> " That the River Authority construct and operate the river intakes, the associated controls and pumping machinery, the intake aqueducts and the reservoir, and do supply raw water to the several water undertakings as may be necessary ".

The Consulting Engineer, Consultant Chemist, and other technical advisers who had been instructed by the Water Board were retained, and it was agreed that the Water Board should be repaid £15,987 in respect of the fees, costs and expenses which they had incurred.

Appreciation of the work and foresight of the Water Board, and of the assistance and information which has been received from their Chief Engineer and his staff must be recorded.

Further reference will be made to the Rutland Project in Section 8.

With other River Authorities in the South East every opportunity was taken to support the Water Resources Board in seeking to persuade the Ministry of Housing and Local Government to authorise a feasibility study of the Wash Barrage. It is satisfactory to record that the Minister's decision to authorise in the first instance a Desk Study arose out of a suggestion which had obviously impressed him, made by the Chairman of the Water Conservation Committee when in July the Minister received a deputation from the representatives of the Water Resources Board and three of the river authorities between the Wash and the Thames.

It was decided to appear at the Public Inquiry concerning the draft South Lincolnshire Water Board Order in support of the Ministry's proposal to transfer the water undertakings of Peterborough City Council and of the five adjoining District Councils to the South Lincolnshire Water Board. The City Council has provided an adequate and extremely cheap water supply for many years. Consolidation was in accordance with the Ministry of Health's White Paper on a National Water Policy published in 1944. Following a Public Inquiry in 1962 into several applications for licences under section 14 of the Water Act, 1945 the Ministry wrote:

> " The Inspector remarks that the interests of the two statutory water undertakers (i.e. South Lincolnshire Water Board and Peterborough City) are in direct conflict. Each abstracts ground water from the Lincolnshire Limestone, and each is affected in some degree by the operation of the other. One undertaking has its sources deep inside the area of the other, and is likely to take the greater quantity of water. He considers that the shortage of water revealed by the Inquiry shews the need for co-ordination and a unification of interests, and that it has become obvious that there should be only one public water undertaking in the Area. There is a strong case on engineering grounds for the re-grouping of water undertakers in the area considered at the Inquiry ".

It is believed that by the early 1970's the Peterborough City undertaking and the five districts for which they provide a bulk supply will have reached the limit of their present entitlement in the Lincolnshire limestone. Subject to short term temporary measures—and measures which would be materially facilitated if the re-grouping took place—the proposed " new town " expansion at Peterborough must then be supplied from the Rutland Project, and it will eventually be necessary for the South Lincolnshire Water Board to take water from there for their District as it now exists. Regrouping can only result in greater flexibility, and it will be a great advantage to have " one hand on the tap ".

The Minister confirmed the Order.

It is hoped that a discussion with the Lincolnshire River Authority regarding the release of water from the River Glen through fresh water outlets into the drains in the Black Sluice Internal Drainage District to meet the needs of spray irrigators there will have overcome any difficulty, as it would be unfortunate if river authority boundaries proved to be an obstacle in the transfer of water as may be necessary for agricultural requirements. The Drainage Board's application for a licence of right was rejected, as it was considered that they had not abstracted water within the meaning of section 33(1) (b), but that water had been fed into the drains independently of them to meet the needs of the individual spray irrigators.

The Lincolnshire River Authority were told that any direct request from their licence holders for water to be fed into the Black Sluice drains could not be accepted, but that if the water in the Black Sluice system was insufficient to meet protected rights and a request was made by the Lincolnshire River Authority then (at the discretion of this Authority) water would be released from the River Glen, provided that the flow there was sufficient for the purpose. Licences of Right relating to the River Glen are far in excess of dry weather flow, and uncontrolled use of the fresh water outlets could create difficulties in drought periods. Losses vary considerably according to the nature of the sub-soil, and it is estimated that in times of drought some 19 gallons of water released into the drainage system may be lost by evaporation and absorption for every gallon gainfully used.

It has not been possible to formulate a policy as to the requirement for water meters, particularly by spray irrigators, and a wet summer prevented a full appraisal of the problems. The outcome of discussions at national level are awaited with interest. Accurate measurements must be made where necessary for the effective administration of water conservation, to control abstractions, and to ensure that the Charging Scheme is equitably enforced. It is hoped, however, that the need for meters can be kept to the very minimum. In many cases it may suffice if meters are installed for limited periods as a check, and to calibrate the capacity of the plant, so that assessments can then be made on hours run x capacity. The efficiency of this method will depend on spray irrigators returning the log sheets with the relevant data reliably completed, and it is pleasing to note that there is growing co-operation in this respect. Unfortunately two wet summers have made it difficult to draw any useful conclusion as to metering spray irrigations and the compilation of records.

The recommendation to appoint Field Officers, primarily to deal with licensing administration, was accepted with some hesitation as it was feared that it might create ill will and suspicion. In fact the two ex-police officers who were appointed have done an excellent job on public relations, and their tact, courtesy, and helpfulness appears to have been greatly appreciated.

