WHALLEY CREEK
FISH HABITAT ASSESSMENT

1994

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Introduction:

This focused environmental impact assessment of the area located between McGuffie Road and Hammond Bay, Nanaimo, B. C. was prepared by M. C. Wright and Associates at the request of the Regional District of Nanaimo. The main focus of this study was to determine the utilization and condition of Whalley Creek rearing and spawning habitat in the area adjacent to and below the proposed expansion of the existing sewage treatment plant. This study provides the necessary information needed to identify the sensitive areas in Whalley Creek and what measures would be necessary to protect this habitat during construction of the plant. If a negative impact is realized this information will also provide the necessary data to mitigate such an impact. This report assumes that the regional district will be using Plant Layout Option 4.

When the RDN has identified the final layout of the plant, then a plan must be developed detailing how to protect the Fisheries Sensitive Zone (FSZ) during construction. Any negative impacts the plant expansion creates will require further planning so that mitigation strategy can be developed and implemented. Once the RDN has started to develop their work plans for habitat protection, close consultation with representatives of the Department of Fisheries and Oceans and the Ministry of the Environment will be required.

Scope of the Study:

Whalley Creek is located within the municipality of Nanaimo, B. C. and originates at a marsh located 2099.3 meters from the creek mouth in Hammond Bay. It flows east before discharging into Hammond Bay.

Because of the nature and limited scale of the proposed project, this environmental impact assessment was focused primarily on the fisheries resources and habitat within the immediate vicinity of the development and the areas below the proposed development. Although land development has been the cause of considerable hydrological and fisheries impacts for the area above the sewage treatment plant, this area was not included in the study as it will not be impacted by expansion of the treatment plant. The areas below the proposed site are included because any negative impact within the vicinity of the plant can

have an accumulated affect on the areas below.

FISH HABITAT ASSESSMENT:

See Figures 1,2 and 3 for habitat transect locations.

Habitat Assessment Section 1: Hammond Bay to Morningside Drive

This section flows north paralleling Morningside Drive and then east into Hammond Bay (Fig. 1). The mean gradient of section 1 is 3.9% (range: 0.5% - 13.0%). The stream channel lies within a ravine which rises to a maximum height of 6.8 meters above the stream bottom. Average channel width and wetted width for the 38 transects was 3.67 meters (range: 0.96 - 6.54) and 1.70 meters (range: 0.96 -3.4) respectively. The mean depth for the wetted area of section 1 is 0.097 meters (range: 0.005 - 0.55).

The area surveyed is characterized by a series of riffles, glides and pools. Riffles and glides comprised 63.87% and 21.73% of the wetted area respectively. Pools comprised 11.4% of the total wetted area. There are a total of 11 pools in this section, which provide fish habitat of varying quality. Pool quality has been defined as average to low for most of the pools in this area because less than 50% of the pool perimeter had fish cover and very little instream cover. Pool cover (such as LOD, organic debris, overhanging vegetation within 0.3 meters of the water surface, rubble, boulders, undercut banks or water depth) (Platts et al. 1983),is defined as any material or condition that provides protection to fish from predators or competitors. Only two pools (M1+11.3 and M1+110) provide good rearing habitat while the rest are considered to be of average to poor quality (Fig.1). None of the pools are of sufficient size to support resident adult fish. In most cases the pools are too shallow and do not have adequate cover. At best the two pools within this section could hold two pairs of adult fish during spawning.

Pools were classified by the condition that formed or maintained the pool. The majority of the pools were formed by LOD (large organic debris) or bedrock and boulders. Some of the pools were established by residents damming the wetted area so that they could pump water from the creek up to their property. Although these altered areas created some rearing habitat, the pools were of poor quality, lacking in shoreline and instream cover. One pool in particular (M1+56) created a barrier to

juvenile fish which impedes their upstream migration. Degradation of the stream channel has changed the type of habitat available to salmonids. For example, pool volumes have decreased due to sedimention and the lack of debris required to form and maintain deep pools. Coho salmon require deep pools as rearing habitat, reduction in pool volume has led to the reduction or possibly the elimination of this species in Whalley Creek.

Surface substrate composition was variable throughout section 1 (Appendix Table 1). The dominant substrate varied from fines to bedrock. Gravel (small and large) was the dominant substrate at 47% of the transects. Cobble (small and large) dominated the substrate composition at 26.3% of the transects. Boulders were the dominant substrate for one transect only. Fines were the dominant and subdominant substrate at 18.4% and 24% of the transects respectively. Visual observation of surface substrate indicates that there is approximately 90 meters of substrate suitable for spawning. Although some of the section has been identified as suitable for spawning, depth of the wetted area would be a major limiting factor.

Sediment compaction (the relative density or looseness of stream bed material) was low for 53% of the transects. Compaction was moderate to high at 34.2% and 10.5% of the transects respectively.

Crown closure varied from 0 to 100%. The canopy consists of hemlock, maple, alder and cedar. The understorey consists of deer fern, ivy, bracken fern, salal, devils club and salmonberry.

Stream cover was low throughout the reach with only two pools with a cover rating of high (Appendix Table 1). The rest of the stream had moderate to poor cover. The typical cover features; cutbanks, overhanging vegetation, and LOD were limited throughout this section. Cutbanks within this section provide a small amount of summer and winter habitat for juvenile fish but the wetted area was generally too shallow, to provide protection for adult fish. LOD was also low in abundance. Only 6 pieces (range, length: 1.25 to 10.45 meters, diameter: 0.30 to 1.4 meters) were rated and measured as a cover feature (Appendix Table 4). LOD in this section provides cover from predators and high stream flows as well as being the key factor in forming pools. The habitat created by the LOD was of average to poor quality. The limited amount of LOD in this section has probably reduced overwinter survival and affected habitat composition.

Bisson et al. (1987) states that the loss of large debris has led to a shift in stream habitat composition that favours underyearling trout at the expense of the older trout age classes as well as, both underyearling and yearling coho salmon.

The stream banks in the areas listed below have received major and or severe alterations by water flows:

Right Bank	Left Bank
1+35 to 1+56	1+56
1+71.8	1+71.8
	1+81
	1+90
1+110	1+110
	1+115
1+120	1+120
1+134	1+134
	1+145

The remainder of the banks have shown light to moderate alterations. The only area to show no sign of erosion was at M1+11.3. The dominant bank material was soil (>60%) for both banks, other materials that dominated bank composition were fines, root mass, LOD, bedrock and boulder (Appendix Table 1). In two locations, M1+145 and M1+190, property owners stabilized the banks with landscaping rock.

Vegetative stability for stream banks at the transect markers were rated as poor (RB=64.71% and LB= 55.88%), the remaining banks evaluated at the markers were rated as having fair (RB=11.76%, LB=14.71%), good (RB=17.65%, LB=23.53%) and excellent (RB=5.8%, LB=5.8%) vegetative stability.

Mean right and left bank height for section 1 is 0.89 (range: 0.15 to 2.23) and 0.96 (range: 0.24 to 1.9) meters respectively (Table 1).

Habitat Assessment Section 2: Morningside Drive to Shore Road

This section flows east within a ravine between Shore Road and Morningside Drive (Fig. 2). The maximum elevation of the ravine walls is 5.24 meters above the streambed. The average height of the left and right wall of the ravine is 3.3 meters and 3.86 meters respectively. The measured mean gradient

for this section is 3.58% (range: 0.5% to 8.5%). The mean channel and wetted widths are 4.36 meters (range: 2.63 - 8.71) and 1.736 meters (range: 0.9 - 2.46) respectively. The average depth of the wetted area for the 24 transects was 0.076 meters (range: 0.001 - 0.281) (Table 1.).

Stream habitat was evaluated at 24 transects, spaced at 3 to 15 meter intervals. This area of Whalley Creek is comprised of a series of riffles, glides and pools. Riffles are the dominant habitat unit in this section. The three habitat units; riffles, glides and pools comprised 55.8%, 28.14%, and 16.06% of the wetted area respectively.

There are 10 pools in section 2 that provide rearing habitat for juvenile cutthroat trout. As in section 1 the pools were rated for habitat quality. The pools were rated as poor (55.6%), average (33.3%) and good (11.1%). The mean pool length for this section is 3.23 meters (Table 1). Only one pool in this section was rated as having good (M2+176) cover for fish. This pool had both good cover around the perimeter and good instream cover (LOD). Unfortunately the pool has been degraded by settling out of sediment which has caused infilling of the pool thus reducing the quality of the rearing habitat. The maximum depth of this pool was 0.16 meters.

The remainder of the pools all provide some cover, but are not of a size or quality to support a large number of juveniles nor could they support resident adult fish, except during the bankfull stage. During the summer months there is no habitat that could support adult size fish. The pools are too shallow during periods of drought and therefore would not provide refuge for adult cutthroat trout. Substrate quality in all of the pools is dominated by fines, affecting incubation success of eggs deposited in these areas.

Surface substrate composition was variable throughout section 2 (Appendix Table 2). The dominant substrate varied from fines to large cobble. Gravel (small and large) and fines were the dominant substrate at 41.7% of the transects respectively. Cobble (small and large) dominated the substrate composition at 16.6% of the transects. Gravel(small and large) were the subdominant substrate at 87.5% of the transects. Visual observation of surface substrate indicates that approximately 93.5 (44.4%) meters of substrate is suitable for spawning. Although substrate composition indicates that there are areas

that have suitable substrate for spawning, low water levels are a major limiting factor. Fall base flows in Whalley Creek are too low to allow easy migration and spawning of adult fish, especially coho. Areas in section 2 where the dominant substrate is fine material will have poor incubation success. High levels of sediment smother eggs and kill salmonid alevins.

Sediment compaction (the relative density or looseness of stream bed material) was low for 62.5% of the transects. Compaction was moderate at 37.5% of the transects. No areas of high compaction were observed in section 2.

Crown closure varied from 50% to 100%. The canopy consists of hemlock, fir, maple, alder and cedar. The understorey consists of deer fern, ivy, salal, devils club, various species of grass, blackberry, buttercup, horsetail, skunk cabbage and bleeding heart.

Stream cover was low throughout the reach with only one pool with a cover rating of good (Appendix Table 2). The rest of the stream had moderate to poor stream cover. The typical cover features; cutbanks, overhanging vegetation, and LOD were limited throughout this section. Cutbanks provide limited summer and winter habitat for juvenile fish while the wetted area, was generally too shallow to provide protection for adult fish. Cutbanks were small in size also limiting their value as cover except when the stream is at the bank full stage. LOD was also limited in abundance. Only 6 pieces (range, length:2.7 to 13.06 meters, diameter: 0.17 to 0.8 meters) were rated and measured as a cover feature (Appendix Table 2). LOD in this section provides cover from predators and high stream flows as well as being a key factor in forming pools. The habitat created by the LOD was of average to poor quality. The limited amount of LOD in this section has probably reduced overwinter survival and affected the habitat composition. One large debris pile located between M2+143.5 and M2+155.1 created some rearing habitat but was of average quality. This debris pile was comprised of large and small LOD (Appendix Table 4). This area does not impede passage of fish, but could become a barrier if small debris in the form of branches and LOD continue to accumulate in large quantities. Other debris piles (M2+19 to M2+20.5, M2+176.8 to M2+179.4 and M2+194.12 to M2+195.83) in the section were generally unstable and small and therefore, would more than likely shift during high flows.

Mean right and left bank height for section 2 is 0.86 meters (range: 0.08 to 2.2) and 0.79 meters (range: 0.26 to 1.49) meters respectively (Table 1).

The stream banks in the areas listed below have received major and or severe alterations by water flows:

Right Bank	Left Bank
2+107 to 2+144	2+96 to 2+113

The remainder of the banks have shown light to moderate alterations. The dominant bank material was soil (>90%) for both banks, other materials that dominated bank composition were fines, root wad and LOD (Appendix Table 2).

Vegetative stability for stream banks at the transect markers were rated as poor (RB=72.2% and LB= 76.5%), the remaining banks evaluated at the markers were rated as having fair (RB=22.2%, LB=5.9%) and good (RB=5.6%, LB=17.6%)vegetative stability. At 75% of the transects, less than 50% of the stream banks were covered in vegetation, making section 2 highly susceptible to stream bank erosion.

Habitat Assessment Section 3: Shore Road to the Sewage Treatment Plant

This section flows east between the Sewage Treatment Plant and Shore Road (Fig. 3). Stream habitat was evaluated at 45 transects, spaced primarily (87%) at 5.0 meter intervals (range: 2.5 to 13.4 meters). This area of Whalley Creek is comprised of a series of riffles, glides and pools. Glides are the dominant habitat unit in this section. The three habitat units; glides, riffles and pools comprised 58.02%, 39.25%, and 2.73% of the wetted area respectively.

The left bank of section 3 is frequently confined by terraces while the right bank is occasionally confined by terraces, with the majority of the right bank being bordered by flood plain. This flood plain is adjacent to Hammond Bay Road and is the proposed site of construction for the expansion of the sewage treatment plant. The average height of the left and

right terraces is 1.76 meters and 1.12 meters respectively. The measured mean gradient for this section is 1.5% (range: 1.0% to 2.0%). The mean channel and wetted widths are 3.61 meters (range: 2.75 - 5.70) and 1.465 meters (range: 0.67 - 3.11). The average depth of the wetted area for the 45 transects was 0.071 meters (range: 0.002 - 0.85) (Table 1).

There are 2 pools (M3+59.63 and M3+141.43) in section 3 that provide rearing habitat for juvenile cutthroat trout (Appendix Table 3). As in sections 1 and 2 the pools were rated for habitat quality. All pools were rated as poor and have been seriously degraded, lacking both instream cover and cover around the perimeter. There are remnants of cutbanks that have been altered by stream flow on both sides of the pool. The right bank has eroded severely and undercut too quickly, which has caused bank material to slough off into the stream bottom. Fine sediment blankets the bottom of the pools to depths >15.0 cm. Pool lengths for this section are 1.97 (M3+59.63) and 4.3 (M3+4.3) meters. The maximum depth of the two pools located at M3+59.63 and M3+141.43 are 0.31 and 0.13 meters respectively (Appendix Table 3).

The only area in Section 3 that would provide cover for adult size fish is the inside of the culvert below the weir at the Sewage Treatment Plant. The rest of the section has been too badly degraded to support any appreciable number of either adult or juvenile fish. During the summer months pools are shallow and there is no habitat that could support adult size fish. Substrate quality in all of the pools is dominated by fines, thus affecting incubation success of eggs deposited in these areas.

Surface substrate composition was variable throughout Section 3 (Appendix Table 3). The dominant substrate varied from organic debris to large cobble. Fine sediment was the dominant substrate at 45.2% of the transects. Gravel(small and large) dominated the substrate composition at 33.3% of the transects. Gravel (small and large) were the subdominant substrate at 57.1% of the transects. Visual observation of surface substrate indicates that approximately 92.0 (39.2%) meters of substrate is suitable for spawning. The majority of area determined as having suitable substrate for spawning was located between M3+0 and M3+97 however, this area would probably experience poor egg to fry survival because of the high levels of fine sediment on the stream bottom upstream of the site. The larger fine sediment transported downstream during high flows can trap alevins in

redds, while the small fine particles decrease the permeability through the spawning gravel thereby decreasing oxygen reaching the eggs, and leading to high mortality.

Substrate quality deteriorated above M3+97 and by M3+143 the substrate was largely covered in fine sediment, in some areas >15.0 cm. deep. Although substrate composition indicates that there are areas that are suitable for spawning, high levels of fine sediment and low water depths would be a major limiting factor. Fall base flows in Whalley Creek are too low to allow easy migration and spawning of adult fish, especially coho. Areas in section 3 where the dominant substrate is fine material, will have poor incubation success.

Sediment compaction (the relative density or looseness of stream bed material) was low for 76.2% of the transects. Compaction was moderate at 21.4% of the transects. There was one area of high compaction in section 3.

Crown closure varied from 50% to 100%. The canopy consists of hemlock, fir, alder and cedar. The understorey consists of deer fern, devils club, various species of grass and blackberry.

Stream cover was poor throughout the reach (Appendix Table 3). In section 3 >70% of the area provided no cover for fish. The areas that did provide cover were of poor quality and would support juvenile fish only. The typical cover features; cutbanks, overhanging vegetation, and LOD were limited throughout this section. Cutbanks within this section provide very little summer and/or winter habitat for juvenile fish, while the wetted area, was generally too shallow to provide protection for adults. Cutbanks were generally small in size, limiting their value as cover. Abundance of LOD was low with only 7 pieces (range, length:1.4 to 5.48 meters, diameter: 0.11 to 0.63 meters) being rated and measured as a cover feature (Appendix Table 4). LOD in this section provides some cover for juvenile fish from predators and high stream flows. The habitat created by the LOD was of poor quality. The limited amount of LOD in this section has most likely reduced overwinter survival and affected habitat composition. One large debris pile located between M3+97 and M3+103.28 created some rearing habitat but was of poor quality. This debris pile was comprised of large and small LOD (Appendix Table 4). Although this area does not impede passage of fish, it could if small debris in the form of branches and LOD continue to accumulate in large enough quantities.

