The Cain Consultancy

Lake Enhancement & Bio-engineering Consultants

The Darent River

D/S of Lullingstone Lake

Recommendations for habitat Enhancement

A report detailing observations from a site visit on 29th June 2002.

Prepared on behalf of the Wild Trout Trust

For

The Kingfisher Angling and Preservation Society

1.0 INTRODUCTION

1.1. Catchment background

The Darent catchment has suffered from low flows for many years, a major contributor being the abstraction of groundwater by Thames Water plc.

Below the KAPC sections, flows have been augmented with water from a borehole, and over the past 12 months Thames Water has reduced the level of abstraction. Flows seem to have recovered and will be seen at their best following high winter precipitation and wet summers. Abstraction, however, will remain a concern and this will have a bearing on recommendations to improve the in-stream habitat, and the degree to which those works will need to be applied.

1.2. Site Background.

The KAPC manages two stretches of the Darent up and down-stream of Lullingstone lake, both of which are little fished by club members, the lake having proven more popular.

Whilst the upper reach is not covered by the scope of this report, the downstream section is stocked annually with brown trout in an attempt to develop the area as a river fishery, but with limited success.

For ease of description, the downstream section has been divided into 4 main beats (see Fig. 1), which will be dealt with in turn.

The beats starts below each of the four low-level weirs (installed some 20 years ago to raise water levels and reduce the impact of low flows).

2.0 CURRENT SITE STATUS AND SOLUTIONS

Current status and general overview.

The surveyed river section is generally over wide for the volume of water passing through it, and the subsequent installation of weirs and impoundments by the EA is a classic knee-jerk response to problems of habitat deterioration in low-flow situations. Sedimentation has increased as a result, and in-stream conditions are far worse following the installations than before.

Heavy tree cover is playing an important role in minimising the presence of *Ranunculus* community and other beneficial macrophytes and these plants should be encouraged wherever possible to supplement water depths and inter-crown scour.

The stream is clearly dependent on a regular input of stocked fish, and any works carried out need to focus on the creation of appropriate adult habitat to maximise their availability to anglers. The other essential features such as spawning redds, swim up fry habitat and yearling habitat will also need be created as part of this programme of works. However, prevailing conditions suggest that natural spawning is unlikely to be successful and if it is, this should be considered a bonus.

Overall, the river channel needs to be narrowed and re-designed to include a number of important features outlined in the notes below.

2.1 Section 1(Lake outfall to first weir)

The following notes summarise our observations on this stretch:

- Channel form is straight and wide (12-14 m) (front cover photo).
- Water depth is uniform and shallow with laminar flow.
- River bed substrate is sandy gravel and uniformly covered with light sediments and algal/diatomous blooms.
- The weir impoundments have caused a 'ponding' effect upstream (see Photo 1). These EA installed Breezeblock groins have inhibited the free flow of water, hence the siltation and general degradation of the in-stream habitat (see Photo 2).
- Macrophyte cover is extremely sparse on the river bed. This is due to lack of flow in an over widened channel in combination with heavy shading.

Photo 1. Weir 1 with debris and block groin

Photo 2. Breezeblock groin u/s weir 1

Proposed solutions:

- Remove weir 1 and breezeblock groins.
- Narrow channel width by up to 40% (incorporate pinch-release system).
- Restructure meander and pool/riffle sequence using marginal brushwood structures (see Fig 2).
- Create variable river bed and water flow / depth structure.
- Create pond / wetland habitats on and behind brushwood installations.
- Implement tree management programme to reduce overhead shading (trim boughs, coppicing etc.)

2.2. Section 2 (Between weirs 1 and 2)

Current status:

- Below weir 1, on the true right bank, there is another small EA breezeblock groin.
- Below this, the channel narrows to 7 m.
- The channel begins to form a meandering sequence and the flow is more variable, as are the habitats, with a more defined pool/rifle sequence and cleaner gravels.
- Parts of this section could be used as a `template' for channel improvements along other sections.
- Slight ponding occurs immediately upstream of weir 2.

Proposed solutions:

- Remove weir 2 and breezeblock groins.
- Install cut tree trunk on bank-side at channel edge to provide adult trout cover.
- Observe sequences of pool, riffle (shallow, fast-flowing gravel areas) and depositional bar habitats and use this narrower, more natural channel system as a reference for creating new fish habitats.

2.3. Section 3 (Between weirs 2 and 3)

Current status:

- Immediately below weir 2 a deep scour-pool has developed.
- A mid-channel island has formed just downstream. This constricts the channel a to 4 m width and creates deep (0.5 m), faster flows along the true right bank (see Photo 3).
- In the lower reach downstream, the channel widens again.
- A uniform, deeper flow resumes towards the third weir (see Photo 4).
- A number of mixed fish species were seen in this section identifying it as an important section for habitat improvement.

Photo 3. Weir 2 and deposited island d/s (arrowed).

Photo 4. Wider and deeper habitat of lower

Proposed solutions:

- Remove weir 3 and breezeblock groins.
- Pinch channel width on lower reach by constructing low-level brushwood mattresses along bank edges (see Fig 3).
- Create brushwood and gravel structure to control flows where appropriate. (in place of weir).
- Ensure protection of inflow to floodplain wetland on true UH bank.

2.4. Section 4 (Between weirs 3 and 4) Current status:

- This section is located on an over widened O/S meander.
- A low-level, single breeze block wall has been installed by the EA for an unknown purpose, with a ponded and silted area to the left.
- In the upper half of this section, natural meanders continue with pool and depositional side-bar habitats.

- The channel widens in the mid-section where the EA have installed more breezeblocks to narrow the channel. The installation was never completed and has not produced any beneficial results.

- Heavy shading caused by a large alder tree plantation and several overhanging trees.

Photo 5. Block installation in Section 4 with ponded area and island to the left.

Proposed solutions:

- Remove weir 4 and breezeblock structures.
- Coppice mature alders to improve light levels.
- Construct a brushwood retaining wall with woven front edge (either single or double sided) Install at summer water level to narrow channel and create a shallow ponded area to the rear. The ponded area can be in-filled, partially or wholly with brushwood brashings from pollarded trees. This will inundate in winter and rapidly silt up to form a boggy marginal sill. (see Fig 4).
- Leave one or two cut trees within the ponded area to create a variety of habitats and introduce bio-diversity.
- Consider reinstatement of flows along side-channel to create backwater habitats.
- Lower reach could also receive brushwood channel narrowing structures.

3.0 GENERAL COMMENTS FOR PROJECT

DESIGN 3.1. General Program of Proposed

Works.

