INTEGRATED CONSTRUCTED WETLAND

TIMOLEAGUE AGRI GEN

November 2012

VESI Environmental Ltd.

Project:
INTEGRATED CONSTRUCTED WETLAND TIMOLEAGUE AGRI GEN

Title: Report on the use of an Integrated Constructed Wetland for treatment of surface water runoff at the Timoleague Agri Gen facility, Trimoleague, Co. Cork

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Prepared for: NRGE
Mooresfort
Lattin
Co. Tipperary

Prepared by: Vesi Environmental Ltd
3013 Euro Innovation Park,
Euro Business Park,
Little Island, Cork.
Tel: 0214355912

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1. Introduction

An Integrated Constructed Wetland (ICW) system is proposed as part of the planned development at the Timoleague Agri Gen facility at Barry's Hall, Timoleague. The proposed ICW is designed for the treatment surface water runoff from trafficked areas and internal roads at the at Timoleague Agri Gen facility.

Figure 1. Location of proposed ICW system.

2. Integrated Constructed Wetlands

There are many different types of constructed wetlands worldwide with an ever-widening range of application from polishing to complete treatment systems for a wide range of effluent types. ICWs are a novel approach to water treatment addressing total water management (primary, secondary, tertiary, low flows and flood abatement) and have been an ongoing development for over 23 years in Ireland.

The Government approved guidelines on ICWs were published by the Department of Environment, Community and Local Government in December 2010: 'Integrated Constructed Wetlands - A Guidance Document for Farmyard soiled water and domestic wastewater applications'.

The ICW concept effectively integrates the following three objectives:

- Water management - The containment and treatment of influents within emergent vegetated areas using wherever possible local soil-material.
- Landscape fit - The aesthetic placement of the containing wetland structure into the local landscape towards enhancing a site's ancillary values.
- Biodiversity - Enhanced habitat diversity and nature management.

The emphasis on explicit integration facilitates processing synergies, robustness and sustainability that are not generally available in other constructed wetland designs. The benefits of ICW systems are primarily due to larger scaling patterns and their greater biological complexity. ICW systems have been successfully applied to a range of effluent types in different situations when appropriate assessment, design and construction are conducted.

Treatment processes within Integrated Constructed Wetlands

Constructed wetlands improve through flowing water through physical, chemical and biological processes. The main treatment processes include;

- Uptake and transformation of contaminants/nutrients by micro-organisms and plants.
- Breakdown and transformation of contaminants/pollutants by micro-organisms and plants.
- Filtration and chemical precipitation through contact with substrate and plant litter.
- Settling of suspended particular matter.
- Chemical transformation of pollutants
- Absorption and ion exchange on the surface of plants, sediment, and litter (of particular relevance to the capture and storage of phosphorous).
- Predation and natural die-off of pathogens (e.g. E. coli and Cryptosporidium)

3. Site suitability

Effluent quality and quantity, location, landscape, geology, hydrology and soils, and economics are all essential considerations necessary in the design of ICW systems. These factors determine whether and how the ICW concept can be applied. Influent composition, hydraulic retention time, and site characteristics are fundamental in calculating the area and form of the ICW.

An area to the northeast of the development area has been identified as providing the location for the development of an ICW.

A summary of the findings of the site assessment is provided in Table 1.

Table 1. Site assessment information

Groundwater vulnerability	High to Low
Subsoils	Till derived from Devonian and carboniferous rocks
Aquifer classification	PI - Poor
Groundwater Response	R1
Surface water features	The East Cruary River is located to the east and the Timoleague River is located to the northwest of the site.
Wells	Wells located on adjacent farms (see accompanying EIS – Soils Geology and groundwater report from IE Consulting Engineers.

Designated Areas	The proposed ICW site is located c.130m from the following designated sites · Courtmacsherry Estuary Special Area of Conservation (SAC 001230) · Proposed National Heritage Area (pNHA 001230) · Courtmacsherry Bay is also a Special Protection Area (SPA 004219)
Land use	Agricultural
Topography	Relatively gently sloping

Figure 2: Location of designated sites within the local area

The information available has been reviewed to assess the suitability of an ICW for the site. The groundwater response for the site is R1 which requires that there is 1.0m of cohesive subsoil material beneath the wetland with the upper 0.5m having a permeability of $<1x10^{-8}$m/s and the ICW shall be located at least 60m away well or spring used for potable water.

Careful consideration is to be given to landscaping the site and integrating it appropriately with the existing site and adjacent lands.