Mean right and left bank height for section 3 is 0.93 meters (range: 0.27 to 1.685) and 0.1.19 meters (range: 0.25 to 2.54) meters respectively (Appendix Table 3).

The stream banks in the areas listed below have received major and or severe alterations by water flows:

Right Bank	Left Bank
3+50	3+55 to 3+59.5
3+62 to 3+82	3+77 to 3+82
3+97 to 3+103	3+92 to 3+103
3+128 to 3+143	3+123
3+153	3+133
	3+143
	3+153

The remainder of the banks have shown light to moderate alterations. The dominant bank material was soil (>70%) for both banks, other materials that dominated bank composition were clay, mud and sand (Appendix Table 3).

Vegetative stability for stream banks at the transect markers were rated as poor (RB=83.3% and LB= 79.2%), the remaining banks evaluated at the markers were rated as having fair (RB=16.7%, LB=20.8%) vegetative stability. At >80.0% of the transects, less than 25% of the stream banks were covered in vegetation, making section 3 highly susceptible to stream bank erosion.

Fish Distribution:

There is very little information on abundance or distribution of salmonids utilizing Whalley Creek. Some habitat assessment was performed by Dave Clough and Associates in 1993. In June of 1994, a small scale assessment of Whalley Creek was performed as part of the "Nanaimo Urban Stream Enhancement Study". The presence of cutthroat trout was confirmed below the sewage treatment plant during both studies, while no fish were found above the plant. The information supplied by these studies was limited and did not provide a complete picture of habitat utilization by salmonids.

Whalley Creek was electrofished on October 21,1994 to determine the distribution of fish in sections 1 to 3. Section 1

was electrofished using a one step removal technique. Sections 2 and 3 were electrofished using a three step removal technique. In sections 1 and 2, 123 (53.7%) and 112 (55.7%) meters of the wetted area were electrofished respectively. The entire wetted area of section 3 was electrofished. Ten subsections were sampled in section 1, ranging in size from 3 to 21 meters (Table 2). Six subsections were sampled in section 2, ranging in size from 11 to 28 meters (Table 2).

Three species of fish were found in Whalley Creek; Cutthroat Trout (*Onchorhynchus clarki*), Pumpkinseed (*Lepomis gibbosus*) and Stickleback (*Gasterosteus aculeatus*). A total of 266 fish were electrofished from sections 1 through 3, of which juvenile cutthroat trout were the most dominant species (Table 2). Cutthroat Trout comprised 97.7% of the total fish, while pumpkinseed and stickleback comprised 1.5% and 0.75% of the total respectively. The majority (51.5%) of the cutthroat trout were found in section 2. The remaining trout were removed from sections 1 (40%) and 3 (8.5%).

Cutthroat trout were distributed throughout sections 1 and 2, while in section 3 cutthroat were found in only 3 areas. The number and location of fish electrofished from each of the sections is summarized in Table 2. Cutthroat were found primarily in pools and drawn from under cutbanks in sections 1 and 2. The majority of the fish (56%) in section 3 were found in the culvert below the weir at the sewage treatment plant. This is the only area that provides any appreciable amount of cover. The low number of fish found in Section 3 clearly shows that the rearing habitat is too badly degraded to support anything more than a minor portion of the Whalley Creek cutthroat trout population.

In 1993, Dave Clough and Associates found coho fry up to Morningside Drive. No coho were found during the 1994 study.

Discussion:

Whalley Creek is a good example of how not to develop around a fish bearing stream. This watershed has seen degradation in all areas of the Fisheries Sensitive Zone (FSZ). The wetted area of the stream has been severely impacted by development through sedimentation to the point that the stream can only be used for rearing of small fish. With the exception of a few isolated areas, it is unlikely that adults of any size could spawn in the

creek. After detailed examination, it became apparent that this creek essentially supports anadromous fish and could not support a resident trout population in its present state. Information supplied by DFO and Dave Clough indicates that Whalley Creek probably supported a coho population which is near to, or in fact, extinct at this time. There were no coho found when the creek was electrofished on October 21.

In general the quality of habitat in the Creek is low. Undercut banks were small and would not provide cover for adult fish. Pools are small, shallow, provide minimal cover for juveniles and no cover for adults, and support low fish abundance. Deep pools are important to Cutthroat Trout and Coho in small streams, as they provide cover even during periods of prolonged drought.

Access to Rearing and Spawning Habitat:

At this time 68.6% of the rearing and spawning habitat is inaccessible, thus limiting utilization to the lower 660.25 meters of Whalley Creek. Migration of adult and juvenile fish is impeded by the weir at the Sewage Treatment Plant. Although badly degraded the habitat above the plant cannot be accessed. Even though this area needs considerable restoration it is important for future fish production that it be made accessible. Even if the area is not restored in the near future a fishway should be installed to allow fish passage to areas that can be utilized (ie.: the pond at the treatment plant).

Small waterfalls established by residents along section 1 create barriers to juvenile fish. These obstacles cause undue stress and hazards to fish which ultimately affects the productivity of present and future populations.

Juvenile migration is also affected by poor placement and design of the culverts at Morningside Drive and Shore Road. These culverts do not meet fisheries standards as they are situated too high above the stream bed and therefore, do not provide ready access into the culvert from outlet pools situated below. Access into the culverts would be possible during high water, but a lack of baffles inside and the steep gradient would create a velocity barrier restricting upstream migration. Water levels during low flows are not adequate to allow migration, even if fish had ready access to the culverts.

The storm drain at Morningside Drive diverts stream water through Morningside Park. This will have a negative impact on juvenile cutthroat trout that get swept out of the creek and into Hammond Bay, or dropped onto the beach at low tide. Any pre-smolt cutthroat trout transported through the storm drain into Hammond Bay are not physiologically able to tolerate salt water and would die.

Insufficient water depth caused by sedimentation also restricts movement of fish to spawning and rearing habitat.

Summary:

1. In its present state, Whalley Creek (specifically Section 3) cannot withstand any further negative impacts as a result of development. Further degradation of this tributary will eventually push the remaining population of trout to extinction. Essentially Whalley Creek will be nothing more than a drainage ditch.

2. At this time Whalley Creek supports juvenile cutthroat trout, pumpkinseeds and stickleback. The cutthroat population is probably anadromous since no adult forms of the species were found while electrofishing.

3.Fish production is limited by;

a. Loss of spawning and rearing habitat due to erosion and sedimentation.

b. Access to spawning and rearing habitat is impeded by poor placement and design of culverts and low base flows, all of which make migration difficult.

c.. The weir at the sewage treatment plant has limited fish access to the lower 660.25 meters of the creek, thus limiting fish production. The RDN should install a fishway at the weir so fish can access the area above the Sewage Treatment Plant.

4. Whalley Creek will require extensive restoration before fish production can be increased. Cost associated with restoration of a tributary varies from about $12,000.00 to $100,000.00 per km.(Koski 1992). Newbury and Gaboury (1993) give a variety of examples of equipment and labour costs associated with habitat restoration and moving sections of a creek.

5. Diversion of stormwater into Whalley Creek has caused major impacts on the FSZ. For example, pools have filled in and vegetative cover has been destroyed.

6. Flows below the treatment plant are no longer strong enough to prevent settling out of sediment. If the weir at the treatment plant was not in place sedimentation in section 3 would not be as extensive.

7. Whalley Creek no longer supports coho spawning and rearing. Coho production is limited by lack of deep pools, insufficient water depths in the riffles and glides, a lack of good spawning substrate and poor access.

8. The riparian zone in section 3 has been degraded and will require restoration.

9. Off channel habitat has been lost. We observed no habitat that would provide overwinter rearing opportunities.

10. Sedimentation has caused infilling of habitat created by course substrate (large cobble and boulders) in riffles, glides and pools.

Potential Impacts and Recommendations:

1. Plant expansion will reduce water permeating through soil and will increase the amount of run off. Parking access and buildings will increase the amount of water that could be transported into the stream. Therefore the RDN will have to look at diverting storm water into a detention area before releasing it into the creek. The engineering department should calculate detention requirements and design a detention facility. Pipers Pub is an example of water no longer being able to permeate through the soil because of the paved parking lot. Run off from the parking lot drains directly into Whalley Creek increasing flows. If any stream restoration is to be implemented then effects of storm water should be considered. The storm water ditch (drainage channels) located by the culvert at the sewage treatment plant should have a series of small detention ponds installed . This may also create some off channel habitat.

2. Continued deterioration of rearing and spawning habitat.

3. Culverts need to be brought up to fisheries standards.

Evaluation of "Plant Layout Secondary Treatment Option 4"

On the basis of this environmental impact assessment, the principle impacts from expansion of the sewage treatment plant will be dependent on which plan the RDN decides to use. Based on the layout of Plan 4, the following will need to addressed;

1. The majority of section 3 will have to be shifted north of its present location. Before the RDN can proceed with this option they will have to develop a plan detailing how this can be achieved. Moving sections of a creek is both time consuming, costly and has been met with varying degrees of success. In discussion with Rick Eliason (DFO), moving a section of any creek is usually looked on as a last resort. In some instances DFO may require that the new channel be left for up to a year to stabilize (banks and riparian zone) before allowing the creek water to be diverted through the new channel.

2. Cost of moving a section of a stream can vary between $50,000.00 and 100,000.00. Newbury and Goboury (1993) present an example of equipment and labour cost associated with moving a section of a stream.

3. The proposed design (prepared by a landscape architect) of the new channel will require considerable planning to ensure that a stable and productive area is created. At this stage the RDN will have to get the design approved by the Department of Fisheries and Oceans and the Ministry of the Environment.

4. If the creek is moved, the area above the treatment plant will have to be restored beforehand.

5. Considerable monitoring of the new channel will be required to ensure that channel integrity is maintained.

6. If the RDN receives approval to move section 3, they should try to persuade the City of Nanaimo, DFO and MOE to restore the habitat above and below section 3. If the area above the sewage treatment plant is not restored, then the degraded upstream habitat will affect the newly created habitat to an extent that the new channel will be degraded and money will have been wasted.

Understanding that the area for expansion of the sewage treatment plant is limited I feel that the RDN should consider some of its alternate development plans. If the RDN decides to develop around section 3 of Whalley Creek, the following should be considered;

a. A "leave strip" of at least 15 meters from the high water mark must be defined. Government agencies may require a "leave strip" of 30 meters, this may be negotiable (Rick Eliason, pers. comm., 1994). The leave strip will have to be defined by legal survey and clearly marked on the Plant Layout Option.

b. Once the "leave-strip" is defined, both DFO and MOE must be consulted to determine if it is adequate to protect the riparian zone.

Once the final plan has been selected and approved the following should be considered;

a. The "leave strips" will have to be clearly defined at the construction site. For example a snow type fence will have to be installed along the "leave strip" boundary (Chilibeck 1993).

b. If encroachment into the FSZ is anticipated during construction, plans will have to be developed and approved by DFO and MOE.

c. If access to the other side of the creek is necessary then this should be established in the least sensitive areas of section 3. Again the plans will have to be developed and approved by both government agencies.

d. After all work is completed, areas of the FSZ that are impacted by construction will have to be re-vegetated.

e. Plans must be developed to control runoff and transport of sediment into Whalley Creek from the construction site. This is discussed in some detail in Chilibeck (1993).

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TABLES

Table 1. A Summary of Physical Features, by Section, for Whalley Creek, 1994.

Physical Feature	Section 1			Section 2			Section 3		
	Mean	Maximum	Minimum	Mean	Maximum	Minimum	Mean	Maximum	Minimum
Wetted Width	1.703	3.40	0.96	1.736	2.46	0.90	1.465	3.11	0.67
Channel Width	3.668	6.54	0.96	4.364	8.71	2.63	3.61	5.70	2.75
Wetted Depth	0.097	0.55	0.005	0.076	0.281	0.001	0.071	0.85	0.002
Pool Length	2.332	4.40	0.70	3.23	6.00	1.00	3.13	4.30	1.97
Riffle Length	8.45	46.9	1.4	12.47	43.4	2.90	6.003	20.47	1.62
Glide Length	3.76	8.80	1.00	7.075	20.00	1.80	9.513	71.50	1.90
Bank Height (Right)	0.89	2.23	0.15	0.86	2.20	0.08	0.93	1.685	0.27
Bank Height (Left)	0.96	1.90	0.24	0.79	1.49	0.26	1.19	2.54	0.25

Table 2. Results of Electrofishing by Section and Species, Whalley Creek, 1994.

Water Temperature:	9.0	Water Clarity	6 inch
Air Temperature:	7.0	Wind Speed	0–5mpa.
Water Cond.:	Muddy	Sky:	Clear
Water Level:	Normal	Countability	Poor

Area Inspected		First Pass			Second Pass			Third Pass			
Marker		Coho	Cutthroat		Coho	Cutthroat		Coho	Cutthroat		Comment
Start	Finish	Fry	Fry	Other	Fry	Fry	Other	Fry	Fry	Other	#
3+0	3+25	0	0	0	0	0	0	0	0	0	
3+45	3+25	0	0	0	0	0	0	0	0	0	
3+59.5	3+45	0	0	0	0	0	0	0	0	0	
3+82	3+59.5	0	2	0	0	0	0	0	0	0	1
3+97	3+82	0	0	0	0	0	0	0	0	0	2
3+128	3+97	0	0	0	0	0	0	0	0	0	3
3+148	3+128	0	3	0	0	3	1 stickleback	0	0	0	
3+168	3+148	0	0	0	0	0	0	0	0	0	
3+188	3+168	0	0	0	0	0	0	0	0	0	
3+209.85	3+188	0	0	0	0	1	0	0	0	0	
Sewage Plant	3+209.85	0	5	1 stickleback 1 pump. seed	0	5	1 pump. seed	0	3	0	4
	Totals	0	10	1 stickleback 1 pump. seed	0	9	1 stickleback 1 pump. seed	0	3	0	Total Cut. 22
2+184.0	2+200	0	19	0	0	14	0	0	3	0	
2+176	2+159	0	9	1 pump. seed	0	5	0	0	2	0	5
2+144	2+124	0	5	1 pump. seed	0	4	0	0	0	0	
2+113	2+485	0	28	0	0	6	0	0	0	0	6
2+51	2+31	0	19	0	0	0	0	0	0	0	7
2+24	2+13	0	20	0	0	0	0	0	0	0	8
	Totals	0	100	2 pump. seed	0	29	0	0	5	0	Total Cut. 134
1+224	1+224	0	5	0							
1+208	1+198	0	6	0							
1+179	1+168	0	2	0							
1+156	1+152	0	5	0							
1+152	1+134	0	21	0							
1+127	1+110	0	17	0							9
1+100	1+86	0	8	0							10
1+81	1+76	0	1	0							11
1+67	1+46	0	24	0							12
1+36	1+16	0	8	0							
1+113	1+11.3	0	6	0							13
1+0	1+0	0	1	0							
	Totals	0	104	0	One pass only for this section			Total Cutthroat for Creek			260

FIGURES

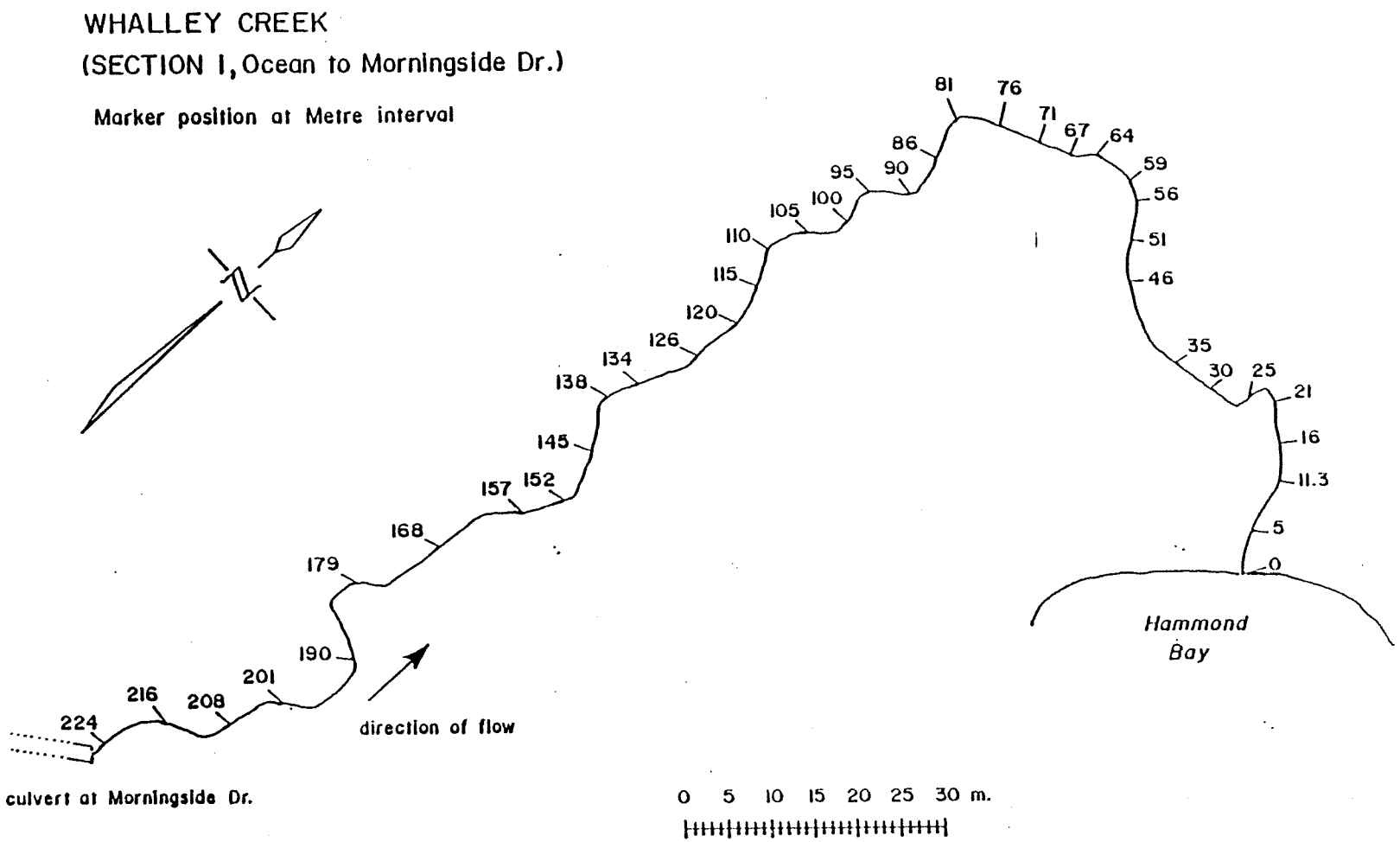


Figure 1. Map of the Study Area, Section 1 (Ocean to Morningside Drive), 1994.