1. Remove existing breezeblock and weir structures, and carry out a general survey of each section including:
   - Channel dimensions (widths, depths, etc);
   - Pool rifle sequences. (existing pool-riffle habitats, slower and faster flows);
   - Potential sources of construction materials.
2. Design and plan installation of channel structures and habitat creation, working in an up- to down-stream order.

3. Plan habitats for the 4 key life-stages of fish:

   i. Spawning adults / egg development: shallow, fast flowing gravel beds (redds).

   ii. Swim-up fry: marginal and emergent fringe habitat, with some weed-free and shaded areas (see photos 6 and 7 below).

   iii. Yearlings: fast, wide shallow riffle areas (photo 8).

   iv. Adults: deeper pools, undercut areas with slower flows and marginal vegetation cover for security and adjacent to shallow feeding areas.

4. Seek Works in Rivers Consent (EA will require general plan outline and designs).

5. General habitat features should include: overall narrowing of existing channel incorporating variable widths (pinch-release scour systems) meander formation, variable bed structure / depths (pool-riffle sequences). Allow for system adjustment and recovery periods immediately after installation and regularly monitor for maintenance.

Photo 6. Example of marginal and emergent fringe habitat creation using brushwood mattresses - ideal for swim-up fry- natural sedimentation processes have accreted the brushwood structure during first winter.

Photo 7. Detail of brushwood structure showing sediment infill and vegetation colonisation

Photo 8. Example of shallow, shaded area ideal for swim up fry.

3.2. River sections to use as templates

- Section 2: narrow section with meanders, deep pool, riffle and depositional sidebars.
- Section 3: immediately below weir 2, deep scour pool, mid-channel island (mirror in 'ski-ramp' bed formation) and narrow, deep, fast flowing section below maple.
- Investigate habitat structure further downstream where the channel is free of weirs and habitats are more naturally variable and note channel-change sequences.

3.3. Habitats of value to maintain during restoration

- Depositional side bars and mid-channel islands: these areas form an important marginal habitat rich in organic matter, woody debris and detritus with variable substrates - vital for aquatic invertebrates.
- Pool-riffle sequences.
- Woody debris (large boughs and brashings.)

3.4. Other site management suggestions

- With the reduction in abstraction, low flows should become less extreme in non-drought years, enhancing the argument for weir removal.
- Devise an extensive program for bough trimming and coppicing of bank side and nearby trees to improve light for aquatic plant growth.
- Introduced structures must be installed in a hydrodynamic manner that follows natural flow lines. Abruptly angled structures will be hardest hit by flows, creating turbulence and destabilisation.
- Enquire about designated status of neighbouring land (e.g. SSSI).

4.0 SUMMARY & CONCLUSIONS

- Despite concerns about low flows, a carefully planned, and systematic program of restoration will have a dramatic and positive effect on the fish-holding capacity of the River Darent site.

- At present, the KAPC habitat structure offers few natural refuges for mature trout, hence the perceived lack of success with the stocking programme, and downstream migration is undoubtedly occurring.

- The weirs act as a physical barrier and prevent upstream migrations. The lake and weir at the top of Section 1 further limit migratory paths from upstream areas, so the encouragement of upstream migration must be a priority.

- The chemistry of the lake water feeding the lower Darent River sections may also be an issue, but would require separate investigation.

- Removal of the blockstone Weirs will allow for the creation of natural flow regimes.

- Channel narrowing will maintain or increase water depth and increase speed of flows.

- Increased flows may result in the regeneration of macrophytes.

- Silt currently smothers bed substrates, plants and invertebrate populations, and the wall-to-wall distribution of sediment needs to be addressed. Slack water areas, and thus sediment deposition, will be reduced via narrowing works, or transported to suitable storage areas.

- The proposed brushwood structures are simple and fairly easy to install. A good proportion of the materials can be sourced on site, thus reducing costs. All of the suggested structures can be modified or used in different river sections depending upon desired results.

- By increasing channel and bed variation and by creating flow diversity, fish are more likely to stay and prosper within the KAPC stretch.

- Often, where significant improvements to a river habitat have been made, natural stocks of fish have migrated into the area in significant numbers. Healthy populations can form quickly, without the need for costly re-stocking.

A day of professional advice is recommended for channel design and the application of the correct structures. This would be appropriate after the weir removal and / or immediately prior to installation works.