Following the assessment of the site characteristics, it has been determined that the development and operation of an ICW is not expected to have any adverse impacts on the surrounding aquatic or terrestrial environment provided that the system is designed and operated in accordance with the DoECLG Guidelines on ICW.

The ICW design endeavours to optimize natural biological, chemical and physical processes of pollutant removal in a way that is compatible with the local aquatic and terrestrial communities and in a way that does not incur negative impact on adjacent aquatic and terrestrial ecosystems.

4. Proposed Integrated Constructed Wetland system.

The treatment system proposed for the site at Timoleague Agri Gen will consist of treatment wetland ponds, with supporting embankments and access.

Free surface water flow is the basic hydrological route for the influent through an ICW. Sequential arrangements of constructed depressions in which aquatic, emergent and marginal plants may be grown are basic to the design to maximise treatment, through plant density and utilisation.

4.1 Wetland Area and layout

The relatively larger land area used in ICW systems compared with that of other treatment wetlands facilitates a greater range of the physical, chemical and biological processes that occur in the wetland environment including that required for the removal of the more difficult contaminants of phosphorus and nitrates.

Interception area: c. 4750m^2
Recommended ICW area 1.5 x interception area (4750m^2) = 7125m^2

The ICW at Timoleague Agri Gen has been designed to have a surface water area of 7340m^2, comprised of four ponds.

Table 2. Wetland pond areas

Wetland pond No.	Area
Pond 1	1320m^2
Pond 2	1000m^2
Pond 3	2900m^2
Pond 4	2120m^2

A wetland layout has been prepared and is shown in the accompanying drawing VE11612_001.

The drawing VE11612_001 provides the general layout proposed and wetland features associated as part of the development, these include

- A series of four shallow vegetated treatment ponds.
- Pipe work between the wetland ponds.
- Access to the ICW site
- Access roads/paths around the ICW ponds.
- Wetland pond planting.
- Tree and shrub planting around the wetland site

Health and safety for both humans and animals are required and incorporated into the design of the ICW. Water depth is generally shallow (typically 200m – 300mm deep) in the ICW. Access to the site is limited through fencing, gates and hedging. The use of signage could be provided to inform users of the site of the hazards (deep water). As part of the commissioning the operators of the ICW should be informed/educated on the type of treatment system, how it functions and the hazards associated with the site if not appropriately used.

The operational water depth within each treatment pond will be between 150 mm - 200 mm, with a capacity to provide periodic increases in water depth. The pond embankments will be gently sloping. The upper embankments will be at least 1.5-2 m wide to allow for safety, proper access and maintenance.

The ponds are connected using 150 mm diameter uPVC pipes. The pipes are placed at the bottom of the wetland floor and water levels can be managed within each pond by placing adjustable bends on the outlet pipe of each pond.

The wetland ponds will be densely planted with appropriate wetland emergent species, such as *Glyceria maxima*, *Carex riparia*, *Typha latifolia* and *Iris pseudacorus.*

4.2 Performance of wetland

The quality of the final effluent will be in the following range, as shown in Table 3.

Table 3. Wetland performance.

Parameter	Concentration
BOD	10 - 5 mg/l
Suspended solids	10 - 5 mg/l
Total phosphorus	<1 mg/l
Ammonia	<1 mg/l

4.3 Discharge

The final effluent will discharge to a land drain, which flows to the East Cruary River and on to Courtmacsherry Estuary. The volume of effluent discharging from the ICW will be variable. Discharge volumes are expected to reduce during dry weather and at times during these periods it is expected that there will be no discharge from the ICW. These reduced and no flows are accounted for when influent flows are low, when climatic factors and wetland processes are taken into account (i.e. containment, plant transpiration and plant interception). There can also be periodic increases in discharge rates during prolonged rainfall events.

5. Construction and landscaping of ICW

The construction of the ICW will involve the excavation and movement of soils on the site to form each wetland pond. The machinery used would include at least a tracked excavator. The main construction works are briefly summarised below.