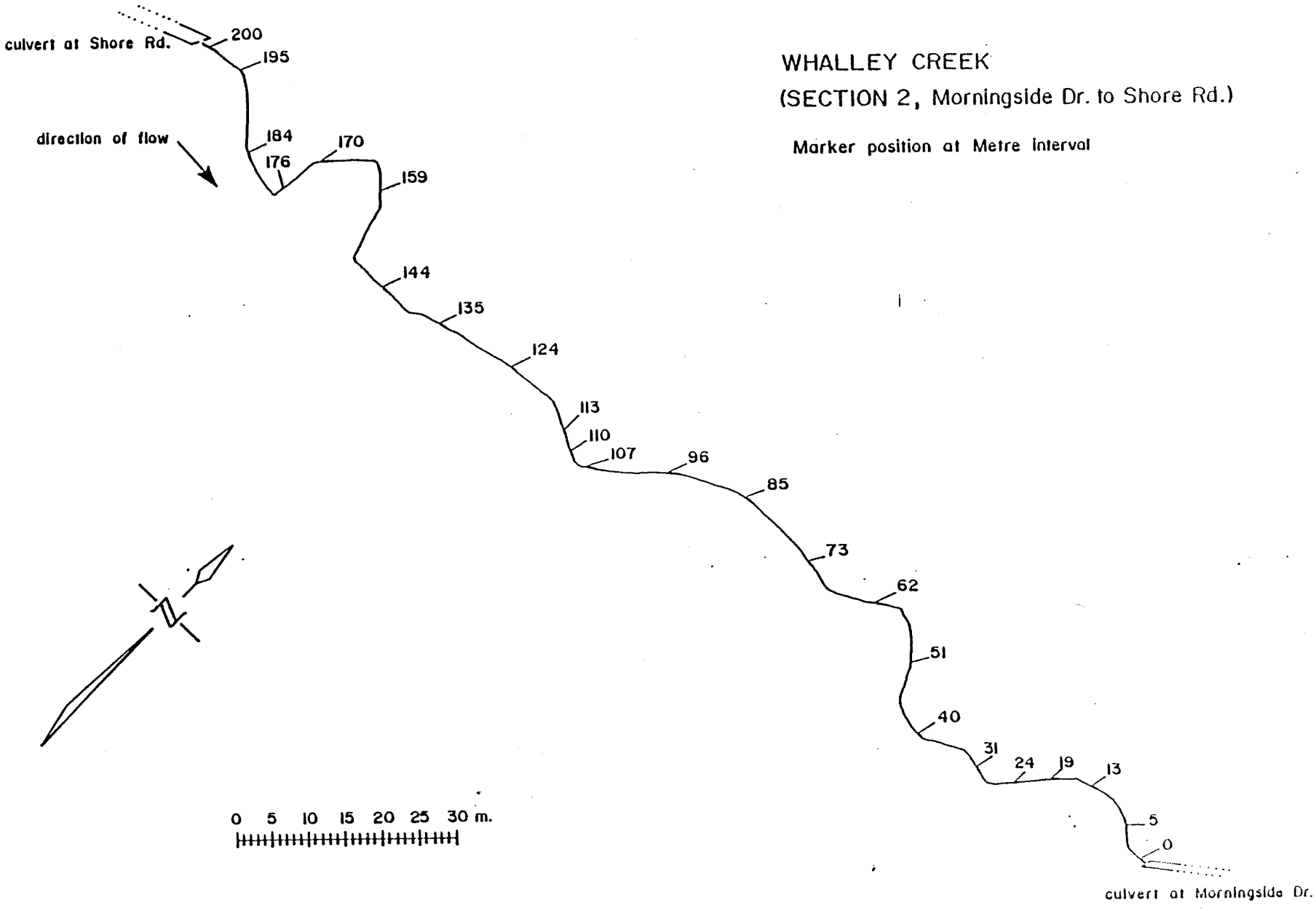


Figure 2. Map of the Study Area, Section 2 (Morningside Drive to Shore Road), 1994

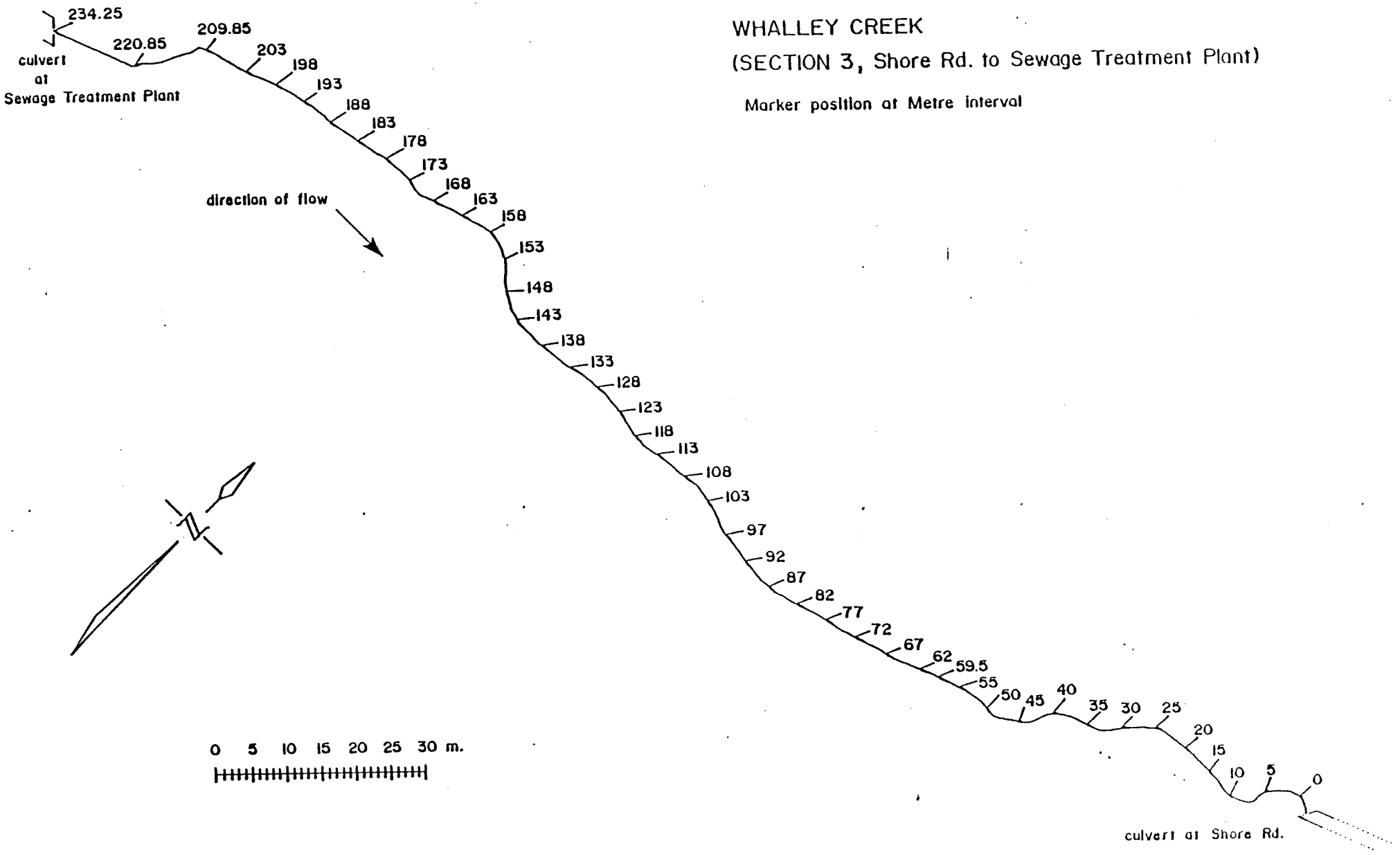


Figure 2. Map of the Study Area, Section 3 (Shore Road to Sewage Treatment Plant), 1994

Appendix Table 1. Results of Fish Habitat Assessment data collected at Whalley Creek, Section 1, 1994.

WHALLEY CREEK HABITAT ASSESSMENT, 1994(SECTION 1, Ocean to Morningside Drive)

Transect Compass Orientat.	Start Marker Number	Stream Channel Width Meters Right to Left	Start Dist. From Marker Meters IE/1+20m	Distance from Right Bank to W. Edge Meters	Stream Depth Profile (Distance from the Waters Edge in Meters) Right											Left	Distance from Left Bank to W. Edge Meters	Mean Depth Along Transect	Total Wetted Width (Meters)
	1	0.96	+0	0.00	0.00	0.48	0.96										0.000	0.115	0.96
					0.034	0.175	0.135												
	1	3.00	+5	0.00	0.00	0.68	1.375										1.625	0.040	1.375
					0.034	0.080	0.005												
	1	3.40	+11.3	0.00	0.00	1.80	2.20	2.60	3.40								0.000	0.162	3.40
					CB	0.230	0.250	0.160	0.170										
	1	5.40	+16	1.81	0.00	0.80	1.45										2.140	0.188	1.45
					0.035	0.180	0.350												
	1	4.36	+21	0.96	0.00	0.70	1.375										2.025	0.050	1.375
					0.025	0.120	0.005												
	1	4.76	+25	2.18	0.00	0.30	0.60	dry to	0.98	1.50	2.00	2.20	2.58				0.380	0.096	2.20
					0.015	0.045	0.010		0.005	0.140	0.260	0.250	0.040						
	1	4.52	+30	1.375	0.00	2.00	2.50	3.02									0.125	0.033	3.02
					0.010	0.010	0.060	0.050											
	1	5.57	+35	0.00	0.00	0.30	0.53	Dry	to	1.20	1.40	1.60	1.85	2.10			4.140	0.044	1.43
					0.040	0.050	0.005			0.005	0.020	0.075	0.14	0.02					
	1	6.08	+46	0.97	0.00	0.50	1.00	1.40	1.80	2.54							2.570	0.117	2.54
					0.030	0.080	0.125	0.170	0.135	0.160									
	1	5.47	+51	1.58	0.00	0.55	0.75	Dry	to	1.05	1.20	1.40	1.55				2.640	0.110	1.25
					0.070	0.070	0.005			0.005	0.350	0.018	0.250						
	1	5.87	+56	2.99	0.00	0.20	0.50	0.70	0.90	1.10	1.40	1.68					1.200	0.087	1.68
					0.010	0.053	0.145	0.180	0.100	0.080	0.120	0.010							
	1	6.54	+59	3.00	0.00	0.70	1.00	1.30	1.70	2.20							1.340	0.054	2.20
					0.015	0.055	0.090	0.075	0.060	0.030									
	1	3.18	+64	0.85	0.00	0.20	0.50	0.80	1.00	1.30	1.62						0.710	0.058	1.62
					0.015	0.072	0.090	0.045	0.050	0.035	0.100								
	1	3.47	+67	0.00	0.00	0.70	0.80	Dry	to	1.30	1.70	2.00	2.50	3.00			0.970	0.150	2.50
					CB	0.260	0.260			0.090	0.160	0.175	0.100	0.005					
	1	2.46	+71	0.43	0.00	0.50	0.80	1.00	1.30	1.80							0.230	0.134	1.80
					0.030	0.180	0.175	0.180	0.180	0.060									
	1	2.22	+76	0.23	0.00	0.40	0.70	1.00	1.25								0.740	0.053	1.25
					0.040	0.075	0.095	0.050	0.005										
	1	2.49	+81	0.30	0.00	0.50	1.00	1.40	1.90								0.290	0.138	1.90
					0.090	0.130	0.130	0.200	CB										
	1	3.68	+86	1.55	0.00	0.50	0.80	1.00	1.40								0.730	0.030	1.40
					0.005	0.030	0.055	0.050	0.010										
	1	2.17	+90	0.47	0.00	0.40	0.60	0.80	1.00	1.20	1.55						0.150	0.253	1.55
					CB	0.210	0.215	0.195	0.140	0.750	0.010								
	1	2.55	+95	0.75	0.00	0.30	0.50	0.80	1.30								0.500	0.137	1.30
					0.005	0.015	0.045	0.070	0.550										

Appendix Table 1. Results of Fish Habitat Assessment data collected at Whalley Creek, Section 1, 1994.

WHALLEY CREEK HABITAT ASSESSMENT, 1994(SECTION 1, Ocean to Morningside Drive)

Transect Compass Orientat.	Start Marker Number	Stream Channel Width Meters Right to Left	Start Dist. From Marker Meters IE/1+20m	Distance from Right Bank to W. Edge Meters	Stream Depth Profile (Distance from the Waters Edge in Meters) Right													Left	Distance from Left Bank to W. Edge Meters	Mean Depth Along Transect	Total Wetted Width (Meters)
	1	2.83	+100	0.80	0.00	0.30	0.50	0.80	1.18										0.850	0.113	1.18
					0.168	0.190	0.140	0.055	0.010												
	1	2.64	+105	0.69	0.00	0.25	0.40	0.50	0.80	1.00	1.30	1.40	1.835						0.115	0.033	1.835
					0.015	0.015	0.010	0.010	0.045	0.055	0.040	0.080	0.030								
	1	3.70	+110	1.26	0.00	0.40	0.80	1.00	1.40	2.30									0.140	0.138	2.30
					0.070	0.115	0.160	0.225	0.250	0.010											
	1	3.32	+115	1.57	0.00	0.40	0.80	1.00	1.30	1.47									0.280	0.177	1.47
					0.015	0.130	0.215	0.200	0.150	0.350											
	1	3.38	+120	0.70	0.00	0.40	0.80	1.00	1.40	1.70	2.45								0.230	0.035	2.45
					0.025	0.070	0.025	0.028	0.045	0.030	0.025										
	1	2.65	+126	0.72	0.00	0.40	0.60	0.80	1.10										0.830	0.079	1.10
					0.040	0.170	0.100	0.070	0.015												
	1	3.50	+134	1.90	0.00	0.40	0.60	0.90	1.20										0.400	0.152	1.20
					0.005	0.170	0.230	0.205	0.150												
	1	2.30	+138	0.00	0.00	0.40	0.80	1.20	1.50										0.800	0.123	1.50
					0.040	0.140	0.235	0.190	0.010												
	1	3.29	+145	0.56	0.00	0.40	0.60	0.80	1.10										1.630	0.053	1.10
					0.015	0.094	0.085	0.065	0.005												
	1	2.75	+152	0.70	0.00	0.40	0.70	0.90	1.30										0.750	0.069	1.30
					0.015	0.130	0.130	0.060	0.010												
	1	1.95	+157	0.21	0.00	0.40	0.60	0.90	1.20										0.540	0.129	1.20
					0.060	0.180	0.190	0.130	0.085												
	1	2.89	+168	1.02	0.00	0.40	0.80	1.00	1.20	1.70									0.170	0.029	1.70
					0.010	0.020	0.028	0.035	0.035	0.045											
	1	4.36	+179	1.68	0.00	0.40	0.70	1.00	1.20	1.70									0.980	0.075	1.70
					0.010	0.050	0.085	0.105	0.122	0.080											
	1	3.25	+190	0.00	0.00	0.40	0.70	1.05											2.200	0.053	1.05
					0.095	0.080	0.030	0.005													
	1	5.60	+201	3.00	0.00	0.40	0.70	1.00	1.98										0.620	0.059	1.98
					0.005	0.043	0.090	0.100	0.055												
	1	4.76	+208	1.30	0.00	0.10	0.40	0.60	0.80	1.00	1.25								2.210	0.121	1.25
					CB	0.058	0.100	0.115	0.090	0.350	0.010										
	1	4.08	+216	0.64	0.00	0.40	0.80	1.00	1.20	1.40	1.60	1.95							1.490	0.080	1.95
					0.005	0.030	0.025	0.025	0.060	0.130	0.175	0.190									
	1	3.98	+224	0.56	0.00	0.40	0.80	1.00	1.40	1.80	2.25								1.170	0.112	2.25
					0.160	0.130	0.180	0.170	0.075	0.030	0.040										

Appendix Table 1. Results of Fish Habitat Assessment data collected at Whalley Creek, Section 1, 1994.

