# SECTION 10

# SANITARY LIFT STATIONS

## 10.1 GENERAL

Aquatera encourages consistency and standardization in the design and construction of wastewater pumping stations.

The standardization is intended to promote designs that facilitate the economical construction, operation and increased reliability. Standardization in equipment and controls will reduce the inventory of spare parts, allow interchangeability and promote safe and efficient operation and maintenance.

## 10.2 LOCATION

### 10.2.1 Proximity to Other Land Uses

Special consideration should be given to the location of wastewater pumping stations relative to existing or proposed adjacent development, in order to minimize the aesthetic impacts in terms of visibility, odor and noise. The location of wastewater pumping stations in the immediate proximity of school sites and playgrounds should be avoided, if possible. Safety and security measures are to be addressed in such cases.

### 10.2.2 Flood Proofing

Pumping stations are to be located outside of the limits of any area subject to surface ponding or inundation by surface water flow during major runoff events to prevent flooding, so that they are accessible in all weather conditions.

### 10.2.3 Vehicle Access

Wastewater pumping stations must be located so as to be readily accessible by road or permanent paved trail in all weather conditions.

## 10.3 PUMPING STATION CONFIGURATION REQUIREMENTS

10.3.1 Either wet well only or wet well/dry well configurations for pumping stations are acceptable, subject to the preferences stated in the following sections.

10.3.2 The wet well (submersible pump) configuration is preferred for facilities with pumping requirements less than 75 kW due to the relatively low capital cost.

10.3.3 As pumping requirements increase, the engineer shall give more preference to the provision of separate wet wells and dry wells, with pumps located in the dry well.

10.3.4 Where technically viable options exist in the choice of the type of pumps or in the station arrangement, a present-worth analysis shall be undertaken to determine the most cost effective equipment and arrangement, including, but not limited to the following factors:

- Cost of the Facility and its life
- Energy costs over the life of the facility
- Life and replacement cost of the pumping equipment, including ancillary equipment, switch gear, lifting and ventilation equipment
- The cost of operation and maintenance
- Reliability
- Safety
- Local availability of repair services
- Flood proofing
- Nuisance to residents of adjacent homes, or users of parks, facilities and developments
- The facility as a possible source of contamination to the environment
- Compatibility with existing pumping stations units

10.3.5 The design is to address the required functional lifetime of the facility structure. This is deemed to be fifty (50) years unless Aquatera specifically approves a different lifetime. The pumping equipment shall be assumed to receive a major overhaul involving renewal of the wearing components at seven (7) to ten (10) year intervals, dependant on service conditions.

10.3.6 The analysis shall bear in mind that the pumping units may require replacement every 15 years. This may be as a result of obsolescence or other reasons.

## 10.4 BUILDING REQUIREMENTS

10.4.1 A building will be required at all pumping stations to house all electrical and control equipment. They may also be required to house such additional space for tool storage, office space and washrooms. These requirements may be reduced for temporary lift stations.

10.4.2 All heating and ventilation equipment and valves are to be housed in the building or a dry well. The building or dry well shall be completely isolated from the pumping station wet well and provision for access to the wet well shall only be from the outside, through doors or access hatches with approved locking devices.

10.4.3 Brick work for building and siding for buildings shall be #240 Buff or an equivalent color approved by Aquatera.

## 10.5 PUMPING CAPACITY REQUIREMENTS

10.5.1 Design Capacity

Pumping equipment shall be selected with capacity in excess of the maximum expected flow as determined by established engineering practice. In all cases, the design capacity flow rate for a wastewater pumping station shall exceed the expected maximum flow rate as determined in accordance with Section 19 of Aquatera's design standards.

10.5.2 Mechanical Redundancy

A minimum of two (2) pumps are required for each pumping station and three (3) are preferred. Generally these pumps shall be identical and interchangeable. Where only two (2) pumping units are provided they shall each be of the same pumping capacity and each unit, operating independently, shall be capable of pumping at the design capacity flow rate for the station under the service conditions. Where three (3) or more pumping units are provided they shall have pumping capacity such that with the largest unit out of service the remaining units operating in parallel are capable of pumping at the design capacity flow rate for the station under the service conditions.

