

- 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 exceedences.
- (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 $\text{Ca}(\text{OH})_2$.
- (b) Soda ash, Na_2CO_3 .
- (c) Ferric sulfate.
- (d) Chlorine.

- (e) Carbon dioxide.
 - (f) Sulfuric acid, H₂SO₄.
 - (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-ft³/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 °C)	mg/L
Total Organic Carbon	mg/L
Temperature	°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.	