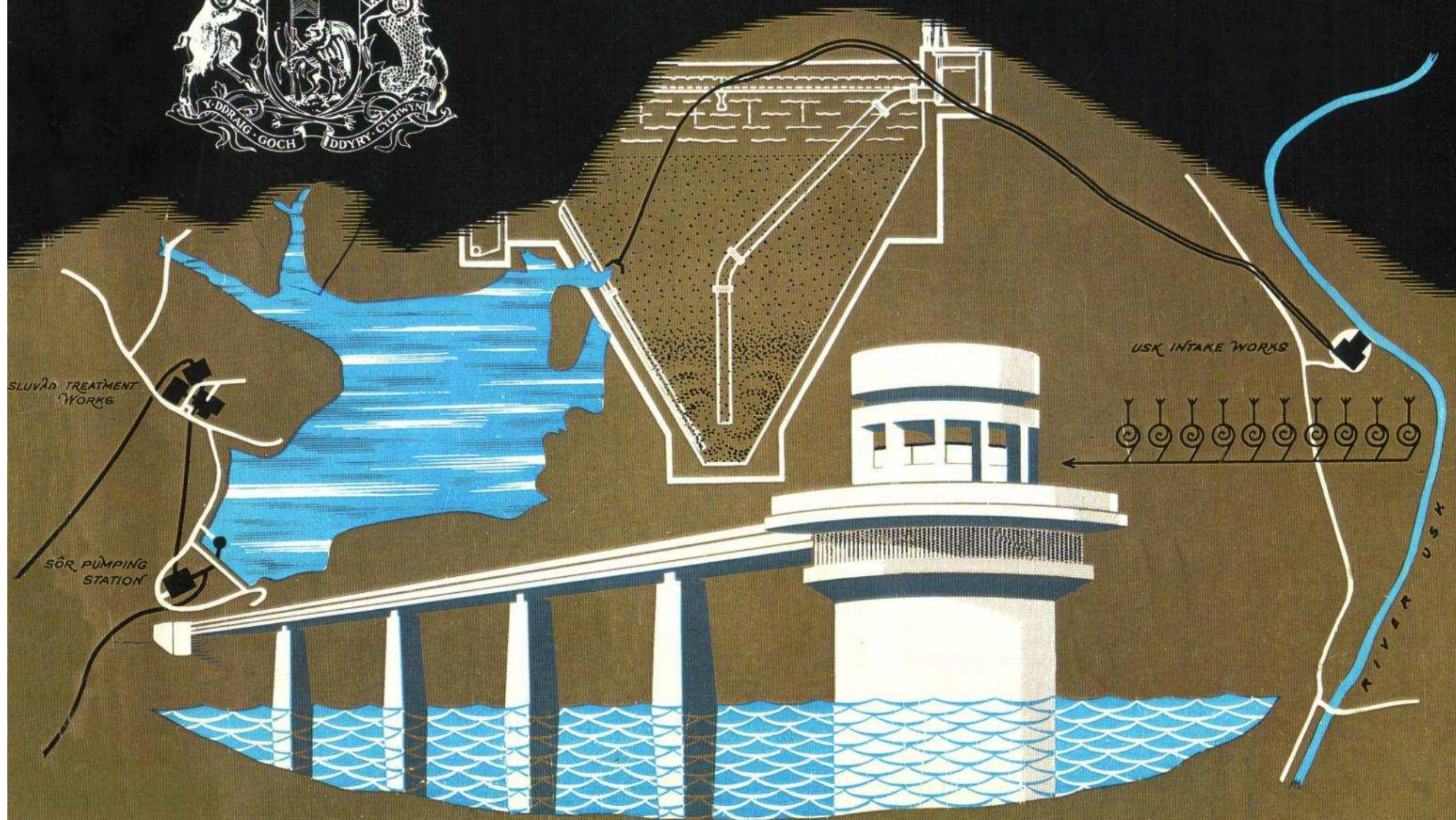


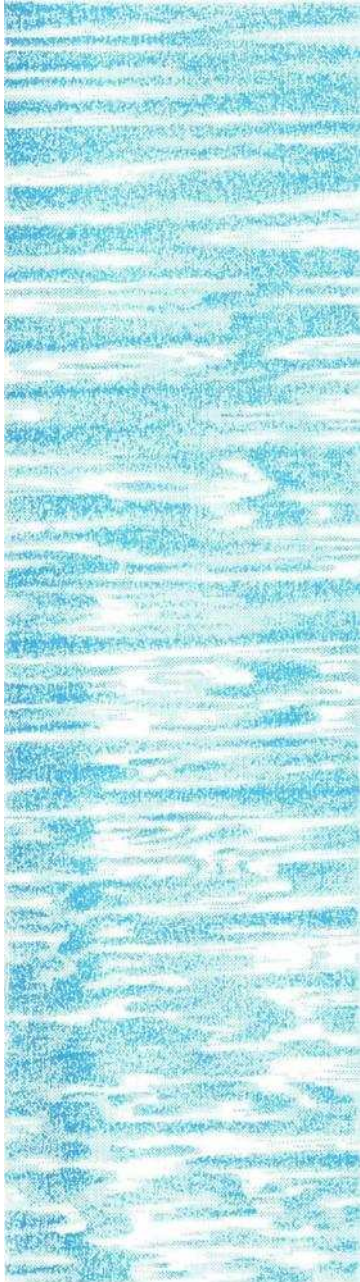


CITY OF CARDIFF

# LLANDEGFEDD WATER SCHEME







# THE LLANDEGFEDD WATER SCHEME

promoted by

## THE CITY OF CARDIFF

in association with

- NEWPORT AND SOUTH MONMOUTHSHIRE WATER BOARD
- PONTYPOOL AND DISTRICT WATER COMPANY
- ABERTILLERY AND DISTRICT WATER BOARD

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\* Members of the Llandegfedd Sub-Committee

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CONSTRUCTION AND ADMINISTRATION OF THE WORKS:

Officers of Cardiff Corporation

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GAMBLIN, M.I.C.E., M.I.W.E.	Deputy Water Engineer and Manager
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E. C. ROBERTS, M.ENG., M.I.C.E., M.I.MUN.E., A-M.T.P.I.	City Surveyor

*Consultants:*

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G. W. COVER, M.I.C.E, M.I.W.F	Consulting Engineer, Treatment Works, Pumping Stations and Pipelines
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EDGAR MORTON. M.Sc., P.A.I.W.E.. A.I.C.E.	Geological Consultant
Professor P. W. ROWE, D.SC..Ph. D., B.Sc.	Consultant of Soil Mechanics
TREVOR DA VIES. F.A.L.P.A.	Valuer
J. LEVER	Landscape Architect
Dr H.A SLYPER BSc, A.M.I.MECH.E	Hydraulics Adviser

Site Staff:-

E. HAYDOCK	Resident Engineer
N. E. MOVES	Resident Engineer (to September 1962)
E. HAYDOCK	Resident Engineer (to January 1964)

WATERWORKS (LLANDEGFEDD)  
SUB-COMMITTEE



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A.M.I.MECH.E., M.I.W.E.



D. G. GAMBLIN,  
M.I.C.E., M.I.W.E.



## **HISTORICAL NOTE**



It became evident in 1950 that further development of Cardiff's water resources was necessary and it was proposed to develop a site at Blaen Taf in the Taf Fawr valley. A Ministry order for the construction of a reservoir here was granted in 1954 but at the same time both Abertillery and Pontypool were seeking new sources.