## 10.6 OPERATIONAL RELIABILITY/EMERGENCY BACK UP PROVISIONS

10.6.1 The design of wastewater pumping facilities must identify and anticipate all events that may affect the functioning of the facility. Provisions must be made to mitigate the consequences of failure of the facility by any mode, so as to prevent property damage, the endangerment of public health or any environmental damage.

10.6.2 Power Supply Reliability Provisions

a. Independent power supply sources. Whenever feasible, the electric power supply to the facility is to be provided from two or more independent distribution sources.
b. Emergency stand by power. In cases where a redundant electrical power supply in not feasible or available, provision of an on-site installed emergency power equipment is required.

10.6.3 Alarm Telemetry – General requirements

Automated remote sensing and telemetry equipment shall be provided at each wastewater pumping station. This equipment shall provide for the

detection of the status of selected operating conditions and transmission of appropriate alarms to the monitoring facilities established and operated by Aquatera. Generally this equipment shall be Pro Talk plus or an approved equivalent.

10.6.4 Overflow Connections

In anticipation of the potential operational failure of a wastewater pumping facility and its backup provisions, the feasibility of providing a gravity overflow is to be evaluated. The elevation and hydraulic capacity of overflow connections are to be optimized to minimize the risk of basement flooding due to a backup in the sanitary system.

10.6.5 Overflows to Storm Drainage Systems

Overflows to storm drainage sewers, storage facilities, natural water courses or surface outfall points will require special justification and will be subject to approval from Alberta Environment and The City of Grande Prairie before acceptance by Aquatera. Overflows to storm services are preferred as opposed to overflows to watercourses.

10.6.6 Overflows to Sanitary Sewer Systems

Provision of an overflow connection to an adjacent or downstream sanitary system is required whenever feasible. This connection should permit the overflow to bypass the pumping station. If this is not possible, then overflow from the pumping station wet well will be permitted.

10.6.7 Prevention of Backflow for Overflows

Overflow connections shall be provided with suitable means to prevent backflow from the overflow into the pumping station.

## 10.7 STAGING OF WASTEWATER PUMPING FACILITIES

10.7.1 Where warranted, due to economic considerations or to accommodate extended periods of development of the contributing areas, the provision of pumping capacity and/or the construction of a wastewater pumping station may be staged appropriately. Where such staging is proposed, all stages are to be defined and related to the anticipated development scenario for the contributing area. A plan of action is to be established as part of the initial design to define the process for the implementation of future stages. The plan should consider continuity of service, the responsibility and financial arrangements for future stage implementation and the most cost effective method for implementing the capacity changes.

10.7.2 A modular approach to the arrangement of structural components and/or pumping units may facilitate staging and should be reviewed as part of the design.

10.7.3 Interim Wastewater Pumping Stations – Design Criteria

There will be no relaxation of the criteria for design and construction for pumping stations that are anticipated to be required for a limited time period unless approved by Aquatera in writing.

## 10.8 DETAILED DESIGN FOR WASTEWATER PUMPING STATIONS

Refer to standard drawing 26.1 for typical arrangement and components of wastewater pumping stations.

## 10.9 WASTEWATER INLET SEWER

10.9.1 Single Sewer Entry to Wet Wells

Only one sewer connection shall be provided into a wet well to convey sewage from the contributing collection system.

10.9.2 Collection Manhole

If more than one sewer enters the site or is required to be connected to the pumping station, a collection manhole shall be provided as a junction point for all incoming sewers. Appropriate stubs shall be provided for future connections. Only a single connection is to be made from the collection manhole to the wet well of the pumping station.

10.9.3 Inlet Sewer Elevation

Excessive entrainment of air into the flow stream entering the wet well should be avoided to prevent entrained air from reducing pump performance or causing loss of prime. Provisions necessary to address this may include drop tubes inside wet wells of small facilities, grade adjustments or a drop manhole upstream of the pumping station. However, inlet sewers shall not enter the wet well at an elevation lower then the normal high liquid level for the design capacity flow rate.

10.9.4 Inflow Shut Off Provisions

An inflow shut off stop log installation shall be provided on the inlet to the wet well so that inflow to the wet well can be stopped. Shut off valves or slide gates should be installed in the first manhole upstream of the pumping station. The shut off equipment shall be of a type and materials for raw sewage service. The installation of shutoff devices within the wet well is not

recommended unless there are no alternatives. Under these circumstances provisions must be made for operating them without entry into the wet well.