WHALLEY CREEK HABITAT ASSESSMENT, 1994 (SECTION 1, Ocean to Morningside Dr.)

*Start Location From Marker	*Finish Location From Marker	Gradient %	*Start Location From Marker	Stream Orientation Compass: Fore Sight	Stream Orientation Compass: Back Sight	Stream Orientation Compass: Dist. Between	Start Distance From Marker le/ 1 + 20m	Discharge Parameters: Length in Meters: Pool Length	Pool Type	Riffle	Glide	Waterfall	Cascade	Start Distance From Marker le/ 1 + 10	Cover on the Transect line Intercept: Right R1	Right R2	Right Hab. Qty.	Mid. R1	Mid. R2	Mid. Hab Qty.	Left R1	Left R2	Left Hab Qty.	Stream Bank Vegetative Stability: Right Bank	Left Bank
1 + 0	1 +6.79	2.5%	1 + 0	146	326	6.79	1 + 0			10.3				1 + 0			7			7			7	3	3
1 +6.79	1 + 12.02		1 + 6.79	160	340	5.23	1+10.3	2.6	14					1 + 5			7			7			7	3	3
1 + 12.02	1 + 14.47	10.0%	1 + 12.02	130	310	2.45	1 + 12.9				4.9			1 + 11.3	11		2	11		2	11	10	2	4	4
1 + 14.47	1 + 23.1	0.5%	1 + 14.47	120	300	8.63	1+ 17.8			1.4				1 + 16			7			7			7	4	4
1 + 23.1	1 + 27.02		1 + 23.1	188	8	3.92	1 + 19.2	1.7	11					1 + 21			7			7			7	3	3
1 + 27.02	1 + 40.34	1.5%	1 + 27.02	80	260	13.32	1 + 20.9			1.9				1 + 25			7			7			7	2	2
1 + 40.34	1 + 49.86	8.0%	1 + 40.34	116	296	9.52	1 + 22.8	1.6	22					1 + 30			7			7			7	2	2
1 + 49.86	1 + 56.9	5.5%	1 + 49.86	140	320	7.04	1 + 24.4				3.3			1 + 35			7			7			7	1	3
1 + 56.9	1 + 61.07	3.5%	1 + 56.9	110	290	4.17	1 + 27.7				1.1			1 + 46			7			7			7	1	1
1 + 61.07	1 + 65.49	4.0%	1 + 61.07	70	250	4.42	1 + 28.8			15.1				1 + 51			7			7			7	1	1
1 + 65.49	1 + 68.48		1 + 65.49	48	228	2.99	1 + 43.9	2.1	22					1 + 56			7			7			7	1	1
1 + 68.48	1 + 74.85	13.0%	1 + 68.48	64	246	6.37	1 + 46.0					1.9		1 + 59	1		6			7			7	1	1
1 + 74.85	1 + 82.9	3.0%	1 + 74.85	50	230	8.05	1 + 47.9				2.7			1 + 64			7			7			7	1	3
1 + 82.9	1 + 88.2		1 + 82.9	334	154	5.30	1 + 50.6			2.3				1 + 67	10		6			7	10		6	1	3
1 + 88.2	1 + 92.03	1.5%	1 + 88.2	344	164	3.83	1 + 52.9						1.75	1 + 71			7			7			7	1	1
1 + 92.03	1 + 98.23	1.0%	1 + 92.03	44	224	6.20	1 + 54.65	4.4	24					1 + 76	3		6	3		6			7	1	1
1 + 98.23	1 + 103.73	1.0%	1 + 98.23	344	164	5.55	1 + 59.05			2.4				1 + 81	3		6	3		6			7	1	1
1 + 103.73	1 + 108.21	1.0%	1 + 103.73	42	222	4.43	1 + 61.45				4.4			1 + 86			7			7			7	3	3
1 + 108.21	1 + 112.15		1 + 108.21	14	194	3.94	1 + 65.85	1.7	9					1 + 90	10		6			7			7	1	1
1 + 112.15	1 + 121.08	8.0%	1 + 112.15	334	154	8.93	1 + 67.55			3.1				1 + 95			7			7			7	1	1
1 + 121.08	1 + 129.37	1.5%	1 + 121.08	358	178	8.29	1 + 70.65	2.95	26					1 + 100			7			7			7	1	2
1 + 129.37	1 + 136.67	5.0%	1 + 129.37	22	202	7.30	1 + 73.6				8.8			1 + 105			7			7	10		6	1	1
1 + 136.67	1 + 141.5		1 + 136.67	13	193	4.83	1 + 82.4			4.7				1 + 110	11	10	2	11		2	11		2	1	1
1 + 141.5	1 + 145.89	3.0%	1 + 141.5	316	136	4.39	1 + 87.1				3.3			1 + 115			7			7			7	2	2
1 + 145.89	1 + 153.65	11.0%	1 + 145.89	330	150	7.76	1 + 90.4			7.0				1 + 120			7			7			7	1	3
1 + 153.65	1 + 159.46		1 + 153.65	24	204	5.81	1 + 97.0				4.2			1 + 126			7			7			7	1	1
1 + 159.46	1 + 165.10	2.0%	1 + 159.46	40	220	5.64	1 + 101.6			8.2				1 + 134			7			7			7	1	1
1 + 165.10	1 + 178.93	2.0%	1 + 165.10	6	186	13.83	1 + 109.8	3.4	16					1 + 138			7			7			7	1	1
1 + 178.93	1 + 182.42		1 + 178.93	50	230	3.49	1 + 113.2			2.2				1 + 145			7			7			7	0	1
1 + 182.42	1 + 186.05		1 + 182.42	360	180	3.63	1 + 115.4				2.4			1 + 152			7			7			7	1	1
1 + 186.05	1 + 194.57	1.5%	1 + 186.05	293	113	8.52	1 + 117.8			5.1				1 + 157			7			7			7	3	3
1 + 194.57	1 + 196.40		1 + 194.57	340	160	1.83	1 + 122.9	1.9	16					1 + 168			7			7			7	1	1
1 + 196.40	1 + 201.40		1 + 196.40	15	195	5.00	1 + 124.8				4.2			1 + 179			7			7			7	1	1
1 + 201.40	1 + 215.23	1.0%	1 + 201.40	48	228	6.26	1 + 129.0			7.0				1 + 190			7			7			7	1	1
1 + 215.23	1 + 223.13		1 + 215.23	12	192	7.57	1 + 136.0	0.7	15					1 + 201			7			7			7	1	1
1 + 223.13	1 + 229.59	2.5%	1 + 223.13	54	234	7.90	1 + 136.7				5.8			1 + 208			7			7			7	0	0
			1 + 229.59	14	194	6.46	1 + 142.5			9.33				1 + 216			7			7			7	2	2
							1 + 151.83						3.1	1 + 224	11	10	6	11		6	11		6	3	3
							1 + 154.53			3.3															
							1 + 158.23				2.8														
							1 + 161.03			46.9															
							1 + 207.93				1.0														
							1 + 208.93			13.4															
							1 + 222.4	2.6	Pool Associated with Culvert															

* Measurements were done with an electronic device
~ 4.6 meters difference between initial measurements.

Appendix Table 1. Results of Fish Habitat Assessment data collected at Whalley Creek, Section 1, 1994.

HABITAT UNIT CODES:

1=Gravel Riffle
2=Cobble Riffle
3=Boulder Riffle
4=Gravel Glide
5=Cobble Glide
6=Boulder Glide
7=Cascade
8=Falls
9=Backwater Pool associated with boulders
10=Backwater Pool associated with rootwad
11= Backwater Pool associated with LOD
12= Trench Pool Associated with Bedrock
13= Secondary Channel Pool
14=Plunge Pool associated with LOD
15=Plunge Pool associated with Boulders
16=Lateral Scour Pool associated with LOD
17= Lateral Scour Pool associated with Rootwad
18=Lateral Scour Pool associated with bedrock
19=Midchannel Scour Pool
20=Dammed Pool associated with LOD
21=Eddy Pool
22=Use when the pool forming features can not be determined
23=Rapids
24 = Pool Associated with Debris
25 = Pump House Pool
26 = Backwater pool associated with man made wall

Streambank Vegetative Stability (To top of bank)

4 = 80% of streambank surface is covered by vegetation, gravel or larger material that does not allow bank erosion.
3 = 50 to 79% of bank surfaces are covered by vegetation, gravel or larger material, allowing minor erosion.
2 = 25 to 49% of bank surfaces are covered by vegetation, gravel or larger materials, allowing major erosion.
1 = <25% of banks are covered by vegetation, gravel or larger material, banks erode each year with high water.
0 = No vegetation

COVER RATING CODES;

1 = Large LWD (>50 cm.)
2 = Med. LWD (20 to 50 cm.)
3 = Small LWD (10 to 20 cm.)
4 = Very large boulders (406.4 to 203.2 cm.)
5 = Large Boulders (203.2 to 101.6 cm.)
6 = Med. boulders (101.6 to 50.8 cm.)
7 = Small Boulders (50.8 to 25.4 cm.)
8 = Overstream Vegetation
9 = Instream Vegetation
10 = Cutbank
11 = Pool (see discharge par. for type)

HABITAT QUALITY CODES:

1 = Good (Adult)
2 = Good (Juv.)
3 = Average (Adult)
4 = Average (Juv.)
5 = Poor (adult)
6 = Poor (Juv.)
7 = No Habitat

Appendix Table 1. Results of Fish Habitat Assessment data collected at Whalley Creek, Section 1, 1994.

WHALLEY CREEK HABITAT ASSESSMENT, 1994 (SECTION 1, Ocean to Morningside Drive.)

Start Marker Number	Start Distance From Marker ie/ 1 + 20m	Bank Height (Meters)		Bank Stability		Bank Composition: Fines = 1, Sm. Gravel = 2, Lg. Gravel = 3, Sm. Cobble = 4, Lg. Cobble = 5, Boulder = 6						Cutbank Dimensions							
						Right Bank			Left Bank			Start Distance From Marker	End Distance From Marker	US. End of Cutbank		Mid. Point of Cutbank		DS. End of Cutbank	
		R	L	R	L	R1	R2	R3	R1	R2	R3			Vert. Depth (m)	Horz. Depth (m)	Vert. Depth (m)	Horz. Depth (m)	Vert. Depth (m)	Horz. Depth (m)
1	+0	0.20	0.38	1	1	1	11	12	1	11	12	1+9.7R	1+12.3		0.40				0.12
1	+5	0.15	0.71	1	1	1	11	12	13	2	12	1+64.0L	1+67.3	0.30	0.40	0.20	0.60	0.14	0.30
1	+11.3	0.70	1.20	0	0	12	12	12	LOD	12	1	1+66.6R	1+67.9	0.13	0.40	0.28	0.80	0.09	0.26
1	+16	0.535	0.74	FP	1	13	8	12	13	8	12	1+90.0R	1+92.6	0.16	0.31	0.205	0.32	0.20	0.50
1	+21	1.70	0.55	1	1	1	13	12	13	12		1+109.68R	1+111.68	0.13	0.25	0.12	0.54	0.20	0.30
1	+25	1.80	0.80	2	2	1			13	1		1+208.5R	1+210.30	0.15	0.12	0.13	0.20	0.10	0.44
1	+30	0.72	1.15	2	2	13	12		13	12		1+217.0L	1+221.8	0.20	0.30	0.06	0.24	0.23	0.23
1	+35	1.50	1.28	4	1	13	12		13	12		1+221.57R	1+225.82	0.10	0.40	0.28	0.90	0.23	0.34
1	+46	2.23	1.10	4	1	13	12		13	12									
1	+51	1.15	0.78	3	2	13	12		13	12	7								
1	+56	2.055	1.07	3	4	13	12		7	13									
1	+59	1.61	1.49	2	2	13	12		7	13									
1	+64	1.00	1.24	2	1	13	12		10	CB									
1	+67	1.10	1.69	2	2	10	13	CB	10	13	CB								
1	+71	1.00	1.40	3	3	13	10	6	13	10	6								
1	+76	1.00	1.50	2	3	13	10		13	10									
1	+81	0.56	1.27	2	4	13	10	LOD	13	10									
1	+86	0.42	0.80	1	1	13			13										
1	+90	0.85	1.90	2	3	10	13		10	13									
1	+95	0.38	0.80	1	1	1	4	6	1	10	6								
1	+100	0.53	1.30	0	2	6	13	1	13	10									
1	+105	1.08	1.19	1	2	6	13	10	10	13									
1	+110	0.615	0.92	3	4	13	10	6	13	10	5								
1	+115	0.73	0.97	2	3	13	10		13	10	6								
1	+120	0.73	0.50	3	3	13	10		13	10									
1	+126	0.70	0.65	2	2	10	13	LOD	10	13	LOD								
1	+134	0.70	1.37	3	3	13	10	2	13	10	6								
1	+138	1.025	1.025	2	2	7	1		13	10	2								
1	+145	1.10	0.50	1	3	MM ROCK WALL			13	10	6								
1	+152	0.55	0.47	1	1	13	10	6	13	10	6								
1	+157	0.24	0.24	1	1	13	10	6	13	10									
1	+168	0.24	0.24	2	1	13	10		13	10									
1	+179	0.815	1.11	0	2	13	6		13	6									
1	+190	1.56	0.65	0	2	MM ROCK WALL			4	13	3								
1	+201	0.90	1.06	2	2	13	2	10	13	10									
1	+208	0.37	0.67	2	2	13	3	2	13	10	3								
1	+216	0.44	1.25	2	2	13	10		13	10									
1	+224	1.03	0.88	2	2	CULVERT			CULVERT										

Appendix Table 1. Results of Fish Habitat Assessment data collected at Whalley Creek, Section 1, 1994.

BANK COMPOSITION CODES

Bedrock =7 Rootwad = 10 Soil = 13
Mud = 8 Sand = 11
Clay = 9 Riperian Rootmass = 12

BANK STABILITY CODES

0 = Stable no errosion NB = Bank not clearly defined. FP = Flood Plain
1 = 1 to 25% Stream banks are slightly altered along the transect line.
2 = 26 to 50 % streambanks are recieving moderate alteration along the transect line.
3 = 51 to 75% streambanks have recieved major alteration along the transect line.
4 = 76 to 100% streambanks are severly altered along the transect line.

APPENDICES

Appendix Table 1. Results of Fish Habitat Assessment data collected at Whalley Creek, Section 1, 1994.

WHALLEY CREEK HABITAT ASSESSMENT, 1994 (SECTION 1,Ocean to Morningside Drive)

Start Marker Number	Start Distance From Marker	SUBSTRATE COMPOSITION												Compaction Check One			Embedded Substrate		Embedded Substrate Code
		R1			R2			R3			R4								
		Q1	Q2	Q3	Q1	Q2	Q3	Q1	Q2	Q3	Q1	Q2	Q3	1	2	3	Yes	No	
1	+0	2			1			3						x				x	
1	+5	2			1			3			4			x				x	
1	+11.3	2			1			3						x				x	
1	+16	S																x	
1	+21	2			1			3			S			x				x	
1	+25	2			1			3			S			x				x	
1	+30	2			1			3			S			x				x	
1	+35	3			2			1						x				x	
1	+46	2			3			1						x				x	
1	+51	4			5			7			2			x				x	
1	+56	7														x		x	
1	+59	1			2			3						x				x	
1	+64	4			3			2			1			x				x	
1	+67	7			4			3			2			x				x	
1	+71	1			2			3							x			x	
1	+76	2			1			3							x			x	
1	+81	1			2			3							x			x	
1	+86	3			2			1			1			x				x	
1	+90	4			3			2			1			x				x	
1	+95	3			2			6			1				x			x	
1	+100	1			3			2						x				x	
1	+105	4			5			3			2				x			x	
1	+110	1			2									x				x	
1	+115	5			6			2			1					x		x	
1	+120	5			4			3			2					x		x	
1	+126	1			2			4								x		x	
1	+134	6			4			3			2				x			x	
1	+138	1			2			6							x			x	
1	+145	3			2			1							x			x	
1	+152	4			3			2						x				x	
1	+157	4			2			3						x				x	
1	+168	2			3			4						x				x	
1	+179	4			3			1			2				x			x	
1	+190	2			4			5			3			x				x	
1	+201	3			5			2			4				x			x	
1	+208	2			1			3			4				x			x	
1	+216	2			1			3			5				x			x	
1	+224	4			5			3			2				x			x	

LEGEND

RANK CODES

R1 = Most Predominate substrate

R2 = Second most Predominate

R3 = Third most Predominate

R4 = Fourth most Predominate

SUBSTRATE CODES

1 = fines (< 2 mm.)

