Reclamation Manual

Design Data Collection Guidelines
Chapter 4 – Specifications Designs

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1. Dams. The Introduction (Chapter 1) for these design data collection guidelines contains additional information concerning: preparing a design data collection request, design data collection requirements, and coordinating the design data collection and submittal. This paragraph lists data required for design of a storage dam; however, design data for a diversion dam shall be submitted in accordance with the list so far as the items are applicable. The Project Team and the Design Team for the dam will review the data used for authorization and the changes that have occurred since that time, the damsite selected, and the choice of structure type and recommend a design data collection program to the design office and an estimated schedule.

A. **General Map(s) Showing:**

(1) A key map locating the general map area.

(2) The structure site or sites.

(3) County and township lines.

(4) Existing towns, residences, private property, highways, roads, bridges with special loads or size limitations, railroads and shipping points, public utilities such as electric power and telephone lines, pipelines, etc., and stream-gauging stations.

(5) Locations of potential construction and permanent access roads, and sites for contractor's staging areas, and construction facilities.

(6) Locations of borrow areas for natural construction materials and disposal areas for waste excavation.

(7) Existing or potential areas or features having a bearing on the design, construction, operation, or management of the project feature such as: recreation areas, fish and wildlife areas, building areas, areas of cultural sensitivity; and areas of archeological, historical and mining or paleontological interest. The locations of these features should bear the parenthetical reference to the agency most concerned; for example, Reclamation (Bureau of Reclamation).

(8) Rights-of-way for construction, access, and staging areas.

(9) Sources of construction power and power transmission facilities.

B. **General Description of Local Conditions Covering:**

(1) The approximate distance from the nearest railroad shipping terminal to the structure site; load restrictions and physical inadequacies of existing roads and structures and an estimate of remedial improvements to accommodate construction hauling; estimate of length and major structures required for new construction access road; and possible alternative means for delivering construction materials and equipment at the structure site.

(2) Local freight or trucking rates.

(3) Availability of or need for permanent buildings for operating personnel.

(4) Availability or accessibility of public facilities or utilities such as: water supply; sewage disposal; telephone utility; fire protection services; and electric power for construction (give location, power supplier, voltage, number of phases, and capacity of existing transmission lines; power rate schedules; probability of interruption of supply; and requirements for additional transmission line, if needed).

(5) Climatic conditions that will affect construction and operation and maintenance procedures such as: amount, rate, and distribution of rain and/or snow; ice conditions; summer and winter temperatures, with extremes; extreme wind velocities and prevailing directions; and probability of excessive dust or sand.

(6) Names and telephone numbers of local utilities and contacts within those organizations.

C. **Surface Data:**

(1) **Survey Control.** Permanent horizontal and vertical survey control should be established at the earliest possible time. A coordinate system on a true north-south grid should be established with the origin located so that all of the features (including borrow areas) at a major structure will be in one quadrant, and so that the values of the coordinates for any major structure are widely separated numerically. The coordinate system should be related to a state or national coordinate system, if available. All preceding survey work, including topography and location and ground surface elevation of subsurface exploration, should be corrected to agree with the permanent control system; and all subsequent survey work, including location and ground surface elevation of subsurface exploration, should be based on the permanent control. All surveys should be tied to the established coordinate system at each construction site.

(2) **Topographic Map.** A topographic map covering an area sufficient to accommodate all possible arrangements of structures including dam, spillway, outlet works, and diversion works; normally this should be on a scale of 1 inch equals 50 feet with a contour interval of 2 feet. For large dams and structures, a scale of 1 inch equals 100 feet with a contour interval of 5 feet is acceptable. For flat or gently sloping topography, contour intervals as low as 1 foot may be desirable. Show the coordinate system and existing land survey corner monuments or special control points established for the topographic survey. Show all manmade features in the included area.

(3) **Aerial Photographs.** Aerial photographs (size 8 by 10 inches, color if feasible) of the sites of major dams and structures. The purpose of the aerial views is to permit early preparation of an artist's rendition of the feature and to permit a study of the environmental impact of the structure. Later such renditions or drawings may be used for inclusion in specifications or for other purposes.

These photographs should be taken from locations that would best show the proposed structure and from a vertical angle of approximately 20E to 30E above the horizontal. Where possible, indicate known tie points to the topographic maps. These photographs should be taken between 11 a.m. and 2 p.m., so as not to show the principal area of the proposed structure in shadow. Also submit the negatives or color slides.

Each region is urged to provide these photographs for smaller dams or auxiliary structures whenever it is considered that artist's conceptions would be beneficial to the project and the architectural designs would be influenced by the physical characteristics of the area.

(4) **Photographs.** Color photographs of all existing facilities or structures in the vicinity of the proposed dam and closeup views of any features which may affect designs. Black and white photographs are acceptable for structures to be removed or demolished. Color or Black and White Photographs of structure sites with structure locations marked in ink.

D. **Foundation Data:**

(1) **General Engineering Requirements:** The need for foundation data should be established by the joint efforts of originating office personnel and the office(s) providing design services. For major structures it is recommended that a field conference be held, including an inspection of the site. This conference should result in a geologic investigations program outlining the need for and extent of surface and subsurface studies, and other requirements. The geologic investigations program

must be based on site conditions and the type of structure. The complexity of the site will determine the detail of the investigation.

(2) **Geologic Data.** The following list of geologic design data provides general guidelines for the collection and reporting of geologic information for this type of facility. The geologist should apply these guidelines with good judgment and sound reasoning, elaborating upon them as required by the particular geologic setting and engineering requirements. Because the collection of geologic data is a dynamic process and often continues into the preparation of final designs, all stages of the specification design geologic exploration program must be constantly coordinated with the designer through the appropriate geology office. The regional or Technical Service Center (TSC) geologic and geophysical staff will provide necessary assistance and guidance in the gathering of these design data.

(a) Compilation, summary, and reporting of Reclamation and non-Reclamation geologic information on the area, with attention being paid to the sequence of explorations and historical geologic events.

(b) Surface geologic map of dam and entire reservoir area showing location of explorations. Locations of all existing explorations should be indicated by coordinates or stationing of the permanent survey control system for the facility. Include evaluation of water-holding capability of reservoir.

(c) Conduct specific foundation exploration at site of all dams and appurtenant structures, diversion or outlet works, spillways, pumping or generating plants. Furnish data adequate for preparing bedrock contour maps, geologic cross sections or other illustrations required to demonstrate foundation conditions.

(d) Factual narrative description of surficial deposits with attention being paid to engineering geologic matters, such as swelling minerals, low-density materials, presence of gypsum and other sulfates, caliche, erodibility (see *Engineering Geology Field Manual*).

(e) Factual narrative description of bedrock with attention being paid to engineering geologic matters such as compressive strength, shear strength, elastic modulus, swelling minerals, presence of gypsum and other sulfates; depth of weathering, fracturing, joints, faults, and other discontinuities.

(f) Photographs, preferably in color, of representative or particular geologic conditions.

(g) Selected determination of engineering properties of surficial deposits and bedrock by laboratory or field tests (in-place density, penetration resistance, permeability, compressive and shear strength, and consolidation or expansion characteristics, etc.). The type and number of samples and tests required should be determined in cooperation with the design office.

(h) Summary and data obtained from exploration by geophysical methods (seismic, resistivity, etc.), if performed.

(i) Determine ground water conditions with attention being paid to water levels and their seasonal fluctuation, occurrence of unconfined and confined aquifers, potential reservoir leakage, water-producing capabilities, chemistry, and land subsidence.

(j) Logs of explorations. Logs of drill holes advanced by churn drilling, chop and wash or other methods which result in less than adequate sample recovery may need to be augmented by appropriate borehole electric (geophysical) logs.

(k) Evaluation of landslide, snowslide, and rockfall conditions. A complete map of possible landslide areas with as much detail as practicable.

(l) Determine age, location, and characteristics of faulting in the vicinity, especially if suspected to be late Pleistocene or Holocene, to assist in the determination of the seismicity of the site by specialists.

(m) Document past, present, and possible future petroleum, water, and mineral extraction operations in vicinity.

(n) Determine geologic conditions which may affect construction methods such as, boulders on ground surface, marshes, drilling conditions, and stability of grout or footing holes, ground temperatures, gases. Any potential surface water runoff problems should be brought to the attention of a regional hydrologist.

(o) Geological information pertinent to reservoir water-holding capability, operation and use, location and type of mines or mining claims, potential landslides and major faults.

E. **Corrosion Survey:**

(1) In situ electrical resistivity measurements of geologic materials in the area of construction. Additional measurements should be made in the areas

where there is a pronounced change in type of geologic materials, drainage, and/or moisture conditions.

(2) Performance history of materials of construction that have been used in the area.

(3) List of structures in the vicinity of (within 1/4 mile) the proposed structure and appurtenant features. Determine if buried structures in the vicinity have corrosion protection and, if so, the type of corrosion protection.

(4) List location, output, and purpose of the direct-current sources in the earth situated within 1/4 mile of the proposed structure and appurtenant features. If the purpose of the direct current is for cathodic protection, describe the structure protected and its location.

(5) Chemistry of geologic materials, ground water, and/or product water.

F. **Construction Materials Data Including:**

(1) Inventory of available impervious and pervious embankment materials and rock for riprap and rockfill. Location of and distance to borrow areas and approximate quantities available.

(2) Information on concrete aggregates. (See *Concrete Manual*.)

(3) Information on sources and character of acceptable road surfacing materials. Consider required excavation material as a possible source.

(4) Data on commercial concrete plants within practical hauling distances from the structure site.

(5) References to results of sampling and analysis of materials including previous tests and photographs of sources.

(6) Report alkali conditions in soil and water which might affect the choice of sulfate resisting cement.

(7) Statement of availability of timber for structural work and lumber for other purposes.

(8) Environmental impacts associated with removing or obtaining construction materials.

(9) Requirements concerning permanent stockpiles and suggested permanent stockpile locations.

(10) Information including catalogues on firms, within practical hauling distance from the site, manufacturing precast concrete products and brick or other masonry units.

G. **Water for Construction Purposes.** For large rivers, this item may be unimportant. For small streams and offstream reservoirs, the item becomes critical. Determine if up to 2-cubic-foot-per-second (ft^3/s) diversion flow for construction purposes can be assured to the contractor. The Government should obtain the water rights required. If necessary to use ground water, obtain information on probable sources and yields. Furnish information on locations and yields of existing wells in the vicinity. Determine restrictions, if any, to use of ground water for this purpose. It may be necessary to obtain permits from State or other governing agencies. Retrieve water quality samples for testing and evaluation.

H. **Hydrologic Data.** The hydrologic data for a dam will be documented in a report for the feasibility designs and will have been updated based on any additional information developed since the feasibility designs. The specifications design data submittal shall reference this document and thus eliminate the need to repeat the information enumerated below. If, for any reason, the information enumerated below is not contained or is not updated in the report prepared for the feasibility design then this information should be provided for the specifications design.

(1) Inflow design flood and possible preceding and recurring flood hydrographs with recommended routing criteria. For a diversion dam involving little or no storage, normally a probability curve of flood peak discharges up to the 100-year point will be sufficient. However, if the structure is judged to pose a significant threat to a downstream population, the design flow may be based on a longer recurrence interval.

(2) Flood hydrographs for frequencies of 5, 10, and 25 years for use in diversion during construction. Requirements for maintaining streamflow or diversions during construction and maximum length, time, and number of permitted interruptions.

(3) Data for preparation of specifications hydrographs, including the location of gauging station at or near the damsite and the dates for which hydrographs should be prepared. Copies of the daily discharge record should be supplied for stations with unpublished records.

(4) Method of reservoir operation for flood control and maximum permissible releases.

I. **Reservoir Data:**

(1) Area capacity curves and/or tables to at least the dam crest elevation.

(2) Topography for small reservoirs, on a scale of 1 inch equals 400 feet and a contour interval of 5 feet; for large reservoirs, on a scale of 1 inch equals 2,000 feet and a contour interval of 10 feet.

(3) Completed reservoir storage allocations, showing storage allocations and corresponding elevations.

(4) Physical, economic, or legal limitations to maximum reservoir water surface.

(5) Anticipated occurrence and amounts of sediment, ice (thickness), and drift (trash), and possible effect on reservoir outlets, spillway, and other appurtenances.

(6) Extent of anticipated wave action including a discussion of wind fetch.

J. **Operating Data:**

(1) Details of required downstream control sections, measuring devices, gauging stations, or other operating works.

(2) Reservoir backwater curves, including the effect of sediment deltas if upstream right-of-way will be critically affected or damaged.

(3) Location, hydraulic section, and water surface elevation of irrigation or power canal diverting from the reservoir.

(4) Annual periodic fluctuations of reservoir levels shown by tables or charts summarizing reservoir operation studies for the critical and normal climatic periods. Include any annual reservoir drawdowns for operation and maintenance purposes.

(5) Tailwater curves, sedimentation studies, degradation and aggradation studies should be included.

(6) Required outlet and sluiceway capacities for respective reservoir water surfaces; and sill elevations. Give type and purpose of reservoir releases and the time of year to be made; include minimum release during winter. If temperature or water quality control of releases is anticipated, the degree and purpose of the control should be included.

(7) Type of operation, i.e., full-time resident caretaker, remote control, etc.

(8) The operational impacts of the project that require alternative designs, e.g., outlet works and downstream river temperature, spillways and gas supersaturation, increased channel scour, and downstream channel protection, etc.

K. **Miscellaneous Data:**

(1) Requirements for roadway on crest of dam (and approaches) including guardrails, street lighting, and guideposts. Present or future requirement for highway crossing on dam, including application of public law for highway bridges on Federal dams.

(2) Requirements for temporary or permanent facilities for illuminating the downstream face of the dam during filling and operating conditions.

(3) Requirements for temporary construction access roads, permanent access and service roads, and relocation of existing roads or railroads. Include any limiting requirements imposed by road owners for public access/haul roads.

(4) Details of fishways and screens with recommendations of State and Federal fish authorities.

(5) Existing works to be replaced by incorporation into dam.

(6) Future powerplant or power development.

(7) Navigation facilities.

(8) Possibility of raising crest of dam in future.

(9) Recommendations or commitments to maintain specific flow requirements for biological and/or recreational resources.

(10) Anticipated future river channel improvement or other construction which might change downstream river regimen.

(11) Required provisions for public safety and visitor facilities.

(12) Data on upstream dams and reservoirs.

(13) Anticipated recreation facilities that will affect the dam design and/or should be included in original design.

(14) (For concrete storage dams), daily readings of maximum, minimum, and mean temperatures of air and river water. Until a weather station is

established, temperatures should be obtained whenever possible. Date, time of day, and corresponding air and water temperatures should be recorded.

(15) Recommended period for construction.

(16) Commitments for delivery of water or power.

(17) Unusual local pest (termites, borers, etc.) action and recommended preventive measures.

(18) Designated areas to be cleared of vegetation, with description of kinds, size, and density of growth. State recommended method of payment; i.e., lump-sum price for specific area with defined limits, or unit price per acre for specific area whose limits may change during construction. If there is a variation in the density of growth or in the difficulty of clearing operations for the designated area to be cleared, the work should be segregated into not more than three items with the limits of respective areas clearly established. If vegetation to be cleared is very sparse or is such as can be removed without special equipment or separate operations, the cost of clearing should be included in the prices bid for excavation or prices bid for other items of work.

(19) Provide data on the method(s) of brush and tree disposal permitted by local and State pollution regulatory agencies.

(20) Problems of bank erosion in reservoir area.

(21) Description of existing project fire protection and security plans which will be applied to this feature, together with any specific requirements for this dam.

(22) Provide information on upstream and downstream log booms, including whether or not it needs to be relocated.

L. **Cost Data:**

(1) Estimate of cost of right-of-way or easements for reservoir, dam, and appurtenant works. Include supporting data.

(2) Curve showing estimated cost of right-of-way versus elevation of reservoir water surface from normal elevation to maximum estimated surcharge elevation or other physical or economic limit. Include supporting data.

(3) Estimates of cost for clearing reservoir area and for removing or replacing private improvements in the area. Include supporting data.

(4) Estimates of cost for relocating railroads, highways, roads, water systems, and other public utilities from the damsite or reservoir area. Include supporting data. Where buildings are located within the area to be cleared by the prime contractor, and if disposal will be his responsibility, designate building groups by number and furnish detailed list of buildings

for each group. Details should include general description, size, materials, and general condition. Determine if disposal will be the responsibility of prime contractor. If not, submit dates when disposition will be completed by others.

(5) Information on local labor supply and labor problems.

(6) Information on important construction work in progress or planned in the vicinity and the presence of interested contractors or subcontractors in the area.

M. **Right-of-Way.** A marked print shall be submitted showing the following data:

(1) Proposed right-of-way boundaries for construction purposes in the vicinity of damsite.

(2) Proposed right-of-way boundaries for access purposes (if required).

(3) Designation of areas within right-of-way boundaries for the following special purposes:

(a) Disposal of waste material.

(b) Contractor's plant, storage, and other incidental purposes.

(c) Borrow sources.

(d) Government's construction facilities (if applicable).

(4) Existing private or public easements and right-of-way across or adjacent to alignment.

N. **Environmental Considerations.** Implementation of design features should be consistent with environmental commitments listed in the National Environmental Policy Act compliance document. Implementation of design features should be consistent with agreements reached between Interior bureaus, Federal agencies, and other governmental agencies.

Design data should include, as a minimum, a brief description of the environmental resources that could be affected by the proposed development. The emphasis should be on those areas within the range of alternatives open to the designers in developing a structural design. The following items should also be included in the design data:

(1) Cultural (historical, archeological, architectural, and paleontological) resources in the area of the dam and the reservoir basin.

(2) The need for blending structures with the surroundings.

(3) Comments on any ecological, aesthetic, or other environmental aspects peculiar to this location which would affect layout or conceptual design.

(4) Indicate the suitability and possibility of present and future use of land adjacent to Reclamation facilities by the public for recreation, hobbies, sports, leisure, education, health, housing, etc. Provide data on zoning regulations and subdivision proposals.

(5) Furnish data on allowable noise limits in the vicinity of the proposed plant where fixed by law or local ordinance, or where otherwise considered necessary or advisable; measurements of existing daytime or nighttime ambient noise levels in the area; and distances to the nearest residential units.

(6) Identify special environmental compliance requirements including water quality standards such as suppression of nitrogen, adequate oxygen levels, and temperature control and control of turbidity during construction; preservation of existing growth adjacent to construction; obliteration of temporary roads and restoration to original appearance; dust abatement, etc. Give recommendations on steps to be taken to meet these requirements.

(7) Impact of moving construction materials on existing road facilities, including consideration of such factors as traffic congestion, effect on road condition, air pollution, etc.

(8) Background on the need for fish facilities such as screens, fishways, and barriers.

(9) Comments on disposal of special excavation problem materials such as lignite.

(10) Give borrow area and temporary haul road restoration requirements such as stockpiling of top soil, regrading of the area, general cleanup, etc.

(11) Give consideration to using required excavated material in lieu of material from other borrow sources wherever possible.

(12) Erosion and sediment control.

(13) The need for a field conference to resolve critical environmental problems with participation of other agencies.

(14) Review of designs by other agencies including at what stage of design and level of their review, and the findings of the Fish and Wildlife Coordination Act Report.

(15) Reservoir clearing plan to consider fish and wildlife requirements.

(16) Anticipated public use around the structure.

(17) Environmental permit requirements (401, 404, Storm Water Runoff, etc.)

(18) Special environmental requirements for transmission lines or underground transmission systems.

(19) Location, volume, and contamination levels or any solid waste or hazardous waste facilities within the reservoir basin.

(20) Location of any underground storage tanks within the reservoir basin.

O. **Electrical Data.** Data listed below will be required to initiate design. The data furnished should be sufficient to permit designers to complete the basic design (single-line diagram) for the dam. After designs have progressed enough to develop details of electrical system needs, designers will prepare a list of additional data required to complete final design of electrical installation.

(1) Names and telephone numbers of electrical power suppliers and contacts within those organizations.

(2) Location of point where connection to power supply will be made.

(3) System voltage at which power will be supplied, number of phases, and whether service will be overhead or underground.

(4) Electrical system reliability criteria.

(5) Discuss requirements for an alternate power source. If an alternate supply is required, indicate:

(a) If required by a State or local authority.

(b) If source should be an engine-generator.

(c) If a threat to life or property will result if normal power supply is lost.

(d) Loads requiring service from alternate source.

(6) Requirements for remote monitoring of conditions at the facility. Discuss location of remote station, and items required to be monitored.

(7) Requirements for supervisory control, including location of station from which supervisory control is exercised.

(8) Requirements for voice and data communications between the supervisory master station and the remote facility.

P. **Site Security.** Many Reclamation projects may require a security risk assessment. The need for a site-specific security risk assessment should be considered for feasibility designs where an assessment may impact the field cost estimate and for specifications designs. Specific issues to consider are contained in Section 14 of Chapter 7 – Site Security and Public and Worker Safety. If assistance is required to determine specific design data needs, contact the Office of Security, Safety and Law Enforcement. Where design data and designs include site-specific security assessment, compliance with Reclamation Manual DM Part444 – Physical Protection and Facility Security, Chapters 1 and 2 is required.

2. Powerplants and Pumping Plants. The Introduction (Chapter 1) for these design data collection guidelines contains additional information concerning: preparing a design data collection request, design data collection requirements, and coordinating the design data collection and submittal. The following is a list of possible data required for design of powerplants and pumping plants and additions, modifications, or rehabilitations to existing powerplant and pumping plants. The size and complexity of the structure should govern the amount and detail of the design data required. Where both pumping and generating functions are to be provided in the same plant, furnish design data for both.

For existing non- Reclamation powerplants and pumping plants (i.e., Bureau of Indian Affairs), single-line diagrams and switching diagrams which include equipment ratings will be necessary for a proper evaluation of existing equipment within the scope of any proposed changes.

A. General Map Showing:

(1) A key map locating the general map area within the State.

(2) The structure site or Sites.

(3) County and township lines.

(4) Existing towns, highways, roads, railroads and shipping points, public utilities such as electric power and telephone lines, pipelines, etc., and stream-gauging stations.

(5) Locations of potential construction and permanent access roads, and sites for contractor's staging areas and construction facilities.

(6) Locations of borrow areas for natural construction materials and disposal areas for waste excavation.

(7) Existing or potential areas or features having a bearing on the design, construction, operation, or management of the project feature such as: recreation areas, fish and wildlife areas, building areas, areas of cultural sensitivity, and areas of archeological, historical, and mining or paleontological interest. The locations of these features should bear the parenthetical reference to the agency most concerned; for example, Reclamation, National Park Service (NPS), or U.S. Fish and Wildlife Service (FWS).

(8) Rights-of-way boundaries for construction, access, and staging areas.

(9) Sources of construction power and power transmission facilities.

B. General Description of Local Conditions Covering:

(1) The approximate distance from the nearest railroad shipping terminal to the structure site; load restrictions and physical inadequacies of existing roads and structures and an estimate of remedial improvements to accommodate construction hauling; estimate of length and major structures required for new construction access road; and possible alternative means for delivering construction materials and equipment at the structure site.

(2) Local freight or trucking rates.

(3) Availability or accessibility of public facilities or utilities such as: water supply; sewage disposal; telephone utility; fire protection services; and electric power for construction (give location, power supplier, voltage, number of phases, and capacity of existing transmission lines; power rate schedules; probability of interruption of supply; and requirements for additional transmission line, if needed).

(4) Climatic conditions that will affect design or construction and operation and maintenance procedures such as: amount, rate, and distribution of rain and/or snow; ice conditions; summer and winter temperatures, with extremes; extreme wind velocities and prevailing directions; and probability of excessive dust or sand.

(5) Names and telephone numbers of local utilities and contacts within those organizations.

C. Surface Data:

(1) **Survey Control.** Permanent horizontal and vertical survey control should be established at the earliest possible time. A coordinate system on a true north-south grid should be established with the origin located so that all of the features (including borrow areas) at a major structure will be in one quadrant, and so that the values of the coordinates for any major structure are widely separated numerically. The coordinate system should be related to a State or national coordinate system, if available. All preceding survey work, including topography and location and ground surface elevation of subsurface exploration, should be corrected to agree with the permanent control system; and all subsequent survey work, including location and ground surface elevation of subsurface exploration, should be based on the permanent control. All line surveys should be tied to the established coordinate system at each plant site.

(2) **Topographic Map.** A topographic map covering an area sufficient to accommodate all possible arrangements of structures including intake, tailrace, and penstocks or discharge pipes; normally this should be on a

scale of 1 inch equals 50 feet (a scale of 1 inch equals 100 feet is permitted for large area sites) and a contour interval appropriate for the relief in the project area (1 to 2 feet for flatter areas and 5 feet in areas where relief is significant). For flat or gently sloping topography contour intervals as low as 1 foot may be desirable. Show the coordinate system and existing land survey corner monuments or special control points established for the topographic survey. Show all manmade features in the included area.

(3) **Aerial Photographs.** Aerial photographs (9-inch by 9-inch color infrared photos at 1:24,000 scale) of the sites of powerplants and major pumping plants. The purpose of the aerial views is to permit early preparation of an artist's rendition of the feature and to permit a study of the environmental impact of the structure. Later such renditions or drawings may be used for inclusion in specifications or for other purposes.

These photographs should be taken from locations that would best show the proposed structure and from an oblique angle of approximately 20° to 30° above the horizontal. Where possible, indicate known tie points to the topographic maps. These photographs should be taken between 11 a.m. and 2 p.m., so as not to show the principal area of the proposed structure in shadow. Submit the negatives or color slides.

Each region is urged to provide these photographs for smaller plants or auxiliary structures whenever it is considered that artist's conceptions would be beneficial to the project and the architectural designs would be influenced by the physical characteristics of the area.

(4) **Photographs.** Color photographs of all existing facilities or structures in the vicinity of the proposed plant and closeup views of any features which may affect designs. Black and white photographs are acceptable for structures to be removed or demolished. Color or black and white photographs of structure sites with structure locations marked in ink.

D. Foundation Data. The following data should reflect a recognition and consideration of the type and size of the particular engineering structure and the effect on or relationship to the structure of the significant characteristics of the foundation materials and conditions at the particular site. The TSC geologic and geophysical staff will provide necessary assistance and guidance in the gathering of these design data.

(1) Geologic Data:

(a) A description of regional geology.

(b) A description and interpretation of site geology including physical quality and geologic structure of the foundation strata, seasonal ground water, ground subsidence, seismic conditions, existing and

potential landslide, snowslide and rock fall areas, surface water runoff, and engineering geologic interpretations appropriate to the engineering structure involved including the conditions expected during excavation and construction.

(c) Geologic logs of all subsurface exploration. The coordinate location and ground surface elevation of all existing exploratory holes should, if necessary, be corrected to conform with the

permanent survey control system; and all subsequent exploratory hole locations and elevations should be based on the same survey control system.

(d) A geologic map, plotted on the topographic map of the site, showing surface geology and the location of geologic sections, soil profiles, and all subsurface exploration.

(e) Geologic sections, with detailed soil profiles as required, showing known and interpreted subsurface conditions.

(f) Exploratory holes should be extended into the foundation material well below the base of the structure. An effort should be made to run borehole geophysical logs when appropriate.

(g) Color photographs of pertinent geologic and topographic features of the terrain including aerial photographs if available.

(h) Samples of foundation strata as needed for visual examination or laboratory testing.

(i) Determine age of faulting in vicinity, especially if suspected to be late Pleistocene or Holocene, to assist in the determination of the seismic loading by specialists in the TSC.

(2) **Engineering Data:**

(a) Surficial soils (see *Earth Manual*, latest edition). Note geologic sections and soil profiles in (1)(e) above.

- A classification, in accordance with the Unified Classification System, of the soil in each major strata.
- A description of the undisturbed state of the soil in each major strata.

- A delineation of the lateral extent and thickness of critical, competent, poor, or potentially unstable strata including swelling minerals, gypsum and other sulfates, caliche, etc., in foundations and excavation slopes, especially those to be permanently exposed.

- An estimate or a determination by tests of the significant engineering properties of the strata, such as density, permeability, shear strength, and consolidation or expansion characteristics; and the effect of structure load, changes in moisture and fluctuations, or permanent rise of ground water on these properties.

- A determination by tests of the corrosive properties and sulfate content of the soil and ground water.

(b) Bedrock (see *Engineering Geology Field Manual*). Note geologic sections and soil profiles in (1)(e) above.

- A contour map of the top of bedrock. A description of thickness of weathered, altered, fractured, or otherwise softened zones, and other structural weaknesses and discontinuities.

- A delineation of structurally weak, pervious, and potentially unstable zones and strata of soft rock and/or soil in foundations and excavation slopes, especially those to be permanently exposed, with attention being paid to engineering matters such as swelling minerals, presence of gypsum and other sulfates, caliche, etc.

- An estimate or a determination by tests of the significant engineering properties of the bedrock such as density, absorption, permeability, shear strength, and strain characteristics; and the effect of structure load, changes in moisture, and fluctuations or permanent rise of ground water on those properties.

E. Corrosion Survey:

(1) In situ electrical resistivity measurements of geologic materials in the area of construction. Additional measurements should be made in the areas where there is a pronounced change in type of geologic materials, drainage, and/or moisture conditions.

(2) Performance history of materials of construction that have been used in the area.

(3) List of structures in the vicinity of (within ¼ mile) the proposed structure and appurtenant features. Determine if buried structures in the vicinity have corrosion protection and, if so, the type of corrosion protection.

(4) List location, output, and purpose of the direct-current sources in the earth situated within ¼-mile of the proposed structure and appurtenant features. If the purpose of the direct current is for cathodic protection, describe the structure protected and its location.

(5) Chemistry of geologic materials, ground water, and/or product water.

F. Construction Materials Data Including:

(1) Location of and distance to suitable borrow areas for permeable and impermeable soil materials for fill or embankment; and for riprap for channel or slope protection. If quantities are limited, give approximate volumes available.

(2) An earth materials report containing complete detailed information on those potential sources of soils and rocks that have been selected for final consideration. (See *Earth Manual*.)

(3) Information on concrete aggregates. (See "Final Investigations" in *Concrete Manual*.)

(4) Data on commercial concrete plants within practical hauling distance from the structure site.

(5) Information on sources and character of acceptable road surfacing materials. Consider excavated material as a possible source.

(6) Results of sampling and analysis of materials, including previous tests conducted at the TSC.

(7) Information including catalogues on firms within practical hauling distance from the site manufacturing precast concrete products and brick or other masonry units.

G. Hydrologic Data:

(1) Annual periodic fluctuations of reservoir levels shown by tables or charts summarizing reservoir operation studies for the critical period. Include any annual reservoir drawdowns for operation and maintenance purposes.

Anticipated occurrence and amounts of sediment, ice (thickness), and drift (trash), and possible effect on reservoir outlets to powerplants or pumping plants.

Extent of anticipated wave action including discussion of wind fetch.

Reservoir storage allocations showing storage allocations with corresponding elevations.

Type and purpose of reservoir releases for the time of year to be made; include minimum releases for various seasons.

(2) Information for preparation of specifications hydrographs at the TSC, including the location of gauging stations at or near the structure site and the dates for which hydrographs should be prepared. Copies of the daily discharge record should be supplied for stations with unpublished records.

(3) Where unwatering of a plant site adjacent to a stream or lake is required, give maximum water levels expected during the construction period and the possibility of controlling water levels by operation of upstream or downstream facilities.

(4) Powerplant tailwater curves. Supporting data and computations should accompany the curves. Include information on any existing downstream natural barriers or river control works affecting tailwater and available data on past degradation or aggradation of stream channel and possibility of future changes.

(5) Source of pumping plant water supply other than reservoir: maximum operating, and minimum operating water surface elevations; floodflows; average flow; and anticipated occurrence and amounts of sediment and ice (thickness). Recommend minimum trashrack or gate deck elevation. Include data on possibility of flooding due to ice jams.

(6) Referring to subparagraphs (3) and (5) above, the water surface elevations should be determined for floods of 100-, 50-, and 10-year frequencies.

(7) Analysis of water for chemical and physical characteristics and biological quality. Analysis should include a water quality analysis of intake water to include major ions and cations, corrosivity and parameters listed as maximum contaminant limits in the Surface Water Treatment Rule, Safe Drinking Water Act. See table 1 in the “Water Treatment Plant” section.

H. Operating Data – Powerplants:

(1) Static head and head duration and flow duration curves to be developed (maximum, minimum, weighted average, and rated).

(2) Proposed initial and ultimate power generation capacity.

(3) Characteristics of powerload including: load-duration curve, load factors, typical daily load curves, summaries of power production studies, and power market demands. Value of capacity in dollars per kilowatt per year, value of energy in mills per kilowatt-hour, interest rate and plant factor for economic studies, and cost or value of alternate sources.

(4) Destination, proposed voltage and number of outgoing transmission circuits.

(5) Nature of operations, i.e., whether baseload, peaking or seasonal, attended, semiautomatic, fully automatic, or supervisory controlled (give estimated distances to points of control); other facilities to be controlled from this plant and, if supervisory controlled, location of master station.

(6) Electrical system reliability criteria.

(7) Local load requirements; and availability and capacity of reliable outside sources for alternate supply of station-service power.

(8) Details of downstream control sections, measuring devices, gauging stations, or other operating works.

* The following data apply particularly to small hydroplants:

(9) Need for installed maintenance and handling facilities.

(10) Need for operation when isolated from power system, and including need for black-start capability.

(11) Periods of shutdown (such as seasonal). Give conditions during shutdown, such as: unattended, winter maintenance, and needs for station power.

(12) Connected power system data including:

(a) Voltage.

(b) Name and telephone numbers of electrical power utilities and contacts within those organizations.

(c) Location of point where connection to power utility will be made.

(13) Need for bypass of water during generator shutdown or load rejection.

* There is no arbitrary rating limit for small hydroplants. However, ANSI C50.12 implies that small hydromachines are those below 5,000 kilovoltampere.

I. Operating Data - Pumping Plants:

(1) Types and quantities of trash (including terrestrial and aquatic weeds, algae, etc.) anticipated at the plant intake; locations of trash-disposal areas. Recommend methods of trash handling and disposal.

(2) Water use (municipal and industrial [M&I], irrigation) and distribution requirements: necessity for treating water and recommended method; consumption quantities by months, and locations; initial and ultimate capacities; capacity-duration curves; location of distribution and treating facilities; and special plant availability or reliability requirements. Discuss maximum static head at which maximum capacity is required, or minimum capacity which will suffice at maximum head.

(3) Profile, alignment, and outlet conditions and requirements for discharge lines; recommended types of pipe and types of coatings and linings.

(4) Location, capacity, hydraulic section, and water surface elevation of intake and discharge channels.

(5) Location and direction of existing or proposed incoming powerlines terminating at plant site.

(6) Electrical data. Data listed below will be required to initiate design. The data furnished should be sufficient to permit designers to complete the basic design (single-line diagram) for the pumping plant. After designs have progressed enough to develop details of electrical system needs, designers will prepare a list of additional data required to complete final design of electrical installation.

(a) Names and telephone numbers of electrical power suppliers and contacts within those organizations.

(b) Location of point where connection to power supply will be made.

(c) System voltage at which power will be supplied, number of phases, and whether service will be overhead or underground.

(d) Electrical system reliability criteria.

(e) Discuss requirements for an alternate power source. If an alternate supply is required, indicate:

- If required by State or local authority.
- If source should be an engine-generator.

- If a threat to life or property will result if normal power supply is lost.
- Loads requiring service from alternate source.

(f) Requirements for remote monitoring of conditions at the facility. Discuss location of remote station, and items required to be monitored.

(g) Requirements for supervisory control, including location of station from which supervisory control is exercised.

(h) Requirements for voice and data communications between the supervisory master station and the remote facilities.

(7) Recommended number of pumps and pump sizes.

(8) Requirements for measurement of plant discharge.

(9) Interest rate, pumping power rate, and plant factor for economic studies.

J. Miscellaneous Data:

(1) Existence of transmission lines of other agencies and utility companies operating in the area which might influence connection of power units; furnish voltage, capacity, type of construction, and distance of these lines from powerplant or pumping plant.

(2) Availability of plant equipment repair shops in vicinity; provisions of central shop.

(3) Recommendation as to inclusion of a major or minor machine shop or service area in the plant.

(4) Requirements for enhancement and/protection and preservation of fish. Include recommendations of State fish authorities and Fish and Wildlife Service.

(5) Recommendations on whether plant should be indoor or outdoor structure.

(6) Housed and open operation and maintenance (O&M) storage requirements at site; offsite storage provided; existing storage space and facilities.

(7) Recommended period for construction.

(8) **Site Security.**

(a) Many Reclamation projects may require a security risk assessment. The need for a site-specific security risk assessment should be considered for feasibility designs where an assessment may impact the field cost estimate and for specifications designs. Specific issues to consider are contained in Section 14 of Chapter 7 – Site Security and Public and Worker Safety. If assistance is required to determine specific design data needs, contact the Office of Security, Safety and Law Enforcement. Where design data and designs include site-specific security assessment, compliance with Reclamation Manual DM Part 444 – Physical Protection and Facility Security, Chapters 1 and 2 is required.

(b) Security requirements for protection of plant and equipment from vandalism or sabotage. Recommended specific measures to meet anticipated conditions such as 7-foot yard fence topped with barbed wire, special locks, special doors, heavy safety glass, security lighting, no windows, electronic surveillance equipment, etc.

(c) Description of existing project fire protection plans which will be applied to the plant, together with any specific requirements for this plant.

(9) Expected visitor load at plant. Number of employees at plant and hours/day the plant is staffed. Recommend facilities to be provided.

(10) Requirements for public safety.

(11) Future plans for power or pumping expansion.

(12) State potable water standards, water quality report, and water treatment requirements.

(13) State requirements for wastewater treatment and disposal.

(14) Need for attended operation of plant during and following a nuclear attack.

(15) Commitments for delivery of power or water.

(16) Recommendations for special protection of roof or yard from falling rocks or boulders.

(17) Vegetation to be cleared (kinds, size, and density of growth).

(18) State and local building codes when applicable.

(19) Special exhaust, heating, ventilating, or air-conditioning requirements.

(20) Water for construction purposes. For large rivers, this item may be unimportant. For small streams and offstream reservoirs, the item becomes critical. Determine if up to 2-ft^3/s, diversion flow for construction purposes can be assured to the contractor. The Government should obtain the water rights required. If necessary to use ground water, obtain information on probable sources and yields. Furnish information on locations and yields of existing wells in the vicinity. Determine restrictions, if any, to use of ground water for this purpose. It may be necessary to obtain permits from State or other governing agencies.

(21) Right-of-way. A marked print shall be submitted showing the following data:

(a) Proposed right-of-way boundaries for construction purposes.

(b) Proposed right-of-way boundaries for access purposes (if required).

(c) Designation of areas within right-of-way boundaries for the following special purposes:

- Disposal of waste material
- Contractor's plant, storage, and other incidental purposes
- Borrow sources
- Government construction facilities (if applicable)

(22) Location of existing facilities in the construction area such as pipelines, power and telephone lines, and fences.

(23) Office and file space requirements in plant.

(24) Where a service area or machine shop is specified in a plant, furnish floor area requirements and the name and size of machine tools, benches required, and need for welding booths or rooms.

K. Cost Data:

(1) Where buildings are located within the area to be cleared by the prime contractor, and if disposal will be his responsibility, designate building groups by number and furnish detailed list of buildings for each group. Details should include general description, size, materials, and general conditions. Determine if disposal will be the responsibility of prime contractor. If not, submit dates when disposition will be completed by others.

(2) Information on local labor supply and labor problems.

(3) Information on important construction work in progress or planned in the vicinity and the presence of interested contractors or subcontractors in the area.

(4) Estimate of cost of right-of-way or easements. Include supporting data.

(5) Estimates of cost for relocating railroads, highways, roads, water systems, and other public utilities. Include supporting data.

L. Environmental Considerations. Design data should include, as a minimum, the environmental commitments listed in the NEPA compliance document that would affect dam design and a brief description of the environmental resources that could be affected by the proposed development. The emphasis should be on those areas within the range of alternatives open to the designers in developing a structural design. The following items should also be considered in preparing design data:

(1) Cultural (historical, archeological, architectural, and paleontological) resources in the area of the plant.

(2) The need for blending structures with the surroundings, including placing transmission circuits under ground.

(3) Special environmental requirements for transmission lines or underground transmission systems.

(4) Comment on any ecological, aesthetic, or other environmental aspects peculiar to this location which would affect layout or conceptual design.

(5) Indicate the suitability and possibility of present or future use of land adjacent to Reclamation facilities by the public for recreation, hobbies, sports, leisure, education, health, housing, etc. Provide data on zoning regulations and subdivision proposals.

(6) Furnish data on allowable noise limits in the vicinity of the proposed plant where fixed by law or local ordinance, or where otherwise considered necessary or advisable; measurements of existing daytime and nighttime ambient noise levels in the area; and distances to the nearest residential units.

