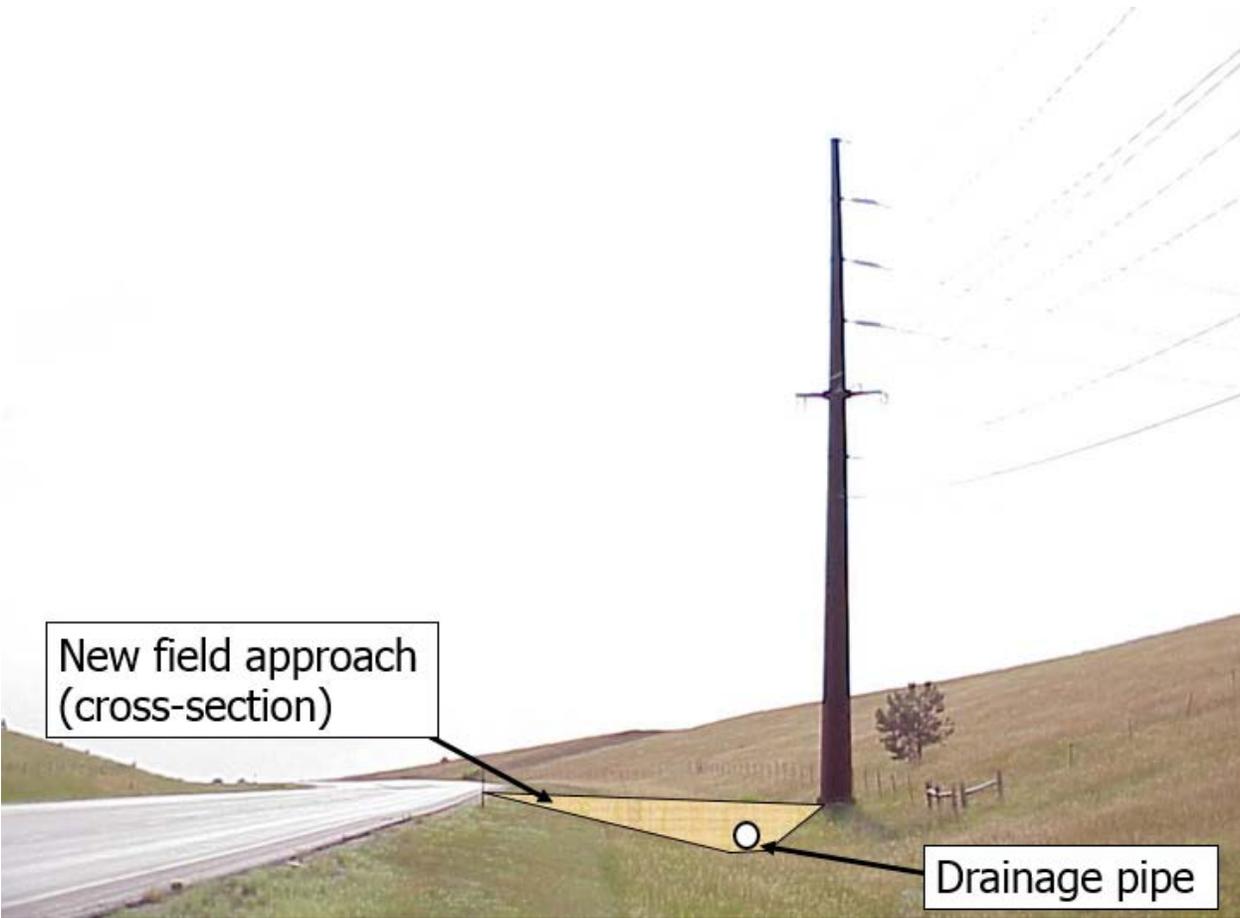
- ⊗ Point No.
- △ Control Point
- Noise Barrier Wall

(Source 6)

[Click to return to Noise Walls](#)

