

spiral) and size of corrugation. Flow line elevations of pipes should be shown at both inlet and outlet. For box culverts to be extended, an accurate sketch should be made showing the size and length of the culvert, thickness of all walls, wings, and slabs, and the angle of the barrel with the survey centreline. Elevations should be given on the top of the bottom slab, top and bottom of top slab, parapet walls, wings, etc., on each end of the culvert.

The type, length and width of roadway, location of bents, number of piles per bent and type of footings should be shown for bridges in place. Profiles should be shown as centerline of roadway, from the edge of pavement left and right of centerline of survey, and under the bridge on centerline of survey. The profiles should accurately define the top and bottom of channel banks and the channel bottom.

**2. High Water Information:** Reliable high water information is necessary to evaluate flood elevations and establish roadway grades. High water elevations should be shown upstream of the proposed project, upstream of significant existing structures, and at some point along or at the end of outfall ditch surveys. The location at which a high water elevation is taken should be clearly recorded in the field notes, along with the date and time if available.

At many locations, it is not possible to obtain documents information on high water. In such cases, elevation may be estimated by observation of natural growth, erosion marks or by other means. The survey crew should provide complete information on the methods used. The crew chief should attempt to obtain information from local residents or maintenance personnel.

The soils investigation usually supplies water table information within the project limits; however, the survey crew should note information pertaining to standing water, areas of heavy seepage, or springs within the basin area.

**3. Lateral Ditch Surveys:** Most highway section projects should routinely include lateral ditch surveys at the locations of existing ditches, streams, wadis, swales, etc. The surveys should provide a clear picture of existing conditions at

any location where water comes to and/or leaves a proposed project. They should clearly show the path and approximate elevations of flow for existing ditches and natural streams. Inflow data should be provided for a distance sufficient to indicate the degree of channelization and the direction of flow, usually a distance of 30 to 100 meters.

Data on the outfall portion should extend far enough to determine the direction and degree of channelization and the rate of fall in water surface, and to reach a point of positive and safe disposal. If ditch or channel work appears necessary, collection of topographic data should continue downstream to a point at which damage to adjacent property appears to be insignificant.

If the length of an outfall raises serious doubts about its usefulness, the field party should terminate the survey at 150 meters and note the approximate distance to a suitable disposal point. This note should give the distance, the water elevation at the approximate end, and a brief description of the topography (i.e., tidal bay, reservoir, wadi, etc.) into which the outfall will drain if extended. The designers can then determine if a further detailed outfall survey is required.

The field survey for a lateral ditch should always include property boundaries or plot walls/fences, which are often the determining factors in the ultimate location of outfalls. With property boundaries marked, the design engineer is in a much better position to determine the extent of cross-sectioning needed to cover possible alterations in alignment, and the design engineer is aware of the limitations in changes he may consider.

**4. Bridge and Large Culvert Surveys:** Locations of larger culverts and bridges often must be detailed. The meander of both banks of a stream for a sufficient distance upstream and downstream to determine the approximate extent of any probable channel relocation should be obtained. This ordinarily can be shown within 150 meters upstream and downstream from the project. Any major overflow channels also should be indicated within approximately the same limits or within the limits that these channels leave and