2 = small gravel (2 mm. to 16 mm.)

3 = large gravel (16 mm. to 64 mm.)

4 = small cobble (64 mm. to 128 mm.)

5 = large cobble (128mm. to 256 mm.)

6 = boulder (>256 mm.)

7 = bedrock

8 = Mud

9 = clay

Compaction Codes

1 = loose (can dislodge with foot)

2 = med. (some movement)

3 = high (no movement)

Embeddedness Codes

1 = 100% to 76% embedded

2 = 75% to 51% embedded

3 = 50 tp 26% embedded

4 = 25% to 1% embedded

5 = 0% embedded

Appendix Table 2. Results of Fish Habitat Assessment data collected at Whalley Creek, Section 2, 1994.

WHALLEY CREEK HABITAT ASSESSMENT, 1994(SECTION 2, Morningside Drive to Shore Rd.)

Transect Compass Orientat.	Start Marker Number	Stream Channel Width Meters Right to Left	Start Dist. From Marker Meters IE/1+20m	Distance from Right Bank to W. Edge Meters	Stream Depth Profile (Distance from the Waters Edge in Meters) Right → Left	Distance from Left Bank to W. Edge Meters	Mean Depth Along Transect	Total Wetted Width (Meters)
	2	5.00	+0	3.20	0.00 0.40 0.90 0.026 0.065 0.043	0.900	0.045	0.90
	2	3.30	+5	1.33	0.00 0.50 0.971 0.017 0.021 0.060	0.999	0.033	0.971
	2	2.87	+13	0.92	0.00 0.30 0.60 0.90 1.30 0.012 0.045 0.076 0.100 0.081	0.650	0.063	1.30
	2	2.81	+19	0.42	0.00 0.30 0.60 0.90 1.20 1.40 1.685 0.175 0.131 0.143 0.134 0.118 0.053 0.035	0.705	0.113	1.685
	2	4.30	+24	0.54	0.00 0.30 0.60 0.90 1.30 0.001 0.071 0.115 0.110 0.022	2.460	0.064	1.30
	2	3.40	+31	0.80	0.00 0.30 0.60 0.90 1.20 1.50 1.80 2.30 0.179 0.255 0.279 0.266 0.210 0.105 0.107 0.068	0.300	0.184	2.30
	2	3.40	+40	0.34	0.00 0.30 0.60 0.90 1.20 1.50 1.90 0.025 0.030 0.045 0.062 0.041 0.042 0.003	1.160	0.035	1.90
	2	4.15	+51	1.46	0.00 0.30 0.60 0.90 1.20 1.50 2.00 0.005 0.034 0.036 0.034 0.041 0.002 0.086	0.690	0.034	2.00
	2	6.90	+62	1.72	0.00 0.30 0.60 0.90 1.20 GB to 2.11 2.61 0.015 0.046 0.045 0.056 0.010 0.005 0.020	3.480	0.028	1.70
	2	5.30	+73	0.72	0.00 0.30 0.60 0.90 1.20 1.50 1.89 0.015 0.020 0.035 0.045 0.048 0.050 0.001	2.690	0.031	1.89
	2	4.60	+85	1.91	0.00 0.30 0.60 0.90 1.20 1.50 2.00 2.25 0.035 0.055 0.071 0.090 0.058 0.057 0.000 0.027	0.440	0.056	2.25
	2	3.79	+96	0.99	0.00 0.30 0.60 0.90 1.20 1.50 1.97 0.013 0.029 0.015 0.017 0.043 0.045 0.062	0.830	0.032	1.97
	2	4.30	+107	1.34	0.00 0.30 0.60 0.90 1.31 0.030 0.098 0.141 Rock 0.046	1.650	0.079	1.31
	2	5.10	+110	1.50	0.00 0.30 0.60 0.90 1.20 1.50 2.00 0.041 0.072 0.105 0.137 0.126 0.072 0.015	1.600	0.081	2.00
	2	3.25	+113	1.52	0.00 0.30 0.60 0.90 1.20 1.41 1.61 0.052 0.076 0.116 0.128 0.140 0.150 0.005	0.120	0.095	1.61
	2	3.34	+124	0.58	0.00 0.60 0.80 GB to 1.10 1.20 1.50 2.00 2.50 2.76 0.021 0.030 0.005 0.005 0.027 0.070 0.090 0.180 0.005	0.300	0.048	2.46
	2	2.63	+135	0.40	0.00 0.30 0.60 0.90 1.20 1.80 2.23 0.020 0.058 0.074 0.105 0.115 0.100 0.005	0.000	0.068	2.23
	2	3.25	+144	1.63	0.00 LOD to 0.38 0.60 0.90 1.31 0.064 0.064 0.130 0.090 0.059	0.690	0.081	0.93
	2	3.91	+159	1.75	0.00 0.60 0.90 1.60 0.020 0.056 0.090 0.085	0.560	0.063	1.60
	2	8.71	+170	2.08	0.00 0.30 0.60 0.90 1.13 Island to 4.92 to 6.63 0.021 0.085 0.112 0.065 0.010 Dry Dry Dry	5.500	0.059	1.13

Appendix Table 2. Results of Fish Habitat Assessment data collected at Whalley Creek, Section 2, 1994.

WHALLEY CREEK HABITAT ASSESSMENT, 1994(SECTION 2, Morningside Drive to Shore Rd.)

Transect Compass Orientat.	Start Marker Number	Stream Channel Width Meters Right to Left	Start Dist. From Marker Meters IE/1+20m	Distance from Right Bank to W. Edge Meters	Stream Depth Profile (Distance from the Waters Edge in Meters) Right													Left	Distance from Left Bank to W. Edge Meters	Mean Depth Along Transect	Total Wetted Width (Meters)
	2	4.71	+176	2.46	0.00	0.30	0.60	0.90	1.40	1.90	2.23								0.020	0.095	2.23
					0.041	0.095	0.162	0.160	0.131	0.072	0.005										
	2	5.57	+184	3.82	0.00	0.30	0.60	0.90	1.20	1.70									0.050	0.121	1.70
					0.048	0.111	0.160	0.175	0.200	0.031											
	2	5.59	+195	1.23	0.00	0.30	0.60	0.90	1.20	1.50	1.97								2.390	0.130	1.97
					0.050	0.175	0.240	0.211	0.135	0.076	0.021										
	2	4.56	+200	0.90	0.00	0.30	0.60	0.90	1.20	1.50	2.00	2.32							1.340	0.184	2.32
					0.120	0.162	0.235	0.281	0.310	0.210	0.110	0.045									

Appendix Table 2. Results of Fish Habitat Assessment data collected at Whalley Creek, Section 2, 1994.

WHALLEY CREEK HABITAT ASSESSMENT, 1994 (SECTION 2, Morningside dr. to Shore Rd.)

* Start Location From Marker	*Finish Location From Marker	Gradient %	* Start Location From Number	Stream Orientation Compass			Start Distance From Marker	Discharge Parameters					Start Distance From Marker	Cover on the Transect Line Intercept									Stream Bank Vegetative Stability	
								Length in Meters						Right		Hab.	Mid.		Hab.	Left		Hab.	Right	Left
				Fore Sight	Back Sight	Dist. Between	ie/1 + 20m	Pool Length	Pool Type	Riffle	Glide	Side Channel	ie/2 + 20	R1	R2	Qty.	R1	R2	Qty.	R1	R2	Qty.	Bank	Bank
Culvert	2 + 3.88		Culvert	90	270	2.93	2 + 0			11.95			2 + 0			7			7			7	1	3
2 + 3.88	2 + 10.00		2 + 3.88	117	297	6.12	2 + 11.95				1.8		2 + 5			7			7			7	1	1
2 + 10.00	2 + 17.22		2 + 10.00	80	260	7.22	2 + 13.75			3.0			2 + 13			7			7	10		6	2	3
2 + 17.22	2 + 29.54	1.0%	2 + 17.22	44	224	12.32	2 + 16.75	3.75	14				2 + 19	10		6			7			7	3	2
2 + 29.54	2 + 35.48	6.0%	2 + 29.54	102	283	5.94	2 + 20.5			8.9			2 + 24			7			7			7	1	1
2 + 35.48	2 + 40.60		2 + 35.48	63	243	5.12	2 + 29.4	2.4	14				2 + 31	11		6	11		6	10		6	1	1
2 + 40.60	2 + 47.11	4.0%	2 + 40.60	100	280	6.51	2 + 31.8				1.8		2 + 40			7			7			7	1	1
2 + 47.11	2 + 53.23	0.5%	2 + 47.11	153	333	6.12	2 + 33.6			26.9			2 + 51			7			7			7	2	FP
2 + 53.23	2 + 59.98		2 + 53.23	124	304	6.75	2 + 60.5				3.1		2 + 62			7			7			7	2	2
2 + 59.98	2 + 71.27		2 + 59.98	60	240	11.29	2 + 63.6			43.4			2 + 73			7			7			7	FP	FP
2 + 71.27	2 + 89.58		2 + 71.27	94	274	18.31	2 + 107.0				3.0		2 + 85			7			7			7	1	1
2 + 89.58	2 + 101.19	1.0%	2 + 89.58	62	242	11.61	2 + 110.0	3.0	22				2 + 96			7			7			7	1	1
2 + 101.19	2 + 112.57		2 + 101.19	52	232	11.38	2 + 113.0			5.0			2 + 107			7			7			7	1	1
2 + 112.57	2 + 116.37	2.0%	2 + 112.57	106	286	3.80	2 + 118.0	6.0 L	11	6.0R			2 + 110			7			7			7	1	1
2 + 116.37	2 + 121.93		2 + 116.37	120	300	5.56	2 + 124.0				20.0		2 + 113	2		6			7	10		6	1	1
2 + 121.93	2 + 127.77		2 + 121.93	82	262	5.84	2 + 144.0	3.5	9				2 + 124			7	3		6	10		6	1	1
2 + 127.77	2 + 142.46		2 + 127.77	80	260	14.69	2 + 147.5				17.4		2 + 135			7			7			7	1	1
2 + 142.46	2 + 146.54	3.0%	2 + 142.46	64	244	4.08	2 + 164.9	1.0	11				2 + 144	2		7			7			7	1	1
2 + 146.54	2 + 149.18		2 + 146.54	92	272	2.64	2 + 165.9	2.2	14				2 + 159			7			7			7	2	1
2 + 149.18	2 + 157.08		2 + 149.18	92	272	7.90	2 + 168.1				3.0		2 + 170			7			7	10		6	1	1
2 + 157.08	2 + 165.50	8.0%	2 + 157.08	160	340	8.42	2 + 171.1			3.8			2 + 176	11	2	2	11		2	11		2	1	1
2 + 165.50	2 + 171.35		2 + 165.50	127	307	5.85	2 + 174.9	2.0	14				2 + 184			7			7			7	1	1
2 + 171.35	2 + 180.12	3.0%	2 + 171.35	44	224	8.77	2 + 176.9			6.4			2 + 195	11		4	11		4	11		4	1	1
2 + 180.12	2 + 186.81	8.5%	2 + 180.12	6	186	6.69	2 + 183.3				6.5		2 + 200	11		4	11		4	11		4	1	1
2 + 186.81	2 + 193.34		2 + 186.81	106	286	6.53	2 + 189.8			2.9														
2 + 193.34	2 + 203.72		2 + 193.34	131	311	10.38	2 + 192.7	5.1	20															
2 + 203.72	2 + 210.42	2.0%	2 + 203.72	86	262	7.65	2 + 192.7	3.35	Culvert															
2 + 210.42	to Culvert	4.0%																						

* Measurements were made with an electronic device with ~ 10.22 m. difference from initial measurements.

HABITAT UNIT CODES:

1=Gravel Riffle
2=Cobble Riffle
3=Boulder Riffle
4=Gravel Glide
5=Cobble Glide
6=Boulder Glide
7=Cascade
8=Falls
9=Backwater Pool associated with boulders
10= Backwater Pool associated with rootwad
11= Backwater Pool associated with LOD
12= Trench Pool Associated with Bedrock
13= Secondary Channel Pool
14=Plunge Pool associated with LOD
15=Plunge Pool associated with Boulders
16=Lateral Scour Pool associated with LOD
17= Lateral Scour Pool associated with Rootwad
18=Lateral Scour Pool associated with bedrock
19=Midchannel Scour Pool
20=Dammed Pool associated with LOD
21=Eddy Pool
22=Use when the pool forming features can not be determined
23=Rapids

Appendix Table 2. Results of Fish Habitat Assessment data collected at Whalley Creek, Section 2, 1994.

Streambank Vegatative Stability (To top of bank)

4 = 80% of streambank surface is covered by vegetation, gravel or larger material that does not allow bank erosion.
3 = 50 to 79% of bank surfaces are covered by vegetation, gravel or larger material, allowing minor erosion.
2 = 25 to 49% of bank surfaces are covered by vegetation, gravel or larger materials, allowing major erosion.
1 = <25% of banks are covered by vegetation, gravel or larger material, banks erode each year with high water.
0 = No vegetation

COVER RATING CODES;
1 = Lardge LWD (>50 cm.)
2 = Med. LWD (20 to 50 cm.)
3 = Small LWD (10 to 20 cm.)
4 = Very large boulders (406.4 to 203.2 cm.)
5 = Large Boulders (203.2 to 101.6 cm.)
6 = Med. boulders (101.6 to 50.8 cm.)
7 = Small Boulders (50.8 to 25.4 cm.)
8 = Overstream Vegetation
9 = Instream Vegetation
10 = Cutbank
11 = Pool (see discharge par. for type)

HABITAT QUALITY CODES:
1 = Good (Adult)
2 = Good (Juv.)
3 = Average (Adult)
4 = Average (Juv.)
5 = Poor (adult)
6 = Poor (Juv.)
7 = No Habitat

Appendix Table 2. Results of Fish Habitat Assessment data colected at Whalley Creek, Section 2, 1994.

WHALLEY CREEK HABITAT ASSESSMENT, 1994 (SECTION 2, Morningside Dr. to Shore Rd.)

Start Marker Number	Start Distance From Marker ie/ 1 + 20m	Bank Height (Meters)		Bank Stability		Bank Composition: Fines = 1, Sm. Gravel = 2, Lg. Gravel = 3, Sm. Cobble = 4, Lg. Cobble = 5, Boulder = 6						Cutbank Dimensions							
						Right Bank			Left Bank			Start Distance From Marker	End Distance From Marker	US. End of Cutbank		Mid. Point of Cutbank		DS. End of Cutbank	
		R	L	R	L	R1	R2	R3	R1	R2	R3			Vert. Depth (m)	Horz. Depth (m)	Vert. Depth (m)	Horz. Depth (m)	Vert. Depth (m)	Horz. Depth (m)
2	+0	2.2	0.97	2	1	13	3	2	13	3	2	2+11.89L	2+15.09	0.23	0.30	0.22	0.45	0.09	0.21
2	+5	1.3	0.92	2	2	13	3	2	13	3	2	2+13.86R	2+15.86	0.17	0.25	0.12	0.69	0.003	0.21
2	+13	0.74	0.925	1	2	13	3	2	13	3	2	2+18.3R	2+20.2	0.30	0.40	0.13	0.30	0.003	0.35
2	+19	0.79	0.77	1	1	13	3	2	13	12	11	2+111.28L	2+113.4	0.06	0.54	0.20	0.38	0.003	0.22
2	+24	1.17	0.65	1	1	10	13	3	13	12	2	2+119.10L	2+127.08	0.20	0.20	0.44	0.48	0.30	0.70
2	+31	0.73	1.12	2	1	13	12	2	13	12	2	2+132.64L	2+134.3	0.25	0.30	0.27	0.66	0.15	0.33
2	+40	0.30	0.29	2	1	13	3	2	13	2	3	2+135.3L	2+140.52	0.18	0.23	0.50	0.60	0.005	0.30
2	+51	0.08	0.26	1	FP	13	3	2	13	3	2	2+138.36R	2+140.36	0.10	0.20	0.35	0.30	0.003	0.30
2	+62	0.96	1.43	1	1	13	12	3	13	12	2	2+164.49L	2+172.60	0.20	0.60	0.10	0.83	0.10	0.22
2	+73	0.10	0.17	FP	FP	13	12		13	11									
2	+85	1.05	0.43	1	FP	13	12	3	13	4	2								
2	+96	1.88	0.97	2	4	13	2	3	13	2	3								
2	+107	1.39	1.11	3	3	13	2	3	13	2	3								
2	+110	1.33	1.36	3	3	13	2	3	13	2	2								
2	+113	1.16	1.28	3	3	13	3	2	13	3	12								
2	+124	1.41	1.49	3	2	13	3	2	13	2	12								
2	+135	1.02	1.19	2	2	13	12	2	13	12	2								
2	+144	1.27	1.22	3	2	13	12	2	13	12	2								
2	+159	0.81	1.04	2	2	1	2	3	13	12	2								
2	+170	0.47	0.85	2	3	13	12	2	13	2	12								
2	+176	0.51	0.67	2	2	LOD	13	12	13	11	2								
2	+184	0.60	0.26	2	2	13	2		13	10	12								
2	+195	0.72	0.81	2	2	13	11	2	3	2	13								
2	+200	1.10	1.08	0	2	CULVERT			CULVERT										

BANK COMPOSITION CODES

Bedrock = 7 | Rootwad = 10 | Soil = 13

Mud = 8 | Sand = 11

Clay = 9 | Riperian Rootmass = 12

BANK STABILITY CODES

0 = Stable no errosion NB = Bank not clearly defined. FP = Flood Plain

1 = 1 to 25% streambanks are slightly altered along the transect line

2 = 26 to 50% streambanks are recieving moderate alteration along the transect line.