The Pontypool Water Company had surveyed a site some 2 miles below the present Llandegfedd Reservoir and found that its potential was far greater than required. The Ministry of Housing and Local Government then requested Cardiff Corporation to consider joining this Scheme as an alternative to their own Blaen Taf proposal.

Two other factors determined the choice of the present site. Newport Corporation intimated that it required additional water supplies and there was the possibility of the Spencer Steelworks being constructed in South Wales. The original Llandegfedd site was not large enough and the present one was selected when it became apparent that a reservoir of more than 5,000 million gallons capacity could be constructed here.

Agreement was reached between Cardiff Corporation, Newport Corporation, Pontypool and District Water

Company, and Abertillery and District Water Board that the Cardiff Corporation Water Undertaking should act as promoters of the Llandegfedd Scheme, providing water for all the authorities.

A Public Enquiry was held on October 2nd, 1957, and an order granted in November 1958 under the title of Cardiff Corporation Water (Llandegfedd Reservoir) Order 1958. This Order covered the construction of an impounding reservoir on the Sor Brook, together with road diversions, a river intake works on the Usk at Rhadyr, a river gauge and weir improvement on the Usk at Trostrey.

Agreement had not, at this stage, been reached on the siting of the Treatment Works, but the Corporation ultimately purchased 60 acres of farmland at Sluvad and the works were planned to occupy 15 of these, the remainder being let to a farm tenant.

The first contract (Aqueducts) was let in October 1960, and the contract for the construction of the reservoir was started in April 1961.

The filling of the reservoir commenced in October 1963 and supplies of water were made available to the associated authorities on March 9th, 1964.







## **GENERAL DESCRIPTION**

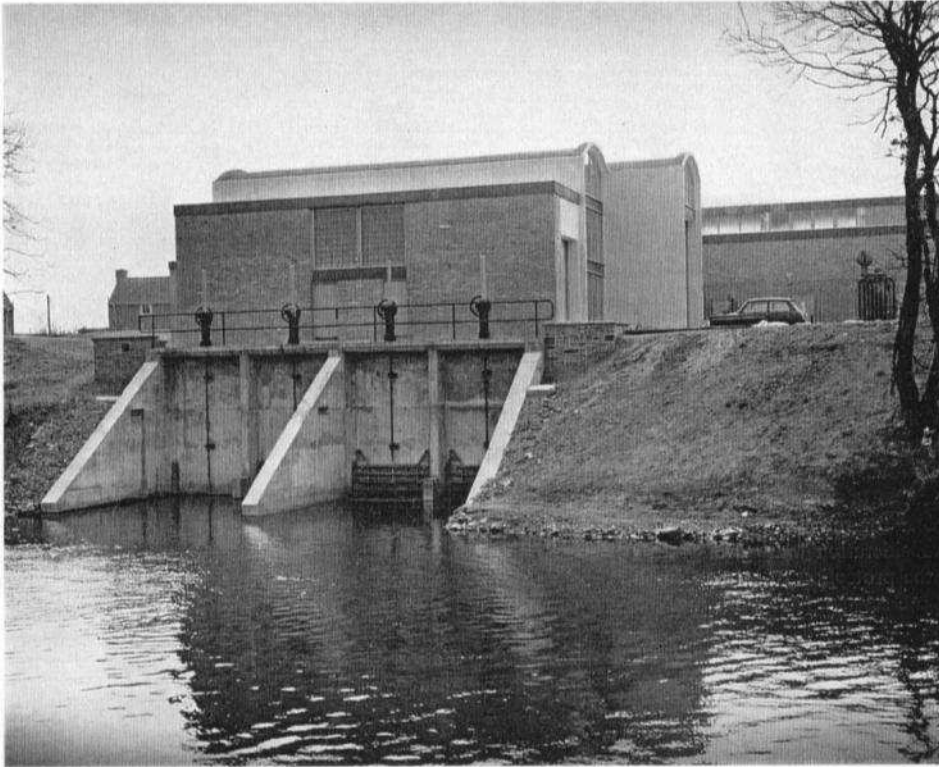


THE Llandegfedd Development has been carried out in two stages, and at the completion of the final stage in 1965 water will be available to the associated authorities as follows:

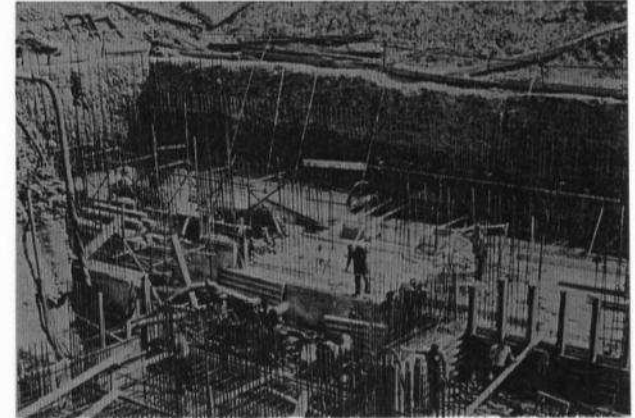
Cardiff .	9 m.g.d
Newport	5 m.g.d
Abertillery	2 m.g.d
Pontypool	3 m.g.d
Provision for Spencer	
Steelworks	1,825 m.g.d
Maximum supply rate	
Required	34 m.g.d. approx.

The yield from the catchment area is estimated at 2-2 m.g.d. Compensation water has been assessed at 550,000 g.p.d., leaving a nett yield of 1\*65 m.g.d. for supply purposes. To meet the demand, additional water will be pumped from the Usk and pumping rates have been agreed with the River Board, maximum abstraction being 70 m.g.d.

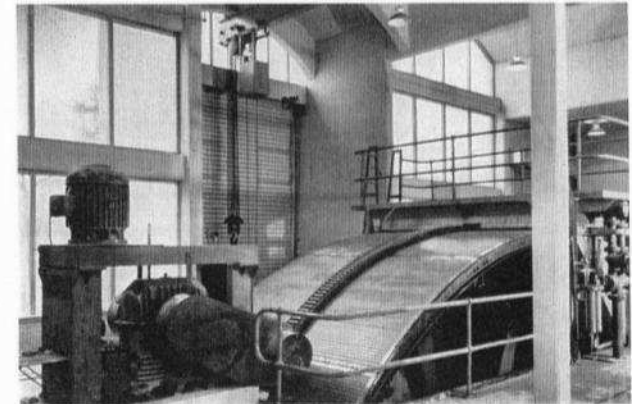
Water pumped from the Usk flows to the impounding reservoir via a pre-stressed concrete aqueduct. Raw water is then pumped from the reservoir to the Treatment Works at Sluvad at an elevation of 480 feet O.D. Treated water supplies then gravitate to Cardiff, Pontypool, and Abertillery. Raw water supplies for Newport and the Steelworks gravitate directly from the impounding reservoir, by-passing the Sor Pumping Station. Both Pumping Stations are remotely controlled from the Treatment Works by land-line.



