South Carolina
Department of Transportation

INSTRUCTIONAL BULLETIN NO. 2009-4

SUBJECT: Design and Implementation of Alternate Pipe
EFFECTIVE DATE: October 1, 2009
SUPERSEDES: Instructional Bulletin 2008-5
RE: 1) SC-M-714 – Permanent Pipe Culvert
2) Engineering Directive Memorandum No. 24 – Selection of Drainage Pipe for Use in South Carolina
3) Requirements for Hydraulic Design Studies – May 26, 2009

General

To comply with Engineering Directive Memorandum 24, all appropriate pipe types should be included on all projects, where practical. Pipe types are identified as one of two pipe alternates on SCDOT projects, "smooth wall pipe" or "corrugated wall pipe." There are three "smooth wall pipe" types, which are high density polyethylene (HDPE) pipe type S, reinforced concrete pipe (RCP), and spiral ribbed aluminum pipe (SRAP). The only type of "corrugated wall pipe" is corrugated aluminum alloy pipe (CAAP).

The engineer of record (or designer), in collaboration with the project's hydraulic design lead engineer and the roadway design lead engineer, will determine which pipe alternates are acceptable on each project to be let to contract. The structural design lead engineer will provide a structural analysis of the pipe when fill heights are outside the limits of the fill height tables found in the SCDOT Standard Drawings.

To accomplish the above, the responsible design engineer should have a preliminary field inspection and an engineering review made of the existing pipe on a project to determine if the structural and hydraulic conditions of the pipe will allow it to be retained. When it is necessary to extend or retain existing pipe within SCDOT rights-of-way or drainage easements, the original pipe should be evaluated to determine if it may be retained. The following is a guide to assist the engineer in evaluating existing pipe.

I. Structural Conditions

1. Retained pipe should be in good physical condition
2. Retained pipe should meet structural design of newly installed pipe
3. If retained pipe does not meet structural design of newly installed pipe:
   a. Retained pipe should be in good physical condition
   b. Retained pipe should not have additional loading due to significant increase or decrease in fill height
   c. Retained pipe should not have additional loading due to a change in roadway alignment (i.e. existing pipe under sidewalk becomes pipe under travelway.)

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II. Hydraulic Conditions

1. Existing pipe should not be subject to a change in hydraulic requirements that damage the pipe or exceed the normal hydraulic conditions for the same pipe diameter.

III. Preliminary Pipe Inspection

1. If structural and hydraulic conditions are met, perform an initial pipe camera inspection to evaluate the pipe for signs of damage, deterioration, or functional problems.

The responsible design engineer for the project should make an engineering review of the existing pipe based on the structural conditions, hydraulic conditions, and preliminary inspection to determine if it may be retained. All new pipe should meet the strength requirements (class, gage) listed in the SCDOT Standard Drawings regardless of the class or gage of the retained pipe. Follow SC-M-714 and the SCDOT Standard Drawings for connections between existing pipe and newly installed pipe. Always use a standard drainage structure or designed interface at the junction between different pipe types, classes, or joint details and connections between existing and new pipe.

If existing pipe shows any sign of deterioration or functional problems, rehabilitation or replacement of these sections may be necessary. When road closures are an option, insufficient pipe should be replaced with one of the acceptable pipe types using standard installation practices. When road closure is not an option, trenchless pipe rehabilitation (lining, grouting, etc.) and trenchless pipe replacement (adjacent jack and bore, horizontal directional drilling, etc.) should be evaluated to determine if either option is appropriate. Pipe types not listed in this document may be used for trenchless installations if documentation is provided that shows the structural and hydraulic performance meets or exceeds those parameters for the pipe types listed. Trenchless pipe design and installation should be in accordance with the special provision "Trenchless Pipe Installation."

During the field review, the project development team should observe existing pipe in the area and discuss with the appropriate maintenance office the prior history of pipe performance in the area of the future project. When site conditions indicate poor pipe performance, the responsible engineer for the project should work with pipe industry professionals, when needed, to determine the appropriate pipe design.

Adverse environmental conditions may result in additional protection required in the pipe; thereby, modifying standard material design. Additional protection (liners, paved inverts, thicker walls, head walls (in addition to structural requirements)) should not reduce the hydraulic capacity of the pipe and should allow the pipe to meet required structural capacity after all expected damage has occurred. Changes to the inside geometry of the pipe culvert will require that an additional hydraulic analysis be conducted. Extreme environmental conditions beyond those listed above may result in changing the designed pipe to a box culvert, floorless culvert, aluminum structural plate arch, or bridge.

Selection of pipe material to use on projects may be dependent on the availability of the pipe size required to meet the hydraulic design. SCDOT standard drawings list the most commonly used pipe sizes. In some applications box culverts, floorless culverts, aluminum structural plate pipe, aluminum structural plate arch, or bridges may be preferred. Site environmental conditions may also result in the preference of one system over the others.

When it is appropriate, all pipe types will be specified in the construction plans to allow contractors to use the most cost effective drainage system available. Contractors are required to follow the construction plans in conjunction with the Supplemental Technical Specification SC-M-714, and the appropriate standard drawings when making the selection of which pipe type to use. Permanent pipe materials allowed in Engineering Directive Memorandum No. 24 are not permitted to be substituted with any pipe material not listed as an allowable material, except as noted herein.

Implementation Schedules

Implementation of this instructional bulletin and associated memorandums and specifications will be included in all new consulting engineering contracts executed after October 1, 2009. For projects developed and designed by Departmental staff, alternate pipe will be considered when a design field review has not yet been conducted prior to October 1, 2009.

Drainage Systems

For the purposes of this instructional bulletin, the definition of a "closed" drainage system shall be defined as a series of drainage structures (catch basins, drop inlets, manholes, etc.) linked together by drainage pipes with a common outlet point or an independent crossline pipe. Generally, a closed drainage pipe system will carry runoff from the drainage area of a section of roadway to an outfall. Some common examples of outfalls are ditches, streams or rivers.

An "open" drainage system shall be defined as a series of open channels (ditches) conveying runoff with or without the short interruptions of drainage pipes (driveway, sideline, or crossline pipes).

Mixing of Alternate Pipe

When placing new pipe, alternate pipe (smooth wall vs. corrugated wall pipe) should not be mixed within a single drainage system. However, alternate pipe can be used for different drainage systems within a project. Alternate pipe (smooth wall pipe or corrugated wall pipe) may be used to tie with an existing crossline pipe if a structure such as a junction box is used with the appropriate seals or connections as long as the hydraulic capacity and structural design requirements are met.

Hydraulic Analyses of Closed Drainage Systems

The hydraulic designer will perform a hydraulic design analysis for a circular "smooth wall pipe" system. Thereafter, a second hydraulic design analysis will be performed for a "corrugated wall pipe" system.

If vertical clearance is a concern for a line of pipe, then other pipe shapes may be selected. Both, elliptical reinforced concrete pipe and aluminum pipe arch may be selected to provide the vertical clearance desired; however, these pipe types will require a structural analysis to determine the minimum and maximum fill heights in accordance with Instructional Bulletin 2007-4.

In general, it is most cost effective to design pipe culvert segments (of equal hydraulic capacity) in the following order:

1. Single barrel circular pipe culvert
2. Single barrel non-circular pipe culvert (elliptical, pipe arch, etc.)
3. Multiple barrel circular pipe culvert
4. Multiple barrel non-circular pipe culvert
5. Single barrel box culvert (reinforced concrete, aluminum)
6. Multiple barrel box culvert
7. Specialty structures (bridges, floorless culverts)

Hydraulic Design Criteria

The hydraulic design criteria to be used for alternate pipe are listed in items 1 through 4 below. These design criteria will enable the hydraulic designer to perform a complete evaluation and determine which alternate pipe can be recommended for use on SCDOT projects.

1. The Manning's "n" values shown in Table 1 in the Appendix will be used in the design of pipe systems.
2. The standard hydraulic design procedure of matching soffit to soffit will be used, if possible.
3. The hydraulic design analysis for "corrugated wall pipe" may dictate the elimination of the "corrugated wall pipe" alternate. If any of the following criteria are met, the "corrugated wall pipe" alternate will be eliminated.

   A. When the analysis for "smooth wall pipe" is 48 inches or less in diameter and requires "corrugated wall pipe" to be greater than 6 inches larger than the required pipe sizes for the "smooth wall pipe." Note: When the design of "smooth wall pipe" is greater than 48 inches in diameter, the "greater than 6 inch" restriction will not apply.
   B. The analysis for the "corrugated wall pipe" requires a double line of storm drain to convey the design discharge when the "smooth wall pipe" only requires a single line of storm drain.
   C. The analysis for the "corrugated wall pipe" indicates the current flow line at outfalls cannot be hydraulically, environmentally, or economically constructed due to the required pipe size.
   D. The analysis for the "corrugated wall pipe" requires the use of a non-circular pipe when the "smooth wall pipe" allows circular pipe.

4. The hydraulic design study report should contain a brief section describing the alternate pipe designs. As a minimum, it should indicate the reason why any pipe type is eliminated from a project.

Hydraulic Analyses of Open Drainage Systems

The information outlined in the previous section dealing with Hydraulic Analyses of Closed Drainage Systems is applicable to Hydraulic Analyses of Open Drainage Systems except for the second hydraulic design criterion dealing with matching soffit to soffit. This criterion is not applicable for Open Drainage Systems.

The hydraulic designer will use the pipe information provided by the roadway designer and will select one of the acceptable models (software) specified in the SCDOT's "Requirements for Hydraulic Design Studies" to design open drainage systems. It should be noted that for driveway pipe 24 inches or less in diameter and 40 feet or less in length, alternate pipe (smooth wall pipe and corrugated wall pipe) of the same diameter will be used. When driveway pipe (existing or new) is 30 inches or larger in diameter, the hydraulic designer will evaluate and recommend the pipe size for each alternate. In addition, sideline pipes 40 feet or longer and all crossline pipes will be appropriately sized.

The hydraulic designer will be responsible for providing redlined plans to the roadway designer. The redlined plans will contain information for crossline pipe, sideline pipe (40 feet or greater) and driveway pipe modified in size or where the roadway designer has requested a recommended size from the hydraulic designer.

Geotechnical Analyses

The geotechnical engineer will determine the standard penetration test number (SPT "N") for each run of pipe except driveway pipe by using the nearest available soil boring at an appropriate depth for the pipe. This data will be provided to the roadway designer to be entered into the drainage table on the construction plans. This value is to be used by the contractor and the resident engineer, and compared to the standard drawing values to determine where pipe foundations are required. The need of additional foundation for driveway pipe will be determined by the resident engineer.