(7) Identify special environmental compliance requirements for ensuring that water quality standards are met, including suppression of nitrogen, adequate oxygen levels, and temperature control and control of turbidity during construction; preservation of existing growth adjacent to construction; obliteration of temporary roads and restoration to original appearance; dust abatement, etc. Give recommendations on steps to be taken to meet these requirements.

(8) Recommendations or commitments to maintain a specific hydrologic flow level to support biological or recreational resources.

(9) Impact of moving construction materials on existing road facilities, including consideration of such factors as traffic congestion, effect on road condition, air pollution, etc.

(10) Background on the need for fish facilities such as screens, fishways, and barriers.

(11) Comment on disposal of special excavation problem materials such as lignite.

(12) Specify seeding or replanting requirements for erosion control or aesthetics.

(13) Furnish data on State or local restrictions on the use of soil herbicides, or local factors limiting their use.

(14) Anticipated public use and access around the structure.

(15) Potential Indian trust assets.

(16) Any threatened and/or endangered habitat in or adjacent to the project.

M. Plant Uprating:

(1) Design data should include that listed under this section for feasibility designs, plus target date(s) for completing the uprate work and the outage periods when the unit(s) may be removed from service. In addition, the TSC should be asked for a specific list of design data required.

N. Large Synchronous Machine Armature Rewinds:

(1) The office responsible for design should be asked for a specific list of design data required.

O. Mechanical Systems and Equipment:

(1) Heating, ventilating, and air-conditioning system requirements. Preference for evaporative cooling or refrigeration cooling for the main plant/building area. Preference for electric or gas heat utilizing propane/natural gas.

(2) Is natural gas available at the site?

(3) Noise restrictions at the site.

(4) Requirements for emergency engine generator set for the plant/building. Systems to be connected to the standby emergency engine generator set.

(5) Anticipated engine generator usage for sizing the fuel storage tank.

(6) Preferred fuel (diesel/propane/natural gas) for the engine generator set.

(7) Required water quality analysis to determine the materials of construction for the plant piping systems. Types of materials of construction for existing piping systems conveying water. Have there been any corrosion problems with existing systems?

(8) Types of water supplies available at the site for plant/building fire suppression and other water usage requirements.

(9) Preferences concerning the method of joining the piping components for the various plant/building auxiliary mechanical systems. Are victaulic type grooved coupling connections acceptable?

(10) Types of hazardous materials on the existing piping systems (i.e., lead based paint, asbestos).

3. Visitors Centers. The Introduction (Chapter 1) for these design data collection guidelines contains additional information concerning: preparing a design data collection request, design data collection requirements, and coordinating the design data collection and submittal. Much design data prepared for previously designed features may be available and should be utilized for the design of the visitor center. Communication between visitor center designers and project personnel is essential in arriving at adequate design data.

A. Design Narrative:

(1) Discuss the determination of the need for public visitation.

(a) Uniqueness or informational/educational aspects of the project which would merit public visitation.

(b) Information to be related to the public for other interested agencies.

(2) Visitation projections basis.

(a) Accessibility.

(b) Visitor center density within 100 miles.

(c) Recreation facility density within 100 miles.

(d) Visitor use of similar facilities within project area, river basin, or Region.

(e) Visitor interest in project during construction phase if applicable.

B. **Overall Planning:**

(1) Relationship between the visitor center and planned recreation facilities.

(2) Accessibility of potential or selected visitor center sites to highways and project features.

(3) Complementary facilities to be located within or near other project features such as information kiosks, overlooks, tour routes, signage, exhibit spaces within structures, etc.

(4) Community or other use of portions of the building during hours when it is not open for public visitation.

C. **General Requirements of the Visitor Facilities:**

(1) General outline of interpretive plan including suggested physical requirements for presentation of information.

(2) Overall space requirements for above.

(3) Estimated number of people to be accommodated at one time.

(4) Parking facilities.

(5) Offices and/or other associated space requirements.

(6) Concessionaire considerations.

(7) Anticipated hours and months of operation.

(8) Number of operating and support personnel required.

(9) Description of existing project fire protection and security plans which will be applied to this feature, along with any specific requirements for this visitor center.

(10) Special heating, ventilation, and air conditioning requirements for artifact storage and preservation, and laboratory ventilation and exhaust.

D. **Physical and Climatic Data:**

(1) **General Map Showing:**

(a) A key map locating the general map area within the State.

(b) The structure site.

(c) Existing towns, highways, roads, railroads, public utilities, transmission lines, substations, townships, range, and section line.

(d) Locations of access road and sites for required construction facilities.

(e) Locations of borrow areas for natural construction materials and disposal areas for waste excavation.

(2) **Availability or Accessibility of Public Facilities or Utilities Such As:** Water supply, sewage disposal, telephone utility, fire protection services, natural gas supply, and electric power for construction and operation. Provide names and addresses of utility suppliers. Also provide gas and electric rates.

(3) **Climatic and Physical Site Conditions**. Include items that will affect design, construction, and operation and maintenance such as: amount, rate, and distribution of rain, snow, and hail; heating and air-conditioning design temperatures; maximum wind velocities and their directions; probability of excessive dust or sand; local frost depths; ground water presence and depths; vegetation to be cleared or preserved including kinds, sizes, and density of growth. Show exact locations of existing utilities and/or other facilities on site which must be removed, avoided, or where special criteria is provided for interference and restoration.

(4) **Photographs.** Color photographs of the site including surrounding construction features and pertinent geologic and topographic features of terrain. Include aerial photographs if available.

(5) **Survey Control.** Minimal field surveys should be done to obtain horizontal and vertical control. Use of any existing coordinate system or vertical control system is acceptable, but tying to the State or national system is recommended where practical.

(6) **Detailed Site Topography.** A topographic map covering an area sufficient to include all practical arrangements of the structure, access, rights-of-way, survey control, existing manmade features, vegetation, and locations and identification of drill holes, test pits, etc., where not included on separate maps. The scale and contour interval should be determined on the basis of the size of structure to be built and the complexity of the terrain. A scale of 1 inch equals 50 feet and contour interval of 2 feet will generally be suitable.

E. **Foundation Data:**

(1) **General Engineering Requirements.** The amount and detail of foundation data required will vary with the site and with the type of construction. The guiding criteria should be to provide sufficient data to allow the designer to determine the type of foundation required for the structure and to identify major foundation problems. Adequate foundation data may be obtained for small structures from an inspection of surface conditions and one or two exploratory holes to determine foundation conditions some distance below the footings of the structure. Maximum use should be made of existing data. For larger structures and/or for more complex geological areas a field conference should be held to determine the geologic investigations program required.

(2) **Geological Data.** The following list of geologic design data provides general guidelines for the collection and reporting of geologic information for this type of facility. The TSC geologic and geophysical staff will provide necessary assistance and guidance in the gathering of these design data.

(a) Compilation, summary, and reporting of Reclamation and non-Reclamation geologic information on the area, with attention being paid to the sequence of explorations and historical geologic events.

(b) Surface geologic map showing location of explorations. Locations of all existing explorations should be indicated by coordinates or stationing of the permanent survey control system for the facility.

(c) Factual narrative description of surficial deposits with attention being paid to engineering geologic matters, such as swelling minerals, presence of gypsum, and other sulfates, caliche erodibility (see *Earth Manual*).

(d) Factual narrative description of bedrock with attention being paid to engineering geologic matters such as swelling minerals, presence of gypsum, and other sulfates; and to depth, weathering, joints, faults, and other planes of weakness.

(e) Photographs, preferably in color, of representative or particular geologic conditions.

(f) Selected determination of engineering properties of surficial deposits and bedrock.

(g) Summary and data of exploration geophysical surveys (seismic, resistivity, etc.).

(h) Determine ground water conditions with attention being paid to water levels and their seasonal fluctuation occurrence of unconfined and confined aquifers, water producing capabilities, chemistry, and subsidence.

(i) Logs of explorations. An effort should be made to run appropriate borehole geophysical logs in appropriate drill holes.

(j) Evaluation of landslide, snowslide, and rockfall conditions.

(k) Determine age of faulting in vicinity, especially if suspected to be late Pleistocene or Holocene, to assist in the determination of the maximum credible earthquake by the Engineering Geology Group, TSC.

(l) Document past, present, and possible future petroleum water, and mineral extraction operations in vicinity.

(m) Determine geologic conditions which may affect construction methods such as, boulders on ground surface, marshes, drilling

conditions, and stability of grout or footing holes, ground temperatures, gases. Any potential surface water runoff problems should be brought to the attention of a regional hydrologist.

F. **Corrosion Survey:**

(1) In situ electrical resistivity measurements of geologic materials in the area of construction. Additional measurements should be made in the areas where there is a pronounced change in type of geologic materials, drainage, and/or moisture conditions.

(2) Performance history of materials of construction that have been used in the area.

(3) List of structures in the vicinity of (within ¼ mile) the proposed structure and appurtenant features. Determine if buried structures in the vicinity have corrosion protection and, if so, the type of corrosion protection.

(4) List location, output, and purpose of the direct-current sources in the earth situated within ¼ mile of the proposed structure and appurtenant features. If the purpose of the direct current is for cathodic protection, describe the structure protected and its location.

(5) Chemistry of geologic materials, ground water, and/or product water.

G. **Construction Materials Data Including:**

(1) Inventory of available impervious and pervious embankment materials and rock for riprap and rockfill. Location of and distance to borrow areas and approximate quantities available.

(2) Information on concrete aggregates. (See *Concrete Manual*)

(3) Information on sources and character of acceptable road surfacing materials. Consider required excavation material as a possible source.

(4) Data on commercial concrete plants within practical hauling distances from the structure site.

(5) References to results of sampling and analysis of materials including previous tests and photographs of sources.

(6) Report alkali conditions in soil and water which might affect the choice of sulfate resisting cement.

(7) Statement of availability of timber for structural work and lumber for other purposes.

(8) Environmental impacts associated with removing or obtaining construction materials.

(9) Requirements concerning permanent stockpiles and suggested permanent stockpile locations.

(10) Information including catalogues on firms, within practical hauling distance from the site, manufacturing precast concrete products and brick or other masonry units.

H. **Environmental Considerations.** Design data should include, as a minimum, the environmental commitments listed in the NEPA compliance document that would affect the design and a brief description of the setting and the resources that would be affected by the proposed visitor center.

The following items should be included:

(1) Cultural (historical, archeological, architectural, and paleontological) resources in the area of the plant.

(2) The need for blending the structure with surroundings. Include reasoning for this suggested handling.

(3) Landscaping and other special environmental requirements.

(4) A brief listing of the area's native and/or commonly used plant materials.

I. **Electrical Data.** Data listed below will be required to initiate design. The data furnished should be sufficient to permit designers to complete the basic design (single-line diagram) for the visitors' center. After designs have progressed enough to develop details of electrical system needs, designers will prepare a list of additional data required to complete final design of electrical installation.

(1) Names and telephone numbers of electrical power suppliers and contacts within those organizations.

(2) Location of point where connection to power supply will be made.

(3) System voltage at which power will be supplied, number of phases, and whether service will be overhead or underground.

(4) Discuss requirements for an alternate power source. If an alternate supply is required, indicate:

(a) If required by State or local authority.

(b) If source should be an engine-generator.

(c) If a threat to life or property will result if normal power supply is lost.

(d) Loads requiring service from alternate source.

(5) Requirements for remote monitoring of conditions at the facility, such as fire protection or security systems. Discuss location of remote station, and items required to be monitored.

J. Miscellaneous Data:

(1) Heating, ventilating, and air-conditioning system requirements. Preference for evaporative cooling or refrigeration cooling for the main plant/building area. Preference for electric or gas heat utilizing propane/natural gas.

(2) Is natural gas available at the site?

(3) Noise restrictions at the site.

(4) Requirements for emergency engine generator set for the plant/building. Systems to be connected to the standby emergency engine generator set.

(5) Anticipated engine generator usage for sizing the fuel storage tank.

(6) Preferred fuel (diesel/propane/natural gas) for the engine generator set.

(7) Required water quality analysis to determine the materials of construction for the plant piping systems. Types of materials of construction for existing piping systems conveying water. Have there been any corrosion problems with existing systems?

(8) Types of water supplies available at the site for plant/building fire suppression and other water usage requirements.

(9) Preferences concerning the method of joining the piping components for the various plant/building auxiliary mechanical systems. Are victaulic type grooved coupling connections acceptable?

(10) Types of hazardous materials on the existing piping systems (i.e., lead based paint, asbestos).

K. Site Security. Many Reclamation projects may require a security risk assessment. The need for a site-specific security risk assessment should be considered for feasibility designs where an assessment may impact the field cost estimate and for specifications designs. Specific issues to consider are contained in Section 14 of Chapter 7 – Site Security and Public and Worker Safety. If assistance is required to determine specific design data needs, contact the Office of Security, Safety and Law Enforcement. Where design data and designs include

site-specific security assessment, compliance with Reclamation Manual DM Part 444 – Physical Protection and Facility Security, Chapters 1 and 2 is required.

4. Tunnels. The Introduction (Chapter 1) for these design data collection guidelines contains additional information concerning: preparing a design data collection request, design data collection requirements, and coordinating the design data collection and submittal.

A. General Map(s). The General Map should cover the project area and the area immediately surrounding the project within approximately 2 or 3 miles. The scale of the General Map should be adequate to clearly show listed details. A scale of approximately 1 to 3 miles per inch is commonly used. The following data are shown on a General Map for feasibility and specifications level design data collection:

(1) A key map locating the general map within the State.

(2) A legend of symbols used for existing and constructed facilities.

(3) North arrow.

(4) Existing or potential areas or features having a bearing on the design, construction, operation, or management of the project. The locations of these features should bear the parenthetical reference to the agency or entity which owns or operates the property; for example, the Bureau of Reclamation (Reclamation):

(a) Name of agency responsible for maintaining and/or managing the affected land.

(b) Recreation areas; fish and wildlife areas; building areas; highways, railroads, and shipping points; housing; areas of cultural sensitivity; areas of archeological, historical, and mining or paleontological interest; and bridges with special loads or size limitations.

(c) Existing towns, residences, private property, roads, transmission lines, substations, stream-gauging stations.

(d) Areas of environmental concern.

(e) Public utilities such as electric power and telephone lines, pipelines, etc.

(f) County, range, township, and section lines.

(g) Land use restrictions such as easements and rights-of-way.

(5) Rights-of-way:

(a) Show rights-of-way required or available for facility/structure sites, construction access, and staging areas.

(b) Land ownership boundaries and legal jurisdictions. Indicate ownership by agency acronym or private land with "private."

(6) The proposed structures and features:

(a) Location of features to be constructed or modified.

(b) Locations of potential construction and permanent access roads, sites for contractor's staging areas and construction facilities, and sites for temporary water treatment facilities.

(c) Locations of borrow areas for natural construction materials, locations of commercial quarries, and disposal areas for waste excavation.

(d) Sources of construction power and power transmission facilities.

(e) Sources of water for construction.

B. **Location Map** (may be combined with General Map). Location maps are commonly used as a condensed method of showing location and alignment of the features and associated structures. The location map may be combined with the general map, site plan, or plan and profile drawings for small areas. A scale of 1 inch = 1,000 feet to 1 inch = 2,000 feet is commonly used for location maps. The location map should show:

(1) **General:**

(a) North arrow.

(b) Proposed alignment, major structures, and delivery locations by symbols. Station and appropriate ties to section lines, section corners, existing buildings, pipelines, roads, railroads, etc.

(c) Topography and ownership information should be shown.

(d) Towns, roads, railroads, streams, existing pipelines, canals, reservoirs, etc.

(e) Transportation facilities and other cultural features.

(f) Location of borrow areas, riprap sources, sources of special pipe embedment material, if required

(g) Disposal areas for wasting excess excavation.

(h) For distribution systems, show ownership, turnout locations, and irrigable areas served.

(i) Sources of power for construction and operation and maintenance.

(j) Existing or potential areas or features having a bearing on the design, construction, or operation and maintenance such as: recreation areas, fish and wildlife areas, railroads, housing, and areas of archeological, historical, and mining and paleontological interest.

(k) Where the scale does not permit proper detail of a congested area, a blowup at a larger scale may be included elsewhere on the drawing and referenced to its proper location.

(l) Where density of the structures or other features is such that individual stationing and naming is impractical, the information should be shown in tabular form and station marks shown on the alignment.

(m) Linear feature (tunnel), together with structures, adits, and stations. Structures and delivery locations are normally shown by symbol.

(n) Legend of symbols for existing and proposed facilities

(o) Right-of-way and land ownership information.

C. General Description of Local Conditions. The following data may be required for feasibility and specifications designs:

(1) Information relating to access for possible site visit by the design team, access for foundation exploration and construction, and access limitations due to environmental restrictions, etc.

(2) Access to the site for operation and maintenance (O&M) forces.

(3) Permits or permit requirements and any past permit violations or exceedences.

(4) Name and description of similar construction in the area or region.

(5) The approximate distance from the nearest railroad shipping terminal to the structure site; load restrictions and physical inadequacies of existing roads and structures and an estimate of remedial improvements to accommodate construction hauling; estimate of access road length and major structures required for new construction; and possible alternative means for delivering construction materials and equipment to the structure site.

(6) Availability or accessibility of public facilities or utilities such as water supply, sewage disposal, telephone utility, fire protection services, and electric power for construction (give location, power supplier, voltage, number of phases, and capacity of existing transmission lines; power rate schedules; probability of interruption of supply; and requirements for additional transmission line, if needed).

(a) Names, telephone numbers, email addresses, and Web sites of local utilities and contacts within those organizations.

(7) Climatic conditions that will affect design, construction, and O&M such as amount, rate, and distribution of rain, snow, and hail; ice conditions; heating and air-conditioning design temperatures; summer and winter temperatures with extremes; maximum wind velocities and their directions; probability of excessive dust or sand.

(8) Local frost depths.

(9) Ground water presence and depths.

(10) Vegetation to be cleared or preserved including kinds, sizes, and density of growth.

(11) Road detour requirements.

D. Surface Data:

(1) **Survey Control.** Permanent horizontal and vertical survey control should be established at the earliest possible time. All line surveys should be tied to the state plane coordinate system at each portal, and at points of intersection where changes in the bearing of the tunnel centerline occur. Grid to ground correction factors including altitude and coordinate system correction should be furnished.

(2) **Topographic Map.** A topographic map showing alignment of the tunnel and location of all possible arrangements of structures including inlet or intake, control or access shafts, air vents, adits, and outlet portal; normally this should be on a scale of 1 inch equals 400 feet (a scale of 1 inch equals 200 feet is preferable for short tunnels) and a contour interval of 5 feet. If

a topographic map is unavailable, strip topography may be furnished. Topographic maps of portal sites should be on a scale of 1 inch equals 50 feet and a contour interval of 2 feet and should have contours high enough to include top of portal cut slopes. For flat or gently sloping topography, contour intervals as small as 1 foot may be desirable. Show the coordinate system and existing land survey monuments and special control points established for the topographic survey. Show all manmade features in the included area.

(3) **Aerial Photographs.** Aerial photographs (size 8 by 10 inches, color if feasible) of the portals or other major structure sites. The purpose of the aerial views is to permit early preparation of an artist's rendition of the feature and to permit a study of the environmental impact of the structure. Later such renditions or drawings may be used for inclusion in specifications or for other purposes.

These photographs should be taken from locations that would best show the proposed structure and from a vertical angle of approximately 20E to 30E above the horizontal. Where possible, indicate known tie points to the topographic maps, tunnel portal site, and tunnel alignment. These photographs should be taken between 11 a.m. and 2 p.m., so as not to show the principal area of the proposed structure in shadow. Submit the negatives or color slides.

Each Region is urged to provide these photographs for shaft sites or auxiliary structures whenever it is considered that artist's conceptions would be beneficial to the project and the designs would be influenced by the physical characteristics of the area.

(4) **Photographs.** Color photographs of all existing facilities or structures in the vicinity of the proposed tunnel and closeup views of any features which may affect designs. Black and white photographs are acceptable for structures to be removed or demolished. Color or black and white photographs along tunnel alignment with structure locations and tunnel alignment marked in ink.

E. Tunnel Alignment and Geologic Data.

(1) **General Engineering Requirements.** The location of tunnel portals, tunnel alignment and scope of the geological investigation, including number and location of drill holes, should be established by the originating office personnel with assistance from the region and TSC representatives. It is recommended that a field conference be held, including an inspection of the site. This conference should result in the selection of probable tunnel portals, tunnel alignment, and a geologic investigations program outlining the need for and extent of surface and subsurface studies, and

other requirements. The geologic investigations program must be based on site conditions, type of rock formations, probability of encountering large water flows or dangerous gas, and the time and funds available for the study and will make maximum use of existing data. The U.S. National Committee on Tunneling and Technology (USNCTT) recommendation that the total length of boreholes equal 1.5 times the tunnel length may be used as a guide. The complexity of the site will be considered in determining the detail of the investigation. Location of portals will depend on required elevations, the most economical alignment, rock conditions, local topography, drainage, ease of access, and available staging area.

(2) **Geologic Data.** The following list of geologic design data provides general guidelines for the collection and reporting of geologic information for tunnels. The geologist should apply these guidelines with good judgment and sound reasoning, elaborating upon them as required by the particular geologic setting and engineering requirements. Because the collection of geologic data is a dynamic process and often continues into the preparation of final designs, all stages of the specification design geologic exploration program must be constantly coordinated with the designer through the appropriate geology office. The TSC geologic and geophysical staff will provide necessary assistance and guidance in the gathering of these design data.

(a) Compilation, summary, and reporting of Reclamation and non-Reclamation geologic information on the area, with attention being paid to the sequence of explorations and historical geologic events.

(b) Surface geologic map showing location of explorations. Locations of all existing explorations should be indicated by coordinates or stationing of the permanent survey control system for the facility.

(c) Particular foundation exploration at portal locations, adit, shaft, or other structure sites. At portal sites attention must be paid to the geologic aspects of potential slope stability problems.

(d) Factual narrative description of surficial deposits, especially at portal sites and low cover reaches, with attention being paid to engineering geologic matters', such as swelling minerals, low-density materials, presence of gypsum and other sulfates, caliche, erodibility (see Earth Manual).

(e) Factual narrative description of bedrock with attention being paid to engineering matters such as swelling minerals, presence of gypsum and other sulfates; and depth, weathering, joints, faults, and other planes of weakness.

(f) Selected samples for determination of engineering properties of surficial deposits and bedrock along tunnel grade, such as specific weight; absorption; solubility; compressive, tensile, and shear strength; permeability; modulus of deformation; expansion; uplift; and effects of air and water on engineering properties. The type and number of specimens required for these determinations should be coordinated with the TSC.

(g) For a mechanically excavated tunnel, quartz content and cementation coefficient determined by petrographic analysis are appropriate data to be collected. Shore scleroscope and Schmidt hammer hardness tests are also useful.

(h) For pressure tunnel design, measure the in situ state of stress of the rock. Discuss the creep of rock. Determine the permeability of the rock in place. Discuss the relationship of jointing to deformation modules.

(i) Photographs, preferably in color, of representative or particular geologic conditions.

(j) Summary and data of exploration geophysical surveys (seismic, resistivity, etc.), if performed.

(k) Determine ground water conditions with attention being paid to water levels and their seasonal fluctuation, occurrence of unconfined and confined aquifers, water producing capabilities, water temperature, chemistry, and ground subsidence.

(l) Logs of exploration. Logs of drill holes advanced by churn drilling, chop, and wash, or other methods which result in less than adequate sample recovery may need to be augmented by appropriate borehole electric (geophysical) logs or optical borehole (borehole camera) image plots.

(m) Evaluation of landslide, snowslide, and rock fall conditions, especially at portals.

(n) Determine age of faulting in vicinity, especially if suspected to be late Pleistocene or Holocene.

(o) Document past, present, and possible future petroleum, water, and mineral extraction operations in vicinity.

(p) Determine geologic conditions which may affect construction methods such as boulders on ground surface, marshes, drilling conditions, and stability of grout or footing holes, ground

temperatures, gases. Any potential surface water runoff problems should be brought to the attention of a regional hydrologist.

F. Corrosion Survey.

(1) In situ electrical resistivity measurements of geologic materials in the area of construction. Additional measurements should be made in the areas where there is a pronounced change in type of geologic materials, drainage, and/or moisture conditions.

(2) Performance history of materials of construction that have been used in the area.

(3) List of structures in the vicinity of (within ¼ mile) the proposed structure and appurtenant features. Determine if buried structures in the vicinity have corrosion protection and, if so, the type of corrosion protection.

(4) List location, output, and purpose of the direct-current sources in the earth situated within 1/4 mile of the proposed structure and appurtenant features. If the purpose of the direct current is for cathodic protection, describe the structure protected and its location.

(5) Chemistry of geologic materials, ground water, and/or product water.

G. Construction Materials Data including:

(1) Location of and distance of suitable borrow areas for permeable and impermeable soil materials for fill or embankment; and for riprap for channel or slope protection. If quantities are limited, give approximate volumes available.

(2) An earth materials report containing complete detailed information on those potential sources of soils and rocks that have been selected for final consideration. (See *Earth Manual*.)

(3) Information on concrete aggregates. (See "Final Investigations" in Reclamation's *Concrete Manual*.)

(4) Data on commercial concrete and cement plants within practical hauling distance from the structure site.

(5) Information on sources and character of acceptable road surfacing materials and railway bedding materials where these may be required. Consider excavated material as a possible source.

(6) Results of sampling and analysis of materials, including previous tests.

(7) Information including catalog of firms within practical hauling distance from the site manufacturing precast concrete products that may be interested in manufacture of precast concrete tunnel segment liners or structural shapes that could be utilized in associated features outside the tunnel.

H. Hydrologic Data:

(1) Annual periodic fluctuations of reservoir levels shown by tables or charts summarizing reservoir operation studies for the critical period, where the tunnel has an inlet or outlet directly from or into the reservoir.

(2) Anticipated occurrence and amounts of silt, ice (thickness), and drift (trash), and possible effect on tunnel intakes or tunnel flow.

(3) Extent of anticipated wave action including discussion of wind fetch, where the tunnel has an inlet or outlet directly from or into the reservoir.

(4) Reservoir storage allocations showing storage allocations with corresponding elevations.

(5) Type and purpose of reservoir releases for the time of year to be made, include minimum releases for various seasons, where relevant.

(6) Data for preparation of specifications hydrographs, including the location of gauging stations at or near the tunnel site and the dates for which hydrographs should be prepared. Copies of the daily discharge record should be supplied for stations with unpublished records.

(7) Where unwatering or dewatering of a portal site adjacent to a stream or lake is required, give maximum water levels expected during the construction period and the possibility of controlling water levels by operation of upstream or downstream facilities. Provide recommendations on time of year when shoreline facilities should be constructed to take best advantage of low water levels.

(8) Data on past degradation or aggradation of stream channel and possibility of future changes for direct connecting streams or cross drainage channels.

(9) Source of water being transported other than reservoir: maximum operating, and minimum operating water surface elevations; floodflows; average flow; and anticipated occurrence and amounts of bed load and ice (thickness) in river, stream, or channel. Recommend minimum trashrack or gate deck elevation where applicable. Include data on possibility of flooding due to ice jams.

(10) Analysis of water for chemical and physical characteristics and biological quality.

I. Operating Data:

(1) Purpose – vehicular or water.

(2) Capacity of tunnel, including largest future anticipated discharge requirements.

(3) Location, hydraulic section, and hydraulic grade line at inlet and outlet channels, pipelines, or reservoirs.

(4) Type of operation, continuous or cyclic (include possible periods of shutdown for maintenance), free flow, or pressure tunnel.

(5) Flow controls and measurement required, including smallest and largest flows to be controlled and/or measured; degree of automation of controls (give estimated distance to point of central control).

(6) Commitments for delivery of water or power.

(7) Water use (M&I. irrigation) and distribution requirements: necessity for treating water and recommended method; consumption quantities by months, and locations; initial and ultimate capacities; capacity-duration curves; location of distribution and treating facilities; and special reliability requirements. Discuss minimum upstream head at which maximum capacity is required, minimum delivery capacity required for both maximum and minimum upstream heads and degree of control and accuracy of measurement required for these limiting conditions.

(8) Details of upstream or downstream control sections, water measuring devices, gauging stations, or other operating works.

J. Miscellaneous Data:

(1) Permits required for railway and/or road crossings including any local permits required, such as local Air Quality Permits.

(2) Flood protection at tunnel portals.

(3) Availability of gates and control equipment repair shops in vicinity; provisions for central shop.

(5) Recommendations on whether gate hoist equipment, controls, and measuring devices should be indoor or outdoor types.

(6) Housed and open O&M storage requirements at site; offsite storage to be provided; existing storage space and facilities.

(7) Site Security.

(a) Many Reclamation projects may require a security risk assessment. The need for a site-specific security risk assessment should be considered for feasibility designs where an assessment may impact the field cost estimate and for specifications designs. Specific issues to consider are contained in Section 14 of Chapter 7 – Site Security and Public and Worker Safety. If assistance is required to determine specific design data needs, contact the Office of Security, Safety and Law Enforcement. Where design data and designs include site-specific security assessment, compliance with Reclamation Manual DM Part 444 – Physical Protection and Facility Security, Chapters 1 and 2 is required.

(b) Security requirements for protection of structures and equipment from vandalism or sabotage. Recommend specific measures to meet anticipated conditions such as 7-foot yard fence topped with barbed wire, special locks, special doors, heavy safety glass, security lighting, no windows, electronic surveillance equipment, etc.

(c) Description of existing fire protection plan which will be applied to the tunnel, together with any specific requirements for this tunnel.

(8) Expected visitor load at site and special requirements for transport of Government personnel in and out of tunnel.

(9) Requirements for public safety.

(10) State potable water standards and water treatment requirements. These requirements should be cleared with water quality agencies in the State where tunnel is to be constructed.

(11) State requirements for waste water treatment and disposal, and recommendations as to possible alternatives on prevention, control, and abatement of air and water pollution. List any restrictions imposed on construction activity by EPA waste water discharge permit.

(12) Location of water treatment facilities.

(13) Commitments for delivery of power or water.

(14) Recommendations for special protection at portals from falling rocks or boulders.

(15) Vegetation to be cleared (kinds, size, and density of growth) and clearing methods not permitted, e.g. burning or disposing on site.

(16) State and local building codes when applicable.

(17) Special exhaust, heating, ventilating, or air-conditioning requirements.

(18) Right-of-Way. A marked print shall be submitted showing the following data:

(a) Proposed right-of-way boundaries for construction purposes, temporary and permanent.

(b) Proposed right-of-way boundaries for access purposes (if required).

(c) Designation of areas within right-of-way boundaries for the following special purposes:

- Disposal of waste material
- Contractor's plant, storage, and other incidental purposes
- Government construction facilities (if applicable)

(19) Disposition of existing facilities in the construction area such as pipelines, power and telephone lines, and fences.

(20) Where a service area is specified furnish area requirements.

(21) Requirements for installation of power, lighting or telemetering cables in tunnel.

(22) Environmental Permit requirements (401, 404, Storm Water Runoff, etc.)

(23) Requirements for providing permanent access to the tunnel or adit portal for operation and maintenance purposes.

K. Cost Data for Field Cost Estimate. The field cost estimate is an estimate of the capital costs of a feature or project from award to construction; non-contract costs are not included. Cost data developed in previous or other studies (either by Reclamation or others) should be included with the design data submittal. Include a description or outline of estimating methods and data used. The following design data for feasibility and specifications levels designs should be considered for submittal:

(1) **Procurement Strategy.** Will solicitation be advertised and awarded under other than full and open competition? This includes solicitations

which will be set aside under socio-economic programs that may limit competition or allow award to other than the lowest bid or proposal.

(2) Estimate of cost of ROW for all features including reservoirs, dams, and appurtenant works.

(3) Information on local labor supply and labor problems.

(4) Local freight or trucking rates.

(5) Housing accommodations.

(6) Interest rate for economic studies.

(7) Power rate in mills per kilowatt-hour, interest rate, and plant factor for economic tunnel, and pipeline sizing studies in cases where transported water is pumped.

(8) Estimated cost for construction items which cannot readily be determined in the design office and include the supporting data:

(a) Clearing reservoir area and for removing or replacing private improvements in the area.

(b) Earthwork (common and rock), excavation with freehaul distance. For canals, include compacting embankment, canal lining, and borrow (with free haul distance)

(c) Riprap, guardrail, culverts, row fencing, and gates.

(d) Designated areas to be cleared of vegetation, with description of kinds, size, and density of growth. State recommended method of payment (i.e., lump-sum price for area with defined limits or unit price per acre for area with limits subject to change during construction). Use separate payment items for clearly defined areas differing in growth density and difficulty of clearing operations. If vegetation to be cleared is very sparse or can be removed without special equipment or separate operations, the cost of clearing should be included in the prices bid for excavation or prices bid for other appropriate items of work.

(9) Where buildings are located within the area to be cleared by the prime contractor, and if disposal will be the contractor's responsibility, designate building groups by number and furnish detailed list of buildings for each group. Details should include general description, size, materials, and general condition. Drawings should be provided of these buildings, if available, that depict dimensions, construction materials, the structural

system for the building, and major electrical and mechanical equipment. Determine if disposal will be the responsibility of the prime contractor. If not, submit dates when disposal will be completed by others.

(10) Information on important construction work that is in progress or planned in the vicinity and the presence of interested contractors or subcontractors in the area.

(11) If potential actions exceed anticipated funding, an assessment should be made as to whether the cost estimate will reflect incremental costs of these potential actions. Provide any known increment or arrangement of the incremental costs.

(12) Local and tribal taxes.

(13) Estimates of costs for relocating railroads, highways, roads, water systems, and other public utilities. Include supporting data.

(14) Method for projecting cost into the future if required.

(15) Cost of local materials (precast concrete, etc.).

L. Environmental Considerations. Design data should include, as a minimum, the environmental commitments listed in the NEPA compliance document that would affect the design and a brief description of the environmental and ecological values that could be affected by the proposed development. The emphasis should be on those areas in the range of alternatives open to the designers in developing a structural design. The following items should also be considered in preparing design data:

(1) Cultural (archeological, historical, and paleontological) resources of influence within the project area.

(2) The need for blending structures with the surroundings.

(3) Comment on any ecological, aesthetic, or other environmental aspects including protection of wildlife which would affect layout or conceptual design.

(4) Indicate the suitability and possibility of present or future use of land adjacent to Bureau facilities by the public for recreation, hobbies, sports, leisure, education, health, housing, etc. Provide data on zoning regulations and subdivision proposals.

(5) Furnish data on allowable noise limits and blasting in the vicinity of the proposed facilities where fixed by law or local ordinance, or where

otherwise considered necessary or advisable; measurements of existing daytime and nighttime ambient noise levels in the area; and distances to the nearest residential units.

(6) Identify special environmental compliance requirements for ensuring water quality standards are met including temperature control and control of turbidity during construction; preservation of existing growth adjacent to construction; obliteration of temporary roads and restoration to original appearance; dust abatement, etc. Give recommendations on steps to be taken to meet these requirements.

(7) Impact of moving construction materials on existing road facilities, including consideration of such factors as traffic congestion, effect on road condition, air pollution, etc.

(8) Background on the need for fish facilities such as screens, fishways, and barriers.

(9) Recommendations or commitments to maintain specific flow requirements for biological and/or recreational resources.

(10) Comment on disposal of special excavation problem materials such as lignite.

(11) Specify seeding or replanting requirements for erosion control or aesthetics.

(12) Furnish data on State or local restrictions on the use of soil herbicides, or local factors limiting their use.

(13) Specify requirements for clearing and disposal of timber.

M. Electrical Data. Data listed below will be required to initiate design. The data furnished should be sufficient to permit designers to complete the basic design (single-line diagram) for the tunnel. After designs have progressed enough to develop details of electrical system needs, designers will prepare a list of additional data required to complete final design of electrical installation.

(1) Names and telephone numbers of electrical power suppliers and contacts within their organizations.

(2) Location of point where connection to power supply will be made.

(3) System voltage at which power will be supplied, number of phases, and whether service will be overhead or underground.

(4) Discuss requirements for an alternate power source. If an alternate supply is required, indicate:

(a) If required by a State or local authority.

(b) If source should be an engine-generator.

(c) If a threat to life or property will result if normal power supply is lost.

(d) Loads requiring service from alternate source.

(5) Requirements for remote monitoring of conditions at the facility. Discuss location of remote station, and items required to be monitored.

(6) Requirements for supervisory control, including location of station from which supervisory control is exercised.

(7) Requirements for voice and data communications between the supervisory master station and the remote facilities.

N. Construction Considerations. The following design data items should be considered for feasibility and specifications designs:

(1) Construction schedule:

(a) One contract or several contracts.

(b) Any construction timeframe restrictions

(c) Are designers required to provide a construction schedule and/or logic diagram?

(d) Recommended period for construction.

(e) Recommended period for completion of construction work and features of the work that should be completed early.

(f) Permissible times to make connections to existing facilities.

(2) Allowable in-river materials (permanent and temporary).

(3) Construction constraints including allowable construction methods, traffic considerations, environmental restrictions, climatic restrictions, blasting limitations, etc.

(4) Filling and draining criteria for dam, ponds, and pipelines

(5) Unusual conditions for excavation or construction.

(6) Extent of construction surveying to be accomplished by Government surveyors.

(7) Water for construction purposes. For large rivers, this item may be unimportant. For small streams and offstream reservoirs, the item becomes critical. Determine if up to 2 ft^3/s of diversion flow for construction purposes can be assured to the contractor. The Government should obtain the water rights required. If it is necessary to use ground water, obtain information on probable sources and yields. Furnish information on locations and yields of existing wells in the vicinity. Determine restrictions, if any, to use of ground water for this purpose. It may be necessary to obtain permits from State or other governing agencies. Retrieve water quality samples for testing and evaluation.

(a) Water treatment requirements for return flows

(8) Requirements for maintaining streamflow or diversions during construction and maximum length, time, and number of permitted interruptions.

(9) Required permits from government agencies and others.

(10) Requirements for meeting criteria for suppression of nitrogen, adequate oxygen levels, and temperature control and control of turbidity during construction.

(11) Requirements for temporary construction access roads, permanent access and service roads, and relocation of existing roads or railroads. Include any limiting requirements imposed by road owners for public access/haul roads.

(13) Give borrow area and temporary haul road restoration requirements such as stockpiling of topsoil, grading of the area, general cleanup, etc.

(14) Give consideration to using required excavated material in lieu of material from other borrow sources wherever possible.

5. Canals. The Introduction (Chapter 1) for these design data collection guidelines contains additional information concerning: preparing a design data collection request, design data collection requirements, and coordinating the design data collection and submittal.

A. General Map(s). The General Map should cover the project area and the area immediately surrounding the project within approximately 2 or 3 miles. The scale of the General Map should be adequate to clearly show listed details. A scale of approximately 1 to 3 miles per inch is commonly used. The following data are shown on a General Map for feasibility and specifications level design data collection:

(1) A key map locating the general map within the State.

(2) A legend of symbols used for existing and constructed facilities.

(3) North arrow.

(4) Existing or potential areas or features having a bearing on the design, construction, operation, or management of the project. The locations of these features should bear the parenthetical reference to the agency or entity which owns or operates the property; for example, the Bureau of Reclamation (Reclamation):

(a) Name of agency responsible for maintaining and/or managing the affected land.

(b) Recreation areas; fish and wildlife areas; building areas; highways, railroads, and shipping points; housing; areas of cultural sensitivity; areas of archeological, historical, and mining or paleontological interest; and bridges with special loads or size limitations.

(c) Existing towns, residences, private property, roads, transmission lines, substations, stream-gauging stations.

(d) Areas of environmental concern.

(e) Public utilities such as electric power and telephone lines, pipelines, etc.

(f) County, range, township, and section lines.

(g) Land use restrictions such as easements and rights-of-way.

(5) Rights-of-way:

(a) Show rights-of-way required or available for facility/structure sites, construction access, and staging areas.

(b) Land ownership boundaries and legal jurisdictions. Indicate ownership by agency acronym or private land with "private."

(6) The proposed structures and features:

(a) Location of features to be constructed or modified.

(b) Locations of potential construction and permanent access roads, sites for contractor's staging areas and construction facilities, and sites for temporary water treatment facilities.

(c) Locations of borrow areas for natural construction materials, locations of commercial quarries, and disposal areas for waste excavation.

(d) Sources of construction power and power transmission facilities.

(e) Sources of water for construction.

B. Location Maps. Location maps are commonly used as a condensed method of showing location and alignment of the features and associated structures. The location map may be combined with the general map, site plan, or plan and profile drawings for small areas. A scale of 1 inch = 1,000 feet to 1 inch = 2,000 feet is commonly used for location maps. The location map should show:

(1) **General:**

(a) North arrow.