*Usk Intake and Pumping Station*



*Foundation construction for Usk Intake and Pumping Station*



*One of the two Rotary Screens, final installation stage*





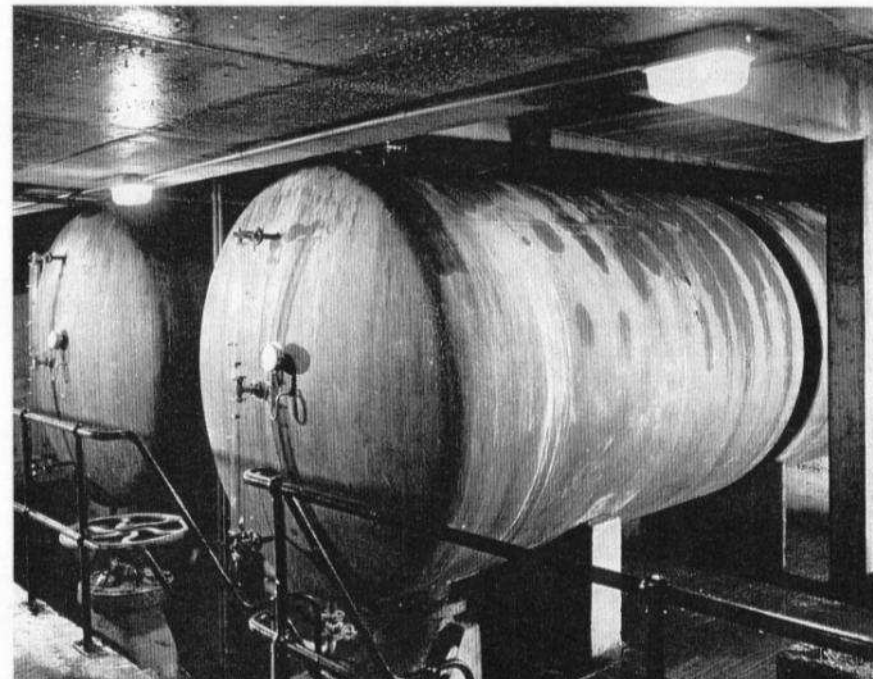
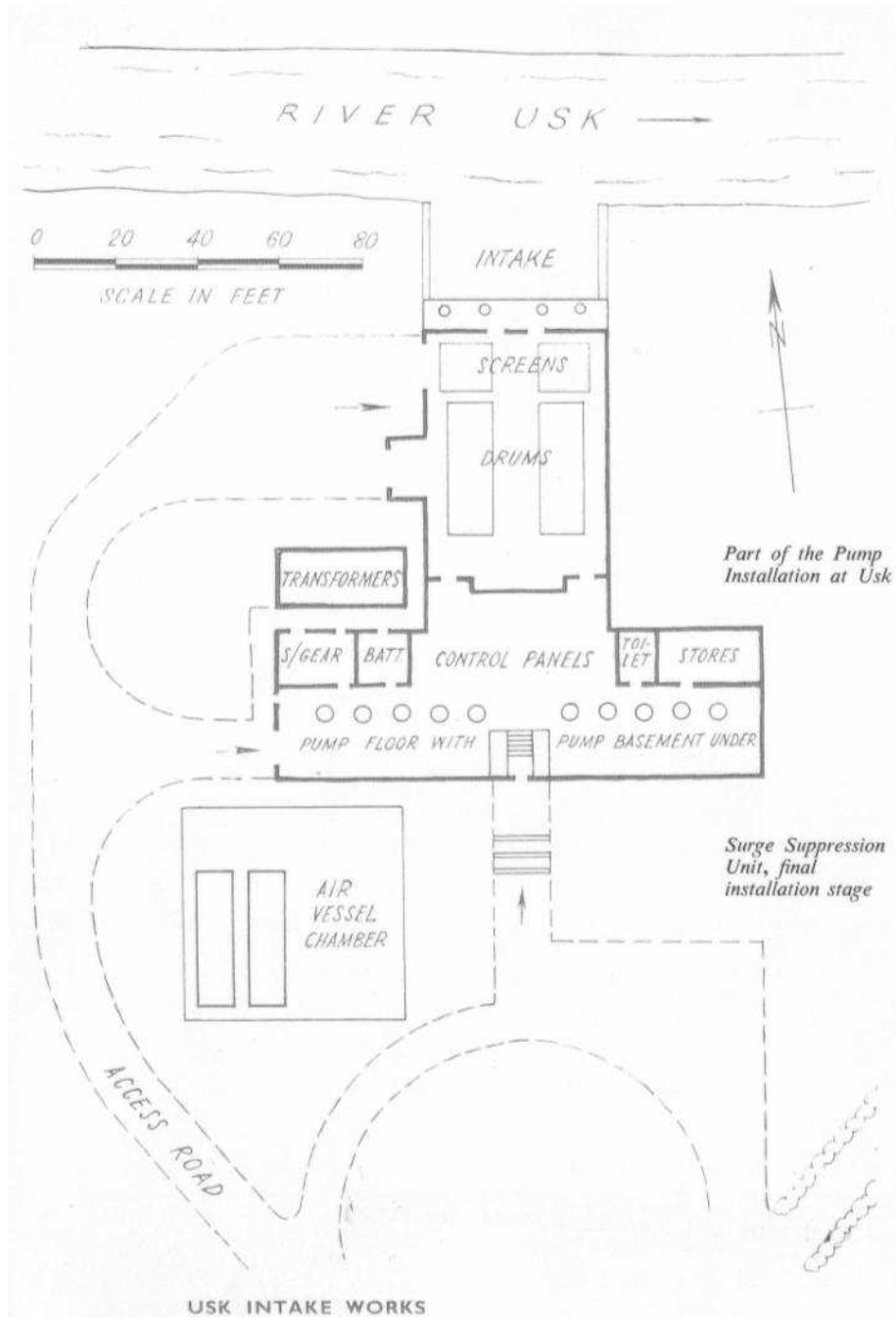
## ***INTAKE AND USK PUMPING STATION***



MOST of the civil engineering work here is below ground and river level. The intake in the Usk itself leads water through penstocks to either of two chambers where it passes first through automatically controlled self-cleaning trash screens. From there it is conducted to the inside of two 30 feet diameter rotary screens of fine mesh. The large diameter is necessary to cater for the rise and fall of the river, and very careful consideration was given in the design of these screens to the protection of salmon smolt. Drainage arrangements of the screens have been made to enable the fish to return to the river without injury. The screens are cleaned by external sprays; each of them is capable of dealing with 40 m.g.d

The ten pumps are of the vertical spindle split-casing type installed in a dry well. The five first stage pumps can deliver 7 m.g.d. each and are driven by 630 B.H.P. motors with direct on-line starting. 10 m.g.d. pumps are being installed in the second stage to provide stand-by capacity at maximum pumping rates. Electrical supply is taken from the grid at 11 K.V. and transformed down to 3.3 K.V. The pumping main is protected by surge suppression equipment. Pumps, electrical machinery, and ancillary equipment were supplied by the Harland Engineering Company Limited.

The entire Station is operated by remote control from Sluvad Treatment Works.





