Appendix F

Ecological Assessment

District Plan change for Lincoln South Development Area; Aquatic Ecology

Prepared for:

Rolleston Industrial Developments Ltd.

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Contents

1 Executive Summary

A private plan change is proposed for a rezone of an approximate 186 Ha land parcel south of the Lincoln Township. The area is currently zoned for rural land use, and is currently used largely for dairying and grazing.

There is some ecological information available in the region to be rezoned and the surrounding area. These indicate the presence of several common fish, many with marine lifecycles, and a compromised aquatic macroinvertebrate fauna and low stream health metrics. Some fish in the receiving waters have a conservation status, this includes the longfin eel and inanga (the common whitebait). There is a historic lamprey record, a threatened species, but it is unknown if this species still exists in the catchment, let along the receiving waters. It is considered the freshwater crayfish (koura) may reside in flow-stable waterways in the region, especially where the banks are stable.

A zone change, per se, does not, in isolation guarantee aquatic habitat improvement degradation or improvement. However, in Canterbury, there is an increasing number of successful restorations of degraded aquatic habitats in rezoned rural land which demonstrates improved ecological values from residential watersheds under a regime of treated stormwater restored habitats, and consideration of ecological dispersal and life-cycling.

Notwithstanding zone change issues, a number of habitats in the region need to be ecologically surveyed. This is required prior to a detailed assessment of environmental effects at a future subdivision consent stage and/or in the event that works are undertaken within the District Plan's 10m waterbody setback for earthworks and development. These habitats are specified in the recommendations.

2 Introduction

Rolleston Industrial Developments Ltd. is proposing to develop rural land for residential use on the immediate south boundary of the Lincoln township (Fig. 1). It lies directly south of the Verdeco Park and Te Whariki developments. The area, based on the topographic maps, is relatively flat, of approximately 186 Ha, and at an elevation of about 9 m a.s.l. It is bounded to the north by the Verdeco Park and Te Whariki residential developments and to Collins Road to the south. The west boundary is an ephemeral waterway termed Western Boundary Drain and the area extends eastwards to the setback boundary of the LII River, south of Moirs Lane. The land is currently zoned as rural, and its current land use is primarily for dairying and grazing.

3 Objectives

In support of the private plan change application, and the section 32 (RMA) evaluation, the overall scope of this study is to provide an assessment of the following matters:

- An assessment of the existing ecological values of the Lincoln South Area,
- An assessment of the ecological effects associated with the type of development likely to result from the proposed residential zoning.

