19. Geotechnical Considerations for Pipeline Alignments.

a. General.

1) This section discusses the geotechnical features that should be considered to obtain the most trouble free pipeline alignment. The selection of a pipeline alignment is typically based upon the requirements of the project, the physical constraints of the site and economics. Also consider the following geotechnical features during the selection of the alignment.

b. Geology of the Site.

1) The geology of the site can significantly affect the cost of the project. If rock is encountered, not only do excavation costs increase, but special pipe bedding material will also be required. The alignment should be chosen to minimize the amount of rock encountered. The geologic map of Maryland prepared by the US Geological Survey may be used to obtain information on the geologic settings of the proposed alignment.

c. Soil Conditions.

1) The soil conditions affect both the design and construction of pipelines. For flexible pipe, such as PVC, the pipe supporting strength is partially provided by the soil side support. If the soil is very soft, the pipe class or pipe type should be upgraded to compensate for the weak soil. In marshy areas, special consideration should be given to create a stable subgrade condition. Information from soil borings, existing construction projects in the vicinity of the proposed alignment and the Soil Survey Reports for Montgomery and Prince George's Counties prepared by the US Department of Agriculture may be used to obtain information on the existing soil conditions.

2) Construction costs are also greatly affected by the soil conditions. They not only affect the excavation process, but also affect the type of temporary support needed for the trench walls. For soils with no or short stand-up times, some form of support would be needed which adds to the cost of the project.

d. Groundwater Conditions.

1) Groundwater within the pipe zone almost always increases construction costs. Groundwater control during the construction phase requires the use of extra equipment and results in longer construction times. Areas with high groundwater should be avoided, if possible.

e. Crossing of Highways and Railroads Requiring Tunneling.

1) Crossing under major highways and railroads usually requires tunneling. The cost of the project substantially increases when tunneling is required. The alignment should be chosen to minimize the need for tunneling. If a tunnel is required, it should be located in an area where the geologic soils and groundwater conditions are favorable, see Part Three, Section 25 (Tunnels), and Section 26 (Tunnel Design Criteria). All tunnel requirements and permit issues of the authority having jurisdiction over the highway or railroad should be considered.

f. Crossing of Environmentally Sensitive Areas.

1) Pipelines going through environmentally sensitive areas such as streams, lakes and wetlands require special attention, see Part Three, Section 23 (Pipeline Design in Wetlands). Not only are complex environmental design and construction issues involved, but also permitting issues and complying with different agency regulations also create complications. Every effort should be made to avoid these areas. A thorough review and analysis of crossing these areas should be done during the conceptual design to minimize disruptions and surprises during construction. Resolution of environmental issues is often a very slow process. Therefore, these issues should be given top priority during the early stages of design.

g. Crossing Contaminated Areas.

1) To the extent practical, align the pipeline to avoid contaminated areas. Soil and groundwater contamination can result in health, safety, technical, and legal complications. Investigation and resolution of these issues is often complex and lengthy. Therefore, the possibility of site contamination should be examined during the preliminary alignment stage. See Part Three, Section 24 (Pipelines Crossing Contaminated Areas) for detailed information on investigation and design requirements.

h. Proximity to Existing Structures and Other Utilities.

1) Proximity to existing structures or formations, such as a natural or man-made slopes, see Part Three, Section 22 (Slope Stability), retaining walls, buildings and other utilities should be considered during the selection of the pipeline alignment, see Part Three, Section 3 (Pipeline Crossings and Clearances). A buffer zone is needed to minimize the impact of the trench excavation on the integrity of the structure and to facilitate future maintenance, see Part Three, Section 18 (Temporary Construction Support Criteria). Early coordination with PEPCO, Bell Atlantic (C&P), BG&E, and gas and oil companies will minimize possible conflicts which may delay the project.

i. Need for Deep Cuts or Excessive Fills.

1) The pipeline alignment should be selected such that deep cuts or excessive fills are avoided where possible. Deep cuts not only increase the volume of excavation, but also increase the cost of temporary support for the trench, see Part Three, Section 18 (Temporary Construction Support Criteria). Excessive fill also increases the cost of the project by requiring large volumes of borrow material and extensive compaction efforts. Additionally, future maintenance of the pipeline is more difficult and the loading on the pipe increases substantially which requires the use of a higher class of pipe.

j. Need for Special Bedding and/or Backfill.

1) Special bedding and backfill invariably increases the cost of the project and its use should be minimized. A pipeline going through an area with poor soil conditions may require special bedding and backfill. Altering the route such that the pipeline does not go through the area with poor soil conditions may eliminate this.

k. Need for Blocking and/or Restrained Joints.

1) Horizontal bends. At every horizontal bend and other fittings, an unbalanced thrust acts upon the pipeline, which tends to push the pipe joints open. There are two methods for preventing the joints from opening. The first method involves the installation of a concrete block behind the bend, which will transfer the thrust load from the bend to the soil. In the second method, the pipe joints are restrained on both sides of the bend for a sufficient distance. Both methods increase the construction cost as more material and labor is required. To reduce construction costs, if possible, the alignment should be chosen with the least number of bends and other fittings so that the need for thrust restraint is minimized. Curved alignments may be used to eliminate horizontal bends.

2) Vertical bends. Similar to horizontal bends, vertical bends also create thrust forces. In the case of upper vertical bends, the thrust force is normally anchored by the weight of a concrete block installed under the bend. Alternatively, the joints may be restrained. For lower vertical bends, the thrust force is either transferred to the soil through a concrete block installed under the bend or by restraining the joints. In both cases, additional costs are incurred. The alignment should be chosen to minimize the need for vertical bends. A curved alignment may reduce the need for vertical bends.

3) Thrust blocking versus restrained joints.

a) Restrained joints are normally used when there is not enough space for the installation of the concrete block due to the existence of other adjacent utilities or other conditions. In such cases, a slight change in the alignment may provide the necessary space for the concrete block and eliminate the need for restrained pipe joints.

b) The cost of restraining pipe joints is generally higher than the cost of concrete blocks. Concrete blocks are therefore, the preferred method of thrust restraint. For larger diameter piping, thrust blocks can become large and costly. Therefore, for pipe sizes larger than 24-inch, see Part Three, Section 27 (Thrust Restraint Design for Buried Piping) for further guidance on evaluating the cost of thrust blocking versus restrained joints.