## **EMBANKMENT AND DAM**



### DETAILS of embankment

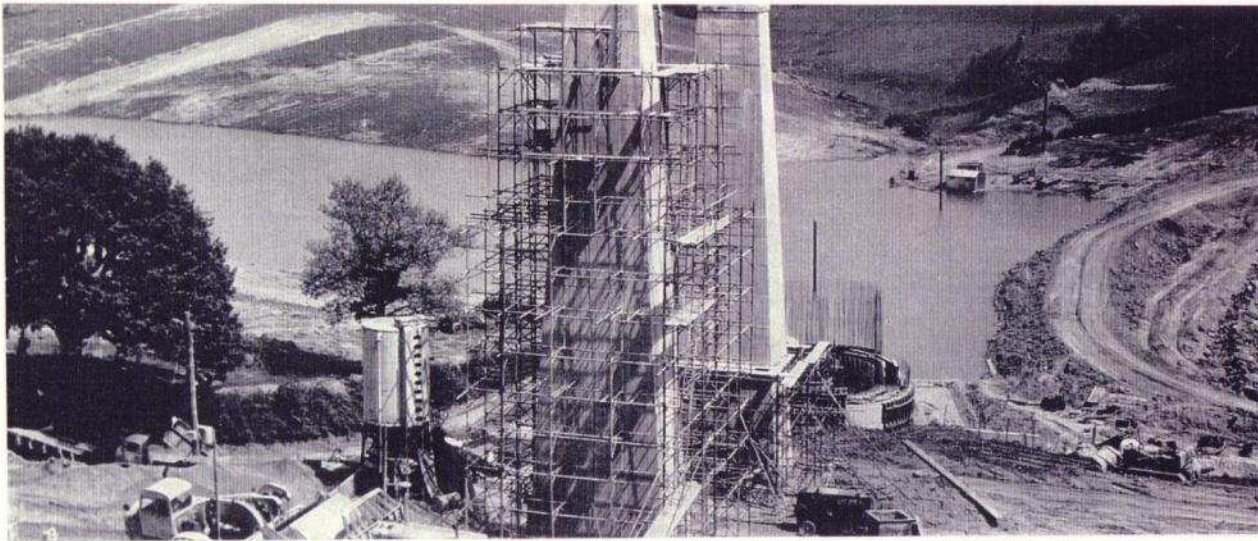
T.W.L	280 feet A.O.D
Length at T.W.L.	1,150 feet
Maximum height above stream bed	124 feet
Area of water surface at T.W.L	434 acres

The dam is formed by an earth embankment constructed from materials excavated on site. The core wall consists of rolled clay fill obtained from sub-surface clays and weathered shales. To avoid excessive pore pressures, blankets of crushed limestone 24 inches thick were placed at approximately 20 feet vertical levels. Twenty-three

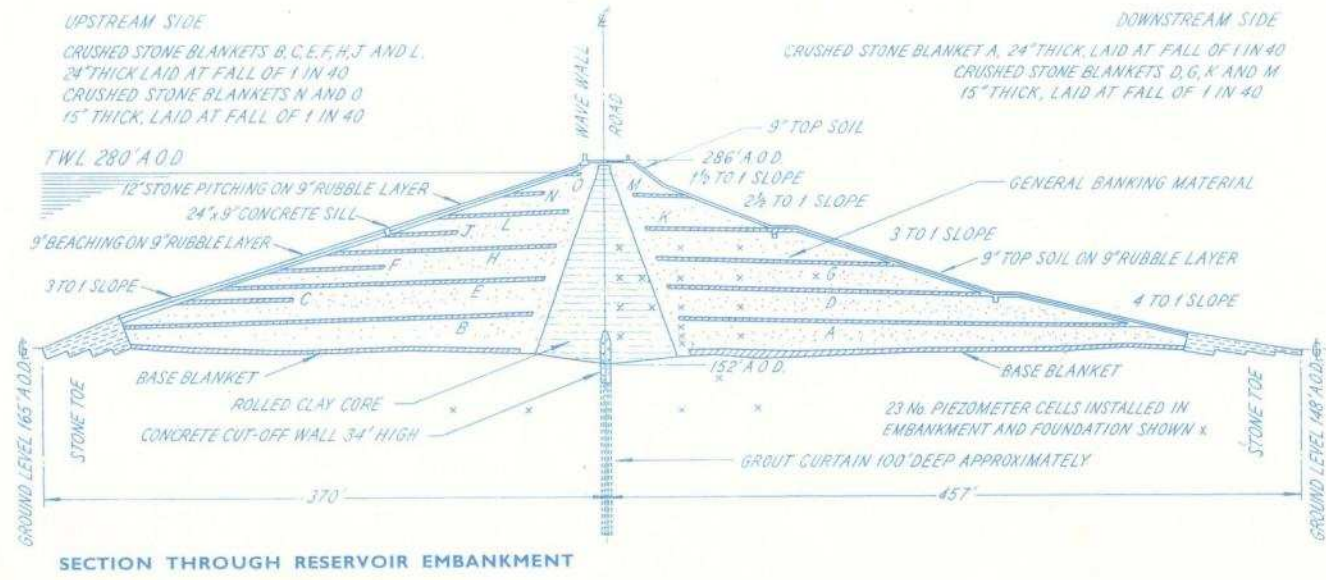
piezometers were installed in the embankment to record pore pressures.

