UNITED STATES DEPARTMENT OF AGRICULTURE
Rural Utilities Service

BULLETIN 1751F-642

SUBJECT: **Construction Route Planning of Buried Plant**

TO: All Telecommunications Borrowers
RUS Telecommunications Staff

EFFECTIVE DATE: Date of Approval

EXPIRATION DATE: Seven years from effective date

OFFICE OF PRIMARY INTEREST: Outside Plant Branch, Telecommunications Standards Division

PREVIOUS INSTRUCTIONS: This bulletin replaces RUS Bulletin 1751F-642, Staking of Buried Plant, dated June 26, 1992.

FILING INSTRUCTIONS: Discard RUS Bulletin 1751F-642, Staking of Buried Plant, dated June 26, 1992, and replace it with this bulletin. File with 7 CFR 1751 and is available to RUS staff on RUSNET.

PURPOSE: This bulletin provides RUS borrowers, consulting engineers, contractors and other interested parties with information concerning construction route planning of buried plant construction projects.

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ABBREVIATIONS

BET	Building Entrance Terminal
BFCP	Buried Filled Cable Pre-Designated Area Assembly Unit
CATV	Community Antenna Television Service
CFR	Code of Federal Regulations
HFM	Hand-push, Wheel-type Footmeter
LD	Loan Design
NEC	National Electrical Code
NESC	National Electrical Safety Code
NID	Network Interface Device
R/W	Rights-of-way
RUS	Rural Utilities Service
SAIC	Serving Area Interface Cabinet
SAVE	Serving Area Value Engineering
TE&CM	Telecommunications Engineering and Construction Manual
VFM	Vehicle Mounted Footmeter

DEFINITIONS

BFCP: A buried filled cable assembly unit which informs the contractor that the installation in that particular area will be much more difficult than normal because of the presence of underground facilities or severe rights-of-way restrictions.

Building Entrance Terminal: A building entrance terminal is comprised of housing containing both primary station protectors and connector terminals for each conductor pair provided by the telecommunications company and used by the customer. The primary station protectors may be fused or fuseless.

Construction Corridor: A corridor having a minimum width of 1 rod (5.0 meters) along the designated route for buried cable and wire placement, which permits passage and operation of the construction equipment.

Construction Drawings: The drawings developed through the construction route planning process and used to guide the construction of outside plant facilities.

Construction Route Planning Personnel: Representatives of the engineer responsible for gathering field data and preparing construction drawings.

Loan Design: A comprehensive engineering plan for the project used to support a loan application to RUS.

Network Interface Device: A network interface device is comprised of a housing suitable for outdoor installation which contains a compartment accessible by only telecommunications employees which includes a primary station protector and means for terminating telecommunications service wire conductors and/or metallic shields, and a compartment accessible by customers which includes a RJ-11 plug and jack of the type specified in Part 68 of FCC regulations.

Reduced Construction Corridor: A construction corridor having a width less than the standard "Construction Corridor."

Resident Engineer: The representative of the Engineer who is delegated full-time "on site" responsibilities for overall project administration, design, construction route planning, and construction.

Restricted Construction Corridor: A standard or reduced construction corridor containing the presence of existing buried telecommunications and/or other utilities facilities, rights-of-way restrictions, or other factors.

<u>Rights-of-Way</u>: The strips of land over which facilities such as highways, railroads, power lines, other utilities, or telecommunication lines are constructed.

<u>RUS Accepted (Material and Equipment)</u>: Material and equipment which RUS has reviewed and determined that:

a. Final assembly is conducted within the United States, Mexico, or Canada or any of their respective territories and the cost of United States, Mexican, or Canadian, manufactured components, in any combination, is more than 50 percent of the total cost of all components utilized in the material or equipment, and

b. The material or equipment complies with pertinent RUS or industry standards and field experience has demonstrated that the material or equipment is suitable for use on systems of RUS telecommunications borrowers.

<u>RUS Technically Accepted (Material and Equipment)</u>: Material and equipment which RUS has reviewed and determined that:

a. Final assembly is not conducted within the United States, Mexico, or Canada, or any of their territories, or the cost of components within the material or equipment which are manufactured within the United States, Mexico, or Canada, or any of their territories, cost 50 percent or less than the total cost of all components utilized in the material or equipment, and

b. The material or equipment complies with pertinent RUS or industry standards and field experience has demonstrated that the material or equipment is suitable for use on systems of RUS telecommunications borrowers.

1. GENERAL

1.1 Construction route planning is the process of reviewing and assessing proposed construction routes and preparing drawings and tabulations to show the locations and quantities of construction units required. It should be consistent with the construction proposed in the Loan Design (LD). It should be undertaken with the objective of constructing buried plant which conforms to Rural Utilities Service (RUS) standards, is free from hazards, and is economical. The information and recommendations in this bulletin are advisory.

1.2 Personnel performing the construction route planning should be familiar with and have access to the following materials:

a. The approved LD (including maps) and any revisions;

b. List of subscribers giving map locations and grades of service;

c. List of held service orders;

d. Maps showing any available, executed or planned rights-of way (R/W) easements;

e. National Electrical Safety Code (NESC) (latest edition);

f. National Electrical Code (NEC) (latest edition);

g. Existing local and State electrical codes, especially where they are more stringent than the NESC and NEC codes;

h. Construction routing and R/W selection;

i. Route, pole, and housing numbering;

j. Existing construction drawings;

k. Capabilities of various types of plowing and trenching equipment;

l. Station installation procedures;

m. Clearances according to NEC and NESC Codes;

n. Association of American Railroads Crossing Standard;

o. Design and construction of joint buried plant (electric and telephone) according to NEC and NESC codes;

p. RUS Form 515, Telephone System Construction Contract;

q. RUS Bulletin 345-150, Specifications and Drawings for Construction of Direct Buried Plant (RUS Form 515a);

r. RUS Bulletin 345-154, Specifications and Drawings for Service Entrance and Station Protector Installation (RUS Form 515g);

s. RUS Bulletin 380-1, Right-of-Way and Title Procedures;

t. RUS Bulletin 1751F-626, Staking of Aerial Plant;

u. RUS Bulletin 1751F-640, Design of Buried Plant - Physical Considerations;

v. RUS Bulletin 1751F-641, Construction of Buried Plant;

w. RUS Bulletin 1751F-670, Outside Plant Corrosion Consideration;

x. RUS Bulletin 1751F-801, Electrical Protection Fundamentals;

y. RUS Bulletin 1751F-805, Electrical Protection at Customer Locations;

z. RUS Bulletin 1751F-815, Electrical Protection of Outside Plant;

aa. RUS Bulletin 1753F-401(PC-2), RUS Standard for Splicing Copper and Fiber Optic Cables (codified under 7 CFR 1755.200);

bb. The following RUS Telecommunications Engineering and Construction Manual (TE&CM) Sections:

1. 116, Plant Engineering and Record System;

2. 210, Telephone System Design - Sizing Criteria;

3. 230, General Principles of Feeder - Distribution Cable Engineering (Serving Area Value Engineering [SAVE]);

4. 231, Design Techniques of Feeder-Distribution Cable Engineering (SAVE);

5. 232, Transmission Design Cost Considerations of Feeder-Distribution Cable Engineering (SAVE);

6. 424, Design Guideline for Telecommunications Subscriber Loop Plant;

7. 628, Plastic-Insulated Cable Plant Layout;

8. 629, Cable Plant Layout - Serving Area Value Engineering (SAVE) for Rural Systems;

9. 648, Serving Area Value Engineering-Physical Plant; and

10. 822, Electrical protection of Carrier Equipment.