(b) Proposed alignment, major structures, and delivery locations by symbols. Station and appropriate ties to section lines, section corners, existing buildings, pipelines, roads, railroads, etc.

(c) Topography and ownership information should be shown.

(d) Towns, roads, railroads, streams, existing pipelines, canals, reservoirs, etc.

(e) Transportation facilities and other cultural features.

(f) Location of borrow areas, riprap sources, sources of special pipe embedment material, if required

(g) Disposal areas for wasting excess excavation.

(h) For distribution systems, show ownership, turnout locations, and irrigable areas served.

(i) Sources of power for construction and operation and maintenance.

(j) Existing or potential areas or features having a bearing on the design, construction, or operation and maintenance such as: recreation areas, fish and wildlife areas, railroads, housing, and areas of archeological, historical, and mining and paleontological interest.

(k) Where the scale does not permit proper detail of a congested area, a blowup at a larger scale may be included elsewhere on the drawing and referenced to its proper location. Where density of the structures or other features is such that individual stationing and naming is impractical, the information should be shown in tabular form and station marks shown on the alignment.

(l) Linear feature (canal, pipeline, wasteway, drains, etc.), together with structures and stations. Structures and delivery locations are normally shown by symbol.

(m) Legend of symbols for existing and proposed facilities

(n) Right-of-way and land ownership information.

C. General Description of Local Conditions. The following data may be required for feasibility and specifications designs:

(1) Information relating to access for possible site visit by the design team, access for foundation exploration and construction, and access limitations due to environmental restrictions, etc.

(2) Access to the site for operation and maintenance (O&M) forces.

(3) Permits or permit requirements and any past permit violations or exceedences.

(4) Name and description of similar construction in the area or region.

(5) The approximate distance from the nearest railroad shipping terminal to the structure site; load restrictions and physical inadequacies of existing roads and structures and an estimate of remedial improvements to accommodate construction hauling; estimate of access road length and major structures required for new construction; and possible alternative means for delivering construction materials and equipment to the structure site.

(6) Availability or accessibility of public facilities or utilities such as water supply, sewage disposal, telephone utility, fire protection services, and electric power for construction (give location, power supplier, voltage, number of phases, and capacity of existing transmission lines; power rate schedules; probability of interruption of supply; and requirements for additional transmission line, if needed).

(a) Names, telephone numbers, email addresses, and Web sites of local utilities and contacts within those organizations.

(7) Climatic conditions that will affect design, construction, and O&M such as amount, rate, and distribution of rain, snow, and hail; ice conditions; heating and air-conditioning design temperatures; summer and winter temperatures with extremes; maximum wind velocities and their directions; probability of excessive dust or sand.

(8) Local frost depths.

(9) Ground water presence and depths.

(10) Vegetation to be cleared or preserved including kinds, sizes, and density of growth.

(11) Road detour requirements.

D. Survey Control. Use of an existing coordinate system or tying to the township and range system is acceptable, but tying to the State or national system is recommended if practical. If existing facilities are affected or incorporated into the designs, the verification of the original coordinate systems and datum.

E. Topographic Maps.

(1) Strip Topography. Strip topography covering the proposed canal location should generally be provided. The desired scale is 1 inch equals 200 feet with a 2-foot contour interval and a minimum strip width of 200 feet. The strip topography should be provided on plan and profile drawings. If the project area is flat or small, a 1-foot contour interval may be required.

Aerial photographs or mosaics of the proposed canal alignment and of major structure sites should also be provided if available.

(2) Topographic maps at structure sites are required only where major or complicated structures are planned, unusual conditions exist, or judgment dictates that more information will be required for review or design. These site maps normally will be on a scale of 1 inch equals 20 feet to 50 feet and a contour interval of 1 foot (scale should be enlarged and/or contour interval decreased to 1 foot when necessary to clarify conditions

establishing alignment, earthwork, delivery water surface elevations, and related details). Exploration holes should be located on the maps.

(3) Topographic maps should be furnished covering all the project area showing ownerships, gross acreage, and irrigable acreage for each ownership, 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.

(4) Where the source of the water is a canal, reservoir, or pipeline with turnout or headworks located outside the distribution system area boundary, topographic maps of the same scale and contour interval provided for above, should be submitted covering all the areas in which the connecting feeder main is to be located. The water surface elevation range in the source canal or reservoir or hydraulic gradient range in the source pipeline should be shown. Also, where appropriate, data such as capacities, grades, etc., should be shown.

F. Plan and Profile Drawings. Plan and profile drawings are normally requested for linear features such as roads, canals, and pipelines. Drawings are prepared so that both plan and profile are plotted on one sheet. Strip topography may be used for the plan view. The plan view may not be required if shown on other drawings. These drawings are normally prepared with a 1 inch = 10 feet vertical scale and the horizontal scales of 1 inch = 200 feet unless more or less detail is required. The scale should be adjusted, as required, if it is necessary to show details. Plan and profile drawings should show features such as:

(1) **General:**

(a) North arrow and land survey lines.

(b) Proposed centerline and stationing and curve data.

(c) Location of existing features such as highways, railroads, public utilities, major drainages, and any other features that will affect the location and cost of proposed project facilities.

(d) Ties and stationing for turnouts, sublaterals and deliveries, as well as road crossings, railroad crossings and utility crossings. Grid coordinates for major structures such as pumping plants, flow control stations, tanks, reservoirs, etc.

(e) Land control survey lines with ties to alignment where appropriate.

(f) Survey data to include stationing, ties to existing features, etc.

(g) Existing ground surface contours with date of surveys and mapping. Significant topographic features.

(h) Existing utility lines within the right-of-way and requirements for relocation.

(i) Location of any existing intersecting facilities, watercourses, or other physical features affecting the new line or riprap protection on steep slopes.

(j) Cross drainage and direction of flow. Location of riprap protection on steep slopes. For major cross drainages, include flow (ft^3/s) and associated frequency (years)

(k) Low wire elevations and station of power lines (include voltage) where they cross the alignment.

(l) Buildings, fences, and other obstructions.

(m) Right-of-way.

(n) Feature alignment, curve data, and stationing.

(o) Pipe - Hydraulic properties by reaches of proposed features including hydraulic gradeline, feature dimensions, and pressure class for pipe.

(p) Open channel - Hydraulic and section properties: bottom width, side slopes, water depth, hydraulic equation used, and associated coefficient are often shown in a table.

(q) Structures (including conduit size for siphons, turnouts, and culverts).

(r) Alignment of laterals, sublaterals, overflow wasteways, reservoirs, and access roads.

(s) Crossings: Individual drawings should be furnished that show the plan and the profile, drawn to appropriate scales, of the following types of crossings:

- Railroad crossings.
- Highway crossings which cannot be constructed by open-cut methods.
- River or canal crossings.

(t) Roads, borrow pits, and waste areas.

(u) Areas where special construction effort is required: low-density soils, high ground water table, bedrock, etc.

(v) Profile: The profile should show, as a minimum, bottom grade, original ground surface, utilities and other subsurface features, and water surface.

(2) **Siphons, Road Crossings, and Associated Pipelines:**

(a) Anticipated right-of-way widths and minimum radius of curve that should be used to establish right-of-way (ROW) limits at points of intersection on pipeline centerline alignment. Where possible, curves having a minimum radius of 500 feet should be used at horizontal changes in the direction of the pipeline alignment. On large diameter pipelines, curve radii of 1,000 feet or more may be desirable to permit use of "pulled" joints in pipe or curves rather than concrete encasements.

(b) Areas where special construction effort is required, such as directional drilling, microtunneling, compacting pipe trench backfill up to the ground surface, excavating the pipe trench using shoring or a safety shield, limits of encasement under proposed drains or canals, etc.

(c) Profile: Existing ground surface, centerline elevations of pipelines, canals, hydraulic gradeline, utilities or other subsurface features where they cross the alignment. Hydraulic gradeline and pressure class for pipelines.

G. Canal Lining. Type of lining required: earth, concrete, or membrane.

H. Foundation Data.

(1) **General Engineering Requirements.** The data for Specifications design is similar to that for Feasibility design. They differ only in greater accuracy, detail, and completeness of investigation and testing, particularly for specific conditions (e.g., ground water, very soft or unstable foundation materials, and zones of rock excavation). If only minor additions or revisions are involved in the descriptions, interpretation, and geological sections previously submitted for feasibility design, the new data may be submitted as a supplement; otherwise completely revised new text, sections, and profiles should be prepared.

The need for additional foundation data should be established by the design office personnel with assistance from the region and originating

office representatives. For major structures, it is recommended that a field conference be held, including an inspection of the site. This conference should result in a geologic investigations program outlining the need for and extent of surface and subsurface studies, and other requirements. The geologic investigations program must be based on site conditions, type of structure, and the time and funds available for the study and will make maximum use of existing data. The complexity of the site will determine the detail of the investigation.

Sufficient data on foundation conditions must be included to determine type of excavation materials that will be encountered and geotechnical analysis required. Drill holes shall be located at intervals of 2,500 ft. unless site conditions demand more frequent logs. Logs of all drill holes, auger holes, and exploration pits will be included. Recommendations for lining, based on foundation conditions, and any other data will be included. Major soil types should be identified, including such significant factors as expansive and low-density soils, rock, and high-water tables.

(2) **Geologic Data.** The following list of geologic design data provides general guidelines for the collection and reporting of geologic information for canals. The geologist should apply these guidelines with good judgment and sound reasoning, elaborating upon them as required by the particular geologic setting and engineering requirements. Because the collection of geologic data is a dynamic process and often continues into the preparation of final designs, all stages of the specification design geologic exploration program must be constantly coordinated with the designer through the appropriate geology office. The design engineer and geologic and geophysical staff will provide necessary assistance and guidance in the gathering of these design data.

(a) Compilation, summary, and reporting of Bureau and non-Bureau geologic information on the area, with attention being paid to the sequence of explorations and historical geologic events.

(b) Surface geologic map of canal alignment showing location of explorations. Locations of all existing explorations should be indicated by coordinates or stationing of the permanent survey control system for the canal.

(c) Specific foundation exploration at bridges, inverted siphons, check structures, pumping plants, and other major structure sites; at deep cuts; and where required to explore particular geologic problems such as soft foundations or low-density material.

(d) Factual narrative description of surficial deposits with attention being paid to engineering geologic matters, such as swelling

minerals, low-density material, presence of gypsum and other sulfates, caliche, erodibility (see Earth Manual).

(e) Factual narrative description of bedrock with attention being paid to engineering geologic matters such as swelling minerals, presence of gypsum and other sulfates; and to depth, weathering, joints, faults, and other planes of weakness.

(f) Selected determination of engineering properties of surficial deposits and bedrock by laboratory or field tests (in-place density, penetration resistance, permeability, shear strength, gradation, and consolidation or expansion characteristics, etc.). The type and number of samples and tests required should be determined in cooperation with the TSC.

(g) Photographs, preferably in color, of representative or particular geologic conditions.

(h) Summary and data of exploration geophysical surveys (seismic, soil resistivity, etc.), if performed.

(i) Determine ground water conditions with attention being paid to water levels and their seasonal fluctuation, occurrence of unconfined and confined aquifers, potential leakage, water-producing capabilities including permeability tests, chemistry, and land subsidence.

(j) Logs of exploration. Logs of drill holes advanced by churn drilling, chop and wash, or other methods which result in less than adequate sample recovery should be augmented by borehole electric (geophysical) logs where appropriate. Log holes shall be spaced at 2500 ft.

(k) Evaluation of landslide, snowslide, and rockfall conditions. If it is relevant, include a map of possible slide areas with as much detail as practicable.

(l) If threat to life is significant, determine age of faulting in vicinity, especially if suspected to be late Pleistocene or Holocene.

(m) Document past, present, and possible future petroleum, water, and mineral extraction operations in vicinity.

(n) Determine geologic conditions which may affect construction methods such as, boulders on ground surface, marshes, cemented zones in surficial materials, etc. Any potential surface water runoff

problems should be brought to the attention of a regional hydrologist.

(o) Samples of foundation materials and ground water should be obtained and tested to determine any possible chemical reaction with the canal concrete or metalwork..

(p) Ensure that canal is not constructed on old spoil banks.

I. Corrosion Survey.

(1) In situ electrical resistivity measurements of geologic materials in the area of construction. Additional measurements should be made in the areas where there is a pronounced change in type of geologic materials, drainage, and/or moisture conditions.

(2) Performance history of materials of construction that have been used in the area.

(3) List location, output, and purpose of the direct-current sources in the earth situated within ¼ mile of the proposed structure and appurtenant features. If the purpose of the direct current is for cathodic protection, describe the structure protected and its location.

(4) List of structures within ¼ mile of the vicinity of the proposed structure and appurtenant features. Determine if buried structures in the vicinity have cathodic protection and, if so, the type and location of the cathodic protection groundbed.

(5) Information as to any unusual chemistry in the area from geologic materials, ground water, or manmade sources shall be gathered. In particular, analyze for pH, chlorides, and sulfates.

(6) Report alkali conditions in soil and water, which might affect the choice of sulfate resisting cement.

(7) Associated Pipe, Road Crossings, and Siphons: In order to determine corrosion mitigation measures for external surfaces, corrosivity surveys shall be performed on all projects where buried pipe options with ferrous materials are considered. This survey shall include information relating to the native corrosivity of the surroundings and to interfering direct current (DC) and alternating current (AC). The following determination shall be included:

(a) In-situ electrical resistivity measurements in accordance with the 10-percent Soil Resistivity Method (see Technical Memorandum No. MERL-05-19) shall be made. Resistivity data are to be

processed through an inversion program such as Resix-Plus (Interpex, Ltd.) or equivalent. The controlling 10-percent soil resistivity shall be determined following computer processing of the data.

(b) Road salt use is aggressive and shall be noted.

(c) Identify the location of any nearby high-voltage AC (HVAC) transmission lines running parallel or nearly parallel to the pipeline in question. If not parallel, provide approximate angle of real or projected intersection between the pipeline and such electrical transmission lines. Determine:

- Distance from the pipeline to the nearest tower legs
- Horizontal distance between the ground below the nearest load carrying conductors and the nearest pipeline segment(s) roughly paralleling the conductors
- Distance of the conductors above ground.
- Obtain from the power company the geometric mean radius (GMR) of the shield wires and their lineal resistance (e.g., Ohms per kilometer).
- Obtain from the power company the maximum fault currents anticipated along the run of the pipeline for each circuit.
- Obtain from the power company the maximum anticipated current loading of each circuit.
- Obtain from the power company the horizontal and vertical separation distances between each of the phase conductors and shield wires.
- Obtain from the power company the order in which the phases are arranged on the tower.
- Measure the longitudinal electric field strength for AC lines using the horizontal wire method and obtain from the power company the percent of line load at the time of the measurement.
- Determine soil resistivity at pipe depth along the powerline route.

(d) Identify the location of any high-voltage DC (HVDC) grounding electrode beds within 50 miles of the pipeline.

(e) Based on soil resistivity values, Technical Memorandum No. 8140-CC-2003-1, *Corrosion Considerations for Metallic Water Pipe* (posted on the Intranet) presents required external corrosion protection measures for pipelines.

J. Construction Materials Data including:

(1) Classification of all materials taken from test holes as soils, rock, etc., should be designed according to Unified Soils Classification System (see Earth Manual). Location and extent of rock, areas of high ground water (present and future), and other unusual conditions should be shown.

(2) Information on concrete aggregates. (See "Final Investigations" in Concrete Manual.)

(3) Information on sources and character of acceptable road surfacing materials, if required.

(4) References to service history of materials if used previously and to results of sampling and analysis, including previous tests in the central Bureau laboratories.

(5) Environmental impacts associated with removing or obtaining construction material.

(6) Dispersive soil analyses.

K. Hydrologic Data including:

(1) Design flood frequency to be used for design of cross drainage structures.

(2) Peak design flow discharges for minor drainage areas, except where temporary ponding time uphill of the canal is a design consideration, then hydrographs of the design storms should be submitted, and topography should extend uphill of the canal a sufficient distance to cover the temporarily inundated area.

(3) Hydrographs of design floods for major cross-drainage areas if the canal section extends across the natural channel or broad, poorly defined drainage.

(4) The expected volume of sediment taken into the canal and/or accumulated uphill of a canal drain inlet used for major cross-drainage areas for large capacity canals.

(5) Peak discharge or hydrograph, as appropriate, for flood frequency greater than design frequency.

(6) Tailwater curves, sedimentation studies, degradation, and aggradation studies should be included if they are critical.

L. Operating Data including:

(1) Source of water.

(2) Water surface elevations and capacities at control points along canal at deliveries.

(3) Plan of operation for waterway including extent of automatic and/or supervisory control. If supervisory control, give location of master station. Demand or supply control system.

(5) A list of all structures showing stationing, type, size, and other control data.

(6) Provisions for cross-drainage structures, wasteways, and spillways including estimated structure capacity.

(7) Measuring facilities required in canal and turnouts.

(8) Percent of design capacity that the canal is expected to carry each month, and probable dates that it may be taken out of service for maintenance each year.

(9) For canals operated in subfreezing weather: minimum temperatures, lengths of time freezing may occur, average and maximum ice depths, conditions to be anticipated as to alternate freezing and thawing, and probability of canal drifting full of snow.

(10) Explain any proposed rotational, scheduled irrigation, or full demand plan and alternative types of systems considered.

(11) Character of water to be conveyed with respect to probable sediment deposition and anticipated growth of algae in the channel and of other water-loving plants or weeds along banks.

(12) Type of maintenance machinery contemplated.

(13) Type of communications system contemplated.

(14) Type of water service for land (include planning report if available):

(a) Furrow irrigation.

(b) Pumped system (Reclamation or farmer).

(c) Design efficiency.

(d) Filling and draining criteria.

M. Structure Data including:

(1) **General.** Unless shown elsewhere, the information should be submitted on tabulations for similar structures, data sheets, or special sketches. Do not duplicate.

(2) **Cross Drainage:**

(a) Design capacity, frequency of design storm, and map of contributory drainage area.

(b) Strip topography of canal - Augmented, if necessary, by sufficient data to show the requirements of outlet control and allowable inlet pondage.

- The information should be shown in tabular form and station marks shown on the alignment.
- Maximum, normal, and minimum flows in live stream, if existing, possibility of scour.

(3) **Road, Highway, and Railroad Crossings (siphons, bridges, and culvert):**

(a) Point of contact for each crossing.

(b) Type of structure and possible alternatives.

(c) Base of rail elevation for railroad, and crown elevation and width of surfacing for road. Minimum clearance between top of culvert or siphon and base of rail or crown of road.

(d) Railroad or highway right-of-way limits. Number and location of future tracks and sidings; or limits of highway widening. Location of shoofly or detour if required during construction.

(e) For smaller culverts and siphons, possibility of jacking pipe through roadbed, and if feasible, agency's approval of this type of construction.

(f) Maximum encroachment limits on highway or railroad right-of-way during construction and for completed structure, including canal banks.

(g) Location, bottom grade, dimensions, and capacity of any existing drainage ditches.

(h) Highway or railroad loadings.

(i) Method of maintaining traffic during construction.

(j) Liability obligations to be assumed by Government construction contractor and types of indemnity bonds or liability insurance (with maximum limits) to be furnished by contractor, as set forth in crossing agreement with railroad company or highway department.

(4) **Wasteways and Spillways:**

(a) Type of control (slide gate, radial gate, side overflow, siphonic overflow) and capacity. Weather warning plan is required.

(b) Range of control of water surface if wasteway is to be automatic.

(5) **Checks:**

(a) Type of control, stoplog, slide gate, or radial gate. Capacity of overflow weir, if desired. Type of operation (i.e., manual, automatic, and/or remotely monitored and controlled). Requirements for backup power.

(b) Details of combination requirements, if to be combined with other structures.

(6) **Turnouts:**

(a) Capacity, minimum operating water surface in canal, and maximum water surface immediately below turnout.

(b) Type of measuring device and whether data are telemetered.

(c) Operation and maintenance road elevations and clearances.

(d) Requirement for screens if turnout is to be connected with a pipe distribution system or sprinkler irrigation system.

(7) **Chutes and Drops:**

(a) Range in capacities, water surface, and bottom grade elevations, both upstream and downstream.

(b) Combinations with other structures such as checks, siphons, operating or highway bridges, or turnouts.

(c) Range in capacities if the chute or drop is to be used as a measuring device; and reason for measurement.

(8) **Measuring Devices:**

(a) Type of structure and accuracy required.

(b) Bottom grade and maximum and minimum operating water surfaces both upstream and downstream.

(c) Maximum and minimum capacity to be measured.

(d) Whether a continuous record of discharge is required and whether remotely monitored. Telemetering requirements.

(9) **Miscellaneous Information:**

(a) Months of the year in which flow of irrigation ditches or drains to be crossed can be suspended.

(b) Prevalence of any unusual local pest action such as termites, dry rot, and marine borers; local practices for combating same.

(c) Hold water during winter for livestock.

(d) Need for operating roads on or along canal banks.

(e) Legal or practical requirements for fencing; recommended type of fencing if required.

(f) Number, width, and loading requirements for farm bridges.

(g) Special requirements and locations of safety devices such as guardrailing, security lighting, fences in populated areas, nets, and racks; game crossing requirements, fencing, and escapes.

(h) Type, location, owner, and requirements of irrigation and utility crossings.

N. Environmental Considerations. Implementation of design features should be consistent with the environmental commitments as described in the NEPA compliance document (include document) that would affect the design and a brief description of the setting and the resources that would be affected by the proposed canal. Implementation of design features should be consistent with agreements reached (include agreements) between Interior Bureaus, Federal agencies, and other Governmental agencies.

Design data should include, as a minimum, a brief description of the environmental resources that could be affected by the proposed development. The emphasis should be focused on those areas within the range of alternatives open to the designers in developing a structural design. The following items should also be considered in preparing design data:

(1) The environmental setting, photographs, both black and white and color, are helpful.

(2) Cultural (historical, archeological, architectural, and paleontological) resources in the area of the canal.

(3) Wildlife or refuge areas and wetlands.

(4) Background on the need for fish facilities such as screens, fishways, and barriers.

(5) The need for blending structures with the surroundings, restoring borrow areas, and reseeding spoil banks.

(6) The need for a field conference to resolve critical environmental problems with participation of other agencies.

(7) Review of designs by other agencies including the findings of the Fish and Wildlife Coordination Act Report.

(8) Anticipated public use around the structure.

(9) The need for escape structures or crossings for human, deer, or other wildlife including special fencing needs.

(10) Special environmental requirements for transmission lines or underground transmission systems.

(11) Any threatened and/or endangered critical habitat in/or adjacent to the canal alignment.

(12) The need for restoring borrow areas and reseeding spoil banks.

(13) The water quality and location of return flows.

(14) Environmental considerations such as water pollution control standards, noise and dust abatement requirements, areas that will require landscaping, replacement of topsoil, seeding, architectural treatment for structures, tree lists, endangered species, and mitigation requirements, etc.

O. Electrical Data. Data listed below will be required to initiate design. The data furnished should be sufficient to permit designers to complete the basic design (single-line diagram) for the canal, wasteway, spillway, check, turnout, chute, drop, or other structure. After designs of the facility have progressed enough to develop details of electrical system needs, designers will prepare a list of additional data required to complete final design of electrical installation.

(1) Name and telephone numbers of electrical power suppliers and contacts within those organizations.

(2) Location of point where connection to power supply will be made.

(3) System voltage at which power will be supplied, number of phases, and whether service will be overhead or underground.

(4) Electrical system reliability criteria.

(5) Discuss requirements for an alternate power source. If an alternate supply is required, indicate:

(a) If required by State or local authority.

(b) If source should be an engine-generator.

(c) If a threat to life or property will result if normal power supply is lost.

(d) Loads requiring service from alternate source.

(6) Requirements for remote monitoring of conditions at the facility. Discuss location of remote station, and items required to be monitored.

(7) Requirements for supervisory control, including location of station from which supervisory control is exercised.

(8) Requirements for voice and data communications between the supervisory master station and the remote facilities.

P. Cost Data for Field Cost Estimate. The field cost estimate is an estimate of the capital costs of a feature or project from award to construction; non-contract costs are not included. Cost data developed in previous or other studies (either by Reclamation or others) should be included with the design data submittal. Include a description or outline of estimating methods and data used. The following

design data for feasibility and specifications levels designs should be considered for submittal:

(1) Procurement Strategy. Will solicitation be advertised and awarded under other than full and open competition? This includes solicitations which will be set aside under socio-economic programs that may limit competition or allow award to other than the lowest bid or proposal.

(2) Estimate of cost of ROW for all features including reservoirs, dams, and appurtenant works. Include supporting data:

(a) For reservoirs, include a curve showing estimated cost of ROW versus elevation of reservoir water surface from normal elevation to maximum estimated surcharge elevation or other physical or economic limit. Include supporting data.

(3) Information on local labor supply and labor problems.

(4) Local freight or trucking rates.

(5) Housing accommodations.

(6) Interest rate for economic studies.

(7) Power rate in mills per kilowatt-hour, interest rate, and plant factor for economic tunnel, and pipeline sizing studies in cases where transported water is pumped.

(8) Estimated cost for construction items which cannot readily be determined in the design office and include the supporting data:

(a) Clearing reservoir area and for removing or replacing private improvements in the area.

(b) Earthwork (common and rock), excavation with freehaul distance. For canals, include compacting embankment, canal lining, and borrow (with free haul distance)

(c) Riprap, guardrail, culverts, row fencing, and gates.

(d) Designated areas to be cleared of vegetation, with description of kinds, size, and density of growth. State recommended method of payment (i.e., lump-sum price for area with defined limits or unit price per acre for area with limits subject to change during construction). Use separate payment items for clearly defined areas differing in growth density and difficulty of clearing operations. If vegetation to be cleared is very sparse or can be

removed without special equipment or separate operations, the cost of clearing should be included in the prices bid for excavation or prices bid for other appropriate items of work.

(9) Where buildings are located within the area to be cleared by the prime contractor, and if disposal will be the contractor's responsibility, designate building groups by number and furnish detailed list of buildings for each group. Details should include general description, size, materials, and general condition. Drawings should be provided of these buildings, if available, that depict dimensions, construction materials, the structural system for the building, and major electrical and mechanical equipment. Determine if disposal will be the responsibility of the prime contractor. If not, submit dates when disposal will be completed by others.

(10) Information on important construction work that is in progress or planned in the vicinity and the presence of interested contractors or subcontractors in the area.

(11) If potential actions exceed anticipated funding, an assessment should be made as to whether the cost estimate will reflect incremental costs of these potential actions. Provide any known increment or arrangement of the incremental costs.

(12) Local and tribal taxes.

(13) Estimates of costs for relocating railroads, highways, roads, water systems, and other public utilities. Include supporting data.

(14) Method for projecting cost into the future if required.

(15) Cost of local materials (precast concrete, etc.).

Q. Construction Considerations. The following design data items should be considered for feasibility and specifications designs:

(1) Construction schedule:

(a) One contract or several contracts.

(b) Any construction timeframe restrictions

(c) Are designers required to provide a construction schedule and/or logic diagram?

(d) Recommended period for construction.

(e) Recommended period for completion of construction work and features of the work that should be completed early.

(f) Permissible times to make connections to existing facilities.

(g) Whether construction schedule will be adaptive, (e.g., provide a remedy, observe the effects, and then modify remedy as required).

(2) Allowable in-river materials (permanent and temporary).

(3) Construction constraints including allowable construction methods, traffic considerations, environmental restrictions, climatic restrictions, blasting limitations, etc.

(4) Filling and draining criteria for dam, ponds, and pipelines

(5) Unusual conditions for excavation or construction.

(6) Extent of construction surveying to be accomplished by Government surveyors.

(7) Water for construction purposes. For large rivers, this item may be unimportant. For small streams and offstream reservoirs, the item becomes critical. Determine if up to 2 ft^3/s of diversion flow for construction purposes can be assured to the contractor. The Government should obtain the water rights required. If it is necessary to use ground water, obtain information on probable sources and yields. Furnish information on locations and yields of existing wells in the vicinity. Determine restrictions, if any, to use of ground water for this purpose. It may be necessary to obtain permits from State or other governing agencies. Retrieve water quality samples for testing and evaluation.

(a) Water treatment requirements for return flows

(8) Requirements for maintaining streamflow or diversions during construction and maximum length, time, and number of permitted interruptions.

(9) Required permits from government agencies and others.

(10) Requirements for meeting criteria for suppression of nitrogen, adequate oxygen levels, and temperature control and control of turbidity during construction.

(11) Impact of moving construction materials on existing road facilities, including consideration of such factors as traffic congestion, effect on road condition, air pollution, etc.

(12) Requirements for temporary construction access roads, permanent access and service roads, and relocation of existing roads or railroads. Include any limiting requirements imposed by road owners for public access/haul roads.

(13) Comments on disposal of special excavation problem materials such as lignite.

(14) Give borrow area and temporary haul road restoration requirements such as stockpiling of topsoil, grading of the area, general cleanup, etc.

(15) Give consideration to using required excavated material in lieu of material from other borrow sources wherever possible.

R. **Site Security.** Many Reclamation projects may require a security risk assessment. The need for a site-specific security risk assessment should be considered for feasibility designs where an assessment may impact the field cost estimate and for specifications designs. Specific issues to consider are contained in Section 14 of Chapter 7 – Site Security and Public and Worker Safety. If assistance is required to determine specific design data needs, contact the Office of Security, Safety and Law Enforcement. Where design data and designs include site-specific security assessment, compliance with Reclamation Manual DM Part 444 – Physical Protection and Facility Security, Chapters 1 and 2 is required.

6. Pipelines. The Introduction (Chapter 1) for these design data collection guidelines contains additional information concerning: preparing a design data collection request, design data collection requirements, and coordinating the design data collection and submittal. The design data collection requirements included in this section cover pressure and gravity or open (low-pressure) pipeline systems.

A. General Map(s). The General Map should cover the project area and the area immediately surrounding the project within approximately 2 or 3 miles. The scale of the General Map should be adequate to clearly show listed details. A scale of approximately 1 to 3 miles per inch is commonly used. The following data are shown on a General Map for feasibility and specifications level design data collection:

(1) A key map locating the general map within the State.

(2) A legend of symbols used for existing and constructed facilities.

(3) North arrow.

(4) Existing or potential areas or features having a bearing on the design, construction, operation, or management of the project. The locations of these features should bear the parenthetical reference to the agency or entity which owns or operates the property; for example, the Bureau of Reclamation (Reclamation):

(a) Name of agency responsible for maintaining and/or managing the affected land.

(b) Recreation areas; fish and wildlife areas; building areas; highways, railroads, and shipping points; housing; areas of cultural sensitivity; areas of archeological, historical, and mining or paleontological interest; and bridges with special loads or size limitations.

(c) Existing towns, residences, private property, roads, transmission lines, substations, stream-gauging stations.

(d) Areas of environmental concern.

(e) Public utilities such as electric power and telephone lines, pipelines, etc.

(f) County, range, township, and section lines.

(g) Land use restrictions such as easements and rights-of-way.

(5) Rights-of-way:

(a) Show rights-of-way required or available for facility/structure sites, construction access, and staging areas.

(b) Land ownership boundaries and legal jurisdictions. Indicate ownership by agency acronym or private land with "private."

(6) The proposed structures and features:

(a) Location of features to be constructed or modified.

(b) Locations of potential construction and permanent access roads, sites for contractor's staging areas and construction facilities, and sites for temporary water treatment facilities.

(c) Locations of borrow areas for natural construction materials, locations of commercial quarries, and disposal areas for waste excavation.

(d) Sources of construction power and power transmission facilities.

(e) Sources of water for construction.

B. Location Maps. Location maps are commonly used as a condensed method of showing location and alignment of the features and associated structures. The location map may be combined with the general map, site plan, or plan and profile drawings for small areas. A scale of 1 inch = 1,000 feet to 1 inch = 2,000 feet is commonly used for location maps. The location map should show:

(1) **General:**

(a) North arrow.

(b) Proposed alignment, major structures, and delivery locations by symbols. Station and appropriate ties to section lines, section corners, existing buildings, pipelines, roads, railroads, etc.

(c) Topography and ownership information should be shown.

(d) Towns, roads, railroads, streams, existing pipelines, canals, reservoirs, etc.

(e) Transportation facilities and other cultural features.

(f) Location of borrow areas, riprap sources, sources of special pipe embedment material, if required

(g) Disposal areas for wasting excess excavation.

(h) For distribution systems, show ownership, turnout locations, and irrigable areas served.

(i) Sources of power for construction and operation and maintenance.

(j) Existing or potential areas or features having a bearing on the design, construction, or operation and maintenance such as: recreation areas, fish and wildlife areas, railroads, housing, and areas of archeological, historical, and mining and paleontological interest.

(k) Where the scale does not permit proper detail of a congested area, a blowup at a larger scale may be included elsewhere on the drawing and referenced to its proper location.

(l) Where density of the structures or other features is such that individual stationing and naming is impractical, the information should be shown in tabular form and station marks shown on the alignment.

(m) Linear feature (canal, pipeline, wasteway, drains, etc.), together with structures and stations. Structures and delivery locations are normally shown by symbol.

(n) Legend of symbols for existing and proposed facilities

(o) Right-of-way and land ownership information.

(2) **Distribution Systems.** Where the source of the water is a canal, reservoir, or pipeline with turnout or headworks located outside the distribution system area boundary, topographic maps should be submitted covering all the areas in which the connecting feeder main is to be located. The water surface elevation range in the source canal or reservoir or hydraulic grade line range in the source pipeline should be shown. Also, where appropriate, data such as capacities, grades, etc., should be shown.

C. General Description of Local Conditions Covering. The following data may be required for feasibility and specifications designs:

(1) Information relating to access for possible site visit by the design team, access for foundation exploration and construction, and access limitations due to environmental restrictions, etc.

(2) Access to the site for operation and maintenance (O&M) forces.

(3) Permits or permit requirements and any past permit violations or exceedences.

(4) Name and description of similar construction in the area or region.

(5) The approximate distance from the nearest railroad shipping terminal to the structure site; load restrictions and physical inadequacies of existing roads and structures and an estimate of remedial improvements to accommodate construction hauling; estimate of access road length and major structures required for new construction; and possible alternative means for delivering construction materials and equipment to the structure site.

(6) Availability or accessibility of public facilities or utilities such as water supply, sewage disposal, telephone utility, fire protection services, and electric power for construction (give location, power supplier, voltage, number of phases, and capacity of existing transmission lines; power rate schedules; probability of interruption of supply; and requirements for additional transmission line, if needed).

(a) Names, telephone numbers, email addresses, and Web sites of local utilities and contacts within those organizations.

(7) Climatic conditions that will affect design, construction, and O&M such as amount, rate, and distribution of rain, snow, and hail; ice conditions; heating and air-conditioning design temperatures; summer and winter temperatures with extremes; maximum wind velocities and their directions; probability of excessive dust or sand.

(8) Local frost depths.

(9) Ground water presence and depths.

(10) Vegetation to be cleared or preserved including kinds, sizes, and density of growth.

(11) Road detour requirements.

D. Survey Control. Survey control is required for all surveys including surveys associated with aerial photography. If existing facilities or features are affected or incorporated into designs, then verification of original coordinate system with current coordinate system and datum should be made.

E. Topographic Maps.

(1) Topographic maps, when used, should be furnished covering all the project area showing ownerships, gross acreage, and irrigable acreage for each ownership, 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.

(2) Location and layout should be based on the latest system used in previous designs or preliminary studies. A scale of 1 inch equals 100 feet to 1 inch equals 400 feet and a contour interval of 2 feet is satisfactory. Structures proposed on the pipeline should be shown by symbols; where proposed pipeline locations are shown on these maps. If the project area is flat or small, a 1-foot contour interval may be required.

(3) Where the source of the water is a canal, reservoir, or pipeline with turnout or headworks located outside the distribution system area boundary, topographic maps of the same scale and contour interval provided for above, should be submitted covering all the areas in which the connecting feeder main is to be located. The water surface elevation in the source canal or reservoir or hydraulic gradient in the source pipeline should be shown. Also, where appropriate, data such as capacities, grades, etc., should be shown.

(4) Unless the information can be shown in adequate detail on the plan-profile drawing and/or the location map, topographic maps should be furnished for the proposed sites for pumping plants, flow control stations, reservoirs, regulating tanks, surge stands, etc. Such maps should be prepared with a scale of 1 inch equals 20 feet and a contour interval of 2 feet unless steep terrain requires a greater interval for clarity. If the project area is flat or small, a 1-foot contour interval may be required.

F. Plan and Profile Drawings. Plan and profile drawings are normally requested for linear features such as roads, canals, and pipelines. Drawings are prepared so that both plan and profile are plotted on one sheet. The plan view may not be required if shown on other drawings. These drawings are normally prepared with a 1 inch = 10 feet vertical scale and the horizontal scales from 1 inch = 100 feet to 1 inch = 200 feet unless more or less detail is required. The scale should be adjusted, as required, if it is necessary to show details. Plan and profile drawings should show features such as:

(1) **General:**

(a) Strip topography may be used for the plan view.

(b) North arrow and land survey lines.

(c) Proposed centerline and stationing and curve data.

(d) Location of existing features such as highways, railroads, public utilities, major drainages, and any other features that will affect the location and cost of proposed project facilities.

(e) Ties and stationing for turnouts, sublaterals and deliveries, as well as road crossings, railroad crossings and utility crossings. Grid coordinates for major structures such as pumping plants, flow control stations, tanks, reservoirs, etc.

(f) Land control survey lines with ties to alignment where appropriate.

(g) Survey data to include stationing, ties to existing features, etc.

(h) Existing ground surface contours with date of surveys and mapping. Significant topographic features.

(i) Existing utility lines within the right-of-way and requirements for relocation.

(j) Location of any existing intersecting facilities, watercourses, or other physical features affecting the new line or riprap protection on steep slopes.

(k) Cross drainage and direction of flow. Location of riprap protection on steep slopes. For major cross drainages, include flow (ft^3/s) and associated frequency (years)

(l) Low wire elevations and station of power lines (include voltage) where they cross the alignment.

(m) Buildings, fences, and other obstructions.

(n) Right-of-way.

(o) Feature alignment, curve data, and stationing.

(p) Hydraulic properties by reaches of proposed features (including hydraulic gradeline, feature dimensions, and pressure class for pipelines).

(q) Structures (including conduit size for siphons, turnouts, and culverts).

(r) Alignment of laterals, sublaterals, overflow wasteways, reservoirs, and access roads.

(s) Crossings: Individual drawings should be furnished that show the plan and the profile, drawn to appropriate scales, of the following types of crossings:

- Railroad crossings.

- Highway crossings which cannot be constructed by open-cut methods.
- River or canal crossings.

(t) Roads, borrow pits, and waste areas.

(u) Anticipated right-of-way widths and minimum radius of curve that should be used to establish right-of-way (ROW) limits at points of intersection on pipeline centerline alignment. Where possible, curves having a minimum radius of 500 feet should be used at horizontal changes in the direction of the pipeline alignment. On large diameter pipelines, curve radii of 1,000 feet or more may be desirable to permit use of "pulled" joints in pipe or curves rather than concrete encasements.

(v) Areas where special construction effort is required, such as directional drilling, microtunneling, compacting pipe trench backfill up to the ground surface, excavating the pipe trench using shoring or a safety shield, limits of encasement under proposed drains or canals, etc.

(w) Profile: Existing ground surface, centerline elevations of pipelines, canals, hydraulic gradeline, utilities or other subsurface features where they cross the alignment.

G. Geologic Data. The following list of geologic design data provides general guidelines for the collection and reporting of geologic information for this type of facility. The geologist should apply these guidelines with good judgment and sound reasoning, elaborating upon them as required by the particular geologic setting and engineering requirements. Because the collection of geologic data is a dynamic process and often continues into the preparation of final designs, all stages of the specification design geologic exploration program must be constantly coordinated with the designer through the appropriate geology office. The TSC geologic and geophysical staff will provide necessary assistance and guidance in the gathering of these design data.

(1) Compilation, summary, and reporting of Bureau and non-Bureau geologic information on the area, with attention being paid to the sequence of explorations and historical geologic events.

(2) Surface geologic map showing locations of explorations. Locations of all existing explorations should be indicated by coordinates or stationing of the permanent survey control system for the facility.

(3) Specific foundation exploration criteria (if required).

(4) Factual narrative description of surficial deposits with attention being paid to engineering geologic matters, such as swelling minerals, low-density materials, presence of gypsum and other sulfates, caliche, erodibility (see Earth Manual). Strength of the trench wall is necessary to determine trench type for flexible pipe.

(5) Factual narrative description of bedrock with attention being paid to engineering geologic matters such as swelling minerals, presence of gypsum and other sulfates; and depth of weathering, joints, faults, and other planes of weakness.

(6) Selected determination of engineering properties of surficial deposits and bedrock by visual examination or laboratory testing.

(7) Test pits shall be excavated at 2,500 ft. intervals and laboratory testing shall be performed to determine proctor or relative densities. This information will be used to determine trench type.

