APPENDIX B2: CERTIFICATE OF SATISFACTORY EXECUTION –WORKS ONLY

ACTIVITY *(Title of Applicant Activity)*	**Process, Civil, Mechanical & Electrical design and build acting as PSDP and PSCS**		
SITE **Construction contract:** *(Title & brief description)*	**Merck Millipore Compliance and Capacity Upgrade** Glan Agua Ltd was awarded the Process, Civil, Mechanical and Electrical Design contract for Merck Millipore WWTW Compliance and Capacity Upgrade. The appointment consists of the design, build and commissioning of an upgraded WWTW at the pharmaceutical site in Co. Cork. MEIC Ltd is the main Civil Subcontractor on the project and are responsible for all civil elements of the contract including earthworks, pipelines, pumping stations etc.  		
Site location:	Carrigtwohill, Co Cork		
Proportion of Project undertaken by the Applicant	100%	Tender entity (*Sole trader/ Joint Venture)*:	Private Limited Company
GENERAL INFO Role of Company in delivery of Service:	**Scope of Works** **Civil and Construction Works:** • Earthworks and Excavations Bulk earthworks was required to reduce the levels (particularly the Eastern and Northern areas) of the existing WWTP. A geosynthetic clay (or similar approved) lined swale and catchment pond was constructed to the Eastern and North-Eastern boundaries of the site to serve as environmental protection to the adjacent lands during the construction works. The type of liner used is a Bentomat AS50 geosynthetic clay liner (GCL) (or similar approved). Bentomat AS50 consists of a layer of natural sodium bentonite encapsulated between woven and non-woven geotextiles, which are needle-punched together to provide internal reinforcement. The internal reinforcement minimizes clay shifting, thus allowing the GCL to maintain consistent low permeability and maximum performance under a wide variety of field conditions. The bulk excavations shall generally lower the level of the areas where works are to be constructed. Any sides to the bulk excavations shall be battered back at a safe angle to ensure slope stability. Permanent Fencing: Modifications to the existing fence line included provision of three new sets of access gates at the Western boundary of the WWTP site. New galvanised palisade fencing (to match existing) was placed along the revised site boundary to the North, East and South of the site. • **Drainage** Construction of concrete hardstandings and concrete roadways within the entire footprint of the site, such that all areas of the site will be sealed to prevent runoff from potentially contaminating the underlying ground in		

	the event of a spillage. The entire surface area of the site including rooftops are drained into a stormwater collection network. The stormwater network shall discharge into the existing pumping station, where it shall then be pumped to the existing stormwater manhole outside the South Western end of the WWTP site. The stormwater collection network was designed and constructed in accordance with <Clause 2.4> and its sub-clauses of Section 6: Civil, Structural and Architectural Specifications of the Contract Documents. • **Aeration Tank No. 2 / Catch and Release Tanks** <u>Piled Foundations:</u> This is involved the construction of 40 no. Ø450 mm CFA end bearing piles, each capable of transmitting vertical loads of up to 650 kN and horizontal loads of up to 50 kN. A piling platform was constructed to accommodate the piling rig. The excess pile lengths were cut and trimmed to cut-off level. The piled foundations were designed, constructed and tested in accordance with the provisions of the Institution of Civil Engineers (ICE) Specification for Piling and Embedded Retaining Walls (SPERW). <u>Reinforced Concrete Base Slab:</u> A reinforced concrete base slab was designed and constructed in accordance with the CSA Specification. The multi-purpose slab shall be designed to incorporate the pile caps and ground beams and to transfer the design loads from the Aeration Tank to the piled foundations. <u>Glass-Lined Steel Tank:</u> Aeration Tank No. 2 was constructed using a glass-lined steel tank and a glass-reinforced plastic (GRP) roof. The tank was constructed on top of the reinforced concrete base slab, with a 150 mm thick “seal pour” concrete base. The tank was provided with a low level access manway and an access ladder with a viewing platform at eaves level. The roof was constructed of ‘beam and infill’ GRP to allow the removable diffusers to be lifted out of the tank. • **MCC and Laboratory Building** The MCC and Laboratory (MCCL) Building shall be constructed in accordance with the building regs and the roof shall be designed for Factory Mutual (FM) approval. • **Dewatering Building Extension** Extension of the existing sludge dewatering building. • **Roads/Hardstandings** The site roadways will be constructed of 175 mm thick reinforced concrete. High yield steel mesh reinforcement provided throughout. The roads will be designed and constructed in a manner such that optimum stormwater drainage conditions can be provided. Expansion joints shall be provided for. Precast concrete kerbing shall be constructed along the perimeter of the site to provide a liquid retaining seal and thus ensure that no leakage to ground can occur. The roadways will be delineated from the hardstandings by permanent linemarking. • **Plinths** Various plinths shall be provided to the following structures: • DAF units. • IBC Bunds. • Blowers.

