

4. Surveying

- A. **General.** Surveys are used to gather data critical (particularly for feasibility and specifications design levels) to the design and evaluation of the project and to create drawings and maps. Surveys provide data regarding existing features (topography, drainage, etc.), existing structures, utilities, and ties to the desired coordinate system. The design and project teams should determine data required to be shown on the maps and drawings. If existing maps are used, they should be reviewed for adequacy and accuracy.

Surveying is most often not required for an appraisal design. Existing survey information and data are typically used.

Surveys may be required for feasibility designs when:

- (1) Existing drawings are required to be updated with additional data.
- (2) Existing maps/drawings are unavailable or unsuitable:
 - (a) Existing maps (surveyed drawings or U.S. Geological Survey (USGS) topographic maps) do not adequately show existing features (i.e., fences, ditches, utilities, right-of-way, etc.). USGS maps may have up to +/- 40 feet vertical inaccuracies.
 - (b) Existing drawings do not adequately show topography; for example, relief is extreme and/or a high level of accuracy is required for design studies but is not available on existing maps.
 - (c) Existing maps/drawings do not show entire area required for design.
- (3) A tie to an existing coordinate system is required. Selection of the preferred and appropriate coordinate system should be coordinated between the design team and client office. (See “Survey Control” section.)

Site specific surveys are normally required for specifications designs since they require, for both design and construction, a high level of detail and accuracy.

- B. **Acquisition of Survey Data.** Surveys may be performed by either ground forces or by aerial photogrammetry or a combination of both. Aerial surveys are more common when surveys of large areas are required.

Electronic files developed by surveying should be submitted to the design office in the format used by the design office for Computer Aided Drafting (CAD) drawings.

- C. **Survey Control.** Show coordinate system and existing land survey monuments and special control points established for the survey. All preceding survey work and all subsequent survey work, including topography and location, and ground surface elevations of subsurface exploration, should be revised to conform with the permanent control system.

All points contained in the electronic files should have coordinates for northing and easting and values which correspond to the ground level elevations. Specify the vertical datum, such as National Geodetic Vertical Datum (NGVD), and the horizontal datum, such as the State Plane Coordinates (NAD83) along with epoch date.

Legends should show grid factors and reduction to sea level factor, or a combination of the two.

Feasibility phase: Tying to the State or national plane coordinate system is recommended.

Specifications phase: Permanent horizontal and vertical survey control should be established at the earliest possible time. The coordinate system should be related to a State or national coordinate system.

- D. **Content.** The surveys should cover an area sufficient to show all the possible arrangements of proposed structures and features, as well as existing structures and features which may affect the project (see Section 2, “General Maps(s),” Section 5, “Topographic Maps,” and Section 7, “Drawings” (location map, plan and profile drawings, and site plan)). Surveys should show content according to Reclamation drafting standards and should include the following data:

(1) **Existing Facilities:**

- (a) Existing manmade site features such as roads, parking turnarounds, buildings, structures, power lines, buried tanks, campgrounds, leach fields, picnic areas, and marinas.
- (b) Constructed surface drainage features such as drainage from the approach roadways, streams, and ravines, along with any existing bridges or culverts (include invert elevations) in close proximity.
- (c) Naturally formed site features such as springs, marsh areas, overflow channels, channel changes, edge of water, high water marks, types of vegetative cover, large boulders, exposed bedrock, etc.
- (d) Surface and underwater topography (bathymetric chart) (see Section 5, “Topographic maps”).

- (e) Water surface elevations on date of survey.
- (f) Existing right-of-way and fencing. Give dimensions and bearings of the property lines and a dimensional tie to a known section corner.
- (g) Township lines, range lines, and section lines.
- (h) Alignment of all transmission lines and utilities within the area.

(2) **Proposed Features/Facilities:**

- (a) Locations and ties to proposed facilities:
 - Ties and stations for proposed facilities such as buildings, structures, power lines, buried utility lines and tanks, picnic areas, marinas, sublaterals and deliveries, road crossings, railroad crossings, and utility crossings.
 - Grid coordinates for major structures such as pumping plants, flow control stations, tanks, reservoirs, etc.
- (b) Proposed right-of-way acquisitions and fencing.
- (c) Geologic exploration holes, test pits, trenches, etc.
- (d) For power and pumping plants and water delivery facilities such as canals and pipelines, show:
 - Hydraulic grade line in the source canal, reservoir, or pipeline. Also show data such as capacities, grades, etc.
 - Proposed centerline location and stationing.
- (e) For distribution systems, show ownerships, gross acreage, and irrigable acreage for each property; proposed delivery location and type; and delivery water surface elevation. The acreage information, delivery type, and delivery water surface elevation may be omitted from the maps if the information is submitted separately in tabular form.
- (f) Drains:
 - A rough depth-to-barrier map for areas where clays, shale, sandstone, or other low permeable materials occur at depths which will adversely affect drainage.

- A land classification map showing land classes by standard symbols and location of any special deep test holes.

(g) Wetlands:

- A rough depth-to-barrier map for areas where clays, shale, sandstone, or other slowly permeable materials occur at depths which will adversely affect the wetland.

(h) Bridges:

- Provide a profile of the centerline of the river or stream bottom, where practical, for a minimum distance of 500 feet upstream and 500 feet downstream from the centerline of the proposed bridge structure. The profile should be plotted to a horizontal scale of 1 inch equals 50 feet and a vertical scale of 1 inch equals 10 feet.
- Provide at least four cross sections of the stream. Sections should be taken immediately upstream and downstream of the structure, and the other sections should be taken at each end of the stream profile. These cross sections should be typical of the stream. Indicate the elevations of low, present, and high water.