(8) Drill holes shall be drilled at 2,500 ft. intervals to a depth of 15 ft. below the invert of the pipe or until bedrock is encountered. This information will is used to determine where suitable pipe foundations exist.

(9) Photographs representative of particular geologic conditions.

(10) Summary and data of exploration geophysical surveys (seismic, soil resistivity, etc.), if performed.

(11) Determine ground water conditions with attention being paid to water levels and their seasonal fluctuation, occurrence of unconfined and confined aquifers, water-producing capabilities, chemistry, and ground subsidence.

(12) Logs of exploration. Logs of drill holes advanced by churn drilling, chop and wash, or other methods which result in less then adequate sample recovery should be augmented by borehole electric (geophysical) logs where appropriate.

(13) Evaluation of landslide, snow slide, and rockfall conditions. If a threat to life exists then determine age of faulting in vicinity, especially if suspected to be late Pleistocene or Holocene.

(14) Document past, present, and possible future petroleum, water, and mineral extraction operations in vicinity.

(15) Determine geologic conditions which may affect construction methods such as, boulders on ground surface, marshes, drilling conditions, stability

of drilled holes, ground temperatures, or gases. Any potential surface water runoff problems should be brought to the attention of a hydrologist.

H. Corrosion Survey. Corrosion surveys shall be performed on all projects where pipe and fitting options with ferrous materials are considered. In order to determine corrosion mitigation measures for external surfaces, corrosivity surveys shall be performed on all projects where buried pipe options with ferrous materials are considered. This survey shall include information relating to the native corrosivity of the surroundings and to interfering direct current (DC) and alternating current (AC). The following determinations shall be included:

(1) In-situ electrical resistivity measurements of geologic materials in the area of construction. Additional measurements should be made in the areas where there is a pronounced change in type of geologic materials, drainage, and/or moisture conditions.

(2) Performance history of construction materials that have been used in the area.

(3) List of structures within ¼ mile of the vicinity of the proposed structure and appurtenant features. Determine if buried structures in the vicinity have cathodic protection and, if so, the type and location of the cathodic protection groundbed.

(4) List location, output, and purpose of the direct-current sources in the earth situated within ¼ mile of the proposed structure and appurtenant features. If the purpose of the direct current is for cathodic protection, describe the structure protected and its location.

(5) Information as to any unusual chemistry in the area from geologic materials, ground water, or manmade sources shall be gathered. In particular, analyze for pH, chlorides, and sulfates.

(6) Report alkali conditions in soil and water which might affect the choice of sulfate resisting cement.

(7) In-situ electrical resistivity measurements in accordance with the 10-percent Soil Resistivity Method (see Technical Memorandum No. MERL-05-19) shall be made. Resistivity data are to be processed through an inversion program such as Resix-Plus (Interpex, Ltd.) or equivalent. The controlling 10-percent soil resistivity shall be determined following computer processing of the data.

(8) Road salt use is aggressive and shall be noted.

(9) Identify the location of any nearby high-voltage AC (HVAC) transmission lines running parallel or nearly parallel to the pipeline in question. If not

parallel, provide approximate angle of real or projected intersection between the pipeline and such electrical transmission lines. Determine:

- Distance from the pipeline to the nearest tower legs.
- Horizontal distance between the ground below the nearest load carrying conductors and the nearest pipeline segment(s) roughly paralleling the conductors.
- Distance of the conductors above ground.
- Obtain from the power company the geometric mean radius (GMR) of the shield wires and their lineal resistance (e.g., Ohms per kilometer).
- Obtain from the power company the maximum fault currents anticipated along the run of the pipeline for each circuit.
- Obtain from the power company the maximum anticipated current loading of each circuit.
- Obtain from the power company the horizontal and vertical separation distances between each of the phase conductors and shield wires.
- Obtain from the power company the order in which the phases are arranged on the tower.
- Measure the longitudinal electric field strength for AC lines using the horizontal wire method and obtain from the power company the percent of line load at the time of the measurement.
- Determine soil resistivity at pipe depth along the powerline route.

(10) Identify the location of any high-voltage DC (HVDC) grounding electrode beds within 50 miles of the pipeline.

(11) Based on soil resistivity values, Technical Memorandum No. 8140-CC-2004-1, *Corrosion Considerations for Metallic Water Pipe* (posted on the Intranet) presents required external corrosion protection measures for pipelines.

I. Construction Materials Data.

(1) Classification of all materials taken from test holes as soils, rock, etc., should be designated according to Unified Soils Classification System (see Earth Manual). Location and extent of rock, areas of high ground water (existing and future conditions), and other unusual conditions should be shown.

(2) Information on concrete aggregates and recommendation of type of cement to be used, e.g., sulfate-resistant cement.

(3) Source, location, and gradation of acceptable road or service yard surfacing materials, and/or embedment materials.

(4) Location of manufacturers of potential pipe alternatives.

(5) Desirability of including controlled low strength material (CLSM) as an allowable pipe embedment option.

(6) Maximum Standard Proctor and relative density tests of pipe trench for determining trench type and soil strength.

(7) Embedment requirements for pipe (native soil, select material, gravel, CLSM).

(8) Reference to service history of any material thought suitable for use on project if previously used, to include results of sample analysis and tests.

(9) Types of pipe commonly used on the project or in the project area including types of pipe which are not acceptable for use on the project.

(10) Source, location, availability, and cost of water to be used for construction.

J. Operating Data:

(1) The hydraulic data.

(a) Full demand system or rotational flow measurement requirements

(b) Filling and draining criteria

(2) Type of water service desired by the water district to include:

(a) Pressure at farm delivery point.

(b) Location of farm delivery with respect to high point of land to be irrigated.

(c) Suggested configuration of farm delivery, including type of flowmeter, type of valve control, and use of automatic control (telemetering). Requirements for components to facilitate electronic readout of flowmeter.

(d) Use of automatic controls: Automatic pump restart after power failure; installation of alarms, warning devices, tank or reservoir water level indicators at pumping plants, etc.

(e) Type of water screening devices required at delivery turnout, i.e., traveling or stationary screens.

(3) Irrigation data:

(a) Season requirement. This is usually stated in terms of acre-feet per productive acre per year for irrigation (application efficiency already considered).

(b) Monthly requirement. Expressed as a percentage of season requirement for each month of operation. Irrigation flows will be distributed over the irrigation season and will vary based on crop requirements per month.

(c) Peak requirement. This is the basic criteria for sizing pipelines and can be based on the maximum demand for a month, peak day, or other time period. The demand should be stated as the number of productive acres to be served by a flow of 1 ft^3/s or a flow rate of a specified number of gallons per minute required to irrigate 1 acre. Note distribution of irrigable acres along the irrigation system.

(d) Criteria for reducing irrigable acres to productive acres. This can be expressed as a percentage of the irrigable area.

(e) Basic criteria for sizing farm deliveries. This may be shown as a table showing the maximum and minimum number of productive acres to be served by deliveries of 1 ft^3/s, 2 ft^3/s, 3 ft^3/s, etc.

(f) Type of farm distribution system, including pressure required at farm delivery of sprinkler or drip irrigation systems.

(g) Controls and equipment to be included in farm deliveries such as flowmeters, control valves, open stands, and pressure-reducing valves.

(4) Municipal and/or industrial conveyance systems. In general, the data requirements are the same as for irrigation distribution systems. In addition provide:

(a) A general profile and alignment drawing of the entire system should be furnished at a vertical scale of 1 inch equals 100 feet and a horizontal scale of either 1 inch equals 1,000 feet, 1 inch equals 2,000 feet, or 1 inch equals 5,000 feet, depending on roughness of the terrain and length of the pipeline.

(b) Location of water treatment plant, if required, and of terminal tank.

(c) Maximum and minimum water level elevations at raw water intake and clearwell.

(d) Overflow, maximum, normal, and minimum water level elevations, size of facility, mode of connection to, etc., where delivery is made to a terminal tank or reservoir owned by a city or other agency.

(e) Flowmeter requirements at the outlet and at the terminal facility.

(f) State health department requirements for disinfection of the pipeline, tanks, and reservoir; chlorine booster stations, chlorine residual level and sampling points, etc.

(g) Requirements for chlorination stations in pipelines, tanks, and reservoirs.

(h) Anticipated right-of-way widths and minimum radius of curve that should be used to establish ROW limits at points of intersection on pipeline centerline alignment. Where possible, curves having a minimum radius of 500 feet should be used at horizontal changes in direction of pipeline alignment. On large diameter pipelines, curve radii of 1,000 feet or more may be desirable to permit use of "pulled" joints in pipe or curves rather than concrete encasements.

(i) State or local requirements and codes related to construction of a municipal water distribution system.

(j) Requirements for compacting backfill in pipe trenches to the ground surface, e.g., through irrigated farm land, at road crossings or stream crossings.

(k) Peaking factor.

(l) Yearly requirement. This is usually stated in terms of acre-feet per year or ft^3/s or mgd.

(m) Monthly requirement. Expressed as a percentage of the yearly requirement for each month of operation. M&I systems may be

spread out equally over the entire year when better data is not available.

(n) Peak requirement. This is the basic criteria for sizing pipelines and can be based on the maximum demand for a month, peak day, or other time period.

(o) Delivery demands can be stated in acre-feet per month or ft^3/s and pressure requirements at the delivery points.

(p) Capacity for future development.

(q) Controls and equipment to be included in deliveries such as flowmeters, control valves, altitude valves, and pressure-reducing valves, etc.

(r) Chlorination requirements.

(s) Fire demand.

(t) Lifeline designation?

K. Miscellaneous Data:

(1) Criteria for flow measurement and/or screening at lateral turnouts.

(2) Location and data on existing sources of electric power, including construction power sources and dates when power will be available.

(3) If a pumped system, use data listed under Pumping Plants and Powerplants, as applicable.

(4) Any limitations imposed on height of stands, tanks, and other structures due to location, by the Federal Aviation Administration, Environmental Protection Agency, State, county, municipal, or district regulations. Maximum wind velocities expected at tank sites and requirements for beacon lights.

(5) Minimum cover on lateral pipelines based on farming over pipe, frost depth, depth to ground water, type of soils, vehicle wheel loadings, etc.

(6) Details of drainage system (if existing or proposed) that will influence designs of irrigation pipe distribution system.

(7) Plan of irrigation desired by the district to include: Operation of delivery by individual landowner or district personnel, fire protection, domestic requirements and plans for future district expansion (where applicable). If

domestic flow is to be provided, State health department requirements for water-supply systems.

(8) Fencing details as desired by the operating district.

(9) Safety requirements for slope of pipe trench walls.

(10) Maximum predicted and recorded flood stage elevations to be expected at major drainage and river crossings and recommended cover required for protection against scour at these locations.

(11) Suggested types of pipe to be allowed as alternatives, i.e., steel, reinforced concrete pressure pipe, polyvinyl-chloride (PVC), high density polyethylene (HDPE), etc.

(12) Water quality data: sulfites, chlorides, etc.

(13) A list of previous Reclamation or other projects that have been constructed in the area.

L. Electrical Data. Data listed below will be required to initiate design. The data furnished should be sufficient to permit designers to complete the basic design (single-line diagram) for the distribution systems. After designs of the facility have progressed enough to develop details of electrical system needs, designers will prepare a list of additional data required to complete final design of electrical installation.

(1) Names and telephone numbers of electrical power suppliers and contacts within their organizations.

(2) Location of point where connections to power supply will be made.

(3) System voltage at which power will be supplied, number of phases, and whether service will be overhead or underground.

(4) Electrical system reliability criteria.

(5) Discuss requirements for an alternative power source. If an alternative supply is required, indicate:

(a) If required by State or local authority.

(b) If source should be an engine-generator.

(c) If a threat to life or property will result if normal power supply is lost.

(d) Loads requiring service from alternative source.

(6) Requirements for remote monitoring of conditions at the facility. Discuss location of remote station, and items required to be monitored.

(7) Requirements for supervisory control, including location of station from which supervisory control is exercised.

(8) Requirements for voice and data communications between the supervisory master station and the remote facilities.

M. Environmental Considerations. Information should be included which will aid the designer in minimizing the environmental impacts due to construction of these systems. The following items should be considered in preparing design data:

(1) Photographs of the environmental setting.

(2) Cultural (historical archeological, architectural, and paleontological) resources along any alignment or within the area of the distribution system.

(3) Wildlife or refuge areas.

(4) Existing or potential wetland areas.

(5) Any threatened and/or endangered critical habitat within or adjacent to the pipeline system.

(6) Areas of heavy public use should be clearly identified.

(7) The need for restoring borrow areas and reseeding spoil banks.

(8) The water quality and location of return flows.

(9) Environmental considerations such as water pollution control standards, noise and dust abatement requirements, areas that will require landscaping, replacing of topsoil, seeding, architectural treatment for structures, tree lists, endangered species, and mitigation requirements, etc.

N. Right-of-Way (ROW).

(1) Determine the minimum ROW limits for construction and the permanent ROW limits required.

(2) Limits of rights-of-way, extent of casing pipe required, minimum cover, and any local permit requirements required at railroad and highway crossings. Where a paved highway crossing can be made by open-cut methods the road surfacing requirements for replacing the pavement.

(3) The method for determining the ROW and how the ROW will be obtained should be described.

O. Cost Data for Field Cost Estimate. The field cost estimate is an estimate of the capital costs of a feature or project from award to construction; non-contract costs are not included. Cost data developed in previous or other studies (either by Reclamation or others) should be included with the design data submittal. Include a description or outline of estimating methods and data used. The following design data for feasibility and specifications levels designs should be considered for submittal:

(1) Procurement Strategy. Will solicitation be advertised and awarded under other than full and open competition? This includes solicitations which will be set aside under socio-economic programs that may limit competition or allow award to other than the lowest bid or proposal.

(2) Estimate of cost of ROW for all features including reservoirs, dams, and appurtenant works. Include supporting data:

(3) Information on local labor supply and labor problems.

(4) Local freight or trucking rates.

(5) Housing accommodations.

(6) Interest rate for economic studies.

(7) Power rate in mills per kilowatt-hour, interest rate, and plant factor for economic tunnel, and pipeline sizing studies in cases where transported water is pumped.

(8) Estimated cost for construction items which cannot readily be determined in the design office and include the supporting data:

(a) Clearing reservoir area and for removing or replacing private improvements in the area.

(b) Earthwork (common and rock), excavation with freehaul distance. For canals, include compacting embankment, canal lining, and borrow (with free haul distance)

(c) Riprap, guardrail, culverts, row fencing, and gates.

(d) Designated areas to be cleared of vegetation, with description of kinds, size, and density of growth. State recommended method of payment (i.e., lump-sum price for area with defined limits or unit price per acre for area with limits subject to change during

construction). Use separate payment items for clearly defined areas differing in growth density and difficulty of clearing operations. If vegetation to be cleared is very sparse or can be removed without special equipment or separate operations, the cost of clearing should be included in the prices bid for excavation or prices bid for other appropriate items of work.

(9) Where buildings are located within the area to be cleared by the prime contractor, and if disposal will be the contractor's responsibility, designate building groups by number and furnish detailed list of buildings for each group. Details should include general description, size, materials, and general condition. Drawings should be provided of these buildings, if available, that depict dimensions, construction materials, the structural system for the building, and major electrical and mechanical equipment. Determine if disposal will be the responsibility of the prime contractor. If not, submit dates when disposal will be completed by others.

(10) Information on important construction work that is in progress or planned in the vicinity and the presence of interested contractors or subcontractors in the area.

(11) If potential actions exceed anticipated funding, an assessment should be made as to whether the cost estimate will reflect incremental costs of these potential actions. Provide any known increment or arrangement of the incremental costs.

(12) Local and tribal taxes.

(13) Estimates of costs for relocating railroads, highways, roads, water systems, and other public utilities. Include supporting data.

(14) Method for projecting cost into the future if required.

(15) Cost of local materials (precast concrete, etc.).

P. Construction Considerations. The following design data items should be considered for feasibility and specifications designs:

(1) Construction schedule:

(a) One contract or several contracts.

(b) Any construction timeframe restrictions

(c) Are designers required to provide a construction schedule and/or logic diagram?

(d) Recommended period for construction.

(e) Recommended period for completion of construction work and features of the work that should be completed early.

(f) Permissible times to make connections to existing facilities.

(g) Whether construction schedule will be adaptive, (e.g., provide a remedy, observe the effects, and then modify remedy as required).

(2) Allowable in-river materials (permanent and temporary).

(3) Construction constraints including allowable construction methods, traffic considerations, environmental restrictions, climatic restrictions, blasting limitations, etc.

(4) Filling and draining criteria for dam, ponds, and pipelines

(5) Unusual conditions for excavation or construction.

(6) Extent of construction surveying to be accomplished by Government surveyors.

(7) Water for construction purposes. For large rivers, this item may be unimportant. For small streams and offstream reservoirs, the item becomes critical. Determine if up to 2 ft^3/s of diversion flow for construction purposes can be assured to the contractor. The Government should obtain the water rights required. If it is necessary to use ground water, obtain information on probable sources and yields. Furnish information on locations and yields of existing wells in the vicinity. Determine restrictions, if any, to use of ground water for this purpose. It may be necessary to obtain permits from State or other governing agencies. Retrieve water quality samples for testing and evaluation.

(a) Water treatment requirements for return flows

(8) Requirements for maintaining streamflow or diversions during construction and maximum length, time, and number of permitted interruptions.

(9) Required permits from government agencies and others.

(10) Requirements for meeting criteria for suppression of nitrogen, adequate oxygen levels, and temperature control and control of turbidity during construction.

(11) Impact of moving construction materials on existing road facilities, including consideration of such factors as traffic congestion, effect on road condition, air pollution, etc.

(12) Requirements for temporary construction access roads, permanent access and service roads, and relocation of existing roads or railroads. Include any limiting requirements imposed by road owners for public access/haul roads.

(13) Comments on disposal of special excavation problem materials such as lignite.

(14) Give borrow area and temporary haul road restoration requirements such as stockpiling of topsoil, grading of the area, general cleanup, etc.

(15) Give consideration to using required excavated material in lieu of material from other borrow sources wherever possible.

Q. **Site Security.** Many Reclamation projects may require a security risk assessment. The need for a site-specific security risk assessment should be considered for feasibility designs where an assessment may impact the field cost estimate and for specifications designs. Specific issues to consider are contained in Section 14 of Chapter 7 – Site Security and Public and Worker Safety. If assistance is required to determine specific design data needs, contact the Office of Security, Safety and Law Enforcement. Where design data and designs include site-specific security assessment, compliance with Reclamation Manual DM Part 444 – Physical Protection and Facility Security, Chapters 1 and 2 is required.

7. Access Roads and Railroad or Highway Relocation. The Introduction (Chapter 1) for these design data collection guidelines contains additional information concerning: preparing a design data collection request, design data collection requirements, and coordinating the design data collection and submittal. For a railroad or highway relocation, the data should represent the standards of design and construction which, in negotiations with the owner of the facility, have been agreed upon as satisfying the principle of equivalent replacement.

A. **General Map Showing:**

(1) A key map locating the general map area within the State.

(2) The alignment of the railroad or highway relocation or of the access road.

(3) County and township lines.

(4) Existing towns, highways, roads, railroads and shipping points, public utilities such as electric power and telephone lines, pipelines, etc., and stream-gauging stations.

(5) Locations of sites required for construction facilities.

(6) Locations of borrow areas for natural construction materials and disposal areas for waste excavation.

(7) Existing or potential areas or features having a bearing on the design, construction, possible use and future maintenance of the relocation or access road such as: recreation areas, fish and wildlife areas, building areas, and areas of archeological, historical and mining or paleontological interest. The locations of these features should bear the parenthetical reference to the agency most concerned; for example, Reclamation, NPS, or FWS.

B. **Topographic Map.** A topographic map or strip topography showing the relocation or access alignment and the bridge structure sites with a scale of 1 inch equals 400 feet and a contour interval of not over 5 feet. A scale of 1 inch equals 100 feet (50 feet at bridge sites) and 2-foot contour intervals is desirable for making paper locations, bridge layouts, and earthwork quantity computations. A coordinate system should be established and related to a State or national coordinate system, if available. Show the coordinate system ties to the survey line and locate existing land survey corner monuments or special control points established for the topographic survey. Show all manmade features in the included area.

C. **Foundation Data:**

(1) **General Engineering Requirements.** The need for foundation data should be established by originating office personnel with assistance from the region and TSC representatives. For major bridge structures and unusual or difficult road alignments, it is recommended that a field conference be held, including an onsite inspection.

The following data should reflect a recognition and consideration of the scope of the relocation or access required and the type and size of bridge structures anticipated.

(2) **Geologic Data.** The following list of geologic design data provides general guidelines for the collection and reporting of geologic information for this type of facility. The geologist should apply these guidelines with good judgment and sound reasoning, elaborating upon them as required by the particular geologic setting and engineering requirements. Because the collection of geologic data is a dynamic process and often continues into the preparation of final designs, all stages of the specification design geologic exploration program must be constantly coordinated with the designer through the appropriate geology office. The TSC geologic and geophysical staff will provide necessary assistance and guidance in the gathering of these design data.

(a) Compilation, summary, and reporting of Reclamation and non-Reclamation geologic information on the area, with attention being paid to the sequence of explorations and historical geologic events.

(b) Surface geologic map of the alignment showing location of explorations. Locations of all existing explorations should be indicated by coordinates or stationing of the permanent survey control system for the facility.

(c) Specific foundation exploration at site of major bridges, deep cuts, other structures sites, or where problem areas such as soft foundation or poor drainage require.

(d) Factual narrative description of surficial deposits with attention being paid to engineering geologic matters, such as swelling minerals, low-density materials, presence of gypsum and other sulfates, caliche, erodibility (see *Earth Manual*).

(e) Factual narrative description of bedrock with attention being paid to engineering geologic matters such as swelling minerals, presence of gypsum and other sulfates; and depth of weathering, joints, faults, and other planes of weakness.

(f) Photographs, preferably in color, of representative or particular geologic conditions.

(g) Selected determination of engineering properties of surficial deposits and bedrock by laboratory or field tests (in-place density, penetration resistance, permeability, shear strength, and consolidation or expansion characteristics, etc.). The type and number of samples and tests required should be determined in cooperation with the TSC.

(h) Summary and data of exploration geophysical surveys (seismic, resistivity, etc.).

(i) Determine ground water conditions with attention being paid to water levels and their seasonal fluctuation occurrence of unconfined and confined aquifers, potential seepage areas, water-producing capabilities, chemistry, and land subsidence.

(j) Logs of explorations. Logs of drill holes advanced by churn drilling, chop and wash, or other methods which result in less than adequate sample recovery should be augmented by appropriate borehole electric (geophysical) logs.

(k) Evaluation of landslide, snowslide, and rockfall conditions. A complete map of possible slide areas with as much detail as practicable.

(l) Document past, present, and possible future petroleum water, and mineral extraction operations in vicinity.

(m) Determine geologic conditions which may affect construction methods such as, boulders on ground surface, marshes, drilling conditions, and stability of grout or footing holes, ground temperatures, gases. Any potential surface water runoff problems should be brought to the attention of a regional hydrologist.

D. **Corrosion Survey.**

(1) In situ electrical resistivity measurements of geologic materials in the area of construction. Additional measurements should be made in the areas where there is a pronounced change in type of geologic materials, drainage, and/or moisture conditions.

(2) Performance history of materials of construction that have been used in the area.

(3) List of structures in the vicinity of (within ¼ mile) the proposed structure and appurtenant features. Determine if buried structures in the vicinity have corrosion protection and, if so, the type of corrosion protection.

(4) List location, output, and purpose of the direct-current sources in the earth situated within ¼ mile of the proposed structure and appurtenant features. If the purpose of the direct current is for cathodic protection, describe the structure protected and its location.

(5) Chemistry of geologic materials, ground water, and/or product water.

E. **Construction Materials Data Including:**

(1) Location of and distance to suitable borrow areas for permeable and impermeable soil materials for fill or embankment; and for riprap for channel or slope protection. If quantities are limited, give approximate volumes available.

(2) An earth materials report containing complete detailed information on those potential sources of soils and rocks that have been selected for final consideration. (See *Earth Manual*.)

(3) Information on concrete aggregates. (See "Final Investigations" in *Concrete Manual*.)

(4) Data on commercial concrete plants within practical hauling distance from the bridge site.

(5) Information on sources and character of acceptable road surfacing materials. Consider excavated material as a possible source.

(6) Results of sampling and analysis of materials, including previous tests conducted at the Engineering and Research Center.

(7) Information, including catalogues, on firms within practical hauling distance from the bridge site which manufacture precast concrete products such as beams and piles.

F. **Operating Data Including:**

(1) For railroad: Track classification, type of service, limiting grades and curvature, design load limits, other operating limitations or requirements, and typical roadbed section showing depth and type of ballast, weight of rail, and size, spacing, and type of tie.

(2) For railroad: Information on operating facilities such as communication lines, signal systems, passing tracks and sidings, service roads and depots.

(3) For roads: Road classification, design speed, limiting grades and curvature, design load limits, superelevation limits and typical roadway section showing road width and thickness and type of surfacing.

G. **Miscellaneous Data:**

(1) For railroad, drawing of typical roadway cross section showing:

(a) Centerline of track.

(b) Subgrade (top of embankment or bottom of excavation).

(c) Roadbed widths (shoulder to shoulder) at subgrade for both embankment and excavation.

(d) Embankment slopes and excavation slopes (earth and rock).

(e) Required berms.

(f) Thickness and top of embankment riprap, if required.

(g) Dimensions and positions of roadbed ditches and service road.

(h) Clearance between multiple tracks on curves and tangents.

(i) Dimensions of ballast section.

(j) Size of ties and weight of rail (welded or jointed rail).

(k) Distance from subgrade to top of rail.

(2) For highway or road, drawing of typical roadway cross section showing:

(a) Centerline of road.

(b) Subgrade (top of embankment or bottom of excavation).

(c) Roadbed widths (shoulder to shoulder) at subgrade for both embankment and excavation.

(d) Embankment slopes and excavation slopes (earth and rock).

(e) Required berms.

(f) Thickness and top of embankment riprap, if required.

(g) Dimensions and positions of roadbed ditches, and protective dikes and ditches.

(h) Number of courses of surfacing, types of materials, thickness and width of each course, and transverse slope from crown.

(i) Amount of superelevation (including changes in subgrade) and widening for horizontal curves.

(j) Position of guardrails, guard posts, or delineators.

(3) For railroad, alignment and profile drawings (prepared in the current or compatible CADD software, 24 inches by 36 inches in plot size, with horizontal scale of 1 inch equals 200 feet and vertical scale of 1 inch equals 20 feet) showing:

(a) Horizontal position of track centerline with complete curve and spiral information, right-of-way lines, existing track for 1,000 feet each way from points of connection, and any survey ties.

(b) Vertical position on track centerline of original ground line, new subgrade (with complete information on grades, elevations, and vertical curves), existing subgrade for 1,000 feet each way from points of connection, and any survey ties or datum equations.

(c) Location, type, and nominal dimensions of all required structures and operating facilities (bridges, culverts, ditches, passing tracks, sidings, motorcar set-offs, etc.).

(d) Location of any existing intersecting facilities, watercourses, or other physical features affecting the new line.

(e) Location of protective ditches and dikes.

(f) Location and type of right-of-way fencing and gates.

(4) For highway or road, alignment and profile drawings (prepared in current or compatible CADD software, 24 inches by 36 inches in plot size with horizontal scale of 1 inch equals 100 feet and vertical scale of 1 inch equals 10 feet) showing:

(a) Horizontal position of road centerline with complete curve information, right-of-way lines, existing road for 500 feet each way from points of intersection, and any survey ties.

(b) Vertical position on road centerline of the original ground line, new subgrade (with complete information on grades, elevations, and vertical curves), existing road surface for 500 feet each way from points of intersection, and any survey ties or datum equations.

(c) Location, type, and nominal dimensions of all required structures (bridges, culverts, etc.).

(d) Location of any existing intersecting facilities, watercourses, or other physical features affecting the new road.

(e) Location of protective ditches and dikes.

(f) Location of guardrails, guard posts, or delineators.

(g) Location and type of right-of-way fences and gates.

(h) Location of any existing roadway lighting and/or requirements for new roadway lighting.

(5) Structure details:

(a) Site topography for each structure (including tunnel portals) on a scale of 1 inch equals 50 feet and a contour interval of 2 feet. For major drainage structures, the topography should extend a minimum of 500 feet upstream and downstream from the site.

(b) Recommended type, size, dimensions, and kind of construction material (and alternatives).

(c) For drainage structures: shape, size, slope, and character of each catchment area, probable rainfall intensity, and anticipated runoff through each structure; location, distance, physical dimensions, and characteristics of, any downstream streamflow, control; and recommendations for wingwalls or headwalls.

(d) For bridges and overpasses; hydrologic stream data; clearances (with permissible encroachments during construction) and controlling elevations (existing water surface, top of rail, crown of road, etc.).

(e) For tunnel: cross section showing inside clearance line, roadbed section with ditches and gutters, dimensions of safety niches (and motorcar set-offs for railroad); recommended type of lining, if required; profile on centerline showing ground surface, elevation and grade of subgrade, and geologic data.

(f) For railroad: standard designs and loadings for structures; standards for rails, tie plates, angle bars, bolts, spikes, lock washers, and rail anchors; specifications for ballast; standard designs for turnouts, guardrails, derails, road crossings, motorcar

setoffs, roadway signs and fencing; and any design or construction practices or procedures not in accord with Bureau practice.

(g) For highway or road: standard designs and loadings for structures; standards and specifications for surfacing; standard designs for cattle guards, guardrails or guard posts, roadway signs and culvert markers, and fencing; and any design or construction practices or procedures not in accord with Bureau practice.

(6) Estimated quantities for all construction schedule items which cannot readily be determined in design office, i.e., earthwork (common and rock), overhaul of roadway excavation with free-haul distance, riprap guardrail, culverts, and right-of-way fencing and gates.

(7) For railroad: a summary of the current quality and standards of construction of existing railroad for both track and structures with photographs of typical features.

(8) Designated areas to be cleared of vegetation, with description of kinds, size, and density of growth. State recommended method of payment, i.e., lump-sum price for area with defined limits or unit price per acre for area with limits subject to change during construction. Use separate payment items for clearly defined areas differing in growth density and difficulty of clearing operations. If vegetation to be cleared is very sparse or is such as can be removed without special equipment or separate operations, the cost of clearing should be included in the prices bid for excavation or prices bid for other items of work.

H. **Cost Data:**

(1) Estimate of cost of right-of-way or easements. Include supporting data.

(2) Information on local labor supply and labor problems.

(3) Information on important construction work in progress or planned in the vicinity and the presence of interested contractors or subcontractors in the area.

(4) Estimates of cost for relocating public utilities within the construction area. Include supporting data.

(5) Estimates of cost for removal of buildings and other structures within the construction area. Include a general description and recommended disposal of the structures.

I. **Environmental Considerations.** Implementation of design features should be consistent with the environmental commitments listed in the project's NEPA compliance

document. Implementation of design features should be consistent with agreements reached between Interior bureaus, Federal agencies, and other governmental agencies.

Design data should include, as a minimum, a brief description of the environmental resources that could be affected by the proposed development. The emphasis should be on those areas within the range of alternatives open to the designers in developing a railroad or highway relocation, an access road alignment, or a bridge structural design. The following items should also be considered in preparing design data:

(1) Cultural (historical, archeological, architectural, and paleontological) resources along or adjacent to any potential alignment.

(2) The need for blending roadways and structures with the surroundings.

(3) Comment on any ecological, aesthetic, or other environmental aspects peculiar to this location which would affect roadway alignment or bridge layout or conceptual design.

(4) Indicate the suitability and possibility of present or future use of land adjacent to Reclamation facilities by the public for recreation, hobbies, sports, leisure, education, health, housing, etc. Provide data on zoning regulations and subdivision proposals.

(5) Furnish data on allowable noise limits in the vicinity of the proposed railroad, highway, or access road alignment where fixed by law or local ordinance, or where otherwise considered necessary or advisable; measurements of existing daytime and nighttime ambient noise levels in the area; and distances to the nearest residential units.

(6) Identify special environmental compliance requirements including water quality standards such as suppression of nitrogen, adequate oxygen levels, and temperature control and control of turbidity during construction; preservation of existing growth adjacent to construction; obliteration of temporary or abandoned roadways and restoration to original appearance; dust abatement, etc. Give recommendations on steps to be taken to meet these requirements.

(7) Impact of moving construction materials on existing road facilities, including consideration of such factors as traffic congestion, effect on road condition, air pollution, etc.

(8) Background on the need for fish protection during construction at stream crossings.

(9) Recommendations or commitments to maintain specific flow requirements for biological and/or recreational resources.

(10) Comment on disposal of material from clearing operations. Consider State and local burning regulations, burying or chipping of materials, and maximum utilization of merchantable timber.

(11) Erosion and sediment control.

(12) The need for a field conference to resolve critical environmental problems with participation of other agencies.

(13) Review of designs by other agencies.

(14) Railroad, highway, or access road clearing plan to consider fish and wildlife requirements.

(15) Anticipated public use of Reclamation access roads.

(16) Any threatened and/or endangered critical habitat in/or adjacent to the potential alignments.

8. Drains. The Introduction (Chapter 1) for these design data collection guidelines contains additional information concerning: preparing a design data collection request, design data collection requirements, and coordinating the design data collection and submittal.

Specification design of drainage systems requires as a minimum the same type of basic data as feasibility design. The data are brought up to date and in more detail to show ground water conditions under irrigation and in addition includes data from any test drains which may have been installed. At the specifications stage, project lands and farm units are fixed, the irrigation distribution system has been completed, data from test drains are probably available, and the specific drainage requirements for various areas can be determined. The following paragraphs give a check list of drainage data required for specifications design.

A. **Basic Data.** The design of open drains for the collection of surface and subsurface water requires data primarily on surface conditions, i.e., topography; flood runoff; soil erosion characteristics; outlet requirements for storm water and waste water from irrigation and laterals; and county, State, Federal, and private structure requirements. For subsurface drains to control ground water and salinity, the primary data required are on soils and substrata. Design of subsurface drains is based largely upon hydraulic conductivity of the various soil strata above the uppermost slowly permeable barrier in the soil profile, the position and thickness of these strata, landforms, surface infiltration rates, contemplated land use and irrigation practices, precipitation records, topography, and historic ground water conditions.

The amount and coverage of the drainage investigations will depend on the knowledge, judgment, and experience of the drainage engineer. The reliability of the drainage requirements will depend on obtaining sufficient and proper information to be used for interpretation.

B. **General Map.** A general map showing project area with location of proposed drains, nearby towns, road, railroads, and a key map locating the general map area within the State.

C. **Location Map.** A location map usually at a scale of 1 inch equals 2,000 feet showing location of the proposed drains and any existing drains, roads, railroads, powerlines, and gravel sources. This map may be combined with the general map for small areas.

D. **Topographic Maps.** Topographic maps, usually at a scale of 1 inch = 200 feet with 1 or 2 feet contour intervals, for showing the final drainage layout and which also show existing drains, roads, improvements, canals, reservoirs, railroads, highways, wetlands, etc.

E. **Land Classification Map.** A land classification map showing land classes by standard symbols and location of any special deep test holes.

F. **Depth-to-Barrier Map.** A depth-to-barrier map for areas where clays, shales, sandstone, or other slowly permeable materials occur at depths which will adversely affect drainage.

G. **Profiles.** Appropriate multiple profiles across typical areas showing ground surface elevations, stratifications, permeabilities, and ground water levels.

H. **Plan and Profile Drawings:**

(1) **General.** These drawings are normally prepared so that both plan and profile are shown on a scale of 1 inch equals 200 feet horizontally with 1 inch equals 10 feet vertically on profile. The plan should depict location of drains, location and size of manholes, drain stationing and significant topographic features. The profile should depict bottom grade, ground surface, hydraulic properties, and sections is usually required. Plan and profile drawings should show features such as contours, roads, borrow pits, original ground surface and drain alignment and curve data. All features and details should be shown in ink.

(2) **Details to Be Shown Are:**

(a) Stationing

(b) Structures (including conduit size for siphons, turnouts, and culverts)

(c) Right-of-way and easement lines if established.

(d) North arrow and land survey lines.

(e) Original ground surface and bottom grade on profile.

(f) Hydraulic properties by reaches of proposed section.

(g) Buildings, fences and other obstructions.

I. **Typical Sections.** Typical sections showing proposed earthwork dimensions for open and closed drains should be provided. For concrete lined drains, detail views of the lining may be required for clarification.

J. **Survey Control.** Use of an existing coordinate system or to the township and range system is acceptable, but tying to the State or national Plane Coordinate system is recommended if practical.

K. **General Description as it Affects Drainage Requirements and Covering:**

(1) Regional geology and geomorphology, topography, and climate.

(2) Texture, structure, hydraulic conductivity, infiltration, chemical characteristics, and stratification of soils, subsoils, and substrata. Agronomic classification should be shown but the unified system is a useful supplement if available.

(3) Chemical characteristics of ground water and irrigation water.

(4) Ground water conditions, including sources, position, any artesian pressures, and gradients.

(5) Contemplated land use and irrigation practices.

(6) Natural surface drainage, flood history, and channel locations and characteristics.

L. **Hydrologic Data:**

(1) Precipitation and runoff records.

(2) Area-discharge curve of 5-, 10-, and 25-year storms for use in design of drains to remove surface water from irrigable lands.

(3) Permissible additional capacity of natural channels which will convey drain water, based on consideration of probable frequency of flooding and the resultant damages to crops and project works.

(4) Drain design capacity including water accretion from canal and lateral losses, and surface waste and deep percolation losses from farm-water application.

(5) Hydrographs showing typical ground water fluctuations in selected observation wells.

(6) Stability of natural channels receiving drain flow.

M. **Existing Systems.** Comparative data from lands in the vicinity having similar soils and drainage conditions and already under irrigation:

(1) Map of the existing drainage system.

(2) General discussions of soil and substrata characteristics and the depths, capacities, and spacings of the drains.

(3) Detailed data on particular drains where the factors affecting drainage are similar to those in the project area. The data will cover type of drain, design, soil and substrata characteristics, ground water conditions, construction and maintenance problems, discharge, land use, irrigation practices, and area effectively drained for good crop production.

N. **Miscellaneous Data:**

(1) Unusual conditions for excavation or construction.

(2) Availability of construction materials including gravel for filters.

(3) Permeabilities and gradations of gravel sources.

(4) Structure requirements of other agencies, corporations, and individuals.

(5) Information on local labor supply and labor problems.

(6) Identify impoundments, streams, and/or wetlands likely to be affected by drain flows.

(7) Identify probably range of concentrations for various constituents such as pesticides, selenium, etc.

O. **Quantities.** Estimated quantities for drain excavation, envelope material, compacting embankment, borrow, overhaul (with free haul distance), pipe size and length, manholes, guard fences, right-of-way fencing and gates, cattle guards, etc. Also provide location of drainage discharge with a copy of discharge permit including discharge requirements.

P. **Data Sheets.** Data sheets and centerline borings for structures and drains which cannot be obtained until after the definite drainage layout is established. Detailed data sheets will be needed for such structures as:

(1) Highway, canal, and railroad crossings.

(2) Manholes, outlet structures, and pipe end details.

Q. **Environmental Considerations.** During the investigation studies, the environmental impacts of the drainage system on other features, such as municipal, industrial, recreational, water quality, water quality standards, fish and wildlife, and aesthetic requirements should be considered. Close cooperation on environmental matters should be established and maintained between drainage personnel and personnel working in other technical disciplines. Liaison should also be established with the environmental groups in the area.

9. Wells. The Introduction (Chapter 1) for these design data collection guidelines contains additional information concerning: preparing a design data collection request, design data collection requirements, and coordinating the design data collection and submittal.

The design of wells for water supply, drainage, and other similar purposes requires extensive subsurface and other data. Because of the nature of the environment of ground water, maximum reliance for correct interpretation and use of the data must be based on the competence, experience, and judgment of the ground water engineer or geologist.

The following is a minimum checklist of data necessary for specification design and cost estimates for wells and well fields.

A. Maps.

(1) A general location map showing locations of the well site(s) and communities, transportation facilities, and other cultural features.

(2) A construction site map showing locations of the well(s), rights-of-way, access roads, and sources of power and water for construction purposes.

(3) A geologic map showing surface geology, topography, subsurface data points such as existing wells and other similar data.

B. General Conditions.

(1) Location, ownership of, and accessibility to the site.

(2) Location and included area if a well field.

(3) Stratigraphic and structural conditions including general types and sequences of materials.

(4) Drilling conditions - ease of drilling, stability, etc.

(5) Standards, permitting requirements, etc.

(6) Other wells in the immediate area (oil, gas, etc.).

(7) Location and type of power sources, utility easements, buried cables, pipelines, etc.

