

The trimming of the side slopes preparatory to the placing of the porous layers has been commenced. 90,500 cubic yards of excavated material has been handled and 2,567 ft. of drainage-pipes have been placed in connection with this section of the work.

Subsequent to the clearing of the floor of the headrace and forebay all depressions were filled with concrete or with spalls and adequately drained, followed by the placing of the porous layers, which have been 60 per cent. completed. The concrete cut-off wall to cut off seepage, situated at the upstream end of the headrace-lining, has been completed, as is also a short curved wall situated at the junction of the eastern embankment of the penstock intake structure. 829 cubic yards of concrete have been placed in these two structures. It is proposed to carry out the bituminous lining of the headrace and the making of the concrete paving-slabs by contract, and at the end of the year plans and specifications had been prepared and tenders invited.

*Headrace-drainage.*—A drainage-gallery, consisting of two shafts and a series of drives at various levels situated adjacent to the up-stream end of the headrace-lining, was commenced towards the end of the year. This gallery will ultimately be connected to an up-stream drainage-tunnel, which will serve as an outlet for it. A drainage-trench along the centre-line of and situated immediately beneath the headrace-lining has been completed, and consists of a 6 ft. by 3 ft. trench, in which 1,630 lineal feet of 2 ft. concrete pipes were laid and covered with spalls. The outlet of this drain, consisting of 625 lineal feet of concrete-lined shaft and tunnel, will discharge into the gorge near the power-house.

*Main Dam.*—Drilling and grouting of the country, comprising the abutments of the main dam have been in hand for some months, and satisfactory results have been obtained. Well-boring plants are being utilized to drill vertical holes, and special percussion-drilling equipment, operated by compressed air, for the inclined and horizontal holes. Drilling and grouting of vertical holes in the abutments are well advanced, but several months' work of horizontal drilling remains to be done. Clearing of the clay from the surface of the rock and guniting the western abutment of the dam was commenced towards the end of the year, but owing to the action of the severe frosts experienced, the work has been postponed until the spring and summer seasons. Preparatory work in the nature of excavation in connection with the provision of bitumen seals between the dam and the rock abutments is well advanced.

*Diversion-tunnel.*—The diversion-tunnel which was opened during June, 1930, for the purpose of emptying the Arapuni Lake has been continually in service since then for the discharge of the Waikato River, with the exception that on a few brief occasions the gate-valves have been closed for testing and observation purposes. During the year several inspections of the condition of the concrete lining of the tunnel have been made, and it is found to be in a very satisfactory condition.

Large pieces of rock that had accumulated at the entrance of the tunnel during the emptying of the lake were cleared, and considerable trimming of the unstable portions of the cliff above the tunnel intake was carried out. Work has been commenced on the shaft required in connection with the emergency gates that are to be installed. A pilot shaft from the surface into the crown of the tunnel has been completed, and the enlargement to full size of the shaft has been commenced.

One single gate of massive construction is proposed, which will be fabricated overseas. The installation involves the construction of a shaft of liberal dimensions, lined with reinforced concrete, extending from the ground surface for a depth of 162 ft. to the invert of the existing tunnel. The construction of the shaft and a small section of the concrete foundations for the gate-frame may be done while the tunnel is in service, but the completion of the gate-anchorage and the erection and installation of the gate-frame and lifting equipment must be left over until the lake has been filled and the tunnel dewatered. The whole work of the construction of the shaft and gate-chamber, fabrication, erection, and installation of gates will be of considerable magnitude. Repairs to the bases of both the existing gates have been undertaken and are well forward. This involved the raising of both gates, and the dismantling and replacing of the lower section of each.

*Overflow-channel.*—Reconditioning of the upper section of the overflow-channel situated between the spillway extension and the drop weir has been completed. This particular section of the work was limited to the trimming of the rock and covering the whole surface with a 12 in. layer of reinforced concrete. 1,355 cubic yards of concrete were used for the purpose. The major or lower section of the work extends from the drop weir to the upper section of the falls structure, and is 960 ft. in length. The channel on this section is being widened to 150 ft. and the alignment improved. Both the floor and the sides are to be protected with a 12 in. layer of reinforced concrete, and excavation and concreting operations are at present in hand, the former being well advanced. 1,036 cubic yards of concrete, 22 tons of steel, and 5,550 cubic yards of excavation have been handled to date.

*Protection of Waterfall.*—Operations were recommenced on preparations for concreting the falls immediately after authority was obtained for proceeding with the general works of restoration. The protective works are extensive, and generally consist of the trimming of the excavation of the foundation rock to such a shape and to such limits as will permit of the construction of a stream-line reinforced-concrete structure of such dimensions as will accommodate the discharge of 30,000 cusecs. A drainage-gallery, together with a comprehensive system of porous drains, is included in the work; also the strengthening of the foundation rock by steel rods and pressure-grouting.

Excavation work was commenced on three shifts during January, and has proceeded along these lines for the remainder of the year. On the upper section of the structure excavation has been completed and concreting work commenced. The lower section is more extensive than the upper; larger quantities of excavation and reinforced concrete, and the dewatering of a large pool, being involved. Subsequent to the trimming of the batters, some of which were 180 ft. in height, pumping equipment was installed and the pool dewatered. Pumping was greatly facilitated by connecting the discharge from the pumps to a drainage-tunnel, by which means the water was carried directly to the Arapuni Gorge. The pool was effectively dewatered during the month of April, and by continual