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Report 135

A REPORT ON THE IMPROVEMENT WORK ON THE GAMBLE AND

RIFLE RIVERS

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Before improvement, Gamble Creek was not a very favorable place for trout of legal size. The stream was almost uniformly shallow, especially in the upper section above Fontinalis Creek. This particular section of the stream was too wide, without pools, and about ankle deep. There was neither coarse gravel nor rubble, and no good riffles. As a result of having this kind of bottom there was very little food suitable for the larger trout. Various minute forms and amphipods (freshwater "shrimp") were present, but the larger riffle-loving forms such as certain mayfly larvae, caddis fly larvae and stone fly larvae were absent or very scarce. In all of my investigations I did not find a single stone fly larvae.

Not only was there an absence of pools but shelter for larger trout was very poorly developed. What shelter existed was suitable only for young trout.

Because of the foregoing conditions, improvement of the Gamble would of necessity be mainly directed toward the creation of conditions necessary for the production and welfare of trout of a legal size. Since the stream was already more suitable for small fish than for large ones and since a nursery was being maintained, I directed my main efforts toward improving the stream for trout of a legal size. I think it was desired not to make the Gamble a nursery for young trout but to make it a stream where trout fishing would be profitable and enjoyable.

To accomplish this the stream was made narrower and swifter by means of

deflectors. A combination of a deflector and a cover were used to create pools. The deflector confined and accelerated the current, <sup>and</sup> directed by it against a cover below. The front log of the cover then forced the current down so as to dig a hole below. In this way protected pools were formed in the desired places. Where the the water was already deep enough, cover or shelter alone was added. Even these covers deepened the underlying pools, by forcing the current to dig.

The absence of pools and shelter was the main limiting factor in the production of legal trout in the Gamble. Trout will not stay in a section where there are no pools. They can and do feed in a shallow swift section but they do not remain there. They desire some deep, quiet pool where they need not be continuously fighting the current in order to maintain their positions. Pools alone are not sufficient, however; shelter also must be provided. Many streams have pools that are so exposed that trout will not stay in them. And many pools have some cover, but it is not sufficient or of the right kind to give shelter to the larger trout. Good-sized trout will be found to stay in a small pool, providing the cover is adequate and of the right kind to give them sufficient shelter. In providing pools and shelter in the Gamble we removed one of the limiting factors of the stream and increased its carrying capacity for trout. The creating of pools and cover in formerly shallow areas not only enables trout to stay in sections where they could not stay before, but it also makes a greater food supply available. They can now feed in these shallow areas where they could not do so before, due to the fact that there was no cover near by to which they could retreat in time of danger. Trout usually do not range far from their shelter and thus if they are to utilize the whole stream pools and cover must be scattered along the entire stream course.

Attention was also given to the improvement of the food supply Riffles were created by accelerating the current with deflectors. This accelerated current removed

the sand, formed it into bars behind the barriers, and so uncovered extensive gravel areas. This added greatly to the food supply since gravel bottom is very much more productive than sand. The riffles produced became the larders of the stream. They are the home of the larger forms of insect life which are necessary for larger trout. While in 1931 the larger forms of aquatic insects were scarce, and I was unable to find any stone flies whatsoever, this year, just one year after improvement with the production of riffles, I found stone flies in practically the whole length of the stream. This obviously shows that when we produce the correct environment for aquatic animal life of any kind; it will come in and increase without further effort on our part provided there is a <sup>nearby</sup> sufficiently ~~near~~ stock. The creation of suitable habitats has also increased the numbers of other insects suitable for the larger trout.

The mucky deposits which have collected on the bars in the quiet water behind the deflectors have assisted in the production of food. These mucky areas are even richer in food production than the gravel areas. Not only do they produce harrowing mayflies which are suitable for large trout but they are especially rich in food for young trout. The shallow, quiet, warm water areas behind the barrier became nurseries for young trout. These nurseries can be further improved by fastening brush to the tops of the deflectors, allowing it to float on these shallow flats. In this way we can prepare an ideal place for the rearing of young trout, since there is provided warm, quiet water, and suitable food and shelter from birds and larger fish.

Since these mucky areas are such great food producers the establishing of any of these areas will be a decided benefit to a stream. During the past year over 2,575 sq. ft. of these mucky areas have been produced behind the deflectors in the Gamble. This means a tremendous increase in food production.

Plant beds produce more food than any other types of bottom. Although the barriers had been installed only one year when I checked the work; I found plant beds were already beginning on many of the mucky areas in the still water behind the deflectors. A total of over 1,890 sq. ft. of plant beds have been produced behind the

deflectors. This will mean an enormous increase in the amount of food produced in the stream. Not only are the plant beds rich in food but they give shelter to the young fish and furnish food directly for some species. These plant beds are a great benefit to the stream and they should be even more of a benefit by next year.

Brush shelters can become profitable if correctly installed. Brush should be put on top of the deflectors to furnish hides for the young fish. This is one of the best methods of installing brush shelters. If the brush is put directly on the bottom or in a pile bound down tightly it will fill up with mud in a short time and be of no use. Brush should not be put under or around the covers which I have installed below the deflectors. This had been done in several cases and it was causing the pools which had been formed under them to fill up. In <sup>one</sup> case a pool had been filled in to the depth of 8 inches. In many instances I clean brush and rubbish out to form these pools and it would defeat the purpose of the improvement work to put brush back in at these bends. They were formerly so filled up and choked that they were useless and the rubbish had to be removed before a pool could be ~~found~~<sup>formed</sup>. Putting brush around these covers would make it hard or impossible to fish there. The greatest need in the Gamble is deep pools for large fish so that the fishermen can get a catch when they go to the stream. Brush can be added at other places and these pools should be reserved for the larger fish.

In all 97 barriers were installed in Gamble Creek and 51 in the Rifle River. Those in the Gamble are numbered 641 to 732, inclusive, and those in the Rifle are numbered 732 to 785, inclusive.

The improvement work on the Rifle River was done after I left Grousehaven. I had laid out the work and marked the place where each barrier was to be placed, specifying the type to be used.