C. Climatic and Hydrologic Conditions. Materials showing climatic and hydrologic conditions including weather and stream storage or reservoir storage conditions, where applicable.

D. Subsurface Conditions.

(1) Logs, geologic sections, and other material showing stratigraphic and lithologic conditions including rock or soil types, sequence, attitude of beds, and other available geologic data.

(2) Samples and/or cores of subsurface materials or photographs of such.

(3) Logs, hydrographs, hydrogeologic sections, and other material showing ground-water conditions including mode of occurrence, depth to and elevation of the water table or piezometric surface, seasonal and other fluctuations of water levels, flowing conditions, and chemical quality of the ground water.

(4) Logs, hydrogeologic sections, and other material showing aquifer conditions including depth and thickness, types of materials, and factual results of pumping tests.

(5) Descriptions of drilling conditions including anticipated casing requirements to permit drilling, and limitations on drilling equipment and methods.

E. Aquifer Conditions.

(1) Depth.

(2) Thickness.

(3) Type and stability of material.

(4) Size and range if material is granular.

(5) Transmissivity and storativity.

(6) Water budget.

(7) Aquifer storage capacity and amount of water storage.

(8) Depth and thickness of confining unit(s).

(9) Contour maps (bedrock surface, top of aquifer(s), etc.).

(10) Natural recharge and discharge locations and amounts.

(11) Sustained yield potential.

F. Ground-Water Conditions.

(1) Static water level.

(2) Water level trends.

(3) Known locations and types of potential or existing pollution source(s) – either natural or anthropogenic.

(4) Locations, amounts, and usage of existing and planned future withdrawals.

(5) Radius of influence and drawdown map.

(6) Quality of water to include the concentration of major ions and all parameters having primary and secondary maximum contaminant levels as defined by the Safe Drinking Water Act.

G. Well Conditions.

(1) Design yield.

The foregoing factors must be considered in light of ground-water reservoir conditions - areal distribution, recharge, yield, and pumping conditions, including pump costs, power availability and cost, etc.

H. Sections and Details. Sections and details of a typical well showing relationship of the general components and details, where applicable.

I. Well Dimensions. Tabular material showing total depths, casing and screen lengths, and other known or estimated dimensions of the well.

J. Pumping Test Requirements. Material outlining pumping test requirements including design yield and expected drawdown, pump capacity setting, and head requirements, well development requirements, flow measurement requirements, test duration, and disposal of water.

K. Environmental Factors. Material outlining environmental factors including:

(1) Location, size and type of wetlands that could be influenced by the drawdown core or by discharge from the well.

(2) Aesthetic requirements, should be considered in the benefit-cost studies and design of the pumphouse and related powerlines and discharge pipe.

(3) Impact of drilling and testing operations

(4) State standards

(5) Presence of completed facility

(6) Permitting requirements

L. **Safety Factors.** Material outlining safety factors including presence of high subsurface pressures or toxic gases.

M. **Report.** The foregoing data should be included in a report together with a brief, descriptive summary of the geology of the area, existing ground-water conditions and ground-water development to date.

N. **Electrical Data.** Data listed below will be required to initiate design. The design furnished should be sufficient to permit designers to complete the basic design (single-line diagram) for the facility. After designs of the facility have progressed enough to develop details of electrical system needs, designers will prepare a list of additional data required to complete final design of electrical installation.

(1) Names and telephone numbers of electrical power suppliers and contacts within those organizations.

(2) Location of point where connection to power supply will be made.

(3) System voltage at which power will be supplied, number of phases, and whether service will be overhead or underground.

(4) Discuss requirements for an alternate power source. If an alternate supply is required, indicate:

(a) If required by State or local authority.
(b) If source should be an engine-generator.
(c) If a threat to life or property will result if normal power supply is lost.
(d) Loads requiring service from alternate source.

(5) Requirements for remote monitoring of conditions at the facility. Discuss location of remote station, and items required to be monitored.

(6) Requirements for supervisory control, including location of station from which supervisory control is exercised.

(7) Requirements for voice and data communications between the supervisory master station and the remote facilities.

10. Switchyards and Substations. The Introduction (Chapter 1) for these design data collection guidelines contains additional information concerning: preparing a design data collection request, design data collection requirements, and coordinating the design data collection and submittal.

A. **General Map showing:**

(1) A key map locating the general map area within the State.

(2) The structure site or sites.

(3) County and township lines.

(4) Existing towns, highways, roads, railroads and shipping points, public utilities such as electric power and telephone lines, pipelines, etc.

(5) Locations of potential construction and permanent access roads, a sites for contractor's staging areas and construction facilities.

(6) Locations of borrow areas for natural construction materials and disposal areas for waste excavation.

(7) Existing or potential areas or features having a bearing on the design, construction, operation, or management of the project feature such as: recreation areas, fish and wildlife areas, building areas, and areas of archeological, historical and mining, or paleontological interest. The locations of these features should bear the parenthetical reference to the agency most concerned; for example, Reclamation, NPS, or FWS.

B. **General Description of Local Conditions Covering:**

(1) The approximate distance from the nearest railroad shipping terminal to site; load restrictions and physical inadequacies of existing roads and structures and an estimate of remedial improvements to accommodate construction hauling; estimate of length and major structures required for new construction access road; and possible alternative means for delivering construction materials and equipment at the structure site.

(2) Local freight or trucking rates.

(3) Availability or accessibility of public facilities or utilities such as: water supply; sewage disposal; and electric power for construction.

(4) Climatic conditions that will affect design, construction, and operation and maintenance procedures such as: amount, rate, and distribution of rain and/or snow; ice conditions; summer and winter temperatures, with

extremes; extreme wind velocities and prevailing directions; floods; and probability of excessive dust or sand.

C. **Surface Data:**

(1) A topographic map:

(a) Covering an area that will accommodate all expected arrangements of facilities, and rights-of-way, and extending sufficiently to allow for control and disposal of drainage at the site and to indicate the general drainage of the vicinity.

(b) Normally at a scale of 1 inch equals 50 feet.

(c) Giving elevation above sea level and having a contour interval between 1 and 5 feet.

(d) Giving dimensions and bearings of the property lines, and a dimensional tie to a known section corner.

(e) Showing the suggested location of all facilities.

(f) Showing the direction and relative order of all transmission lines and other existing facilities within the area.

(2) Color photographs:

(a) Taken from a high oblique angle, showing the area covered by the topographic map. (Aerial photographs if practicable.)

(b) Closeups showing any features which may affect design; photographs of existing facilities, especially in the vicinity of additions; and any facilities or structures which are to be revised.

(3) Vegetation to be cleared:

(a) Include kinds, sizes, and density of growth of trees and brush.

(b) Include depth of stripping required to remove organic matter or objectionable material.

(4) Seeding or replanting requirements for erosion control or aesthetics.

D. **Foundation Data:** The following data should reflect a recognition of the requirements for switchyard and substation structures and foundations. Maximum loaded structures are the towers which support and anchor electrical conductors and buses, and overhead ground wires. Foundations are required to resist uplift, horizontal, and compression loads with very little movement. Foundations will

normally be less than 10 feet deep and seldom greater than 20 feet deep. The sites are normally leveled by balancing the cut and embankment. The TSC geologic and geophysical staff will provide necessary assistance and guidance in the gathering of these design data.

(1) **Geologic Data:**

(a) A description of site geology including physical quality and geologic structure of the foundation strata, seasonal ground water, and seismic conditions, existing and potential landslide, snowslide, and rockfall areas, expansive clays, possibility of frost heave, and engineering geologic evaluations appropriate to the engineering structures involved. Non-Bureau geologic investigations and reports should be referenced.

(b) Geologic logs of all subsurface exploration. The coordinate location and ground surface elevation of all existing exploratory holes should, if necessary, be corrected to conform with the permanent survey control system; and all subsequent exploratory hole locations and elevations should be based on the same survey control system.

(c) A geologic map, plotted on the topographic map of the site, showing surface geology and the location of geologic sections, soil profiles, and all subsurface exploration.

(d) Geologic sections, with detailed soil profiles as required, showing known subsurface conditions.

(e) Views of pertinent geologic and topographic features should be included in the color photographs required by paragraph C (2) above.

(f) Samples of foundation strata as needed for visual examination or laboratory testing.

(2) **Engineering Data:**

(a) Soils (see *Earth Manual*, latest edition).

- Foundation exploration should include penetration resistance tests in accordance with Field Penetration Test With Split-Tube Sampler, Designation E-21, *Earth Manual*, latest edition, in materials in which the test is applicable. Relative density tests should be made in soils in which the Field Penetration Test is not applicable. In-place density and plasticity tests (liquid limit and plastic index) would be applicable in suspected expansive

soils. All holes should be carried to 20 feet below the estimated final yard grade. Where penetration resistances are less than 15 blows per foot at the 20-foot depth, holes should be 60-foot-minimum depth or at least 5 feet into material having a penetration resistance of 30 or more blows per foot, whichever occurs first.

- Test holes, advanced by augering and without penetration testing, or test pits may be used as required to supplement any of the above exploration, to verify similarity of materials, and to determine depth to bedrock. Bedrock may be encountered at or near the ground surface that cannot be penetrated by penetration testing. In such cases, report whether the bedrock can definitely be expected to extend at least 20 feet below the ground surface. If it is believed that bedrock does not extend 20 feet deep, test holes must be advanced to a depth of at least 20 feet below the ground surface.

- A description of the undisturbed State of the soil in each major strata. Comment on the capability of the material to stand in sides of the hole if augered and undercut for an auger foundation.

- A delineation of the lateral extent and thickness of critical, competent, poor, or potentially unstable strata in foundations and excavation slopes, especially those to be permanently exposed.

- An estimate or a determination by tests of the significant engineering properties of material, such as density, plasticity, shear strength, and consolidation or expansion characteristics; and the effect of changes in Moisture on these properties.

- Describe conditions which may affect construction methods such as boulders on the ground surface, drilling conditions, stability of test holes, and marshy or subsiding ground.

- A determination by tests of the corrosive properties and sulfate content of earth materials and ground water as affecting the choice of cement.

(b) Bedrock (see *Earth Manual*, latest edition).

- If sufficient data exists, a contour map on top of bedrock if encountered in explorations. A description of thickness of

weathered, altered, fractured, or otherwise softened zones, and other structural weaknesses and discontinuities.

- A delineation of structurally weak and potentially unstable zones and strata of soft material in foundations and excavation slopes, especially those to be permanently exposed.

E. **Corrosion Survey.**

(1) In situ electrical resistivity measurements of geologic materials in the area of construction. Additional measurements should be made in the areas where there is a pronounced change in type of geologic materials, drainage, and/or moisture conditions.

(2) Performance history of materials of construction that have been used in the area.

(3) List of structures in the vicinity of (within ¼ mile) the proposed structure and appurtenant features. Determine if buried structures in the vicinity have corrosion protection and, if so, the type of corrosion protection.

(4) List location, output, and purpose of the direct-current sources in the earth situated within ¼ mile of the proposed structure and appurtenant features. If the purpose of the direct current is for cathodic protection, describe the structure protected and its location.

(5) Chemistry of geologic materials, ground water, and/or product water.

F. **Construction Materials Data including:**

(1) Location of and distance to suitable borrow areas for soil materials for fill or embankment. If quantities are limited, give approximate volumes available.

(2) An earth materials report containing information on those potential sources of soils that have been selected for final consideration. (See Earth Manual latest edition.)

(3) Data on commercial concrete plants within practical hauling distance from the structure site.

(4) Results of sampling and analysis of potential concrete aggregate and other materials, including previous tests conducted at the TSC.

G. **Data at Existing Facilities:**

(1) Report any measurable or indicated movement of foundations.

(2) Comment on the suitability and present conditions of yard surfacing.

(3) Report any erosion or drainage problems within or adjacent to the substation which should be corrected.

(4) Report any problems encountered during previous construction or during operations and maintenance.

H. **Electrical Data:**

(1) Switching diagrams showing suggested circuits including all major equipment proposed such as transformers, circuit breakers, and regulators. Where equipment is to be purchased and installed by the Reclamation for the use and benefit of an interconnecting system, with the Reclamation being reimbursed for such installation, comments pertinent to such arrangements should be included as part of the design data.

(2) Capacity of all transformers in kilovoltamperes.

(3) Data for all circuits:

(a) Nominal voltage and destination.

(b) Loadings in kilovolt-amperes or kilowatts and power factor.

(c) Data to determine the type of metering required for each foreign line. (Indicating watt-hour demand meters will be provided unless otherwise specified.)

(d) Size of conductor for existing or foreign line.

(e) Phasing of existing and foreign lines at station.

(f) Minimum voltage during heavy load and maximum voltage during light load for both normal and emergency conditions.

(g) Names and telephone numbers of owners for each foreign line and contacts within their organizations.

(h) Connection agreements with utility transmission operators.

(4) Single-line diagram of foreign primary systems which will connect to Reclamation station. This information is required for relay studies and should include the following:

(a) Location of primary system circuit breakers and relays as contemplated for initial operation. Future changes should be indicated where possible.

(b) Type of primary system relays (distance, overcurrent, etc.) and the relay operating characteristics. The actual relay settings will be required to make coordinating settings of Reclamation relays, but these data need not be provided initially if it will delay receipt of other information. Relay coordination problems, such as slow relaying on primary system, should be presented.

(c) Primary system operating conditions which may affect Reclamation relaying or control.

(d) Reclosing time if automatic reclosing breakers will be used on the primary systems.

(e) Length and characteristics of primary lines and whether they are three-wire or four-wire circuits.

(f) Location, connections, and rating of transformers and synchronous machines which connect to the primary systems. The locations and type of neutral grounding should be included.

(5) Proposed method of operating station, whether attended, unattended, or supervisory controlled.

(6) Heights and locations of existing buildings, transmission lines, and other obstructions which are not associated with the station but are in or near the station site and will present clearance problems.

(7) Type and extent of communication facilities desired.

(8) Capacity charge, energy charge, interest rate, and plant factor to be used in evaluation of transformer losses.

(9) Requirements for lighting for night operation or security purposes.

I. **Building Facilities:**

(1) Service building and maintenance building.

(a) Space requirements for equipment, office, work area, vehicles, and storage.

(b) Minimum door opening sizes.

(c) Water supply and toilet facility requirements.

(d) Air conditioning, heating, and ventilating requirements.

(e) If an existing building is to be replaced, comment on disposition of existing buildings and work to be accomplished by the project.

J. **Environmental Considerations.** Design data should include, as a minimum, a brief description of the environmental commitments listed in the NEPA compliance document that could be affected by the proposed development. The emphasis should be on those areas in the range of alternatives open to the designers in developing a structural design. The following items should also be considered in preparing design data:

(1) The environmental setting.

(2) Cultural (historical, archeological, architectural, and paleontological) resources within the project area.

(3) The need for blending structures with the surroundings, restoring borrow areas, and reseeding spoil banks.

(4) The need for a field conference to resolve critical environmental problems with participation of other agencies.

(5) Review of designs by other agencies.

(6) Anticipated public use around the structure.

(7) Indicate the suitability and possibility of developing Government land adjacent to our facilities for use by the public for recreation, hobbies, sports, leisure, education, health, etc.

(8) Comment on any ecological, aesthetic, or other environmental aspects peculiar to this location which would affect layout or conceptual design.

(9) Refer to the specific requirements of the Environmental Criteria for Electric Transmission Systems by the Departments of the Interior and Agriculture.

K. **Site Security.** Many Reclamation projects may require a security risk assessment. The need for a site-specific security risk assessment should be considered for feasibility designs where an assessment may impact the field cost estimate and for specifications designs. Specific issues to consider are contained in Section 14 of Chapter 7 – Site Security and Public and Worker Safety. If assistance is required to determine specific design data needs, contact the Office of Security, Safety and Law Enforcement. Where design data and designs include site-specific security assessment, compliance with Reclamation Manual DM Part 444 – Physical Protection and Facility Security, Chapters 1 and 2 is required.

11. Transmission Lines. The Introduction (Chapter 1) for these design data collection guidelines contains additional information concerning: preparing a design data collection request, design data collection requirements, and coordinating the design data collection and submittal.

A. **Location Map.** A location map showing proposed routes for the transmission line and showing terminal and intermediate substation locations.

B. **Miscellaneous Data:**

(1) Estimated average and peakloads to be transmitted over the transmission line, annual load factor, and power factor.

(2) Operating voltage of the line.

(3) Date that delivery of power is required.

(4) Delivery points for materials, and proportion of total material required at each point.

(5) Key map, plan and profile sheets, and special crossing drawings for the transmission line prepared in accordance with the manual of instructions for transmission line surveys.

(6) Average value of energy, in mills per kilowatt-hour, for transmission line losses.

(7) Information regarding minimum temperatures, maximum wind velocities, and icing conditions in the vicinity of the transmission line, and an expression of opinion as to whether design of the line for Standard National Electrical Safety Code loading for the area will be satisfactory. (In the State of California, loadings in accordance with General Order No. 95 of the California Public Utilities Commission will be used.

(8) Information regarding facilities to be relocated.

(9) Colored photographs. Aerial or high-angle colored photographs along the alignment showing river, highway, railroad and canal crossings, approaches at each end of the line, and any unusual or problem topographic features.

C. **Foundation Data:** The following data should reflect a recognition of the requirements for transmission line towers and foundations. The towers support and anchor electrical conductors and overhead ground wires in a variety of configurations. The towers also must withstand the wide variety of climatic conditions such as wind, snow, and ice. Foundations are required to resist uplift, horizontal, and compression loads with very little movement. Foundations for

tangent structures in good material will normally vary in depth between 6 feet and 12 feet deep, however foundations for angle and dead-end structures in poorer materials may be considerably deeper. The TSC geologic and geophysical staff will provide necessary assistance and guidance in the gathering of these design data.

(1) **Geologic Data:**

(a) A brief description of surficial material and bedrock that may be encountered in and immediately below footing excavations.

(b) Presence of existing or potential conditions such as snowslide, landslide, heavy rockfall, swampy, high shrink-swell clayey, permafrost or subsidence areas.

(c) Geologic logs of all subsurface exploration. The coordinate location and ground surface elevation of all existing exploratory holes should, if necessary be corrected to conform with the permanent survey control system; and all subsequent exploratory hole locations and elevations should be based on the same survey control system.

(d) A surface geology map, or series of maps, with the route marked thereon (supplemented by annotated colored aerial photos). Inserts at a larger scale must be shown when localized, complex geological conditions exist which may affect tower locations. Reaches of reasonably uniform and typical foundation conditions along the route should be indicated, based on surface inspection, foundation exploration, and general knowledge of the geology of the area. Non-Reclamation geologic investigations and reports should be referenced.

(e) Samples of foundation materials as needed for visual examination or laboratory testing.

(2) **Engineering Data:**

(a) Soils (see *Earth Manual*, latest edition):

- Foundation exploration should include penetration resistance tests in accordance with Field Penetration Test with Split-Tube Sampler, Designation E-21, *Earth Manual*, latest edition, in materials in which the test is applicable. Relative density tests should be made in soils in which the Field Penetration Test is not applicable. In-place density and plasticity tests (liquid limit and plastic index) would be applicable in suspected expansive soils. Note on all logs whether or not caving of the hole has

occurred. All holes should be carried to 25-foot depths. Where penetration resistances are less than 15 blows per foot at the 25-foot depth, holes should be advanced to 60-foot minimum depth or at least 5 feet into material having a penetration resistance of 30 or more blows per foot, whichever occurs first.

Test holes, advanced by augering and without penetration testing, or test pits may be used as required to supplement any of the above exploration, to verify similarity of materials, and to determine depths to bedrock.

Bedrock may be encountered at or near the ground surface that cannot be penetrated by penetration testing. In such cases, report whether the bedrock can definitely be expected to extend at least 20 feet below the ground surface. If it is believed that bedrock does not extend 20 feet deep, test holes must be advanced to a depth of at least 20 feet below the ground surface.

At least two test holes should be drilled in each of the uniform reaches marked on the surface geology map. Wherever possible these holes should be spotted at known angle points and at or near long span crossing tower sites. Additional holes should be drilled as are necessary for reasonable confirmation of the subsurface conditions and their boundaries, and for additional information on any special problem areas.

A test hole and penetration resistance tests are also required at each tower site for strain-type towers; sites on both sides of railroad or highway crossings; and at special structure sites (i.e., towers for other exceptional conditions).

- A description of the undisturbed state of materials encountered, and whether the material will stand in sides of the hole if augered and undercut for an auger footing.

- An estimate of the possible types of footings, for use at strain type, angle, and long span crossing towers.

- Comments on the general adequacy of surface drainage and/or possibility of dangerous erosion. These comments should take into account loss of existing sod cover due to construction activity, need and possibility of reseeding, or need and availability of material for gravel blanket or riprap protection.

- An indication of locations where pile-type footings may be required.
- Comments on probable depth, extent, and seasonal variation of depth of water table.
- Maximum flood levels of rivers or lakes and associated ice or debris-carrying or ice-shove possibilities. Any other unusual conditions that might indicate special foundation problems.
- An estimate or a determination by tests of the significant engineering properties of materials, such as density, plasticity, shear strength, and consolidation or expansion characteristics; and the effect of changes in moisture on these properties.

(b) Bedrock (see *Earth Manual*, latest edition):

- Determine the suitability of bedrock encountered for holding grouted anchor bars. (For satisfactory rocktype footings, the formation can be considerably shattered or jointed, both horizontally and vertically, as the action of the anchor bars is to "stitch together" a sufficient volume to provide safety against uplift.)

  If after nominal cleanoff of soft, weathered (severely weakened) bedrock, the material will provide a reasonably firm key for the concrete, the resulting installation is acceptable.

E. **Corrosion Survey:**

(1) In situ electrical resistivity measurements of geologic materials in the area of construction. Additional measurements should be made in the areas where there is a pronounced change in type of geologic materials, drainage, and/or moisture conditions.

(2) Performance history of materials of construction that have been used in the area.

(3) List of structures in the vicinity of (within ¼ mile) the proposed structure and appurtenant features. Determine if buried structures in the vicinity have corrosion protection and, if so, the type of corrosion protection.

(4) List location, output, and purpose of the direct-current sources in the earth situated within ¼ mile of the proposed structure and appurtenant features. If the purpose of the direct current is for cathodic protection, describe the structure protected and its location.

(5) Chemistry of geologic materials, ground water, and/or product water.

F. **Construction Materials Data.**

(1) If embankments are required, the location of and distance to suitable borrow areas for soil materials.

(2) Data on commercial concrete plants within practical hauling distance from the transmission line.

(3) Results of sampling and analysis of concrete aggregate and other materials, including previous tests conducted at the TSC.

G. **Environmental Considerations.** Design data should include, as a minimum, a brief description of the environmental commitments listed in the NEPA compliance document and the environmental resources affected by the proposed development. The emphasis should be on those areas in the range of alternatives open to the designers in developing a structural design. The following items should also be considered in preparing design data:

(1) The environmental setting.

(2) Cultural (historical, archeological, architectural, and paleontological) resources in the area of the dam and the reservoir basin.

(3) The need for blending structure with the surroundings, restoring borrow areas, and reseeding spoil banks.

(4) The need for a field conference to resolve critical environmental problems with participation of other agencies.

(5) Review of designs by other agencies.

(6) Anticipated public use around the structures.

(7) Indicate the suitability and possibility of developing Government land adjacent to our facilities for use by the public for recreation, hobbies, sports, leisure, education, health, etc.

(8) Comment on any ecological, aesthetic, bird migration corridors, or other environmental aspects peculiar to this location which would affect layout or conceptual design.

(9) Refer to the specific requirements of the Environmental Criteria for Electric Transmission Systems by the Departments of the Interior and Agriculture.

(10) Special environmental considerations for transmission lines or underground transmission systems. Emphasis should be on areas of raptor protection, threatened/endangered species habitat, high scenic or historical value, heavy public use, bird migration corridors, or fragile ecological areas.

H. **Site Security.** Many Reclamation projects may require a security risk assessment. The need for a site-specific security risk assessment should be considered for feasibility designs where an assessment may impact the field cost estimate and for specifications designs. Specific issues to consider are contained in Section 14 of Chapter 7 – Site Security and Public and Worker Safety. If assistance is required to determine specific design data needs, contact the Office of Security, Safety and Law Enforcement. Where design data and designs include site-specific security assessment, compliance with Reclamation Manual DM Part 444 – Physical Protection and Facility Security, Chapters 1 and 2 is required.

12. General Purpose Buildings, Office Buildings, and Operation and Maintenance Facilities. The Introduction (Chapter 1) for these design data collection guidelines contains additional information concerning: preparing a design data collection request, design data collection requirements, and coordinating the design data collection and submittal. (Use specifications design data for both feasibility and specifications.)

A. **General Map Showing:**

(1) A key map locating the general map area within the State.

(2) The development site or sites.

(3) County, township, range, and section lines.

(4) Existing towns, highways, roads, railroads, and public utilities.

(5) Locations of potential construction and permanent access roads, sites for contractor's staging areas, and construction facilities.

(6) Locations of borrow areas for natural construction materials and disposal areas for waste excavation.

(7) Existing or potential areas or features having a bearing on the design, construction, operation, or management of the development such as: recreation areas, fish and wildlife areas, building areas, and areas of archeological, historical, and mining or paleontological interest. The locations of these features should bear the parenthetical reference to the agency most concerned; for example, Reclamation, NPS, or FWS.

B. **General Description of Local Conditions Covering:**

(1) The approximate distance from the nearest railroad shipping terminal to site; load restrictions and physical inadequacies of existing roads and structures and an estimate of remedial improvements to accommodate construction hauling; estimate of length and major structures required for new construction access road; and possible alternative means for delivering construction materials and equipment at the building site.

(2) Local freight or trucking rates.

(3) Availability or accessibility of public facilities or utilities such as: water supply, sewage disposal, and electric power for construction.

(4) Climatic conditions that will affect design, construction, and operation and maintenance procedures such as: amount, rate, and distribution of rain and/or snow; ice conditions; summer and winter temperatures, with

extremes; extreme wind velocities and prevailing directions; floods; and probability of excessive dust or sand.

(5) Copy of county or city development Master Plan, if available, along with codes and regulations for development of land.

(6) Design code. Unless otherwise stated, the architectural and engineering design shall be in accordance with the latest adopted version of the International Building Code (IBC), as developed by the International Code Council (ICC).

C. **Surface Data:**

(1) **Topographic Map:**

(a) Covering an area that will accommodate all expected arrangements of buildings and facilities, and rights-of-way, and extending sufficiently to allow for control and disposal of drainage at the site and to indicate the general drainage of the vicinity.

(b) Normally at a scale of 1 inch equals 50 feet.

(c) Giving elevation above sea level and having a contour interval of 1 foot, depending on the degree of slope.

(d) Giving dimensions and bearings of the property lines, and a dimensional tie to a known section corner.

(e) Showing the suggested location and size of all proposed utilities and facilities.

(f) Showing the location and size of all existing utilities and other existing facilities within the area.

(2) **Color Photographs:**

(a) Taken from a high oblique angle, showing the area covered by the topographic map. (Aerial photographs if practicable.)

(b) Closeups showing any features which may affect design; photographs of existing facilities, especially in the vicinity of additions; and any facilities or structures which are to be revised.

(3) **Vegetation to Be Cleared:**

(a) Include kinds, sizes, and density of growth of trees and brush.

(b) Include depth of stripping required to remove organic matter or objectionable material.

(4) **Seeding or Replanting Requirements.** Seeding or replanting requirements for erosion control and aesthetics.

D. **Foundation Data:**

(1) **General Engineering Requirements.** The amount and detail of foundation data required will vary with the site and with the type of construction. The guiding criteria should be to provide sufficient data to allow the designer to determine the type of foundation required for each building or facility and to identify major foundation problems. Adequate foundation data may be obtained for small structures from an inspection of surface conditions and one or two exploratory holes to determine foundation conditions some distance below the footings of the structure. Maximum use should be made of existing data. For larger structures and/or for more complex geological areas a field conference should be held to determine the geologic investigations program required.

(2) **Geologic Data.** The following list of geologic design data provides general guidelines for the collection and reporting of geologic information for this type of facility. The geologist should apply these guidelines with good judgment and sound reasoning, elaborating upon them as required by the particular geologic setting and engineering requirements. Because the collection of geologic data is dynamic process and often continues into the preparation of final designs, all stages of the specifications design geologic exploration program must be constantly coordinated with the designer through the appropriate geology office. The TSC geologic and geophysical staff will provide necessary assistance and guidance in the gathering of these design data.

(a) Compilation, summary, and reporting of Reclamation and non-Reclamation geologic information on the area, with attention being paid to the sequence of explorations and historical geologic events.

(b) Surface geologic map showing location of explorations. Locations of all existing explorations should be indicated by coordinates or stationing of the permanent survey control system for the facility.

(c) Factual narrative description of surficial deposits with attention being paid to engineering geologic matters, such as swelling minerals, presence of gypsum and other sulfates, caliche, erodibility (see *Earth Manual*).

(d) Factual narrative description of bedrock with attention being paid to engineering geologic matters such as swelling minerals,

presence of gypsum and other sulfates; and to depth, weathering, joints, faults, and other planes of weakness.

(e) Photographs, preferably in color, of representative or particular geologic conditions.

(f) Selected determination of engineering properties of surficial deposits and bedrock.

(g) Summary and data of exploration geophysical surveys (seismic, resistivity, etc.).

(h) Determine ground water conditions with attention being paid to water levels and their seasonal fluctuation, occurrence of unconfined and confined aquifers, water producing capabilities, chemistry, and subsidence.

(i) Logs of explorations. An effort should be made to run appropriate borehole geophysical logs in all drill holes.

(j) Evaluation of landslide, snowslide, and rockfall conditions.

(k) If a building is in a high seismic risk zone and near an active fault, determine age of faulting in vicinity, especially if suspected to be late Pleistocene or Holocene, to assist in the determination of the seismic loading by specialists in the TSC

(l) Document past, present, and possible future petroleum, water, and mineral extraction operations in vicinity.

(m) Determine geologic conditions which may affect construction methods such as boulders on ground surface, marshes, drilling conditions, and stability of grout or footing holes, ground temperatures, gases. Any potential surface water runoff problems should be brought to the attention of a regional hydrologist.

(n) A determination by tests of the corrosive properties and sulfate content of geologic materials and ground water as affecting the choice of cement.

E. **Corrosion Survey:**

(1) In situ electrical resistivity measurements of geologic materials in the area of construction. Additional measurements should be made in the areas where there is a pronounced change in type of geologic materials, drainage, and/or moisture conditions.

(2) Performance history of materials of construction that have been used in the area.

(3) List of structures in the vicinity of (within ¼ mile) the proposed structure and appurtenant features. Determine if buried structures in the vicinity have corrosion protection and, if so, the type of corrosion protection.

(4) List location, output, and purpose of the direct-current sources in the earth situated within ¼ mile of the proposed structure and appurtenant features. If the purpose of the direct current is for cathodic protection, describe the structure protected and its location.

(5) Chemistry of geologic materials, ground water, and/or product water.

F. **Construction Materials Data Including:**

(1) Inventory of available impervious and pervious embankment materials and rock for riprap and rockfill. Location of and distance to borrow areas and approximate quantities available.

(2) Information on concrete aggregates. (See *Concrete Manual*.)

(3) Information on sources and character of acceptable road surfacing materials. Consider required excavation material as a possible source.

(4) Data on commercial concrete plants within practical hauling distances from the structure site.

(5) References to results of sampling and analysis of materials including previous tests and photographs of sources.

(6) Report alkali conditions in soil and water which might affect the choice of sulfate resisting cement.

(7) Statement of availability of timber for structural work and lumber for other purposes.

(8) Environmental impacts associated with removing or obtaining construction materials.

(9) Requirements concerning permanent stockpiles and suggested permanent stockpile locations.

(10) Information including catalogues on firms, within practical hauling distance from the site, manufacturing precast concrete products and brick or other masonry units.

G. **Environmental Considerations.** Design data should include as a minimum a brief description of the setting and the resources that would be affected by the proposed development.

(1) The environmental setting.

(2) Cultural (historical, archeological, architectural, and paleontological) resources within the project area.

(3) The need for blending the development with the surroundings.

(4) The need for a field conference to resolve critical environmental problems with participation of other agencies.

(5) Review of designs by other agencies.

(6) Anticipated public use around the development.

(7) Indicate the suitability and possibility of developing Government land adjacent to our development for use by the public for recreation, hobbies, sports, leisure, education, health, etc.

(8) Comment on any ecological, aesthetic, or other environmental aspects peculiar to this location which would affect layout or conceptual design.

(9) Landscaping and other special environmental requirements.

(10) A brief listing of the area's native and/or commonly used plant materials.

H. **Miscellaneous Data:**

(1) For housing:

(a) Type of natural growth on land.

(b) Number and occupancy of permanent houses.

(c) Number and occupancy of temporary houses.

(d) Expected length of service for housing area.

(e) Type of fuel to be used for heating, air-conditioning, cooking, and water heating.

(2) Type and size of office building, dormitory, laboratory, garage, fire station, warehouse, or other buildings.

(3) For domestic water supply system:

(a) Location of sources and amount of water available. If from river, give high water and low water elevations, also ice conditions during winter. If from ground water, give location of several wells within 2 miles of proposed site with data on depth of well, water levels, yield, logs if available, and chemical analyses of water. If from municipal system provide as-built of connection point and a detailed description of connection requirements.

(b) If source of potable water is from ground water or surface water submit water quality data to include major ions, and cations, corrosivity, and all contaminants listed as maximum contaminate levels in the Safe Drinking Water Act, based on this data the type and degree of treatment will be determined.

(c) Depth of water pipes to prevent freezing.

(d) Recommended type of material for pipelines.

(e) Type of foundation for water tank.

(f) Profile of ground for proposed water-supply line with type of material and percent of rock excavation expected in trench.

(4) For sewage disposal system:

(a) Reference to local and State codes or guidelines for treatment and disposal of sewage.

(b) Results of soil absorption test made at absorption trench. In order to determine the suitability of any area for subsoil effluent disposal, test holes approximately 1 foot square should be dug to the proposed depth of the tile or absorption trench at several points and then filled with water to a depth of about 1 foot. After this water has seeped away and while the bottom of the hole is still wet, it should be filled with water to a depth of 6 inches, and the average time required for the water level to drop 1 inch should be noted.

(c) Feasibility of placing the sewage treatment plant at such an elevation that excess sludge can be removed by gravity.

(d) Furnish a copy of required plumbing code if other than Uniform Plumbing Code (note deviations).

(e) Direction of prevailing winds.

(f) If sewage discharge is to a community sewer, provide the location and as built information on the connection point along with a detailed description concerning the connection requirements.

(5) Types of surfacing for walks and streets in temporary and permanent areas.

(6) Separate preliminary cost estimate for the following: water and sewage systems, electrical distribution system, streets and sidewalks, and each type of building or house required.

(7) Fire protection plan for the community, including information on available fire protection services.

I. **Electrical Data.** Data listed below will be required to initiate design. The data furnished should be sufficient to permit designers to complete the basic design (single-line diagram) for the visitors' center. After designs have progressed enough to develop details of electrical system needs, designers will prepare a list of additional data required to complete final design of electrical installation.

(1) Names and telephone numbers of electrical power suppliers and contacts within those organizations.

(2) Location of point where connection to power supply will be made.

(3) Source and description of power for the facility. If a transmission line is to be built by Reclamation, the information listed under "Transmission Lines" of this chapter should be furnished.

(4) System voltage at which power will be supplied, number of phases, and whether service will be overhead or underground.

(5) Number of buildings to be served, segregating residences and other types, with anticipated load and recommended supply voltage for each type.

(6) Discuss requirements for an alternate power source. If an alternate supply is required, indicate:

(a) If required by State or local authority.

(b) If source should be an engine-generator.

(c) If a threat to life or property will result if normal power supply is lost.

(d) Loads requiring service from alternate source.

(7) Requirements for remote monitoring of conditions at the facility, such as fire protection or security systems. Discuss location of remote station, and items required to be monitored.

(8) Use of electric ranges, electric water heaters, and/or electric heating in residences.

(9) Desire for a series-type street lighting system.

(10) Other requirements for power, such as water pumps, warehouse cranes, machine shops, etc.

(11) Fire protection plan for the community, including information on available fire protection services.

J. **Site Security.** Many Reclamation projects may require a security risk assessment. The need for a site-specific security risk assessment should be considered for feasibility designs where an assessment may impact the field cost estimate and for specifications designs. Specific issues to consider are contained in Section 14 of Chapter 7 – Site Security and Public and Worker Safety. If assistance is required to determine specific design data needs, contact the Office of Security, Safety and Law Enforcement. Where design data and designs include site-specific security assessment, compliance with Reclamation Manual DM Part 444 – Physical Protection and Facility Security, Chapters 1 and 2 is required.

13. Recreational Facilities. The Introduction (Chapter 1) for these design data collection guidelines contains additional information concerning: preparing a design data collection request, design data collection requirements, and coordinating the design data collection and submittal.

This paragraph lists data required for design of recreation facilities. Small scale site development, such as a single campground loop, would need much of the data listed below but only for the area encompassing and immediately surrounding the project site.

A. **General Map(s) Showing:**

(1) A key map locating the general map area.

(2) The general project area and the area immediately surrounding the project within 2 or 3 miles.

(3) Any other recreation areas in the general vicinity and facilities available there.

(4) Restrictions to land uses, such as easements and rights-of-way.

(5) Land ownership boundaries and legal jurisdictions. Indicate ownership by agency acronym or private land with "private."

(6) Land uses in general terms, with private land labeled "private."

(7) Name of agency that manages Reclamation land.

(8) Locations for borrow areas, storage of construction materials, and sites for stockpiling of topsoil.

(9) Limits of construction or physical boundaries of the proposed site development.

B. **Topographic Map Showing:**

(1) Topography covering an area large enough to include all potential site development. The extent of the topography should include the access road and the probable site entrance area. Contours should be at 2-foot intervals or 1 foot intervals if the site is very flat. The data should be in the form of an electronic drawing file which can be used to create a base map. All points contained in the drawing file should have z axis values that correspond to onsite elevation.

(2) Underwater contours with the elevation referenced to upland elevation, if needed for marina design.

(3) Surface drainage features such as streams and ravines and any existing bridges or culverts.

(4) Existing built site features, such as roads, parking, turnarounds, buildings, structures, power lines, buried utility lines and tanks, campgrounds, leach fields, picnic areas, and marinas.

C. **Survey Data:**

(1) **Survey Control.** Permanent horizontal and vertical survey control should be established at the earliest possible time. A coordinate system on a true north-south grid should be established with the origin located so that all of the features (including borrow areas) will be in one quadrant, and so that the values of the coordinates for any major development are widely separated numerically. The coordinate system should be related to a state or national coordinate system, if available. All preceding survey work should be corrected to agree with the permanent control system; and all subsequent survey work should be based on the permanent control. All surveys should be tied to the established coordinate system at each construction site.

(2) **Updated Conditions**. A survey of information needed specifically for small scale design. A new survey may be required which shows site conditions which have changed since the last survey was made. The survey should show contours at a 1 foot interval, with critical spot elevations at edges and corners of existing structures, elevations along drop-offs, swales, and changes in the topography, pipe inverts, locations of drains, guardrails, edges of pavement, trees or other vegetation to save, and any site features that impact small scale design or construction.

D. **Narrative and Photographic Description of Site:**

(1) **Narrative Description of the Project Area**. This should be a brief description of the surrounding area, the nearest population center, its size, and the nature of the surrounding context. A description of existing recreation facilities, capacity, level and season of use, condition of structures and roads.

(2) **Color Photographs of the Site.** All photos should be keyed to the site topographic map. Photos should show problem or hazardous areas, location of proposed facilities, location of possible access points to the site from existing routes, and close ups of existing features such as buildings or structures. These photos should also show favorable offsite views which should be preserved and considered when siting buildings. Photos should also be taken of unfavorable onsite features which should be screened from view or otherwise considered when siting facilities. Photos should show the condition of existing roads and buildings, if possible.

(3) **Aerial Photos**. Color if possible, 8- by 10-inch size, at a scale which allows discerning the nature of the vegetation. The photographs should be taken between 11 a.m. and 2 p.m. to avoid showing the site in shadow. Key the photos to the topographic map.

E. **Site Aesthetics Information:** This information is obtained from a site analysis, and should include:

(1) Favorable views to incorporate.

(2) Objectionable views to be screened, if possible.

(3) Significant sight lines onto the site from offsite. This would be important if there were a need to locate the development where it would not be seen from certain vantage points offsite.

(4) Major site features of interest to be developed into the design as focal points.

(5) Loud or objectionable sounds which need to be physically blocked, if possible.

(6) The need for blending buildings and structures with the surroundings.

F. **Biological Data:**

(1) **Vegetation.** Narrative description of site vegetation, particularly density and distribution. List of dominate species present: grasses, forbs, shrubs, and trees to be used in the site revegetation plan. List of threatened, endangered, and sensitive species in the immediate area of development. Map of dominate plant associations and threatened and endangered species.

