MWP

Appendix 5.1

Bat Survey Report

INTRODUCTION

Malachy Walsh and Partners, Engineering and Environmental Consultants, were commissioned, by BAM Ireland, to carry out bat activity surveys, during the spring of 2022, at the location of a proposed strategic housing development (SHD) at Carrigtwohill Co. Cork. The surveys were conducted to inform the preparation of an Environmental Impact Assessment (EIAR) as part of a planning application under the SHD program.

COMPETENCY OF THE ASSESSOR

The surveyor and report author, Marc Shorten BSc MSc, is a Malachy Walsh and Partners (MWP) staff ecologist with over 15 years of professional experience in biological sciences, across consulting ecology, private research and national wildlife regulation. Marc has expertise and experience in conducting a range of ecological surveys across a variety of taxa, including bat surveying. Marc has extensive reporting experience through roles in academic research, private industry biological research, environmental consultancy and work in the Sea-Fisheries Protection Authority (SFPA).

Marc holds a research MSc in marine animal behaviour and a first-class honours BSc in Zoology and Applied Ecology from University College Cork. He spent five years as Senior Researcher of a marine research company, primarily coordinating research funded by national and European bodies (BIM, European Commission and others). Marc has a number of publications relating to work on regulatory legislation of natural resource management and has worked in authoring, compilation and delivery of appropriate assessments and environmental impact assessment reports.

The information prepared and provided is true and accurate at the time of issue of this report and has been prepared and provided in accordance with the CIEEM Code of Professional Conduct (CIEEM 2022). We confirm that any professional judgement expressed herein is the true and bona fide opinion of professional ecologists.

LEGISLATION

LEGAL AND CONSERVATION STATUS OF BAT SPECIES IN IRELAND

All Irish bat species are protected under the Wildlife Acts (1976 to 2021)[1] and by the Habitats Directive[2] which protects rare species, including bats, and their habitats. All bat species are listed in Annex IV of the Habitats Directive as species protected across their entire natural range and the lesser horseshoe bat is further listed, under Annex II, as a species for which core areas of their habitat must be protected within the Natura 2000 network of protected sites. Under Regulation 51 of the European Communities (Birds and Natural Habitats) Regulations 2011-2021, any person who, in regard to the animal species listed in Annex IV of the Habitats Directive,

a. deliberately captures or kills any specimen of these species in the wild,

[1] Collective citation for the following: Wildlife Act 1976 (no. 39 of 1976); Wildlife (Amendment) Act 2000 (no. 38 of 2000); Wildlife (Amendment) Act 2010 (no. 19 of 2010); Wildlife (Amendment) Act 2012 (no. 29 of 2012) and Heritage Act 2018 (no. 15 of 2018), Part 3. Planning, Heritage and Broadcasting (Amendment) Act 2021 (no.11 of 2021), Chapter 3

[2] Council Directive 92/43/EEC on the Conservation of natural habitats and of wild fauna and flora enacted in Ireland as European Communities (Birds and Natural Habitats) Regulations 2011-2021 (Collective citation for the following: S.I. No. 477 of 2011, S.I. No. 499 of 2013, S.I. No. 355/2015, S.I. No. 293/2021)

b. *deliberately disturbs these species particularly during the period of breeding, rearing, hibernation and migration,*
c. *deliberately takes or destroys eggs of those species from the wild,*
d. *damages or destroys a breeding site or resting place of such an animal, or*
e. *keeps, transports, sells, exchanges, offers for sale or offers for exchange any specimen of these species taken in the wild, other than those taken legally as referred to in Article 12(2) of the Habitats Directive.*

Across Europe, bats are further protected under the Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention 1982), which, in relation to bats, exists to conserve all species and their habitats. The Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention 1979) was instigated to protect migrant species across all European boundaries. The Irish government has ratified both these conventions.

Under Article 11 of the Habitats Directive, each member state is obliged to undertake surveillance of the conservation status of the natural habitats and species in the Annexes and, under Article 17, to report to the European Commission every six years on their status and the implementation of the measures taken under the Directive. In April 2019, Ireland submitted the third assessment of conservation statuses for 59 habitats and 60 species. The current Conservation Status assessments for bat species resident in Ireland are listed in **Table 1**, below; the trend in the Conservation Status for each is included.

Table 1: Overall Assessment of Conservation Status for bat species resident in Ireland (NPWS, 2019)

Species	Overall assessment of Conservation Status	Overall trend in Conservation Status
Brown long-eared bat	Favourable (FV)	Improving
Common pipistrelle	Favourable (FV)	Improving
Daubenton's bat	Favourable (FV)	Improving
Lesser horseshoe bat	Unfavourable-Inadequate (U1)	Deteriorating
Leisler's bat	Favourable (FV)	Improving
Nathusius' pipistrelle	Unknown (X)	N/A[3]
Natterer's bat	Favourable (FV)	Stable
Soprano pipistrelle	Favourable (FV)	Improving
Whiskered bat	Favourable (FV)	Stable

SCIENTIFIC NOMENCLATURE: CONVENTIONS

Species nomenclature follows the standard form of the common name, followed by the binomial, on the first instance of usage in the text or the first instance of usage in a table. Thereafter, for any subsequent usage, common names only are used.

BAT ECOLOGY AND BEHAVIOURS

RESIDENT SPECIES

There are nine resident bat species on the island of Ireland. These species are:

- Common pipistrelle (*Pipistrellus pipistrellus*);
- Soprano pipistrelle ((*Pipistrellus pygmaeus*);

[3] Not provided in NPWS (2019).

- Leisler's bat (*Nyctalus leisleri*);
- Brown long-eared bat (*Plecotus auritus*);
- Lesser horseshoe bat (*Rhinolophus hipposideros*);
- Daubenton's bat (*Myotis daubentonii*);
- Nathusius' pipistrelle (*Pipistrellus nathusii*);
- Natterer's bat (*Myotis nattereri*);
- Whiskered bat (*Myotis mystacinus*).

All are insectivores and all use a seasonal feeding strategy to help build fat reserves during the summer and autumn, before their hibernation during winter - a time, generally, when insects are not available. Most hunt flying prey, but some species, e.g., lesser horseshoe bat or Daubenton's bat, glean their prey from surfaces of leaves or water on which the prey have alighted.

All hibernate during winter and typically become active in late spring and early summer. As the days and nights warm up each species flies out to forage for insects, for progressively longer periods, at night. Around late June or early July, pregnant females give birth to a single offspring which feeds on its mother's milk for 6-7 weeks at which point it can fly and learns to echolocate and to catch its own prey. Mating takes place from August onwards; the female retains the sperm throughout the winter but does not ovulate and become pregnant until spring the following year. The onset of hibernation, which takes place from October/November onwards, begins once temperatures drop and insect prey abundance drops.

HABITAT ASSOCIATIONS

Bats in Ireland feed exclusively on insects and, in the summer, they generally emerge from their roosts, at dusk, to feed. While the distances covered while foraging varies considerably between individual species, all are known to use several different foraging sites in the same night and to move between them to locate areas of high insect density (see Section 4.3 Distribution of Prey).

The interplay between habitat mix, environmental conditions, topography, elevation, and availability of prey is a key determinant of whether a location is suitable for bats as is the distance between roosts and the location in question. Because bats preferentially select certain habitats and avoid others, each species has a strong association with different habitat types to which they exhibit a high level of site loyalty and species will frequently return to the same foraging sites night after night (Entwhistle *et al*., 2001). Because bats are colonial mammals, intergenerational learning is a fundamental characteristic of their biology and one that tends to reinforce site loyalty such that foraging grounds are frequented for periods of years or even decades. As was noted in Section 4.1 Resident Species juvenile bats hunt independently within weeks of birth and, therefore, acquire knowledge of foraging sites before their first hibernation period. Reliability of supply of prey biomass is foundational to each species' capacity to maintain populations at viable levels (in this regard see content on metabolic constraints in Section 4.4 Metabolic Constraints).

Table 2, below, lists and ranks, in order of precedence, the relative importance to bat species of certain landscape features that bats use as they roost, commute, and hunt. They use hunting grounds - foraging sites - to find food and commuting habitats to travel.

Table 2: Landscape features of importance to bat species

Features of high importance	Features of medium importance	Features of low importance
Underground sites	Improved pasture	Intensive arable
Buildings with high bat roost potential	Drainage ditches	Dense urban, particularly lit areas
Broadleaved woodland and scrub	Walls and fences	
River valleys	Minor roads (no hedges)	
Small field systems with low-intensity pasture	Exposed upland sites	
Treelines and hedgerows	Coniferous woodland	
Bridges and structures with high bat roost potential		

(Adapted from the UK Department of Transport's Interim Advice Note 116/08 Nature Conservation Advice in Relation to Bats)[4]

DISTRIBUTION OF PREY

At any location, the abundance of flying insects is heavily influenced by, *inter alia*, wind speed (Møller, 2013). Small insects generally tend to settle in areas with low wind speeds because control and manoeuvrability of flight are optimised where wind speeds are lower than the insect's flight speed (Pasek, 1988). Therefore, within any established foraging ground, existing windbreaks such as tree lines, vegetated field - or roadside - boundaries, and woodland edges create sheltered corridors where concentrations of insects accumulate leeward of these windbreaks, particularly in comparison with adjacent unsheltered areas. Within these sheltered corridors the patterns of distribution will be affected by wind speed, angle of incidence of the wind, permeability of the windbreak, turbulence, vegetative composition, and source of insects (windbreak, local fields, upwind sites) (Pasek, 1988). Bats will know from experience and repetition where insects are likely to be more abundant and will return to these areas (see content on-site loyalty in paragraph 2, Section 4.2 Habitat Associations, preceding). As a result of these variables, bats can be unevenly distributed within any given area due to the influence of localised conditions even on small scales (de Jong & Ahlén, 1991).

METABOLIC CONSTRAINTS

Two fundamental behavioural characteristics impose a high metabolic cost on all bat species – flight and the use of acoustic signalling to navigate, hunt, and communicate. As true fliers, rather than gliders, bats use flapping flight which is one of the most expensive activities in terms of metabolic cost (Winter and von Helversen, 1998). In addition, the metabolic costs of acoustic signalling are about eight times that of the silent animal (Ophir *et al.*, 2010), and the cost of echolocation can be even higher. As a group, therefore, bats have evolved to favour minimal mass because of the energetic demands of flight, hunting, and communication and have developed behaviours that minimise other metabolic costs.

The wing of a bat resembles a modified human hand with a flexible skin membrane that extends between each long finger bone and it is the many movable joints that make bats agile fliers. Because of the thin wing membrane, flying during the heat of the day could be hazardous causing excessive absorption of heat and resulting in dehydration and possible heat prostration. Nocturnality offers protection from the heat and helps bats maintain body temperature and moisture. It also affords protection from aerial predators most of which hunt during the day.

[4] Available at http://www.dft.gov.uk/ha/standards/ians/pdfs/ian116.pdf

Even though they share the characteristics of all mammals - hair, regulated body temperature, the ability to bear live young, and to nurse them; bats are the only mammals to truly fly. Flying consumes so much energy that each female bat is only able to produce a single offspring each year and a bat typically will need to consume about 1/3 of its body weight in food per night; a common pipistrelle, for example, can eat over 3,000 insects in a single night. As insectivores, bats in Ireland feed on arthropods which contain the energy-rich carbohydrate chitin, which is indigestible for the typical mammalian gastrointestinal tract. However, European vespertilionid bat species have evolved an enzymatic adaptation (acidic mammalian chitinase) which enables them to digest the chitin present in their primary source of food to optimize resource use and energy intake (Strobel *et al.* 2013[5]).

This aspect of their ecology, this high metabolic demand, is a key determinant in the foraging strategies of all bat species. Speculative foraging carries too low a risk/reward ratio in that the metabolic costs of flight and echolocation are so high that bats will seek out locations that have previously rewarded energy cost inputs. This aspect of their behaviour is demonstrated by the previously mentioned high level of site loyalty exhibited by bat species and the repeated return to the same foraging sites night after night (Entwhistle *et al*., 2001). In addition, because the cost of flight increases with decreasing body size, de Jong (1994, cited in Erickson *et al*., 2003) hypothesized that smaller bats with slower flight could be restricted from using habitats where insect abundance was low and long-distance foraging flights were required.

Differences in activity on different nights could be the result of climatic conditions, insect availability, or morphological differences between species. Cooler and windier nights tend to suppress the flight activity of bats (Anthony *et al.*, 1981, O'Farrell, 1967 and Stebbings, 1968, cited in Erickson *et al*., 2003) by imposing thermoregulatory stress and by reducing the activity of their insect prey. Strong winds can also increase the cost of flight and can affect the net energy gain for foraging bats (Weimerskirch *et al*., 2012, cited in Møller, 2013).

AUDIO SIGNATURE

Because they have evolved to be active in the dark bats use echolocation, a form of acoustic signalling, for sensing the environment and to orientate and forage at night. It is these signals that were detected and recorded during the surveys described in this report. Echolocation involves the production of pulses of high-frequency sound, usually in the ultrasound range above 20 kHz, and the detection of the returning echoes with acutely sensitive ears. By comparing the outgoing pulse with the returning echoes — which are modified versions of the outgoing pulse — their brains can assemble dynamic images of the surroundings including the size, shape, distance, and motion of their prey - the location of which can be determined, in three dimensions, from its range and direction (Jones, 2005).

Each species uses echolocation in an individualised manner adapted to its preferred habitat and flight behaviour. Species that fly high emit signals over a long-range, i.e., long signals that sweep through a narrow spectrum, which enable them to retrieve information from a long way ahead. Conversely, species that hunt where obstacles are likely to be quite near, or that glean their prey from surfaces such as Daubenton's bat and lesser horseshoe bat, do not need to emit intense pulses because of proximity.

[5]Strobel *et al.* (2013) included analyses of, *inter alia*: common pipistrelle, brown long-eared, Natterer's, Daubenton's and Leisler's bats all of which are vespertilionid bat species resident in Ireland.

SPECIES DETECTABILITY

Because species use echolocation in an individualised manner the detectability of each depends mainly on 2 factors:

- the abundance of the species and its ubiquity in the area surveyed.
- the intensity of its echolocation signals.

As a result, the probability of acoustic detection varies from species to species and this probability is also influenced by the acuity of the microphones in the units used for detection. Each species' intensity of emission is characterised in Table 3, below; the detection range is included.

Table 3: Intensity of emission and detection range (open to semi-open environment)

Intensity of emission	Species	Detection range (m)
Very weak	Lesser horseshoe bat	5
	Whiskered bat	10
	Daubenton's bat	15
	Natterer's bat	15
Medium	Brown long-eared bat	20
	Common pipistrelle	25
	Nathusius' pipistrelle	25
	Soprano pipistrelle	25
Strong	No species in this category are resident in Ireland	N/A
Very strong	Leisler's bat	80

[Adapted from Barataud (2020)]

FIELD SURVEY DESIGN

In light of the foregoing, bearing in mind the habitats present and on the basis of the surveyor's expertise, it was clear to the surveyor that a single sampling point was sufficient to record a representative sample of bat activity at the site. However, in order to ensure that there would be no question as to the robustness of the assessments based on the survey data, it was decided to deploy five units for fourteen nights, with units situated at locations where, should bats be present, representative levels of activity were reasonably foreseeable.

PRELIMINARY BAT ROOST SURVEY (VISUAL DAYTIME SEARCH)

The preliminary bat roost survey was conducted per Aughney *et al*. (2008) and Collins (2016) and was cognisant of criteria included in Marnell *et al*. (2022) (see **Table 4**, below). The site was surveyed in daylight hours to determine if suitable roost habitat sites such as old farmyard buildings or derelict houses were available or present within/adjacent to the PDS. The PDS primarily comprises grassland, scrub and hedgerow habitats with an adjacent apartment building bounding the site to the northwest. While young/ semi-mature trees are present the general age profile and condition were not considered consistent with the characteristics of those typically selected as established roost sites by bats.

Table 4: Species' associations with roost types (from Marnell *et al.*, 2022)

Species	Trees		Buildings		Underground	
	Maternity	Hibernation	Maternity	Hibernation	Maternity	Hibernation
Lesser horseshoe bat *Rhinolophus hipposideros*	L	L	H	M	L	H
Daubenton's bat *Myotis daubentonii*	M?	L?	M	L	M?	H
Whiskered bat *Myotis mystacinus*	M?	M?	H	L	N	H
Natterer's bat *Myotis nattereri*	M?	M?	H	L	L	H
Nathusius' pipistrelle *Pipistrellus nathusii*			H?			
Common pipistrelle *Pipistrellus pipistrellus*	M	M	H	H	N	L
Soprano pipistrelle *Pipistrellus pygmaeus*	M	M	H	H	N	L
Leisler's bat *Nyctalus leisleri*	M	M	H	L	N	N
Brown long-eared bat *Plecotus auritus*	H	H	H	H	N	M

Key
Trees – includes all types of crevice and hollow as well as bat-boxes attached to trees
Buildings – above-ground areas, with an emphasis on roof voids and other areas warmed by the sun.
Underground – anywhere that provides cool humid conditions buffered against rapid temperature change. Includes caves, mines, tunnels, souterrains, fortifications, cellars, ice-houses, lime kilns *etc.*

N – not recorded in recent times
L – low dependence; unusual, but has been recorded
M – some usage recorded, though not the most important type of site
H – the most frequently recorded type of site for this species/activity

PASSIVE AUTOMATED BAT SURVEYS (PABS)

Song Meter[6] Full Spectrum bioacoustic recording units were deployed within the proposed wind farm site for 10 nights during each season. Full Spectrum (FS) detectors continuously record all frequencies and retain details of the call structure. The sound recordings from these detectors are typically very high quality[7] and are stored on the units for later analysis. Because FS detectors record sounds at the full frequency, i.e., ultrasonic sounds are not converted to a

[6] Song Meter Mini Bat manufactured by Wildlife Acoustics Ltd.
[7] https://www.batconservationireland.org/get-involved/bat-detectors-getting-using

lower frequency to make them audible, they can capture, and record, sound in real-time at a high level of detail. The resulting sound files are very large, so these detectors use a triggering system so that recordings are made only when sounds detected are above certain frequency and amplitude thresholds.

The units were programmed to begin recording half an hour before sunset each evening and to continue until half an hour after dawn the next morning. Before deployment, the latitude, longitude, and time zone for each survey location was inputted to each unit and each then automatically determined the times of dawn and dusk, thereby, reducing the likelihood of operator error. Calls emitted by bats that passed within the detecting range of the units (see **Section 4.2 Species Detectability**), during the period of activation, were recorded and their calls were stored for later analysis. Each unit has an omnidirectional microphone that detects bat ultrasonic calls and each unit records and stores data on internal SD cards.

The results are presented in **Section 6.1**, below.

1.1.1 Characteristics of the Sampling Points

Because of the habitat mix within the PDS site, and because as the collection of a representative sample was more likely if the SPs were mainly located along the field boundaries rather than in the open grassland habitats, the bioacoustic units were located on field boundaries in the expectation that, should bats be present, detectable levels of activity were reasonably foreseeable at the selected locations, particularly because bats are known to exhibit a high level of site loyalty and will frequently return to the same foraging sites night after night (Entwhistle *et al*., 2001). This characteristic of the sampling locations also increased the probability that any species with a habitual presence in the survey area would, at some point, be encountered at the locations. The SP locations are illustrated in **Figure 1**, below.

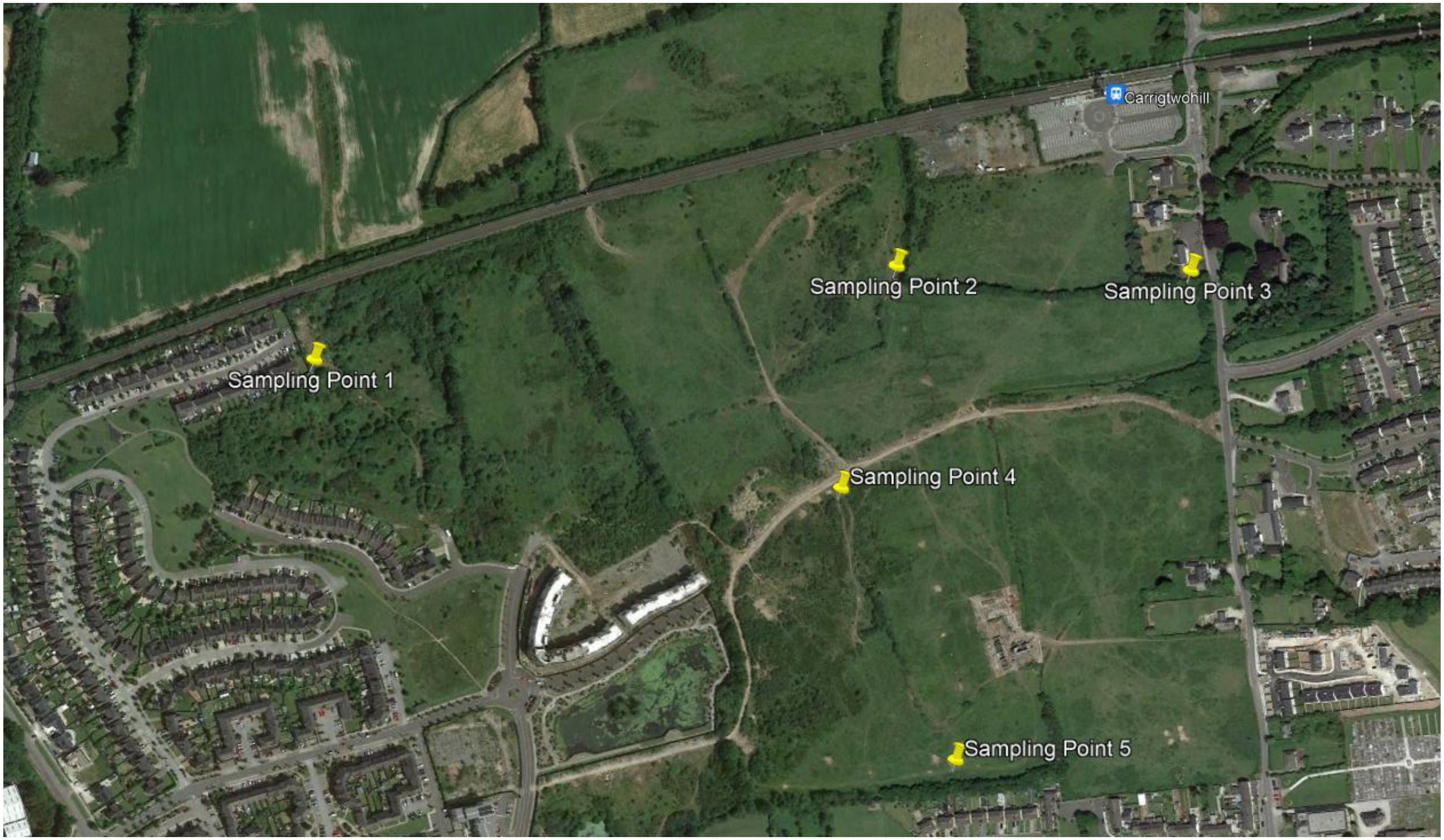

Figure 1: Sampling Point Locations

SONOGRAM ANALYSIS

Post survey, the sound files were converted, using proprietary software[8], to produce sonograms (graphs of the sound recorded). As each species has a unique audio signature, the sonograms, or graphs, can be used to distinguish between one species and another. Using training and experience of sonogram analysis a staff ecologist, with extensive experience of and expertise in sonogram analysis, used the software to eliminate all data files that were not generated by bats. Once an individual call is identified the recording is labelled using tools available in the software.

Not every call emitted by a bat is the echolocation call that is characteristic of the species in question. Many bat species use differently structured echolocation calls, adapted to their habitat structure or foraging situation (Miller & Degn, 1981; Fenton, 1987; Rydell, 1990; Kalko, Schnitzler & Schnitzler, 1993; Jones, 1995 cited in Pfalzer *et al.,* 2003). In addition to echolocation calls, bats use 'social' calls which are differentiated from echolocation calls by their solely communicational function. Pfalzer *et al.* (2003) categorises these into 4 types, as follows, squawk, trill (repeated), cheep (curved), and song (complex). While these can readily be attributed to bats, they cannot be used to differentiate between species. In this report, any calls that match the parameters outlined in the preceding sentences are designated as unidentified. Sonograms of this category are shown in the various tables under the column heading 'NoID'.

RESULTS

SPECIES RECORDED DURING PABS

Because an individual bat can be the source of more than one, or even many, calls, the numbers of calls recorded by the bioacoustic units are not a direct measure of the numbers of any bat species. Bats will frequently fly over and back along short sections of habitat if prey is readily available while foraging and they use linear features to navigate through the landscape, to and from roosts, and within foraging sites. Therefore, the number of calls recorded is likely to be greater than the number of bats that generated them. However, the numbers recorded are a reliable proxy for the levels of bat activity at the proposed development site.

The following species, and bats to which a species or genus could not be attributed, were recorded within the proposed development site**.**

- Soprano pipistrelle (61.39 %)[9] – 9,128 of 15,114 records
- Common pipistrelle (33.36 %) – 5,042 of 15,114 records
- Leisler's bat (5.96 %) – 901 of 15,114 records
- Unidentified bat (0.23 %);[10] – 35 of 15,114 records
- Species from the genus *Myotis* (0.05 %) – 8 of 15,114 records

NUMBERS OF CALLS RECORDED AT INDIVIDUAL SAMPLING POINTS

The numbers of calls of each species and those calls to which a species or genus could not be attributed, that were recorded at each SP during the survey period, are provided in Table 5. In each case, the percentage of the total number recorded, that each species represents, is included. Cells highlighted yellow indicate the highest number of calls recorded for each species; the cell highlighted green is the largest total number of calls recorded at any SP. The percentage of the total activity recorded at each SP is included. While there is a degree of variation in the levels of

[8] Kaleidoscope Pro Software (Manufactured by Wildlife Acoustics Ltd.)
[9] % of all calls recorded during survey period.
[10] See 5.3 Sonogram Analysis.

activity at different SPs, it is considered, in light of the density of the distribution of the sampling points and the relative uniformity of the habitat mix present that this variation is an artefact of the sampling design and not significant in terms of variations in bat activity within the proposed development site.

Soprano pipistrelle and common pipistrelle were the most frequently recorded species, with respective totals of 9,128 passes and 5,042 passes recorded. Leisler's bat (901 passes) was the next most frequently recorded species. While bats from the genus *Myotis* (8 passes) were also recorded, these occurrences were so infrequent that the individuals recorded are considered to be casual records of site usage by this genus. Calls generated by bats to which a species or genus could not be attributed comprise 0.23% of the total.

Table 5: Number of calls of each species recorded at each SP

Species	*Myotis* spp.	Leisler's bat	Common pipistrelle	Soprano pipistrelle	NoID (unidentified bat species)	Total
1	6	287	767	97	1	1,158
2		116	310	1,296	2	1,724
3		194	518	2,585	5	3,302
4	2	105	40	119	8	274
5		199	3,407	5,031	19	8,656
Total	8	901	5,042	9,128	35	15,114
%	0.05%	5.96%	33.36%	60.39%	0.23%	100%

AVAILABILITY OF ROOSTING HABITAT

A site visit prior to the deployment of PAB sampling units was undertaken by the surveyor on the 27th of January 2022, and while there are some mature/semi-mature treelines on-site, the bulk of the vegetation present consists of, scrub, grassland and hedgerow. As noted previously, buildings are high value habitat for bat roosting but there is an absence of built structures apart from areas bounding the PDS, beyond the redline boundary. As such, the surveyor's finding was that the site would not rated as being of high value as bat roost habitat (see **Table 4** above) but was more likely to be of significant value to bats as a foraging habitat.

DISCUSSION

The species recorded are considered to have Favourable conservation statuses (see Table 1).

SPECIES RECORDED: LEVELS OF ACTIVITY

While there is a degree of variation in the levels of activity at different SPs, it is considered, in light of the density of the distribution of the sampling points and the relative uniformity of the habitat mix present, that this variation is an artefact of the sampling design and not significant in terms of variations in levels of usage of the proposed development site.

With regard to species composition: common and soprano pipistrelle bats constitute the most frequently recorded species, and the combined totals of their calls comprise 93.75% of the total of all calls recorded. Leisler's bats comprise 5.96%; unidentified bats 0.23%; species from the genus *Myotis* comprise 0.05%. This mix is entirely consistent with the relative proportions recorded by Malachy Walsh and Partners during the substantial number of PAB surveys the company has carried out, often using significantly larger sampling designs, and in a very wide variety of habitat mixes, since bioacoustic recording units first became the industry standard. It is our conclusion that the species mix recorded, and their relative proportions, is typical of the relative proportions recorded nationally. While bats from the genus *Myotis* were recorded, these occurrences were so infrequent that the individuals recorded are considered to support the conclusion that usage of the site by this genus is casual rather than established and may, in fact, merely be individuals transiting through the site.

SUITABILITY OF THE SITE AS BAT FORAGING HABITAT

Due to the availability of treelines and hedgerows, particularly in the field boundary system, it is reasonable to infer that the site has an intrinsic biodiversity value to bats as these features are considered to be of high value to all species resident in Ireland (see Table 2 Landscape features of importance to bat species) and, while the grassland habitats that comprise the bulk of the PDS site are only of medium value to bats (see Table 2), the hedgerows and treelines that bound them, as well as recolonising scrub vegetation within the grassland mosaic support complexity and variety - in terms of 3-dimensional structure, and species richness - in terms of plant communities. These characteristics are likely to support high macroinvertebrate productivity and, thereby, provide ample prey biomass for bats. These features also function as windbreaks and shelterbelts along which prey will accumulate and bats forage (see 4.3 Distribution of Prey). This aspect of the PDS is significant in light of the previously mentioned high level of site loyalty of bats and their metabolically driven behaviour which results in the repeated preferential selection of the same foraging sites night after night (Entwhistle *et al.*, 2001).

However, and notwithstanding the content of the preceding paragraph, the value of the PDS to bat species is unlikely to be exceptional, either locally or in a wider context, as the site is typical of the habitats adjacent to, and in the nearby vicinity of, the PDS and in the wider geographical area generally. High-quality connectivity to the wider area, evidenced by the extensive field boundary system which provides consistent and uninterrupted flyways and foraging corridors linking the PDS to other locations of comparable biodiversity value; as a consequence, the site is unlikely, based on habitat quality alone, to comprise a hub or hotspot of bat activity relative to other locations.

This characteristic of the location and its extended surrounds is significant in light of the known strong correlation between bat activity and the habitat mix of an area. While preferential habitat selection and the tendency towards site loyalty, which are characteristic of bat foraging behaviours (described see Section 4.2 Habitat Associations), do not preclude the occasional use of sub-optimal habitats, they are key determinants in the level of activity at any location and of the frequency or regularity of its occurrence. For detail on the effects of metabolic constraints on bat activity and behaviours see Section 4.4 Metabolic Constraints, above.

AVAILABILITY OF ROOSTING HABITAT

As outlined in Section 7.2, above, while there are some mature/semi-mature trees on-site, the bulk of the vegetation present consists of hedgerow, scrub and grassland, and was not rated as being of high value as bat roost habitat (see Table 2 above). As such this site is considered more likely to offer foraging habitat to the species recorded rather than significant roosting numbers.

DISCUSSION

The levels of activity recorded, described above, strongly suggest that, while the PDS is within the foraging range of local populations of common and soprano pipistrelle bats and Leisler's bats, the levels of activity, even of these, the most frequently recorded species, are low. With regard to, bats from genus *Myotis*, it is considered, because the numbers recorded comprise such low total numbers of calls that the levels of activity of these species are extremely low. It is concluded that use of the PDS by these species is sporadic and not sustained and the site is not within the core, or extended, foraging range of the local populations of the species recorded. It is concluded that the individuals Myotid bats recorded are vagrants commuting through the site using the site sporadically rather than regularly.

Identification of a risk of impact does not mean that there is a latent possibility of impact(s) on bat species. The level and significance of the impact depend upon the nature of the risk and the extent of the exposure to the risk. The levels of activity recorded during the survey are low and reflective of the normal patterns that pertain to the site. This conclusion, when viewed in conjunction with the evidence provided in the totality of this report, indicates that the proposed development should not pose a significant risk to bat species.

The mitigation measures for bats will follow:

- *Best Practice Guidelines for the Conservation of Bats in the Planning of National Road Schemes* (NRA, 2005a);
- *Guidelines for the treatment of bats during the construction of National Road Schemes* (NRA, 2005b); and
- *NPWS Irish Wildlife Manuals, No. 28: Bat Mitigation Guidelines for Ireland – V2* (Marnell *et al*., 2022).

FELLING OF TREES/VEGETATION

If felling of trees with bat roosting potential (i.e. mature trees with voids, cracks, loose bark and/or ivy cover) is required, a bat survey will be required by a suitably qualified bat ecologist prior to felling; as such works have the potential to cause disturbance and/or damage to roosting bats. Should any tree roosts be identified, a derogation licence from the NPWS will be required to fell or undertake works in close proximity these trees.

For felling of any mature/semi-mature trees, the following NRA (2005a) guidance will be followed:

- Immediately prior to felling, trees should be inspected for the presence of bats and/or other bat activity by a suitably qualified bat ecologist during daylight hours and night-time using a bat detector. This survey should be carried out from dusk through the night until dawn to ensure bats do not re-enter the tree;
- Where examination of the tree has shown that bats have not emerged or returned to tree, felling may proceed the following day. Should a delay in felling be encountered, resurveying is required;
- In areas where bat activity has been recorded, tree-felling must not be conducted in June to early August; and
- As noted in the potential roost habitat section, there are no trees that would be considered as high-value roost habitat. As such, any vegetation and tree removal should be carried out during winter (December to February) to avoid impacts on bats, when even best bat roost habitat recorded on site would be inappropriate as winter roosts. Winter hibernation roosts are generally restricted to places that are sheltered from extremes of temperature (Marnell *et al.*, 2022) and trees present on site are deemed unlikely to provide appropriate winter habitat on the basis of the survey carried out on-site. More generally.

- It is recommended that any trees on site with ivy should be dropped to the ground as gently as possible and left on the ground for a period of 24hrs post felling under the supervision of the ECoW. This soft felling approach will give any bats, if present, the opportunity to vacate.

LIGHTING

In general, artificial light creates a barrier to commuting bats so lighting should be minimised during the active bat season from March to the end of September as it deters some bat species (Marnell et al., 2022). Where lighting is required, directional lighting (i.e. lighting which only shines on access roads and not nearby habitats) should be used to prevent overspill. This can be achieved by the design of the luminaire, the height of the lamp and by using accessories such as hoods, cowls, louvres and shields to direct the light to the intended area only. Modern LED lighting has also been shown to deter bats but it is available in a range of colours other than white which may be used to avoid or lessen impacts. Warmer colour wavelengths between 2700 and 3000 Kelvin seem to have less impact on bats.

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Appendix 5.2

Bird Survey Report

1. INTRODUCTION

1.1 Introduction

Malachy Walsh and Partners was commissioned by BAM to carry out a breeding bird survey at the site of a proposed Strategic Housing Development (SHD) in Carrigtwohill, Co. Cork.

1.2 Ecological Survey for Birds

This report presents the results of breeding bird surveys conducted during the early and middle part of the 2022 bird breeding season. The aim of the survey was to capture a representative sample of breeding bird activity along transects within and adjacent to the proposed development site which were chosen to provide a quantifiable assessment of bird breeding within the area.

The report has been written in accordance with the Chartered Institute of Ecological and Environmental Management (CIEEM) Guidelines for Ecological Report Writing (CIEEM 2017). This report presents the results of breeding bird surveys conducted during the 2022 breeding season. The objective of the survey was to identify breeding bird activity within the proposed development site boundary. The aim of this report is to provide a description of the bird survey methods used, to provide the results of breeding bird surveys and to provide an interpretation of the results. Recommendations/mitigation measures to prevent significant impact on breeding birds have also been outlined.

1.3 Legislation

In Ireland, the primary pieces of domestic legislation providing for the protection of wildlife and the control of activities which may adversely affect wildlife, are the European Communities (Birds and Natural Habitats) Regulations (as amended) and the Wildlife Acts (as amended). S.I. No. 355 of 2015 provides that the following shall be construed together as one:

- Wildlife Act 1976;
- Wildlife (Amendment) Acts of 2000, 2010 and 2012;
- European Communities (Birds and Natural Habitats) (Restrictions of the Use of Poison Bait) Regulations 2010;
- European Communities (Birds and Natural Habitats) Regulations 2011;
- European Communities (Birds and Natural Habitats) (Amendment) Regulations 2013; and
- European Communities (Birds and Natural Habitats) (Amendment) Regulations 2015

The aim of the Wildlife Act 1976, as amended is to provide for the protection and conservation of wild fauna and flora, to conserve a representative sample of important ecosystems, to provide for the development and protection of game resources and to regulate their exploitation, and to provide the services necessary to accomplish such aims. Under the Acts, the Minister responsible for nature conservation may afford protection to all wild species of fauna and flora. Currently all bird species, 22 other animal species or groups of species and 86 species of flora are afforded protected status.

Section 40 of the Wildlife Act 1976, as amended restricts the cutting, grubbing, burning or destruction by other means of vegetation growing on uncultivated land or in hedges or ditches during the nesting and breeding season for birds and wildlife, from 1 March to 31 August.

These restrictions apply not only to private land-users but also to local authorities, public bodies and to contractors. It should also be noted that it is an offence under Section 22 of the Wildlife Act 1976 to wilfully destroy, injure, or mutilate the eggs or nest of a wild bird or to wilfully disturb a wild bird on or near a nest containing eggs or un-flown young birds at any time of the year.

Under Article 4 of the Birds Directive Ireland has classified a number of Special Protection Areas (SPAs) for regularly occurring migratory birds and those birds listed on Annex I of the directive. It is noted that the proposed development site does not overlap with any SPA.

2. METHODOLOGY

2.1 Statement of Authority

The ornithological surveyor and report author, Marc Shorten BSc MSc, is a Malachy Walsh and Partners (MWP) staff ecologist with over 15 years of professional experience in consulting ecology, private research science and national regulatory bodies. Marc has expertise and experience in conducting a range of ornithological surveys, including breeding bird surveys as well as species-specific survey techniques (having been a field surveyor for both the National Red Grouse (*Lagopus lagopus*) Census and Blackwater River Catchment Kingfisher census (*Alcedo atthis*) with BirdWatch Ireland. Marc has extensive reporting experience through roles in academic research, private industry biological research, environmental consultancy as well as the production of fisheries management statistics while with the Sea-fisheries Protection Authority.

Marc holds a research MSc in marine animal behaviour and a first class honours BSc in Zoology and Applied Ecology from University College Cork. Significant experience in collaborative research projects and reporting stems from five years as Senior Researcher of a marine/environmental research company, primarily coordinating research to feed reporting to National and European statutory bodies (BIM, the Sea-fisheries Protection Authority, the Department of Agriculture, Food and the Marine, the European Commission, Interreg and others). Marc has a number of publications relating to work on regulatory legislation of natural resource management. Marc has assisted in compilation and delivery of appropriate assessments and environmental research assessments.

The information prepared and provided is true and accurate at the time of issue of this report and has been prepared and provided in accordance with the CIEEM Code of Professional Conduct (CIEEM 2022). We confirm that any professional judgement expressed herein is the true and bona fide opinion of professional ecologists.

2.2 Breeding Bird Survey

The breeding bird survey carried out was a scaled down version of the BTO Common Bird Census (CBC) methodology (Bibby *et al.*, 2000 & Gilbert *et al*., 1998) which aims to capture a representative sample of breeding bird activity within a survey area during the bird breeding season.

Three visits were made to the proposed development site by the ornithological surveyor on the 27th of January 2022, 25th of March 2022 and 27th of April 2022. This included one preliminary visit to plan transect routes and two surveying visits during the breeding season. As this is a scaled down version of the CBC methodology in terms of the number of visits, the visits were timed to be at least one month apart to increase the value of the data in terms of assessing early or later breeders in the season. It is considered a slight constraint of the study that a further survey visit in June or July could potentially improve the resolution of this breeding species snapshot, however this was not feasible due to logistical constraints of the broader project's planning application timing. The ornithological surveyor slowly walked the proposed routes and sites being considered, stopping at regular intervals to scan with binoculars and to listen for bird calls or song. A map illustrating the routes followed and sites visited for the purposes of survey is shown in Figure 1 below.

Figure 1 Breeding Bird Transects (white lines) and Castlelake monitoring path walked (blue line)

Survey visits were made in the early morning between 6am and 9am to coincide with the peak period of bird activity and all species seen or heard in the survey area and immediate environs were recorded including those in flight. All visits were made during favourable weather conditions, with light winds of <1 on the Beaufort scale and excellent visibility.

All species encountered during the survey were recorded and coded using standard BTO species codes (see: https://www.bto.org/sites/default/files/u16/downloads/forms_instructions/bto_bird_species_codes.pdf) and activity recorded using the BTO breeding evidence codes (see: https://www.bto.org/our-science/projects/birdatlas/methods/breeding-evidence). As this approach is a widely-used standard for assessing breeding bird species presence, no additional effort was made to locate nests for breeding confirmation to avoid risk of excessive disturbance to breeding birds.

2.3 Bird Conservation Status

The conservation status of bird species in Ireland can be assigned in relation to inclusion on various schedules or annexes of national or European legislation or on relevant conservation lists. A species is considered to be of "conservation concern" if it is included on one or more of the following:

- Annex 1 of the EU Birds Directive
- Part 1 of the Fourth Schedule of the Wildlife Acts,
- Birds of Conservation Concern in Ireland 2020-2026 (BoCCI) red list, and
- Birds of Conservation Concern in Ireland 2020-2026 (BoCCI) amber list.

For the purposes of this report, species' conservation status in Ireland is assessed on the basis of the current BoCCI publication (Gilbert *et al.*, 2021) as the most current relevant assessment of species' conservation status in Ireland, as well as Annex 1 of the EU Birds Directive.

3. RESULTS

3.1 Breeding Bird Survey

Breeding bird surveys were carried out during the breeding season on the mornings of 25th of March, and the 27th of April 2022. Surveying was carried out when there were no other personnel present on-site apart from the ornithological surveyor. For this reason, it can considered that there was no anthropogenic disturbance to species prior to the survey and species behaviour was likely representative of relatively undisturbed breeding behaviour. All species seen or heard were recorded, including those in flight over the site.

On 25th of March weather conditions were optimal. There was no precipitation, bright sunshine, excellent visibility, minimal wind (<1 on the Beaufort scale) and <1 octa of cloud cover.

On 27th of March weather conditions were slightly less optimal than the 25/03/2022 visit, though still well within survey methodology parameters and rated as very good to excellent. There was no precipitation, excellent visibility, minimal wind (<1 on the Beaufort scale) and 7 octas of cloud cover.

A total of 33 species were recorded (Table 1) along, or in flight over, the survey transect routes. Just one of these, Blackbird (*Turdus merula*), was classified as confirmed breeding, on the basis of finding recent eggshells. Six species were classified as probable breeders. The remainder of the records were classified as possible or non-breeding species, 22 and 4 respectively. Seven species BOCCI species were recorded i.e. Red list species 2 and Amber list species 5 (Gilbert *et al.*, 2021). Of the two red list species observed, one was recorded as a probable breeder, Meadow Pipit (*Anthus pratensis*) and one as a possible breeder, Snipe (*Gallinago gallinago*). One species listed in Annex 1 of the Birds Directive was recorded in this survey, Little Egret (*Egretta garzetta*), though this species was overflying and non-breeding on site.

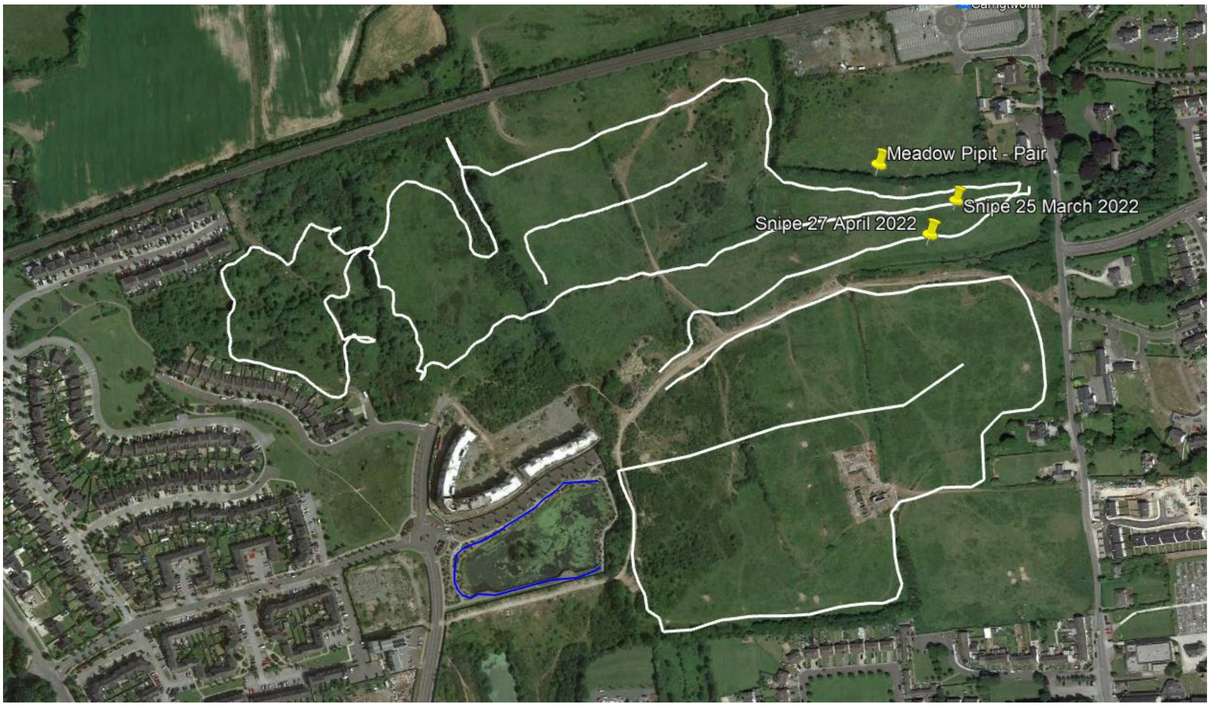

Figure 2 Locations of BoCCI Red List Species observations during breeding birds survey

Only species which are red or amber listed for their breeding populations in Ireland listed in Annex 1 of the Birds Directive are considered as species of conservation concern in this report. As a further check, conservation status was reviewed referencing Nelson *et al*. (2019), as well as the more current Gilbert *et al*. (2021). All species records, together with an indication of their breeding and conservation statuses, are listed in Table 1.

It is noted from other ecological surveying in relation to this project (mammal trail camera surveying) that a Grey Heron (*Ardea cinerea*) was recorded foraging adjacent to the southern transect in Figure 1, and can be considered a separate possible breeding bird outside of the scope of this breeding bird survey. It was noted that there were no heronries in evidence within the trees on the proposed development area or in the immediate vicinity.

Table 1: Breeding Bird Survey Results

Common Name	Species Name	Number of Records		Breeding Status	Highest breeding evidence	Conservation status (BoCCI, Annex 1 of the Birds Directive)	Notes
		25/03/22	27/04/22				
Blackbird	*Turdus merula*	6	8	Confirmed	Eggshells found		
Blue Tit	*Cyanistes caeruleus*	2	3	Probable	Agitated behaviour		
Bullfinch	*Pyrrhula pyrrhula*	2	2	Probable	Pair of birds in suitable habitat		
Buzzard	*Buteo buteo*	2	2	Possible	Species in nesting habitat		
Chaffinch	*Fringilla coelebs*	4	2	Probable	Pair of birds in suitable habitat		
Chiffchaff	*Phylloscopus collybita*	2	4	Possible	Singing male		
Cormorant	*Phalacrocorax carbo*	1		Non-breeding	Flying over		
Dunnock	*Prunella modularis*	3	1	Possible	Singing male/species in nesting habitat		
Feral Pigeon	*Columba livia f. domestica*	7		Possible	Species in nesting habitat		
Goldcrest	*Regulus regulus*	1	2	Possible	Singing male	Amber list	
Great Tit	*Parus major*		1	Possible	Singing male		
Greenfinch	*Carduelis chloris*	1		Possible	Singing male	Amber list	
Grey Heron	*Ardea cinerea*	1	1	Possible	Species in nesting habitat		
Hooded Crow	*Corvus cornix*	5	3	Possible	Species in nesting habitat		
House Sparrow	*Passer domesticus*	1	1	Possible	Singing male	Amber list	
Jackdaw	*Corvus monedula*	1		Possible	Species in nesting habitat		
Linnet	*Carduelis cannabina*	1		Possible	Singing male	Amber list	
Little Egret	*Egretta garzetta*	2		Non-breeding	Flying over	Annex I of the Birds Directive	
Magpie	*Pica pica*	2	2	Possible	Species in nesting habitat		
Mallard	*Anas platyrhynchos*	2	6	Non-breeding	Flying over	Amber list	

Meadow Pipit	*Anthus pratensis*		1	Probable	Pair observed in suitable nesting habitat	Red list	
Pheasant	*Phasianus colchicus*	1		Possible	Species in nesting habitat		
Pied Wagtail	*Motacilla alba yarrellii*	1		Possible	Species in nesting habitat		
Robin	*Erithacus rubecula*	3	4	Probable	Agitated behaviour		
Rook	*Corvus frugilegus*	15	3	Possible	Species in nesting habitat		
Song Thrush	*Turdus philomelos*		2	Possible	Singing male		Also recorded on trailcam during mammal survey.
Siskin	*Carduelis spinus*	1		Possible	Singing male		
Snipe	*Gallinago gallinago*	1	1	Possible	Species in suitable habitat	Red list	Snipe was also flushed near the Woodstock Stream Southeast of Castlelake on 30th of March during a separate site visit.
Starling	*Sturnus vulgaris*	5		Non-breeding	Flying over	Amber list	
Stonechat	*Saxicola torquata*	4	2	Possible	Singing male		
Willow Warbler	*Phylloscopus trochilus*		1	Possible	Singing male	Amber list	
Woodpigeon	*Columba palumbus*	11	13	Possible	Species in nesting habitat		
Wren	*Troglodytes troglodytes*	5	4	Probable	Agitated behaviour		

3.2 Castlelake observations

The associated habitat at Castlelake, which is outside of the proposed development project's redline boundary (see Figure 1) was also included in the breeding bird survey. Although outside the project boundary, Castlelake is hydrological connected to the proposed development site. It was noted in preliminary survey site assessment on the 25th of January 2022 that Castlelake could potentially provide nesting habitat for certain waterbird species.

On the 25th of March 2022, five Mallards (*Anas platyrhynchos*, Amber list) and four Black-headed Gulls (*Larus ridibundus*, Amber list) were noted in the waters of Castlelake.

On the 27th of April 2022, two (female-male) pairs of Mallards (*A. platyrhynchos*, Amber list), three Moorhens (*Gallinula chloropus*) two Mute Swans (*Cygnus olor*, Amber list) and two Coots (*Fulica atra*, Amber list) were noted on the lake. In addition, on the 27th of April, a single Wren (*Troglodytes troglodytes*) and a single Robin (*Erithacus rubecula*) were observed on the banks of the lake.

It is possible that the observed species are breeding birds. While no nests visible on the island vegetation cover could potentially have obscured any nests present.

Though Black-headed Gulls do sometimes nest inland on waterbodies, their absence during the repeat visit, the ongoing disturbance of the site from members of the public using this public path/park amenity area, as well as the nature of the lake and island habitat (relatively small size of island, location in an area subject to disturbance by traffic and walkers), were taken in combination by the ornithological surveyor to indicate that these birds were unlikely to be breeding at this location, which would be likely of low value nesting habitat value to this species.

Look-see observations by the surveyor indicate that Mute Swan (*C. olor*, Amber list), Moorhen (*G. chloropus*), Coot (*F. atra*, Amber list) and Mallard (*A. platyrhynchos*, Amber list) potentially breed at this location.

4. DISCUSSION

The range of bird species recorded during the described breeding bird surveys is reflective of the mosaic of habitats within, and adjacent to, the proposed development site. Of the species recorded as having 'possible' or 'confirmed' breeding status nearly, all were noted in hedgerow, scrub or treeline habitats. Survey results between both survey dateas were broadly in-line with one another, indicating that the survey observations were consistent between visits, and that the assessment of the breeding status of species observed (Table 1) may be taken as a reasonable representation of the breeding species on site. Under Irish wildlife legislation all bird species have protected status and the cutting, grubbing, burning or destruction by other means of vegetation growing on uncultivated land or in hedges or ditches during the nesting and breeding season for birds and wildlife, from 1 March to 31 August is restricted. Therefore, to ensure that an offence is not committed, any clearance of vegetation which cannot be avoided should only occur outside the bird breeding season.

Ground nesting species Snipe (*Gallinago gallinago*, Red list) was classified as 'possible' under the survey methodology and Meadow Pipit (*Anthus pratensis*) were classified as 'probable' breeder at the site. Although based on site fidelity of Snipe between survey days, As noted in the results table, Snipe was also noted during a separate ecological survey in the area near to Woodstock Stream, these repeated records of this species over the site indicate an increased likelihood of 'probable' breeding status for this species.

The other BoCCI Red list species that was observed on-site was Meadow Pipit. This species was noted once, during the first site survey visit, but was noted as a 'probable' breeding species given that it was observed in a pair in suitable habitat.

The seven BoCCI species observed as potentially breeding on site are to be considered carefully in the proposed development plan in order to mitigate potential impacts on breeding habitat due to habitat loss. Aside from loss of habitat, disturbance to birds during the construction and operational phases of the proposed development may be a factor in their continued use of this site. In particular, ground nesting species such as Snipe and Meadow Pipit are particularly vulnerable to disturbance from walkers and dogs.

With regards to birds recorded at Castlelake, disturbance to breeding and/or foraging birds during construction or operational phases of the proposed development will be the primary concern for their continued use of this site. As noted, this site is outside of the redline boundary for development.

Disturbance from construction traffic and plant, as well as the increased traffic and anthropogenic disturbance from residents and people walking their dogs etc. during the operational phase of the proposed development will require consideration to avoid impacts to local populations of the recorded species.

5. RECOMMENDATIONS

5.1 Mitigation for Ornithological Constraints

Trees, scrub and hedgerows within and adjacent to the proposed development site provide nesting habitat for a range of bird species including BOCCI species. For this reason, avoidance of works likely to impact birds must be implemented in terms of phasing works to avoid unnecessary disturbance to any breeding birds that may be using the site during construction.

Pre-construction site clearance and removal of vegetation should be minimised and, where required, only be timed to occur outside the bird breeding season (1st of March to 31st of August inclusive) to avoid undue deleterious impacts on breeding birds.

Should construction works, other than vegetation clearance, be required during the breeding season it is recommended that an experienced Ecological Clerk of Works (ECoW) be consulted to monitor works and minimise resulting disturbance or displacement of sensitive species.

As the proposed development will result in habitat loss to breeding birds on this site it is proposed that, in addition to native planting of hedgerow and tree species, bird nest boxes should be provided on retained trees in order to mitigate habitat loss.

Regarding the nearby Castlelake, the main issue to mitigate against will be disturbance to species there during the construction and operational phases of the proposed project. Given the location of Castlelake within a public amenity area that birds using it will already be used to a significant degree of human disturbance, and so for the Castlelake location the main impact of the proposed development will likely be from the construction phase of the project.

5.2 Enhancement & Mitigation Measures

Given that the construction phase of the proposed project is likely to adversely impact the habitat available for bird species, it is important to give careful consideration to any means by which local bird habitat can be maintained or enhanced. Enhancement should include replacing and replanting of any vegetation removed for works with landscaping planting that incorporates native species rich hedgerows, and trees to provide an overall net gain and to provide links and connectivity with existing landscape features in the surrounding environment (see Landscape chapter). While birds are highly mobile and generally adaptable and able to seek out new territories and habitat in a local area, it is also important the mitigation include bird-specific measures to enhance the site. Measures which should be included in the overall design will be the provision of nest boxes on retained trees throughout the site incorporating a range of dimensions that have been specifically chosen and sited based on their suitability for the BoCCI listed species recorded on site.

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Appendix 5.3

Q-Scheme

MWP

Table A5.1 Intercalibration of EPA Q-rating system with Water Framework Directive status based on macroinvertebrates

Q Value*	WFD Status	WFD Intercalibration Common Metric Value[27]	Pollution Status	Condition**	Ecological description
Q5, Q4-5	High	0.92	Unpolluted	Satisfactory	No or only minor difference from reference condition. Normal community structure, sensitive species present. Ecological processes functioning normally.
Q4	Good	0.853	Unpolluted	Satisfactory	Slight difference from reference condition. Slight change in community structure. Fewer sensitive species present, but increase in species richness and productivity. Ecological processes functioning normally.
Q3-4	Moderate	0.764	Slightly polluted	Unsatisfactory	Moderate difference from reference condition. Moderate change in community structure and loss of some niche species. Some ecological processes altered. Reduced resilience and ability to absorb external shocks.
Q3, Q2-3	Poor	0.627	Moderately polluted	Unsatisfactory	Major difference from reference condition. Significant change in community structure. Significant loss of niche species. Food chains and biogeochemical pathways significantly altered. Limited ability to absorb external shocks
Q2, Q1-2, Q1	Bad	0.42	Seriously polluted	Unsatisfactory	Severe difference from reference condition. Severe change in community structure. Severe loss of niche species and ecological functioning. Food chains collapse and biogeochemical pathways breakdown. Water body incapable of supporting most aquatic life.

** These Values are based primarily on the relative proportions of pollution sensitive to tolerant macroinvertebrates (the young stages of insects primarily but also snails, worms, shrimps etc.) resident at a river site.*

*** "Condition" refers to the likelihood of interference with beneficial or potential beneficial uses.*

[27]From:https://www.epa.ie/pubs/reports/water/other/wfd/EPA_water_WFD_monitoring_programme_main_report.pdf

Table A5.2 Q-value for use in eroding (i.e. riffle-glide) river stretches

EPA Biological Assessment of Water Quality in Rivers and Streams*

Biotic Indices (Q Values) and typical associated macroinvertebrate community structure

WFD Status Groups	Families	High Q5	High Q4-5	Good Q4	Moderate Q3-4	Poor Q3	Poor Q2-3	Bad Q2	Bad Q1-2	Bad Q1
Group A Plecoptera Ephemeroptera Lamellibranchiata	All except Leuctridae Heptageniidae Siphlonuridae *Ephemera danica* *Ameletus inopinatus* *Margaritifera margaritifera*	At least 3 taxa well represented i.e., common to dominant. Expect 5 or more Group A taxa outside of June – Sept period	At least 2 taxa well represented i.e., common to dominant. Expect >2 Group A taxa outside of June-Sept period	At least 1 taxon in reasonable numbers	At least 1 taxon Few - Common	Absent	Absent	Absent	Absent	Absent
Group B Plecoptera Ephemeroptera Trichoptera Odonata Hemiptera	Leuctridae Baetidae (excl *B. rhodani* agg.) Leptophlebidae All Cased Trichoptera Odonata Aphelocheiridae	Few to Numerous	Few to Numerous	Few to Numerous	Few/Absent to Numerous	Few/Absent	Absent	Absent	Absent	Absent
Group C Ephemeroptera	*Baetis rhodani/Baetis atlanticus*	Few to Dominant	Few to Dominant	Numerous to Dominant	Numerous to Excessive	Numerous to Excessive	Few to Common	Absent	Absent	Absent
  Trichoptera Hemiptera Coleoptera Hydracarina Diptera	Ephemerellidae Caenidae All Uncased Trichoptera All excl Aphelocheridae All All All (excl. *Chironomus* & *Eristalis*)	Few to Numerous Group C taxa can represent over 70% of total abundance with good diversity and no single taxa dominant	Few to Numerous Group C taxa can represent over 70% of total abundance with good diversity and no single taxa dominant	Common to Numerous (Never Excessive)	Common to Excessive (usually Dominant or Excessive as a group) Diversity can be reduced with a few taxa dominant	Dominant to Excessive Diversity reduced with a few taxa dominant	Few to Common Diversity reduced with a few taxa	Absent	Absent	Absent
	Simuliidae	Few	Few to common	Few to Numerous	Common to Dominant/Excessive	Common to Excessive	Few to Common	Absent	Absent	Absent
Crustacea	All (excl. Asellidae & *Crangonyx* spp.)									
	Gammarus c.f. duebeni	Few to common	Few to common	Common to Dominant	Common to Excessive	Common to Excessive	Few to Common	Absent	Absent	Absent
Gastropoda Lamellibranchiata Hirudinea Platyhelminthes Oligochaeta	All (excl. *Radix peregra, Physella*) *Anodonta* sp. *Piscicola* sp. All Lumbriculidae, Lumbricidae	Ephemeroptera, Trichoptera may be well represented Others few or absent.	Ephemeroptera, Trichoptera may be well represented Others few or absent.							
Group D Crustacea Megaloptera Gastropoda Lamellibranchiata Hirudinea Oligochaeta	Asellidae, *Crangonyx* Sialidae *Radix peregra, Physella* *Sphaeriidae,* All excl. *Piscicola* Naididae, Enchytraeidae	Few or Absent	Few or Absent	Few or Absent	Few/Absent to Common	Few/Absent to Common	Dominant to Excessive	Dominant to Excessive	Few to common	Few or Absent
Group E Oligochaeta Diptera	Tubificidae, Chironomus, Eristalis spp.	Few or Absent	Few or Absent	Few or Absent	Few or Absent	Few or Absent	Few to Common	Few/Absent to Common	Common to Numerous	Dominant

* This scheme is not intended for assessment of conditions in stagnant waters or where substratum is mud, bedrock or sand. It should be borne in mind that faunal composition is affected by such factors as ground water input, calcification, drainage, canalisation, culverting, marked shading and seasonal factors. Note: **The occurrence/abundance of groups in above table refers to some but not necessarily all the constituents of the group. Single specimens may be ignored.**

Few (<5%), Common (6-20%), Numerous (21-50%), Dominant (51-74%), Excessive (>75%)

Appendix 5.4

Invasive Species Management Plan

Invasive Species Management Plan

Castlelake Strategic Housing Development (SHD), Carrigtwohill, County Cork

BAM Property

May 2022

Contents

Figures

MWP

Project No.	Doc. No.	Rev.	Date	Prepared By	Checked By	Approved By	Status
22461	6007	A	May 2022	OS	MS	AR	DRAFT

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QUALITY
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1. Introduction

A Planning Application is being lodged to Cork County Council by BAM Property for a Strategic Housing Development at Castlelake, Carrigtwohill, Co. Cork (hereafter referred to as the 'proposed development site'). Permission is being sought for the construction of 716 No. residential units with childcare facility, landscaped spaces, and associated works and services (hereafter referred to as the 'proposed development').

During an ecological survey site visit in August 2021 in relation to the preparation of a report to inform the appropriate assessment screening ("AA screening report"), the following invasive species were identified within the redline boundary of the proposed development site:

- Himalayan balsam (*Impatiens glandulifera*);
- Japanese rose (*Rosa rugosa*)

Of these invasive plants, Himalayan balsam (*Impatiens glandulifera*) is listed species on the Third Schedule to the European Communities (Birds and Natural Habitats) (regulations 49 and 50). The best practice management measures for Himalayan Balsam are detailed in Section 4.

Japanese rose (*Rosa rugosa*) is an Amber List species, a species which may impact on the conservation goals of the Water Framework Directive (WFD), though is not a species listed under the Third Schedule. Best practice management of this species is detailed in Section 5.

All general bio-security measures described in Section 4.3 of this Invasive Species Management Plan (ISMP) will be implemented before any construction or enabling works commence for the proposed development project. Species-specific eradication measures outlined in this document will be in process at the earliest possible time within the works plan, in accordance with the required timings of the specified control measures (growing season, seed dispersal timings etc.).

2. Site Location and Description

The proposed development site is located circa 500m northwest of Carrigtwohill village. The site is bounded by agricultural lands to the north, Castlelake housing estate to the west and the Cork Road L3680 to the south. The site is accessed from the Cork Road L3680. Access is also possible from the west via the Castlelake housing estate. The N25 can be accessed to the west and east.

The proposed development bounds the Cork-Midleton Railway line to the north. Carrigtwohill train station is located to the northeast of the site. The train station serves Midleton and Cobh to the east and south and Cork to the west, with onward links to Dublin and the rest of the country.

The new Glounthaune to Midleton Greenway will pass to the south of the site providing an alternative commuter link to Cork and Midleton, providing an amenity for existing and future residents and visitors. An east-west link road is currently under construction along the southern boundary of the main land block. A north-south link road is proposed to join with an existing rail underpass. A site location map is provided in Figure 1 below.

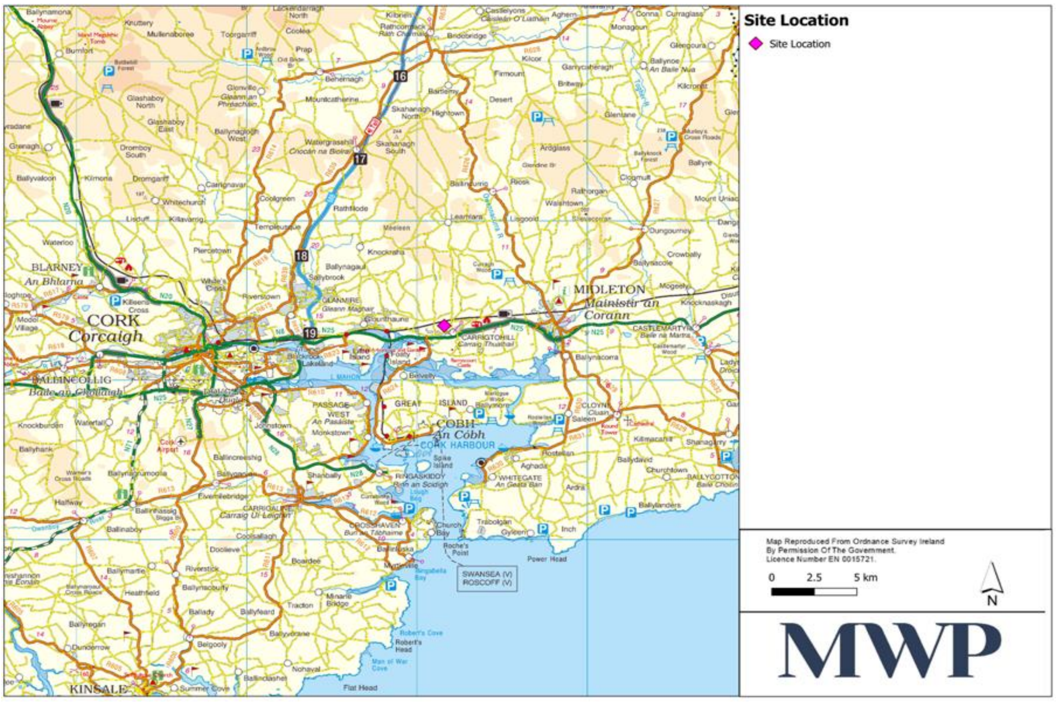

Figure 1: Proposed Development Site Location

The proposed development is relatively flat with the highest elevation of the proposed development being *ca.* 9m AOD. The predominant CORINE (2018) landcover at the proposed development is classified as 'Agricultural Areas/Pastures' with some sections at southwest of site made up of 'Artificial Surfaces – Discontinuous urban fabric'.

According to the online Geological Survey Ireland (GSI) online mapper, the proposed development site is underlain by massive unbedded lime-mudstone from Walsortian Limestones formation at the southern end and Dark muddy limestone, shale of the Ballysteen Formation at the northern end.

Subsoil at the proposed development is classed as 'Sandstone till (Devonian)'. The majority of the aquifer is designated as Regionally Important Aquifer – Karstified (diffuse) with a section at the northern end which is categorised as 'Locally Important Aquifer – Bedrock which is Moderately Productive only in Local Zones'. The groundwater vulnerability of the aquifer is stated as stated mostly as 'moderate' with small sections of the north side of the proposed development designated as 'high'. The GSI define groundwater vulnerability as "…a term used to represent the intrinsic geological and hydrogeological characteristics that determine the ease which groundwater may be contaminated by human activities"

The proposed development is located within the 'Lee, Cork Harbour and Youghal Bay' Water Framework Directive (WFD) catchment (Code:19) and the Tibbotstown_SC_010 sub-catchment. This catchment includes the area drained by the River Lee and all streams entering tidal water in Cork Harbour and Youghal Bay and between Knockaverry and Templebreedy Battery, Co. Cork, draining a total area of 2,153km².

There are a number of waterbodies on site. The Woodstock stream is the largest stream which enters the eastern-most land block near Station Road and flows in a westerly direction before turning south where it flows into the Slatty Pond, which is hydrological connected Great Island SAC (001058) and Cork Harbour SPA (004030). Another small stream bisects the main land block and flows in a southerly direction towards the Woodstock Stream at the southwest of the site.

There is a man-made lake (attenuation pond/lagoon) to the south of the main land block which is currently used as an amenity by local residents. The pond has an overflow into the Woodstock Stream.

The Woodstock Stream joins with a transitional waterbody named Slatty Pond which is located just east of the Slatty Bridge, approximately 900m southwest of the closest point of the proposed development. This transitional water flows under Slatty Bridge, into Slatty Water and on to Lough Mahon (Harpers Island), another transitional waterbody.

Data from the EPA's Water Framework Directive (WFD) monitoring depicts the Lough Mahon as having 'moderate' water quality (2013-2018). There is no WFD monitoring data for Slatty Bridge or any of the waterbodies on or leaving the site. The Woodstock Stream is not a designated salmonoid river and is not in an area designated for Freshwater pearl Mussel. The EPA has classed Lough Mahon (Harpers Island) as being 'At risk' of failing to meets its WFD objectives.

Field surveys undertaken by MWP ecologists for the Carrigtwohill Sustainable Housing Development Appropriate Assessment Screening Report, identified sixteen habitat types across the site:

1. Amenity Grassland (GA2);
2. Amenity Grassland x Ornamental/Non-native Shrub (GA2 x WS3);
3. Amenity Grassland x Scattered Trees and Parkland (GA2 x WD5);
4. Buildings and Artificial Surfaces (BL3);
5. Immature Woodland x Scrub (WS5 x WS1);
6. Improved Agricultural Grassland (GA1);
7. Improved Agricultural Grassland x Scrub (GA1 x WS1)
8. Recolonising Bare Ground (ED2);
9. Recolonising Bare Ground x Buildings and Artificial Surfaces x Scrub (ED3 x BL3 x WS1);
10. Recolonising Bare Ground x Buildings and Artificial Surfaces (ED3 x BL3);
11. Recolonising Bare Ground x Dry Meadows and Grassy Verges (ED3 x GS2);
12. Recolonising Bare Ground x Dry Meadows and Grassy Verges x Scrub (ED3 x GS2 x WS1);
13. Scrub (WS1);
14. Spoil and Bare Ground (ED2);
15. Drainage Ditch (FW4); and
16. Hedgerow x Treeline (WL1 x WL2)

The surveys identified that extents of habitat dominated by Immature Woodland x Scrub, Improved Agricultural Grassland x Scrub, as well as Hedgerow and Treeline habitat have become colonized by the invasive plant species Himalayan balsam. This area coincides with the planned project area thus careful consideration regarding its immediate removal and future management must be considered.

2.1 Designated Sites

The site itself is not within a Natura 2000 site. However, the site is located close to the Cork Harbour SPA (site code: 004030) and the Great Island Channel SAC (Site code: 001058), located 708m and 772m to the south, respectively (see Figure 2).

Figure 2: Location of SACs and SPAs in relation to site location

The eradication and management measures for the invasive alien plant species detailed in this report will not result in significant impacts on any Natura 2000 site.

2.2 Extent of Himalayan Balsam at the Site

Himalayan balsam (*Impatiens glandulifera*) is a member of the Balsaminaceae family. It is a fast growing, and spreads quickly along watercourses where it can form in dense thickets.

Himalayan balsam, as the name suggests, is native to the Himalaya mountains and was originally introduced in Ireland as an ornamental garden plant. It can grow up to 3m in height in a single season and produces bright pink flowers. Himalayan balsam is also a rich source of nectar which attracts pollinators such as bumblebees. The species is found on waterways and damp woodlands throughout Ireland. Himalayan balsam produces thousands of seeds per plant which are released explosively when disturbed, propelling seeds up to 7 meters from the plant. Seeds remain viable up to 18 months and can be transported by wind and water making the Himalayan balsam a rapid coloniser.

As outlined in Section 2, large areas of the immature woodland and scrub habitat and hedgerow and woodland habitat present in the site have become colonised by Himalayan balsam (*Impatiens glandulifera*), see Plate 1Error! Reference source not found. and Plate 2Error! Reference source not found. below.

The immature woodland and scrub habitat in the western area of the site, as well as the hedgerow and treeline habitat and drainage ditch habitat in the centre of the site are the main locations of the Himalayan balsam (*Impatiens glandulifera*) (see Figure 3).

Plate 1: Photograph showing Himalayan balsam at the site

Plate 2: Photograph showing Himalayan balsam at the site

Figure 3: Showing areas of Himalayan balsam (*Impatiens glandulifera* – green hatching) within and adjacent to site and Japanese Rose location (*Rosa rugosa*) within the site redline boundary (pink circle)

2.3 Extent of Japanese Rose at the Site

Japanese rose (*Rosa rugosa*) is a species of rose native to East Asia which is tolerant of salt spray. This unique feature allows it to grow in sandy coastal areas, where it can alter dune formation, as well is in hedgerows and road verges where it can quickly dominate native species therefore reducing biodiversity.

The species produces bright red or purple-pink flowers as well as fruit and was introduced primarily due to its attractive appearance (see Plate 3); it is very common in gardens and in amenity areas. Though initially considered to have been spread for ornamental purposes and through animals, a key vector of spread from gardens is via improper material disposal from gardens or through escape to wild areas via gardens. Japanese rose flowers in June – July and fruits in autumn though is deciduous therefore is more difficult to identify in winter months. Slender thorns and upright stems are a distinguishing feature of this species when compared to other rose species.

The extent of Japanese rose within the redline boundary is relatively limited and isolated, only occurring at the north western boundary (see Figure 3).

Plate 3: Japanese rose (*Rosa rugosa*) and fruit noted at site during ecology survey

3. Legislative Background

The Wildlife Act 1976-2018 (herein the Wildlife Acts) contain provisions relating to non-native invasive species. Regarding exotic species, it is prohibited for anyone without a license to plant or otherwise cause to grow in a wild state, in any place in the State, any species of flora, or the flowers, roots, seeds or spores of flora. The Minister may also issue regulations prohibiting possession or introduction of any species of wild bird, animal or flora, or any part, product or derivative of such wild bird, wild animal or wild flora which may be detrimental to native species (NRA, 2010). The Wildlife Acts do not contain specific provisions that directly govern invasive species control or removal, however it is stated within the legislation that "anyone who plants or otherwise causes to grow in the wild – in any place in the State any species of (exotic) flora, or the flowers, roots, seeds or spores of (exotic) flora shall be guilty of an offence."

Furthermore, Regulation (EU) 1143/2014 on invasive alien species (herein the "IAS Regulation") was agreed by the European Council on 22nd October 2014 and came into force in August 2016. This IAS Regulation conveys the rules to prevent, minimize and mitigate the adverse impacts of the introduction and spread (both with and without intention) of invasive alien species on biodiversity and the related ecosystem services, as well as other adverse impacts on human health or the economy (European Commission, 2017). Target 4.4 of Ireland's National Biodiversity Action Plan 2017-2021 (DCHG, 2017) is that "harmful invasive alien species are controlled and there is reduced risk of introduction and/or spread of new species".

4. Himalayan Balsam *(Impatiens glandulifera)* Eradication

4.1 Best Practice Management Measures

Himalayan balsam (*Impatiens glandulifera*) is listed on the Third Schedule of the Birds and Habitats Regulations and is considered a high-risk invasive species, which has the ability to create competition for resources such as pollinators, light and space, posing a threat to native plant species.

In line with guidance published by the National Roads Authority, now Transport Infrastructure Ireland (The Management of Noxious Weeds and Non-Native Invasive Plant Species on National Roads, 2010) the following control options were identified:

<u>Option 1 – Physical control:</u> Physical removal should be attempted where the ground is level and good access is possible. In the circumstances, plants can be strimmed, cut, or mown back to ground level before flowering in June. The plant should be cut as low as possible, or at least below the lowest node, otherwise re-spouting will occur. Any mechanical removal of Himalayan balsam before June will promote greater seed production in re-growth. The area should be mown regularly to prevent sprouting and flower formation and repeated annually until area is under complete control.

Hand pulling is also another effective method of removal given the shallow rooting of Himalayan balsam. Hand pulling should be repeated in August to deal with sprouting of seeds. Plant material can be disposed of via compost, though due to potential presence of seeds, disposal of landfill or disposal by burning may be favourable.

<u>Option 2 – Chemical control:</u> Effective control of Himalayan balsam using chemical application of glyphosate or 2, 4-D amine applied during the active growth phase in late spring targeting germinating seedlings. However, it should be noted that glyphosate is a broad-spectrum herbicide so care should be taken when applying amongst sensitive species or adjacent to waterbodies where there should be a buffer zone of no chemical application, according to the product instructions.

Grasses are unaffected by glyphosate; therefore, chemical control may be preferable in circumstances wherein grass types are present. Guidelines recommend repeat treatments for five or more year. Ongoing monitoring of the site will also be required in spring and summer to assess seedling presence and possible further control measures.

4.2 Proposed Measures for Eradication of Himalayan Balsam at Carrigtwohill

It is recommended that a combination of the options outlined above is undertaken to eradicate and avoid the spread of the plant both within and outside of the site. The proposed measures are outlined in the following section.