The work on the Rifle on the whole is fairly good but there are some points which should have received greater attention. The stakes used were not long enough, and too few of them were used to hold the barriers. Since the Gamble is a small stream the covers placed in it were necessarily small and it naturally follows that

since the Rifle is a much larger stream the covers built in it would be much larger. The men built the covers larger but they continued to use the same number of stakes that were used in the Gamble. This number has proven to be inadequate and some of the barriers went out due to the stakes pulling. Since the covers in the Rifle were much larger at least twice as many stakes should have been used there as in the Gamble. They also should have been longer as the water was deeper. Only three stakes were used to hold a large tepee cover. At least 6 should have been used and they should have been longer.

In the Rifle, gravel areas have been exposed, bars have been formed which are now covered with a mucky deposit, and plant beds have begun to grow in them. Thus good conditions have been <sup>produced</sup> ~~improved~~ in the Rifle as in the Gamble. Cover has been placed over the pools and some new pools have been formed.

In describing the results of the improvement work I have taken up each barrier in detail and explained just what it has accomplished; I have compared the present conditions with the conditions before improvement; and I have taken measurements of depth across the stream. These measurements of depth are taken in inches and are taken at every yard. Corrections have been made for differences in water level.

In describing each barrier I have given the area of mucky flats and plant beds it has produced. I have also stated when it has uncovered gravel, along with the depth of pools produced.

Only one recheck was made on the insect counts. This was made on a gravel area and it showed a great increase in food production.

Barrier 641 V-type.

Former depths across the stream: 3-4-4-3-4-5-3 inches

Present " " " " : 3-9-5-6-7-7-3 inches

A 17 inch pool has been formed just below the barrier. And there is a good gravel bar for spawning just below this pool. Mucky bars have formed below on each side and there is a good plant bed of chara and watercress below on the right.

Barrier 642. Wing.

Former depths across the stream: 2-4-5-6-7-5-6 inches

Present " " " " : 5-6-4-9-10-8-6 inches

This barrier has also formed a 17 inch pool below it. The wing has also done very good work in forming a pool around the cover just below. A mucky bar of 80 sq. ft. in area has been formed below the barrier. On this bar a plant bed of chara and watercress has started. The bed covers about 64 sq. ft.

Barrier 643. Triangle Cover Type.

This barrier has done excellent work. It is giving very good shelter and it has formed a fine pool. Formerly the water was 9 inches deep under the cover and now it has the following depths along its front: 11-13-16-28-24-18 inches. A gravel bar has been formed below. There is a muck area just below the barrier on the left and a plant bed is starting on it.

Barrier 644. Wing.

Former depths across the stream: 4-4-4-4-4-4-2 inches

Present " " " " : 6-5-9-7-3-2-2 inches

The last two measurements are over the silt bed formed behind the wing. A 14 inch pool has been formed on the right side. This is a deepening of 10 inches. A large muck area of about 160 sq. ft. has formed behind the wing and at least 1/3 of it is already covered with plants—Chara and watercress. The chara which is a new addition is more abundant than the watercress. Caddis larvae have become very abundant in the riffles caused by the barrier.

Barrier 645. Wing.

Former depths across stream: 2-2-2-5-11-16 inches

Present depths " " : 7-9-11-10-11-19 "

A mucky flat of about 64 sq. ft. has formed below the wing and about 1/3 its area is covered with plants—chara and watercress. A sand bar has formed below the outer end of the wing and extends down stream for 40 ft. There is now a fine gravel riffle on the left side which is rich in the forms of insect life that live in such a habitat.

Barrier 646. Bank Cover.

Former depths along the cover: 8-18-17-18-24-26-13-23-24-28 inches

Present " " " " : 17-18-19-20-23-26-27-28-25-25-28 inches

The current from the wing flows along the edge of this cover in just the right way. It is a very good hiding place.

Barrier 647. Wing.

Former depths across the stream: 2-2-4-4-3-8-9-6 inches.

Present " " " " : 4-7-9-10-10-9-8-6 inches

A 14 inch pool has been formed below on the left. A sand bar has formed below the barrier. It covers about 60 sq. ft. and its top is above water at normal stages. Watercress and Chara are growing on it and there is a nice chara bed at the lower end of the deflector. These beginnings should develop into nice beds.

Barrier 648. Bank Cover.

Former depths along the cover: 9-9-8-7-6-8 inches

Present " " " " : 15-12-11-9-9-12 inches

The stream is narrowed here by the barrier just above this one and this barrier gives very good cover along the bank.

Barrier 649. Bank Cover.

Former depths along the cover: 18-19-14-20-26-26-38-35-32-34-26-24-21-16 inches

Present " " " " : 24-21-19-17-25-33-31-32-28-26-21-20-19-16 inches

A chara bed has begun on the right side. The brush put in front and under the cover should not be put around these covers because it has caused the hole under it to fill up. I cleaned these holes out by taking<sup>ing</sup> the brush and trash out of them. Brush shelters are good for small fish but since the Gamble is too shallow now the problem is to improve it for the large fish. If I am correct, I believe it is the large fish that are desired in this stream. If they are to be encouraged here we must have deep pools for them. Our problem then, is not so much to create brush shelters but to form deep pools, since the original purpose of the improvement was to get fish of a legal size to stay in Gamble Creek. The nursery supplies small fish to the stream. Brush for young fish is needed but it should not be placed around covers. It should be fastened to the wings so it will float over the mucky flats. A tight pile of brush behind a wing is not practical since it fills up with silt. Brush shelters as described in the introduction should be added in the Gamble.

Barrier 650. Wing.

Former depths across the stream: 9-8-8-5-4 inches

Present " " " " : 9-14-13-10-9 inches

The gravel banking placed in front of the barrier has stayed very well and the barrier has formed a good pool under the cover just below it. There is, now a pool 24 inches deep below the barrier where previously the water was only 9 inches deep. A muck flat of about 120 sq. ft. has been formed below the barrier. Chara is beginning on the flat.

Barrier 651. Bank. Cover.

Former depths along the cover: 18-13-16-19-14-7-11-11 inches.

Present depths " " " : 16-17-22-24-21-14-20-17-17 inches.



This is a very good cover since it is correctly placed in regard to the current from the barrier above.

