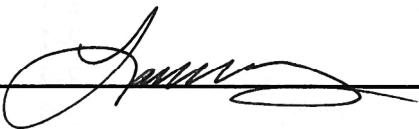


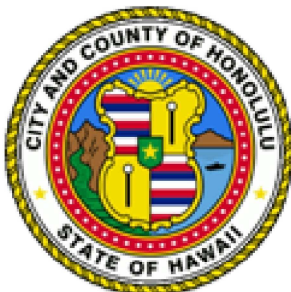
**WASTEWATER SYSTEM
DESIGN STANDARDS
CITY AND COUNTY OF HONOLULU**

July 2017

APPROVED;

Director, Department of Environmental Services





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WASTEWATER SYSTEM DESIGN STANDARDS

VOLUME 1 WASTEWATER COLLECTION SYSTEMS

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ABBREVIATIONS

ABBREVIATIONS

ANSI	American National Standards Institute
BOD, BOD ₅	Biochemical Oxygen Demand
CPA	Capita per acre
CCH, CITY	City and County of Honolulu
CCTV	Closed-circuit television
CF	Cubic feet
CFR	Code of Federal Regulations
CSI	Construction Specifications Institute
DOH	Department of Health, State of Hawaii
DPP	Department of Planning and Permitting, City and County of Honolulu
ENV	Department of Environmental Services, City and County of Honolulu
EPA	U.S. Environmental Protection Agency
FT	Feet
FT/S, FPS	Feet per second
GPAD	Gallons per acre per day
GAL	Gallon
GPCD	Gallons per capita per day
GPD	Gallons per day
GPM	Gallons per minute
HAR	Hawaii Administrative Rules
HECO	Hawaiian Electric Company
HP	Horsepower
IEEE	Institute of Electrical and Electronics Engineers
I/I	Infiltration/inflow
KWH	Kilowatt hour
L	Liter
LB/DAY	Pounds per day
LPSS	Low Pressure Sewer System
µm	Micrometer
MG	Million gallons
MGD	Million gallons per day
MG/L	Milligram per liter

ABBREVIATIONS

MOP	Manual of Practice
NEMA	National Electrical Manufacturers Association
NPSH	Net positive suction head
O&M	Operation and maintenance
PCB	Polychlorinated Biphenyl
PDF	Portable Document Format
POTW	Publically owned treatment works
PSI	Pounds per square inch
SCADA	Supervisory control and data acquisition
SF	Square feet
UIC	Underground Injection Control
USGS	United States Geological Survey
WEC	Department of Environmental Services - Wastewater Engineering and Construction
WEF	Water Environment Federation
WWPS	Wastewater Pump Station

CHAPTER 1

GENERAL REQUIREMENTS

1.1 Purpose, Scope and Responsibilities

The Wastewater System Design Standards (Design Standards) are established to identify requirements for the planning, design, construction and operation of wastewater facilities owned and operated by the Department of Environmental Services (ENV) of the City and County of Honolulu (City) and for facilities intended to be dedicated to the City.

The Design Standards are intended to promote quality and consistency throughout the City wastewater infrastructure. Designs that are consistent with accepted industry practices and suited to unique local conditions are encouraged. The Design Standards have been prepared pursuant to Articles 1 through 10, Chapter 14, Revised Ordinances of Honolulu 1990, as amended. A key objective is to facilitate compliance with the Clean Water Act, National Pollutant Discharge Elimination System (NPDES) permits issued by the State of Hawaii Department of Health (DOH), as well as other water quality and public health regulatory requirements of the DOH and the United States Environmental Protection Agency (EPA).

The Design Standards for wastewater facilities shall be comprised of the latest edition of the following as posted in electronic files in PDF format on the ENV website:

- Wastewater Design Standards, Volume 1, Wastewater Collection Systems Chapters 1, 2 and 3
- Wastewater Design Standards, Volume 2, Wastewater Treatment Plants
- Wastewater Standard Specifications, which shall replace wastewater related provisions in the “Standard Specifications for Public Works Construction,” September 1986 (Public Works Standard Specifications)
- Wastewater Standard Details which shall replace Part 3 (Sewers) and Part 4 (Sewer Pump Station & Treatment Plants) details in “Standard Details for Public Works Construction,” September 1984 (Public Works Standard Details)
- Wastewater Standard Notes

- Public Works Standard Specifications (applicable non-wastewater sections)
- Public Works Standard Details (applicable non-wastewater sections)

Wastewater Design Standards Volume 1 addresses gravity sewers, pump stations and force mains, and supersedes the "Design Standards of the Department of Wastewater Management Volume I," dated July 1993. Wastewater Design Standards Volume 2 addresses the design of wastewater treatment plants.

The City's ENV - Wastewater Engineering and Construction Division (WEC) will be maintaining "Wastewater Standard Specifications" and "Wastewater Standard Details." WEC will also maintain "Wastewater Standard Notes." The Design Engineer shall be responsible for obtaining and incorporating general and other notes from other City and State agencies and applicable utility companies. Any additional project specific notes required by the Design Engineer shall be included on the plans as "Project Specific Notes."

Deviation, changes, or additions to the Wastewater Standard Specifications, Wastewater Standard Details or to the General Terms and Conditions shall be covered by project specific Special Provisions. Modification of these Design Standards requested by the Design Engineer shall be submitted in writing and reviewed by the City for approval. The ENV Director shall be the final authority in interpreting and modifying these Design Standards.

These Design Standards present basic design requirements to promote reliable and functional performance of wastewater systems, and to facilitate the review and approval process for planning, design and construction of wastewater facilities. These Design Standards are not intended to restrict the Design Engineer from applying his or her engineering knowledge and experience, or from exercising his or her skill or judgment. City review and approval shall not absolve the Design Engineer of his or her responsibility for the accuracy and completeness of the plans and specifications, and the design-related performance, constructability, start-up/commissioning, and operation and maintenance aspects of the wastewater facilities.