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The Darent River

Addendum

Project Drawings

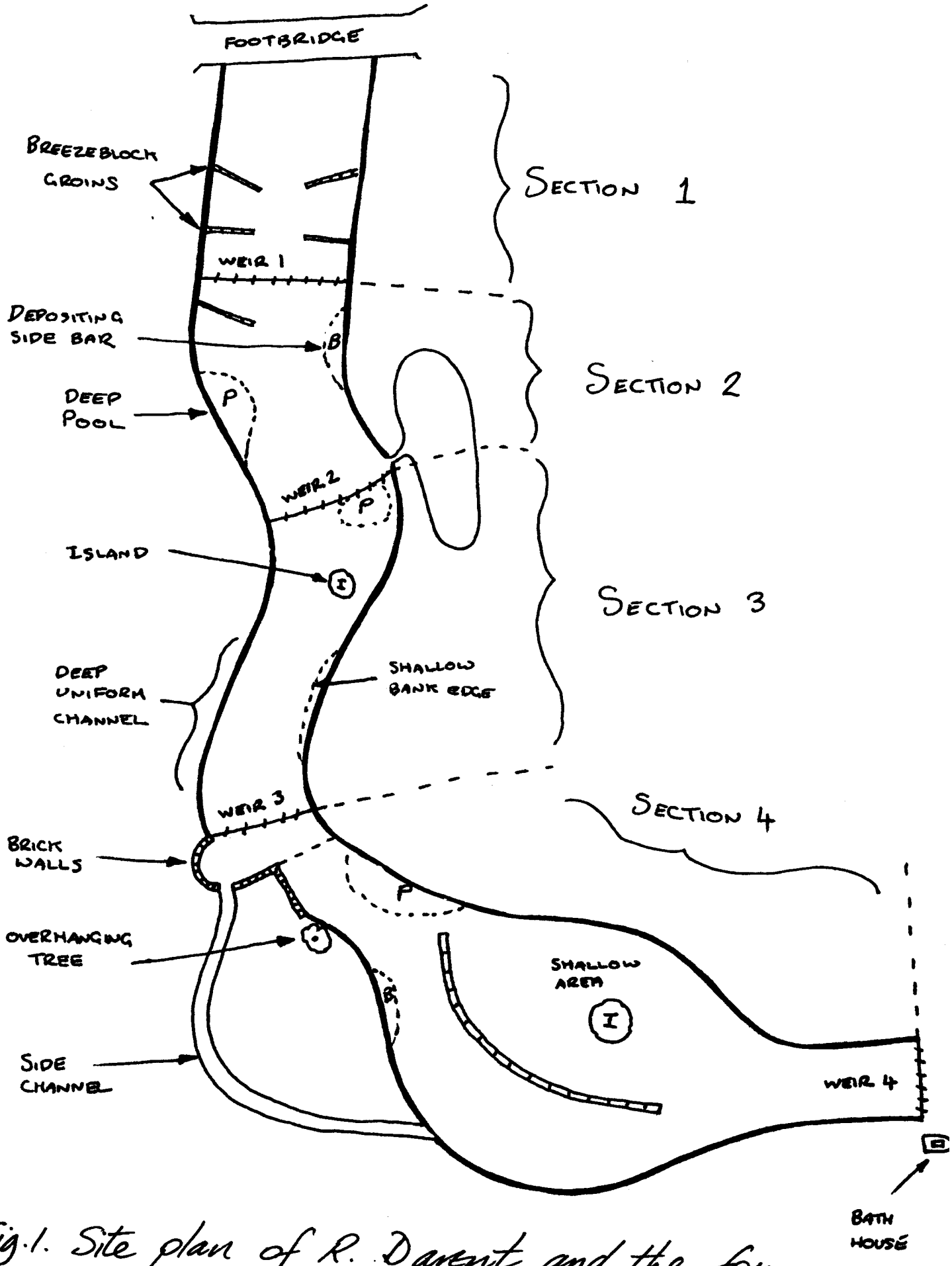
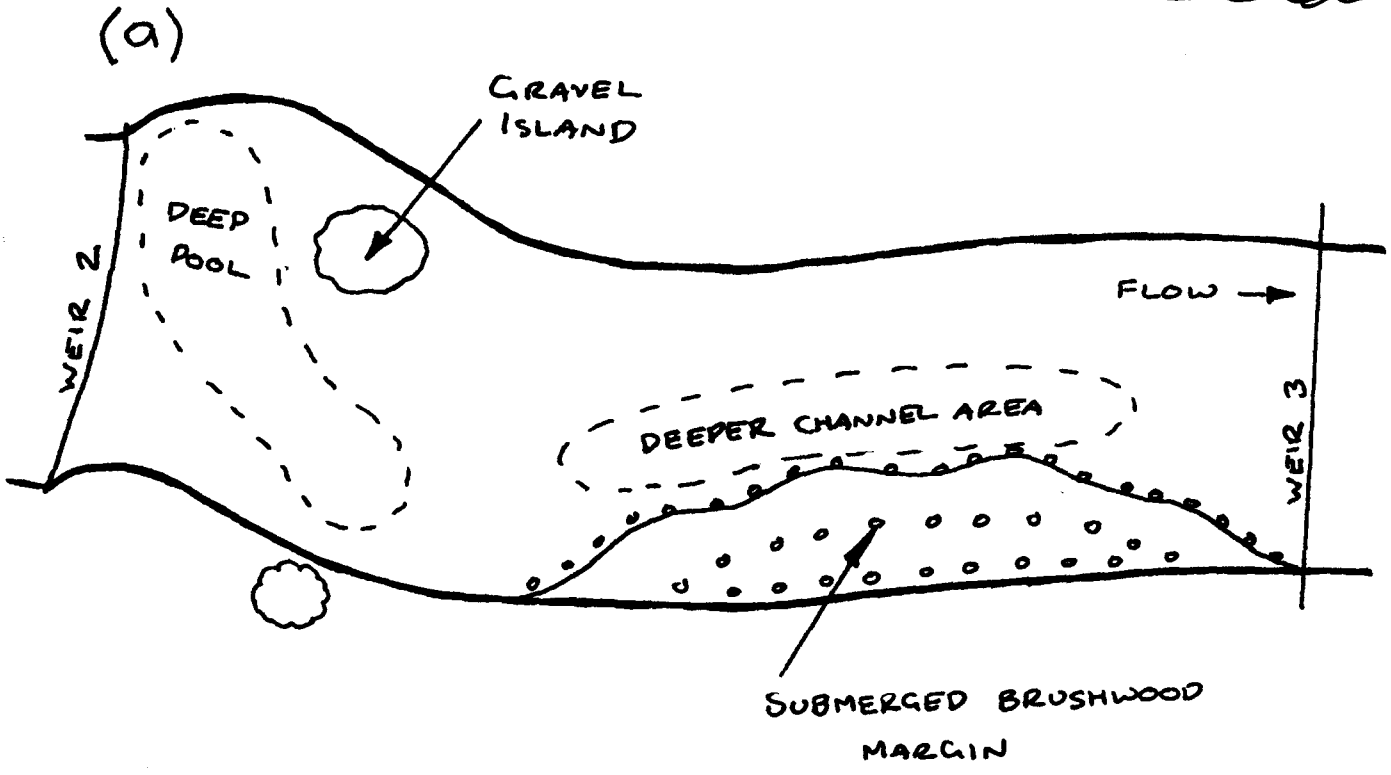


Fig. 1. Site plan of R. Darent and the four beats requiring restoration works.