Structural Analyses

The structural design analyses will use the results of the hydraulic design analyses and the minimum and maximum fill heights to determine which specific type, class, or gage of pipe will be used. Standard Drawings 714-205-01, 714-205-02, 714-605-01, 714-605-02, 714-705-01, 714-705-02, 714-810-01, and 714-810-02 contain the fill height requirements for the various types, classes and gauges of pipes based on standard and construction loading. The roadway designer will determine the proposed minimum and maximum fill heights over the pipe by measuring the following conditions:

> Maximum cover = finished grade (top of curb, top of pavement, etc.) elevation **minus** the elevation of the top (outside diameter) of the pipe for each run between catch basins.
>
> Minimum cover = top of subgrade (for pipe not under traffic, finished grade may be used) **minus** the elevation of the top (outside diameter) of the pipe.

Note: Minimum and maximum cover (worst case) will be measured for each run of pipe between catch basins and for each crossline pipe.

The roadway designer will analyze the proposed plan (minimum and maximum) fill heights versus the fill height requirement shown in the standard drawings except for driveway pipe. Once the type, size, class or gage of the proposed pipes are determined, the minimum and maximum allowable fill heights common to all pipe types selected will be entered into the drainage table in the construction plans except for driveway pipe. The roadway designer will maximize the number of pipe types for a project that meet the hydraulic and structural analyses. The contractor will determine the fill heights for driveway pipe and select the proper class or gage required which will be reviewed by the resident engineer.

When installation depths fall outside the limits of the standard drawing fill height tables for pipe, then a custom or not applicable (NA) condition is encountered. For custom conditions, the roadway designer, hydraulic designer, and structural designer should consider altering the pipe design (changing pipe elevations, diameter, etc.) or working with members of the pipe industry to determine an appropriate custom pipe design. Loading for custom pipes shall meet or exceed the loading and design methodology used to develop the SCDOT standard drawing fill height tables for all pipes as described in Instructional Bulletin 2007-4. Not applicable (NA) conditions indicate that pipe type is not appropriate for designed conditions.

End Treatments

Install end treatments to meet the needs of the hydraulic or roadway design. Construct end treatments in accordance with SCDOT standard drawings or special design drawings in the plans for pipe end structures, pipe beveled ends, pipe straight ends, concrete pads, headwalls, wingwalls, apron/cut-off wall systems, etc. Protect embankment slopes from erosion at the inlet and outlet of pipes by installing riprap in accordance with SC-M-714 and SCDOT standard drawings around all end treatments to prevent scour. Exceptions to pipe end protection will be at the discretion of the hydraulic engineer and the roadway design engineer.

The design or construction engineer may place additional riprap at any pipe end whenever deemed necessary. Any installation of pipe may require beveled ends to match the adjacent slope for vehicle safety. If a project specifies the beveled ends, then all alternate pipe shall be beveled or an appropriate beveled end treatment provided. Flexible pipe shall include a structural design for beveled ends as required by SCDOT standard drawings. Beveled pipe ends should be noted during the field review.

Procedure for Placing Alternate Pipe Information on Plans for Projects with a Closed System

For a closed system, the hydraulic designer will complete the drainage design using current drainage design software and will provide a report electronically to the roadway designer. The hydraulic designer will identify all types of drainage pipes, culverts and structures in the report given to the roadway designer. When the hydraulic designer determines that the corrugated wall alternate will be eliminated due to hydraulic design criteria not being met, then the hydraulic designer will note the reason the corrugated wall alternate is not a viable alternate for that particular system. No corrugated wall alternate design will be provided in the hydraulic report. The roadway designer will place the report into a spreadsheet in order to further develop the drainage table data for the plans. The roadway designer will acquire data from the geotechnical designer, district personnel, and the standard drawings in order to complete the final drainage data table to be placed in the plans. All pipes will be identified on the plans with a link ID. Drainage structures will be labeled on the plan sheet as in the past, but adding its node ID (For example: Construct Catch Basin Type_________ (CB-_________)). A complete listing of these "IDs" is contained in Table 2 in the Appendix.

Only the pipe and drainage structures indicated on a plan sheet will be included in the Drainage Data Table for that sheet. Drainage data for a closed system will be placed on the same table with the drainage data for an open system.

Procedure for Placing Alternate Pipe Information on Plans for Projects with an Open Drainage System

The roadway designer will label all existing pipe with link-ID (DP- _____, SLP-_____, or CLP-_____), and place existing driveway, sideline, or crossline pipe information in the drainage data table. A complete listing of these "IDs" is contained in Table 2 in the Appendix.

Where the existing driveway pipe is 30 inches or larger, the roadway designer will place a note on the plans at that pipe location stating, "Need recommendation from hydraulic designer." After the above information is placed on the plans, the plans will be provided to the hydraulic designer to complete the project hydraulic analysis.

For driveway pipes 30 inches or larger in diameter, the hydraulic designer will evaluate and recommend their sizes. The hydraulic designer will analyze crosslines and appropriate sideline pipes, and provide the results on redlined plans to the roadway designer showing the crossline and sideline information as well as driveway pipes that are recommended to be changed in size or where the roadway designer has requested a recommendation from the hydraulic designer.

The roadway designer will use the redlined plans provided by the hydraulic designer to update the plans and place the driveway, sideline and crossline pipe information in the drainage data table. The driveway, sideline and crossline pipe information is to be placed in the same drainage data table used for a closed system in the same set of plans. The roadway designer will be responsible to determine the minimum and maximum fill heights for sideline and crossline pipe. Minimum and maximum fill heights for driveway pipe (DP) will be determined by the contractor and verified by the resident engineer before the contractor selects the type of pipe to be placed on a project.

Examples Showing Alternate Pipe Information on Plans

Three examples of placing pipe data on construction plans for closed systems have been developed and are described below. Drainage structures will be labeled on the plans along with a structure identification ("ID"). Pipe shown on the plans will be labeled with the appropriate pipe "ID." Table 2 in the Appendix shows the "ID" naming convention. The fourth example shows how to handle pipe in open systems.

Any of the following three examples may be used for closed systems in the preparation of the final construction plans.

Example 1: The preferred method for larger projects is to dither the drainage but not label the drainage on the plan, or plan and profile sheet. Provide a drainage sheet (D1, D2, ...) with roadway design dithered and all drainage items shown in bold and labeled as shown on the attached example. Place the drainage table on the bottom of the drainage sheet. See "Example 1" in the Appendix.

Example 2: For small projects with limited number of plan and profile sheets (3 or less), it may be desired to place the drainage data on the bottom of the following sheet with the option of the station-offset descriptions on the top. See "Example 2" in the Appendix.

Example 3: Another allowable method consists of a full plan sheet (with topographic and drainage layout) followed with the drainage data in the table on the top of the profile sheet. See "Example 3" in the Appendix.

*Slight modifications to the three examples previously mentioned may be made at the discretion of the roadway designer to accommodate the need to vary the sheet layout as necessary. Modifications to these examples should be kept to a minimum so plan consistency will be achieved.

Example 4: Demonstrates how pipe in open systems are shown on plans. The drainage data for pipes in an open system are to be placed in the drainage data table. Drainage data for open and closed systems, if on the same plan sheet; are to be placed in the same drainage data table.

Calculation of Quantities:

As noted earlier, a drainage system of pipe is defined as a series of drainage structures (catch basins, drop inlets, manholes, etc.) linked together by drainage pipes with a common outlet point or an independent crossline pipe. The hydraulic and structural design for each system will determine if "smooth wall pipe" and/or "corrugated wall pipe" can be used and if so what type, size, class and gage.

The roadway designer will calculate the quantities of pipe using the pay items of "smooth wall pipe" and "corrugated wall pipe" of the diameter specified by the design. "Smooth wall pipe" includes reinforced concrete pipe (RCP), high density polyethylene (HDPE), and spiral ribbed aluminum pipe (SRAP). "Corrugated wall pipe" includes only corrugated aluminum alloy pipe (CAAP). The roadway designer should reference the latest pay item list to obtain the appropriate pay item numbers.

If both "smooth wall pipe" and "corrugated wall pipe" are viable alternatives, then the quantities of each type and diameter of pipe for that system will be added to the drainage table. The roadway designer will analyze each drainage system then separately add the quantities of "smooth wall pipe" and "corrugated wall pipe." Pipe quantities will be the linear measurement from end to end of the pipe through tees, wyes, bends, reducers, increasers, beveled ends and elbows (See Figure 1, lines 5-10), excluding all drainage structures, as described in Supplemental Technical Specification SC-M-714. The manufacturing expense to make tees, wyes, bends, reducers, increasers, beveled ends and elbows will be measured and paid per each installed and complete as shown in the plans.

If only one pipe type is specified for a drainage system, then the quantity of pipe for that drainage system including connectors will be shown and the quantity will be a normal pay item. An example would be a case where a drainage system could only be constructed using RCP. The roadway designer would create a normal pay item for "smooth wall pipe" of the diameter specified (see Figure 1, line 3) and only list the "smooth wall pipe" on the drainage table in the plans indicating only the RCP option. The remaining vacant blocks should be filled with a single dashed line (—).

If a system design specifies only RCP for the smooth wall pipe, and CAAP for the corrugated wall pipe, then the designer will place the respective items and quantities for "smooth wall pipe" and "corrugated wall pipe" into the drainage table and add to the alternate pay item groups.

All blocks for each line entry shall be completed. In cases where one pipe type is not allowed, the corresponding blocks are to be filled with a single dashed line (—), and no class, gage, etc. indicated.

The following is an example plan pay item quantity sheet which shows normal and alternate pay items. A project may have both, normal and alternate pay items. In the example, the 72' of 18" SMOOTH WALL PIPE shall be smooth wall only with no other option available. The alternate quantities of 584' of 18" SMOOTH WALL PIPE are in addition to the 72' of 18" SMOOTH WALL PIPE.

NORMAL PAY ITEMS

Line #	Item	Description	Quantity	Unit
1	2031000	UNCLASSIFIED EXCAVATION	1,000	CY
2	2033000	BORROW EXCAVATION	550	CY
3	7143618	18" SMOOTH WALL PIPE	72	LF
4	8101000	SEEDING MULCHED	1.789	MSY

SELECT FROM THE FOLLOWING ALTERNATE PAY ITEMS
BIDDERS SHALL BID ON ONLY ONE ALTERNATE

ALTERNATE 1

5	7143618	18" SMOOTH WALL PIPE	584	LF
6	7143624	24" SMOOTH WALL PIPE	224	LF
7	7143805	18"X18" SM. WALL PIPE CUL.TEE	2	EA

ALTERNATE 2

8	7144518	18" CORR. WALL PIPE	584	LF
9	7144524	24" CORR. WALL PIPE	224	LF
10	7144705	18"X18" CORR.WALL PIPE CUL.TEE	2	EA

FIGURE 1

After Project is Awarded for Construction

To effectively monitor the various types of pipe outlined in the new SCDOT Permanent Pipe Specification (SC-M-714) and to accurately track what type of pipe is being installed, a procedure has been developed for identifying each type of pipe using SiteManager.

Below, is a listing of each type of pipe along with a code to be entered into SiteManager. When a contract has a smooth wall pipe item, the resident construction engineer will enter the corresponding code shown below in the "**Items**" window in SiteManager in the box labeled "**Supplemental Descriptions**."