- WAS Bund
- RAS Bund
- Generator and Fuel Tank

These plinths will be reinforced concrete and shall be individually designed and constructed to transfer the loadings from the various structures to the supporting ground beneath.

Process Design & Construction

Design: Glan Agua undertook a fully detailed design of the process upgrade of the existing WWTP. The inflows were based from 5 different production waste streams (CPG, IC1, IC2, Aircast & Utilities) culminating in a Total Maximum Design Hydraulic Peak Flow of 40 m^3/hour. The design works included a full set of process design calculations, for the new upgraded WWTP at the Merck Millipore (WWTP CCU Project) facility in Carrigtwohill Co. Cork. The upgraded WWTP is based on extending the existing plant. The upgraded plant is a designed as an extended Activated Sludge (AS) suspended growth process, similar to the existing plant and comprises the following elements:

Catch Tanks: Three circular covered tanks are provided for storage/buffering of facility wastewaters prior to delivery to the main part of the WWTP. The contents of the catch tanks are chemically conditioned before being pumped at equalised concentrations and pH levels to the Balance Tank. The facility to recycle or direct pumped flows to other Catch Tanks is incorporated. Each Catch Tank is provided with a mixer to ensure adequate mixing. Two forward feed pumps are provided for each Catch Tank to deliver wastewater to the Balance Tank.

Balance Tank: A fully mixed circular covered tank is provided for equalisation of the chemically conditioned wastewaters from the catch tanks prior to delivery to the Aeration Tanks. The Balance Tank is provided with mixers to ensure adequate mixing. Two sets of forward feed pump deliver wastewater from the balance tank to the Aeration Tanks.

Aeration Tanks: Two circular covered aeration tanks are provided for biological treatment of the wastewater from the Balance Tank. Aeration tank No.1 and No.2 are normally operated in parallel. An individual aeration tank can be taken out of service for maintenance/low load conditions. Both tanks have a fine bubble diffused aeration system with two dedicated invertor driven blowers. A fifth standby blower is provided as a standby to either set of blowers. The dissolved oxygen (D.O) level within each aeration tank is continuously monitored. The D.O level within each aeration tank is controlled with the speed of the duty blower decreasing in response to high D.O level and increasing in response to low D.O level. It is noted that REDOX control of the Air Blowers is an option that is operator selectable. Each aeration tank is equipped with a Heat Exchanger to lower the mixed liquor temperature, so that optimum process conditions prevail. On detection of a high pre-set temperature within an aeration tank, the cooling tower pumps and the mixed recycle pumps operate. The pumps operate until a pre-set low temperature is reached.