Due to the extensive nature of the established Himalayan balsam on site, existing plants will be mowed to ground level before flowering occurs in June and where ground is level. Hand-pulling methods may also be employed during the pre-flowering season and is most effect following rainfall. Pulled and mown sites will be revisited in August for follow-up pulling. Stockpiled material should be removed, covered and fenced off, to prevent any further spread of seeds on site. Works will be undertaken always using a single designated piece of machinery, e.g., one strimmer, mower, cutter etc. Vegetation material removed via physical controls should be disposed of via landfill or burning to remove risk of by propagation by seeds. Coincidentally, chemical control measures may be employed in late April to May, during the active growth phase in late spring, using glyphosate. The chemical treatment may be applied using foliar spray, wiper application or spot treatment. Areas treated with glyphosate will require retreatment in later summer months to target seedling germination and again annually for ongoing control. Given the extensive nature of Himalayan balsam at the site, it is recommended that follow up monitoring is undertaken on the site and spraying of regrowth carried out as necessary. Further to the above, toolbox talks will be carried out to communicate measures to all personnel involved.

4.3 Biosecurity Measures

In addition to the above, the following biosecurity measures will be implemented:

- Any vehicles/plant operating within the infested areas will be cleaned thoroughly when entering and / or leaving the exclusion zones.
  - Designated wash-down areas will be set up within the exclusion zone, and away from drains and watercourses; plant/equipment will be washed down on geotextile membrane, so that any potential contaminated material will be contained.
  - Vehicles will be cleaned of all earth and loose sediments, with particular attention paid to tyre treads, wheel arches and hinged joints.
  - The minimum amount of machinery possible will be used to minimise the potential spread of the species.
  - All tools, materials and work wear will be inspected, and cleaned as necessary, with particular attention paid to footwear and hand tools.
- Work boots will be dipped in or scrubbed with a disinfectant solution and thoroughly dried afterwards before being used on the site for the first time;
- PPE and tools will remain on site for the duration of construction;
- All PPE will be visually inspected and any attached vegetation or debris removed.

5. Japanese Rose

5.1 Best Practice Management Measures

Though not a species listed under Third Schedule, control of Japanese rose to prevent its spread within the area should be implemented to avoid inadvertent propagation of this species. Physical removal of the entire plant, at both small- and large-scale infestations, is recommended. Chemical control using herbicide is also an effective control.

5.2 Proposed Measures for Eradication of Japanese Rose at Carrigtwohill

Physical removal of the plant by hand-pulling is effective for small populations but roots and rhizomes must also be removed to prevent recolonisation. Hand-pulling can be combined with application of glyphosate. Applications of the herbicide can be made with brush to avoid affecting other plants. As per chemical control of Himalayan balsam, use of herbicide must be fully in keeping with manufacturer instructions and with consideration to appropriate buffer zones when adjacent to water bodies. Follow up monitoring and treatment will be necessary to ensure full long-term eradication (Weidema, 2006).

5.3 Biosecurity Measures

Japanese rose is suspected to disperse via rhizomes, water and seeds within fruit. Therefore, a similar protocol as that described in Section 4.3 should be employed when removing Japanese rose.

6. Other Considerations

The landscape plan for the site which is being developed separately must have regard to Invasive Species Ireland's Amber list. Planting schedules must not include species on these lists, as they may have invasive properties which would be detrimental to the overall biodiversity of the site.

7. References

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Weidema, I. (2006): NOBANIS – Invasive Alien Species Fact Sheet – *Rosa rugosa*. – From: Online Database of the European Network on Invasive Alien Species – NOBANIS www.nobanis.org, Date of access 26/05/2022.

Appendix 5.5

Macroinvertebrate Results

Table A5.3 Macroinvertebrates recorded during biological sampling on waterbodies draining the proposed development site during May 2022.

Taxon / species	Pollution sensitivity group	Site							
		1	2	3	4	5	6	7	8
MAYFLIES (Uniramia, Ephemeroptera)									
Family Heptagenidae									
Yellow upright *Rhithrogena semicolorata*	A	f			f			p	
Yellow may dun *Heptagenia sp.*	A							f	
Spiny crawler mayflies (Seratellidae)									
Yellow evening dun *Seratella* sp.	C	f	f		c			c	
Baetidae									
Large dark olive *Baetis rhodani*	C	c	c	f	n			n	
Iron blue dun *Alainites muticus*	B	c							
STONEFLIES (Order Plecoptera)									
Common yellow sally *Isoperla grammatica*	A				f				
CASED CADDIS FLIES (Tricoptera)									
Northern caddisflies (Limnephilidae)	B	f			f	f	f	f	
Limnephilus sp.	B	f	f	f	f	p		f	
Long horned caddisflies (Leptoceridae)	B								c
Glossosomatidae	B	f	n		f			f	
Primitive caddisflies (Sericostomatidae)									
Black caperer *Sericostoma personatum*	B	f			c			f	
Odontoceridae									
Odontocerum albicorne	B				f			p	
CASELESS CADDIS FLIES (Trichoptera)									
Grey flags (Hydropsychidae)									
Hydropsyche sp.	C	f	f	f	f			f	
Gallery building caddisflies (Philopomatidae)					f			p	
Green sedges (Rhyacophilidae)									
The sandfly *Rhyacophila* sp.	C		p		f			p	
Trumpet-net caddisflies (Polycentropodidae)									
Polycentropus sp.	C			f					
DAMSELFLIES (Odonata, Zygoptera)									
Red and blue damselflies (Coenagriidae)	B								
TRUE FLIES (Diptera)									
Blackfly (Simulidae)									
Simulium sp.	C	f		f	c			c	
Craneflies (Tipulidae)	C								
Tipula sp.				f					
Pediciidae									
Dicranota sp.	C	f	f					f	
Family Chironomidae									

Taxon / species	Pollution sensitivity group	Site							
		1	2	3	4	5	6	7	8
Rheotanytarus sp.	C		f	f			f		c
Green chironomid	C	f				f	d	f	c
Biting Midge (Ceratopogonidae)	C								
Empididae									
Clinocera sp.	C	f	p				p	p	f
BEETLES (Coleoptera)									
Diving beetles (Dytiscidae)			p						p
Riffle Beetle (Elmidae)									
Elmis aenea	C		p		f			c	
Limnius volckmarii	C	f	p		f			f	
SNAILS (Mollusca, Gastropoda)									
Family Lymnaeidae									
Wandering snail *Radix balthica*	D								p
Great pond snail *Lymnaea stagnalis*	C								p
Family Hydrobiidae									
Common Bithynia *Bithynia tentaculata*	C								p
Jenkin's spire shell *Potamopyrgus antipodarium*	C	f		f	f			c	
Family Physidae									
Bladder Snail *Physa fontinalis*	D					f			p
Family Ancylidae									
River limpet *Ancylus fluviatilis*	C					c		p	
MUSSELS (Mollucsa, Bivalva)									
Orb/Pea Mussels (Sphaeridae)	D								
Pisidium sp.	D								
CRUSTACEANS (Crustacea)									
Amphipods (Amphipoda, Gammaridae)									
Freshwater shrimp *Gammarus* sp.	C	c	n	n	c		f	c	
Isopods, Asellidae									
Asellus aquaticus	D	c		c			f		c
LEECHES (Hirudinae)									
Erpobdellidae									
Erpobdella sp.	D								
Flatworms *(Platyhelminthes)*									
Planaridae	E	p	f		f				c
BUGS (Hemiptera)									
Broad shouldered water skaters (Gerridae)									
Gerris sp.	C			f					
Lesser water boatman (Corixidae)									p
Pygmy backswimmers (Pleidae)	C								c
SPIDERS (Crustacea, Arachnida)									

Taxon / species	Pollution sensitivity group	Site							
		1	2	3	4	5	6	7	8
Water mite (Order Hydracarina)	C	n		c					c
SEGMENTED WORMS (Annelida, Clitellata)									
Aquatic earthworm (Lumbriculidae)	D					p			

present (single specimen), **f**ew (<5%), **c**ommon (6-20%), **n**umerous (21-50%), **d**ominant (51-74%), **e**xcessive (>75%)

Appendix 7.1

Flood Risk Assessment

Castlelake SHD, Carrigtwohill Co. Cork Flood Risk Assessment

Technical Report

October 21

2021s1374

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Revision History

Revision Ref / Date Issued	Amendments	Issued to
S3.P01/ 27 October 2021	Daft Issue	BAM Property
A3.C01/ 28 October 2021	Final Issue	BAM Property

Contract

This report describes work commissioned by BAM Property, on behalf of BAM Property, by a letter dated 22 September 2021. BAM Property's representative for the contract was Paul Kenneally. Paul Browne, David Casey and Ross Bryant of JBA Consulting carried out this work.

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Purpose

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Contents

List of Figures

Abbreviations

AEP................................ Annual Exceedance Probability
CCC .... Cork County Council
CFRAM .... Catchment Flood Risk Assessment and Management
DoEHLG.......................... Department of the Environment, Heritage and Local Government
EU .... European Union
FFL................................. Finished Floor Level
FRA................................ Flood Risk Assessment
GDSDS .... Greater Dublin Strategic Drainage Strategy
GSI .... Geological Survey of Ireland
HEFS .... High-End Future Scenario
ICPSS .... Irish Coastal Protection Strategy Study
LAP .... Local Area Plan
MD .... Municipal District
MRFS............................. Mid-Range Future Scenario
NCFHM .... National Coastal Flood Hazard Mapping
NIFM……………………….National Indicative Fluvial Mapping
OPW .... Office of Public Works
PFRA .... Preliminary Flood Risk Assessment
SFRA .... Strategic Flood Risk Assessment
SHD .... Strategic Housing Development
SPA................................ Special Protection Area

1 Introduction

Under "The Planning System and Flood Risk Management - Guidelines for Planning Authorities" (DoEHLG & OPW, 2009) proposed development must undergo a Flood Risk Assessment to ensure sustainability and effective management of flood risk.

1.1 Terms of Reference and Scope

JBA Consulting was appointed by BAM Property to prepare a Flood Risk Assessment (FRA) for a proposed residential development located in Carrigtwohill, Co. Cork.

1.2 Flood Risk Assessment; Aims and Objectives

This study is being completed to inform the future development of the site as it relates to flood risk. It aims to identify, quantify and communicate to Planning Authority officials and other stakeholders the risk of flooding to land, property and people and the measures that would be recommended to manage the risk.

The objectives of this FRA are to:

- Identify potential sources of flood risk;
- Confirm the level of flood risk and identify key hydraulic features;
- Assess the impact that the proposed development has on flood risk;
- Develop appropriate flood risk mitigation and management measures which will allow for the long-term development of the site.

Recommendations for development have been provided in the context of the OPW / DoEHLG planning guidance, "The Planning System and Flood Risk Management - Guidelines for Planning Authorities". A review of the likely effects of climate change, and the long-term impacts this may have on any development has also been undertaken.

For general information on flooding, the definition of flood risk, flood zones and other terms see 'Understanding Flood Risk' in Appendix A.

1.3 Development Proposal

The proposed site is extensive and covers an area of c.18.126ha, of which c.15.433ha is stated to be developable and 2.693ha to be undevelopable. It is proposed to construct the following as part of a Strategic Housing Development (SHD) within a greenfield site:

- 239no. house units of varying type;
- 250no. duplex units of varying type;
- 217no. apartment units of varying type;
- 7no. apartment blocks.

The layout of the proposed development is provided in Figure 1-1.

The proposed development consists of 8no. sites, which are as follows:

- Castlelake North Site
- Blandcrest Site
- Castlelake West Site
- Castlelake South Site 01
- Castlelake South Site 02
- Station Road North Site
- Station Road South Site 01
- Station Road South Site 02

The overall site is located to the south of the Cork-Midleton railway line, west of Station Road, east of several housing estates (Maple Crescent, Line Court, Oakbrook) and north of the existing Aldi shopping complex. 2no. proposed access roads will link the development to Station Road (north and south of the proposed post primary school) and connect with the existing roundabout at Maple Crescent. Areas of soft landscaping are proposed throughout the development.

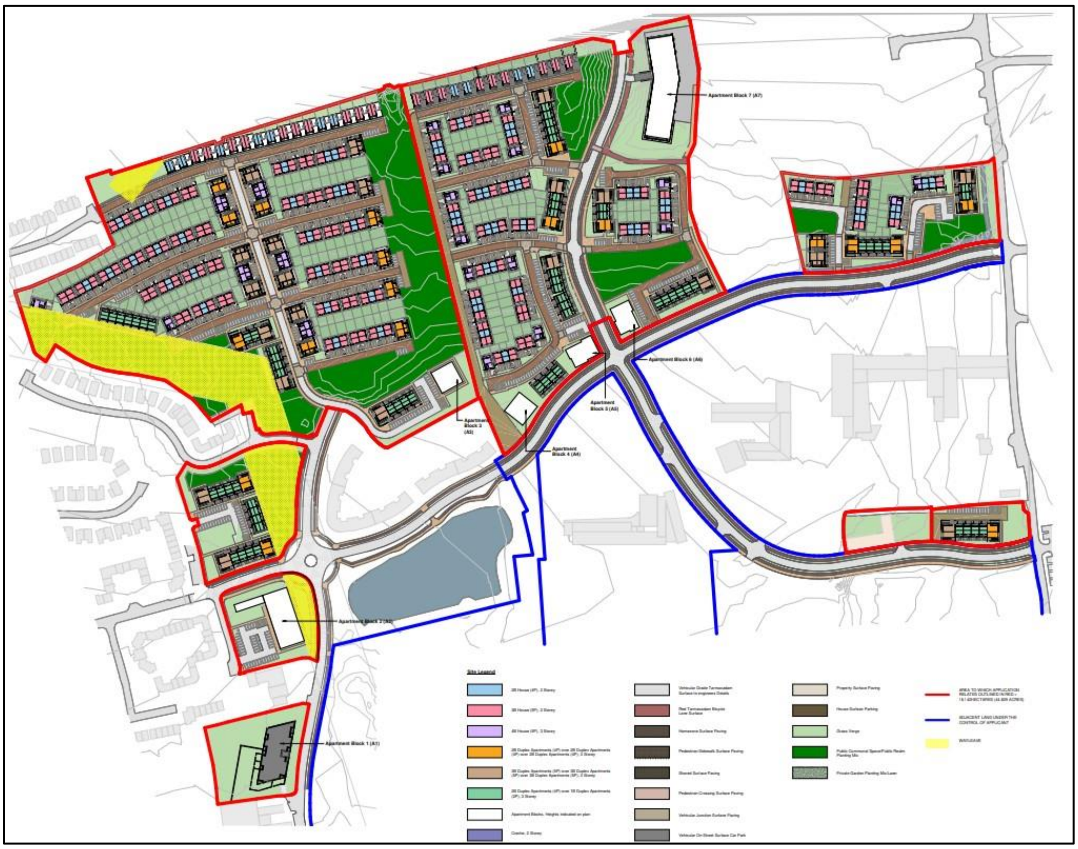


Figure 1-1: Proposed Site Layout

As part of this development and other development adjacent to the site, it is proposed to culvert the existing field drain running north to south through the Castlelake North Site. This culvert will convey surface water entering the site via culverts under the railway line safely through the site before discharging to the Woodstock River further downstream.

1.4 Report Structure

Section 2 of this report gives an overview of the study location and associated watercourses. Section 3 contains background information and identification of sources of flood risk. An assessment of flood risk and site-specific mitigation measures are outlined in Section 5, while conclusions are provided in Section 7.

2 Site Background

This section describes the watercourses, geology and wider geographical area of Carrigtwohill, Co. Cork.

2.1 Location

The proposed site is located in Carrigtwohill, Co. Cork to the west of Station Road and south of the Cork-Midleton railway line. The overall site is split into 8no. individual sites. Several residential estates are located to the west. To the south of the proposed site, there are open fields and residential estates. Much of the existing site contains open fields and areas of dense vegetation overgrowth. Refer to Figure 2-1 for the existing site overview.

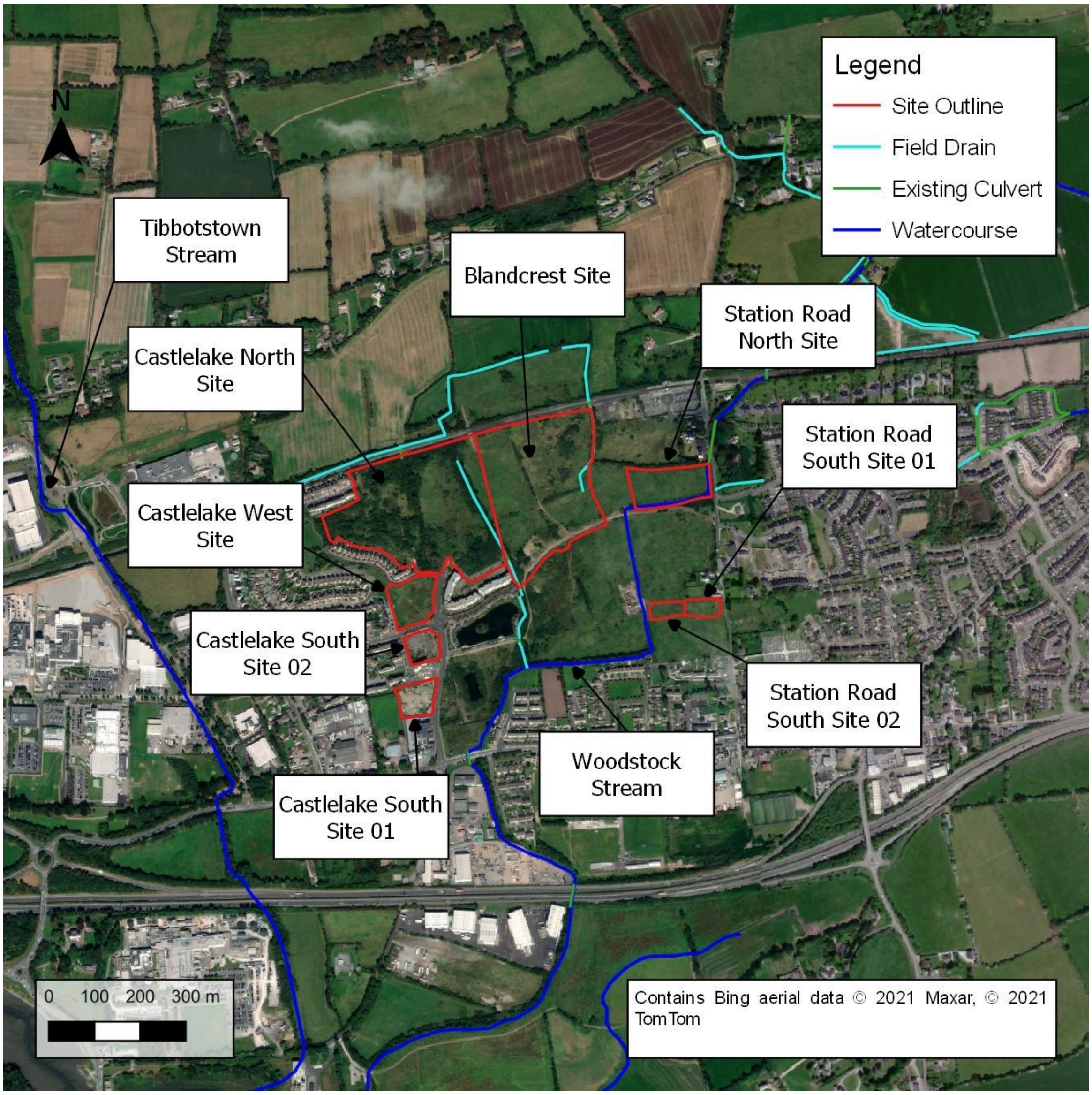


Figure 2-1: Site Overview

2.2 Watercourses

The main hydrological feature in vicinity to the site is the Woodstock Stream. The Woodstock Stream flows into the Slatty Pond c.1.32km southwest of the main site. Slatty Pond ultimately discharges to the Slatty Water in the River Lee estuary / Cork harbour. Slatty Pond is located upstream of Slatty Bridge, which links Fota Island to the townland of Tullagreen. The Cork Harbour area is designated as a Special Protection Area (SPA). There are several field drains within the proposed site confines, including one at the northeast corner of the Blandcrest Site. This flows in a northern direction before passing under the railway line as a culvert. The field drain continues to fall outside of the proposed site before re-entering the Castlelake North Site as a culvert near the northwest corner. This area is severely overgrown, and it is not clear at the time of writing this report whether this culvert ultimately discharges to the existing field drain which runs north to south towards the Cascade apartment complex. However, it is proposed to culvert this section of field drain to connect to the existing culvert near the northwest corner of the Castlelake North Site. The proposed culvert will ultimately discharge to the existing field drain before entering the Woodstock Stream to the north of Ryan and Aherne Place. An existing farm underpass is located c. halfway along the northern boundary and passes under the railway. This has been identified as a potential flow path, which will need to be managed within the proposed design. As part of future developments in the area, it is proposed to culvert the Woodstock Stream to the south of the Station Road South Site 01 and Station Road South Site 02, before turning south to pass under the proposed access road. Refer to Figure 2-1 for a record of existing watercourses and culverts in the area.

2.3 Site Topography

The site covers an area of c.18.126ha, of which c.15.433ha is stated to be developable and 2.693ha to be undevelopable.

The topographical survey for the proposed site was available for review, and summarised as follows:

- Blandcrest Site: North to south fall from 9.00mOD to 2.75mOD;
- Castlelake North Site: North to south fall from 7.25mOD to 3.75mOD;
- Castlelake West Site: West to east fall from 5.50mOD to 4.00mOD;
- Castlelake South Site 02: North to south fall from 5.00mOD to 3.50mOD;
- Castlelake South Site 01: North to south fall from 3.75mOD to 2.75mOD;
- Station Road North Site: North to south fall from 7.50mOD to 5.25mOD, with localised fall to 4.75mOD at the Woodstock Stream at the southeast corner;
- Station Road South Site 02: East to west fall from 5.25mOD to 3.75OD;
- Station Road South Site 01: East to west fall from 7.25moD to 5.25mOD.

Refer to Figure 2-2 for the site topographical survey.

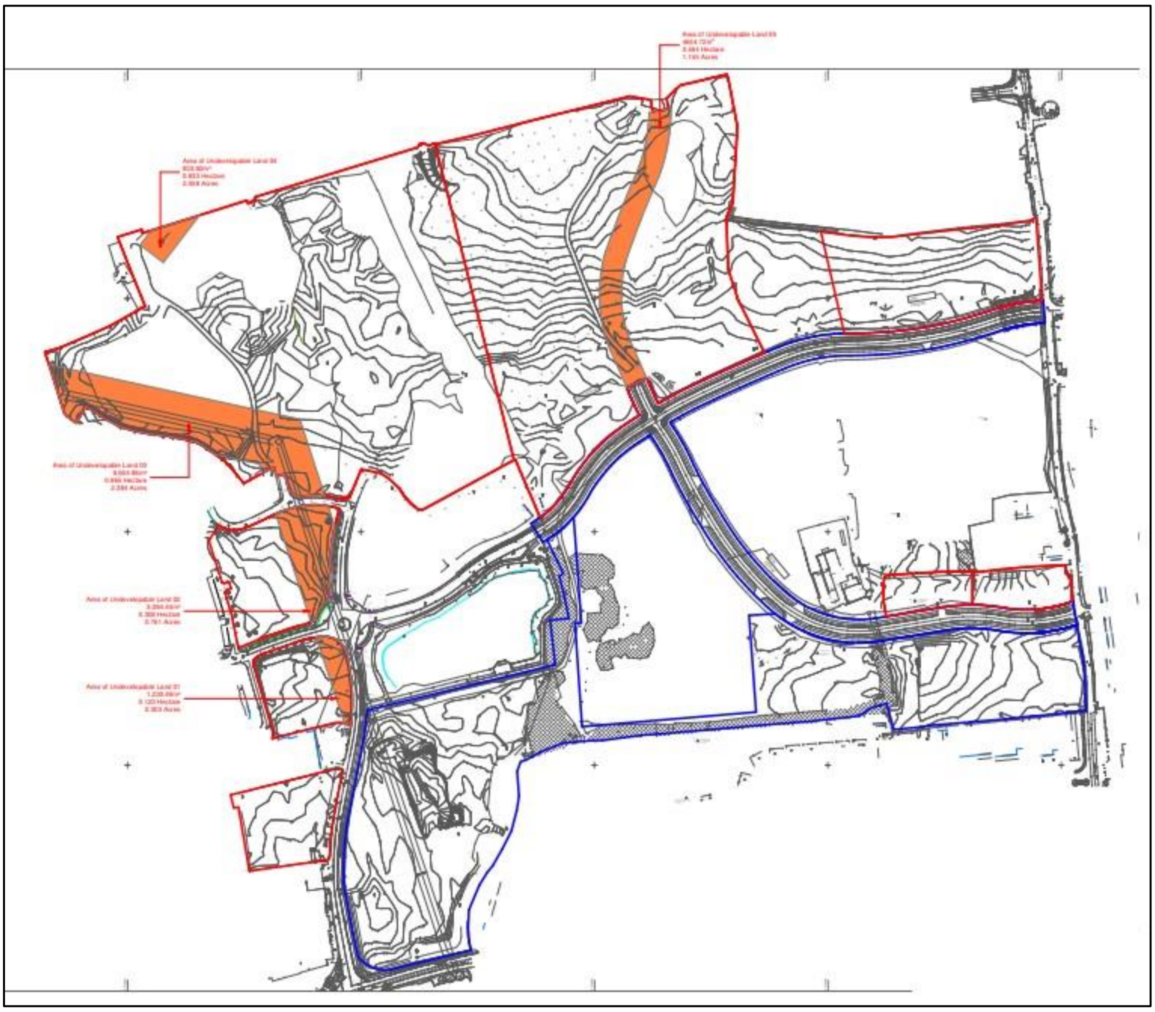


Figure 2-2: Topographical Survey

2.4 Site Geology

The Geological Survey of Ireland (GSI) groundwater and geological maps of the site were reviewed. The subsoil present under the proposed site is primarily tills derived from mainly non-calcareous sandstones belonging to the Acid Brown Earths / Brown Podzolics group. There is a pocket of pocket of the same type of tills material to the west of the proposed site but from the Surface Water Gleys / Ground Water Gleys group. An area of alluvial mineral soils exists c.500m south of the Blandcrest Site, which may be an indicator of previous flooding in the past. Refer to Figure 2-3.

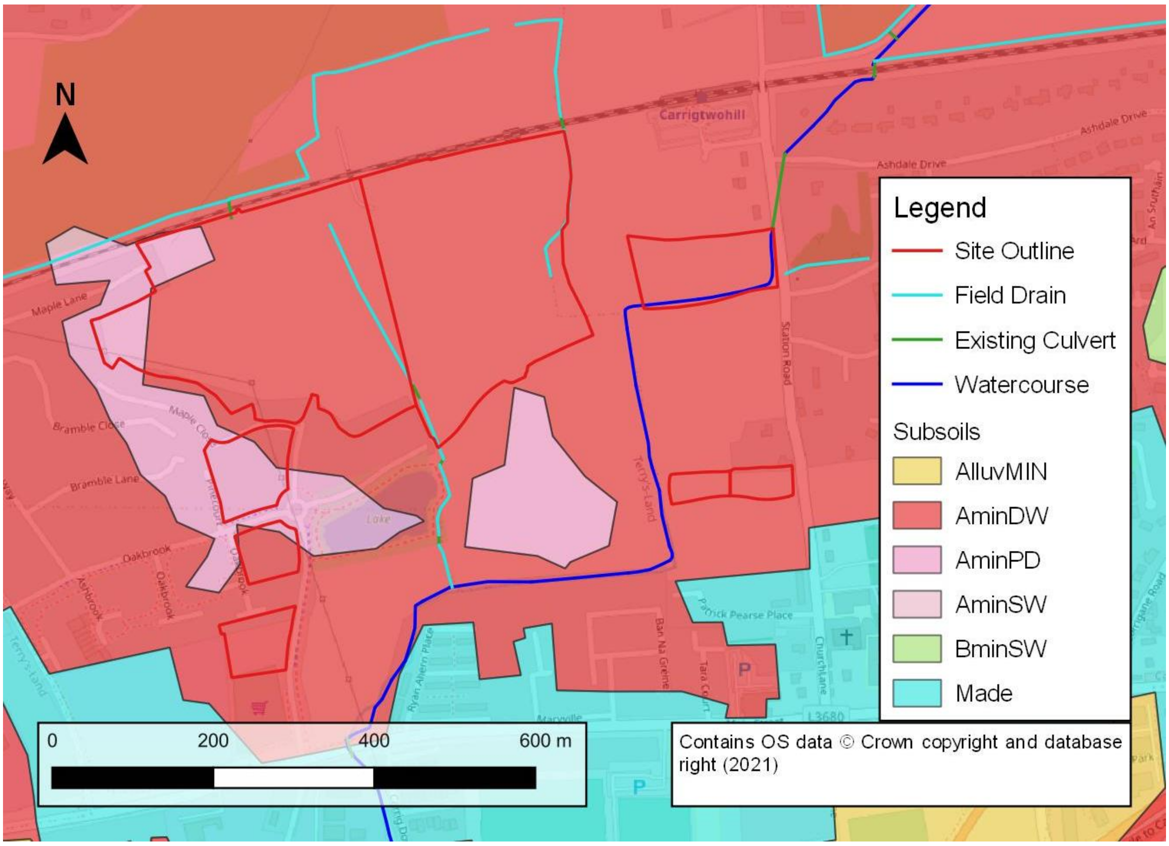


Figure 2-3: Site Subsoils

There are two primary bedrock types present within the proposed site. To the north, the underlying bedrock is classified as the Ballysteen Formation, which is described as dark muddy limestone and shale. To the south, the underlying bedrock is classified as Waulsortian Limestones, which is described as massive unbedded lime-mudstone.

The associated groundwater vulnerability is classified as 'Moderate' to 'High' for the site which indicates that there is a moderate to high risk to the groundwater under the site. This classification is based on relevant hydrogeological characteristics of the underlying geological materials.

A record of historic groundwater and surface water flooding in the Carrigtwohill area by the GSI was also available for review. There were no identified historic groundwater or surface water flood events within the proposed site confines. Groundwater flooding probability extents were available for review on www.floodinfo.ie. There were no identified predictive groundwater flooding extents on-site or nearby.

A review of karstic features in the area shows that there are a number of caves and a swallow hole identified within a c.600-1000m radius from the Blandcrest Site. One cave is identified within the grounds of St. Aloysius College to the southeast. Two caves and a swallow hole are identified within the Cúl Árd housing estate to the east. The accuracies of these karstic features vary to within 20-50m for the caves and 20m for the swallow hole. The underground extents of these karstic features were not available for review at the time of writing this report. It is not unexpected to find these karstic features in the Carrigtwohill area as the local bedrock is predominantly composed of limestone. There are no karstic features identified within the proposed site confines. A well / spring was previously identified at the location of the proposed post primary school, which was not picked up on in the GSI map viewer. Refer to Figure 2-4 for historic groundwater flooding, groundwater vulnerability and karstic features in the area.

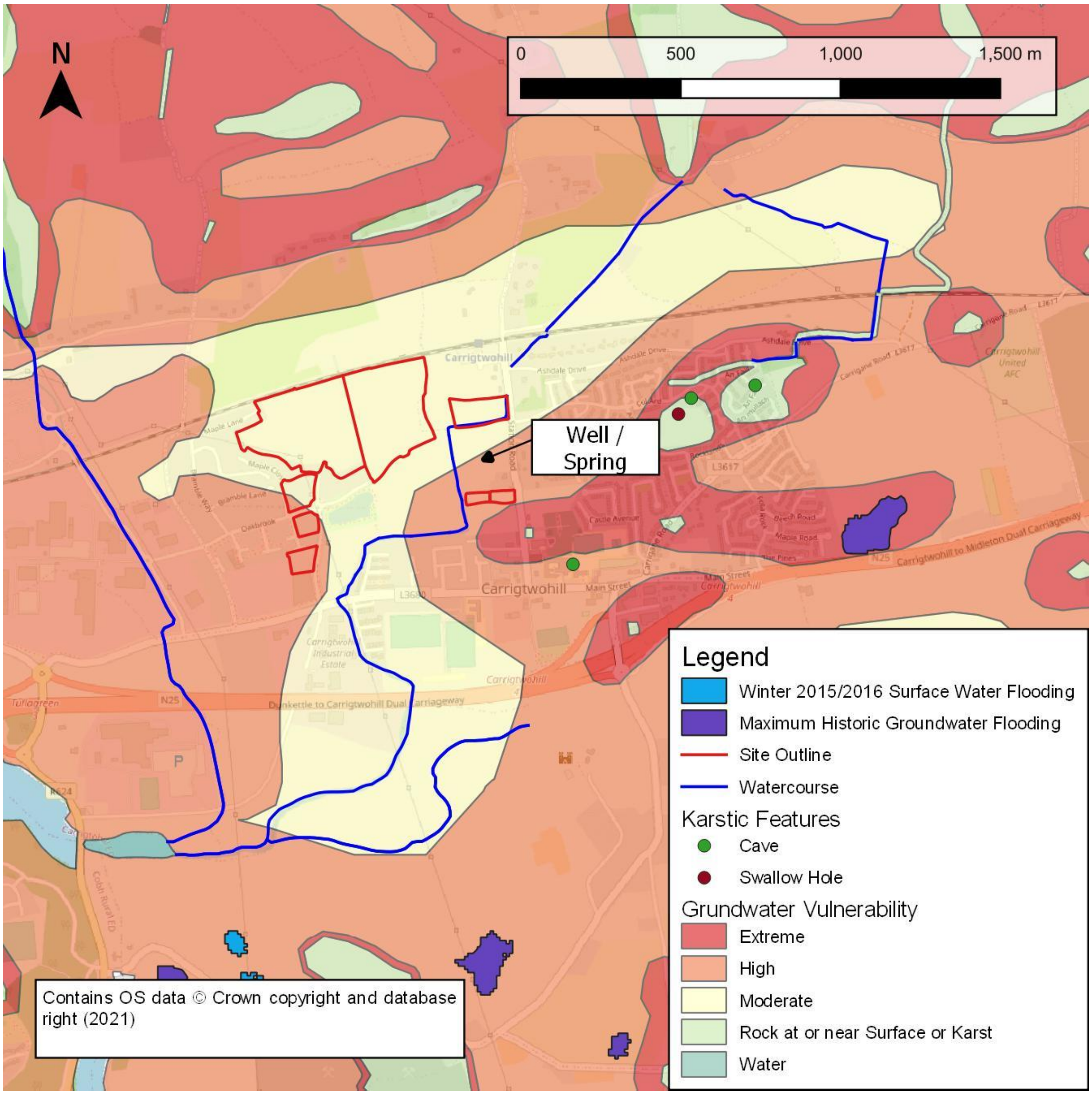


Figure 2-4: GSI Datasets

3 Flood Risk Identification

An assessment of the potential for and scale of flood risk at the site is conducted using historical and predictive information. This identifies any sources of potential flood risk to the site and reviews historic flood information. The findings from the flood risk identification stage of the assessment are provided in the following sections.

3.1 Flood History

Several sources of flood information were reviewed to establish any recorded flood history at, or near the site. This includes the OPW's National Flood Information Portal, www.floodinfo.ie and general internet searches.

3.1.1 Floodinfo.ie

The OPW host a National Flood Information Portal, www.floodinfo.ie, which highlights areas at risk of flooding through the collection of recorded data and observed flood events. Refer to Figure 3-1 for historic / recurring flood events in the Carrigtwohill area.

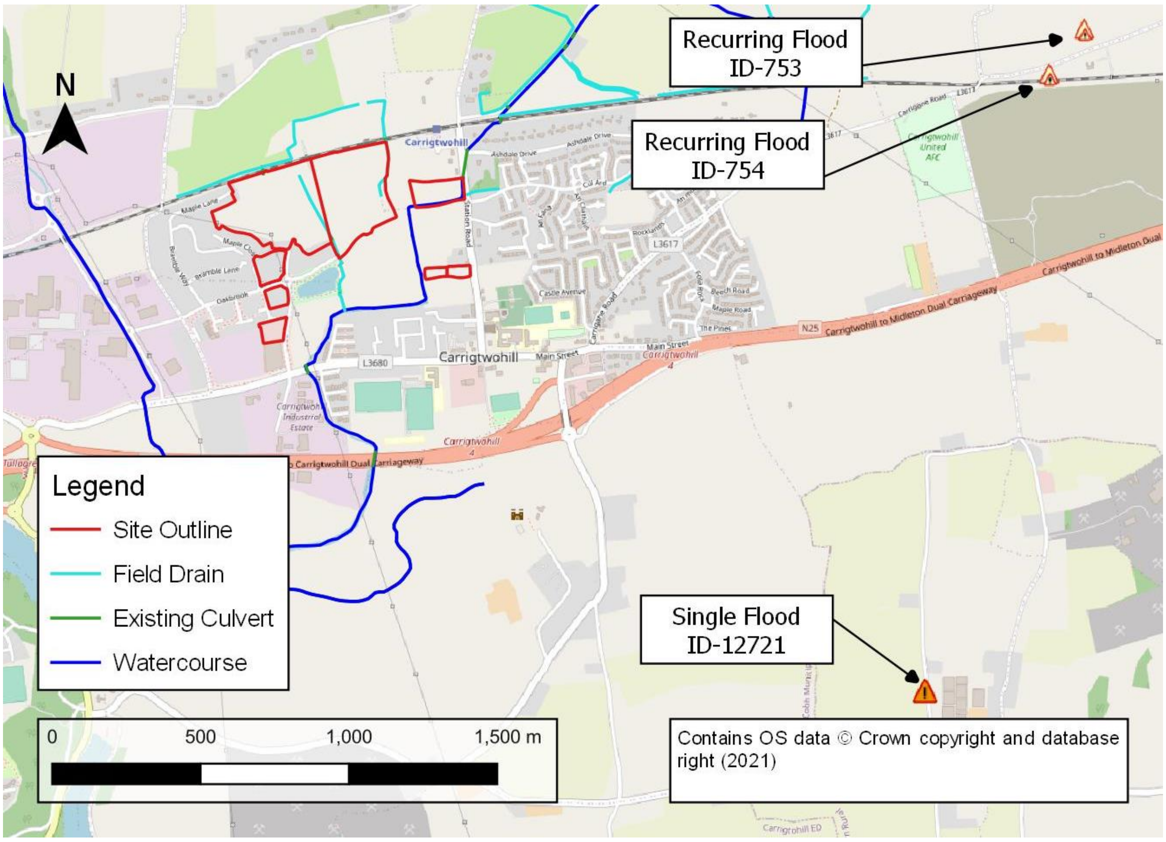


Figure 3-1: Floodinfo.ie Historic / Recurring Flood Events in the Carrigtwohill Area

A review of Figure 3-1 shows several recurring and historic flood events within a 2.5km radius of the proposed site. No flood events have been identified as having occurred within the proposed site confines. A summary of single and recurring flood events is presented below:

- 16 September 2016 - Flooding at Ballintubbrid West, Carrigtohill, Co.Cork. Winter 2016 to 2016 (ID-12721). The floodinfo.ie website states the following:

  "Report by an OPW Engineer based on information extracted from a Minor Flood Relief Works Funding Application submitted to OPW by Cork Co.Co. Contains information on properties affected and mapped extents."

  (www.floodinfo.ie/map/pf_addinfo_report/12721)

It appears that this location aligns with an area of maximum historic groundwater flooding as presented in Figure 3-1. No further information relating to this flood event was available for review.

- 14 April 2005 - Two recurring turlough flood events with ID-753 and ID-754 at Ballyadam, Carrigane, Cork. The floodinfo.ie website states the following for both records:

  "GSI Turlough Data - List of Turloughs with locations (some townlands and a few coordinates in this report for the turlough locations required modification, these have been corrected in the GIS and flood events in conjunction with the GSI and/or other flood reports."

  (www.floodinfo.ie/map/pf_addinfo_report/754)

  (www.floodinfo.ie/map/pf_addinfo_report/753)

No further information was available at the time of writing this report.

3.1.2 Internet Searches

An internet search was conducted to gather information about whether the site and surrounding area was affected by flooding previously. The search returned three results:

- 30 December 2015 - "Yellow weather warning remains in place as 4,600 homes still without power". The Journal.ie website reported this article, in which one site user left a comment on the article, which stated the following:

  "homes and business flooded in … Carrigtwohill,…"

  It was unclear at the time of writing this report where this flooding occurred, nor whether the user's comment was authentic.

  (www.thejournal.ie/storm-frank-weather-power-roads-2523798-Dec2015/)

- 1 February 2016 - "Floods sink council's master plan for thousands of homes in county Cork". The Irish Examiner website reported this article, which stated the following:

  "Council officials have reported they have yet to complete a list of lands flooded during Storm Frank. However, the council acknowledged problems occurred in Carrigtwohill… councillor Anthony Barry, who lives in Carrigtwohill, previously told council officials he was concerned about flooding on most of the 160 acres of lands in the town for the master plan development".

  It was unclear at the time of writing this report where the lands mentioned in the above article extract referred to.

  (www.irishexaminer.com/news/arid-20379213.html)

- 14 October 2019 - "LIVE: Here are all the parts of Cork that you should avoid due to spot flooding". The Cork Beo website reported this article, which stated the following:

  "The main road between Carrigtwohill and Midleton is experiencing large amounts of surface water."

  It was unclear at the time of writing this report where this flooding occurred. The Carrigtwohill to Midleton road is located away to the east of the proposed site.

  (www.corkbeo.ie/news/local-news/live-here-parts-cork-you-17082969)

No flooding incidents were reported to have occurred within the proposed site confines.

3.2 Predictive Flooding

The area has been a subject of several predictive flood mapping or modelling studies and other related studies and plans:

- Office of Public Works (OPW) National Indicative Fluvial Mapping (NIFM);
- Lee Catchment Flood Risk Assessment and Management Study (CFRAM);
- National Coastal Flood Hazard Mapping (NCFHM) 2021;
- Cobh Municipal District (MD) Local Area Plan (LAP) 2017 Strategic Flood Risk Assessment (SFRA);
- Draft Cork County Development Plan 2021 Strategic Flood Risk Assessment (SFRA);

The level of detail presented by each method varies according to the quality of the information used and the approaches involved.

3.2.1 Office of Public Works (OPW) National Indicative Fluvial Mapping (NIFM)

The OPWs National Indicative Fluvial Mapping (NIFM) flood extents have recently been uploaded to the www.floodinfo.ie website. These replace the OPW PFRA mapping. The current available extents highlight the probabilities of fluvial flooding for the 0.1% (low probability) and 1% (medium probability) AEP fluvial flood events. At the time of writing this report, the high probability flood extents for the area were not available for review. A review of the NIFM mapping shows the Castlelake North Site, Castlelake West Site and Castlelake South Site 02 are subject to flooding during the 1% AEP fluvial event, refer to Figure 3-2.

This fluvial flow path emanates from the Tibbotstown Stream to the west and does not account for remedial works which have recently taken place on the stream, including culverting and re-routing of sections. It also does not consider the Cork-Midleton railway line, which traverses across this flow path. The railway line will ultimately impede any potential fluvial flow path from the Tibbotstown Stream.

Further discussion on the flood map is undertaken in Section 4.2.1.

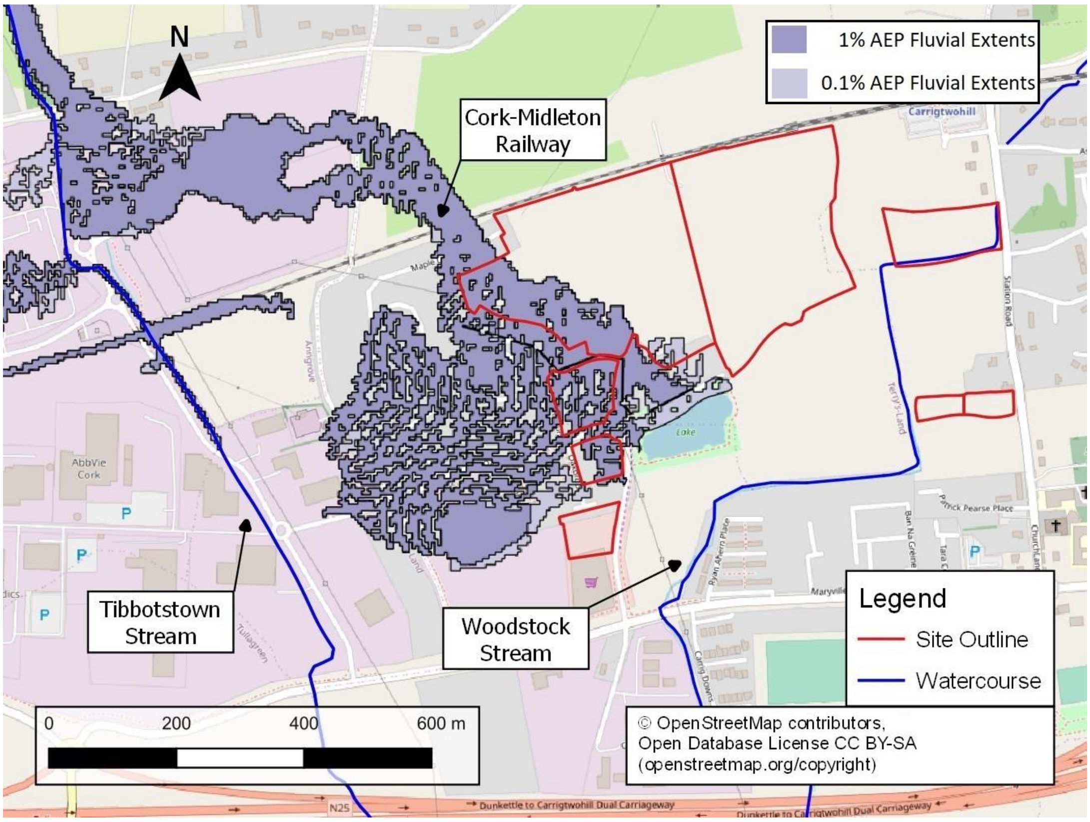


Figure 3-2: OPW NIFM Fluvial Extents - Present Day

3.2.2 Lee Catchment Flood Risk Assessment and Management Study (CFRAM)

The primary source of data with which to identify flood risk to the site is the Lee CFRAM study. Predictive fluvial and coastal flood extents for the local area are available on floodinfo.ie. A review of the fluvial flood extents shows that the northeast corner of the Castlelake South Site 01 is subject to flooding during the 0.1% AEP fluvial flood event. However, JBA carried out detailed modelling of the Woodstock Stream under Planning Application Reference 19/5707, which indicates that this site is not at risk of flooding from the 1% AEP and 0.1% AEP flood events. This is outlined in detail in Section 4. The nearest CFRAM coastal flood extents are located to the south, and do not extend north of the N25 Carrigtwohill bypass. Therefore, they do not impact upon the proposed site. Refer to Figure 3-3 for the CFRAM flood extents.

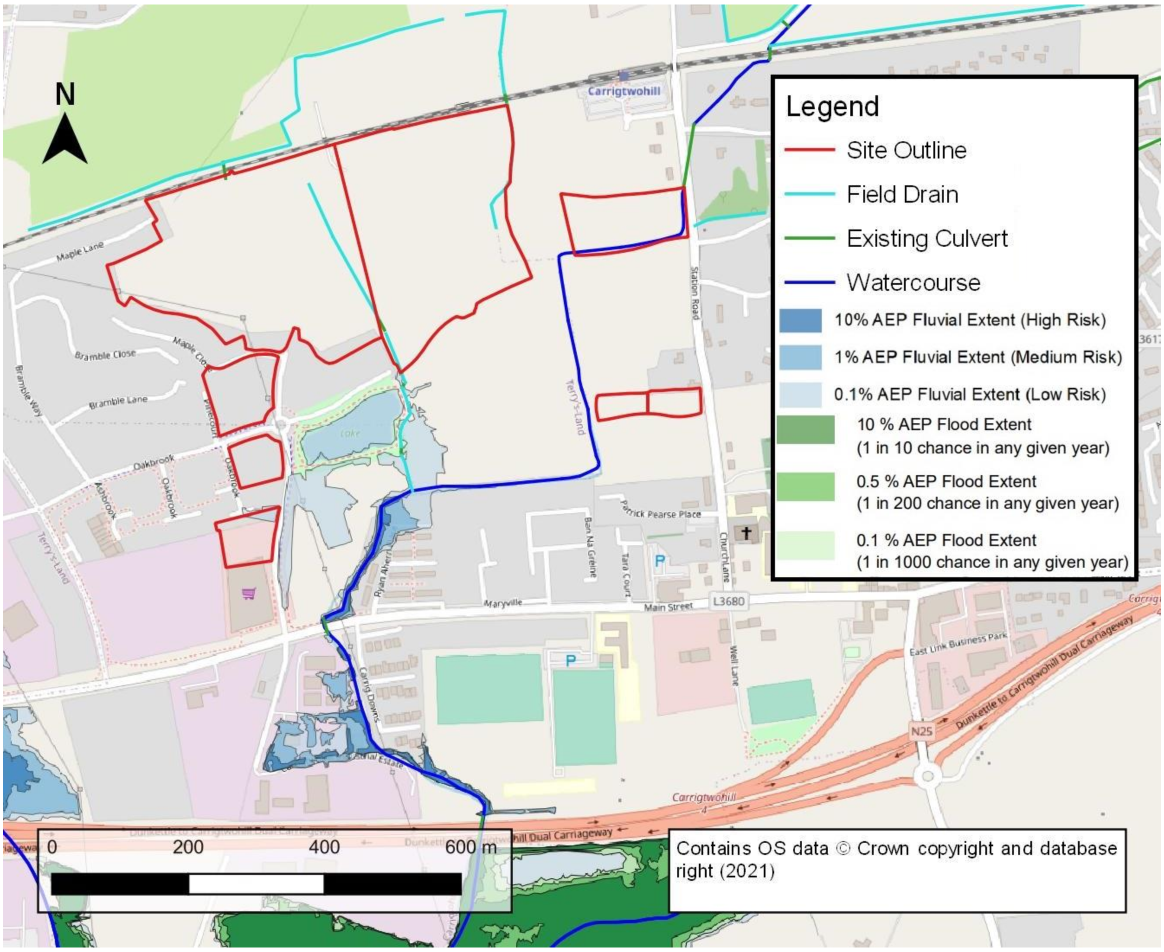


Figure 3-3: Lee CFRAM Flood Extents

3.2.3 National Coastal Flood Hazard Mapping (NCFHM) 2021

The NCFHM 2021 study is an improvement on the ICPSS and contains predictive coastal flood extents and depths. The predictive coastal flood extents and flood depths for the area are available on floodinfo.ie. A review of the predictive coastal flood extents shows that the southeast corner of the Castlelake North Site, the southwest corner of the Blandcrest Site, and a significant portion of the Castlelake South Site 01 are subject to flooding during the 0.5% AEP coastal flood event. Extended areas at these locations are also subject to flooding during the 0.1% AEP coastal flood event, as well as a small portion of the Castlelake South Site 02. Refer to Figure 3-4 for the NCFHM predictive coastal flood extents. Corresponding flood depth maps for the area are also available.

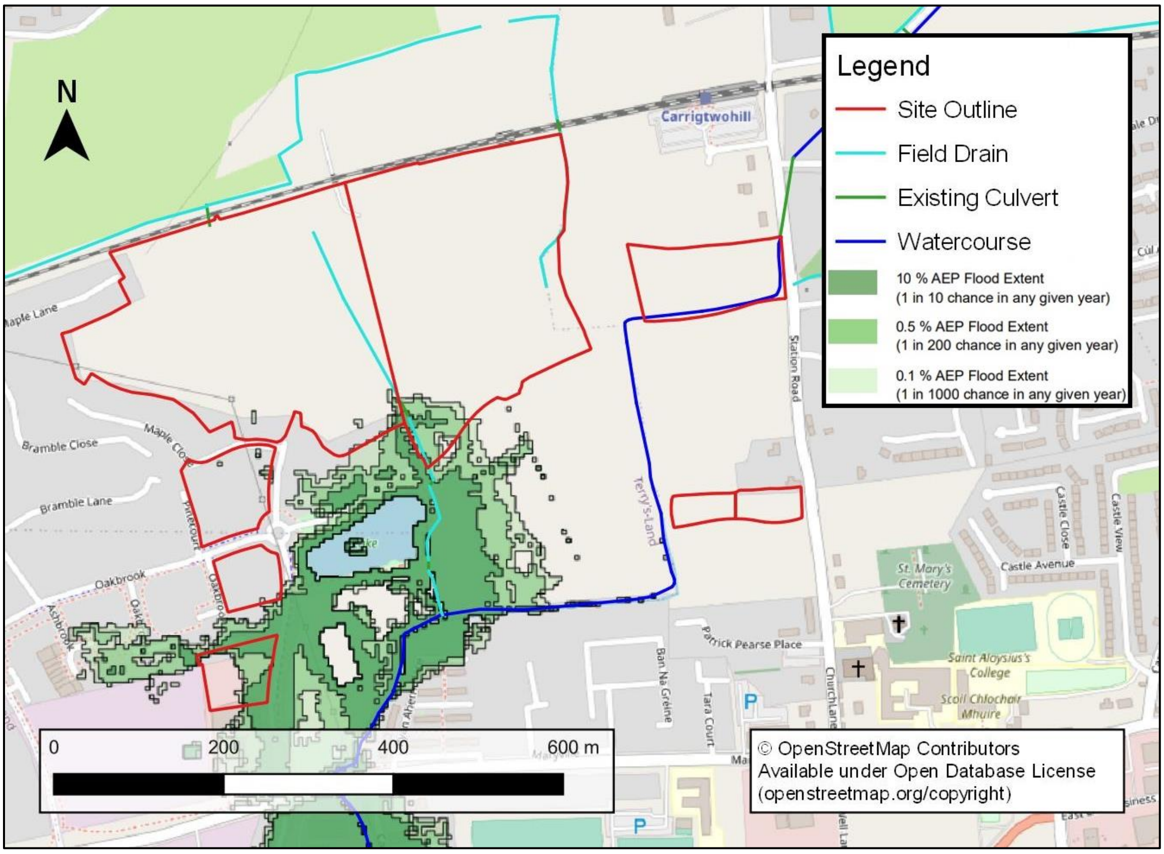


Figure 3-4: NCFHM Coastal Flood Extents - Present Day

The NCFHM maps were produced using estimated extreme water levels from Phase 1 of the Irish Coastal Wave and Water Level Modelling Study (ICWWS 2018) node points. The nearest node point to the proposed site with modelled levels to accurately reflect on-site condition is South Point C3, located c.7.9km away in the Lee estuary, near Rochestown. The predicted water levels at this node were available for review on floodinfo.ie, and are presented in Table 3-1.

AEP (%)	Present Day (mOD)	MRFS (mOD)
10%	2.76	3.26
0.5%	3.12	3.62
0.1%	3.31	3.81

Table 3-1: ICWWS 2018 Water (Joint Probability Tide and Surge) Levels (South Point C3)

3.2.4 Cobh Municipal District (MD) Local Area Plan (LAP) 2017 Strategic Flood Risk Assessment (SFRA)

The Cobh Municipal District Local Area Plan was released in 2017 and sets out the detailed planning strategy and land use zoning for the towns and villages of the Cobh MD, with the exception of Cobh town itself. As part of the LAP SFRA, flood zone and land use zoning maps were prepared. The maps were uploaded to the Cobh LAP 2017 online map viewer and were available for review. In preparation for the LAP, CCC updated their indicative flood zone mapping (from the 2011 LAP) to include information which became available under the National CFRAM programme. The flood zones were created using predictive fluvial and tidal flooding only. The flood zones are based on an undefended scenario and do not consider the presence of flood defences. A review of the flood zones map shows the southeast corner and along the field drain in the Castlelake North Site, the southwest corner of the Blandcrest Site, and a portion of the Station Road North Site are located within Flood Zone A. An extended portion of the southeast corner of the Castlelake North Site, the southwest corner of the Blandcrest Site, and a significant portion of the Castlelake South Site 01 are located within Flood Zone B. Refer to Figure 3-5.

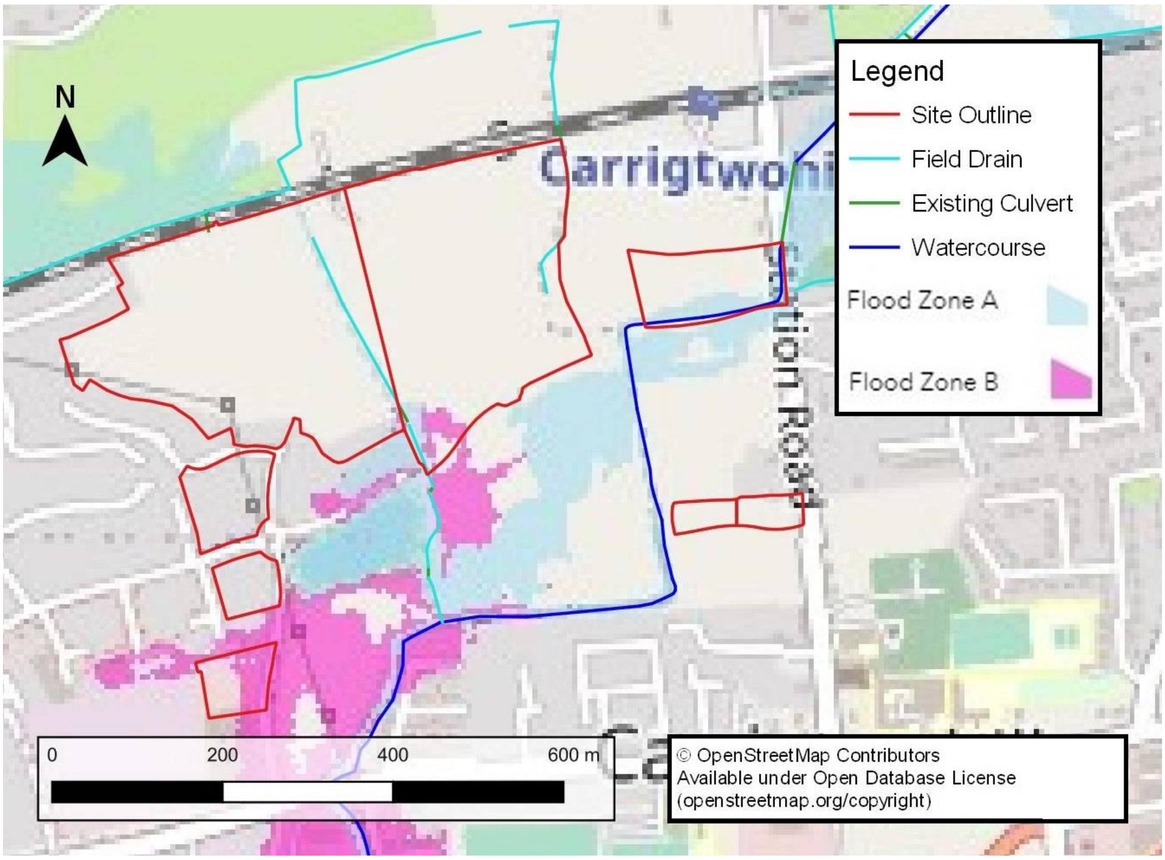


Figure 3-5: Cobh MD LAP 2017 Flood Zones

A review of the land use zoning map shows that the Castlelake North Site, Blandcrest Site and Station Road North Site are zoned as "Residential". The Castlelake South Site 01, Station Road South Site 01 and Station Road South Site 02 are zoned as "Town Centre". The Castlelake West Site and Castlelake South Site 02 have not been zoned under the LAP. The Cobh MD LAP 2017 land use zoning map is available in Appendix B.

3.2.5 Draft Cork County Development Plan 2021 Strategic Flood Risk Assessment (SFRA)

In accordance with Section 11 of the Planning and Development Act 2000 (as amended) Cork County Council (CCC) are in the process of drafting a new county development plan for the period 2022-2028. A draft plan dated 2021 was available for review at the time of writing this report. A draft SFRA for the County Development Plan 2022-2028 was prepared in accordance with the requirements of 'The Planning System and Flood Risk Management - Guidelines for Planning Authorities' (2009) and Circular PL02/2014 (August 2014). The draft SFRA provides an assessment of all types of flood risk within the County and assisted CCC to make informed strategic land-use planning decisions and formulate flood risk policies. This flood risk information has enabled CCC to apply 'The Guidelines' sequential approach, and where necessary the Justification Test, to appraise sites for suitable land zonings and identify how flood risk can be managed as part of the development plan. As part of the draft County Development Plan, flood zone and land use zoning maps were prepared. The maps were uploaded to the draft County Development Plan 2021 online map viewer and were available for review.

The LEE CFRAM study identified areas in the south of Carrigtwohill and recommended a more detailed flood risk assessment (FRA) for Carrigtwohill take place. CCC carried out this FRA and identified a number of areas in Carrigtwohill at risk of flooding. This is reflected in the land use zoning maps for the draft development plan. The flood zones were created using predictive fluvial and tidal flooding only. The flood zones are the same as those outlined in the Cobh MD LAP 2017 and shown in Figure 3-5. The draft CCC development plan 2021 flood zones map is available in Appendix B.

The land use zoning map for the draft CCC Development Plan 2021 is the same as that produced for the Cobh MD LAP 2017, with the only difference being the zoning category "Town Centre" is renamed as "Town Centres/Neighbourhood Centres". The map is available for review in Appendix B.

4 Hydraulic Modelling

4.1 Hydrology

To assist in the estimation of potential flood risk to the proposed development area, this section provides flow estimates for the 1% and 0.1% AEP flood event flows expected along the watercourses that flow through the area of interest.

The flows for the model were calculated for a number of hydrological estimation points (HEPs), refer to Figure 4-1. HEPs were calculated along the Tibbotstown, Woodstock and Poulaniska Streams. Flows were calculated using a range of flow estimation methods, but the FSU method was used for the design flows.

The flows were applied to the model by summing each of the lateral sub-catchments together for each watercourse and applying this to the point inflow flows at the upstream extent of each watercourse. Figure 4-1 shows the 1% AEP flows to be applied to each watercourse based on this approach. This method ensures the lateral catchment areas are accounted for in the flows without the complication of deriving the lateral flows applying them along the watercourse.

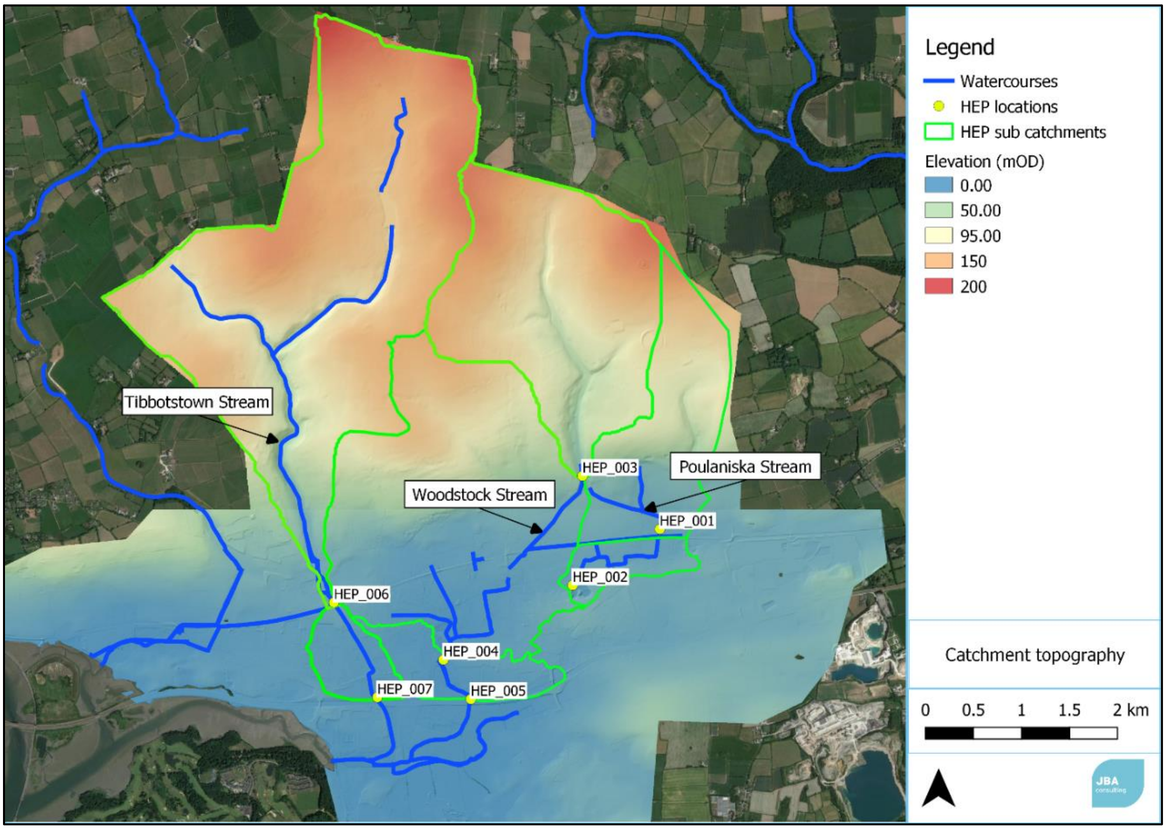


Figure 4-1: Catchment Area

4.1.1 Model Set-up

To assess flood risk at the site, a 1D/2D Flood Modeller/TUFLOW hydraulic model was constructed, allowing for the modelling of river channels, streams, floodplains and hydraulic structures to predict water levels for a range of scenarios. The hydraulic model was developed in the following stages:

- A 1D/2D TUFLOW model of the Tibbotstown and Woodstock Rivers was created based on a detailed survey data which has been supplemented by DTM data,
- Inclusion of constructed culvert along the Woodstock Stream west of Station Road,
- Inclusions of flood mitigation measures undertaken along the Tibbotstown Stream,
- Hydraulic simulations were run to derive the existing flood extent to determine Flood Zones A and B (the 1% and 0.1% AEP flood events),
- The model was then updated to account for road embankments and features not captured by the LIDAR data,

- The scenario examining the effect of climate change (+20% flow under the MRFS scenario) was also assessed.

The fluvial results from the hydraulic modelling are presented in Figure 4-2, while the tidal flood extents are presented in Appendix C. Review of the tidal flood maps confirm that the development is not at risk from the tidal flood events.

The hydraulic model includes a completed culvert along the Woodstock Stream (refer to Figure 4-2) but excludes the works included as part of the school development. The works undertaken as part of the school development has no impact on the site. Refer to planning application 19/5707 for the mitigation measures and resulting flood extents.

Review of Figure 4-2 highlights areas within the development that are at risk of inundation during a 0.1% AEP flood event. The area is located at the junction between the Woodstock Stream and Station Road. Floodwater overtop onto Station Road and ultimately the site before discharging back into the Woodstock Stream.

The inundation within the development's redline boundary and associated mitigation measures will be discussed further in Section 5.

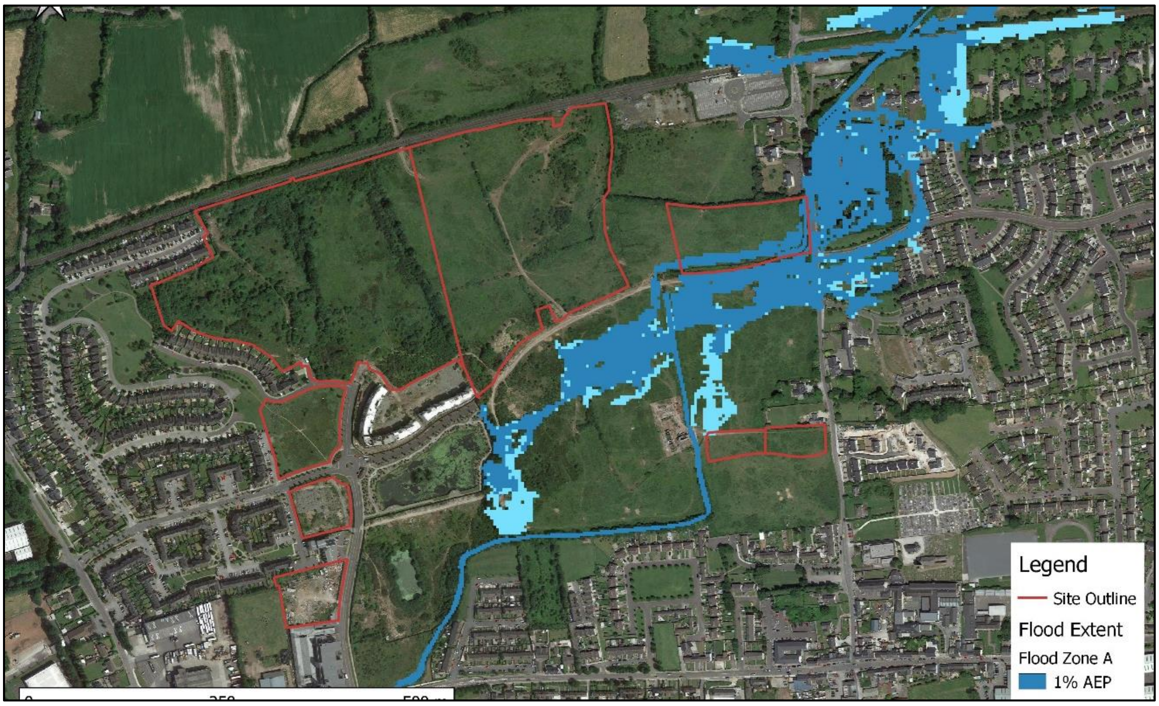


Figure 4-2: Pre-Development Flood Extents (No Mitigation Measures)

4.2 Flood Sources

The initial stage of a Flood Risk Assessment requires the identification and consideration of probable sources of flooding. Following the initial phase of this Flood Risk Assessment, it is possible to summarise the level of potential risk posed by each source of flooding, and are described below.

4.2.1 Fluvial / River

The main watercourses in the area are the Woodstock Stream and the Tibbotstown Stream. The fluvial sources are summarised as follows:

- There is no record of historic fluvial flooding having occurred within the proposed site confines;
- As per the Cork County Development Plan 2014/draft Cork County Development Plan 2021 SFRA, areas of the proposed site are located within Flood Zones A and B, meaning there is a "High" and "Medium" probability of flooding occurring, respectively. The majority of the site is located within Flood Zone C, indicating there is a "Low" probability of flooding occurring;
- As per the Cobh Municipal District Local Area Plan 2017 SFRA, areas of the proposed site are located within Flood Zones A and B, meaning there is a "High" and "Medium" probability of flooding occurring, respectively. The majority of the site is located within Flood Zone C, indicating there is a "Low" probability of flooding occurring;
- The OPW NIFM study indicated flooding on-site for the 1% AEP flood event ("Medium" probability), however, it is concluded that this fluvial flow path does not take account of modifications to the Tibbotstown Stream and the presence of the Cork-Midleton railway line, which acts as a physical barrier. Therefore, the site is deemed not to be impacted by the NIFM predicted flood extents;
- The CFRAM study indicated flooding in the Castlelake South Site 01 for the 0.1% AEP flood event ("Low" probability).

To account for recently completed works along the Tibbotstown Stream and a culvert along the Woodstock, a hydraulic model has been developed by JBA to confirm the pluvial flood risk to the site. The model is presented in Section 4

The fluvial risk is addressed and further presented in detail in the mitigation measures section of this report.

4.2.2 Tidal / Coastal

The proposed site is located upstream of the Lee estuary / Cork Harbour area. It is located in close proximity to the coastline and there is a potential for floodwaters to surge up the Woodstock Stream. The coastal sources are summarised as follows:

- There is no record of historic tidal flooding having occurred within the proposed site confines;
- As per the Cork County Development Plan 2014/draft Cork County Development Plan 2021 SFRA, areas of the proposed site are located within Flood Zones A and B, meaning there is a "High" and "Medium" probability of flooding occurring, respectively. The majority of the site is located within Flood Zone C, indicating there is a "Low" probability of flooding occurring;
- The CFRAM study indicated no flooding on-site for the 0.1% AEP flood event;
- The NCFHM study indicated that the southeast corner of the Castlelake North Site, the southwest corner of the Blandcrest Site, and a significant portion of the Castlelake South Site 01 are subject to flooding during the 0.5% AEP coastal flood event. Extended areas at these locations, as well as a small portion of the Castlelake South Site 02, are also subject to flooding during the 0.1% AEP coastal flood event.

To date the Lower Lee/ CFRAM study is the most detailed study undertaken of the study area. The study does not indicate any tidal flooding of the study area. The NCFHM does indicate flooding but may not incorporate sufficiently detailed LIDAR data.

To confirm the flood risk to the site a hydraulic model has been developed to confirm the tidal flood risk to the development. This is presented in Section 4.

The tidal risk is addressed and further presented in detail in the mitigation measures section of this report.

4.2.3 Pluvial / Surface Water

Pluvial / surface water flooding is the result of rainfall-generated overland flows that arise before run-off can enter a watercourse or sewer. It is particularly sensitive to increases in hard-standing ground / urbanised areas and is usually associated with rainfall events of high intensity. There is no record of historic pluvial flooding in the area, nor any relevant predictive pluvial flood mapping studies. However, the risk from pluvial inundation is always present. The pluvial risk is addressed and further presented in detail in the mitigation measures section of this report.

4.2.4 Groundwater

Groundwater flooding results from high sub-surface water levels that impact upper levels of the soil strata and overland areas that are usually dry. The groundwater risk is summarised as follows:

- The groundwater vulnerability has been classified as "Moderate" to "High" by the GSI groundwater vulnerability maps.
- There are no predictive groundwater flood extents located on-site or nearby,
- There is no record of any historical groundwater or surface water flooding within the proposed site confines.
- Review of the GSI Groundwater Flood Map does not indicate any groundwater water flooding within or adjacent to the development boundary.

In summary, there is no known risk of groundwater flooding in this area. In addition, the site will be developed and much of it is proposed to be fully covered in hardstanding, thus it has been screened out at this stage.

5 Flood Risk Assessment

5.1 Flood Risk

The flood risk to the 8no. proposed sites which make up the development is summarised in the following sections.

Proposed culvert works as part of this development to capture pluvial/surface water flows along the existing drainage channel along the north eastern boundary of the Blandcrest stie. The flood extents presented in Figure 5-1 take into account specific measures discussed below.

Figure 5-1: Post-Development Flood Map

5.1.1 Blandcrest Site

Review of Figure 5-1 confirms that the site is completely located within Flood Zone C. The main flood risk to the is presented by an existing drainage ditches that collects local surface water from lands north of the railway line. There are two culverts located along the railway line that convey surface water onto the site via the local drainage network.

Two sperate culverts will be installed to manage surface water flows entering the site from under the railway line, refer to Figure 5-2 for the proposed culvert location though the site. The proposed culvert system will discharge this to an existing drainage ditch at the southern end of the site.

No specific mitigation measures are required to manage fluvial flood risks to the site.

To minimise the pluvial flood risk it is recommended that a threshold of 150mm between the ground floor and surrounding hardstanding areas.

Figure 5-2: Blandcrest Site / Castlelake North Site

5.1.2 Castlelake North Site/ Castlelake South Site 01/ Castlelake South Site 02

The remaining areas of the development identified as Castlelake North, Castlelake South 01 and Castlelake South 02 are all located in Flood Zone C. The flood extents are based on the JBA hydraulic model and validated against the CFRAM/Lower Lee model results.

No specific mitigations are required to manage the fluvial flood risk to these areas. Typical measures will be provided in Sections 5.2 and Section 5.3.

To minimise the pluvial flood risk it is recommended that a threshold of 150mm between the ground floor and surrounding hardstanding areas.

5.1.3 Station Road North Site

Areas of this site along the southern boundary are located in Flood Zones A and B, meaning there is a "High" and "Moderate" risk of flooding in these areas, refer to Figure 5-3. As it is proposed to include residential development in these areas, it is necessary to include mitigation measures to counter the fluvial risk. Mitigation measures are discussed in Section 5.1.3. It is noted that the minimum FFL provided at the Station Road North Site is 6.6mOD

It is noted that the majority of the flood extents are located within the public green space at the south-eastern corner of the site. To manage the existing 1% AEP and 0.1% AEP flood events it is necessary to profile the landscaping in the greenspace to divert overland flows back in channel. This will remove the flood risk to the site, refer to Figure 5-3.

The post-development flood extents are presented in Figure 5-3, which confirms that all residential properties are appropriately mitigated, post development.

To minimise the pluvial flood risk it is recommended that a threshold of 150mm between the ground floor and surrounding hardstanding areas.

The flood levels for the modelled flood events are presented in Table 5-1. Review of Table 5-1 confirms that the adjacent apartment block to node WOOD00315 has a freeboard of 500mm above the 1% AEP MRFS flood event.