Stage 1	Excavation of a number of trial pits around the ICW site to determine ground conditions.
Stage 2	Stripping of topsoil from the ICW area, store and protect for later use.
Stage 3	Excavation of sub-soil to the required level and creation of embankments (construction levels to be confirmed prior to excavation)
Stage 4	Layering and compaction of soils for pond embankments and soil liner – the base of the ICW shall be comprised of 1.0m of cohesive subsoil material with the upper 0.5m having a permeability of less than $1x10^{-8}$m/s.
Stage 5	Creation of embankments- Gently sloping embankments (1:1-1:2) Height of embankment min.1.0 m. Width of top embankments ~2m wide.
Stage 6	Installation of pipe works
Stage 7	Re-distribution of top-soil loosely over the base of each pond to a depth of 250mm
Stage 8	Placement of stones/chippings beneath inlet pipes
Stage 9	Planting each pond with emergent vegetation

It is currently expected that there will be no requirement to import or export soil material from the site for the construction of the ICW and that suitable soils are present within the overall development site.

Each pond base shall be level throughout. Levels shall be taken following the placement of the topsoil over the base of the ponds to demonstrate that pond areas are level throughout.

Full details of the wetland layout are provided in the drawing VE11612_01.

Risk mitigation measures should be employed during the construction of the proposed integrated constructed wetland to limit the impact on adjacent surface water and groundwater environments through proper management and supervision.

Wetland planting and landscaping

The landscaping of the wetland will be in keeping with the existing landscape. The wetland ponds will be densely planted using a selection of emergent plant species, such as *Typha latifolia, Carex riparia, Iris pseudacorus* and *Glyceria maxima*.

Wetlands are known to support an immense variety of plant and animal life. The development of a treatment wetland and in particular an ICW within the site would provide a habitat for many animal, bird, insect and plant species. It is recommended that the entire wetland site be landscaped to maximise the potential for wildlife creation and enhancement. This would also be in keeping with the ICW objectives.

Landscaping around the wetland site will include planting trees and grasses. Trees are not recommended on the ICW embankments where access would be restricted or where there would be a possible risk of infiltration via roots. The tree species selected should be in keeping with the existing vegetation of the site. Tree planting will provide stabilisation of the embankments (especially on the western side), the seclusion of the ICW site, while also enhancing the habitat, aesthetic and amenity values of the site.

An ICW incorporates aesthetic appeal and amenity value through appropriate land forming design implemented during construction. The process of design ensures that the final ICW structure 'fits' well into the landscape; e.g. by making the enclosing embankments curvilinear and conforming them to the site's topography. Subsequent vegetation development will further enhance the visual appearance of the system. Appropriate land forming of the structure to fit the landscape also reduces maintenance, thus enhancing a variety of amenity values and improving its sustained functionality.

6. Operation and maintenance of ICW

Integrated constructed wetlands are designed to be as self-maintaining and as self-operable as possible. Some of the recommended monitoring procedures have been listed below for the ICW at Barry's Hill:

- Water level management and flow maintenance – Maintain an operational water level of ~200-300mm. Overtime there will be a build up of vegetation and sediment in the ponds, which will require the outlet pipes to be adjusted to maintain appropriate water depths.
- Surface water monitoring of influent and final effluent
- Flow monitoring of influent and final effluent
- Vegetation monitoring and maintenance – The vegetation in the wetland ponds should be assessed regularly to ensure they are growing, especially during the growing season. Vegetation, especially grassed areas, around the wetland ponds should be regularly maintained/cut to provide for easy and safe access for monitoring and maintenance.
- Maintenance of access – fences, gates and access routes should be maintained to ensure safe and easy access is maintained, while also restricting access for livestock.
- Maintenance of inlet and outlet pipes – The area around the inlet and outlet pipes should be kept clear so that flows between ponds are maintained and that vegetation or sediments do not build up in or around the pipe work. Access should be maintained to all inlet and outlet pipe areas to facilitate monitoring and maintenance.
- Maintenance of grass embankments – upper/grass access ways should be cut regularly and sloping embankments should have the grass cut at least once a year to provide for easy and safe access for monitoring.
- Maintenance of trees – Trees and shrubs shall be maintained as appropriate. The establishment of trees shall be maintained so that they do not restrict access around the site.
- Sediment/sludge management – Overtime there will be a build up of sediment in the wetland ponds, which will need to be cleaned out to maintain the proper functionality of the ICW. The initial wetland pond will require cleaning out first, however this is not expected for a least 5 years.

Further details on the operation and maintenance of the ICW will be prepared for the on-site operator/owner to provide guidance and ensure that the adequate procedures for the ICW system are implemented on an on-going basis.