In response to a request from the Association of River Authorities for suggestions for amendments to the Water Resources Act, the following observations were made:

Section 4: further provision should be made for the transfer of water from one area to another.

Section 24(i) the limitation of 1,000 gallons made it difficult to apply the *de minimis* maxim in other cases, and it operated harshly.

Section 25(i) there should be an expeditious licensing procedure for isolated and emergency abstractions.

Section 25(ii) provision should be made to enable spray contractors to take water as necessary.

Section 25(iii) there should be a definition of " domestic use ".

Section 26: provision to exonerate river authorities from responsibility for protected rights of which they have no knowledge was necessary.

Section 32: the requirement that river authorities should be notified of transfers of licences within one month operated unreasonably, and should be modified.

Section 42: it should not be necessary to advertise minor variations of a licence which did not affect third parties.

Part V(i) provision to waive charges when the amount is small and to waive the licence fee where it may be excessive in relation to the amount of water abstracted.

(ii) power to make special arrangements as to charges should be extended so that in appropriate circumstances they could be levied on the water lost to the source of supply instead of on the water abstracted (e.g. in the case of a recirculation from an enclosed gravel pit.)

It will be appreciated that these suggestions are dependent on amending legislation. The Act has to be administered as it is, and the fact that some amendments are considered to be desirable can in no way prejudice its enforcement.

The practice of some internal drainage boards of allowing tidal saline water to flow back into the drains as an effective and economical way of controlling weed growth was considered, as it was pointed out that the water in the drains may thereby be rendered unfit for abstraction by licence holders for the purposes specified in their Licences. One Licence Holder had surrendered his Licence for that reason. It was accepted that it was in the public interest that internal drainage boards should continue to take tidal saline water for that purpose, and it was decided that Licence holders should be informed that the Authority can give no assurance that water is suitable for the purpose for which Licences may be issued.

2. PERIODIC SURVEY

The Water Resources Board's Memorandum WRB7 containing further guidance as to the scope and method of making and presenting the statutory survey confirmed that the preparatory work had proceeded on right lines.

Re-examination of the demands and present resources did not reveal any significant variation in the assessment made for the purpose of the Water Resources Board's Report on Water Supplies in South East England, and it emphasized the urgency of developing new sources. Imports from the Great Ouse Water Authority's Grafham Water, controlled overpumping of the Lincolnshire limestone, and a limited yield from river gravels are not sufficient to meet the estimated deficit of over 80 m.g.d. by the year 2001. The gap can only be closed by abstractions from the middle reaches of the Rivers Welland and Nene at times when flows are sufficient for storage in a new reservoir or reservoirs. It appears that will be necessary by 1975.

3. HYDROMETRIC SCHEMES

Expenditure on Part I of the Hydrometric Scheme amounted to £18,570, bringing the aggregate to £38,662, and leaving an estimated expenditure of £40,000 to complete that Part.

Work on new river gauging stations, or on improving and modernizing the river gauging stations installed by the River Nene Catchment Board some 30 years ago, was completed or was in hand as follows:

(i) *Orton, River Nene.* The station has been in operation since 1940, and modernization and improvements were completed at a final cost of £6,833.

(ii) *Wollaston, River Nene.* Intermittent observations of low flows have been made at Wollaston (near Wellingborough) since 1944. A scheme providing for the replacement of the broad crested weir with a Crump type weir in order to record river flows up to 80 cusecs has been approved at an estimated cost of £3,696.

(iii) *Tallington, River Welland.* The compound station of a capacity of 5,100 cusecs became operational in October, and cost £13,480. The work included substantial modification to a flat topped weir across the main channel.

(iv) *Barrowden, River Welland.* The station became operational in February, and cost £2,912. It has a simple Crump type weir to measure medium/low flows, and it is complementary to the nearby Tixover station where higher flows are recorded.

(v) *Belmesthorpe, River Gwash.* The station, which has a simple Crump type weir of a capacity of 875 cusecs, became operational in April and cost £5,353. It replaced a temporary low flow weir at which twice weekly observations have been taken during summer months since 1961.

(vi) *Foster's Bridge, River Chater.* The station, which has a compound Crump type weir of a capacity of 665 cusecs, became operational in January. Previously data was obtained from a temporary low flow weir at Ketton where twice weekly observations had been made during summer months since 1961.

(vii) *Manthorpe, River East Glen.* The station, which has a small simple Crump type weir with a capacity of 10 cusecs, became operational in March and cost £1,110. This station and the Shillingthorpe station were designed to measure low flows of the East and West Glen, which are influenced to a significant extent by the Lincolnshire limestone aquifer for which long term information is required.

(viii) *Shillingthorpe, River West Glen.* Work at this station was nearing completion, and it is estimated that the cost will be £955. The simple Crump type weir was designed to measure up to 18 cusecs.

The rain gauge network was expanded by the recruitment of twelve more voluntary observers. By 1969 it is hoped to complete the coverage with 98 stations at approximately 1 raingauge to 16 square miles.