(2) **Wildlife.** List of threatened and endangered species that have migration routes, critical habitat, or outstanding habitat in the immediate area. Map of any species' migration patterns, critical habitat, and outstanding habitat that occurs on or adjacent to the project site. List of animals which may pose a danger to users or which may require special accommodations in site design, for example bears or moose.

(3) **Wetlands.** Map of the outline of the wetland showing seasonal fluctuation of the water surface level and a narrative description of the plant associations within the wetland.

G. **Geologic and Soils Data:**

(1) Depth to bedrock, ground water, and frost line for siting underground utility lines, buried tanks, and foundations.

(2) Location of underground water and springs which may impact location or construction of facilities such as campgrounds and roads.

(3) Evidence of seasonal or occasional event of flooding over the banks of local streams and notations or map showing where the water goes.

(4) Soil survey and map of soil texture for determining susceptibility of soils to erosion, and suitability of soils for building foundations, roads, trails, and leach fields.

(5) Areas of existing erosion, subsidence, or high soil moisture, which should be avoided.

(6) Seismic stability in areas prone to earthquakes.

(7) Evaluation of potential landslide, snowslide, and rockfall areas.

(8) Availability of potential fill materials on site and nearby, and a description of the type of materials.

H. **Flood Plain Data:** Map of 5-, 10-, 25-, and 100-year flood plain levels. Buildings and campgrounds within frequently flooding areas should be avoided.

I. **Weather Data:** Direction, intensity, seasonality, and daily fluctuations of wind. Probability of excessive blowing dust or sand. Seasonality, amount, duration, and intensity of precipitation. Seasonal and daily fluctuations of temperature.

J. **User Data:**

(1) Anticipated user activities and needs.

(2) Demographics of user: age, socioeconomic group, families or individuals, physical abilities, recreation activity preferences.

(3) Length of stay – a few hours, overnight, few days.

(4) Destination or stop-over site.

(5) Seasons of use and differing uses by different users as the seasons change.

(6) Number of users expected at one time to use the site for an average weekend; for a holiday.

(7) Type of equipment the user is expected to bring along and the spatial/physical site requirements to accommodate that equipment.

(8) Utility requirements of the user (water, electricity, sewer).

K. **Utilities:**

(1) **Electricity:**

(a) Source of electricity: location of the point where the connection to power utility will be made, the capacity, and type-single phase/three-phase.

(b) Location of existing transformers.

(c) Estimated electrical peak load.

(d) Routes of proposed distribution lines and whether they are to be overhead or underground.

(e) Name and location of local utility company.

(f) State and local code requirements.

(g) Feasibility of applying solar collectors or adaptors to buildings.

(h) Feasibility and expense of generating power onsite with wind power.

(2) **Potable Water:**

(a) Source of existing potable and nonpotable water.

(b) Routes and sizes of existing pipes.

(c) Proposed distribution routes of new pipes.

(d) Available pressure (lb/in^2) and flow (gpm).

(e) Location of potential or existing wells, treatment facilities, and holding tanks.

(f) Name and location of local utility company.

(3) **Storm Water Runoff:**

(a) Codes and restrictions which affect site development.

(b) Impoundment requirements in quantity and duration.

(c) Conditions of the drainage plan, if applicable.

(4) **Sewage Disposal Systems:**

(a) **Pull-away systems:** spatial and access requirements of the pumping trucks which will service the vault toilet buildings and any retaining tanks, including turning radii and road gradient limitations.

(b) **Onsite disposal systems (primary treatment plus a leach field):**

- Necessary slope, soil, and spatial quantity requirement.
- Spatial requirements for future expansion of the system.
- Requirements and restrictions of local codes.
- Site environmental restrictions.
- Environmental compliance requirements for discharging to local streams (if that is an option).
- Spatial and access requirements of the vehicles or equipment which will be needed to service the treatment system.

(5) **Gray Water:** Opportunities to use gray water for landscape irrigation or in other nonpotable ways, considering code and environmental restrictions.

L. **Roads Data:**

(1) **Existing Roads**.

(a) Location and vehicle capacity of existing access route to site.

(b) Road and shoulder widths, depths, and materials.

(c) Direction of travel.

(d) Physical limitations to primary road, such as its condition, grade, and turning radii.

(2) **Proposed Roads:**

(a) Turning radii required for roads and parking lots, based on vehicles which are anticipated to use the facility.

(b) Wheel loading of anticipated vehicles which will use the facility.

(c) Need for a corrugated metal or plastic pipe at road crossings.

(d) Need for low water crossing.

(e) State and Federal highway regulations.

(f) Width, depth, length, and materials needed for new roads.

(g) Proximity of source of base course materials.

M. **Program Requirements:** From a resource management plan or other planning effort.

(1) Desired level of development, for example: urban, rural, semi-primitive.

(2) Numbers and locations of proposed facility elements, for example: numbers of pull-through sites with shade shelters; number of shade shelters and group use areas; number of sites with full utility hookups; number of day-use sites.

(3) Carrying capacities of the particular site, for example: proposed density of campsites or maximum number of boats in the marina and on the reservoir.

(4) Facilities that need to be replaced or upgraded to meet Reclamation and local codes and standards.

(5) Outlines of restricted use areas, such as non-motorized areas.

(6) Requirements for interpretation and the desired associated facilities, such as kiosks, bulleting boards, or signs. This includes interpretation for accessibility features as required by American with Disabilities Act Accessibility Guidelines (ADAGG) and the Uniform Federal Accessibility Standards (UFAS).

(7) Special events and peak use demands.

(8) Site specific issues relative to development that were identified during the planning stage.

N. **Accessibility Requirements:** Specific construction details and layout criteria which are required for universal accessibility under UFAS and ADAAG.

O. **Concessionaire's Requirements:**

(1) Type of equipment the user is expected to rent onsite from the concessionaire and the spatial/physical site requirements and location(s) to accommodate the storage and servicing of that equipment.

(2) Environmental compliance requirements of concessionaire's operation that effect site design.

(3) Conditions of the Commercial Services Plan.

(4) Utility requirements of the concessionaire, e.g. gas and phone

P. **Facility Operations and Maintenance Requirements:**

(1) Fee collection methods and location requirements for facility security. Methods to achieve security.

(2) Requirements to close off one part of a recreation are from another.

(3) Requirements for vandal-proofing facilities and types of construction materials needed or preferred. Need for lighting at particular points and whether the lighting is for safety or security.

(4) Requirements for fire safety, such as the need for fire trucks and ambulances to traverse the site. Need for emergency vehicles to be able to reach facilities and acceptable limits of access.\

(5) Roads and buildings needed for general maintenance of the area and their associated spatial and functional requirements.

Q. **Revegetation and Landscaping Needs:**

(1) Availability of nursery grown plants of the desired tree and shrub species. Availability of grass and forb seeds of the desired species.

(2) Practicality of collecting plants from project site to be used in revegetation plan.

(3) Cost effectiveness of collecting versus purchasing large trees and cacti.

(4) Irrigation needs, based on water regime requirements of the plants that will be used, and local growing conditions.

(5) Plant hardiness zone of project area.

(6) Number of days of frost in the area of the project site.

(7) Source of water for irrigation.

(8) Identify trees/vegetation which may or may not be removed.

(9) **Need to Stabilize Eroding Stream Banks or Lake Shores.** Exact location and nature of the erosion; the desired treatment, if known;

whether it is hard surfacing or live material. List of sources of native plant materials which are growing nearby, if known, which can be used as a source for cuttings.

(10) Need for design of erosion control plan including silt fences, temporary seeding, erosion control blankets, etc. during construction to mitigate soil erosion and potential siltation of streams and water bodies.

R. **Dock and Marina Data:**

(1) Site topography covering an area large enough to include all potential marina development sites, with contours at 2-foot intervals or 1-foot intervals if the site is very flat.

(2) Underwater contours with the elevation referenced to upland elevation.

(3) General slope and landform characteristics required for good marina development.

(4) General characteristics of land and water at site.

(5) Site exposure and prevailing winds.

(6) Location of vertical and horizontal obstructions in the proposed marina development area.

(7) Location, proximity, and size requirements of parking, including vehicles and vehicles with boat trailers.

(8) Condition of roads and their suitability for use by vehicles towing boat trailers.

S. **Miscellaneous Data:**

(1) Code restrictions, snow and wind loads, or environmental requirements related to specific activities that will occur at the site.

(2) Reservoir surface water elevations – at season's highest, average summer pool, and at season's lowest – for use in designing fishing and boating facilities.

(3) General condition of existing buildings, roads, recreation facilities, utility systems.

(4) Shooting range requirements.

(5) Description and map of archeologically significant areas to avoid.

(6) Need for an environmental permit, such as for compliance with Sections 401 and 404 of the Clean Water Act, if construction is anticipated to impact a wetland.

(7) Comments on any ecological, aesthetic, or other environmental aspects peculiar to this location that would affect layout or conceptual design.

(8) Unusual local pest that would influence type of construction materials and the selection of plant materials to use in planting plans.

(9) Cultural (historical, archeological, architectural, and paleontological) resources in the area of the recreation facility. There may be a need for a preliminary examination of the site for artifacts if the design site is within areas of known archeological importance. This is because the artifacts can be excavated or the site design modified to avoid adverse impact to the artifacts.

14. Fishways. The Introduction (Chapter 1) for these design data collection guidelines contains additional information concerning: preparing a design data collection request, design data collection requirements, and coordinating the design data collection and submittal.

A. General Map Showing:

(1) A key map locating the general map area within the State.

(2) Location of the structure site.

(3) County, township, range, and section lines.

(4) Existing towns, highways, roads, railroads, public and private utilities, transmission lines, substations, canals, rivers, streams, and stream-gauging stations.

(5) Locations of construction access road and sites for required construction facilities.

(6) Sources of natural construction materials, location of commercial quarries, and disposal areas for waste material.

(7) Existing or potential areas or features having a bearing on the design, construction, operation, or management of the project feature such as: housing and building areas; and areas of paleontological, archeological, historical or mining interest.

(8) Sources of construction power and power for operation.

(9) Scale of the general map should be adequate to clearly show listed details.

(10) North arrow.

B. Topographic Maps. Both a map and a electronic file, in AutoCAD or compatible format, of the topography covering the structure site should be provided. A contour interval of 1-foot is required in the immediate vicinity of the structures. Elsewhere, larger contour intervals may be acceptable. These site maps normally will be on a scale of 1 inch equals 50 feet. Exploration holes should be located on the maps. Aerial photographs of the proposed structure site should also be provided if available.

C. Site Plan Drawing. Both a drawing and an electronic file, in AutoCAD or compatible format, should be provided. The following should be shown:

(1) Existing dam and appurtenant structures.

(2) Proposed fish ladder location.

(3) Highways, roads, railroads and canals.

(4) Right-of-way and easement lines.

(5) North arrow and land survey lines.

(6) Existing utility lines within the right-of-way and requirements for relocation.

(7) Fences.

(8) Contours.

D. General Description of Local Conditions Covering:

(1) The capabilities of and constraints imposed by local shipping and transportation facilities.

(2) Names and telephone numbers of local utilities and irrigation districts and contacts within those organizations.

(3) Name and brief description of similar construction in the area or region. Preferable to use Reclamation projects if possible.

(4) Previous applicable studies.

(5) Access to the site.

(6) Availability or accessibility of public facilities or utilities such as: water supply; sewage disposal; telephone utility; fire protection services; and electric power for construction.

(7) Climatic conditions that will affect construction and operation procedures such as: amount, rate, and distribution of rain and/or snow; ice conditions; summer and winter temperatures, with extremes; and extreme wind velocities and prevailing directions. (Extensive tabulations are not necessary.)

(8) Any construction restrictions such as timeframe restrictions, climatic restrictions, blasting limitations, etc.

(9) Photographs of construction site and existing features which may effect design.

(10) Seismic conditions.

(11) River trash loading.

E. Survey Control. Use of an existing coordinate system or tying to the township and range system is acceptable, but tying to the State or national system is recommended if practical.

F. Foundation Data:

(1) **General Engineering Requirements.** The data for Specifications design is very similar to that for Feasibility design. They differ only in ***greater accuracy, detail, and completeness*** of investigation and testing, particularly for specific conditions (e.g., ground water, very soft or unstable foundation materials, and zones of rock excavation). If only minor additions or revisions are involved in the descriptions, interpretation, and geological sections previously submitted for feasibility design, the new data may be submitted as a supplement; otherwise completely revised new text, sections, and profiles should be prepared.

The need for additional foundation data should be established by originating office personnel with assistance from the region and TSC representatives. For major structures, it is recommended that a field conference be held, including an inspection of the site. This conference should result in a geologic investigations program outlining the need for and extent of surface and subsurface studies, and other requirements. The geologic investigations program must be based on site conditions, type of structure, and the time and funds available for the study and will make maximum use of existing data. The complexity of the site will determine the detail of the investigation.

Sufficient data on foundation conditions must be included to determine type of excavation materials that will be encountered. Logs of all drill holes, auger holes, and exploration pits will be included. Major soil types should be identified, including such significant factors as expansive and low-density soils, rock, and high-water tables.

G. Geologic Data. The following list of geologic design data provides general guidelines for the collection and reporting of geologic information. The geologist should apply these guidelines with good judgment and sound reasoning, elaborating upon them as required by the particular geologic setting and engineering requirements. Because the collection of geologic data is a dynamic process and often continues into the preparation of final designs, all stages of the specification design geologic exploration program must be constantly coordinated with the designer through the appropriate geology office. The TSC geologic and geophysical staff will provide necessary assistance and guidance in the gathering of these design data.

(1) Compilation, summary, and reporting of Reclamation and non-Reclamation geologic information on the area, with attention being paid to the sequence of explorations and historical geologic events.

(2) Surface geologic map of the fish ladder site showing location of explorations. Locations of all existing explorations should be indicated by coordinates or stationing of the permanent survey control system for the canal.

(3) Specific foundation exploration at fish ladder site to explore particular geologic problems such as soft foundations or low-density material.

(4) Factual narrative description of surficial deposits with attention being paid to engineering geologic matters, such as swelling minerals, low-density material, presence of gypsum and other sulfates, caliche, erodibility (see *Earth Manual*).

(5) Factual narrative description of bedrock with attention being paid to engineering geologic matters such as swelling minerals, presence of gypsum and other sulfates; and to depth, weathering, joints, faults, and other planes of weakness.

(6) Selected determination of engineering properties of surficial deposits and bedrock by laboratory or field tests (in-place density, penetration resistance, permeability, shear strength, gradation, and consolidation or expansion characteristics, etc.). The type and number of samples and tests required should be determined in cooperation with the TSC.

(7) Photographs, preferably in color, of representative or particular geologic conditions.

(8) Summary and data of exploration geophysical surveys (seismic, resistivity, etc.), if performed.

(9) Determine ground water conditions with attention being paid to water levels and their seasonal fluctuation, occurrence of unconfined and confined aquifers, potential leakage, water-producing capabilities including permeability tests, chemistry, and land subsidence.

(10) Logs of exploration. Logs of drill holes advanced by churn drilling, chop and wash, or other methods which result in less than adequate sample recovery should be augmented by borehole electric (geophysical) logs where appropriate.

(11) Evaluation of landslide, snowslide, and rockfall conditions. If it is relevant, include a map of possible slide areas with as much detail as practicable.

(12) If threat to life is significant, determine age of faulting in vicinity, especially if suspected to be late Pleistocene or Holocene.

(13) Document past, present, and possible future petroleum, water, and mineral extraction operations in vicinity.

(14) Determine geologic conditions which may affect construction methods such as, boulders on ground surface, marshes, cemented zones in surficial materials, etc. Any potential surface water runoff problems should be brought to the attention of a regional hydrologist.

(15) Samples of foundation materials and ground water should be obtained and tested to determine any possible chemical reaction with the concrete or metalwork.

H. Corrosion Survey:

(1) In situ electrical resistivity measurements of geologic materials in the area of construction. Additional measurements should be made in the areas where there is a pronounced change in type of geologic materials, drainage, and/or moisture conditions.

(2) Performance history of materials of construction that have been used in the area.

(3) List of structures in the vicinity of (within ¼ mile) the proposed structure and appurtenant features. Determine if buried structures in the vicinity have corrosion protection and, if so, the type of corrosion protection.

(4) List location, output, and purpose of the direct-current sources in the earth situated within ¼ mile of the proposed structure and appurtenant features. If the purpose of the direct current is for cathodic protection, describe the structure protected and its location.

(5) Chemistry of geologic materials, ground water, and/or product water.

I. Construction Materials Data Including:

(1) An earth materials report containing complete detailed information on those potential sources of soils and rocks that have been selected for final consideration. (See *Earth Manual*.)

(2) Information on concrete aggregates. (See "Final Investigations" in *Concrete Manual*).

(3) Information on sources and character of acceptable road surfacing materials, if required.

(4) References to service history of materials if used previously and to results of sampling and analysis, including previous tests in the central Reclamation laboratories.

(5) Environmental impacts associated with removing or obtaining construction material.

(6) Dispersive soil analyses.

J. Biological Data:

(1) Fish species targeted.

(2) Fish species swimming abilities.

(3) Behavior.

(4) Fish migration season.

(5) Age of fish targeted.

(6) Minimum and maximum size of the species.

(7) Run size.

(8) Biological requirements of the species (e.g., spawning, rearing or foraging habitats that require protection).

(9) Source(s) of fish ladder water.

K. Hydrological Data:

(1) Range of river flows.

(2) Percent exceedance curves for flows.

(3) River water surfaces at dam tied to downstream gauge.

(4) Both tailwater and forebay rating curves over range of flows.

(5) River velocities.

(6) Diversion amounts and dates, if applicable.

(7) Provide seasonal 1-year, 2-year, 5-year, 10-year, 25-year, 50-year, and 100-year river flow rates and water surfaces for evaluating construction related structures such as cofferdams and bypasses.

L. Agency Coordination:

(1) List of agencies to coordinate with.

(2) Review of designs by other agencies, including the findings of the Fish and Wildlife Coordination Act Report (if available).

(3) The need for a field conference to resolve critical environmental problems with participation of other agencies.

(4) Agency criteria which is required to be complied with.

M. Sedimentation Data: Sufficient data on the soil at the proposed structure site(s) must be included to determine whether sedimentation will be a problem.

N. Existing Structure Data. As-built structural, mechanical and electrical drawings of the existing dam and appurtenant structures should be included.

O. Fishways Data:

(1) Type of fishway selected:

(a) Pool-type ladder

- Vertical slot
- Pool and weir ladder
- Weir and orifice ladder
- Full width stream weir

(b) Baffled channel

- Riprap channel with boulder weirs

(c) Roughened chute ladder

- Alaska Steeppass
- Denil
- Roughened stream channel
- Pool-chute fish ladder

(d) Low gradient channel

(e) Vertical lift

(2) Range of river flows to design for.

(3) Fishway design flow.

(4) Maximum and minimum head loss or drop through the slots, orifice and weirs.

(5) Maximum and minimum fishway floor slope.

(6) Minimum water depth.

(7) Minimum clear opening between vertical trashrack bars.

(8) Minimum spacing of horizontal trashrack bars.

(9) Maximum velocity through trashrack.

(10) Minimum fishway pool volume.

(11) Energy Dissipation Factor (EDF).

(12) Capacity based on fish run size.

(13) Location of fishway exit from dam crest, spillways or any river outlet gates, etc.

(14) Requirement for stoplog slots or gates to be provided for dewatering the ladder.

(15) Requirement for entire fishway, including entrance and exit structures, to be covered with grating.

(16) Predation issues.

(17) Provision for future dam raise.

P. Fish Entrance Areas (or Pools):

(1) Field observations and sketches of flow patterns above and below the barrier should be made, especially at high flows.

(2) Observations of fish location and orientation when attempting to pass a barrier.

(3) Entrance flow.

(4) Type of fishway entrance (e.g., suppressed weir, contracted weir, vertical slot or orifice).

(5) Number and dimension(s) of entrance(s).

(6) Fishway entrance(s) location(s) and alignment(s).

(7) Minimum flow depth through gate.

(8) Minimum depth and radius of pool outside of entrance gate.

(9) Design head loss across entrance gate.

(10) Minimum velocity in the gate flow contraction.

(11) Requirement for instrumentation.

(12) Need for jet attraction pipes.

(13) Design flow of jet attraction pipe where applicable.

(14) Velocity of jet attraction pipes where applicable.

(15) Location of attraction pipe outlet and orientation to the river flow.

Q. Auxiliary Water Systems:

(1) Flow required.

(2) Vertical or horizontal diffuser grating?

(3) Maximum clear opening between bars of diffuser grate.

(4) Design flow per gross wetted area of diffuser grate.

(5) Maximum clear opening of vertical bars of intake trashrack.

R. Other Features:

(1) Equipment needed to determine fish movement by telemetry or other means where applicable.

(2) Need for trap and evaluation facility.

(3) Requirements for supplemental lighting.

(4) Location of access required by fishery interests.

S. Construction Data:

(1) Construction window to complete all work.

(2) Restrictions on in-water work.

T. Operating and Maintenance Data:

(1) Plan of operation for fish ladder facilities, dam and canal.

(2) Portion of year structures should be designed to operate.

(3) O&M access requirements.

U. Miscellaneous Information:

(1) Prevalence of any unusual local pest action such as termites, dry rot, and marine borers; local practices for combating same.

(2) Special requirements and locations of safety devices such as guardrailing, security lighting and fences in populated areas.

V. Environmental Considerations. Implementation of design features should be consistent with the environmental commitments as described in the NEPA compliance document. Implementation of design features should be consistent with agreements reached between Interior bureaus, Federal agencies, and other governmental agencies.

Design data should include, as a minimum, the environmental issues and/or requirements that would affect a fish ladder design and a brief description of the environmental resources that could be affected by the proposed development. The emphasis should be on those areas within the range of alternatives open to the designers in developing a structural design. The following items should also be considered in preparing design data:

(1) The environmental setting, photographs, both black and white and color, are helpful.

(2) Cultural (historical, archeological, architectural, and paleontological) resources in the area of the fish ladder.

(3) Background on the need for fish ladder.

(4) The need for blending structures with the surroundings, restoring borrow areas, and reseeding spoil banks.

(5) The need for a field conference to resolve critical environmental problems with participation of other agencies.

(6) Review of designs by other agencies, including the findings of the Fish and Wildlife Coordination Act Report (if available).

(7) Anticipated public use around the structure.

(8) Any threatened and/or endangered critical habitat in or adjacent to the fish ladder.

(9) Existing or potential wetland areas

W. Operating Data Including:

(1) Source(s) of fish ladder water.

(2) Plan of operation for fish ladder..

(3) Percent of design capacity that the fish ladder is expected to carry each month, and probable dates that it may be taken out of service for maintenance each year.

(4) For fish ladders operated in subfreezing weather: minimum temperatures, lengths of time freezing may occur, average and maximum ice depths, conditions to be anticipated as to alternate freezing and thawing, and probability of fish ladders drifting full of snow.

(5) Character of water to be conveyed with respect to probable sediment deposition.

(6) Type of maintenance machinery contemplated.

(7) Type of communications system contemplated.

X. Electrical Data. Data listed below will be required to initiate design. After designs of the facility have progressed enough to develop details of electrical system needs, designers will prepare a list of additional data required to complete final design of electrical installation.

(1) Name and telephone numbers of electrical power suppliers and contacts within those organizations.

(2) Location of point where connection to power supply will be made.

(3) System voltage at which power will be supplied, number of phases, and whether service will be overhead or underground.

(4) Electrical system reliability criteria.

(5) Discuss requirements for an alternate power source. If an alternate supply is required, indicate:

(a) If required by State or local authority.

(b) If source should be an engine-generator.

(c) If a threat to life or property will result if normal power supply is lost.

(d) Loads requiring service from alternate source.

(6) Requirements for remote monitoring of conditions at the facility. Discuss location of remote station, and items required to be monitored.

(7) Requirements for supervisory control, including location of station from which supervisory control is exercised.

(8) Requirements for voice and data communications between the supervisory master station and the remote facilities.

15. Fish Barriers. The Introduction (Chapter 1) for these design data collection guidelines contains additional information concerning: preparing a design data collection request, design data collection requirements, and coordinating the design data collection and submittal.

A. General Map Showing:

(1) A key map locating the general map area within the State.

(2) Location of the structure site.

(3) County, township, range, and section lines.

(4) Existing towns, highways, roads, railroads, public and private utilities, transmission lines, substations, rivers, streams, and stream-gauging stations.

(5) Locations of construction access road and sites for required construction facilities.

(6) Sources of natural construction materials, location of commercial quarries, and disposal areas for waste material.

(7) Existing or potential areas or features having a bearing on the design, construction, operation, or management of the project feature such as: housing and building areas; and areas of paleontological, archeological, historical or mining interest.

(8) Sources of construction power and power for operation.

(9) Scale of the general map should be adequate to clearly show listed details.

(10) North arrow.

B. Topographic Maps. Both a map and a electronic file, in AutoCAD or compatible format, of the topography covering the structure site should be provided. A contour interval of 1-foot is required in the immediate vicinity of the structures. Elsewhere, larger contour intervals may be acceptable. These site maps normally will be on a scale of 1 inch equals 50 feet. Exploration holes should be located on the maps. Aerial photographs of the proposed structure site should also be provided if available. Details to be shown are:

(1) Proposed locations of fish screen facilities including bypass pipe.

(2) Location of existing features such as diversion dam, headworks, highways, railroads, public and private utilities, and any other features that may affect the location and cost of the fish screen facilities. Note modifications required to headworks, if any.

(3) Existing right-of-way. Proposed acquisition of additional right-of-way should be discussed.

(4) Location of river thalweg.

(5) Below water contours should be included.

C. Site Plan Drawing. Both a drawing and an electronic file, in AutoCAD or compatible format, should be provided. The following should be shown:

(1) Proposed fish screen facilities including bypass pipe.

(2) Highways, roads and railroads.

(3) Right-of-way and easement lines.

(4) North arrow and land survey lines.

(5) Existing utility lines within the right-of-way and requirements for relocation.

(6) Fences.

(7) Contours.

D. General Description of Local Conditions Covering:

(1) The capabilities of and constraints imposed by local shipping and transportation facilities.

(2) Names and telephone numbers of local utilities and irrigation districts and contacts within those organizations.

(3) Name and brief description of similar construction in the area or region. Preferable to use Reclamation projects if possible.

(4) Previous applicable studies.

(5) Access to the site.

(6) Availability or accessibility of public facilities or utilities such as: water supply; sewage disposal; telephone utility; fire protection services; and electric power for construction.

(7) Climatic conditions that will affect construction and operation procedures such as: amount, rate, and distribution of rain and/or snow; ice conditions;

summer and winter temperatures, with extremes; and extreme wind velocities and prevailing directions. (Extensive tabulations are not necessary.)

(8) Any construction restrictions such as timeframe restrictions, climatic restrictions, blasting limitations, etc.

(9) Seismic conditions.

(10) Photographs of the construction site and existing features which may effect design.

E. Survey Control. Use of an existing coordinate system or tying to the township and range system is acceptable, but tying to the State or national system is recommended if practical.

(1) Right-of-way surveys are required to locate government owned property at the structure site.

F. Foundation Data:

(1) **General Engineering Requirements.** The data for Specifications design is very similar to that for Feasibility design. They differ only in ***greater accuracy, detail, and completeness*** of investigation and testing, particularly for specific conditions (e.g., ground water, very soft or unstable foundation materials, and zones of rock excavation). If only minor additions or revisions are involved in the descriptions, interpretation, and geological sections previously submitted for feasibility design, the new data may be submitted as a supplement; otherwise completely revised new text, sections, and profiles should be prepared.

The need for additional foundation data should be established by originating office personnel with assistance from the region and TSC representatives. For major structures, it is recommended that a field conference be held, including an inspection of the site. This conference should result in a geologic investigations program outlining the need for and extent of surface and subsurface studies, and other requirements. The geologic investigations program must be based on site conditions, type of structure, and the time and funds available for the study and will make maximum use of existing data. The complexity of the site will determine the detail of the investigation.

Sufficient data on foundation conditions must be included to determine type of excavation materials that will be encountered. Logs of all drill holes, auger holes, and exploration pits will be included. Major soil types should be identified, including such significant factors as expansive and low-density soils, rock, and high-water tables.

G. Geologic Data. The following list of geologic design data provides general guidelines for the collection and reporting of geologic information. The geologist should apply these guidelines with good judgment and sound reasoning, elaborating upon them as required by the particular geologic setting and engineering requirements. Because the collection of geologic data is a dynamic process and often continues into the preparation of final designs, all stages of the specification design geologic exploration program must be constantly coordinated with the designer through the appropriate geology office. The TSC geologic and geophysical staff will provide necessary assistance and guidance in the gathering of these design data.

(1) Compilation, summary, and reporting of Reclamation and non-Reclamation geologic information on the area, with attention being paid to the sequence of explorations and historical geologic events.

(2) Surface geologic map of the fish screen facilities site showing location of explorations. Locations of all existing explorations should be indicated by coordinates or stationing of the permanent survey control system for the canal.

(3) Specific foundation exploration at fish screen facilities site to explore particular geologic problems such as soft foundations or low-density material.

(4) Factual narrative description of surficial deposits with attention being paid to engineering geologic matters, such as swelling minerals, low-density material, presence of gypsum and other sulfates, caliche, erodibility (see *Earth Manua*l).

(5) Factual narrative description of bedrock with attention being paid to engineering geologic matters such as swelling minerals, presence of gypsum and other sulfates; and to depth, weathering, joints, faults, and other planes of weakness.

(6) Selected determination of engineering properties of surficial deposits and bedrock by laboratory or field tests (in-place density, penetration resistance, permeability, shear strength, gradation, and consolidation or expansion characteristics, etc.). The type and number of samples and tests required should be determined in cooperation with the TSC.

(7) Photographs, preferably in color, of representative or particular geologic conditions.

(8) Summary and data of exploration geophysical surveys (seismic, resistivity, etc.), if performed.

(9) Determine ground water conditions with attention being paid to water levels and their seasonal fluctuation, occurrence of unconfined and confined aquifers, potential leakage, water-producing capabilities including permeability tests, chemistry, and land subsidence.

(10) Logs of exploration. Logs of drill holes advanced by churn drilling, chop and wash, or other methods which result in less than adequate sample recovery should be augmented by borehole electric (geophysical) logs where appropriate.

(11) Evaluation of landslide, snowslide, and rockfall conditions. If it is relevant, include a map of possible slide areas with as much detail as practicable.

(12) If threat to life is significant, determine age of faulting in vicinity, especially if suspected to be late Pleistocene or Holocene.

(13) Document past, present, and possible future petroleum, water, and mineral extraction operations in vicinity.

(14) Determine geologic conditions which may affect construction methods such as, boulders on ground surface, marshes, cemented zones in surficial materials, etc. Any potential surface water runoff problems should be brought to the attention of a regional hydrologist.

(15) Samples of foundation materials and ground water should be obtained and tested to determine any possible chemical reaction with the concrete or metalwork.

H. Corrosion Survey:

(1) In situ electrical resistivity measurements of geologic materials in the area of construction. Additional measurements should be made in the areas where there is a pronounced change in type of geologic materials, drainage, and/or moisture conditions.

(2) Performance history of materials of construction that have been used in the area.

(3) List of structures in the vicinity of (within ¼ mile) the proposed structure and appurtenant features. Determine if buried structures in the vicinity have corrosion protection and, if so, the type of corrosion protection.

(4) List location, output, and purpose of the direct-current sources in the earth situated within ¼ mile of the proposed structure and appurtenant features. If the purpose of the direct current is for cathodic protection, describe the structure protected and its location.

(5) Chemistry of geologic materials, ground water, and/or product water.

I. Construction Materials Data Including:

(1) An earth materials report containing complete detailed information on those potential sources of soils and rocks that have been selected for final consideration. (See *Earth Manual*.)

(2) Information on concrete aggregates. (See "Final Investigations" in *Concrete Manua*l.)

(3) Information on sources and character of acceptable road surfacing materials, if required.

(4) References to service history of materials if used previously and to results of sampling and analysis, including previous tests in the central Reclamation laboratories.

(5) Environmental impacts associated with removing or obtaining construction material.

(6) Dispersive soil analyses

J. Biological Data:

(1) Fish species targeted.

(2) Fish species swimming abilities.

(3) Behavior.

(4) Fish migration season.

(5) Age of fish targeted.

(6) Minimum and maximum size of the species.

(7) Run size.

(8) Biological requirements of the species (e.g., spawning, rearing or foraging habitats that require protection).

K. Hydrological Data:

(1) Range of river flows.

(2) Percent exceedance curves for flows.

(3) River hydraulic data.

(4) River rating curves over range of design flows.

(5) River velocities.

(6) Provide seasonal 1-year, 2-year, 5-year, 10-year, 25-year, 50-year, and 100-year river flow rates and water surfaces for evaluating construction related structures such as cofferdams and bypasses.

L. Canal Hydraulic Data:

(1) Canal flow range and corresponding water surface elevations.

(2) Maximum canal design flow.

(3) Percent exceedance curves for flows.

(4) Available head at point of diversion.

(5) How diversions are made.

(6) Dates of diversions.

(7) Availability of bypass flow.

(8) Type of tailwater control for fishscreen, if any.

M. Agency Coordination:

(1) List of agencies to coordinate with.

(2) Review of designs by other agencies, including the findings of the Fish and Wildlife Coordination Act Report (if available).

(3) The need for a field conference to resolve critical environmental problems with participation of other agencies.

(4) Agency criteria which is required to be complied with.

N. Sedimentation Data: Sedimentation studies, degradation, and aggradation studies should be included if appropriate. Sufficient data on the soil at the proposed structure site(s) must be included to perform these tests.

O. Fish Screen Data:

(1) Type of screen required (e.g., flat plate, drum, etc.).

(2) Maximum allowable approach velocity. Approach velocity measured perpendicular to the screen face.

(3) Minimum allowable sweeping velocity. Sweeping velocity measured parallel to the screen face.

(4) Maximum allowable time of travel for fish moving along the screen face before entering a bypass.

(5) Maximum clear opening of the screen mesh.

(6) Maximum and minimum drum screen submergence, if applicable.

(7) If applicable, are drum screens to operate at optimum submergence for all flows?

(8) Maximum and minimum design flows through screens.

(9) Should screen structure be expandable if canal flow is increased in future.

(10) Predation issues.

P. Fish Bypass Data:

(1) Entrance requirements (e.g., flow control weir, etc.).

(2) Maximum and minimum entrance velocities.

(3) Maximum and minimum conveyance velocities.

(4) Is there a requirement for pumpback system with secondary screens.

(5) If on a river, trashrack bar spacing.

Q. Trashrack Data:

(1) Amount and type of floating debris in canal and/or river.

(2) Minimum clear opening between trashrack bars.

(3) Cleaning system.

R. Other Features:

(1) Criteria for fish viewer where applicable.

(2) Criteria for adult trapping facility where applicable.

(3) Equipment needed to determine fish movement by telemetry or other means where applicable.

(4) Requirements for supplemental lighting.

(5) Location of access required by fishery interests.

S. Construction Data:

(1) Construction window to complete all work.

(2) Restrictions on in-water work.

(3) Will bypass around canal construction site be required?

T. Operating and Maintenance Data:

(1) Plan of operation for fish screen facilities.

(2) Portion of year structures should be designed to operate.

(3) Dates of irrigation season.

(4) O & M access requirements.

(5) Method for cleaning rotating drums.

(6) Responsibility for maintaining screens.

(7) Type of equipment to remove screens for service (e.g., gantry, jib crane, mobile truck).

(8) Frequency of O&M.

(9) Ability and experience of O&M personnel to maintain proposed screens.

(10) Will cleaning of screens be problematic source(s) of fish screen facilities water.

(11) Percent of design capacity that the fish screen facilities is expected to carry each month, and probable dates that it may be taken out of service for maintenance each year.

(12) For fish screen facilities operated in subfreezing weather: minimum temperatures, lengths of time freezing may occur, average and maximum ice depths, conditions to be anticipated as to alternate freezing and thawing, and probability of fish screens drifting full of snow.

(13) Character of water to be conveyed with respect to probable sediment deposition.

(14) Type of maintenance machinery contemplated.

(15) Type of communications system contemplated.

U. Miscellaneous Information:

(1) Prevalence of any unusual local pest action such as termites, dry rot, and marine borers; local practices for combating same.

(2) Special requirements and locations of safety devices such as guardrailing, security lighting and fences in populated areas.

V. Environmental Considerations. Implementation of design features should be consistent with the environmental commitments as described in the NEPA compliance document. Implementation of design features should be consistent with agreements reached between Interior bureaus, Federal agencies, and other governmental agencies.

Design data should include, as a minimum, the environmental issues and/or requirements that would affect a fish screen facilities design and a brief description of the environmental resources that could be affected by the proposed development. The emphasis should be on those areas within the range of alternatives open to the designers in developing a structural design. The following items should also be considered in preparing design data:

(1) The environmental setting, photographs, both black and white and color are helpful.

(2) Cultural (historical, archeological, architectural, and paleontological) resources in the area of the fish screen facilities.

(3) Background on the need for fish facilities.

(4) The need for blending structures with the surroundings, restoring borrow areas, and reseeding spoil banks.

(5) The need for a field conference to resolve critical environmental problems with participation of other agencies.

(6) Review of designs by other agencies, including the findings of the Fish and Wildlife Coordination Act Report (if available).

(7) Anticipated public use around the structure.

(8) Any threatened and/or endangered critical habitat in or adjacent to the fish screen facilities.

(9) Existing or potential wetland areas

W. Electrical Data. Data listed below will be required to initiate design. After designs of the facility have progressed enough to develop details of electrical

system needs, designers will prepare a list of additional data required to complete final design of electrical installation.

(1) Name and telephone numbers of electrical power suppliers and contacts within those organizations.

(2) Location of point where connection to power supply will be made.

(3) System voltage at which power will be supplied, number of phases, and whether service will be overhead or underground.

(4) Electrical system reliability criteria.

(5) Discuss requirements for an alternate power source. If an alternate supply is required, indicate:

    (a) If required by State or local authority.

    (b) If source should be an engine-generator.

    (c) If a threat to life or property will result if normal power supply is lost.

    (d) Loads requiring service from alternate source.

(6) Requirements for remote monitoring of conditions at the facility. Discuss location of remote station, and items required to be monitored.

(7) Requirements for supervisory control, including location of station from which supervisory control is exercised.

(8) Requirements for voice and data communications between the supervisory master station and the remote facilities.

16. Wetlands. The Introduction (Chapter 1) for these design data collection guidelines contains additional information concerning: preparing a design data collection request, design data collection requirements, and coordinating the design data collection and submittal. Biological data other than that requested in this guideline may be required. This section lists data which may be required for specifications design of wetlands projects. The project team and the design team should review these guidelines to determine and assemble the final data request for a specific project. All wetlands projects should involve appropriate specialists in biology, hydrology (surface and groundwater), landscape site planning, and/or water quality (chemical limnology) disciplines. Depending on the scope and complexity, wetlands project plans should be developed or reviewed by a certified Professional Wetlands Scientist (PWS) or at a minimum by a member of the Society of Wetlands Scientists (SWS).

According to the U.S. Environmental Protection Agency:

- **Wetlands –** "those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs and similar areas."

- **Coastal Wetlands –** "found along the Atlantic, Pacific, Alaskan, and Gulf coasts. They are closely linked to our nation's estuaries, where sea water mixes with fresh water to form an environment of varying salinities."

- **Inland Wetlands –** "most common on floodplains along rivers and streams (riparian wetlands), in isolated depressions surrounded by dry land (for example, playas, basins, and "potholes"), along the margins of lakes and ponds, and in other low-lying areas where the ground water intercepts the soil surface where precipitation sufficiently saturates the soil (vernal pools and bogs)."

The following is a list of possible data required for design of wetlands:

A. **General Description of Proposed Wetlands Project:**

(1) **General Map(s) Showing:**

(a) A key map locating the general map area.

(b) The construction site or sites.

(c) Reference sites (if used).

(d) County and township lines.

(e) Existing towns, residences, private property, highways, roads, bridges with special loads or size limitations, railroads and shipping points, public utilities such as electric power and telephone lines, pipelines, etc., and stream-gauging stations.

(f) Locations for potential construction and permanent access roads, sites for contractor's staging areas, and construction facilities.

(g) Locations of borrow areas for natural construction materials and disposal areas for waste excavation.

(h) Existing or potential areas or features having a bearing on the design, construction, operation, or management of the project feature such as: recreation areas, fish and wildlife areas, building areas, areas of cultural sensitivity; and areas of archeological, historical and mining or paleontological interest. The locations of these features should bear the parenthetical reference to the agency most concerned; for example, Reclamation.

(i) Rights-of-way for construction, access, and staging areas.

(j) Sources of construction power and power transmission facilities.

(k) Buried utilities, pipelines, tanks, or other structures within the proposed construction site.