SiteManager Pipe Codes

Smooth Wall Pipe:

RCP3	REINFORCED CONCRETE PIPE CLASS III
RCP4	REINFORCED CONCRETE PIPE CLASS IV
RCP5	REINFORCED CONCRETE PIPE CLASS V
HDPES	HIGH DENSITY POLYETHYLENE PIPE TYPE S
SRAP16	SPIRAL RIBBED ALUMINUM PIPE 16 GAGE
SRAP14	SPIRAL RIBBED ALUMINUM PIPE 14 GAGE
SRAP12	SPIRAL RIBBED ALUMINUM PIPE 12 GAGE
SRAP10	SPIRAL RIBBED ALUMINUM PIPE 10 GAGE

Corrugated Wall Pipe:

CAAP16	CORRUGATED ALUMINUM ALLOY PIPE 16 GAGE
CAAP14	CORRUGATED ALUMINUM ALLOY PIPE 14 GAGE
CAAP12	CORRUGATED ALUMINUM ALLOY PIPE 12 GAGE
CAAP10	CORRUGATED ALUMINUM ALLOY PIPE 10 GAGE
CAAP8	CORRUGATED ALUMINUM ALLOY PIPE 8 GAGE

In SiteManager, smooth wall pipe is preloaded as reinforced concrete pipe. If the contractor opts to install a different type of pipe, a zero-dollar change order should be created for the anticipated amount using the same item code, and entering a negative amount for the original line item.

For example: If a contract is let with 1,000 feet of 7143618: 18" SMOOTH WALL PIPE as line item 0150 and the contractor is using "Reinforced Concrete Pipe Class IV", "RCP4" should be entered into the "Supplemental Descriptions" box in the "Items" window in SiteManager. If the contractor decides to install 200 linear feet of High Density Polyethylene Pipe Type S in lieu of Concrete Pipe, a change order must be created to add 200 feet of 7143618 with a supplemental description of HDPES under line item 0151. The change order should also reflect a -200 lf. adjustment to line item 0150; thereby, "backing out" the concrete quantities.

If there is a change to the type of pipe, a quick change order can be created and approved without requiring multiple levels of approval or affecting any contractor or resident construction engineer ratings.

In addition to the above, the resident construction engineer will be required to complete the drainage data table included in the construction plans. To complete the table, the resident will simply check which type pipe is installed during construction. This information will be turned in as part of the "as-built" plans. As mentioned earlier, minimum and maximum fill heights for driveway pipe (DP) will be determined by the contractor and verified by the resident construction engineer before the contractor selects the type of pipe to place on a project. The need of additional foundation for driveway pipe will be determined after project award by the resident construction engineer and adjustments to the quantities will be made to reflect "additional pipe foundation" work.

Approved: ______________________________
E. S. Eargle
Preconstruction Support Engineer

ESE:cks
Attachments
cc:
Jim Feda, Director of Maintenance
Steve Ikerd, FHWA
Ron Patton, Director of Planning
Danny Shealy, Director of Construction
Rick Werts, Director of Traffic Engineering
Matt Lifsey, RP Engineer – Lowcountry
Mike Barbee, Interim RP Engineer – Pee Dee
Randall Young, RP Engineer – Midlands
Mark Lester, RP Engineer – Upstate
Milt Fletcher, Material and Research Engineer

File:PC/ESE

APPENDIX

Table 1: Manning's "n" Values for Various Pipe Types and Sizes

Corrugated Aluminum Alloy Pipe (Corrugated Wall Pipe)

Corrugation	Nominal Diameter (In.)	Manning's - "n" Value
2 2/3" x 1/2"	12	*
2 2/3" x 1/2"	15	*
2 2/3" x 1/2"	18	0.015
2 2/3" x 1/2"	24	0.015
3" x 1"	30	0.024
3" x 1"	36	0.024
3" x 1"	42	0.024
3" x 1"	48	0.024
3" x 1"	54	0.024
3" x 1"	60	0.024
3" x 1"	66	0.027
3" x 1"	72	0.027
3" x 1"	78	0.027
3" x 1"	84	0.027
3" x 1"	90	0.027
3" x 1"	96	0.027
3" x 1"	108	0.027
3" x 1"	120	0.027

* Contact Manufacturer - For Manning's "n" Value
See Standard Drawings 714-810-01, and 714-810-02 for Fill Height details, etc.

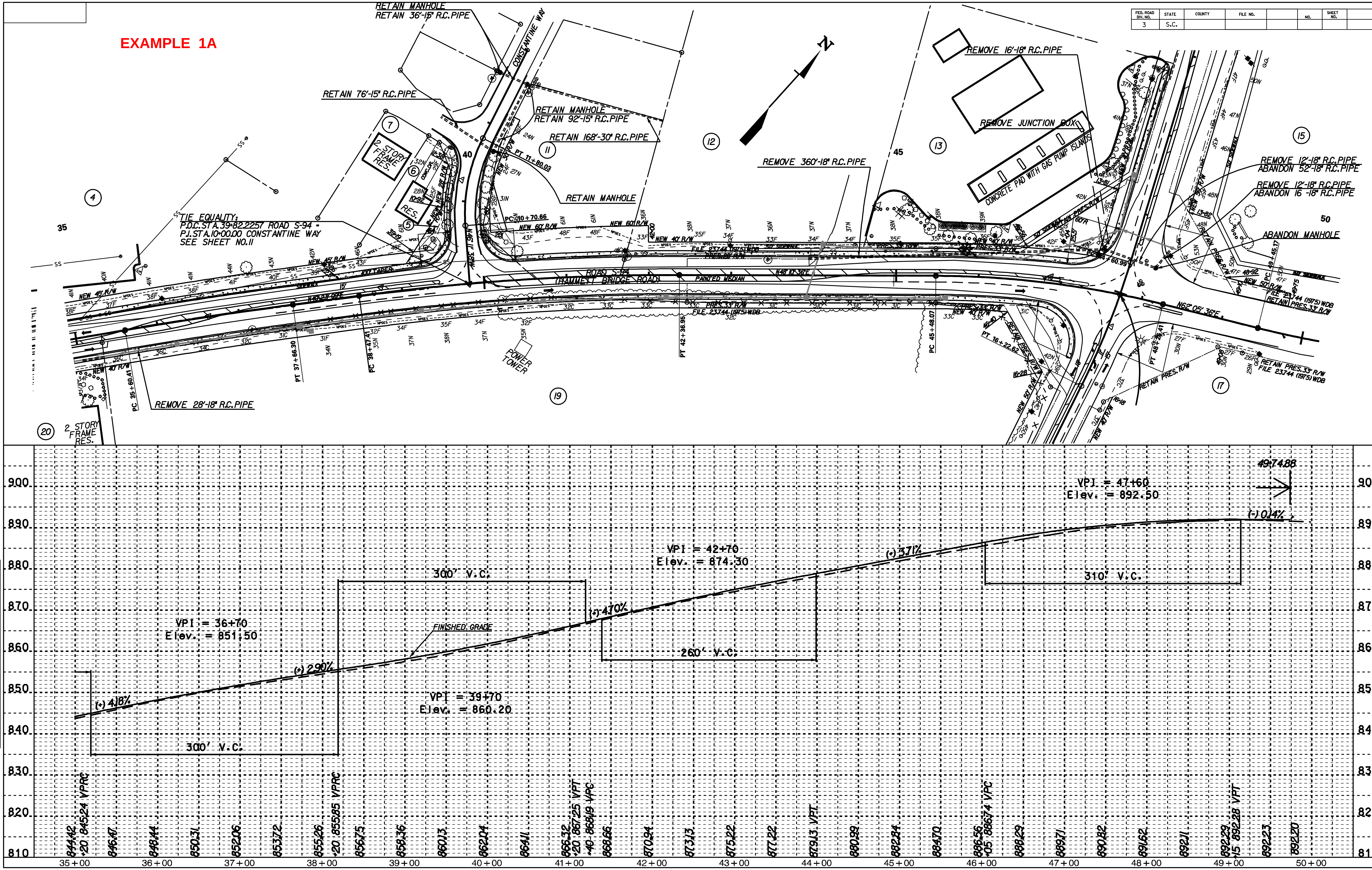
High Density Polyethylene Pipe - Type S, Spiral Ribbed Aluminum Pipe, and Reinforced Concrete Pipe (Smooth Wall Pipe)

	Nominal Diameter (In.)	Manning's - "n" Value
	12	*
	15	*
	18	0.012
	24	0.012
	30	0.012
	36	0.012
	42	0.012
	48	0.012
	54	0.012
	60	0.012
	66	0.012
	72	0.012
	78	0.012
	90	0.012
	96	0.012
	108	0.012
	120	0.012

* Contact Manufacturer - For Manning's "n" Value
See Standard Drawings 714-205-01, 714-205-02, 714-605-01, 714-605-02, 714-705-01, 714-705-02 for Fill Height details, etc.

Table 2: Drainage Structure "ID" and Pipe Naming Convention	
Drainage Structure "ID"	
New Drainage Structure	
Node Type	*ID Prefix*
CB Type 1, 9, 15, 16, 17, 18	CB
DI 112, 115, 24 x 24, 24 x 36	DI
Tee Joints	T
MH, JB	MH, JB
Dummy Nodes	DN
Outlet	OP
Water Quality Structure	WQS
Bends (15, 30, 45, 90)	B
Wyes	Y
Rebuild Existing Structure	RB
Existing Drainage Structure	
All CB, DI, Tee Joints, MH, JB, Dummies, Outlets, Water Quality Structure, Bends, Wyes	EX
Pipe Naming Convention – Items USED in Geopak Drainage	
Node Type	*ID Prefix*
Existing Pipe	EP
New Pipe	NP
Pipe Naming Convention - Items NOT used in Geopak Drainage	
Node Type	*ID Prefix*
Arch Pipe	AP
Box Culvert	BC
Crossline Pipe	CLP
Driveway Pipe	DP
Elliptical Pipe	ELP
Sideline Pipe	SLP