## 10.10 WET WELL SIZE AND DETAIL

10.10.1 Size Considerations

i. Wet wells are to be of adequate size to suit equipment space, operator access requirements and active volume considerations.

ii. To minimize dead storage volume, the depth from the "pump off" level to the floor of the wet well shall be kept to an acceptable minimum. The required depth will be dictated by suction pipe inlet conditions, pump manufacturer's requirements for submergence or cooling, net positive suction head, priming requirements and vortex control.

iii. Wet wells must be sized small enough to minimize the total retention time, the time sewage is held in the wet well and any rising forcemain, and yet be large enough to control the frequency of pump starts. The maximum retention time in the wet well should not exceed thirty (30) minutes for the design minimum flow rate anticipated when the contributing area is fully developed. Total retention time in the wet well and forcemain shall be kept to a minimum (generally less than four (4) hours) to avoid anaerobic fermentation and the resultant production of odorous, hazardous and corrosive gases. Otherwise, provisions must be made to control anaerobic conditions. It is desirable to have a wet well with sufficient active volume so that all sewage within the discharge forcemain will be replaced during one pumping cycle, especially if sags exist in the forcemain profile.

iv. Wet wells should be sized large enough to maximize pump life by decreasing the frequency of pump starts. However, in the interest of limiting excessive detention time, wastewater pumping stations will inherently be subject to relatively high frequencies of switching cycles. Exceeding a frequency of 12 starts per hour for motors above 30 kw increases the cost of switch gear and motor maintenance and the reliability and life of the machinery and electrical components will decrease. Accordingly sufficient storage between switching levels should be provided to limit the number of pump starts, normally to 6 per hour with pump alternation and 10 per hour with the standby pump inoperative. The manufacturer's recommendations with regard to the allowable frequency of pump starts for the specific size and type of motor are to be satisfied.

10.10.2 Wet Well Shaping and Benching

i. Wet wells shall be arranged and benched to limit dead spaces were solids can accumulate and to provide smooth, uniform, unobstructed flow to the pump suction influence zones. Wet well floors should have a minimum slope of 1:1 to a hopper type bottom. The horizontal area of the hopper type bottom should be no larger then necessary for the proper installation of the pump or suction pipe.

ii. The cross sectional area and shape of the wet well above the benching is to be constant or increasing from the bottom towards the top.

10.10.3 Vortex Prevention

Suction elbows, baffle plates, vortex breakers, or drop tubes are to be provided as required.

10.10.4 Corrosion Considerations – Wet Well

i. All bolts, nuts and other fasteners used in the wet well areas are to be stainless steel. All supports, brackets, gratings, ladders and other structures shall be of corrosion resistant materials.

ii. All aluminum doors or hatches are recommended for access to the wet wells. Installation of electrical equipment and wiring within the wet well is to be avoided unless it is essential that it be located in the wet well.

## 10.11 Pumps

10.11.1 Pump Selection Considerations

i. Submersible pumps are preferred for all situations. Pumps are to be removable and replaceable without dewatering the wet well or requiring personnel to enter the wet well. All pumps in a lift station shall be identical and interchangeable.

ii. Pump impellers shall be of a non clog design and be capable of passing spherical solids of up to 75 mm in diameter.

iii. Pumps are to be selected which provide optimum efficiencies at actual operating points. The power rating of the motor should not be exceeded by the pump at any operating condition on the characteristic curve for the pump selected.

iv. Flush valves or recirculation pipes to the wet well shall be provided for aeration and suspension of grit and solids in the wet well.

v. Pump selection shall also take into account the availability of local repair service. Pumps selected shall also take into account the manufacture's experience and history in the design and selection of pumps for raw sewage use.

10.11.2 Pump Electrical Requirements

Main pump motors shall operate at 600 volt, 3 phase power. Refer to the Design Guidelines for Electrical and Control Systems for Sewage Lift Stations for details of electrical power, panels and connections.

## 10.12 Pump, Valve and Piping Arrangement

10.12.1 Pump and Discharge Header Arrangement

Two or more pumps shall be connected in a parallel arrangement to a common header, which must be located within a control building or dry well, such that the isolation and check valves are accessible for operation and maintenance. Consideration shall be given to allow access to the isolation and check valves that does not require confirmed space entry.