(2) **General Purpose and Function (Definitions are provided at the back of this section):**

(a) Discuss type of wetlands work:

(i) Establishment of new wetlands.

(ii) Restoration of previously existing wetlands.

(iii) Enhancement or enlargement of an existing wetland.

(iv) Replacement for abandoned or displaced wetlands.

(v) Protection and maintenance of existing wetlands.

(b) State overall approach to resolving problems:

(i) Watershed based.

(ii) Local area.

(iii) Both of the above.

(iv) Use natural or bioengineering approach or a combination of both.

(c) Describe, in detail, any specific functional requirements and goals for the wetland:

(i) Habitat restoration (restore habitat to a pre-existing condition) or creating a new wetlands:

- Restore native species.
- Create and sustain diverse habitats supporting diverse species.
- Protect or re-establish threatened or endangered species.
- Increase or improve wildlife habitat.
- Increase or improve plant habitat.
- Restore hydrologic and vegetative characteristics of altered meadows and riparian areas.
- Requirements for removal of non-native plant or animal species.

(ii) River or land restoration:

- Replace acres lost to manmade or naturally occurring activities or events.
- Provide bank or shoreline protection.
- Reduce loss of topsoil.
- Facilitate onsite sediment disposal.

(iii) Facilitate fish passage and habitat requirements (create, restore, enhance).

(iv) Recreation:

- Aesthetic needs or desires.

- Facilitate or improve sporting activities (e.g., hunting, boating, fishing, camping, and bird watching).

(v) Moderation of stream flows and flood protection:

- Reduce peak flows.
- Increase water retention.
- Increase base flow.

(vi) Water treatment for instream flows, wastewater, and overland flows:

- Reduce suspended sediment.
- Remove nutrients and/or pollutants.
- Prevent and correct pollution discharges.

(d) Describe conditions envisioned immediately after construction and long term.

(e) Type of wetlands (coastal, inland, bog, etc.).

(3) **Wetlands Project Requirements:**

(a) Describe the source(s) of water for the wetlands: river, reservoir, ground water, overland flow, or piped in.

(b) Describe any specific Federal or State Regulations.

(c) Provide desired review requirements of designs by other agencies including timeframe, period, or stage of design for the review and the level of the review.

(d) Input from advisory groups and technical teams assembled to facilitate or oversee work.

(e) Describe alternatives to be considered.

(f) Describe pre-established requirements or preferences:

(i) Potential location(s) of wetlands.

(ii) Area, shape, and depth requirements.

(iii) Importation of plants and/or animals.

(iv) Intentions to emulate conditions at an another existing site:

- Location of existing site.
- Description of desired conditions.

(g) Descriptions of existing or future conditions that will have an impact on design, arrangement, and/or location of wetlands such as:

(i) Commercial, industrial, residential, or agricultural development or operations in vicinity.

(ii) Current ground water conditions and potential future changes.

(iii) Potential changes in river channel conditions (e.g. flow, degradation, aggradation, bank erosion, etc.).

(iv) River control operations such as upstream dams and powerplants.

(h) Description of any known restrictions for construction, timing of construction, placement of facilities, water quality standards, duration of construction, preservation of existing vegetation and facilities, or construction access.

(i) Proposed project timeframe.

(j) Required provisions for public safety, accessibility, or visitor facilities.

(k) Proposed vegetation and planting requirements:

(i) Discuss the purpose(s) of the vegetation: habitat, water treatment, bank stability, re-establish original vegetation, feed for endangered species.

(ii) Specify seeding or planting requirements.

- Discuss how planting will be accomplished and whether planting can be accomplished by self-design (allowing volunteer wetland plants to be established without active planting efforts).

(iii) Furnish State or local restrictions concerning the use of soil herbicides, or local factors limiting their use.

(iv) Cost effectiveness of collecting vs. purchasing plant materials:

- Discuss the availability of riparian shrub species growing locally on public land that could be harvested for cuttings if needed.
- Practicality of collecting plants to be used in revegetation plan from: project site, other wetlands, other river sites.

(v) Revegetation limitations:

- Depth to ground water around shoreline. Discuss how wide the band of moist soils is, how steeply soil moisture drops off, and the seasonality of the water table.
- Ability of the soil immediately uphill of the shoreline to hold moisture, how fast draining the soil is based on texture or underlying geology.

(vi) Need for armoring the shoreline against wave action, particularly on a windy site or where there is a long fetch across a large water body. Is plant material desired or is a hard material desired, or a combination of the two?

(vii) Irrigation or water control needs, based on water regime requirements of the plants that will be used, and local growing conditions.

(viii) Upland vegetation requirements:

- The need for restoring and seeding cuts and fills and spoil banks.
- Source of water for irrigation, if required.

(ix) Water treatment wetlands:

- Desired goals for water treatment.
- Shoreline gradient required or desired, if any.
- Draw down requirements, seasonality and length of dry season.

- Shoreline and upland requirements for wildlife considerations.
- Suitable plants required and available for the wetlands.
- Water control requirements: depth, flow, time passing through wetland.
- Product water quality requirements (see "Water Quality" subsection and table 1 for water quality monitoring parameters).

(l) Special requirements for the water body:

(i) Water depth conditions. – Discuss the required water depth conditions and the ratios of those conditions, such as the amount of shallow benches in relation to deep water that is desired. Give amounts of each water depth desired, specifically shallow benches, intermediate benches, and deep water; and the depth of water in inches or feet required for each condition. Include a minimum required amount of water access for waterfowl, in linear feet.

(ii) Islands. – Discuss whether islands are desired and the purpose for them. Include the required shoreline configuration of the landform to support those uses, such as shallow benches, etc. Include the total acres desired to be designated to islands.

(m) Operating and maintenance data requirements:

(i) Anticipated adaptive management requirements if any.

(ii) Self sustainability requirements - Minimum or no maintenance requirements.

(iii) Details of required downstream control sections, measuring devices, gauging stations, or other operating works.

(iv) Standards by which to measure progress.

(v) Vehicle or boat access requirements for maintenance.

(vi) Need for installed maintenance and handling facilities.

(vii) Facilities required to facilitate monitoring.

(viii) Availability of or need for permanent buildings for operating personnel.

(4) **Post-Construction Evaluation and Monitoring Requirements:**

(a) Baseline standards for evaluation.

(b) Organization responsible for followup action if required.

B. **Coordination Requirements**

(1) Coordination/input requirements from other government and nongovernmental organizations and agencies. Identify agencies and organizations which will have input into the design, construction, and operation of the wetland. The roles and responsibilities of each party should be clearly defined.

(2) Identify any "land use agreements", or similar mechanisms which secure short- or long-term commitments by the parties to manage the site for a set of established objectives. This should include issues related to water rights/entitlements which are anticipated for the management and operation of the wetland system.

C. **Specific Wetlands Project Considerations and Parameters:**

(1) **Historic and Existing Site Conditions:**

(a) For projects where it is desired to simulate prior conditions, it is necessary to determine the historic time and conditions that are desired and feasible to simulate.

(b) Old maps.

(c) Interviews with residents.

(d) Old photographs of the wetlands area.

(e) Existing wetlands site and area vegetation:

(i) Narrative description of existing site vegetation.

(ii) Dominant plant associations (group of plants that are common and growing on the site).

(iii) Habitat survey:

- Community type.

- Surface cover.

(iv) Describe endangered plant species growing on the site including where they are located.

(v) A brief listing of the area's native tree, shrub, forb (a flowering plant, with a non-woody stem, that is not grass), and grass species growing locally.

(vi) Identify trees/vegetation which may or may not be removed.

(f) Wildlife uses of the site:

(i) Include the animals targeted for use and their specific needs and uses for the site, including feeding, cover, loafing, nesting, etc. Include the specific predator-prey relationships and how that influences design requirements such as the need for islands or specific landform types.

(ii) Is the site critical habitat for any endangered species? If so when and how do the endangered species use the site?

(g) Land use survey of upland areas, areas adjacent to the wetlands site, and the wetlands site.

(h) Soils:

(i) Provide published soil surveys by county, state, National Resources Conservation Service or others. Surveys may indicate soil types (sand, loam, clay, etc.), texture, and use (rangeland, agriculture, etc.).

(ii) Discuss the availability of topsoil either at the site or locally.

(iii) Discuss the moisture holding capacity, salinity, herbicides, plant disease organisms, or other problems with the soils.

(iv) If the wetland will be constructed from dry land, what is the availability of topsoil, either on site or locally? Typically the top six inches of soil over an area that will be cut or filled would be stripped, stockpiled, and spread back over new contours to create the final grade.

(v) Soil chemical properties related to plant growth for revegetation purposes:

- Results of a routine soil analysis performed by a professional soils testing laboratory, including recommendations for amending the soil for desired plant types to be grown. The analysis report giving values for soil texture, pH, soluble salts, organic matter, amount of available nutrients, lime. Nutrient levels reported in parts per million of the elemental nutrient. Additional tests for gypsum and sodium adsorption ration may be run.

- Presence of soil contaminants that could be toxic in high enough concentration, such as petroleum products or herbicides. Levels of heavy metals on land that has been mined.

(vi) Presence of plant or animal disease organisms.

(2) **Environmental Considerations.** Implementation of design features should be consistent with environmental commitments listed in the NEPA compliance document and should be consistent with agreements reached between Interior bureaus, Federal agencies, and other governmental agencies.

Design data should include, as a minimum, a brief description of the environmental resources that could be affected by the proposed development. The emphasis should be on those areas within the range of alternatives open to the designers in developing a design. The following items should also be included in the design data:

(a) Cultural (historical, archeological, architectural, and paleontological) resources in the area of the construction.

(b) The need for blending structures with the surroundings.

(c) Comments on ecological, aesthetic, or other environmental aspects peculiar to this location which would affect layout or conceptual design.

(d) Data on allowable noise limits in the vicinity of the facilities or where otherwise considered necessary or advisable; measurements of existing daytime or nighttime ambient noise levels in the area; and distances to the nearest residential units.

(e) Problems with existing bank erosion.

(f) Erosion and sediment control requirements.

(g) Environmental Permit requirements (Clean Water Act).

(h) Special environmental requirements for transmission lines or underground transmission systems.

(i) Location, volume, and contamination levels or any solid waste or hazardous waste facilities within the construction area.

(j) Provide data on the method(s) of brush and tree disposal permitted by local and State pollution regulatory agencies.

(k) Biological information requirements:

(i) Disease vector control considerations. Diseases may be carried by several animals most commonly mosquitoes. Discuss which disease vectors may be present and potential control measures such as:

- Water management – prevention of stagnant water
- Excavation depths
- Use of insecticides
- Timing of construction
- Other control measures

(ii) Potential invasive species which may damage the wetlands and or adjacent areas.

(iii) State anticipated impacts to threatened and endangered species and mitigation measures which can be taken to avoid/and or minimize these impacts. Emphasis should be placed on gathering, or planning for the collection of any data which will later be required to support necessary permit applications (including Ecological Society of America (ESA) consultations and Clean Water Act (CWA) section 404 permits).

(3) **Water Supply and Water Quality Factors.** If hydrologic data were documented in a report for the Feasibility Designs, they should be updated based on additional information developed since the Feasibility Designs. The Specifications Design data submittal shall reference the feasibility design document and thus eliminate the need to repeat the information enumerated below. If the information enumerated below is not contained or is not updated in the report prepared for the Feasibility Design then this information should be provided for the Specifications Design:

(a) Source of water for wetlands:

(i) Describe the source of water (river, reservoir, and ground water).

(ii) Is the source of water continuous or intermittent?

(iii) Will rainfall, river flows, or reservoir adequately supply water or will supplemental water be required?

(b) Rivers/streams – hydrologic data:

(i) Design floods and flood hydrographs. Normally a probability curve of flood peak discharges up to 100-year recurrence period will be sufficient.

(ii) Flood hydrographs for frequencies of 2, 5, 10, and 25 years for use during construction.

(iii) Monthly hydrographs for past 10 to 100 years.

(iv) Data for preparation of specifications hydrographs, including the location of gauging station at or near the construction site and the dates for which hydrographs should be prepared. Copies of daily discharge record should be supplied for stations with unpublished records.

(v) Historical monthly flow averages. Include periods of expected no-flow or aquifer size and recharge rate monthly averages.

(c) River Morphology:

(i) Water surface elevation curves, sedimentation studies, degradation and aggradation studies should be included. Water surface elevations should be determined for floods of 100-, 50-, 10-, 5-, and 2-year frequencies.

(ii) Potential impacts of the project that require design considerations, e.g., increased channel scour, and downstream channel protection, etc.

(iii) Anticipated future river channel improvement or other construction (upstream and downstream in the river) which might change regimen.

(iv) Data on upstream and downstream dams, diversions, pumping plants, and reservoirs.

(d) Reservoirs:

(i) Maximum and minimum operating water surfaces.

(ii) Operating procedures.

(e) Anticipated occurrences and amounts of silt, sediments, biomass, ice (thickness) and drift (trash).

(f) Ground water:

(i) Describe and provide background data on ground water elevations over time period, including seasonal and over a long period of time.

(ii) Chemical composition (See table 1 for water quality monitoring parameters).

(iii) Recharge and percolation rates.

(g) Water Quality:

(i) Existing water quality (see table 1 for water quality monitoring parameters).

(ii) Results of water quality studies carried out at or near the site.

(iii) Potential changes to land use which may affect water quality: industrial, residential, logging, mining, and agricultural.

(iv) Product water quality requirements (water treatment wetlands):

- Water quality requirements or standards which have to be met.
- Desired salinity of product water and limits on specific ion levels, if applicable.
- Consider potential impacts to the wetlands site, which may occur from surface water runoff originating form off-site sources, containing salts, fertilizers, oils, or any other non-point source of pollution

- Screening requirements for potential contaminants which may impact the ability of the project to meet design and operating criteria, or pose potential hazards to wildlife or human health and safety.

(4) **Climate.** Climatic conditions that will affect construction and operation and maintenance procedures such as: amount, rate, and distribution of rain and/or snow; ice conditions; summer and winter temperatures, with extremes; and probability of excessive dust or sand.

(a) Number of days of frost in the area of the project site.

(b) Evaporation - Annual net evaporation rates and monthly distribution. Include average monthly wind velocities, extreme wind velocities and prevailing directions.

C. **Site Design and Construction Data:**

(1) **Surface Data Including Historic Conditions:**

(a) **Surveying:**

(i) **Survey Control.** Permanent horizontal and vertical survey control should be established at the earliest possible time. A coordinate system on a true north-south grid should be established with the origin located so that all of the features (including borrow areas) at a major structure will be in one quadrant, and so that the values of the coordinates for any major structure are widely separated numerically. The coordinate system should be related to a state or national coordinate system, if available. All preceding survey work, including topography and location and ground surface elevation of subsurface exploration, should be corrected to agree with the permanent control system; and all subsequent survey work, including location and ground surface elevation of subsurface exploration, should be based on the permanent control. All surveys should be tied to the established coordinate system at each construction site.

(ii) Survey data should show existing facilities such including:

- Existing manmade site features such as roads, parking turnarounds, buildings, structures, power lines, buried tanks, campgrounds; leach fields, picnic areas, and marinas.

- Surface drainage features such as drainage from the approach roadways, streams, and ravines plus any existing bridges or culverts (include invert elevations) in close proximity.

- Site features which would be important design information such as, springs, marsh areas, overflow channels, channel changes, edge of water, high water marks, types of vegetative cover, large boulders, exposed bedrock, etc.

- Surface and underwater topography (bathymetric chart) (see subsection for "Topography").

- Existing right-of way, easement and fencing. Give dimensions and bearings of the property lines and a dimensional tie to a known section corner as required.

- Township lines, range lines, and section lines.

- Show the direction of all transmission lines within the area.

- Indicate general drainage of the area.

(iii) Survey data should show proposed features/facilities including:

- Show locations and ties to all proposed facilities such as buildings, structures, powerlines, 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.

- Proposed right-of-way and easement acquisitions and fencing.

- Geologic exploration holes.

- Location of river thalweg.

- Channel modifications.

(b) **Topographic Map.** A topographic map covering an area sufficient to accommodate all possible arrangements of structures and features; normally this should be on a scale of 1 inch equals 50 feet with a contour interval of 1 foot (wetlands are normally flat areas which require a small contour interval for design and construction). Show the coordinate system and existing land survey corner monuments or special control points established for the topographic survey. Show all manmade features in the included area.

Show underwater contours (bathymetric chart). Bathymetric survey should extend a minimum100 feet upstream, 100 feet downstream, and 100 feet beyond the ends of the wetlands. The area covered by the Bythymetric survey should be large enough to cover all alternative sites and site arrangements being evaluated.

(c) **Photographs:**

(i) Photographs of all existing facilities or structures in the vicinity of the proposed wetland and close-up views of any features which may affect designs and/or layouts. Photographs of structure sites with structure locations marked in ink.

(ii) Photographs of existing vegetation at the site, vegetation at any reference sites, and photographs of vegetation proposed for planting or seeding.

(d) **Aerial Photographs.** Aerial photographs (size 8 by 10 inches) of the proposed wetland sites including existing structures.

These photographs should be taken from locations that would best show the proposed wetland. Where possible, indicate known tie points to the topographic maps. Aerial photographs from directly overhead may be beneficial in assessing geologic features when studied with stereographic methods. Submit the electronic files, negatives or color slides.

(2) **Foundation Data:**

(a) **General Engineering Requirements.** The need for foundation data should be established by the joint efforts of originating office personnel and the office(s) providing design services. For major features it is recommended that a field conference be held, including an inspection of the site. This conference should result in a geologic investigations program outlining the need for and extent of surface and subsurface studies, and other requirements.

The geologic investigations program must be based on site conditions and the types of features and structures. The complexity of the Site will determine the detail of the investigation.

Sufficient data on foundation conditions must be included to determine type of excavation materials that will be encountered. Logs of all drill holes, auger holes, and exploration pits will be included.

(b) **Geologic Data.** The following list of geologic design data provides general guidelines for the collection and reporting of geologic information for this type of feature. The geologist should apply these guidelines with good judgment and sound reasoning, elaborating upon them as required by the particular geologic setting and engineering requirements. Because the collection of geologic data is a dynamic process and often continues into the preparation of final designs, all stages of the specification design geologic exploration program must be constantly coordinated with the designer through the appropriate geology office. The designated geologic and geophysical staff will provide necessary assistance and guidance in the gathering of these design data.

(i) Compilation, summary, and reporting of Reclamation and non-Reclamation geologic information on the area, with attention being paid to the sequence of explorations and historical geologic events.

(ii) Surface geologic map of wetland area showing location of explorations. Locations of all existing explorations should be indicated by coordinates or stationing of the permanent survey control system for the facility.

(iii) Conduct specific foundation exploration at site of all hydraulic and appurtenant structures.

(iv) Factual narrative description of surficial deposits with attention being paid to engineering geologic matters, such as swelling minerals, low-density materials, presence of gypsum and other sulfates, caliche, erodibility (see *Engineering Geology Field Manual*).

(v) Photographs of representative or particular geologic conditions.

(vi) Selected determination of engineering properties of surficial deposits and bedrock by laboratory or field tests.

The type and number of samples and tests required should be determined in cooperation with the design office.

(vii) Summary and data obtained from exploration by geophysical methods (seismic, resistivity, etc.), if performed.

(viii) Determine ground water conditions with attention being paid to water levels and their seasonal fluctuation, occurrence of unconfined and confined aquifers, water-producing capabilities, chemistry, and land subsidence.

(ix) Determine depth to impermeable layer.

(x) Determine soil percolation rates (exfiltration and infiltration).

(xi) Provide logs of explorations.

(xii) Document past, present, and possible future petroleum, water, and mineral extraction operations in vicinity.

(xiii) Determine geologic conditions which may affect construction methods such as, boulders on ground surface, marshes, ground temperatures, and gases. Any potential surface water runoff problems should be brought to the attention of a regional hydrologist.

(xiv) Determine soil compaction (density).

(3) **Corrosion Survey (if structures are involved):**

(a) In situ electrical resistivity measurements of geologic materials in the area of construction. Additional measurements should be made in the areas where there is a pronounced change in type of geologic materials, drainage, and/or moisture conditions.

(b) Performance history of constructed materials that have been used in the area.

(c) List of structures in the vicinity of (within ¼ mile) the proposed features. Determine if buried structures in the vicinity have corrosion protection and, if so, the type of corrosion protection.

(d) List location, output, and purpose of the direct-current sources in the earth situated within ¼ mile of the proposed features. If the

purpose of the direct current is for cathodic protection, describe the structure protected and its location.

(e) Chemistry of geologic materials, ground water, and/or product water.

(4) **Construction Materials Data:**

(a) Location of and distance to suitable borrow areas for permeable and impermeable soil materials for fill or embankment; topsoil; and for riprap for channel or slope protection. If quantities are limited, give approximate volumes available.

(b) An earth materials report containing complete detailed information on those potential sources of soils and rocks that have been selected for final consideration. (See *Earth Manual*.)

(c) Information on concrete aggregates. (See "Final investigations" in *Concrete Manual*).

(d) Data on commercial concrete plants within practical hauling distance from the structure site.

(e) Information on sources and character of acceptable road surfacing materials. Consider excavated material as a possible source.

(f) Results of sampling and analysis of materials, including previous tests.

(g) Information, including catalogues from manufacturers within practical hauling distance from the site, concerning precast concrete products and brick or other masonry units.

(5) **Electrical Data.** Data listed below will be required to initiate design of any facilities requiring electric power. The data furnished should be sufficient to permit designers to complete the basic design (single-line diagram) for the required features. After designs have progressed enough to develop details of electrical system needs, designers will prepare a list of additional data required to complete final design of electrical installation:

(a) Names, telephone numbers, email addresses and web sites of electrical power suppliers and contacts within those organizations.

(b) Location of point where connection to power supply will be made.

(c) System voltage at which power will be supplied, number of phases, and whether service will be overhead or underground.

(d) Electrical system reliability criteria.

(e) Discuss requirements for an alternate power source. If an alternate supply is required, indicate:

(i) If required by a State or local authority.

(ii) If source should be an engine-generator.

(iii) Other energy sources, fossil fuel, solar, geothermal, wind.

(iv) If a threat to life or property will result if normal power supply is lost.

(v) Loads requiring service from alternate source.

(f) Requirements for remote monitoring of conditions at the facility. Discuss location of remote station, and items required to be monitored.

(g) Requirements for supervisory control, including location of station from which supervisory control is exercised.

(h) Requirements for voice and data communications between the supervisory master station and the remote facility.

(i) Electric power for construction (give location, power supplier, voltage, number of phases, and capacity of existing transmission lines; power rate schedules; probability of interruption of supply; and requirements for additional transmission line, if needed).

(6) **Construction Considerations:**

(a) Construction schedule:

(i) One contract or several contracts.

(ii) Whether construction schedule will be adaptive, (e.g., provide a remedy, observe the effects, and then modify remedy as required).

(b) Recommended period for construction.

(c) Measures which need to be taken prior to construction.

(d) Unusual local pest (termites, borers, etc.) action and recommended preventive measures.

(e) Allowable in-river materials (permanent and temporary).

(f) Allowable construction methods.

(g) Water for construction purposes. For large rivers, this item may be unimportant. For small streams and offstream reservoirs, the item becomes critical. Determine if up to 2-ft^3/s diversion flow for Construction purposes can be assured to the contractor. The Government should obtain the water rights required. If necessary to use ground water, obtain information on probable sources and yields. Furnish information on locations and yields of existing wells in the vicinity. Determine restrictions, if any, to use of ground water for this purpose. It may be necessary to obtain permits from State or other governing agencies. Retrieve water quality samples for testing and evaluation.

(h) Requirements for maintaining stream flow or diversions during construction and maximum length, time, and number of permitted interruptions.

(i) Is a construction schedule and/or logic diagram required?

(j) Required permits from government agencies and others.

(k) The approximate distance from the nearest railroad shipping terminal to the structure site; load restrictions and physical inadequacies of existing roads and structures and an estimate of remedial improvements to accommodate construction hauling; estimate of length and major structures required for new construction access road; and possible alternative means for delivering construction materials and equipment to the wetlands site.

(l) Impact of moving construction materials on existing road facilities, including consideration of such factors as traffic congestion, effect on road condition, air pollution, etc.

(m) Requirements for temporary construction access roads, permanent access and service roads, and relocation of existing roads or railroads. Include any limiting requirements imposed by road owners for public access/haul roads.

(n) Comments on disposal of special excavation problem materials such as lignite.

(o) Give borrow area and temporary haul road restoration requirements such as stockpiling of top soil, grading of the area, general cleanup, etc.

(p) Give consideration to using required excavated material in lieu of material from other borrow sources wherever possible.

(q) Requirements for meeting criteria for suppression of nitrogen, adequate oxygen levels, and temperature control and control of turbidity during construction.

(r) Availability or accessibility of public facilities or utilities such as: water supply, sewage disposal, telephone utility, and fire protection services for construction. Names telephone numbers, email addresses and web sites of local utilities and contacts within those organizations.

(s) Disposal areas for excess excavated materials.

(7) **Cost Data:**

(a) Estimate of cost of right-of-way or easements. Include supporting data.

(b) Total anticipated construction budget if known.

(c) If potential actions exceed anticipated funding, should the cost estimate reflect incremental costs of potential actions? Provide any known increment or arrangement of the incremental costs.

(d) Estimates of cost for clearing construction area and for removing or replacing private improvements in the area. Include supporting data.

(e) Estimates of cost for relocating railroads, highways, roads, water systems, and other public utilities from site. Include supporting data. Where buildings are located within the area to be cleared by the prime contractor, and if disposal will be the contractor's responsibility, designate building groups by number and furnish detailed list of buildings for each group. Details should include general description, size, materials, and general condition. Determine if disposal will be the responsibility of prime contractor. If not, submit dates when disposition will be completed by others.

(f) Information on important construction work in progress or planned in the vicinity (including upstream and downstream of the site).

(g) Designated areas to be cleared of vegetation, with description of kinds, size, and density of growth. State recommended method of payment; i.e., lump-sum price for specific area with defined limits, or unit price per acre for specific area whose limits may change during construction. If there is a variation in the density of growth or in the difficulty of clearing operations for the designated area to be cleared, the work should be segregated into not more than three items with the limits of respective areas clearly established. If vegetation to be cleared is very sparse or is such as can be removed without special equipment or separate operations, the cost of clearing should be included in the prices bid for excavation or prices bid for other items of work.

(h) Local freight or trucking rates.

(8) **Right-of-Way.** Show the following data:

(a) Proposed right-of-way boundaries for construction purposes.

(b) Proposed right-of-way boundaries for access purposes.

(c) Designation of areas within right-of-way boundaries for the following special purposes:

(i) Disposal of waste material.

(ii) Contractor's plant, storage, and other incidental purposes.

(iii) Borrow sources.

(iv) Government’s construction facilities (if applicable).

(d) Existing private or public easements and right-of-way across or adjacent to the construction area.

(9) **Miscellaneous Data:**

(a) Security requirements for protection of equipment from vandalism or sabotage. Recommended specific measures to meet anticipated conditions such as 7-foot yard fence topped with barbed wire, security lighting, electronic surveillance equipment, etc.

Table 1 – Water quality monitoring parameters

Water Quality Monitoring – Selected parameter groups Technical Service Center, 86-68520, January 10, 2007				
Series		Symbol	Parameter	Description
A.	1. 2. 3. 4. 5.	Flow Rate (Q) Water Depth Air Temperature Atmos. Pressure Weather	stream gauge, weir, or flume field record or staff gauge field measurement field barometer reading filed note observations	Site flow and weather measurements
B.	1. 2. 3. 4.	Water Temp. DO pH EC	field measurement field Dissolved Oxygen field / lab pH meter units field / lab Specific Conductivity	Basic field or continuous monitoring methods
C.	1. 2. 3. 4. 5. 6. 7.	$NO_3 + NO_2$ as N NH_3 as N TKN as N SRP-PO_4 TDP TP Chlorophyll a	Dissolved nitrate+nitrite (as N) total Ammonia (as N) total Kjeldahl Nitrogen soluble ortho-Phosphate total dissolved Phosphorus total (unfiltered), Phosphorus total - phytoplankton filter	Nutrients and algae growth indicators
D.	1. 2. 3. 4. 5. 6. 7.	Turbidity TSS VSS BOD_5 COD TOC DOC	Standard turbidity units Total Suspended Solids Volatile Solids, TSS Biochemical Oxygen Demand Chemical Oxidation Demand Total Organic Carbon Dissolved Organic Carbon	Organics and particulate matter indicators
E.	1. 2. 3. 4. 5. 6. 7. 8. 9. 10. 11. 12. 13.	Alkalinity Carbonate Bicarbonate TDS Na K Ca Mg SO_4 Cl SiO_2 F B	meq CO_3+HCO_3 total CO_3 titration total HCO_3 titration total dissolved solids dissolved Sodium dissolved Potassium dissolved Calcium dissolved Magnesium dissolved Sulfate dissolved Chloride dissolved Silica dissolved Fluoride dissolved Boron	Major ions and inorganic chemistry parameters
F.	1. 2. 3.	Fecal Coliform Enterococci E. Coli	unfiltered, std. micro. test unfiltered, std. micro. test unfiltered, std. micro. test	Enteric bacteria indicators
G.	1. 2. 3. 4. 5. 6. 7. 8. 9. 10. 11.	Fe Mn Cu Ni Zn Cr Cd Pb Hg As Se	total Iron total Manganese total Copper total Nickel total Zinc total Chromium total Cadmium total Lead total Mercury total Arsenic total Selenium	Metals and trace elements
Notes:	The parameters represent common water quality indicators. Actual monitoring should be adjusted to study objectives. Other methods may apply to specific site conditions or topics of interest. Refer to applicable sampling, preservation, analytical standard methods, and quality control procedures.			

DEFINITIONS (U.S. Environmental Protection Agency)

- **Basin –** A drainage basin is a region of land where water from rain or snowmelt drains downhill into a body of water, such as a river, lake, dam, estuary, wetland, sea or ocean. The drainage basin includes both the streams and rivers that convey the water as well as the land surfaces from which water drains into those channels. The drainage basin acts like a funnel – collecting all the water within the area covered by the basin and channeling it into a waterway. Each drainage basin is separated topographically from adjacent basins by a ridge, hill or mountain, which is known as a water divide or a watershed.

- **Bog–** A bog is a wetland type that accumulates acidic peat, a deposit of dead plant material.

- **Creation – C**onstruction of a wetland in an area that was not a wetland in the recent past (within the last 100-200 years) and that is isolated from existing wetlands (i.e., not directly adjacent).

- **Enhancement – T**he modification of specific structural features of an existing wetland to increase one or more functions based on management objectives typically done by modifying site elevations or the portion of open water. Although this term implies gain or improvement, a positive change in one wetland function may negatively affect other wasteland functions.

- **Mitigation –** Refers to the restoration, creation, or enhancement of wetlands to compensate for permitted wetland losses.

- **Establishment –** The manipulation of the physical chemical or biological characteristics present to develop a wetland that did not previously exist.

- **Marsh –** A marsh is a type of wetland, featuring grasses, rushes, reeds, typhas, sedges, cat tails, and other herbaceous plants (possibly with low-growing woody plants) in a context of shallow water. A marsh is different from a swamp, which is dominated by trees rather than grasses and low herbs. The water of a marsh can be fresh, brackish or saline.

- **Playas –** Playa lakes are round hollows in the ground in the Southern High Plains of the United States. They are ephemeral, meaning that they are only present at certain times of the year.

- **Prairie potholes –** Prairie potholes are depressional wetlands (primarily freshwater marshes) found most often in the upper Midwest, especially North Dakota, South Dakota, Wisconsin, and Minnesota. This formerly glaciated landscape is pockmarked with an immense number of potholes, which fill with snowmelt and rain in the spring. Some prairie pothole marshes are temporary, while others may be essentially permanent. Here a pattern of rough concentric circles develops. Submerged and floating aquatic plants

take over the deeper water in the middle of the pothole while bulrushes and cattails grow closer to shore. Wet, sedgy marshes lie next to the upland.

- **Protection/Maintenance – T**he removal of a threat to, or preventing decline of wetland conditions by an action in or near a wetland. Includes purchase of land or easement, repairing water control structures or fences, or structural protection such as repairing a barrier island. This term also includes activities commonly associated with the term preservation. Protection/Maintenance does not result in a gain of wetland acres or function.

- **Swamps –** A wetland that features permanent inundation of large areas of land by shallow bodies of water, generally with a substantial number of hummocks, or dry-land protrusions. Swamps are usually regarded as including a large amount of woody vegetation. When a wetland area does not include such vegetation, it is usually termed a marsh.

- **Reallocation or replacement –** Applies when most or all of a wetland is converted to a different type of wetland.

- **Restoration –** The term indicates that degraded and destroyed natural wetland systems will be reestablished to sites where they once existed. But, what wetland ecosystems are we talking about? How far back in time should we go to find target ecosystems? Is establishing any type of wetland enough to be called "restoration"?

    - **Re-establishment** – Restoration should reestablish insofar as possible the ecological integrity of degraded aquatic ecosystems

    - **Rehabilitation** –The manipulation of the physical, chemical, or biological characteristics of a site with the goal of repairing natural/historic functions of degraded wetland. Rehabilitation results in a gain in wetland function, but does not result in a gain in wetland acres

    - Guiding principles:

        - Preserve and protect aquatic resources.

        - Restore ecological integrity – Restoration strives for the greatest progress toward ecological integrity achievable within the current limits of the water shed by using designs that favor the natural processes and communities that have sustained native ecosystems through time.

        - Restore natural structure – Restoring the original site morphology and other; physical attributes is essential to the success of other aspects of the project, such as improving water quality and binging back native biota.

- Restore natural function – It is essential to identify what functions should be present and make missing or impaired functions priorities in the restoration. Verifying whether desired functions have been reestablished can be a good way to determine whether the restoration project has succeeded.
- Broader context – Requires a design based on the entire watershed.
- Natural potential of the watershed – requires knowledge of historical range of conditions that existed on the site prior to degradation and what future conditions might be.
- Ongoing causes of degradation – identify the causes of degradation and eliminate or remediate ongoing stresses wherever possible. It is important to look at upstream and up-slope activities.
- Develop clear and achievable measurable goals –
- Anticipate future changes
- Design for self-sustainability
- Use passive restoration when appropriate – i.e., simply reducing or eliminating the sources of degradation and allowing recovery time. Restoring the hydrologic regime may be enough to let time re-establish the native plant community, with its associated habitat value. Relies on natural processes over time.
- Restore native species and avoid non-native species.
- Use natural fixes and bioengineering techniques, where possible – create wetlands to treat storm water, to restore vegetation on river banks, to enhance natural decontamination of runoff.
- Monitor and adapt.

- **Vernal pools –** A vernal pool is usually a shallow, natural depression in level ground, with no permanent above-ground outlet, that holds water seasonally. They could colloquially be referred to as temporary wetlands. In the Northeast United States (Maine, Massachusetts, and perhaps others) vernal pools fill with the rising water table or with the melt water and rain of spring. Many vernal pools in the northeast are covered with ice in the winter.

17. Bridges. The Introduction (Chapter 1) for these design data collection guidelines contains additional information concerning: preparing a design data collection request, design data collection requirements, and coordinating the design data collection and submittal.

The following data and information are required for specifications (final) design of vehicular bridges. This document can be used to request design data for railroad and pedestrian bridges along with buried box, round, or arch culverts to be constructed under roadways. These buried structures qualify as bridges under the American Association of State Highway and Transportation Officials.

AASHTO's definition of a bridge is as follows: "a structure including supports erected over a depression or an obstruction, such as water, highway, or railway, and having a track or passageway for carrying traffic or other moving loads, and having an opening measured along the center of the roadway of more than 20 feet between undercopings of abutments or spring lines of arches, or extreme ends of openings for multiple boxes; it may also include multiple pipes, where the clear distance between openings is less than half of the smaller contiguous opening."

A. **General Map showing:**

(1) A key map locating the general map area within the State.

(2) A legend of symbols used for existing and constructed facilities.

(3) The location of the structure site, alignment of the roadway, highway, access road or railway.

(4) Existing towns, highways, roads, railroads and shipping points, public and private utilities such as electric power, telephone lines, pipelines, etc., transmission lines, substations, canals, dams, rivers and streams, stream-gauging stations (required only for bridges crossing rivers or streams), county, township, range, and section lines.

(5) Locations of potential construction and permanent access roads, detour routes and major crossings.

(6) Locations of borrow areas for natural construction materials, location of commercial quarries, and disposal areas for waste excavation.

(7) Location of contractor's staging areas, storage of construction materials, sites for stockpiling soil.

(8) Limits of construction or physical boundaries of the proposed bridge site, such as restrictions to land uses, easement and right-of-way.

(9) Existing or potential areas or features having a bearing on the design, construction, possible use and future maintenance of the proposed bridge such as: recreation areas, fish and wildlife areas, building areas, and areas of archeological, historical and mining or paleontological interest. The locations of these features should bear the parenthetical reference to the agency most concerned; for example, Reclamation, NPS, or FWS.

(10) Sources of construction power and potable water to be used for construction.

(11) Scale on the general map should be adequate to clearly show listed details and north arrow.

B. **General Description of Local Conditions Covering:**

(1) **General Engineering Requirements.** There should be a narrative of the project area, which includes a brief description of the surrounding area, the size of the nearest population centers, the condition of bridges and other structures and roads. This description shall include the following (if available):

(a) Location (structure name, structure number, state, county or route number, distance to nearest city or town, etc).

(b) Project description (new structure, replacement, or modification required due to necessary improvements, etc.).

(c) Site description (information relating to access for possible site visit by the design team, access for foundation exploration, and construction, and access limitations due to environmental restrictions, etc.).

(d) Weather and climate conditions that may affect design or construction (temperature extremes, local building code requirements for wind velocities, snow and ice loading, etc.). Rainfall intensity at the site for an estimated 25-year return period event simulated into 5-minute duration increments.

(e) Utilities such as powerlines, waterlines, or telephone lines that require installation on the bridge superstructure or are in the vicinity and may be impacted by the project. Include names, telephone numbers, and internet and email addresses of the local utilities and names of contacts within their organization.

(f) Provide copies of relevant correspondence to and from stakeholders such as Federal, State or local agencies or private entities. These stakeholders input may have an impact in the

design reviews or permitting process. Provide name of contact person, address, telephone number, internet and email address for potential direct contact by the design team.

(g) Provide copies of previous reports or studies that have been prepared by Reclamation or by others.

(h) For bridges crossing rivers or streams, describe waterway condition that may affect design, construction, and operation and maintenance procedures.

(i) The approximate distance from the nearest railroad shipping terminal to the structure site; load restrictions and physical inadequacies of existing roads and structures and an estimate of remedial improvements to accommodate construction hauling; and possible alternative means for delivering construction materials and equipment at the structure site.

(j) Local freight or trucking rates.

(k) Estimated construction timeframes (limitations imposed by such items as traffic, environmental concerns and weather).

(l) Detour requirements and how construction may be staged.

C. **Surface Data:**

(1) **Survey Control.** Survey control is required for all surveys including surveys associated with aerial photography. 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 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.

(2) **Topographic Map.** When the horizontal alignment of the proposed bridge is known, the topographic map should embrace a minimum area of 100 feet upstream and 100 feet downstream and 100 feet beyond the ends of the structure. This area may have to be enlarged to cover any alternate alignments being evaluated or specific construction items such as cut and fill limits and channel modifications. Generally, both a map and an electronic file, in AutoCAD or compatible format, of the topography covering the structure site should be provided. The topographic map should be plotted to a scale of 1 inch equals 10 feet to 1 inch equals 20 feet with a maximum contour interval of 2-feet (if the project area is flat or small, a 1-foot contour interval may be required). Elsewhere, larger contour intervals may be acceptable. The location and identification of all subsurface explorations should be shown on the map. Details to be included are:

(a) Proposed bridge location.

(b) Underwater contours.

(c) Locate and identify existing site features which would be important design information such as roads, parking, turnarounds, buildings, structures, power lines, buried utility lines, campgrounds, picnic areas, springs, marsh areas, overflow channels, channel changes, edge of water, high water marks, types of vegetative cover, large boulders, exposed rock, etc.

(d) Existing right-of-way and proposed acquisition of additional right-of-way should be discussed.

(e) Provide a profile along the existing or proposed road centerline extending at least 500 feet beyond the ends of the bridge. The profile should be plotted to a horizontal scale of 1 inch equals 20 feet. Indicate recommended grade; elevations of extreme low, present and extreme high water; elevations of the stream bottom in the vicinity of the proposed piers or abutments; and type of foundation material underlying the substructure locations.

(f) Provide water surface elevations on the date of the survey and a thalweg of the stream bottom where practical for a minimum distance of 500 feet upstream and 500 feet downstream from the centerline of the proposed bridge. These profiles should be plotted to a horizontal scale of 1 inch equals 50 feet and a vertical scale equals 10 feet.