EXAMPLE 1A


RETAIN MANHOLE
RETAIN 36'-15" R.C.PIPE
CONSTANTINE WAY
RETAIN 76'-15" R.C.PIPE
RETAIN MANHOLE
RETAIN 92'-15" R.C.PIPE
RETAIN 168'-30" R.C.PIPE
RETAIN MANHOLE
REMOVE 16'-18" R.C.PIPE
REMOVE JUNCTION BOX
CONCRETE PAD WITH GAS PUMP ISLANDS
REMOVE 360'-18" R.C.PIPE
REMOVE 12'-18" R.C.PIPE
ABANDON 52'-18" R.C.PIPE
REMOVE 12'-18" R.C.PIPE
ABANDON 16'-18" R.C.PIPE
ABANDON MANHOLE
2 STORY FRAME RES.
RES.
TIE EQUALITY:
P.O.C.STA.39+82.2257 ROAD S-94 =
P.I.STA.10+00.00 CONSTANTINE WAY
SEE SHEET NO.11
ROAD S-94
(HAMMETT BRIDGE ROAD)
PAINTED MEDIAN
POWER TOWER
REMOVE 28'-18" R.C.PIPE
2 STORY FRAME RES.
PT 11+80.03
PC 10+70.66
PC 35+60.41
PT 37+66.30
PC 38+47.41
PT 42+36.95
PC 45+48.07
PT 46+22.62
RETAIN PRES. R/W
FEDERAL ROAD DIV. NO.
STATE
COUNTY
FILE NO.
SHEET NO.
3
S.C.
VPI = 36+70
Elev. = 851.50
300' V.C.
(+) 4.18%
(+) 2.90%
VPI = 39+70
Elev. = 860.20
300' V.C.
FINISHED GRADE
(+) 4.70%
VPI = 42+70
Elev. = 874.30
260' V.C.
(+) 3.71%
VPI = 47+60
Elev. = 892.50
310' V.C.
(-) 0.14%
49+74.88
844.42
+20 845.24 VPRC
846.47
848.44
850.31
852.06
853.72
855.26
+20 855.85 VPRC
856.75
858.36
860.13
862.04
864.11
866.32
+20 867.25 VPT
+40 868.19 VPC
868.66
870.94
873.13
875.22
877.22
879.13 VPT
880.99
882.84
884.70
886.56
+05 886.74 VPC
888.29
889.71
890.82
891.62
892.11
892.29
+15 892.28 VPT
892.23
892.20
900
890
880
870
860
850
840
830
820
810
35+00
36+00
37+00
38+00
39+00
40+00
41+00
42+00
43+00
44+00
45+00
46+00
47+00
48+00
49+00
50+00
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NOTE BOOK
SURVEYED
PLOTTED
ALIGNMENT CHECKED
GRADES CHECKED
STRUCTURE NOTATIONS CHECKED
BY
DATE
AustinME
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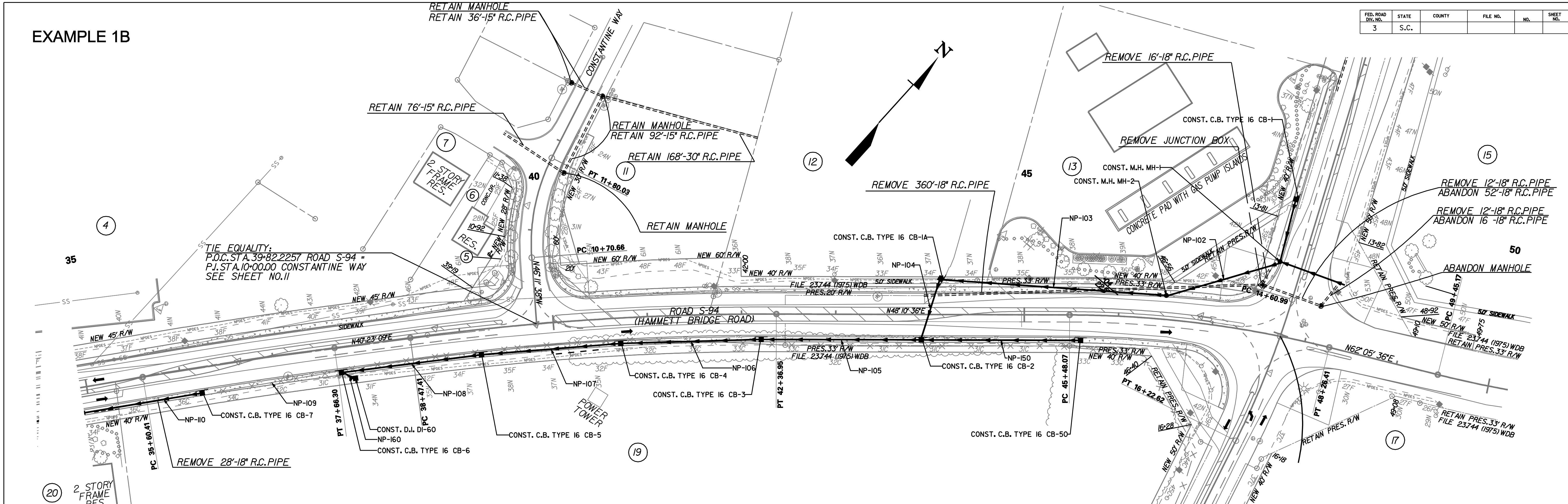
27-JUL-2009
proline.dgn

EXAMPLE 1B



Smooth Wall Pipe

System ID	Link ID	Geometry: Diameter (in)	Geometry: No. of Barrels	Geometry: Pipe Length (ft)	Geometry: Slope (%)	Upstream: Node	Upstream: Node Description	Upstream: Node Station	Upstream: Link Invert (ft)	Downstream: Node	Downstream: Node Description	Downstream: Node Station	Downstream: Link Invert (ft)	Fill Height: Min (ft)	Fill Height: Max (ft)	Min Field SPT "N" below invert	Joint Pressure (psi)	Smooth Wall Options: HDPE Type	Built ✓	RCP Highest Class	Built ✓	SRAP Thickest Gage	Built ✓
1	NP-101	18	1	68.12	0.3	CB-1	C.B. TYPE 16	13+58.00	888.66	MH-1	M.H.	14+26.20	888.47	3.32	2.98	25	10	S		III		16ga	
1	NP-102	18	1	122.87	1.52	MH-1	M.H.	14+26.20	888.47	MH-2	M.H.	46+48.66 R 2	886.6	2.98	1.94	25	10	S		IV		16ga	
1	NP-103	18	1	239.97	3.92	MH-2	M.H.	46+48.66 R 2	886.6	CB 1A	C.B. TYPE 16	44+13.61 R 2	877.32	1.94	2	27	10	S		IV		16ga	
1	NP-104	18	1	67.82	3.51	CB 1A	C.B. TYPE 16	44+13.61 R 2	877.32	CB-2	C.B. TYPE 16	43+90.81 R 2	875.06	2	1.98	35	10	S		IV		16ga	
1	NP-105	18	1	169.85	4.19	CB-2	C.B. TYPE 16	43+90.81 R 2	875.06	CB-3	C.B. TYPE 16	42+20.81 R 2	868.12	1.98	2	25	10	S		IV		16ga	
1	NP-106	18	1	149.13	4.74	CB-3	C.B. TYPE 16	42+20.81 R 2	868.12	CB-4	C.B. TYPE 16	40+70.26 R 2	861.24	2	2	25	10	S		III		16ga	
1	NP-107	18	1	148.32	4.04	CB-4	C.B. TYPE 16	40+70.26 R 2	861.24	CB-5	C.B. TYPE 16	39+20.52 R 2	855.41	2	2	25	10	S		III		16ga	
1	NP-108	18	1	149.77	3.17	CB-5	C.B. TYPE 16	39+20.52 R 2	855.41	CB-6	C.B. TYPE 16	37+70.07 R 2	850.79	2	2.5	27	10	S		III		16ga	
1	NP-109	24	1	149.35	3.55	CB-6	C.B. TYPE 16	37+70.07 R 2	850.29	CB-7	C.B. TYPE 16	36+20.03 R 2	845.13	2	2	25	10	S		III		16ga	
1	NP-110	24	1	134.78	4.23	CB-7	C.B. TYPE 16	36+20.03 R 2	845.13	CB-8	C.B. TYPE 16	34+84.98 R 2	839.6	2	2.22	30	10	S		III		16ga	
1	NP-150	18	1	169.01	3.69	CB-50	C.B. TYPE 16	45+60.10 R 2	881.15	CB-2	C.B. TYPE 16	43+90.81 R 2	875.06	2	1.98	25	10	S		IV		16ga	
1	NP-160	18	1	15.23	8.59	DI-60	D.I. 24"X36"	37+84.08 R 2	852.13	CB-6	C.B. TYPE 16	37+70.07 R 2	850.79	1.08	2.5	25	10	S		IV		16ga	

Corrugated Wall Pipe

System ID	Link ID	Geometry: Diameter (in)	Geometry: No. of Barrels	Geometry: Pipe Length (ft)	Geometry: Slope (%)	Upstream: Node	Upstream: Node Description	Upstream: Node Station	Upstream: Link Invert (ft)	Downstream: Node	Downstream: Node Description	Downstream: Node Station	Downstream: Link Invert (ft)	Fill Height: Min (ft)	Fill Height: Max (ft)	Min Field SPT "N" below invert	Joint Pressure (psi)	Corrugated Wall Options: CAAP Thickest Gage	Built ✓
1	NP-101	18	1	68.12	0.3	CB-1	C.B. TYPE 16	13+58.00	888.66	MH-1	M.H.	14+26.20	888.47	3.32	2.98	25	10	16ga	
1	NP-102	18	1	122.87	1.52	MH-1	M.H.	14+26.20	888.47	MH-2	M.H.	46+48.66 R 2	886.6	2.98	1.94	25	10	16ga	
1	NP-103	18	1	239.97	3.92	MH-2	M.H.	46+48.66 R 2	886.6	CB 1A	C.B. TYPE 16	44+13.61 R 2	877.32	1.94	2	27	10	16ga	
1	NP-104	18	1	67.82	3.51	CB 1A	C.B. TYPE 16	44+13.61 R 2	877.32	CB-2	C.B. TYPE 16	43+90.81 R 2	875.06	2	1.98	35	10	16ga	
1	NP-105	18	1	169.85	4.19	CB-2	C.B. TYPE 16	43+90.81 R 2	875.06	CB-3	C.B. TYPE 16	42+20.81 R 2	868.12	1.98	2	25	10	16ga	
1	NP-106	18	1	149.13	4.74	CB-3	C.B. TYPE 16	42+20.81 R 2	868.12	CB-4	C.B. TYPE 16	40+70.26 R 2	861.24	2	2	25	10	16ga	
1	NP-107	18	1	148.32	4.04	CB-4	C.B. TYPE 16	40+70.26 R 2	861.24	CB-5	C.B. TYPE 16	39+20.52 R 2	855.41	2	2	25	10	16ga	
1	NP-108	18	1	149.77	3.17	CB-5	C.B. TYPE 16	39+20.52 R 2	855.41	CB-6	C.B. TYPE 16	37+70.07 R 2	850.79	2	2.5	27	10	16ga	
1	NP-109	24	1	149.35	3.55	CB-6	C.B. TYPE 16	37+70.07 R 2	850.29	CB-7	C.B. TYPE 16	36+20.03 R 2	845.13	2	2	25	10	16ga	
1	NP-110	24	1	134.78	4.23	CB-7	C.B. TYPE 16	36+20.03 R 2	845.13	CB-8	C.B. TYPE 16	34+84.98 R 2	839.6	2	2.22	30	10	16ga	
1	NP-150	18	1	169.01	3.69	CB-50	C.B. TYPE 16	45+60.10 R 2	881.15	CB-2	C.B. TYPE 16	43+90.81 R 2	875.06	2	1.98	25	10	16ga	
1	NP-160	18	1	15.23	8.59	DI-60	D.I. 24"X36"	37+84.08 R 2	852.13	CB-6	C.B. TYPE 16	37+70.07 R 2	850.79	1.08	2.5	25	10	16ga	