DAF Clarifiers: Clarification of the biologically treated aeration tank effluent is undertaken in two rectangular steel Dissolved Air Floatation (DAF) Tanks. The mixed liquor (ML) from the aeration tanks is pumped to two Flocculation Tanks each of which fitted with centre driven mixer mechanism. A polymer chemical is added to the Flocculation Tanks to chemically condition the ML prior to its delivery to the DAF Tanks. The

	clarified or supernatent water is collected in the DAF Tank(s) outlet launders with gravity discharge to twin Grey Water Tanks. The clarified water is pumped from the Grey Water Tanks to the WWTP outlet chamber (SE1) and gravitates thereon to the discharge sewer. A percentage of the clarified water is returned by the DAF recycle pumps to the head of the DAF tanks, this allows dissolved air entrainment and generation of DAF fine air bubbles. **EAS & RAS Tanks & Pumps:** The high concentrations of activated sludge that are required for continued biological treatment are achieved by returning the sludge collected in the DAF Tank(s) and re-using it in the treatment of subsequent effluent. The RAS float sludge is skimmed from the DAF Tanks surface with gravity discharge to a single Return Activated Sludge (RAS) Tank. Three variable speed pumps (duty/duty/duty) are provided to pump return activated sludge from the RAS Tank to Aeration Tank No. 1, Aeration Tank No. 2 and the WAS Tank. One of the RAS pumps pumps waste sludge from the RAS Tank to the WAS Tank. Two fixed speed pumps (duty/standby) are provided to pump the waste sludge from the WAS Tank to the Sludge Holding Tank. The duty pump operates on a time on / time off basis. Heavy solids which settle to the bottom of the DAF Tanks are collected by the DAF Tank floor auger and are discharged by gravity to the WAS tank. Discharge of DAF Tank floor solids is effected by the operation of the solids discharge valves. The discharge valves operate on a time on / time off basis. **Sludge Dewatering:** The waste sludge from the DAF Tanks is pumped to the Sludge Holding Tank. The sludge is fed to the centre of the holding tank. The sludge is withdrawn/pumped from the bottom hopper of the tank. The sludge holding tank is equipped with a tank mixer which is operated by the operator to ensure uniform DS of the sludge prior to dewatering. The centrifuge dewatering system consists of the following components: • Two sludge feed pumps delivering sludge to centrifuge No. 1 and centrifuge No. 2 • One auto polymer preparation system • Two poly transfer pumps delivering poly to centrifuge No. 1 and centrifuge No. 2 • Two Westfalia centrifuge units • Two sludge cake pumps delivering sludge cake to Skips 1, 2 or 3. • Three sludge skips. On initiation of the dewatering cycle, a sludge feed pump transfers sludge to a centrifuge, as the sludge enters the centrifuge it is dosed with the required volume of polyelectrolyte. The required dose is delivered from the polymer dosing pump via an in-line mixer. The conditioned sludge enters the centrifuge wherein the solids and water are separated. The separated water or centrate is returned by gravity to the centrate sump and thereon to the Aeration Tanks. The captured solids are discharged to a sludge cake pump from where the cake is pumped to a manifold header pipe which can feed any of the three sludge cake skips. **Chemical Dosing System**: Chemical dosing equipment comprising bunded IBCs, dosing pumps (duty/standby), dosing lines and instrumentation are provided for the following chemicals; • Sodium Hydroxide dosed to the Catch Tanks, Balance Tank, Aeration Tanks and upstream of the Grey Water Tanks.