ENV is responsible for project planning, and the design, construction and inspection of the wastewater facilities initiated and funded by the City's Capital Improvement Program. ENV also reviews planning documents and construction plans and specifications prepared by private and other government agencies to assure that wastewater facilities to be owned and operated by the City conform to these Design Standards, and will not adversely impact existing or future City wastewater facilities. WEC provides construction inspection for these projects.

The City's Department of Planning and Permitting Branch (DPP) is responsible for the review and approval of planning documents and construction plans for non-City Wastewater funded subdivisions, buildings, and infrastructure projects which may or may not be accepted by the City and specifically with respect to their effect on the City's wastewater facilities. DPP issues permits for the construction of these projects and is responsible for construction inspection of subdivision projects.

ENV is responsible for the issuance of all connection permits to the City Wastewater System and assists DPP in the approval process with respect to wastewater matters.

ENV is also responsible for performing long-range planning, reviewing contract documents, securing funding, and operating and maintaining the City's sewer lines, pump stations, force mains, treatment plants and other wastewater facilities and serves as the decision maker on planning, design and construction deviations from the Standards.

1.2 Review and Update

The Design Standards are to be reviewed and updated at least every five years to incorporate Special Provision modifications, made over time, which are considered to be beneficial and applicable for inclusion in future wastewater projects. Suggested modifications to these Standards shall be submitted to the ENV Director in writing for review and consideration to be incorporated into the subsequent updates.

1.3 Definitions

The following definitions shall apply unless the content indicates otherwise.

"Biochemical Oxygen Demand (BOD)" or "BOD₅" means the standard test used in assessing wastewater strength and is the measure of decomposable organic material in domestic or industrial wastewater as represented by the oxygen utilized over a period of five days at 20 degrees Celsius and as determined by the appropriate procedure in "Standard Methods" as amended.

"Branch Sewer" means a sewer which receives wastewater from a relatively small area and discharges into a trunk sewer.

"Building Information Modeling (BIM)" is a process involving the generation and management of digital representations of physical and functional characteristics of places. It may involve 3D model-based processes that equip architects, engineers, and construction professionals with the insight and tools

to more efficiently plan, design, construct, and manage buildings and infrastructure.

“City” means the City and County of Honolulu, a municipal corporation.

“Combined Sewer” means a sewer receiving a mixture of storm water and domestic wastewater with or without industrial wastewater.

“Contractor” means a person who furnished the materials, labor, and equipment necessary for the physical accomplishment of the work.

“Design Engineer” means a licensed engineer in the State of Hawaii, who as an individual and the representative of the selected consulting firm responsible for the planning and design of the wastewater facility, poses the professional and technical skills required for competent planning and design of the project to be constructed.

“Director” means the Director of the Department of Environmental Services.

“Drywell” means the compartment where non-submerged pumping equipment, devices, and appurtenances are installed in a wastewater pump station.

“EPA” means the United States Environmental Protection Agency.

“40 CFR” means Title 40 of the Code of Federal Regulations relating to the protection of the environment.

“Force Main” means a pipeline conveying wastewater under pressure from the discharge end of a wastewater pump station to a point where wastewater flows by gravity.

“Geotechnical Engineer” means a licensed engineer in the State of Hawaii, who possesses the professional and technical skill in soil mechanics.

“Gravity Sewer” means a sewer line or system in which all wastewater flows in descending gradients from source to outlet, or where no pumping is required.

“Groundwater” means subsurface water occupying the saturation zone of the ground.

“Guideline” means any guidance for any action or procedure that is optional and advisory but is recommended by the DPP or ENV.

“Industrial Wastewater” means all wastewater produced in the course of commercial or industrial related permitted activities.

“Infiltration” means water other than sanitary wastewater that enters a sewer system from the ground through defective pipes, pipe joints, connections or manholes. Infiltration does not include inflow.

“Inflow” means water other than sanitary wastewater that enters a sewer system from sources such as roof leaders, cellar/foundation drains, yard drains, area drains, drains from springs and swampy areas, manhole covers, cross connections between storm sewers and sanitary sewers and catch basins. Inflow does not include infiltration.

“Interceptor sewer” means a sewer which is laid transversely to the general sewer system that receives flow from several mains and lateral sewers and conveys such flow to a wastewater treatment plant for treatment and disposal.

“Invert” means the lowest point in the internal cross section of a conduit, manhole, sump or wet well, et cetera.

“Lateral Sewer” or “Lateral” means a branch or side sewer of a minimum six-inch inside diameter in size connected to a public sewer main and ended at the property line or edge of a sewer easement to generally serve not more than one lot and has no other common sewer tributary to it.

“Low Pressure Sewer System” or “LPSS” means a sewer system employing a single grinder pump at each low-lying parcel or an interior lot and a small diameter pressurized lateral leading to the pressure main or a gravity sewer, usually located in the public street.

“Manhole” means an opening in a sewer constructed for the purpose of maintaining a sewer line.

“May” means permissive.

“National Pollutant Discharge Elimination System permit” or “NPDES permit” means the permit issued to the City pursuant to 40 CFR Part 122 under the Clean Water Act and Hawaii Administrative Rules (HAR) Title 11, Chapter 55, and refers to the written requirements established by EPA and/or DOH, which govern the quality and quantity of wastewater effluent discharged from a privately or publicly owned treatment works (POTW).

“Non-City Wastewater Funded Projects” means developments and other projects funded by private entities such as developers, or by other government agencies such as the State of Hawaii Department of Hawaiian Home Lands and Hawaii Community Development Authority.

“Owner” or “Property Owner” means and includes a holder in fee, life tenant, executor, administrator, trustee, guardian or other fiduciary, lessee or licensee holding under any government lease or license of real property.

“Permanent Wastewater Facilities” means wastewater facilities, which are built according to facilities plans or master plans as to location and capacity and intended to be at that location indefinitely.

“Person” means and includes corporation, estate, association, partnership, and trusts, as well as one or more individuals.

“Project Representative” means a project’s owner, developer, planner, Design Engineer, and/or other person knowledgeable about the proposed wastewater or development project and authorized to provide input and information on the project.

“Public Sewer” means a sewer directly controlled by ENV.