Fig 2a. Outline of proposed channel width changes



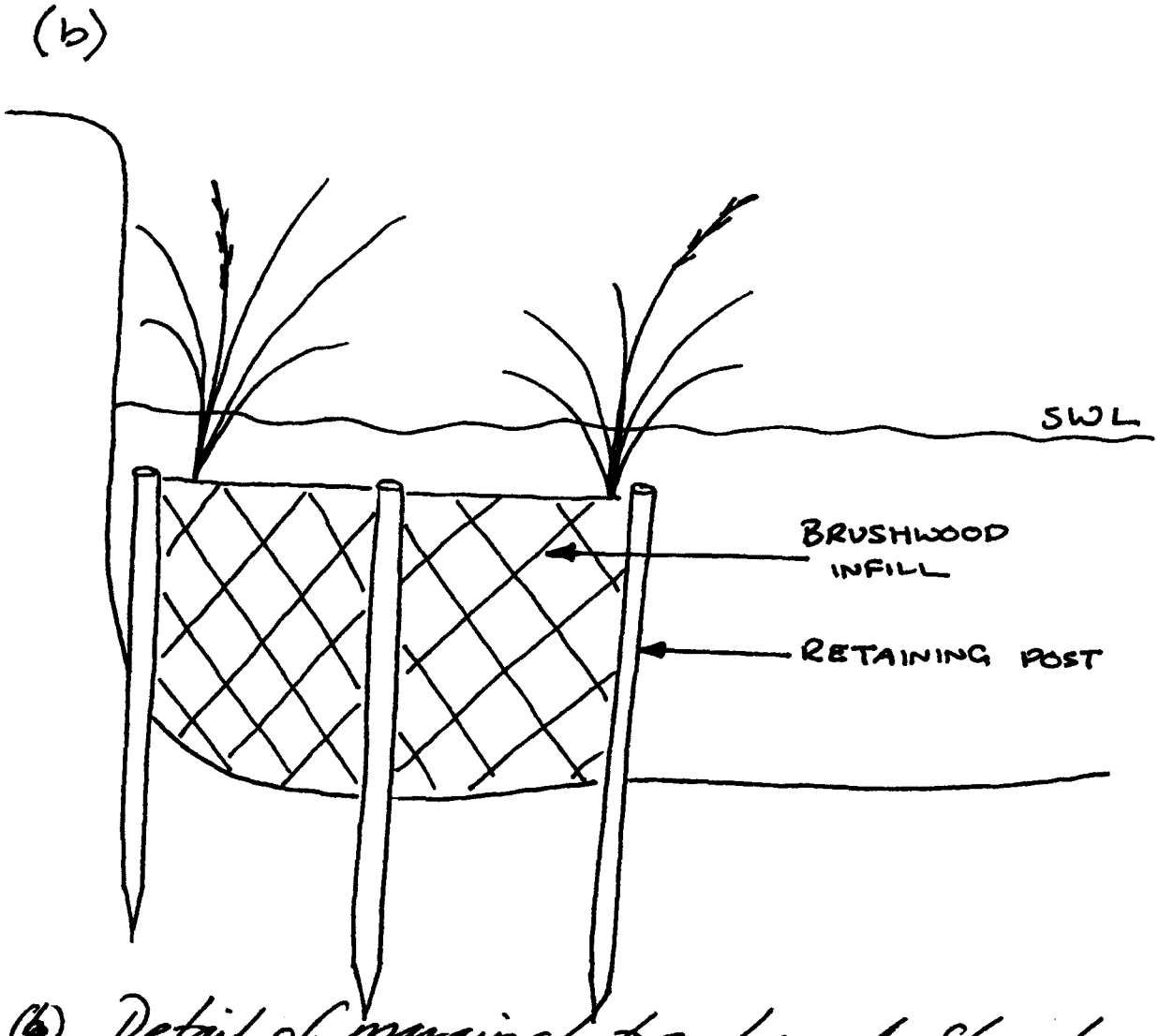


Fig 2. (b) Detail of marginal brushwood structure.

fig 3a. Plan of marginal mattress layout.