3 = 50 to 75% streambanks have recieved major alteration along the transect line.

4 = 76 to 100% streambanks are severly altered along the transect line.

Appendix Table 2. Results of Fish Habitat Assessment data colected at Whalley Creek, Section 2, 1994.

WHALLEY CREEK HABITAT ASSESSMENT, 1994 (SECTION 2, Morningside Dr. to Shore Rd.)

Start Marker Number	Start Distance From Marker	SUBSTRATE COMPOSITION												Compaction Check One			Embedded Substrate		Embedded Substrate Code
		R1			R2			R3			R4								
		Q1	Q2	Q3	Q1	Q2	Q3	Q1	Q2	Q3	Q1	Q2	Q3	1	2	3	Yes	No	
2	+0	4			5			6							x				
2	+5	2			3			4			5				x				
2	+13	1			2			3			4				x				
2	+19	1			2			3						x					
2	+24	1			2			3			4			x					
2	+31	1			2			3						x					
2	+40	2			3			4							x				
2	+51	3			2			4						x					
2	+62	4			3			2						x					
2	+73	3			2			1			4				x				
2	+85	4			3			2			1				x		x		3
2	+96	2			3			4			1			x					
2	+107	5			4			3			1				x				
2	+110	2			3			1						x					
2	+113	2			3			4							x				
2	+124	1			3			4						x					
2	+135	1			2									x					
2	+144	1			2			3							x				
2	+159	2			3			4						x					
2	+170	3			2			1						x					
2	+176	1			2									x					
2	+184	1			2									x					
2	+195	2			1									x					
2	+200	1			2									x					

LEGEND

RANK CODES

R1 = Most Predominate substrate
R2 = Second most Predominate
R3 = Third most Predominate
R4 = Fourth most Predominate

SUBSTRATE CODES

1 = fines (< 2 mm.)
2 = small gravel (2 mm. to 16 mm.)
3 = large gravel (16 mm. to 64 mm.)
4 = small cobble (64 mm. to 128 mm.)
5 = large cobble (128mm. to 256 mm.)
6 = boulder (>256 mm.)
7 = bedrock
8 = Mud
9 = clay

Compaction Codes

1 = loose (can dislodge with foot)
2 = med. (some movement)
3 = high (no movement)

Embeddedness Codes

1 = 100% to 76% embedded
2 = 75% to 51% embedded
3 = 50 tp 26% embedded
4 = 25% to 1% embedded
5 = 0% embedded

Appendix Table 3. Results of Fish Habitat Assessment data collected at Whalley Creek, Section 3, 1994.

WHALLEY CREEK HABITAT ASSESSMENT, 1994(SECTION 3, Shore Rd. to Sewage Treatment Plant)

Transect Compass Orientat.	Start Marker Number	Stream Channel Width Meters Right to Left	Start Dist. From Marker Meters 1E/1+20m	Distance from Right Bank to W. Edge Meters	Stream Depth Profile (Distance from the Waters Edge in Meters) Right → Left	Distance from Left Bank to W. Edge Meters	Mean Depth Along Transect	Total Wetted Width (Meters)
	3	3.59	+0	0.30	0.00 0.011 | 0.30 0.030 | 0.60 0.036 | 0.90 0.048 | 1.20 0.032 | 1.46 0.003	1.830	0.027	1.46
	3	4.83	+5	2.61	0.00 0.002 | 0.30 0.033 | 0.60 0.046 | 0.67 0.021	1.550	0.026	0.67
	3	5.13	+10	0.73	0.00 0.010 | 0.30 0.056 | 0.60 0.028 | 0.90 0.014 | 1.01 0.002	3.390	0.022	1.01
	3	3.25	+15	1.05	0.00 0.038 | 0.30 0.051 | 0.60 0.062 | 0.90 0.040 | 1.20 0.047 | 1.50 0.044 | 1.80 0.016	0.400	0.043	1.80
	3	2.75	+20	1.00	0.00 0.020 | 0.30 0.091 | 0.60 0.197 | 0.90 0.272 | 1.20 0.246 | 1.435 0.150	0.315	0.163	1.435
	3	4.31	+25	1.63	0.00 0.001 | 0.30 0.005 | 0.60 Dry | 0.90 0.080 | 1.20 0.025 | 1.30 0.004	1.980	0.023	0.70
	3	4.39	+30	1.12	0.00 0.020 | 0.30 0.123 | 0.60 0.150 | 0.90 0.085 | 1.20 0.050 | 1.375 0.005	1.895	0.072	1.375
	3	3.70	+35	1.555	0.00 0.040 | 0.30 0.027 | 0.60 0.025 | 0.90 0.053 | 1.20 0.036 | 1.50 0.036 | 1.80 0.015 | 1.86 0.009 | 2.01 CB	0.135	0.027	2.01
	3	3.27	+40	1.225	0.00 0.002 | 0.35 0.031 | LOD to .59 | 0.90 0.076 | 1.20 0.090 | 1.30 0.075 | 1.45 0.060 | CB	0.835	0.048	1.21
	3	4.05	+45	0.255	0.00 CB | 0.20 CB | 0.30 CB | 0.45 0.115 | 0.60 0.090 | 0.90 0.055 | 1.18 0.003	2.615	0.066	1.18
	3	4.09	+50	1.82	0.00 0.010 | 0.30 0.060 | 0.60 0.043 | 0.90 0.045 | 1.20 0.050 | 1.50 0.015 | 1.80 0.002	0.470	0.032	1.80
	3	5.04	+55	1.70	0.00 0.047 | 0.24 0.050 | LOD to | 0.355 0.100 | 0.60 0.085 | 0.90 0.038 | 1.30 0.003	2.155	0.054	1.19
	3	4.615	+59.5	0.93	0.00 CB | 0.20 0.065 | 0.60 0.120 | 0.90 0.090 | 1.20 0.105 | 1.43 0.090 | LOD | 1.55 0.025 | 1.80 0.025 | 1.85 0.003	2.185	0.065	1.5
	3	2.88	+62	0.50	0.00 0.045 | 0.30 0.116 | 0.60 0.120 | 0.90 0.130 | 1.20 0.066 | 1.50 0.020 | 1.61 0.002	0.770	0.071	1.61
	3	3.08	+67	0.04	CB 0.010 | 0.30 0.041 | 0.60 0.030 | 0.90 0.060 | 1.20 0.062 | 1.525 0.005	1.515	0.035	1.525
	3	3.30	+72	1.04	0.00 0.010 | 0.30 0.022 | 0.60 0.055 | 0.90 0.075 | 1.10 0.055 | CB to 2.26 M. Left	0.000	0.043	2.26
	3	3.02	+77	1.13	0.00 0.008 | 0.30 0.060 | 0.60 0.075 | 0.90 0.040 | 1.15 0.002	0.740	0.037	1.15
	3	3.37	+82	0.54	0.00 0.041 | 0.30 0.035 | 0.60 0.020 | 0.90 0.035 | 1.20 0.002 | 1.54 0.030	1.290	0.027	1.54
	3	4.25	+87	1.37	0.00 0.012 | 0.30 0.050 | 0.60 0.075 | 0.90 0.010 | 1.20 0.037 | 1.63 0.005	1.250	0.032	1.63
	3	3.67	+92	1.25	0.00 0.012 | 0.30 0.020 | 0.60 0.052 | 0.90 0.055 | 1.20 0.065 | 1.75 0.078 | 1.85 CB	0.570	0.047	1.85

Appendix Table 3. Results of Fish Habitat Assessment data collected at Whalley Creek, Section 3, 1994.

WHALLEY CREEK HABITAT ASSESSMENT, 1994(SECTION 3, Shore Rd. to Sewage Treatment Plant)

Transect Compass Orientat.	Start Marker Number	Stream Channel Width Meters Right to Left	Start Dist. From Marker Meters IE/I+30m	Distance from Right Bank to W. Edge Meters	Stream Depth Profile (Distance from the Waters Edge in Meters) Right												Left	Distance from Left Bank to W. Edge Meters	Mean Depth Along Transect	Total Wetted Width (Meters)
	3	4.46	+97	1.5	0.00	0.30	0.60	0.90	1.20	1.63								1.330	0.022	1.63
					0.020	0.025	0.000	0.015	0.040	0.009										
	3	4.00	+103	2.76	0.00	0.30	0.60	1.00										0.240	0.039	1.00
					0.015	0.065	0.065	0.010												
	3	2.81	+108	0.5	0.00	0.30	0.60	0.90	1.20	1.56								0.750	0.051	1.56
					0.050	0.054	0.090	0.011	0.010	0.091										
	3	3.95	+113	1.01	0.00	0.30	0.60	0.90	1.20	1.40								1.540	0.067	1.40
					0.040	0.081	0.100	0.085	0.056	0.040										
	3	2.80	+118	0.64	0.00	0.30	0.60	0.90	1.20	1.37								0.790	0.063	1.37
					0.015	0.070	0.055	0.104	0.080	0.055										
	3	3.59	+123	1.88	0.00	0.30	0.60	0.90	1.21									0.500	0.046	1.21
					0.010	0.030	0.035	0.076	0.080											
	3	2.97	+128	0.042	0.00	0.30	0.60	0.90	1.20	1.37								1.558	0.070	1.37
					0.025	0.092	0.100	0.125	0.055	0.020										
	3	3.59	+133	0.97	0.00	0.30	0.60	0.90	1.20									1.420	0.055	1.20
					0.044	0.105	0.080	0.041	0.003											
	3	3.10	+138	1.56	0.00	0.30	0.60	0.90	1.20									0.340	0.035	1.20
					0.003	0.048	0.052	0.055	0.015											
	3	3.87	+143	0.25	0.00	0.30	0.60	0.90	1.20	1.50	1.80	2.10	2.40	3.11				0.510	0.174	3.11
					0.010	0.082	0.180	0.247	0.230	0.215	0.220	0.310	0.195	0.052						
	3	2.54	+148	0.77	0.00	0.30	0.60	0.90	1.17									0.600	0.099	1.17
					0.060	0.110	0.105	0.098	0.120											
	3	2.89	+153	0.47	0.00	0.23	LOD	0.53	0.90	1.30								1.420	0.069	1.00
					0.010	0.071		0.110	0.115	0.040										
	3	2.87	+158	0.75	0.00	0.30	0.60	0.90	1.21									0.910	0.034	1.21
					0.005	0.024	0.053	0.030	0.060											
	3	2.97	+163	0.78	0.00	0.15	0.30	0.60	0.90	1.30								0.890	0.063	1.30
					CB	0.060	0.060	0.095	0.075	0.025										
	3	3.75	+168	0.87	0.00	0.30	0.60	0.90	1.20	1.56								1.320	0.119	1.56
					0.134	0.165	0.205	0.095	0.075	0.040										
	3	4.95	+173	2.22	0.00	0.30	0.60	0.90	1.20	1.60								1.130	0.058	1.60
					0.020	0.090	0.045	0.105	0.070	0.020										
	3	5.70	+ 178	1.8	0.00	0.30	0.60	0.90	1.20	1.64								2.260	0.084	1.64
					0.050	0.120	0.130	0.130	0.070	0.005										
	3	4.50	+183	0.81	0.00	0.30	0.60	0.90	1.20	1.50	1.60							2.090	0.046	1.60
					0.005	0.065	0.084	0.080	0.060	0.020	0.010									
	3	3.69	+188	0.69	0.00	0.30	0.60	0.90	1.20	1.50								1.500	0.050	1.50
					0.015	0.034	0.060	0.100	0.075	0.015										
	3	3.27	+193	0.77	0.00	0.30	0.60	0.90	1.20	1.58								0.920	0.069	1.58
					0.013	0.060	0.080	0.080	0.085	0.095										

Appendix Table 3. Results of Fish Habitat Assessment data collected at Whalley Creek, Section 3, 1994.

WHALLEY CREEK HABITAT ASSESSMENT, 1994(SECTION 3, Shore Rd. to Sewage Treatment Plant)

Transect Compass Orientat.	Start Marker Number	Stream Channel Width Meters Right to Left	Start Dist. From Marker Meters IE/I+20m	Distance from Righ Bank to W. Edge Meters	Stream Depth Profile (Distance from the Waters Edge in Meters) Right												Left	Distance from Left Bank to W. Edge Meters	Mean Depth Along Transect	Total Wetted Width (Meters)
					0.00	0.30	0.60	0.90	1.20	1.50	1.76									
	3	3.43	+198	0.80	0.080	0.120	0.150	0.140	0.120	0.140	0.050							0.870	0.114	1.76
					0.00	0.30	0.60	0.90	1.20	1.50	1.65									
	3	2.98	+203	0.20	0.018	0.060	0.095	0.155	0.160	0.095	0.050							1.130	0.090	1.65
					0.00	0.30	0.50	0.90	1.20	1.30										
	3	2.81	+209.85	0.24	0.085	0.090	0.050	0.060	0.020	0.030								1.270	0.056	1.30
					0.00	0.30	0.60	0.90	1.20	1.72										
	3	4.36	+220.85	0.69	0.055	0.145	0.160	0.140	0.850	0.005								1.950	0.226	1.72
					0.00	0.30	0.60	0.90	1.20	1.40										
	3	4.50	+234.25	0.83	0.380	0.490	0.510	0.460	0.410	0.455								2.270	0.451	1.40

Appendix Table 3. Results of Fish Habitat Assessment data collected at Whalley Creek, Section 3, 1994.

WHALLEY CREEK HABITAT ASSESSMENT, 1994(SECTION 3, Sewage treatment plant to Shore Rd.)