The installation of continuous water level recorders on the non-tidal side of Dog-in-a-Doublet Sluice (R. Nene) and of Surfleet Sluice (R. Glen) was nearing completion.

Part II of the Hydrometric Scheme was approved in principle, subject to any modifications which may be made as a result of improved instrumentation or new measurement techniques. Additional instruments were installed at Bugbrooke Climatological Station. Preparations were made for a fully automated climatological station in the R. West Glen catchment, which will provide data for the long-term investigation of the Lincolnshire limestone aquifer.

Two 24-hour automatic water quality samplers were installed, one on the River Nene at Wansford and the other on the River Welland at Tixover, which was later moved a short distance downstream to Tinwell. Some 80 samples were taken by the Nene apparatus, but only 23 samples by the Welland apparatus, as there were some mechanical difficulties. These sampling stations, in conjunction with the nearby river gauging stations, will provide information on quality/quantity relationships of great value for the purpose of controlling river abstractions in connection with the Rutland reservoir.

4. INVESTIGATION OF WATER IN UNDERGROUND STRATA

The Water Resources Board published in April their Interim Report on Ground Water Resources of the Lincolnshire limestone to the north of Peterborough. Work so far completed indicates that authorised abstractions from the aquifer near and to the south of Bourne may be approaching the estimated resources. It has not been possible on the available data to make an accurate assessment of the resources of the limestone, and as that is essential the Report suggested that further work was necessary on the following lines:

(a) a more detailed study of the flow regime of the River Glen.

(b) a more accurate estimate of the actual evaporation over the limestone outcrop.

(c) the relationship between the rest water level in the limestone and abstraction from the aquifer.

The latter investigation was considered to be the most promising method of determining the available ground water resources. Further development should probably await the outcome of the study of the relationship between the water level in the limestone and the abstractions, but it was suggested that consideration should be given to the sinking of new wells to control the water level and eliminate overflow. Development of the aquifer to the north of Bourne should be allowed as a controlled experiment with the object of changing the direction of the

hydraulic gradient and inducing a flow from north of the R. Slea towards the more heavily developed area in the south.

The Report concluded that consideration should be given to the feasibility of local artificial re-charge. The optimum development of the ground water resources of the aquifer is an economic problem involving such questions as:

(a) What is the minimum controlled pumping level ?

(b) Should the water resources be " mined " as a temporary measure ?

(c) Should the limestone be used as a storage reservoir in conjunction with a surface water intake and artificial recharge ?

Finally the Report suggested that an economic study is necessary to indicate how the resources in the limestone should be developed.

The Interim Report has been of great value, and the Final Report is awaited.

In consultation with the Water Resources Board and in conjunction with the Lincolnshire River Authority detailed field work proceeded on the lines suggested. Numerous observations on river flows and artesian overflows supported the view that ground water—particularly from the Greatford and Wilsthorpe cress beds—makes a significant contribution to the River Glen and its two tributaries. Observations on those lengths of the streams which recharge the aquifer also yielded information, and the protracted dry weather in July revealed the lengths where low flows are sustained by superficial gravel deposits and sources other than limestone springs.

A land use survey of some 10 square miles of the River East Glen catchment provided a more realistic estimate of evaporation.

Investigations proceeded into the resources of the river gravels. In co-operation with the Water Resources Board a testing technique was developed, and a method of measurement and recording was evolved which facilitates an evaluation of the data. Observations are being made at the various sites to record recovery rates.

The safe yields make little contribution to the resources of the Area, as is shewn by the results summarised in the following table:

RIVER GRAVEL INVESTIGATIONS 1967-1968

Estimated Safe Yields

	Location	*Estimated Safe Yield m.g.d.*
River Nene	Stibbington (Test 1)	0.15
	Stibbington (Test 2)	0.20
	Perio	0.60
	Earls Barton	1.50
River Welland	King Street..	0.125
	Deeping St. James	nil

During the winter ten sets of observation tubes were installed at gravel sites in the Welland and Nene Valleys, and variations in the water table are being measured. It is intended to carry out pumping tests at six of the sites in the coming year.

5. MINIMUM ACCEPTABLE FLOW

The problems arising on a determination of Minimum Acceptable Flows have only been considered in relation to the proposed abstractions for the Rutland Project. It is intended to adopt the modal flow (the most frequently occurring flow) for that purpose, that is 60 cusecs (32.4 M.G.D.) for the River Nene at Wansford and 15 cusecs (8.1 M.G.D.) for the River Welland at Tinwell.

6. RESEARCH AND EXPERIMENTAL WORK

Some experimental work was carried out at Harper's Brook Gauging Station (Grid Reference SP.983 799) to assess its suitability for tests on gauging by salt dilution. A stage discharge relationship over a wide range was established by current meter, and systematic salt dilution gauging will be carried out when flows are suitable.

Routine weekly observations at Flore Catchment Station were suspended in December because of the " foot and mouth " restriction.