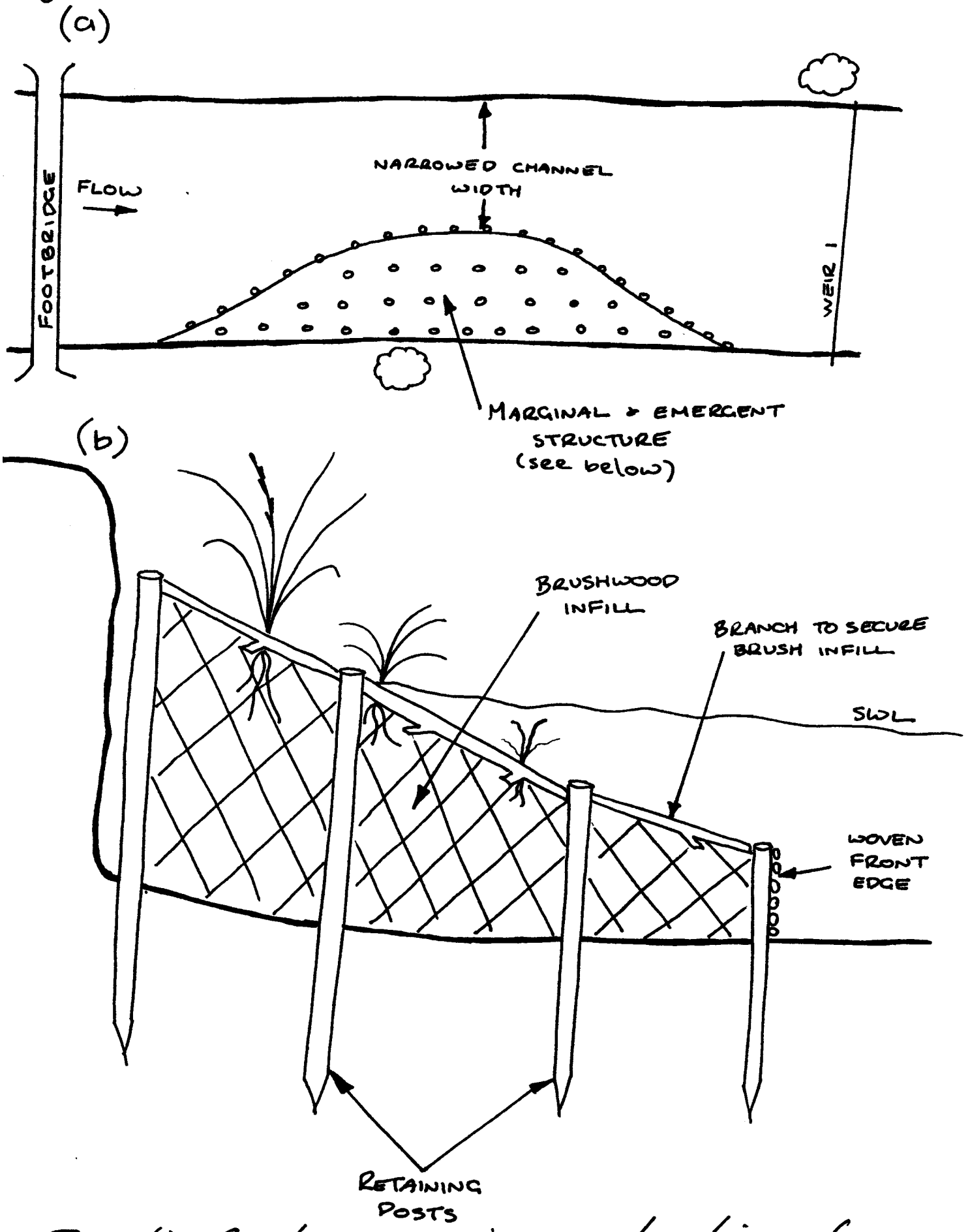
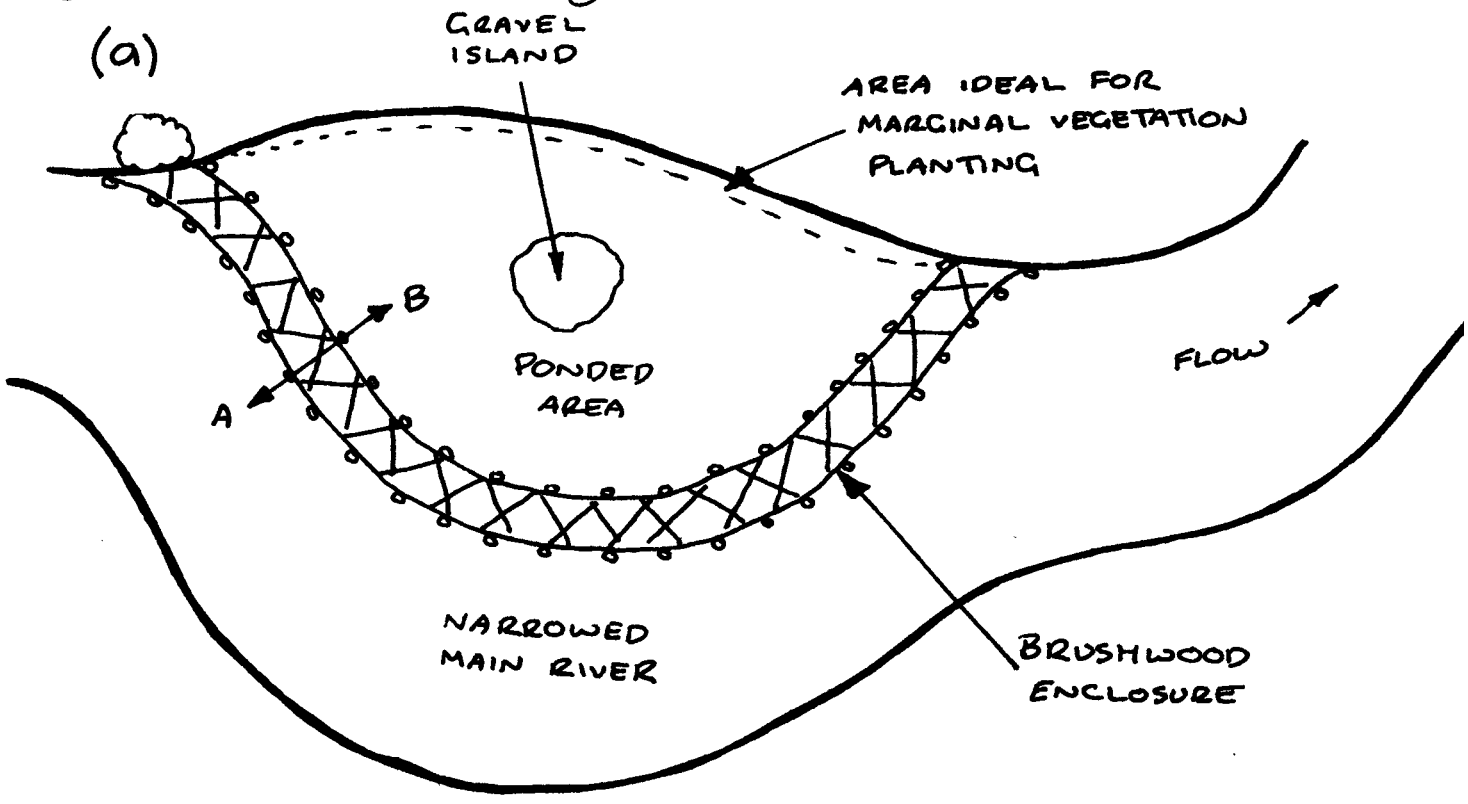


Fig 3.(b) Section showing construction of a marginal mattress.