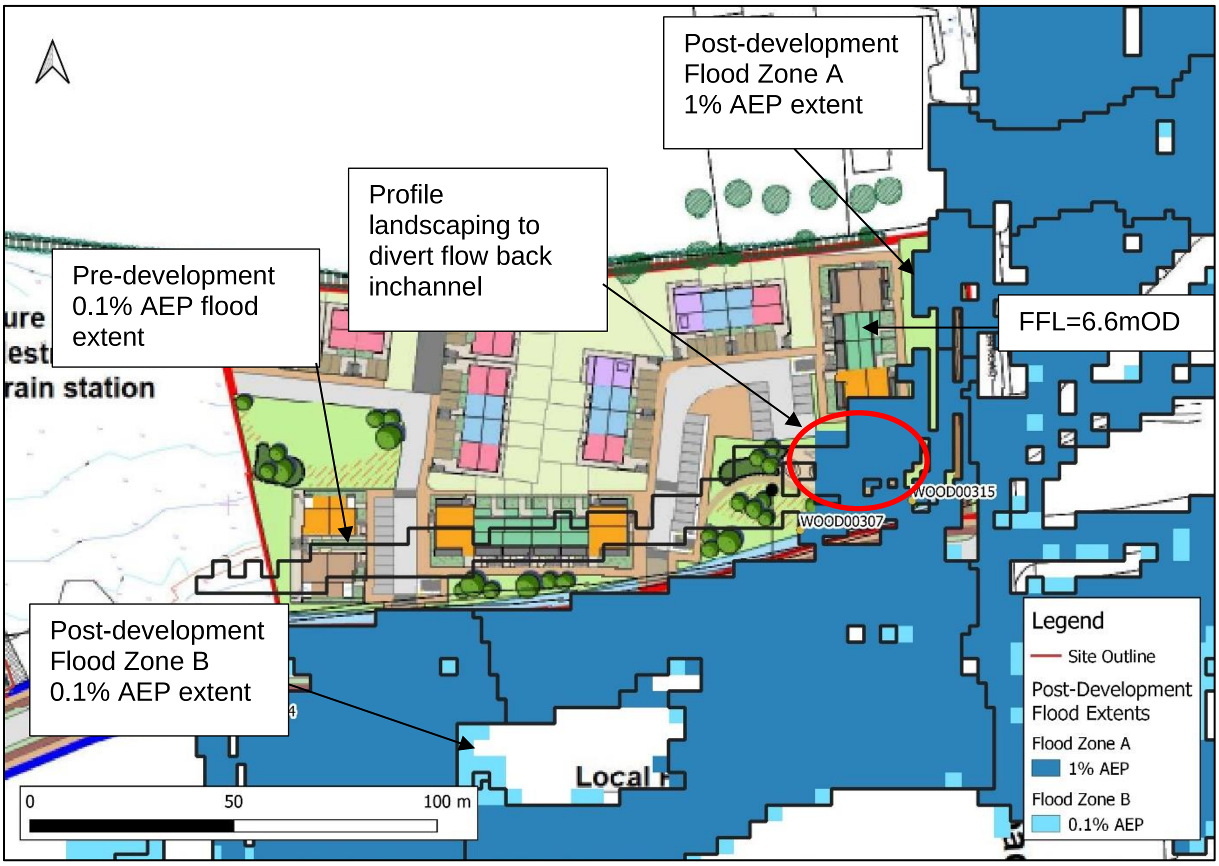


Figure 5-3: Station Road North Site

Key Node	1% AEP (mOD)	1% AEP MRFS (mOD)	0.1% AEP (mOD)
WOOD00315	6.1	6.1	6.13
WOOD00307	5.56	5.57	5.63

Table 5-1: Modelled Flood Levels Summary (Fluvial)

5.2 Finished Floor Levels

The majority of the development is located in Flood Zone C and therefore is at a low risk of flooding. However, to minimise the flood risk particularly from pluvial flooding it is recommended that a threshold of 150mm is provided to the external hardstanding areas.

Specific FFL's for segment Station Road North, a minimum FFL of 6.6mOD is provided to minimise the flood risk. This provides a freeboard of 0.5m above the 1% AEP MRFS flood event.

5.2.1 Areas at Risk from Fluvial Inundation

1no. site has been identified as being at risk from fluvial flooding; the Station Road North Site. It is necessary to set a minimum FFL to mitigate against the fluvial risk. This is done by identifying the predicted flood level for the 1% AEP MRFS fluvial event, and then incorporating allowances for climate change and freeboard, and is outlined as follows:

- As per Table 5-1 the predicted water level for the 1% AEP MRFS fluvial event is 6.1mOD, for the Present Day scenario. This is the level taken from the 'WOOD00315' node, as this is located adjacent to proposed development within the site;
- Finally, a freeboard of 500mm is provided to account for any residual risk to the development, bringing the minimum FFL to 6.6mOD for the apartment block adjacent to the Woodstock Stream.

5.2.2 Areas at risk from Coastal Inundation

None of the 8no. proposed sites has been shown to be at risk from coastal flooding during the 0.5% and 0.1% AEP events for the Present Day scenario. However, Castlelake Site 01 has been identified as being at risk of inundation during the 0.2% AEP HEFS (High End Future Scenario) flood event. The proposed FFL of 3.55mOD is sufficient to protect the development from this event. Therefore, it is not necessary to include mitigation measures to deal with coastal flood risk.

5.3 Drainage Design (Pluvial Flooding)

There is a potential risk of pluvial flooding to the Blandcrest Site via stormwater flow thought the railway culverts. These culverts are connected to local drains on the northern side of the railway line. If not mitigated against, pluvial flood waters would be discharged into the site.

The proposed culvert system provided in Figure 5-2. This culvert will capture stormwater from the railway culverts and convey the stormwater through the site. The proposed culvert will discharge the stormwater to a local drain at the southern end of the site which connects to the Woodbrook Stream.

Regarding direct rainfall onsite, the existing site is greenfield in nature and has not been subject to any previous development. The proposed surface water drainage systems should be designed in accordance with the requirements of the Greater Dublin Strategic Drainage Strategy (GDSDS) guidance documents and incorporating Sustainable Urban Drainage Systems (SuDS) to reduce runoff and improve receiving water quality. The SuDS elements of the proposed drainage systems should be designed in accordance with The SuDS Manual, CIRIA Report C753. The main provisions of the GDSDS and SuDS guidance documents are as follows:

- Reduce runoff by providing interception of the first 5mm of rainfall;
- Provide temporary / permanent water storage;
- Treat runoff before entering receiving watercourses / networks;
- Attenuate for the 30-year design storm, with no on-site flooding;
- Attenuate for the 100-year design storm, with limited on-site flooding permitted;
- Limit discharge to the equivalent greenfield runoff rate for the development;
- Mitigate the effects of climate change by incorporating a minimum allowance for climate change of 10%.

As previously stated, to minimise the pluvial flood risk it is recommended that a threshold of 150mm between the ground floor and surrounding hardstanding areas.

5.4 Climate Change

5.4.1 Fluvial Climate Change Risk

Fluvial modelling was undertaken for the Mid-Range Future Scenario (MRFS). The MRFS extents showed on-site flooding within the Station Road North Site for the 1% and 0.1% AEP events. The results from the MRFS flood model confirm that the site is not at risk of inundation from the predicted MRFS flood event. Refer to Appendix C.1 for the pluvial MRFS floodmap.

Regarding the development at Station Road North, a minimum FFL of 6.6mOD is provided to minimise the flood risk. This provides a freeboard of 0.5m above the 1% AEP MRFS flood event.

5.4.2 Coastal Climate Change Risk

Coastal modelling was undertaken for the Mid-Range and High-End Future Scenarios (MRFS and HEFS, respectively). The MRFS extents showed no on-site flooding in any of the 8no. proposed sites for the 0.5% and 0.1% AEP events. The HEFS showed flooding in the Castlelake South Site 01 for the 0.5% and 0.1% AEP events. Refer to Appendix C.2 for the coastal flood maps

The FFL's for the apartment block within Castlelake South has been set at 3.55mOD which provides a freeboard of 0.34m and 0.2m above the 0.1% HEFS predicated tidal flood levels.

The 0.2% AEP HEFS tidal flood event has been selected as the design event for the site regarding FFL's to minimise flood risk.

The HEFS coastal modelling extents are available for review in Appendix C.

5.4.3 Pluvial Flooding Climate Change

Regarding pluvial flooding and climate change, the potential increase in rainfall can lead to an increased flood risk. To mitigate against climate change, a minimum climate change allowance of 10% should be incorporated into the design of the surface water drainage / attenuation systems as per GDSDS requirements. This, along with setting the minimum FFL of 150mm above external hardstanding areas, will mitigate the ongoing risk of pluvial flooding.

5.5 Residual Risk

Residual risks are defined as risks that remain after all risk avoidance, substitution and mitigation measures have been taken. This flood risk assessment identifies the following as the main sources of residual risk to the proposed development;

- Failure of the on-site surface water drainage / attenuation systems (pluvial risk);

Failure of the surface water systems could include exceedance of the attenuation tank capacities, or blockage of the surface water gullies. To mitigate against failure of the drainage / attenuation systems, it is recommended to set a minimum Finished Flood Level (FFL) of 150mm above any external hardstanding areas.

6 The Justification Test for Development Management

6.1 Strategy

As it is proposed to locate a residential development within Flood Zone A/B, it is necessary to undertake a Justification Test as part of the development.

The source of the inundation during the 0.1% AEP event is an overland flow path following overtopping of the Woodstock Stream east of the Station Road North site

The existing land use is agricultural within the site and a minor section of the site is located within Flood Zone A/B.

The planning guidance appropriate to this development is, "The Planning System and Flood Risk Management" and sets out a framework within which the planning authority should consider proposals for new development in areas of flood risk. This framework is called the Justification Test for Development Management.

The specific aim of the development design is to place all highly vulnerable development outside of Flood Zone A and B. A Justification Test (JT) will be applied and passed in order to satisfy the Guidelines.

In the following text, each of the criteria within the JT is responded to as they relate to the proposed development. For ease of reading, where the responses are supported by technical detail which is contained in this report, an appropriate chapter has been referenced.

6.2 Justification Test: Part 1

The subject lands have been zoned or otherwise designated for the particular use or form of development in an operative development plan, which has been adopted or varied taking account of the planning guidelines.

Under the CCC Development Plan 2014/draft CCC Development Plan 2021 the site is zoned as residential which is the same as the current Cobh MD LAP 2017. The map is available for review in Appendix B.

Conclusion: It has been outlined that the proposed development which comprises residential development is compatible with the current zoning. All residential developments will be raised above the relevant 1% AEP and 0.1% AEP flood levels.

6.3 Justification Test: Part 2

The proposal has been subject to an appropriate flood risk assessment that demonstrates:

(i) the development proposed will not increase flood risk elsewhere and, if practicable, will reduce overall flood risk;

All development will be placed above the 1% AEP and 0.1% AEP flood levels. Mitigation measures have been outlined in Section 5.2 which ensures that the proposed development will not increase the risk of flooding downstream.

Conclusion: All development within Flood Zone A or B will be raised above the 1% AEP and 0.1% AEP flood levels. The proposed mitigation measures will ensure that there is no increase in runoff from the site.

(ii) the development proposal includes measures to minimise flood risk to people, property, the economy and the environment as far as reasonably possible;

All residential areas are located in Flood Zone C and the residential dwellings will be raised above the 1% and 0.1% AEP events and will not be impacted by the predicted flood events.

Conclusion: All residential areas will be located above the 1% and 0.1% AEP flood levels plus appropriate freeboard.

(iii) The development proposed includes measures to ensure that residual risks to the area and/or development can be managed to an acceptable level as regards the adequacy of existing flood protection measures or the design, implementation and funding of any future flood risk management measures and provisions for emergency services access.

The proposed development has been designed with sufficient freeboard to account for any uncertainty in the modelling process. Residual risks have been accounted for as outlined in Section 5.5, relating to modelling uncertainty, climate change and surface water system-related residual risk.

Climate change has also been considered in the development of the mitigation measures.

(iv) The development proposed will address the above in a manner that is also compatible with the achievement of wider planning objectives in relation to development of good urban design and vibrant and active streetscapes.

To address Part (iv) of the Justification Test, please refer to supplementary planning report provided as part of the application.

7 Conclusion

JBA Consulting has undertaken a Flood Risk Assessment for the proposed residential development at Carrigtwohill, Co. Cork. The existing 8no. sites are greenfield in nature and have not been subject to any previous development. A review of the available sources of flooding indicates there are no instances of historic flooding on-site, but there may be a risk from moderate-probability fluvial and pluvial events.

The majority of the development is located in Flood Zone C, however the FRA has determined that a minor section of the Station Road North Site resides within Flood Zone A/B. Mitigation measures have been proposed to manage the flood risks to the Station Road North Site which ensures that the residential areas are located above the 1% AEP and 0.1% AEP flood levels including climate change.

To address the risk of pluvial flooding, surface water drainage / attenuation systems will be incorporated into the development to manage surface water flows on site. It is recommended to set a minimum Finished Floor Level of 150mm above any external hardstanding areas to mitigate against potential failure of the surface water systems. It is also recommended to include climate change allowance into the design of the surface water systems to mitigate against the effects of climate change. These measures will mitigate the ongoing risk of pluvial flooding.

Within the Blandcrest Site, culverts will be installed to manage existing pluvial flows that currently enter the site via culverts under the railway line. These flows will be contained within the dedicated culvert system and discharged into an existing drainage ditch located on the southern end of the site. This retains the existing surface water drainage mechanisms in the area.

Climate Change has been assessed for the site for the fluvial and coastal events. Where necessary, mitigation measures have been provided to minimise flood risks from the climate change events. Post-development all residential areas are located above the predicted fluvial and coastal climate change flood levels.

In summary, the majority of proposed development on-site is located within Flood Zone C. The proposed development within Flood Zone C is deemed appropriate. For development within Flood Zones A and B, mitigation measures have been proposed to manage the ongoing risk of inundation from coastal and fluvial sources. The Justification Test has been undertaken and passed for the development.

This Flood Risk Assessment was undertaken in accordance with 'The Planning System and Flood Risk Management - Guidelines for Planning Authorities' and agrees with the core principles contained within.

Appendices

A Appendix - Understanding Flood Risk

Flood Risk is generally accepted to be a combination of the likelihood (or probability) of flooding and the potential consequences arising. Flood Risk can be expressed in terms of the following relationship:

Flood Risk = Probability of Flooding x Consequences of Flooding

A.1 Probability of Flooding

The likelihood or probability of a flood event (whether tidal or fluvial) is classified by its Annual Exceedance Probability (AEP) or return period years, a 1% AEP flood 1 in 100 chance of occurring in any given year. In this report, flood frequency will primarily be expressed in terms of AEP, which is the inverse of the return period, as shown in the table below and explained above. This can helpful when presenting results to members of the public who may associate the concept of return period with a regular occurrence rather than an average recurrence interval and is the terminology which will be used throughout this report.

Table: Conversion between return periods and annual exceedance probabilities

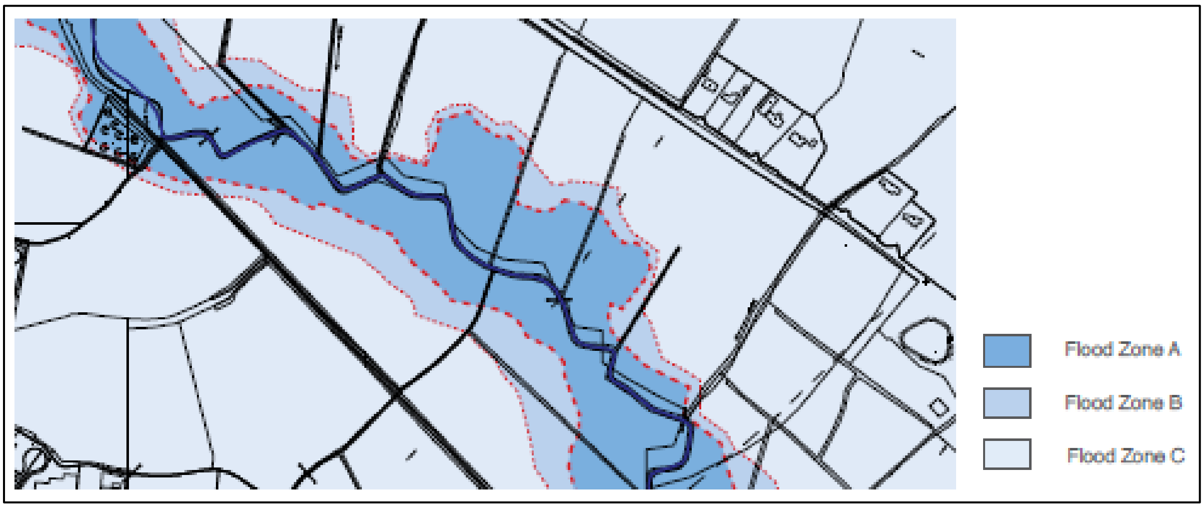
• Return period (years)	• Annual exceedance probability (%)
2	50
10	10
50	2
100	1
200	0.5
1000	0.1

A.2 Flood Zones

Flood Zones are geographical areas illustrating the probability of flooding. For the purpose of the Planning Guidelines, there are 3 types of levels of flood zones, A, B and C.

Zone	Description
Flood Zone A	Where the probability of flooding is highest, greater than 1% (1 in 100) from river flooding or 0.5% (1 in 200) for coastal/ tidal Flooding
Flood Zone B	Moderate probability of flooding, between 1% and 0.1% from rivers and between 0.5% and 0.1% from coastal/ tidal.
Flood Zone C	Lowest probability of flooding, less than 0.1% from both rivers and coastal/ tidal.

It is important to note that the definition of the flood zones is based on an undefended scenario and does not take into account the presence of flood protection structures such as flood walls or embankments. This is to allow for the fact that there is a residual risk of flooding behind the defences will be maintained in perpetuity.



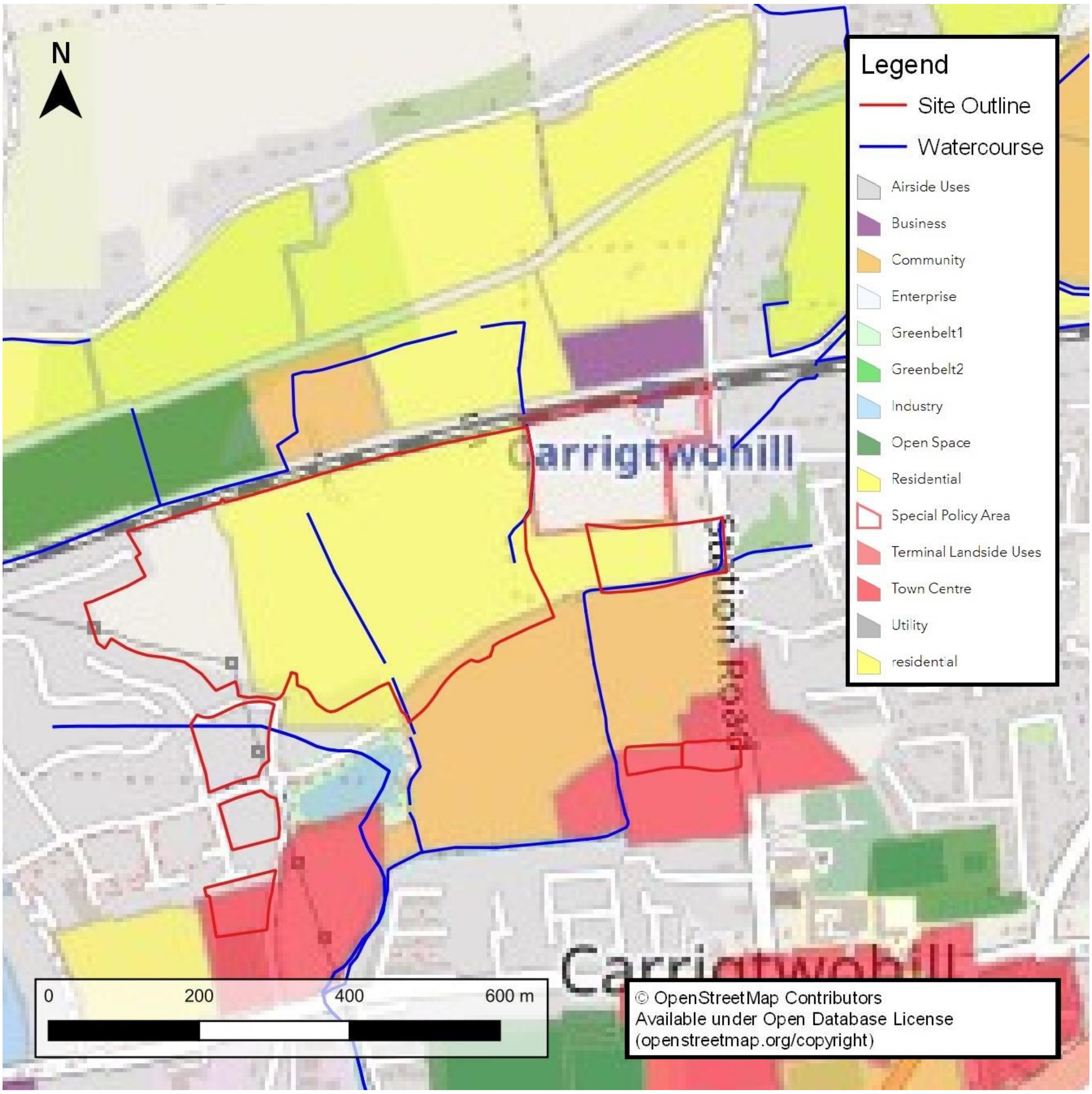
A.3 Consequences of Flooding

Consequences of flooding depend on the Hazards caused by flooding (depth of water, speed of flow. Rate of onset, duration, wave-action effects, water quality) and the vulnerability of receptors (type of development, nature, e.g. age-structure of the population, presence and reliability of mitigation measures etc.)

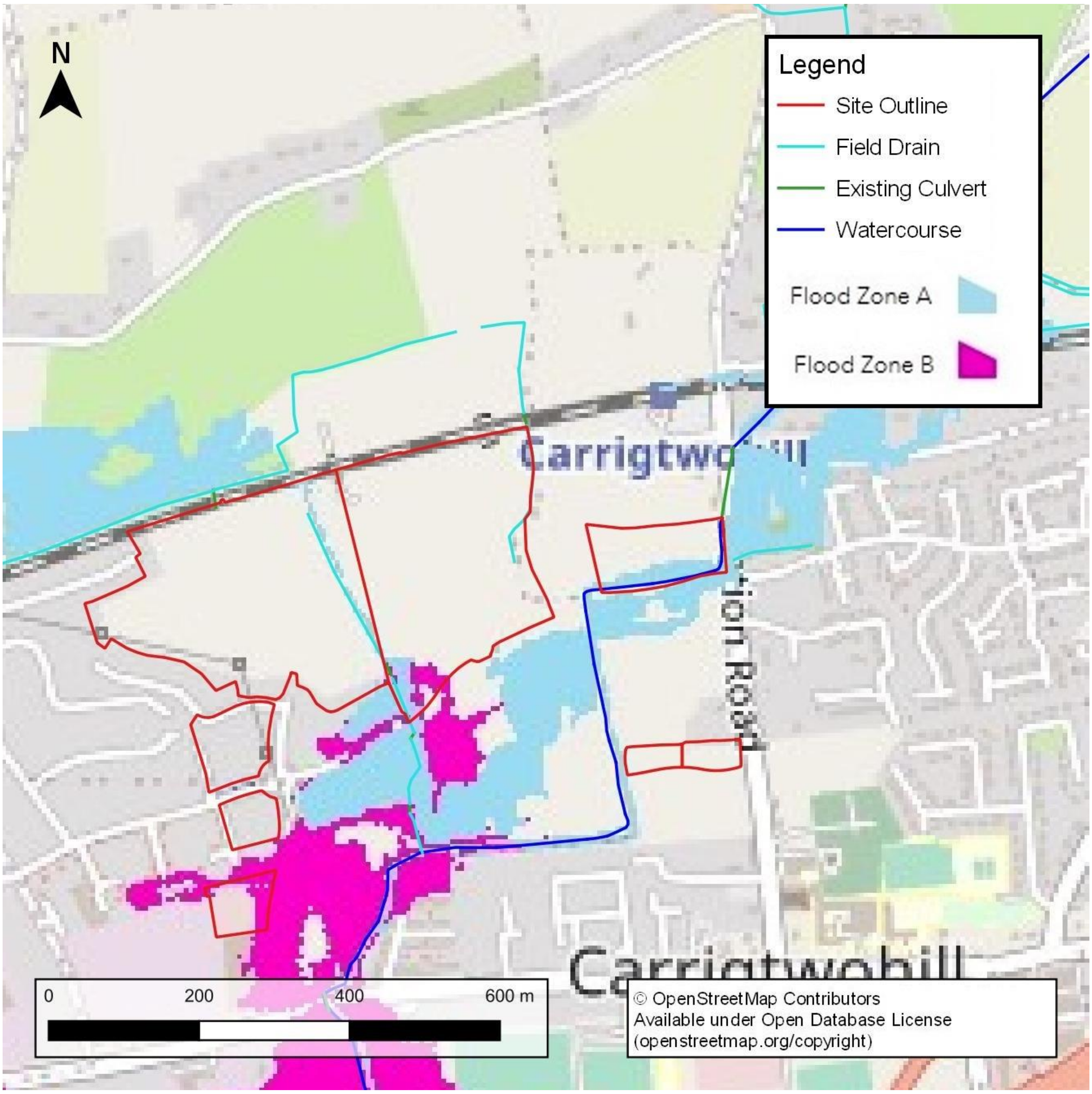
The 'Planning System and Flood Risk Management' provides three vulnerability categories, based on type of development, nature, which are detailed in Table 3.1 of the Guidelines, and are summarised as:

- **Highly vulnerable**, including residential properties, essential infrastructure and emergency service facilities
- **Less vulnerable**, such as retail and commercial and local transport infrastructure, such as changing rooms.
- **Water compatible**, including open space, outdoor recreation and associated essential infrastructure, such as changing rooms.

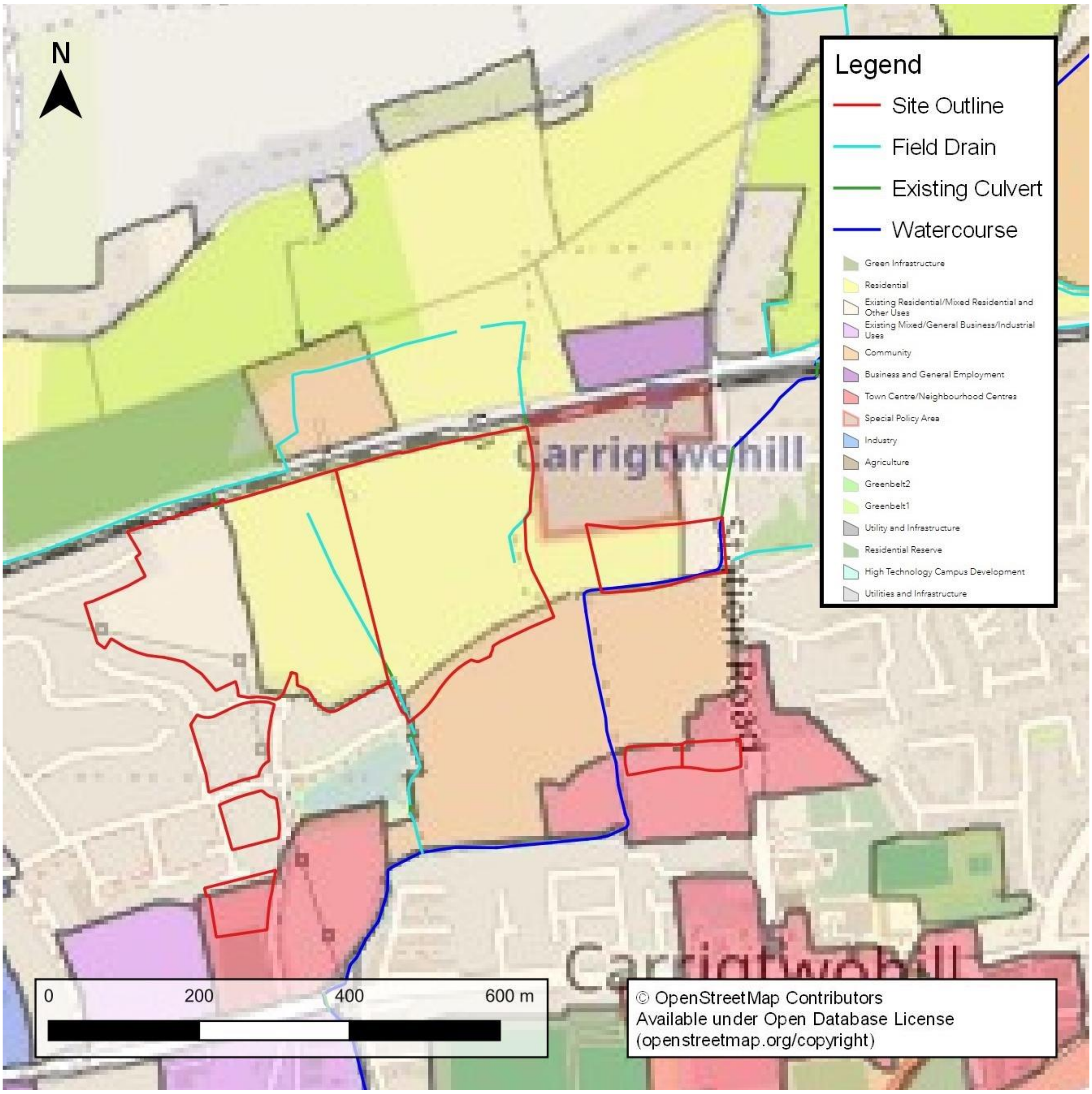
B Appendix - Additional Maps



Cobh MD LAP 2017 Land Use Zoning



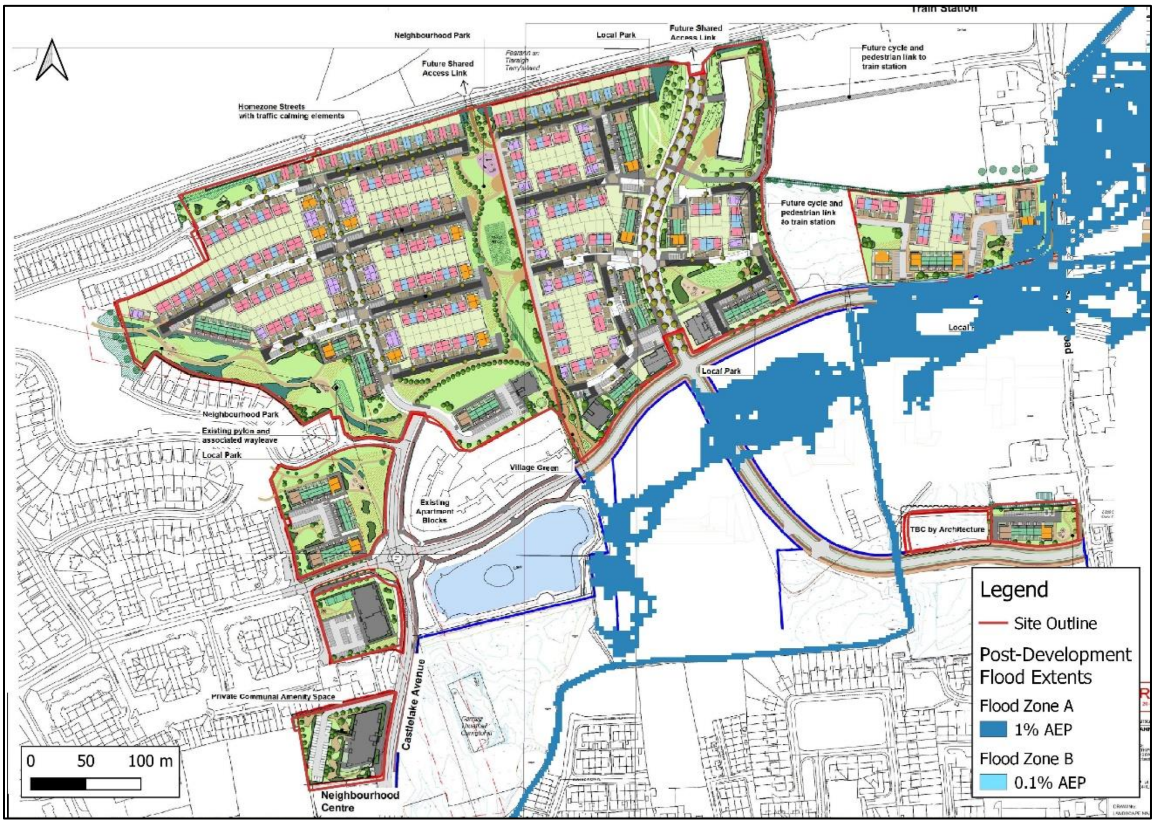
Draft CCC Development Plan 2021 (2022-2028) Flood Zones



Draft CCC Development Plan 2021 (2022-2028) Land Use Zoning

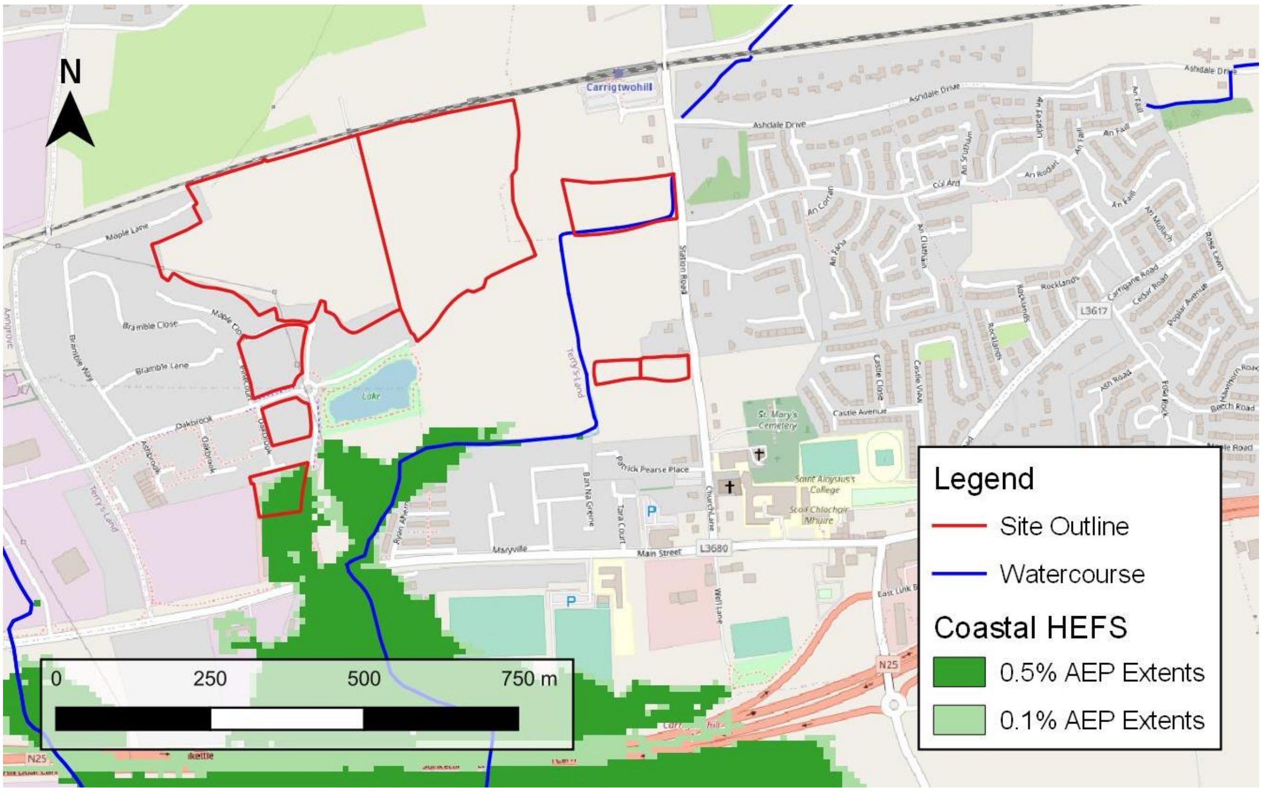
C Climate Change

C.1 Fluvial



Post-Development Fluvial Flood Extents - Mid-Range Future Scenario (MRFS)

C.2 Coastal



Coastal Flood Extents - High-End Future Scenario (HEFS)

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Appendix 9.1

Engineering Services Infrastructure Report

CASTLELAKE SHD

Engineering Services Infrastructure Report

MCW1088-RPS-00-ZZ-
RP0002
S4 P01
09 June 2022

Document status

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Contents

Tables

Appendices

1 INTRODUCTION

1.1 Purpose of the Report

RPS Consulting Engineers have been appointed by BAM Property Ltd to provide for the civil engineering design of the wastewater and surface water sewers, watermains and road vertical geometry design for the proposed Castlelake Strategic Housing Development (SHD) within lands adjacent to the existing Castlelake development at Terrysland, Carrigtwohill, Co. Cork. RPS has previously prepared planning permission documentation to support the existing phases to the Castlelake development.

This report, which provides supporting information on the above, forms part of the SHD planning application for the development and should be read in conjunction with all submitted drawings and reports.

1.2 Background

The Castlelake development lands are located to the west of the town of Carrigtwohill in County Cork. In June 2002, Cork County Council granted planning permission for a proposed development at Castlelake (Planning Reference Nos. 00/7607 and 00/7674). Development on the site to date has been primarily residential. While the original grants of planning permission involved the development of the entire land holding, development to date has been predominantly to the eastern area of the site only, with the remainder of the site typically remaining undeveloped.

It is now proposed to develop the remainder of the site for typically residential use, which will involve the construction of 716nr residential units. It is also proposed to provide a creche within the development. The location of the proposed development within the Castlelake development is shown on the accompanying RPS engineering drawings, and on the architectural drawings which accompany this application.

The sewers and watermains proposed to serve the development will connect to the network of existing sewers and watermains that have been constructed as part of the existing Castlelake development. Sections 3 to 5 below contain information on the design of the proposed wastewater sewer, surface water sewer and watermain networks.

1.3 Proposed Site Location and Description

The proposed site is located on greenfield lands adjacent to the existing Castlelake residential development, in Carrigtwohill, Co Cork. The wider area is currently partially developed, with existing residential dwellings located to the western section of the lands. Access to the site is currently provided via an existing, established junction onto Main Street, and via 2no. new junctions with Station Road, which are currently under construction (under a separate planning permission). The site is bound to the north by the railway line which links Midleton to Cork city at Kent Station, to the west by the existing Castlelake residential development, by Main Street and existing dwelling/development to the south and Station Road to the east.

The development will consist of the construction of a strategic housing development of 716 no. units and a 2 no. storey creche. The proposed development comprises 224 no. houses, 284 no. duplex units and 208 no. apartments. The two storey houses comprise 48 no. detached, 126 no. semi-detached and 50 no. terraced Houses containing 60 no. two bed units, 139 no. three bed units and 25 no. four bed units. The part-one to part-three storey duplex units are contained in 122 no. buildings providing 82 no. one bed units, 142 no. two bed units and 60 no. three bed units. There are 7 no. apartments blocks ranging in height from part-1 to part-5 no. storeys.

- Block 1 is 4 no. storeys and contains 34 no. units (7 no. one bed units, 19 no. two bed units and 8 no. three bed units).
- Block 2 is part-1 to part-5 no. storeys and contains 42 no. units (15 no. one bed units, 20 no. two bed units and 7 no. three bed units).
- Block 3 is 5 no. storeys and contains 17 no. units (8 no. one bed units and 9 no. two bed units).
- Block 4 is 4 no. storeys and contains 13 no. units (6 no. one bed units and 7 no. two bed units).
- Block 5 is 4 no. storeys and contains 13 no. units (6 no. one bed units and 7 no. two bed units).

- Block 6 is 4 no. storeys and contains 13 no. units (6 no. one bed units and 7 no. two bed units).
- Block 7 is 5 no. storeys over basement and contains 76 no. units (23 no. one bed units, 41 no. two bed units and 12 no. three bed units).
- All blocks contain ancillary internal and external resident amenity space.

The proposed development also provides for: hard and soft landscaping; boundary treatments; public realm works; car parking; bicycle stores and shelters; bin stores; lighting; plant rooms; and all ancillary site development works above and below ground.

2 ROADS INFRASTRUCTURE

2.1 General

Vehicular access to the proposed development lands is currently made via the existing, established junction with Main Street. This junction provides for vehicular and pedestrian access to the existing Castlelake development. The existing residential development is served via a network of roads, footways and cycleways which provide access to the existing dwellings.

As part of the separate works to facilitate a new educational campus on lands in the general works area, new infrastructure consisting of roads, footpaths and cycleways have been constructed, along with the provision of 2 no. new access junctions onto Station Road. These works are all being completed under a separate planning permission application.

In order to access the proposed development, it is proposed connect to the existing road infrastructure with new roads, footpath and cycleways to allow for access to be provided throughout the new development. The development's internal layout has been as per the requirements of the Design Manual for Urban Roads and Streets (DMURS) and Cork County Council.

2.2 Road Layout Design

The roads layout for the proposed development can be seen in the accompanying drawings. These drawings provide details on the horizontal and vertical alignment of the proposed road network, including cross-sectional details of same.

The roads proposals typically comprise of the following:

- New 6.0m wide northern spine link road to provide access to lands to north of railway,
- New 6.0m wide road to provide access to the residential core area, located to the north of the existing apartment blocks,
- Local roads of 5.5m carriageway widths have been provided to provide access to the dwellings within the residential development,
- Footpath widths of typically 2.0m have been provided, ,
- Cycle lanes of 1.75m width have been provided along primary northern link road route.

2.3 Proposed Carrigtwohill to Midleton InterUrban Cycleway Route through Proposed Development Lands

Cork County Council have produced a Part 8 planning application of the provision of the Carrigtwohill to Midleton InterUrban Cycleway Phase 1. This Part 8 application was approved by full council on 14th March 2022. Section 1B and 1C of this route is proposed to pass through the Castlelake SHD application site to facilitate access to the Carrigtohill Train Station.

Discussions relating to the proposed route of this cycleway through the application site have been had with Cork County Council at Section 5 pre-consultation stage. A similar, but alternate alignment for this route within the Castlelake SHD application was tabled at this pre-consultation meeting but following these discussions with Cork County Council, the route was subsequently maintained as per the Part 8 alignment. The cycleway arrangement can be seen on the accompanying drawings.

On exit of the existing underpass below the railway line, the proposed Section 1B of the route follows the alignment of the northern spine road to the development, prior to it curving through the greenspace to the south of Apartment A7 block, and then continuing in a southerly direction through third party lands to allow a connection to the proposed educational campus. The Section 1C of the cycleway route is now shown to travel northwards off Section 1A to the rear of the apartment block, prior to turning east to connect to the train station. The horizontal alignment of this revised route has been designed to allow for the provision of this cycleway at gradients no greater than 1:21 where is follows the alignment of the northern spine road.

These gradient soften out to a maximum of 1:70 where the cycleway passes through the greenspace top the south and east of the proposed Apartment A7 block. Details of the proposed cycleway levels and gradients can be seen on drawing MCW1088-RPS-00-XX-DR-C-GE0102.

The cycleway route will be required to pass the vehicular entrance in the Apartment A7 block. An assessment of the level was undertaken to determine if it is feasible to grade separate the cycleway from the apartment entrance at this location.

An assessment on the potential to allow the cycleway route to pass under the vehicular access via an underpass was reviewed. From this assessment, it was determined that there is insufficient distance along its length available to get to the necessary level under the access road to provide suitable clear with the underpass while maintaining incoming and outgoing gradients to the underpass at less than 1:20.

An assessment on the potential to allow the cycleway route to pass over the vehicular access via a bridging type of structure was reviewed. From this assessment, it was again determined that there is insufficient distance along its length available to get to the necessary level over the access road to provide suitable clearance for vehicles passing under while maintaining incoming and outgoing gradients to the underpass at less than 1:20.

Therefore it is proposed that the cycleway route is to pass the entrance to Apartment A7 at similar grade, but the cycleway has been designed to have priority at all times over vehicular traffic entering the car park of Apartment A7. The surface finishes have been designed to indicate that priority is to be provided to the cycleway. Tactile paving will be provided to alert the cycleway users to the upcoming arrangement but they will not be required to yield, as they will have priority.

This format of junction providing priority to cyclists and pedestrians across a vehicular access location is similar to the junctions as proposed along the east-west spine road that has recently been constructed as part of the educational campus works under planning application 19/05707, which was discussed and agreed with Cork County Council Roads Department at that time. This will provide for a level of consistency of cyclist/pedestrian priority junctions within the development area.

3 WASTEWATER DESIGN

3.1 General

The wastewater drainage for the proposed development has been designed in accordance with the requirements of Irish Water, as set out in the document IW-CDS-5030-03, “Code of Practice for Wastewater Infrastructure”, Revision 2. The drainage has also been designed in compliance with IS EN 752 Drain and sewer systems outside buildings, the general principles as set out in Section 3 of the publication “Recommendations for Site Development Works for Housing Areas” published by the Department of the Environment and Local Government, and the EPA publication “Wastewater Treatment Manuals – Treatment Systems for Small Communities, Businesses, Leisure Centres and Hotels” where appropriate.

The wastewater from the existing Castlelake residential development is currently discharged to the public trunk sewer network located to the Main Street. The main trunk wastewater sewers as constructed to the existing Castlelake development have been previously designed to take account of the future development of the entire Castlelake site, i.e. the existing trunk sewer drainage as laid within Castlelake has sufficient capacity to accept the wastewater flow from all existing and proposed development within the subject lands.

Th existing wastewater drainage network as constructed within the existing Castlelake development lands has not as yet been taken in charge by Irish Water and is currently under the control of the applicant.

3.2 Proposed Wastewater Network

It is proposed that a new underground gravity wastewater network will be provided to serve the proposed Castlelake SHD development. This wastewater network has been designed to fall by gravity towards the existing wastewater network as laid for the existing Castlelake development, which ultimately discharges to the public wastewater sewer network at the existing access junction into the development.

3.3 Wastewater Calculations

The proposed Carrigtwohill SHD consists of the provision of 716nr residential dwellings. The proposed wastewater generated from this development has been estimated using the guidance as included within the Irish Water Technical Standard IW-TEC-800-01 “Wastewater Gravity Sewers”, with detailed calculations included as **Appendix A** of this report.

In summary, the wastewater arising from the proposed development is estimated as follows:

- Total Nr of Dwellings = 716nr
- Occupancy Rate = 2.7 per dwelling
- Water Consumption = 150l/p/day
- Domestic Wastewater Contribution = 289,980 litres/day
- Infiltration (10% of Unit Consumption) = 28,998 litres/day
- Dry Weather Flow = 3.7 litres/sec
- Design Flow = 34.2 litres/sec

The MicroDrainage (Innovyze) software package has been used to design the wastewater network and the wastewater network design output is included in **Appendix B**.

3.4 Irish Water Pre-Connection Enquiry

A pre-connection enquiry form was submitted to Irish Water in respect to the wastewater connections from the proposed development. Subsequently, Irish Water confirmed that based on the size of the proposed development and on the capacity currently available, and subject to a valid connection agreement being put in place, the proposed connection to the Irish Water network can be facilitated, with the proviso that some local network upgrades are carried out to the existing public network. A copy of the Confirmation of Feasibility as received from Irish Water has been included as **Appendix C** of this report.

3.5 Irish Water Statement of Design Acceptance

A Statement of Design Acceptance submission was made to Irish Water in respect to the proposed wastewater infrastructure that is to be provided to service the proposed development. Irish Water have returned a Statement of Design Acceptance for the wastewater infrastructure, and a copy of this statement is included as **Appendix D**.

4 SURFACE WATER NETWORK

4.1 Surface Water Strategy

The surface water drainage network for the proposed Castlelake SHD development has been designed in accordance with the principles as set out in Section 3 of the publication "Recommendations for Site Development Works for Housing Areas" published by the Department of the Environment and Local Government, and in accordance with IS EN 752 Drain and sewer systems outside buildings.

The existing stormwater drainage falling onto the northern section of the existing Castlelake development is collected via an underground gravity sewer networks and discharges to the feature amenity attenuation lagoon, which is located centrally to the development lands (discussed further below). It is proposed that the section of the proposed development to the northern extents of the site, which is at an elevated level, is also to discharge to the feature amenity attenuation lagoon. From here, the lagoon will provide for surface water storage prior to the discharge of attenuated run-off to the Woodstock Stream.

The existing stormwater falling onto the existing development to the west of the proposed development is collected via an underground gravity sewer network and discharges towards an underground attenuation system, which is shortly to be under construction by the applicant (discussed further below). This attenuation structure was required to be constructed under the previous planning permissions granted under application reference Nos. 00/7607 and 00/7674 to provide surface water attenuation for the development to the western section of the lands. While it was not installed previously, it has now been designed (by others) and is to be constructed by the applicant as required infrastructure to facilitate the existing development under the previous planning permission. The stormwater drainage for the primarily western section of the development, which is too low lying to connect to the network draining towards the amenity pond, is proposed to be collected via a separate underground gravity sewer network and discharge to this underground attenuation tank. As stated, the tank is shortly to be under construction, and will be in place and operational prior to the commencement of any works on this subject application.

4.2 Proposed Surface Water Network

The surface water falling onto the proposed development will be collected by rainwater pipes to building perimeters and by road gullies to the roads and hardstanding areas, with the run-off directed towards the new surface water gravity sewer system to be provided for the proposed development. The stormwater will flow by gravity towards either the existing attenuation lagoon located centrally to the lands, or the underground attenuation tank (currently under construction under separate planning permission) on lands to the southern section of the site adjacent to Main Street.

The surface water drainage network is designed using the Modified Rational Method, using the following variables:

(i)	Return Period	=	2 Years
(ii)	M5-60(mm)	=	18.0mm
(iii)	Maximum Rainfall	=	50mm/hr
(iv)	Ratio R	=	0.249
(v)	Volumetric Run-Off Coefficient	=	0.75

The surface water run-off from the north-eastern and north-western sections of the proposed development is to be collected by a new stormwater sewer network to be provided for the proposed development. Surface water flows within sections of the proposed network will be attenuated using underground geo-cellular attenuation tanks, with these attenuation tanks strategically located within greenspaces to minimise impact on the landscaping proposal. The purpose of these intermediate attenuation tanks is to restrict the flow entering the existing downstream network, and to reduce the hydraulic loading on the existing networks and amenity lagoon. The flows will ultimately discharge to the existing amenity attenuation lagoon, which is discussed in Section 4.3 below. At this lagoon location, the collected surface water will be attenuated to pre-development greenfield rates of run-off, prior to discharge to the Woodstock Stream.

The surface water run-off from the western section of the proposed development is to be collected by a new stormwater sewer network to be provided for the proposed development. The proposed network will ultimately discharge to an underground attenuation tank system (shortly to be under construction by the applicant) and is discussed in Section 4.3 below. At this tank location, the collected surface water will be attenuated to pre-development greenfield rates of run-off, prior to discharge to the Woodstock Stream.

The surface water network for the proposed development has been modelled with the MicroDrainage (Innovyse) software to ensure that the network will have sufficient capacity to cater conveying the surface water collected from both the existing and proposed development.

The proposed hardstanding areas, in addition to the hardstanding areas within the existing development, have been calculated and these areas were inputted to the MicroDrainage storm network model to allow for the design of the stormwater networks.

Output from the MicroDrainage surface water network design is included in **Appendix E**, along with summaries of simulation results for rainfall events of 5-year and 30-year return periods. The simulation results indicate surcharging in the 5 and 30 year events, but no flooding has been predicted.

4.3 Proposed Surface Water Attenuation Design

4.3.1 Proposed Intermediate Attenuation Tanks

The existing surface water network was originally designed to transfer flows from the proposed development to the existing attenuation lagoon, which is located centrally within the Castlelake lands. The proposed development has a greater extent of hardstanding and greater density of development than that as previously envisaged in the original development masterplan proposed in the 2000's. In addition, requirements regarding attenuation have changed considerably since the original design was undertaken. Therefore, the flows from pre-determined sections of the development require supplementary storage volume to be provided to reduce the hydraulic loading to both the downstream network and also ultimately to the existing amenity lagoon.

As referenced in Section 4.2 above, intermediate attenuation tanks have been strategically located on the proposed surface water network within the development to restrict the flow entering the existing downstream network, and to reduce the hydraulic loading on the existing networks and amenity lagoon. The intermediate attenuation tanks have been designed using the following variables:

(i) M5-60(mm) = 18.0mm

(ii) Ratio R = 0.249

(iii) Volumetric Run-Off Coefficient = 0.75 in Summer, 0.84 in Winter

There are 3no. underground intermediate attenuation tanks proposed in the north-eastern section and 1no. located on the north-western section of the proposed development, with a summary of the tank details as follows:

Table 4-1: Intermediate Attenuation Tanks

Tank No	Plan Area (m^2)	Depth (m)	Invert Level (m OD)	Storage Volume (m^3)	Restricted Outflow (l/s)
1	590	1.600	4.588	900	16.1
2	230	1.600	3.614	345	5.5
3	220	1.075	4.435	200	3.7
4	680	1.600	1.762	1,040	100.0

The proposed tanks are proposed to be constructed using modular geo-cellular units, which will have a void ratio of 95%. The outflows from these tanks will discharge to the surface water network and will flow towards the existing amenity lagoon, where ultimately they will be subjected to further attenuation prior to discharge to the Woodstock Stream (see Section 4.3.2 below).

Detailed MicroDrainage calculation outputs for the design of these 4nr tanks are also included in the surface water network design output included in **Appendix E**.

4.3.2 Analysis of Existing Attenuation Lagoon Serving Northern Lands

As discussed in Section 4.2, the stormwater network to the northern section of the development will collect the run-off from this section of the proposed development and discharge to the existing attenuation lagoon, located centrally to the Castlelake lands. This lagoon was designed and obtained planning permission previously under the applications reg ref 00/7607 and 00/7674, and was originally designed to accommodate flows from approximately 70% of the masterplan lands. Therefore the catchment area for this lagoon has always included lands within the northern section of the site, and the lagoon has originally been designed to accommodate the surface water flows from this development area. Therefore, the lands in the northern section of this subject application are included within the catchment area of the existing amenity lagoon.

As the lagoon has been designed and constructed to accommodate flows from this section of land, it is proposed to utilise the lagoon as an attenuation feature for the proposed SHD site. The lagoon ultimately discharges flows attenuated to greenfield rates to the Woodstock Stream, at a location to the south of the site.

4.3.2.1 Assessment of Allowable Greenfield Runoff from Existing Lagoon

In order to demonstrate that the existing lagoon has sufficient capacity to cater for both the existing incoming flows from the existing development, as well as the additional inflow associated with the proposed SHD, a detailed analysis of the lagoon storage and attenuation capacity has been undertaken.

In order to estimate the pre-development rate of greenfield run-off from the areas connected to the lagoon, a catchment analysis to estimate the areas contributing towards this lagoon has been undertaken. The catchment area for the existing development section to the west of the proposed SHD has been estimated at 8.27 hectares. The catchment area for the proposed SHD application section has been estimated at 18.01 hectares. Therefore the total catchment area contributing to the existing amenity lagoon is 26.28 hectares. This is summarised in **Table 4-2** below.

Table 4-2: Existing Attenuation Lagoon Catchment Areas

Lagoon Catchment Reference	Area (ha)
Existing Developed Area	8.27
Proposed SHD Development Area	18.01
Total Contributing Area	**26.28**

As part of this assessment, the percentage impermeable areas associated with the contributing hardstanding of roads, footpaths, cycleways and roofs within the total contributing area has been estimated at 14.45 hectares. This is approximately equivalent to development 55% density of the total contributing area. An analysis using *IH124 Flood Estimations for Small Catchments* has been undertaken to determine the allowable run-off for the 0.1% AEP event (1 in 100 Year storm) for the total area contributing to the existing lagoon has been undertaken. The calculation has been included in **Appendix F** of this report, and output of the calculation estimates the allowable runoff from this catchment area in a 0.1% AEP event at 129.6l/s.

Therefore the maximum outflow rate from the amenity lagoon shall be required to not exceed 129.6l/s during a 0.1% AEP event (1 in 100 Year).

4.3.2.2 Design Maximum Outflow from Existing Lagoon

An assessment using the MicroDrainage computer design software has been undertaken to ensure that the existing attenuation lagoon has sufficient storage capacity to attenuate the outflow from the entire catchment area to a rate of runoff not to exceed the greenfield run-off values.

The attenuation lagoon design assessment has been undertaken using the following variables:

(i)	M5-60(mm)	=	18.0mm
(ii)	Ratio R	=	0.249
(iii)	Volumetric Run-Off Coefficient	=	0.75 in Summer, 0.84 in Winter
(iv)	Contributing Hardstanding Area	=	14.45 hectares (see Section 4.3.2.1 above)
(v)	Climate Change Allowance	=	10%

As stated above, the MicroDrainage computer design software has been used to analyse the existing attenuation lagoon.

The existing lagoon was designed and constructed as a retention lagoon. Retention lagoons maintain a pool of water throughout the year and hold stormwater runoff following storms. The base level of the lagoon has been designed at +0.0m. The depth of permanent water within the lagoon is 0.8m, which results in a top of permanent water level within the pond of +0.8m. The maximum allowable depth of storage within the pond has been designed as 0.8m, which results in a maximum top water level within the pond of +1.6m. The plan area of the pond at the permanent water level and at the maximum allowable depth of storage level has been calculated from as-built drawings, and this information has been inputted into the MicroDrainage software to develop a model of the existing pond structure.

Using the above referenced variables, a design simulation was run on the attenuation lagoon. The result of this simulation indicates that, during a 0.1% AEP event, the maximum storage depth of water required in the pond is 0.798m, with a maximum outflow from the pond of 129.6l/s.

As this maximum outflow is equal to the allowable runoff from this catchment area in a 0.1% AEP event of 129.6l/s, it is determined that the attenuation lagoon has sufficient storage capacity to restrict the run-off from the developed catchment to that equivalent to the pre-development greenfield rate of run-off.

A summary of the output results for the pond analysis are shown in **Table 4-3** below, with detailed MicroDrainage calculation outputs is included in **Appendix F**.

Table 4-3: Attenuation Lagoon Design Outputs from 0.1% AEP (1 in 100 Year) Event

Base Level of Pond (mOD)	Top Water Level of Permanent Water (mOD)	Top Water Level of Maximum Attenuation (mOD)	Contributing Hardstanding Area (hec)	Maximum Allowable Outflow from Pond (l/s)	Maximum Design Outflow from Pond (l/s)	Storage Volume Required (m^3)	Maximum Storage Volume Provided (m^3)
0.000	0.800	1.600	14.45	129.6	129.6	7,579.1	7,600

From the attenuation lagoon, the stormwater will ultimately flow via a vortex flow restrictor (HydroBrake or similar) to discharge the attenuated outflow from the proposed development site to the Woodstock Stream, at a location to the south of the lands.

Class 1 bypass petrol interceptors have been provided on the inlets to the lagoon to capture hydrocarbons and other contaminants prior to discharge of surface water into the lagoon.

4.3.3 Attenuation Tank Serving Western Lands

The stormwater system to the western section of the development collects the run-off from this section of the proposed development and discharges it towards the underground attenuation tank. This tank is shortly to be under construction (see Section 4.1 above) and is located to the south of the Castlelake lands, adjacent to Main Street. This underground tank was previously part of the surface water strategy included within the planning applications Reg Ref 00/7607 and 00/7674, and includes the western lands of the proposed development within its design catchment area. This construction of this attenuation structure was not previously completed, but it is now proposed to be constructed as it is an essential feature of the development as proposed under the planning applications Reg Ref 00/7607 and 00/7674. The design of this tank has been undertaken by others, and does not form part of the SHD application.

The hardstanding areas for the sections of the proposed SHD lands that are located to the western area of the lands, adjacent to the existing access road into the development, were included within the catchment area for this attenuation tank. As a result, this attenuation tank has been designed to collect the run-off from this section of the proposed development. The underground tank structure discharges attenuated flows to the Woodstock Stream, to the south of the site.

4.3.3.1 Assessment of Allowable Greenfield Runoff from Attenuation Tank

In order to demonstrate that the attenuation tank has sufficient capacity to cater for both the existing incoming flows from the existing development, as well as the additional inflow associated with the proposed SHD development, a detailed analysis of the storage and attenuation capacity has been undertaken.

In order to estimate the pre-development rate of greenfield run-off from the areas connected to the tank, a catchment analysis to estimate the contributing area to this tank has been undertaken. The entire catchment area for the existing development section has been estimated at 15.77 hectares. The proposed catchment areas for the proposed SHD application sections have been included within this overall area assessment. Therefore the total catchment area contributing to the attenuation tank is 15.77 hectares. This has been summarised in Table 4-4 below.

Table 4-4: Attenuation Tank Catchment Area

Tank Catchment Reference	Area (ha)
Existing Developed Area	15.77
Proposed SHD Development Area	Included in Above
Total Contributing Area	**15.77**

An analysis using *IH124 Flood Estimations for Small Catchments* has been undertaken to determine the allowable run-off for the 0.1% AEP event (1 in 100 Year storm) for the total area contributing to the existing tank has been undertaken. The calculation has been included in **Appendix G** of this report, and output of the calculation estimates the allowable runoff from this catchment area in a 0.1% AEP event at 77.8l/s.

Therefore the maximum outflow rate from the attenuation tank shall be required to not exceed 77.8l/s during a 0.1% AEP event (1 in 100 Year).

4.3.3.2 Design Maximum Outflow from Attenuation Tank

An assessment using the MicroDrainage computer design software has been undertaken by others to ensure that the existing attenuation tank has sufficient storage capacity to attenuate the outflow from the entire catchment area to a rate of runoff not to exceed the greenfield run-off values.

As stated above, the MicroDrainage computer design software has been used to analyse the attenuation tank requirements.

The tank has been designed (by others) as using modular geo-cellular units, which will have a void ratio of 95%. The plan layout of the tank was determined to avoid the existing electrical infrastructure located to the area, while ensuring adequate storage capacity is provided to allow for flow attenuation to greenfield rates of run-off. The plan area of the tank is 2,310m^2 and the depth is 2.0m.

The result of this simulation indicates that, during a 0.1% AEP event, the maximum storage depth of water required in the tank is 1.996m, with a maximum outflow from the tank of 72.0l/s.

As this maximum outflow is less than the allowable runoff from this catchment area in a 0.1% AEP event of 77.8l/s, it is determined that the attenuation tank has been designed to provide sufficient storage capacity to restrict the run-off from the developed catchment to that equivalent to the pre-development greenfield rate of run-off.

A summary of the output results for the tank analysis are shown in Table 4-5 below, with detailed MicroDrainage calculation outputs is included in **Appendix G**.

Table 4-5: Attenuation Tank Design Outputs from 0.1% AEP (1 in 100 Year) Event

Base Level of Tank (mOD)	Maximum Depth of Attenuation Tank (m)	Plan Area of Attenuation Tank (m^2)	Maximum Allowable Outflow from Tank (l/s)	Maximum Design Outflow from Tank (l/s)	Storage Volume Required (m^3)	Maximum Storage Volume Provided (m^3)
0.075	2.00	2,310	77.8	72.0	4,611	4,620

From the attenuation tank, the stormwater will ultimately flow via a vortex flow restrictor (HydroBrake or similar) to discharge the attenuated outflow from the proposed development site to the Woodstock Stream, at a location to the south of the lands.

A class 1 bypass petrol interceptor have been provided on the outlet from the tank to capture hydrocarbons and other contaminants prior to discharge of surface water into the Woodstock Stream.

4.3.4 Total Catchment Assessment

In order to demonstrate the maximum stormwater run-off from the developed site does not exceed the allowable run-of rate, an analysis has been undertaken on the entire catchment area of the proposed site.

The catchment area for the entire site, including both the existing developed lands and the proposed development areas, has been calculated as 42.05 hectares. As discussed in Section 4.3.2 and 4.3.3 above, 26.28 hectares drains towards the existing attenuation lagoon and the remaining 15.77 hectares drains towards a primary attenuation tank located to the south of the development.

Using IH124, the greenfield run-off from the entire catchment area of total allowable runoff for the site has been calculated as 207.4l/s. This represents the maximum allowable outflow from the site during a 0.1% AEP event (1 in 100 Year).

From the calculation undertaken in Sections 4.3.2 and 4.3.3 above, it can be seen that the maximum runoff from the lagoon and the attenuation tank have been estimated at 129.6l/s and 72.0l/s respectively. The sum of these allowable outflows from the existing attenuation lagoon and the underground attenuation tank sums to 201.6l/s, which is less than the maximum allowable outflow of 207.4l/s.

Therefore it is deemed that the proposed attenuation strategy to be provided for the Castlelake SHD will restrict the surface water outflow from the developed site to the Woodstock Stream to a value equivalent to the pre-development greenfield rate of run-off.

Further details on these calculations are given in **Appendix H**.

4.3.5 Infiltration Trench to Low Lying Road Area Adjacent to Underpass

The final section of the northern spine road, prior to it exiting the site boundary and entering the existing underpass under the railway, is located at too low a level to facilitate a gravity connection back to the existing surface water network. When the underpass was originally designed, the proposal at that stage was that the surface water collected at this low point would be discharged towards a pump station, where it would be pumped to a higher level to facilitate a connection to the gravity network. However, in the time frame since the underpass was originally constructed, Cork County Council has advised that they would not take a surface water pumping station in charge. Therefore, an alternate drainage solution will be required for this area.

It is proposed that the final 40m section of this road will instead be drained by the provision of a dedicated soakaway to cater for this short section of road way. Gullies will collect rainwater from this section of road and direct towards a new soakaway, which will be designed in accordance with the requirements of BRE 365 Soakaway design. At detailed design stage, onsite infiltration testing will be undertaken at the actual level of the proposed soakaway to determine the infiltration properties of the subsoil and a detailed design of the soakaway will be carried out.

In advance of this, a design has been undertaken on the proposed soakaway to indicate its appropriateness. The design as done using the MicroDrainage computer software, using the following variables:

(i)	M5-60(mm)	=	18.0mm
(ii)	Ratio R	=	0.249
(iii)	Volumetric Run-Off Coefficient	=	0.75 in Summer, 0.84 in Winter
(iv)	Contributing Area	=	0.11 hectares
(v)	Climate Change Allowance	=	10%
(vi)	Infiltration Value	=	5.0x 10^{-5} m/s

A conservative value of 5.0x 10^{-5} m/s was used in the design to represent the known ground conditions on site. The output from this design with detailed MicroDrainage collection outputs is included in **Appendix I**.

5 POTABLE WATER DESIGN

5.1 General

The potable water infrastructure for the proposed development has been designed in accordance with the requirements of Irish Water, as set out in the document IW-CDS-5020-03, "Code of Practice for Water Infrastructure", Revision 2. The water supply has also been designed in accordance with the principles as set out in Section 4 of the publication "Recommendations for Site Development Works for Housing Areas" published by the Department of Environment and Local Government, and in accordance with the Irish Water Code of Practice for Water Infrastructure.

There is currently an existing DN180 PE100 watermain serving the existing section of the Castlelake development. This watermain connects to the existing public infrastructure to Main Street at the access junction into the development. A bulk water-meter has been provided at this location. This existing watermain has not yet been taken in charge by Irish Water and is currently under the control of the applicant.

It is proposed to form a new connection with the existing internal watermain to the development with a new DN180 PE100 watermain to serve the proposed development. The watermains will be provided with fire hydrants at no more than 46m from any dwelling and sluice valves will be provided to isolate the dwellings in groups of no more than 40nr dwellings.

There will be no new connections proposed to the public watermain network external to the development lands. Instead, new connections will be made to the network as constructed within the Castlelake lands, but not yet taken in charge.

5.2 Water Drawdown

The proposed development consists of the provision of 716nr residential units. Section 3.7 of the Irish Water Code of Practice for Water Design states that the average daily domestic demand shall be based on a per-capita consumption of 150 l/person/day and an average occupancy ratio of 2.7 persons per dwelling. The average day/peak week demand should be taken as 1.25 times the average daily domestic demand. The peak demand for sizing the pipe network should normally be 5.0 times the average day/peak week demand.

Based on these figures, the water demand arising from the proposed development is calculated as follows:

Total Number of Dwellings	=	706nr
Occupancy Rate	=	2.7 per dwelling
Population	=	2.7 x 716
	=	1,993nr persons
Consumption	=	150 litres/day/person
Average Daily Domestic Demand	=	1,993 x 150litres/day
	=	289,980 litres/day
Average Day/Peak Week Demand	=	1.25 x 289,980
	=	362,475 litres/day
Peak Demand	=	5 x 362,475
	=	1,812,375 litres/day
	=	1,812m^3/day
	=	20.98l/s

Therefore, Peak Water Demand associated with the new development is 1,812m^3/day.

5.3 Irish Water Pre-Connection Enquiry

A pre-connection enquiry form was submitted to Irish Water in respect to the water connections from the proposed development. Subsequently, Irish Water confirmed that based on the size of the proposed development and on the capacity currently available, and subject to a valid connection agreement being put in place, the proposed connection to the Irish Water network can be facilitated, with the proviso that some local network upgrades are carried out to the existing public network. A copy of the Confirmation of Feasibility as received from Irish Water has been included as **Appendix C** of this report.

5.4 Irish Water Statement of Design Acceptance

A Statement of Design Acceptance submission was made to Irish Water in respect to the proposed water infrastructure that is to be provided to service the proposed development. Irish Water have returned a Statement of Design Acceptance for the water infrastructure, and a copy of this statement is included as **Appendix D**.

6 EXISTING WATERBODIES

6.1 General

The proposed site plan area is currently traversed by 2nr. waterbodies/ditches which will be impacted by the proposed development. The locations of the waterbodies are described as follows:

North to South Waterbody: An existing culvert crosses under the railway line at the northern boundary of the Castlelake lands. The culvert connects to an existing 750mm diameter culvert at the southern side of the railway line, which flows in an easterly direction for approximately 230m. From here, the waterbody turns to flow in a southerly direction through the site before discharging to the Woodstock Stream. This waterbody is to be maintained and incorporated into the proposed landscaping features of the development.

East to West Drainage Ditch: An existing open drainage ditch enters the proposed site on its eastern boundary with Irish Rail lands. This waterbody flows under the railway in an existing culvert, prior to entering the site and flows in a westerly direction to connect to the waterbody traveling south through the site. This waterbody is to be culverted locally to allow the proposed development of the site to take place.

6.2 North to South Waterbody

This waterbody rises to lands to the north of the Castlelake lands and ultimately discharges into the Woodstock Stream. The waterbody runs parallel to the railway line at the northern site boundary and then flows in a southerly direction through the site to where it meets the Woodstock Stream at the location shown on drawings MCW1088-RPS-00-XX-DR-301 01 to 02.

A section of the waterbody running parallel to the railway line has previously been culverted as part of the original Castlelake development works. The culvert, which is 750 mm diameter, forms part of a diversion proposal that was required to allow development of the site to take place.

It is proposed to maintain this waterbody in its open format along its course through the site, up until the location where it reaches the existing culvert under the main distributor road. It is intended that this waterbody will be incorporated into the landscape architecture design for the proposed development. Further and more details in relation to the maintaining of this existing waterbody can be seen within the landscape architect proposal, as included within this application.

6.3 East to West Drainage Ditch

This waterbody rises to the north-east of the Castlelake site and enters the site along its boundary with the Irish Rail lands. The stream crosses under the Cork-Midleton railway line, before flowing in a south-westerly direction through the development. It drains to waterbody that flows in a southerly direction through the Castlelake lands and ultimately discharges to the Woodstock Stream. The drainage ditch is shown on drawings MCW1088-RPS-00-XX-DR-301 01 to 02.

The following data summarises the characteristics of the drainage ditch catchment:

- Total Catchment Area — $0.11km^2$
- Soil Factor — Soil Type S_2
- Average Annual Rainfall — 1030mm

Current planning regulations in relation to new developments stipulate the use of SUDS in order to attenuate stormwater discharges to existing greenfield runoff conditions. Consequently, the calculations in this report do not assume a growth in urbanisation beyond the current level, and assume that any future design flows should be of the same magnitude as those that the catchment currently produces. An allowance for a 20% increase in flows due to climate change has been allowed for within the calculations.

As the contributing area is less than 25 km^2, the catchment response to rainfall was estimated using the Institute of Hydrology, Report No. 124 Method. The Institute of Hydrology Report No. 124 (IH124) Flood Estimation for Small Catchments sets out the Catchment Characteristics Method for estimation of flood flows. The most appropriate method of calculating extreme river flows for a small catchment (<25km^2) uses Equation 7.1 of the report. This method utilises three catchment characteristics to estimate run off from catchments; AREA, SAAR, and SOIL.

The unfactored Mean Annual Flood (MAF) or Qbar is calculated using the following equation:

$$Q_{bar} = 0.00108\ (AREA^{0.89} SAAR^{1.17} SOIL^{1.27})$$

The design flows for various return periods for this waterbody are summarised in **Table 6-1**.

Table 6-1: Design Flows for East to West Drainage Ditch

Annual Flow for T Return Period of Years (Q_T)	Q_T (IH 124) (m^3/s)
Q_{10}	0.10
Q_{50}	0.13
Q_{100}	0.14

The design flow for a 100-year return period to be used in this report is 0.14m^3/s, which is the Q100 as predicted by IH 124.

It is proposed to culvert this waterbody along its course through the site. It is also proposed to divert this stream to flow within the proposed layout, which allows for the relocation of the stream away from the proposed residential units. The proposed culvert arrangement is shown on drawings MCW1088-RPS-00-XX-DR-301 01 to 02.

The proposed structure is a 600mm diameter pipe for its length (twin 450mm diameter for the final 14m length to avoid clashing with the proposed storm and foul drainage), until it ties into existing waterbody flowing from north to south. The 600mm dia. has been selected based on the estimated flows and also to reduce to potential for the occurrence of blockages within the culvert. The proposed culvert has been designed using MicroDrainage software and the proposed IH124 design flows. The culvert has been simulated for the 1, 5, 30 and 100 year return period events and no flooding is predicted in the network.

The proposed invert levels along the length of the culvert range from 6.100m OD upstream to 1.710mOD downstream, where the proposed culvert discharges to the existing North to South waterbody.

7 PUBLIC LIGHTING

As part of the recent project to construct the distributor roads within the Castlelake lands as part of a separate project with planning registration reference PL19/05707, a public lighting layout design for the new roads infrastructure was produced. This proposal consists of a public lighting of design class M4, with C3 lighting class used at conflict areas. The lamps have been provided in a staggered arrangement, installed either side of the road, as this distributes the light more uniformly. The public lighting layout was submitted to Cork County Council Roads Management and Development Department for their agreement. Following the compliance submission, on 28th July 2021 Cork County Council noted their acceptance of the proposed lighting design.

In order to ensure compatibility across the proposed SHD site, it is proposed that the public lighting arrangement for the Castlelake SHD should reflect the existing lighting arrangement as recently installed. Therefore it is proposed that as part of the proposed SHD works, new public lighting consisting of design class M4 lamps, located typically as a staggered arrangement will be provided. The existing lamp specification consists of 9.5klm LED lanterns which are post top mounted on 8m columns. A similar specification is proposed work the Castlelake SHD project.

Plan arrangement drawings, MCW1088-RPS-00-XX-DR-E-PL001 01 to 09 have been produced and have been submitted to accompany this application. In addition, drawings MCW1088-RPS-00-XX-DR-E-PL01-10 has been produced which provides typical cross-sections indicating the proposed locations of the lamp standards relative to the road cross-section.