7. LICENCES

(a) Abstraction Licences

The Table on Page 18 records the Licences of Right (with variations which have been made) extant at 31st March.

Nine Licences for agricultural abstractions " other than spray irrigation " were revoked at the request of the Licence holders, but most of them had been issued to abstractors who, although entitled to Licences of Right, had ceased to abstract on obtaining a public water supply; they did not wish to continue to pay an annual fee to " protect their rights ", or to cover themselves in the event of an emergency. Eleven Licences for spray irrigation were also revoked at the request of the Licence holders, but the authorised quantities were small or extremely small. Two Licences for small industrial abstractions (motor garages) were similarly revoked.

Five Licences of Right relating to abstractions authorised after March 1963 under the South Lincolnshire Area (Conservation of Water) Order 1948 made pursuant to section 14 of the Water Act 1945 were varied by deleting the limitations in time imposed by the Minister of Housing and Local Government pending the establishment of the Authority. Two Licences of Right were varied to permit increased abstractions, as the applicant had underestimated his actual abstraction, and a third Licence of Right was varied consequent upon the Licence holder taking additional land and requiring more water. A Licence of Right issued to a statutory water undertaking was varied to permit a substantial increase in the authorised abstraction on the rationalisation of their resources. Two Licences of Right were varied by the authorisation of additional or substituted boreholes in close proximity to boreholes which had become inadequate, but with no increase in the licensed quantities.

Nine applications for Licences were received, three in respect of agriculture, five in respect of industrial uses, and one for the hydraulic testing of a gas main. It was not necessary to refuse any applications, but the practice of discussing and investigating proposals as soon as any enquiry is received has so far prevented expenditure being incurred on advertising applications which were unlikely to be successful.

The net effect of the revocations, variations and new Licences is an increase of 1,450,572 thousand gallons per annum.

Of the ten appeals against the refusal of applications for Licences of Right, three have been withdrawn, and it appears that one may not be pursued. The Minister determined two of the appeals in favour of the Authority. In a third case he decided that the Authority were right on the face of the application to issue a Licence in the terms in which they did, and that there would have been some justification in his dismissing the appeal forthwith. But as he had to decide the appeal as if the application had been made to him in the first instance, he permitted the applicant to make further representations and corrections on the facts. The appeal had been made by the Ministry of Agriculture, Fisheries & Food, Agricultural Land Service, Lincoln, as the abstractor was a tenant on the Ministry's Small Holdings Estate. A final decision is awaited. Three appeals are still pending, including two from the Central Electricity Generating Board against the metering provisions, but it is hoped that a formula as to a method of assessment will be agreed with the Board.

LICENCES OF RIGHT
extant at 31st March, 1968

Area	Agriculture (other than spray irrigation)		Industrial (other than water cooling abstractions)		Industrial Cooling (C.E.G.B.)		Domestic (not exempt)		Public Supply		Miscellaneous		Totals	
	Authorised annual		*Authorised annual*		*Authorised annual*		*Authorised annual*		*Authorised annual*		*Authorised annual*		*Authorised annual*	
	No.	*abstraction*	*No.*	*abstraction*	*No.*	*abstraction*	*No.*	*abstraction*	*No.*	*abstraction*	*No.*	*abstraction*	*No.*	*abstraction*
31/1	4	1,146	4	490,200					1	290,000	1	1,000	4	1,146
2	4	1,936	2	44,074									14	784,638
3	10	1,204											14	46,084
4	4	1,355											6	1,960
5	5	1,755											8	9,480
6	5	1,709											11	6,614
7	8	1,189	1	2,000,000			2	332	4	451,600			17	2,003,861
8	10	4,478	2	260,000					5	482,475			29	273,130
9	26	3,946	4	152,435					1	4,380			50	623,490
10	14	2,819	2	21,500			2	335	1	2,190,000			40	531,594
11	11	1,826,741	3	113,450			1	500	2	1,400,140			59	1,998,229
12	10	1,220,568							5	2,912,800	2	3,686	29	3,444,768
13	9	1,332	11	933,065									63	2,411,805
14	18	197,735	14	916,697									129	4,215,759
TOTAL	138	3,267,913	43	4,931,421	5	1,167	19	7,731,395	3	4,686	473	16,352,558		
32/1	7	1,328	3	12,165					2	44,000			16	48,543
2	12	6,157	10	512,912					2	20,260			29	45,869
3	11	2,328	4	526,300					4	7,082,500	3	9,800	60	7,651,852
4	5	3,620	9	150,085	1	35,000,000	1	8,000	1	8,613,000	1	250	16	9,147,823
5	7	1,059	12	890,900					3	515,000			35	35,694,000
6	14	6,735							1	855,000	2	110	43	1,816,754
7	4	583	2	1,120,000					2	74,000			16	87,317
8	7	2,780	28	1,619,630			1	525					21	1,148,671
9	46	17,767	1	2,500			1	277	13	1,246,200	2	2,095	137	2,992,056
10	9	2,515	10	584,535					3	230,600			29	279,977
11	11	1,478			1	9,000,000							64	9,665,547
TOTAL	133	46,350	79	5,419,027	2	44,000,000	3	8,802	31	18,680,560	8	12,255	466	68,578,409
TOTAL 31-32	271	3,314,263	122	10,350,448	2	44,000,000	8	9,969	50	26,411,955	11	16,941	939	84,930,967