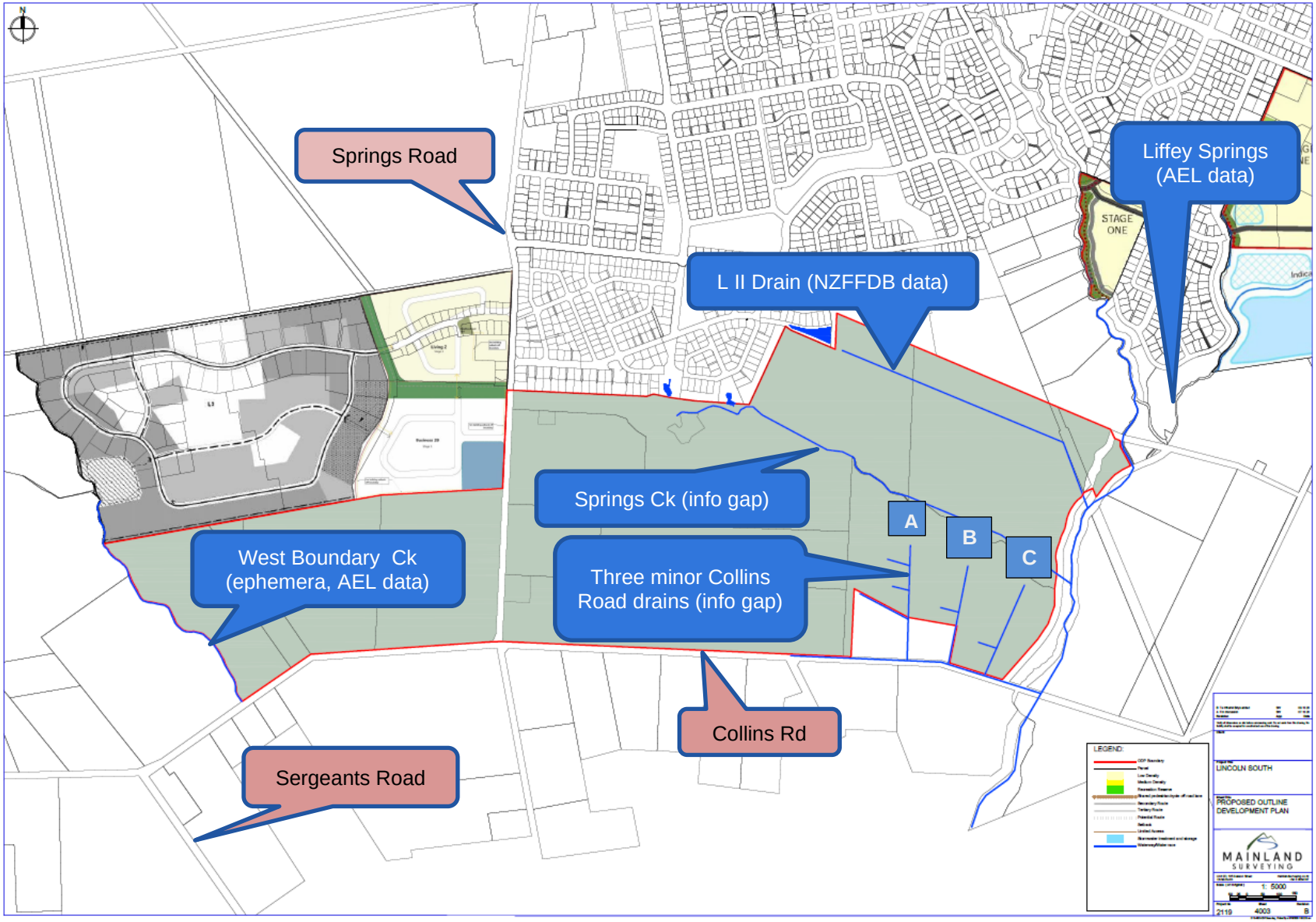

Figure 1. Red polygon = proposed plan change area, with major waterways and roads indicated.

4 Existing ecological knowledge of waterways

4.1 West Boundary Drain

West Boundary Drain borders the west boundary of the development area (Fig. 1), and the reach bordering the Verdeco Park Development Area to the north was surveyed by Aquatic Ecology Limited (AEL) in April 2019. This reach was found to be ephemeral, thus, conveying rainwater during rain events, but drying out between rain events. It was fished during a rain event, to check for transitory aquatic values, including fish, but none were caught.

The reach bordering the plan change area is also suspected to be dry. At the south-east corner of the development area, at Collins Road, West Boundary Drain was dry in October 2020 (Fig. 2a). The waterway was also dry in April 2019 during our Verdeco Park survey when the bed was similarly covered in willow weed and creepers (Figs.2 b,c).

Collins Road Drain appears ephemeral too, but during rain events would flow south-west to the intersection with Sergeants Road, and with inflows form further west, would appear to provide permanent flowing water southwards along Sergeants Road. During the recent October reconnaissance, the channel of Collins Road Drain was filled with tall fescue grass, indicating a normally dry channel (Fig. 3a).

Figure 2a. West Boundary Drain looking north from Collins Road (9/10/20).

Figure 2b. The bed of West Boundary Drain at Collins Road (April 2019)

Figure 2c. Looking south-west along Collins Road Drain, no surface water, damp bed with willow weed (April 2019).

Figure 3a. Looking eastwards along Collins Road Drain (9/10/20).

4.2 LI Creek (Liffey Stream)

The L1 rises north of the Lincoln township, flows south through the town, and enters the LII River below its headwaters. AEL ecologically evaluated the L1 headwaters upstream of the proposed development area in March 2018. This work was undertaken in pursuit of civil works required for the construction on a new school in the area and consenting for the dewatering discharge for trenching operations.

The waters were very clear at baseflow, with a measured mean baseflow turbidity of 2.4 NTU (n=3). A temperature and dissolved oxygen logger indicated that the autumnal diel (i.e. over a 24 hr period) temperature regime varied between approximately 12.9-15.5 degrees, and dissolved oxygen levels varied between 94% in the mid-afternoon to a minimum of 72% just after dawn. We considered that the LI Creek is a thermally stable spring-fed river exhibiting normal variation in dissolved oxygen concentrations typical for a well-vegetated and shaded waterway.