7. Summary

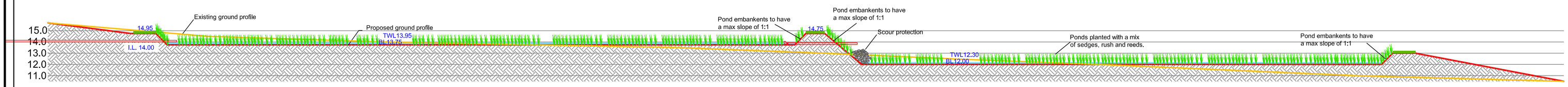
An Integrated Constructed Wetland system has been designed for the treatment of surface water runoff from trafficked areas on the Timoleague Agri Gen site. The ICW will consist of a series of four ponds through which inflowing water will be reduced of its various dissolved and particulate constituents.

The design of the ICW system is in line with the DoEHLG guidelines on ICWs, (Integrated Constructed Wetlands - Guidance Document for farmyard soiled water and domestic wastewater applications, 2010).

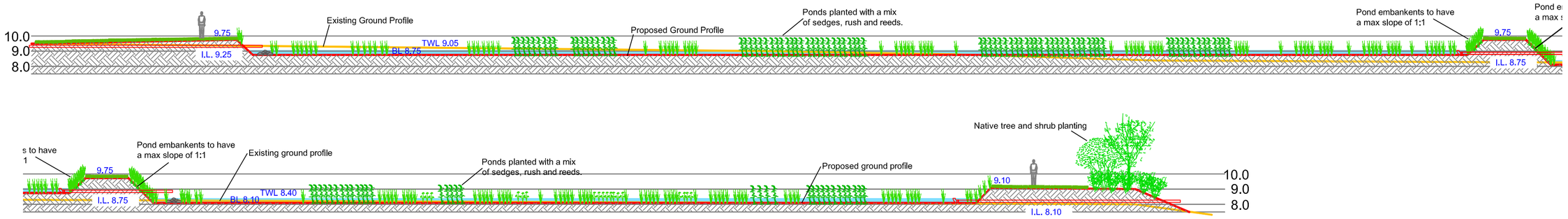
The process of site assessment has determined the suitability of the site for an ICW. A layout of the proposed ICW has been provided in the accompanying drawing VE11612_001. The proposed ICW will cover a treatment/surface water area of c.7340m^2, with an overall area of c.15,000m^2.

The proposed treatment system will provide additional values through appropriate landscaping, so that it's structure 'fits' into the local environment and enhances the aesthetic and biodiversity values of the site.

A detailed operation and maintenance plan will be prepared for the operator of the ICW to advise on the various procedures to ensure the continued performance and sustainability of the system.