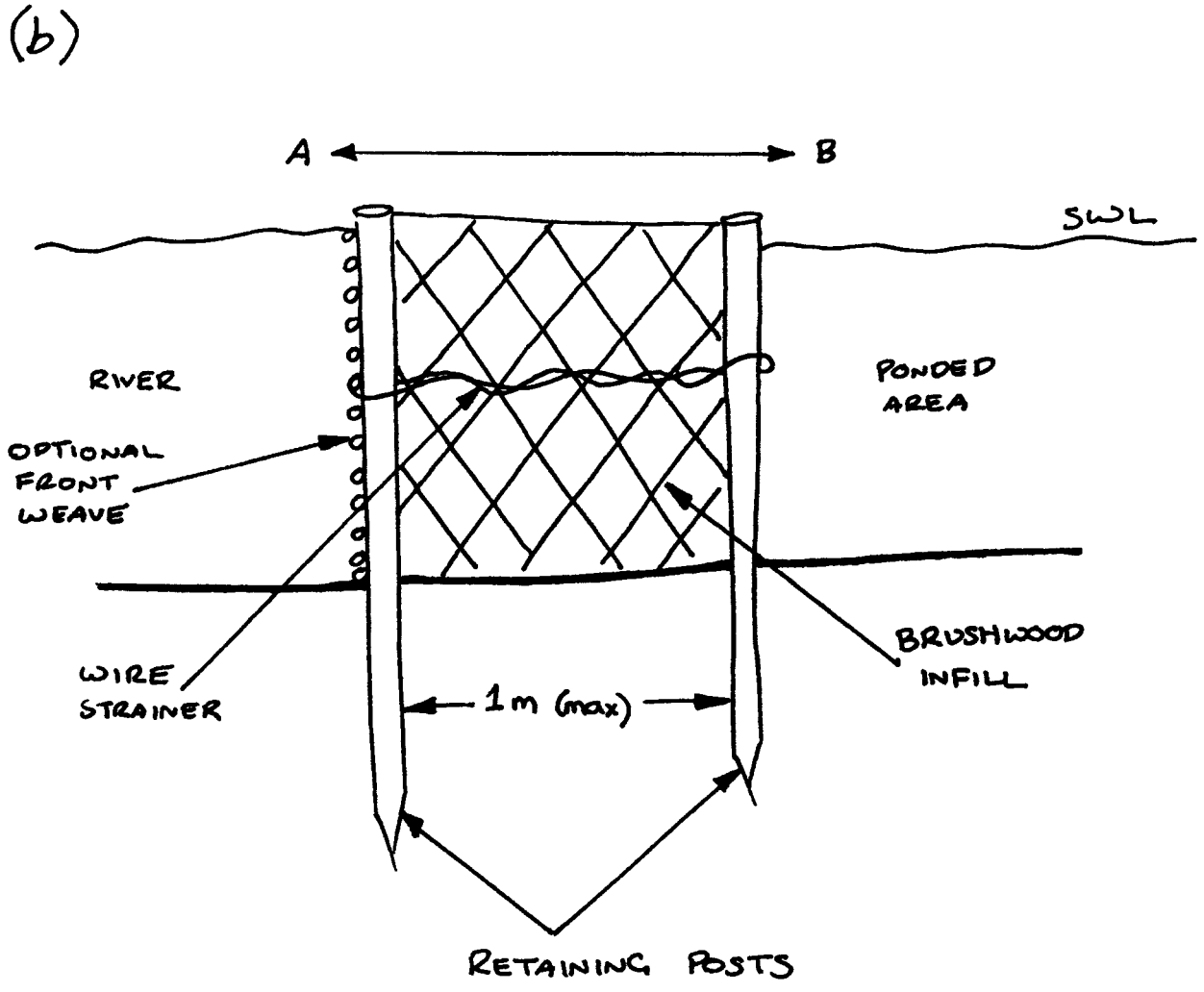
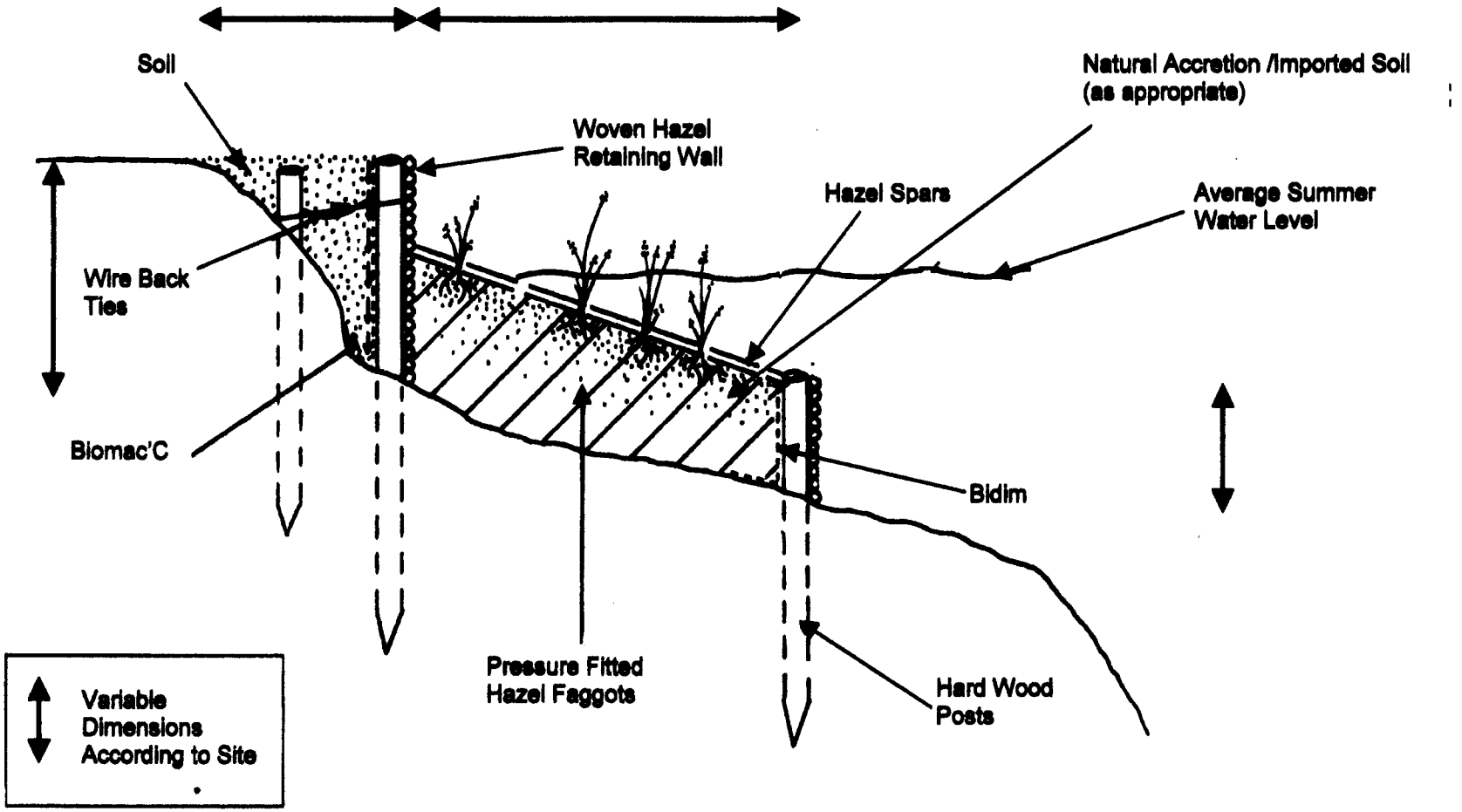


Fig 4b. Section showing construction of pseudo bank/divider.