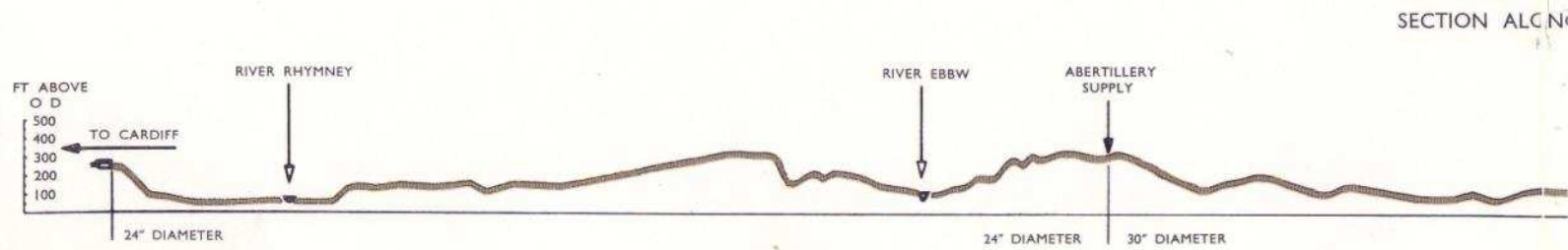
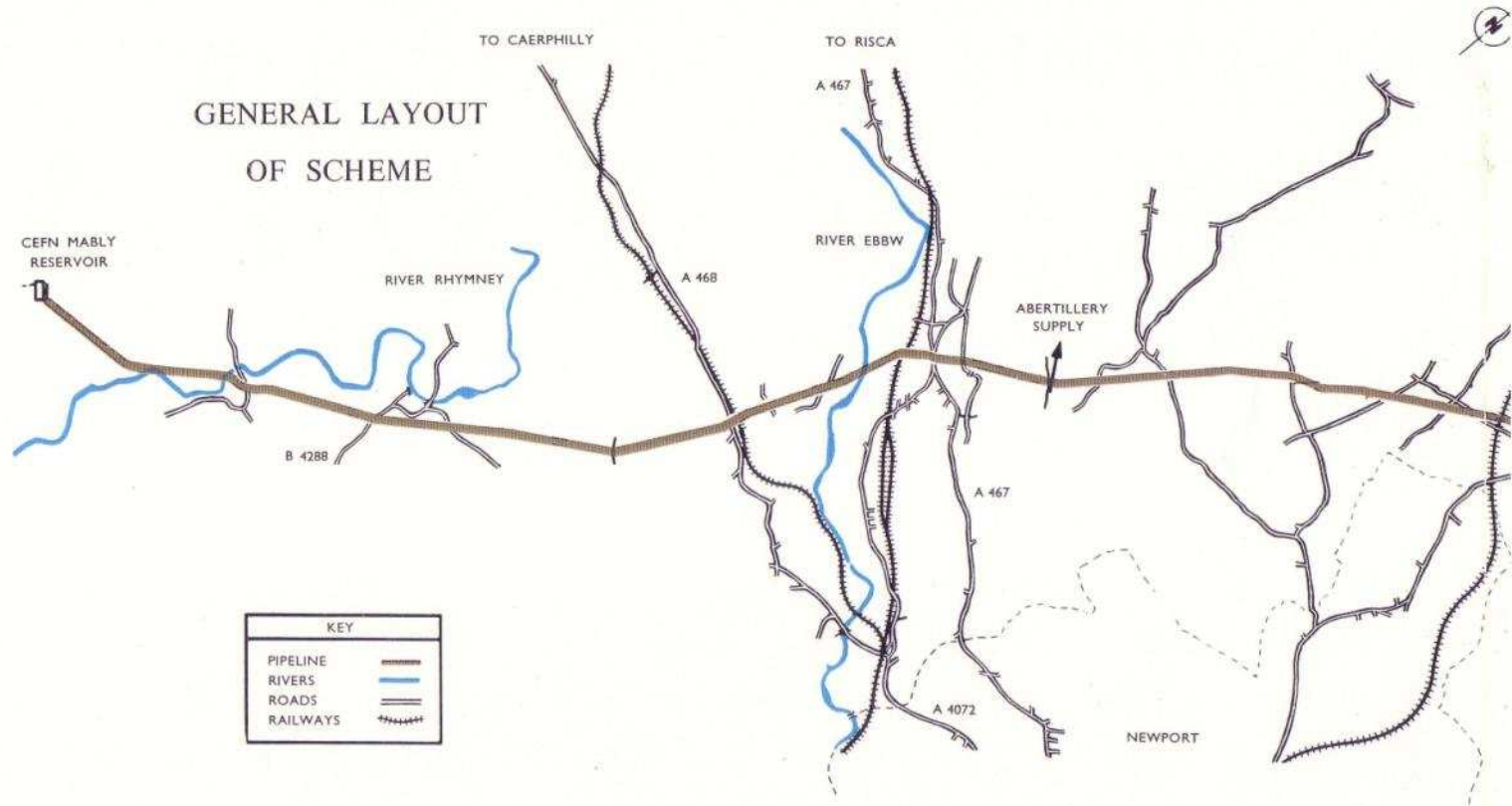
The water seal below ground level consists of a concrete cut-off wall to a depth of 30 to 40 feet supplemented by a grout curtain which continues to a depth of 100 feet in place.



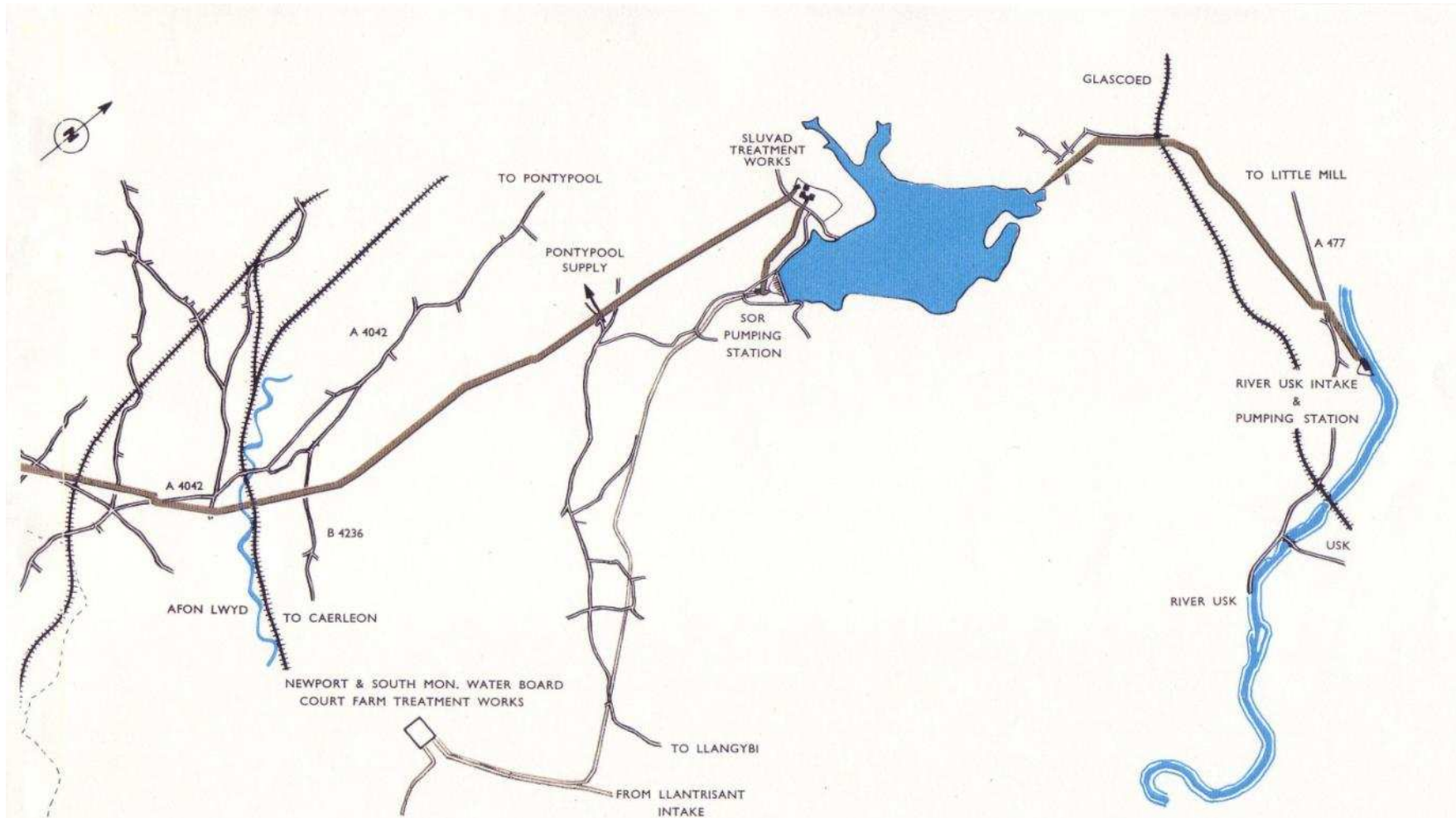


A stage in construction at Llandegfedd

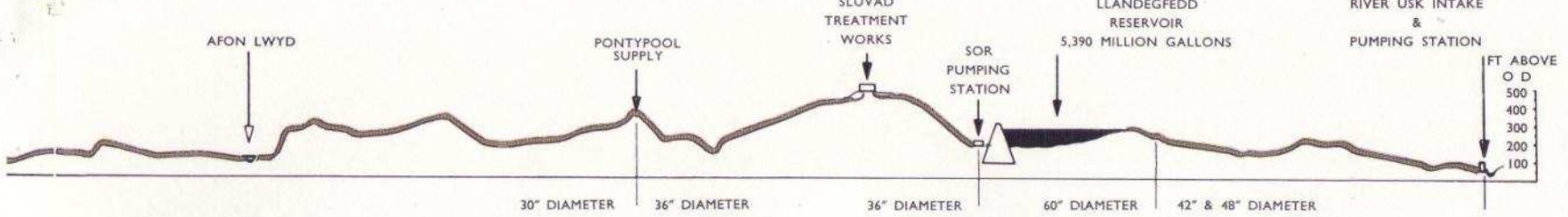








ALONG PIPELINE







## **RESERVOIR AND SÔR STATION**



The draw-off arrangements of the reservoir are unique in that conventional draw-off valves have been replaced by siphons. A reinforced concrete valve tower is provided with foundations on solid rock and incorporated with a concrete tunnel. This runs beneath the dam, some 20 feet above the lowest point of the valley, on the western side of the reservoir. The overflow is formed by a circular weir concentric with the valve shaft and is well able to cater for the worst flood which might be expected on the 1,590 acres of the Sor Brook catchment.