1.3 Construction route planning personnel along with representatives of the borrower should attend the Pre-Construction Route Planning Conference and construction route planning should conform to the agreements and requirements contained in the Pre-Construction Route Planning Conference minutes. When construction is planned to be performed on public R/W, it may be advantageous to have a Department of Transportation official present at the Pre-Construction Route Planning Conference.

1.4 Even though it is beneficial for construction route planning personnel to be familiar with the material listed in Paragraph 1.2 above, construction route planning personnel are not usually expected to design the buried outside plant. They are expected to make field measurements of cable and wire lengths as well as miscellaneous unit lengths, unit locations, and locate outside plant housings for loading (when loaded lines are determined by RUS to be economically feasible and the overall system design complies with the Modernization Plan [7 CFR 1751, Subpart B]), branch splices, subscriber terminations, etc. They also locate obstacles such as culverts and underground facilities of other utilities as discussed later. They verify the general route which has been tentatively selected by the engineer and should discuss any difficulties noted in the proposed routing with the engineer before making any changes.

1.5 Investigation, coordination, and thorough planning of the route should be of paramount importance to avoid future problems that the borrower may encounter in the operation and maintenance of the plant. In the case of buried plant, firm decisions should be made in the design stage.

1.6 The physical presence of the buried plant facilities, characteristics of the terrain, and electrical and mechanical protection of the buried plant facilities should also be considered in determining the construction route.

2. PRE-CONSTRUCTION ROUTE PLANNING ACTIVITIES

2.1 Before construction route planning begins, construction route planning personnel should receive assurances from the borrower that R/W agreements or permits have been obtained. Any suitable means, such as easement strip maps to indicate the R/W conditions, may be used for this purpose. Property owners who wait until construction route planning is performed to observe the route taken before granting an easement should be noted as well as the status of easements on other properties. The RUS borrower should furnish a qualified representative to accompany the construction route planning personnel to negotiate with landowners for easements. Any precautions to be observed during construction should be noted on the construction drawings.

2.2 When service order activities indicate changes in subscriber estimates, the resident engineer should be informed and if necessary, action should be taken to revise the initial design to ensure that construction will be adequate to meet subscriber demands. Any design changes should be reflected in the construction drawings of the project, but 7 CFR 1753.3 requires that written approval for significant changes must be obtained from the borrower and RUS.

2.3 Construction route planning personnel should mark only those lines shown in the approved LD except for minor changes dictated by field conditions. The resident engineer should inform the construction route planning personnel of any routes, leads, or service connections which for any reason are not to be constructed and for those additional routes that are to be constructed.

2.4 Careful consideration should be given to the usability of R/W obtained on each parcel of land on which cables and/or wires are to be constructed. If R/W are not satisfactory from a construction standpoint because of poor routing, hazardous conditions, heavy clearing, rock, swampy soil, lawns, insufficient construction corridor width for the plow train, etc., the resident engineer should discuss the conditions with the borrower so that an attempt can be made either to procure additional R/W or to relocate the proposed section of route.

2.5 When the borrower is required to submit engineering information as a prerequisite for procuring a permit, license, franchise, or authorization from public bodies or private corporations in connection with proposed construction, construction route planning personnel should furnish the resident engineer with the necessary field data to prepare the required information and drawings for the borrower. Examples of situations for which permits may be required are:

a. Plowing or trenching on or adjacent to roads and highways;

b. Crossing of highways;

c. Bridge attachments;

d. Crossing navigable streams or other bodies of water;

e. Crossing railroads;

f. Joint occupancy trenches with another utility;

g. Crossing buried facilities of other utilities;

h. Crossing land owned or controlled by public bodies;

i. Location of outside plant housings or poles on public R/W; and

j. Other sensitive environmental areas.

2.6 The borrower and resident engineer should agree on the construction route planning markers (such as stakes, bright colored paint, etc,), installation time of the markers, and marking symbols to be used during the construction route planning operation to identify the proposed construction route. All of the above items should be agreed to at the Pre-Construction Route Planning Conference and discussed at the Pre-Bid Conference.

3. NATIONAL ELECTRICAL SAFETY CODE (NESC)

3.1 It is very important that construction route planning personnel know and understand the requirements set forth in the NESC for telecommunications system outside plant construction as well as the requirements of the local authorities in the particular locality where construction route planning is to be performed.

3.2 Some localities (States and/or municipalities) have requirements for telecommunications buried plant which are more stringent than those of the latest edition of the NESC. <u>The authorities administering these provisions expect that the more stringent requirements be observed</u>. For localities where no requirements are established, the provisions of the latest edition of the NESC should be followed. RUS Loan Contracts and Mortgages require borrowers to observe all appropriate codes that may pertain.

3.3 The portions of the NESC that construction route planning personnel should be particularly concerned with are Parts 2 and 3 which deal with the installation and maintenance of overhead and underground lines. NESC rules are not intended to serve as a basis for designing or construction route planning of telecommunications plant. The rules should be considered as the minimum standards that should be met to help assure the plant is constructed to withstand the mechanical loads and stresses to which it will be subjected, be reasonably protected from the possible effects of electrical disturbances, and be relatively free from hazards to the general public and to telecommunications maintenance personnel.

4. NATIONAL ELECTRICAL CODE (NEC)

4.1 The purpose of the NEC is the practical safeguarding of persons and property from hazards arising from the use of electricity. The NEC includes the basic minimum provisions for installation of telecommunications facilities on subscribers' premises.

4.2 Chapter 8, "Communications Systems," Article 800, "Communication Circuits," of the NEC discusses minimum conductor insulation requirements and station grounding. Most authorities make it mandatory to observe the requirements set forth in the NEC unless their local requirements are more stringent, in which case the latter should be observed.