*Start Location From Marker	*Finish Location From Marker	Gradient %	*Start Location From Marker	Stream Orientation Compass			Start Distance From Marker	Discharge Parameters					Start Distance From Marker	Cover on the Transect Line Intercept									Stream Bank Vegetative Stability	
				Fore Sight	Back Sight	Dist. Between		Length in Meters						Right		Hab.	Mid.		Hab.	Left		Hab.	Left	Right
								Pool L x W	Pool Type	Riffle	Glide	Side Channel		R1	R2	Qty.	R1	R2	Qty.	R1	R2	Qty.	Bank	Bank
Culvert	3 + 2.59		Culvert	114	294	2.59	Culvert			20.47			3 + 0			7			7			7	1	1
3 + 2.59	3 + 8.21		3 + 2.59	54	234	5.62	3 + 20.47				4.43		3 + 5			7			7			7	1	1
3 + 8.21	3 + 10.54		3 + 8.21	360	108	2.33	3 + 24.9			4.63			3 + 10			7			7			7	1	1
3 + 10.54	3 + 13.3		3 + 10.54	60	244	2.76	3 + 29.53				4.67		3 + 15			7			7			7	1	1
3 + 13.3	3 + 24.74		3 + 13.3	92	272	11.44	3 + 34.2			5.36			3 + 20			7			7	10		6	1	1
3 + 24.74	3 + 28.23		3 + 24.74	80	260	3.49	3 + 39.56				6.74		3 + 25			7			7			7	1	1
3 + 28.23	3 + 35.87		3 + 28.23	43	223	7.64	3 + 46.3			4.76			3 + 30			7			7			7	1	1
3 + 35.87	3 + 44.61		3 + 35.87	64	244	8.74	3 + 51.06				2.45		3 + 35			7			7			7	1	1
3 + 44.61	3 + 47.97		3 + 44.61	34	214	3.36	3 + 53.51			6.12			3 + 40			7	2		6			7	1	2
3 + 47.97	3 + 52.14		3 + 47.97	58	238	4.17	3 + 59.63	1.97	6				3 + 45	10		6			7			7	1	1
3 + 52.14	3 + 55.65		3 + 52.14	98	278	3.51	3 + 61.6				4.0		3 + 50			7			7			7	1	1
3 + 55.65	3 + 64.80		3 + 55.65	76	256	9.15	3 + 65.6			4.31			3 + 55	3		6			7			7	2	1
3 + 64.80	3 + 90.15		3 + 64.80	76	256	25.35	3 + 69.91				3.32		3 + 59.5	3		6	3		6	2		6	1	1
3 + 90.15	3 + 99.75		3 + 90.15	98	280	9.60	3 + 73.23			4.78			3 + 62	3		6	3		6	2		6	1	1
3 + 99.75	3 + 107.05		3 + 99.75	108	288	7.30	3 + 78.01				1.9		3 + 67			7			7			7	1	1
3 + 107.05	3 + 117.86		3 + 107.05	86	266	10.81	3 + 79.91			11.4			3 +72			7			7	10		6	1	1
3 + 117.86	3 + 127.83	1.0%	3 + 117.86	100	280	9.97	3 + 91.31				4.9		3 + 77			7			7	10		6	1	1
3 + 127.83	3 + 135.65		3 + 127.83	84	264	7.82	3 + 96.21			1.8			3 + 82	8		6			7			7	1	1
3 + 135.65	3 + 148.00		3 + 135.65	90	270	12.35	3 + 98.01						3 + 87			7			7			7	3	1
3 + 148.00	3 + 154.17		3 + 148.00	118	298	6.17	3 + 103.31			4.2			3 + 92			7			7	10		6	1	1
3 + 154.17	3 + 159.07		3 + 154.17	128	308	4.90	3 + 107.51				10.88		3 + 97	2	3	6	2	3	6	2	3	6	2	1
3 + 159.07	3 + 162.56		3 + 159.07	110	290	3.49	3 + 118.39			1.62			3 + 103	3		6	3		6	3		6	1	1
3 + 162.56	3 + 173.9		3 + 162.56	74	254	11.34	3 + 119.98				3.3		3 + 108	3		6	3		6	3		6	1	1
3 + 173.9	3 + 180.24		3 + 173.9	94	274	6.34	3 + 123.28			8.71			3 + 113			7			7			7	1	2
3 + 180.24	3 + 203.40		3 + 180.24	80	260	23.16	3 + 131.99				1.56		3 + 118			7			7			7	1	1
3 + 203.40	3 + 212.64	2.0%	3 + 203.40	73	253	9.24	3 + 133.55			2.74			3 + 123			7			7			7	1	1
3 + 212.64	3 + 217.63		3 + 212.64	24	204	4.99	3 + 136.29				1.99		3 + 128			7			7			7	1	1
3 + 217.63	3 + 223.08		3 + 217.63	42	222	5.45	3 + 138.28			3.15			3 + 133			7			7			7	1	1
3 + 223.08			3 + 223.08	73	253	12.04	3 + 141.43	4.3					3 + 138			7			7			7	1	1
							3 + 145.73				11.55		3 + 143	11	10	6	11		6	11		6	1	1
							3 + 157.28			6.0			3 + 148			7			7			7	1	2
							3 + 163.28				71.5		3 + 153	2		6	2		6	2		6	2	1
							3 + 234.78	Culvert					3 + 158			7			7			7	1	1
													3 + 163	10	7	6			7			7	2	2
													3 + 168			7			7			7	2	2
													3 + 173			7			7			7	2	2
													3 + 178			7			7			7	1	1
													3 + 183			7			7			7	1	1
													3 + 188			7			7			7	1	1
													3 + 193			7			7			7	1	1
													3 + 198			7			7			7	1	1
													3 + 203			7			7			7	1	1
													3 + 209.85			7			7			7	1	1
													3 + 220.85			7			7			7	1	1
													3 + 234.25	12		6	12		6	12		6	1	1

Appendix Table 3. Results of Fish Habitat Assessment data collected at Whalley Creek, Section 3, 1994.

* Distance was measured with an electronic device

POOL CODES

Backwater pool associated with boulders = 1
Backwater pool associated with rootwad = 2
Backwater pool associated with LWD = 3
Trench pool associated with bedrock = 4
Secondary channel pool = 5

POOL CODES

Plunge pool associated with LWD = 6
Lateral Scour pool associated with LWD = 7
Lateral Scour pool associated with rootwad = 8
Lateral Scour pool associated with bedrock = 9
Dammed pool associated with LWD = 10

Streambank Vegetative Stability (To top of bank)

4 = 80% of streambank surface is covered by vegetation, gravel or larger material that does not allow bank erosion.
3 = 50 to 79% of bank surfaces are covered by vegetation, gravel or larger material, allowing minor erosion.
2 = 25 to 49% of bank surfaces are covered by vegetation, gravel or larger materials, allowing major erosion.
1 = <25% of banks are covered by vegetation, gravel or larger material, banks erode each year with high water.
0 = No vegetation

COVER RATING CODES;

1 = Lardge LWD (>50 cm.)
2 = Med. LWD (20 to 50 cm.)
3 = Small LWD (10 to 20 cm.)
4 = Very large boulders (406.4 to 203.2 cm.)
5 = Large Boulders (203.2 to 101.6 cm.)
6 = Med. boulders (101.6 to 50.8 cm.)
7 = Small Boulders (50.8 to 25.4 cm.)
8 = Overstream Vegetation
9 = Instream Vegetation
10 = Catbank
11 = Pool (see discharge par. for type)
12 = Culvert

HABITAT QUALITY CODES:

1 = Good (Adult) 7 = No Habitat
2 = Good (Juv.)
3 = Average (Adult)
4 = Average (Juv.)
5 = Poor (adult)
6 = Poor (Juv.)

Appendix Table 3. Results of Fish Habitat Assessment data collected at Whalley Creek, Section 3, 1994.

WHALLEY CREEK HABITAT ASSESSMENT, 1994 (SECTION 3, Sewage Treatment Plant to Shore Rd.)

Start Marker Number	Start Distance From Marker ie/ 1 + 20m	Bank Height (Meters)		Bank Stability		Bank Composition: Fines = 1, Sm. Gravel = 2, Lg. Gravel = 3, Sm. Cobble = 4, Lg. Cobble = 5, Boulder = 6						Cutbank Dimensions						
						Right Bank			Left Bank			Start Distance From Marker	End Distance From Marker	US. End of Cutbank		Mid. Point of Cutbank		DS. End of Cutbank	
		R	L	R	L	R1	R2	R3	R1	R2	R3			Vert. Depth (m)	Horz. Depth (m)	Vert. Depth (m)	Horz. Depth (m)	Vert. Depth (m)	Horz. Depth (m)
3	+0	0.91	0.94	2	2	13	11	3	13	2		3+41.2R	3+46.22	0.095	0.30	0.15	0.45	0.05	0.10
3	+5	0.92	0.42	2	1	13	2	3	11	2	3	3+68.99L	3+73.4	0.13	0.10			0.18	0.12
3	+10	1.685	0.25	0	0	13	2	3	13	3	2	3+75.0L	3+77.0	0.06	0.13	0.20	0.315	0.18	0.12
3	+15	1.37	0.12	0	2	13	2	3	11	2	3	3+91.5L	3+95.8	0.19	0.33	0.30	0.50	0.14	0.115
3	+20	1.22	1.27	0	0	13	2	12	13	2	12	3+141.7R	3+146.95	0.46	0.20	0.90	0.58	0.30	0.20
3	+25	1.51	1.45	2	2	13	2	3	13	2	12	3+143.89L	3+146.49	0.06	0.11	0.20	0.35	0.15	0.10
3	+30	1.13	1.31	0	1	13	2	12	13	2	12	3+162.77R	3+163.0	0.14	0.12	0.13	0.16	0.07	0.07
3	+35	1.26	NB	1	1	13	2		13	2									
3	+40	1.295	1.26	2	2	13	2	3	13										
3	+45	1.325	1.43	3	2	13	12	2	13	2									
3	+50	1.40	1.23	4	2	13	2	12	13	12	2								
3	+55	1.58	2.54	2	4	13	2	12	13	2	3								
3	+59.5	1.24	1.92	2	4	13	2	12	13	2	3								
3	+62	1.10	1.57	3	2	13	2	12	13	2	12								
3	+67	1.28	1.37	3	2	13	12	2	13	2	12								
3	+72	1.10	1.91	4	2	13	2	12	13	2	12								
3	+77	0.935	1.79	3	3	13	2	12	13	2	12								
3	+82	0.97	1.15	4	4	13	2	12	13	2	12								
3	+87	1.24	1.34	2	2	13	2	12	13	2	12								
3	+92	1.155	1.39	2	3	13	2	3	13	2	12								
3	+97	1.39	1.41	3	4	13	2	12	13	2	12								
3	+103	0.85	0.73	3	3	13	12		13	12									
3	+108	0.65	1.41	1	1	13	2	12	13	3	2								
3	+113	0.53	0.76	2	1	13	2	12	13	2	12								
3	+118	0.63	0.87	2	1	13	2	3	13	12	4								
3	+123	0.93	0.85	2	3	13	2		9	2									
3	+128	0.85	1.19	3	2	9	2		13	2	12								
3	+133	1.09	1.44	4	3	9	11	2	9	11	2								
3	+138	1.16	1.38	3	2	9	2	3	13	2	12								
3	+143	1.21	1.26	3	3	13	12	2	13	12	2								
3	+148	0.27	1.28	1	1	13	12		13	5	12								
3	+153	0.34	0.83	4	3	8			13	12	2								
3	+158	0.69	1.13	2	1	8	12		13	12	2								
3	+163	0.6	1.18	1	1	13	12	2	13	12	2								
3	+168	0.6	1.05	2	2	13	12		13	12									
3	+173	0.42	1.33	2	2	13	6	12	13	12									

Appendix Table 3. Results of Fish Habitat Assessment data collected at Whalley Creek, Section 3, 1994.

WHALLEY CREEK HABITAT ASSESSMENT, 1994 (SECTION 3, Sewage Treatment Plant to Shore Rd.)

Start Marker Number	Start Distance From Marker ie/ 1 + 20m	Bank Height (Meters)		Bank Stability		Bank Composition: Fines = 1, Sm. Gravel = 2, Lg. Gravel = 3, Sm. Cobble = 4, Lg. Cobble = 5, Boulder = 6						Cutbank Dimensions: Start Distance From Marker	End Distance From Marker	US. End of Cutbank		Mid. Point of Cutbank		DS. End of Cutbank	
						Right Bank			Left Bank					Vert. Depth (m)	Horz. Depth (m)	Vert. Depth (m)	Horz. Depth (m)	Vert. Depth (m)	Horz. Depth (m)
		R	L	R	L	R1	R2	R3	R1	R2	R3								
3	+178	0.32	1.08	2	2	8	LOD	12	8	12									
3	+183	0.39	1.16	2	2	8	12		8	12									
3	+188	0.65	1.49	2	2	13	12		13	12	5								
3	+193	0.55	1.25	2	2	13	12	4	13	12									
3	+198	0.31	1.34	2	2	8	12		8	12									
3	+203	0.27	1.04	2	2	8	12		8	12	6								
3	+209.85			2	2	8	12		8	12	6								

BANK COMPOSITION CODES

Bedrock =7 Rootwad = 10 Soil = 13
Mud = 8 Sand = 11
Clay = 9 Riperian Rootmass = 12

BANK STABILITY CODES

0 = Stable no errosion NB = Bank not clearly defined. FP = Flood Plain
1 = 1 to 25% Stream banks are slightly altered along the transect line.
2 = 26 to 50 % streambanks are recieving moderate alteration along the transect line.
3 = 51 to 75% streambanks have recieved major alteration along the transect line.
4 = 76 to 100% streambanks are severly altered along the transect line.

Appendix Table 3. Results of Fish Habitat Assessment data collected at Whalley Creek, Section 3, 1994.

WHALLEY CREEK HABITAT ASSESSMENT, 1994 (SECTION 3,Shore Rd. to Sewage Treatment Plant)

Start Marker Number	Start Distance From Marker	SUBSTRATE COMPOSITION												Compaction Check One			Embedded Substrate		Embedded Substrate Code
		R1			R2			R3			R4								
		Q1	Q2	Q3	Q1	Q2	Q3	Q1	Q2	Q3	Q1	Q2	Q3	1	2	3	Yes	No	
3	+0	4			3			2			1			x					
3	+5	4			3			2			1			x					
3	+10	4			3			2			1			x					
3	+15	4			3			2			1				x				
3	+20	1			2			1						x					
3	+25	4			3			2			1			x					
3	+30	1			3			2			4				x		x		2
3	+35	3			2			1			4				x				
3	+40	3			2			1							x				
3	+45	3			2			1			4			x					
3	+50	1			2			3							x				
3	+55	4			3			2			1				x				
3	+59.5	1			2			5			1			x					
3	+62	10			1			2			2			x					
3	+67	1			2			5							x				
3	+72	2			3			4			5				x				
3	+77	2			5			3			6			x					
3	+82	2			4			3						x					
3	+87	2			3			5			4				x				
3	+92	4			2			3			1					x			
3	+97	3			4			2			1			x					
3	+103	1			2									x					
3	+108	2			3			1						x					
3	+113	1			2									x					
3	+118	3			2			1						x					
3	+123	2			3			1						x					
3	+128	2			1			3						x					
3	+133	2			1			3						x					
3	+138	2			1			3						x					
3	+143	8			1									x					
3	+148	8			10									x					
3	+153	8			5									x					
3	+158	4			3			2			1			x					
3	+163	5			4			2						x					
3	+168	8			2			3						x					
3	+173	8			8			5			10			x					
3	+178	8			10									x					

LEGEND

RANK CODES

R1 = Most Predominate substrate

R2 = Second most Predominate

R3 = Third most Predominate

R4 = Fourth most Predominate

SUBSTRATE CODES

1 = fines (< 2 mm.)

2 = small gravel (2 mm. to 16 mm.)

3 = large gravel (16 mm. to 64 mm.)

4 = small cobble (64 mm. to 128 mm.)

5 = large cobble (128mm. to 256 mm.)

6 = boulder (>256 mm.)

7 = bedrock

8 = Mud

9 = clay

10 = Organic debris

Compaction Codes

1 = loose (can dislodge with foot)

2 = med. (some movement)

3 = high (no movement)

Embeddedness Codes

1 = 100% to 76% embedded

2 = 75% to 51% embedded

3 = 50 tp 26% embedded

4 = 25% to 1% embedded

5 = 0% embedded

Appendix Table 3. Results of Fish Habitat Assessment data collected at Whalley Creek, Section 3, 1994.

WHALLEY CREEK HABITAT ASSESSMENT, 1994 (SECTION 3,Shore Rd. to Sewage Treatment Plant)

Start Marker Number	Start Distance From Marker	SUBSTRATE COMPOSITION												Compaction Check One			Embedded Substrate		Embedded Substrate Code
		R1			R2			R3			R4								
		Q1	Q2	Q3	Q1	Q2	Q3	Q1	Q2	Q3	Q1	Q2	Q3	1	2	3	Yes	No	
3	+183	1			8			10						x					
3	+188	8			1									x					
3	+193	8			5									x					
3	+198	8												x					
3	+203	1			8									x					

LEGEND

RANK CODES

R1 = Most Predominate substrate
R2 = Second most Predominate
R3 = Third most Predominate
R4 = Fourth most Predominate

SUBSTRATE CODES

1 = fines (< 2 mm.)
2 = small gravel (2 mm. to 16 mm.)
3 = large gravel (16 mm. to 64 mm.)
4 = small cobble (64 mm. to 128 mm.)
5 = large cobble (128mm. to 256 mm.)
6 = boulder (>256 mm.)
7 = bedrock
8 = Mud
9 = clay
10 = Organic debris

Compaction Codes

1 = loose (can dislodge with foot)
2 = med. (some movement)
3 = high (no movement)

Embeddedness Codes

1 = 100% to 76% embedded
2 = 75% to 51% embedded
3 = 50 tp 26% embedded
4 = 25% to 1% embedded
5 = 0% embedded

Appendix Table 4. LWD Results during Fish Habitat Assessment on Whalley Creek, Sectoins 1 through 3, 1994.