Area	Agricultural and Horticultural Spray Irrigation						Agriculture and Domestic		Grand Totals	
	Summer		*All Year*		*Total*					
	Authorised annual		*Authorised annual*		*Authorised annual*		*Authorised annual*		*Authorised annual*	
	No.	*abstraction*	*No.*	*abstraction*	*No.*	*abstraction*	*No.*	*abstraction*	*No.*	*abstraction*
31/1	1	450			1	450	3	1,052	4	1,502
2	2	806			2	806			2	806
3										
4							2	605	2	605
5			1	25	1	25	2	7,700	3	7,725
6							6	4,905	6	4,905
7							8	2,672	8	2,672
8	3	1,725	4	5,820	7	7,545	12	6,595	19	14,140
9	3	3,530	1	500	4	4,030	9	6,159	13	10,189
10	6	15,900	5	895	11	16,795	12	8,400	23	25,195
11	22	42,520	3	7,800	25	50,320	15	9,908	40	60,228
12	4	15,650	1	25	5	15,675	10	10,250	15	25,925
13	39	76,943	14	42,862	53	119,805	1	300	54	120,105
14	56	137,607	29	57,927	85	195,534	20	4,372	105	199,906
TOTAL	136	295,131	33	26,633	169	321,764	100	62,918	269	384,682
32/1	1	3,200			1	3,200	7	3,215	8	6,415
2	9	34,525	8	3,770	17	38,295	11	4,087	28	42,382
3	1	3,000			1	3,000	15	6,017	16	9,017
4	4	12,475	6	2,381	10	14,856	4	1,653	14	16,509
5	9	60,192	1	90	10	60,282	4	5,000	14	65,282
6	2	2,900	1	77	3	2,977	4	3,727	7	6,704
7	7	16,911			7	16,911	7	9,757	14	26,668
8	26	86,867	8	7,330	34	94,197	13	11,890	47	106,087
9	9	42,374	3	1,645	12	44,019	4	343	16	44,362
10	35	66,994	6	11,340	41	78,334	1	1,200	42	79,534
TOTAL	103	329,438	33	26,633	136	356,071	74	55,344	210	411,415
TOTAL 31-32	239	624,569	62	84,560	305	709,129	174	118,262	479	827,391

(Quantities in 1000 gallons)

LICENCES NOT OF RIGHT
issued during year

Agriculture (other than spray irrigation)		*Agricultural and Horticultural Spray irrigation*		*Industrial Uses Significant losses*		*Industrial Uses Water cooling Sand and gravel Other minimum losses*		*Domestic (not exempt)*		*Public Supply*		*Miscellaneous*		*Totals*	
Authorised annual		*Authorised annual*		*Authorised annual*		*Authorised annual*		*Authorised annual*		*Authorised annual*		*Authorised annual*		*Authorised annual*	
No.	*abstraction*	*No.*	*abstraction*	*No.*	*abstraction*	*No.*	*abstraction*	*No.*	*abstraction*	*No.*	*abstraction*	*No.*	*abstraction*	*No.*	*abstraction*
Nene Hydrometric area															
1	312			1	54,750	2	296,450							4	351,512
Welland Hydrometric area															
2	730					2	13,940					1	4,750 expired 16.1.68	5	19,420
3	1,042			1	54,750	4	310,390					1	4,750	9	370,932

(Quantities in 1000 gallons)

LICENCES NOT OF RIGHT
extant at 31st March 1968

Agriculture (other than spray irrigation)		*Agricultural and Horticultural Spray irrigation*		*Industrial Uses Significant losses*		*Industrial Uses Water cooling Sand and gravel Other minimum losses*		*Domestic (not exempt)*		*Public Supply*		*Miscellaneous*		*Totals*	
Authorised annual		*Authorised annual*		*Authorised annual*		*Authorised annual*		*Authorised annual*		*Authorised annual*		*Authorised annual*		*Authorised annual*	
No.	*abstraction*	*No.*	*abstraction*	*No.*	*abstraction*	*No.*	*abstraction*	*No.*	*abstraction*	*No.*	*abstraction*	*No.*	*abstraction*	*No.*	*abstraction*
Nene Hydrometric area															
4	3,472	8	21,641	3	131,970	5	1,416,000	2	6,300	4	621,750			26	2,201,133
Welland Hydrometric area															
4	779	3	3,213			2	13,940	1	729	1	365,000	1	27,000	12	410,661
8	4,251	11	24854	3	131,970	7	1,429,940	3	7,029	5	986,750	1	27,000	38	2,611,794

(Quantities in 1000 gallons)

There was a better response by spray irrigators in returning log sheets recording particulars required to make an assessment of the abstractions, but it is essential that all the log sheets should be returned and reliably completed if it is to be possible to restrict metering to the minimum. Metering will be necessary in the case of spray irrigators who opt to pay under the two part tariff, but it is hoped that the charges under the first Charging Scheme will be such that the cost and inconvenience of metering will not be worth the saving on the two part tariff.