Appendix A
Wastewater Design Calculations

Wastewater Flows - New Networks

Project:	MCW1088 Carrigtwohill Residential Development
Calculation:	716nr Dwellings
Date:	23/05/2022
Calculation By:	KC
Checked By:	GMcC

Equation 1				
Wastewater Contribution - Domestic				
No. of Dwellings		716		
Occupancy Rate		2.7	per dwelling	IW-TEC-800-01 Section 6.2.1
Population	(P)	1,933		
Water Consumption	(G)	150	l/ca/day	IW-TEC-800-01 Section 6.2.2
Domestic Wastewater Contribution	(PG)	289,980	litres/day	
Wastewater Contribution - Commercial/Trade				
Commercial/Industrial Population	(P_E)	0		
Commercial/Industrial Water Consumption	(G_E)	0	l/ca/day	
Domestic WW Element of Commercial & Industrial Flows	($P_E G_E$)	0	litres/day	
Proposed Trade Flows	(E)	0	litres/day	
Peaking Factors				
Peaking Factor (Domestic)	(Pf_{Dom})	6		IW-TEC-800-01 Table 6.2.5
Peaking Factor (Domestic element of Industrial)	($Pf_{Dom,Ind}$)	3		IW-TEC-800-01 Table 6.2.7
Peaking Factor (Trade Flow)	(Pf_{Trade})	3		IW-TEC-800-01 Table 6.2.9
Infiltration				
Infiltration (Domestic) New = 10% of Unit Consumption (10% PG)	(I)	28,998	litres/day	IW-TEC-800-01 Table 6.2.4
Infiltration (Industrial) New = 10% of Unit Consumption (10% $P_E G_E$)	(I_{Indust})	0	litres/day	IW-TEC-800-01 Table 6.2.5
Design Foul Flow	(Eqn. 1)	**1,768,878**	litres/day	
		1,769	m^3/day	
		20.5	litres/sec	
Dry Weather Flow	(DWF)	**318,978**	litres/day	
		319	m^3/day	
		3.7	litres/sec	

Equation 2				
Modified Rational Method				
Total Site Area		18.82	ha	
Catchment Area		15.6	ha	
Standard Average Annual Rainfall	SAAR	1032	mm	uksuds.com
Percentage Impermeability	PIMP	55.00	%	SPON Urban Drainage value for dense housing
Soil Index	SOIL	0.3		uksuds.com
Urban Catchment Wetness Index	UCWI	116		GDSDS Figure D1
Percentage Runoff >= 0.4*PIMP	PR	41.44	%	
Percentage Runoff <= 0.4*PIMP	PR	22.00	%	
Runoff Coefficient	Cv	0.75		
Routing Coefficient	Cr	1.3		IW-TEC-800-01 Table 6.3.3
Time of Entry	T_e	7	min	IW-TEC-800-01 Table 6.3.2
Longest Pipe Route	L	2500	m	
Assumed Velocity in Pipe	V	1.0	m/s	
Time of Flow	T_f	41.67	min	
Time of Concentration	T_c	48.67	min	
Return Period	RP	2	1-in-(RP)year	IW-TEC-800-01 Table 5.4
Rainfall Intensity	i	19.58	mm/hr	Met Eireann DDF Table
Peak Flow	Qp	**832**	l/s	
	Qp	**0.83**	m^3/s	
	Qp	**71,859,656**	litres/day	
Misconnection Allowance - Domestic				
% of Gross Site Area		3.00	%	IW-TEC-800-01 Table 6.2.10
Surface Water Allowance (Domestic)	SW	13.72	l/s	
Surface Water Allowance (Domestic)		1,185,684	l/day	
Misconnection Allowance - Commercial/Industrial				
% of Gross Site Area		0.00	%	IW-TEC-800-01 Table 6.2.11
Surface Water Allowance (Commercial)	SW_E	0.00	l/s	
Surface Water Allowance (Commercial)		0.00	l/day	

Design Flow (Eqn. 1 + Eqn. 2)		**2,954,562**	litres/day	
		2,955	m^3/day	
		34.2	litres/sec	

Appendix B
MicroDrainage Wastewater Outputs

FOUL SEWERAGE DESIGN

Design Criteria for Foul - Main

Pipe Sizes STANDARD Manhole Sizes STANDARD

Industrial Flow (l/s/ha)	0.00	Add Flow / Climate Change (%)	0
Industrial Peak Flow Factor	0.00	Minimum Backdrop Height (m)	0.000
Flow Per Person (l/per/day)	200.00	Maximum Backdrop Height (m)	0.000
Persons per House	2.70	Min Design Depth for Optimisation (m)	1.275
Domestic (l/s/ha)	0.00	Min Vel for Auto Design only (m/s)	0.75
Domestic Peak Flow Factor	6.00	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for Foul - Main

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	Houses	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
F-1.000	40.866	0.681	60.0	0.000	6	0.0	1.500	o	225	Pipe/Conduit	
F-1.001	45.045	0.300	150.0	0.000	7	0.0	1.500	o	225	Pipe/Conduit	
F-1.002	29.529	0.299	98.8	0.000	2	0.0	1.500	o	225	Pipe/Conduit	
F-2.000	18.612	0.052	360.0	0.000	0	141.0	1.500	o	450	Pipe/Conduit	
F-3.000	13.256	0.221	60.0	0.000	6	0.0	1.500	o	225	Pipe/Conduit	
F-3.001	45.772	0.305	150.0	0.000	6	0.0	1.500	o	225	Pipe/Conduit	
F-3.002	37.837	0.393	96.3	0.000	4	0.0	1.500	o	225	Pipe/Conduit	
F-1.003	63.463	0.988	64.2	0.000	12	0.0	1.500	o	450	Pipe/Conduit	
F-4.000	59.989	0.750	60.0	0.000	11	0.0	1.500	o	225	Pipe/Conduit	
F-4.001	45.315	0.302	150.0	0.000	14	0.0	1.500	o	225	Pipe/Conduit	

Network Results Table

PN	US/IL (m)	Σ Area (ha)	Σ Base Flow (l/s)	Σ Hse	Add Flow (l/s)	P.Dep (mm)	P.Vel (m/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
F-1.000	6.600	0.000	0.0	6	0.0	10	0.34	1.48	59.0	0.2
F-1.001	5.919	0.000	0.0	13	0.0	18	0.32	0.94	37.2	0.5
F-1.002	5.619	0.000	0.0	15	0.0	18	0.39	1.16	45.9	0.6
F-2.000	4.408	0.000	141.0	0	0.0	346	1.07	0.95	150.9	141.0
F-3.000	5.500	0.000	0.0	6	0.0	10	0.34	1.48	59.0	0.2
F-3.001	5.279	0.000	0.0	12	0.0	18	0.31	0.94	37.2	0.5
F-3.002	4.974	0.000	0.0	16	0.0	18	0.40	1.17	46.5	0.6
F-1.003	4.356	0.000	141.0	43	0.0	197	2.13	2.25	358.3	142.6
F-4.000	5.150	0.000	0.0	11	0.0	15	0.38	1.48	59.0	0.4
F-4.001	4.150	0.000	0.0	25	0.0	25	0.39	0.94	37.2	0.9

Network Design Table for Foul - Main

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	Houses	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
F-4.002	38.214	0.255	150.0	0.000	0	0.0	1.500	o	225	Pipe/Conduit	
F-5.000	15.011	0.250	60.0	0.000	6	0.0	1.500	o	225	Pipe/Conduit	
F-6.000	13.167	0.219	60.0	0.000	6	0.0	1.500	o	225	Pipe/Conduit	
F-5.001	53.996	0.360	150.0	0.000	8	0.0	1.500	o	225	Pipe/Conduit	
F-5.002	29.769	0.305	97.6	0.000	0	0.0	1.500	o	225	Pipe/Conduit	
F-1.004	63.971	0.998	64.1	0.000	12	0.0	1.500	o	450	Pipe/Conduit	
F-7.000	59.328	0.989	60.0	0.000	6	0.0	1.500	o	225	Pipe/Conduit	
F-7.001	59.328	0.396	150.0	0.000	6	0.0	1.500	o	225	Pipe/Conduit	
F-7.002	52.530	0.526	99.9	0.000	6	0.0	1.500	o	225	Pipe/Conduit	
F-7.003	52.392	0.900	58.2	0.000	12	0.0	1.500	o	225	Pipe/Conduit	
F-8.000	15.011	0.250	60.0	0.000	6	0.0	1.500	o	225	Pipe/Conduit	
F-9.000	13.167	0.219	60.0	0.000	3	0.0	1.500	o	225	Pipe/Conduit	
F-8.001	53.996	0.360	150.0	0.000	15	0.0	1.500	o	225	Pipe/Conduit	
F-8.002	32.029	0.531	60.3	0.000	6	0.0	1.500	o	225	Pipe/Conduit	

Network Results Table

PN	US/IL (m)	Σ Area (ha)	Σ Base Flow (l/s)	Σ Hse	Add Flow (l/s)	P.Dep (mm)	P.Vel (m/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
F-4.002	3.848	0.000	0.0	25	0.0	25	0.39	0.94	37.2	0.9
F-5.000	4.508	0.000	0.0	6	0.0	10	0.34	1.48	59.0	0.2
F-6.000	4.477	0.000	0.0	6	0.0	10	0.34	1.48	59.0	0.2
F-5.001	4.258	0.000	0.0	20	0.0	22	0.37	0.94	37.2	0.8
F-5.002	3.898	0.000	0.0	20	0.0	20	0.42	1.16	46.2	0.8
F-1.004	3.368	0.000	141.0	100	0.0	199	2.14	2.26	358.7	144.8
F-7.000	5.405	0.000	0.0	6	0.0	10	0.34	1.48	59.0	0.2
F-7.001	4.416	0.000	0.0	12	0.0	18	0.31	0.94	37.2	0.5
F-7.002	4.021	0.000	0.0	18	0.0	19	0.41	1.15	45.7	0.7
F-7.003	3.495	0.000	0.0	30	0.0	22	0.58	1.51	59.9	1.1
F-8.000	3.736	0.000	0.0	6	0.0	10	0.34	1.48	59.0	0.2
F-9.000	3.705	0.000	0.0	3	0.0	8	0.27	1.48	59.0	0.1
F-8.001	3.486	0.000	0.0	24	0.0	24	0.39	0.94	37.2	0.9
F-8.002	3.126	0.000	0.0	30	0.0	22	0.57	1.48	58.8	1.1

Network Design Table for Foul - Main

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	Houses	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
F-1.005	75.294	0.209	360.3	0.000	9	0.0	1.500	o	450	Pipe/Conduit	
F-1.006	15.968	0.044	360.0	0.000	0	0.0	1.500	o	450	Pipe/Conduit	
F-1.007	16.002	0.096	166.7	0.000	0	0.0	1.500	o	450	Pipe/Conduit	
F-10.000	15.980	0.107	149.3	0.000	19	0.0	1.500	o	225	Pipe/Conduit	
F-11.000	17.112	0.285	60.0	0.000	7	0.0	1.500	o	225	Pipe/Conduit	
F-10.001	55.969	0.373	150.1	0.000	25	0.0	1.500	o	225	Pipe/Conduit	
F-10.002	11.310	0.075	150.0	0.000	0	0.0	1.500	o	225	Pipe/Conduit	
F-10.003	11.263	0.075	150.0	0.000	0	0.0	1.500	o	225	Pipe/Conduit	
F-1.008	29.623	0.082	360.0	0.000	0	0.0	1.500	o	450	Pipe/Conduit	
F-12.000	55.715	0.929	60.0	0.000	10	0.0	1.500	o	225	Pipe/Conduit	
F-12.001	55.715	0.371	150.0	0.000	7	0.0	1.500	o	225	Pipe/Conduit	
F-13.000	35.984	0.600	60.0	0.000	4	0.0	1.500	o	225	Pipe/Conduit	
F-12.002	69.886	0.562	124.4	0.000	24	0.0	1.500	o	225	Pipe/Conduit	

Network Results Table

PN	US/IL (m)	Σ Area (ha)	Σ Base Flow (l/s)	Σ Hse	Add Flow (l/s)	P.Dep (mm)	P.Vel (m/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
F-1.005	2.370	0.000	141.0	169	0.0	361	1.08	0.95	150.8	147.3
F-1.006	2.161	0.000	141.0	169	0.0	361	1.08	0.95	150.9	147.3
F-1.007	2.117	0.000	141.0	169	0.0	268	1.49	1.40	222.1	147.3
F-10.000	2.318	0.000	0.0	19	0.0	22	0.36	0.94	37.3	0.7
F-11.000	2.496	0.000	0.0	7	0.0	11	0.36	1.48	59.0	0.3
F-10.001	2.211	0.000	0.0	51	0.0	35	0.49	0.94	37.2	1.9
F-10.002	1.838	0.000	0.0	51	0.0	35	0.49	0.94	37.2	1.9
F-10.003	1.763	0.000	0.0	51	0.0	35	0.49	0.94	37.2	1.9
F-1.008	1.463	0.000	141.0	220	0.0	366	1.08	0.95	150.9	149.3
F-12.000	6.258	0.000	0.0	10	0.0	13	0.40	1.48	59.0	0.4
F-12.001	5.329	0.000	0.0	17	0.0	21	0.35	0.94	37.2	0.6
F-13.000	5.558	0.000	0.0	4	0.0	9	0.30	1.48	59.0	0.2
F-12.002	4.958	0.000	0.0	45	0.0	31	0.50	1.03	40.9	1.7

Network Design Table for Foul - Main

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	Houses	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
F-14.000	54.722	0.912	60.0	0.000	22	0.0	1.500	o	225	Pipe/Conduit	
F-14.001	54.786	0.365	150.0	0.000	3	0.0	1.500	o	225	Pipe/Conduit	
F-14.002	47.039	0.314	150.0	0.000	11	0.0	1.500	o	225	Pipe/Conduit	
F-14.003	21.437	0.143	150.0	0.000	2	0.0	1.500	o	225	Pipe/Conduit	
F-12.003	44.656	0.298	150.0	0.000	0	0.0	1.500	o	225	Pipe/Conduit	
F-15.000	27.994	0.467	60.0	0.000	76	0.0	1.500	o	225	Pipe/Conduit	
F-15.001	36.576	0.244	150.0	0.000	0	0.0	1.500	o	225	Pipe/Conduit	
F-15.002	7.519	0.050	150.0	0.000	0	0.0	1.500	o	225	Pipe/Conduit	
F-15.003	26.365	0.176	150.0	0.000	0	0.0	1.500	o	225	Pipe/Conduit	
F-15.004	16.836	0.759	22.2	0.000	0	0.0	1.500	o	225	Pipe/Conduit	
F-15.005	36.837	1.107	33.3	0.000	0	0.0	1.500	o	225	Pipe/Conduit	
F-12.004	38.756	0.258	150.0	0.000	7	0.0	1.500	o	225	Pipe/Conduit	
F-12.005	25.356	0.707	35.9	0.000	5	0.0	1.500	o	225	Pipe/Conduit	
F-16.000	48.121	1.330	36.2	0.000	20	0.0	1.500	o	225	Pipe/Conduit	
F-16.001	44.313	0.295	150.0	0.000	2	0.0	1.500	o	225	Pipe/Conduit	
F-16.002	30.800	0.205	150.0	0.000	3	0.0	1.500	o	225	Pipe/Conduit	
F-16.003	35.409	0.236	150.0	0.000	1	0.0	1.500	o	225	Pipe/Conduit	

Network Results Table

PN	US/IL (m)	Σ Area (ha)	Σ Base Flow (l/s)	Σ Hse	Add Flow (l/s)	P.Dep (mm)	P.Vel (m/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
F-14.000	6.130	0.000	0.0	22	0.0	19	0.52	1.48	59.0	0.8
F-14.001	5.218	0.000	0.0	25	0.0	25	0.39	0.94	37.2	0.9
F-14.002	4.853	0.000	0.0	36	0.0	29	0.44	0.94	37.2	1.4
F-14.003	4.539	0.000	0.0	38	0.0	30	0.45	0.94	37.2	1.4
F-12.003	4.396	0.000	0.0	83	0.0	44	0.57	0.94	37.2	3.1
F-15.000	6.900	0.000	0.0	76	0.0	34	0.76	1.48	59.0	2.9
F-15.001	6.433	0.000	0.0	76	0.0	42	0.55	0.94	37.2	2.9
F-15.002	6.190	0.000	0.0	76	0.0	42	0.55	0.94	37.2	2.9
F-15.003	6.139	0.000	0.0	76	0.0	42	0.55	0.94	37.2	2.9
F-15.004	5.964	0.000	0.0	76	0.0	27	1.08	2.44	97.1	2.9
F-15.005	5.205	0.000	0.0	76	0.0	29	0.93	1.99	79.3	2.9
F-12.004	4.098	0.000	0.0	166	0.0	62	0.69	0.94	37.2	6.2
F-12.005	3.840	0.000	0.0	171	0.0	44	1.16	1.92	76.4	6.4
F-16.000	5.200	0.000	0.0	20	0.0	16	0.60	1.91	76.0	0.8
F-16.001	3.870	0.000	0.0	22	0.0	23	0.38	0.94	37.2	0.8
F-16.002	3.575	0.000	0.0	25	0.0	25	0.39	0.94	37.2	0.9
F-16.003	3.369	0.000	0.0	26	0.0	25	0.40	0.94	37.2	1.0

Network Design Table for Foul - Main

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	Houses	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
F-12.006	21.574	0.108	200.0	0.000	0	0.0	1.500	o	225	Pipe/Conduit	
F-12.007	25.063	0.125	200.5	0.000	0	0.0	1.500	o	225	Pipe/Conduit	
F-17.000	42.824	0.714	60.0	0.000	4	0.0	1.500	o	225	Pipe/Conduit	
F-17.001	7.696	0.051	150.0	0.000	0	0.0	1.500	o	225	Pipe/Conduit	
F-17.002	57.007	0.380	150.0	0.000	6	0.0	1.500	o	225	Pipe/Conduit	
F-17.003	5.711	0.038	150.0	0.000	0	0.0	1.500	o	225	Pipe/Conduit	
F-17.004	34.491	0.539	64.0	0.000	2	0.0	1.500	o	225	Pipe/Conduit	
F-18.000	20.534	0.342	60.0	0.000	0	0.0	1.500	o	225	Pipe/Conduit	
F-17.005	24.509	0.163	150.4	0.000	2	0.0	1.500	o	225	Pipe/Conduit	
F-19.000	22.048	0.375	58.8	0.000	13	0.0	1.500	o	225	Pipe/Conduit	
F-17.006	20.431	0.286	71.4	0.000	0	0.0	1.500	o	225	Pipe/Conduit	
F-20.000	33.622	1.306	25.7	0.000	10	0.0	1.500	o	225	Pipe/Conduit	
F-17.007	20.060	0.344	58.3	0.000	0	0.0	1.500	o	225	Pipe/Conduit	
F-12.008	48.272	0.241	200.0	0.000	0	0.0	1.500	o	225	Pipe/Conduit	

Network Results Table

PN	US/IL (m)	Σ Area (ha)	Σ Base Flow (l/s)	Σ Hse	Add Flow (l/s)	P.Dep (mm)	P.Vel (m/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
F-12.006	3.133	0.000	0.0	197	0.0	73	0.66	0.81	32.2	7.4
F-12.007	3.025	0.000	0.0	197	0.0	73	0.66	0.81	32.2	7.4
F-17.000	5.415	0.000	0.0	4	0.0	9	0.30	1.48	59.0	0.2
F-17.001	4.701	0.000	0.0	4	0.0	11	0.22	0.94	37.2	0.2
F-17.002	4.650	0.000	0.0	10	0.0	16	0.29	0.94	37.2	0.4
F-17.003	4.270	0.000	0.0	10	0.0	16	0.29	0.94	37.2	0.4
F-17.004	4.232	0.000	0.0	12	0.0	15	0.42	1.44	57.1	0.5
F-18.000	4.035	0.000	0.0	0	0.0	0	0.00	1.48	59.0	0.0
F-17.005	3.693	0.000	0.0	14	0.0	19	0.33	0.94	37.2	0.5
F-19.000	3.905	0.000	0.0	13	0.0	15	0.44	1.50	59.6	0.5
F-17.006	3.530	0.000	0.0	27	0.0	22	0.52	1.36	54.0	1.0
F-20.000	4.550	0.000	0.0	10	0.0	11	0.53	2.27	90.2	0.4
F-17.007	3.244	0.000	0.0	37	0.0	24	0.62	1.50	59.8	1.4
F-12.008	2.900	0.000	0.0	234	0.0	80	0.69	0.81	32.2	8.8

Network Design Table for Foul - Main

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	Houses	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
F-21.000	41.143	0.890	46.2	0.000	16	0.0	1.500	o	225	Pipe/Conduit	
F-21.001	56.708	0.717	79.1	0.000	6	0.0	1.500	o	225	Pipe/Conduit	
F-22.000	26.509	0.585	45.3	0.000	12	0.0	1.500	o	225	Pipe/Conduit	
F-22.001	35.791	0.380	94.2	0.000	13	0.0	1.500	o	225	Pipe/Conduit	
F-22.002	7.702	0.051	150.0	0.000	0	0.0	1.500	o	225	Pipe/Conduit	
F-22.003	37.232	0.248	150.0	0.000	21	0.0	1.500	o	225	Pipe/Conduit	
F-22.004	26.487	0.197	134.5	0.000	13	0.0	1.500	o	225	Pipe/Conduit	
F-21.002	13.525	0.068	200.0	0.000	0	0.0	1.500	o	225	Pipe/Conduit	
F-21.003	21.929	0.110	200.0	0.000	0	0.0	1.500	o	225	Pipe/Conduit	
F-21.004	23.702	0.119	200.0	0.000	0	0.0	1.500	o	225	Pipe/Conduit	
F-21.005	10.813	0.054	200.0	0.000	0	0.0	1.500	o	225	Pipe/Conduit	
F-23.000	22.150	0.369	60.0	0.000	8	0.0	1.500	o	225	Pipe/Conduit	
F-23.001	29.449	0.196	150.0	0.000	5	0.0	1.500	o	225	Pipe/Conduit	
F-24.000	18.408	0.500	36.8	0.000	4	0.0	1.500	o	225	Pipe/Conduit	
F-23.002	23.019	0.153	150.0	0.000	2	0.0	1.500	o	225	Pipe/Conduit	
F-23.003	16.151	0.108	150.0	0.000	0	0.0	1.500	o	225	Pipe/Conduit	

Network Results Table

PN	US/IL (m)	Σ Area (ha)	Σ Base Flow (l/s)	Σ Hse	Add Flow (l/s)	P.Dep (mm)	P.Vel (m/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
F-21.000	3.990	0.000	0.0	16	0.0	15	0.51	1.69	67.2	0.6
F-21.001	3.100	0.000	0.0	22	0.0	20	0.47	1.29	51.3	0.8
F-22.000	3.845	0.000	0.0	12	0.0	13	0.47	1.71	67.9	0.5
F-22.001	3.260	0.000	0.0	25	0.0	22	0.46	1.18	47.0	0.9
F-22.002	2.880	0.000	0.0	25	0.0	25	0.39	0.94	37.2	0.9
F-22.003	2.829	0.000	0.0	46	0.0	33	0.47	0.94	37.2	1.7
F-22.004	2.580	0.000	0.0	59	0.0	36	0.53	0.99	39.3	2.2
F-21.002	2.383	0.000	0.0	81	0.0	47	0.51	0.81	32.2	3.0
F-21.003	2.315	0.000	0.0	81	0.0	47	0.51	0.81	32.2	3.0
F-21.004	2.206	0.000	0.0	81	0.0	47	0.51	0.81	32.2	3.0
F-21.005	2.087	0.000	0.0	81	0.0	47	0.51	0.81	32.2	3.0
F-23.000	5.420	0.000	0.0	8	0.0	12	0.37	1.48	59.0	0.3
F-23.001	5.051	0.000	0.0	13	0.0	18	0.32	0.94	37.2	0.5
F-24.000	5.355	0.000	0.0	4	0.0	8	0.35	1.90	75.4	0.2
F-23.002	4.855	0.000	0.0	19	0.0	22	0.36	0.94	37.2	0.7
F-23.003	4.701	0.000	0.0	19	0.0	22	0.36	0.94	37.2	0.7

Network Design Table for Foul - Main

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	Houses	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
F-23.004	4.198	0.028	150.0	0.000	0	0.0	1.500	o	225	Pipe/Conduit	
F-23.005	56.839	0.387	146.9	0.000	14	0.0	1.500	o	225	Pipe/Conduit	
F-25.000	27.673	0.461	60.0	0.000	5	0.0	1.500	o	225	Pipe/Conduit	
F-26.000	35.600	0.593	60.0	0.000	5	0.0	1.500	o	225	Pipe/Conduit	
F-25.001	33.080	0.221	150.0	0.000	1	0.0	1.500	o	225	Pipe/Conduit	
F-27.000	16.692	0.278	60.0	0.000	7	0.0	1.500	o	225	Pipe/Conduit	
F-27.001	3.764	0.025	150.0	0.000	0	0.0	1.500	o	225	Pipe/Conduit	
F-25.002	4.901	0.025	200.0	0.000	0	0.0	1.500	o	225	Pipe/Conduit	
F-28.000	19.125	0.319	60.0	0.000	14	0.0	1.500	o	225	Pipe/Conduit	
F-28.001	24.137	0.161	150.0	0.000	8	0.0	1.500	o	225	Pipe/Conduit	
F-28.002	40.864	0.376	108.7	0.000	14	0.0	1.500	o	225	Pipe/Conduit	
F-29.000	8.000	0.053	150.0	0.000	0	0.0	1.500	o	225	Pipe/Conduit	
F-30.000	23.667	0.394	60.1	0.000	7	0.0	1.500	o	225	Pipe/Conduit	
F-30.001	19.912	0.133	150.0	0.000	9	0.0	1.500	o	225	Pipe/Conduit	

Network Results Table

PN	US/IL (m)	Σ Area (ha)	Σ Base Flow (l/s)	Σ Hse	Add Flow (l/s)	P.Dep (mm)	P.Vel (m/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
F-23.004	4.593	0.000	0.0	19	0.0	22	0.36	0.94	37.2	0.7
F-23.005	4.565	0.000	0.0	33	0.0	28	0.43	0.95	37.6	1.2
F-25.000	4.884	0.000	0.0	5	0.0	10	0.32	1.48	59.0	0.2
F-26.000	5.016	0.000	0.0	5	0.0	10	0.32	1.48	59.0	0.2
F-25.001	4.423	0.000	0.0	11	0.0	17	0.30	0.94	37.2	0.4
F-27.000	5.300	0.000	0.0	7	0.0	11	0.36	1.48	59.0	0.3
F-27.001	5.022	0.000	0.0	7	0.0	14	0.26	0.94	37.2	0.3
F-25.002	4.202	0.000	0.0	18	0.0	23	0.32	0.81	32.2	0.7
F-28.000	3.650	0.000	0.0	14	0.0	15	0.45	1.48	59.0	0.5
F-28.001	3.331	0.000	0.0	22	0.0	23	0.38	0.94	37.2	0.8
F-28.002	3.170	0.000	0.0	36	0.0	27	0.49	1.10	43.8	1.4
F-29.000	2.734	0.000	0.0	0	0.0	0	0.00	0.94	37.2	0.0
F-30.000	6.018	0.000	0.0	7	0.0	11	0.36	1.48	58.9	0.3
F-30.001	5.624	0.000	0.0	16	0.0	20	0.34	0.94	37.2	0.6

Network Design Table for Foul - Main

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	Houses	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
F-31.000	22.300	0.372	60.0	0.000	7	0.0	1.500	o	225	Pipe/Conduit	
F-31.001	4.294	0.029	150.0	0.000	0	0.0	1.500	o	225	Pipe/Conduit	
F-31.002	13.038	0.087	150.0	0.000	6	0.0	1.500	o	225	Pipe/Conduit	
F-32.000	41.848	0.697	60.0	0.000	42	0.0	1.500	o	225	Pipe/Conduit	
F-32.001	6.976	0.047	150.0	0.000	0	0.0	1.500	o	225	Pipe/Conduit	
F-33.000	36.397	0.607	60.0	0.000	34	0.0	1.500	o	225	Pipe/Conduit	

Network Results Table

PN	US/IL (m)	Σ Area (ha)	Σ Base Flow (l/s)	Σ Hse	Add Flow (l/s)	P.Dep (mm)	P.Vel (m/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
F-31.000	5.498	0.000	0.0	7	0.0	11	0.36	1.48	59.0	0.3
F-31.001	5.126	0.000	0.0	7	0.0	14	0.26	0.94	37.2	0.3
F-31.002	5.098	0.000	0.0	13	0.0	18	0.32	0.94	37.2	0.5
F-32.000	2.500	0.000	0.0	42	0.0	25	0.63	1.48	59.0	1.6
F-32.001	1.803	0.000	0.0	42	0.0	32	0.46	0.94	37.2	1.6
F-33.000	1.900	0.000	0.0	34	0.0	23	0.59	1.48	59.0	1.3

Appendix C
Irish Water Confirmation of Feasibility

Uisce Éireann
Bosca OP 448
Oifig Sheachadta na Cathrach Theas
Cathair Chorcaí

Irish Water
PO Box 448,
South City
Delivery Office,
Cork City.

www.water.ie

Lyndubh Developments Ltd.
C/o Gary McCormack
RPS
Innishmore
Ballincollig
Cork
P31KR68

2 June 2022

Re: CDS21006488 pre-connection enquiry - Subject to contract | Contract denied

Connection for Multi/Mixed Use Development of 725 unit(s) at Castlelake, Carrigtohill, Co. Cork

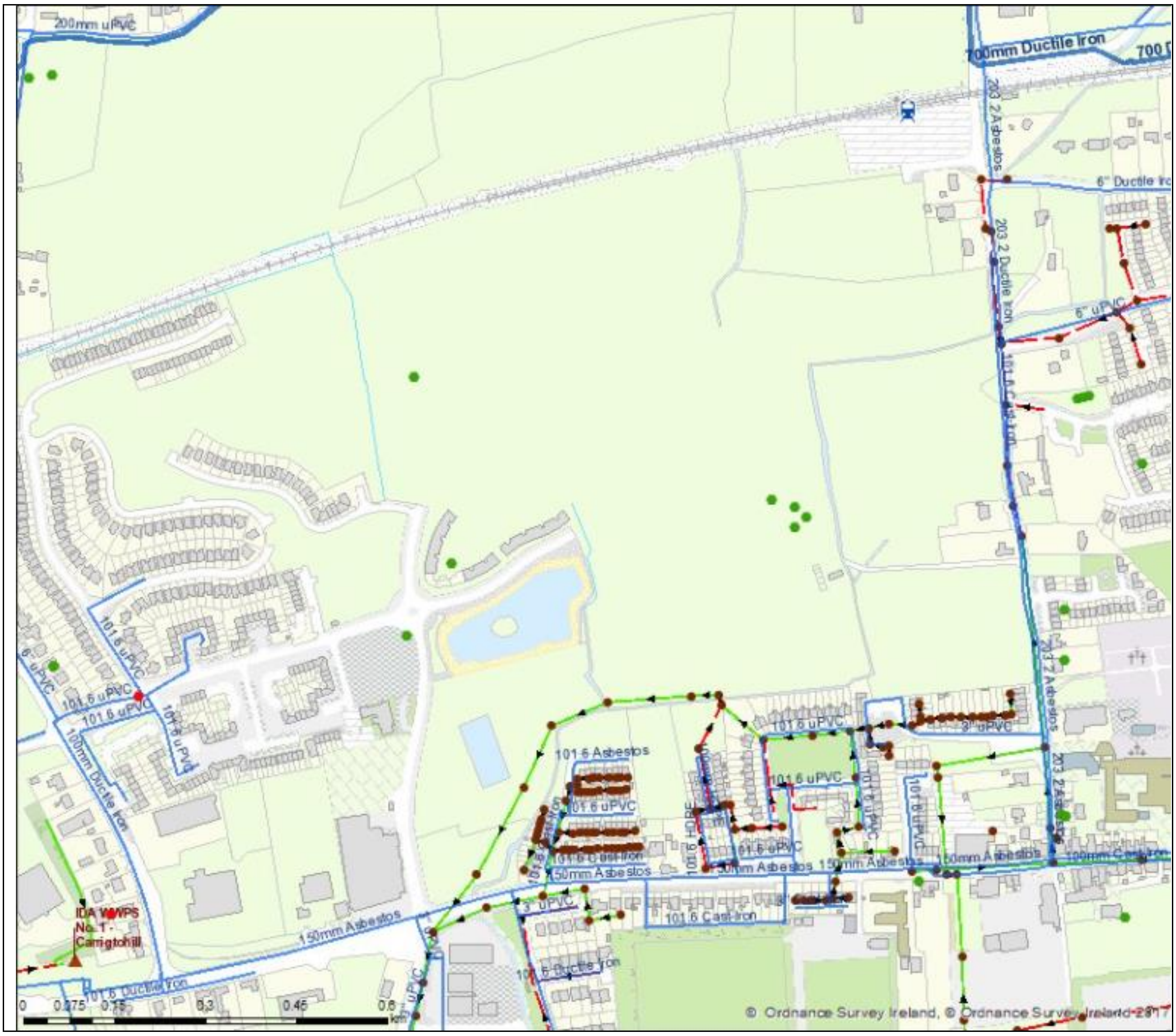
Dear Sir/Madam,

Irish Water has reviewed your pre-connection enquiry in relation to a Water & Wastewater connection at Castlelake, Carrigtohill, Co. Cork (the **Premises**). Based upon the details you have provided with your pre-connection enquiry and on our desk top analysis of the capacity currently available in the Irish Water network(s) as assessed by Irish Water, we wish to advise you that your proposed connection to the Irish Water network(s) can be facilitated at this moment in time.

SERVICE	**OUTCOME OF PRE-CONNECTION ENQUIRY** **THIS IS NOT A CONNECTION OFFER. YOU MUST APPLY FOR A CONNECTION(S) TO THE IRISH WATER NETWORK(S) IF YOU WISH TO PROCEED.**
Water Connection	Feasible Subject to network upgrades
Wastewater Connection	Feasible Subject to network upgrades
SITE SPECIFIC COMMENTS	
Water Connection	Water Network: Due to the scale of the development, some watermains will have to be upsized. At connection application stage you will be required to liaise with Irish Water to determine the full extent of upsizing required. These upgrades will be at the applicants expense.
Wastewater Connection	Wastewater Network: Connection to the Networks may be through 3rd party infrastructure. All relevant wayleaves and permissions would need to be obtained by the Client. Due to the scale of the development, some sewers will have to be upsized. At connection application stage you will be required to liaise with Irish water

	to determine the full extent of upsizing required. These upgrades will be at the applicants expense.
The design and construction of the Water & Wastewater pipes and related infrastructure to be installed in this development shall comply with the Irish Water Connections and Developer Services Standard Details and Codes of Practice that are available on the Irish Water website. Irish Water reserves the right to supplement these requirements with Codes of Practice and these will be issued with the connection agreement.	

The map included below outlines the current Irish Water infrastructure adjacent to your site:



Reproduced from the Ordnance Survey of Ireland by Permission of the Government. License No. 3-3-34

Whilst every care has been taken in its compilation Irish Water gives this information as to the position of its underground network as a general guide only on the strict understanding that it is based on the best available information provided by each Local Authority in Ireland to Irish Water. Irish Water can assume no responsibility for and give no guarantees, undertakings or warranties concerning the accuracy, completeness or up to date nature of the information provided and does not accept any liability whatsoever arising from any errors or omissions. This information should not be relied upon in the event of excavations or any other works being carried out in the vicinity of the Irish

Water underground network. The onus is on the parties carrying out excavations or any other works to ensure the exact location of the Irish Water underground network is identified prior to excavations or any other works being carried out. Service connection pipes are not generally shown but their presence should be anticipated.

General Notes:

1) The initial assessment referred to above is carried out taking into account water demand and wastewater discharge volumes and infrastructure details on the date of the assessment. **The availability of capacity may change at any date after this assessment.**
2) This feedback does not constitute a contract in whole or in part to provide a connection to any Irish Water infrastructure. All feasibility assessments are subject to the constraints of the Irish Water Capital Investment Plan.
3) The feedback provided is subject to a Connection Agreement/contract being signed at a later date.
4) A Connection Agreement will be required to commencing the connection works associated with the enquiry this can be applied for at https://www.water.ie/connections/get-connected/
5) A Connection Agreement cannot be issued until all statutory approvals are successfully in place.
6) Irish Water Connection Policy/ Charges can be found at https://www.water.ie/connections/information/connection-charges/
7) Please note the Confirmation of Feasibility does not extend to your fire flow requirements.
8) Irish Water is not responsible for the management or disposal of storm water or ground waters. You are advised to contact the relevant Local Authority to discuss the management or disposal of proposed storm water or ground water discharges
9) To access Irish Water Maps email datarequests@water.ie
10) All works to the Irish Water infrastructure, including works in the Public Space, shall have to be carried out by Irish Water.

If you have any further questions, please contact Michael Galvin from the design team at mgalvin@water.ie For further information, visit **www.water.ie/connections.**

Yours sincerely,

Yvonne Harris

Head of Customer Operations

Appendix D
Irish Water Statement of Design Acceptance

Uisce Éireann
Bosca OP 448
Oifig Sheachadta na Cathrach Theas
Cathair Chorcaí

Irish Water
PO Box 448,
South City
Delivery Office,
Cork City.

www.water.ie

Gary McCormack
Innishmore
Ballincollig
Co. Cork

8 June 2022

Re: Design Submission for Castlelake, Carrigtwohill, Co. Cork (the "Development") (the "Design Submission") / Connection Reference No: CDS21006488

Dear Gary McCormack,

Many thanks for your recent Design Submission.

We have reviewed your proposal for the connection(s) at the Development. Based on the information provided, which included the documents outlined in Appendix A to this letter, Irish Water has no objection to your proposals.

This letter does not constitute an offer, in whole or in part, to provide a connection to any Irish Water infrastructure. Before you can connect to our network you must sign a connection agreement with Irish Water. This can be applied for by completing the connection application form at www.water.ie/connections. Irish Water's current charges for water and wastewater connections are set out in the Water Charges Plan as approved by the Commission for Regulation of Utilities (CRU)(https://www.cru.ie/document_group/irish-waters-water-charges-plan-2018/).

You the Customer (including any designers/contractors or other related parties appointed by you) is entirely responsible for the design and construction of all water and/or wastewater infrastructure within the Development which is necessary to facilitate connection(s) from the boundary of the Development to Irish Water's network(s) (the "**Self-Lay Works**"), as reflected in your Design Submission. Acceptance of the Design Submission by Irish Water does not, in any way, render Irish Water liable for any elements of the design and/or construction of the Self-Lay Works.

If you have any further questions, please contact your Irish Water representative:
Name: Kyle Jackson
Email: kyle.jackson@water.ie

Yours sincerely,

Yvonne Harris

Yvonne Harris
Head of Customer Operations

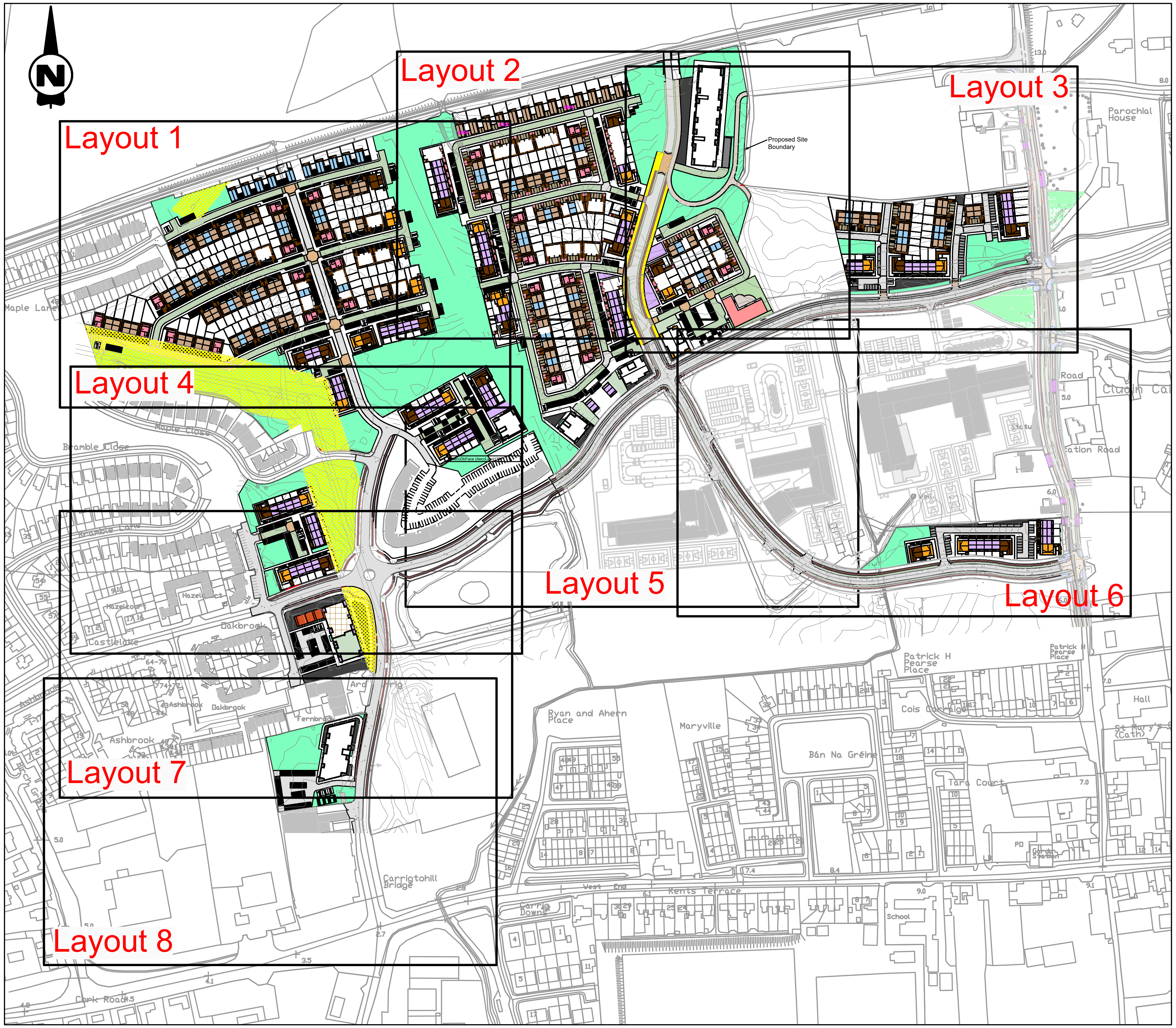
Appendix A

Document Title & Revision

- [MCW1088-RPS-00-XX-DR-C-DR0101 01 to 09 S3 P04]
- [MCW1088-RPS-00-XX-DR-C-DR0102-01 Rev.S3 P03]
- [MCW1088-RPS-00-XX-DR-C-DR0102-02 to 04 Rev.S3 P02]
- [MCW1088-RPS-00-XX-DR-C-UT0101 01 to 09 Rev S3 P03]

For further information, visit ***www.water.ie/connections***

Notwithstanding any matters listed above, the Customer (including any appointed designers/contractors, etc.) is entirely responsible for the design and construction of the Self-Lay Works. Acceptance of the Design Submission by Irish Water will not, in any way, render Irish Water liable for any elements of the design and/or construction of the Self-Lay Works.



Ordnance Survey Ireland

Client	General Notes		Rev	Date	Drn Chk	Amendment / Issue	App
	(i) Hard copies, dwf and pdf will form a controlled issue of the drawing. All other formats (dwg etc.) are deemed to be an uncontrolled issue and any work carried out based on these files is at the recipients own risk. RPS will not accept any responsibility for any errors from the use of these files, either by human error by the recipient, listing of the un-dimensioned measurements, compatibility with the recipients software, and any errors arising when these files are used to aid the recipients drawing production, or setting out on site.	(iii) This drawing is the property of RPS, it is a project confidential classified document. It must not be copied used or its contents divulged without prior written consent. The needs and expectations of client and RPS must be considered when working with this drawing.	S3 P04	08/06/22	PQR GMcC	Issue for Review and Comment	BB
	(ii) DO NOT SCALE, use figured dimensions only.	(iv) Information including topographical survey, geotechnical investigation and utility detail used in the design have been provided by others.	P01	26/10/21	PQR GMcC	Pre-Application Submission	BB
		(v) All Levels refer to Ordnance Survey Datum, Malin Head.					

rps

Scale	1:2000 @ A1 1:4000 @ A3	Project	Castlelake SHD
Created on	18/10/2021	Title	Proposed Foul Infrastructure Key Plan
Sheets	01 of 09		

Model File Identifier	File Identifier	Status	Rev
MCW1088-RPS-00-XX-DR-C-DR0101	MCW1088-RPS-00-XX-DR-C-DR0101-01	S3	P04

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Client	General Notes
	(i) Hard copies, dwf and pdf will form a controlled issue of the drawing. All other formats (dwg etc.) are deemed to be an uncontrolled issue and any work carried out based on these files is at the recipients own risk. RPS will not accept any responsibility for any errors from the use of these files, either by human error by the recipient, listing of the un-dimensioned measurements, compatibility with the recipients software, and any errors arising when these files are used to aid the recipients drawing production, or setting out on site.
	(ii) DO NOT SCALE, use figured dimensions only.
	(iii) This drawing is the property of RPS, it is a project confidential classified document. It must not be copied used or its contents divulged without prior written consent. The needs and expectations of client and RPS must be considered when working with this drawing.
	(iv) Information including topographical survey, geotechnical investigation and utility detail used in the design have been provided by others.
	(v) All Levels refer to Ordnance Survey Datum, Malin Head.

Rev	Date	Drn Chk	Amendment / Issue	App
S3 P04	08/06/22	PGR GMcG	Issue for Review and Comment	BB
P01	26/10/21	PGR GMcG	Issued for Information	GMcG

Model File Identifier: MCW1088-RPS-00-XX-DR-C-DR0101

Scale: 1:500 @ A1, 1:1000 @ A3
Created on: 18/10/2021
Sheets: 02 of 09

Project: Castlelake SHD

Title: Proposed Foul Infrastructure Drainage Layout (1 of 8)

File Identifier: MCW1088-RPS-00-XX-DR-C-DR0101-02
Status: S3
Rev: P04

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R:\MCW1088 - BAM Castlelake Residential D\(o)\8.0 Drawings\DR\MCW1088-RPS-00-XX-DR-C-DR0101.dwg

Client

General Notes

(i) Hard copies, dwf and pdf will form a controlled issue of the drawing. All other formats (dwg etc.) are deemed to be an uncontrolled issue and any work carried out based on these files is at the recipients own risk. RPS will not accept any responsibility for any errors from the use of these files, either by human error by the recipient, listing of the un-dimensioned measurements, compatibility with the recipients software, and any errors arising when these files are used to aid the recipients drawing production, or setting out on site.

(ii) DO NOT SCALE, use figured dimensions only.

(iii) This drawing is the property of RPS, it is a project confidential classified document. It must not be copied used or its contents divulged without prior written consent. The needs and expectations of client and RPS must be considered when working with this drawing.

(iv) Information including topographical survey, geotechnical investigation and utility detail used in the design have been provided by others.

(v) All Levels refer to Ordnance Survey Datum, Malin Head.

Rev	Date	Drn / Chk	Amendment / Issue	App
S3 P04	08/06/22	PGR / GMcC	Issue for Review and Comment	BB
S2 P01	26/10/21	PGR / GMcC	Pre-Application Submission	BB

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Model File Identifier: MCW1088-RPS-00-XX-DR-C-DR0101

Scale: 1:500 @ A1, 1:1000 @ A3

Created on: 18/10/2021

Sheets: 03 of 09

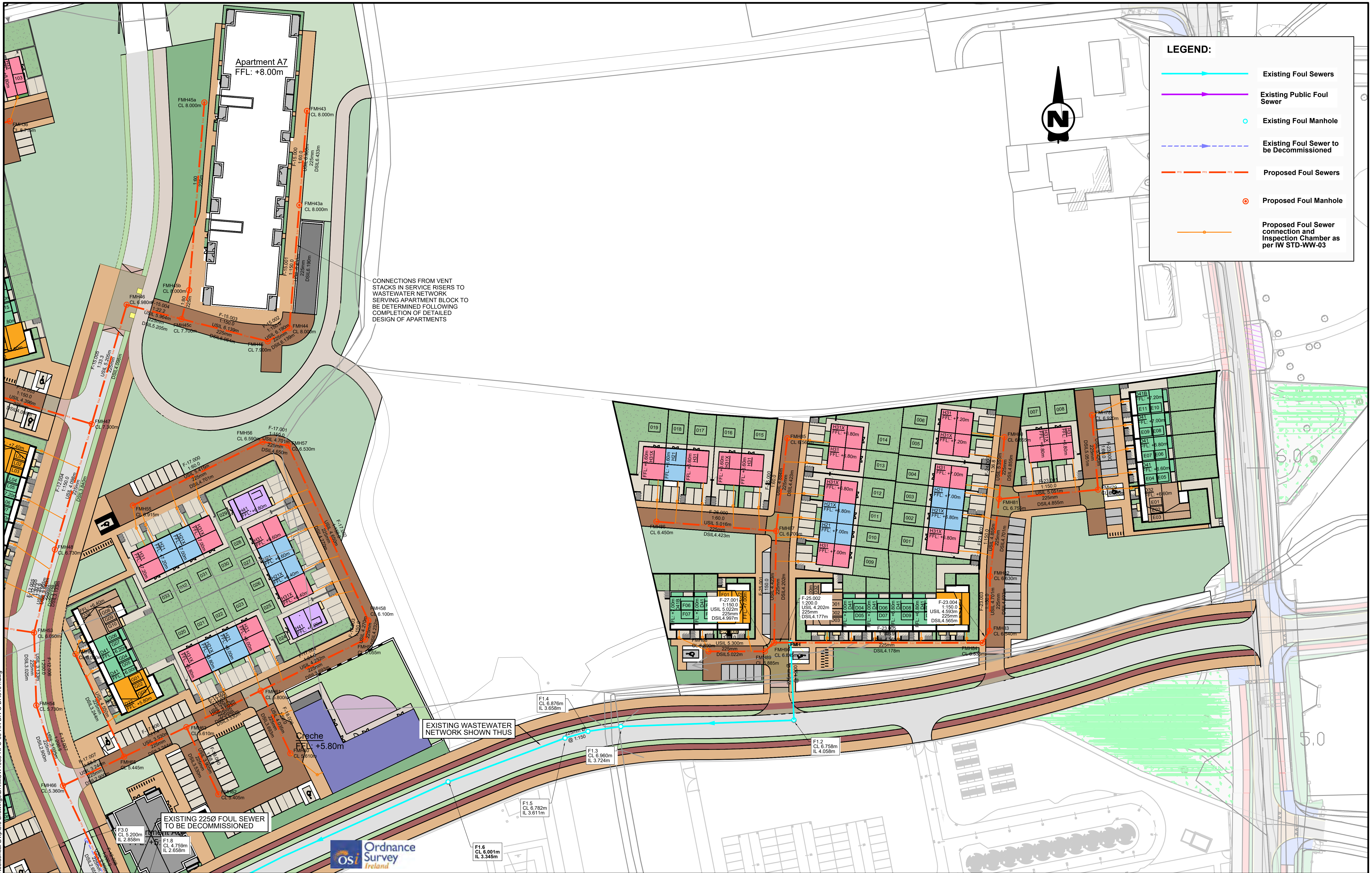
Project: Castlelake SHD

Title: Proposed Foul Infrastructure Drainage Layout (2 of 8)

File Identifier: MCW1088-RPS-00-XX-DR-C-DR0101-03

Status: S3

Rev: P04



Client

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(v) All Levels refer to Ordnance Survey Datum, Malin Head.

Rev	Date	Drn Chk	Amendment / Issue	App
S3 P04	08/06/22	PGR GMcC	Issue for Review and Comment	BB
P01	26/10/21	PGR GMcC	Pre-Application Submission	BB

Scale: 1:500 @ A1, 1:1000 @ A3

Created on: 18/10/2021

Sheets: 04 of 09

Project: Castlelake SHD

Title: Proposed Foul Infrastructure Drainage Layout (3 of 8)

Model File Identifier: MCW1088-RPS-00-XX-DR-C-DR0101

File Identifier: MCW1088-RPS-00-XX-DR-C-DR0101-04

Status: S3

Rev: P04

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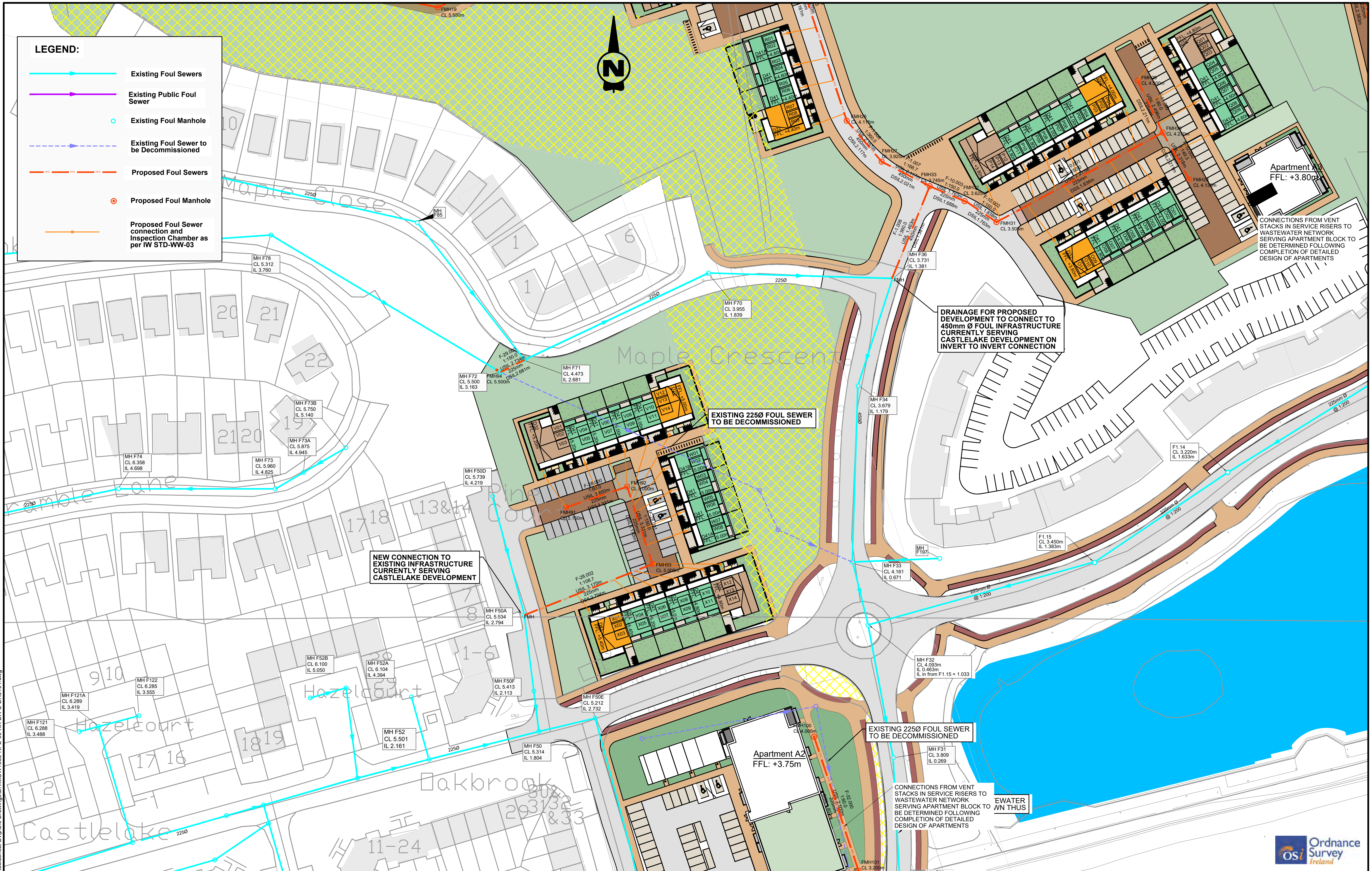

Client	General Notes

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Rev	Date	Drn Chk	Amendment / Issue	App
S3 P04	08/06/22	PGR GMcC	Issue for Review and Comment	BB
P01	26/10/21	PGR GMcC	Pre-Application Submission	BB

rps

Model File Identifier: MCW1088-RPS-00-XX-DR-C-DR0101

Scale: 1:500 @ A1, 1:1000 @ A3
Created on: 18/10/2021
Sheets: 05 of 09

Project: Castlelake SHD

Title: Proposed Foul Infrastructure Drainage Layout (4 of 8)

File Identifier: MCW1088-RPS-00-XX-DR-C-DR0101-05
Status: S3
Rev: P04

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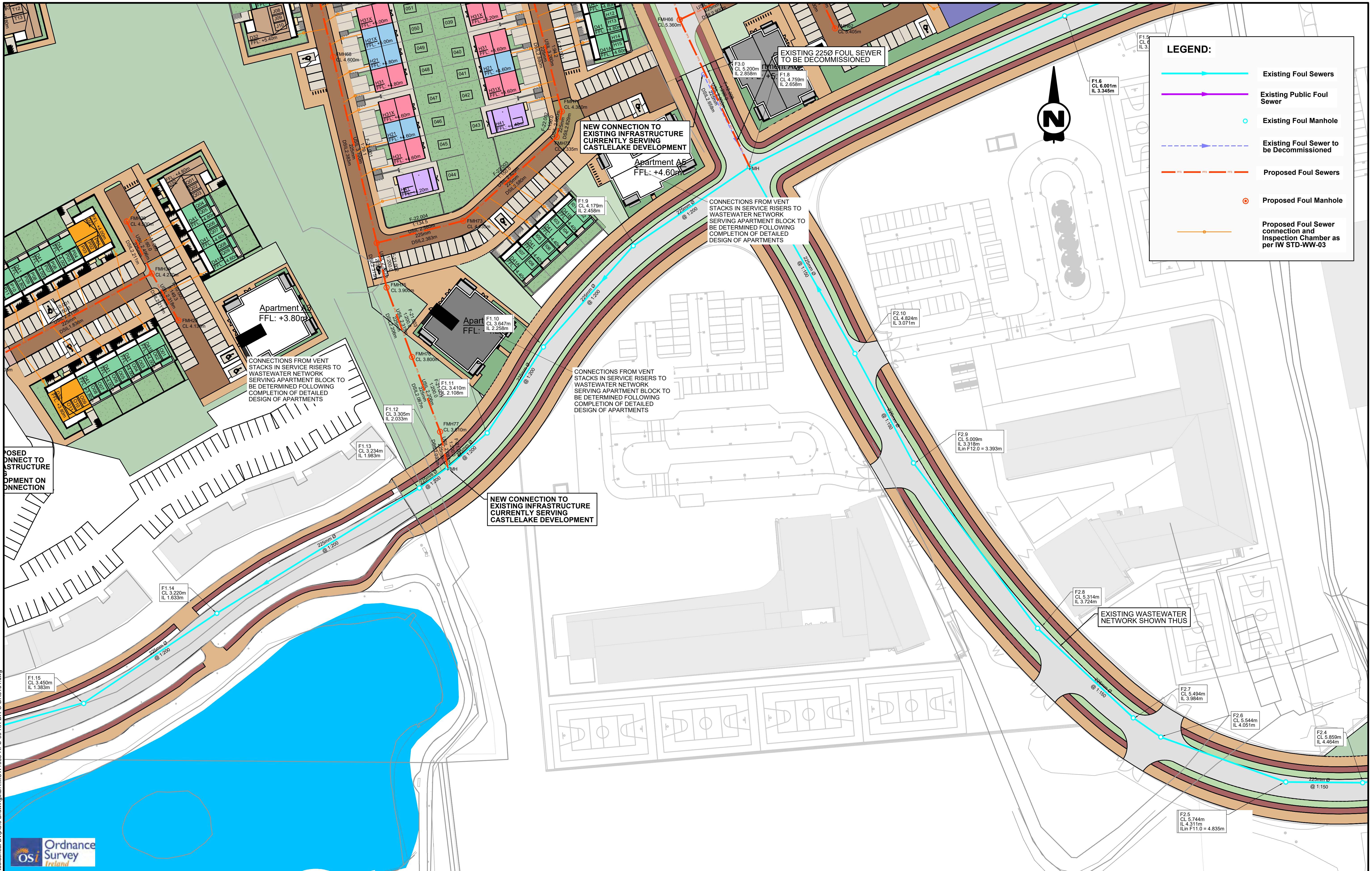

Client

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Rev	Date	Drn Chk	Amendment / Issue	App
S3 P04	08/06/22	PGR GMcC	Issue for Review and Comment	BB
P01	26/10/21	PGR GMcC	Pre-Application Submission	BB

Scale: 1:500 @ A1, 1:1000 @ A3
Created on: 18/10/2021
Sheets: 06 of 09

Project: Castlelake SHD

Title: Proposed Foul Infrastructure Drainage Layout (5 of 8)

Model File Identifier: MCW1088-RPS-00-XX-DR-C-DR0101

File Identifier: MCW1088-RPS-00-XX-DR-C-DR0101-06

Status: S3

Rev: P04

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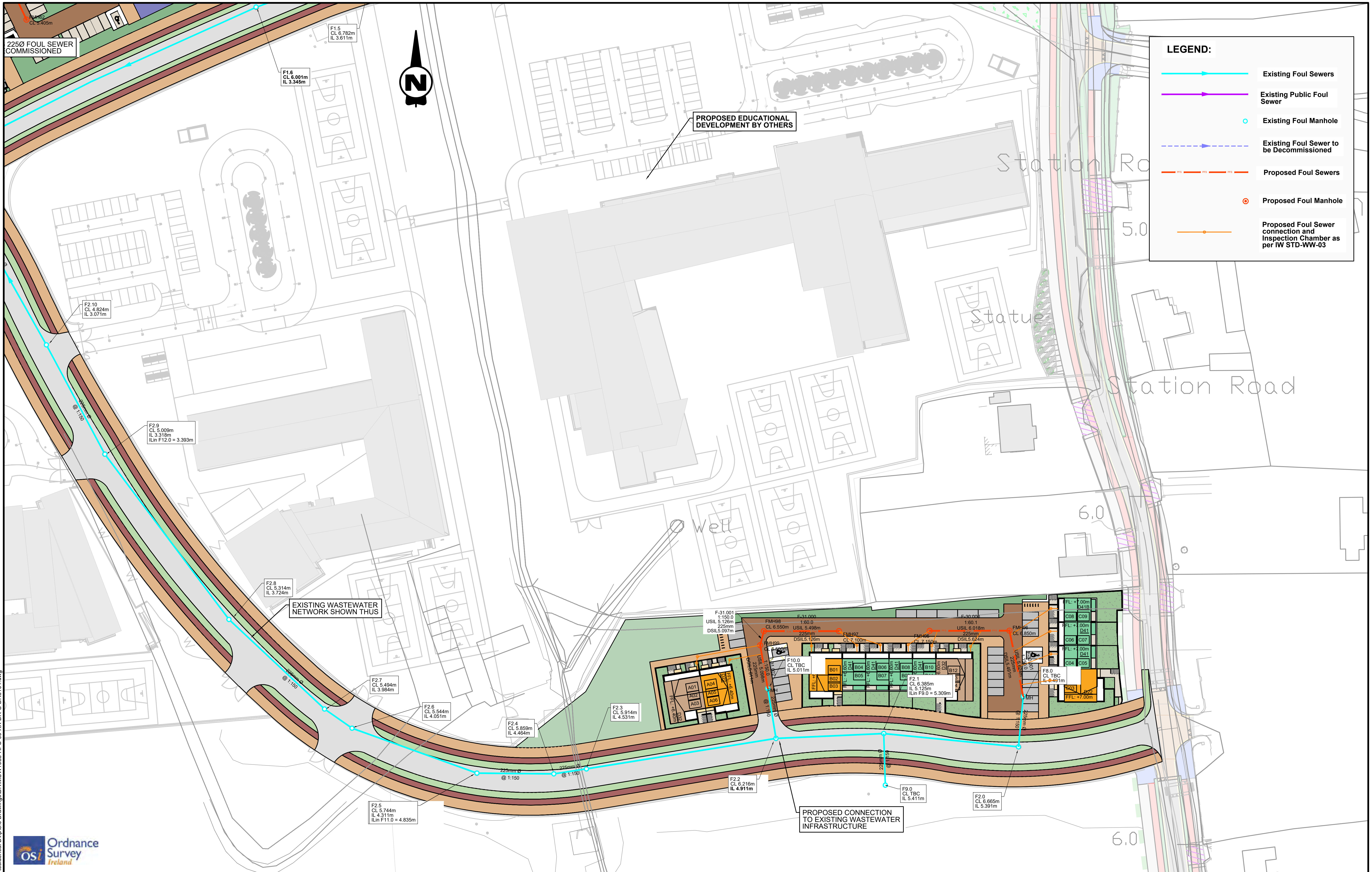

Client	General Notes

General Notes

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Rev	Date	Drn/Chk	Amendment / Issue	App
S3 P04	08/06/22	PGR/GMcC	Issue for Review and Comment	BB
P01	26/10/21	PGR/GMcC	Pre-Application Submission	BB

rps

Model File Identifier: MCW1088-RPS-00-XX-DR-C-DR0101

Scale: 1:500 @ A1, 1:1000 @ A3

Created on: 18/10/2021

Sheets: 07 of 09

Project: Castlelake SHD

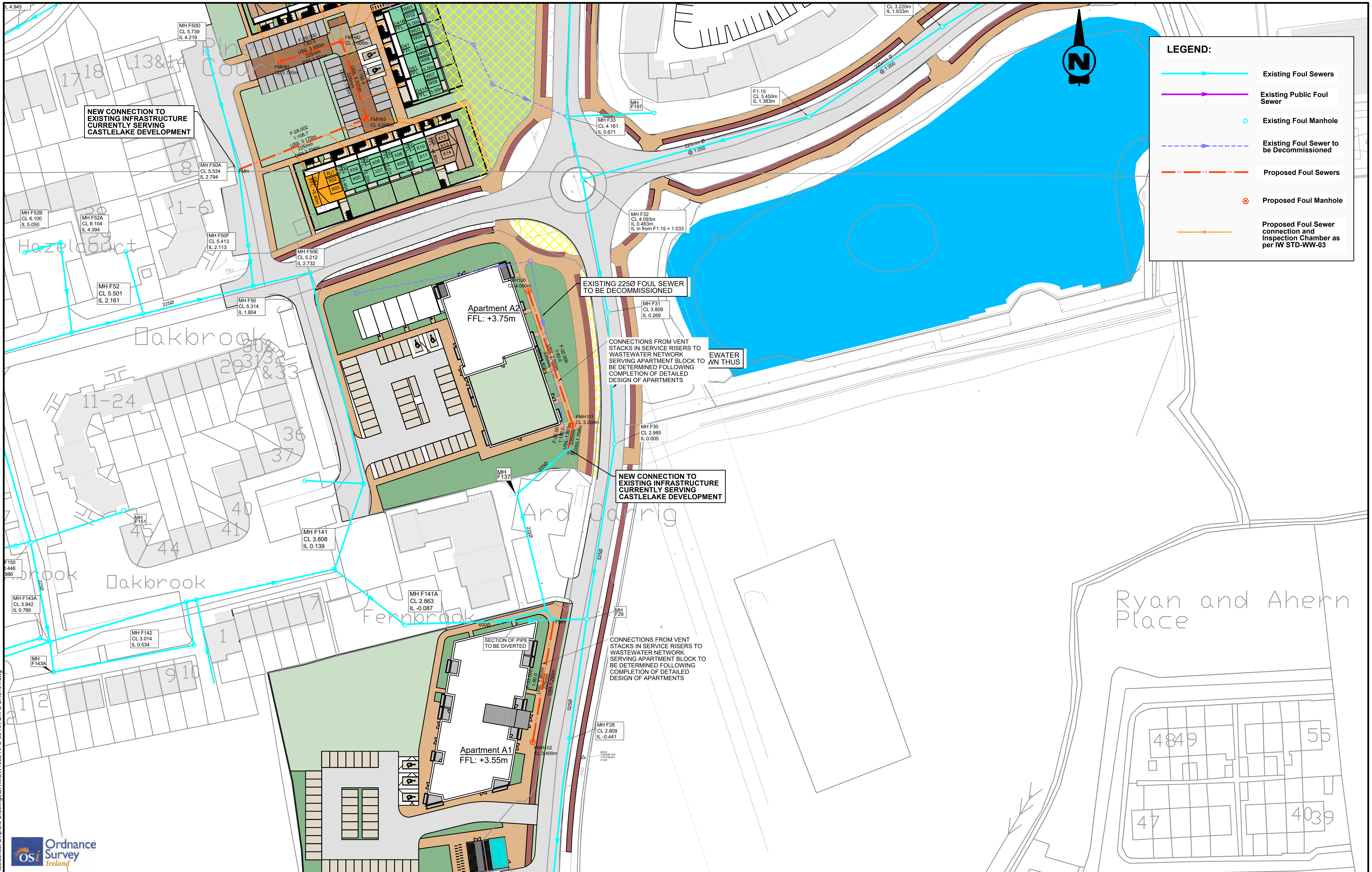
Title: Proposed Foul Infrastructure Drainage Layout (6 of 8)

File Identifier: MCW1088-RPS-00-XX-DR-C-DR0101-07

Status: S3

Rev: P04

R:\MCW1088 - BAM Castlelake Residential Dvlp\8.0 Drawings\DR\MCW1088-RPS-00-XX-DR-C-DR0101.dwg



S3 P04	08/06/22	PGR GMcC	Issue for Review and Comment	BB
P01	26/10/21	PGR GMcC	Pre-Application Submission	BB
Rev	Date	Drn Chk	Amendment / Issue	App

Client

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Model File Identifier: MCW1088-RPS-00-XX-DR-C-DR0101

Scale: 1:500 @ A1 / 1:1000 @ A3
Created on: 18/10/2021
Sheets: 08 of 09

Project: Castlelake SHD

Title: Proposed Foul Infrastructure Drainage Layout (7 of 8)

File Identifier: MCW1088-RPS-00-XX-DR-C-DR0101-08 | Status: S3 | Rev: P04

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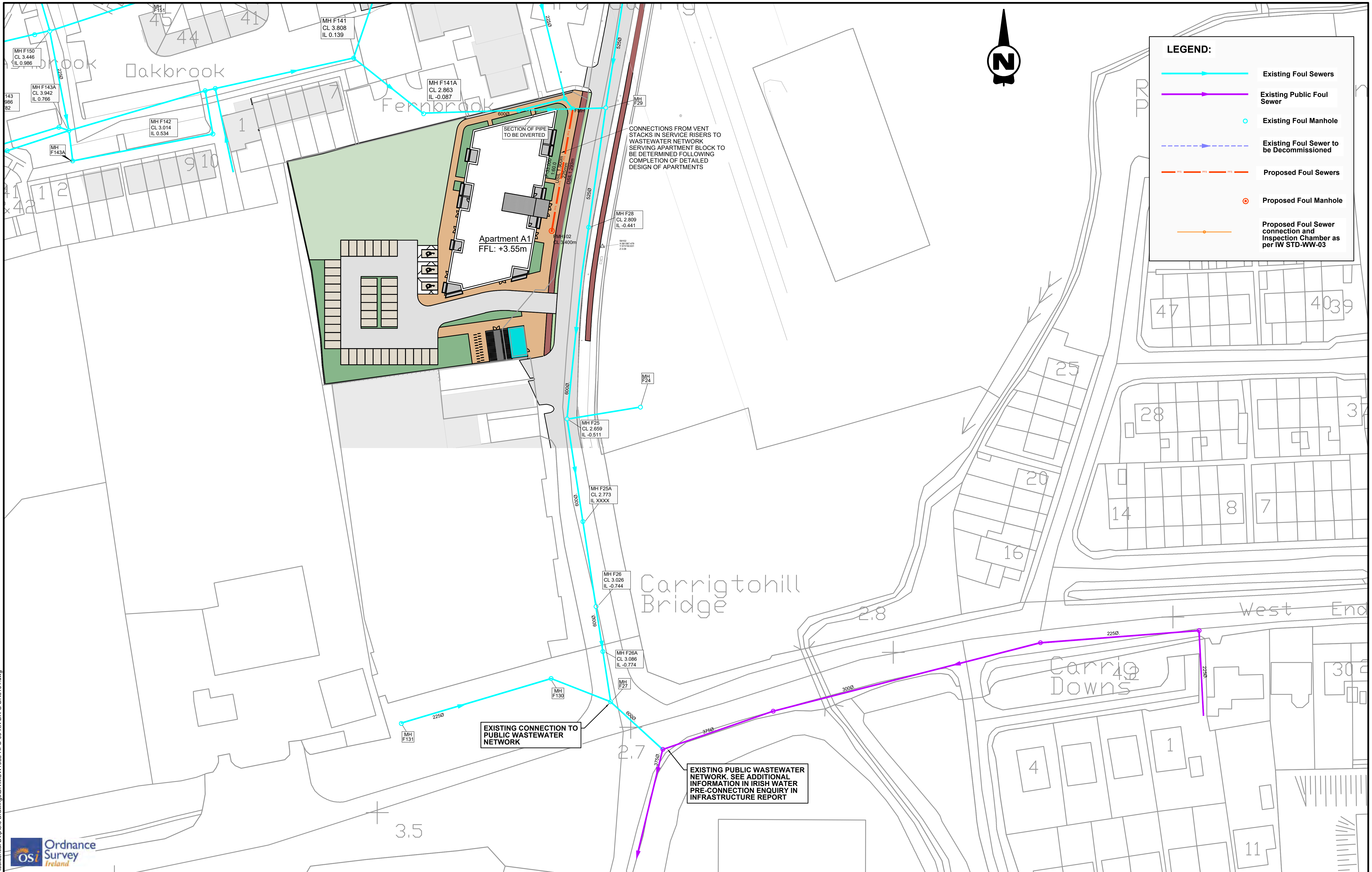

R:\MCW1088 - BAM Castlelake Residential Dvlp\8.0 Drawings\DR\MCW1088-RPS-00-XX-DR-C-DR0101.dwg

Client

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Rev	Date	Drn / Chk	Amendment / Issue	App
S3 P04	08/06/22	PGR / GMcC	Issue for Review and Comment	BB
P01	26/10/21	PGR / GMcC	Pre-Application Submission	BB

rps

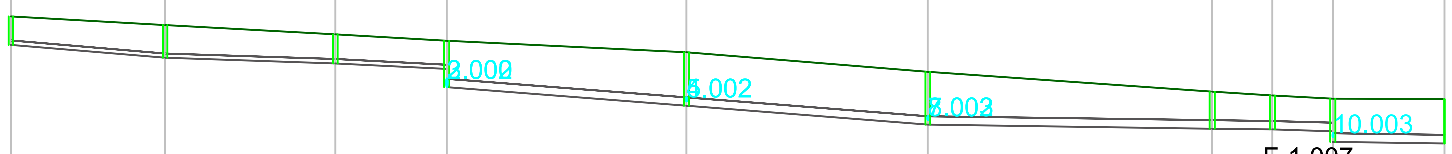
Model File Identifier: MCW1088-RPS-00-XX-DR-C-DR0101

Scale: 1:500 @ A1, 1:1000 @ A3
Created on: 18/10/2021
Sheets: 09 of 09

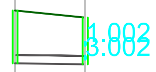
Project: Castlelake SHD
Title: Proposed Foul Infrastructure Drainage Layout (8 of 8)

File Identifier: MCW1088-RPS-00-XX-DR-C-DR0101-09
Status: S3
Rev: P04

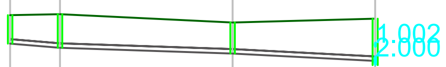
MH Name	FMH1	FMH2	FMH3	FMH8	FMH16	FMH25	FMH26	FMH27	FMH33	FMH
Hor Scale 1000 / Ver Scale 200 / Datum (m) 0.000										
PN	F-1.000	F-1.001	F-1.002	F-1.003	F-1.004	F-1.005	F-1.006	F-1.007	F-1.008	
Dia (mm)	225	225	225	450	450	450	450	450	450	
Slope (1:X)	60.0	150.0	98.8	64.2	64.1	360.3	360.0	166.7	360.0	
Cover Level (m)	8.100	7.645	7.160	6.820	6.210	5.170	4.115	3.920	3.745	3.731
Invert Level (m)	6.600	5.919 5.919	5.619 5.619	5.320 4.356	3.368 3.368	2.370 2.370	2.161 2.161	2.117 2.117	2.021 1.463	1.381
Length (m)	40.866	45.045	29.529	63.463	63.971	75.294	15.968	16.002	29.623	



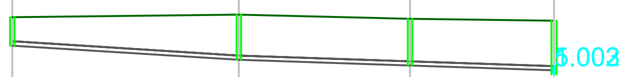
MH Name	FMH4	FMH8
Hor Scale 1000 / Ver Scale 200 / Datum (m) 0.000		
PN	F-2.000	
Dia (mm)	450	
Slope (1:X)	360.0	
Cover Level (m)	7.200	6.820
Invert Level (m)	4.408	4.356
Length (m)	18.612	



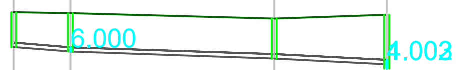
MH Name	FMH5	FMH6	FMH7	FMH8
Hor Scale 1000 / Ver Scale 200 / Datum (m) 0.000				
PN	F-3.000	F-3.001	F-3.002	
Dia (mm)	225	225	225	
Slope (1:X)	60.0	150.0	96.3	
Cover Level (m)	7.000	7.060	6.605	6.820
Invert Level (m)	5.500	5.279 5.279	4.974 4.974	4.581
Length (m)	13.256	45.772	37.837	



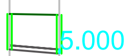
MH Name	FMH9	FMH10	FMH11	FMH16
Hor Scale 1000 / Ver Scale 200 / Datum (m) 0.000				
PN	F-4.000	F-4.001	F-4.002	
Dia (mm)	225	225	225	
Slope (1:X)	60.0	150.0	150.0	
Cover Level (m)	6.400	6.540	6.325	6.210
Invert Level (m)	5.150	4.150 4.150	3.848 3.848	3.593
Length (m)	59.989	45.315	38.214	



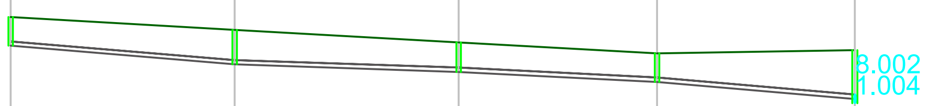
MH Name	FMH12	FMH14	FMH15	FMH16
Hor Scale 1000 / Ver Scale 200 / Datum (m) 0.000				
PN	F-5.000	F-5.001	F-5.002	
Dia (mm)	225	225	225	
Slope (1:X)	60.0	150.0	97.6	
Cover Level (m)	6.345	6.300	6.010	6.210
Invert Level (m)	4.508	4.258 4.258	3.898 3.898	3.593
Length (m)	15.011	53.996	29.769	



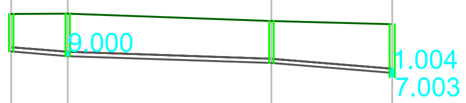
MH Name	FMH13	FMH14
Hor Scale 1000 / Ver Scale 200 / Datum (m) 0.000		
PN	F-6.000	
Dia (mm)	225	
Slope (1:X)	60.0	
Cover Level (m)	6.350	6.300
Invert Level (m)	4.477	4.258
Length (m)	13.167	



MH Name	FMH17	FMH18	FMH19	FMH20	FMH25
Hor Scale 1000 / Ver Scale 200 / Datum (m) 0.000					
PN	F-7.000	F-7.001	F-7.002	F-7.003	
Dia (mm)	225	225	225	225	
Slope (1:X)	60.0	150.0	99.9	58.2	
Cover Level (m)	6.905	6.240	5.580	4.995	5.170
Invert Level (m)	5.405	4.416 4.416	4.021 4.021	3.495 3.495	2.595
Length (m)	59.328	59.328	52.530	52.392	



MH Name	FMH21	FMH23	FMH24	FMH25
Hor Scale 1000 / Ver Scale 200 / Datum (m) 0.000				
PN	F-8.000	F-8.001	F-8.002	
Dia (mm)	225	225	225	
Slope (1:X)	60.0	150.0	60.3	
Cover Level (m)	5.720	5.740	5.340	5.170
Invert Level (m)	3.736	3.486 3.486	3.126 3.126	2.595
Length (m)	15.011	53.996	32.029	



Client

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Rev	Date	Drn/Chk	Amendment / Issue	App
S3 P03	08/06/2022	PGR GMcC	Issue for Review and Comment	BB
S3 P02	03/06/22	PGR GMcC	Issue for Review and Comment	BB
S3 P01	23/05/22	PGR GMcC	Issue for Review and Comment	BB
P01	26/10/21	PGR GMcC	Pre-Application Submission	BB

Scale: As Shown @ A1, Half @ A3
Created on: 24/10/2021
Sheets: 01 of 04
Project: Castlelake SHD
Title: Proposed Foul Infrastructure Longitudinal Sections (1 of 4)
Model File Identifier: MCW1088-RPS-00-XX-DR-C-DR0102
File Identifier: MCW1088-RPS-00-XX-DR-C-DR0102-01
Status: S3
Rev: P03

R:\MCW1088 - BAM Castlelake Residential Dvlp\8.0 Drawings\DR\MCW1088-RPS-00-XX-DR-C-DR0102.dwg

MH Name	FMH22		FMH23
Hor Scale 1000 / Ver Scale 200 / Datum (m) 0.000			
PN		F-9.000	
Dia (mm)		225	
Slope (1:X)		60.0	
Cover Level (m)	5.605		5.740
Invert Level (m)	3.705		3.486
Length (m)		13.167	

MH Name	FMH28		FMH30		FMH31		FMH32		FMH33
Hor Scale 1000 / Ver Scale 200 / Datum (m) 0.000									
PN		F-10.000		F-10.001		F-10.002		F-10.003	
Dia (mm)		225		225		225		225	
Slope (1:X)		149.3		150.1		150.0		150.0	
Cover Level (m)	4.135		4.270		3.505		3.625		3.745
Invert Level (m)	2.318		2.211 2.211		1.838 1.838		1.763 1.763		1.688
Length (m)		15.980		55.969		11.310		11.263	

MH Name	FMH29		FMH30
Hor Scale 1000 / Ver Scale 200 / Datum (m) 0.000			
PN		F-11.000	
Dia (mm)		225	
Slope (1:X)		60.0	
Cover Level (m)	4.500		4.270
Invert Level (m)	2.496		2.211
Length (m)		17.112	

MH Name	FMH34		FMH35		FMH37		FMH42		FMH47		FMH48		FMH53		FMH54		FMH66		FMH
Hor Scale 1000 / Ver Scale 200 / Datum (m) 0.000																			
PN		F-12.000		F-12.001		F-12.002		F-12.003		F-12.004		F-12.005		F-12.006		F-12.007		F-12.008	
Dia (mm)		225		225		225		225		225		225		225		225		225	
Slope (1:X)		60.0		150.0		124.4		150.0		150.0		35.9		200.0		200.5		200.0	
Cover Level (m)	7.758		8.115		8.450		7.630		7.300		6.730		6.050		5.730		5.360		4.759
Invert Level (m)	6.258		5.329 5.329		4.958 4.958		4.396 4.396		4.098 4.098		3.840 3.840		3.133 3.133		3.025 3.025		2.900 2.900		2.658
Length (m)		55.715		55.715		69.886		44.656		38.756		25.356		21.574		25.063		48.272	

MH Name	FMH36		FMH37
Hor Scale 1000 / Ver Scale 200 / Datum (m) 0.000			
PN		F-13.000	
Dia (mm)		225	
Slope (1:X)		60.0	
Cover Level (m)	8.715		8.450
Invert Level (m)	5.558		4.958
Length (m)		35.984	

MH Name	FMH38		FMH39		FMH40		FMH41		FMH42
Hor Scale 1000 / Ver Scale 200 / Datum (m) 0.000									
PN		F-14.000		F-14.001		F-14.002		F-14.003	
Dia (mm)		225		225		225		225	
Slope (1:X)		60.0		150.0		150.0		150.0	
Cover Level (m)	7.630		7.370		7.915		7.835		7.630
Invert Level (m)	6.130		5.218 5.218		4.853 4.853		4.539 4.539		4.396
Length (m)		54.722		54.786		47.039		21.437	

MH Name	FMH43		FMH43a		FMH44		FMH45		FMH45c		FMH46		FMH47
Hor Scale 1000 / Ver Scale 200 / Datum (m) 0.000													
PN		F-15.000		F-15.001		F-15.002		F-15.003		F-15.004		F-15.005	
Dia (mm)		225		225		225		225		225		225	
Slope (1:X)		60.0		150.0		150.0		150.0		22.2		33.3	
Cover Level (m)	8.000		8.000		8.000		7.900		7.700		6.980		7.300
Invert Level (m)	6.900		6.433 6.433		6.190 6.190		6.139		5.964 5.964		5.205 5.205		4.098
Length (m)		27.994		36.576		7.519		26.365		16.836		36.837	

Client

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Rev	Date	Drn / Chk	Amendment / Issue	App
S3 P02	03/06/22	PGR / GMcC	Issue for Review and Comment	BB
S3 P01	23/05/22	PGR / GMcC	Issue for Review and Comment	BB
P01	26/10/21	PGR / GMcC	Pre-Application Submission	BB

Scale: As Shown @ A1, Half @ A3
Created on: 24/10/2021
Sheets: 02 of 04
Project: Castlelake SHD
Title: Proposed Foul Infrastructure Longitudinal Sections (2 of 4)
Model File Identifier: MCW1088-RPS-00-XX-DR-C-DR0102
File Identifier: MCW1088-RPS-00-XX-DR-C-DR0102-02
Status: S3
Rev: P02

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MH Name	FMH49	FMH50	FMH51	FMH52	FMH53
Hor Scale 1000 / Ver Scale 200					12.005
Datum (m) 0.000					
PN	F-16.000	F-16.001	F-16.002	F-16.003	
Dia (mm)	225	225	225	225	
Slope (1:X)	36.2	150.0	150.0	150.0	
Cover Level (m)	7.155	5.820	5.675	5.830	6.050
Invert Level (m)	5.200	3.870 3.870	3.575 3.575	3.369 3.369	3.133
Length (m)	48.121	44.313	30.800	35.409	

MH Name	FMH55	FMH56	FMH57	FMH58	FMH59	FMH61	FMH63	FMH65	FMH66
Hor Scale 1000 / Ver Scale 200						18.000	19.000	20.000	12.007
Datum (m) 0.000									
PN	F-17.000	F-17.001	F-17.002	F-17.003	F-17.004	F-17.005	F-17.006	F-17.007	
Dia (mm)	225	225	225	225	225	225	225	225	
Slope (1:X)	60.0	150.0	150.0	150.0	64.0	150.4	71.4	58.3	
Cover Level (m)	6.915	6.590	6.530	6.100	6.055	5.800	5.610	5.445	5.360
Invert Level (m)	5.415	4.701 4.701	4.650 4.650	4.270 4.270	4.232 4.232	3.693 3.693	3.530 3.530	3.244 3.244	2.900
Length (m)	42.824	7.696	57.007	5.711	34.491	24.509	20.431	20.060	

MH Name	FMH60	FMH61
Hor Scale 1000 / Ver Scale 200		17.004
Datum (m) 0.000		
PN	F-18.000	
Dia (mm)	225	
Slope (1:X)	60.0	
Cover Level (m)	5.610	5.800
Invert Level (m)	4.035	3.693
Length (m)	20.534	

MH Name	FMH62	FMH63
Hor Scale 1000 / Ver Scale 200		17.005
Datum (m) 0.000		
PN	F-19.000	
Dia (mm)	225	
Slope (1:X)	58.8	
Cover Level (m)	5.405	5.610
Invert Level (m)	3.905	3.530
Length (m)	22.048	

MH Name	FMH64	FMH65
Hor Scale 1000 / Ver Scale 200		17.006
Datum (m) 0.000		
PN	F-20.000	
Dia (mm)	225	
Slope (1:X)	25.7	
Cover Level (m)	6.050	5.445
Invert Level (m)	4.550	3.244
Length (m)	33.622	

MH Name	FMH67	FMH68	FMH74	FMH75	FMH76	FMH77	FMH
Hor Scale 1000 / Ver Scale 200			22.004				
Datum (m) 0.000							
PN	F-21.000	F-21.001	F-21.002	F-21.003	F-21.004	F-21.005	
Dia (mm)	225	225	225	225	225	225	
Slope (1:X)	46.2	79.1	200.0	200.0	200.0	200.0	
Cover Level (m)	5.490	4.600	4.100	3.900	3.800	3.610	3.305
Invert Level (m)	3.990	3.100 3.100	2.383 2.383	2.315 2.315	2.206 2.206	2.087 2.087	2.033
Length (m)	41.143	56.708	13.525	21.929	23.702	10.813	

MH Name	FMH69	FMH70	FMH71	FMH72	FMH73	FMH74
Hor Scale 1000 / Ver Scale 200						21.001
Datum (m) 0.000						
PN	F-22.000	F-22.001	F-22.002	F-22.003	F-22.004	
Dia (mm)	225	225	225	225	225	
Slope (1:X)	45.3	94.2	150.0	150.0	134.5	
Cover Level (m)	5.345	4.760	4.380	4.335	4.135	4.100
Invert Level (m)	3.845	3.260 3.260	2.880 2.880	2.829	2.580 2.580	2.383
Length (m)	26.509	35.791	7.702	37.232	26.487	

MH Name	FMH78	FMH79	FMH81	FMH82	FMH83	FMH84	FMH
Hor Scale 1000 / Ver Scale 200			24.000				
Datum (m) 0.000							
PN	F-23.000	F-23.001	F-23.002	F-23.003	F-23.004	F-23.005	
Dia (mm)	225	225	225	225	225	225	
Slope (1:X)	60.0	150.0	150.0	150.0	150.0	146.9	
Cover Level (m)	6.920	6.350	6.755	6.630	6.540	6.535	6.850
Invert Level (m)	5.420	5.051 5.051	4.855 4.855	4.701 4.701	4.593 4.593 4.565	4.565	4.178
Length (m)	22.150	29.449	23.019	16.151	4.198	56.839	

MH Name	FMH80	FMH81
Hor Scale 1000 / Ver Scale 200		23.001
Datum (m) 0.000		
PN	F-24.000	
Dia (mm)	225	
Slope (1:X)	36.8	
Cover Level (m)	6.855	6.755
Invert Level (m)	5.355	4.855
Length (m)	18.408	

Client: bam

General Notes
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(v) All Levels refer to Ordnance Survey Datum, Malin Head.