Barrier 652. Wing.

Former depths across the stream: 13-19-14-8 inches.

Present depths across the stream: 16-20-12-10 inches.

A pool 22 inches deep has been formed below the barrier. Gravel has been uncovered above, below and on the right of the barrier. A mucky bar covering about 63 sq. ft. has been built up. Two clumps of Chara and a large clump of White Water Buttercup has started above the barrier and chara is starting below the barrier on the bar.

Barrier 653. Wing.

Former depths across stream: 5-7-7-6-8 inches

Present " " " : 8-12-13-11-8 inches.

Formerly the bottom here was covered with sand now it is all gravel from the barrier <sup>down</sup> to the ~~next~~ barrier except for the mucky bar behind the wing. This gravel area is rich in food. The muck area covers 84 sq. ft. Watercress and Chara grow here. A Chara bed just above the barrier covers about 48 sq. ft. These plant beds add greatly to the food supply.

Barrier 654. Y-type.

Former depths across the stream. 9-10-10-10-7 inches

Present depths across the stream: 10-12-18-17-10 inches.

Formerly the bottom at this point was nearly all sand. Now the channel has a pure gravel bottom all the way to the next barrier <sup>and is 17</sup> <sup>deep</sup> to 20 inches. An area of 100 sq. ft. has been covered with muck behind the left wing. Chara is beginning here. A Chara bed is also beginning above on the right.

Barrier 655. V-type.

Former depths across the stream: 3-9-8-10-7 inches

Present " " " " : 9-12-17-11-8 inches

All sand has been cleaned away so it is a pure gravel bottom. Chara beds are beginning above on the left.

Barrier 656. Wing.

Former depths across the stream: 7-8-7-4-5 inches

Present " " " " : 9-13-11-6-8 inches

A small silt bed with some Chara and Watercress has been found below the barrier.

Barrier 657. Wing type.

Former depth across the stream: 3-7-11-10-6-4 inches.

Present " " " " : 11-15-11-10 silt bar with plant beds.

This barrier has removed the sand to expose the gravel underneath. About 500 sq. ft. of gravel has been exposed. The tree put in on the right to shut off the stream there and produce a muck flat has been very successful. There is now a mucky area of about 70 sq. ft. covered with watercress behind this log. Below the wing on the left a mucky area of about 100 sq. ft. has been formed. A Chara bed is beginning on this flat. These mucky areas and plant beds will add greatly to the food supply of both young and old trout. The gravel exposed is rich in the larger forms of insects suitable to the older trout.

Barrier 658. V-type.

Former depths across the stream: 5-7-7-9-8-6 inches.

Present " " " " : 10-10-12-12-9-7 inches.

The sand has been removed from the gravel and there is a gravel bar below formed by the material removed from the channel formed by the barrier. There is now a 21-inch pool in the channel. Cover is provided under the ends of the wings. A mucky area 60 sq. ft. in area has formed on the left and White Water Buttercup and Chara are beginning on it. Chara is also beginning above the barrier on the left.

Barrier 659. Wing type.

Former depths across the stream: 7-5-9-9-6-6 inches

Present " " " " : 11-12-13-11-14-10 inches.

Formerly sand was collecting around the gravel in the crevices and cutting down the food production. This sand has been removed and there is now all gravel bottom below the barrier and extending down to the next barrier. Over 400 sq. ft. of gravel has been exposed. A pool 20 inches deep has been formed at the lower end of the barrier. There is now a good current along the side and a good pool around the cover below on the left. A mucky bar 30 sq. ft. in area has been formed behind the wing. White Water Buttercup is increasing on it.

Barrier 660. Bank Cover.

Formerly the water around this barrier was uniformly 8 inches deep. Now there is a very nice pool under this cover. Depths along the cover from top to bottom are 20-15-12-16 inches. Formerly the stream bottom here was sand on the right and mud on the left. Now it is gravel bottom all the way across the stream and down to the next barrier.

Barrier 661. Wing.

The purpose of the wing was to send the current to the other side of the stream and shut off the large bend here forming a silt flat. It has accomplished this very well since the whole area of about 240 sq. ft. is now a mucky flat half of which is covered with Chara and watercress. This place is now a good feeding ground for young trout.

Barrier 662. Cover.

This barrier was built the fall before I came. It is too small to give adequate cover. It should be made larger. The wing above has formed a pool under this barrier.

Former depths along the log: 13-16-11-10 inches.

Present " " " " : 14-18-17-15 inches.

Barrier 663. Wing.

Former depths across the stream: 15-17-11-3 inches.

Present depths across the stream: 14-19-14-13 inches.

There is a large silt flat below on the left. A pool 20 inches deep has been formed below. It has been formed by the removal of the sand to expose the gravel.

Barrier 664. Wing.

Former depths across the stream: 8-9-7-3-4-6-10-9 inches.

Present " " " " : 8-7-9-5-4-5-3-2 inches

The last three measurements are taken across the bar formed behind the wing and are thus shallower. The area behind this wing is a very good place for young fish. There is a good deal of trash, sticks, logs and brush there which gives good shelter. A bar is forming at the lower end and Chara has started on it.

Barrier 665. Wing.

Former depths across the stream: 6-8-10-7-6 inches.

Present " " " " : 10-10-13-6-9 inches.

The pool opposite the right end of the barrier has been deepened from 8 inches to 14 inches. Some Chara is growing above along the right bank.

Barrier 666. Bank Cover.

Too much brush has been placed under this cover. It has caused a filling in under the cover. It had already filled in 7 inches when I examined it, and was making it impossible to fish the barrier. ~~when I examined it.~~

Former depths along the cover: 11-7-9-10-7-9-10 inches.

Present " " " " : 10-10-13-16-12-12-18 inches.

Barrier 667. Bank Cover.

Former depths along the front of the cover: 14-18-18-16 inches.

Present " " " " " " " : 11-21-21-21 inches

Former " " " barrier: 16-16-13-10-10-10 inches

Present " " " " : 21-21-18-14-14-14 inches.

There is a muck flat on the left with a chara bed beginning on it. Gravel bottom has been exposed along the barrier.