Physical habitat scores for the LI headwaters, compared to national values, were low, but in well-shaded habitats, the lack of sunlight appeared to inhibit the growth of weeds like watercress and monkey musk in some places, and native charophytes (*Nitella* sp.) were prominent. The physical habitat scored highly for bank stability, low erosion, and high levels of shade. Hydraulic variation and habitat abundance for invertebrates and fish cover abundance was usually low.

Koura were quite common, 5 caught in the fishing catch, and one with eggs (in berry). Invertebrate stream health metrics based on previously available data indicated poor stream health in the upper L1 River (MCI-sd = 65). A total of 200 fish were caught, composed of 6 species, common bully, longfin eel, upland bully, brown trout, bluegill bully, and shortfin eel. Of these, the longfin eel and bluegill bully have a conservation status of “declining”. The bluegill bully record was a first for this catchment, and adopts habitats in particularly fast water. Therefore, it is currently unknown, but considered unlikely, if it would inhabit resident habitats in the receiving waters of the LII River for this Plan-change area.

The upper reach of the L1 provided stable gravels downstream of the Gerald Street culvert (Taylor & Good 2006), and the New Zealand Freshwater Fish Database (NZFFDB) lists a historic (1920) record of lamprey in the upper reaches of the LII Creek (Edward Street, Lincoln, Card No. 50483). There is a recent (2015) giant bully record from the Lincoln township, surprisingly inland (33 km) for this species, and I consider that this record may be a misidentification.

4.3 LII River

The outline development plan depicts the development area extending to approximately 10 m (not counting the proposed green space along the boundary) of the LII River, a waterway with significant instream values. As noted above, the District Plan requires a 10m setback for earthworks from waterbodies.

The LII River, nears its confluence with the LI tributary, forms the eastern boundary of the development area. In 2007, AEL was involved in the plan change, stormwater AEE and monitoring of the Liffey Springs residential development between Liffey Stream (the spring-fed headwaters of the LII River) and the LI tributary.

At the time of the 2007 survey, the upper reaches of the LII, at the north-east corner of the development area, was composed of four common native fish species, shortfin eel, longfin eel (some large), common bully, and upland bully. Of these, the longfin eel has a conservation status of “declining” (numbers) (Dunn *et al.* 2017).

The invertebrate fauna contained koura (freshwater crayfish), but the remaining macroinvertebrates were commonly encountered species, with a stream health metric indicating ‘poor’ stream health (MCI-sb = 67.6), where a score less than 80 is categorised as poor (Stark & Maxted 2007).

4.4 New Zealand Freshwater Fish Database Records

Currently (19/10/20), there are 32 fish records in the LII catchment on the New Zealand Freshwater Fish Database (NZFFDB), with a species list provided below (Table 1). Within the LII dataset, the 5 most frequently encountered species are the common bully, upland bully, longfin eel, inanga (the common whitebait) and the shortfin eel.

Of these 32 records, 4 are quite recent (September 2020), and from an unnamed aligned waterway which passes through the development area and discharges into the LII River (Figs. 1, 4). These records indicate that this waterway provides habitat for a number of common lowland species: longfin eel, shortfin eel, inanga, upland bully, and common bully. Of these the longfin eel and inanga have a national conservation status of declining (numbers) Dunn *et al.* (2017).

The fish pest rudd was recorded near the mouth at Te Waiora/Lake Ellesmere, distant from the plan change area. Rudd has been recorded from other rivers near the lake. Goldfish, which can form problematic wild populations, have been recorded near Te Waiora/Lake Ellesmere, and in a pond near Templeton Hospital, both well away from the plan change area.

Koura have been infrequently recorded from the catchment (Table 1), but because they are difficult to catch, are often more common and well-distributed than records indicate.

Table 1. Freshwater Fish Species List from the LII River (NZFFDB), sorted from the most commonly recorded to the least recorded.