5. OUTSIDE PLANT ASSEMBLY UNITS

5.1 The general buried plant design in the approved LD should be translated by the resident engineer into a specific design in sufficient detail to enable construction of the plant. To facilitate the specific design, standard "assembly units" have been devised for most major components of outside plant. Detailed descriptions of all standard buried plant assembly units are given in RUS Bulletin 345-150, Specifications and Drawings for Construction of Direct Buried Plant (RUS Form 515a).

5.2 Where standard assembly units are insufficient to provide for unique construction requirements, "nonstandard assembly units" should be created in detail to meet those requirements. RUS 7 CFR 1753.6 requires that the nonstandard assembly units and related drawings be RUS approved when RUS loan funds will be used to finance their construction. RUS prefers, however, that the number of "nonstandard assembly units" be kept to the absolute minimum and that every effort be made to utilize RUS "standard assembly units" as far as practical.

5.3 The complete physical outside plant as contemplated in the LD should be depicted by specifying the appropriate types, quantities and locations of standard and nonstandard assembly units on construction drawings.

6. CONSTRUCTION ROUTE PLANNING

6.1 Construction route planning personnel should begin construction route planning by checking the status of R/W and permit easements, by marking control points on the LD maps, by making a reconnaissance of the proposed construction areas, and checking and noting the items listed below:

a. Terrain;

b. Location of establishments;

c. Natural control points;

d. Plowing or trenching locations as determined by fences, roads, R/W easements, rivers, bridges, etc.;

e. Obstacles for plow trains or trenchers;

f. Sufficient construction corridor R/W for plow trains;

g. Locations of other buried utilities; and

h. Locations of existing outside plant housings.

6.2 Control points are those points or areas along a proposed construction route where circumstances demand special consideration by construction route planning personnel in specifying appropriate construction units. Examples of control points are:

a. Street, alley, and highway intersections;

b. Rivers, streams, drainage ditches, and canals;

c. Private driveways, field entrances, and fence corners;

d. Railroad R/W;

e. Other buried facilities;

f. Junctions between cable and wire;

g. Junctions with branch cables;

h. Housing locations;

i. Subscribers' premises;

j. Trees;

k. Reduced and restricted construction corridor R/W;

l. Outcropping of rock;

m. Buried splice closures; and

n. Areas identified in the Borrower Environmental Report, Environmental Assessment or Environmental Impact Statement.

6.3 Housings should be placed along buried cable or wire leads at the following locations:

a. At subscriber distribution points within a reasonable service distance to all prospective subscribers;

b. At junctions with lateral runs of cable or wire including possible future extensions;

c. At bonding and grounding locations for fiber optic cable plant;

d. At aerial inserts, if it is necessary to splice the cable or wire. (Ready-access closures may be used for splicing to aerial cable inserts);

e. At cable loading points for initial or ultimate loading (when loaded lines are determined by RUS to be economically feasible and the overall system design complies with the Modernization Plan [7 CFR 1751, Subpart B]); and

f. At Serving Area Interface Cabinet (SAIC) and digital carrier and lightwave repeater locations.

6.4 For buried copper cable or wire plant, direct buried filled splice cases should be considered in lieu of outside plant housings at the following locations:

a. When above-ground splicing as referenced in Paragraph 6.3 is not practicable; or

b. At reel end splices.

6.5 For buried fiber optic cable plant, direct buried filled splice cases installed in handholes are the preferred method of splicing fiber optic cable plant.

6.6 Data to be shown on construction drawings may be recorded in a notebook or on construction drawings as the route is being traveled in the field. This field data may then be recorded on construction drawings back at the office. Information that will be necessary for construction is recorded on one set of drawings. Information pertaining to removal of existing plant is recorded on a separate set of drawings.

6.7 Information to be included on construction drawings is that which is necessary to prepare the plans and specifications and to construct the outside plant. The construction drawings should be prepared so that they may be used as permanent plant records.

6.8 After the subscriber data is brought up-to-date on the construction drawing and the actual construction route is selected, the actual sizing of the cables or wires for the plant layout, line assignments, and the proper sizes for outside plant housings or direct buried filled splice cases may be performed in the engineer's office. The construction drawings containing the above information should be made available to the interested parties for discussion at the Pre-Bid Conference.

6.9 Low cost placement of cable or wire is usually obtainable when the burial depth of the cable or wire can be maintained within the shoulders or backslopes of roads and highways. The cable or wire route should be selected so as to minimize property damage from heavy equipment used in the plow train. Locations of the proposed outside plant housings should be selected to minimize possible damage from vehicular traffic and to allow for easy maintenance access. Burying of cable or wire directly in the roadbed should always be avoided if possible.

6.10 Burying the cable or wire across private R/W in rural areas having fences or where land is cultivated to extreme depths generally is not economical in certain situations and should be avoided. However, the use of private R/W for placement of cable or wire should be considered if placement would be more economical than in or along road shoulders or backslopes of roads and highways.

6.11 When a private R/W is chosen as the construction route, each property owner should be contacted. Discussions should be held with each property owner to emphasize to the owner the need to provide protection to cable or wire. The selection of the cable or wire route, and cable or wire depth is of utmost importance when using the private R/W. The type and placement of above ground warning and route signs to identify the construction route should be discussed with each property owner. Each property owner should also be provided with a construction drawing showing the proposed construction route and the proposed locations of all buried facilities, housings, and signs to be located on the owner's property.

6.12 Permission should be obtained from Department of Transportation authorities at locations where public R/W are to be used. Possible highway improvements, such as road widening, should be considered in planning the construction route. Future road work can result in costly telecommunications plant rearrangements.

6.13 Investigations should also be made to locate other buried facilities such as water, gas, sewer, power, community antenna television (CATV), telecommunications and oil lines. The location of these facilities should be performed by obtaining maps from the other utilities and by means of cable locators. Located facilities should be indicated on the construction drawings to warn the contractor of their presence. Predesignated Areas should be established on system detail maps where in the judgement of construction route planning personnel installations will be much more difficult because of the presence of numerous or complex existing underground facilities or severe R/W restrictions. Such system map locations are possible areas to note predesignated construction units such as the BFCP units. The units should appear on the construction drawings in advance of bidding. A recommended procedure to be followed for showing the general location of pipelines is discussed in Paragraph 11.3.

6.14 Cable and wire routes should be marked on construction drawings by reference to natural or manmade landmarks to facilitate the placement and future location of cable or wire.

6.15 Where difficulty may be encountered in finding stakes used as construction route planning markers at a later date, the stake locations should be indicated by driving four-foot building laths adjacent to the stakes or by providing some other suitable method of identification. Where stakes are used as construction route planning markers on R/W that are hidden from the road because of brush, trees, crops, etc., a suitable identification marker (such as a strip of bright colored cloth or plastic marking tape tied on a fence or some other visible roadside location) should be provided to indicate each stake location from the road. Where permitted by transportation department authorities, a colored stripe could be painted on the edge of the pavement to show the approximate location of the stake. It will also be helpful to place appropriate notes on the construction drawings.