“Project Special Provisions” means project-specific special provisions prepared by the Design Engineer.

“Public Works Standard Details” means the current edition of the Standard Details for Public Works Construction, Department of Public Works, City and County of Honolulu and the Counties of Kauai, Maui, and Hawaii.

“Public Works Standard Specifications” means the current edition of the Standard Specifications for Public Works Construction, Department of Public Works, City and County of Honolulu and the Counties of Kauai, Maui, and Hawaii.

“Separate Sewer” means a sewer intended to receive only domestic wastewater with or without industrial wastewater and no storm or surface water.

“Sewage” means the spent water of a community which may include a combination of the liquid and water-carried wastes from residence, commercial building, industrial plants, and institutions, together with any groundwater, surface water, and storm water that may be present. Used interchangeably with wastewater.

“Sewer” or “Sanitary Sewer” means a pipe or conduit for carrying wastewater.

“Sewerage,” “Sewerage System,” or “Collection System” means the system of piping, pumping station and force main, with appurtenances for collecting and conveying sewage.

“Sewer System” means the system of piping, pumping station, force main, and treatment plant with appurtenances for collecting, conveying and treating sewage from source to discharge.

“Shall” means mandatory requirement.

“Should”, “Preferred”, or “Recommended” means discretionary use on the part of the City.

“Siphon” or “Inverted Siphon” means a sewer, often crossing beneath a gulch, a watercourse or an obstruction, which runs full or under greater-than-atmospheric pressure because its profile is depressed below the hydraulic grade line.

“Slope” means the inclination or gradient of the invert of a sewer expressed as a decimal, or percentage.

“Standards” or “Wastewater Standards” means the design standards and guidelines of the Department adopted, pursuant to Articles 1 through 10, Chapter 14, Revised Ordinances of Honolulu (ROH) 1990, as amended.

“Trunk Sewer”, “Main Sewer” or “Main” means a sewer, which receives flows from one or more branch sewers.

“Wastewater” means same as sewage.

“Wastewater Facilities” means a comprehensive term, which includes facilities for collecting, transporting, pumping, treating and disposal of wastewater.

“Wastewater Master Plan” means a detailed document that shows the location, size and direction of flow of all existing and proposed sewers, including applicable pumping station(s) and wastewater treatment plant(s) for each tributary areas of the subdivision or other development, and the basis of design at critical points in the proposed sewer system.

“Wastewater Pump Station” means any arrangement of devices within a structure used for lifting and forcing out wastewater under pressure and discharging it into a gravity system or a receiving wastewater facility.

“Wastewater Standard Details” means the current edition of the Wastewater Standard Details.

“Wastewater Standard Specifications” means the current edition of the Wastewater Standard Specifications.

“Wastewater Standard Notes” means the current edition of the Wastewater Notes.

“Wastewater System” means the category of all wastewater and wastewater sludge conveyance, treatment, use, and disposal systems, including all wastewater collection systems (sewers, pump stations and force mains), treatment works, wastewater sludge facilities and recycled water systems.

“Wastewater Treatment Plant” means any arrangement of devices and structures for treating domestic wastewater and industrial wastewater as permitted under regulatory requirements. It excludes cesspools, individual household septic tank systems and individual household aerobic units.

“Wetwell” means a compartment of a wastewater pump station used for the storage of wastewater for pumping purposes.

1.4 General Requirements for Submittals and Approvals for Private and Other Non-City Wastewater Funded Projects

For new development projects that require new wastewater facilities intended to be dedicated to the City or relocation/upgrade of City wastewater facilities, the Project Representative may meet with the DPP to discuss the project. The Project Representative may include the project’s owner, developer, planner, Design Engineer or other appropriate representatives. If more than one person is authorized to serve as the Project Representative, information shall be provided on the role and authority of each representative involved, and one person shall be designated as the primary contact.

The initial meeting shall be held at an early conceptual stage of the project, and additional follow-up meetings may be held as necessary. Based on the size and complexity of the project, DPP may request the presence of representatives from ENV who can provide input and documents on existing and proposed wastewater facilities associated with the project.

The City may require the following wastewater system related documents be submitted to ENV for review and approval prior to and during the design stage of the project.

- Wastewater Master Plan.
- Engineering Report for new or upgraded sewers, wastewater pump stations, force mains, and treatment plants.
- Construction plans and specifications.

The Wastewater Master Plan should normally be submitted following or in conjunction with the new development's overall master plan or other primary planning document.

Environmental documents such as environmental assessments and environmental impact statements, and other related permit documents may be required to be submitted to DPP for review and general coordination.

Where appropriate based on the scope of the proposed wastewater work, DPP will forward the documents to ENV for review, comments and general coordination. Although ENV will be the primary reviewer for major off-site sewer improvements, wastewater pump station, force main and treatment plant projects, all submittals and the comment/responses shall be coordinated through DPP.

The number of hard copy sets of reports, drawings, specifications, electronic files in PDF, or other approved format and other data shall be as specified by DPP.

Submittals will be reviewed by appropriate City departments for conformance to these Standards. Documents shall be revised and resubmitted as required by DPP. The number of required copies to be submitted, including requirements for submittal of electronic copies, shall be coordinated with and meet the latest requirements of DPP.

The project Owner shall be responsible for determining and meeting the requirements of all other applicable regulatory and approving agencies.

Preparation of construction plans and specifications should not be undertaken until the engineering report and conceptual plans have been approved.

Approval by the City shall not relieve the Design Engineer of his or her responsibilities and professional obligations. The Design Engineer shall be responsible for the adequacy of design and accuracy and completeness of the plans and specifications. Changes or revisions to correct any deficiencies shall not be made without prior City approval. Such changes and revisions shall be at the expense of the Design Engineer and at no cost to the City.

After final approvals have been secured, the requested number of full size and half size prints of plans and copies of the specifications and electronic files in PDF format shall be submitted to DPP. The submitted prints shall be reproduced from the original tracings or electronic files, shall be clean and clearly legible, and shall be printed to accurate scale based on the scales indicated on the drawings.

No changes during construction are allowed without approval of the City.