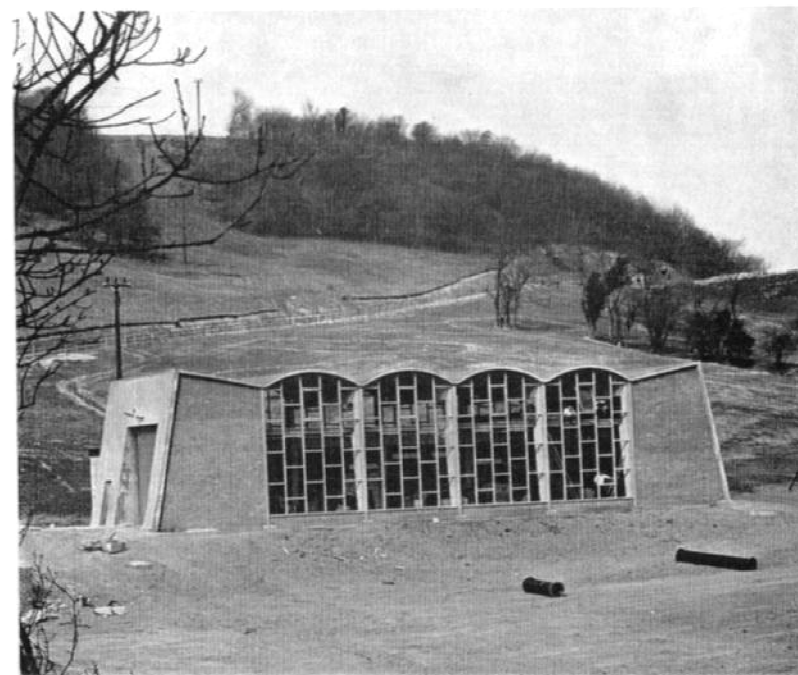
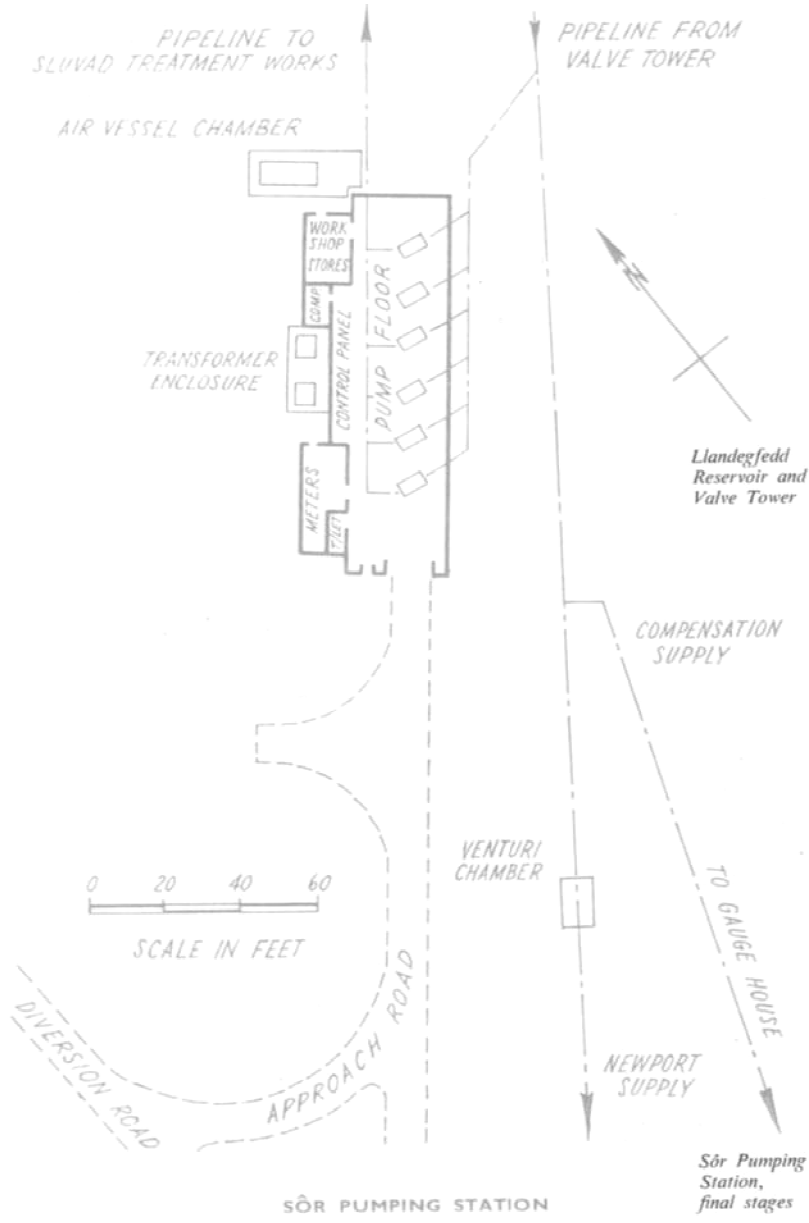
Water for supply and compensation purposes can be taken from any of three draw-off positions in the shaft through stainless steel-lined siphons controlled by compressed air equipment. The siphons are protected on the reservoir side by stainless steel gratings and hand-operated penstocks.

Access to the valve shaft is via a concrete bridge from the Sluvad-Coed-y-Paen road. This road runs across the dam at a width of 10 feet with a passing place of 16 feet width in the centre and a footpath on the reservoir side.

Although it is customary in a comprehensive water scheme to have filters or treatment plant downstream of the reservoir, certain factors at Llandegfedd made it more practicable to pump the whole 15 m.g. output per day from the reservoir to a treatment station at 480 feet A.O.D., whence the treated water could gravitate to Cardiff.

The Sor Pumping Station contains horizontal split-casing type pumps. The three pumps installed in the first stage are each capable of delivering 3 m.g.d. to the Sluvad Treatment Works and are driven by variable speed 330 B.H.P. motors of the A.C. commutator type controlled by induction regulators. The second stage pumps have constant speed squirrel cage induction motors. Surge suppression equipment has also been installed. As at the Usk Intake Station, all plant is either automatically operated or capable of remote control from Sluvad.

Alternative connections to the national grid have been obtained for both Sor and Sluvad to cope with possible breakdowns in the power supply. Duplicate 11,000/415 volt transformers have been installed.





## **SLUVAD TREATMENT WORKS**



**BEFORE** any detailed planning of the type of treatment works required could be carried out, very careful consideration had to be given to the quality of raw water it was to receive and analyses of the river water were carried out over a long period.