AustinME
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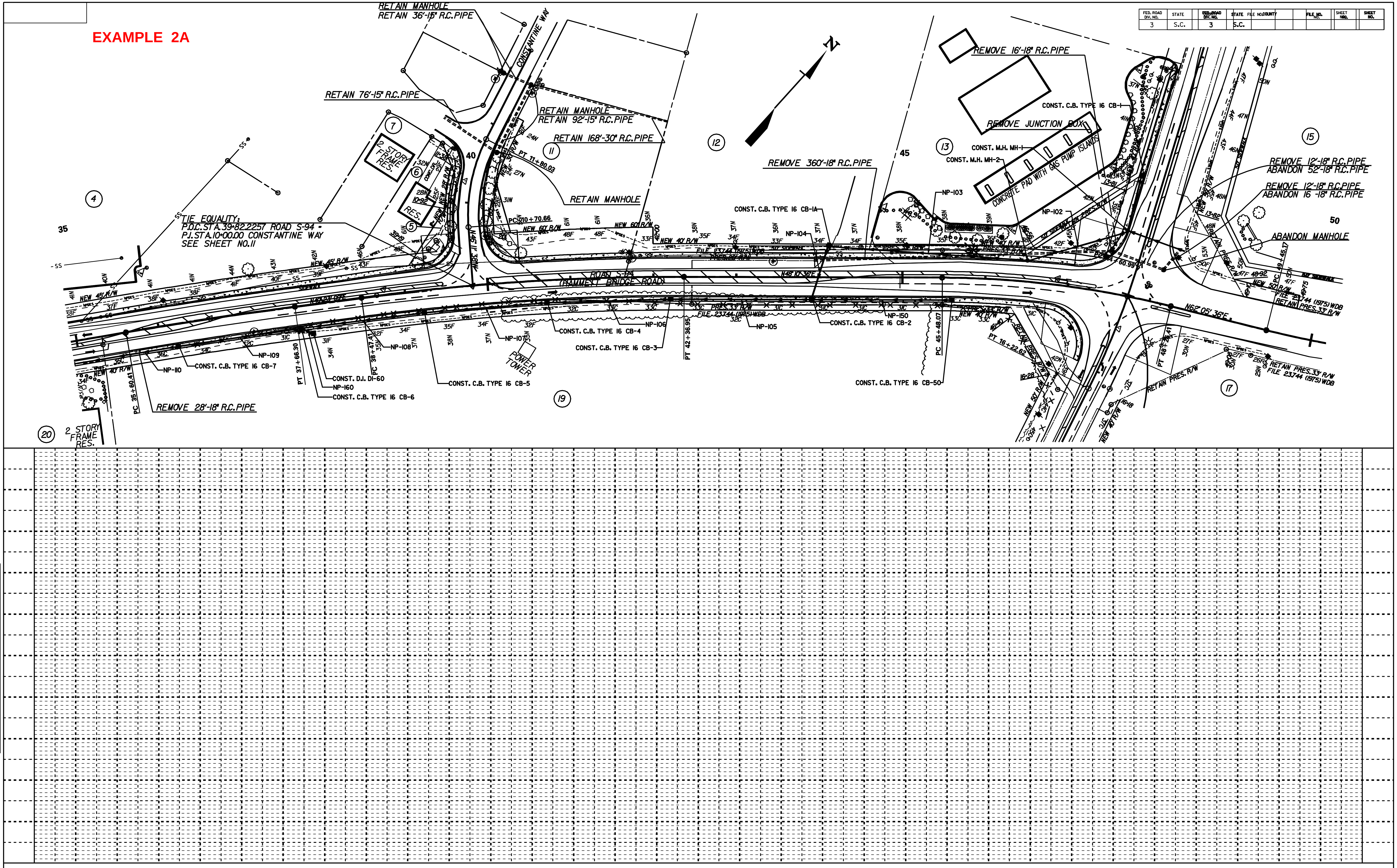
14-SEP-2009

EXAMPLE 2A



PLAN

SURVEYED
PLOTTED
ALIGNMENT CHECKED
R/W CHECKED
NOTE BOOK
No.
BY
DATE

$$user$$
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$$$date$$$$

PROFILE

SURVEYED
PLOTTED
GRADES CHECKED
B.M.'S NOTED
STRUCTURE NOTATIONS CHECKED
NOTE BOOK
No.
BY
DATE

proline6.dgn

FED. ROAD DIV. NO.	STATE	COUNTY	FILE NO.	NO.	SHEET NO.
3	S.C.				

EXAMPLE 2B

LEFT
Station-Offset Description

35+10--22.3' M.HOLE-S/S
35+34--23.5' M.HOLE-S/S
35+70--89.3' M.HOLE-S/S
35+89--68.6' LIGHT POLE 4IN PLASTIC
35+98--72.8' W.VALVE
36+11--30.6' P.POLE
37+17--52.9' TREE 10IN PECAN
37+64--138.7' I.PIN
38+10--100.2' I.PIN
38+10--43.3' P.POLE
38+34--37.7' M.HOLE-S/S
38+56--61.3' I.PIN
38+66--.5' I.PIN
39+05--134.2' BLDG.
39+19--33.8' TREE 4 MAPLE
39+24--46.9' WALL 6 BLOCK U
39+28--39.3' W.VALVE
39+32--46.6' WALL
39+33--47.0' FLR.BED
39+33--49.1' SHRUB
39+37--41.8' WALL
39+37--50.5' FLR.BED
39+42--45.6' SIGN
39+42--55.3' SIGN
39+42--55.7' FLR.BED
39+43--58.1' SHRUB
39+44--41.1' WALL
39+46--58.9' FLR.BED
39+47--50.5' SIGN OCK
39+47--60.2' WALL 4 ROCK U
39+48--44.6' FLOOD LIGHT
39+48--69.0' WALL
39+49--43.6' WALL
39+51--53.8' WALL
39+52--48.6' WALL
39+56--50.1' FLAG POLE
39+61--56.7' I.PIN
39+61--57.5' FLAG POLE
39+61--62.3' LIGHT POLE 4 PLASTIC
39+62--73.8' TREE 4 MAPLE
39+64--95.8' TREE 4 MAPLE
39+65--104.9' I.PIN
39+67--117.8' TREE 4 MAPLE
39+73--138.8' TREE 4 MAPLE
40+01--58.9' WITNESS POST BS
40+04--55.3' W.VALVE
40+04--76.1' TREE 4 MAPLE
40+05--48.6' W.METER
40+05--55.4' F.HYD.
40+06--65.5' FLAG POLE
40+06--96.2' TREE 4 MAPLE
40+07--48.6' W.VALVE
40+09--56.3' FLAG POLE
40+09--62.7' FLR.BED

40+10--115.4' TREE 4 MAPLE
40+10--50.6' W.VALVE
40+10--53.3' FLR.BED
40+12--47.1' FLAG POLE
40+13--70.5' FLR.BED
40+15--134.5' TREE 4 MAPLE
40+17--44.6' FLR.BED
40+18--61.6' SHRUB LINE
40+25--40.0' FLR.BED
40+29--59.8' FLR.BED
40+32--44.5' SHRUB LINE
40+40--39.4' FLR.BED
40+42--35.1' TREE 2 MAPLE
41+61--30.5' G.WIRE
41+63--30.1' G.WIRE

41+71--30.2' P.POLE
41+72--29.5' T.V.PED.
41+75--23.3' WITNESS POST BS
41+84--26.0' M.HOLE-S/S
42+98--42.4' G.WIRE
42+99--35.8' P.POLE
43+44--18.9' WITNESS POST GAS
44+50--36.4' I.PIN
44+70--48.0' W.VALVE
44+73--80.0' FLR.BED
44+77--84.2' LIGHT POLE 4X4 METAL
44+87--29.8' M.HOLE-S/S
44+97--81.3' FLR.BED
45+02--75.3' MISC PT.GREASE PIT MH
45+03--80.6' MISC PT.GREASE PIT MH
45+05--39.0' P.POLE
45+07--72.1' MISC PT.4 PVC
45+07--96.5' SHRUB LINE
45+13--80.3' TREE 4 MAPLE
45+13--91.4' CONCRETE PAD
45+16--76.7' FLR.BED
45+16--94.3' CONCRETE PAD
45+17--89.6' MISC PT.VAC/AIR
45+19--86.9' CONCRETE PAD
45+21--89.8' CONCRETE PAD
45+37--77.8' CONCRETE PAD
45+38--70.9' MISC PT.PHONE
45+39--56.5' FLR.BED
45+41--57.1' TREE 4 MAPLE
45+43--72.8' CONCRETE PAD
45+48--33.0' I.PIN
45+50--53.5' SHRUB LINE
45+51--55.2' CONCRETE PAD
45+51--65.3' CONCRETE PAD
45+52--49.1' FLR.BED
45+55--60.9' U/G TANK FILL CAP
45+62--49.1' TREE 4 MAPLE
45+63--60.8' U/G TANK FILL CAP
45+67--60.6' U/G TANK FILL CAP
45+70--60.7' U/G TANK FILL CAP

45+72--60.7' U/G TANK FILL CAP
45+75--63.1' MISC PT.VENT
45+77--60.7' U/G TANK FILL CAP
45+79--60.7' U/G TANK FILL CAP
45+82--60.6' U/G TANK FILL CAP
45+83--111.5' CONCRETE PAD
45+84--111.0' CANOPY
45+89--46.5' TREE 4 MAPLE
45+90--60.8' U/G TANK FILL CAP
45+95--111.5' GAS PUMP ISL
45+96--90.0' CONCRETE PAD
45+96--92.0' CANOPY
45+98--60.6' U/G TANK FILL CAP
46+01--60.6' U/G TANK FILL CAP
46+02--100.2' GAS PUMP ISL 8
46+05--44.8' FLR.BED
46+05--54.9' CONCRETE PAD
46+05--64.0' CONCRETE PAD
46+15--127.7' GAS PUMP ISL
46+16--51.5' W.VALVE
46+17--48.5' FLR.BED
46+17--50.3' W.VALVE
46+17--52.0' W.VALVE
46+18--55.6' TREE 4 MAPLE
46+21--55.0' FLR.BED
46+23--116.5' GAS PUMP ISL 8
46+23--64.3' FLR.BED
46+29--61.3' LIGHT POLE 4X4 METAL
46+35--144.4' GAS PUMP ISL
46+43--133.5' GAS PUMP ISL 8
46+97--52.2' P.POLE
46+97--70.4' G.WIRE
47+15--46.3' G.WIRE
47+17--141.7' FLR.BED
47+21--138.5' FLR.BED
47+24--50.2' G.WIRE
47+27--138.7' FLR.BED
47+27--148.2' SHRUB LINE
47+34--146.3' W.VALVE
47+37--57.0' T.V.PED.
47+39--42.8' P.POLE
47+44--60.8' G.WIRE
47+45--50.4' J.BOX
47+93--16.0' W.VALVE
47+94--21.1' W.VALVE
47+96--46.6' W.VALVE
47+97--18.1' W.VALVE
48+08--40.7' M.HOLE
48+21--59.2' P.POLE
48+26--78.5' G.WIRE
48+39--61.7' G.WIRE
48+79--67.0' P.POLE
48+86--121.4' TREE 2IN HOLLY
48+87--107.4' FLR.BED
48+90--117.1' FLR.BED
48+91--118.2' SIGN
48+93--100.1' FLR.BED
49+02--135.6' TREE 4IN CHERRY
49+04--102.3' FLR.BED
49+05--103.2' SIGN 4 BRICK
49+08--97.2' TREE 2IN HOLLY