Habitat Inventory Whalley Creek, 1994 (Sections 1 through 3)

Start Distance From Marker (ie/ 41 + 55)	Finish Distance From marker (ie/42 + 9)	Compass Orientation Looking D. Stream	Length of LWD (m)	Diameter of LWD US (m)	Diameter of LWD DS (m)	Position of LWD * see codes US	Position of LWD * see codes DS	Location of LWD (m) Relative to Right Bank US (m)	Location of LWD (m) Relative to Right Bank DS (m)	Height Above Streambed US	Height Above Streambed DS	Cover Type	Habitat Type Created	Species
1+59.0	1+60.8	194	1.8	0.3	1.4	2	2	1.3				5	3	1
1+72.89	1+83.34	70	10.45	0.30	0.45	0,2,3	0,2		0.91	0.37	0.66	4	3	3
1+106.45	1+109.0	6	2.55	0.39	0.40	2	0,3		1.9		0.2	4	3	3
1+110.3	1+111.55	332	1.25	0.55	0.50	3	1		1.7			4	3	3
1+111.1	1+112.8	44	1.70	0.60	0.40	1	1		2.00			5	3	8
1+123.19	1+124.85	352	1.65	0.60	0.33	2	2	1.30	1.57			4	3	8
2+111.0	2+113.7	148	2.70	0.43	*	2	1	*Embedded	Right bank			4	3	3
2+137.36	2+140.96	110	3.60	0.23	0.36	2	0	3.06	On R.bank		0.38	4	3	3
2+143.45	2+156.51	86	13.06	0.72	0.22	0	0	On R.bank	1.75	2.14	0.241	4	3	3
2+145.85	2+155.5	90	9.65	0.30	0.30	0	0	Embedded	1.75	0.55	0.9	4	3	2
2+166.75	Perpendicular	164	10.29	0.40	0.80	0	3			0.26		4,5	3	3
2+173.40	2+177.40	134	4.00	0.23	0.17	2	1	1.21	3.65			4	3	3
3+55.34	3+56.74	132	1.40	0.345	0.39	2	1	1.40	Embedded			4	1	3
3+55.7	3+62.20	92	6.5	0.11	0.15	2	0	2.00	2.8		0.41	4	3	3
3+98.8	3+102.62	160	3.83	0.38	0.26	0	0	Embedded	0.6	0.39	0.35	4	1	2
3+97.4	3+100.95	60	3.55	0.15	0.27	2	2	0.20	0.59			4	3	2
3+98.8	3+102.04	60	3.24	0.30	0.234	2	2	1.00	1.34			4	3	2
3+98.8	3+101.44	52	2.64		0.63	1	1	1.25	1.87			4	3	2
3+151.33	3+156.81	146	5.48	0.31	0.24	1	1	1.50	0.00		0.15	4	3	2

Legend

LWD POSITION

0 = above surface
1 = embedded
2 = on streambed
3 = on riverbank

HABITAT TYPES CREATED

0 = no habitat
1 = winter habitat
2 = summer habitat
3 = summer and winter habitat

COVER TYPES

1 = branch
2 = limb
3 = whole tree
4 = stem
5 = Root mass
6 = Living Tree

SPECIES

1 = fir
2 = alder
3 = cedar
4 = hemlock
5 = pine
6 = spruce
7 = willow
8 = maple
9 = unknown

***For Height above Streambed, fill out only if LWD Position = 0

Appendix Table 5. Bank Slope at Whalley Creek, Sections 1 through 3, 1994.

Location		Right Bank Looking Downstream (top to bottom of Bank)				Left Bank Looking Downstream (top to bottom of Bank)			
Section Number	Marker Number	Length m.	Height m.	Slope Percent	Total Mean Slope	Length m.	Height m.	Slope Percent	Total Mean Slope
3	+0	3.40				2.60	1.00	38.46%	
3	+10	3.80	1.75	46.05%		0.70	0.43	61.43%	
						0.24			
3	+20	4.46	2.01	45.07%		3.60	1.32	36.67%	
		0.99	0.17	17.17%	31.12%				
3	+35	7.24	1.78	24.59%		7.85	1.94	24.71%	
3	+45	1.48	1.48	100.00%		1.45	1.17	80.69%	
			—			1.05	0.43	40.95%	
						0.86	0.14	16.28%	45.97%
3	+55	2.20	0.45	20.45%			2.21		
		0.20	0.28	140.00%	80.23%	1.375	0.49	35.64%	
						0.95	0.04	4.21%	19.92%
3	+72	0.92	0.92	100.00%		2.20	1.72	78.18%	
3	+82	2.20	1.33	60.45%		3.10	0.95	30.65%	
						1.416	0.98	69.21%	
									33.28%
3	+97	0.75	0.56	74.67%		1.52	0.47	30.92%	
		0.70	0.82	117.14%		1.05	1.05	100.00%	65.46%
		0.60	0.51	85.00%	92.27%				
3	+113	0.56	0.56	100.00%		1.07	0.55	51.40%	
						1.25	0.68	54.40%	52.90%
3	+128	0.86	0.86	100.00%		1.55	0.74	47.74%	
						0.43	0.43	100.00%	73.87%
3	+143	1.29	1.29	100.00%		1.50	0.67	44.67%	
						0.90	0.76	84.44%	64.56%
3	+153	0.70	0.39	55.71%		3.00	1.21	40.33%	
						1.37	0.88	64.23%	52.28%
3	+163	0.95	0.33	34.74%		4.84	1.29	26.65%	
		0.35	0.25	71.43%	53.08%	1.55	0.73	47.10%	
						1.22	0.83	68.03%	47.26%
3	+188	1.20	0.40	33.33%		5.72	2.06	36.01%	
		1.92	0.44	22.92%	28.13%	1.50	0.13	8.67%	
						2.05	0.87	42.44%	
						1.60	0.94	58.75%	36.47%
3	+209.85	0.36	0.35	97.22%		1.26	0.99	78.57%	
2	+195	3.87	2.56	66.15%		4.48	2.05	45.76%	
		4.04	1.03	25.50%	45.82%	3.34	0.17	5.09%	
						2.60	0.93	35.77%	28.87%
2	+184	3.82	2.99	78.27%		2.28	0.53	23.25%	
		2.84	0.49	17.25%	47.76%	0.22	0.22	100.00%	61.62%
2	+159	2.50	1.12	44.80%		4.92	4.18	84.96%	
		1.30	0.29	22.31%		0.25	0.22	88.00%	86.48%
		0.40	0.36	90.00%					
		0.85	0.85	100.00%					
		2.50	1.25	50.00%					
		1.40	0.10	7.14%					
		0.45	0.27	60.00%	53.46%				
2	+124	6.36	4.56	71.70%		7.47	3.66	49.00%	
		0.80	0.68	85.00%	78.35%	1.50	1.56	104.00%	76.50%

Appendix Table 5. Bank Slope at Whalley Creek, Sections 1 through 3, 1994.

Location		Right Bank Looking Downstream (top to bottom of Bank)				Left Bank Looking Downstream (top to bottom of Bank)			
Section Number	Marker Number	Length m.	Height m.	Slope Percent	Total Mean Slope	Length m.	Height m.	Slope Percent	Total Mean Slope
2	+96	1.80	0.98	54.44%		2.00	0.75	37.50%	
		2.00	1.24	62.00%		1.40	0.95	67.86%	52.68%
		2.10	1.95	92.86%	69.77%				
2	+73	4.50	3.81	84.67%		3.53	3.73	105.67%	
						0.45	0.93	206.67%	
						10.02	1.5	14.97%	109.10%
2	+51	2.43	0.94	38.68%		2.16	0.76	35.19%	
		4.74	1.52	32.07%		5.05	1.68	33.27%	34.23%
		4.03	2.49	61.79%	44.18%				
2	+33	6.57	3.43	52.21%		4.90	2.33	47.55%	
		3.13	0.30	9.58%					
		0.4	0.44	110.00%	57.26%				
2	+5	2.24	3.70	165.18%		3.92	1.16	29.59%	
						1.80	0.96	53.33%	41.46%
1	+224	2.67	1.57	58.80%		4.76	2.17	45.59%	
						1.03	0.14	13.59%	
						0.90	0.35	38.89%	32.69%
1	+201	5.50	2.10	38.18%		10.60	3.12	29.43%	
		2.30	0.25	10.87%	24.53%				
1	+168	4.49	1.58	35.19%		6.01	3.25	54.08%	
						4.12	0.31	7.52%	30.80%
1	+105	10.19	3.75	36.80%		9.75	5.26	53.95%	
		1.10	0.65	59.09%	47.95%				
1	+51	12.00	5.60	46.67%		12.67	5.68	44.83%	
		1.70	1.26	74.12%	60.39%	2.71	0.87	32.10%	38.47%

Appendix 6. Electroshocking Supplemental Notes

1. M3+67 to M3+72 - two cutthroat fry in the glide. Both fish are in good condition.

2. 1 cutthroat present in the pool (right bank) below the debris jam above (~8 cm.) M3+97. No fish were found along the left bank.

3. Bypassed the debris jam.

4. All but 1 cutthroat was from the pool and inside the culvert at the sewage treatment plant. Numbers are probably higher. The battery on the electroshocker died. Each time the anode was placed in the culvert 2 to 3 cutthroat were pulled out therefore, cutthroat probably utilize the area through the culvert to the face of the weir.

5. Cutthroat were distributed throughout this section. One was a 1+, the rest were probably sub 1's.

6. Cutthroat in the pool/glide near 185 (95%) and 113, most were sub 1's, one very small 1+.

7. No cutthroat were found in the culvert at 2+51. The majority were out of the plunge pool at 2+31.

8. Majority @ pool 2+19, three fish were over 1.5 grams.

9. Most fish were from the pool @ 110, all fish were small.

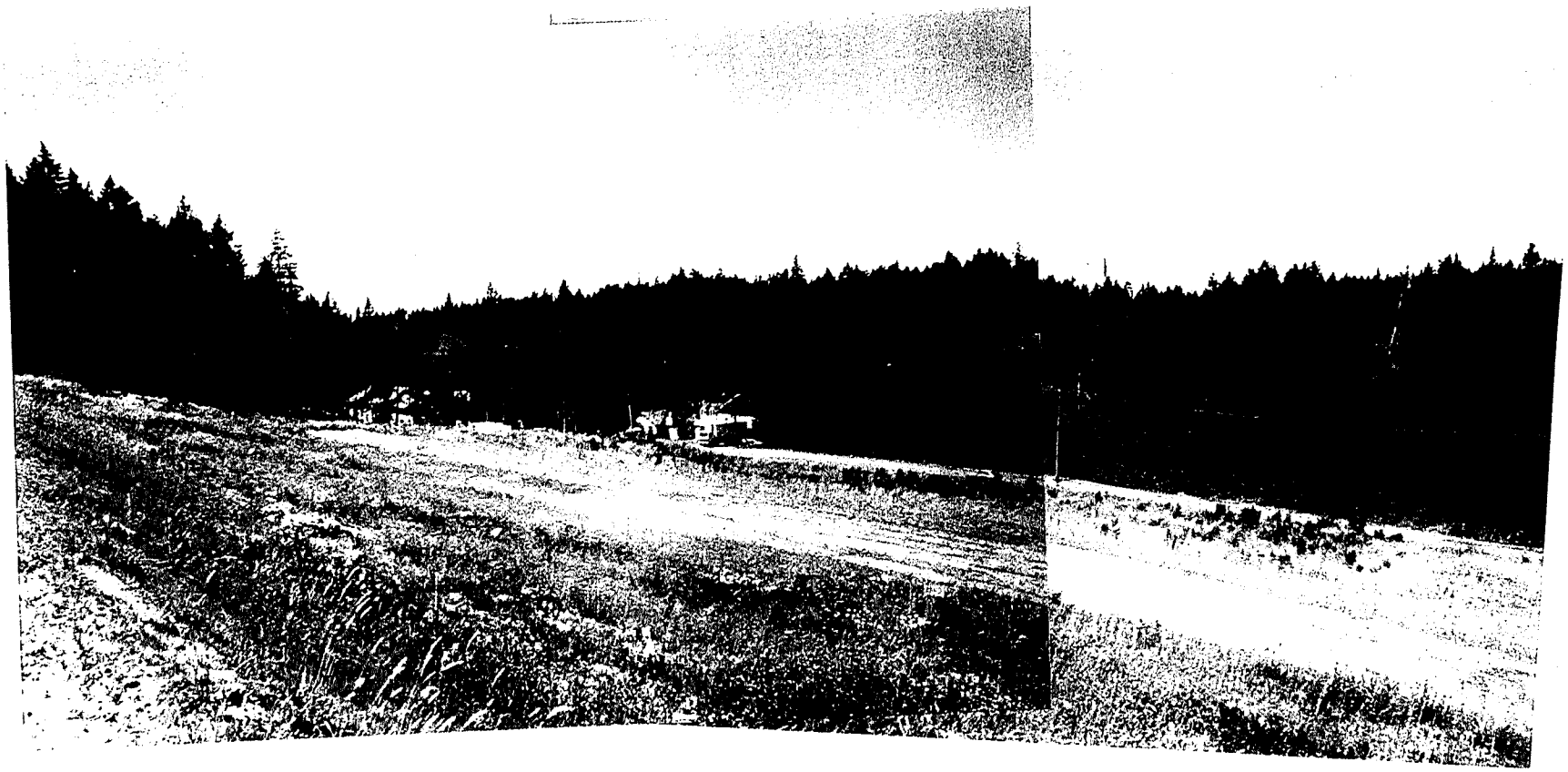
10. All fish were very small and skinny.

11. Includes LOD (ie\tree) approximately 5.5 to 10 grams.

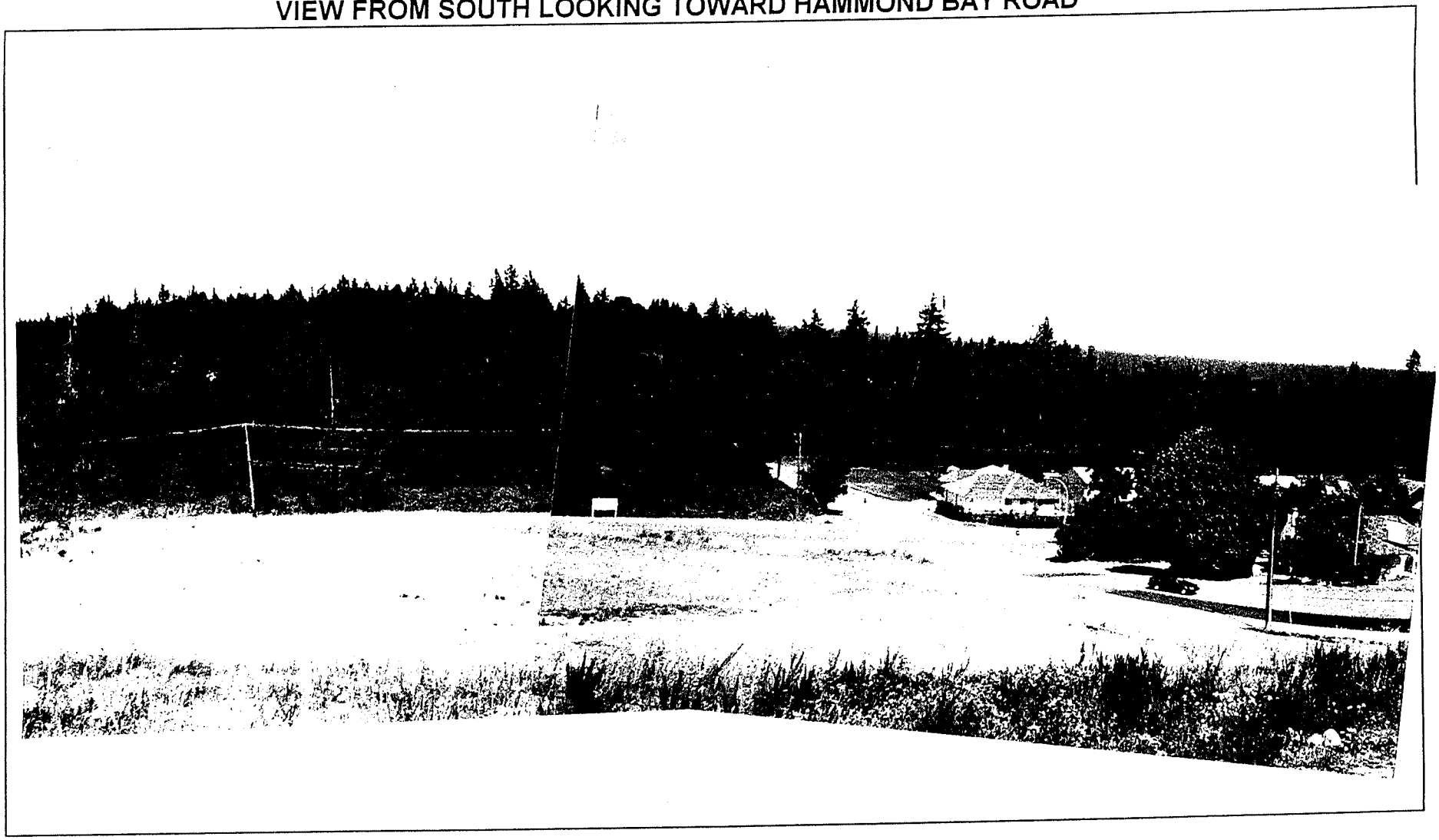
12. most fish were founds in the pool at 1+56.

13. In pool above the debris jam and one at the high tide mark.

VIEW FROM SOUTH LOOKING TOWARD HAMMOND BAY ROAD



VIEW FROM SOUTH LOOKING TOWARD HAMMOND BAY ROAD



SOUTHWEST CORNER: MCGUFFIE & HAMMOND BAY ROADS

INTERIOR OF LOT 1, PLAN 32351 FROM SHORES DRIVE