Rev	Date	Drn / Chk	Amendment / Issue	App
S3 P02	03/06/22	PGR / GMcC	Issue for Review and Comment	BB
S3 P01	23/05/22	PGR / GMcC	Issue for Review and Comment	BB
P01	26/10/21	PGR / GMcC	Pre-Application Submission	BB

rps

Scale: As Shown @ A1, Half @ A3
Project: Castlelake SHD
Created on: 24/10/2021
Title: Proposed Foul Infrastructure Longitudinal Sections (3 of 4)
Sheets: 03 of 04
Model File Identifier: MCW1088-RPS-00-XX-DR-C-DR0102
File Identifier: MCW1088-RPS-00-XX-DR-C-DR0102-03
Status: S3
Rev: P02

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MH Name	FMH85 FMH87 FMH90 FMH
Hor Scale 1000 / Ver Scale 200	26.000 27.001
Datum (m) 0.000	F-25.001
PN	F-25.000 F-25.002
Dia (mm)	225 225 225
Slope (1:X)	60.0 150.0 200.0
Cover Level (m)	6.560 6.700 6.845 6.850
Invert Level (m)	4.884 4.423 4.423 4.202 4.202 4.177
Length (m)	27.673 33.080 4.901

MH Name	FMH86 FMH87
Hor Scale 1000 / Ver Scale 200	25.000
Datum (m) 0.000	
PN	F-26.000
Dia (mm)	225
Slope (1:X)	60.0
Cover Level (m)	6.450 6.700
Invert Level (m)	5.016 4.423
Length (m)	35.600

MH Name	FMH88 FMH89 FMH90
Hor Scale 1000 / Ver Scale 200	25.001
Datum (m) 0.000	F-27.000
PN	F-27.001
Dia (mm)	225 225
Slope (1:X)	60.0 150.0
Cover Level (m)	6.800 6.885 6.845
Invert Level (m)	5.300 5.022 5.022 4.997 3.764
Length (m)	16.692

MH Name	FMH91 FMH92 FMH93 FMH
Hor Scale 1000 / Ver Scale 200	
Datum (m) 0.000	F-28.001
PN	F-28.000 F-28.002
Dia (mm)	225 225 225
Slope (1:X)	60.0 150.0 108.7
Cover Level (m)	5.150 5.000 5.000 5.534
Invert Level (m)	3.650 3.331 3.331 3.170 3.170 2.794
Length (m)	19.125 24.137 40.864

MH Name	FMH94 FMH
Hor Scale 1000 / Ver Scale 200	
Datum (m) 0.000	
PN	F-29.000
Dia (mm)	225
Slope (1:X)	150.0
Cover Level (m)	5.500 4.473
Invert Level (m)	2.734 2.681
Length (m)	8.000

MH Name	FMH95 FMH96 FMH
Hor Scale 1000 / Ver Scale 200	
Datum (m) 0.000	F-30.001
PN	F-30.000
Dia (mm)	225 225
Slope (1:X)	60.1 150.0
Cover Level (m)	7.150 6.850 6.780
Invert Level (m)	6.018 5.624 5.624 5.491
Length (m)	23.667 19.912

MH Name	FMH97 FMH98 FMH99 FMH
Hor Scale 1000 / Ver Scale 200	
Datum (m) 0.000	F-31.001
PN	F-31.000 F-31.002
Dia (mm)	225 225 225
Slope (1:X)	60.0 150.0 150.0
Cover Level (m)	7.100 6.550 6.500 6.000
Invert Level (m)	5.498 5.126 5.1?7 / 5.097 5.098 5.011
Length (m)	22.300 4.294 13.038

MH Name	FMH100 FMH101 FMH
Hor Scale 1000 / Ver Scale 200	
Datum (m) 0.000	
PN	F-32.000 F-32.001
Dia (mm)	225 225
Slope (1:X)	60.0 150.0
Cover Level (m)	4.000 3.200 3.200
Invert Level (m)	2.500 1.803 1.803 1.756
Length (m)	41.848 6.976

MH Name	FMH102 FMH
Hor Scale 1000 / Ver Scale 200	
Datum (m) 0.000	
PN	F-33.000
Dia (mm)	225
Slope (1:X)	60.0
Cover Level (m)	3.400 3.300
Invert Level (m)	1.900 1.293
Length (m)	36.397

Client: bam

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Rev	Date	Drn / Chk	Amendment / Issue	App
S3 P02	03/06/22	PGR / GMcC	Issue for Review and Comment	BB
S3 P01	23/05/22	PGR / GMcC	Issue for Review and Comment	BB
P01	26/10/21	PGR / GMcC	Pre-Application Submission	BB

rps

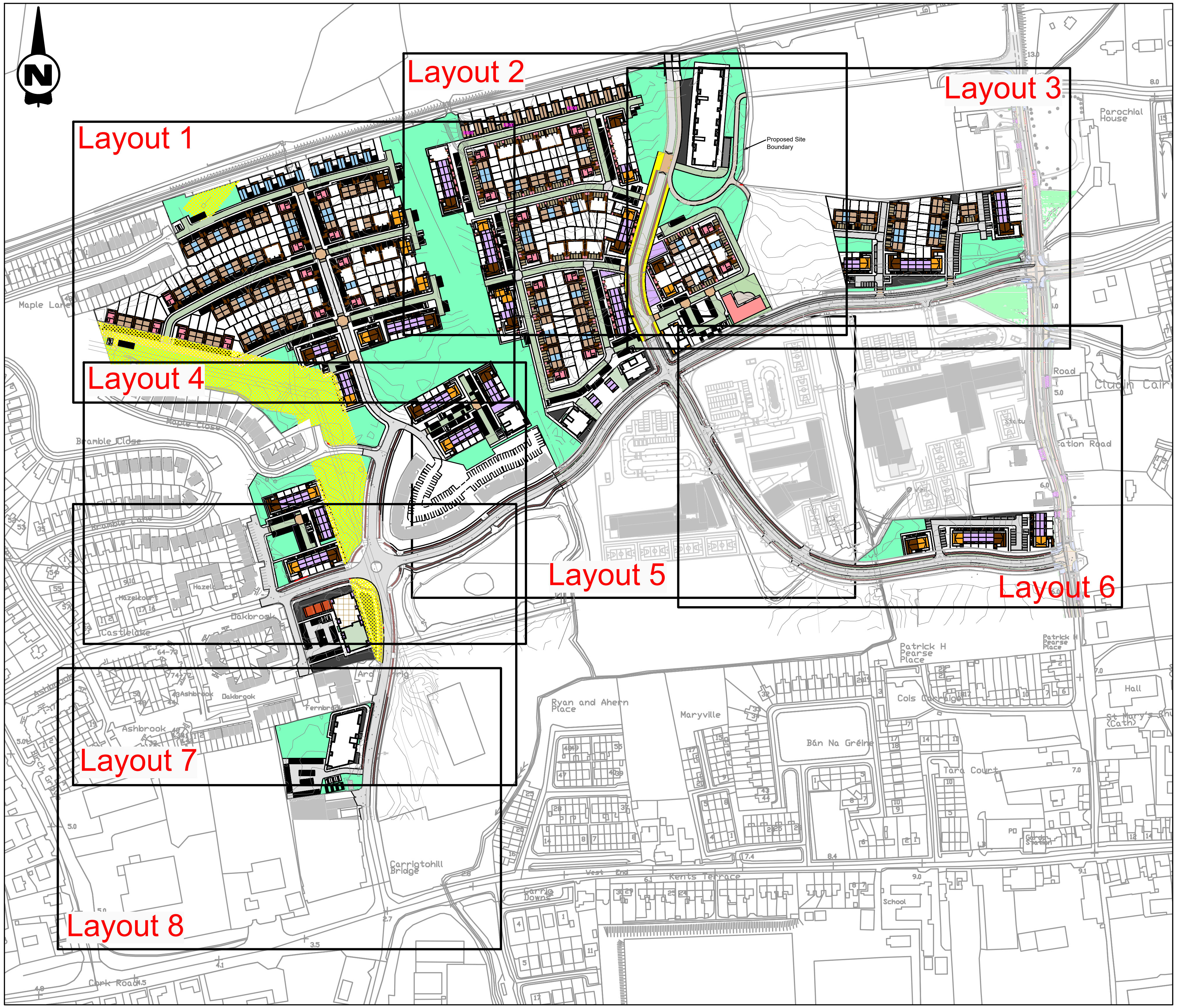
Model File Identifier: MCW1088-RPS-00-XX-DR-C-DR0101

Scale: As Shown @ A1, Half @ A3
Created on: 24/10/2021
Sheets: 04 of 04

Project: Castlelake SHD

Title: Proposed Foul Infrastructure Longitudinal Sections (4 of 4)

File Identifier: MCW1088-RPS-00-XX-DR-C-DR0101-04 | Status: S3 | Rev: P02



Ordnance Survey Ireland

Client

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Rev	Date	Drn / Chk	Amendment / Issue	App
S3 p03	08/06/22	PGR GMcC	Issue for Review and Comment	BB
S3 P02	03/06/22	PGR GMcC	Issue for Review and Comment	BB
S3 P01	23/05/22	PGR GMcC	Issue for Review and Comment	BB
P01	26/10/21	PGR GMcC	Pre-Application Submission	BB

rps

Model File Identifier: MCW1088-RPS-00-XX-DR-C-UT0101

Scale: 1:2000 @ A1, 1:4000 @ A3

Created on: 13/09/2021

Sheets: 01 of 09

Project: Castlelake SHD

Title: Proposed Watermain Infrastructure Key Plan

File Identifier: MCW1088-RPS-00-XX-DR-C-UT0101-01

Status: S3

Rev: P03

LEGEND:

(solid light blue line)	Existing Watermains
(orange/blue line)	Existing Watermains to be Decommissioned
(blue dashed line)	Proposed DN180 SDR17 PE100 Watermains
(purple dashed line)	Proposed 100mm dia Water Connection
SV	Proposed Sluice Valve
FH	Proposed Hydrant
AV	Proposed Air Valve
ScV	Proposed Scour Valve
WO	Proposed Washout Hydrant
●	Proposed Boundary Box
(symbol)	Proposed Bulk Meter
(symbol)	Proposed Manifold with Individual Meters

WATERMAIN NOTES:

1. BULK METERS TO BE PROVIDED (BY DEVELOPER) FOR EACH NEW DEVELOPMENT, IN ACCORDANCE WITH STD-W-02 & STD-W-26A.
2. ALL CHAMBERS TO BE CONSTRUCTED IN ACCORDANCE WITH IW-CDS-5020-26.
3. THRUST / SUPPORT BLOCKS TO BE LOCATED ON BENDS AND T JUNCTIONS AND AS REQUIRED, BASED ON STD-W-28.
4. WHERE POSSIBLE, WATERMAINS TO HAVE A MINIMUM 300mm VERTICAL AND HORIZONTAL CLEARANCE TO ALL OTHER SERVICES.
5. PROPOSED SLUICE VALVES IN ACCORDANCE WITH STD-W-15.
6. PROPOSED AIR VALVES IN ACCORDANCE WITH STD-W-22.
7. WHERE MINIMUM PIPE COVER CANNOT BE ACHIEVED, CONCRETE SURROUND TO GRADE C25/30 IS REQUIRED AS PER DIMENSIONS SPECIFIED IN STD-W-31.

Client

General Notes

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Rev	Date	Drn Chk	Amendment / Issue	App
S3 p03	08/06/22	PGR GMcC	Issued fro Review and Comment	BB
S3 P02	03/06/22	PGR GMcC	Issue for Review and Comment	BB
S3 P01	23/05/22	PGR GMcC	Issue fot Review and Comment	BB
P01	26/10/21	PGR GMcC	Pre-Application Submission	BB

Scale: 1:500 @ A1, 1:1000 @ A3
Created on: 13/09/2021
Sheets: 02 of 09

Project: Castlelake SHD

Title: Proposed Watermain Infrastructure Watermain Layout (1 of 8)

Model File Identifier: MCW1088-RPS-00-XX-DR-C-UT0101

File Identifier: MCW1088-RPS-00-XX-DR-C-UT0101-02

Status: S3

Rev: P03

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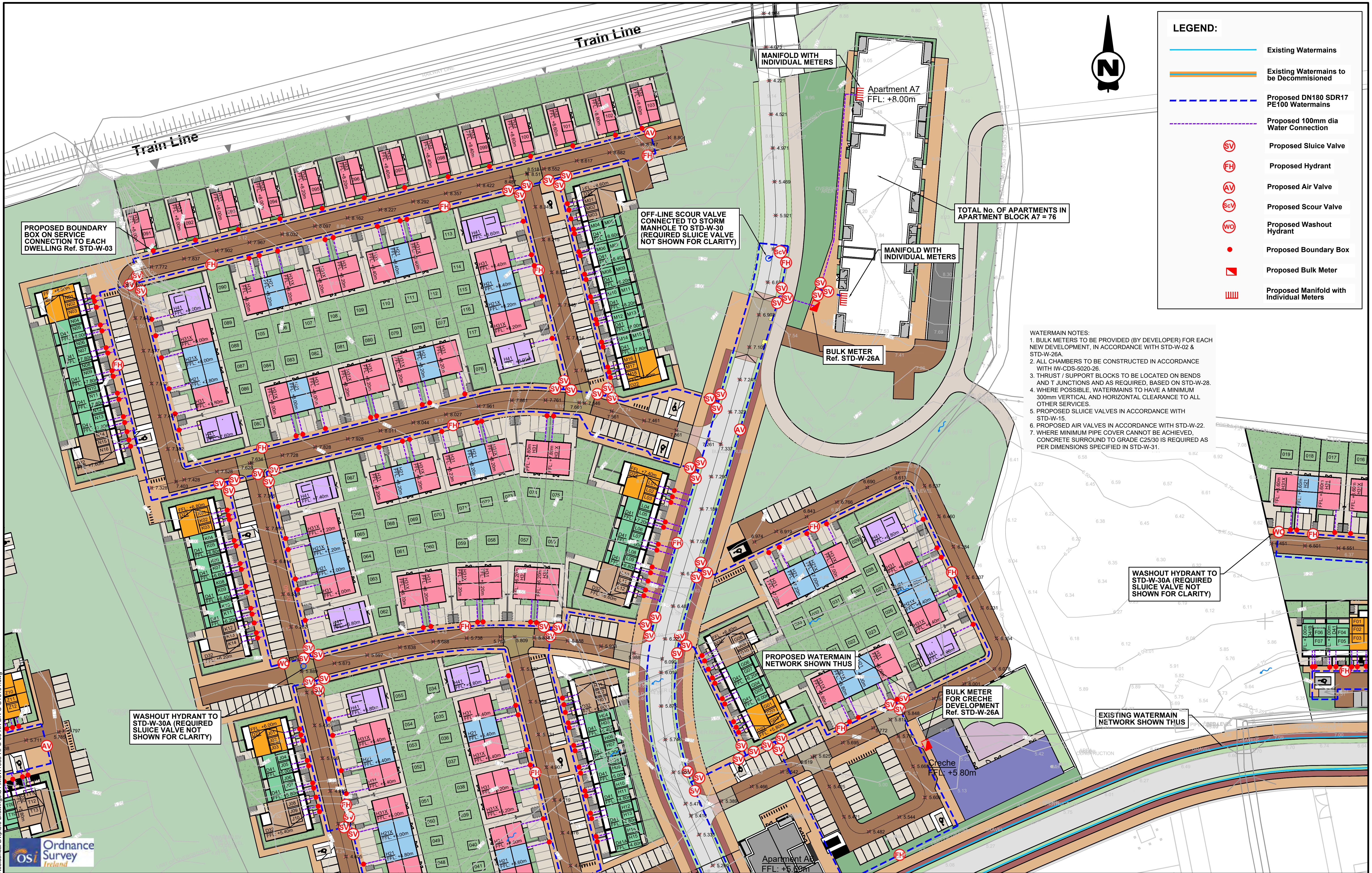

LEGEND:

- Existing Watermains
- Existing Watermains to be Decommisioned
- Proposed DN180 SDR17 PE100 Watermains
- Proposed 100mm dia Water Connection
- SV — Proposed Sluice Valve
- FH — Proposed Hydrant
- AV — Proposed Air Valve
- ScV — Proposed Scour Valve
- WO — Proposed Washout Hydrant
- Proposed Boundary Box
- Proposed Bulk Meter
- Proposed Manifold with Individual Meters

WATERMAIN NOTES:

1. BULK METERS TO BE PROVIDED (BY DEVELOPER) FOR EACH NEW DEVELOPMENT, IN ACCORDANCE WITH STD-W-02 & STD-W-26A.
2. ALL CHAMBERS TO BE CONSTRUCTED IN ACCORDANCE WITH IW-CDS-5020-26.
3. THRUST / SUPPORT BLOCKS TO BE LOCATED ON BENDS AND T JUNCTIONS AND AS REQUIRED, BASED ON STD-W-28.
4. WHERE POSSIBLE, WATERMAINS TO HAVE A MINIMUM 300mm VERTICAL AND HORIZONTAL CLEARANCE TO ALL OTHER SERVICES.
5. PROPOSED SLUICE VALVES IN ACCORDANCE WITH STD-W-15.
6. PROPOSED AIR VALVES IN ACCORDANCE WITH STD-W-22.
7. WHERE MINIMUM PIPE COVER CANNOT BE ACHIEVED, CONCRETE SURROUND TO GRADE C25/30 IS REQUIRED AS PER DIMENSIONS SPECIFIED IN STD-W-31.

Client

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Rev	Date	Drn / Chk	Amendment / Issue	App
S3 P03	08/06/22	PGR / GMcC	Issue for Review and Comment	BB
S3 P02	03/06/22	PGR / GMcC	Issue for Review and Comment	BB
S3 P01	23/05/22	PGR / GMcC	Issue for Review and Comment	BB
P01	26/10/21	PGR / GMcC	Pre-Application Submission	BB

Scale: 1:500 @ A1, 1:1000 @ A3

Created on: 13/09/2021

Sheets: 03 of 09

Project: Castlelake SHD

Title: Proposed Watermain Infrastructure Watermain Layout (2 of 8)

Model File Identifier: MCW1088-RPS-00-XX-DR-C-UT0101

File Identifier: MCW1088-RPS-00-XX-DR-C-UT0101-03

Status: S3

Rev: P03

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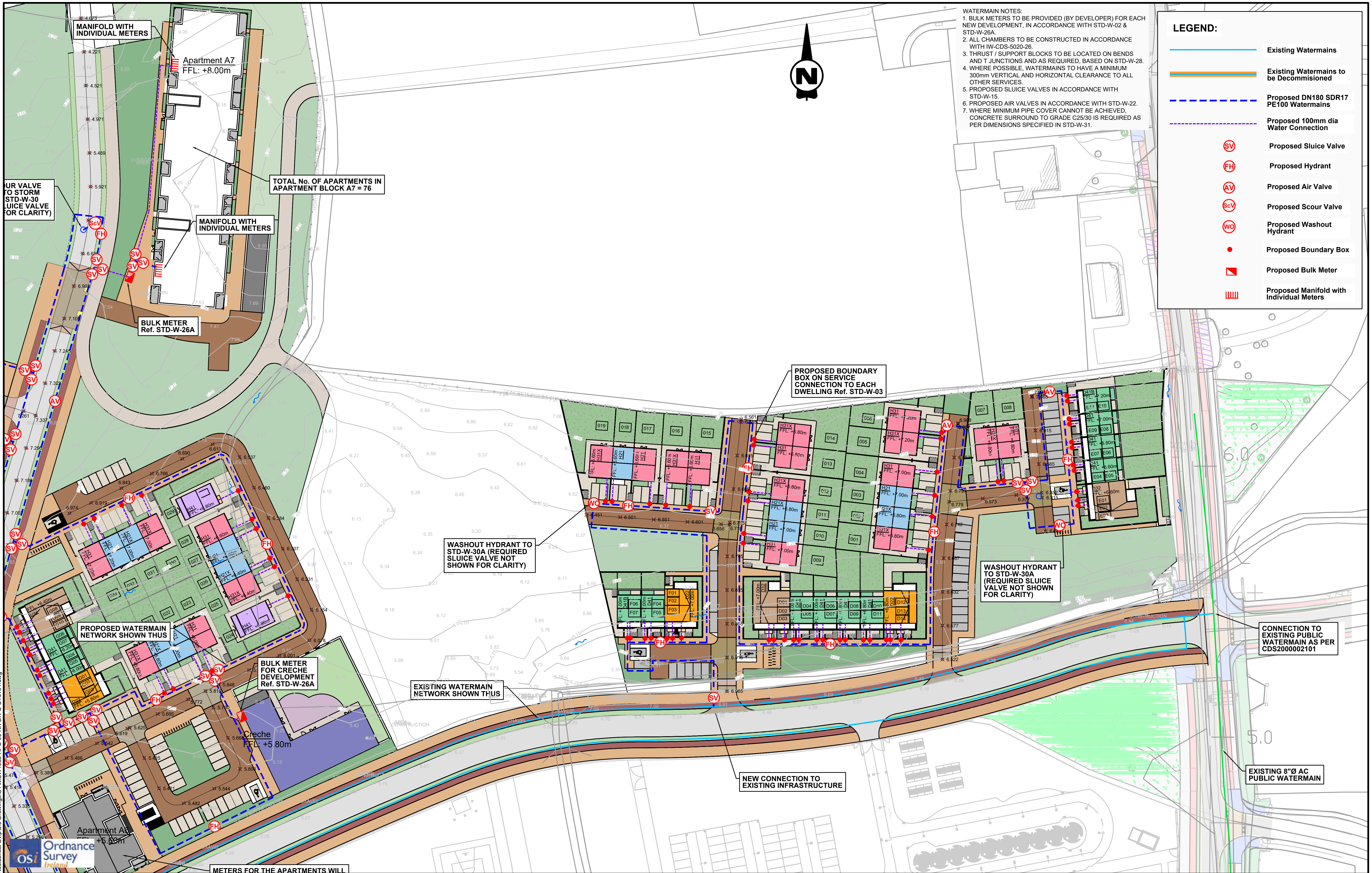

Client

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Rev	Date	Drn Chk	Amendment / Issue	App
S3 P03	08/06/22	PGR GMcC	Issue for Review and Comment	BB
S3 P02	03/06/22	PGR GMcC	Issue for Review and Planning	BB
S3 P01	23/05/22	PGR GMcC	Issue for Review and Comment	BB
P01	26/10/21	PGR GMcC	Pre-Application Submission	BB

Model File Identifier: MCW1088-RPS-00-XX-DR-C-UT0101

Scale: 1:500 @ A1, 1:1000 @ A3

Created on: 13/09/2021

Sheets: 04 of 09

Project: Castlelake SHD

Title: Proposed Watermain Infrastructure
Watermain Layout
(3 of 8)

File Identifier: MCW1088-RPS-00-XX-DR-C-UT0101-04

Status: S3

Rev: P03

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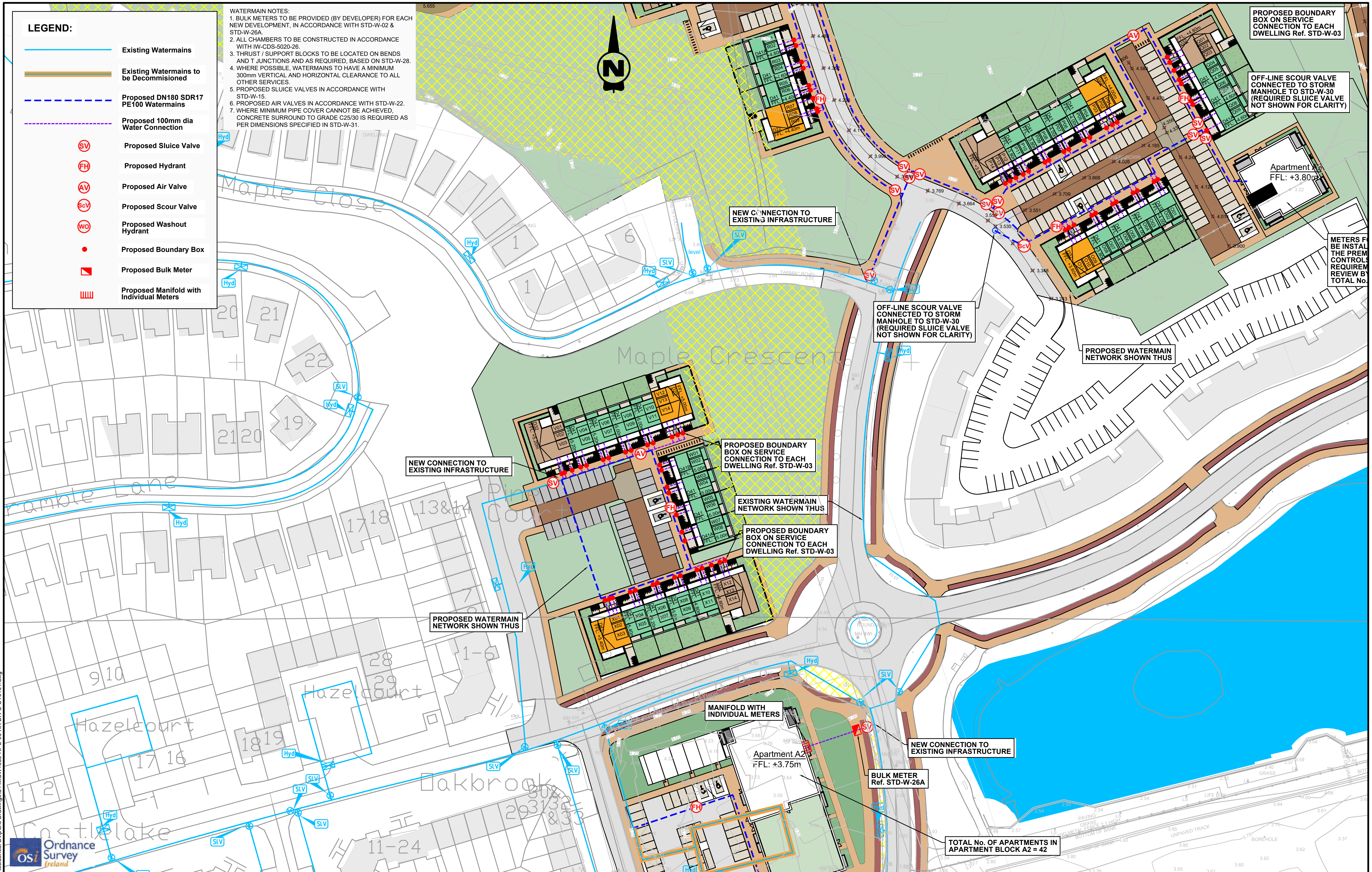

Client

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Rev	Date	Drn / Chk	Amendment / Issue	App
S3 P03	08/06/2022	PGR / GMcC	Issue for Review and Comment	BB
S3 P02	03/06/22	PGR / GMcC	Issue for Review and Comment	BB
S3 P01	23/05/22	PGR / GMcC	Issue for Review and Comment	BB
P01	26/10/21	PGR / GMcC	Pre-Application Submission	BB

rps

Scale	1:500 @ A1 / 1:1000 @ A3
Created on	13/09/2021
Sheets	05 of 09
Project	Castlelake SHD
Title	Proposed Watermain Infrastructure Watermain Layout (4 of 8)
Model File Identifier	MCW1088-RPS-00-XX-DR-C-UT0101
File Identifier	MCW1088-RPS-00-XX-DR-C-UT0101-05
Status	S3
Rev	P03

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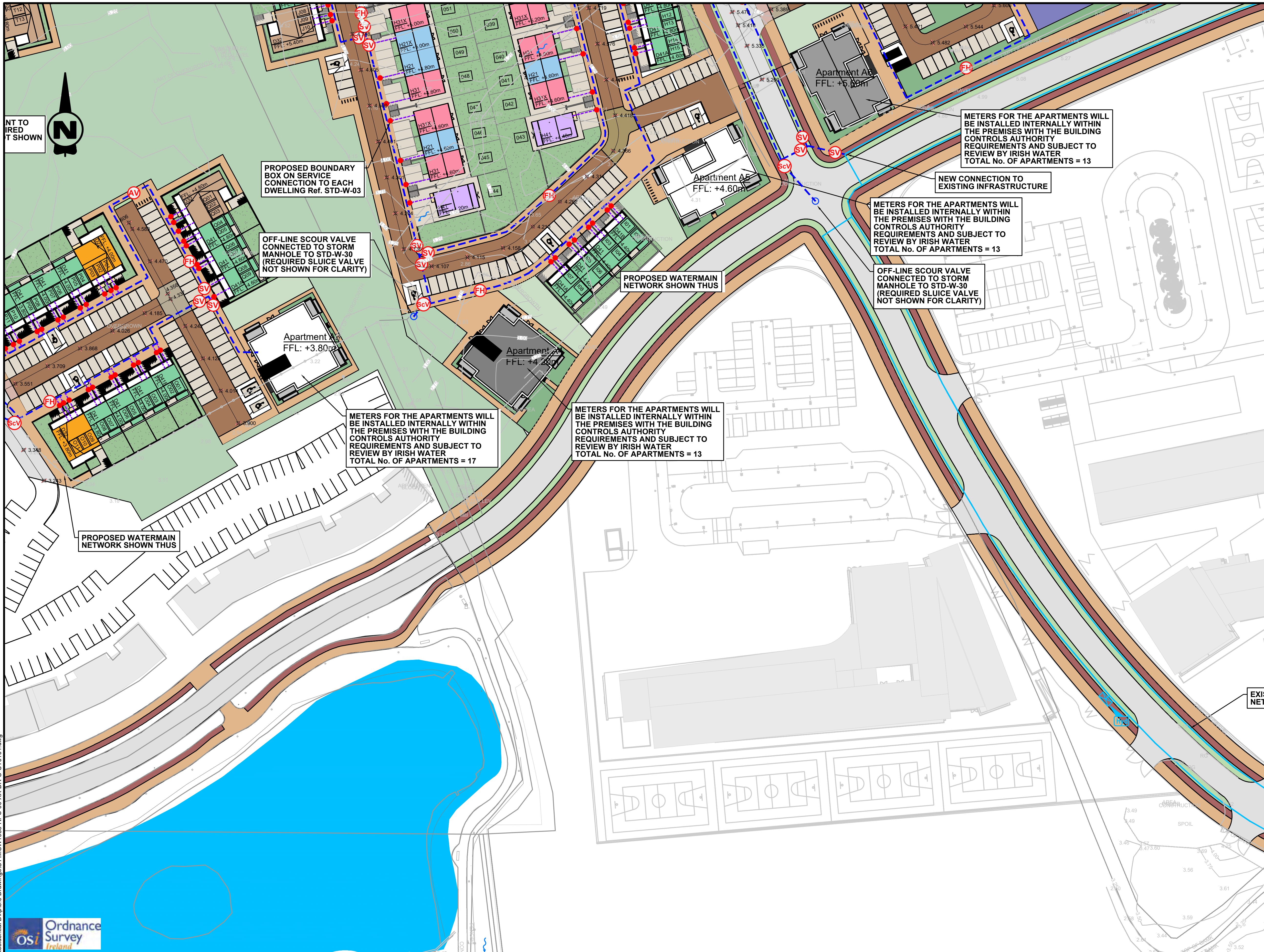

LEGEND:

- Existing Watermains
- Existing Watermains to be Decommisioned
- Proposed DN180 SDR17 PE100 Watermains
- Proposed 100mm dia Water Connection
- SV Proposed Sluice Valve
- FH Proposed Hydrant
- AV Proposed Air Valve
- ScV Proposed Scour Valve
- WO Proposed Washout Hydrant
- Proposed Boundary Box
- Proposed Bulk Meter
- Proposed Manifold with Individual Meters

WATERMAIN NOTES:

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2. ALL CHAMBERS TO BE CONSTRUCTED IN ACCORDANCE WITH IW-CDS-5020-26.
3. THRUST / SUPPORT BLOCKS TO BE LOCATED ON BENDS AND T JUNCTIONS AND AS REQUIRED, BASED ON STD-W-28.
4. WHERE POSSIBLE, WATERMAINS TO HAVE A MINIMUM 300mm VERTICAL AND HORIZONTAL CLEARANCE TO ALL OTHER SERVICES.
5. PROPOSED SLUICE VALVES IN ACCORDANCE WITH STD-W-15.
6. PROPOSED AIR VALVES IN ACCORDANCE WITH STD-W-22.
7. WHERE MINIMUM PIPE COVER CANNOT BE ACHIEVED, CONCRETE SURROUND TO GRADE C25/30 IS REQUIRED AS PER DIMENSIONS SPECIFIED IN STD-W-31.

Client

General Notes

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(ii) DO NOT SCALE, use figured dimensions only.

(iii) This drawing is the property of RPS, it is a project confidential classified document. It must not be copied used or its contents divulged without prior written consent. The needs and expectations of client and RPS must be considered when working with this drawing.

(iv) Information including topographical survey, geotechnical investigation and utility detail used in the design have been provided by others.

(v) All Levels refer to Ordnance Survey Datum, Malin Head.

Rev	Date	Drn	Chk	Amendment / Issue	App
S3 P03	08/06/22	PGR	GMcC	Issue for Review and Comment	BB
P01	26/10/21	PGR	GMcC	Pre-Application Submission	BB

rps

Model File Identifier: MCW1088-RPS-00-XX-DR-C-UT0101

Scale: 1:500 @ A1, 1:1000 @ A3

Created on: 13/09/2021

Sheets: 06 of 09

Project: Castlelake SHD

Title: Proposed Watermain Infrastructure Watermain Layout (5 of 8)

File Identifier: MCW1088-RPS-00-XX-DR-C-UT0101-06

Status: S3

Rev: P03

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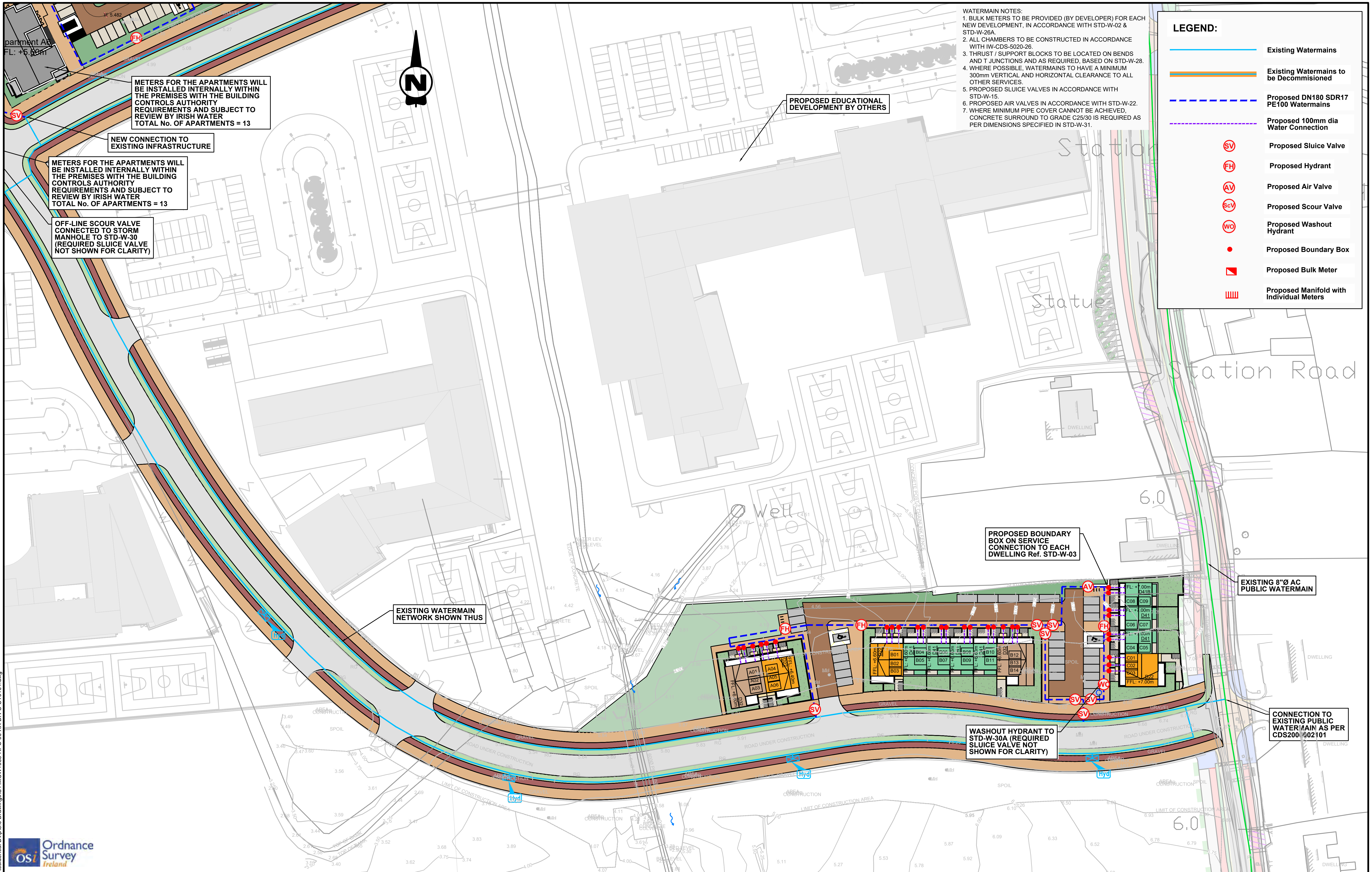

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Rev	Date	Drn/Chk	Amendment / Issue	App
S3 P03	08/06/22	PGR/GMcC	Issue for Review and Comment	BB
P01	26/10/21	PGR/GMcC	Pre-Application Submission	BB

rps

Scale: 1:500 @ A1, 1:1000 @ A3
Created on: 13/09/2021
Sheets: 07 of 09
Project: Castlelake SHD
Title: Proposed Watermain Infrastructure Watermain Layout (6 of 8)
Model File Identifier: MCW1088-RPS-00-XX-DR-C-UT0101
File Identifier: MCW1088-RPS-00-XX-DR-C-UT0101-07
Status: S3
Rev: P03

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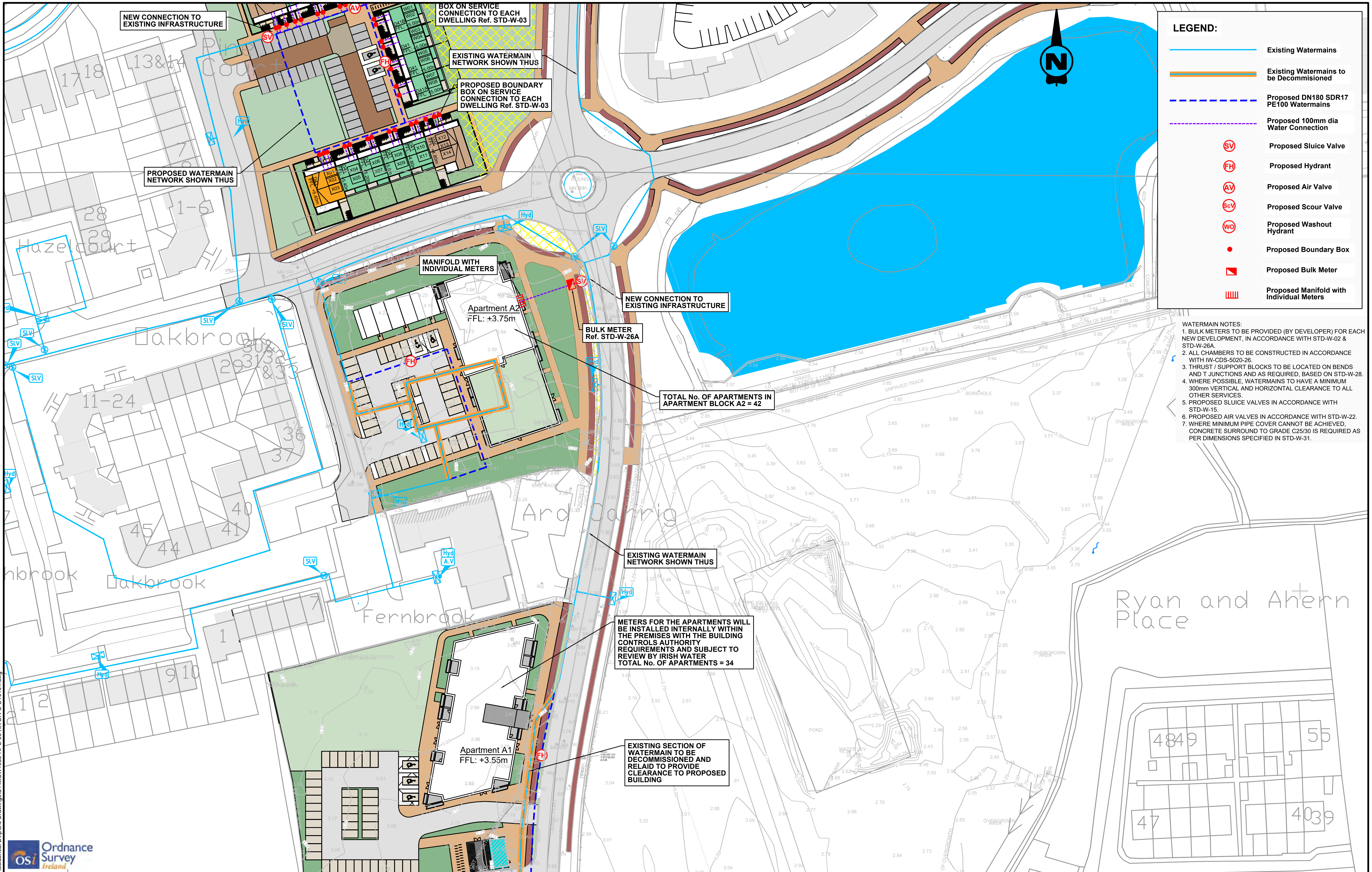

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Rev	Date	Drn Chk	Amendment / Issue	App
S3 P03	08/06/22	PGR GMcC	Issue for Review and Comment	BB
P01	26/10/21	PGR GMcC	Pre-Application Submission	BB

Scale 1:500 @ A1 1:1000 @ A3
Created on 03/09/2021
Sheets 08 of 09

Project: Castlelake SHD
Title: Proposed Watermain Infrastructure Watermain Layout (7 of 8)

Model File Identifier: MCW1088-RPS-00-XX-DR-C-UT0101
File Identifier: MCW1088-RPS-00-XX-DR-C-UT0101-08
Status: S3
Rev: P03

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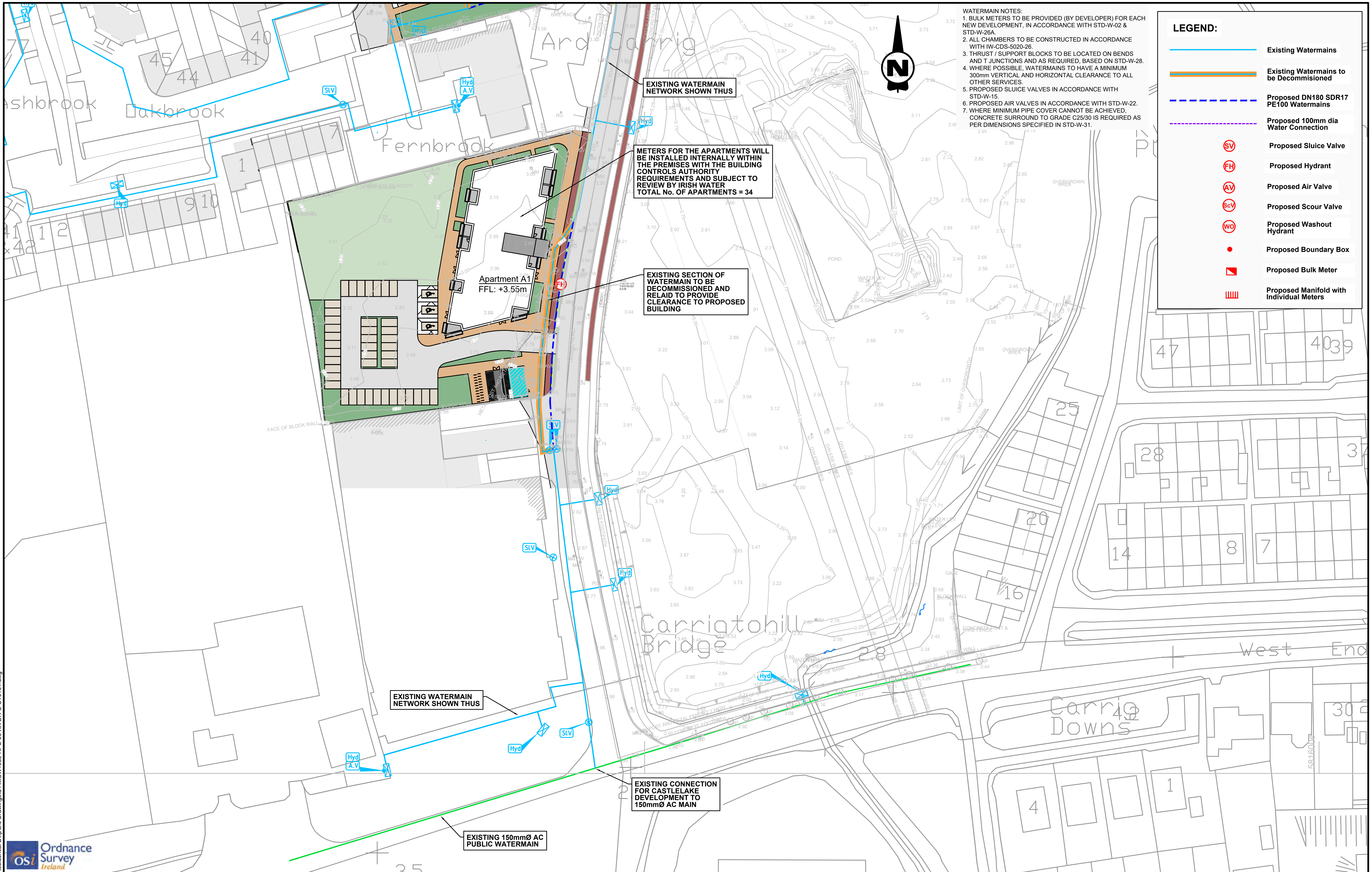

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S3 P03	08/06/22	PGR / GMcC	Issue for Review and Comment	BB
P01	26/10/21	PGR / GMcC	Pre-Application Submission	BB

rps

Model File Identifier: MCW1088-RPS-00-XX-DR-C-UT0101

Scale: 1:500 @ A1, 1:1000 @ A3
Created on: 13/09/2021
Sheets: 09 of 09

Project: Castlelake SHD

Title: Proposed Watermain Infrastructure Watermain Layout (8 of 8)

File Identifier: MCW1088-RPS-00-XX-DR-C-UT0101-09
Status: S3
Rev: P03

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Ordnance Survey Ireland

Appendix E
MicroDrainage Stormwater Outputs

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - Scotland and Ireland

Return Period (years)	2	PIMP (%)	100
M5-60 (mm)	18.000	Add Flow / Climate Change (%)	10
Ratio R	0.249	Minimum Backdrop Height (m)	0.000
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	0.000
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.275
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for Storm

« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S-1.000	42.725	0.465	91.9	0.141	4.00	0.0	0.600	o	225	Pipe/Conduit	
S-1.001	44.570	0.490	91.0	0.136	0.00	0.0	0.600	o	225	Pipe/Conduit	
S-1.002	29.285	0.802	36.5	0.059	0.00	0.0	0.600	o	225	Pipe/Conduit	
S-2.000	16.597	0.097	171.0	0.041	4.00	0.0	0.600	o	225	Pipe/Conduit	
S-2.001	48.868	0.303	161.3	0.129	0.00	0.0	0.600	o	225	Pipe/Conduit	
S-2.002	38.884	0.227	171.3	0.093	0.00	0.0	0.600	o	225	Pipe/Conduit	
S-1.003	63.774	0.671	95.0	0.240	0.00	0.0	0.600	o	375	Pipe/Conduit	
S-3.000	64.117	0.375	171.0	0.239	4.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S-1.000	50.00	4.52	6.630	0.141	0.0	0.0	1.9	1.36	54.3	21.1
S-1.001	50.00	5.06	6.165	0.277	0.0	0.0	3.8	1.37	54.5	41.3
S-1.002	50.00	5.29	5.675	0.337	0.0	0.0	4.6	2.17	86.4	50.1
S-2.000	50.00	4.28	5.500	0.041	0.0	0.0	0.6	1.00	39.6	6.1
S-2.001	50.00	5.07	5.403	0.169	0.0	0.0	2.3	1.03	40.8	25.2
S-2.002	48.95	5.72	5.100	0.263	0.0	0.0	3.5	1.00	39.6	38.3
S-1.003	47.20	6.29	4.723	0.840	0.0	0.0	10.7	1.86	205.3	118.1
S-3.000	50.00	5.07	4.875	0.239	0.0	0.0	3.2	1.00	39.6	35.6

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S-3.001	47.134	0.191	247.0	0.236	0.00	0.0	0.600	o	300	Pipe/Conduit	
S-3.002	34.771	0.107	325.0	0.042	0.00	0.0	0.600	o	375	Pipe/Conduit	
S-4.000	13.570	0.151	89.9	0.000	4.00	0.0	0.600	o	225	Pipe/Conduit	
S-5.000	17.242	0.101	171.0	0.040	4.00	0.0	0.600	o	225	Pipe/Conduit	
S-4.001	58.479	0.342	171.0	0.216	0.00	0.0	0.600	o	225	Pipe/Conduit	
S-4.002	30.194	0.155	194.8	0.038	0.00	0.0	0.600	o	300	Pipe/Conduit	
S-1.004	63.545	0.868	73.2	0.243	0.00	0.0	0.600	o	450	Pipe/Conduit	
S-6.000	59.281	0.670	88.5	0.154	4.00	0.0	0.600	o	225	Pipe/Conduit	
S-6.001	59.281	0.670	88.5	0.131	0.00	0.0	0.600	o	225	Pipe/Conduit	
S-6.002	52.672	0.595	88.5	0.131	0.00	0.0	0.600	o	300	Pipe/Conduit	
S-6.003	49.103	0.151	325.0	0.177	0.00	0.0	0.600	o	375	Pipe/Conduit	
S-7.000	17.242	0.101	171.0	0.044	4.00	0.0	0.600	o	225	Pipe/Conduit	
S-8.000	13.570	0.251	54.1	0.034	4.00	0.0	0.600	o	225	Pipe/Conduit	
S-7.001	61.058	0.247	247.0	0.215	0.00	0.0	0.600	o	300	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S-3.001	48.51	5.86	4.425	0.475	0.0	0.0	6.2	1.00	70.4	68.7
S-3.002	46.78	6.44	4.159	0.518	0.0	0.0	6.6	1.00	110.4	72.1
S-4.000	50.00	4.16	4.850	0.000	0.0	0.0	0.0	1.38	54.9	0.0
S-5.000	50.00	4.29	4.800	0.040	0.0	0.0	0.5	1.00	39.6	6.0
S-4.001	50.00	5.27	4.699	0.257	0.0	0.0	3.5	1.00	39.6	38.3
S-4.002	48.98	5.71	4.282	0.295	0.0	0.0	3.9	1.12	79.4	43.0
S-1.004	45.55	6.89	3.977	1.895	0.0	0.0	23.4	2.38	378.3	257.2
S-6.000	50.00	4.71	5.420	0.154	0.0	0.0	2.1	1.39	55.3	22.9
S-6.001	49.94	5.42	4.750	0.285	0.0	0.0	3.9	1.39	55.3	42.4
S-6.002	48.25	5.95	4.005	0.416	0.0	0.0	5.4	1.67	118.2	59.8
S-6.003	45.88	6.76	3.335	0.593	0.0	0.0	7.4	1.00	110.4	81.0
S-7.000	50.00	4.29	4.100	0.044	0.0	0.0	0.6	1.00	39.6	6.5
S-8.000	50.00	4.13	4.250	0.034	0.0	0.0	0.5	1.78	70.9	5.0
S-7.001	50.00	5.31	3.924	0.293	0.0	0.0	4.0	1.00	70.4	43.6

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S-7.002	30.321	0.418	72.5	0.077	0.00	0.0	0.600	o	300	Pipe/Conduit	
S-1.005	35.791	0.199	179.9	0.044	0.00	0.0	0.600	o	600	Pipe/Conduit	
S-9.000	19.627	0.115	171.0	0.041	4.00	0.0	0.600	o	225	Pipe/Conduit	
S-1.006	41.828	0.515	81.2	0.099	0.00	0.0	0.600	o	600	Pipe/Conduit	
S-1.007	17.293	0.200	86.5	0.022	0.00	0.0	0.600	o	600	Pipe/Conduit	
S-1.008	15.019	0.110	136.5	0.015	0.00	0.0	0.600	o	600	Pipe/Conduit	
S-10.000	26.058	0.152	171.4	0.142	4.00	0.0	0.600	o	225	Pipe/Conduit	
S-11.000	23.350	0.377	61.9	0.089	4.00	0.0	0.600	o	225	Pipe/Conduit	
S-10.001	60.547	0.245	247.1	0.236	0.00	0.0	0.600	o	300	Pipe/Conduit	
S-10.002	13.128	0.040	325.0	0.015	0.00	0.0	0.600	o	375	Pipe/Conduit	
S-10.003	12.009	0.037	325.0	0.024	0.00	0.0	0.600	o	375	Pipe/Conduit	
S-1.009	23.178	0.024	975.0	0.044	0.00	0.0	0.600	o	900	Pipe/Conduit	
S-1.010	30.179	0.031	975.0	0.000	0.00	0.0	0.600	o	900	Pipe/Conduit	
S-1.011	48.163	0.024	2006.8	0.000	0.00	0.0	0.600	o	1200	Pipe/Conduit	
S-1.012	24.661	0.060	412.0	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S-7.002	49.40	5.58	3.677	0.370	0.0	0.0	4.9	1.85	130.6	54.4
S-1.005	44.70	7.21	2.959	2.901	0.0	0.0	35.1	1.81	512.5	386.4
S-9.000	50.00	4.33	3.250	0.041	0.0	0.0	0.6	1.00	39.6	6.1
S-1.006	44.06	7.47	2.760	3.041	0.0	0.0	36.3	2.70	764.5	399.1
S-1.007	43.79	7.58	2.245	3.063	0.0	0.0	36.3	2.62	740.8	399.6
S-1.008	43.50	7.70	2.045	3.078	0.0	0.0	36.3	2.08	588.8	399.6
S-10.000	50.00	4.44	2.800	0.142	0.0	0.0	1.9	1.00	39.6	21.2
S-11.000	50.00	4.23	3.025	0.089	0.0	0.0	1.2	1.66	66.2	13.3
S-10.001	49.84	5.45	2.573	0.468	0.0	0.0	6.3	1.00	70.4	69.4
S-10.002	49.12	5.67	2.253	0.483	0.0	0.0	6.4	1.00	110.4	70.7
S-10.003	48.49	5.87	2.213	0.507	0.0	0.0	6.7	1.00	110.4	73.2
S-1.009	42.61	8.09	1.760	3.629	0.0	0.0	41.9	1.00	633.0	460.6
S-1.010	41.51	8.60	1.736	3.629	0.0	0.0	41.9	1.00	633.0	460.6
S-1.011	39.60	9.57	1.705	3.629	0.0	0.0	41.9	0.83	933.8	460.6
S-1.012	50.00	4.41	1.681	0.000	100.0	0.0	9.1	1.00	158.3	100.0

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S-12.000	59.069	0.345	171.0	0.201	4.00	0.0	0.600	o	225	Pipe/Conduit	
S-12.001	58.734	0.238	247.0	0.150	0.00	0.0	0.600	o	300	Pipe/Conduit	
S-13.000	38.044	1.598	23.8	0.108	4.00	0.0	0.600	o	225	Pipe/Conduit	
S-12.002	71.451	0.240	297.7	0.280	0.00	0.0	0.600	o	375	Pipe/Conduit	
S-14.000	48.554	0.270	179.8	0.286	4.00	0.0	0.600	o	300	Pipe/Conduit	
S-14.001	50.398	0.204	247.0	0.094	0.00	0.0	0.600	o	300	Pipe/Conduit	
S-14.002	50.398	0.155	325.0	0.195	0.00	0.0	0.600	o	375	Pipe/Conduit	
S-14.003	23.889	0.074	325.0	0.052	0.00	0.0	0.600	o	375	Pipe/Conduit	
S-12.003	39.667	0.389	102.0	0.072	0.00	0.0	0.600	o	375	Pipe/Conduit	
S-15.000	65.311	0.264	247.0	0.321	4.00	0.0	0.600	o	300	Pipe/Conduit	
S-15.001	5.361	0.022	247.0	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S-15.002	45.902	1.439	31.9	0.039	0.00	0.0	0.600	o	300	Pipe/Conduit	
S-16.000	19.233	0.112	171.0	0.036	4.00	0.0	0.600	o	225	Pipe/Conduit	
S-15.003	36.127	0.146	247.0	0.051	0.00	0.0	0.600	o	300	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S-12.000	50.00	4.99	6.230	0.201	0.0	0.0	2.7	1.00	39.6	29.9
S-12.001	48.17	5.97	5.810	0.351	0.0	0.0	4.6	1.00	70.4	50.4
S-13.000	50.00	4.24	7.245	0.108	0.0	0.0	1.5	2.69	107.1	16.2
S-12.002	44.97	7.11	5.497	0.739	0.0	0.0	9.0	1.04	115.4	99.0
S-14.000	50.00	4.69	6.035	0.286	0.0	0.0	3.9	1.17	82.7	42.6
S-14.001	49.56	5.54	5.765	0.381	0.0	0.0	5.1	1.00	70.4	56.2
S-14.002	46.96	6.38	5.486	0.576	0.0	0.0	7.3	1.00	110.4	80.5
S-14.003	45.85	6.77	5.331	0.628	0.0	0.0	7.8	1.00	110.4	85.7
S-12.003	44.04	7.48	5.257	1.439	0.0	0.0	17.2	1.79	198.2	188.8
S-15.000	50.00	5.09	6.825	0.321	0.0	0.0	4.3	1.00	70.4	47.8
S-15.001	50.00	5.18	6.561	0.321	0.0	0.0	4.3	1.00	70.4	47.8
S-15.002	49.82	5.46	6.539	0.360	0.0	0.0	4.9	2.79	197.5	53.4
S-16.000	50.00	4.32	5.276	0.036	0.0	0.0	0.5	1.00	39.6	5.3
S-15.003	47.89	6.06	5.089	0.447	0.0	0.0	5.8	1.00	70.4	63.7

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S-12.004	11.888	0.020	590.0	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	
S-12.005	17.783	0.030	590.0	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	
S-12.006	7.444	0.005	1488.9	0.000	0.00	0.0	0.600	o	900	Pipe/Conduit	
S-12.007	1.751	0.003	590.0	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	
S-12.008	43.651	0.177	247.0	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S-12.009	43.382	0.687	63.1	0.188	0.00	0.0	0.600	o	300	Pipe/Conduit	
S-17.000	47.357	1.476	32.1	0.251	4.00	0.0	0.600	o	225	Pipe/Conduit	
S-18.000	21.528	0.126	171.0	0.044	4.00	0.0	0.600	o	225	Pipe/Conduit	
S-17.001	44.448	0.180	247.0	0.070	0.00	0.0	0.600	o	300	Pipe/Conduit	
S-17.002	26.984	0.109	247.0	0.068	0.00	0.0	0.600	o	300	Pipe/Conduit	
S-17.003	34.361	0.139	247.0	0.058	0.00	0.0	0.600	o	300	Pipe/Conduit	
S-12.010	23.928	0.058	412.0	0.042	0.00	0.0	0.600	o	450	Pipe/Conduit	
S-12.011	25.184	0.116	217.1	0.047	0.00	0.0	0.600	o	450	Pipe/Conduit	
S-19.000	27.762	0.162	171.0	0.118	4.00	0.0	0.600	o	225	Pipe/Conduit	
S-20.000	45.521	0.345	131.9	0.109	4.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S-12.004	43.56	7.68	4.643	1.886	0.0	0.0	22.2	1.00	281.4	244.7
S-12.005	42.87	7.98	4.623	1.886	0.0	0.0	22.2	1.00	281.4	244.7
S-12.006	42.52	8.13	4.593	1.886	0.0	0.0	22.2	0.80	510.8	244.7
S-12.007	42.46	8.16	4.588	1.886	0.0	0.0	22.2	1.00	281.4	244.7
S-12.008	50.00	4.73	4.585	0.000	16.1	0.0	1.5	1.00	70.4	16.1
S-12.009	50.00	5.10	4.408	0.188	16.1	0.0	4.2	1.98	140.1	45.7
S-17.000	50.00	4.34	5.700	0.251	0.0	0.0	3.4	2.32	92.2	37.3
S-18.000	50.00	4.36	4.350	0.044	0.0	0.0	0.6	1.00	39.6	6.5
S-17.001	50.00	5.10	4.149	0.365	0.0	0.0	4.9	1.00	70.4	54.3
S-17.002	49.49	5.56	3.969	0.433	0.0	0.0	5.8	1.00	70.4	63.9
S-17.003	47.69	6.13	3.860	0.491	0.0	0.0	6.3	1.00	70.4	69.8
S-12.010	46.52	6.53	3.571	0.721	16.1	0.0	10.7	1.00	158.3	117.7
S-12.011	45.69	6.84	3.513	0.768	16.1	0.0	11.1	1.38	218.8	122.3
S-19.000	50.00	4.46	3.997	0.118	0.0	0.0	1.6	1.00	39.6	17.6
S-20.000	50.00	4.67	5.435	0.109	0.0	0.0	1.5	1.14	45.2	16.3

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S-20.001	5.510	0.060	91.8	0.005	0.00	0.0	0.600	o	225	Pipe/Conduit	
S-20.002	53.628	0.410	130.8	0.125	0.00	0.0	0.600	o	225	Pipe/Conduit	
S-20.003	5.565	0.060	92.8	0.006	0.00	0.0	0.600	o	225	Pipe/Conduit	
S-20.004	36.150	0.614	58.9	0.052	0.00	0.0	0.600	o	225	Pipe/Conduit	
S-21.000	25.564	0.149	171.0	0.133	4.00	0.0	0.600	o	225	Pipe/Conduit	
S-20.005	25.036	0.111	225.6	0.050	0.00	0.0	0.600	o	300	Pipe/Conduit	
S-19.001	16.906	0.053	320.0	0.023	0.00	0.0	0.600	o	375	Pipe/Conduit	
S-22.000	35.714	0.768	46.5	0.065	4.00	0.0	0.600	o	225	Pipe/Conduit	
S-19.002	11.793	0.037	320.0	0.022	0.00	0.0	0.600	o	375	Pipe/Conduit	
S-23.000	1.912	0.005	382.3	0.000	4.00	0.0	0.600	o	450	Pipe/Conduit	
S-23.001	5.679	0.014	412.0	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
S-19.003	11.793	0.048	247.0	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S-12.012	18.485	0.045	412.0	0.031	0.00	0.0	0.600	o	450	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S-20.001	50.00	4.73	5.090	0.115	0.0	0.0	1.6	1.36	54.3	17.1
S-20.002	49.62	5.52	5.030	0.240	0.0	0.0	3.2	1.14	45.4	35.5
S-20.003	49.39	5.59	4.620	0.245	0.0	0.0	3.3	1.36	54.0	36.1
S-20.004	48.27	5.94	4.560	0.297	0.0	0.0	3.9	1.71	67.9	42.8
S-21.000	50.00	4.43	4.095	0.133	0.0	0.0	1.8	1.00	39.6	19.8
S-20.005	47.07	6.34	3.871	0.480	0.0	0.0	6.1	1.04	73.7	67.3
S-19.001	46.28	6.62	3.685	0.621	0.0	0.0	7.8	1.01	111.3	85.6
S-22.000	50.00	4.31	4.550	0.065	0.0	0.0	0.9	1.92	76.5	9.7
S-19.002	45.75	6.81	3.632	0.708	0.0	0.0	8.8	1.01	111.3	96.5
S-23.000	50.00	4.03	3.614	0.000	0.0	0.0	0.0	1.03	164.4	0.0
S-23.001	50.00	4.13	3.609	0.000	0.0	0.0	0.0	1.00	158.3	0.0
S-19.003	50.00	4.20	3.595	0.000	5.5	0.0	0.5	1.00	70.4	5.5
S-12.012	44.87	7.15	3.396	0.799	21.6	0.0	11.9	1.00	158.3	130.6

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S-24.000	44.836	0.262	171.0	0.202	4.00	0.0	0.600	o	225	Pipe/Conduit	
S-24.001	57.558	0.987	58.3	0.143	0.00	0.0	0.600	o	225	Pipe/Conduit	
S-25.000	26.864	0.620	43.3	0.168	4.00	0.0	0.600	o	225	Pipe/Conduit	
S-25.001	38.083	0.225	169.3	0.161	0.00	0.0	0.600	o	300	Pipe/Conduit	
S-26.000	17.375	0.102	170.3	0.051	4.00	0.0	0.600	o	225	Pipe/Conduit	
S-25.002	10.343	0.042	247.0	0.061	0.00	0.0	0.600	o	300	Pipe/Conduit	
S-25.003	38.930	0.122	320.0	0.099	0.00	0.0	0.600	o	375	Pipe/Conduit	
S-25.004	28.665	0.090	320.0	0.049	0.00	0.0	0.600	o	375	Pipe/Conduit	
S-24.002	10.501	0.025	412.0	0.066	0.00	0.0	0.600	o	450	Pipe/Conduit	
S-24.003	22.840	0.055	412.0	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
S-24.004	23.402	0.057	412.0	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
S-24.005	9.493	0.073	130.0	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
S-24.006	5.743	0.288	19.9	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
S-27.000	51.515	0.330	156.1	0.089	4.00	0.0	0.600	o	225	Pipe/Conduit	
S-27.001	5.643	0.033	171.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S-27.002	32.659	0.191	171.0	0.079	0.00	0.0	0.600	o	225	Pipe/Conduit	
S-27.003	5.501	0.032	171.9	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S-24.000	50.00	4.75	4.050	0.202	0.0	0.0	2.7	1.00	39.6	30.1
S-24.001	50.00	5.31	3.788	0.345	0.0	0.0	4.7	1.72	68.2	51.4
S-25.000	50.00	4.22	3.900	0.168	0.0	0.0	2.3	1.99	79.2	25.0
S-25.001	50.00	4.75	3.205	0.329	0.0	0.0	4.5	1.21	85.2	49.0
S-26.000	50.00	4.29	3.157	0.051	0.0	0.0	0.7	1.00	39.7	7.6
S-25.002	50.00	4.92	2.980	0.441	0.0	0.0	6.0	1.00	70.4	65.7
S-25.003	49.45	5.57	2.863	0.540	0.0	0.0	7.2	1.01	111.3	79.6
S-25.004	47.95	6.04	2.741	0.589	0.0	0.0	7.6	1.01	111.3	84.1
S-24.002	47.42	6.22	2.576	1.000	0.0	0.0	12.8	1.00	158.3	141.3
S-24.003	46.33	6.60	2.551	1.000	0.0	0.0	12.8	1.00	158.3	141.3
S-24.004	45.27	6.99	2.496	1.000	0.0	0.0	12.8	1.00	158.3	141.3
S-24.005	45.04	7.08	2.439	1.000	0.0	0.0	12.8	1.78	283.3	141.3
S-24.006	44.99	7.10	2.366	1.000	0.0	0.0	12.8	4.57	726.7	141.3
S-27.000	50.00	4.82	5.350	0.089	0.0	0.0	1.2	1.04	41.5	13.2
S-27.001	50.00	4.92	5.020	0.089	0.0	0.0	1.2	1.00	39.6	13.2
S-27.002	49.80	5.46	4.987	0.168	0.0	0.0	2.3	1.00	39.6	24.9
S-27.003	49.49	5.56	4.796	0.168	0.0	0.0	2.3	0.99	39.5	24.9