RIGHT
Station-Offset Description

35+02-76.0' TREE 4 BIRCH
35+05-43.8' FLR.BED
35+10-141.7' BLDG.
35+10-75.2' FLR.BED
35+12-84.9' BLDG.
35+16-67.4' SHRUB LINE
35+20-78.2' T.V.PED.
35+23-54.6' FLR.BED
35+23-54.8' FLR.BED
35+23-73.1' FLR.BED
35+23-90.6' WALL 4 BLOCK U
35+24-60.0' WALL
35+30-10.1' I.PIN
36+36-28.4' FENCE 48
37+13-23.5' WITNESS POST BS
37+14-26.7' FENCE
37+75-24.9' FENCE
38+02-23.6' FENCE
38+76-23.4' FENCE
39+53-23.8' FENCE
40+16-19.9' WDS.LINE
40+16-44.7' WDS.LINE
40+17-22.7' FENCE
40+31-84.7' POWER TOWER OWER
40+40-71.8' POWER TOWER
40+44-93.7' POWER TOWER
40+53-80.8' POWER TOWER
40+73-23.2' FENCE
40+89-18.9' WDS.LINE
41+62-19.0' WDS.LINE
41+63-28.5' FENCE
42+45-20.4' WDS.LINE
42+46-32.9' FENCE
42+46-33.0' I.PIN
43+29-33.8' FENCE
43+30-24.5' WDS.LINE
44+06-33.7' FENCE
44+08-25.3' WDS.LINE
44+77-28.7' WDS.LINE
44+77-39.8' WDS.LINE
44+78-33.2' FENCE

Smooth Wall Pipe

		Geometry				Upstream				Downstream				Fill Height		Min Field	Joint	Smooth Wall Options					
System ID	Link ID	Diameter (in)	No. of Barrels	Pipe Length (ft)	Slope (%)	Node	Node Description	Node Station	Link Invert (ft)	Node	Node Description	Node Station	Link Invert (ft)	Min (ft)	Max (ft)	SPT "N" below invert	Pressure (psi)	HDPE Type	Built ✓	RCP Highest Class	Built ✓	SRAP Thickest Gage	Built ✓
1	NP-101	18	1	68.12	0.3	CB-1	C.B. TYPE 16	13+58.00	888.66	MH-1	M.H.	14+26.20	888.47	3.32	2.98	25	10	S		III		16ga	
1	NP-102	18	1	122.87	1.52	MH-1	M.H.	14+26.20	888.47	MH-2	M.H.	46+48.66 R 2	886.6	2.98	1.94	25	10	S		IV		16ga	
1	NP-103	18	1	239.97	3.92	MH-2	M.H.	46+48.66 R 2	886.6	CB 1A	C.B. TYPE 16	44+13.61 R 2	877.32	1.94	2	27	10	S		IV		16ga	
1	NP-104	18	1	67.82	3.51	CB 1A	C.B. TYPE 16	44+13.61 R 2	877.32	CB-2	C.B. TYPE 16	43+90.81 R 2	875.06	2	1.98	35	10	S		IV		16ga	
1	NP-105	18	1	169.85	4.19	CB-2	C.B. TYPE 16	43+90.81 R 2	875.06	CB-3	C.B. TYPE 16	42+20.81 R 2	868.12	1.98	2	25	10	S		IV		16ga	
1	NP-106	18	1	149.13	4.74	CB-3	C.B. TYPE 16	42+20.81 R 2	868.12	CB-4	C.B. TYPE 16	40+70.26 R 2	861.24	2	2	25	10	S		III		16ga	
1	NP-107	18	1	148.32	4.04	CB-4	C.B. TYPE 16	40+70.26 R 2	861.24	CB-5	C.B. TYPE 16	39+20.52 R 2	855.41	2	2	25	10	S		III		16ga	
1	NP-108	18	1	149.77	3.17	CB-5	C.B. TYPE 16	39+20.52 R 2	855.41	CB-6	C.B. TYPE 16	37+70.07 R 2	850.79	2	2.5	27	10	S		III		16ga	
1	NP-109	24	1	149.35	3.55	CB-6	C.B. TYPE 16	37+70.07 R 2	850.29	CB-7	C.B. TYPE 16	36+20.03 R 2	845.13	2	2	25	10	S		III		16ga	
1	NP-110	24	1	134.78	4.23	CB-7	C.B. TYPE 16	36+20.03 R 2	845.13	CB-8	C.B. TYPE 16	34+84.98 R 2	839.6	2	2.22	30	10	S		III		16ga	
1	NP-150	18	1	169.01	3.69	CB-50	C.B. TYPE 16	45+60.10 R 2	881.15	CB-2	C.B. TYPE 16	43+90.81 R 2	875.06	2	1.98	25	10	S		IV		16ga	
1	NP-160	18	1	15.23	8.59	DI-60	D.I. 24"X36"	37+84.08 R 2	852.13	CB-6	C.B. TYPE 16	37+70.07 R 2	850.79	1.08	2.5	25	10	S		IV		16ga	

Corrugated Wall Pipe

		Geometry				Upstream				Downstream				Fill Height		Min Field	Joint	Corrugated Wall Options	
System ID	Link ID	Diameter (in)	No. of Barrels	Pipe Length (ft)	Slope (%)	Node	Node Description	Node Station	Link Invert (ft)	Node	Node Description	Node Station	Link Invert (ft)	Min (ft)	Max (ft)	SPT "N" below invert	Pressure (psi)	CAAP Thickest Gage	Built ✓
1	NP-101	18	1	68.12	0.3	CB-1	C.B. TYPE 16	13+58.00	888.66	MH-1	M.H.	14+26.20	888.47	3.32	2.98	25	10	16ga	
1	NP-102	18	1	122.87	1.52	MH-1	M.H.	14+26.20	888.47	MH-2	M.H.	46+48.66 R 2	886.6	2.98	1.94	25	10	16ga	
1	NP-103	18	1	239.97	3.92	MH-2	M.H.	46+48.66 R 2	886.6	CB 1A	C.B. TYPE 16	44+13.61 R 2	877.32	1.94	2	27	10	16ga	
1	NP-104	18	1	67.82	3.51	CB 1A	C.B. TYPE 16	44+13.61 R 2	877.32	CB-2	C.B. TYPE 16	43+90.81 R 2	875.06	2	1.98	35	10	16ga	
1	NP-105	18	1	169.85	4.19	CB-2	C.B. TYPE 16	43+90.81 R 2	875.06	CB-3	C.B. TYPE 16	42+20.81 R 2	868.12	1.98	2	25	10	16ga	
1	NP-106	18	1	149.13	4.74	CB-3	C.B. TYPE 16	42+20.81 R 2	868.12	CB-4	C.B. TYPE 16	40+70.26 R 2	861.24	2	2	25	10	16ga	
1	NP-107	18	1	148.32	4.04	CB-4	C.B. TYPE 16	40+70.26 R 2	861.24	CB-5	C.B. TYPE 16	39+20.52 R 2	855.41	2	2	25	10	16ga	
1	NP-108	18	1	149.77	3.17	CB-5	C.B. TYPE 16	39+20.52 R 2	855.41	CB-6	C.B. TYPE 16	37+70.07 R 2	850.79	2	2.5	27	10	16ga	
1	NP-109	24	1	149.35	3.55	CB-6	C.B. TYPE 16	37+70.07 R 2	850.29	CB-7	C.B. TYPE 16	36+20.03 R 2	845.13	2	2	25	10	16ga	
1	NP-110	24	1	134.78	4.23	CB-7	C.B. TYPE 16	36+20.03 R 2	845.13	CB-8	C.B. TYPE 16	34+84.98 R 2	839.6	2	2.22	30	10	16ga	
1	NP-150	18	1	169.01	3.69	CB-50	C.B. TYPE 16	45+60.10 R 2	881.15	CB-2	C.B. TYPE 16	43+90.81 R 2	875.06	2	1.98	25	10	16ga	
1	NP-160	18	1	15.23	8.59	DI-60	D.I. 24"X36"	37+84.08 R 2	852.13	CB-6	C.B. TYPE 16	37+70.07 R 2	850.79	1.08	2.5	25	10	16ga	