Fig 2b. Bank Revetment and Sloping Mattress



VARIANT OF Fig 2b. WHERE A BANK NEEDS TO BE RE-CLAIMED FOR ACCESS PURPOSES

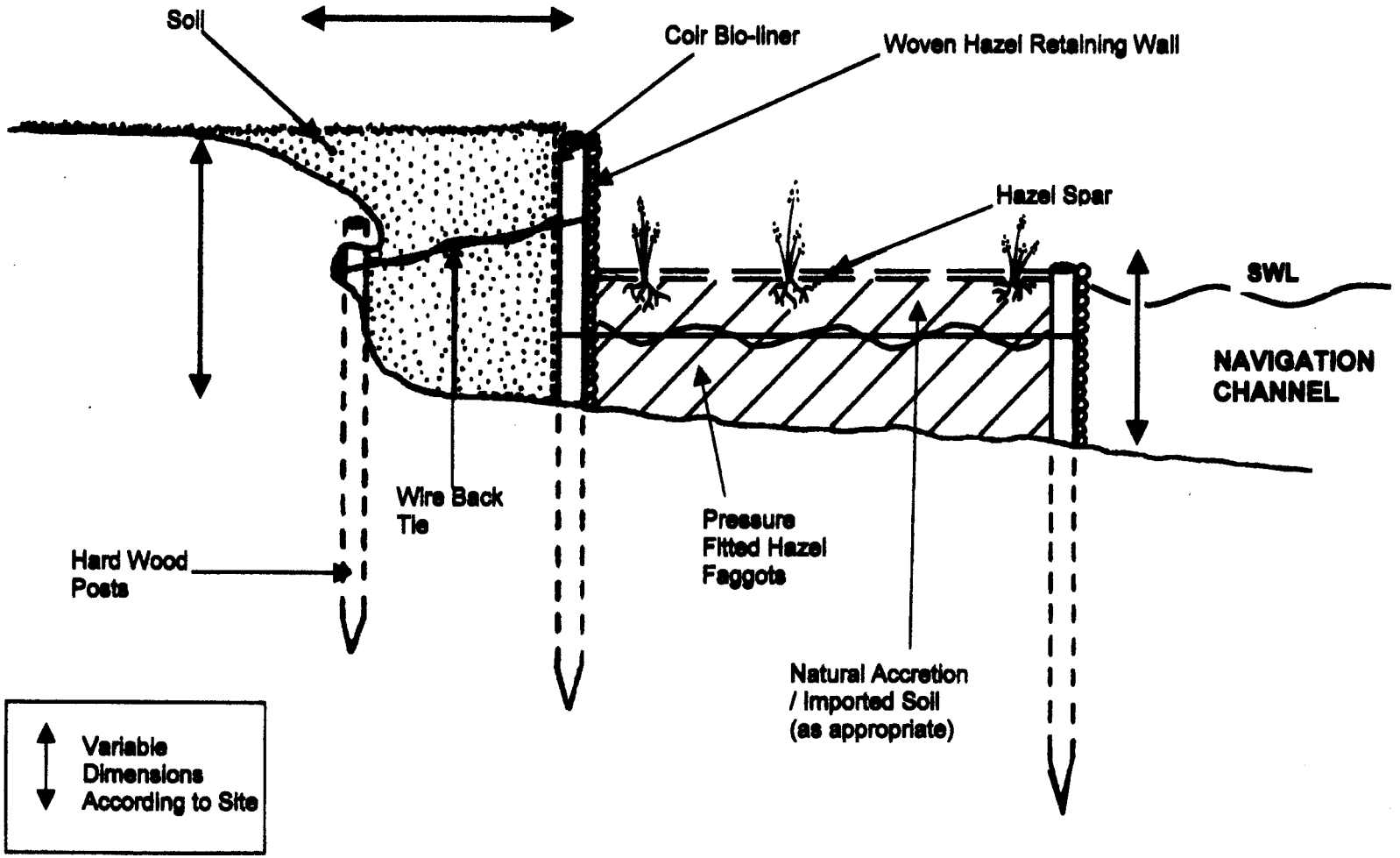


Fig 3a. PLAN OF A BRUSHWOOD MATTRESS

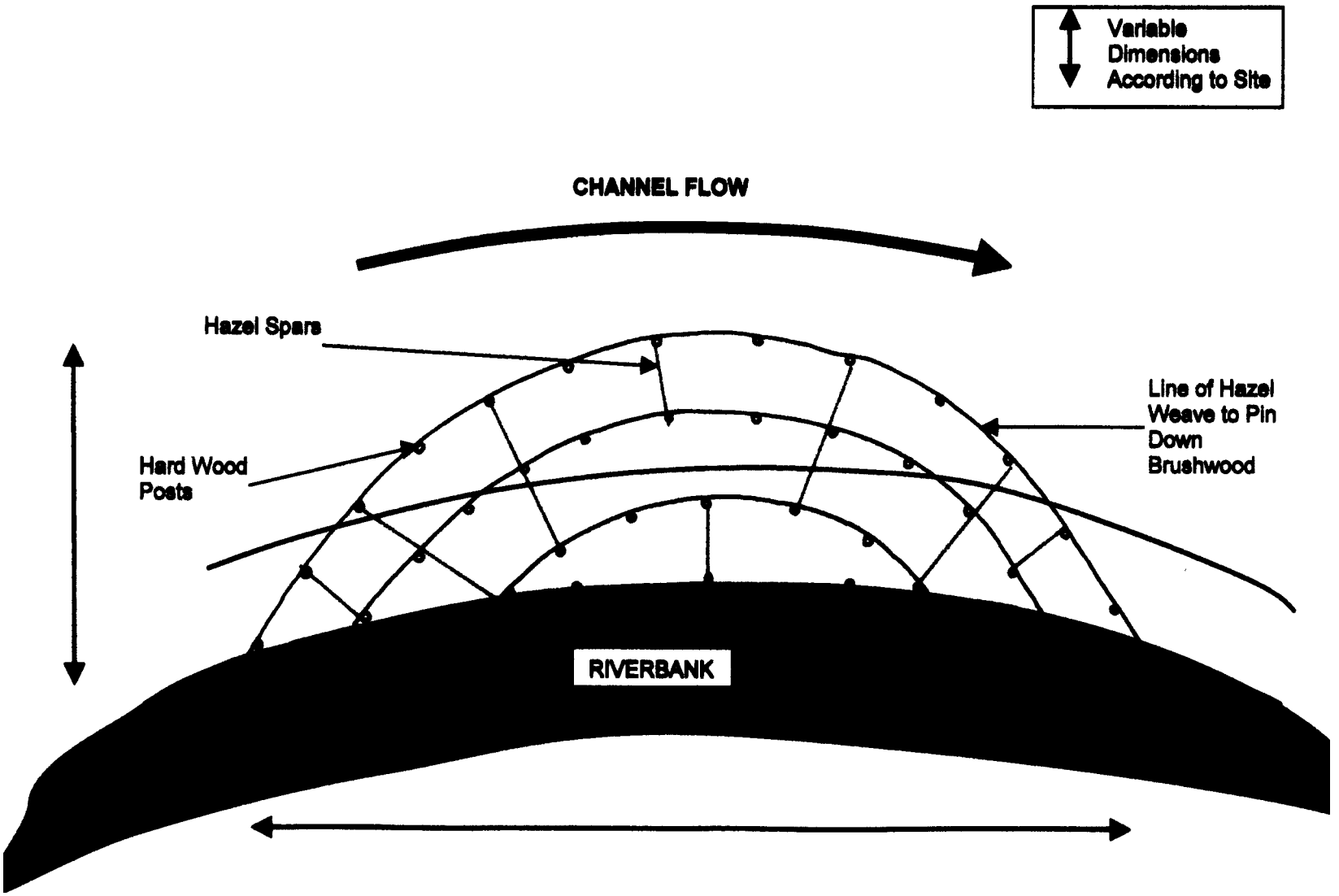
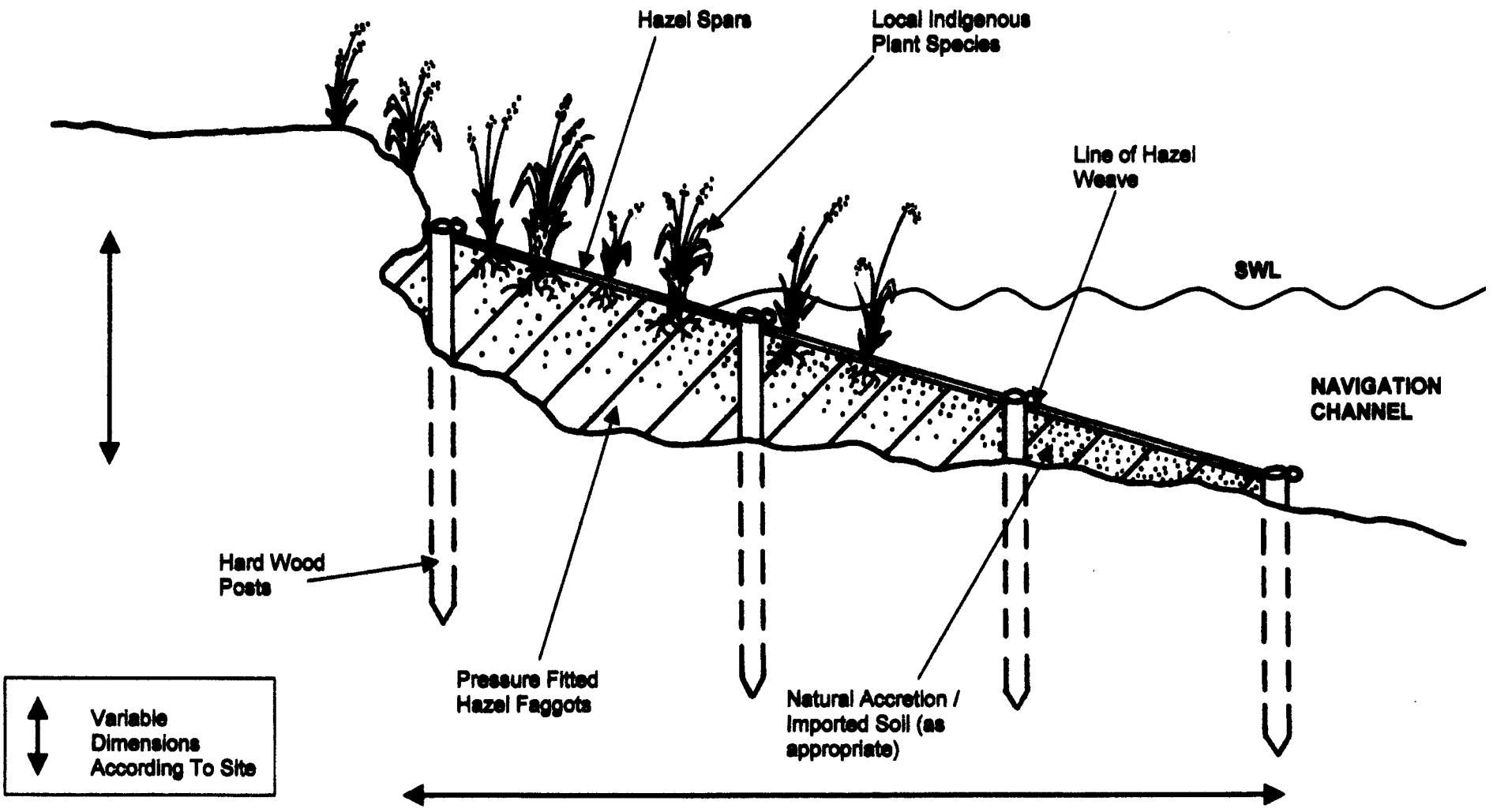


Fig 3b. CONSTRUCTION OF SLOPING MARGINAL MATTRESS