1.5 General Requirements for Submittals and Approvals for City-Funded Wastewater Projects

For most wastewater projects initiated and funded by the City, the Design Engineer's work will be coordinated by ENV for all planning and design issues, performance, reliability, operation and maintainability.

Long-range planning projects, such as Facilities Plans, shall be administered and managed by ENV. Facilities Plans outline a long-range plan for capital improvements and typically address wastewater facilities for the entire sewerage basin servicing a wastewater treatment plant.

Submittals will also include cost estimates of the project at appropriate stages of the project. The details of the project scope, submittals, schedule, and design responsibilities shall be as indicated in the Design Engineer's contract with the City.

1.6 General Requirements for Wastewater Master Plan, Engineering Report and Other Reports

Wastewater Master Plans, Engineering Reports and other required documentation shall be comprehensive and address the requirements of Chapter 1 and 2 of this Volume 1 and the applicable requirements of Volume 2.

Reports shall be typewritten, minimum size 11 font, and neatly bound with comb-type binding or in a 3-ring binder. The report shall be reproduced on 8½-inch by 11-inch paper, except figures and maps may be submitted on 11-inch by 17-inch foldouts. Full size plans, if required, shall be folded and submitted in pockets bound with the report. The plans and reports shall also be submitted in electronic file PDF format.

For Non-City Wastewater Funded Projects, failure on the part of the project Owner or his or her representatives to submit the required information and documents may lead to a delay in review and approval of the project.

1.7 Wastewater Master Plan

A Wastewater Master Plan may be required by the City for new developments to provide information on the proposed new or upgraded wastewater facilities to service the development.

The Wastewater Master Plan should typically include the following information:

- A. Description. Provide a brief description of the proposed development, including relevant land use and zoning information and if intended any incremental phasing of the proposed development.
- B. Location and Service Area of Facilities. Indicate the specific locations of existing and proposed sewers, wastewater pump stations, and wastewater treatment works. Include a discussion of the rationale for the layout and location of the proposed wastewater facilities. Indicate the limits of the initial and future areas to be serviced.
- C. Relationship to Regional Plans. Discuss the relationship between the proposed wastewater facilities and other short- and long-range planning documents such as the Development Plan, Sustainable Communities Plan, Regional Wastewater Facilities Plan, Basin Facilities Plan and other planning documents prepared by the City. Discussions shall be also included on development plans by private developers and other entities for other downstream or upstream areas in the region that may impact the capacity of existing and proposed wastewater facilities.

Where applicable, discussions should be included to evaluate the cost-effectiveness and economy of scale benefits of increasing the capacity of the new or upgraded existing collection system facilities to accommodate other additional future development. The City may suggest holding one or more meetings with other landowners and developers in the region to promote coordination in meeting the required wastewater collection system capacity for all of the anticipated development in the region. The City may request information on appropriate alternatives and anticipated implementation timeframes.

- D. Topography, Hydrology and Geology. Describe the topography, hydrology and geology of the sewered area to be served by the development and areas involving work associated with new or upgraded offsite wastewater facilities. Also describe areas within the development that cannot or are not anticipated to be serviced by sewers.

Pertinent site characteristics information that may result in performance and operational issues with the new or upgraded wastewater facilities shall be clearly identified. Poor or unstable soils, high water table or other

subsurface water conditions of concern, steep topography and difficult access, drainage problems, and flood hazards shall be considered. Discuss mitigative measures proposed to be used in the design of the wastewater facilities to contend with special or difficult site characteristics.

A suitable map shall be included with a scale of not less than 1-inch equals 400 feet and contour intervals not greater than 10 feet.

Information from Federal Emergency Management Agency (FEMA) flood insurance maps shall be included. The information shall be used to assess whether the site is subject to flooding and the need to implement flood mitigation measures or relocate the proposed wastewater facilities.

- E. Population. An estimate of the population of the proposed area shall be provided based on consideration of zoning, projected densities, and other relevant available information. The estimated population and the anticipated timeframe for the various phases of development shall be provided. A discussion shall be included to demonstrate compatibility with the City's Development Plan or Sustainable Communities Plan, Regional Wastewater Facility Plan, and other applicable planning documents.
- F. Wastewater Flows and Characteristics. The estimated wastewater average, maximum and peak design flows from the new development at various phases of development shall be provided as required by Chapter 2. Phasing of project development shall include mitigation measures to address problems due to initial low flows. Potential future flows from additional tributary areas outside the development shall be addressed. A timetable shall be provided showing anticipated periods when additional flows will be introduced into the wastewater system.

The anticipated volume and characteristics of present and future high strength wastewater or other unusual industrial or commercial wastewater flow shall also be discussed.

The basis of the flow estimates, showing consistency with and/or deviations from the Standards shall be documented.

- G. Assessment of Existing Wastewater Facilities and Impact from New Development. The condition and capacity of the existing downstream sewers, pump stations, force mains and treatment plant shall determine if upgrade of the facilities are required. The condition and capacity may be based on available information provided by the City, the results of past approved studies conducted by the City and others, and independent investigations. If condition and capacity information is not available from the City, the project Owner may be required to provide an assessment.

The City shall make the final determination regarding the need for upgrade to existing facilities to accommodate the proposed new flow.

- H. Description of New and Upgraded Wastewater Facilities. Preliminary design information shall be provided for the proposed new or upgraded wastewater facilities. Typical information to be provided includes pipeline or facility layouts, preliminary sizing, materials of construction, special and/or non-standard design features, and special operation and maintenance requirements.

Phasing information and coordination requirements shall be provided for multi-phase or multi-developer projects and any City planned improvements.