6.16 Construction route planning personnel should proceed along the route, marking and detailing the following information (some of which may be done in the resident engineer's office) on construction sheets:

a. Cable and wire routes;

b. Footage measurements along the route;

c. Road names, road numbers, road surfaces, road widths, R/W, fences, pole lines, etc.;

d. Lakes, ponds, streams, etc.;

e. Approximate locations of obstructions that may be encountered during actual construction of the project, such as other buried utilities, pipelines, etc.;

f. Locations and types of the outside plant housings and poles;

g. Locations of direct buried filled splice cases;

h. The distances in feet or meters from the plow or trench line to each outside plant housing or pole;

i. The distances in feet or meters along the buried construction route between lateral trenches to outside plant housings or poles. These distances should be chain or wheel measured but under certain conditions such as flat terrain, cable paralleling road, or highway R/W, a vehicle mounted foot-meter may also be used for the measurement (See Table 1 and Paragraph 6.18);

j. Vertical footage measurements in feet or meters inside each outside plant housing;

k. The lengths of service wires or cables in feet or meters from outside plant housings to subscriber's network interface devices (NIDs), building entrance terminals (BETS), or fused primary station protectors;

l. Outside plant housing numbers;

m. Pair sizes, gauges and types of copper cables or wires;

n. Number of optical fibers and types of fiber optic cables;

o. Tentative load point locations (when loaded lines are determined by RUS to be economically feasible and the overall system design complies with the Modernization Plan [7 CFR 1751, Subpart B]);

p. Tentative digital carrier repeater locations;

q. Tentative lightwave repeater locations;

r. Types of station protection and grounding;

s. Special considerations such as increased depths, minor route deviations, easement reservations, etc.;

t. Construction corridor widths, reduced construction corridor widths, and restricted construction corridors;

u. Grounding and bonding procedures at all splice locations;

v. All miscellaneous construction units for the plant installation such as warning signs, etc.; and

w. All outside plant assembly units necessary to construct the buried plant.

An example of a blank construction drawing designed for this purpose is given in Figure 1. Other forms of construction drawings depicting similar information may be used.

6.17 Construction route planning markers should be used to show the location of the following:

a. Proposed outside plant housings;

b. Proposed direct buried filled splice cases;

c. Proposed handhole and manhole locations;

d. Proposed control danger points such as underground utilities, culverts, etc.;

e. Proposed poles and anchors for aerial inserts;

f. Proposed miscellaneous units such as split metal guards and warning signs;

g. Proposed road and/or highway crossing locations; and

h. Proposed railroad crossing locations.

The applicable cable or wire route numbers, outside plant housing numbers, or pole numbers should be appropriately marked on the construction route planning markers so as to be legible at the time of construction.

6.18 Acceptable measuring techniques used in construction route planning of buried plant are (See Table 1):

a. Chaining;

b. Vehicle mounted footmeter (VFM);

c. Hand-pushed, wheel-type footmeter (HFM); or

d. Stadia rod.

6.18.1 Chaining or VFM is the method of measurement generally used in urban areas. When the chaining method is used, caution should exercised used to avoid the following most common errors:

a. Dropping or adding a complete chain length;

b. Reversing the chain so that the wrong figure is read; and

c. Not holding the end of the chain even with the chaining pin.

6.18.2 Chaining, VFM, or HFM is the method of measurement generally used in rural areas.

6.18.3 Since measurements are intended to represent the length of the telecommunications plant, they should be made along the contour of the ground surface for buried plant. When gullies or sharp breaks in the terrain are encountered, measurements should be made approximately parallel to the route where the cable or wire is expected to be installed.

6.18.4 VFMs or HFMs may be used to check field observed measurements. Such checks should result in fewer major measurement errors. VFMs or HFMs should be calibrated at least once a day over a measured 1000 foot (304.8 meter) distance. VFMs should not be used in situations where the vehicle wheels could slip, such as in mud, snow, loose gravel, or on steep slopes resulting in excessive or erratic VFM rotation.

6.18.5 The stadia rod is a relatively accurate and fast method of measuring distance when there are no obstructions in the line of vision and the terrain is flat between the transit and rod. It may be used to good advantage for measuring distances across bodies of water, etc.

6.18.6 Measurements of cable or wire length should be made twice, either by rechecking the distances on existing plant records or by actually remeasuring the cable or wire routes. This is particularly important for cables or wires ordered to specified lengths for placing in conduit systems, or between major predetermined control points, especially with fiber optic cable plant.

6.18.7 **Measurement Techniques**: Listed in Table 1 are suggested measurement techniques for most situations:

TABLE 1
Suggested Measurement Techniques

Type of Area	Measurement Situations	Original Measurement	Check Measurement
Urban	Conduit Systems	Chain	Chain
Urban	Cables and Wires	Chain or VFM (See Note 1)	Chain, VFM, HFM, or existing records (See Note 1)
Rural	Cables and Wires Public R/W	Chain or VFM (See Note 1)	VFM, HFM, or existing records (See Note 1)
Rural	Private R/W	Chain or HFM (See note 1)	HFM or existing records (See Note 1)
Rural	Distance between load points (See Note 2)	Chain, VFM, or HFM (See Note 1)	VFM, HFM, or existing records (See Note 1)
Rural	Distance between digital carrier or lightwave repeaters	Chain, VFM, or HFM (See Note 1)	VFM, HFM, or existing records (See Note 1)
Urban or Rural	Drops - Aerial	Chain, VFM, or HFM between drop poles. HFM from drop pole to house. (See Note 1)	Chain or use HFM during final inventory (See Note 1)
Urban or Rural	Drops - Buried	HFM from buried plant housing to house (See Note 1)	Use sequential marking during final inventory

Note (1): VFMs and HFMs should be calibrated frequently and used in accordance with the manufacturer's recommendations.

Note (2): When loaded lines are determined by RUS to be economically feasible and the overall system design complies with the Modernization Plan (7 CFR 1751, Subpart B).

6.19 Outside plant housings should be specified within a reasonable service distance from potential subscribers. The housings should be specified at junction points from which future extensions may be run even though not required in the initial construction. The size of the housing should be large enough to accommodate future branch cables or wires. Future loading requirements (See Note 2 on Page 18) should also be taken into account in sizing the housings. Pole mounted housings or riser guards should be specified at junctions of buried plant and aerial plant. The housings mounted on stub poles should be specified where additional mechanical strength or protection is required.