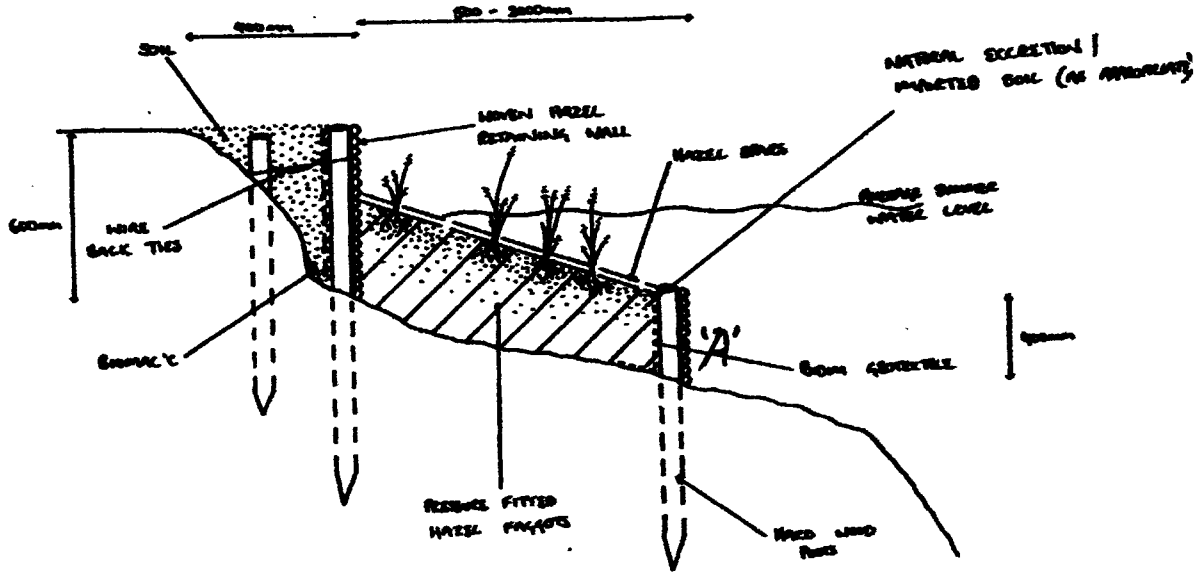


Fig 5. Section of [illegible]

Variants of all the proposed structures can be used when they serve a useful and specific purpose.

In the diagram above, a swim-up-fry area on the submergent section of the mattress can be created. The vertical face also provides holding water against the pseudo bank at 'A' for yearling plus fish.