- I. Permits and Clearances. Permit and clearance requirements associated with the project shall be discussed and address issues of special concern, such as whether a project or any part of it is affected by land use restrictions, or causes an additional discharge load into an impaired water body. Regulatory requirements to be considered in the master planning phase shall include, but are not limited to the following:

- Flood Hazard Variance
- Environmental Assessment/Environmental Impact Statement
- Special Management Area (SMA)
- Shoreline Setback Variance
- Special District Permit
- Hawaii Coastal Zone Management Program
- Hawaii Coastal Nonpoint Pollution Control Program
- Conservation District Use Application
- Historic Preservation Review
- Underground Injection Control (UIC) Permit
- Department of Army Permits
- Stream Channel Alteration Permit
- Water Quality Certification

- DOH Permits
- Easement/Land Acquisition
- Zoning
- Federal funding requirements where applicable

1.8 Engineering Reports for City Funded and Non-City Funded WW Projects

- 1.8.1 General Requirements for Engineering Reports. After meeting the master plan requirements, an engineering report may be required to provide detailed and project-specific information on the proposed new or upgraded wastewater facilities.

The nature and detail of information in the engineering report will vary depending on whether the project involves new or existing facilities, the size and scope of the work and whether the proposed work involves sewers, pump stations, force mains or treatment plant facilities. The specific requirements for the various types of facilities are presented below.

- 1.8.2 Engineering Reports for Sewer Projects. The engineering report may be required to include the following information:

A. Description of Existing and Proposed Sewers

1. Extent (Limits). Briefly describe the extent of the existing and proposed sewers with reference to a general map or exhibit. Describe the areas of probable future expansion of the sewer system.
2. Capacity. Discuss any factors that may affect future changes in population. Indicate present zoning and Development Plan or Sustainable Communities Plan land use designation. Based on information provided by the City, discuss the capacity available in the existing sewers to handle the additional flow from the proposed project and other anticipated projects in the projected ultimate service area.

Identify all existing sewers whose capacity will be negatively impacted or exceeded by the projected flows. Show the relationship of point of discharge of proposed sewers to the existing system, including invert elevations of points of connection to existing sewers.

3. Impact on Downstream Facilities. Discuss the type and capacity of the wastewater treatment facility which the project will discharge into and based on information from the City, indicate the ability of the wastewater treatment facility to handle the wastewater from the proposed project. If the proposed project discharges into a wastewater pump station, discuss the capacity of the wastewater pump station and indicate whether sufficient pumping capacity is available.

- B. Basis of Design. For each pipeline reach (except laterals) in the sewer system, provide wastewater flow calculations, using Wastewater Design Standards in Chapter 2 for both existing and future conditions. If incremental phasing of the project is intended then calculations shall be provided for each increment.

Deviations from the Design Standards shall be listed, described, and subject to the approval of the ENV Director.

- C. Soil Conditions. Perform soil investigations, including borings as recommended by a geotechnical engineer to adequately characterize soil conditions and identify the need for special foundation design. Investigations to identify the possible presence of contaminated soils are also recommended.

- D. Special Conditions. Discuss special conditions applicable to the project and any proposed mitigative measures or special design. Examples of such conditions include but are not limited to the following:
 1. Need for special design for such conditions as poor soils, contaminated soils, high water table or other subsurface water conditions of concern, drainage and flooding problems, difficult access, unusually steep or flat sewer slopes, bridge crossings, highway crossings, and major utility crossings and/or relocations.

 2. Need to accommodate special industrial, commercial or other non-domestic wastewater discharges that may require special consideration due to different flow volumes and variations, high strength, and wastewater characteristics that may contribute to corrosion, odor and toxicity concerns.

 3. Need for odor mitigation and control measures due to existing or projected odor problems caused by upstream and downstream factors associated with existing and new collection system facilities. Factors impacting odors may include septic wastewater and release of odorous gases from turbulence. Release of odors may be

aggravated by inadequate headspace and air flow caused by high sewer water levels.

4. Provide justification for the need to locate any sewer facilities in easements and discuss the adequacy of provisions for all weather access to manholes for maintenance and sewer lines for repair, rehabilitation or replacement.
 5. For projects that require special means and methods to complete construction, discuss the unusual conditions that require consideration of efforts to ensure constructability.
- E. Conceptual Plan and Profiles. Where applicable, conceptual drawings may cover:
1. General layout of project and project limits.
 2. Incremental phasing and design alternatives.
 3. Designs to accommodate special conditions.
- F. Planning Level Cost Estimates. Include a cost estimate conforming to the American Association of Cost Engineering (AACE) International Recommended Practice No. 18R-97 - Class 3 Estimate with an accuracy of between -10% to +30%.
- G. Assessment of Environmental Impacts. Summarize relevant findings from the environmental review documents prepared for the project. If not already addressed by such documents, describe short and long-term environmental impacts and proposed mitigation measures associated with the construction and operation of the proposed sewers. Address relevant environmental concerns such as traffic disruption, noise, odors, dust, ground vibration/settlement, disposal of dewatering effluent during construction, and any storm water related mitigating efforts.

Discuss special design features and contract document provisions that were determined to be required as part of the environmental assessment, environmental impact statement, or any other environmental permitting process.

1.8.3 Engineering Reports for Wastewater Pump Station and Force Main Projects. For projects involving pump stations and/or force mains, the engineering report shall include the following information:

- A. Description of Tributary Areas and Connection to Existing Sewer System

1. Describe the extent of the existing and proposed tributary areas to each proposed pump station with reference to a general map or exhibit. Show the proposed sewer system layout.
 2. Provide information justifying the need for the pump station. Discuss applicable alternatives such as use of deep gravity sewer lines in lieu of a pump station. Provide a comparative cost analysis that shall include capital, annual operation and maintenance, and present worth costs for alternatives with and without the use of a pump station.
 3. Describe the areas of probable future expansion of the sewer system tributary to the pump station. Discuss factors that may affect future changes in population, service areas, and increases to wastewater design flows. Discussions should include timelines for future flow changes that can be estimated. Indicate the present zoning and Development Plan or Sustainable Communities Plan land use designation. Discuss provisions to accommodate future flow increases.
 4. Show the locations of the proposed wastewater pump station, force main, and point of discharge.
 5. Discuss the capacity available in the existing sewers to handle the additional flows and the projected peak pumping rate of the proposed pump station. Identify all existing sewers whose capacity will be exceeded by the projected flows.
- B. Site. Discuss the accessibility of the proposed pump station site, the proximity to residential or developed areas, and availability of utilities. Show the topography of the site and the proposed layout of the wastewater pump station.
- C. Basis of Design. As a minimum, the following design data and calculations shall be required to be included in the report:
1. Flow
 - a. Design period.
 - b. Design equivalent population.
 - c. Area served in acres and zoning.
 - d. Average per capita wastewater contribution.