Section A-A1 Scale 1:200



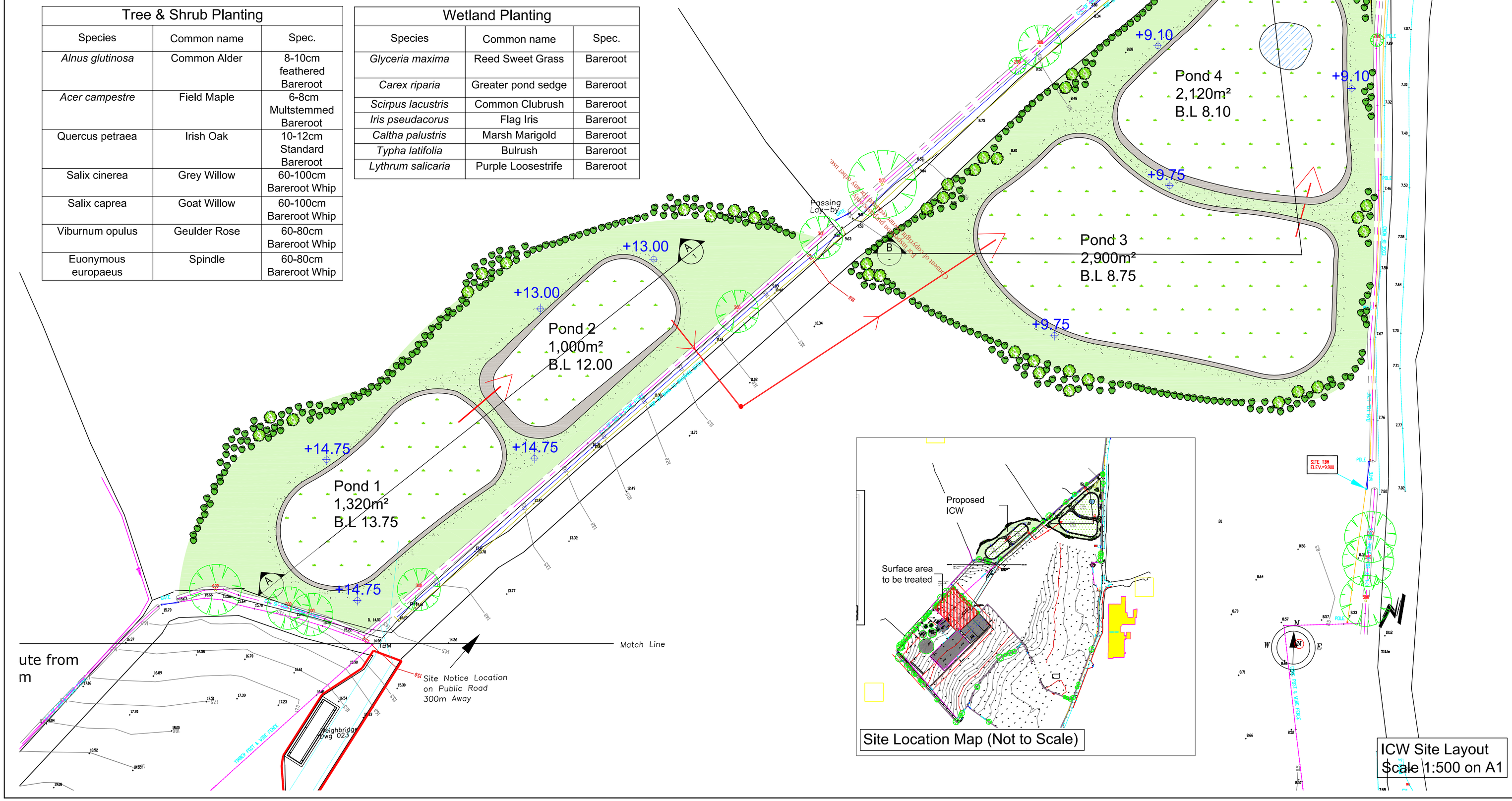
Section B-B1 Scale 1:200

Tree & Shrub Planting

Species	Common name	Spec.
Alnus glutinosa	Common Alder	8-10cm feathered Bareroot
Acer campestre	Field Maple	6-8cm Multstemmed Bareroot
Quercus petraea	Irish Oak	10-12cm Standard Bareroot
Salix cinerea	Grey Willow	60-100cm Bareroot Whip
Salix caprea	Goat Willow	60-100cm Bareroot Whip
Viburnum opulus	Geulder Rose	60-80cm Bareroot Whip
Euonymous europaeus	Spindle	60-80cm Bareroot Whip

Wetland Planting

Species	Common name	Spec.
Glyceria maxima	Reed Sweet Grass	Bareroot
Carex riparia	Greater pond sedge	Bareroot
Scirpus lacustris	Common Clubrush	Bareroot
Iris pseudacorus	Flag Iris	Bareroot
Caltha palustris	Marsh Marigold	Bareroot
Typha latifolia	Bulrush	Bareroot
Lythrum salicaria	Purple Loosestrife	Bareroot



Title:
Timoleague Agrigen Integrated Constructed Wetland (ICW)

LEGEND

- Area of open water
- Effluent pipes, flow direction & manholes for inspection & monitoring
- Wetland pond planting
- Grass areas around ponds to be mown to maintain access
- Pond embankments to have gentle slopes of max 1:1
- Native tree Planting
- Native whip hedge planting

NOTES:

1. SEE ACCOMPANYING ICW DESIGN REPORT
2. DO NOT SCALE FROM THIS DRAWING. THIS DRAWING IS FOR INFORMATION ONLY.
3. LEVELS TO BE CHECKED AND CONFIRMED ON SITE

Wetland areas
Pond 1 1,320m²
Pond 2 1,000m²
Pond 3 2,900m²
Pond 4 2,120m²
Total pond area 7,340m²

VESI Environmental Ltd
3013 Innovation Park,
Euro Business Park,
Little Island, Cork.

Tel/Fax: 021 4355912
Email:info@vesienviro.com
Website:www.vesienviro.com

Project: Timoleague Agrigen ICW

Client: NRGE
Drawing No: VE11612_001
Drawn By: J. Laffey
Checked By: A. Carty

Status: DRAFT Planning

Date: November 2012

Scale: 1:500 on A1