6.20 Outside plant housings on highway R/W should be placed as close to the fence line as possible to provide maximum protection to the housings from traffic and road and farm equipment. If such placement is not possible due to the absence of fences or because of planned highway widening programs, the housing should be placed in some other reasonably protected location. The construction route planning personnel should consider appropriate methods of guarding against damage if the housing will be exposed to road or farm machinery, farm animals, or other hazards. Such methods may include the use of stub poles, orange colored housings or buried splices (RUS recommends, however, that buried splices be used only as a last resort). Long stub poles may be used in high vegetation areas. Consideration may also be given to mounting the housing high on a stub pole with a riser guard to protect the cable or wire for the desired height. This may be advantageous in areas subject to flooding or heavy snow. If this type of construction is used, the bottom of the housing should be sealed with a material that will not allow entry of birds, rodents, or insects into the base of the housings.

6.21 Outside plant housing and pole numbering should be in accordance with RUS Telecommunications Engineering & Construction Manual (TE&CM) Section 116, Plant Engineering and Record System, or some other suitable numbering system. All housings should be marked with the appropriate cable, load point (See Note 2 on Page 18), route, and housing number.

6.22 When the field work has been completed by construction route planning personnel and the necessary entries on the construction drawings are completed, construction route planning personnel turn the construction drawings over to the resident engineer. The resident engineer inserts other data and prepares final form construction drawings which will be used for preparing the "Plans and Specifications."

6.23 In computations made to locate load points (See Note 2 on Page 18), the engineer adds to the in-line plowed lengths, the lengths which are trenched from the plow line to housing or pole, plus an amount representing the vertical runs in the housing or on poles.

6.24 To meet transmission objectives, especially with respect to maintaining the proper end sections beyond the last load point (See Note 2 on Page 18), particular care has to be exercised when making subscriber assignments. A thorough explanation of bridge taps and excessive end sections and their effect on transmission loss and frequency response is given in RUS TE&CM Section 424, Design Guidelines for Telecommunications Subscriber Loop Plant.

6.25 The locations determined for load coil housings (See Note 2 on Page 18) following the field construction route planning may indicate places where a housing for service connections can be combined with load coil locations. The reverse (moving the load point) is not desirable because of the precision required in locating load coils.

7. OUTSIDE PLANT HOUSING SELECTION

7.1 RUS accepted or technically accepted outside plant housings should be selected to allow sufficient room for splicing, loading (See Note 2 on Page 18), carrier equipment, terminating the initial cable or wire installation, and future cable or wire installations as well as for ease of maintenance. All manufacturers of housings design their product to contain minimum specified components. They are designed for splicing, loading (See Note 2 on Page 18), carrier equipment or looping in and out various size cables and wires but will not necessarily be large enough to perform all four functions for a given size cable or wire. The recommended capabilities of all housings are specified in RUS Bulletin 1753F-401(PC-2), RUS Standard for Splicing Copper and Fiber Optic Cables. This data should be studied to select the proper size housing.

7.2 Outside plant housings also may be used to provide above-ground appearances of buried fiber optic cables. RUS accepted or technically accepted outside plant housings for use on buried fiber optic plant are available to accommodate the fiber optic cable slack and the fiber optic splice case.

7.3 One objective in the selection of housings is to preserve the natural beauty of the countryside. There are, however, instances where it may be desirable that facilities be clearly identified and visible. This may be done by mounting the housing on tall stub poles or using orange colored housings.

8. TERMINAL BLOCKS

8.1 Moisture collecting on the inside of outside plant housings should seldom be a problem if RUS accepted or technically accepted filled splicing connectors are used for connecting service wire drops instead of terminal blocks.

8.2 However, in locations where use of filled splicing connectors is not practical due to high service order activity, filled terminal blocks having RUS acceptance or technical acceptance may be used to avoid moisture and corrosion problems.

8.3 RUS in accordance with RUS Bulletin 1753F-401(PC-2), RUS Standard for Splicing Copper and Fiber Optic Cables, does not allow the use of nonfilled terminal blocks on RUS financed construction projects.

9. RAILROAD CROSSINGS

9.1 The NESC specifies minimum vertical and horizontal clearances for aerial and underground railroad crossings, as well as minimum strength requirements for poles, conductors, anchors and guys, and maximum crossing spans. The Association of American Railroads also publishes requirements regarding clearances, strength of poles, conductors, anchors and guys, and span lengths titled "Specification For Communication Lines Crossing the Tracks of Railroads."

9.2 Some railroads owners as well as States or municipalities may have specifications which differ from the NESC and the Association of American Railroads. Therefore, before design and construction route planning work is undertaken, railroad and/or State or municipal officials should be consulted regarding their crossing requirements. The more stringent requirements should be followed.

9.3 A drawing showing the detailed crossing layout is often necessary for submission to railroad and/or State or municipal officials for approval and for inclusion in the crossing agreement. This drawing should also be included with the construction drawings.

10. ROAD AND HIGHWAY CROSSINGS

10.1 The most acceptable method of crossing State and local roads and highways and the most acceptable procedures to be used in both cutting and repairing pavements should be discussed and agreed to with transportation department officials at the Pre-Construction Route Planning Conference. Such cutting and repairing agreements should be made available to the bidding contractors to assist them in preparing their proposals. Any local regulations concerning the cutting and repair of private roads, lanes, and driveways should also be called to the attention of all contractors at the Pre-Bid Conference.

10.2 After discussions with transportation department officials and visual inspection of the route, construction route planning personnel can verify the preliminary entries of control points on the LD maps or construction drawings.

10.3 The cable or wire route should be planned to cross the road as necessary to serve subscribers without the use of aerial inserts, if possible. Such crossings could be constructed by cutting or sawing perpendicularly across the road, by trenching perpendicularly across the road, by directional boring under the road, or by pipe pushing under the road. Since road crossings are often undesirable and expensive, construction route planning personnel should select the side of the paved road for the most general routing of the cable or wire which will result in the fewest crossings. If numerous crossings are necessary, burying the cable or wire on both sides of the road may be the most economical choice.

10.4 Existing conduit under roads and highways, as well as across bridges, should be used where available. Lengths of new conduit may be placed along with the cable or wire where the road or highway is opened. This will facilitate future reinforcement or replacement.

11. PIPELINE CROSSINGS

11.1 Crossing of pipelines and facilities of other utilities should be done in the most economical and mutually satisfactory manner. This would normally involve placing the cable or wire directly over these facilities. If sufficient depth cannot be obtained, it may be necessary either to place split cable guards over the cable or wire at the crossing, to cut and resplice the cable or wire, or to use directional boring to achieve the greater depth.