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S-28.000	14.450	0.085	171.0	0.042	4.00	0.0	0.600	o	225	Pipe/Conduit	
S-28.001	6.410	0.115	55.7	0.035	0.00	0.0	0.600	o	225	Pipe/Conduit	
S-27.004	23.947	0.097	247.0	0.052	0.00	0.0	0.600	o	300	Pipe/Conduit	
S-29.000	25.520	0.783	32.6	0.082	4.00	0.0	0.600	o	225	Pipe/Conduit	
S-27.005	17.786	0.072	247.0	0.040	0.00	0.0	0.600	o	300	Pipe/Conduit	
S-27.006	2.166	0.009	247.0	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S-27.007	7.301	0.011	663.5	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S-27.008	1.133	0.005	247.0	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S-27.009	1.839	0.022	83.6	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S-30.000	26.940	0.350	77.0	0.081	4.00	0.0	0.600	o	225	Pipe/Conduit	
S-31.000	40.958	0.240	171.0	0.101	4.00	0.0	0.600	o	225	Pipe/Conduit	
S-30.001	30.499	0.178	171.0	0.064	0.00	0.0	0.600	o	225	Pipe/Conduit	
S-30.002	6.023	0.035	171.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S-32.000	15.684	0.092	171.0	0.070	4.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S-28.000	50.00	4.24	5.370	0.042	0.0	0.0	0.6	1.00	39.6	6.3
S-28.001	50.00	4.30	5.285	0.077	0.0	0.0	1.0	1.76	69.8	11.5
S-27.004	48.22	5.96	4.689	0.296	0.0	0.0	3.9	1.00	70.4	42.6
S-29.000	50.00	4.18	5.450	0.082	0.0	0.0	1.1	2.30	91.4	12.2
S-27.005	47.32	6.25	4.592	0.418	0.0	0.0	5.4	1.00	70.4	59.0
S-27.006	47.21	6.29	4.520	0.418	0.0	0.0	5.4	1.00	70.4	59.0
S-27.007	46.63	6.49	4.446	0.418	0.0	0.0	5.4	0.60	42.6«	59.0
S-27.008	46.58	6.51	4.435	0.418	0.0	0.0	5.4	1.00	70.4	59.0
S-27.009	50.00	4.02	4.430	0.000	3.7	0.0	0.3	1.43	56.9	3.7
S-30.000	50.00	4.30	5.045	0.081	0.0	0.0	1.1	1.49	59.3	12.0
S-31.000	50.00	4.68	4.935	0.101	0.0	0.0	1.4	1.00	39.6	15.1
S-30.001	50.00	5.19	4.695	0.246	0.0	0.0	3.3	1.00	39.6	36.6
S-30.002	50.00	5.30	4.517	0.246	0.0	0.0	3.3	1.00	39.6	36.6
S-32.000	50.00	4.26	5.300	0.070	0.0	0.0	0.9	1.00	39.6	10.4

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S-32.001	5.582	0.033	171.0	0.019	0.00	0.0	0.600	o	225	Pipe/Conduit	
S-30.003	4.566	0.018	247.0	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S-33.000	24.783	0.145	171.0	0.134	4.00	0.0	0.600	o	225	Pipe/Conduit	
S-33.001	28.205	0.165	171.0	0.105	0.00	0.0	0.600	o	225	Pipe/Conduit	
S-33.002	41.137	0.167	247.0	0.090	0.00	0.0	0.600	o	300	Pipe/Conduit	
S-34.000	16.771	0.041	409.0	0.000	4.00	0.0	0.600	o	450	Pipe/Conduit	
S-34.001	43.363	0.600	72.3	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
S-35.000	20.252	0.118	171.6	0.147	4.00	0.0	0.600	o	225	Pipe/Conduit	
S-35.001	12.023	0.070	171.8	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S-36.000	38.527	1.198	32.2	0.148	4.00	0.0	0.600	o	225	Pipe/Conduit	
S-37.000	16.575	0.097	171.0	0.038	4.00	0.0	0.600	o	225	Pipe/Conduit	
S-37.001	13.453	0.303	44.4	0.022	0.00	0.0	0.600	o	225	Pipe/Conduit	
S-38.000	16.808	0.300	56.0	0.051	4.00	0.0	0.600	o	225	Pipe/Conduit	
S-38.001	9.233	0.100	92.3	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S-32.001	50.00	4.36	5.208	0.089	0.0	0.0	1.2	1.00	39.6	13.3
S-30.003	50.00	5.37	4.065	0.335	0.0	0.0	4.5	1.00	70.4	49.9
S-33.000	50.00	4.41	3.936	0.134	0.0	0.0	1.8	1.00	39.6	20.0
S-33.001	50.00	4.89	3.791	0.239	0.0	0.0	3.2	1.00	39.6	35.6
S-33.002	49.43	5.57	3.551	0.329	0.0	0.0	4.4	1.00	70.4	48.4
S-34.000	50.00	4.28	2.816	0.000	0.0	0.0	0.0	1.00	158.9	0.0
S-34.001	50.00	4.58	2.775	0.000	0.0	0.0	0.0	2.39	380.7	0.0
S-35.000	50.00	4.34	2.100	0.147	0.0	0.0	2.0	1.00	39.6	21.9
S-35.001	50.00	4.54	1.982	0.147	0.0	0.0	2.0	0.99	39.5	21.9
S-36.000	50.00	4.28	1.900	0.148	0.0	0.0	2.0	2.32	92.1	22.1
S-37.000	50.00	4.28	1.600	0.038	0.0	0.0	0.5	1.00	39.6	5.6
S-37.001	50.00	4.39	1.503	0.060	0.0	0.0	0.8	1.97	78.3	8.9
S-38.000	50.00	4.16	1.600	0.051	0.0	0.0	0.7	1.75	69.6	7.6
S-38.001	50.00	4.27	1.300	0.051	0.0	0.0	0.7	1.36	54.1	7.6

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S-37.002	36.810	0.215	171.0	0.038	0.00	0.0	0.600	o	225	Pipe/Conduit	
S-37.003	10.480	0.061	171.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S-37.004	15.333	0.216	71.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S-39.000	19.807	0.116	170.7	0.066	4.00	0.0	0.600	o	225	Pipe/Conduit	
S-39.001	4.945	0.029	171.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S-39.002	18.427	0.108	171.0	0.036	0.00	0.0	0.600	o	225	Pipe/Conduit	
S-40.000	24.030	0.141	170.4	0.071	4.00	0.0	0.600	o	225	Pipe/Conduit	
S-40.001	25.710	0.150	171.0	0.104	0.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S-37.002	50.00	5.01	1.200	0.149	0.0	0.0	2.0	1.00	39.6	22.2
S-37.003	50.00	5.18	0.985	0.149	0.0	0.0	2.0	1.00	39.6	22.2
S-37.004	50.00	5.35	0.923	0.149	0.0	0.0	2.0	1.55	61.8	22.2
S-39.000	50.00	4.33	5.573	0.066	0.0	0.0	0.9	1.00	39.7	9.8
S-39.001	50.00	4.41	5.457	0.066	0.0	0.0	0.9	1.00	39.6	9.8
S-39.002	50.00	4.72	5.428	0.102	0.0	0.0	1.4	1.00	39.6	15.1
S-40.000	50.00	4.40	5.839	0.071	0.0	0.0	1.0	1.00	39.7	10.5
S-40.001	50.00	4.83	5.698	0.175	0.0	0.0	2.4	1.00	39.6	26.1

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	10.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs	0	Number of Storage Structures	4
Number of Online Controls	4	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	2	Cv (Summer)	0.750
Region	Scotland and Ireland	Cv (Winter)	0.840
M5-60 (mm)	15.300	Storm Duration (mins)	30
Ratio R	0.273		

Online Controls for Storm

Hydro-Brake® Optimum Manhole: SMH37, DS/PN: S-1.012, Volume (m³): 59.4

Unit Reference	MD-SHE-0387-1000-1600-1000
Design Head (m)	1.600
Design Flow (l/s)	100.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	387
Invert Level (m)	1.681
Minimum Outlet Pipe Diameter (mm)	450
Suggested Manhole Diameter (mm)	Site Specific Design (Contact Hydro International)

Control Points	**Head (m)**	**Flow (l/s)**
Design Point (Calculated)	1.600	99.8
Flush-Flo™	0.619	99.7
Kick-Flo®	1.194	86.6
Mean Flow over Head Range	-	82.4

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**
0.100	10.8	1.200	86.8	3.000	135.5	7.000	205.1
0.200	38.4	1.400	93.5	3.500	146.1	7.500	212.1
0.300	73.4	1.600	99.8	4.000	155.9	8.000	218.9
0.400	96.3	1.800	105.7	4.500	165.2	8.500	225.5
0.500	98.8	2.000	111.2	5.000	173.9	9.000	232.0
0.600	99.6	2.200	116.5	5.500	182.2	9.500	238.2
0.800	98.4	2.400	121.5	6.000	190.1		
1.000	94.9	2.600	126.4	6.500	197.7		

Hydro-Brake® Optimum Manhole: SMH55, DS/PN: S-12.007, Volume (m³): 10.2

Unit Reference	MD-SHE-0172-1610-1600-1610
Design Head (m)	1.600
Design Flow (l/s)	16.1
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	172
Invert Level (m)	4.588
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1500

Hydro-Brake® Optimum Manhole: SMH55, DS/PN: S-12.007, Volume (m³): 10.2

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.600	16.1
Flush-Flo™	0.472	16.0
Kick-Flo®	1.012	12.9
Mean Flow over Head Range	-	13.9

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	6.1	1.200	14.0	3.000	21.7	7.000	32.6
0.200	14.2	1.400	15.1	3.500	23.4	7.500	33.7
0.300	15.5	1.600	16.1	4.000	24.9	8.000	34.8
0.400	16.0	1.800	17.0	4.500	26.3	8.500	35.8
0.500	16.0	2.000	17.9	5.000	27.7	9.000	36.8
0.600	15.9	2.200	18.7	5.500	29.0	9.500	37.8
0.800	15.2	2.400	19.5	6.000	30.3		
1.000	13.2	2.600	20.3	6.500	31.4		

Hydro-Brake® Optimum Manhole: SMH78, DS/PN: S-19.003, Volume (m³): 4.4

Unit Reference	MD-SHE-0102-5500-1600-5500
Design Head (m)	1.600
Design Flow (l/s)	5.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	102
Invert Level (m)	3.595
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.600	5.5
Flush-Flo™	0.442	5.3
Kick-Flo®	0.906	4.2
Mean Flow over Head Range	-	4.7

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.4	0.300	5.2	0.500	5.3	0.800	4.8
0.200	4.8	0.400	5.3	0.600	5.2	1.000	4.4

Hydro-Brake® Optimum Manhole: SMH78, DS/PN: S-19.003, Volume (m^3): 4.4

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
1.200	4.8	2.400	6.6	5.000	9.4	8.000	11.8
1.400	5.2	2.600	6.9	5.500	9.8	8.500	12.1
1.600	5.5	3.000	7.4	6.000	10.2	9.000	12.4
1.800	5.8	3.500	7.9	6.500	10.6	9.500	12.8
2.000	6.1	4.000	8.5	7.000	11.0		
2.200	6.4	4.500	8.9	7.500	11.4		

Hydro-Brake® Optimum Manhole: SMH104, DS/PN: S-27.008, Volume (m^3): 2.3

Unit Reference	MD-SHE-0091-3700-1000-3700
Design Head (m)	1.000
Design Flow (l/s)	3.7
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	91
Invert Level (m)	4.435
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	3.7
Flush-Flo™	0.299	3.7
Kick-Flo®	0.631	3.0
Mean Flow over Head Range	-	3.2

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.9	1.200	4.0	3.000	6.2	7.000	9.2
0.200	3.6	1.400	4.3	3.500	6.6	7.500	9.5
0.300	3.7	1.600	4.6	4.000	7.1	8.000	9.8
0.400	3.6	1.800	4.9	4.500	7.5	8.500	10.1
0.500	3.5	2.000	5.1	5.000	7.8	9.000	10.4
0.600	3.2	2.200	5.3	5.500	8.2	9.500	10.6
0.800	3.3	2.400	5.6	6.000	8.6		
1.000	3.7	2.600	5.8	6.500	8.9		

Storage Structures for Storm

Tank or Pond Manhole: SMH37, DS/PN: S-1.012

Invert Level (m) 1.681

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	650.0	1.600	650.0	1.601	0.0

Tank or Pond Manhole: SMH55, DS/PN: S-12.007

Invert Level (m) 4.588

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	565.0	1.600	565.0	1.601	0.0

Tank or Pond Manhole: SMH76, DS/PN: S-23.000

Invert Level (m) 3.614

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	215.0	1.600	215.0	1.601	0.0

Tank or Pond Manhole: SMH104, DS/PN: S-27.008

Invert Level (m) 4.435

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	200.0	1.000	200.0	1.001	0.0

Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	10.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	4
Number of Online Controls	4	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.249
Region	Scotland and Ireland	Cv (Summer)	0.750
M5-60 (mm)	18.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	150.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 5, 30
Climate Change (%)	0, 0, 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S-1.000	SMH1	15 Winter	30	+0%	30/15 Summer				7.022
S-1.001	SMH2	15 Winter	30	+0%	30/15 Summer				6.804
S-1.002	SMH3	15 Winter	30	+0%	30/15 Summer				5.978
S-2.000	SMH4	15 Winter	30	+0%	30/15 Summer				6.073
S-2.001	SMH5	15 Winter	30	+0%	30/15 Summer				6.057
S-2.002	SMH6	15 Winter	30	+0%	5/15 Summer				5.768
S-1.003	SMH7	15 Winter	30	+0%	30/15 Summer				5.292
S-3.000	SMH8	15 Winter	30	+0%	5/15 Summer				6.002
S-3.001	SMH9	15 Winter	30	+0%	5/15 Summer				5.284
S-3.002	SMH10	15 Winter	30	+0%	30/15 Summer				4.917
S-4.000	SMH11	15 Winter	30	+0%	30/15 Summer				5.524
S-5.000	SMH12	15 Winter	30	+0%	30/15 Summer				5.546
S-4.001	SMH13	15 Winter	30	+0%	5/15 Winter				5.529
S-4.002	SMH14	15 Winter	30	+0%	30/15 Summer				4.914
S-1.004	SMH15	15 Winter	30	+0%	30/15 Summer				4.819
S-6.000	SMH16	15 Winter	30	+0%	30/15 Summer				5.787
S-6.001	SMH17	15 Winter	30	+0%	30/15 Summer				5.449
S-6.002	SMH18	15 Winter	30	+0%	30/15 Summer				4.439

Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S-1.000	SMH1	0.167	0.000	0.73			37.5	SURCHARGED	
S-1.001	SMH2	0.414	0.000	1.31			68.2	SURCHARGED	
S-1.002	SMH3	0.078	0.000	0.98			78.8	SURCHARGED	
S-2.000	SMH4	0.348	0.000	0.27			9.5	SURCHARGED	
S-2.001	SMH5	0.429	0.000	0.98			38.3	SURCHARGED	
S-2.002	SMH6	0.443	0.000	1.54			57.7	SURCHARGED	
S-1.003	SMH7	0.194	0.000	0.96			185.6	SURCHARGED	
S-3.000	SMH8	0.902	0.000	1.39			53.5	SURCHARGED	
S-3.001	SMH9	0.559	0.000	1.59			105.1	SURCHARGED	
S-3.002	SMH10	0.383	0.000	1.05			103.7	SURCHARGED	
S-4.000	SMH11	0.449	0.000	0.06			3.0	SURCHARGED	
S-5.000	SMH12	0.521	0.000	0.26			9.2	SURCHARGED	
S-4.001	SMH13	0.605	0.000	1.51			57.8	SURCHARGED	
S-4.002	SMH14	0.332	0.000	0.76			54.8	SURCHARGED	
S-1.004	SMH15	0.392	0.000	1.00			348.8	SURCHARGED	
S-6.000	SMH16	0.142	0.000	0.78			41.4	SURCHARGED	
S-6.001	SMH17	0.474	0.000	1.25			66.4	SURCHARGED	
S-6.002	SMH18	0.134	0.000	0.83			92.5	SURCHARGED	

Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
S-6.003	SMH19	15 Winter	30	+0%	30/15 Summer			
S-7.000	SMH20	15 Winter	30	+0%	30/15 Summer			
S-8.000	SMH21	15 Winter	30	+0%				
S-7.001	SMH22	15 Winter	30	+0%	30/15 Summer			
S-7.002	SMH23	15 Winter	30	+0%	30/15 Summer			
S-1.005	SMH24	15 Winter	30	+0%	30/15 Summer			
S-9.000	SMH25	15 Winter	30	+0%	30/15 Summer			
S-1.006	SMH26	15 Winter	30	+0%	30/15 Summer			
S-1.007	SMH27	15 Winter	30	+0%	5/15 Summer			
S-1.008	SMH28	15 Winter	30	+0%	5/15 Summer			
S-10.000	SMH29	15 Winter	30	+0%	5/15 Winter			
S-11.000	SMH30	15 Winter	30	+0%	30/15 Summer			
S-10.001	SMH31	15 Winter	30	+0%	5/15 Summer			
S-10.002	SMH32	15 Winter	30	+0%	5/15 Summer			
S-10.003	SMH33	15 Winter	30	+0%	5/15 Summer			
S-1.009	SMH34	120 Winter	30	+0%	5/15 Summer			
S-1.010	SMH35	120 Winter	30	+0%	30/120 Winter			
S-1.011	SMH36	120 Winter	30	+0%				
S-1.012	SMH37	120 Winter	30	+0%	5/30 Summer			
S-12.000	SMH38	15 Winter	30	+0%	5/15 Summer			
S-12.001	SMH39	15 Winter	30	+0%	30/15 Summer			
S-13.000	SMH40	15 Winter	30	+0%				
S-12.002	SMH41	15 Winter	30	+0%	5/15 Winter			
S-14.000	SMH42	15 Winter	30	+0%	30/15 Summer			
S-14.001	SMH43	15 Winter	30	+0%	30/15 Summer			
S-14.002	SMH44	15 Winter	30	+0%	5/15 Winter			
S-14.003	SMH45	15 Winter	30	+0%	5/15 Summer			
S-12.003	SMH46	15 Winter	30	+0%	5/15 Summer			
S-15.000	SMH47	15 Winter	30	+0%	30/15 Summer			
S-15.001	SMH48	15 Winter	30	+0%	5/15 Summer			
S-15.002	SMH49	15 Winter	30	+0%				
S-16.000	SMH50	15 Winter	30	+0%	30/15 Summer			
S-15.003	SMH51	15 Winter	30	+0%	5/15 Summer			
S-12.004	SMH52	720 Winter	30	+0%	1/15 Summer			
S-12.005	SMH53	720 Winter	30	+0%	5/180 Winter			
S-12.006	SMH54	720 Winter	30	+0%	30/180 Winter			
S-12.007	SMH55	720 Winter	30	+0%	5/180 Winter			
S-12.008	SMH56	2160 Winter	30	+0%				
S-12.009	SMH57	15 Winter	30	+0%				
S-17.000	SMH58	15 Winter	30	+0%	30/15 Winter			
S-18.000	SMH59	15 Winter	30	+0%	30/15 Summer			
S-17.001	SMH60	15 Winter	30	+0%	5/15 Summer			
S-17.002	SMH61	15 Winter	30	+0%	5/15 Summer			
S-17.003	SMH62	15 Winter	30	+0%	5/15 Summer			
S-12.010	SMH63	15 Winter	30	+0%	30/15 Summer			
S-12.011	SMH64	15 Winter	30	+0%	30/15 Summer			
S-19.000	SMH65	480 Winter	30	+0%	5/15 Summer			
S-20.000	SMH66	15 Winter	30	+0%	30/15 Summer			
S-20.001	SMH67	15 Winter	30	+0%	30/15 Summer			

Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
S-6.003	SMH19	4.107	0.397	0.000	1.24			126.7	SURCHARGED
S-7.000	SMH20	4.387	0.062	0.000	0.36			12.7	SURCHARGED
S-8.000	SMH21	4.380	-0.095	0.000	0.16			10.0	OK
S-7.001	SMH22	4.363	0.139	0.000	1.19			79.5	SURCHARGED
S-7.002	SMH23	4.097	0.120	0.000	0.75			89.0	SURCHARGED
S-1.005	SMH24	3.950	0.391	0.000	1.23			529.4	SURCHARGED
S-9.000	SMH25	3.655	0.180	0.000	0.35			12.7	SURCHARGED
S-1.006	SMH26	3.646	0.287	0.000	0.83			543.8	SURCHARGED
S-1.007	SMH27	3.287	0.442	0.000	1.22			545.9	SURCHARGED
S-1.008	SMH28	2.989	0.344	0.000	1.58			547.0	SURCHARGED
S-10.000	SMH29	3.660	0.635	0.000	0.91			33.4	SURCHARGED
S-11.000	SMH30	3.584	0.334	0.000	0.36			22.1	SURCHARGED
S-10.001	SMH31	3.533	0.660	0.000	1.61			107.9	SURCHARGED
S-10.002	SMH32	2.856	0.228	0.000	1.32			109.7	SURCHARGED
S-10.003	SMH33	2.777	0.189	0.000	1.40			114.2	SURCHARGED
S-1.009	SMH34	2.720	0.060	0.000	1.32			399.4	SURCHARGED
S-1.010	SMH35	2.713	0.077	0.000	1.07			394.4	SURCHARGED
S-1.011	SMH36	2.706	-0.199	0.000	0.39			384.9	OK
S-1.012	SMH37	2.657	0.526	0.000	0.75			99.5	SURCHARGED
S-12.000	SMH38	7.260	0.805	0.000	1.13			43.0	SURCHARGED
S-12.001	SMH39	6.916	0.806	0.000	1.03			68.8	SURCHARGED
S-13.000	SMH40	7.334	-0.136	0.000	0.33			33.8	OK
S-12.002	SMH41	6.683	0.811	0.000	1.36			148.5	SURCHARGED
S-14.000	SMH42	6.892	0.557	0.000	0.95			73.9	SURCHARGED
S-14.001	SMH43	6.784	0.719	0.000	1.20			79.9	SURCHARGED
S-14.002	SMH44	6.574	0.713	0.000	1.06			108.7	SURCHARGED
S-14.003	SMH45	6.408	0.702	0.000	1.20			113.9	SURCHARGED
S-12.003	SMH46	6.299	0.668	0.000	1.49			268.1	SURCHARGED
S-15.000	SMH47	7.401	0.276	0.000	1.26			84.7	SURCHARGED
S-15.001	SMH48	6.939	0.079	0.000	1.79			85.0	SURCHARGED
S-15.002	SMH49	6.690	-0.149	0.000	0.50			92.5	OK
S-16.000	SMH50	5.799	0.298	0.000	0.22			8.0	SURCHARGED
S-15.003	SMH51	5.788	0.399	0.000	1.55			100.6	SURCHARGED
S-12.004	SMH52	5.732	0.489	0.000	0.49			65.2	SURCHARGED
S-12.005	SMH53	5.730	0.507	0.000	0.40			65.0	SURCHARGED
S-12.006	SMH54	5.728	0.235	0.000	0.15			64.5	SURCHARGED
S-12.007	SMH55	5.727	0.539	0.000	0.07			16.0	SURCHARGED
S-12.008	SMH56	4.685	-0.200	0.000	0.24			16.0	OK
S-12.009	SMH57	4.549	-0.159	0.000	0.45			58.4	OK
S-17.000	SMH58	5.931	0.006	0.000	0.84			74.3	SURCHARGED
S-18.000	SMH59	5.146	0.571	0.000	0.34			12.2	SURCHARGED
S-17.001	SMH60	5.127	0.678	0.000	1.35			88.8	SURCHARGED
S-17.002	SMH61	4.796	0.527	0.000	1.62			102.5	SURCHARGED
S-17.003	SMH62	4.506	0.346	0.000	1.73			112.1	SURCHARGED
S-12.010	SMH63	4.079	0.059	0.000	1.24			162.9	SURCHARGED
S-12.011	SMH64	3.992	0.030	0.000	0.92			168.4	SURCHARGED
S-19.000	SMH65	4.667	0.445	0.000	0.14			5.2	SURCHARGED
S-20.000	SMH66	5.874	0.214	0.000	0.69			29.6	SURCHARGED

Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
S-20.001	SMH67	5.793	0.478	0.000	0.74			25.5	SURCHARGED

PN	US/MH Name	Level Exceeded
S-6.003	SMH19	
S-7.000	SMH20	
S-8.000	SMH21	
S-7.001	SMH22	
S-7.002	SMH23	
S-1.005	SMH24	
S-9.000	SMH25	
S-1.006	SMH26	
S-1.007	SMH27	
S-1.008	SMH28	
S-10.000	SMH29	
S-11.000	SMH30	
S-10.001	SMH31	
S-10.002	SMH32	
S-10.003	SMH33	
S-1.009	SMH34	
S-1.010	SMH35	
S-1.011	SMH36	
S-1.012	SMH37	
S-12.000	SMH38	
S-12.001	SMH39	
S-13.000	SMH40	
S-12.002	SMH41	
S-14.000	SMH42	
S-14.001	SMH43	
S-14.002	SMH44	
S-14.003	SMH45	
S-12.003	SMH46	
S-15.000	SMH47	
S-15.001	SMH48	
S-15.002	SMH49	
S-16.000	SMH50	
S-15.003	SMH51	
S-12.004	SMH52	
S-12.005	SMH53	
S-12.006	SMH54	
S-12.007	SMH55	
S-12.008	SMH56	
S-12.009	SMH57	
S-17.000	SMH58	
S-18.000	SMH59	
S-17.001	SMH60	

Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Level Exceeded
S-17.002	SMH61	
S-17.003	SMH62	
S-12.010	SMH63	
S-12.011	SMH64	
S-19.000	SMH65	
S-20.000	SMH66	
S-20.001	SMH67	

Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
S-20.002	SMH68	15 Winter	30	+0%	30/15 Summer			
S-20.003	SMH69	15 Winter	30	+0%	5/15 Summer			
S-20.004	SMH70	15 Winter	30	+0%	30/15 Summer			
S-21.000	SMH71	15 Winter	30	+0%	5/15 Summer			
S-20.005	SMH72	480 Winter	30	+0%	1/15 Summer			
S-19.001	SMH73	480 Winter	30	+0%	1/15 Summer			
S-22.000	SMH74	480 Winter	30	+0%				
S-19.002	SMH75	480 Winter	30	+0%	1/15 Summer			
S-23.000	SMH76	480 Winter	30	+0%	5/120 Winter			
S-23.001	SMH77	480 Winter	30	+0%	5/120 Summer			
S-19.003	SMH78	480 Winter	30	+0%	1/15 Summer			
S-12.012	SMH79	15 Winter	30	+0%	30/15 Summer			
S-24.000	SMH80	15 Winter	30	+0%	5/15 Summer			
S-24.001	SMH81	15 Winter	30	+0%	30/15 Summer			
S-25.000	SMH82	15 Winter	30	+0%	30/15 Summer			
S-25.001	SMH83	15 Winter	30	+0%	30/15 Summer			
S-26.000	SMH84	15 Winter	30	+0%	30/15 Summer			
S-25.002	SMH85	15 Winter	30	+0%	5/15 Summer			
S-25.003	SMH86	15 Winter	30	+0%	5/15 Winter			
S-25.004	SMH87	15 Winter	30	+0%	5/15 Summer			
S-24.002	SMH88	15 Winter	30	+0%	5/15 Summer			
S-24.003	SMH89	15 Winter	30	+0%	5/15 Summer			
S-24.004	SMH90	15 Winter	30	+0%	5/15 Summer			
S-24.005	SMH91	15 Winter	30	+0%	30/15 Summer			
S-24.006	SMH92	15 Winter	30	+0%				
S-27.000	SMH93	15 Winter	30	+0%	30/15 Summer			
S-27.001	SMH94	15 Winter	30	+0%	30/15 Summer			
S-27.002	SMH95	15 Winter	30	+0%	30/15 Summer			
S-27.003	SMH96	15 Winter	30	+0%	5/15 Summer			
S-28.000	SMH97	15 Winter	30	+0%				
S-28.001	SMH98	15 Winter	30	+0%				
S-27.004	SMH99	15 Winter	30	+0%	5/15 Summer			
S-29.000	SMH100	15 Winter	30	+0%				
S-27.005	SMH101	15 Winter	30	+0%	5/15 Summer			
S-27.006	SMH102	720 Winter	30	+0%	5/15 Summer			
S-27.007	SMH103	720 Winter	30	+0%	5/15 Summer			
S-27.008	SMH104	720 Winter	30	+0%	5/60 Winter			
S-27.009	SMH105	120 Summer	30	+0%				
S-30.000	SMH106	15 Winter	30	+0%	30/15 Summer			
S-31.000	SMH107	15 Winter	30	+0%	30/15 Summer			
S-30.001	SMH108	15 Winter	30	+0%	5/15 Summer			
S-30.002	SMH109	15 Winter	30	+0%	5/15 Summer			
S-32.000	SMH110	15 Winter	30	+0%				
S-32.001	SMH111	15 Summer	30	+0%				
S-30.003	SMH112	15 Winter	30	+0%	5/15 Summer			
S-33.000	SMH113	15 Winter	30	+0%	30/15 Summer			
S-33.001	SMH114	15 Winter	30	+0%	5/15 Summer			
S-33.002	SMH115	15 Winter	30	+0%	30/15 Summer			
S-34.000	SMH116	15 Summer	1	+0%				

Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
S-20.002	SMH68	5.730	0.475	0.000	1.12			48.9	SURCHARGED
S-20.003	SMH69	5.269	0.424	0.000	1.49			51.5	SURCHARGED
S-20.004	SMH70	5.151	0.366	0.000	0.91			58.1	SURCHARGED
S-21.000	SMH71	4.810	0.490	0.000	0.92			33.7	SURCHARGED
S-20.005	SMH72	4.713	0.543	0.000	0.32			21.2	SURCHARGED
S-19.001	SMH73	4.702	0.643	0.000	0.30			27.0	SURCHARGED
S-22.000	SMH74	4.663	-0.112	0.000	0.04			3.0	OK
S-19.002	SMH75	4.697	0.691	0.000	0.40			33.0	SURCHARGED
S-23.000	SMH76	4.655	0.591	0.000	0.05			7.0	SURCHARGED
S-23.001	SMH77	4.695	0.636	0.000	0.05			5.9	SURCHARGED
S-19.003	SMH78	4.703	0.808	0.000	0.09			5.3	SURCHARGED
S-12.012	SMH79	3.881	0.035	0.000	1.49			177.8	SURCHARGED
S-24.000	SMH80	4.967	0.692	0.000	1.23			46.6	SURCHARGED
S-24.001	SMH81	4.624	0.611	0.000	1.14			74.8	SURCHARGED
S-25.000	SMH82	4.211	0.086	0.000	0.68			50.1	SURCHARGED
S-25.001	SMH83	4.037	0.532	0.000	1.03			81.7	SURCHARGED
S-26.000	SMH84	3.842	0.460	0.000	0.31			10.9	SURCHARGED
S-25.002	SMH85	3.821	0.541	0.000	1.85			102.7	SURCHARGED
S-25.003	SMH86	3.679	0.440	0.000	1.21			121.8	SURCHARGED
S-25.004	SMH87	3.527	0.411	0.000	1.33			130.1	SURCHARGED
S-24.002	SMH88	3.376	0.350	0.000	2.23			212.6	SURCHARGED
S-24.003	SMH89	3.229	0.228	0.000	1.61			210.7	SURCHARGED
S-24.004	SMH90	3.084	0.138	0.000	1.59			209.1	SURCHARGED
S-24.005	SMH91	2.939	0.050	0.000	1.24			209.7	SURCHARGED
S-24.006	SMH92	2.643	-0.173	0.000	0.69			210.1	OK
S-27.000	SMH93	5.668	0.093	0.000	0.64			25.4	SURCHARGED
S-27.001	SMH94	5.598	0.353	0.000	0.79			23.5	SURCHARGED
S-27.002	SMH95	5.557	0.345	0.000	0.98			36.5	SURCHARGED
S-27.003	SMH96	5.368	0.347	0.000	1.30			38.3	SURCHARGED
S-28.000	SMH97	5.466	-0.129	0.000	0.38			13.2	OK
S-28.001	SMH98	5.399	-0.112	0.000	0.50			24.0	OK
S-27.004	SMH99	5.290	0.301	0.000	1.03			64.7	SURCHARGED
S-29.000	SMH100	5.534	-0.141	0.000	0.30			25.5	OK
S-27.005	SMH101	5.185	0.293	0.000	1.55			93.5	SURCHARGED
S-27.006	SMH102	5.133	0.313	0.000	0.27			14.5	SURCHARGED
S-27.007	SMH103	5.132	0.386	0.000	0.38			14.5	SURCHARGED
S-27.008	SMH104	5.130	0.395	0.000	0.06			3.7	SURCHARGED
S-27.009	SMH105	4.482	-0.173	0.000	0.12			3.7	OK
S-30.000	SMH106	5.397	0.127	0.000	0.42			23.1	SURCHARGED
S-31.000	SMH107	5.456	0.296	0.000	0.65			24.6	SURCHARGED
S-30.001	SMH108	5.349	0.429	0.000	1.60			59.1	SURCHARGED
S-30.002	SMH109	4.873	0.131	0.000	1.98			59.3	SURCHARGED
S-32.000	SMH110	5.429	-0.096	0.000	0.62			21.8	OK
S-32.001	SMH111	5.380	-0.053	0.000	0.93			27.5	OK
S-30.003	SMH112	4.443	0.078	0.000	1.75			82.7	SURCHARGED
S-33.000	SMH113	4.520	0.359	0.000	0.93			33.8	SURCHARGED
S-33.001	SMH114	4.392	0.376	0.000	1.63			60.0	SURCHARGED
S-33.002	SMH115	3.939	0.088	0.000	1.24			81.1	SURCHARGED

Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
S-34.000	SMH116	2.816	-0.450	0.000	0.00			0.0	OK

PN	US/MH Name	Level Exceeded
S-20.002	SMH68	
S-20.003	SMH69	
S-20.004	SMH70	
S-21.000	SMH71	
S-20.005	SMH72	
S-19.001	SMH73	
S-22.000	SMH74	
S-19.002	SMH75	
S-23.000	SMH76	
S-23.001	SMH77	
S-19.003	SMH78	
S-12.012	SMH79	
S-24.000	SMH80	
S-24.001	SMH81	
S-25.000	SMH82	
S-25.001	SMH83	
S-26.000	SMH84	
S-25.002	SMH85	
S-25.003	SMH86	
S-25.004	SMH87	
S-24.002	SMH88	
S-24.003	SMH89	
S-24.004	SMH90	
S-24.005	SMH91	
S-24.006	SMH92	
S-27.000	SMH93	
S-27.001	SMH94	
S-27.002	SMH95	
S-27.003	SMH96	
S-28.000	SMH97	
S-28.001	SMH98	
S-27.004	SMH99	
S-29.000	SMH100	
S-27.005	SMH101	
S-27.006	SMH102	
S-27.007	SMH103	
S-27.008	SMH104	
S-27.009	SMH105	
S-30.000	SMH106	
S-31.000	SMH107	
S-30.001	SMH108	
S-30.002	SMH109	

Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Level Exceeded
S-32.000	SMH110	
S-32.001	SMH111	
S-30.003	SMH112	
S-33.000	SMH113	
S-33.001	SMH114	
S-33.002	SMH115	
S-34.000	SMH116	

Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S-34.001	SMH117	15 Summer	1	+0%					2.775
S-35.000	SMH118	15 Winter	30	+0%	30/15 Summer				2.433
S-35.001	SMH119	15 Winter	30	+0%	30/15 Summer				2.246
S-36.000	SMH120	15 Winter	30	+0%					2.017
S-37.000	SMH121	15 Winter	30	+0%					1.690
S-37.001	SMH122	15 Summer	30	+0%					1.583
S-38.000	SMH123	15 Winter	30	+0%					1.677
S-38.001	SMH124	15 Winter	30	+0%					1.510
S-37.002	SMH125	15 Winter	30	+0%	30/15 Summer				1.489
S-37.003	SMH126	15 Winter	30	+0%	30/15 Summer				1.233
S-37.004	SMH127	15 Winter	30	+0%					1.069
S-39.000	SMH128	15 Winter	30	+0%					5.695
S-39.001	SMH129	15 Winter	30	+0%					5.607
S-39.002	SMH130	15 Winter	30	+0%					5.591
S-40.000	SMH131	15 Winter	30	+0%	30/15 Summer				6.106
S-40.001	SMH132	15 Winter	30	+0%	30/15 Summer				6.045

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S-34.001	SMH117	-0.450	0.000	0.00			0.0	OK	
S-35.000	SMH118	0.108	0.000	1.20			43.1	SURCHARGED	
S-35.001	SMH119	0.039	0.000	1.30			43.9	SURCHARGED	
S-36.000	SMH120	-0.108	0.000	0.53			46.2	OK	
S-37.000	SMH121	-0.135	0.000	0.33			11.8	OK	
S-37.001	SMH122	-0.145	0.000	0.27			18.6	OK	
S-38.000	SMH123	-0.148	0.000	0.26			15.9	OK	
S-38.001	SMH124	-0.015	0.000	0.31			13.9	OK	
S-37.002	SMH125	0.064	0.000	1.09			40.9	SURCHARGED	
S-37.003	SMH126	0.023	0.000	1.24			41.2	SURCHARGED	
S-37.004	SMH127	-0.079	0.000	0.75			41.1	OK	
S-39.000	SMH128	-0.103	0.000	0.57			20.5	OK	
S-39.001	SMH129	-0.075	0.000	0.70			20.1	OK	
S-39.002	SMH130	-0.062	0.000	0.86			30.5	OK	
S-40.000	SMH131	0.042	0.000	0.55			20.0	SURCHARGED	
S-40.001	SMH132	0.122	0.000	1.34			49.0	SURCHARGED	

Appendix F
Existing Attenuation Lagoon Assessment

Summary of Results for 100 year Return Period (+10%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	1.045	0.245	60.8	0.0	60.8	2238.6	O K
30 min Summer	1.136	0.336	100.1	0.0	100.1	3084.3	O K
60 min Summer	1.226	0.426	126.2	0.0	126.2	3939.0	O K
120 min Summer	1.320	0.520	129.2	0.0	129.2	4840.6	O K
180 min Summer	1.373	0.573	129.6	0.0	129.6	5352.6	O K
240 min Summer	1.407	0.607	129.6	0.0	129.6	5686.0	O K
360 min Summer	1.447	0.647	129.6	0.0	129.6	6079.7	O K
480 min Summer	1.473	0.673	129.6	0.0	129.6	6334.8	O K
600 min Summer	1.491	0.691	129.6	0.0	129.6	6515.0	O K
720 min Summer	1.504	0.704	129.6	0.0	129.6	6644.8	O K
960 min Summer	1.520	0.720	129.6	0.0	129.6	6800.4	O K
1440 min Summer	1.525	0.725	129.6	0.0	129.6	6847.1	O K
2160 min Summer	1.500	0.700	129.6	0.0	129.6	6600.9	O K
2880 min Summer	1.461	0.661	129.6	0.0	129.6	6212.4	O K
4320 min Summer	1.376	0.576	129.6	0.0	129.6	5384.6	O K
5760 min Summer	1.303	0.503	128.9	0.0	128.9	4676.5	O K
7200 min Summer	1.247	0.447	127.1	0.0	127.1	4134.4	O K
8640 min Summer	1.206	0.406	125.1	0.0	125.1	3742.8	O K
10080 min Summer	1.180	0.380	118.3	0.0	118.3	3504.3	O K
15 min Winter	1.074	0.274	73.2	0.0	73.2	2504.5	O K
30 min Winter	1.175	0.375	116.2	0.0	116.2	3451.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
15 min Summer	84.119	0.0	1669.4	0.0	26
30 min Summer	58.884	0.0	2509.7	0.0	40
60 min Summer	38.654	0.0	3809.0	0.0	68
120 min Summer	24.725	0.0	4954.3	0.0	126
180 min Summer	18.893	0.0	5718.2	0.0	184
240 min Summer	15.573	0.0	6309.0	0.0	242
360 min Summer	11.832	0.0	7220.0	0.0	336
480 min Summer	9.725	0.0	7927.2	0.0	398
600 min Summer	8.348	0.0	8513.3	0.0	464
720 min Summer	7.369	0.0	9018.0	0.0	530
960 min Summer	6.051	0.0	9862.4	0.0	670
1440 min Summer	4.579	0.0	11124.6	0.0	946
2160 min Summer	3.458	0.0	13202.4	0.0	1360
2880 min Summer	2.830	0.0	14391.4	0.0	1756
4320 min Summer	2.132	0.0	16125.1	0.0	2508
5760 min Summer	1.744	0.0	17975.0	0.0	3224
7200 min Summer	1.492	0.0	19192.3	0.0	3896
8640 min Summer	1.313	0.0	20219.3	0.0	4584
10080 min Summer	1.180	0.0	21055.5	0.0	5256
15 min Winter	84.119	0.0	1920.1	0.0	26
30 min Winter	58.884	0.0	2868.8	0.0	39

Summary of Results for 100 year Return Period (+10%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
60 min Winter	1.278	0.478	128.2	0.0	128.2	4431.0	O K
120 min Winter	1.385	0.585	129.6	0.0	129.6	5471.9	O K
180 min Winter	1.446	0.646	129.6	0.0	129.6	6072.4	O K
240 min Winter	1.487	0.687	129.6	0.0	129.6	6474.3	O K
360 min Winter	1.537	0.737	129.6	0.0	129.6	6968.3	O K
480 min Winter	1.563	0.763	129.6	0.0	129.6	7230.1	O K
600 min Winter	1.576	0.776	129.6	0.0	129.6	7363.6	O K
720 min Winter	1.588	0.788	129.6	0.0	129.6	7477.7	O K
960 min Winter	1.598	0.798	129.6	0.0	129.6	7579.1	O K
1440 min Winter	1.587	0.787	129.6	0.0	129.6	7470.2	O K
2160 min Winter	1.533	0.733	129.6	0.0	129.6	6932.9	O K
2880 min Winter	1.462	0.662	129.6	0.0	129.6	6224.8	O K
4320 min Winter	1.327	0.527	129.3	0.0	129.3	4903.1	O K
5760 min Winter	1.228	0.428	126.3	0.0	126.3	3957.6	O K
7200 min Winter	1.178	0.378	117.5	0.0	117.5	3484.8	O K
8640 min Winter	1.149	0.349	105.8	0.0	105.8	3206.5	O K
10080 min Winter	1.127	0.327	96.4	0.0	96.4	3000.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
60 min Winter	38.654	0.0	4303.1	0.0	68
120 min Winter	24.725	0.0	5585.2	0.0	124
180 min Winter	18.893	0.0	6440.0	0.0	182
240 min Winter	15.573	0.0	7101.0	0.0	238
360 min Winter	11.832	0.0	8119.7	0.0	350
480 min Winter	9.725	0.0	8910.1	0.0	456
600 min Winter	8.348	0.0	9565.5	0.0	500
720 min Winter	7.369	0.0	10129.7	0.0	570
960 min Winter	6.051	0.0	11072.1	0.0	724
1440 min Winter	4.579	0.0	12472.7	0.0	1032
2160 min Winter	3.458	0.0	14811.0	0.0	1472
2880 min Winter	2.830	0.0	16150.6	0.0	1876
4320 min Winter	2.132	0.0	18118.1	0.0	2600
5760 min Winter	1.744	0.0	20151.8	0.0	3280
7200 min Winter	1.492	0.0	21521.1	0.0	3896
8640 min Winter	1.313	0.0	22682.3	0.0	4600
10080 min Winter	1.180	0.0	23644.4	0.0	5344

Project: Castlelake SHD
Project No.: MCW1088
Calculation: 100-yr Greenfield Runoff
Calcs By: KC
Checked By: GMcC
Date: 24/05/2022

Site Location:	Castlelake Main Pond			
Design Storm Return Period:	100 years			
Climate Change Factor:	10 %			
Soil Type:	2			
Total Site Area (m^2):	262754 m^2			
Total Site Area (ha):	26.28 ha			
Percentage Runoff - Hardstanding:	55 %		55% Density	
Percentage Runoff - Grass/Verge:	0 %			
Percentage Runoff - Cutting:	0 %			
Hardstanding Area:	14.45 ha	............@	Permeability	100%
Grass/Verge Area:	11.82 ha	............@	Permeability	0%
Effective Impermeable Area:	14.45 ha			

Allowable Outflow	**Calculate**
IH124: $QBAR = 0.00108 \times AREA^{0.89} \times SAAR^{1.17} \times SOIL^{2.17}$	
AREA:	0.26 km^2
SAAR:	947 mm
SOIL:	0.3
QBAR/ha	2.60 l/s/ha
Allowable Outflow (QBAR)	**68.20 l/s**

Storm Event Return Period	Growth Curve Factor (South)	Factored Q	Allowable Outflow
		l/s	l/s
1 year return period:	0.85	2.21	57.97
2 year return period:	0.96	2.49	65.47
5 year return period:	1.21	3.14	82.52
10 year return period:	1.38	3.58	94.11
25 year return period:	1.59	4.13	108.43
30 year return period:	1.62	4.20	110.48
50 year return period:	1.74	4.52	118.66
100 year return period:	1.90	4.93	**129.58**
200 year return period:	2.05	5.32	139.81

Appendix G
Existing Attenuation Tank Assessment

Project: Castlelake SHD
Project No.: MCW1088
Calculation: 100-yr Greenfield Runoff
Calcs By: KC
Checked By: GMcC
Date: 24/05/2022

Site Location:	Castlelake Attenuation Tank	
Design Storm Return Period:	100 years	
Climate Change Factor:	10 %	
Soil Type:	2	
Total Site Area (m^2):	157782 m^2	
Total Site Area (ha):	15.78 ha	

Allowable Outflow	**Calculate**
IH124: $QBAR = 0.00108 \times AREA^{0.89} \times SAAR^{1.17} \times SOIL^{2.17}$	
AREA:	0.16 km^2
SAAR:	947 mm
SOIL:	0.3
QBAR/ha	2.60 l/s/ha
Allowable Outflow (QBAR)	**40.95 l/s**

Storm Event Return Period	**Growth Curve Factor (South)**	**Factored Q**	**Allowable Outflow**	
		l/s	**l/s**	
1 year return period:	0.85	2.21	34.81	
2 year return period:	0.96	2.49	39.31	
5 year return period:	1.21	3.14	49.55	
10 year return period:	1.38	3.58	56.51	
25 year return period:	1.59	4.13	65.11	
30 year return period:	1.62	4.20	66.34	
50 year return period:	1.74	4.52	71.26	
100 year return period:	1.90	4.93	**77.81**	
200 year return period:	2.05	5.32	83.95	

Summary of Results for 100 year Return Period (+10%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	0.611	0.611	71.8	1410.5	O K
30 min Summer	0.844	0.844	71.8	1949.6	O K
60 min Summer	1.085	1.085	71.8	2506.0	O K
120 min Summer	1.336	1.336	71.8	3086.7	O K
180 min Summer	1.481	1.481	71.8	3420.6	O K
240 min Summer	1.570	1.570	71.8	3627.0	O K
360 min Summer	1.668	1.668	71.8	3852.3	O K
480 min Summer	1.709	1.709	71.8	3946.8	O K
600 min Summer	1.732	1.732	71.8	4000.6	O K
720 min Summer	1.745	1.745	71.8	4030.8	O K
960 min Summer	1.752	1.752	71.8	4046.5	O K
1440 min Summer	1.721	1.721	71.8	3975.3	O K
2160 min Summer	1.628	1.628	71.8	3759.9	O K
2880 min Summer	1.514	1.514	71.8	3497.2	O K
4320 min Summer	1.228	1.228	71.8	2837.1	O K
5760 min Summer	0.972	0.972	71.8	2244.6	O K
7200 min Summer	0.769	0.769	71.8	1775.4	O K
8640 min Summer	0.615	0.615	71.8	1421.4	O K
10080 min Summer	0.503	0.503	71.2	1162.5	O K
15 min Winter	0.686	0.686	71.8	1585.7	O K
30 min Winter	0.950	0.950	71.8	2194.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	87.244	0.0	1410.8	25
30 min Summer	60.780	0.0	1983.4	40
60 min Summer	39.838	0.0	2660.9	68
120 min Summer	25.434	0.0	3403.9	128
180 min Summer	19.424	0.0	3902.2	186
240 min Summer	16.003	0.0	4288.2	244
360 min Summer	12.152	0.0	4885.9	362
480 min Summer	9.984	0.0	5352.9	452
600 min Summer	8.569	0.0	5742.5	508
720 min Summer	7.563	0.0	6080.5	572
960 min Summer	6.209	0.0	6651.7	702
1440 min Summer	4.695	0.0	7525.6	984
2160 min Summer	3.543	0.0	8604.2	1404
2880 min Summer	2.899	0.0	9384.9	1820
4320 min Summer	2.183	0.0	10583.6	2600
5760 min Summer	1.784	0.0	11575.9	3304
7200 min Summer	1.526	0.0	12375.1	4032
8640 min Summer	1.344	0.0	13069.1	4672
10080 min Summer	1.207	0.0	13678.5	5352
15 min Winter	87.244	0.0	1585.8	25
30 min Winter	60.780	0.0	2226.3	40

Summary of Results for 100 year Return Period (+10%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	1.224	1.224	71.8	2828.0	O K
120 min Winter	1.514	1.514	71.8	3497.3	O K
180 min Winter	1.677	1.677	71.8	3873.8	O K
240 min Winter	1.782	1.782	71.8	4117.2	O K
360 min Winter	1.905	1.905	71.8	4399.9	O K
480 min Winter	1.963	1.963	71.8	4535.1	O K
600 min Winter	1.987	1.987	71.8	4589.9	O K
720 min Winter	1.992	1.992	71.9	4602.7	O K
960 min Winter	1.996	1.996	72.0	4611.3	O K
1440 min Winter	1.935	1.935	71.8	4470.4	O K
2160 min Winter	1.774	1.774	71.8	4098.2	O K
2880 min Winter	1.584	1.584	71.8	3659.3	O K
4320 min Winter	1.107	1.107	71.8	2556.5	O K
5760 min Winter	0.734	0.734	71.8	1695.4	O K
7200 min Winter	0.494	0.494	71.1	1140.5	O K
8640 min Winter	0.361	0.361	68.1	833.3	O K
10080 min Winter	0.314	0.314	63.5	724.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	39.838	0.0	2983.2	68
120 min Winter	25.434	0.0	3815.0	126
180 min Winter	19.424	0.0	4373.0	182
240 min Winter	16.003	0.0	4805.1	240
360 min Winter	12.152	0.0	5474.3	352
480 min Winter	9.984	0.0	5996.8	462
600 min Winter	8.569	0.0	6432.7	566
720 min Winter	7.563	0.0	6810.7	600
960 min Winter	6.209	0.0	7448.8	746
1440 min Winter	4.695	0.0	8420.4	1058
2160 min Winter	3.543	0.0	9638.5	1520
2880 min Winter	2.899	0.0	10512.7	1968
4320 min Winter	2.183	0.0	11860.8	2736
5760 min Winter	1.784	0.0	12966.8	3408
7200 min Winter	1.526	0.0	13862.6	4040
8640 min Winter	1.344	0.0	14641.3	4592
10080 min Winter	1.207	0.0	15328.6	5160

Model Details

Storage is Online Cover Level (m) 3.000

Tank or Pond Structure

Invert Level (m) 0.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	2310.0	2.000	2310.0	2.001	0.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0331-7220-2000-7220
Design Head (m)	2.000
Design Flow (l/s)	72.2
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	331
Invert Level (m)	0.000
Minimum Outlet Pipe Diameter (mm)	375
Suggested Manhole Diameter (mm)	Site Specific Design (Contact Hydro International)

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.000	72.1
Flush-Flo™	0.634	71.8
Kick-Flo®	1.372	60.1
Mean Flow over Head Range	-	61.4

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	9.8	1.200	66.4	3.000	87.7	7.000	132.5
0.200	33.8	1.400	60.6	3.500	94.5	7.500	137.0
0.300	60.4	1.600	64.7	4.000	100.9	8.000	141.4
0.400	69.3	1.800	68.5	4.500	106.8	8.500	145.7
0.500	71.1	2.000	72.1	5.000	112.4	9.000	149.8
0.600	71.8	2.200	75.5	5.500	117.8	9.500	153.8
0.800	71.2	2.400	78.7	6.000	122.9		
1.000	69.6	2.600	81.8	6.500	127.8		

Appendix H
Calculations for Overall Run-Off from Entire Development

Project: Castlelake SHD
Project No.: MCW1088
Calculation: 100-yr Greenfield Runoff
Calcs By: KC
Checked By: GMcC
Date: 09/09/2021

Site Location:	Castlelake Total Catchment	
Design Storm Return Period:	100 years	
Climate Change Factor:	10 %	
Soil Type:	2	
Total Site Area (m^2):	420536 m^2	
Total Site Area (ha):	42.05 ha	

Allowable Outflow	**Calculate**
IH124: $QBAR = 0.00108 \times AREA^{0.89} \times SAAR^{1.17} \times SOIL^{2.17}$	
AREA:	0.42 km^2
SAAR:	947 mm
SOIL:	0.3
QBAR/ha	2.60 l/s/ha
Allowable Outflow (QBAR)	**109.15 l/s**

Storm Event Return Period	**Growth Curve Factor (South)**	**Factored Q**	**Allowable Outflow**	
		l/s	**l/s**	
1 year return period:	0.85	2.21	92.78	
2 year return period:	0.96	2.49	104.78	
5 year return period:	1.21	3.14	132.07	
10 year return period:	1.38	3.58	150.63	
25 year return period:	1.59	4.13	173.55	
30 year return period:	1.62	4.20	176.82	
50 year return period:	1.74	4.52	189.92	
100 year return period:	1.90	4.93	**207.38**	
200 year return period:	2.05	5.32	223.76	

Appendix I
Infiltration Trench Design Outputs

Summary of Results for 30 year Return Period (+10%)

Half Drain Time : 88 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	3.106	1.106	1.8	11.6	O K
30 min Summer	3.478	1.478	2.1	15.5	O K
60 min Summer	3.778	1.778	2.3	18.7	O K
120 min Summer	3.964	1.964	2.5	20.6	O K
180 min Summer	4.022	2.022	2.5	21.2	O K
240 min Summer	4.028	2.028	2.5	21.3	O K
360 min Summer	3.984	1.984	2.5	20.8	O K
480 min Summer	3.918	1.918	2.5	20.1	O K
600 min Summer	3.847	1.847	2.4	19.4	O K
720 min Summer	3.774	1.774	2.3	18.6	O K
960 min Summer	3.632	1.632	2.2	17.1	O K
1440 min Summer	3.383	1.383	2.0	14.5	O K
2160 min Summer	3.091	1.091	1.8	11.5	O K
2880 min Summer	2.870	0.870	1.6	9.1	O K
4320 min Summer	2.559	0.559	1.3	5.9	O K
5760 min Summer	2.354	0.354	1.2	3.7	O K
7200 min Summer	2.209	0.209	1.0	2.2	O K
8640 min Summer	2.111	0.111	1.0	1.2	O K
10080 min Summer	2.050	0.050	0.9	0.5	O K
15 min Winter	3.250	1.250	1.9	13.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	64.776	0.0	23
30 min Summer	45.106	0.0	36
60 min Summer	29.822	0.0	60
120 min Summer	19.270	0.0	94
180 min Summer	14.827	0.0	130
240 min Summer	12.287	0.0	164
360 min Summer	9.409	0.0	232
480 min Summer	7.778	0.0	300
600 min Summer	6.707	0.0	368
720 min Summer	5.942	0.0	434
960 min Summer	4.908	0.0	564
1440 min Summer	3.745	0.0	814
2160 min Summer	2.854	0.0	1188
2880 min Summer	2.352	0.0	1556
4320 min Summer	1.790	0.0	2288
5760 min Summer	1.474	0.0	3000
7200 min Summer	1.268	0.0	3688
8640 min Summer	1.121	0.0	4416
10080 min Summer	1.011	0.0	5080
15 min Winter	64.776	0.0	24

Summary of Results for 30 year Return Period (+10%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
30 min Winter	3.676	1.676	2.3	17.6	O K
60 min Winter	4.030	2.030	2.5	21.3	O K
120 min Winter	4.241	2.241	2.7	23.5	O K
180 min Winter	4.293	2.293	2.8	24.1	O K
240 min Winter	4.279	2.279	2.8	23.9	O K
360 min Winter	4.174	2.174	2.7	22.8	O K
480 min Winter	4.043	2.043	2.6	21.5	O K
600 min Winter	3.919	1.919	2.5	20.1	O K
720 min Winter	3.799	1.799	2.4	18.9	O K
960 min Winter	3.583	1.583	2.2	16.6	O K
1440 min Winter	3.233	1.233	1.9	12.9	O K
2160 min Winter	2.861	0.861	1.6	9.0	O K
2880 min Winter	2.604	0.604	1.4	6.3	O K
4320 min Winter	2.272	0.272	1.1	2.9	O K
5760 min Winter	2.078	0.078	0.9	0.8	O K
7200 min Winter	2.045	0.045	0.8	0.5	O K
8640 min Winter	2.040	0.040	0.7	0.4	O K
10080 min Winter	2.036	0.036	0.7	0.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
30 min Winter	45.106	0.0	36
60 min Winter	29.822	0.0	62
120 min Winter	19.270	0.0	100
180 min Winter	14.827	0.0	138
240 min Winter	12.287	0.0	176
360 min Winter	9.409	0.0	250
480 min Winter	7.778	0.0	320
600 min Winter	6.707	0.0	390
720 min Winter	5.942	0.0	458
960 min Winter	4.908	0.0	592
1440 min Winter	3.745	0.0	850
2160 min Winter	2.854	0.0	1220
2880 min Winter	2.352	0.0	1592
4320 min Winter	1.790	0.0	2300
5760 min Winter	1.474	0.0	3000
7200 min Winter	1.268	0.0	3560
8640 min Winter	1.121	0.0	4352
10080 min Winter	1.011	0.0	5064

Appendix J
MicroDrainage Culvert Outputs

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Culverts

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - Scotland and Ireland

Return Period (years)	100	PIMP (%)	100
M5-60 (mm)	18.000	Add Flow / Climate Change (%)	0
Ratio R	0.249	Minimum Backdrop Height (m)	0.000
Maximum Rainfall (mm/hr)	105	Maximum Backdrop Height (m)	0.000
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.275
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for Culverts

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
C-1.000	4.916	0.074	66.4	0.000	20.00	140.0	0.600	o	600	Pipe/Conduit	🔒
C-1.001	4.916	0.008	590.0	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	🔒
C-1.002	43.848	0.660	66.4	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	🔒
C-1.003	26.005	0.200	130.0	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	🔓
C-1.004	8.067	0.045	179.3	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	🔓
C-1.005	45.395	0.683	66.5	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	🔒
C-1.006	45.395	0.077	590.0	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	🔓
C-1.007	27.018	0.046	590.0	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	🔒
C-1.008	45.575	0.077	590.0	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	🔓
C-1.009	49.011	0.333	147.2	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	🔓
C-1.010	14.190	0.034	412.0	0.000	0.00	0.0	0.600	oo	43	Pipe/Conduit	🔒

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
C-1.000	66.45	20.03	6.100	0.000	140.0	0.0	0.0	2.99	845.6	140.0
C-1.001	66.31	20.11	5.275	0.000	140.0	0.0	0.0	1.00	281.4	140.0
C-1.002	65.90	20.35	5.085	0.000	140.0	0.0	0.0	2.99	845.6	140.0
C-1.003	65.57	20.56	4.425	0.000	140.0	0.0	0.0	2.13	603.4	140.0
C-1.004	65.45	20.63	4.225	0.000	140.0	0.0	0.0	1.82	513.4	140.0
C-1.005	65.05	20.88	3.487	0.000	140.0	0.0	0.0	2.99	845.2	140.0
C-1.006	63.86	21.64	2.804	0.000	140.0	0.0	0.0	1.00	281.4	140.0
C-1.007	63.18	22.10	2.200	0.000	140.0	0.0	0.0	1.00	281.4	140.0
C-1.008	62.07	22.86	2.154	0.000	140.0	0.0	0.0	1.00	281.4	140.0
C-1.009	61.50	23.27	2.077	0.000	140.0	0.0	0.0	2.01	567.0	140.0
C-1.010	61.17	23.51	1.744	0.000	140.0	0.0	0.0	1.00	316.5	140.0

Simulation Criteria for Culverts

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	10.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs	0	Number of Storage Structures	0
Number of Online Controls	0	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	2	Cv (Summer)	0.750
Region	Scotland and Ireland	Cv (Winter)	0.840
M5-60 (mm)	15.300	Storm Duration (mins)	30
Ratio R	0.273		

Summary of Critical Results by Maximum Level (Rank 1) for Culverts

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	10.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	0
Number of Online Controls	0	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.249
Region	Scotland and Ireland	Cv (Summer)	0.750
M5-60 (mm)	18.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	150.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 5, 30, 100
Climate Change (%)	0, 0, 0, 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
C-1.000	CMH1	10080 Summer	100	+0%					6.379
C-1.001	CMH2	15 Summer	1	+0%					5.651
C-1.002	CMH3	15 Summer	1	+0%					5.275
C-1.003	CMH4	15 Summer	1	+0%					4.667
C-1.004	CMH5	15 Summer	1	+0%					4.532
C-1.005	CMH6	15 Summer	1	+0%					3.673
C-1.006	CMH7	15 Summer	1	+0%					3.151
C-1.007	CMH8	10080 Winter	100	+0%					2.585
C-1.008	CMH9	1440 Winter	100	+0%					2.500
C-1.009	CMH10	1440 Winter	30	+0%					2.305
C-1.010	CMH11	2160 Winter	5	+0%					2.012

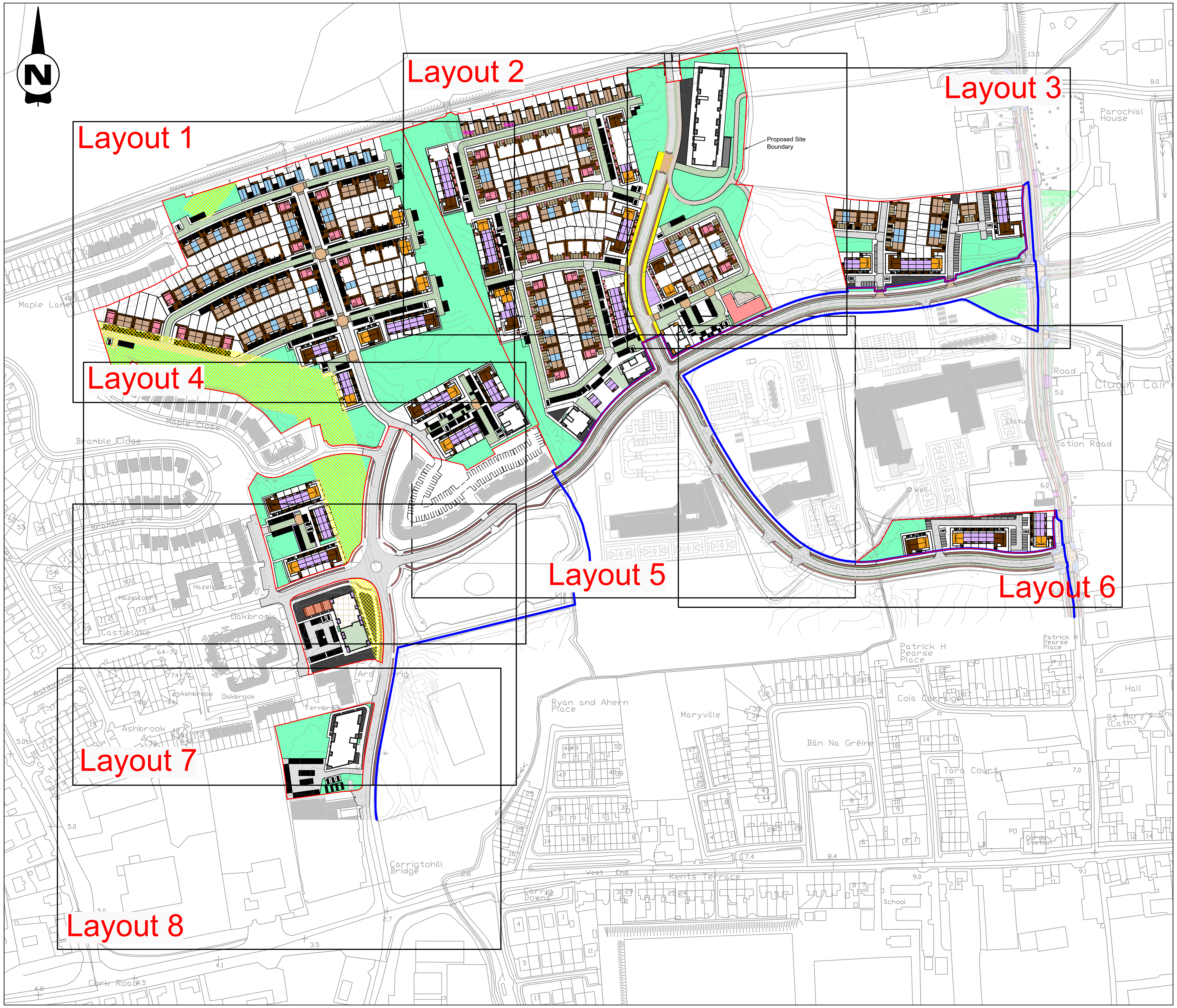
PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
C-1.000	CMH1	-0.321	0.000	0.44			154.0	OK	

Summary of Critical Results by Maximum Level (Rank 1) for Culverts

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
C-1.001	CMH2	-0.224	0.000	0.71			154.2	OK	
C-1.002	CMH3	-0.410	0.000	0.21			154.8	OK	
C-1.003	CMH4	-0.358	0.000	0.34			154.0	OK	
C-1.004	CMH5	-0.293	0.000	0.51			154.1	OK	
C-1.005	CMH6	-0.414	0.000	0.21			154.2	OK	
C-1.006	CMH7	-0.254	0.000	0.63			154.0	OK	
C-1.007	CMH8	-0.215	0.000	0.71			154.0	OK	
C-1.008	CMH9	-0.254	0.000	0.63			154.0	OK	
C-1.009	CMH10	-0.372	0.000	0.31			154.0	OK	
C-1.010	CMH11	-0.182	0.000	0.75			154.0	OK	

Appendix 9.2

Watermain infrastructure Drawings



J:\MCW1088 - BAM Castlelake Residential Dvlp\8.0 Drawings\UT\MCW1088-RPS-00-XX-DR-C-UT0101.dwg

Ordnance Survey Ireland

Client: bam

General Notes
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(v) All Levels refer to Ordnance Survey Datum, Malin Head.

Rev	Date	Drn	Chk	Amendment / Issue	App
S3 P01	23/05/22	PGR	GMcC	Issue for Review and Comment	BB
P01	26/10/21	PGR	GMcC	Pre-Application Submission	BB

rps

Scale: 1:2000 @ A1, 1:4000 @ A3
Created on: 13/09/2021
Sheets: 01 of 09
Project: Castlelake SHD
Title: Proposed Watermain Infrastructure Key Plan
Model File Identifier: MCW1088-RPS-00-XX-DR-C-UT0101
File Identifier: MCW1088-RPS-00-XX-DR-C-UT0101-01
Status: S3
Rev: P01

WATERMAIN NOTES:

1. BULK METERS TO BE PROVIDED (BY DEVELOPER) FOR EACH NEW DEVELOPMENT, IN ACCORDANCE WITH STD-W-02 & STD-W-26.
2. ALL CHAMBERS TO BE CONSTRUCTED IN ACCORDANCE WITH IW-CDS-5020-26.
3. THRUST / SUPPORT BLOCKS TO BE LOCATED ON BENDS AND T JUNCTIONS AND AS REQUIRED, BASED ON STD-W-28.
4. WHERE POSSIBLE, WATERMAINS TO HAVE A MINIMUM 300mm VERTICAL AND HORIZONTAL CLEARANCE TO ALL OTHER SERVICES.
5. PROPOSED SLUICE VALVES IN ACCORDANCE WITH STD-W-15.
6. PROPOSED AIR VALVES IN ACCORDANCE WITH STD-W-22.
7. WHERE MINIMUM PIPE COVER CANNOT BE ACHIEVED, CONCRETE SURROUND TO GRADE C25/30 IS REQUIRED AS PER DIMENSIONS SPECIFIED IN STD-W-31.

Client: bam

General Notes

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(v) All Levels refer to Ordnance Survey Datum, Malin Head.

Rev	Date	Drn / Chk	Amendment / Issue	App
S3 P01	23/05/22	PGR / GMcC	Issue fot Review and Comment	BB
P01	26/10/21	PGR / GMcC	Pre-Application Submission	BB

Scale: 1:500 @ A1, 1:1000 @ A3

Created on: 13/09/2021

Sheets: 02 of 09

Project: Castlelake SHD

Title: Proposed Watermain Infrastructure Watermain Layout (1 of 8)

Model File Identifier: MCW1088-RPS-00-XX-DR-C-UT0101

File Identifier: MCW1088-RPS-00-XX-DR-C-UT0101-02

Status: S3

Rev: P01

J:\MCW1088 - BAM Castlelake Residential Dvlp\8.0 Drawings\UT\MCW1088-RPS-00-XX-DR-C-UT0101.dwg

WATERMAIN NOTES:

1. BULK METERS TO BE PROVIDED (BY DEVELOPER) FOR EACH NEW DEVELOPMENT, IN ACCORDANCE WITH STD-W-02 & STD-W-26.
2. ALL CHAMBERS TO BE CONSTRUCTED IN ACCORDANCE WITH IW-CDS-5020-26.
3. THRUST / SUPPORT BLOCKS TO BE LOCATED ON BENDS AND T JUNCTIONS AND AS REQUIRED, BASED ON STD-W-28.
4. WHERE POSSIBLE, WATERMAINS TO HAVE A MINIMUM 300mm VERTICAL AND HORIZONTAL CLEARANCE TO ALL OTHER SERVICES.
5. PROPOSED SLUICE VALVES IN ACCORDANCE WITH STD-W-15.
6. PROPOSED AIR VALVES IN ACCORDANCE WITH STD-W-22.
7. WHERE MINIMUM PIPE COVER CANNOT BE ACHIEVED, CONCRETE SURROUND TO GRADE C25/30 IS REQUIRED AS PER DIMENSIONS SPECIFIED IN STD-W-31.

J:\MCW1088 - BAM Castlelake Residential Dvlp\8.0 Drawings\UT\MCW1088-RPS-00-XX-DR-C-UT0101.dwg

Client: bam

General Notes

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Rev	Date	Drn / Chk	Amendment / Issue	App
S3 P01	23/05/22	PGR / GMcC	Issue for Review and Comment	BB
P01	26/10/21	PGR / GMcC	Pre-Application Submission	BB

rps

Scale: 1:500 @ A1, 1:1000 @ A3

Created on: 13/09/2021

Sheets: 03 of 09

Project: Castlelake SHD

Title: Proposed Watermain Infrastructure Watermain Layout (2 of 8)

Model File Identifier: MCW1088-RPS-00-XX-DR-C-UT0101

File Identifier: MCW1088-RPS-00-XX-DR-C-UT0101-03

Status: S3

Rev: P01

WATERMAIN NOTES:
1. BULK METERS TO BE PROVIDED (BY DEVELOPER) FOR EACH NEW DEVELOPMENT, IN ACCORDANCE WITH STD-W-02 & STD-W-26.
2. ALL CHAMBERS TO BE CONSTRUCTED IN ACCORDANCE WITH IW-CDS-5020-26.
3. THRUST / SUPPORT BLOCKS TO BE LOCATED ON BENDS AND T JUNCTIONS AND AS REQUIRED, BASED ON STD-W-28.
4. WHERE POSSIBLE, WATERMAINS TO HAVE A MINIMUM 300mm VERTICAL AND HORIZONTAL CLEARANCE TO ALL OTHER SERVICES.
5. PROPOSED SLUICE VALVES IN ACCORDANCE WITH STD-W-15.
6. PROPOSED AIR VALVES IN ACCORDANCE WITH STD-W-22.
7. WHERE MINIMUM PIPE COVER CANNOT BE ACHIEVED, CONCRETE SURROUND TO GRADE C25/30 IS REQUIRED AS PER DIMENSIONS SPECIFIED IN STD-W-31.

LEGEND:

- Existing Watermains
- Existing Watermains to be Decommissioned
- Proposed DN180 SDR17 PE100 Watermains
- SV Proposed Sluice Valve
- FH Proposed Hydrant
- AV Proposed Air Valve
- Proposed Site Boundary

Ordnance Survey Ireland

J:\MCW1088 - BAM Castlelake Residential Dvlp\8.0 Drawings\UT\MCW1088-RPS-00-XX-DR-C-UT0101.dwg

Client: bam

General Notes
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Rev	Date	Drn Chk	Amendment / Issue	App
S3 P01	23/05/22	PGR GMcC	Issue for Review and Comment	BB
P01	26/10/21	PGR GMcC	Pre-Application Submission	BB

rps

Scale: 1:500 @ A1, 1:1000 @ A3
Created on: 13/09/2021
Sheets: 04 of 09
Project: Castlelake SHD
Title: Proposed Watermain Infrastructure Watermain Layout (3 of 8)
Model File Identifier: MCW1088-RPS-00-XX-DR-C-UT0101
File Identifier: MCW1088-RPS-00-XX-DR-C-UT0101-04
Status: S3
Rev: P01

LEGEND:

- Existing Watermains
- Existing Watermains to be Decommissioned
- Proposed DN180 SDR17 PE100 Watermains
- SV — Proposed Sluice Valve
- FH — Proposed Hydrant
- AV — Proposed Air Valve
- Proposed Site Boundary

WATERMAIN NOTES:
1. BULK METERS TO BE PROVIDED (BY DEVELOPER) FOR EACH NEW DEVELOPMENT, IN ACCORDANCE WITH STD-W-02 & STD-W-26.
2. ALL CHAMBERS TO BE CONSTRUCTED IN ACCORDANCE WITH IW-CDS-5020-26.
3. THRUST / SUPPORT BLOCKS TO BE PROVIDED ON BENDS AND T JUNCTIONS AND AS REQUIRED, BASED ON STD-W-28.
4. WHERE POSSIBLE, WATERMAINS TO HAVE A MINIMUM 300mm VERTICAL AND HORIZONTAL CLEARANCE TO ALL OTHER SERVICES.
5. PROPOSED SLUICE VALVES IN ACCORDANCE WITH STD-W-15.
6. PROPOSED AIR VALVES IN ACCORDANCE WITH STD-W-22.
7. WHERE MINIMUM PIPE COVER CANNOT BE ACHIEVED, CONCRETE SURROUND TO GRADE C25/30 IS REQUIRED AS PER DIMENSIONS SPECIFIED IN STD-W-31.

J:\MCW1088 - BAM Castlelake Residential Dvlp\8.0 Drawings\UT\MCW1088-RPS-00-XX-DR-C-UT0101.dwg

Client: bam

General Notes
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Rev	Date	Drn / Chk	Amendment / Issue	App
S3 P01	23/05/22	PGR / GMcC	Issue for Review and Comment	BB
P01	26/10/21	PGR / GMcC	Pre-Application Submission	BB

rps

Scale: 1:500 @ A1, 1:1000 @ A3
Created on: 13/09/2021
Sheets: 05 of 09
Project: Castlelake SHD
Title: Proposed Watermain Infrastructure Watermain Layout (4 of 8)
Model File Identifier: MCW1088-RPS-00-XX-DR-C-UT0101
File Identifier: MCW1088-RPS-00-XX-DR-C-UT0101-05
Status: S3
Rev: P01

WATERMAIN NOTES:
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6. PROPOSED AIR VALVES IN ACCORDANCE WITH STD-W-22.
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J:\MCW1088 - BAM Castlelake Residential Dvlp\8.0 Drawings\UT\MCW1088-RPS-00-XX-DR-C-UT0101.dwg

Client: bam

General Notes
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Rev	Date	Drn. Chk	Amendment / Issue	App
S3 P01	23/05/22	PGR GMcC	Issue for Review and Comment	BB
P01	26/10/21	PGR GMcC	Pre-Application Submission	BB

rps

Scale: 1:500 @ A1, 1:1000 @ A3
Created on: 13/09/2021
Sheets: 06 of 09

Project: Castlelake SHD

Title: Proposed Watermain Infrastructure
Watermain Layout
(5 of 8)

Model File Identifier: MCW1088-RPS-00-XX-DR-C-UT0101

File Identifier: MCW1088-RPS-00-XX-DR-C-UT0101-06

Status: S3

Rev: P01

Client

bam

General Notes
(i) Hard copies, dwf and pdf will form a controlled issue of the drawing. All other formats (dwg etc.) are deemed to be an uncontrolled issue and any work carried out based on these files is at the recipients own risk. RPS will not accept any responsibility for any errors from the use of these files, either by human error by the recipient, listing of the un-dimensioned measurements, compatibility with the recipients software, and any errors arising when these files are used to aid the recipients drawing production, or setting out on site.
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Rev	Date	Drn Chk	Amendment / Issue	App
S3 P01	23/05/22	PGR GMcC	Issue for Review and Comment	BB
P01	26/10/21	PGR GMcC	Pre-Application Submission	BB

rps

Model File Identifier: MCW1088-RPS-00-XX-DR-C-UT0101

Scale: 1:500 @ A1, 1:1000 @ A3
Created on: 13/09/2021
Sheets: 07 of 09

Project: Castlelake SHD

Title: Proposed Watermain Infrastructure Watermain Layout (6 of 8)

File Identifier: MCW1088-RPS-00-XX-DR-C-UT0101-07

Status: S3

Rev: P01

J:\MCW1088 - BAM Castlelake Residential Dvlp\8.0 Drawings\UT\MCW1088-RPS-00-XX-DR-C-UT0101.dwg

WATERMAIN NOTES:
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2. ALL CHAMBERS TO BE CONSTRUCTED IN ACCORDANCE WITH IW-CDS-5020-26.
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Client: bam

General Notes
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Rev	Date	Drn Chk	Amendment / Issue	App
S3 P01	23/05/22	PGR GMcC	Issue for Review and Comment	BB
P01	26/10/21	PGR GMcC	Pre-Application Submission	BB

rps

Scale: 1:500 @ A1, 1:1000 @ A3
Created on: 03/09/2021
Sheets: 08 of 09
Project: Castlelake SHD
Title: Proposed Watermain Infrastructure Watermain Layout (7 of 8)
Model File Identifier: MCW1088-RPS-00-XX-DR-C-UT0101
File Identifier: MCW1088-RPS-00-XX-DR-C-UT0101-08
Status: S3
Rev: P01

J:\MCW1088 - BAM Castlelake Residential Dvlp\8.0 Drawings\UT\MCW1088-RPS-00-XX-DR-C-UT0101.dwg

WATERMAIN NOTES:
1. BULK METERS TO BE PROVIDED (BY DEVELOPER) FOR EACH NEW DEVELOPMENT, IN ACCORDANCE WITH STD-W-02 & STD-W-26.
2. ALL CHAMBERS TO BE CONSTRUCTED IN ACCORDANCE WITH IW-CDS-5020-26.
3. THRUST / SUPPORT BLOCKS TO BE LOCATED ON BENDS AND T JUNCTIONS AND AS REQUIRED, BASED ON STD-W-28.
4. WHERE POSSIBLE, WATERMAINS TO HAVE A MINIMUM 300mm VERTICAL AND HORIZONTAL CLEARANCE TO ALL OTHER SERVICES.
5. PROPOSED SLUICE VALVES IN ACCORDANCE WITH STD-W-15.
6. PROPOSED AIR VALVES IN ACCORDANCE WITH STD-W-22.
7. WHERE MINIMUM PIPE COVER CANNOT BE ACHIEVED, CONCRETE SURROUND TO GRADE C25/30 IS REQUIRED AS PER DIMENSIONS SPECIFIED IN STD-W-31.