10.12.2 Pump Removal

Pumps are to be connected such that when any pump is removed for servicing the remaining pump(s) will remain operational. Submersible pumps shall be removable and replaceable without the need for dewatering the wet well or for personnel to enter into the wet well.

10.12.3 Pump Suction Arrangement

Each pump shall have its own individual intake and/or suction connection to the wet well.

10.12.4 Suction Crossover (wet well/dry well lift stations)

In wet well/dry well stations, a full size valved cross over pipe shall be installed connecting the individual suction pipes and shut off valves shall be placed on the pump suction pipes between the crossover connections and the pumps. The piping and valve arrangement shall be such that it will permit the isolation of any individual pump for maintenance and/or removal.

10.12.5 Provision for Back Flushing

Piping and valves shall be provided to back flush each pumping unit and its suction connection, using the discharge flow from another pump directed through the discharge of the unit being flushed.

10.12.6 Piping and Valve Requirements

i. Minimum size of piping. The minimum diameter of piping for all pump suction and discharge piping shall be 100 mm nominal. Piping shall be sized such that flow velocity will not exceed 1.8 m/s in suction piping or 3.5 m/s in the discharge header within the pumping station. Flow velocities should not be less then 0.75 m/s, to maintain solids in suspension. Discharge piping should be as large as possible while still maintaining the minimum velocity for scouring.

ii. Pipe Materials. All piping within the wastewater pumping station shall be of corrosion resistant materials. All flange bolting within the wet well shall be stainless steel. Buried pipe under the facility and within the excavation zone of the pumping facility shall be a minimum of standard wall welded steel with yellow jacket exterior and cement or epoxy coated interior, or galvanized pipe with polyken tape wrapped exterior with Cathodic protection.

iii. Pipe Pressure Rating. Pressure rating for piping within the pumping facility shall suit the service requirements, but shall also have a minimum pressure rating of 900 kpa.

10.12.7 Check Valves

i. Pump Discharge. A check valve shall be installed on the discharge line between each pump and isolation valve. These check valves shall not be mounted in a vertical position. When vertical mounting of a check valve is necessary then the check valve shall not be of the flapper type.

ii. Bypass Tee. A check valve shall be installed after the bypass tee connection shut off valve to prevent backflow into any connected auxiliary pump. This valve may be mounted vertically if necessary.

iii. Check valve types. Check valves shall be supplied with external levers and spring and limit switches to indicate and prove the valve opening.

10.12.8 Isolation Valves

Shut off valves shall be included on the discharge lines from each pump between the check valve and discharge header. This shall allow isolation of each pumping unit and check valve for repair or replacement.

10.12.9 A forcemain isolation valve shall be included on the main discharge pipe where it connects to the discharge forcemain leaving the facility. This is to allow for isolation of the forcemain from the pumping station.

10.12.10 Bypass Provisions

A tee connection with a shut off valve on the branch shall be provided on the main discharge pipe within each pumping station, upstream from the Forcemain Isolation Valve. The arrangement is to allow for either bypassing the station using auxiliary pumping equipment, or bypassing the forcemain and pumping to an alternate outlet line. The unconnected end of the tee connection must be orientated to face towards an access hatch or entryway to facilitate the connection of the auxiliary pump discharge or outlet line.

10.12.11 Provisions for Removal of Valves and Equipment

Provisions shall be made in the piping for removal of all valves and equipment. Appropriately located vent and drain valves shall be provided to permit drainage of all piping to facilitate removal of valves and equipment.

## 10.13 Pump Control and Instrumentation Requirements

Refer to Design Guidelines for Electrical and Control Systems for Sewage Pumping Stations.

10.13.1 Control panel and flood proofing

The control panel shall be located so that it cannot be flooded under any foreseeable circumstances.

10.13.2 Pressure Gauges

Taps with shut off valves suitable for quick connect pressure gauges shall be provided on each suction and discharge. The location of these taps shall be such that the locations are suitable and easily accessible.

i. Gauge taps shall be installed on the suction and discharge side of

all dry well mounted pumps and on the main discharge to the forcemain. The gauge taps are required to permit the determination of operating pressures of the pumps for comparison with pump curves and identification of any change in operating pressure that could be indicative of an operational problem. Pump discharge gauge taps should be located between the pump discharge and the discharge check valve.

ii. Gauges should be a compound pressure/vacuum type, equipped with a diaphragm seal and isolation valves. Gauges provided for discharge lines shall be liquid filled with a maximum range of at least twice the operating pressure.