11.2 Some pipeline companies require that telecommunications cable or wire be placed a fixed distance below the pipeline. This may require either cutting the cable or wire, trenching, splicing and installing a buried splice enclosure or an outside plant housing or the use of the directional boring method. This applies to all crossings of railroads, roads, highways, bridges, pipelines, etc. Generally, it is the responsibility of the construction route planning personnel to determine the most advantageous and economical method to use. Generally, it is the responsibility of the contractor to avoid damaging facilities which are crossed and to restore them and their contents if damaged.

11.3 Since a pipeline can only be precisely located by exposing it to view, construction route planning personnel should make special markings on the construction drawings showing approximate pipeline locations and also should provide appropriate cautionary notes regarding the facilities to cross. This is especially important as to the exact location of the pipes. Suggested correct and incorrect locating methods are shown in Figure 2.

12. STATION INSTALLATIONS

12.1 Station installations include the construction route planning of buried service wire assembly units, NID assembly units, BET assembly units, or fused protector assembly units.

12.2 Where the objectives of safety and electrical protection conflict with the objectives of appearance and economy, the decision should always favor safety and protection.

12.3 Construction route planning of the buried service wire or cable should conform with the NID, BET, or fused station protector location which will facilitate connections to the subscriber's inside wiring and which, at the same time, will ensure interconnection between the telephone, power, and water pipe grounds. RUS recommends that the NID, BET, or fused station protector location be chosen to be as close as practicable to where there is easy access to the electric service grounding system (electric service grounding conductor, metal conduit covering the electric service grounding conductor, or other means of access to the electric service grounding system).

13. ELECTRICAL PROTECTION

13.1 Construction route planning personnel should be provided with the detailed protective measures to be employed which have been decided upon in the system design. RUS Bulletins 1751F-801, -802, -805, and -815 include details regarding applicable protection practices.

13.2 In order to minimize the possibility of conflict with or interference from power distribution systems, crossings of power and communication systems should be minimized. Where joint occupancy of power and telecommunications facilities is contemplated, the provisions of the NEC and NESC codes and any more stringent local codes should be followed.

13.3 RUS recommends that joint occupancy construction be limited to 1/2 mile (800 kilometers) or less to help minimize possibilities for telecommunications interference caused by power line harmonics.

13.4 Auxiliary protection of buried wire or cable against direct contact with power conductors is not required. Station installations connected by buried wire from aerial extensions may require auxiliary protection as described in appropriate sections of RUS Bulletin 1751F-805, Electrical Protection at Customer Locations.

13.5 It is important that construction route planning personnel understand the difference in the objective of station protection as compared to plant protection. Plant protection is primarily concerned with balancing the cost of maintaining unprotected plant and the value of service interruption against the cost of applying and maintaining protective devices which will reduce or eliminate this plant maintenance. Station protection is concerned with the personal safety of the subscriber and maintenance personnel, protection of the subscriber's premises against fire and protection of the station equipment and wiring against damage and circuit outage. <u>Adequate protection of persons and premises should be provided at all station installations</u>.

14. FINAL INVENTORY CONSTRUCTION DRAWINGS

14.1 Final inventory construction drawings are usually made after construction completion by correcting the initial construction drawings. Due to design changes during construction, the initial construction drawings may require some modifications, particularly in regard to cable or wire lengths, load points (See Note 2 on Page 18), digital carrier repeater locations, and lightwave repeater locations. The resident engineer and contractor should agree on all the quantities and units appearing on the final inventory construction drawings. The corrected construction drawings are then prepared in final form as permanent plant records.

14.2 The "as built" or final inventory construction drawings should provide the following information in complete detail:

a. An inventory of all outside plant units installed; and

b. The physical location of the buried facilities.

14.3 These construction drawings should give a record of the amount of materials and their locations in the field, and also provide the borrower with a basis for a reliable schematic with which to locate the cable or wire either for trouble-shooting, upgrading, or coordinating with other utilities and construction activities that might occur in the future. An example of a final inventory construction drawing, as well as the construction symbols used in preparing the drawings, are shown in Figures 3 and 4, respectively.

14.4 To facilitate future reinforcement, the construction drawing should be corrected and marked with reasonable accuracy so future construction crews will know the approximate locations of existing cables or wires and the approximate locations and depths of any underground facilities. If a greater than normal depth has been specified to facilitate future reinforcing, the resident engineer should make certain that this depth is achieved during construction. For instance, a nominal cable or wire depth of 36 inches (914 millimeters) may be used with the thought that additional cable or wire may be placed at a nominal depth of 24 inches (610 millimeters) in the future.

14.5 The outside plant housings, buried splices, cable or wire lengths, etc., required for cable or wire repairs should be so designated on the construction drawings to facilitate trouble-shooting later; however, this repair material information should not be included in the final inventory for compensation purposes.