Metering may be necessary where accurate data is required because authorised abstractions are substantial in relation to the resources, and it will be essential to ensure that authorised abstractions are not exceeded. It is hoped that in many cases "spot checks" will suffice, and that it may be possible to "calibrate" spray irrigation equipment so that abstractions can be assessed with sufficient reliability on hours run x pump capacity.

It is fully accepted that statistics and data must be accumulated as may be necessary for an

effective water conservation policy, and to accord with the Water Resources Board's requirements in making a national appreciation. At the same time, it is hoped that those who may be somewhat remote from the Licence holders who will have to fill in the forms will remember that data should not be required unless it serves a useful purpose, or there is a reasonable prospect that it may do so. Form filling which does not serve an obvious purpose is one of the surest ways of jeopardising public relations, and in " form filling " River Authorities got off to a very bad start as a result of the prescribed application forms for Licences of Right.

It was stated in the Second Annual Report that seven spray irrigation applications had been refused, as it had soon become evident that to avoid derogation from protected rights prospective abstractors would have to provide off stream storage and take water during winter months only. The Report on Water Supplies in South East England was quoted in support:

> " In the Welland and Nene area there will be little scope for further direct abstraction of surface water for spray irrigation in dry weather, although the matter is complicated by the practice hitherto of diverting Nene flow into the catchment of the Great Ouse for the maintenance of water levels in the Fens. The effective demand has been assessed and must be met by provision of local farm storage, or by diversion from major surface storage schemes."

It may have appeared that the policy was to reject all applications for spray irrigation unless winter storage was provided, but in September it was formally resolved that every application for a Licence for spray irrigation should be considered according to the circumstances of the case, and that due regard be had to the provisions of section 45. (Section 45 enables a river authority to suspend Licences for spray irrigation at times when drought conditions may make that desirable.)

(b) Impounding Licences

No applications for Impounding Licences have been received.

8. CONSERVATION WORKS

Rutland Project

(Note: As important developments have taken place since 31st March it was considered advisable to report on the position as at 31st August, 1968.)

Reference is also made to this matter in Section 1.

Mid-Northamptonshire Water Board had been considering the potential value of the two rivers since 1964, and they had come to the conclusion that the only suitable sites for a reservoir or reservoirs were at Manton (between Oakham and Uppingham) and at Empingham (between Oakham and Stamford), and that a yield of some 50 M.G.D. would be required by taking water for pumped storage from the River Nene below Oundle and from the River Welland near Tixover.

After making the initial assessment as required by section 14 it was decided that the two rivers should be fully developed as constituting the only practicable way of meeting the demand envisaged up to the year 2001, which covers the period adopted for the purpose of " Water Supplies in South East England ".

It was also decided that there would be great advantages in adopting a partial river regulation scheme for the River Welland, and that the Authority would be in a better position to control abstractions to meet the needs of the Area downstream of the abstraction points if responsibility for the Project was taken over from the Water Board.

The Consulting Engineers submitted their Interim Report on the 31st July 1968 on a scheme to ensure the maximum practicable utilisation of the Welland and Nene rivers for the supply of water to the Area. A preliminary report had been submitted on 14th June on the possibilities, the sites and choice of site, yield and cost.

Consulting Engineers agreed that the requirements set out in the South East Report were still substantially correct, and that the deficiencies in M.G.D. to be met were as follows:

1975	1977	1981	2001
12.23	18.91	29.90	82.41

They confirmed that the Mid-Northamptonshire Water Board were correct in their conclusion that the only practicable scheme to meet the anticipated deficiency of say 80 M.G.D. in the year 2001 is to pump from the rivers to large storage reservoirs.

On the data available, they estimate it will be necessary to pump at rates up to 200 M.G.D. from the Nene, leaving a prescribed flow of 30 M.G.D., and of up to 100 M.G.D. from the Welland, leaving a prescribed flow of 15 M.G.D., and that to maintain an output of 80 M.G.D. for supply purposes storage of 42,000 M.G. will be required. Water required in the Lowland Area, amounting to 34.61 M.G.D. by 2001, could be abstracted from the Welland when the flow is adequate, and thus reduce the intake to the reservoir, but in times of drought the Lowland Area would have to be supplied from storage.

Some 64 valleys where the topography suggested there might be a suitable site for a reservoir were investigated, but Consulting Engineers were satisfied that the storage capacity would be too small to be worth consideration, or that the site was too remote from streams from which water could be obtained in adequate quantities, and in the majority of cases the geology was unfavourable.