Barrier 668. Wing.

Former depths across the stream: 11-11-8-7 inches.

Present " " " " : 16-17-11-7 inches.

The pool on the right below has been deepened from 16 inches to 20 inches. A sand bar has been formed below the wing which at the line of examination was extending 4 inches above the water. Grass is growing on it. Below there is a mucky area on which Chara is beginning to grow. The channel on the right has been deepened all the way to the next barrier.

Barrier 669. Bank Cover.

Former depths along the front log of the cover: 6-16-18-17 inches.

Present " " " " " " " " : 11-20-23-21 inches.

Former " " " cover top of bottom: 15-18-18-18-18-18-18 inches

Present " " " " " " " " : 21-21-23-23-21-20-21-21 inches.

The sand has been removed from beneath and along the side of the cover to expose gravel. This is an excellent cover.

Barrier 670. V-type.

Former depths across the stream: 8-6-2-2-2-5-8 inches.

Present " " " " : 10-6-5-15-14-8-9 inches.

There is a good riffle below this barrier for a distance of 60 ft.. The water is uniformly 14 inches deep for a long distance down stream in the channel formed by the barrier. There are mucky areas and chara beds on both sides of the channel. There is a large very dense chara bed above on the left <sup>which</sup> ~~which~~ covers 100 sq. ft., and one just below the barrier on the left covering 50 sq. ft. Beds are also starting on the right side.

Barrier 671. X-type.

This barrier has a large log in front. ~~of~~ The purpose of the log being to cause a pool to form due to the swift water from the barrier above.

Former depths across: 7-11-11-10-9-6 inches.

Present " " : 10-12-23-26-18-9 inches.

There is now a pool 14 to 20 inches deep under the cover. This barrier gives very good shelter.

Barrier 672. Wing.

This barrier consists of a wing built on each side of the stream for the purpose of shutting off a channel on each side and sending all the water through the center channel. These wings have very successfully confined the stream into one channel. The left channel has filled up and the one on the right is filling up. High Chara beds have developed above each wing so that the water flows through a 4 ft. channel between them. A large patch of watercress has developed below the left wing.

Former depths across main channel: 14-16-8 inches

Present " " " " : 17-14-5 inches.

Former depth at pool below 18 inches; present depth 22 inches.

Barrier 673. Bank Cover.

Former depths along the cover: 12-18-17-18-19-20-20 inches.

Present depths along the cover: 17-19-21-19-23-23-25 inches.

This makes a very nice hide along the bank. It can easily be fished.

Barrier 674. Wing.

A muck bar has been formed below the barrier on the right side. A chara bed has started on the right side. Very little digging has been done.

Barrier 675. Combination deflector and cover.

This is a combination of a deflector and a cover. A wing throws the current directly under the cover. There is also some cover behind the wing.

Former depths across the stream: 10-14-12-8 inches.

Present " " " " : 25-25-28-17 inches.

There is now a 38 inch pool under the cover. Thus the barrier has produced a very good hole and it is giving excellent cover. There is now a large and very dense chara bed just below the barrier. It covers about 60 sq. ft. On the left side the mucky area and plant beds extend all the way to the next barrier.

Barrier 676. Wing.

Former depths across the stream 5-10-11-12-11 inches. This barrier has exposed a very large area of gravel both above and below the barrier. The sand has been piled up in a bar below the wing and is now covered with muck. A chara bed has become established at the lower end of the barrier. Silt has been deposited above the barrier and watercress is growing on it.

Former depths across the stream: 5-10-11-12-11 inches

Present depths across the stream: 7-11-13-13-15 inches

Former depths in channel at lower end of barrier: 10-10-10 inches.

Present " " " " " " " " :16-17-13 inches.

Barrier 677. Triangle Cover type.

A bar is forming behind the barrier and several clumps of chara have appeared on it. There is a pool under the cover 12 to 20 inches deep. This cover is in very good shape.

Former depth across the front of the cover: 9-11-12-16 inches.

Present depth across the front of the cover: 13-19-18-17 inches.

Barrier 678. Combination Wing and Cover.

Gravel has been exposed under the cover and below the wing by the removal of the sand covering. A pool 28 inches deep has been formed under the cover. This is a very good combination for producing pools and shelter.

Former depths across the stream: 7-11-14-14-14-7 inches

Present " " " " : 7-17-22-23-18-8 inches.

Barrier 679. Raft Cover.

This cover is one that has proven to be very effective. It gives the effect of an overhanging bank. A Chara bed has begun on the right side.

Former depths along the barrier: 17-16-22-22-23-16-14-17-19 inches

Present " " " " : 17-20-24-22-26-19-16-14-20 inches

Barrier 680. Wing with Diverter.

Gravel bottom has been uncovered on the right side <sup>by</sup> ~~of~~ the removal of sand. The mucky area and watercress clumps which were behind the wing have enlarged. The sand has been washed from the gravel for some distance down stream. A pool 20 inches deep has been formed below the barrier.

Former depths across the stream: 7-10-10-7-8-4 inches

Present depths " " " : 8-13-12-10-10-8 inches

Barrier 681. Cover.

Former depths across the stream: 9-12-10-7-5-4-4-4 inches

Present " " " " : 11-13-14-18-13-6-3-4 inches

The pool formed under the cover is 14 to 20 inches deep. Gravel has been exposed under the cover and a gravel bar has been built up just below it. A mucky flat and a chara bed have been established on the right side. The chara bed covers about 60 sq. ft.

Barrier 682.

Former depths across the stream: 6-7-13-14-11-8 inches.

Present " " " " : 8-11-15-17-11-8 inches.

The wire on the barrier has broken and it should be repaired.

Barrier 683. Crib cover.

Former depths across the stream: 6-12-16-16-9 inches

Present " " " " : 6-12-17-21-19 inches.

This barrier gives good cover and it has formed an 18 inch pool under it. A chara bed has been added above in the center and on the left, also below in the quite water below the barrier.

Barrier 684. Teepee cover.

Former depths across the stream: 9-13-12-11-9 inches.

Present " " " " : 18-21-20-21-14 inches.

A fine pool has been formed under the cover. Silt bars have formed above on each side of the stream. Chara beds have become established on each side above the



barrier and below the barrier.