- e. Maximum flow factor.
- f. Dry weather infiltration rate.
- g. Wet weather infiltration/inflow rate.
- h. Design flow rates and velocities: low, average, maximum, and peak.
- i. Phasing of the project development to account for the impacts of initial low flow conditions.

2. Pump Station

- a. Pump selection.
- b. Pumping Operation.
- c. Wet well sizing.
- d. Preliminary analysis of structures.
- e. Ventilation.
- f. Preliminary Electrical Power and Generator.
- g. Instrumentation and Controls (SCADA).
- h. Odor control requirements.
- i. Noise attenuation requirements.
- j. Pump Station Failure. Describe the effects of a prolonged station outage, including the anticipated rise in wastewater levels in the wetwell and upstream sewers, the location of the projected spill point, and estimated available response time. Describe provisions to minimize pump station outages, including proposed emergency bypass provisions, standby power, and proposed equipment and system redundancy.

3. Force Main

- a. Provide force main design information (size, material, plan and profile). Discharge manhole outlet pipe size determination (to verify that entrance control conditions will not cause

surcharging). Release of odors due to force main operations shall be addressed and mitigated.

Provide information for the gravity sewers (size, length, slope, pipe material) at least 1,000 feet downstream of the force main discharge manhole. Include the proposed method of corrosion control for upstream and downstream sewers and manholes.

- b. Discuss water hammer analysis and control provisions for both surge pressure and vacuum conditions. To the extent possible, force mains shall be designed to prevent or mitigate surge pressure and vacuum conditions. Pump operations and emergency conditions such as a power outage shall be addressed and the impact of water hammer surges and induced vacuum conditions on force mains shall be determined. Surge pressure and vacuum relief equipment and valves shall be provided as required.
- c. Describe the extent of potential internal and external corrosion and the means provided to mitigate pipe degradation.

4. Operations

- a. Equipment quality and reliability.
- b. Pump/motor performance monitoring, and system alarms and SCADA monitoring.
- c. Accessibility and equipment shutdown/removal provisions.
- d. Routine flushing and wash down provisions.
- e. Skill level for operation, maintenance and repairs.
- f. Availability of spare parts and local servicing.
- g. Safety (adequate access and working room, equipment guards, slip resistant floors and stairs, raised operating platforms, adequate equipment hoisting provisions, warning signs, ventilation, gas monitors, fire protection, etc.).
- h. Continuity of services during construction, including proposed construction phasing, bypassing requirements, and number and duration of planned outages.

5. Other Considerations.

- a. Access and security.
 - b. Water supply (flow and pressure, water meter size and capacity, backflow prevention, fire protection adequacy, irrigation requirements, etc.).
 - c. Aesthetics and architectural design (building materials and architectural treatment, landscaping, fencing, etc.)
 - d. Soil conditions and structural design, including results of site soil investigations and soil borings, evaluation of unusual foundation conditions and proposed foundation design, anticipated dewatering requirements and methods, and structural design criteria.
 - e. Hazardous materials and site contamination issues, including ground contamination and hazardous materials in existing facilities, including asbestos, lead-based paint, and PCBs.
6. Essential Features. Describe the essential features of construction and operation. If pumps, piping, or other equipment are to be installed in stages, discuss the staging sequence and the future changes necessary. Show schematic drawing of pump station and architectural treatment of the structures.
 7. Conceptual Layout Plans including site plan and piping layout.
 8. Deviations from the Wastewater Design Standards shall be listed, described, and subject to the approval of the ENV Director.
- 1.8.4 Engineering Reports for Wastewater Treatment Plant Projects. For projects involving wastewater treatment facilities, the engineering report shall include information described in Volume 2 of the Design Standards. A meeting may be arranged with DPP and ENV to discuss the scope of the project and engineering report.

All planning, design and construction work for treatment facilities to be dedicated to the City, which may include additional units, new treatment facilities or upgrade of existing treatment facilities, shall be coordinated, and reviewed for approval by the City.

1.9 Construction Plans

1.9.1 Organization. Where a single set of plans include wastewater pump stations and wastewater treatment plants together with offsite gravity lines and force mains, it is preferred that the plans for offsite pipelines precede the plans for the wastewater pump stations and wastewater treatment plants.

1.9.2 General. All plans submitted to the City for review shall meet the following requirements:

- A. Sheet Size. 22-inch x 34-inch sheet size.
- B. Lettering Size. The lettering size (1/8-inch minimum) and line weights shall be readily legible on half scale reproductions made from the original drawings. The features and callouts for the new work shall be easily differentiated from existing features on the plans.
- C. Legibility. All prints of drawings shall be legible, of high quality and produced on high contrast background paper capable of reproducing prints of equal or better quality than the original plans.
- D. Engineer's Licensure Seal. All sheets, except for the Title Sheet, shall have the Design Engineer's name, stamp of his or her licensure seal, signature, date of license expiration, and comply with HAR 16-115-9.
- E. Computer Aided Design Drafting (CADD). Drawings shall be provided in a CADD file format specified by the City which may also include Building Information Modeling (BIM) for pump station and wastewater treatment and disposal facilities.
- F. North Arrow. Include a north arrow on all maps, plan and profile sheets and details shown in the plan view.
- G. Drawing Scale. Include drawing scales presented both numerically and as a graphical bar on all sheets. Avoid Not to Scale details.

1.9.3 Content of Plans. The plans, together with the Special Provisions and applicable referenced Standard Details and Standard Specifications, shall provide the working information for the contract and construction of the facilities. The plans shall generally be as described below.

- A. Title Sheet. The Title Sheet shall include, but not limited to the following:
 - Project Title.
 - Tax Map Key.