Common name	Scientific name	No. of records
Common bully	*Gobiomorphus cotidianus*	28
Upland bully	*Gobiomorphus breviceps*	24
Longfin eel	*Anguilla dieffenbachii*	23
Inanga	*Galaxias maculatus*	20
Shortfin eel	*Anguilla australis*	14
Brown trout	*Salmo trutta*	8
Unidentified eel	*Anguilla sp.*	8
Koura	*Paranephrops*	3
Unidentified bullies	*Gobiomorphus sp.*	3
Unidentified galaxias	*Galaxiid*	3
Goldfish	*Carassius auratus*	2
Common smelt	*Retropinna retropinna*	1
Freshwater mussel	*Hyridella menziesi*	1
Giant bully	*Gobiomorphus gobioides*	1
Rudd	*Scardinius erythrophthalmus*	1
Southern lamprey	*Geotria australis*	1
Torrentfish	*Cheimarrichthys fosteri*	1

Figure 4. The four NZFFDB records (red pins) in, or close, to the development area (green polygon).

4.5 Ecological values and sensitivity of the wider receiving environment

There is some information on the ecology of the LII River. Historically in the Te Waihora catchment, after the Selwyn River, the lower reaches of the LII was the most heavily fished for brown trout (Hardy & Taylor 1989).

There are two routes which stormwater can discharge from the site into the LII River. One is via Collins Road, Sergeants Road drain, finally discharging into the LII River near Yarrs Road. The identified fish fauna downstream of that point is composed of longfin eel, shortfin eel, inanga, common bully, and near the lake, goldfish and rudd, .However, there is fishing method bias in these records, and a number of other native and introduced fish will be present, including brown trout and common smelt.

Stormwater discharge to the east enters the LII River more directly and further upstream than *via* the Collins Road drain. The LII was apparently well-fished by the Department of Conservation in 2015 downstream of this potential discharge point (NZFFDB 10468). At that point, common native fish species were identified, specifically common bully, longfin and shortfin eels, inanga, upland bully and brown trout.

The most sensitive fish will be the common smelt which has been only electric-fished from the roadside drain along Days Road, but not the mainstem. However, this sea-migratory fish must migrate up the main river to reach the Days Road drain, but this location is well downstream of the Lincoln South area. Given that this fish is sensitive to urban contaminants (Cd, Zn, phenols *in* Hickey 2000) , in terms of an eventual assessment of environmental effects (AEE), it is important to know the upstream limit of common smelt in the LII River.

In almost all situations, NZ's aquatic invertebrates are more sensitive to urban contaminants than the fish. In this potential receiving environment, and based on available information (Hickey 2000) the freshwater shrimp (*Paratya curvirostris*) is likely to be the most sensitive.

4.6 Ecological knowledge gaps in the proposed development area

There are information gaps about the ecological values in three principal locations as indicated in Fig. 1. This information will be required to assess the level of protection these habitats require because of a Zone change, and potential assessment of ecological effects following potential residential development. The ecological issues surrounding these three locations are discussed below.

4.6.1 Springs Creek

Based on the recent photographic reconnaissance, and the recent survey in an adjacent waterway (see Sec. 4.4), I expect ecological values to be moderately high in Springs Creek. This opinion is based on the observation that the waterway is mostly fenced, with stable banks, and at least around the homestead, the margins are well vegetated with a wide riparian strip (Google Earth imagery, Drop boxed INOVO, e2 field photographs).

The discharges from the springheads at the top of the system form the basis of the baseflow, but augmented by more (fenced) spring-head inflows further downstream and eastwards. The waterway is subject to surface-water abstraction for dairy production. There is some gravel in the vicinity, which would form particularly valuable habitat for bullies and juvenile eels.

The fish fauna is currently unknown, but expected to be quite similar to that in the LII Drain indicated in Fig. 1 (i.e. longfin eel, shortfin eel, inanga, upland bully, and common bully). Where the hydraulics are suitable, there may be some trout spawning gravels, and these may be utilised for spawning by the upland bully. However, the linear nature of the channel, along with even gradient would suggest any trout spawning habitat is quite limited. Where the banks are stable, it is quite possible freshwater crayfish are present.

4.6.2 Isolated permanent and semi-permanent waterbodies

Along with Springs Creek, and the minor lateral drains, several isolated waterbodies require further investigation. These are located north-east of the intersection of Collins Road and Springs Road, and are comprised of 5 ponds visible on imagery in the recent past (i.e. since 2004, Fig. 5). These waterbodies align with old fluvial channels possibly dating back to the old course of the Waimakariri River.