PLAN | NOTE BOOK | No. | SURVEYED | PLOTTED | ALIGNMENT CHECKED | RT. OF WAY CHECKED | BY | DATE

PROFILE | NOTE BOOK | No. | SURVEYED | PLOTTED | GRADES CHECKED | BLK'S NOTED | STRUCTURE NOTATIONS CHECKED | BY | DATE

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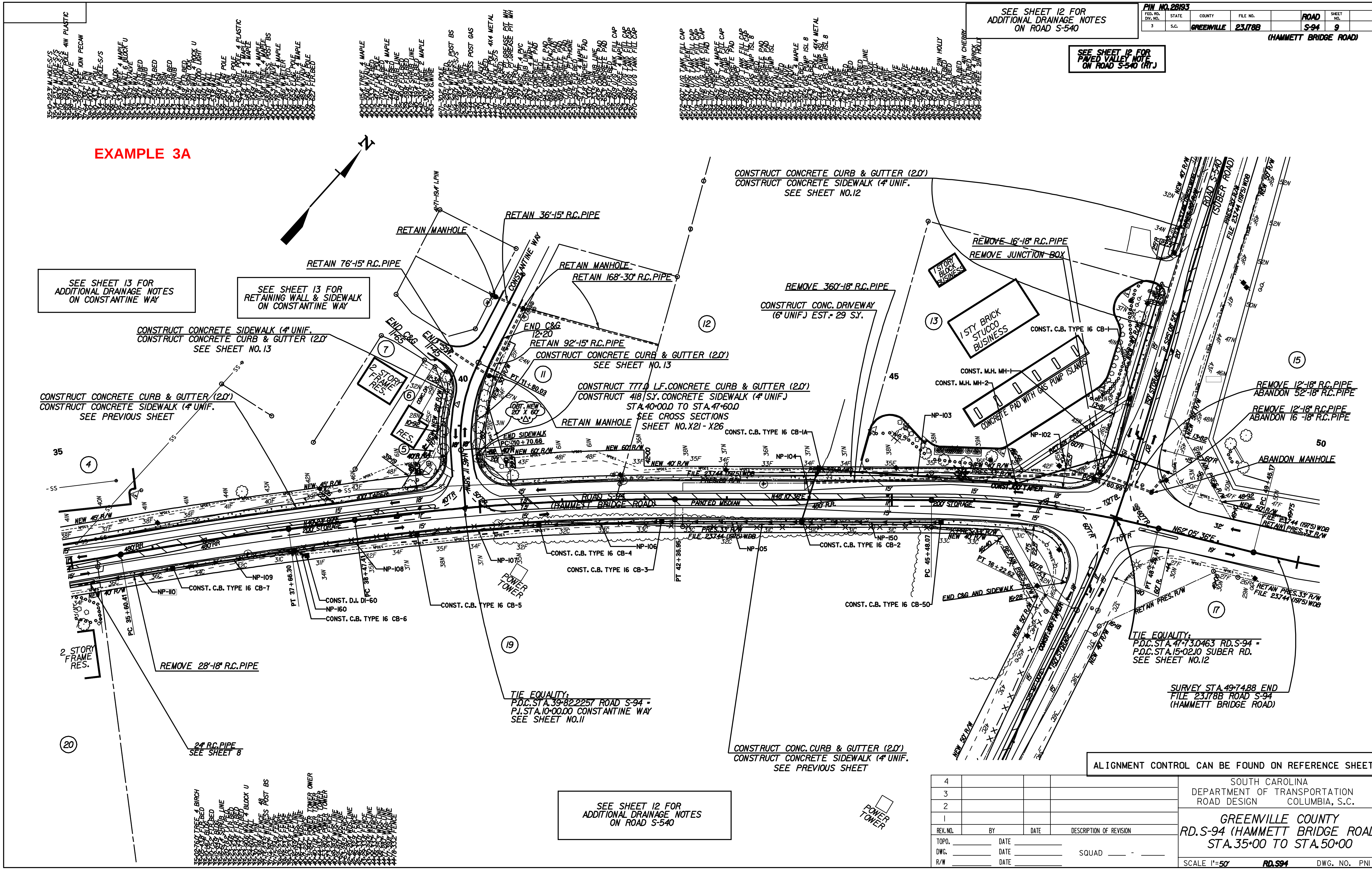
14-SEP-2009



EXAMPLE 3A
PIN NO. 28193
FED. RD. DIV. NO. 3 | STATE S.C. | COUNTY GREENVILLE | FILE NO. 23.178B | ROAD S-94 | SHEET NO. 9
(HAMMETT BRIDGE ROAD)
SEE SHEET 12 FOR ADDITIONAL DRAINAGE NOTES ON ROAD S-540
SEE SHEET 12 FOR PAVED VALLEY NOTE ON ROAD S-540 (RT.)
SEE SHEET 13 FOR ADDITIONAL DRAINAGE NOTES ON CONSTANTINE WAY
SEE SHEET 13 FOR RETAINING WALL & SIDEWALK ON CONSTANTINE WAY
RETAIN 36'-15" R.C. PIPE
RETAIN MANHOLE
RETAIN 76'-15" R.C. PIPE
RETAIN 168'-30" R.C. PIPE
CONSTRUCT CONCRETE SIDEWALK (4" UNIF.)
CONSTRUCT CONCRETE CURB & GUTTER (2.0')
SEE SHEET NO. 13
END C&G 12+20
RETAIN 92'-15" R.C. PIPE
CONSTRUCT CONCRETE CURB & GUTTER (2.0')
SEE SHEET NO. 13
CONSTRUCT CONCRETE CURB & GUTTER (2.0')
CONSTRUCT CONCRETE SIDEWALK (4" UNIF.)
SEE PREVIOUS SHEET
CONSTRUCT 777.0 LF. CONCRETE CURB & GUTTER (2.0')
CONSTRUCT 418 SY. CONCRETE SIDEWALK (4" UNIF.)
STA. 40+00.0 TO STA. 47+60.0
SEE CROSS SECTIONS SHEET NO. X21 - X26
RETAIN MANHOLE
CONSTRUCT CONCRETE CURB & GUTTER (2.0')
CONSTRUCT CONCRETE SIDEWALK (4" UNIF.)
SEE SHEET NO. 12
REMOVE 360'-18" R.C. PIPE
CONSTRUCT CONC. DRIVEWAY (6" UNIF.) EST. = 29 SY.
REMOVE 16'-18" R.C. PIPE
REMOVE JUNCTION BOX
1 STY. BRICK STUCCO BUSINESS
1 STORY BLOCK BUSINESS
CONCRETE PAD WITH GAS PUMP ISLANDS
CONST. C.B. TYPE 16 CB-1
CONST. M.H. MH-1
CONST. M.H. MH-2
REMOVE 12'-18" R.C. PIPE
ABANDON 52'-18" R.C. PIPE
REMOVE 12'-18" R.C. PIPE
ABANDON 16'-18" R.C. PIPE
ABANDON MANHOLE
ROAD S-540 (SUBER ROAD)
ROAD S-94 (HAMMETT BRIDGE ROAD)
CONSTANTINE WAY
2 STORY FRAME RES.
REMOVE 28'-18" R.C. PIPE
24" R.C. PIPE SEE SHEET 8
CONST. C.B. TYPE 16 CB-7
CONST. C.B. TYPE 16 CB-6
CONST. D.I. DI-60
CONST. C.B. TYPE 16 CB-5
CONST. C.B. TYPE 16 CB-4
CONST. C.B. TYPE 16 CB-3
CONST. C.B. TYPE 16 CB-2
CONST. C.B. TYPE 16 CB-1A
CONST. C.B. TYPE 16 CB-50
POWER TOWER
TIE EQUALITY:
P.O.C. STA. 39+82.2257 ROAD S-94 = P.I. STA. 10+00.00 CONSTANTINE WAY
SEE SHEET NO. 11
TIE EQUALITY:
P.O.C. STA. 47+73.0463 RD. S-94 = P.O.C. STA. 15+02.10 SUBER RD.
SEE SHEET NO. 12
SURVEY STA. 49+74.88 END
FILE 23.178B ROAD S-94 (HAMMETT BRIDGE ROAD)
CONSTRUCT CONC. CURB & GUTTER (2.0')
CONSTRUCT CONCRETE SIDEWALK (4" UNIF.)
SEE PREVIOUS SHEET
SEE SHEET 12 FOR ADDITIONAL DRAINAGE NOTES ON ROAD S-540
ALIGNMENT CONTROL CAN BE FOUND ON REFERENCE SHEET
SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION ROAD DESIGN COLUMBIA, S.C.
GREENVILLE COUNTY
RD. S-94 (HAMMETT BRIDGE ROAD)
STA. 35+00 TO STA. 50+00
SCALE 1"=50'
RD. S94
DWG. NO. PN1
REV. NO. | BY | DATE | DESCRIPTION OF REVISION
TOPO. DATE
DWG. DATE
R/W DATE
SQUAD

EXAMPLE 3B

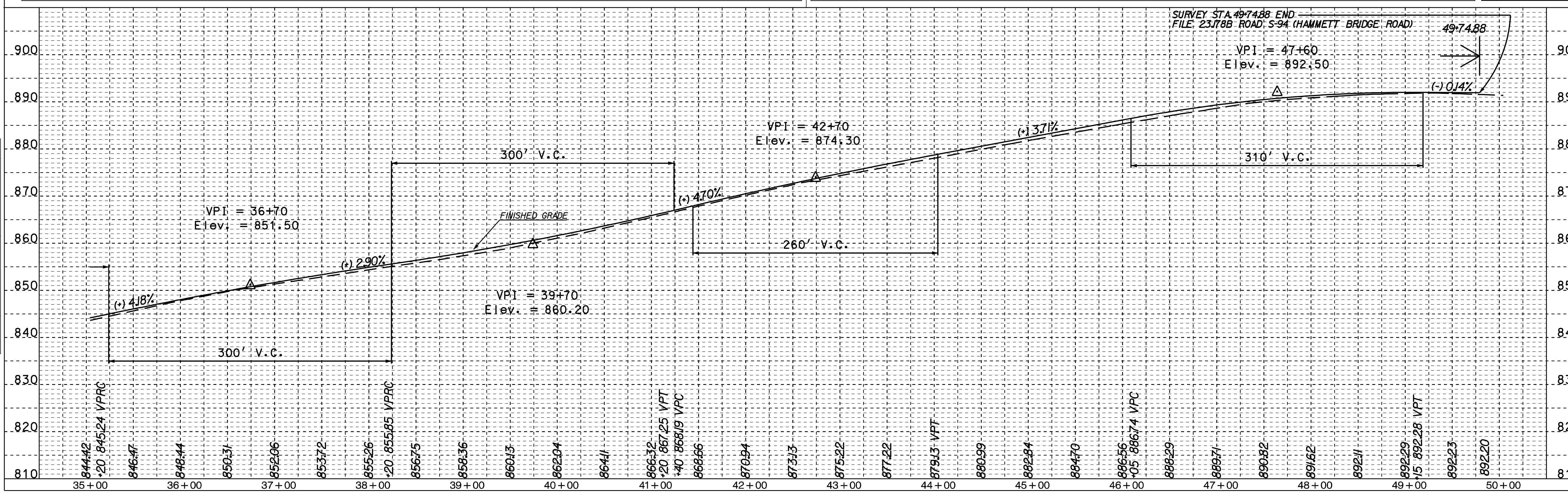
FED. ROAD DIV. NO.	STATE	COUNTY	FILE NO.	NO.	SHEET NO.
3	S.C.				