- Vicinity map showing the project location on a map of Oahu.
 - Location map, larger scale map than vicinity map, showing cross streets adjacent and near the project site.
 - Index to drawings.
 - Approval signatures and date.
- B. General Sheets. The General Sheets shall include, but not limited to the following:
- Index to drawings (if not on Title Sheet).
 - Construction notes.
 - List of abbreviations and symbols used in the plans.
 - Key Plan showing the general features of construction and relative location of the project's subareas.
 - Boring logs.
 - Benchmarks.
- C. Other civil sheets. The following may be applicable:
- Flow Control/Bypass plans.
 - Construction phasing plans.
 - Erosion control plans.
- D. Plan and Profile Sheets. The following describes requirements applicable to typical sewer plan and profile sheets. Similar requirements shall apply to force mains.

Each proposed sewer and its structures shall be stationed continuously upgrade from station 0+00 at its point of connection to another sewer line or terminal structure, either proposed or existing. Sewer line stationing shall be provided at all structures and laterals. Where a sewer structure is part of two separate sections of sewer lines, both sewer line stations shall

be shown. ENV's sewer identification numbers shall be shown for existing sewer line and manholes.

Generally, a plan view and profile view of the proposed sewer shall be the same sheet.

1. Plan View. The plan view shall be drawn at a scale no smaller than $1" = 40'$. The plan view shall include, but not be limited to the following:
 - a. Location of proposed line with horizontal alignment information.
 - b. Sewer line, lateral, and structure stationing.
 - c. Sewer line size and direction of flow.
 - d. Ties from street monuments, property pins, survey controls, or other existing features to enable the proposed sewer line(s) to be laid out.
 - e. All known existing structures and utilities both above and below ground which may interfere with the proposed construction (i.e. existing sewers, force mains, water mains, gas mains, storm drains, electrical, telephone, cable television, traffic attenuator loop, signal corps conduits, etc.).
 - f. Existing and proposed topography with contours and spot elevations.
 - g. Location of streets, property lines, City and State right-of-ways, and existing and proposed easements.
 - h. Addresses and tax map key numbers of affected properties, including adjacent properties.
 - i. Boring locations.
 - j. Natural or manmade features such as streams, waterways, buildings, etc.; include the direction of flow of the streams.
 - k. Board of Water Supply water meter numbers.
 - l. Identification of all properties which are not serviceable by gravity sewers.

2. Profile view. Sewer profiles shall be drawn at a scale no smaller than 1" = 40' horizontal and 1" = 8' vertical and shall read from downstream to upstream, left to right whenever possible. The horizontal scale shall be the same as the plan view. Plan and profile views shall be one over the other on the sheet. Profile views shall include, but not be limited to the following:
 - a. The existing grade at the time of construction and the finished grade.
 - b. Manhole invert, top of rim, and existing grade if different than top of rim.
 - c. Manhole stationing.
 - d. Pipe size, material, length and slope between adjacent manholes; length shall be measured from center to center of manholes.
 - e. Hydraulic data and characteristics of every sewer main segment between adjacent manholes, including the following:
 - i. Pipe inside diameter, inches.
 - ii. Manning's "n" value.
 - iii. Pipe slope, feet per feet (ft/ft).
 - iv. Design Flow (Q_{DES} Peak Flow), and Full Pipe Flow (Q_{FULL}) in MGD.
 - v. Velocity (V_{FULL}) at full pipe, feet per second (ft/s).
 - vi. Velocity (V_{DES}) and depth (D_{DES}) when flowing at design flow.
 - f. Existing and proposed utilities or other facilities that cross the alignment of the sewer.
 - g. Vertical clearance between the sewer and other utilities when the vertical clearance is less than 12 inches.
- E. Details. Include details to provide information required to construct the project in accordance with the design intent and to meet performance objectives. Include modified Wastewater Standard Details and Public

Works Standard Details in the drawings as needed. Provide plan views, elevations, sections, schematics, notes, etc., as necessary.

- F. Traffic Control Plans. Traffic control plans shall be included in the construction plans as required. Work located on City roadways shall require approval from the DPP Traffic Review Branch and the Department of Transportation Services. Work located on State roadways shall require approval from the State Department of Transportation, Highways Division.
- G. Plans for Wastewater Pump Stations. The plans for wastewater pump stations, including details, shall be clear, easily understood and address the work specific to the project. Plans shall address both demolition and new work. The following plans and information shall be provided as applicable:

1. Site, Civil and Other General Plans.

- a. Plot plan showing layout of site and building(s), including driveway and number of parking stalls, exterior yard piping and appurtenances, fencing, and utilities. Property lines shall be shown. Utility lines (water, fuel, electrical, and other lines) shall be shown in precise locations to minimize potential damage from future excavations.
- b. Plans and details for grading, drainage, erosion control, landscaping, and irrigation system.
- c. Elevation of regulatory flood level if location is in a floodplain. If a regulatory flood elevation is applicable, include information on the USGS or other approved bench mark used for the survey data.
- d. Table of Design Data. Applicable basic design data from Section 1.8.3.C.

2. Other Plans.

Provide plans, elevations, sections, details and other plans for buildings, wetwells and vaults, and other structures. Include notes, equipment schedules, data tables and isometric drawings as required to clearly define the work. Plans shall have sufficient information to evaluate adequacy of space, lifting provisions, and other aspects associated with maintenance and repair of equipment.

Drawings and information shall be coordinated across the various disciplines. In addition to the basic wastewater pumps and piping,

other equipment and auxiliary systems shall be adequately detailed and subjected to thorough cross-discipline coordination. These systems include those associated with pump level controls and alarms, non-potable seal and flush water pumps, drain sump pumps, air-conditioning and ventilation, sound attenuation, odor control, equipment hoisting, and emergency backup power.