Rapid City, South Dakota, Power Pole

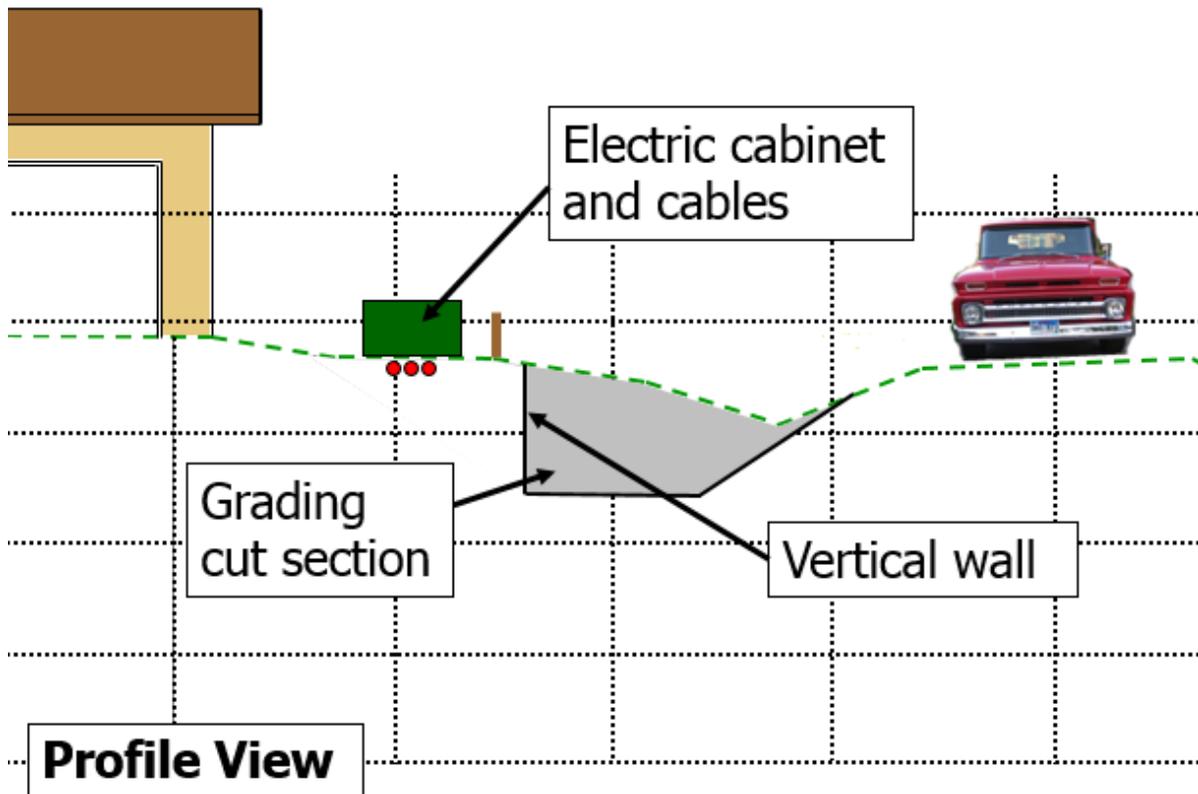




(Source 1)

[Click to return to Poles / Overhead Lines](#)

Rapid City, South Dakota, Drainage Ditch







(Source 1)

[Click to return to Ditches / Slopes](#)

