

Cork Main Drainage

Lough Mahon Crossing & Ballinure Header Chamber

The Cork Main Drainage Scheme is designed to end extensive pollution of the River Lee and Lough Mahon. The €250 million scheme is one of the largest engineering projects ever undertaken in the Republic of Ireland. This scheme will collect and treat 13 million gallons of raw sewage and polluted water which is flowing into the River Lee in Cork City each day. The scheme is, arguably, the most significant project ever undertaken by Cork City Council. Lough Mahon and the Estuary which are grossly polluted at present will be brought up to EU bathing standards.



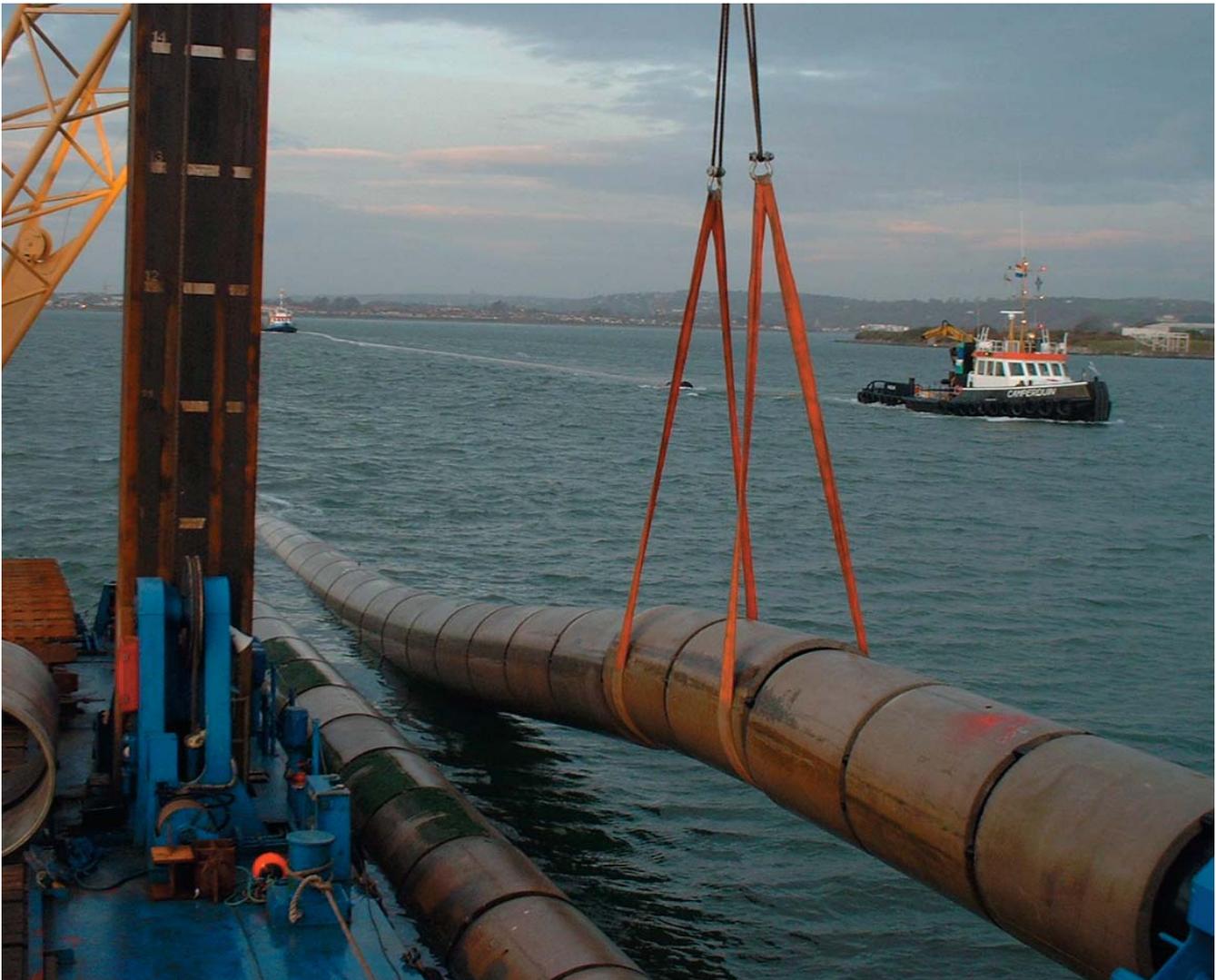
Pipes being towed to Cork Harbour (courtesy E G Pettit & Company).(courtesy E G Pettit & Company)

Consulting Engineers for this major project are *E G Pettit & Co.* the largest indigenous Consulting Engineering firm in Ireland who are based in Cork City.

The scheme is being implemented through 19 separate contracts varying in value from €100,000 to €70,000,000. Conventional procurement contracts were adopted for all but the treatment works which is procured through a Design, Build and Operate (DBO) Contract. The largest of the conventionally procured contracts is the Lough Mahon Crossing and Ballinure Header Chamber contract. The value of this contract is €31 million and the contract is itself technically very interesting. Main contractor is *Van Oord ACZ Ltd*, a Dutch owned Marine & Civil Engineering specialist. *Van Oord* entered into a partnership arrangement with a local Cork contracting firm P.J. Hegarty for the performance of the land based works. This association was formed prior to the submission of the tender.

The project is divided equally between Marine Works and land based Civil Engineering Works. The Ballinure Header Chamber receives pumped flows from a number of outlying pumping stations and is the central collection point for the city's sewage prior to transfer of the foul flows through siphon pipes under Lough Mahon and onto the treatment works site. The Lough Mahon Crossing and Ballinure Header Chamber Contract implements a significant element of the infrastructure associated with the Cork Main Drainage Scheme.