For Stage I of the construction, to supply a total of 6 m.g.d. treated water, six chemical treatment and filter units were installed. The probable quality of the water to be treated was still unknown since the fact of its being stored in a 5,390 m.g. capacity reservoir before treatment had to be taken into account. A feature of the installation, therefore, is an experimental unit of 1 m.g.d. which can be run in parallel with the main plant for investigatory purposes without affecting the output of the station.

The raw water is pumped from Sor into a flash mixer where ferrous sulphate is added as a coagulant (with provision for sulphate of alumina or other chemicals if required).

The water then passes into the hopper-bottoms of the upward flow sedimentation tanks where the turbulence induces flocculation. The agitation reduces as the water rises in the tank through a deep zone of suspended sludge which encourages the formation of larger and more rapidly settling particles. The settled water passes through the sludge blanket and is drawn off at the surface for passage to the filters.

These are of straightforward rapid gravity design - sand resting on a bed of graded gravel. Automatic control equipment is provided for filter washing, operated by loss of head through the filters, with, in addition, an automatic sequencer to ensure the correct order of washing.

Provision is made for two-stage chlorination, the final dosage being automatically controlled. Finally, the water passes to the treated water reservoirs after dosing with hydrated lime to correct the pH value.

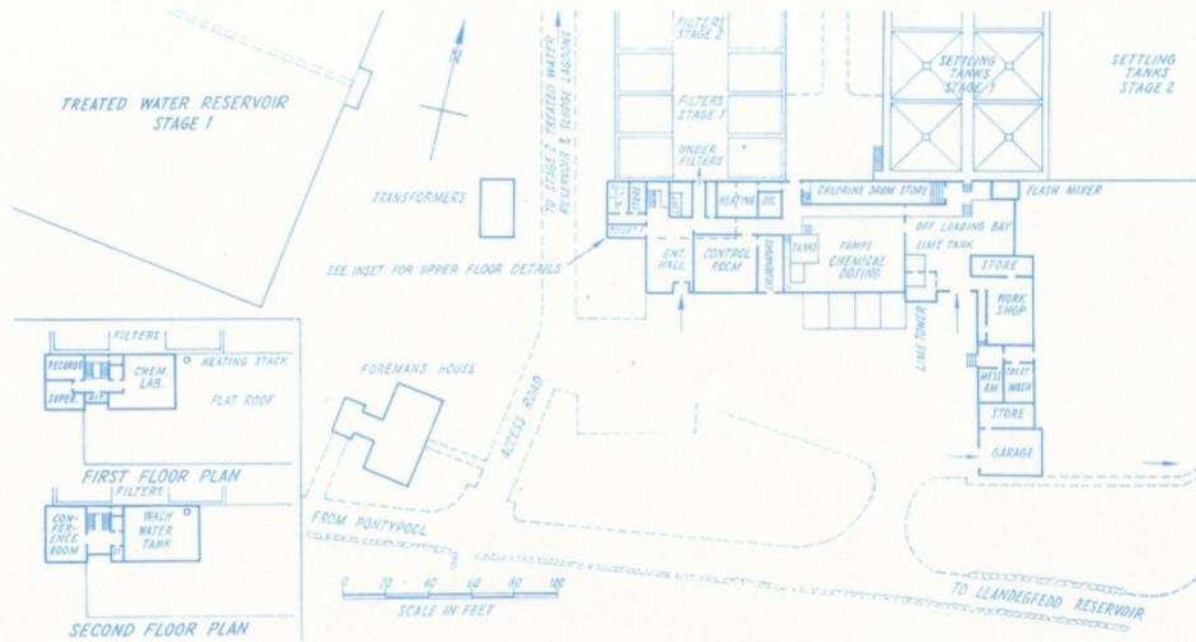




Entrance Hall, Sluval Treatment Works



The Control Room



SLUVAL TREATMENT WORKS



## ***SLUVAD Continued***

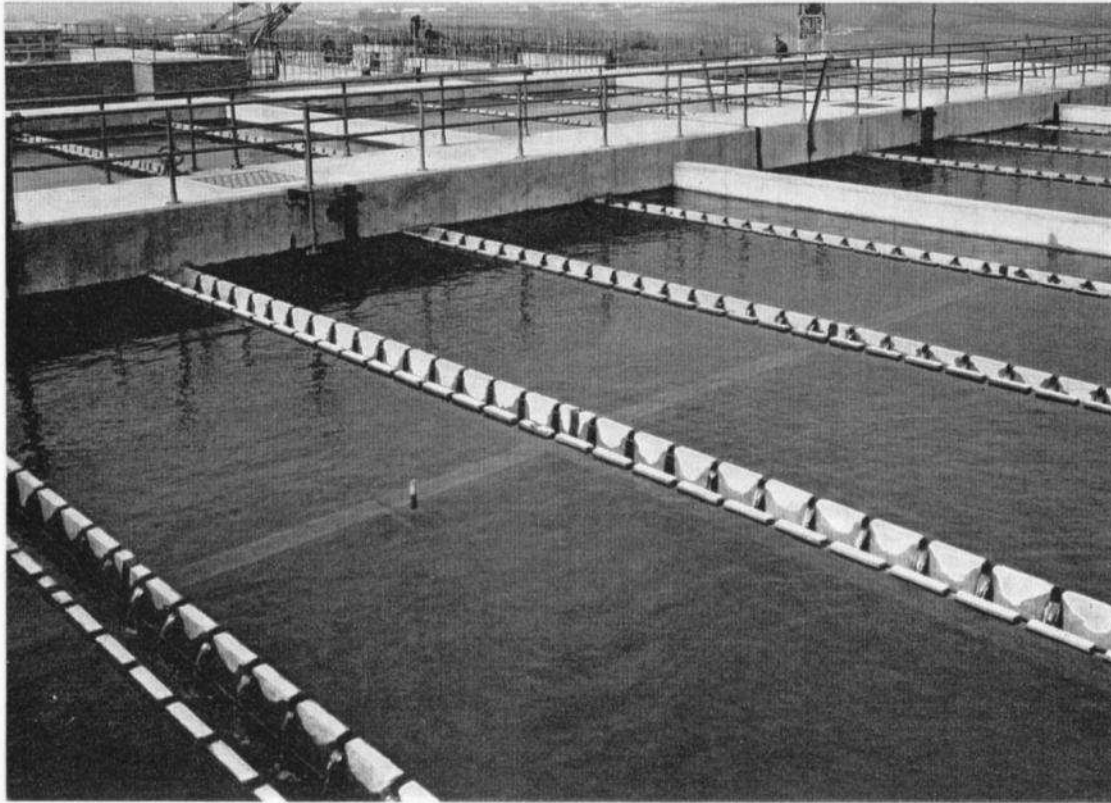


The entire treatment plant at Sluvad, including the further eight filters and ancillary equipment which will be incorporated in the Scheme, is being supplied by the CANDY FILTER COMPANY LIMITED.