Isolated ponds in Canterbury may form habitats of the Canterbury mudfish, a species with high conservation status. No Canterbury mudfish records exist on the NZFFDB in the LII catchment. However, at the time of writing, few suitable habitats appear to have been surveyed in this catchment. Maintenance of Canterbury mudfish habitat is not necessarily at odds with a plan change, but identification of habitats is critical as early as possible in the planning process.

Figure 5. The five isolated ponds which warrant ecological survey in the eastern half of the area proposed for re-zoning.

4.6.3 Collins Road Drains

These three spring-fed waterways discharge to Collins Road Drain, and recent imagery suggests that they are currently well-fenced from stock (Figs. 6 a, b). Collectively, these 3 waterways appear to be fed by approximately 10 (or so) springs heads. There also appears to be number of springs heads along the bank of the L II River, but which for the most part, may be protected by the waterway setback.

Given the evident stability of the channel form, these stable channels may form habitat for koura, inanga, common bully and upland bully. Given easy fish access to the LII, freshwater mussels may also be present. Freshwater mussels have a juvenile lifestage which attaches to fish for the purpose of dispersal.

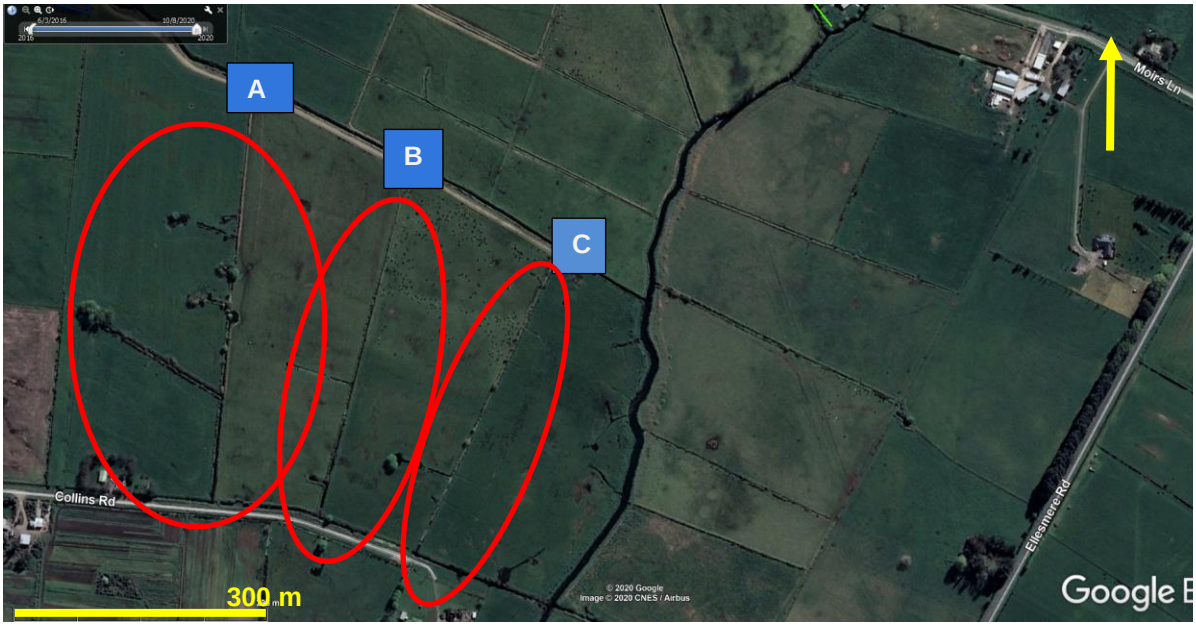

Figure 6a. The three springfed drains discharging into Collins Drain.

Figure 6b. The confluence of a Minor Collins Road Drain and Collins Road Drain "A". The waterway and springheads appear to be well-fenced based on the Google imagery. The fencing around the waterways "B" & "C" were similar.

5 General notes to protect ecological values and plan change level

5.1 Physical habitat notes

Spring fields are aquatic habitats sensitive to hydrological changes potentially manifested by change in land use. Maintaining groundwater flow to the springs is paramount to their future viability, and often at odds with high density development, where stormwater may be diverted away from areas of groundwater and springwater recharge.

It is apparent most of the spring heads and outlets in the proposed development area are already partially protected by fencing, and they are otherwise protected by the 10m setback for waterbodies in the District Plan. The riparian vegetation suggests they have been fenced in the recent past, but possibly not historically. The now-stable banks form important refuge habitat for all of the native fish and the native freshwater crayfish, but also form refuge and roosting areas for the native invertebrates upon which the fish feed. Koura require extensive cover, as they are vulnerable to cannibalism, but also predation from eels and trout.