	• Sodium Thiosulphate dosed to the Catch Tanks • Nutrient dosed to the Aeration Tanks • Polymer dosed to the DAF Flocculation Tanks. • A13 dosed to the DAF Flocculation Tanks • De-foam chemicals dosed to Aeration Tanks and centrifuges centrate discharge The Sodium Thiosulphate pumps operate in response to a signal from production with dosing proportional to the summated inlet flows. The Nutrient pumps operate whilst the balance tank forward feed pumps operate, with the dose rate being manually set and controlled by the operator. The Sodium Hydroxide pumps operate in response to detection of a pre-set low pH within an individual Catch Tank, the Balance Tank or one of the Aeration Tanks. On detection of a low pH within a given tank, the tanks' caustic dose actuated valve line will open, and the caustic dosing pump will start operation. The Polymer and A13 dosing pumps operate when the DAF Tanks are operational. The Polymer Dosing Pumps pump neat poly which is diluted in line to the DAF Tanks. The operation of the De-foam pumps are manually set and controlled by the operator **Odour Control:** Foul air containment is accomplished using covers or enclosures. The covers are kept under a slight negative pressure to prevent odour leaks at cover seals and hatches. The following tanks/areas are continuously ventilated: • Catch Tank No. 1, 2 & 3 • Balance Tank • Aeration Tank No. 1 & 2 • DAF Tank No. 1 & 2 (including Flocculation Tanks) • RAS and EAS Tanks • Sludge Dewatering Room • Sludge Skips • Sludge Holding Tank The foul air is collected and conveyed to a Biological Biofilter for treatment and subsequent discharge to atmosphere, an emergency facility shall be provided to connect to the existing TOC. Two ventilation fans are provided (duty / standby). The standby fan starts automatically on failure of the duty fan. The fans are provided with variable speed drives which allow the operator to manually increase/decrease the overall ventilation rate. The biologically treated foul air is normally emitted to atmosphere. Where the biofilter is not operational, the main duct valve is manually closed and flow is re-directed to the existing TOC. The biological biofilter is provided with a water recycle system to maintain the biofilter media in a moist condition. The water recycle system comprises a water sump and two submersible pumps. The pumps operate continuously recycling water to the biofilter. Two discrete level switches are provided within the sump, with the potable water supply line valve opening (to supply water) at a pre-set low level and closing at a pre-set high level. The sump is provided with a high level pump starting when the levels rise above the high level switch. **Sludge Dewatering:** Construction of a new centrifuge and poly dosing system. Extension of existing sludge dewatering building to accommodate the new centrifuge. Relocation of control panel for existing centrifuge. Construction of additional sludge skip loading bay. Pipework modifications. **EAS & RAS Tanks & Pumps:** Construction of new fabricated stainless steel tanks. Provision and installation of new progressive cavity pumps.

	On-site fabrication and construction of stainless steel process pipework. Site wiring to new MCC panel. **DAF Clarifiers:** Installation of 2 new fabricated stainless steel DAF clarifiers, grey water tanks and flocculation tanks. Construction of access mezzanine and staircases. Installation of new pumps, compressors, stainless steel process pipework. **Aeration Tank:** Refurbishment of existing Aeration Tank No. 1. Upgrading of existing fine bubble diffused air system. Emptying and cleaning of existing tank. Sludge dewatering and disposal off site. Inspection and concrete repairs to existing tank structure. Pattern testing. Installation of new air blowers. **Balance Tank:** Empty, clean and inspect existing balance tank. Condition survey of existing structure. Installation of 2 new forward feed pumps in existing tank and Re-commission tank. **Catch Tanks:** Complete MEICA installation on existing partially complete Catch Tank. Construction of 2 additional Catch Tanks including demolition of existing emergency tankage and construction of reinforced concrete bund. Construction of fabricated galvanised steel access mezzanine. Installation of stainless steel process pipework, pumps valves and fittings. **Odour Control:** Design and installation of a new odour collection network and abatement unit. Collection network made from GRP ducting supported on galvanised steel over ground pipe rack. **Chemical Dosing System:** Installation of chemical dosing infrastructure at multiple locations on site consisting of bunded IBCs, stainless steel pump stands, chemical dosing pumps, braided dosing lines, injection points and static mixers. **Mechanical & Electrical Design & Construction** **Design:** Production of P&IDs. HAZOP & Client Design Workshop attendance with subsequent design revisions. Mechanical design of the pipework comprising: • Hydraulic Calculations • Pipework sizing • Pipe engineering • Pipework supports • Flexibility/expansion Mechanical equipment design & specification: • Access ladders • Stairs • Walkways Technical Selection of Equipment • Blowers, • Pumps • Compressors • Valves Electrical Engineering: • Specification and design of Motor Control Centre Control Panels

- Panels are Form 2 type panels with fully automated drive controls
- UPS
- Internal fire protection

Design of Cabling and Containment System to current standards.