Client: bam

General Notes
(i) Hard copies, dwf and pdf will form a controlled issue of the drawing. All other formats (dwg etc.) are deemed to be an uncontrolled issue and any work carried out based on these files is at the recipients own risk. RPS will not accept any responsibility for any errors from the use of these files, either by human error by the recipient, listing of the un-dimensioned measurements, compatibility with the recipients software, and any errors arising when these files are used to aid the recipients drawing production, or setting out on site.
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(iv) Information including topographical survey, geotechnical investigation and utility detail used in the design have been provided by others.
(v) All Levels refer to Ordnance Survey Datum, Malin Head.

Rev	Date	Drn	Chk	Amendment / Issue	App
S3 P01	23/05/22	PQR	GMcC	Issue for Review and Comment	BB
P01	26/10/21	PQR	GMcC	Pre-Application Submission	BB

rps

Scale: 1:500 @ A1, 1:1000 @ A3
Created on: 13/09/2021
Sheets: 09 of 09
Project: Castlelake SHD
Title: Proposed Watermain Infrastructure Watermain Layout (8 of 8)
Model File Identifier: MCW1088-RPS-00-XX-DR-C-UT0101
File Identifier: MCW1088-RPS-00-XX-DR-C-UT0101-09
Status: S3
Rev: P01

J:\MCW1088 - BAM Castlelake Residential Dvlp\8.0 Drawings\UT\MCW1088-RPS-00-XX-DR-C-UT0101.dwg

J:\MCW1088 - BAM Castlelake Residential Dvlp\8.0 Drawings\UT\MCW1088-RPS-00-XX-DR-C-UT0102.dwg

Client

bam

General Notes

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Rev	Date	Drn Chk	Amendment / Issue	App
S3 P01	23/05/22	PGR GMCC	Issue for Review and Comment	BB
P01	26/10/21	PGR GMCC	Pre-Application Submission	BB

rps

Scale: See Drg. @ A1 / See Drg. @ A3

Created on: 21/10/2021

Sheets: 01 of 01

Project: Castlelake SHD

Title: Proposed Watermains Infrastructure Water Network Standard Details

Model File Identifier: MCW1088-RPS-00-XX-DR-C-UT0102

File Identifier: MCW1088-RPS-00-XX-DR-C-UT00102-01

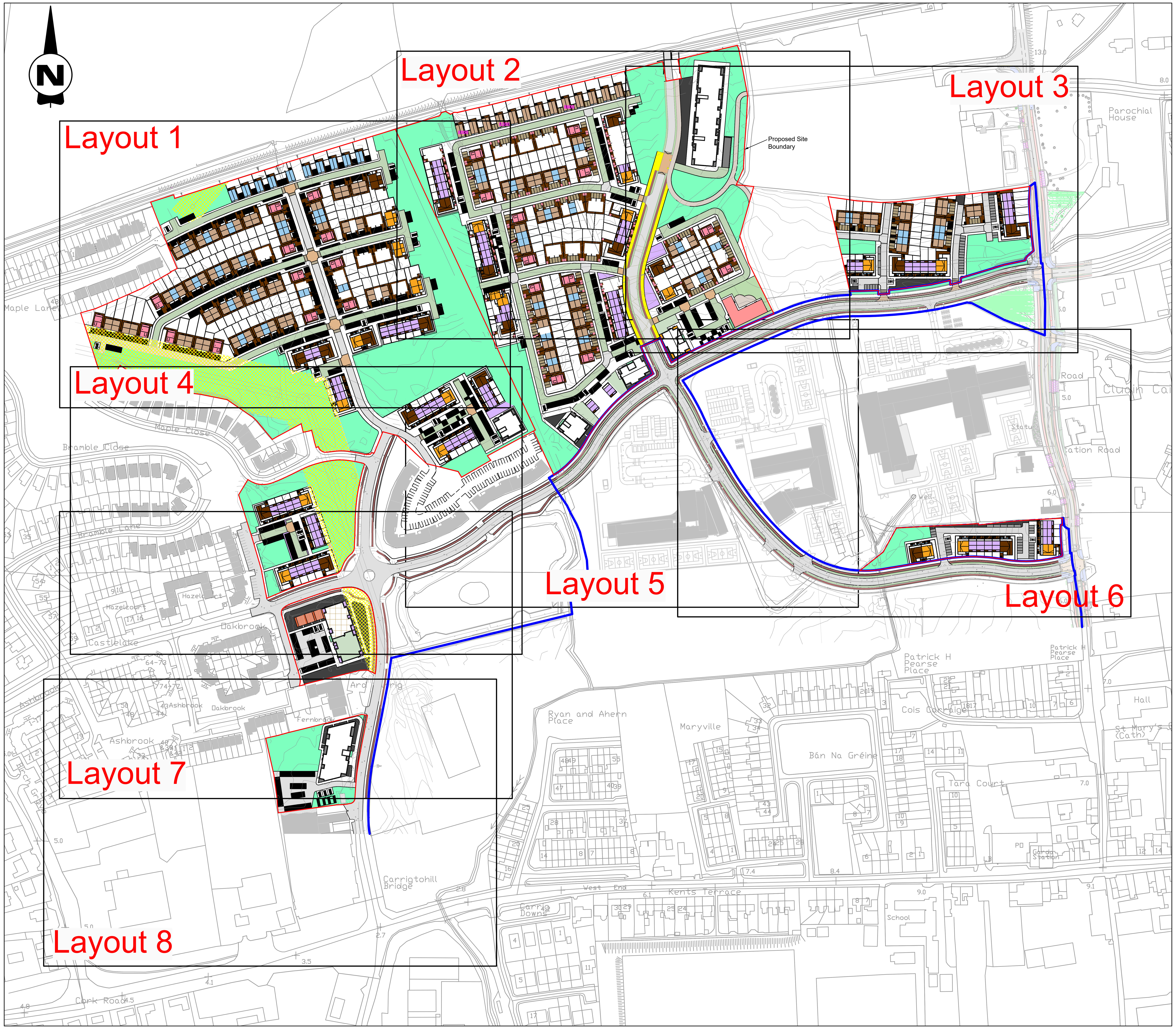
Status: S3

Rev: P01

MWP

Appendix 9.3

Foul Infrastructure Drawings



Ordnance Survey Ireland

Client

bam

General Notes

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(v) All Levels refer to Ordnance Survey Datum, Malin Head.

Rev	Date	Drn / Chk	Amendment / Issue	App
S3 P01	23/05/22	PGR / GMcC	Issue for Review and Comment	BB
P01	26/10/21	PGR / GMcC	Pre-Application Submission	BB

rps

Scale	1:2000 @ A1 1:4000 @ A3
Created on	18/10/2021
Sheets	01 of 09
Project	Castlelake SHD
Title	Proposed Foul Infrastructure Key Plan
Model File Identifier	MCW1088-RPS-00-XX-DR-C-DR0101
File Identifier	MCW1088-RPS-00-XX-DR-C-DR0101-01
Status	S3
Rev	P01

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J:\MCW1088 - BAM Castlelake Residential Dvlp\8.0 Drawings\DR\MCW1088-RPS-00-XX-DR-C-DR0101.dwg

Client: bam

General Notes

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Rev	Date	Drn	Chk	Amendment / Issue	App
S3 P01	23/05/22	PGR	GMcG	Issue for Review and Comment	BB
P01	26/10/21	PGR	GMcG	Issued for Information	GMcG

rps

Scale: 1:500 @ A1, 1:1000 @ A3

Created on: 18/10/2021

Sheets: 02 of 09

Project: Castlelake SHD

Title: Proposed Foul Infrastructure Drainage Layout (1 of 8)

Model File Identifier: MCW1088-RPS-00-XX-DR-C-DR0101

File Identifier: MCW1088-RPS-00-XX-DR-C-DR0101-02

Status: S3

Rev: P01

J:\MCW1088 - BAM Castlelake Residential Dvlp\8.0 Drawings\DR\MCW1088-RPS-00-XX-DR-C-DR0101.dwg

Client

bam

General Notes

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(v) All Levels refer to Ordnance Survey Datum, Malin Head.

Rev	Date	Drn / Chk	Amendment / Issue	App
S3 P01	23/05/22	PGR / GMcC	Issue for Review and Comment	
P01	26/10/21	PGR / GMcC	Pre-Application Submission	BB

rps

Model File Identifier: MCW1088-RPS-00-XX-DR-C-DR0101

Scale: 1:500 @ A1, 1:1000 @ A3

Created on: 18/10/2021

Sheets: 03 of 09

Project: Castlelake SHD

Title: Proposed Foul Infrastructure Drainage Layout (2 of 8)

File Identifier: MCW1088-RPS-00-XX-DR-C-DR0101-03

Status: S3

Rev: P01

Client

bam

General Notes

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(v) All Levels refer to Ordnance Survey Datum, Malin Head.

Rev	Date	Drn	Chk	Amendment / Issue	App
S3 P01	23/05/22	PGR	GMcC	Issue for Review and Comment	BB
P01	26/10/21	PGR	GMcC	Pre-Application Submission	BB

rps

Scale: 1:500 @ A1, 1:1000 @ A3

Created on: 18/10/2021

Sheets: 04 of 09

Project: Castlelake SHD

Title: Proposed Foul Infrastructure Drainage Layout (3 of 8)

Model File Identifier: MCW1088-RPS-00-XX-DR-C-DR0101

File Identifier: MCW1088-RPS-00-XX-DR-C-DR0101-04

Status: S3

Rev: P01

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J:\MCW1088 - BAM Castlelake Residential Dvlp\8.0 Drawings\DR\MCW1088-RPS-00-XX-DR-C-DR0101.dwg

Client: bam

General Notes
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(v) All Levels refer to Ordnance Survey Datum, Malin Head.

Rev	Date	Drn / Chk	Amendment / Issue	App
S3 P01	23/05/22	PGR / GMcC	Issue for Review and Comment	BB
P01	26/10/21	PGR / GMcC	Pre-Application Submission	BB

rps

Model File Identifier: MCW1088-RPS-00-XX-DR-C-DR0101

Scale	1:500 @ A1 1:1000 @ A3
Created on	18/10/2021
Sheets	05 of 09
Project	Castlelake SHD
Title	Proposed Foul Infrastructure Drainage Layout (4 of 8)
File Identifier	MCW1088-RPS-00-XX-DR-C-DR0101-05
Status	S3
Rev	P01

Client	General Notes		Rev	Date	Drn Chk	Amendment / Issue	App
bam	(i) Hard copies, dwf and pdf will form a controlled issue of the drawing. All other formats (dwg etc.) are deemed to be an uncontrolled issue and any work carried out based on these files is at the recipients own risk. RPS will not accept any responsibility for any errors from the use of these files, either by human error by the recipient, listing of the un-dimensioned measurements, compatibility with the recipients software, and any errors arising when these files are used to aid the recipients drawing production, or setting out on site. (ii) DO NOT SCALE, use figured dimensions only.	(iii) This drawing is the property of RPS, it is a project confidential classified document. It must not be copied used or its contents divulged without prior written consent. The needs and expectations of client and RPS must be considered when working with this drawing. (iv) Information including topographical survey, geotechnical investigation and utility detail used in the design have been provided by others. (v) All Levels refer to Ordnance Survey Datum, Malin Head.	S3 P01	23/05/22	PGR GMcC	Issue for Review and Comment	BB
			P01	26/10/21	PGR GMcC	Pre-Application Submission	BB

rps

Scale: 1:500 @ A1, 1:1000 @ A3
Created on: 18/10/2021
Sheets: 06 of 09
Project: Castlelake SHD
Title: Proposed Foul Infrastructure Drainage Layout (5 of 8)
Model File Identifier: MCW1088-RPS-00-XX-DR-C-DR0101
File Identifier: MCW1088-RPS-00-XX-DR-C-DR0101-06
Status: S3
Rev: P01

J:\MCW1088 - BAM Castlelake Residential Dvlp\8.0 Drawings\DR\MCW1088-RPS-00-XX-DR-C-DR0101.dwg

Client	General Notes		Rev	Date	Drn Chk	Amendment / Issue	App
bam	(i) Hard copies, dwf and pdf will form a controlled issue of the drawing. All other formats (dwg etc.) are deemed to be an uncontrolled issue and any work carried out based on these files is at the recipients own risk. RPS will not accept any responsibility for any errors from the use of these files, either by human error by the recipient, listing of the un-dimensioned measurements, compatibility with the recipients software, and any errors arising when these files are used to aid the recipients drawing production, or setting out on site.	(iii) This drawing is the property of RPS, it is a project confidential classified document. It must not be copied used or its contents divulged without prior written consent. The needs and expectations of client and RPS must be considered when working with this drawing.	S3 P01	23/05/22	PQR GM&C	Issue for Review and Comment	BB
	(ii) DO NOT SCALE, use figured dimensions only.	(iv) Information including topographical survey, geotechnical investigation and utility detail used in the design have been provided by others.	P01	26/10/21	PQR GM&C	Pre-Application Submission	BB
		(v) All Levels refer to Ordnance Survey Datum, Malin Head.					

rps

Scale	1:500 @ A1 / 1:1000 @ A3
Created on	18/10/2021
Sheets	07 of 09
Project	Castlelake SHD
Title	Proposed Foul Infrastructure Drainage Layout (6 of 8)
Model File Identifier	MCW1088-RPS-00-XX-DR-C-DR0101
File Identifier	MCW1088-RPS-00-XX-DR-C-DR0101-07
Status	S3
Rev	P01

J:\MCW1088 - BAM Castlelake Residential Dvlp\8.0 Drawings\DR\MCW1088-RPS-00-XX-DR-C-DR0101.dwg

Client

bam

General Notes

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(v) All Levels refer to Ordnance Survey Datum, Malin Head.

Rev	Date	Drn Chk	Amendment / Issue	App
S3 P01	23/05/22	PGR GMcC	Issue for Review and Comment	BB
P01	26/10/21	PGR GMcC	Pre-Application Submission	BB

rps

Model File Identifier: MCW1088-RPS-00-XX-DR-C-DR0101

Scale: 1:500 @ A1, 1:1000 @ A3

Created on: 18/10/2021

Sheets: 08 of 09

Project: Castlelake SHD

Title: Proposed Foul Infrastructure Drainage Layout (7 of 8)

File Identifier: MCW1088-RPS-00-XX-DR-C-DR0101-08

Status: S3

Rev: P01

J:\MCW1088 - BAM Castlelake Residential Dvlp\8.0 Drawings\DR\MCW1088-RPS-00-XX-DR-C-DR0101.dwg

Client

bam

General Notes

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Rev	Date	Drn	Chk	Amendment / Issue	App
S3 P01	23/05/22	PGR	GMcC	Issue for Review and Comment	BB
P01	26/10/21	PGR	GMcC	Pre-Application Submission	BB

rps

Scale 1:500 @ A1 1:1000 @ A3

Created on 18/10/2021

Sheets 09 of 09

Project: Castlelake SHD

Title: Proposed Foul Infrastructure Drainage Layout (8 of 8)

Model File Identifier: MCW1088-RPS-00-XX-DR-C-DR0101

File Identifier: MCW1088-RPS-00-XX-DR-C-DR0101-09

Status: S3

Rev: P01

J:\MCW1088 - BAM Castlelake Residential Dvlp\8.0 Drawings\DR\MCW1088-RPS-00-XX-DR-C-DR0101.dwg

Longitudinal Section 1 (Hor Scale 1000, Ver Scale 200, Datum (m) 0.000)

MH Name	FMH1	FMH2	FMH3	FMH8	FMH16	FMH25	FMH26	FMH27	FMH33	FMH
Profile labels				3.000 / 3.002	4.002 / 5.002	7.003 / 8.003			10.003	
Cover Level (m)	8.100	7.645	7.160	6.820	6.210	5.170	4.115	3.920	3.745	3.731
Invert Level (m)	6.600	6.089 / 6.089	5.660 / 5.660	5.320 / 4.356	3.368 / 3.368	2.370 / 2.370	2.161 / 2.161	2.116 / 2.116	2.020 / 1.463	1.381

PN	F-1.000	F-1.001	F-1.002	F-1.003	F-1.004	F-1.005	F-1.006	F-1.007	F-1.008
Dia (mm)	225	225	225	450	450	450	450	450	450
Slope (1:X)	80.0	105.0	86.8	64.2	64.1	360.0	360.0	166.7	360.0
Length (m)	40.866	45.045	29.529	63.463	63.971	75.294	15.968	16.002	29.623

Longitudinal Section 2 (Hor Scale 1000, Ver Scale 200, Datum (m) 0.000)

MH Name		FMH8
Profile labels		1.002 / 3.002
PN	F-2.000	
Dia (mm)	450	
Slope (1:X)	360.0	
Cover Level (m)	7.200	6.820
Invert Level (m)	4.408	4.356
Length (m)		

Longitudinal Section 3 (Hor Scale 1000, Ver Scale 200, Datum (m) 0.000)

MH Name		FMH6	FMH7	FMH8
Profile labels				1.002 / 2.000
Cover Level (m)	7.000	7.060	6.605	6.820
Invert Level (m)	5.500	5.334 / 5.334	5.029 / 5.029	4.581

PN	F-3.001	F-3.002
Dia (mm)	225	225
Slope (1:X)	150.1	84.5
Length (m)	45.772	37.837

Longitudinal Section 4 (Hor Scale 1000, Ver Scale 200, Datum (m) 0.000)

MH Name	FMH9	FMH10	FMH11	FMH16
Profile labels				5.003 / 4.003
Cover Level (m)	6.400	6.540	6.325	6.210
Invert Level (m)	4.900	4.150 / 4.150	3.848 / 3.848	3.593

PN	F-4.000	F-4.001	F-4.002
Dia (mm)	225	225	225
Slope (1:X)	80.0	150.0	150.0
Length (m)	59.989	45.315	38.214

Longitudinal Section 5 (Hor Scale 1000, Ver Scale 200, Datum (m) 0.000)

MH Name		FMH14	FMH15	FMH16
Profile labels		6.000		4.003
Cover Level (m)	6.345	6.300	6.010	6.210
Invert Level (m)	4.500	4.312 / 4.312	3.952 / 3.952	3.593

PN	F-5.001	F-5.002
Dia (mm)	225	225
Slope (1:X)	150.0	82.9
Length (m)	53.996	29.769

Longitudinal Section 6 (Hor Scale 1000, Ver Scale 200, Datum (m) 0.000)

MH Name	FMH13	FMH14
Profile labels		5.000
PN	F-6.000	
Dia (mm)		
Slope (1:X)		
Cover Level (m)	6.350	6.300
Invert Level (m)	4.477	4.312
Length (m)	13.167	

Client: bam

General Notes
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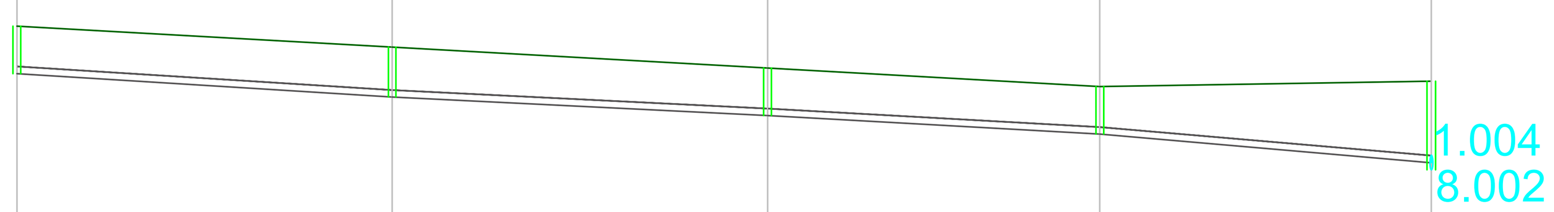
Rev	Date	Drn / Chk	Amendment / Issue	App
S3 P01	23/05/22	PGR / GMcC	Issue for Review and Comment	BB
P01	26/10/21	PGR / GMcC	Pre-Application Submission	BB

rps

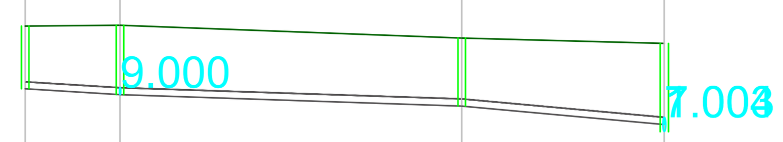
Model File Identifier: MCW1088-RPS-00-XX-DR-C-DR0102

Scale: As Shown @ A1, Half @ A3
Created on: 24/10/2021
Sheets: 01 of 05
Project: Castlelake SHD
Title: Proposed Foul Infrastructure Longitudinal Sections (1 of 5)
File Identifier: MCW1088-RPS-00-XX-DR-C-DR0102-01
Status: S3
Rev: P01

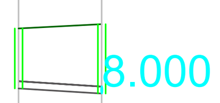
J:\MCW1088 - BAM Castlelake Residential Dvlp\8.0 Drawings\DR\MCW1088-RPS-00-XX-DR-C-DR0102.dwg



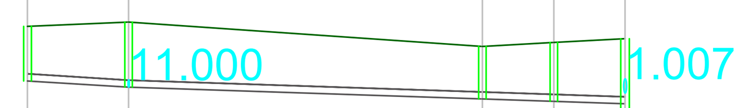
MH Name	FMH17	FMH18	FMH19	FMH20	FMH25
Hor Scale 1000					
Ver Scale 200					
Datum (m) 0.000					
PN	F-7.000	F-7.001	F-7.002	F-7.003	
Dia (mm)	225	225	225	225	
Slope (1:X)	80.0	101.8	89.8	58.2	
Cover Level (m)	6.905	6.240	5.580	4.995	5.170
Invert Level (m)	5.405	4.663 4.663	4.080 4.080	3.495 3.495	2.595
Length (m)	59.328	59.328	52.530	52.392	



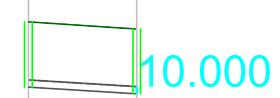
MH Name	FMH21	FMH23	FMH24	FMH25
Hor Scale 1000				
Ver Scale 200				
Datum (m) 0.000				
PN	F-8.000	F-8.001	F-8.002	
Dia (mm)	225	225	225	
Slope (1:X)	80.0	150.0	54.8	
Cover Level (m)	5.720	5.740	5.340	5.170
Invert Level (m)	3.728	3.540 3.540	3.180 3.180	2.595
Length (m)	15.011	53.996	32.029	



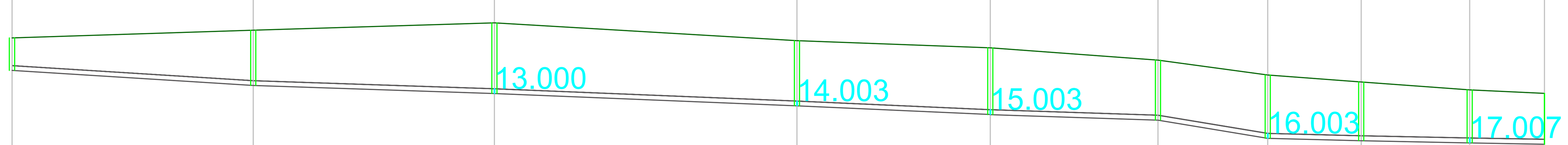
MH Name	FMH22	FMH23
Hor Scale 1000		
Ver Scale 200		
Datum (m) 0.000		
PN	F-9.000	
Dia (mm)	225	
Slope (1:X)	80.0	
Cover Level (m)	5.605	5.740
Invert Level (m)	3.705	3.540
Length (m)	13.167	



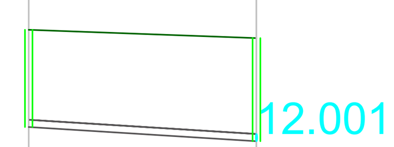
MH Name	FMH28	FMH30	FMH31	FMH32	FMH33
Hor Scale 1000					
Ver Scale 200					
Datum (m) 0.000					
PN	F-10.000	F-10.001	F-10.002	F-10.003	
Dia (mm)	225	225	225	225	
Slope (1:X)	80.0	150.1	150.0	150.0	
Cover Level (m)	4.135	4.270	3.505	3.625	3.745
Invert Level (m)	2.411	2.211 2.211	1.838 1.838	1.763 1.763	1.688
Length (m)	15.980	55.969	11.310	11.263	



MH Name	FMH29	FMH30
Hor Scale 1000		
Ver Scale 200		
Datum (m) 0.000		
PN	F-11.000	
Dia (mm)	225	
Slope (1:X)	80.0	
Cover Level (m)	4.500	4.270
Invert Level (m)	2.426	2.212
Length (m)	17.112	



MH Name	FMH34	FMH35	FMH37	FMH42	FMH47	FMH48	FMH53	FMH54	FMH66	FMH
Hor Scale 1000										
Ver Scale 200										
Datum (m) 0.000										
PN	F-12.000	F-12.001	F-12.002	F-12.003	F-12.004	F-12.005	F-12.006	F-12.007	F-12.008	
Dia (mm)	225	225	225	225	225	225	225	225	225	
Slope (1:X)	80.0	150.0	123.5	111.6	150.0	30.3	200.0	250.0	278.3	
Cover Level (m)	7.758	8.115	8.450	7.630	7.300	6.730	6.050	5.730	5.360	5.200
Invert Level (m)	6.258	5.562 5.562	5.190 5.190	4.624 4.624	4.224 4.224	3.965 3.965	3.128 3.128	3.020 3.020	2.920 2.920	2.858
Length (m)	55.715	55.715	69.886	44.656	38.756	25.356	21.574	25.063	17.256	



MH Name	FMH36	FMH37
Hor Scale 1000		
Ver Scale 200		
Datum (m) 0.000		
PN	F-13.000	
Dia (mm)	225	
Slope (1:X)	80.0	
Cover Level (m)	8.715	8.450
Invert Level (m)	5.640	5.190
Length (m)	35.984	

Client: bam

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Rev	Date	Drn / Chk	Amendment / Issue	App
S3 P01	23/05/22	PDR / GMcC	Issue for Review and Comment	BB
P01	26/10/21	PDR / GMcC	Pre-Application Submission	BB

rps

Model File Identifier: MCW1088-RPS-00-XX-DR-C-DR0102

Scale: As Shown @ A1, Half @ A3
Created on: 24/10/2021
Sheets: 02 of 05
Project: Castlelake SHD
Title: Proposed Foul Infrastructure Longitudinal Sections (2 of 5)
File Identifier: MCW1088-RPS-00-XX-DR-C-DR0102-02
Status: S3
Rev: P01

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Hor Scale 1000 / Ver Scale 200 / Datum (m) 0.000

MH Name	FMH38	FMH39	FMH40	FMH41	FMH42
Cover Level (m)	7.630	7.370	7.915	7.835	7.630
Invert Level (m)	6.130	5.446 / 5.446	5.081 / 5.081	4.767 / 4.767	4.624

PN	F-14.000	F-14.001	F-14.002	F-14.003
Dia (mm)	225	225	225	225
Slope (1:X)	80.0	150.0	150.0	150.0
Length (m)	54.722	54.786	47.039	21.437

12.002

Hor Scale 1000 / Ver Scale 200 / Datum (m) 0.000

MH Name	FMH43	FMH44	FMH45	FMH46	FMH47
Cover Level (m)	8.000	8.000	7.900	6.980	7.300
Invert Level (m)	6.900	6.093 / 6.093	6.043 / 6.043	5.205 / 5.205	4.224

PN	F-15.000	F-15.001	F-15.002	F-15.003
Dia (mm)	225	225	225	225
Slope (1:X)	80.0	150.0	52.0	37.6
Length (m)	64.570	7.519	43.201	36.837

12.003

Hor Scale 1000 / Ver Scale 200 / Datum (m) 0.000

MH Name	FMH49	FMH50	FMH51	FMH52	FMH53
Cover Level (m)	7.155	5.820	5.675	5.830	6.050
Invert Level (m)	5.200	3.865 / 3.865	3.570 / 3.570	3.364 / 3.364	3.128

PN	F-16.000	F-16.001	F-16.002	F-16.003
Dia (mm)	225	225	225	225
Slope (1:X)	36.0	150.0	150.0	150.0
Length (m)	48.121	44.313	30.800	35.409

12.005

Hor Scale 1000 / Ver Scale 200 / Datum (m) 0.000

MH Name	FMH55	FMH56	FMH57	FMH58	FMH59	FMH61	FMH63	FMH65	FMH66
Cover Level (m)	6.915	6.590	6.530	6.100	6.055	5.800	5.610	5.445	5.360
Invert Level (m)	5.415	4.880 / 4.880	4.828 / 4.828	4.448 / 4.410	4.448 / 4.410	3.693 / 3.693	3.530 / 3.530	3.244 / 3.244	2.920

PN	F-17.000	F-17.001	F-17.002	F-17.003	F-17.004	F-17.005	F-17.006	F-17.007
Dia (mm)	225	225	225	225	225	225	225	225
Slope (1:X)	80.0	150.0	150.0	150.0	48.1	150.0	71.4	61.9
Length (m)	42.824	7.696	57.007	5.711	34.491	24.509	20.431	20.060

18.000 19.000 20.000 12.007

Hor Scale 1000 / Ver Scale 200 / Datum (m) 0.000

MH Name	FMH60	FMH61
Cover Level (m)	5.610	5.800
Invert Level (m)	3.950	3.693
PN	F-18.000	
Dia (mm)	225	
Slope (1:X)	79.9	
Length (m)	20.534	

17.004

Hor Scale 1000 / Ver Scale 200 / Datum (m) 0.000

MH Name	FMH62	FMH63
Cover Level (m)	5.405	5.610
Invert Level (m)	3.905	3.530
PN	F-19.000	
Dia (mm)	225	
Slope (1:X)	58.8	
Length (m)	22.048	

17.005

Hor Scale 1000 / Ver Scale 200 / Datum (m) 0.000

MH Name	FMH64	FMH65
Cover Level (m)	6.050	5.445
Invert Level (m)	4.550	3.244
PN	F-20.000	
Dia (mm)	225	
Slope (1:X)	25.7	
Length (m)	33.622	

17.006

Client: bam

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Rev	Date	Drn / Chk	Amendment / Issue	App
S3 P01	23/05/22	PQR / GMcC	Issue for Review and Comment	BB
P01	26/10/21	PQR / GMcC	Pre-Application Submission	BB

rps

Scale: As Shown @ A1, Half @ A3
Created on: 24/10/2021
Sheets: 03 of 05
Project: Castlelake SHD
Title: Proposed Foul Infrastructure Longitudinal Sections (3 of 5)
Model File Identifier: MCW1088-RPS-00-XX-DR-C-DR0102
File Identifier: MCW1088-RPS-00-XX-DR-C-DR0102-03
Status: S3
Rev: P01

J:\MCW1088 - BAM Castlelake Residential Dvlp\8.0 Drawings\DR\MCW1088-RPS-00-XX-DR-C-DR0102.dwg

MH Name	FMH67	FMH68	FMH74	FMH75	FMH76	FMH77	FMH
Hor Scale 1000 / Ver Scale 200			22.004				
Datum (m) 0.000							
PN	F-21.000	F-21.001	F-21.002	F-21.003	F-21.004	F-21.005	
Dia (mm)	225	225	225	225	225	225	
Slope (1:X)	46.2	75.6	220.0	220.0	220.0	225.3	
Cover Level (m)	5.490	4.600	4.100	3.900	3.800	3.610	3.305
Invert Level (m)	3.990	3.100 3.100	2.350 2.350	2.289 2.289	2.189 2.189	2.081 2.081	2.033
Length (m)	41.143	56.708	13.525	21.929	23.702	10.813	

MH Name	FMH69	FMH70	FMH71	FMH72	FMH73	FMH74
Hor Scale 1000 / Ver Scale 200						21.001
Datum (m) 0.000						
PN	F-22.000	F-22.001	F-22.002	F-22.003	F-22.004	
Dia (mm)	225	225	225	225	225	
Slope (1:X)	45.3	94.2	150.0	150.0	115.2	
Cover Level (m)	5.345	4.760	4.380	4.335	4.135	4.100
Invert Level (m)	3.845	3.260 3.260	2.880 2.880	2.829 2.829	2.580 2.580	2.350
Length (m)	26.509	35.791	7.702	37.232	26.487	

MH Name	FMH78	FMH79	FMH81	FMH82	FMH83	FMH84	FMH
Hor Scale 1000 / Ver Scale 200			24.000				
Datum (m) 0.000							
PN	F-23.000	F-23.001	F-23.002	F-23.003	F-23.004	F-23.005	
Dia (mm)	225	225	225	225	225	225	
Slope (1:X)	69.2	150.0	150.0	150.0	150.0	130.1	
Cover Level (m)	6.920	6.350	6.755	6.630	6.540	6.535	6.850
Invert Level (m)	5.420	5.100 5.100	4.904 4.904	4.750 4.750	4.643 4.643	4.615 4.615	4.178
Length (m)	22.150	29.449	23.019	16.151	4.198	56.839	

MH Name	FMH80	FMH81
Hor Scale 1000 / Ver Scale 200		23.001
Datum (m) 0.000		
PN	F-24.000	
Dia (mm)	225	
Slope (1:X)	40.8	
Cover Level (m)	6.855	6.755
Invert Level (m)	5.355	4.904
Length (m)	18.408	

MH Name	FMH85	FMH87	FMH90	FMH
Hor Scale 1000 / Ver Scale 200		26.000	27.001	
Datum (m) 0.000				
PN	F-25.000	F-25.001	F-25.002	
Dia (mm)	225	225	225	
Slope (1:X)	80.0	150.0	200.0	
Cover Level (m)	6.560	6.700	6.845	6.850
Invert Level (m)	4.769	4.423 4.423	4.202 4.202	4.178
Length (m)	27.673	33.080	4.901	

MH Name	FMH86	FMH87
Hor Scale 1000 / Ver Scale 200		25.000
Datum (m) 0.000		
PN	F-26.000	
Dia (mm)	225	
Slope (1:X)	67.6	
Cover Level (m)	6.450	6.700
Invert Level (m)	4.950	4.423
Length (m)	35.600	

MH Name	FMH88	FMH89	FMH90
Hor Scale 1000 / Ver Scale 200			25.001
Datum (m) 0.000			
PN	F-27.000	F-27.001	
Dia (mm)	225	225	
Slope (1:X)	80.0	150.0	
Cover Level (m)	6.800	6.885	6.845
Invert Level (m)	5.300	5.091 5.091	5.066
Length (m)	16.692	3.764	

Client: bam

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Rev	Date	Drn / Chk	Amendment / Issue	App
S3 P01	23/05/22	PDR / GMcC	Issue for Review and Comment	BB
P01	26/10/21	PDR / GMcC	Pre-Application Submission	BB

rps

Scale: As Shown @ A1, Half @ A3
Created on: 24/10/2021
Sheets: 04 of 05
Project: Castlelake SHD
Title: Proposed Foul Infrastructure Longitudinal Sections (4 of 5)
Model File Identifier: MCW1088-RPS-00-XX-DR-C-DR0101
File Identifier: MCW1088-RPS-00-XX-DR-C-DR0101-04
Status: S3
Rev: P01

J:\MCW1088 - BAM Castlelake Residential Dvlp\8.0 Drawings\DR\MCW1088-RPS-00-XX-DR-C-DR0102.dwg

MH Name	FMH91	FMH92	FMH93	FMH
Hor Scale 1000				
Ver Scale 200				
Datum (m) 0.000				
PN	F-28.000	F-28.001	F-28.002	
Dia (mm)	225	225	225	
Slope (1:X)	80.0	150.0	89.6	
Cover Level (m)	5.150	5.000	5.000	5.534
Invert Level (m)	3.650	3.411 / 3.411	3.250 / 3.250	2.794
Length (m)	19.125	24.137	40.864	

MH Name	FMH94	FMH
Hor Scale 1000		
Ver Scale 200		
Datum (m) 0.000		
PN	F-29.000	
Dia (mm)	225	
Slope (1:X)	16.6	
Cover Level (m)	5.500	4.473
Invert Level (m)	3.163	2.681
Length (m)	8.000	

MH Name	FMH95	FMH96	FMH
Hor Scale 1000			
Ver Scale 200			
Datum (m) 0.000			
PN	F-30.000	F-30.001	
Dia (mm)	225	225	
Slope (1:X)	149.8	149.7	
Cover Level (m)	6.850	6.850	6.780
Invert Level (m)	5.782	5.624 / 5.624	5.491
Length (m)	23.667	19.912	

MH Name	FMH97	FMH98	FMH99	FMH
Hor Scale 1000				
Ver Scale 200				
Datum (m) 0.000				
PN	F-31.000	F-31.001	F-31.002	
Dia (mm)	225	225	225	
Slope (1:X)	149.7	150.0	149.9	
Cover Level (m)	6.700	6.550	6.500	6.000
Invert Level (m)	5.275	5.126 / 5.126	5.097 / 5.098	5.011
Length (m)	22.300	4.294	13.038	

MH Name	FMH100	FMH101	FMH
Hor Scale 1000			
Ver Scale 200			
Datum (m) 0.000			
PN	F-32.000	F-32.001	
Dia (mm)	225	225	
Slope (1:X)	80.0	148.4	
Cover Level (m)	4.000	3.200 / 3.200	
Invert Level (m)	2.500	1.977 / 1.977	1.930
Length (m)	41.848	6.976	

MH Name	FMH102	FMH
Hor Scale 1000		
Ver Scale 200		
Datum (m) 0.000		
PN	F-33.000	
Dia (mm)	225	
Slope (1:X)	80.0	
Cover Level (m)	3.400	3.300
Invert Level (m)	1.900	1.445
Length (m)	36.397	

Client

bam

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Rev	Date	Drn / Chk	Amendment / Issue	App
S3 P01	23/05/22	PGR / GMcC	Issue for Review and Comment	BB
P01	26/10/21	PGR / GMcC	Pre-Application Submission	BB

rps

Model File Identifier: MCW1088-RPS-00-XX-DR-C-DR0101

Scale: As Shown @ A1, Half @ A3

Created on: 24/10/2021

Sheets: 05 of 05

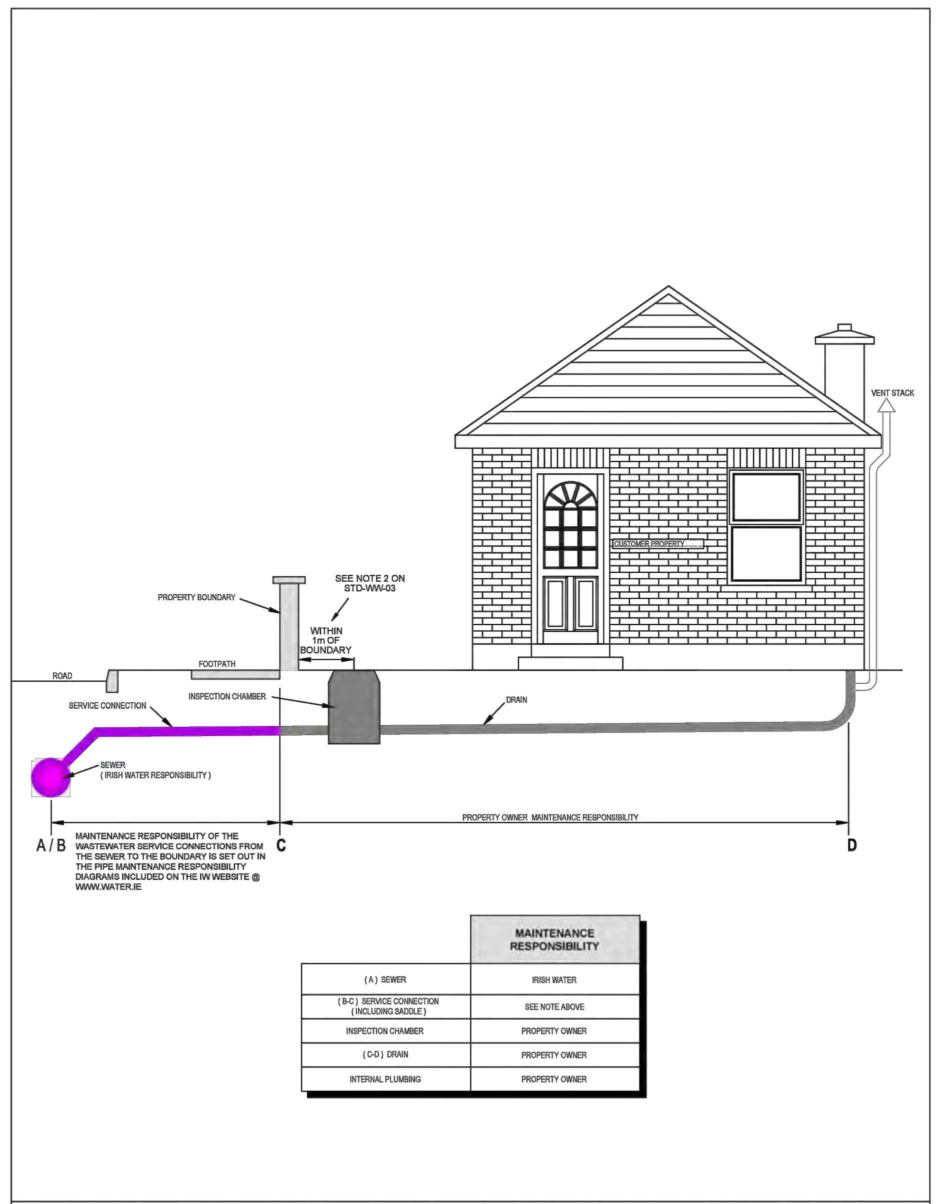
Project: Castlelake SHD

Title: Proposed Foul Infrastructure Longitudinal Sections (5 of 5)

File Identifier: MCW1088-RPS-00-XX-DR-C-DR0101-05

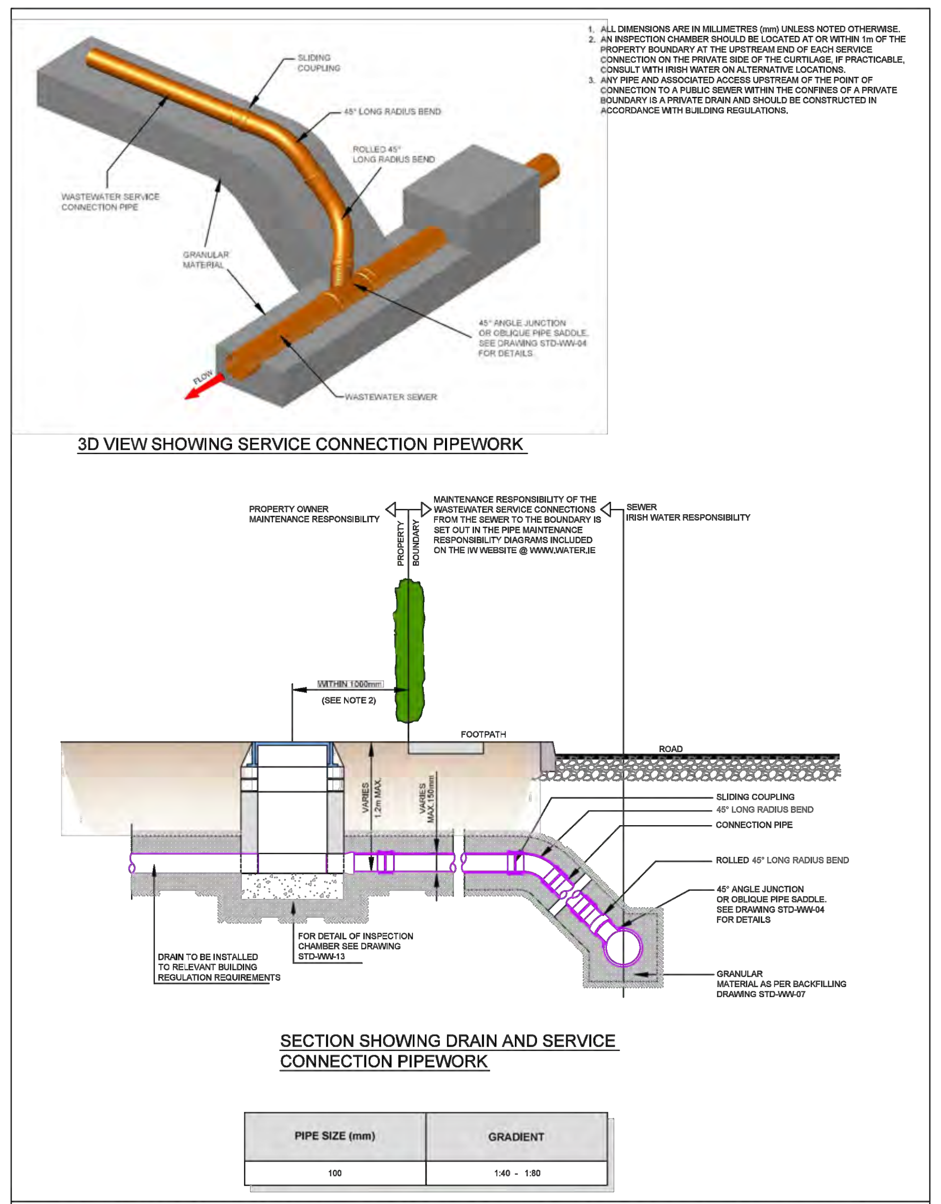
Status: S3

Rev: P01



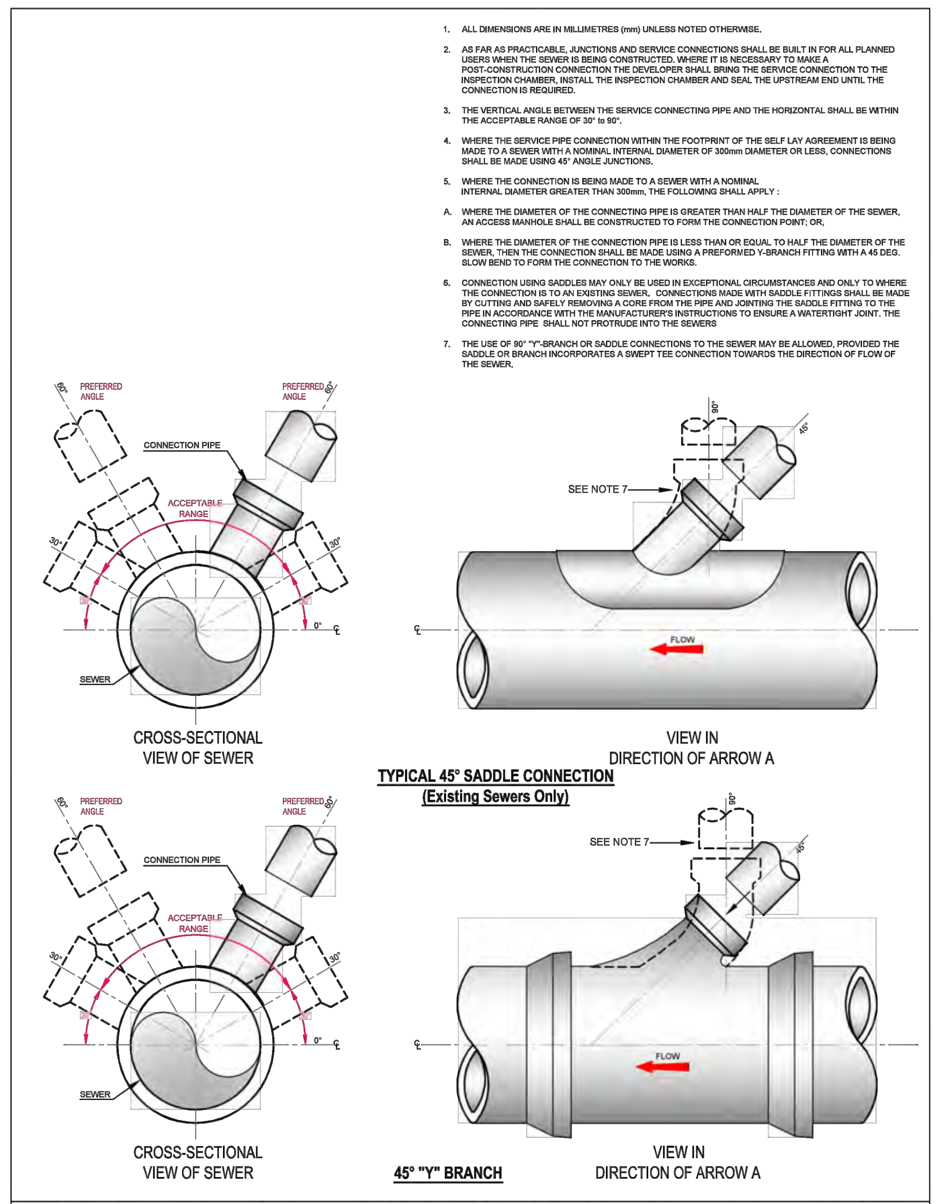
REFER TO INDEX SHEET FOR NOTES REGARDING DESIGN RESPONSIBILITY & RISK ASSESSMENT

UISCE ÉIREANN : IRISH WATER — STANDARD DETAILS - WASTEWATER — WASTEWATER SERVICE CONNECTION MAINTENANCE RESPONSIBILITY — SEPT. 2015 — STD-WW-01 — 2



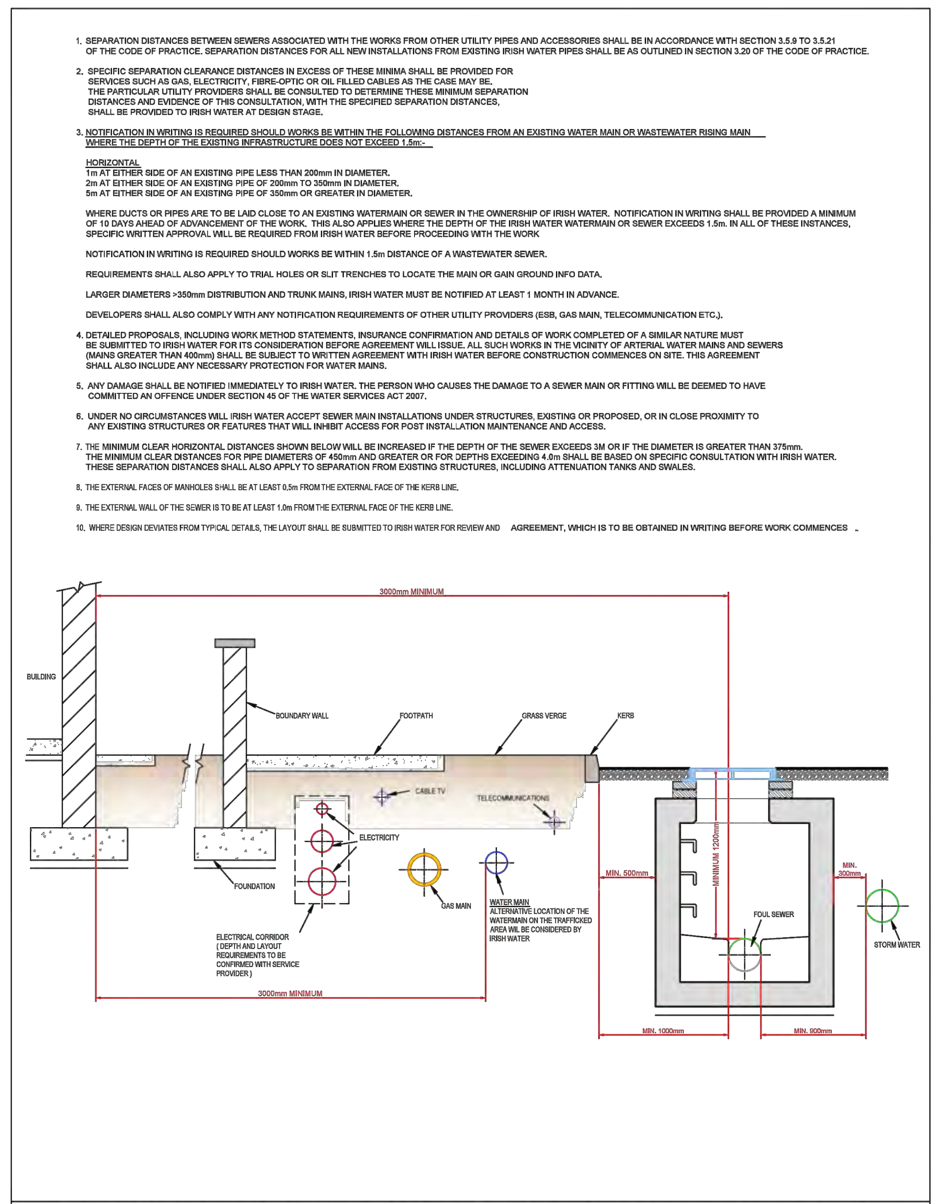
REFER TO INDEX SHEET FOR NOTES REGARDING DESIGN RESPONSIBILITY & RISK ASSESSMENT

UISCE ÉIREANN : IRISH WATER — STANDARD DETAILS - WASTEWATER — DRAIN AND SERVICE CONNECTION PIPEWORK — SEPT. 2015 — STD-WW-03 — 2



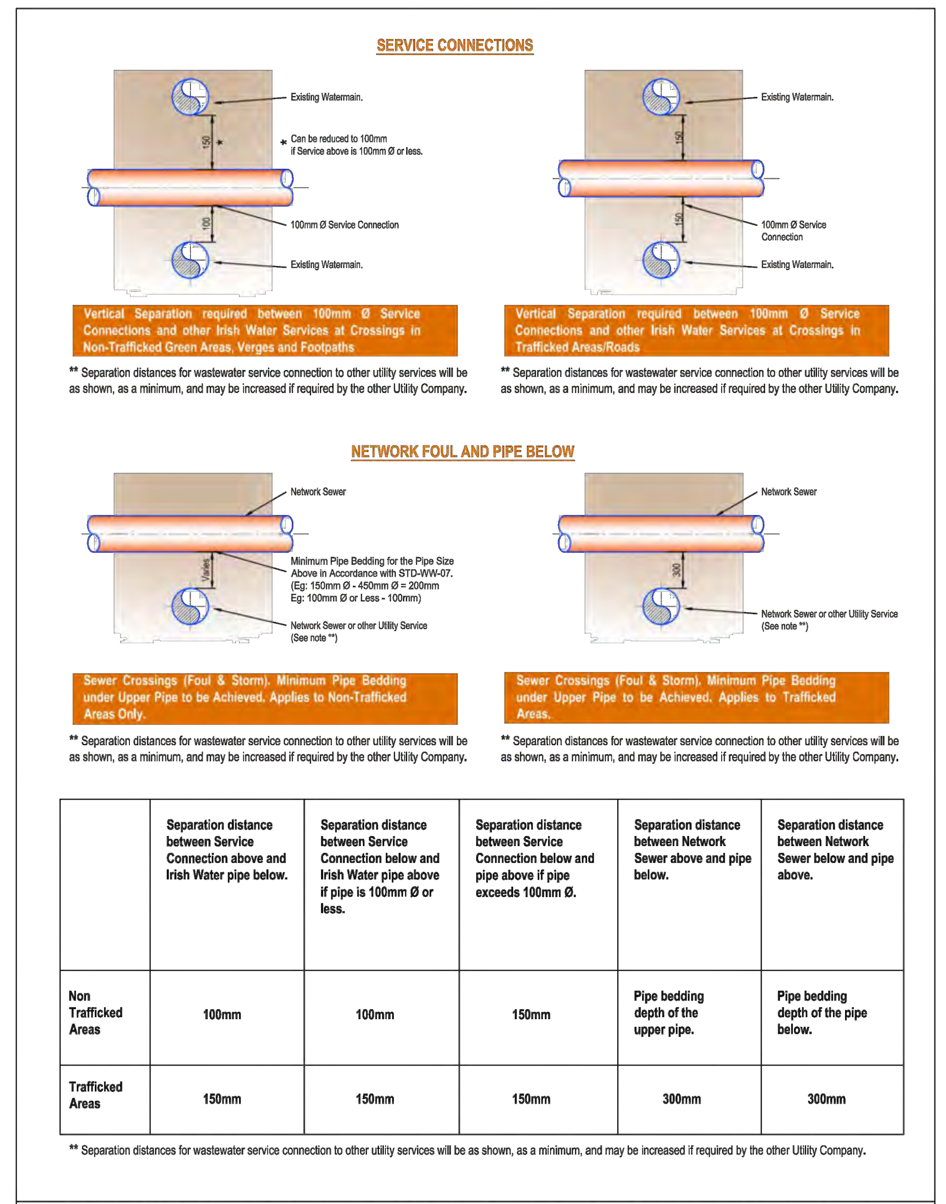
REFER TO INDEX SHEET FOR NOTES REGARDING DESIGN RESPONSIBILITY & RISK ASSESSMENT

UISCE ÉIREANN : IRISH WATER — STANDARD DETAILS - WASTEWATER — TYPICAL SEWER / SERVICE PIPE CONNECTION — SEPT. 2015 — STD-WW-04 — 2



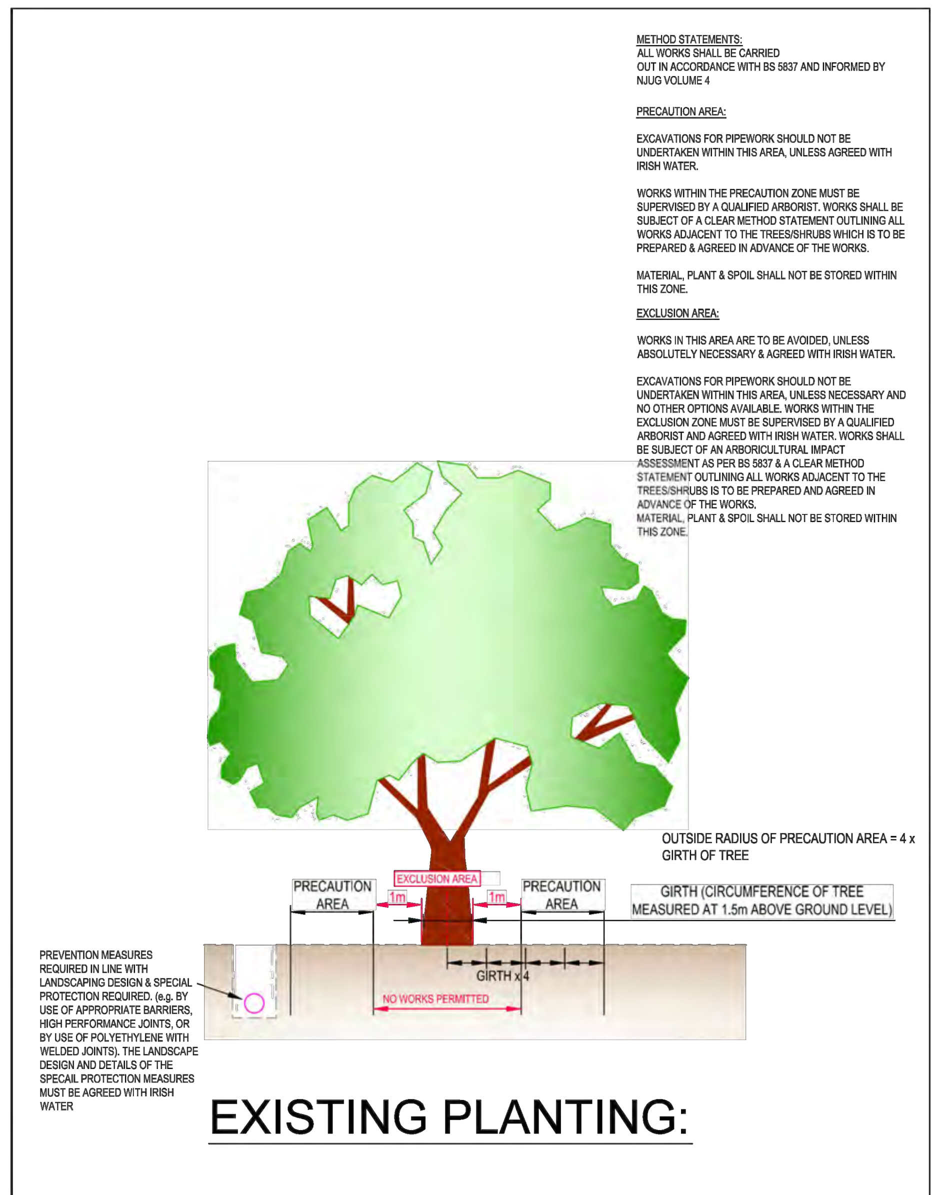
REFER TO INDEX SHEET FOR NOTES REGARDING DESIGN RESPONSIBILITY & RISK ASSESSMENT

UISCE ÉIREANN : IRISH WATER — STANDARD DETAILS - WASTEWATER — TYPICAL SERVICE LAYOUT INDICATING SEPARATION DISTANCES — STD-WW-05 — 2



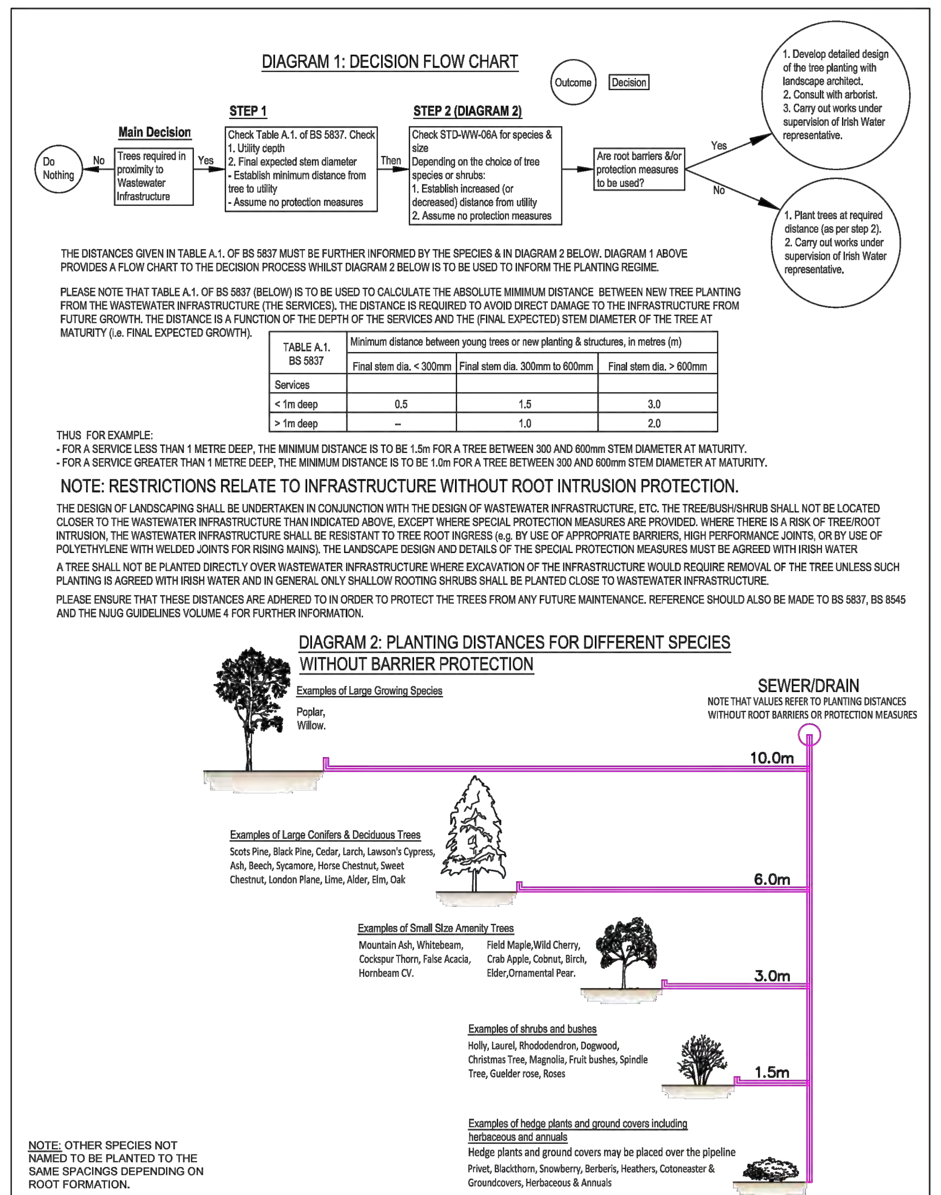
REFER TO INDEX SHEET FOR NOTES REGARDING DESIGN RESPONSIBILITY & RISK ASSESSMENT

UISCE ÉIREANN : IRISH WATER — STANDARD DETAILS - WASTEWATER — WASTEWATER SERVICE CONNECTION VERTICAL SEPARATION DISTANCES — FEB. 2020 — STD-WW-05A — 0



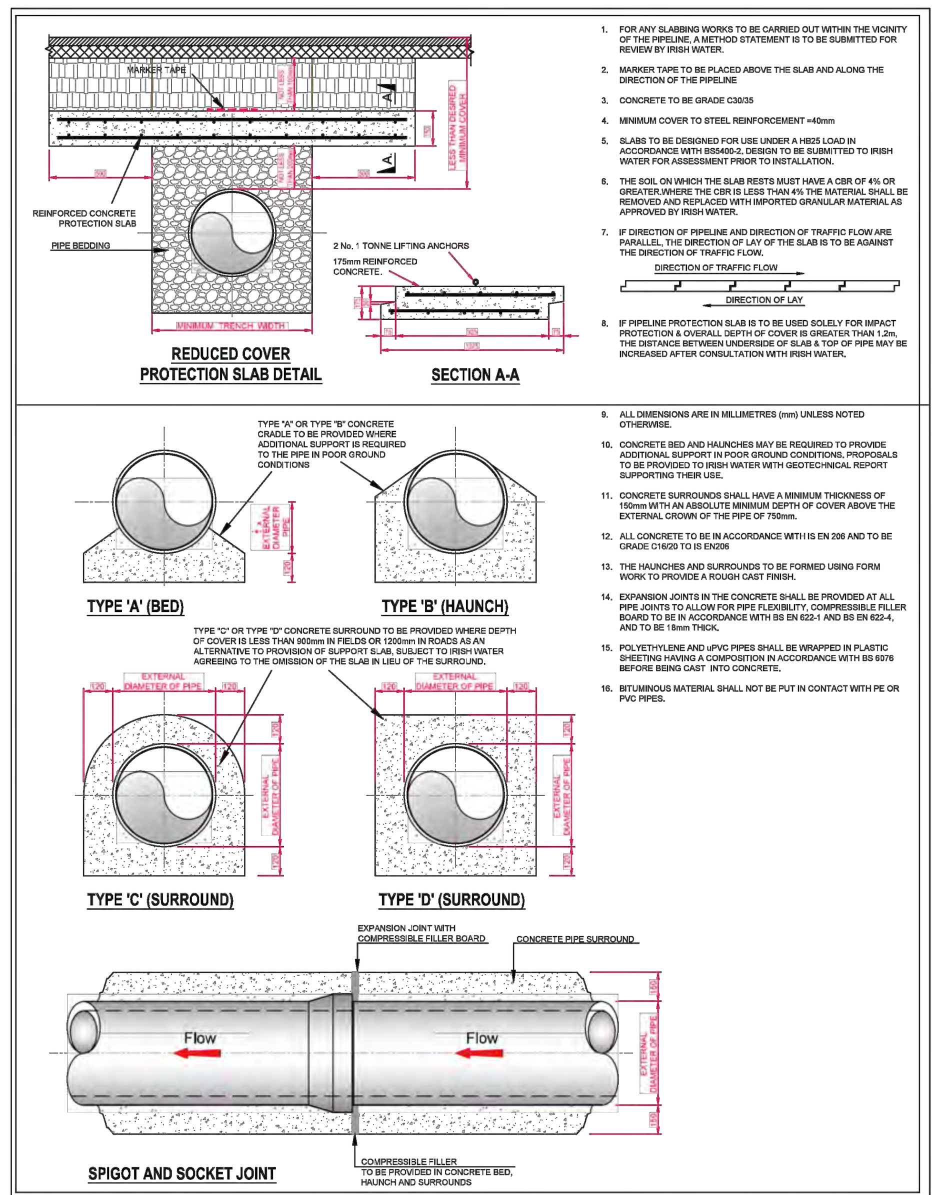
REFER TO INDEX SHEET FOR NOTES REGARDING DESIGN RESPONSIBILITY & RISK ASSESSMENT

UISCE ÉIREANN : IRISH WATER — STANDARD DETAILS - WASTEWATER — RESTRICTIONS ON WASTEWATER INFRASTRUCTURE WORKS ADJACENT TO TREES — SEPT. 2015 — STD-WW-06 — 2



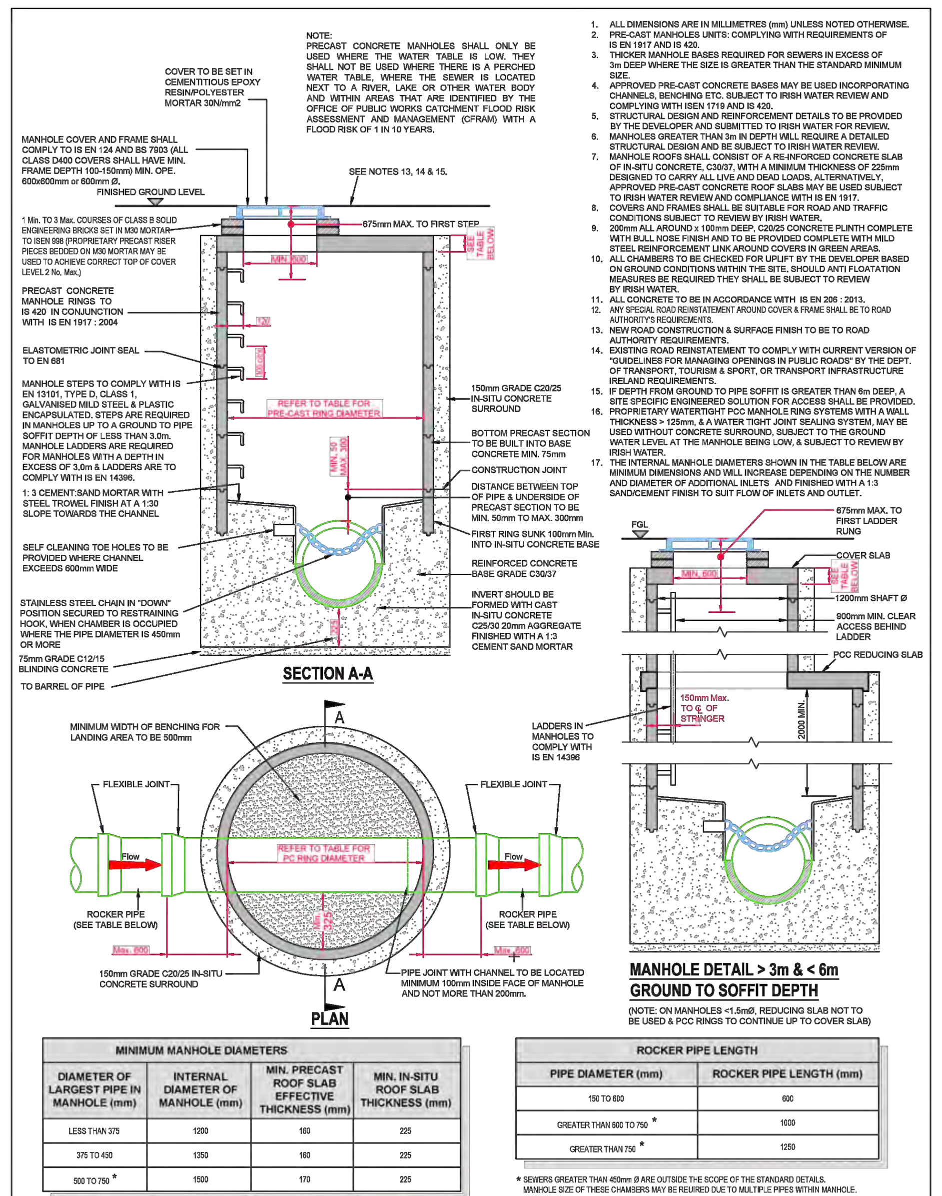
REFER TO INDEX SHEET FOR NOTES REGARDING DESIGN RESPONSIBILITY & RISK ASSESSMENT

UISCE ÉIREANN : IRISH WATER — STANDARD DETAILS - WASTEWATER — RESTRICTIONS ON NEW TREES / SHRUBS PLANTING ADJACENT TO SEWERS — JUL. 2017 — STD-WW-06A — 1



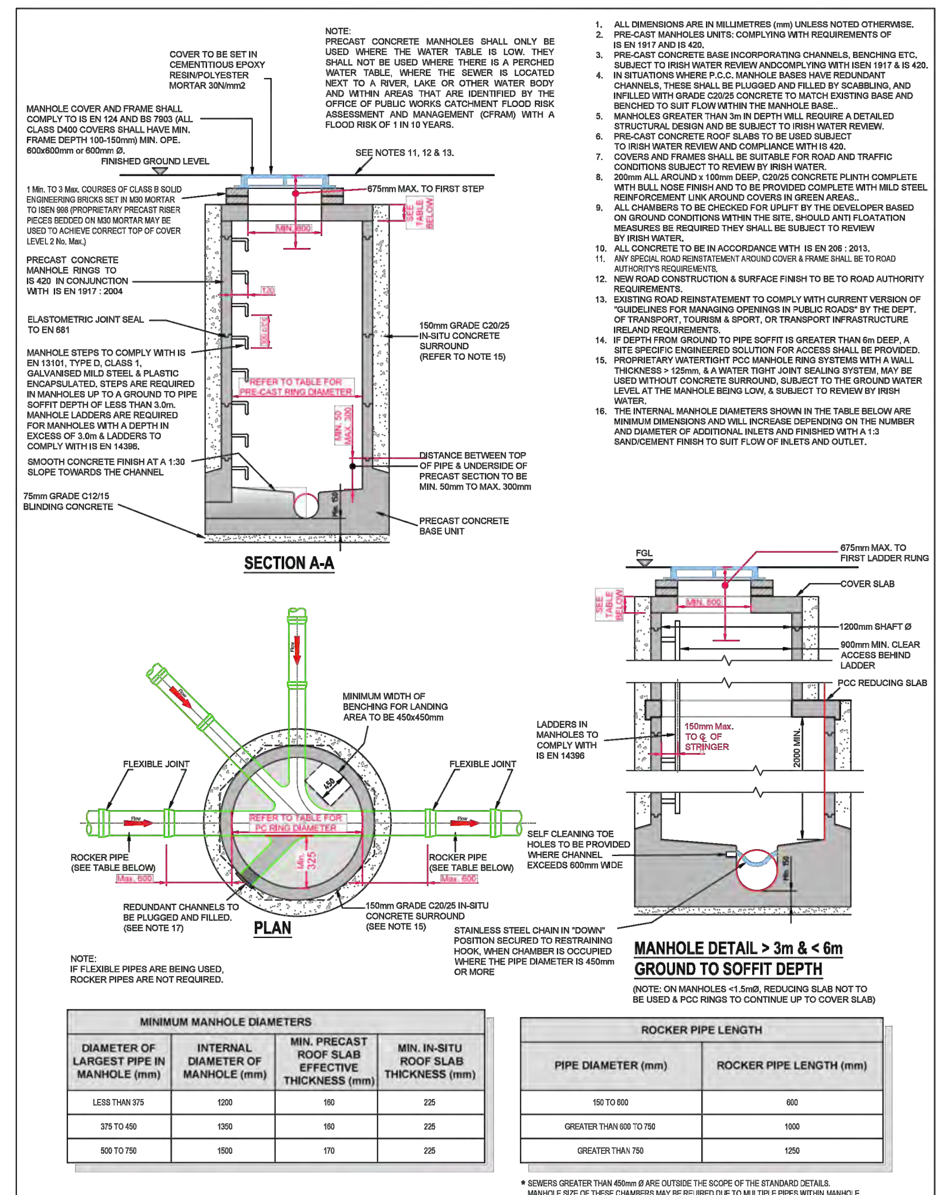
REFER TO INDEX SHEET FOR NOTES REGARDING DESIGN RESPONSIBILITY & RISK ASSESSMENT

UISCE ÉIREANN : IRISH WATER — STANDARD DETAILS - WASTEWATER — CONCRETE PROTECTION SLAB, BED, HAUNCH, AND SURROUND, TO WASTEWATER PIPES — SEPT. 2015 — STD-WW-08 — 1



REFER TO INDEX SHEET FOR NOTES REGARDING DESIGN RESPONSIBILITY & RISK ASSESSMENT

UISCE ÉIREANN : IRISH WATER — STANDARD DETAILS - WASTEWATER — PRE-CAST CONCRETE MANHOLE WITH CAST IN-SITU BASE — SEPT. 2015 — STD-WW-10 — 3



REFER TO INDEX SHEET FOR NOTES REGARDING DESIGN RESPONSIBILITY & RISK ASSESSMENT

UISCE ÉIREANN : IRISH WATER — STANDARD DETAILS - WASTEWATER — PRE-CAST CONCRETE MANHOLE WITH PRECAST BASE — SEPT. 2015 — STD-WW-10A — 0

Client: bam

General Notes
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(v) All Levels refer to Ordnance Survey Datum, Malin Head.