Gravel substrate is important for native bully spawning, as they adhere their eggs to the large stones and cobbles, but coarse substrate is also valuable for fish cover, and bully abundance has been experimentally demonstrated to increase (and decrease) with the amount of available stony substrate (Jowett & Boustead 2001).

5.2 Possible change in ecological values associated with Plan Change

A plan rezoning from pervious rural land to residential will inevitably lead to higher stormwater discharge, because the proportion of impervious land will increase. The quality and quantity of the stormwater discharge will be dictated by the development intensity, the quality of the stormwater treatment train, the degree to which stormwater volumes are retained, and their discharge rate to surface waters. However, ultimately, all surface stormwater discharge will enter the LII River. Thus, quantification of ecological impacts, as for an AEE approach will be set out when stormwater design and flow rates are available.

Generally, the more peaked storm hydrograph associated with discharge from urbanised catchments which lack storm discharge attenuation can be quite averse to ecological values in the receiving environment (Suren & Elliott 2004). However, with improvements in stormwater treatment, along with physical habitat enhancements, within a development, and along the local receiving waterway, these adverse impacts can be reduced.

However, often rural waterways, at least in New Zealand, have been ecologically compromised in the past by the lack of fencing. While recent fencing is a welcome change for the natural environment, often the years of stock-accelerated bank erosion has meant the channel have already become over-widened in relation to the baseflow and prone to further sedimentation due to adverse hydraulics. The sediment, often nutrient rich, facilitates weed growth to the point it must be mechanically dredged causing further bank damage and widening.

Over time, Plan change from rural to residential can lead to further baseflow loss in channels which are already artificially widened as described above. Ecologically, this change is manifested by the gradual sedimentation of any stream gravels and its diverse habitat-specific fauna (i.e. caddisflies, mayflies, abundance of small native fish). With baseflow loss, even with banks now stabilised, this leads to a shallow, warm, silted channel inhabited by little else but midge larvae, segmented worms, and mud snails.

On a positive note, the development phase, and the associated mechanisation, provides a unique opportunity to reduce and restore effective wetted widths of waterways for low baseflows, yet still engineer hydraulic capacity for stormflows. An example of rural-to-residential land use change with good ecological outcomes is the spring-fed Kaputone Stream catchment of the Styx River in Christchurch where both ecological and water quality parameters indicate improving stream health. However, this beneficial change does take some years to manifest, probably largely due to access issues for instream inhabitants.

Invertebrate and fish dispersal are important elements to maintain life cycles. There is an increasing body of knowledge about dispersal and fish migration requirements to ensure restored habitats are available for colonisation. The recent MFE specifications on culvert placement in waterways will allow sea-migratory fish to colonise restored habitats.

In summary, changes in ecological values associated with Plan and land use change, can be detrimental, or beneficial, to the associated waterways. It all depends on utilising the critical time window when waterways are available for design and construction in respect to ecological function.

6 Recommendations

Overall, from a plan change/rezoning perspective if the development incorporates key design items such as:

- Stormwater discharging via first flush basins, detention basins and wetlands to attenuate stormflow and reduce contaminants to appropriate SDC & ECan guidelines.
- Reserves/green space placed directly adjacent to key ecological waterways to protect them (i.e. western boundary drain, Springs Creek, LII River, natural springs and isolated waterbodies)
- Fencing waterways with ecological value from further stock access.
- Adherence to the 10m waterbody setback rules, or detailed assessment through a resource consent process

then the possibility of the plan change/rezoning ecological impacts being beneficial to the environment are likely to be increased. Currently, the draft outline development plan (ODP) proposed for the Lincoln South plan change shows many of these key design items proven to protect aquatic ecology.

As a prerequisite to a submission of any subdivision consent application and subsequent land development, AEL recommends ecological assessment of the following habitats, in order to identify any ecologically significant biota, and construct mitigation measures to maintain and protect ecological values:

- isolated waterbodies east of Springs Road
- minor drains in the south east corner of the development
- the LII River immediately downstream of the region proposed for re-zoning.
- Springs Creek

In summary, if the listed key design items are implemented, along with the further ecological assessments, AEL believes this plan change will not necessarily manifest adverse ecological effects.

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