Specification of electrical equipment:

- MCC Panels
- Isolators
- Emergency Stops
- Light fittings
- Trace Heating

Construction:

Mechanical – stainless steel process pipework constructed to ASME IX standards. All welder fitters coded to the Glan Agua Welding Procedure (ASME IX). Installation of schedule 5 and schedule 10 stainless steel pipework. Installation of the following equipment:

- Submersible pumps
- Dry mounted submersible pumps
- Progressive cavity pumps
- Mixers
- Air blowers
- Compressors
- Air receivers
- Valves (all types)
- Pneumatic actuators
- Electric actuators
- Heat exchangers
- Flow meters
- Diffuser grids
- In-line static mixers

The following piping materials were used:

- Stainless steel (schedules 5 and 10)
- Carbon steel
- Galvanised mild steel
- Polypropylene
- Solvent jointed uPVC

Electrical – Complete site wiring of all equipment, provision of containment to new overground pipe/cable rack. Numerous tie-ins, shut downs and complex installations were completed. Installation of all equipment listed above. Domestic installation of Control Building. Site wide Fire Alarm. Access and security network. Site lighting.

Demolition Works:

Extensive and substantial demolitions were undertaken as part of the phased works.

Demolitions included:

- Demolition of existing 1,200m3 Reinforced Concrete Emergency Tank incorporating Sanitisation and Sludge Holding Compartments. Decommissioning and demolition of all existing Mechanical & Electrical infrastructure (pumps, mixers, pipework, structural steel roof & cladding).
- Demolition of existing MCC & Laboratory Building. Decommissioning & removal of a variety of switchgear including

	MCC Panels, Main incomer panel, domestic distribution panels, equipment specific panels, laboratory equipment. • Demolition of existing services. Removal of sludge infrastructure, removal of 500m of underground stainless steel pipework. Grubbing up service trenches. Electrical decommissioning. Plant Air & Water services decommissioning. All works were undertaken on a phased basis, using Permit to Work systems, and in conjunction with Client production requirements. All of the waste materials were disposed of, offsite by licensed disposal companies. Waste management and proper disposal of all materials was paramount as part of the contract. All of the materials were sorted into different categories such as inert materials, steel and metals, plastics, cables and contaminants. Each category was disposed of offsite using licensed disposal companies. **Instrumentation, Control and Automation Design & Construction** Design: Specification of instrumentation • Level switches • Ultrasonic transmitters • LEL • DO • Redox • pH • Temperature • Flow meters Outline design & details design of Control and automation systems based on Ethernet Communications system and Intouch SCADA system. Preparation of Process Control Philosophy Document. Main PLC selection. Small PLC for emergency stop and global stop systems. **Health & Safety Aspects of the Contract** • Entry into Confined Space • Excavations • Structural Stability • Lifting Operations / Cranes • Road Works • Traffic Management • Scaffolding • Underground Services • Overhead Cables • Working at Heights • Piling • Vibration, Noise and Dust • Working with hazardous materials / live sewers
Name & address of Contracting Authority responsible for the project:	Merck Millipore, Carrigtwohill, Co. Cork
Contracting Authority contact name:	Kieran Twomey — Phone no.: 00353 21 4883666
OTHER INFORMATION Provider of Civil Design : Glan Agua Ltd. Provider of Civil and Building Construction: MEIC Ltd. Provider of Mechanical, Electrical & Process Design and Installation: Glan Agua Ltd. Project Supervisor (Design Stage): Glan Agua Ltd. Project Supervisor (Construction Stage): Glan Agua Ltd.	

CONTRACTOR'S NAME:	Glan Agua Ltd