Typical plans that should be provided include the following:

- a. Architectural plans, elevations, and details for the pump station structures, including separate standby emergency generator buildings. Design of sound attenuation louvers, doors, acoustic panels, duct silencers and other noise reduction equipment and features where applicable shall be based on the recommendations of the acoustical engineer and coordinated with the mechanical work.
- b. Structural plans, elevations, sections, and details for the pump station structures, including the drywell/wetwell, other buildings, large vaults, pipe supports, and structural modifications.
- c. Process plans, elevations, sections and details for pumps, valves, and piping. Where applicable, the plans should also address emergency bypass provisions, odor control systems; drain trenches/lines and sump pumps, and other station components not otherwise detailed on drawings of other disciplines. Proposed wetwell levels associated with level control system for pump operation and alarms shall be coordinated with the electrical work and shall be shown on the process and/or electrical/instrumentation drawings. Where appropriate, suggested phasing and station bypass plans shall be included.
- d. Mechanical plans, elevation, sections and details for air-conditioning and ventilation systems, plumbing and sanitary fixtures, and emergency generator fuel and exhaust systems.
- e. Electrical and instrumentation/SCADA plans and details, including applicable electrical site and floor plans; panel, conduit and lighting fixture schedules and layouts; control equipment arrangement; wiring diagrams (one line and elementary control diagrams) for power distribution and controls; plans for HECO power supply, transformers, disconnect switches, automatic transfer switch, and emergency generator; and requirements for arc-flash analysis and signage.

- f. Other plans, sections, elevations, schematics, details and notes as required to show the proposed construction.

H. Plans for Wastewater Treatment Plants. See Volume 2 of the Design Standards for information on plans for wastewater treatment plants. The general concepts and requirements of the plans for the treatment plants are similar to that described above for pump stations.

1.10 Special Provisions

1.10.1 General. All work to be done shall be in accordance with the Wastewater Standard Specifications, Wastewater Standard Details and the General Terms and Conditions of the City. Deviation, changes or additions to the Wastewater Standard Specifications, Wastewater Standard Details or to the General Terms and Conditions of the City shall be covered by the Special Provisions for the project. Project Special Provisions shall be prepared by the Design Engineer and may reference non-wastewater sections of the current edition of the “Standard Specifications for Public Works Construction” where appropriate. The Special Provisions shall be prepared in a format following the Wastewater Standard Specifications.

The Special Provisions shall be printed on 8½-inch x 11-inch paper and shall also be provided in an electronic file format specified by the City.

1.11 Other Requirements

1.11.1 Design Calculations and Supporting Information. Calculations and supporting information pertinent to the design to supplement information in the Engineering Report shall be submitted to the City. Such calculations will be used by the City to help ensure satisfactory compliance with performance and reliability, and acceptable operation and maintenance requirements. Provide additional supporting information as requested by the City and/or as appropriate to clarify or resolve any concerns related to bidding requirements, constructability, phasing, public safety, and other issues. Any failure on the part of the applicant or his or her representatives to submit such calculations and supporting information may lead to delay in review, additional submittals, and approval of the desired project.

1.11.2 Revisions to Approved Plans and Specifications. Changes, deviations and additions to the approved project plans and specifications shall be approved by the City in writing before such changes are incorporated into the project. Sufficient time shall be afforded for City review and approval before construction of the affected work.

1.11.3 Continuity of Wastewater System Operation During Construction. The Project Special Provisions shall include requirements for keeping the existing wastewater system in operation at all times during construction, unless an exception has been obtained from ENV. Provisions for 100 percent redundancy shall be considered.

1.11.4 Record Plans. Record drawing tracings and electronic files of the construction plans, reflecting the as-built conditions, shall be submitted for inclusion in the City files. The tracings and electronic files in PDF format shall conform to current WEC record drawing preparation instructions. Changes made by addendum and change orders shall be incorporated into the record drawings.

The record drawings are to accurately represent changes made in the field. The location and elevations or details of all features constructed should be recorded accurately for future reference. The record drawings shall be submitted to the City for review and approval. When required corrections shall be made to the record drawings and the drawings shall be resubmitted for approval prior to dedicated acceptance of the work by the City.

1.11.5 Shop Drawings. The Special Provisions shall include provisions for submission of shop drawings for review and approval before fabrication. The requested number of sets of prints of shop drawings shall be submitted to the City for approval.

1.11.6 Manuals and Plans. Manuals and plans shall contain sufficient information on the installation, operation, maintenance, and repair of the equipment; training and operational procedures and spill and contingency plans.

When the manual addresses more than one model of the equipment, non-applicable information shall be crossed out and/or the applicable information shall be clearly indicated. Each binder shall be labeled on its front cover and spine with the name of the facility, date, and subject matter.

The format of the manual, required sections and the level of detail will be provided to the Design Engineer by ENV. Manuals shall be computer generated, minimum size 11 font, bound in loose-leaf "D" ring binders on 8½-inch by 11-inch paper, except figures and maps may be submitted on 11-inch by 17-inch foldouts. Full size plans, if required, shall be folded and submitted in pockets bound with the report.

Equipment and Operation and Maintenance (O&M) manuals, and plans shall also be provided in electronic original searchable file (PDF) format. Scanned copies of originals shall not be acceptable.

A Facility Operations and Maintenance Manual for the facilities to be constructed shall be required for all wastewater pump station and wastewater

treatment plant projects. The manual shall provide the operations and maintenance personnel the proper understanding, techniques, and any other information necessary to efficiently start up, operate, shut down, test and maintain their facilities. O&M manuals shall include a spare parts list for all mechanical electrical and instrumentation equipment. O&M manuals shall comply with applicable statutes, ordinances and regulations, including the provisions of HAR, Title 11, Chapter 62, of DOH. The format of the manual, required sections and the level of detail will be provided to the Design Engineer by ENV.

- 1.11.7 Initial Start-up Procedure Training. Services of field engineers or qualified personnel for all equipment provided shall assist and instruct the City's operating and maintenance personnel. Such services shall commence before or concurrently with the final acceptance testing.
- 1.11.8 Spill Contingency Plan and Emergency Response Plan. Spill Contingency Plans and Emergency Response Plans shall be provided for all new facilities. The plan shall provide instructions to the operator on how emergencies are to be handled. If the project is a modification/upgrade to an existing facility, the existing Spill Contingency Plan and Emergency Response Plan should be revised and updated. The format of the plan, required sections and the level of detail will be provided to the Design Engineer by ENV.

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