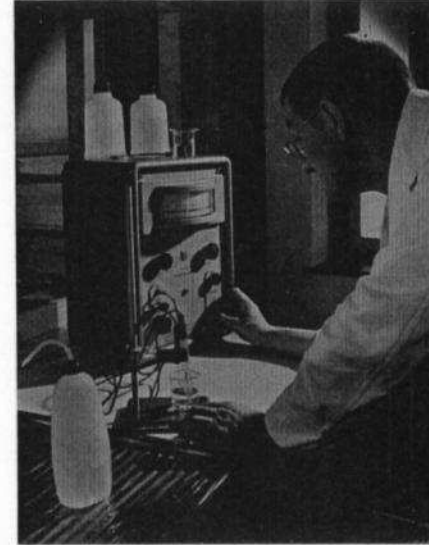
All necessary civil engineering work, including the Administration Building, completing Stage I, has been carried out by M. J. GLEESON LIMITED. The remaining civil engineering construction - additional sedimentation tanks and filter shells, together with a second service reservoir of 3 m.g. capacity - is being undertaken by THYSSEN (GREAT BRITAIN) limited.

The final capacity of Sluvad, when all work is completed, will be 15 m.g.d. of treated water.

The attractive and spacious Administration Building contains a chemical and bacteriological laboratory; men's messroom, washing facilities, and showers; a conference room; stores, workshop, and garage. It also houses the nerve-centre of the entire Scheme - the Central Control Room. Here complex instrumentation controls all operations including those at the Sor and Usk Pumping Station, and there is a teleprinter link between it and the South Wales Electricity Board.



*Sedimentation Tanks, Shuvad*



*Carrying out a pH test*



*The Laboratory*





## **PIPELINES**



The aqueduct from the Usk Pumping Station to the impounding reservoir consists of 3,960 yards of 42 inch diameter pre-stressed concrete cylinder pipes with Lock joints and 1,030 yards of 60 inch diameter pre-stressed concrete pipes with Johnson couplings. For the second stage of the Scheme, an additional 48 inch diameter pre-stressed concrete pumping main is being laid parallel to the 42 inch diameter main. These pipes are supplied by STANTON AND STAVELEY LIMITED.

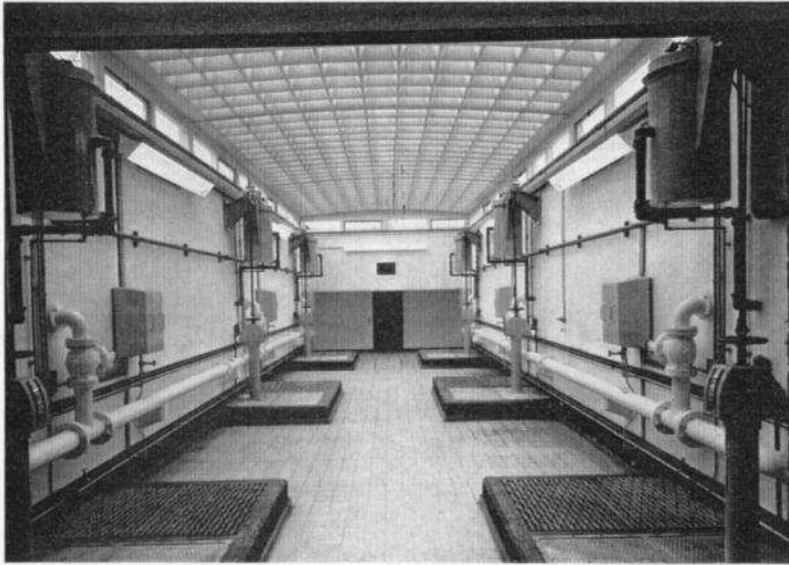
The rising main from the Sor Pumping Station to the Treatment Works consists of 36 inch diameter welded steel pipes, concrete lined and sheathed externally with bitumen reinforced with woven fibre-glass fabric. This main is 1,000 yards long and the pipes were provided by CLAYTON, SON AND COMPANY LIMITED.

The treated water gravitates to Cardiff through, in the first length, a pipeline 2,400 yards long of 36 inch diameter pre-stressed concrete cylinder pipes. A supply of 3 m.g.d

is made to the Pontypool and District Water Company at the end of this length. From this point the aqueduct continues in 30 inch diameter pre-stressed cylinder pipes for a further 9,700 yards. Provision is made at this point for a supply of 3 m.g.d. to the Abertillery and District Water Board. The supply to Cardiff flows through a 24 inch diameter spun iron pipe-line with Tyton joints, for a length of 9,300 yards, terminating in the new Cefn Mably service reservoir. These pipes were supplied by STANTON and STAVELEY LIMITED.

Three railway crossings have been carried out by Auger type thrust boring, the longest being 200 feet in extent. River crossings were carried out by means of simply supported steel pipe spans, the pipes being provided by CLAYTON, SON AND COMPANY LIMITED.

Raw water for the Newport and South Monmouthshire Water Board and the Spencer Steel Works gravitates from the reservoir through a trunk main laid by the Water Board.



*Filter Inspection Gallery, Sluvad*



*Diversion Culvert and Outlet Main – construction stage*



## **CONCLUSION**



THE Llandegfedd Water Scheme is one of the most comprehensive in the country and embodies several unique features in its design and layout. It may well prove to be the forerunner of other such schemes providing river water for large undertakings.

It has been conceived and brought in to operation with the minimum disturbance to the normal life of the surrounding countryside and during its construction has imposed no

restrictions whatsoever on farming or other activities outside the reservoir area.

It is inevitable that a project of this size and type should make topographical changes; nevertheless it can and will have considerable amenity value. Trout fishing, sailing, nature-study, ornithology are among the recreational possibilities of the reservoir. Landscaping will be carried out wherever possible to enable buildings to blend into their surroundings.





## THE LLANDEGFEDD WATER SCHEME

### MAIN CONTRACTORS

Reservoir and Road Diversion		LEHANE, MACKENZIE AND SHAND LIMITED
Pumping Stations .		M. J. GLEESON (CONTRACTORS) LIMITED
Treatment Works:		
	Stage I	M. J. GLEESON (CONTRACTORS) LIMITED
	Stage II	THYSSEN (GREAT BRITAIN) LIMITED
Treatment and Filtration Plant .		THE CANDY FILTER COMPANY LIMITED
Pumping Equipment		THE HARLAND ENGINEERING COMPANY LIMITED
Aqueducts:		
	Stage I	J. L. KIER LIMITED
	Stage II	DAVIES, MIDDLETON AND DAVIES LIMITED
River Gauge		THYSSEN (GREAT BRITAIN) LIMITED

### SUB-CONTRACTORS

Pre-stressed Concrete Pipes		STANTON AND STAVELEY LIMITED
Spun Iron Pipes .		
Steel Pipes		CLAYTON, SON AND COMPANY LIMITED
Pressure Grouting .		FOUNDATION ENGINEERING LIMITED
Steel Pipes and Pressure Vessels		THE SOUTH DURHAM IRON AND STEEL COMPANY LIMITED
Penstocks		GLENFIELD AND KENNEDY LIMITED
Control Valves and Screens		J. BLAKEBOROUGH AND SONS LIMITED
Instrumentation		ELLIOTT PROCESS AUTOMATION LIMITED
Chlorination		WALLACE AND TIERNAN LIMITED
Steel Reinforcement		T. C. JONES AND COMPANY LIMITED
Heating Installation		HEATING (CARDIFF) LIMITED
Electrical Installation Cables		GWINNUTT LIMITED A.E.I LIMITED
Cables		A.E.I. LIMITED

*The City of Cardiff Corporation wishes to thank all those who have in diverse ways contributed to and assisted in the design, construction and successful completion of the Scheme*

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