Smooth Wall Pipe

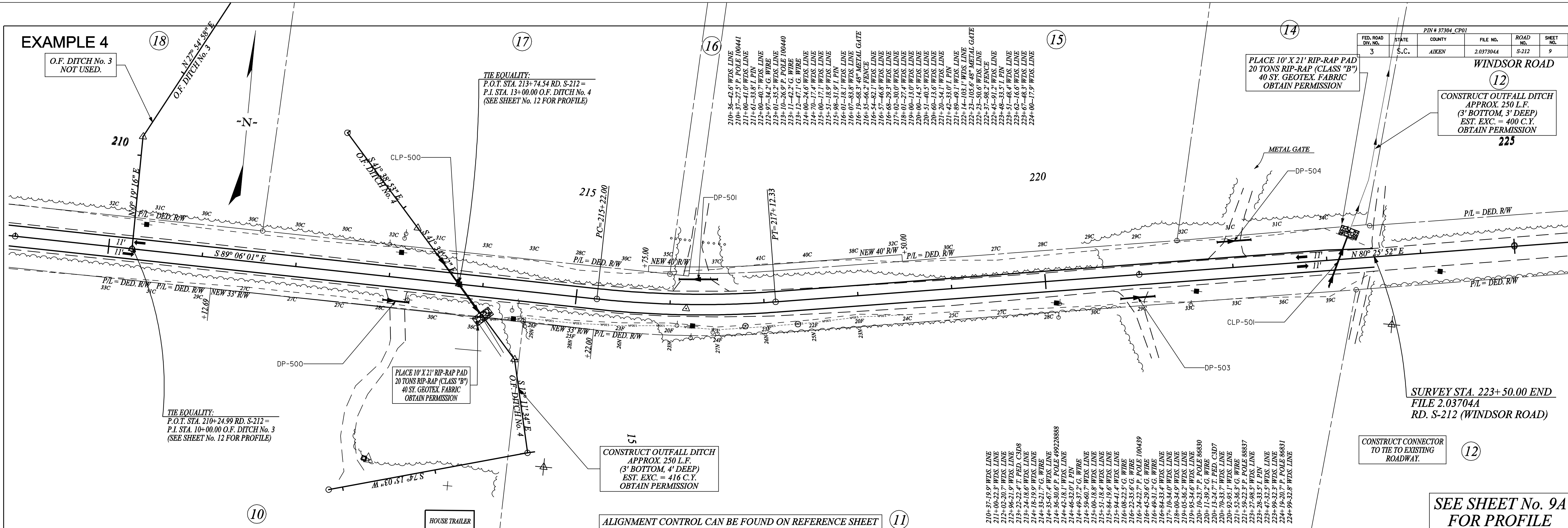
		Geometry				Upstream				Downstream				Fill Height		Min Field	Joint	Smooth Wall Options					
System ID	Link ID	Diameter (in)	No. of Barrels	Pipe Length (ft)	Slope (%)	Node	Node Description	Node Station	Link Invert (ft)	Node	Node Description	Node Station	Link Invert (ft)	Min (ft)	Max (ft)	SPT "N" below invert	Pressure (psi)	HDPE Type	Built ✓	RCP Highest Class	Built ✓	SRAP Thickest Gage	Built ✓
1	NP-101	18	1	68.12	0.3	CB-1	C.B. TYPE 16	13+58.00	888.66	MH-1	M.H.	14+26.20	888.47	3.32	2.98	25	10	S		III		16ga	
1	NP-102	18	1	122.87	1.52	MH-1	M.H.	14+26.20	888.47	MH-2	M.H.	46+48.66 R 2	886.6	2.98	1.94	25	10	S		IV		16ga	
1	NP-103	18	1	239.97	3.92	MH-2	M.H.	46+48.66 R 2	886.6	CB 1A	C.B. TYPE 16	44+13.61 R 2	877.32	1.94	2	27	10	S		IV		16ga	
1	NP-104	18	1	67.82	3.51	CB 1A	C.B. TYPE 16	44+13.61 R 2	877.32	CB-2	C.B. TYPE 16	43+90.81 R 2	875.06	2	1.98	35	10	S		IV		16ga	
1	NP-105	18	1	169.85	4.19	CB-2	C.B. TYPE 16	43+90.81 R 2	875.06	CB-3	C.B. TYPE 16	42+20.81 R 2	868.12	1.98	2	25	10	S		IV		16ga	
1	NP-106	18	1	149.13	4.74	CB-3	C.B. TYPE 16	42+20.81 R 2	868.12	CB-4	C.B. TYPE 16	40+70.26 R 2	861.24	2	2	25	10	S		III		16ga	
1	NP-107	18	1	148.32	4.04	CB-4	C.B. TYPE 16	40+70.26 R 2	861.24	CB-5	C.B. TYPE 16	39+20.52 R 2	855.41	2	2	25	10	S		III		16ga	
1	NP-108	18	1	149.77	3.17	CB-5	C.B. TYPE 16	39+20.52 R 2	855.41	CB-6	C.B. TYPE 16	37+70.07 R 2	850.79	2	2.5	27	10	S		III		16ga	
1	NP-109	24	1	149.35	3.55	CB-6	C.B. TYPE 16	37+70.07 R 2	850.29	CB-7	C.B. TYPE 16	36+20.03 R 2	845.13	2	2	25	10	S		III		16ga	
1	NP-110	24	1	134.78	4.23	CB-7	C.B. TYPE 16	36+20.03 R 2	845.13	CB-8	C.B. TYPE 16	34+84.98 R 2	839.6	2	2.22	30	10	S		III		16ga	
1	NP-150	18	1	169.01	3.69	CB-50	C.B. TYPE 16	45+60.10 R 2	881.15	CB-2	C.B. TYPE 16	43+90.81 R 2	875.06	2	1.98	25	10	S		IV		16ga	
1	NP-160	18	1	15.23	8.59	DI-60	D.I. 24"X36"	37+84.08 R 2	852.13	CB-6	C.B. TYPE 16	37+70.07 R 2	850.79	1.08	2.5	25	10	S		IV		16ga	

Corrugated Wall Pipe

		Geometry				Upstream				Downstream				Fill Height		Min Field	Joint	Corrugated Wall Options	
System ID	Link ID	Diameter (in)	No. of Barrels	Pipe Length (ft)	Slope (%)	Node	Node Description	Node Station	Link Invert (ft)	Node	Node Description	Node Station	Link Invert (ft)	Min (ft)	Max (ft)	SPT "N" below invert	Pressure (psi)	CAAP Thickest Gage	Built ✓
1	NP-101	18	1	68.12	0.3	CB-1	C.B. TYPE 16	13+58.00	888.66	MH-1	M.H.	14+26.20	888.47	3.32	2.98	25	10	16ga	
1	NP-102	18	1	122.87	1.52	MH-1	M.H.	14+26.20	888.47	MH-2	M.H.	46+48.66 R 2	886.6	2.98	1.94	25	10	16ga	
1	NP-103	18	1	239.97	3.92	MH-2	M.H.	46+48.66 R 2	886.6	CB 1A	C.B. TYPE 16	44+13.61 R 2	877.32	1.94	2	27	10	16ga	
1	NP-104	18	1	67.82	3.51	CB 1A	C.B. TYPE 16	44+13.61 R 2	877.32	CB-2	C.B. TYPE 16	43+90.81 R 2	875.06	2	1.98	35	10	16ga	
1	NP-105	18	1	169.85	4.19	CB-2	C.B. TYPE 16	43+90.81 R 2	875.06	CB-3	C.B. TYPE 16	42+20.81 R 2	868.12	1.98	2	25	10	16ga	
1	NP-106	18	1	149.13	4.74	CB-3	C.B. TYPE 16	42+20.81 R 2	868.12	CB-4	C.B. TYPE 16	40+70.26 R 2	861.24	2	2	25	10	16ga	
1	NP-107	18	1	148.32	4.04	CB-4	C.B. TYPE 16	40+70.26 R 2	861.24	CB-5	C.B. TYPE 16	39+20.52 R 2	855.41	2	2	25	10	16ga	
1	NP-108	18	1	149.77	3.17	CB-5	C.B. TYPE 16	39+20.52 R 2	855.41	CB-6	C.B. TYPE 16	37+70.07 R 2	850.79	2	2.5	27	10	16ga	
1	NP-109	24	1	149.35	3.55	CB-6	C.B. TYPE 16	37+70.07 R 2	850.29	CB-7	C.B. TYPE 16	36+20.03 R 2	845.13	2	2	25	10	16ga	
1	NP-110	24	1	134.78	4.23	CB-7	C.B. TYPE 16	36+20.03 R 2	845.13	CB-8	C.B. TYPE 16	34+84.98 R 2	839.6	2	2.22	30	10	16ga	
1	NP-150	18	1	169.01	3.69	CB-50	C.B. TYPE 16	45+60.10 R 2	881.15	CB-2	C.B. TYPE 16	43+90.81 R 2	875.06	2	1.98	25	10	16ga	
1	NP-160	18	1	15.23	8.59	DI-60	D.I. 24"X36"	37+84.08 R 2	852.13	CB-6	C.B. TYPE 16	37+70.07 R 2	850.79	1.08	2.5	25	10	16ga	



EXAMPLE 4



Smooth Wall Pipe

System ID	Link ID	Geometry: Diameter (in)	Geometry: No. of Barrels	Geometry: Pipe Length (ft)	Geometry: Slope (%)	Upstream: Node	Upstream: Node Description	Upstream: Node Station	Upstream: Link Invert (ft)	Downstream: Node	Downstream: Node Description	Downstream: Node Station	Downstream: Link Invert (ft)	Fill Height: Min (ft)	Fill Height: Max (ft)	Min Field SPT "N" below invert	Joint Pressure (psi)	Smooth Wall Options: HDPE Type	Built ✓	RCP Highest Class	Built ✓	SRAP Thickest Gage	Built ✓
OPEN	DP-500	18	1	28	-	-	-	212+95.81	-	-	-	213+23.80	-	-	-	-	10						
OPEN	DP-501	15	1	40.78	-	-	-	216+50.86	-	-	-	216+09.05	-	-	-	-	10						
OPEN	DP-503	15	1	36.39	-	-	-	220+78.37	-	-	-	221+14.76	-	-	-	-	10						
OPEN	DP-504	15	1	36	-	-	-	221+85.08	-	-	-	222+21.07	-	-	-	-	10						
OPEN	CLP-500	18	1	76	-	-	-	12+62.26	-	-	-	13+38.25	-	327.6	326.5	23	10						
OPEN	CLP-501	18	1	56.05	-	-	-	222+99.86	-	-	-	223+23.31	-	332.81	332.78	23	10						

Corrugated Wall Pipe

System ID	Link ID	Geometry: Diameter (in)	Geometry: No. of Barrels	Geometry: Pipe Length (ft)	Geometry: Slope (%)	Upstream: Node	Upstream: Node Description	Upstream: Node Station	Upstream: Link Invert (ft)	Downstream: Node	Downstream: Node Description	Downstream: Node Station	Downstream: Link Invert (ft)	Fill Height: Min (ft)	Fill Height: Max (ft)	Min Field SPT "N" below invert	Joint Pressure (psi)	Corrugated Wall Options: CAAP Thickest Gage	Built ✓
OPEN	DP-500	18	1	28	-	-	-	212+95.81	-	-	-	213+23.80	-	-	-	-	10		
OPEN	DP-501	15	1	40.78	-	-	-	216+50.86	-	-	-	216+09.05	-	-	-	-	10		
OPEN	DP-503	15	1	36.39	-	-	-	220+78.37	-	-	-	221+14.76	-	-	-	-	10		
OPEN	DP-504	15	1	36	-	-	-	221+85.08	-	-	-	222+21.07	-	-	-	-	10		
OPEN	CLP-500	18	1	76	-	-	-	12+62.26	-	-	-	13+38.25	-	327.6	326.5	23	10		
OPEN	CLP-501	18	1	56.05	-	-	-	222+99.86	-	-	-	223+23.31	-	332.81	332.78	23	10		

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21-SEP-2009

AltPipeSht.dgn