The Consulting Engineers also came to the conclusion that the Empingham and Manton valleys were the only suitable sites to meet the requirements, and they recommended that a Scheme should be carried out in two stages:

Stage 1 would include the construction of a reservoir at Empingham impounding 27,300 million gallons, with a surface area of 3,114 acres, top water level being 275′ O.D. and the embankment about 115 feet high; and the construction of an aqueduct to carry water from the Nene at Wansford and from the Welland near Tinwell, with necessary pumping stations.

Stage II would involve the construction of a reservoir at Manton impounding 21,500 million gallons with a surface area of 1,470 acres, top water level being 375′ O.D. and the embankment about 140 feet high; and the construction of an aqueduct to carry water from Empingham to Manton, with necessary pumping stations.

The two reservoirs with a total capacity of some 48,800 million gallons (including bottom water) would provide 80 M.G.D., which would be taken by Mid-Northamptonshire Water Board and the City of Leicester Water Undertaking by means of a pumping station and pipeline, and would be supplied to South Lincolnshire Water Board by means of regulating the river flow and an intake from the Welland near Market Deeping.

Stage I to be completed by 1975 would yield 51.5 M.G.D. sufficient to meet the anticipated demand to about 1990. Stage II would then be proceeded with.

They estimated that (excluding land compensation) Stage I will cost £15.5m. to £16.1m., and Stage II will cost £13.0m. to £13.5m. according to whether a pipeline or a tunnel is adopted for the aqueduct.

In view of the Report it was believed that it would be better to seek Parliamentary powers to build both reservoirs—Stage 1 to be completed as soon as possible and Stage II to be commenced as soon as it becomes clear that the demand can no longer be met from the first reservoir, and that there is no feasible alternative to the second reservoir because:

> (i) The full utilisation of the water resources of the area to meet the anticipated demands is dependent on the implementation of both Stage I and Stage II, and it would be less than honest to present a scheme piecemeal.
>
> (ii) Section 14 of the Water Resources Act requires a river authority to prepare an

estimate of future demand for twenty years ahead, and the proposals are in accordance with that obligation.

(iii) It may be imprudent to construct an aqueduct of a capacity less than sufficient to supply both reservoirs, and it would be wrong to present proposals to Parliament which pre-empt on a future Bill.

(iv) The prospect of a second reservoir in the latter part of this century may result in owners of the land which may eventually be required for that purpose being unable to dispose of it for its full market value, and if they are prejudiced it is right that they should be able to require the Authority to purchase any " blighted " land at a fair price in an unfettered market.

(v) The reservoir will contain " used " water, and the high natural salt content may encourage the growth of algae such that the full yield may not be available from the first reservoir. A second reservoir may be necessary to enable the first reservoir to be rested and to provide flexibility of operation if algal growth becomes a problem.

The Ministry of Housing and Local Government intimated that they were not prepared to support the River Authority in seeking powers to build two reservoirs, and without such support Parliament would be unlikely to authorise two reservoirs. It was therefore decided to accept the Ministry of Housing and Local Government's view, but it must be put on record that the Authority can not be held responsible for having failed to make a full assessment of the problems, for having presented a Scheme which may well prove to be piecemeal, and for any " blight " which might affect the land on the site of the second reservoir.

Careful consideration was given as to whether the reservoir should be at Empingham or Manton. It was fully realised that the Manton site has the advantage that the area of agricultural land covered by water would be some 1,650 acres less than at Empingham. But the conclusion was reached that in spite of such a saving the technical and financial advantages of the Empingham site were unassailable.

The Empingham site has the following advantages:

(i) It would yield an additional 11 M.G.D., and suffice for four years longer, which may prove to be significant if developments should result in a second reservoir being unnecessary.

(ii) The length of aqueduct to Empingham would be shorter than to Manton, and there would be a saving in capital costs of some £1.2m.

(iii) The Empingham site is some 100-feet below the Manton site and there would be a saving in pumping costs of some £70,000 per annum.

(iv) It is sounder to build the lower reservoir first and then pass to the higher reservoir, rather than in the reverse order.

(v) The height of the embankment at Manton will create engineering problems which should be deferred as long as possible.

(vi) The construction of an embankment at Manton of sufficient width to carry the Oakham-Uppingham road creates problems which should be deferred as long as possible.

At a Special Meeting on the 8th August it was decided to make every effort to deposit a Bill in the coming Parliamentary Session seeking powers to build a reservoir at Empingham as described in the Consulting Engineer's Report, with an aqueduct from the Nene at Wansford and the Welland at Tinwell. The cost of the Scheme is estimated at £15.5 million.

If a correct appreciation of the problems has been made a second reservoir will be required about 1990, and it will be necessary to seek further Parliamentary powers in about 15 years' time.

It is very much regretted that the reservoir will mean that some people will lose their homes, and that some farmers will lose a substantial part of their land and suffer a serious reduction in their livelihood. Everything possible will be done to limit the hardship, but it is the price that has to be paid if the country is to expand and if the standard of living is to improve.

Discussions are proceeding with Rutland County Council, the Rural District Council, and the various other bodies and organisations concerned.