Barrier 685. Cover.

The logs in this barrier are starting to waterlog.

Former depths along the cover: 16-16-16-16-11-14-19 inches.

Present " " " " : 17-18-17-17-14-17-19 inches.

Barrier 686. Cover and Pool Former.

This barrier has formed a very good pool. It furnishes a very attractive place for fish.

Former depths across the stream: 13-16-20-18-16 inches.

Present depths " " " : 21-28-33-34-26 inches.

Barrier 687. Wing.

Former depths across the stream: 4-10-11-8-7-7-7 inches.

Present " " " " : 8-13-12-7-8-7-7 inches.

A silt flat has been formed below on the left and gravel has been exposed on the right. A chara bed is beginning below the barrier.

Barrier 688. Wing.

Former depths across the stream: 6-10-12-13-10 inches.

Present depths across " " : 9- 12-13-12-11 inches.

A good pool has been formed below this barrier when before the water was 12 inches deep. This pool is 12 by 6 ft. and 27 inches deep. A gravel bar has been formed below it. Gravel has been uncovered around the barrier. There is now a silt bed below the barrier with chara beginning on it. Chara is also beginning above on both sides of the stream.

Barrier 689. Wing.

Former depths across the channel: 7-9-10 inches.

Present " " " " : 11-16-14 inches.

The mucky flats and chara beds below the barrier are larger and better. Also a new bed of chara about 60 sq. ft. The channel on the left has been deepened for a distance down stream of about 30 sq. ft.

Barrier 690. Triangle Cover.

Former depths across front of cover: 6-8-9-11

Present " " " " " : 12-16-15-12

There is now a pool 16-17 inches deep under the cover. A large dense plant bed of Chara and White Water Buttercup has formed below on the left. It covers at least 100 sq. ft.

Barrier 691. Wing.

Former depths across the stream: 3-5-8-10-10-8-5 inches.

Present " " " " " : 6-6-8-10-11-11-9 inches

Barrier 692. Raft Cover.

This barrier is close along the bank. It is the last one above the Fontinalis bridge.

Former depths along the cover: 10-15-16-13-11-10 inches.

Present <sup>depth</sup> depths along " " : 14-15-15-13-10-9 inches.

Barrier 693. Wing with Divertor.

Former depths across the stream: 9-10-11-12-13-11 inches.

Present " " " " " : 19-20-23-29-33-31 inches.

This barrier has dug a very good pool just below it due to the high water going over its top. There is a very good pool below on the right side. Gravel has been uncovered here.

Barrier 694. Wing.

Former depths across the stream: 8-10-11-12-13-11-7 inches.

Present " " " " " : 16-14-19-17-19-12-7 inches.

Two paces below on the left there is a pool 17 inches deep.

Barrier 695. Wing.

Former depths across the stream: 7-13-16-16-20-16-8 inches.

Present " " " " " : 12-16-17-23-24-24-15 "

There is a pool 21 inches deep below on the left. A muck covered bar has been formed below the barriers.

Barrier 696. Raft Cover.

This barrier has caused the formation of a pool 30 inches deep. It is giving good cover along the bank. The pool has a gravel bottom.

Barrier 697. Wing.

Former depths across the stream: 10-12-20-17-14-7 inches.

Present " " " " : 40-26-25-25-20-14 inches.

Two paces below on the right the water was formerly 23 inches deep and now it is 42 inches deep. This barrier has made an exceptional pool and there is good cover over it.

Barrier 698. Raft Cover.

Former depths along the cover: 20-21-16-25-20-18 inches.

Present " " " " : 13-15-24-22-16-21 inches.

This cover is not doing good work.

Barrier 699. Square Cover type.

Former depths across the stream: 9-9-14-12-11-14 inches.

Present " " " " : 15-18-11-10-14-16 inches.

There is a pool 19 inches deep below on the left. A chara bed has become established in the quiet water below the cover.

Barrier 700. Wing.

Former depths across the stream: 12-6-12-17-13-8 inches.

Present " " " " : 12-9-20-23-19-22 inches.

A large muck flat and plant bed has formed below along the inside of the bend. It covers about 200 sq. ft. or at least 2/3 of it is covered with plants. Two paces below the barrier on the left there is a pool 24 inches deep.

Barrier 701. Wing.

Former depths across the stream: 8-10-10-18-16-12-5 inches.

Present depths across the stream: 4-24-24-24-17-19-16 inches

There is a 22 inch pool below on the left.

Barrier 702. Raft Cover.

Former depths along the cover: 20-22-22-23-24-25 inches

Present " " " " : 23-24-24-24-25-23 inches

This barrier is giving good cover.

Barrier 703. Wing.

Former depths across the stream: 10-12-13-13-13 inches.

Present depths " " " " : 11-19-20-22-17 inches.

Formerly the pool on the left was 11 inches deep; now it is 22 inches deep.

This barrier makes nice fishing water around the natural cover already in the stream.

Barrier 704: Cover.

Former depths across the stream: 8-18-17-13-6-7 inches.

Present " " " " : 17-23-32-32-30-32 inches

This barrier makes a very nice cover.

Barrier 705. Combination Deflector and Cover.

Former depths across the stream: 10-10-18-14-12-9 inches.

Present " " " " : 12-24-28-29-28-24 inches.

The pool formed under this barrier is large and it is deep enough so that it has a gravel bottom. This type appears to be quite successful here.

Barrier 706. Raft Cover.

Former depths along the cover: 15-15-13-13-13-12 inches.

Present depths along the cover: 19-19-19-16-13-13 inches.

This raft is giving good cover and it has formed a gravel bottom pool on the right. Any gravel in a sand section like this is valuable.

Barrier 707. Raft Cover and Deflector.

Former depths across the stream: 7-15-15-10-8-7-7 inches.

Present " " " " : 23-28-27-17-19-27-28 inches.

This one gives good cover and has dug a hole around its end and underneath. There is a large chara bed above.

707A or 786.

The purpose of this barrier is to shut off one of the side channels at the upper end of Mallard Pond. It has done this very well. Chara has blocked the channel, shutting it off completely.