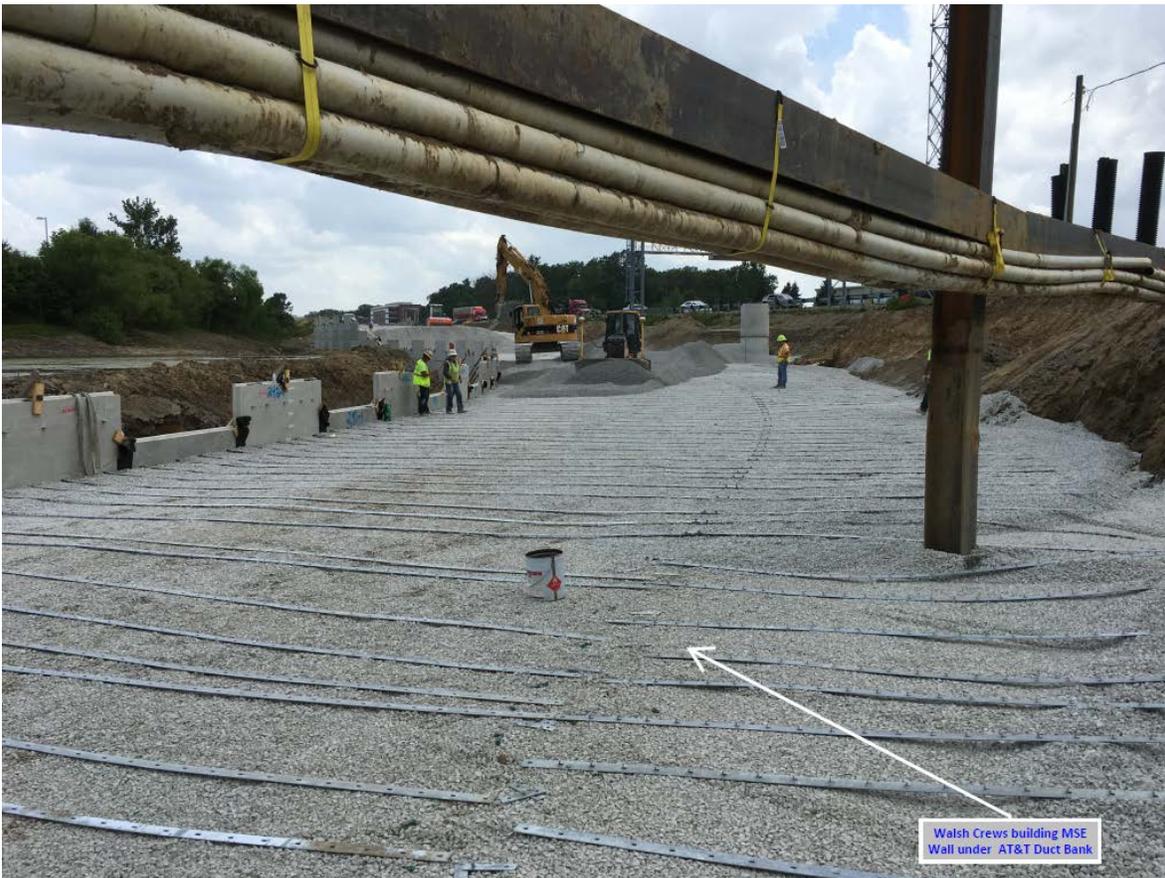
Fishers, Indiana, Supporting Facilities





(Above images courtesy of Mike Hoy, INDOT)



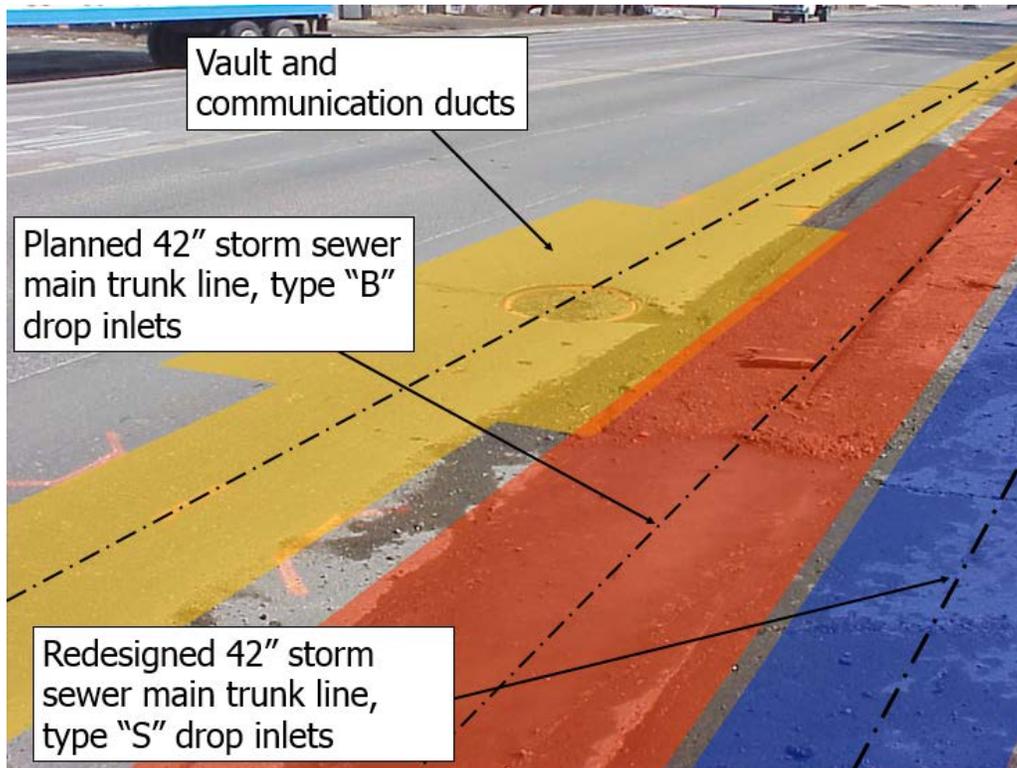




(Source 5)

[Click to return to Structural Walls](#)

### Aberdeen, South Dakota, Storm Sewer



(Source 1)

[Click to return to Storm Sewer / Drains](#)