(g) 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.

(3) **Aerial Photographs.** Aerial photographs (9-inch by 9-inch color infrared photos at 1:24,000 scale) of the bridge site. The purpose of the aerial views is to permit early preparation of an artist's rendition of the bridge and to permit a study of the environmental impact of the structure. Later such renditions or drawings may be used for inclusion in specifications or for other purposes.

(4) **Photographs.** Digital color photographs of all existing facilities or structures in the vicinity of the proposed bridge site with close-up views of any features which may affect designs. These photographs should be taken to best show the proposed structure and, if possible, indicate known tie points to the topographic maps.

(a) All photos should be keyed to the site map. Photos should show problem or hazardous areas, location of the proposed bridge, location of possible access points to the site from existing routes, and close ups of existing features such as buildings and other structures. These photos should also show favorable offsite views that should be preserved and considered when determining bridge location.

D. **Foundation Investigation Data:**

(1) **General Engineering Requirements.** The need for foundation data should be established by originating office personnel with assistance from the region and TSC representatives. For major bridge structures and unusual or difficult road alignments, it is recommended that an onsite inspection and a field conference be held.

The purpose of performing foundation investigations is to determine the elevation of suitable foundation materials to support the bridge abutments and piers. The foundation investigations help determine the profile of the subsurface materials in the areas of the abutments or piers and show graphic logs of the subsurface exploration. Although some foundation investigation is usually required for all structures, in some cases an extensive exploration program may not be necessary for smaller buried structures.

The TSC design team will prepare preliminary bridge design layouts and a field exploration request. The TSC geologic and geophysical staff will

work with the appropriate field staff and provide necessary assistance and guidance in the gathering of these design data.

(2) **Geologic Data.** The following list of geologic design data provides general guidelines for the collection and reporting of geologic information for bridges. The data should reflect a recognition and consideration of the scope and size of bridge structure anticipated. The geologist should apply these guidelines with good judgment and sound reasoning, elaborating upon them as required by the particular geologic setting and engineering requirements. Because the collection of geologic data is a dynamic process and often continues into the preparation of final designs, all stages of the specification design geologic exploration program must be constantly coordinated with the designer through the appropriate geology office.

(a) A description of the regional geology.

(b) Compilation, summary, and reporting of Reclamation and non-Reclamation geologic information on the area with attention being paid to the sequence of explorations and historical geologic events.

(c) A surface geologic map of the bridge site, plotted on the topographic map of the bridge site, showing surface geology and the location of geologic sections, soil profiles, and of all subsurface explorations, including coordinates or stationing.

(d) A description and interpretation of site geology including physical quality and geologic structure of the foundation strata, seasonal ground water, ground subsidence, existing and potential landslide, snowslide and rock fall areas, surface water runoff; and engineering geologic interpretations appropriate to the structure involved, including the conditions expected during excavation and construction.

(e) Geologic logs of all subsurface exploration. An exploratory drill hole is required at each critical bridge foundation element (abutment or pier). The coordinate location and ground surface elevation of all existing and subsequent exploratory drill holes should conform to the permanent survey control system.

(f) Exploratory drill holes should be at least 50 feet long or extend 10 feet into competent bedrock. Logs shall include split tube blow counts at a minimum of 5-foot intervals.

(g) Geologic cross sections, with detailed soil profiles as required, showing known and interpreted subsurface conditions. Soil

classification in accordance with the Unified Soil Classification System.

(h) Digital color photographs of pertinent geologic and topographic features of the terrain.

(i) Selected determination of engineering properties of surficial deposits and bedrock by laboratory or field tests (in-place density, penetration resistance, permeability, shear strength, and consolidation or expansion characteristics, etc.). The type and number of samples and tests required should be determined in cooperation with the TSC.

(j) Samples of foundation strata as needed for visual examination or laboratory testing. Test pits and results of material testing should be included.

(k) For bridges over rivers and streams, in-stream material samples to determine D_{50} for scour analysis.

(l) Soil survey to determine suitability of soils and type of materials to be used for backfill behind bridge abutments and wing walls.

(m) Determine age of faulting in vicinity, especially if suspected to be late Pleistocene or Holocene, to assist in the determination of the seismic loading by design specialists in the TSC.

(n) Determine ground water conditions with attention being paid to water levels and their seasonal fluctuation occurrence of unconfined and confined aquifers, potential seepage areas, water-producing capabilities, chemistry, and land subsidence.

(o) Determine geologic conditions which may affect construction methods such as, boulders on ground surface, marshes, drilling conditions, and stability of grout or footing holes, ground temperatures, gases. Any potential surface water runoff problems should be brought to the attention of a regional hydrologist

(3) **Engineering Data:**

(a) Surficial soils (see *Earth Manual*, latest edition). Note geologic sections and soil profiles in (2) (c) above.

- A classification, in accordance with the Unified Soil Classification System, of the soil in each major strata.

- A description of the undisturbed state of the soil in each major strata.

- A delineation of the lateral extent and thickness of critical, competent, poor, or potentially unstable strata, including swelling minerals, gypsum and other sulfates, caliche, etc., in foundations and excavation slopes, (especially those to be permanently exposed).

- An estimate or a determination by tests of the significant engineering properties of the strata, such as density, permeability, shear strength, and consolidation or expansion characteristics; and the effect of structure load, changes in moisture, and fluctuations or permanent rise of ground water on these properties.

- A determination by tests of the corrosive properties and sulfate content of the soil and ground water

(b) Bedrock (see *Engineering Geology Field Manual*). Note geologic sections and soil profiles in (2) (c) above.

- A contour map of the top of bedrock. A description of thickness of weathered, altered, fractured, or otherwise softened zones and other structural weaknesses and discontinuities.

- A delineation of structurally weak, pervious, and potentially unstable zones and strata of soft rock and/or soil in foundations and excavation slopes (especially those to be permanently exposed) with attention being paid to engineering matters such as swelling minerals, presence of gypsum and other sulfates, caliche, etc.

- An estimate or a determination by tests of the significant engineering properties of the bedrock such as density, absorption, permeability, shear strength, and strain characteristics; and the effect of structure load, changes in moisture, and fluctuations or permanent rise of ground water on those properties

E. **Hydrologic Data (required for bridges crossing rivers and streams):**

(1) Annual periodic fluctuations of stream or river water levels.

(2) Flood frequency design flows for 50 and 100 year intervals.

(3) Estimated water surface elevations on date of survey.

(4) 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.

(5) Provide at least three cross sections of the stream. One section should be taken at or near the centerline of the bridge and the other sections 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.

(6) Drainage area located upstream of the bridge site.

(7) Include information on any existing downstream natural barriers or river control works affecting tailwater and available data on past degradation or aggradation of stream channel and possibility of future changes.

(8) Where unwatering of a bridge site adjacent to a stream or lake is required, give maximum water levels expected during the construction period and the possibility of controlling water levels by operation of upstream or downstream facilities.

(9) Information for preparation of specifications hydrographs at the TSC, including the location of gauging stations at or near the structure site and the dates for which hydrographs should be prepared. Copies of the daily discharge record should be supplied for stations with unpublished records.

(10) Anticipated occurrence and amounts of sediment, ice (thickness), and drift (trash).

(11) Analysis of water for chemical and physical characteristics and biological quality. Analysis should include a water quality analysis of intake water to include major ions and cations, corrosivity, and parameters listed as maximum contaminant limits in the Surface Water Treatment Rule, Safe Drinking Water Act.

(12) Erosion protection requirements and calculated scour depths, which will be used for support structure foundation design.

F. **Design Standards:** For vehicular bridges, the design code is the AASHTO LRFD Design Specifications published by AASHTO. Applicable state design standards will also be followed when these requirements are more stringent than AASHTO's. The following is a list of the types of facilities carried by the bridge structures that are designed at the TSC.

(1) Highways and roads open to the public.

(a) New bridge designs shall be based on construction to current standards where traffic count and other considerations show justification. Bridge clear widths on public roads shall meet requirements of State, county, city, or local entity standards for the road classification.

(b) Replacement in kind shall be used where the existing bridge design live load and roadway width are equivalent to current standards and are considered adequate or where there is no justification for upgrading to higher or current standards.

(c) Live load requirements higher than current standards shall be used only when there is a special need or consideration. An example is heavy construction vehicle traffic.

(2) Access roads. Designs shall be based on AASHTO design guidelines for access roads with modifications for unusual circumstances such as the need for higher standards due to the magnitude of the project, special haul problems, recreation needs, etc.

(3) Recreation roads. Relocated roads, highways, or access roads intended for recreation purposes or which will contribute to such purposes may be constructed to higher standards with justifications, and shall be fully identified and described, including the proposed standards, at the feasibility design.

(4) Railroads. Designs shall be based on replacement in kind with consideration given to higher standards as required by AREMA.

(5) Repair and rehabilitation of existing bridges. Designs shall be based on restoration to original load capacity unless there is justification for upgrading to current standards.

(6) Modification of existing bridges. Widening, lengthening, earthquake retrofit, permit load strengthening, or installing other features (fencing, railing, etc) to existing bridges shall have justification and shall be fully identified and described, including proposed standards.

(7) Other unique purpose. They shall be fully identified and described, including proposed standards.

(8) Pedestrian access bridges are to be designed in accordance with AASHTO's *Guide Specifications for Pedestrian Bridges*.

G. **User and Operating Data:**

(1) For road and highways:

(a) Number of traffic lanes, including shoulders.

(b) Typical roadway cross section.

(c) Pedestrian sidewalk requirements.

(d) Design loading other than HS20, load limits.

(e) Deck protection or rehabilitation – thickness and type of surfacing, or future surfacing, i.e. asphalt overlays.

(f) For rehabilitation or replacement – existing structure information including as-built drawings, the condition of concrete, steel, and timber material, etc.

(g) For replacement – the disposal of old bridge.

(h) Existing cross drainage structures located within the proposed construction site, including hydraulic requirements.

(2) Current and future activities and needs: The current and future road classification. The future classification from the county or State Department of Transportation responsible for road maintenance. Include type of equipments or vehicles that will cross the bridge.

(3) For railroad bridges:

(a) Track classification, type of service, limiting grades and curvature, design load limits, other operating limitations or requirements, and typical roadbed section showing depth and type of ballast, weight of rail, size, spacing, and type of tie.

(b) Information on operating facilities, such as communication or signal lines. Provide a point of contact and phone number for the railroad.

(4) Utility requirements of the user (water, electricity, sewer).

H. **Miscellaneous Data:** The bridge roadway design cross section should be coordinated with the required cross section for roadways or railroads. See Section 7 G (1) for typically required data for roadways or railroads. In addition, plan and profile drawings showing the following should be provided:

(1) For highway or road bridges, the plan and profile drawings (prepared in electronic format and plotted on 22 inches by 34 inches, Architectural D, with horizontal scale of 1 inch equals 100 feet and vertical scale of 1 inch equals 10 feet) showing:

(a) Horizontal position of road centerline with complete curve information, right-of-way lines, existing road for 500 feet each way from points of intersection, and any survey ties.

(b) Vertical position on road centerline of the original ground line, new subgrade (with complete information on grades, elevations, and vertical curves), existing road surface for 500 feet each way from points of intersection, and any survey ties or datum equations.

(c) Location, type, and nominal dimensions of all required structures (bridges, culverts, etc.).

(d) Location of any existing intersecting facilities, watercourses, or other physical features affecting the new bridge.

(e) Location of protective ditches and dikes.

(f) Location of guardrails, guard posts, or delineators.

(g) Location and type of right-of-way fences and gates.

(2) For railroad bridges, the plan and profile drawings (prepared in electronic format and plotted on 22 inches by 34 inches, Architectural D, with horizontal scale of 1 inch equals 200 feet and vertical scale 1 inch equals 20 feet) showing:

(a) Horizontal position of track centerline with complete curve and spiral information, right-of-way lines, existing track for 1,000 feet each way from points of connection, and any survey ties.

(b) Vertical position on track centerline of original ground line, new subgrade (with complete information on grades, elevations, and vertical curves), existing subgrade for 1,000 feet each way from points of connection, and any survey ties or datum equations.

(c) Location, type, and nominal dimensions of all required structures and operating facilities (bridges, culverts, ditches, passing tracks, sidings, motorcar set-offs, etc.).

(d) Location of any existing intersecting facilities, watercourses, or other physical features affecting the new line.

(e) Location of protective ditches and dikes.

(f) Location and type of right-of-way fencing and gate

I. **Construction Materials Data Including:**

(1) Location and estimated available quantities: Distance to suitable borrow areas for permeable and impermeable soil materials required for fill or embankment; distance to quarry or stockpile for riprap required for channel or slope protection. If quantities are limited, give approximate volumes available.

(2) An earth materials report containing complete detailed information on those potential sources of soils and rocks that have been selected for final consideration. (See *Earth Manual*.).

(3) Information on concrete aggregates. (See "Final Investigations" in *Concrete Manual*.)

(4) Data on commercial concrete and precast concrete plants within practical hauling distance from the bridge site.

(5) Estimated quantities for all construction schedule items which cannot readily be determined in design office, i.e., earthwork (common and rock), overhaul of roadway excavation with free-haul distance, riprap guardrail, culverts, and right-of-way fencing and gates.

(6) Results of sampling and analysis of materials, including previous tests conducted at the TSC.

(7) Geologic data describing construction materials to be obtained from commercial sources.

J. **Cost Data:**

(1) Estimate of cost of right-of-way or easements. Include supporting data.

(2) Information on local labor supply and labor problems.

(3) Information on important construction works in progress or planned in the vicinity and the presence of interested contractors or subcontractors in the area.

(4) Estimates of cost for relocating public utilities within the construction area. Include supporting data.

(5) Estimates of cost for removal of buildings and other structures within the construction area. Include a general description and recommended disposal of the structures.

(6) Provide any pertinent cost estimates or information that has been prepared or obtained by Reclamation or the owner. The cost estimates shall include a description or outline of estimating methods and data used.

(7) Designated areas to be cleared of vegetation, with description of kinds, size, and density of growth. State recommended method of payment, i.e., lump-sum price for area with defined limits or unit price per acre for area with limits subject to change during construction. Use separate payment items for clearly defined areas differing in growth density and difficulty of clearing operations. If vegetation to be cleared is very sparse or can be removed without special equipment or separate operations, the cost of clearing should be included in the prices bid for excavation or prices bid for other appropriate items of work

K. **Environmental Considerations.** Implementation of design features should be consistent with the environmental commitments listed in the project's NEPA compliance document. Implementation of design features should be consistent with agreements reached between Interior bureaus, Federal agencies, and other governmental agencies.

Design data should include, as a minimum, a brief description of the environmental resources that could be affected by the proposed development. The emphasis should be on those areas within the range of alternatives open to the designers in developing a railroad or highway relocation, an access road alignment, or a bridge structural design. The following items should also be considered in preparing design data:

(1) Cultural (historical, archeological, architectural, and paleontological) resources along or adjacent to any potential alignment.

(2) The need for blending the bridge structure with the surroundings and the need for restoring and for reseeding cuts and fills.

(3) Comment on any ecological, aesthetic, or other environmental aspects peculiar to this location which would affect the bridge layout or roadway approaches.

(4) Indicate the suitability and possibility of present or future use of land adjacent to Reclamation facilities by the public for recreation, hobbies, sports, leisure, education, health, housing, etc. Provide data on zoning regulations and subdivision proposals.

(5) Furnish data on allowable noise limits in the vicinity of the proposed bridge where fixed by law or local ordinance, or where otherwise considered necessary or advisable; measurements of existing daytime and nighttime ambient noise levels in the area; and distances to the nearest residential units.

(6) Identify special environmental compliance requirements including water quality standards such as suppression of nitrogen, adequate oxygen levels, and temperature control and control of turbidity during construction; preservation of existing growth adjacent to construction; obliteration of temporary or abandoned roadways and restoration to original appearance; dust abatement, etc. Give recommendations on steps to be taken to meet these requirements.

(7) Impact of moving construction materials on existing road facilities, including consideration of such factors as traffic congestion, effect on road condition, air pollution, etc.

(8) Background on the need for fish protection and passage during construction at stream crossings.

(9) Recommendations or commitments to maintain specific flow requirements for biological and/or recreational resources.

(10) Any threatened and/or endangered critical habitat in/or adjacent to the potential alignments.

(11) The need for game/livestock protection, including crossings, fencing, etc.

(12) Wildlife, wetlands, required environmental permits, construction window, traffic restrictions, and detour requirements.

(13) Comment on disposal of material from clearing operations. Consider State and local burning regulations, burying or chipping of materials, and maximum utilization of merchantable timber.

(14) Limitations that may affect in-stream construction, foundation investigation work. Restrictions for encroaching onto the waterway for placing falsework, cofferdams, sheet piles, etc.

(15) Erosion and sediment control.

(16) The need for a field conference to resolve critical environmental problems with participation of other agencies.

(17) Review of designs by other agencies.

(18) Railroad, highway, or access road clearing plan to consider fish and wildlife requirements.

(19) Anticipated public use of Reclamation access roads.

(20) State and local building codes when applicable.

(21) Water for construction purposes.

(22) Applicable permits and monitoring requirements.

L. **Site Security.** Many Reclamation projects may require a security risk assessment. The need for a site-specific security risk assessment should be considered for feasibility designs where an assessment may impact the field cost estimate and for specifications designs. Specific issues to consider are contained in Section 14 of Chapter 7 – Site Security and Public and Worker Safety. If assistance is required to determine specific design data needs, contact the Office of Security, Safety and Law Enforcement. Where design data and designs include site-specific security assessment, compliance with Reclamation Manual DM Part 444 – Physical Protection and Facility Security, Chapters 1 and 2 is required.

18. Removal of Dams and Hydroelectric Facilities. (A design data collection section has not been prepared for these features. Until a section is prepared, the following reference should be used, "*Guidelines for Retirement of Dams and Hydroelectric Facilities*," Task Committee on Guidelines for Retirement of Dams and Hydroelectric Facilities, American Society of Civil Engineers (1997)).

The Introduction (Chapter 1) for these design data collection guidelines contains additional information concerning: preparing a design data collection request, design data collection requirements, and coordinating the design data collection and submittal.

19. Water Treatment Plants. The Introduction (Chapter 1) for these design data collection guidelines contains additional information concerning: preparing a design data collection request, design data collection requirements, and coordinating the design data collection and submittal.

The following is a list of possible data required for specifications design of water treatment facilities. The size and complexity of the process system and structures should govern the amount and detail of the design data required.

A. **General Map Showing:**

(1) A key map locating the general map area within the State.

(2) The plant site and other applicable construction areas.

(3) Existing towns, highways, roads, railroads, public utilities (electric power, telephone lines, pipelines, etc.), streams, stream-gauging stations, canals, drainage channels.

(4) Existing or potential areas or features having a bearing on the design, construction, operation, or management of the project feature such as: recreation areas; fish and wildlife areas; building areas; and areas of archeological, historical, and mining or paleontological interest. The locations of these features should bear the parenthetical reference to the agency most concerned: for example Reclamation.

(5) County lines, township lines, range lines, and section lines.

(6) Locations of construction access roads, permanent roads, and sites for required construction facilities.

(7) Sources of natural construction materials and disposal areas for waste material, including the extent of mitigation required.

(a) Location of disposal areas for debris, sediment, sludge, and spent chemicals from cleaning or storage solutions.

(8) Water sources to be treated such as surface water or underground water.

(9) Location of potential waste areas (i.e., channels).

(10) Brine disposal ponds.

(a) Location of disposal ponds.

(b) Location of channels and storage locations for brines, sludge, and chemicals.

(c) Locations of disposal areas for pond residue waste material.

(11) Scale of general map should be adequate to clearly show listed details.

B. **General Description of Local Conditions Covering:**

(1) The approximate distance from the nearest railroad shipping terminal to the structure site; load restrictions and physical inadequacies of existing roads and structures and an estimate of remedial improvements to accommodate construction hauling; estimate of length and major structures required for new construction access road; and possible alternative means for delivering construction materials and equipment at the structure site.

(2) Availability of housing and other facilities in nearest towns, requirements for a construction camp, and need for permanent buildings for operating personnel.

(3) Availability or accessibility of public facilities or utilities such as: water supply; sewage disposal; telephone utility; fire protection services; and electric power for construction.

(4) Climatic conditions that will affect construction and operation and maintenance procedures such as: amount, rate, and distribution of rain and/or snow; ice conditions; monthly maximum and minimum (or at least summer and winter) temperatures, and relative humidity; extreme wind velocities and prevailing directions; and probability of excessive dust or sand.

(5) Names, telephone numbers, email addresses and web sites of local utilities; and contacts within those organizations.

(6) Copies of existing feasibility, planning or assessment reports.

(7) Permits or permit requirements and any past permit violations or exeedences.

(8) State and local building codes when applicable.

C. **Surface Data:**

(1) **Survey Control**. Permanent horizontal and vertical survey control should be established at the earliest possible time. A coordinate system on a true north-south grid should be established with the origin located so that all of the features (including borrow areas) at a major structure will be in one quadrant, and so that the values of the coordinates for any major structure are widely separated numerically. The coordinate system should be

related to a State or national coordinate system, if available. All preceding survey work, including topography and location and ground surface elevation of subsurface exploration, should be corrected to agree with the permanent control system; and all subsequent survey work, including location and ground surface elevation of subsurface exploration, should be based on the permanent control.

All line surveys should be tied to the established coordinate system at each plant site.

(2) **Topographic Map:**

A topographic map covering an area sufficient to include all practical arrangements of the facilities including intake, product and reject lines, brine ponds, switchyard or substation, service area, sludge disposal area, trash disposal area, and visitor facilities. Show all manmade features in the included area on the map. A scale of 1-inch equals 50 feet with a 2-foot contour interval is suitable for most structures. The scale, contour interval, and detail should be based on the conditions and need at each particular site.

(3) **Aerial Photographs:**

Aerial photographs (size 8 by 10 inches, color if feasible) of the sites of major dams and structures. The purpose of the aerial views is to permit early preparation of an artist's rendition of the feature and to permit a study of the environmental impact of the structure. Later such renditions or drawings may be used for inclusion in specifications or for other purposes.

These photographs should be taken from locations that would best show the proposed structure and from a vertical angle of approximately 20 to 30 degrees above the horizontal. Where possible, indicate known tie points to the topographic maps. These photographs should be taken between 11 a.m. and 2 p.m., so as not to show the principal area of the proposed structure in shadow. Also submit the negatives or color slides.

Each region is urged to provide these photographs for smaller dams or auxiliary structures whenever it is considered that artist’s conceptions would be beneficial to the project and the architectural designs would be influenced by the physical characteristics of the area.

(4) **Photographs:**

Color photographs of all existing facilities or structures in the vicinity of the proposed plant and closeup views of any features which may affect designs. Black and white photographs are acceptable for structures to be

removed or demolished. Color or Black and White Photographs of structure sites with structure locations marked in ink.

D. **Foundation Data:**

The amount and detail of foundation data required for a specifications design will vary. The guiding criteria should be to provide sufficient data to allow the designer to determine the type of foundation required for the structures and to identify major foundation problems. Adequate foundation data may be obtained for small structures from an inspection of surface conditions and one or two exploratory holes to determine type of overburden and foundation conditions some distance below the base of the structure. These data, and any other data in the following paragraph that are relevant, along with a brief description of geologic conditions of the site, can be included in the design data.

A geologic report shall be prepared and a field conference should be held, including an inspection of the site to determine the geologic investigations program. In developing the geologic program and in preparing the geologic report, the following should be considered:

(1) **Geologic Data:**

(a) A description of regional geology.

(b) A description and interpretation of site geology including physical quality and geologic structure of the foundation strata, seasonal ground water, ground subsidence, seismic conditions, existing and potential landslide, snowslide and rock fall areas, surface water runoff, and engineering geologic interpretations appropriate to the engineering structure involved including the conditions expected during excavation and construction.

(c) Geologic logs of all subsurface exploration. The coordinate location and ground surface elevation of all existing exploratory holes should, if necessary, be corrected to conform with the permanent survey control system; and all subsequent exploratory hole locations and elevations should be based on the same survey control system.

(d) A geologic map, plotted on the topographic map of the site, showing surface geology and the location of geologic sections, soil profiles, and all subsurface exploration.

(e) Geologic sections, with detailed soil profiles as required, showing known and interpreted subsurface conditions.

(f) Exploration holes should be extended into the foundation material well below the base of the structure. An effort should be made to run borehole geophysical logs when appropriate.

(g) Color photographs of pertinent geologic and topographic features of the terrain including aerial photographs if available.

(h) Samples of foundation strata as needed for visual examination or laboratory testing.

(i) Determine age of faulting in vicinity, especially if suspected to be late Pleistocene or Holocene, to assist in the determination of the seismic loading by specialists.

(j) A determination of natural ground water level.

(2) **Engineering Data:**

(a) Surficial soils (see *Earth Manual*, latest edition). Note geologic sections and soil profiles in (1)(e) above.

- A classification, in accordance with the Unified Classification System, of the soil in each major strata.
- A description of the undisturbed state of the soil in each major strata.
- A delineation of the lateral extent and thickness of critical, competent, poor, or potentially unstable strata including swelling minerals, gypsum and other sulfates, caliche, etc., in foundations and excavation slopes, especially those to be permanently exposed.
- An estimate or a determination by tests of the significant engineering properties of the strata, such as density, permeability, shear strength, and consolidation or expansion characteristics; and the effect of structure load, changes in moisture and fluctuations, or permanent rise of ground water on these properties.
- A determination by tests of the corrosive properties and sulfate content of the soil and ground water.

(b) Bedrock (see *Engineering Geology Field Manual*). Note geologic sections and soil profiles in (1)(e) above.

- A contour map of the top of bedrock. A description of thickness of weathered, altered, fractured, or otherwise softened zones, and other structural weaknesses and discontinuities.

- A delineation of structurally weak, pervious, and potentially unstable zones and strata of soft rock and/or soil in foundations and excavation slopes, especially those to be permanently exposed, with attention being paid to engineering matters such as swelling minerals, presence of gypsum and other sulfates, caliche, etc.

- An estimate or a determination by tests of the significant engineering properties of the bedrock such as density, absorption, permeability, shear strength, and strain characteristics; and the effect of structure load, changes in moisture, and fluctuations or permanent rise of ground water on those properties.

(c) Brine disposal ponds:

- Excavation, fill and slope lines for ponds.

- Special problems such as possible ground water contamination and regulations governing seepage losses should be addressed.

- Major soil types should be identified including significant factors such as expansive and low-density soils, dispersive soils, rock. Material tests should be performed as required to identify problem soils.

- Water table elevation.

- Lining recommendations will be considered along with the foundation material in making recommendations regarding lining. See "*Brine Disposal Pond Manual*."

E. **Corrosion Survey:**

(1) In situ electrical resistivity measurements of geologic materials in the area of construction. Additional measurements should be made in the areas where there is a pronounced change in type of geologic materials, drainage, and/or moisture conditions.

(2) Performance history of construction materials that have been used in the area.

(3) List of structures in the vicinity of (within ¼ mile) the proposed structure and appurtenant features. Determine if buried structures in the vicinity have corrosion protection and, if so, the type of corrosion protection.

(4) List location, output, and purpose of the direct-current sources in the earth situated within ¼ mile of the proposed structure and appurtenant features. If the purpose of the direct current is for cathodic protection, describe the structure protected and its location.

(5) Chemistry of geologic materials, ground water, and/or product water.

F. **Construction Materials Including:**

(1) An earth materials report containing complete detailed information on those potential sources of soils and rocks that have been selected for final consideration. (See *Earth Manual*.)

(2) Location and distance to suitable borrow areas for permeable and impermeable soil materials for fill or embankment; and for riprap for channel or slope protection. If quantities are limited, give approximate volumes available.

(3) Information on concrete aggregates. (See "Final Investigations" in *Concrete Manual*., "Investigation and Selection of Concrete Materials," 8th Edition).

(4) Information on sources and character of acceptable road surfacing materials. Consider excavated material as a possible source.

(5) Data on commercial concrete plants within practical hauling distance from the structure site.

(6) Information including catalogs on firms within practical hauling distance from the site manufacturing precast concrete products and brick or other masonry units.

(7) Results of sampling and analysis of materials, including previous tests.

G. **Hydrologic Data:**

(1) Description of feed water source (surface water, ground water, drains, wells, wastewater, partially treated wastewater, etc.).

(2) Monthly periodic fluctuations of feed water flows shown by tables or charts summarizing operation studies for normal and minimum and

maximum periods. Include periods of expected no-flow or aquifer size and recharge rate monthly averages.

(3) Maximum, maximum and minimum operating water surface elevations; flood flows; average flow. For under ground sources, include expected drawdown during pumping as a function of pumping rate.

(4) Recommend minimum trashrack or gate deck elevation.

(5) Anticipated occurrence and amounts of silt, sediments, biomass, ice (thickness) and drift (trash), and possible effect on feedwater source outlets to pretreatment plants or inlets to desalting plants.

(6) Potential location for and volume of reservoir(s) suitable for leveling of daily or annual fluctuation in flow or salinity of water source.

(7) Where unwatering of a plant site adjacent to a stream or lake is required, give maximum water levels expected during the construction period and the possibility of controlling water levels by operation of upstream or downstream facilities.

(8) Determine composition of feed water; see table 2 at the end of this section.

(9) For brine disposal ponds obtain flood frequency flows for major surface channels.

H. **Operating Data:**

A testing program may be required to assimilate these data:

(1) Results of investigations or design studies proposed during feasibility design.

(2) Results of pretreatment studies carried out at or near the proposed facility site.

(3) Commitments for water delivery. Product water use and distribution requirements. Projected monthly quantity of product water delivery on demand basis or minimum delivery required over useful plant life.

(4) Recommendations on whether plant should be an indoor or outdoor structure.

(5) Flow, pressure, or other parameters and measurement accuracy requirements.

(6) Future plans for facility expansion. Proposed initial and ultimate plant capacity, and staged construction recommendations.

(7) Product water quality data to include the following:

(a) Desired salinity and pH of product water and limits on specific ion levels, if applicable.

(b) Desired percent of water recovery.

(c) Post treatment requirements for pH and limitations on chemical constituents for the desalting plant product water and brine reject.

(8) Recommendations for maintenance of water quality standards including:

(a) Published guidelines and regulations for air and water quality standards.

(b) Suppression of nitrogen, adequate oxygen levels, and temperature control and control of turbidity during construction; also requirements for multilevel intakes.

(9) Maximum acceptable cost of product water, dollars per thousand gallons.

(10) Profile, alignment, and requirements for intake, product, and reject lines; recommended types of pipe and types of coatings and linings.

(11) Current estimated dollar value of:

(a) Product water.

(b) Salt removed.

(c) Water to replace reject.

(12) The availability and cost of possible energy sources:

(a) Amount of power required for operation of facilities.

(b) Electrical (see also Section 2, "Powerplants and Pumping Plants").

- Location and direction of existing or proposed incoming powerlines terminating at site.

- Source and voltage of incoming power. Name of agency or utility supplying power, limitation on motor starting voltage drops and number of starts, power factor limitation, and distance to source.

- Power voltage, number of phases, and capacity of existing transmission lines; power rate (power company energy and

demand charges), schedules; probability of interruption of supply; and requirements for additional transmission line, if needed.

- Existence of transmission lines of other agencies and utility companies operating in the area which might influence connection of power units; furnish voltage, capacity, type of construction, and distance for these lines from pretreatment and desalting facilities.
- Short circuit capacity of incoming power systems.
- A copy of applicable power company regulations.
- If a switchyard is required, refer to Section 10, "Switchyards and Substations."
- Other energy sources, fossil fuel, solar, geothermal, wind.

(13) Disposal sites locations:

(a) The suggested disposal sites should be able to meet requirements of either State or the U.S. Environmental Protection Agency for discharge of pollutants.

(b) Plant reject flow.

(c) Debris, biomass, aquatic weeds, sediment, and sludge.

(d) Spent chemicals from pretreatment and desalting cleaning and storage solutions.

(14) Nature of operation, i.e., whether attended, semiautomatic, fully automatic, or supervisory controlled. If supervisory controlled, give location of master station.

(15) Regional comprehensive operating scheme, including possible integration with any existing scheme.

(16) Availability, cost, and method of shipment of treatment chemicals, such as:

(a) Lime, CaO, and $Ca(OH)_2$.

(b) Soda ash, Na_2CO_3.

(c) Ferric sulfate.

(d) Chlorine.

(e) Carbon dioxide.

(f) Sulfuric acid, H_2SO_4.

(g) Sodium hexametaphosphate.

(h) Others.

(17) For brine disposal ponds:

(a) Source and quantity of water.

(b) Water surface elevations and capacity at inlet control.

(c) Annual net evaporation rates and monthly distribution.

(d) Average monthly wind velocities and prevailing direction.

(e) Plan of operation for disposal pond controls including extent of supervisory control.

(f) Provisions for surface drainage in the area of disposal ponds.

(g) Provisions for cleaning ponds and delineation of disposal areas for residue from ponds.

(h) Possible utilization of residue from ponds such as reclaiming chemicals, etc.

(i) Evaporation enhancement programs to be considered such as spray or dyes.

(18) If recalcination is to be considered provide information for determining the feasibility of recalcination, such as environmental factors and market potential for excess lime.

(19) Market potential for treatment byproducts such as sludge or brine.

(20) Estimated number of O&M personnel.

(21) Source of potable water.

(22) State potable water standards and water treatment requirements.

(23) Source of water supply for fire protection.

(24) Description of work tasks that require special lighting.

(25) Availability of plant equipment repair shops in vicinity; provisions of central shop. Recommendation for maintenance facilities.

(26) Disposition of existing facilities in the area such as pipelines, power and telephone lines, and fences.

(27) Office and file space requirements in facilities

(28) Recommendation for inclusion, in the plant, of a major or minor machine shop or service area. Where a service area or machine shop is specified in a plant, furnish floor area requirements and the name and size of machine tools, benches required, and need for welding booths or rooms.

(29) Special exhaust, heating, ventilating, or air conditioning requirements.

(30) Housed and open O&M storage requirements at site; offsite storage to be provided; existing storage space and facilities.

I. **Right-of-Way.** A marked print showing the following data:

(1) Proposed right-of-way boundaries for construction purposes.

(2) Proposed right-of-way boundaries for access purposes (if required).

(3) Designation of areas within right-of-way boundaries for the following special problems.

(a) Disposal of waste material.

(b) Contractor's plant, storage, and other incidental purposes.

(c) Contractor's camp (if applicable).

(d) Government construction facilities (if applicable).

J. **Environmental Considerations.** Design data should include, as a minimum, a brief description of the environment that could be affected by the proposed development. The emphasis should be on those areas in the range of alternatives open to the designers in developing a process and plant design. The following items should also be considered in preparing design data:

(1) The environmental setting.

(2) Impact of product water quality on proposed use of water or the mixing with natural waters.

(3) Historical and archeological values.

(4) Background on the need for fish facilities, such as fishways and barriers.

(5) Impact of moving construction materials on existing road facilities, including consideration of such factors as traffic congestion, effect on road condition, air pollution, etc.

(6) Erosion and sediment control.

(7) Specify seeding or replanting requirements for erosion control or esthetics.

(8) Comment on disposal of special excavation problem materials such as lignite.

(9) The need for blending structures with the surroundings, including placing transmission circuits underground.

(10) The need for a field conference to resolve critical environmental problems with participation of other agencies.

(11) Anticipated public use around the structure.

(12) Furnish data on allowable noise limits in the vicinity of the proposed facility where fixed by law or local ordinance, or where otherwise considered necessary or advisable; measurements of existing daytime and nighttime ambient noise levels in the area: and distances to the nearest residential units.

(13) Published guidelines and regulations concerning air and water quality standards.

(14) Furnish data on state or local restrictions on the use of soil herbicides or local factors limiting their use.

(15) Recommendations for landscaping and source of irrigation water.

(16) State requirements for wastewater treatment and disposal.

(17) Brine disposal ponds.

(a) The need for escape structures and/or protective fences for human beings, deer, or other wildlife.

(b) Any laws or regulations that pertain to seepage of ground water or disposal of residue from ponds.

(c) Local effects of increased humidity due to evaporation.

K. **Cost Data.** Cost data developed in preliminary estimates should be included.

(1) Where buildings are located within the area to be cleared by the prime contractor, and if disposal will be the contractor's responsibility, designate building groups by number and furnish detailed list of buildings for each group. Details should include general description, size, materials, and general condition. Determine if disposal will be the responsibility of prime contractor. If not, submit dates when disposition will be completed by others**.**

(2) Information on local labor supply and labor problems. Note if there are labor shortages for key trade groups or other concerns which may require premium pay.

(3) Information on important construction work in progress or planned in the vicinity and the presence of interested contractors or subcontractors in the area.

(4) Impact of planned disposal systems.

(5) Interest rate for economic studies.

(6) Power company energy and demand charges.

(7) Pumping power rate for economic studies.

(8) Repayment interest rate.

(9) Local freight or trucking rates.

(10) Estimates of cost of relocating railroads, highways, roads, water systems, and other public utilities. Include supporting data.

(11) Estimate of cost of right-of-way or easements.

(12) Disposition of existing facilities in the construction area such as pipelines, power and telephone lines, and fences.

L. **Site Security:**

(1) Security requirements for protection of plant and equipment from vandalism or sabotage.

(2) Expected visitor load at plant. Requirements for public safety and visitors facilities.

M. **Construction Considerations:**

(1) **Water for Construction Purposes.** For large rivers, this item may be unimportant. For small streams and offstream reservoirs, the item becomes critical. Determine if up to 2-ft^3/s diversion flow for Construction purposes can be assured to the contractor. The Government should obtain the water rights required. If necessary to use ground water, obtain information on probable sources and yields. Furnish information on locations and yields of existing wells in the vicinity. Determine restrictions, if any, to use of ground water for this purpose. It may be necessary to obtain permits from State or other governing agencies. Retrieve water quality samples for testing and evaluation.

(2) Recommended period for construction.

N. **Coordination with Other Agencies:**

(1) List of agencies and organizations outside of Reclamation which will have design and construction requirements inputs. Also, give names of contact persons, mailing addresses, telephone numbers, email addresses, and web sites.

(2) Design data requirements.

(3) Review requirements.

O. **Miscellaneous Data:**

(1) Recommendations for landscaping, irrigation sprinkler system, and source of irrigation water.

(2) Recommendations for inclusion of visitor facilities.

(3) Recommendations for special protection of roof or yard from falling rocks or boulders.

(4) Vegetation to be cleared (kinds, size, and density of growth).

P. **Site Security.** Many Reclamation projects may require a security risk assessment. The need for a site-specific security risk assessment should be considered for feasibility designs where an assessment may impact the field cost estimate and for specifications designs. Specific issues to consider are contained in Section 14 of Chapter 7 – Site Security and Public and Worker Safety. If assistance is required to determine specific design data needs, contact the Office of Security, Safety and Law Enforcement. Where design data and designs include site-specific security assessment, compliance with Reclamation Manual DM Part 444 – Physical Protection and Facility Security, Chapters 1 and 2 is required.

Table 2 – Feedwater quality data requirements

Parameter	Units
Total Hardness as $CaCO_3$	mg/L
Calcium (Ca^{+2})	mg/L
Magnesium (Mg^{+2})	mg/L
Sodium (Na^{+})	mg/L
Potassium (k^{+})	mg/L
Total Cations	meq/L
Total Alkalinity as $CaCO_3$	mg/L
Carbonate (CO_3^{-2})	mg/L
Bicarbonate (HCO_3^{-})	mg/L
Sulfate (SO_4^{-2})	mg/L
Fluoride (F^{-})	mg/L
Chloride (Cl^{-})	mg/L
Nitrate (NO^{-3})	mg/L
Phosphate (PO_4^{-3})	mg/L
Total Anions	meq/L
Aluminum (Al^{+3})	mg/L
Barium (Ba^{+2})	mg/L
Copper (Cu^{+2})	mg/L
Iron (Total)	mg/L
Iron (Dissolved-Fe^{+2})	mg/L
Manganese (Total)	mg/L
Manganese (Dissolved-Mn^{+2})	mg/L
Arsenic (As^{+3})	µg/L
Selenium (Total)	mg/L
Selenium (Dissolved-Se^{-2})	µg/L
Strontium (Sr^{+2})	mg/L
Dissolved Oxygen (O_2)	mg/L
Hydrogen Sulfide/Sulfide	mg/L
Total Suspended Solids	mg/L
Silica (SiO_2)	mg/L
Specific Conductivity	µohm/cm
Total Dissolved Solids (TDS, Evap @ 180 ^{o}C)	mg/L
Total Organic Carbon	mg/L
Temperature	^{o}C
Turbidity	NTU
pH	Unitless
Notes:	
Monthly minimums, maximums and average concentrations of the above parameters for 12 consecutive months is ideal. May need bacteriological (cryptosporidium, giardia, e-coli) data. May need PAH's, HAA's or TTHM data.	