707B or 787. Wing.

This is the first barrier below Mallard Pond.

Former depths across the stream: 9-12-11-10-11-10-12-12-12-13-13-15-16-14-14 inches

Present depths across the stream: 15-29-32-39-38-30-27-26-27-26-26-20-15 inches.

A deep hole has been formed under this barrier. The accelerated current produced by this barrier has formed a pool 42 inches deep under the cover, <sup>which</sup> Ned Jewett put in some time ago.

Barrier 709. Square Cover.

This barrier is giving good cover. These covers are just what the section needs since it is so open. A pool 20 to 35 inches deep has been formed under the cover. This will give the fish a place to stay in this section.

Barrier 710. V-type Deflector.

The water in this section is swifter since the level of Devoe<sup>Lake</sup> has been lowered. A hole has been formed under the barrier and the channel has been deepened from a former depth of 19 inches to 32 inches. The barrier accelerates the current.

Barrier 711. Wing.

This barrier directs the current to the right where it has formed a fine pool under the raft cover located there. A hole 20 inches deep has been formed under the wing. ~~A hole 20 inches deep~~

Barrier 712. Raft Cover.

Former depths along the raft: 27-24-24-23-30-37-38-38-36-31 inches.

Present " " " " : 32-28-32-33-39-44-44-40-40-37 inches.

This is a good hide for fish.

Barrier 713. V-type.

Former depths across the stream: 5-6-9-12-13-16-15-15-14-13-10-6 inches

Present depths " " " : 3-10-13-13-16-18-21-23-28-16-21-16 inches.

This barrier has greatly accelerated the current and has dug a large pool all the way to the cover below and has formed a hole under the cover. This pool (a channel on the center of the stream) is 30 inches deep.

Barrier 714: Square Cover.

Former depths across the cover: 14-15-16-16-19-22-22-18 <sup>inches</sup> inches.

Present " " " " : 26-30-28-30-30-31-33-36 inches.

This is a large cover.

Barrier 715. Combination Deflector and Cover.

Former depths across the stream: 9-14-12-17-18-21-18-17-18-23-18-18 inches

Present depths across the stream: 14-15-16-17-22-25-30-35-36-33-30-21 inches.

This barrier has formed a fine pool and is giving good cover over it.

Barrier 716. Tepee Cover.

Former depths across the stream: 3-9-18-20-20-24-26-26-24-17-16-15--5 inches.

Present " " " " : 12-16-18-23-23-28-28-29-28-22-17-13-6 inches.

This barrier is giving excellent cover and it is easy to fish.

Barrier 717. Wing.

Former depths across: 6-9-12-14-20-25-26-28-29-28-24-19-12-11-9 inches.

Present " " : 10-16-20-22-28-33-30-29-32-34-33-29-21-13-10 inches.

The water has cleaned out a hole underneath the wing. A bar has been built up below. There is now shelter under the barrier.

Barrier 718. Square Cover.

This barrier is holding well. It has formed a pool under it 17-22 inches deep.

Barrier 719. Wing.

Former depths across the stream: 8-14-14-16-16-16-16-16-13-12 inches.

Present " " " " : 10-15-17-21-22-18-17-17-13-15 inches.

The pool just below on the right was 16 inches deep and now it is 19 inches. There is also a pool 25 inches deep in the center of the stream. Potomageton pectinatus is growing on the bar formed behind the wing. The cover put in at the outer end of this barrier is <sup>doing</sup> ~~going~~ good.

Barrier 720. Triangle Cover.

Former depths across the stream: 10-18-22-23-21-18-12-12-8 inches.

Present " " " " : 13-18-23-26-25-23-19-16-13 inches.

This is a good cover. It has remained in good condition and it has formed a hole under it.

Barrier 721. Wing.

Former depths across the stream: 7-12-12-18-22-19-15-9-3-3 inches.

Present " " " " : 6-13-15-19-28-32-34-26-13-10 inches.

This wing has accelerated the current causing it to dig ~~the~~ holes. Formerly the water was 24 inches deep three paces below on the left and now it is 29 inches deep.

Barrier 722. Cover.

Former depths across the stream: 7-13-24-25-31-30-14-10-6 inches.

Present " " " " : 9-22-27-28-35-33-21-17-13 inches.

Formerly the water was 26 inches deep under the cover and now it is 35 inches deep.

Barrier 723. Wing.

Former depths across the stream: 10-17-17-17-20-21-22-19-18-17-12 inches.

Present " " " " : 11-17-22-20-22-23-23-25-24-20-16 inches.

Below in the center of the stream it is 23 inches deep. There is now a hole under the wing.

Barrier 724. Triangle Cover.

This barrier is giving good cover. There is a 16-21 inch ~~ex~~ pool under it.

Barrier 725. Square cover.

Former depths across the stream: 6-10-17-24-23-19-17-17-15-8 inches.

Present depths across the stream: 4-11-19-21-23-27-32-31-29-18 inches.

This barrier is doing good since it is greatly needed in this open section.

Barrier 726. Square Cover.

This barrier is supplying needed cover in the wide open section and it is forming a pool under itself.

Barrier 727. Wing.

This barrier has deepened the water under its outer end and has formed a pool below.

Barrier 728. Triangle Cover.

This is a good trout shelter.

Former depths across the barrier front: 10-20-23-20-21-21 inches

Present " " " " " : 11-30-30-23-27-25 "

There is a good pool under the cover.

Barrier 729. Wing.

Former depths across: 5-15-20-23-27-29-22-18-17-14 inches

Present depths across: 14-24-22-27-32-28-28-33-30-21 inches.

Just below the end of the barrier there is now 34 inches of water. A bar has been built up behind the wing and a pool has been formed under the outer end of the barrier.

Barrier 730. Square Cover.

Former depths across the stream: 5-15-20-23-27-29-22-18-17-4 inches.

Present " " " " : 9-18-26-28-30-35-39-26-19<sup>6</sup>/<sub>4</sub> inches.

The pool under the cover is 32 inches deep.

Barrier 731. Wing.

Former depth across: 7-14-14-14-14-18-21-23-24-26-27-16 inches.