Rev	Date	Drn Chk	Amendment / Issue	App
S3 P01	23/05/22	PGR GMcC	Issue for Review and Comment	BB
P01	26/10/21	PGR GMcC	Pre-Application Submission	BB

rps

Model File Identifier: MCW1074-RPS-00-XX-DR-C-DR0103

Scale: See Drg. @ A1 / See Drg. @ A3

Created on: 21/10/2021

Sheets: 02 of 02

Project: Castlelake SHD

Title: Proposed Foul Infrastructure Foul Network Standard Details 1 of 2

File Identifier: MCW1074-RPS-00-XX-DR-C-DR0103-01

Status: S3

Rev: P01

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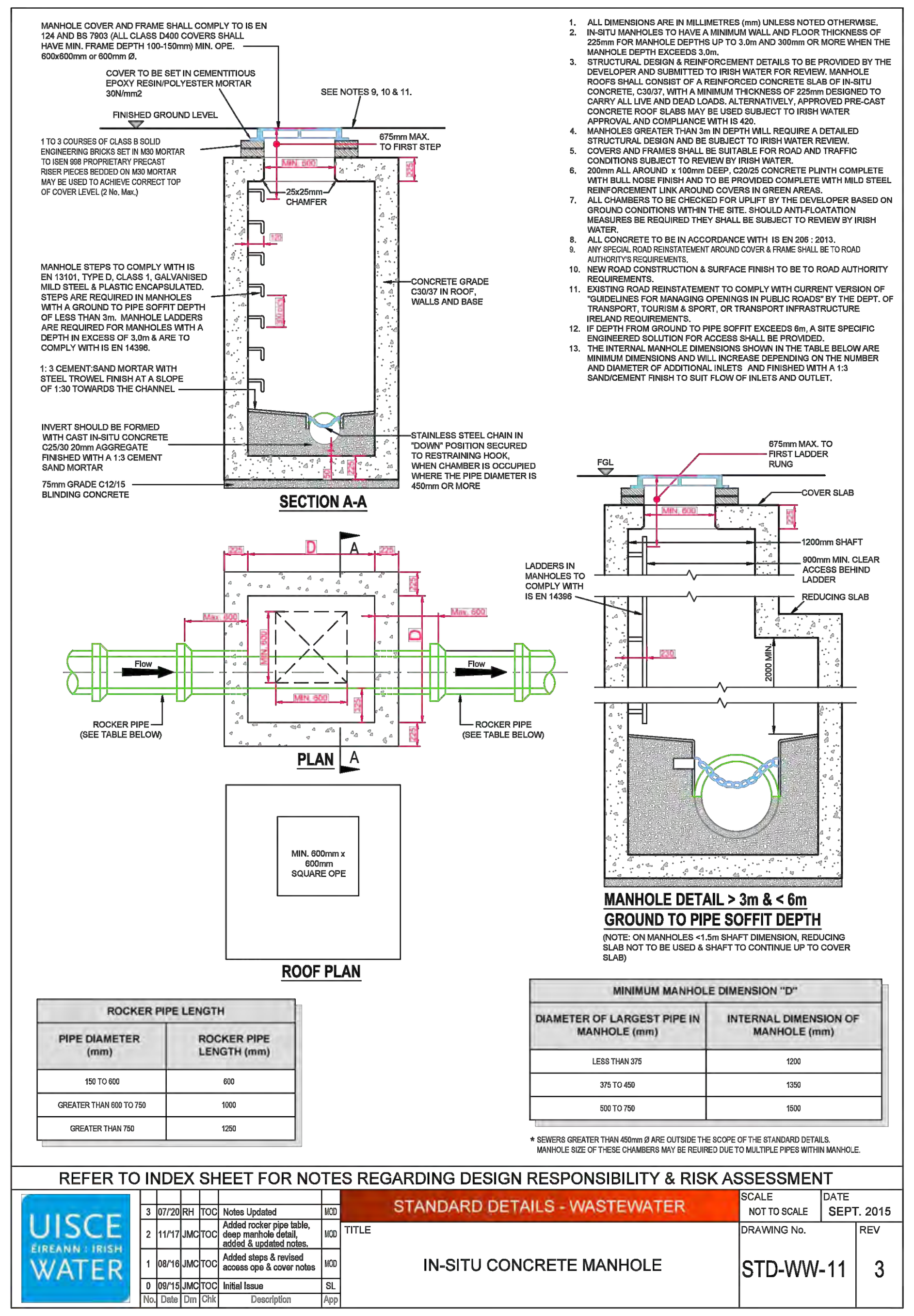

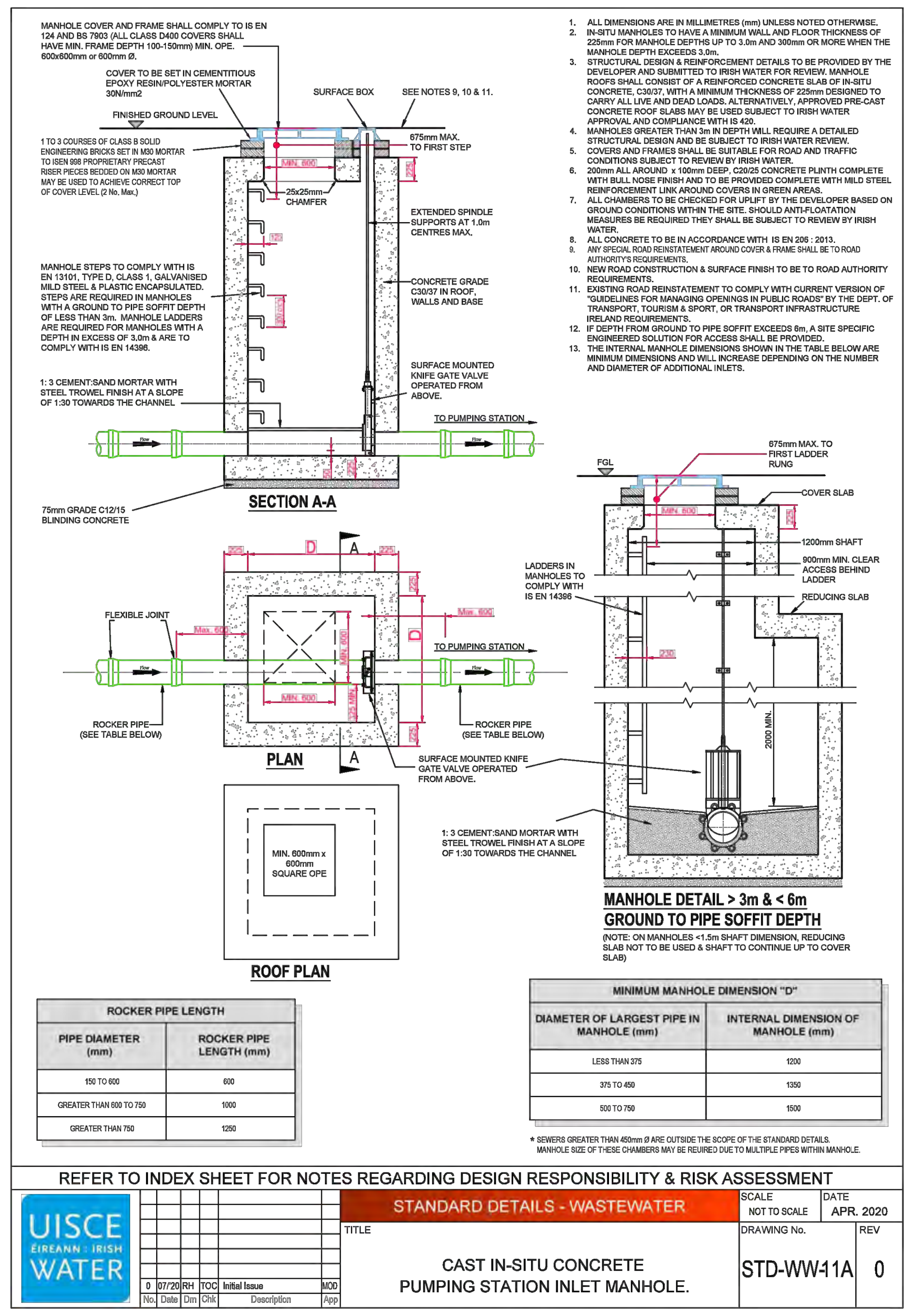

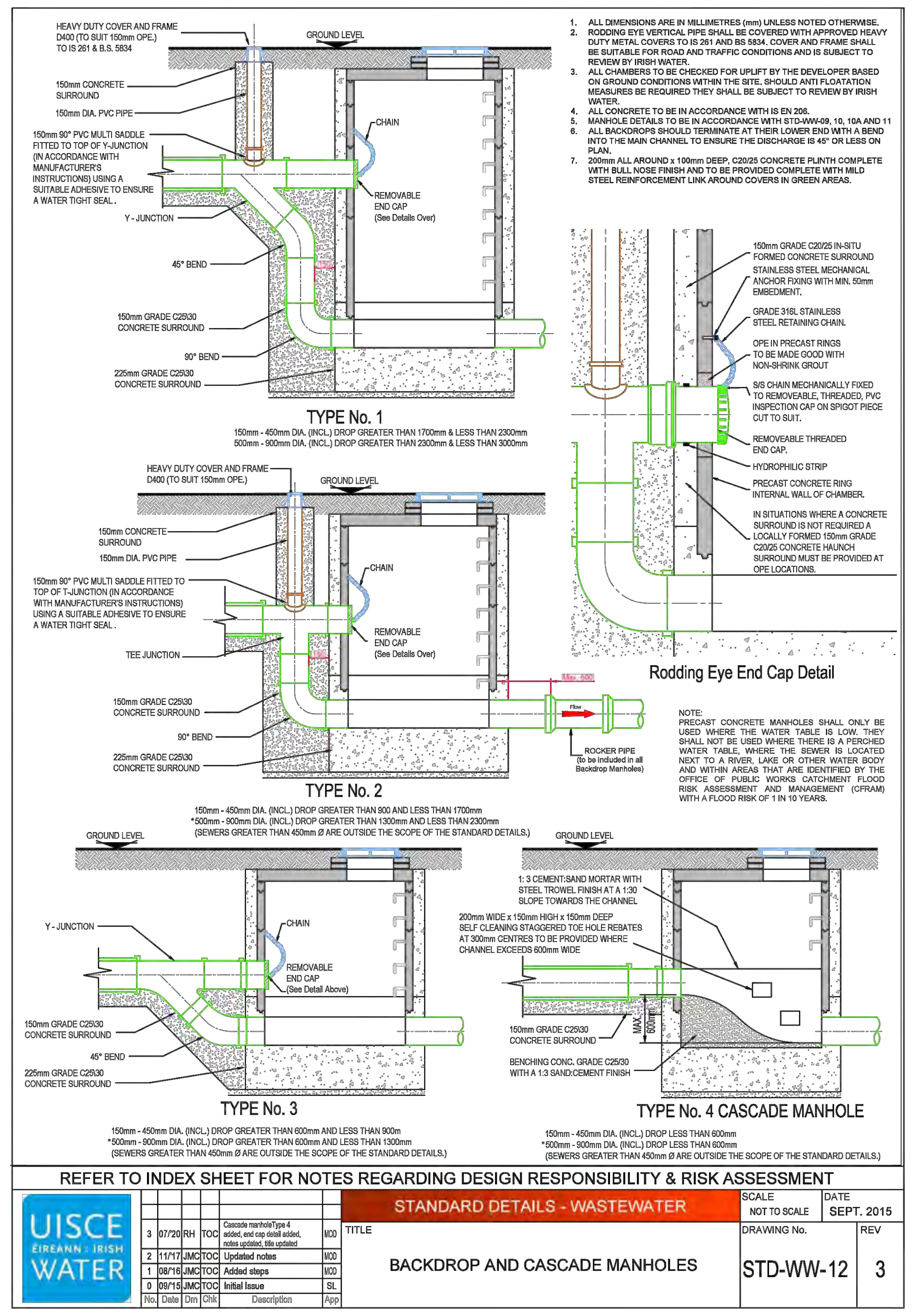

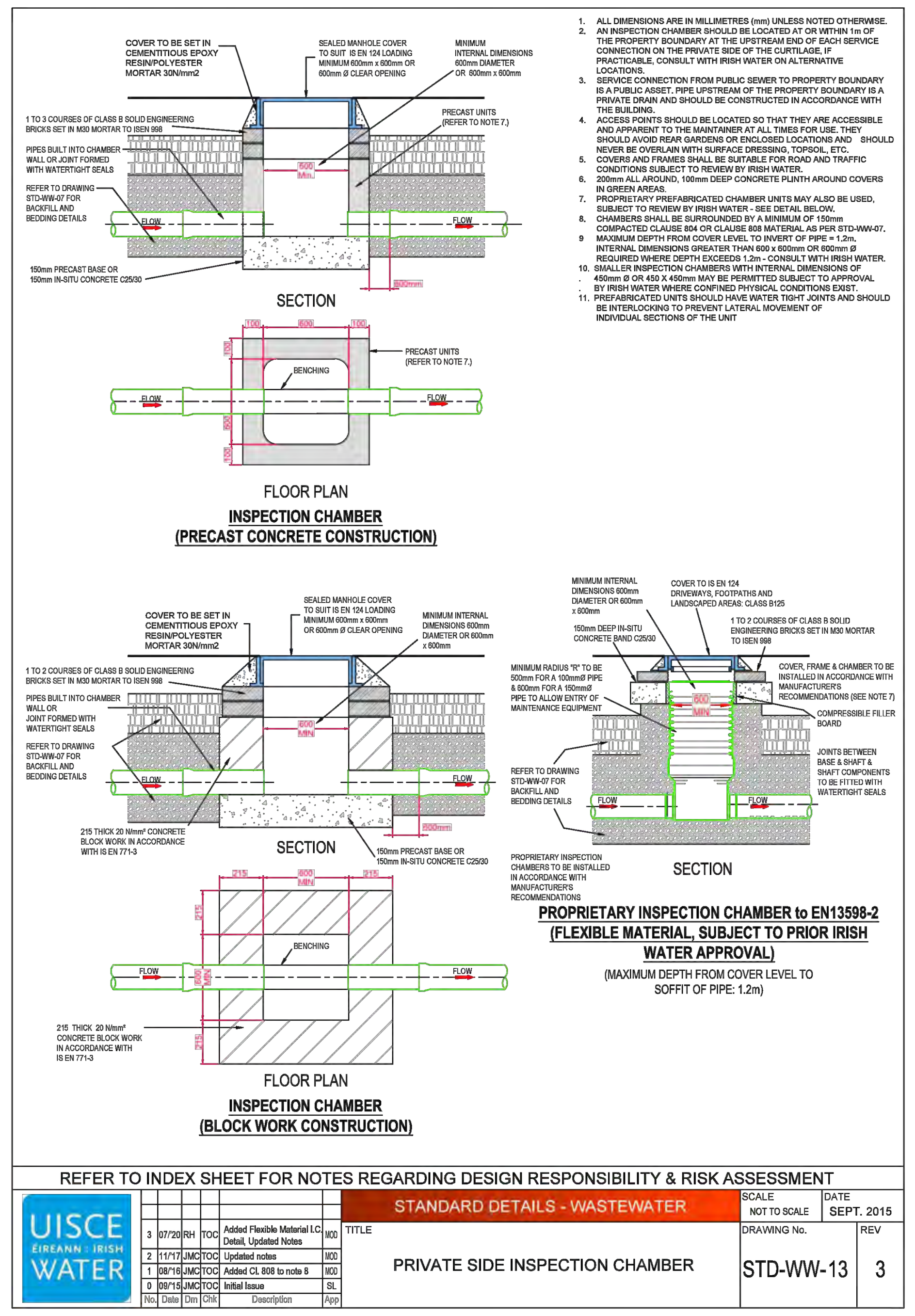

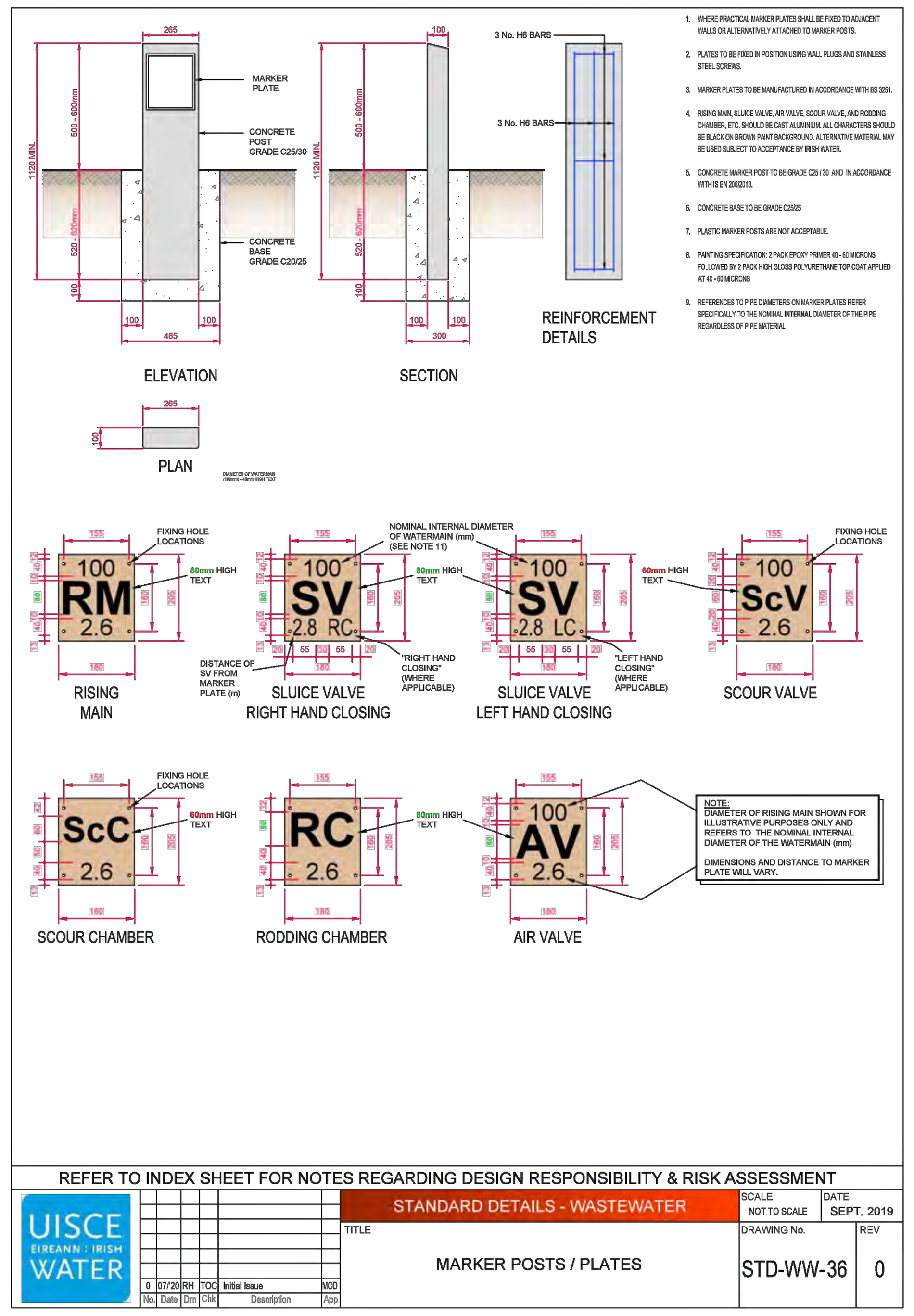

J:\MCW1088 - BAM Castlelake Residential Dvlp\8.0 Drawings\DR\MCW1088-RPS-00-XX-DR-C-DR0103.dwg

Client

General Notes

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Rev	Date	Drn Chk	Amendment / Issue	App
S3 P01	23/05/22	PGR GMcC	Issue for Review and Comment	
P01	26/10/21	PGR GMcC	Pre-Application Submission	BB

Model File Identifier: MCW1074-RPS-00-XX-DR-C-DR0103

Scale: See Drg. @ A1 / See Drg. @ A3

Created on: 21/10/2021

Sheets: 02 of 02

Project: Castlelake SHD

Title: Proposed Foul Infrastructure
Foul Network Standard Details
2 of 2

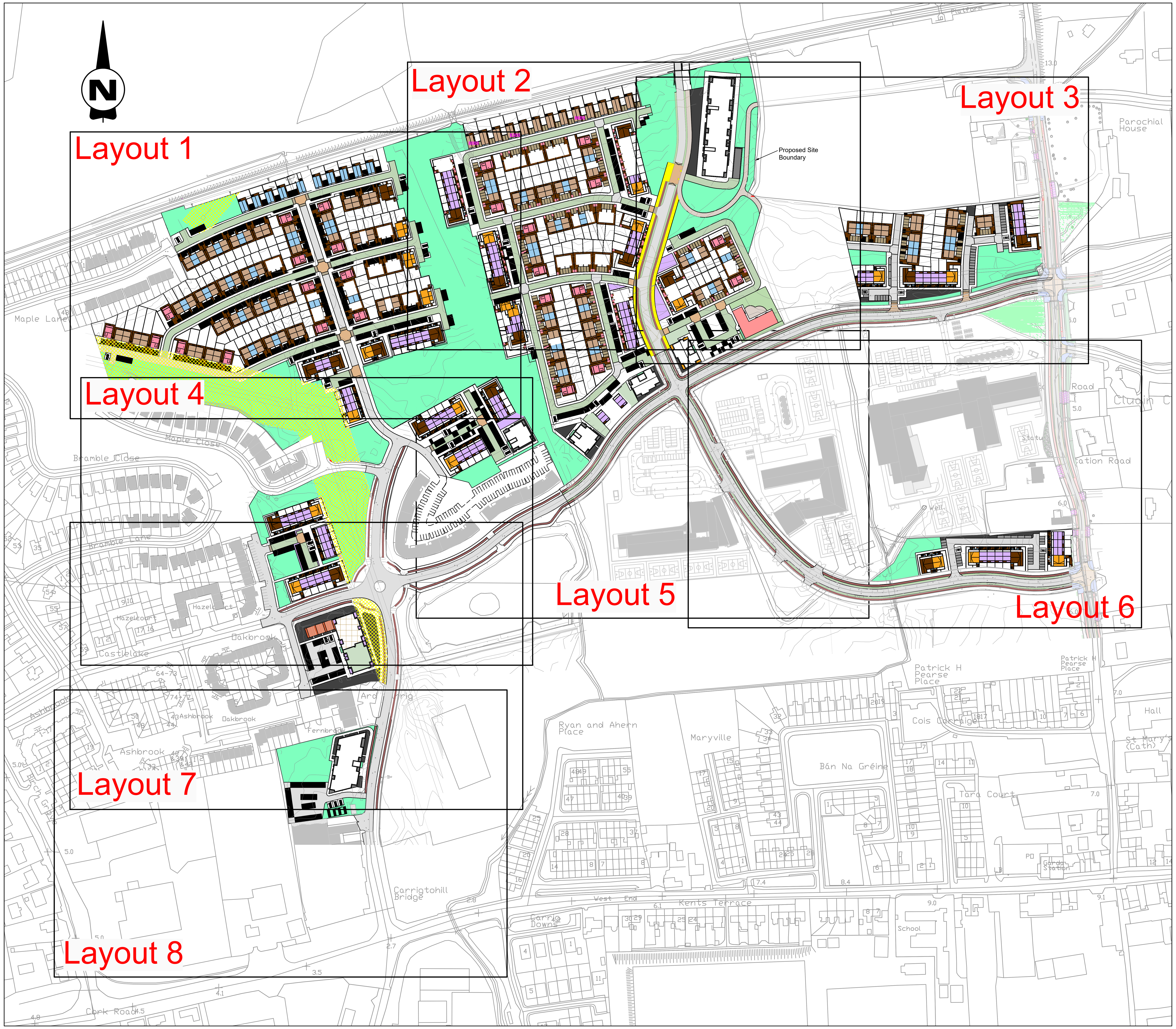
File Identifier: MCW1074-RPS-00-XX-DR-C-DR0103-02

Status: S3

Rev: P01

Appendix 9.4

Storm Infrastructure Drawings



Ordnance Survey Ireland

Client

bam

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Rev	Date	Drn / Chk	Amendment / Issue	App
S3 P02	26/05/22	PGR / GMcC	Issue for Review and Comment	BB
S3 P01	24/05/22	PGR / GMcC	Issue for Review and Comment	BB
P01	26/10/21	PGR / GMcC	Pre-Planning Submission	BB

rps

Scale: 1:2000 @ A1, 1:4000 @ A3

Created on: 15/09/2021

Sheets: 01 of 09

Project: Castlelake SHD

Title: Proposed Storm Infrastructure Key Plan

Model File Identifier: MCW1088-RPS-00-XX-DR-C-DR0201

File Identifier: MCW1088-RPS-00-XX-DR-C-DR0201-01

Status: S3

Rev: P02

J:\MCW1088 - BAM Castlelake Residential Dvlp\8.0 Drawings\DR\MCW1088-RPS-00-XX-DR-C-DR0201.dwg

Client

bam

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(i) Hard copies, dwf and pdf will form a controlled issue of the drawing. All other formats (dwg etc.) are deemed to be an uncontrolled issue and any work carried out based on these files is at the recipients own risk. RPS will not accept any responsibility for any errors from the use of these files, either by human error by the recipient, listing of the un-dimensioned measurements, compatibility with the recipients software, and any errors arising when these files are used to aid the recipients drawing production, or setting out on site.

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S3 P02	26/05/22	PGR / GMcC	Issue for Review and Comment	BB
S3 P01	24/05/22	PGR / GMcC	Issue for Review and Comment	BB
P01	26/10/21	PGR / GMcC	Pre-Planning Submission	BB

rps

Scale: 1:500 @ A1, 1:1000 @ A3

Created on: 15/09/2021

Sheets: 02 of 09

Project: Castlelake SHD

Title: Proposed Storm Infrastructure Drainage Layout (1 of 8)

Model File Identifier: MCW1088-RPS-00-XX-DR-C-DR0201

File Identifier: MCW1088-RPS-00-XX-DR-C-DR0201-02

Status: S3

Rev: P02

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J:\MCW1088 - BAM Castlelake Residential Dvlp\8.0 Drawings\DR\MCW1088-RPS-00-XX-DR-C-DR0201.dwg

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S3 P01	24/05/22	PGR / GMcC	Issue for Review and Comment	BB
P01	26/10/21	PGR / GMcC	Pre-Planning Submission	BB

rps

Scale: 1:500 @ A1, 1:1000 @ A3

Created on: 15/09/2021

Sheets: 03 of 09

Project: Castlelake SHD

Title: Proposed Storm Infrastructure Drainage Layout (2 of 8)

Model File Identifier: MCW1088-RPS-00-XX-DR-C-DR0201

File Identifier: MCW1088-RPS-00-XX-DR-C-DR0201-03

Status: S3

Rev: P02

Client

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(i) Hard copies, dwf and pdf will form a controlled issue of the drawing. All other formats (dwg etc.) are deemed to be an uncontrolled issue and any work carried out based on these files is at the recipients own risk. RPS will not accept any responsibility for any errors from the use of these files, either by human error by the recipient, listing of the un-dimensioned measurements, compatibility with the recipients software, and any errors arising when these files are used to aid the recipients drawing production, or setting out on site.

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S3 P02	26/05/22	PGR GMcC	Issue for Review and Comment	BB
S3 P01	24/05/22	PGR GMcC	Issue for Review and Comment	BB
P01	26/10/21	PGR GMcC	Pre-Planning Submission	BB

rps

Scale 1:500 @ A1 1:1000 @ A3

Created on 15/09/2021

Sheets 04 of 09

Project: Castlelake SHD

Title: Proposed Storm Infrastructure Drainage Layout (3 of 8)

Model File Identifier: MCW1088-RPS-00-XX-DR-C-DR0201

File Identifier: MCW1088-RPS-00-XX-DR-C-DR0201-04

Status: S3

Rev: P02

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bam	(i) Hard copies, dwf and pdf will form a controlled issue of the drawing. All other formats (dwg etc.) are deemed to be an uncontrolled issue and any work carried out based on these files is at the recipients own risk. RPS will not accept any responsibility for any errors from the use of these files, either by human error by the recipient, listing of the un-dimensioned measurements, compatibility with the recipients software, and any errors arising when these files are used to aid the recipients drawing production, or setting out on site. (ii) DO NOT SCALE, use figured dimensions only.	(iii) This drawing is the property of RPS, it is a project confidential classified document. It must not be copied used or its contents divulged without prior written consent. The needs and expectations of RPS and RPS must be considered when working with this drawing. (iv) Information including topographical survey, geotechnical investigation and utility detail used in the design have been provided by others. (v) All Levels refer to Ordnance Survey Datum, Malin Head.		

Rev	Date	Drn / Chk	Amendment / Issue	App
S3 P02	26/05/22	PGR / GMcC	Issue for Review and Comment	BB
S3 P01	24/05/22	PGR / GMcC	Issue for Review and Comment	BB
P01	26/10/21	PGR / GMcC	Pre-Planning Submission	BB

rps

Scale: 1:500 @ A1, 1:1000 @ A3
Created on: 15/09/2021
Sheets: 05 of 09

Project: Castlelake SHD

Title: Proposed Storm Infrastructure Drainage Layout (4 of 8)

Model File Identifier: MCW1088-RPS-00-XX-DR-C-DR0201

File Identifier: MCW1088-RPS-00-XX-DR-C-DR0201-05

Status: S3

Rev: P02

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J:\MCW1088 - BAM Castlelake Residential Dvlp\8.0 Drawings\DR\MCW1088-RPS-00-XX-DR-C-DR0201.dwg

Client

bam

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S3 P02	26/05/22	PGR	GMcC	Issue for Review and Comment	BB
S3 P01	24/05/22	PGR	GMcC	Issue for Review and Comment	BB
P01	26/10/21	PGR	GMcC	Pre-Planning Submission	BB

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Model File Identifier: MCW1088-RPS-00-XX-DR-C-DR0201

Scale: 1:500 @ A1, 1:1000 @ A3

Created on: 15/09/2021

Sheets: 06 of 09

Project: Castlelake SHD

Title: Proposed Storm Infrastructure Drainage Layout (5 of 8)

File Identifier: MCW1088-RPS-00-XX-DR-C-DR0201-06

Status: S3

Rev: P02

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Rev	Date	Drn / Chk	Amendment / Issue	App
S3 P02	26/05/22	PGR / GMcC	Issue for Review and Comment	BB
S3 P01	24/05/22	PGR / GMcC	Issue for Review and Comment	BB
P01	26/10/21	PGR / GMcC	Pre-Planning Submission	BB

rps

Scale: 1:500 @ A1, 1:1000 @ A3

Created on: 15/09/2021

Sheets: 07 of 09

Project: Castlelake SHD

Title: Proposed Storm Infrastructure Drainage Layout (6 of 8)

Model File Identifier: MCW1088-RPS-00-XX-DR-C-DR0201

File Identifier: MCW1088-RPS-00-XX-DR-C-DR0201-07

Status: S3

Rev: P02

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Client: bam

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Rev	Date	Drn Chk	Amendment / Issue	App
S3 P02	26/05/22	PGR GMcC	Issue for Review and Comment	BB
S3 P01	24/05/22	PGR GMcC	Issue for Review and Comment	BB
P01	26/10/21	PGR GMcC	Pre-Planning Submission	BB

rps

Model File Identifier: MCW1088-RPS-00-XX-DR-C-DR0201

Scale: 1:500 @ A1, 1:1000 @ A3

Created on: 15/09/2021

Sheets: 08 of 09

Project: Castlelake SHD

Title: Proposed Storm Infrastructure Drainage Layout (7 of 8)

File Identifier: MCW1088-RPS-00-XX-DR-C-DR0201-08

Status: S3

Rev: P02

Client

bam

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S3 P01	24/05/22	PGR / GMcC	Issue for Review and Comment	BB
P01	26/10/21	PGR / GMcC	Pre-Planning Submission	BB

rps

Scale 1:500 @ A1 1:1000 @ A3

Created on 15/09/2021

Sheets 09 of 09

Project: Castlelake SHD

Title: Proposed Storm Infrastructure Drainage Layout (8 of 8)

Model File Identifier: MCW1088-RPS-00-XX-DR-C-DR0201

File Identifier: MCW1088-RPS-00-XX-DR-C-DR0201-09

Status: S3

Rev: P02

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Appendix 9.5

Operational Waste Management Plan

OPERATIONAL WASTE MANAGEMENT PLAN

Castlelake SHD

Lands at Castlelake, Terrysland, Carrigtwohill, Cork

Prepared for BAM Property Ltd. – June 2022

CONTENTS

01 INTRODUCTION

A Planning Application is being lodged to an Bord Pleanala by BAM Property Ltd. for a Strategic Housing Development at Castlelake, Terrysland, Carrigtwohill,Co. Cork. The application site is positioned to the north-west of the centre of Carrigtwohill, comprised of a series of land parcels with a combined area of 18.30 hectares, 16.30 hectares of which are developable lands and accommodating 716 dwelling units distributed across the development as varying Character Areas.

The proposed development comprises a variety of residential accommodation in a number of built forms distributed throughout the development;

224 Detached, Semi-detached and Terraced two storey own-door access
284 Duplex Units with own door access and
208 Apartments - one to three bed units

The site lies north of the N25 motorway corridor and has both road frontage and main vehicular access road connections onto Station Road with two underpasses constructed along the northern boundary of the site to accommodate future development lands.

Access to the development will be via the existing main distributor road system in Castlelake to the south-west, Station Road to the east and the planned connector roads between these and the underpass to the north.

To the south of the application site are Castlelake Park. To the west is existing Castlelake housing adjoining the western boundary of this application.

02 PLANNING AND POLICY

The development at Castlelake, Terrysland, Carrigtwohill, adheres to Cork County Council provisions for Waste Management. Storage and collection of waste will be undertaken on site in accordance with the Cork County Development Plan 2022-2028[a] and the standard BS 5906:2005 Waste Code of Practice.

The European Commission's Circular Economy Action Plan: For a Cleaner More Competitive Europe[b] was adopted in 2020 and promotes a transition towards the principles of a circular economy, facilitating the use of materials at their highest value for as long as possible and then recycling or reusing them at the end of their service life with the end result being the generation of minimal waste.

The government's Waste Action Plan for a Circular Economy-Ireland's National Waste Policy 2020-2025[c] endorses this approach and aims to shift the focus of waste management away from waste disposal and treatment to ensure that materials and products remain in productive use for longer. This is aimed at preventing waste and supporting reuse through a policy framework that discourages the wasting of resources and rewards circularity.

Currently, Cork is part of the Southern Waste Region. The strategic vision of the Southern Region Waste Management Plan 2015-2021 is to rethink our approach to managing waste, by viewing our waste streams as valuable material resources, leading to a healthier environment and sustainable commercial opportunities for our economy. Particular emphasis is placed on preventing and designing out waste at the initial stage of any activity, thus achieving the highest level of the waste hierarchy, namely waste prevention.

The Southern Region Waste Management Office has commenced the process of drafting the next Waste Management Plan. This proposal supports the sustainable management of waste in line with the objectives of the Southern Region Waste Management Plan 2015-2021[d] and its successor. This proposal acknowledges that policies and objectives in relation to waste management in Cork County and are reflective of overarching EU, National and Regional policy and legislation.

The European Commission adopted the new circular economy action plan (CEAP)[e] in March 2020. It is one of the main building blocks of the European Green Deal, Europe's new agenda for sustainable growth. It is also a prerequisite to achieve the EU's 2050 climate neutrality target and to halt biodiversity loss. Measures that will be introduced under the new action plan aim to:

- make sustainable products the norm in the EU
- empower consumers and public buyers
- focus on the sectors that use most resources and where the potential for circularity is high such as: electronics and ICT, batteries and vehicles, packaging, plastics, textiles, construction and buildings, food, water and nutrients
- ensure less waste
- make circularity work for people, regions and cities
- lead global efforts on circular economy

This Waste Management Plan is assembled in accordance with the amended Planning and Development Act 2000 and Section 22(10A) of the Waste Management Acts 1996-2008 as the objectives for waste recovery and disposal facilities within the development are outlined.

a Cork County Development Plan 2022-2028. (Relevant Plan at time of lodging)
b The European Commission's Circular Economy Action Plan: For a Cleaner More Competitive Europe.
Source: https://ec.europa.eu/environment/circular-economy
c A Waste Action Plan for a Circular Economy: Ireland's National Waste Policy 2020-2025.
Source: https://www.gov.ie/en/publication/4221c-waste-action-plan-for-a-circular-economy
d Southern Region Waste Management Plan 2015 – 2021.
Source: http://southernwasteregion.ie/content/southern-region-waste-management-plan-2015-2021-associated-reports
e Circular Economy Action Plan.
Source: https://ec.europa.eu/environment/strategy/circular-economy-action-plan_en#ecl-inpage-872

03 WASTE DISPOSAL

3.1 Housing and Duplex Units - Bin Strategy

Adequate storage, recycling and composting areas have been provided which accommodate the separation of waste for disposal.

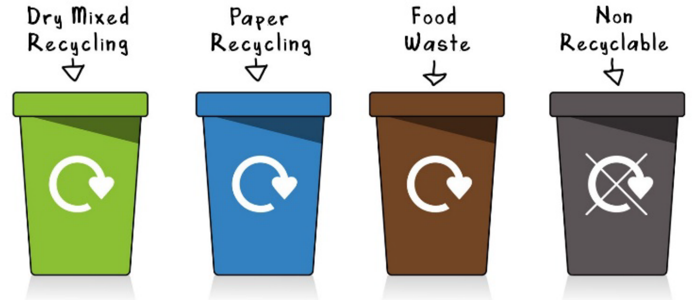
- Bin stores have been provided at the rate of three bins per house / duplex unit.
- All house and Duplex units have been provided with securely enclosed bin stores located to the front or to the side/rear of the units in dedicated store areas.

Bin Storage Design Intent - House and Duplex Units

3.2 Apartments – Bin Strategy

Residents of the apartments will be required to segregate their waste into the following main waste categories within their own apartment units:

- Dry Mixed Recyclables;
- Mixed Non-Recyclables;
- Organic waste; and
- Glass.



The residents will be required to provide and maintain appropriate waste receptacles within their units to facilitate segregation at source of these waste types. The location of the bins within the units will be at the discretion of the residents. As required, the residents will need to bring these segregated wastes from their apartments to the main residential Waste Storage Area (WSA) located at ground level typically.

The main residential WSA has been appropriately sized to accommodate the estimated waste arisings for the residential units based on a weekly collection frequency and the provision of the appropriate waste management equipment, correctly laid out and efficiently managed.
See Section 3.3 Waste Calculation Assumptions for calculation method and the calculated bin provision for Apartment 07 as example.

As it is assumed that all waste will be delivered by householders to Ground level communal refuse stores, design measures have been taken to ensure the ease and safety of this delivery.
See Section 3.4 Waste Collection - Apartments for Refuse Room locations and Collection point for Apartment 07 as example.

03 WASTE DISPOSAL

3.3 Waste Calculation Assumptions - Apartment Buildings

- Occupancy rates are assumed to be 2 persons per one bed apartments, 4 persons per 2 bed apartment and 6 persons per 3 bed apartment.
- Household waste will be source separated into recyclables, residual, and organic wastes. Wheeled bins will be available in waste storage rooms also for WEEE and waste glass.
- It is assumed that approximately 60% of waste generated will be dry mixed recyclables. 30% of waste generated will be residual waste, and 10% of waste generated will be organic waste. The waste management system will be flexible to allow for increases in the proportion of source segregated recyclables and reduction of residual wastes in the future. This includes the European Commission's 70% target for re-use and recycling of waste by 2030.[1]
- Once weekly waste collection per waste type of residential & other waste is assumed for the purpose of these calculations.
- It is assumed that all waste will be delivered by householders to basement level communal waste stores. Communal waste rooms will be located in each podium basement for each building block, representing one communal waste room per two blocks.
- The EPA reported a household waste generation rate per capita of 321kg per annum for 2017, the most recent year for which published data is available.[2]
- Density of 0.21 tonnes/m3 or 0.21 tonnes/1000 litres for waste calculations.

Calculation - Apartment 07

A calculation of the Waste Category Split, Waste Estimation and the resulting Waste Provision Bin requirements for Apartment Building 07 is demonstrated in the adjacent table.
The calculated figure of 9 no. 1100ltr and 7 no. 240ltr bin provision is provided for within the building layout and distributed across 2 no. Refuse rooms positioned at ground floor.

Summary							
Waste Type	Building	Apartment No.	Refuse Room	Collection Point	MSW Waste Estimation (ltr)	MSW Waste Provision (ltr)	Additional Provisions
Residential	Apartment 7	76	RFA7-1 / 2	A	8274	9760	1820

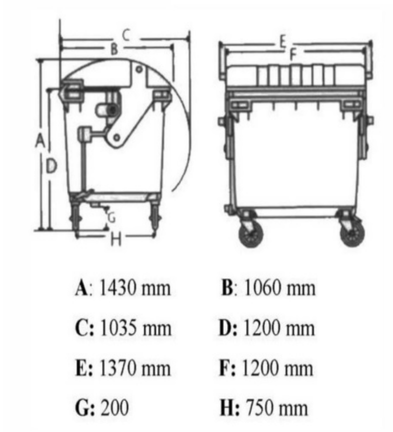
Municipal Solid Waste (MSW) Estimation							
Apartment Type	Occupancy	Number	Total Population	Waste/Annum *(kg)	Waste/Annum ** (m3)	Waste/Week (m3)	Waste/Week (ltr)
1 Bed	2	23	46	14766	70.31	1.35	1350
2 Bed	4	41	164	52644	250.69	4.82	4812
3 Bed	6	12	72	23112	110.06	2.12	2113
	Total:	76	282	90522	431.06	8.29	8274

Assumptions
* 321 kg/person/annum
** 210 kg/m3

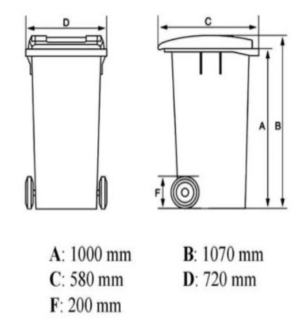
Waste Category Split						
Waste Type		%	Waste/Week (ltr)	1100ltr Bin No.	240ltr Bin No.	Total Waste Provision (ltr)
Municipal Solid Waste (MSW)		100%	8274			
	Dry mixed recylables	60%	4965	5		5500
	Residual Waste	30%	2482	3		3300
	Organic Waste	10%	827		4	960
			Subtotal:	8	4	9760
Additional Waste Provisions						
	Glass Recycling				3	720
	WEE			1		1100
			Subtotal:	1	3	1820
			Total :	9	7	11580

Waste Calculation Table - Apartment 07

1100ltr Bin



240ltr Bin



1 Towards a Circular Economy.
Source: https://eceuropa.eu/commission/presscorner/detail/el/MEMO_14_450
2 Household Waste Statistics for Ireland.
Source: https://www.epa.ie/publications/monitoring--assessment/waste/national-waste-statistics/Household-Waste-2017-data.pdf

03 WASTE DISPOSAL

3.4 Waste Collection - Apartment Buildings

There are numerous private contractors that provide household and commercial waste collection in the area. All waste contractors servicing the proposed development must hold a valid waste collection permit for the specific waste types collected. All waste collected must be transported to registered, permitted and/or licensed facilities only.

Each apartment building has 1-2 Refuse Stores located at the ground floor located in close proximity to the circulation stairs and building entrances for ease of accessibility. *See below Figure 01 Refuse Store Locations*

Each Building has in turn been allocated a refuse collection point .These designated areas are easily accessed by each refuse rooms. The bins will be conveyed by personnel nominated by the building management company to the collection point. Refuse truck turning zones, will help to prevent traffic congestion during weekly and fortnightly collections. *See below Figure 02 Capacity Layout - Typical Refuse Store*

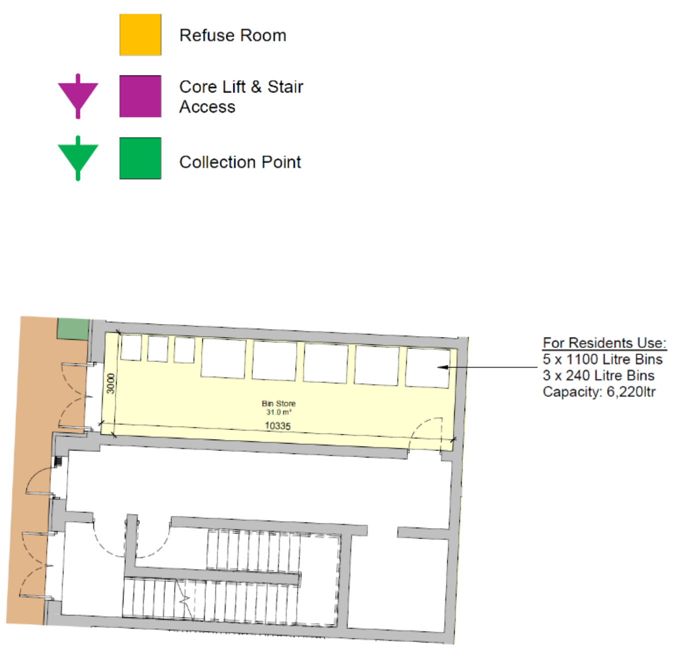


Figure 02: Refuse Store Capacity
Ground Floor Apartment 07

Figure 01: Refuse Store Locations and Refuse Collection Point
Ground Floor Apartment 07

04 THE CRÈCHE FACILITY

The Crèche tenant will be required to segregate their waste into the following waste categories within their unit;

- Dry Mixed Recyclables;
- Mixed Non-Recyclables;
- Organic waste; and
- Glass.

The crèche unit will store their waste within their own unit. Suitably sized bins should be strategically located within the unit as required by the tenant to facilitate segregation at source of these waste types.

All waste receptacles used should comply with the IS EN 840 2012 standard for performance requirements of mobile waste containers and should be clearly labelled and colour coded to avoid cross contamination of the different waste streams. Graphical signage should be posted above or on the bins to show exactly which wastes can be put in each. If there is food preparation carried out by the crèche tenant, organic waste from kitchen should be collected in bins as close to food preparation area as possible.

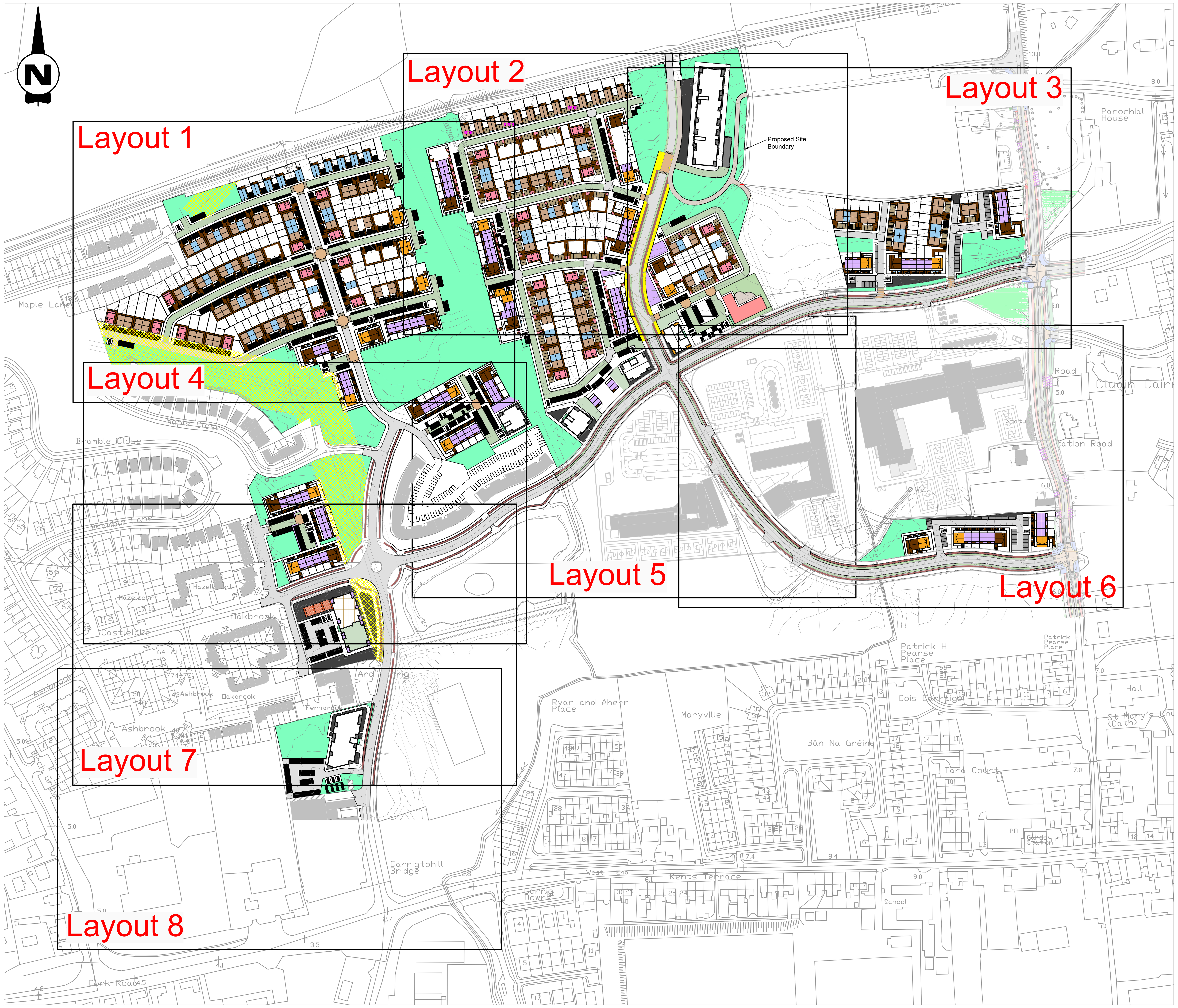
Based on the recommended bin requirements, it is anticipated that dry mixed recyclables, mixed non-recyclables and organic waste will be collected on a weekly basis and glass collected less frequently as required. Other waste materials such as batteries, WEEE, light bulbs and cooking oil (if generated) will be generated less frequently and in smaller quantities.

The crèche tenant will be required to store any of these wastes in appropriate receptacles within their own unit pending collection by a waste contractor.

The crèche tenant or personnel nominated by the building management company will be responsible for conveying the crèche bins to the collection point at building perimeter.

Appendix 9.6

Public Lighting Infrastructure Drawings



Ordnance Survey Ireland

Client: bam

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(v) All Levels refer to Ordnance Survey Datum, Malin Head.

Rev	Date	Drn Chk	PGR GMcC	Amendment / Issue	App
S3 P01	27/05/22			Issue for Review and Comment	BB

rps

Scale	1:2000 @ A1 1:4000 @ A3
Created on	25/05/2022
Sheets	01 of 09
Project	Castlelake SHD
Title	Proposed Public Lighting Infrastructure Key Plan
Model File Identifier	MCW1088-RPS-00-XX-DR-C-PL0101
File Identifier	MCW1088-RPS-00-XX-DR-C-PL0101-01
Status	S3
Rev	P01

J:\MCW1088 - BAM Castlelake Residential Dvlp\8.0 Drawings\PL\MCW1088-RPS-00-XX-DR-C-PL0101.dwg

KEY TO PUBLIC LIGHTING SYMBOLS

REF. No.	SYMBOL	DESCRIPTION
1.	08m	9.5klm LED LANTERN POST TOP MOUNTED ON 08m COLUMN.

Client: bam

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Rev	Date	Drn	Chk	Amendment / Issue	App
S3 P01	27/05/22	PGR	GMcC	Issue for Review and Comment	BB

rps

Scale: 1:500 @ A1, 1:1000 @ A3
Created on: 25/05/2022
Sheets: 02 of 09

Project: Castlelake SHD

Title: Proposed Public Lighting Infrastructure Lighting Layout (1 of 8)

Model File Identifier: MCW1088-RPS-00-XX-DR-C-PL0101

File Identifier: MCW1088-RPS-00-XX-DR-C-PL0101-02

Status: S3

Rev: P01

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S3 P01	27/05/22	PGR	GMcC	Issue for Review and Comment	BB

rps

Scale	1:500 @ A1 1:1000 @ A3
Created on	25/05/2022
Sheets	03 of 09
Project	Castlelake SHD
Title	Proposed Public Lighting Infrastructure Lighting Layout (2 of 8)
Model File Identifier	MCW1088-RPS-00-XX-DR-C-PL0101
File Identifier	MCW1088-RPS-00-XX-DR-C-PL0101-03
Status	S3
Rev	P01

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Rev	Date	Drn / Chk	Amendment / Issue	App
S3 P01	27/05/22	PGR / GMcC	Issue for Review and Comment	BB

rps

Scale	1:500 @ A1 1:1000 @ A3
Created on	25/05/2022
Sheets	04 of 09
Project	Castlelake SHD
Title	Proposed Public Lighting Infrastructure Lighting Layout (3 of 8)
Model File Identifier	MCW1088-RPS-00-XX-DR-C-PL0101
File Identifier	MCW1088-RPS-00-XX-DR-C-PL0101-04
Status	S3
Rev	P01

KEY TO PUBLIC LIGHTING SYMBOLS

REF. No.	SYMBOL	DESCRIPTION
1.	08m	9.5klm LED LANTERN POST TOP MOUNTED ON 08m COLUMN.

Client

bam

General Notes

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S3 P01	27/05/22	PGR GMcC	Issue for Review and Comment	BB

Scale	1:500 @ A1 1:1000 @ A3
Created on	25/05/2022
Sheets	05 of 09
Project	Castlelake SHD
Title	Proposed Public Lighting Infrastructure Lighting Layout (4 of 8)
Model File Identifier	MCW1088-RPS-00-XX-DR-C-PL0101
File Identifier	MCW1088-RPS-00-XX-DR-C-PL0101-05
Status	S3
Rev	P01

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Rev	Date	Drn Chk	Amendment / Issue	App
S3 P01	27/05/22	PGR GMcC	Issue for Review and Comment	BB

rps

Scale: 1:500 @ A1, 1:1000 @ A3

Created on: 25/05/2022

Sheets: 06 of 09

Project: Castlelake SHD

Title: Proposed Public Lighting Infrastructure Lighting Layout (5 of 8)

Model File Identifier: MCW1088-RPS-00-XX-DR-C-PL0101

File Identifier: MCW1088-RPS-00-XX-DR-C-PL0101-06

Status: S3

Rev: P01

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Ordnance Survey Ireland

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S3 P01	27/05/22	PGR / GMcC	Issue for Review and Comment	BB

rps

Scale: 1:500 @ A1, 1:1000 @ A3

Created on: 25/05/2022

Sheets: 07 of 09

Project: Castlelake SHD

Title: Proposed Public Lighting Infrastructure Lighting Layout (6 of 8)

Model File Identifier: MCW1088-RPS-00-XX-DR-C-PL0101

File Identifier: MCW1088-RPS-00-XX-DR-C-PL0101-07

Status: S3

Rev: P01

Client

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S3 P01	27/05/22	PGR / GMcC	Issue for Review and Comment	BB

rps

Scale: 1:500 @ A1, 1:1000 @ A3

Created on: 25/05/2022

Sheets: 08 of 09

Project: Castlelake SHD

Title: Proposed Public Lighting Infrastructure Lighting Layout (7 of 8)

Model File Identifier: MCW1088-RPS-00-XX-DR-C-PL0101

File Identifier: MCW1088-RPS-00-XX-DR-C-PL0101-08

Status: S3

Rev: P01

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KEY TO PUBLIC LIGHTING SYMBOLS		
REF. No.	SYMBOL	DESCRIPTION
1.	08m	9.5klm LED LANTERN POST TOP MOUNTED ON 08m COLUMN.

Client

bam

General Notes

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Rev	Date	Drn / Chk	Amendment / Issue	App
S3 P01	27/05/22	PGR / GMcC	Issue for Review and Comment	BB

rps

Scale: 1:500 @ A1, 1:1000 @ A3

Created on: 25/05/2022

Sheets: 09 of 09

Project: Castlelake SHD

Title: Proposed Public Lighting Infrastructure Lighting Layout (8 of 8)

Model File Identifier: MCW1088-RPS-00-XX-DR-C-PL0101

File Identifier: MCW1088-RPS-00-XX-DR-C-PL0101-09

Status: S3

Rev: P01

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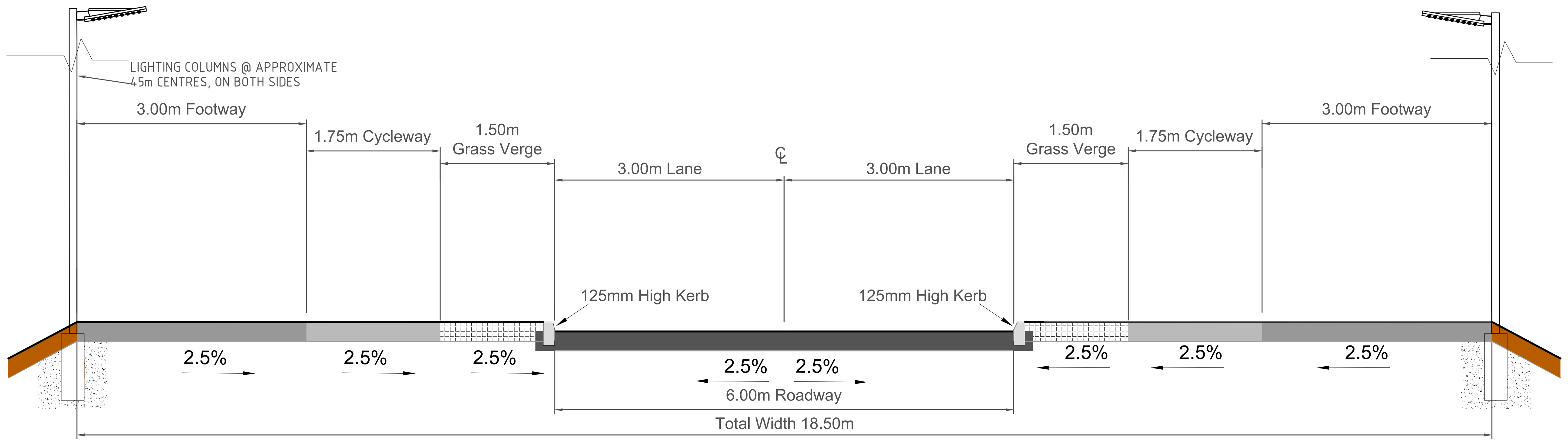
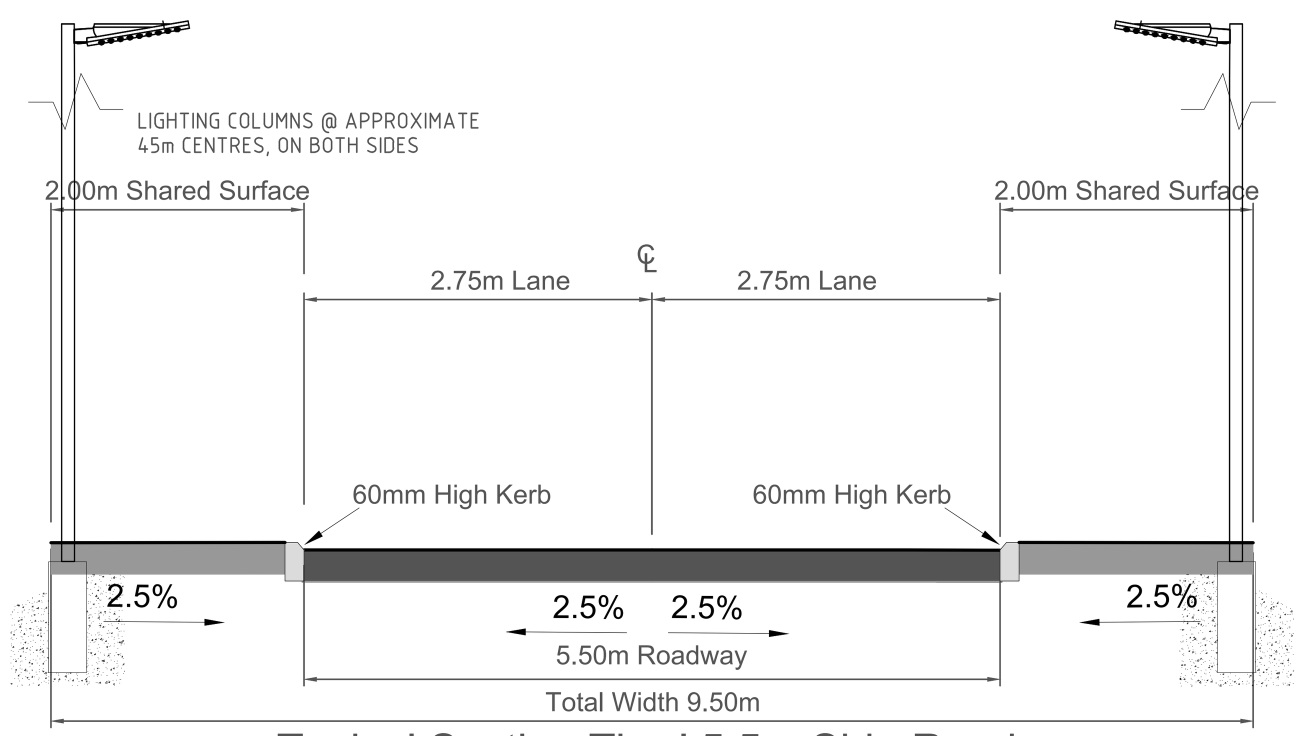


Typical Section Thru' 6.0m Main Road 01

(Scale 1 : 50)

Typical Section Thru' 6.0m Main Road 02

(Scale 1 : 50)



Typical Section Thru' 5.5m Side Road

(Scale 1 : 50)

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Client: bam

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Rev	Date	Drn	Chk	Amendment / Issue	App
S3 P01	27/05/22	PQR	GMcC	Issue for Review and Comment	BB

rps

Model File Identifier: MCW1088-RPS-00-XX-DR-C-PL0102

Scale	1:50 @ A1 1:100 @ A3
Created on	27/05/2022
Sheets	01 of 01
Project	Castlelake SHD
Title	Proposed Public Lighting Infrastructure Typical Cross Sections
File Identifier	MCW1088-RPS-00-XX-DR-C-PL0102-01
Status	S3
Rev	P01

MWP

Appendix 10.1

17th to 19th Century Maps

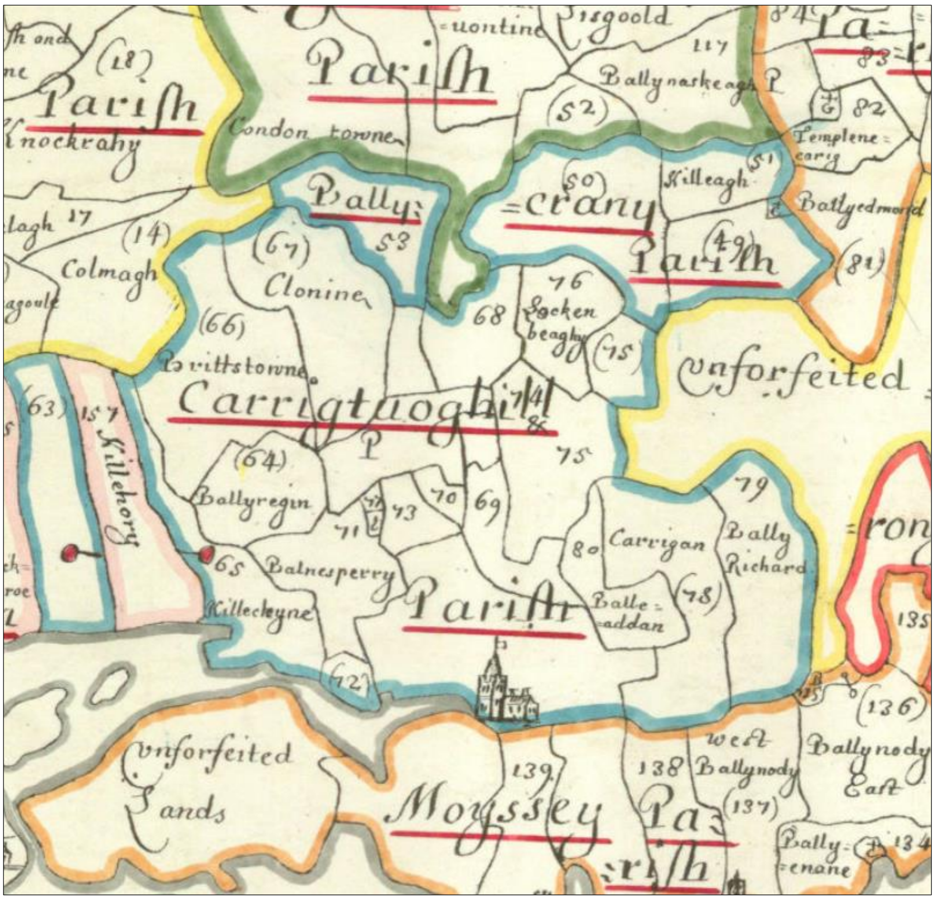

Figure A10.1: Down Survey Barony Map (1654-1659) depicting the parish of Carrigtohill, spelt '*Carrigtuoghill*' and Barryscourt Castle

Figure A10.2: Taylor and Skinner road map (1777) depicting the village of Carrigtohill, spelt '*Carrigtwohill*' and the gentlemen's seats in the surrounding area

Figure A10.3: Grand Jury Map of 1811 depicting the village of '*Carrigtuohill*' as a small rural village

Appendix 10.2

Site Walkover Photographs

Plate 1: Area 1 (Field 1a), looking north along trackway running N-S through the centre of this field

Plate 2: Area 1 (Field 1a), looking north

Plate 3: Area 1 (Field 1b) looking SE

Plate 4: Area 2 (Field 2a), looking north at blocked up underpass under railway line


Plate 5: Area 2 (Field 2a), looking NW


Plate 6: Area 2 (Field 2b), looking northeast

Plate 7: Area 2 (Field 2b), looking northwest

Plate 8: Area 3, looking NE

Plate 9: Area 3, looking SE

Plate 10: Area 4, looking west

Plate 11: Area 5, looking west

Plate 12: Area 6, looking west

MWP

Appendix 10.3

Ground Inspection Report for Geophysical Survey

Mr Oliver Ryan
Contracts Manager
BAM Ireland
Euro Business Park
Little Island
Cork
T45 R902

22nd May 2022

Re: Proposed geophysical survey at Terrysland, Carrigtohill, Cork

Dear Oliver

I made a visit to BAM's site in Terrysland, Carrigtohill (Cork) last November 2021 in respect of a proposed geophysical survey prior to archaeological test trenching. Our professional opinion is that this site is not suitable to geophysical survey. The lands within the proposed development comprise mostly of narrow margins of overgrown and disturbed terrain, with existing modern boundaries, modern services, routes of access and construction in very close proximity.

My recommendation is that targeted archaeological test trenching or monitoring would be a better means of determining the location of archaeological remains, if present, within the site boundary. Geophysical survey at the site of proposed development in Terrysland Carrigtohill is not deemed appropriate due to expected large-scale interference from modern sources and blank areas in the data due to difficult terrain.

If you require any further clarification on this matter please don't hesitate to give me a call.

Yours sincerely,

John Nicholls.

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Appendix 11.1

Landscape Masterplan

Note:

Included here is an A3 version of the proposed Landscape Masterplan. A larger A0 version of the same plan along with landscape sections and a landscape design rationale report have been submitted separately to the EIAR as part of the supporting planning documentation for this application.

Proposed Landscape Masterplan: Not to Scale

Appendix 13.1

2019 Pre Covid-19 Peak Hour Junction Traffic Turning Volumes

Junction	Approach	Movement To	2019 Pre Covid-19 Peak Hour Vehicles (HCVs)	
			AM	PM
N25 Junction 3 Northern Roundabout	L3004	L3678	201 (4)	155 (1)
		N25 Eastbound On-Ramp	184 (6)	219 (4)
		R624	147 (7)	217 (6)
		L3004	1 (0)	0
	L3678	N25 Eastbound On-Ramp	77 (5)	67 (3)
		R624	304 (8)	341 (3)
		L3004	184 (3)	86 (1)
	R624	L3004	455 (13)	132 (2)
		L3678	298 (2)	119 (4)
		N25 Eastbound On-Ramp	151 (5)	117 (1)
	N25 Eastbound Off-Ramp	L3004	54 (2)	46 (14)
		L3678	314 (9)	316 (12)
		N25 Eastbound On-Ramp	20 (1)	30 (2)
		R624	240 (22)	585 (6)
Castlelake Access/L3678 Main Street/Industrial Estate Access	Castlelake Access	Main Street East	96 (6)	135 (0)
		Industrial Estate	0	3 (0)
		Main Street West	10 (0)	27 (0)
	Main Street East	Industrial Estate	13 (3)	16 (1)
		Main Street West	412 (7)	147 (3)
		Castlelake Access	76 (0)	73 (0)
	Industrial Estate	Main Street West	13 (6)	52 (4)
		Castlelake Access	0	2 (0)
		Main Street East	5 (2)	24 (2)
	Main Street West	Castlelake Access	20 (0)	85 (0)
		Main Street East	242 (3)	493 (3)
		Industrial Estate	20 (5)	41 (12)
L3606 Station Road/L7643 An Guagán	Station Road North	An Guagán	48 (0)	35 (0)
		Station Road South	144 (3)	66 (2)
	An Guagán	Station Road South	155 (0)	34 (0)
		Station Road North	81 (1)	19 (0)
	Station Road South	Station Road North	83 (1)	125 (2)
		An Guagán	98 (0)	108 (0)
L3606 Station Road (Church	Station Road (Church Lane)	Main Street East	53 (0)	65 (2)
		Main Street West	196 (3)	63 (1)

Lane)/L3680 & L3678 Main Street	Main Street East	Main Street West	316 (2)	193 (1)
		Station Road (Church Lane)	27 (0)	59 (0)
	Main Street West	Station Road (Church Lane)	98 (1)	201 (3)
		Main Street East	247 (3)	487 (2)
L3680 Main Street/L3612	Main Street East	L3612	239 (5)	108 (3)
		Main Street West	210 (0)	110 (0)
	L3612	Main Street West	203 (2)	142 (1)
		Main Street East	106 (8)	217 (3)
	Main Street West	Main Street East	203 (2)	419 (2)
		L3612	101 (0)	145 (2)
N25 Junction 4 North	L3612 North	East Link Business Park	14 (0)	23 (0)
		L3612 South	336 (5)	233 (3)
	East Link Business Park	L3612 South	60 (0)	47 (0)
		L3612 North	8 (1)	9 (0)
	L3612 South	L3612 North	198 (8)	193 (3)
		East Link Business Park	71 (0)	50 (0)
	N25 Eastbound Off-Ramp	L3612 North	106 (1)	151 (0)
		East Link Business Park	89 (1)	35 (3)
		L3612 South	64 (12)	34 (1)
N25 Junction 4 South	L3612 North	Local Cul-de-Sac Road	4 (0)	2 (0)
		L3612 South	71 (14)	97 (5)
		N25 Westbound On-Ramp	383 (4)	218 (1)
	N25 Westbound Off-Ramp	Local Cul-de-Sac Road	10 (0)	0
		L3612 South	10 (4)	8 (2)
		N25 Westbound On-Ramp	6 (0)	2 (0)
		L3612 North	213 (5)	193 (3)
	Local Cul-de-Sac Road	L3612 South	0	0
		N25 Westbound On-Ramp	7 (0)	0
		L3612 North	1 (0)	0
	L3612 South	N25 Westbound On-Ramp	47 (5)	18 (0)
		L3612 North	53 (3)	52 (0)
		Local Cul-de-Sac Road	1 (0)	0

Appendix 13.2

Cork County Council Predicted 2025 Do Minimum Peak Hour Junction Traffic Turning Volumes

Junction	Approach	Movement To	2025 Do Minimum Peak Hour Vehicles	
			AM	PM
N25 Junction 3 Northern Roundabout	L3004	L3678	470	80
		N25 Eastbound On-Ramp	233	193
		R624	153	84
	L3678	N25 Eastbound On-Ramp	48	144
		R624	529	640
		L3004	376	40
	R624	L3004	474	565
		L3678	399	472
		N25 Eastbound On-Ramp	151	122
	N25 Eastbound Off-Ramp	L3004	0	107
		L3678	134	297
		R624	246	283
Castlelake Access/L3678 Main Street/Industrial Estate Access	Castlelake Access	Main Street East	197	28
		Industrial Estate	3	2
		Main Street West	196	38
	Main Street East	Industrial Estate	20	24
		Main Street West	455	225
		Castlelake Access	122	168
	Industrial Estate	Main Street West	13	52
		Castlelake Access	0	2
		Main Street East	5	24
	Main Street West	Castlelake Access	59	113
		Main Street East	156	720
		Industrial Estate	22	42
L3606 Station Road (Church Lane)/L3680 & L3678 Main Street	Station Road (Church Lane)	Main Street East	176	38
		Main Street West	68	9
	Main Street East	Main Street West	479	291
		Station Road (Church Lane)	252	264
	Main Street West	Station Road (Church Lane)	21	140
		Main Street East	323	692
L3680 Main Street/L3612	Main Street East	L3612	172	134
		Main Street West	408	359
	L3612	Main Street West	448	209
		Main Street East	89	118

	Main Street West	Main Street East	451	679
		L3612	97	119
N25 Junction 4 North	L3612 North	East Link Business Park	49	47
		L3612 South	221	207
	East Link Business Park	L3612 South	82	21
		L3612 North	16	14
	L3612 South	L3612 North	363	214
		East Link Business Park	74	42
	N25 Eastbound Off-Ramp	L3612 North	159	103
		East Link Business Park	74	5
		L3612 South	58	25
N25 Junction 4 South	L3612 North	L3612 South	101	92
		N25 Westbound On-Ramp	261	158
	N25 Westbound Off-Ramp	L3612 South	26	24
		L3612 North	378	217
	L3612 South	N25 Westbound On-Ramp	57	22
		L3612 North	59	51

Appendix 13.3

Cork County Council Predicted 2025 Do Something Peak Hour Junction Traffic Turning Volumes

Junction	Approach	Movement To	2025 Do Something Peak Hour Vehicles	
			AM	PM
N25 Junction 3 Northern Roundabout	L3004	L3678	347	108
		N25 Eastbound On-Ramp	190	77
		R624	135	194
	L3678	N25 Eastbound On-Ramp	118	76
		R624	427	424
		L3004	278	56
	R624	L3004	513	270
		L3678	387	185
		N25 Eastbound On-Ramp	135	69
	N25 Eastbound Off-Ramp	L3004	347	108
		L3678	190	77
		R624	135	194
Castlelake Access/L3678 Main Street/Industrial Estate Access	Castlelake Access	Main Street East	71	42
		Industrial Estate	4	7
		Main Street West	131	47
	Main Street East	Industrial Estate	6	7
		Main Street West	257	113
		Castlelake Access	86	50
	Industrial Estate	Main Street West	13	52
		Castlelake Access	0	2
		Main Street East	5	24
	Main Street West	Castlelake Access	70	304
		Main Street East	187	346
		Industrial Estate	27	47
L3606 Station Road (Church Lane)/L3680 & L3678 Main Street	Station Road (Church Lane)	Main Street East	355	196
		Main Street West	51	15
	Main Street East	Main Street West	262	154
		Station Road (Church Lane)	240	240
	Main Street West	Station Road (Church Lane)	34	56
		Main Street East	218	455
L3680 Main Street/L3612	Main Street East	L3612	229	221
		Main Street West	286	311
	L3612	Main Street West	332	182
		Main Street East	150	194

	Main Street West	Main Street East	433	475
		L3612	178	193
N25 Junction 4 North	L3612 North	East Link Business Park	44	36
		L3612 South	363	378
	East Link Business Park	L3612 South	88	42
		L3612 North	6	12
	L3612 South	L3612 North	370	253
		East Link Business Park	85	48
	N25 Eastbound Off-Ramp	L3612 North	103	112
		East Link Business Park	70	26
		L3612 South	47	37
N25 Junction 4 South	L3612 North	L3612 South	85	114
		N25 Westbound On-Ramp	413	342
	N25 Westbound Off-Ramp	L3612 South	19	18
		L3612 North	388	227
	L3612 South	N25 Westbound On-Ramp	58	27
		L3612 North	63	75

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		Castlelake Access	0	2
		Main Street East	5	24
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		Industrial Estate	27	47
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	N25 Westbound Off-Ramp	L3612 South	19	18
		L3612 North	388	227
	L3612 South	N25 Westbound On-Ramp	58	27
		L3612 North	63	75