## 10.14 Maintenance and Operation Provisions

### 10.14.1 Pump and Equipment Removal

i. Permanent hoist equipment and access hatches shall be provided to permit the removal and/or replacement of any pieces of station equipment. Hoists and beams should, if possible, allow for placement of equipment onto service vehicles without double handling the equipment or use of mobile cranes.

ii. As an alternative in specific cases, appropriate vehicle access and adequate access hatches may be provided to allow for the use of mobile exterior cranes as approved by Aquatera.

iii. For wet well pump installations, the provision and arrangement of lifting equipment shall be such that the necessity for personnel to enter the wet well for removal of equipment is minimized or eliminated.

iv. Lifting equipment shall have sufficient capacity to handle the heaviest loads of equipment based on ultimate design and shall include allowances for dynamic forces due to load shifting. The capacity of all lifting equipment shall be clearly posted on the equipment. Eyebolts in the walls and ceilings if required shall be provided for rigging chain hoists or come-alongs.

### 10.14.2 Access into Station Structures

i. Suitable and safe means of access shall be provided for all equipment requiring inspection, maintenance and to the wet well for inspection and cleaning.

ii. Stairways and ladders shall comply with applicable legislation. All stairs shall be of a non-skid type.

iii. Access to wet wells shall not be from dry wells.

iv. Doors and access hatches shall be equipped with suitable locking devices.

v. For all entry hatches, non-protruding extension ladders shall be provided. The extension ladders shall be located far enough from the walls to be able to be pulled up through the access opening and extend 1.0 m above the opening.

vi. Access hatches located outside shall be sealed and have sufficient overhang to prevent rainwater inflow. Odor tight aluminum hatch covers shall be used.

10.14.3 Lighting

i. Adequate lighting shall be provided for the entire facility. The light fixtures shall be either vapor proof fluorescent in dry wells and/or explosion proof incandescent in wet wells. Emergency backup lighting shall also be provided.

ii. Wet well lighting shall be arranged so as to be indirect and maintained from outside of the wet well.

iii. Exterior lighting shall be provided to illuminate all building entrance areas, entrance hatches and outside equipment. Exterior lighting shall be designed so as to not create a nuisance to any nearby developments.

10.14.4 Ventilation

i. Forced mechanical ventilation is required at all waste water facilities. Suitable equipment shall be installed to provide for continuous ventilation at a minimum rate of six (6) air exchanges per hour in each of the wet well and dry well areas. Completely separate systems are required for each well and there will be no interconnection between the wet well and dry well ventilation systems.

ii. Fresh air, heated and thermostatically controlled, shall be forced into each area at a point 150 mm above the floor in dry wells and 150 mm above the high water level in wet wells and exhausted at higher levels. In wells with a depth greater then 4.5 m multi inlets and outlets shall be considered in the design.

iii. Increased ventilation on access. Consideration shall be given to

the provision of automatic controls to increase ventilation rates to 20 -30 air changes per hour, interconnected to turn on with the light switches and door switches, in addition to the continuous ventilation requirements.

iv. Provision shall be made to detect and actuate an alarm if the ventilation system should fail. A local alarm indicator, noticeable prior to entering the station, but not noticeable to the general public is required. A volume control buzzer and red beacon on the inside of the building, visible as soon as the doors are opened, is acceptable. This alarm shall also be connected to the overall alarm system for the station.

v. Provisions for back up ventilation to wet wells. Provision shall be made for ventilation of wet wells using portable ventilation equipment, in case of failure of the permanent on site ventilation.

10.14.5 Balancing Report

For stations with new or refitted ventilation systems, a balancing report is required, signed by a professional engineer, indicating measured ventilation flows and actual air change rates. This will be forwarded by the Engineer to the Aquatera Project Engineer and posted in the station.

## 10.15 Heating

Heating systems shall be designed so as to minimize heating costs. Consideration shall be given to the use of high efficiency furnaces or boilers and the provision of heat recovery units to recover waste heat from exhausted air. The entire facility shall be designed taking into account energy conservation.

10.15.1 Water Supply

A potable water supply complete with a sufficient length of 50 mm hose shall be provided for the cleaning of floors, pumps and other equipment. There shall be no physical connection that might under any circumstances cause contamination of the potable water supply. Backflow prevention and cross-connection control shall comply with the most current Provincial and City of Grande Prairie plumbing regulations.