Present " " : 14-19-20-19-21-21-33-45-47-38-28-23 inches.

A pool 20 ft. long and 33 inches deep has been found below the outer end of the wing. The high water going over the barrier has formed a large pool 25 ft. by 25 ft. and 34 inches deep, just below the barrier. A bar has been built up



below.

Barrier 732. Bank Cover.

This barrier furnishes a good hiding place for trout. It has caused a 43 inch pool to be formed along side it.

Former depths from the center of stream to left bank: 18-21-23-24-26-27-16 inches  
Present " " " " " " " " " : 19-21-28-40-38-30-21

This is the last barrier built in the Gamble.

Barrier 733-Omitted.

Beginning with Barrier 734 the rest of the barriers are in the Rifle River.

Barrier 734. Raft Cover.

There is now a pool 34 inches deep under the raft. It gives good cover and fish are swarming around and ~~under~~<sup>under</sup> it.

Barrier 735. Wing with Director.

This barrier is in good condition. It has deepened <sup>the water</sup> 7 to 12 inches on the left side. Minnows are swarming in the quiet water behind the barrier. A large chara bed is beginning on the bar below the wing. There is a pool 22 inches deep below on the left.

Barrier 736. Triangle cover.

Former depths right to left from the center of the stream: 6-8-10-14-14-15-13 inches  
Present " " " " " " " " " " : 10-14-18-19-18-16-13 "

This cover has a good hole under it and it is giving good shelter.

Barrier 737. Wing.

Former depths across the stream: 13-13-14-14-14-16-12-13-14-13-14 inches.

Present " " " " : 7-8-12-13-13-18-17-21-21-24-16 "

Gravel bottom has been exposed in the channel for a distance of over 30 ft. down stream. A good pool has been formed along the raft cover below. There is a good

plant below the barrier.

Barrier 738. Raft Cover.

This cover has not been damaged. It is furnishing a nice place for fish.

Barrier 739. Raft Cover.

This barrier has dug 12 to 15 inches and there is now a pool 34 inches deep under it. It is a good shelter. I believe this cover should have been staked up to prevent waterlogging.

Barrier 740. V-deflector.

Former depths across the stream: 7-16-16-13-13-13-11-11-9-7-6-7-8-8-7 inches

Present " " " " : 16-21-16-22-26-28-25-17-19-15-6-6-9-8-2 inches

There is now 25 inches of water in the channel formed by the deflector. This pool is 60 ft. long. A hole has been found under the right wing. There is a large weed bed above on the right which covers about 100 sq. ft. Also one above on the left of about 25 sq. ft. in area. There are very large beds beginning below each wing which when developed will occupy about 200 sq. ft. on each side of the stream.

Barrier 741. Triangle Cover.

This barrier is holding well. It has deepened the water both around and under it, in fact out to the center of the stream. The pool underneath is 22-27 inches deep where it was formerly 15 inches deep.

Barrier 742. Wing.

This wing has uncovered gravel on the right and built a sand bar below and behind it. There is a fine plant bed below on the lee of the wing which covers about 150 sq. ft. The pool on the right is 21 inches deep and extends almost to the next barrier.

Barrier 743. Wing.

Sand has been removed to form a gravel bottom pool 50' x 8' and 28 inches deep. There is an immense plant bed below the wing and extending down stream for 100 ft.

Barrier 744. Raft Cover.

There is now all gravel bottom around this cover. It has a 20 to 22 inch pool under it and a 22 to 25 inch pool along side.

Barrier 745. Raft Cover.

This barrier has created a good home for trout. It has a pool 45 inches deep under it. This barrier can easily be fished.

Barrier 746. Raft Cover.

This barrier is located in an ideal place and it is giving excellent cover. It has created a pool beneath itself.

Barrier 747. V-deflector.

Bars have been formed below each wing and these are ~~several~~ covered with aquatic plants. The bed on the right covers 400 sq. ft. and the one on the left 150 sq. ft. This deflector has done a lot of digging. It has formed pools under each wing and there is a pool 25 inches deep on the right side and in the channel there is a pool 8' x 60' and 22 inches deep. This pool has been formed by the removal of sand and it has a rubble and gravel bottom.

Barrier 748. Raft Cover.

This cover is so located that it can easily be fished. There are many minnows around it.

Barrier 749. Raft Cover.

This barrier gives good cover over a 3 ft. pool. The water is 41 inches deep alongside the cover.

Barrier 750. Raft Cover.

This barrier is in good shape. When I examined it there was many minnows and suckers around it.

Barrier 751. Teepee Cover.

This barrier was not installed correctly. The men built it much larger than

those that we put in the Gamble but they did not use any more stakes. Since this is a larger river, the covers are necessarily larger and should have twice as many stakes. I believe this one will go out. It is giving good cover however at present.

Barrier 752. V-deflector.

This barrier should have more stakes as it is not staked securely. Also it should have been chinked and banked. It has deepened the channel on the center about 5 inches and ~~there~~ there is a plant bed below both wings.

Barrier 753. Raft Cover.

This barrier is giving good shelter at present but it may go out <sup>so</sup> ~~or~~ it is not securely built.

Barrier 754. Raft Cover.

A pool 27 inches deep has been formed under this barrier. The raft forms a good hide.

Barrier 755. V-deflector.

Former depths across the stream: 2-4-6-9-11-9-11-11-11-11-12-12-10-8-6-4 inches

Present " " " " : 10-10-14-16-21-22-20-13-22-21-17-18-20-15-13-10 in.

The current has founned a pool in the center of the stream 40' long and 15 inches deep. The barrier has greatly enlarged and improved the silt flats and plant beds.

Barrier 756. Wing.

Former depths across the stream: 13-20-25-20-19-17-16-14-7-3-3 inches.

Present " " " " : 10-20-27-35-36-37-35-31-21-11-3 inches.

This wing has made a new hole underneath and around its outer end.

Barrier 757. Raft Cover.

There is now a pool 35 inches deep under this cover. It creates a good hide and resting place. The current flows along its edge and does not turn so as to take a fly under the cover.

Barrier 758. Raft Cover.

This barrier is giving excellent cover. Some provision should be made to keep it from sinking when it waterlogs.