Incoming flows to the Header Chamber are screened and passed through grit classifiers before being transported to the treatment works site through a 4.75km length of twin 1200mm diameter siphon pipes, 3.5km of which is under the tidal waters of Lough Mahon. Work commenced in May 2001 and by April 2002 all marine works were substantially complete as were the land based pipelines. The Header Chamber is due for completion in October 2002.



Joining of marine pipes (courtesy E G Pettit & Company)

Header Chamber

All of the raw wastewater passing through the Ballinure Header Chamber will be screened and grit removed before being conveyed to the wastewater treatment plant at Carrigrenan. This will provide for the removal of any solids, which would otherwise settle out in the siphons underneath Cork Harbour en route to the treatment plant.

Fine screening to 5mm will be achieved by use of three band screens operating in parallel, with each capable of passing up to 1,805 l/s of wastewater. These will operate on a duty/assist/standby basis, although in the event of unusually high wastewater flows or high water levels upstream of the screens, the 'standby' screen will automatically be brought into operation in a further 'assist' mode. Screenings removed from the flow will be treated by washing, dewatering and compaction to render the screenings suitable for disposal to landfill. Any organic or faecal matter removed with the screenings will be returned with the washwater into the main waste water stream.

Following screening of the wastewater, grit will be removed by means of two vortex type grit traps which will pass up to 1,805 l/s and will operate in parallel on a duty/assist basis. Grit which is removed will be washed and cleaned in two grit classifiers operating in parallel. Any organic matter removed with the grit will be returned to the main wastewater stream.

Odour

Any potential for odour nuisance is eliminated by the installation of a specialist odour control treatment system and a suitably

designed ventilation system. All channels and chambers are covered over and separated from the main air space within the building and vented separately to the odour control treatment system. All container skips are fully sealed and screenings and grit are passed into such containers through sealed pipework. The containers are vented to the odour control treatment system during filling.

The Ballinure Header Chamber will be capable of automatic operation and unmanned, except to replace the full screenings and grit containers with empty units. The associated SCADA system will be linked to the main telemetry and control system serving the Cork Main Drainage scheme.

Siphon pipelines

The Ballinure Header Chamber is sited within a proposed business park, over a kilometre from Cork Harbour and a fail safe overflow to a watercourse was not possible. Accordingly, various fail-safe mechanisms were incorporated into the design to ensure that the risk of spillage of foul flows at the header chamber site was eliminated.

Each of the 4750m long siphons (equivalent hydraulic length of 4958m) were designed to operate at a peak pipe flow of 1,8051 litres per second with a head loss of 10m Under this flow regime, there is an available freeboard of 1.6m within the header chamber. This available hydraulic head is utilised to generate greater than normal velocities and thus provide a mechanism for progressively flushing the individual siphon pipes.

The pipe design was originally based on a concrete coated cement lined 42 inch diameter welded steel pipe. Calculations were replicated using a 1200mm dia. High Performance Polyethylene Pipe (HPPE). The hydraulic performance of the 1200mm OD HPPE pipe was marginally better than for the 42" pipe as the reduced pipe roughness co-efficient for HPPE pipe was sufficient to offset the reduction of the inside diameter for the plastic pipe.

To allow the most cost effective solution to be constructed, the tender document included alternatives for the welded/steel and/or the plastic pipe options. The plastic pipe option proved to be the most economically advantageous option for the selected tenderer.

After a detailed evaluation of the tenders it was recommended that *Van Oord ACZ* be appointed contractors for the project. Their tender contained an alternative proposal for maintenance and cleaning of the siphon pipes – a ‘pigging’ alternative which was adjudged to be economically advantageous.

‘Pigging’ proposals

In the *Van Oord ACZ* alternative design proposal, maintenance and cleaning of the submarine section of the siphon was provided for by the provision of ‘pigging’ facilities at the locations of access shaft chambers located close to the shore lines at each side of Lough Mahon. These access shafts were specially modified to accommodate the ‘pigging’ facilities. The design has been carried out on behalf of *Van Oord* by their engineering consultant *Montgomery Watson Harza*, based in the United Kingdom. The design of the ‘pigging’ facilities was based on a ‘pigging’ method using foam ‘pigs’ where the following sequence of operation is followed.

*A foam ‘pig’ is inserted in the ‘pig’ launching facility. The consists of a batch box, which can be isolated from the pipeline by means of valves;

* The valves remain closed until the header tank of the Ballinure Header Chamber is filled with sewage. Subsequently, the valves are opened and the ‘pig’ progresses through the siphon pipe with the gravity flow.

* A pig receiving facility similar to the launching facility is used to remove the ‘pig’ from the siphon pipe at the other end. The sewage is diverted through a connection pipe to the other siphon pipe and discharged to the treatment works.

In addition, a water intake at the launch chamber and an outlet at the receiving chamber has been designed which can be connected to portable pumps so that, if required, additional flow and pressure can be provided to remove a blockage.

Maintenance of the land based sections of the siphon pipe will be by means of access hatches under a carefully controlled methodology.

Van Oord ACZ have also developed and successfully applied a new coupling to join the separate 385m lengths of the polyethylene pipes forming the Lough Mahon siphons. The main component of this new coupling is Glass Reinforced Plastic (GRP). Various prototype testing of this coupling was carried out under the supervision of *E G Pettit & Company*.

The pipes used in this project were towed in bundles of 6 x 385m lengths from Norway in summer and early autumn 2001

The pipes were laid by means of a ‘float and sink’ method over a three week period in November 2001. ■

Note: *The Editor & Publishers wish to thank E.G.Pettit & Company for supplying the above article for publication.*



Aerial view of header chamber under construction (courtesy *E G Pettit & Company*)