### Deadwood, South Dakota, Custom Footing



3 conduits interfere with 36" pole footing diameter

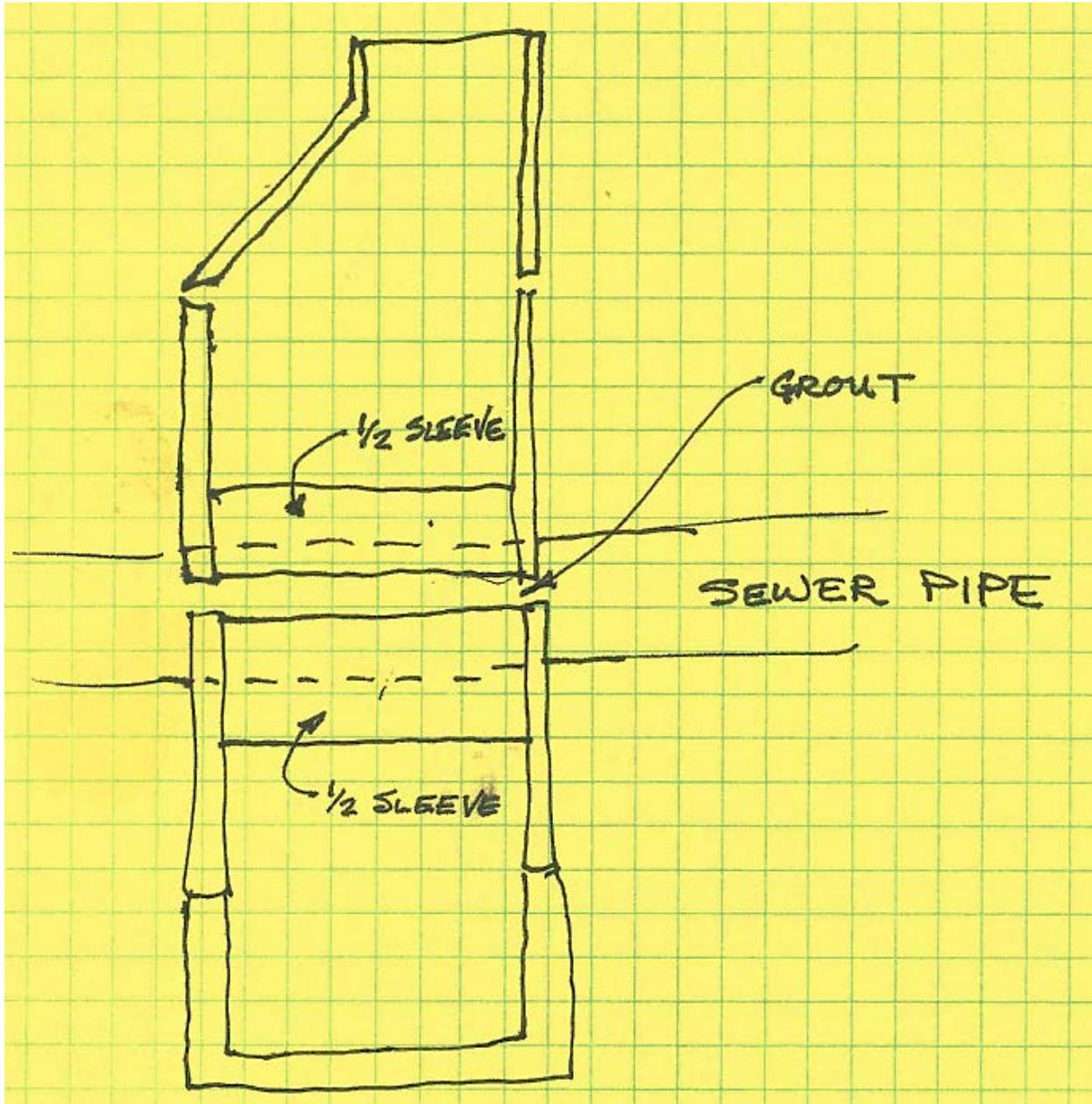


Redesign using 30" sonotube (longer, narrower footing)

(Source 1)

[Click to return to Footings](#)

### Utility Passing through Manhole Sketch



(Source 4)

[Click to return to Storm Sewer / Drains](#)

### Vehicle Crossing Utilities Example



(Source 7)

[Click to return to Underground Lines](#)

## Testimonials

*(This section, while currently blank, will be filled with descriptions of projects where designing and/or constructing around utilities was used successfully, could have been used but was not, or any lessons learned in the design and construct around process)*

- 1.

## References

1. Identification, Management, and Resolution of Utility Conflicts During Projects Development and Delivery Training Materials, Lesson 2 PowerPoint. (n.d.). Retrieved July 7, 2016, from [http://www.trb.org/StrategicHighwayResearchProgram2SHRP2/Pages/Training\\_Materials\\_for\\_Identification\\_of\\_UTILITY\\_Conflicts\\_and\\_Solutions\\_906.aspx](http://www.trb.org/StrategicHighwayResearchProgram2SHRP2/Pages/Training_Materials_for_Identification_of_UTILITY_Conflicts_and_Solutions_906.aspx)
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## Revisions / Changelog

- I. Document created. 7 July 2016. Anthony Gray.
- II. Preliminary revision of draft structure and language. 27 July 2016. Gail Lee.
- III. Peer revision and discussion of structure and content. 1 August 2016. Steve Robinson, Gail Lee, Edward Sluder, Anthony Gray.
- IV.