FIGURE 1 Example of Typical Construction Drawing

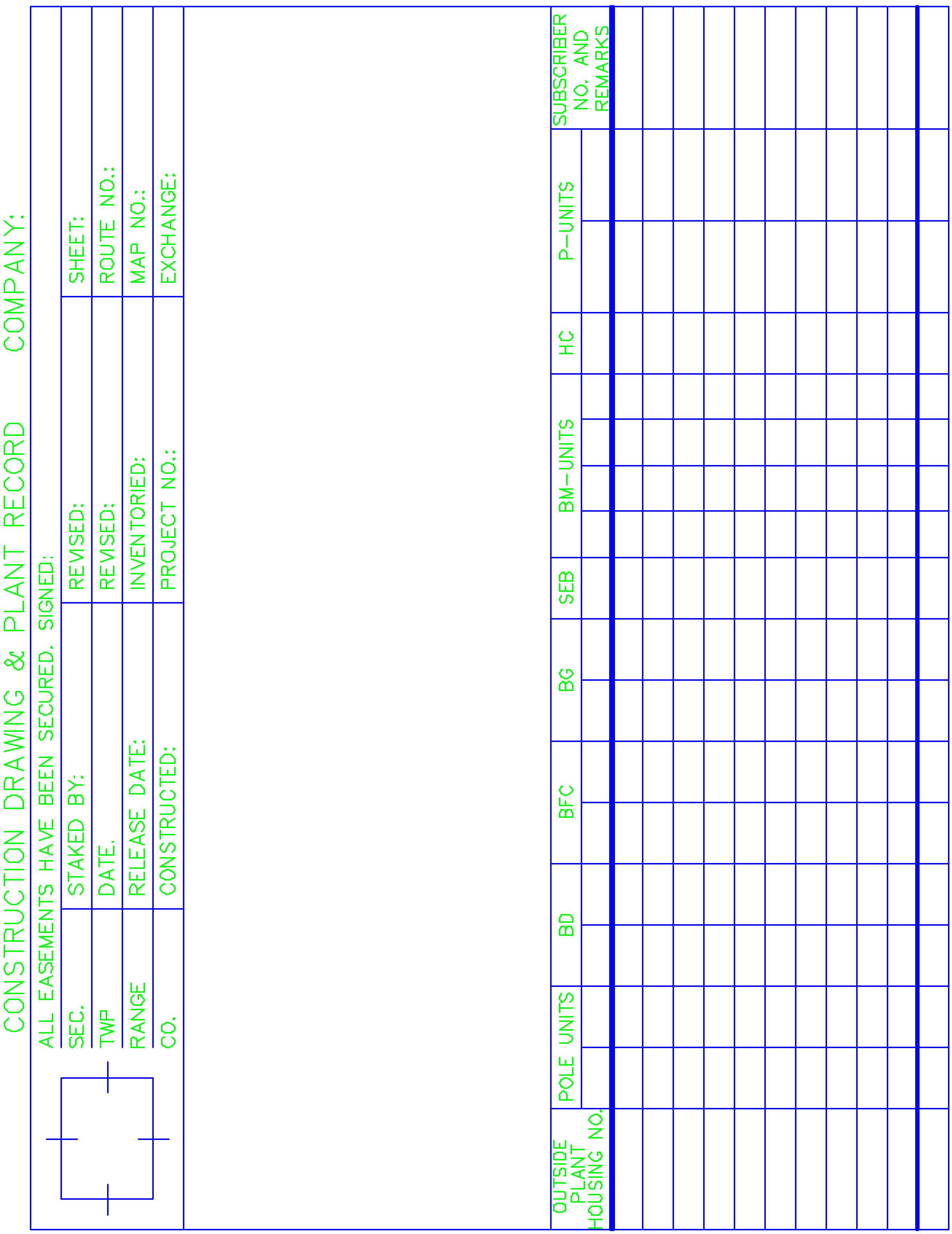
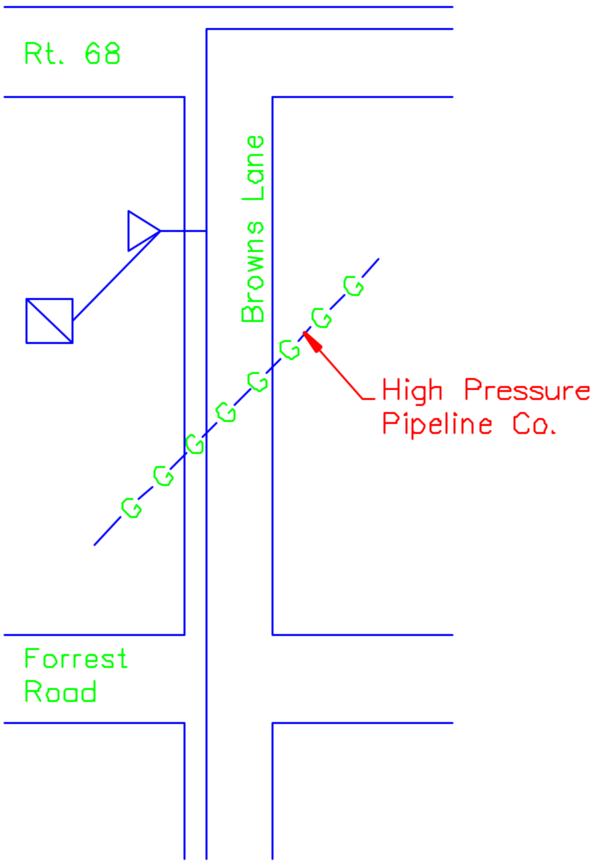
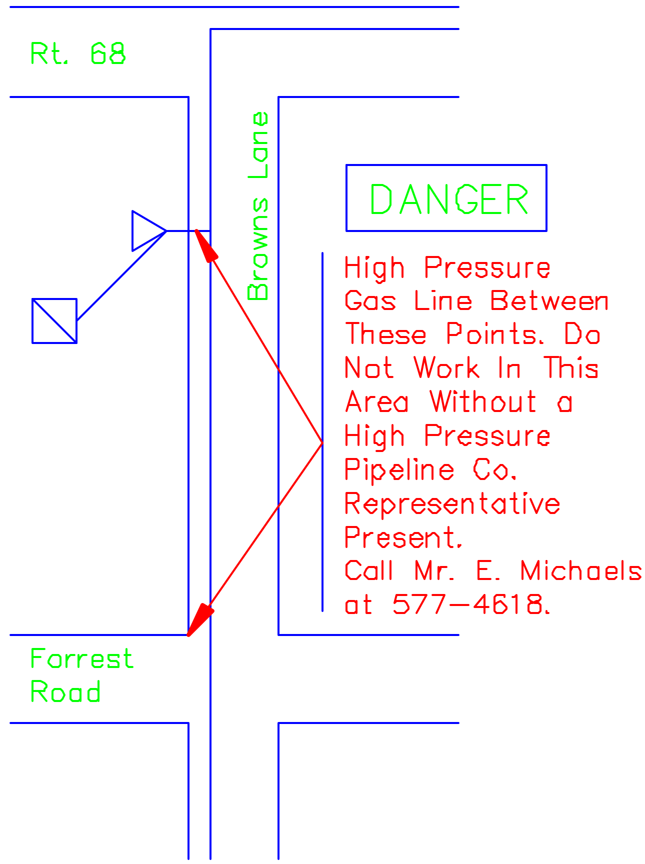


FIGURE 2 Methods of Locating Buried Pipelines on Drawings



INCORRECT

The contractor may think that the pipeline is halfway between the road intersection and the subscriber. Since the drawing is not to scale, this may result in plowing through the pipeline.



CORRECT

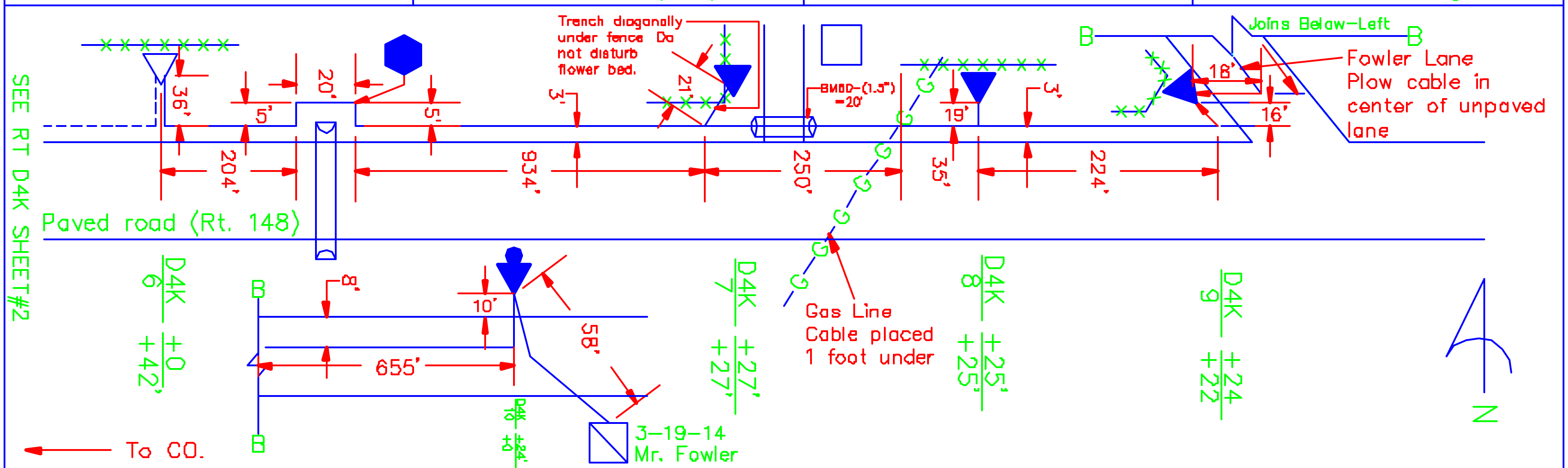
The contractor must get a pipeline representative on the the job site before entering the danger area.