10.15.2 Provisions for Operating Personal

i. Washroom facilities. A partitioned washroom and lavatory may be required that includes at a minimum the following:

- a toilet;

- a large sink;
- a washroom exhaust fan interlocked with the light switch;
- floors drains with positive trapping;
- a mirror;
- soap dispenser;
- towel dispenser.

ii. Office Space. Dependant on the size of the facility a portioned office may be required. Regardless of the size the minimum office facilities shall be provided:

- Single pedestal desk and swivel/tilt arm chair; alternatively a plan table with storage and a drafting chair may be provided;
- Floor mat;
- Waste receptacle;
- Storage for manuals and spare parts.

iii. Safety Equipment

- As specified by Aquatera, or as a minimum the following:
- 2 harnesses – 4-D coded webb complete with T -8 legs
- Man winch
- Retractable life line
- Davit arm and flush mounted davit base or equivalent

## 10.16 Sump Pump

Dry wells shall be equipped with a sump and sump pump to deal with leakage or seepage. The sump pump is to discharge into the wet well at a point above the maximum high water level. A check valve shall be provided in the discharge pipe to preclude backflow of wastewater into the sump.

## 10.17 Site Requirements

### 10.17.1 Vehicle Access

A minimum 4.5 m wide paved road shall be provided to the site, with extensions as appropriate to provide maintenance vehicle access to the facility, electrical transformers and for the removal and delivery of other station equipment. Paved parking shall also be provided for parking of maintenance staff and service vehicles.

### 10.17.2 Fencing

All above ground pumping facilities shall be fenced. The fence shall as a minimum have a gate for entry of vehicles and equipment and additionally

a man gate may be required. Any gates shall be lockable and the developer shall equip them with an Aquatera lock. Fences shall typically be zinc coated industrial grade steel chain link security type. Fence height shall be 1.83 m in overall height complete with three-strand barbed wire overhang installed above the 1.83 m height. Where dictated by esthetic reasons an architectural fence providing a similar level of security may be required.

10.17.3 Site Grading

The pumping station site shall be designed with adequate grade so that surface water drains freely away from the building and no ponding of water occurs adjacent to the building, entrances or within the site. Site elevations shall be established such that the facility shall not be subject to flooding due to runoff flows or ponding under any conditions of rainfall or runoff from snowmelt.

10.17.4 Landscaping and Aesthetic Considerations

As a minimum, pumping stations shall be landscaped with gravel. A weed barrier shall be placed with a minimum of 75 (seventy five) mm depth of 20 (twenty) mm gravel in all areas that are not hard surfaced. Where the proximity to residential areas, public lands or other uses dictates the need for additional landscaping to conceal the facility and/or to make it blend into the surroundings or to enhance the appearance, these requirements shall be included as part of the facility design. Additional landscaping requirements may include, but not limited to, planting of trees, shrubbery or other architectural treatment of the structure.

10.17.5 Signage

All pumping facilities shall have as a minimum 1 (one) 600 (six hundred) mm by 1200 (twelve hundred) mm sign. The sign shall have Aquatera's registered logo on it only. No reference on the signage should indicate a pumping station. The sign shall also include Aquatera's phone number (780) 538-0348.

## 10.18 Operating, Maintenance and Service Manual

10.18.1 As part of the design of a waste water pumping station, the design engineer shall prepare and provide an Operating, Maintenance and Service Manual for the facility.

10.18.2 Four (4) complete copies of the manual are to be provided prior to the transfer of the facility operation to Aquatera. This shall generally be at the time of the approval of a construction completion certificate (CCC). When completion of the manual is not feasible prior to the CCC, the

Engineer may accept an interim form of the operation and maintenance manual at CCC. The completed manual shall be provided by the developer prior to the issuance of a final construction completion certificate (FAC).

10.18.3 The manual shall include complete equipment manufacturer's operation, maintenance, service and repair instructions and complete parts lists for all mechanical and electrical equipment, including, but not limited to, all control diagrams and schematics with wires individually numbered and identified. Each set shall be firmly bound in a hard covered binder and include test results and calibration of all equipment from commissioning and testing conducted by a professional engineer for the Developer prior to application of a CCC.

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