Barrier 759. Wing.

This barrier has dug a hole around its outer end and below in the center of the stream. It has built up a bar below in the still water and plant growth has increased.

Barrier 760. Raft. Cover.

There is a pool 25 inches deep under this cover. It makes a good hide. This raft cannot sink after waterlogging because it is held up by a dead head log.

Barrier 761. Wing.

This barrier has moved since the stake at the inner end has been pulled out. It should have been staked more securely. This barrier will probably go out eventually. It has dug some.

Barrier 762. Raft Cover. †

There is now a pool 34 inches deep under the cover. It makes a fine hide.

Barrier 763. Wing.

This barrier was put in for the purpose of making the stream narrower since it is much too wide here. The right half of the stream has cleaned down to gravel and the left half is a dense mass of aquatic plants. It probably will fill up in time.

Barrier 764. Teepee type.

Gave out. It was held by three stakes only. While this is enough on the Gamble where the stream is small and the barrier necessarily small it is not enough in the Rifle.

Barrier 765. Raft Cover.

In place and giving good cover.

Barrier 766. Raft Cover.

This barrier has remained in good shape. It is giving cover over a 23-inch pool which it has formed.

Barrier 767. Tepee Cover.

Barrier 764 has come down and caught on the cover. It pulled all its stakes. They are now wedged together and the <sup>outer</sup> over end of 764 is wedged against a raft just below. They may stay. There is now a hole 4 feet deep under them. This barrier has pulled two of its stakes. Thus the whole thing should be restaked.

Barrier 768. Raft Cover.

This is a large and very fine cover. It forms an excellent hide along the bank.

Barrier 769. Boom Cover type.

This barrier is in good shape. It is protecting the bank from erosion and is giving excellent and much needed cover. It is over a deep hole. Large covers such as these are needed here since the river is open.

Barrier 770. Raft Cover.

This one is in good shape. It is doing good work as a cover.

Barrier 771. Boom Cover Type.

This barrier is holding well but the stakes should have been larger since the water is so deep. It is protecting this bank which was eroding quite rapidly. The large size of the barrier makes it efficient in cooling the pool under it.

Barrier 772. Boom Cover.

This barrier is shutting off the beginning of a cut across the meadow. During high water the water flows through here and over the meadow. It gives good cover which is much needed since there are no trees along the banks.

Barrier 773. Raft Cover.

The river is very deep here. This barrier is holding well and forms a nice hide.

Barrier 774. Raft Cover.

This barrier is still in place but it should have been staked more securely.

Barrier 775. Wing.

This barrier is doing very good work. It has built up a bar below it which is now within 6 inches of the surface. A plant bed is becoming established on the bar. Also a good pool has been formed on the left side. It is 30 ft. long and 39 inches deep.

Barrier 776. Square Cover.

This barrier has dug down to clay bottom and there is now a hole 35 inches deep under it. This makes a good hide. The stakes are not down deep enough. It would probably go out in time.

Barrier 777. Wing.

This barrier has done very fine work. It has ~~found~~ formed a gigantic sand bar below it. This bar is 3 to 4 ft. deep and covers about 400 sq. ft. This means that a lot of sand has been removed from pools. There is a 43 inch hole under the barrier and a very deep pool all along the bank for a distance of 60 ft. This pool is 5 - 8 ft. deep.

Barrier 778. Boom Cover.

This barrier has stood up well. All of these floating types should be strengthened and poles put under them to prevent them from sinking when the material becomes water-logged. This one is protecting the bank and giving good cover.

Barrier 779.

Gone out.

Barrier 780. Teepee Cover.

Barrier 779 has caught on this one. These two have made a very good hole underneath them<sup>side</sup>. This pool is now 33-40 inches deep and it has a good cover over it. A sand bar has been found below.

Barrier 781. Raft Cover.

This barrier makes a hide along the bank over deep water.

Barrier 782.

This barrier has almost entirely gone out. It should have been staked better.

Barrier 783. Square Cover.

The stakes used in this barrier were too short. The result was that the barrier in forming a pool dug them out, the current carrying <sup>ied</sup> most of the barrier away. What is left is giving some cover.

Barrier 784. Raft Cover.

This barrier has withstood the flood. It is making a hide along the bank and is of good use.

Barrier 785. Raft Cover.

This barrier has remained in good shape. It is giving shelter for fish along the bank serving as an overhanging bank.

### CONCLUSION

All of the barriers that were placed in the Gamble have remained in place, although some of them need repairing. The wire on Barrier 682 has broken allowing the log to swing around so it is doing very little good. This should be repaired.

Some of the deflectors need to have logs placed in front of them at their base to prevent the water flowing underneath them. Dead heads should be used for this purpose. They should be securely wired and backed with gravel. Barriers that need to be repaired in this manner are: 641, 642, 655, 656, 662, 663 and 707B.

Stakes have gone out on barriers 710 and 719 and should be replaced.

Brush shelters should be placed on many of the deflectors. Those have been spoken of in the introduction. These repairs and additions can be made at any time. If so desired, I should be glad to supervise this work.

The work on the Rifle did not hold so well. A total of seven barriers were lost or partly wrecked. This is not a large number considering 55 were constructed. Those that were lost or damaged were improperly staked. If a barrier is properly staked and wired it can be made to stay.

Some of the raft cover types should be staked and fastened up so they will not sink when they become waterlogged. Longer stakes should be put in along the boom covers.

In conclusion I think the improvement work has greatly improved conditions, in particular on the Gamble. While in 1931 I saw only one trout in the Gamble and that was in the lower section. This year I saw many trout in all sections. Good pools and



hides have been produced which have greatly improved the stream for large trout. The carrying capacity of the stream has been greatly increased and trout can now stay where they could not stay before. The pools are now large enough to offer homes for larger trout. Food conditions and the food supply have been very much bettered. I believe I am safe in saying that food production in the Gamble in the section down to Fontinalis Creek has been doubled. The stream is now much more attractive for both small and larger trout. Where the large trout work up into the new pools good catches of trout should be secured.

The cover on the Rifle gives much needed shelter since the stream is very open. Many more trout should stay in these holes now.

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