FIGURE 3 Example of Final Inventory Construction Drawing

CONSTRUCTION DRAWING & PLANT RECORD   COMPANY: Ocean Telephone Co.

ALL EASEMENTS HAVE BEEN SECURED. SIGNED: *George Cole* 12/20/89

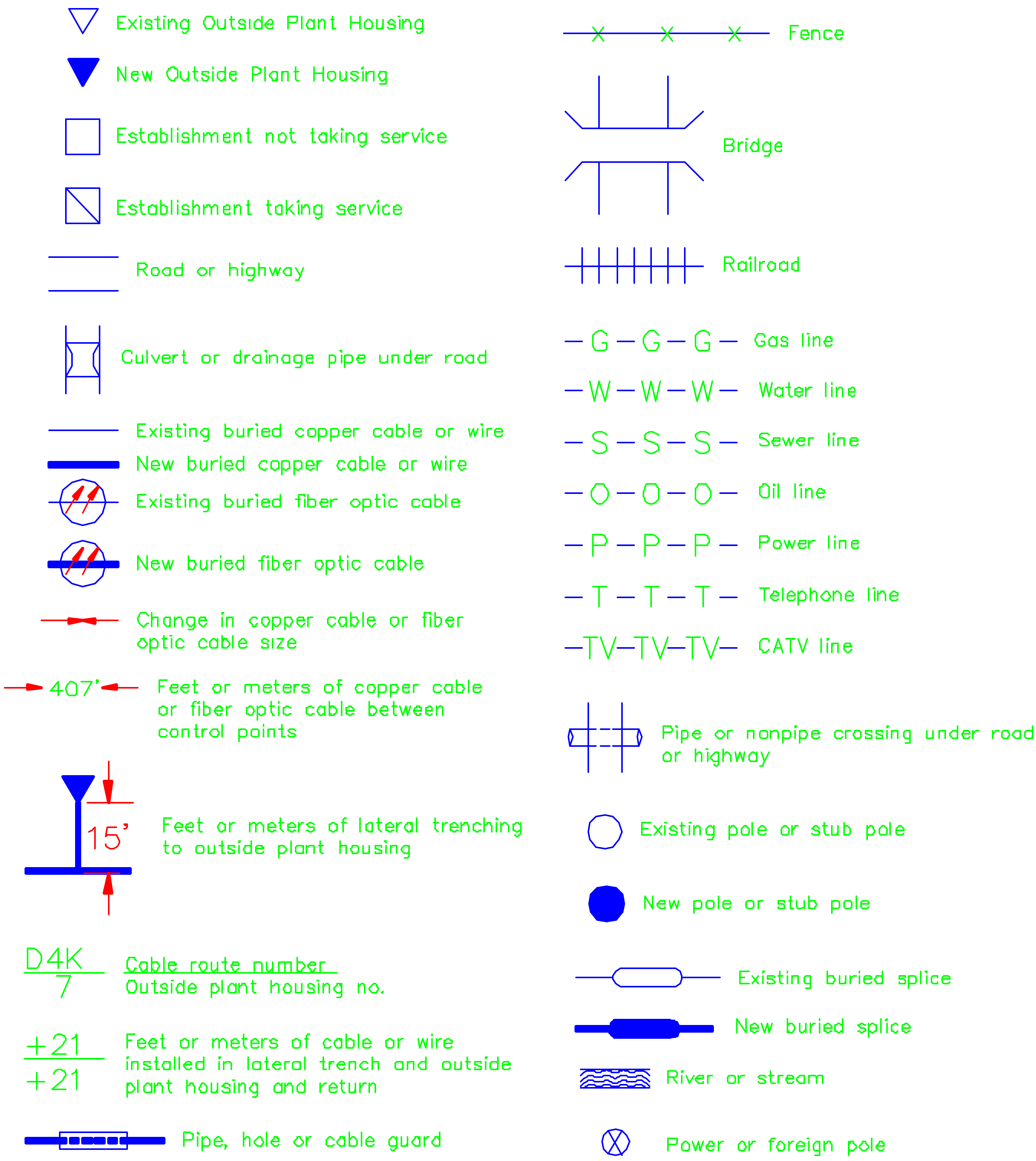
SEC. 19	STAKED BY: R.A.	REVISED: 3/29/90	SHEET: 3 OF 3
TWP 5N	DATE: 1/17/90	REVISED:	ROUTE NO.: D4K
RANGE 6E	RELEASE DATE: 1/24/90	INVENTORIED: 3/29/90	MAP NO.: 3
CO. Hickory Hills	CONSTRUCTED: 3/29/90	PROJECT NO.: N.J. 904-D1	EXCHANGE: Hickory Hill



OUTSIDE PLANT HOUSING NO.	POLE UNITS		BD		BFC		BG		SEB	BM-UNITS			HC	P-UNITS		SUBSCRIBER NO. AND REMARKS
	BA-4		3	3A	12-24	6-24			2-22	60-1.5"	83	53	1	1-1AF2		
D4K6																
												1				
D4K7			1		1237											
D4K8			1		337					20'			.12			
D4K9			1		271								.12			
D4K10	1			1		703			58		1		.06	1		3-19-14
																Mr. Fowler
TOTAL	1		3	1	1845	703			58	1	1	1	.30	1		

Note: To convert feet to meters multiply by 0.3048 meters

FIGURE 4 Examples of Buried Plant Construction Route Planning Symbols



Note: To convert feet to meters multiply by 0.3048 meters

FIGURE 4 Examples of Buried Plant Construction Route Planning Symbols (Continued)