Sywell Reservoir (Higham Ferrers and Rushden Water Board)

It was apparent from test pumping carried out on the Earls Barton gravels that the safe yield was not sufficient to justify increasing the capacity of Sywell Reservoir. If the County Planning Authority will agree to fluctuating water levels in the gravel pits at Earls Barton and at Higham Ferrers, with some detriment to the landscape which may result, then these sources could be used to augment the yield from the Reservoir.

Re-circulation of Industrial Water—Blatherwycke Lake

Because of other commitments it was not possible to further explore the possibility of Stewarts & Lloyds making greater use of the water in Blatherwycke Lake by means of re-circulation in order to meet their requirements at Corby Steel Works.

Whittlesey Clay Pits

A proposal was considered to use the brick-clay pits on the south side of the Nene/Ouse boundary at Whittlesey for storage of water to be taken from the nearby River Nene, but the Great Ouse River Authority's consultants were of the opinion that the sides of the pits had not sufficient stability to withstand variations in water level. Other sources of supply and other storage facilities to meet local spray irrigation needs are to be sought.

Billing Brook

A geological appraisal has been made of the site of a possible reservoir on the Billing Brook near Peterborough, but the demands on the River Nene for the Rutland Project leave insufficient water to sustain a reservoir there to meet the requirements in the Peterborough District.

9. AGREEMENTS UNDER SECTION 81 AND ORDERS UNDER SECTION 82

No Agreements or Orders have been made under Sections 81 and 82.

10. CHARGES

As was explained in the Second Annual Report, it was decided that before negotiating interim charges as required by section 62 it was desirable to formulate provisionally the Charging Scheme to be brought into operation under section 58 in 1969. It was appreciated that the provisional scheme might have to be modified or amended in the light of experience during the interim period and in consequence of any guidance which might be forthcoming as a result of discussions at national level. The provisional Scheme could then be used as a basis for negotiating interim charges, and if such modifications as eventually proved to be necessary were not substantial then transitional difficulties between the interim charges and the section 58 Scheme would be avoided or minimised.

Those who were subject to them accepted the interim charges, although admittedly they were not abstractors who were liable to any substantial payment. No difficulties or defects became apparent and the provisional Scheme proved to be remarkably similar in principle to the draft in the Memorandum on Charging Schemes published by the Ministry of Housing and Local Government.

It was apparent that the initial approach to the problem had been sound, and that the provisional Scheme without any modification could be submitted to the Minister for approval for the purpose of section 58. The problem was one of drafting rather than principle, and in this respect the Ministry's Model Scheme was not considered to be particularly suitable nor readily intelligible.

An assessment of the chargeable Licences shewed that some 89,613,323 thousand gallons were being abstracted, but the extent to which the Charging Scheme may result in some Licence Holders—particularly spray irrigators—relinquishing their Licences or requiring the authorised quantities to be reduced can not be foreseen. Neither can it be known what the demand for the two part tariff will be, and some section 60 agreements will be necessary.

The annual expenditure over the first five years is likely to be of the order of £80,000 per annum. The Licence fees amount to little more than £3,000 per annum, and the revenue to be raised by the Charging Scheme (and section 60 agreements) may thus be taken to be of the order of £80,000. A standard unit charge of 0.5d would produce about £86,000 and it was felt that a maximum standard unit charge of 0.87d would be sufficient to cover contingencies and rises in costs.

The draft Scheme was circulated to the various representative bodies for their observation, and as there was no cause to make any amendment it was formally sealed on the 29th February.

The only objection of any significance was from the Central Electricity Generating Board, and the Public Inquiry was awaited.

The Schedule to the Scheme is set out below.

CATEGORIES OF PURPOSE, PERIOD OF ABSTRACTION AND SOURCE OF SUPPLY WITH RELATIVE FACTORS

Purpose		*Winter Abstraction*			*Summer Abstraction*			*Annual Abstraction*			
		Non-tidal river	*Ground water*	*Artificial water-course*	*Non-tidal river*	*Ground water*	*Artificial water-course*	*Non-tidal river*	*Ground water*	*Artificial water-course*	*Tidal Waters*
Group I	Relative Factor	0.04	0.01	0.06	0.4	0.1	0.6	0.2	0.05	0.3	
	Maximum Charge	0.0348d	0.0087d	0.0522d	0.348d	0.087d	0.522d	0.174d	0.0435d	0.261d	
Group II	Relative Factor	0.2	0.05	0.3	2.0	0.5	3.0	1.0	0.25	1.5	0.004
	Maximum Charge	0.174d	0.0435d	0.261d	1.74d	0.435d	2.61d	0.87d	0.2175d	1.305d	0.0035d
Group III	Relative Factor	0.8	0.2	1.2	8.0	2.0	12.0	4.0	1.0	6.0	
	Maximum Charge	0.696d	0.174d	1.044d	6.96d	1.74d	10.44d	3.48d	0.87d	5.22d	

RAINFALL GAUGING STATIONS

RECORDS TAKEN BY THE AUTHORITY

Station		*National Grid Reference*	*Station No. B.R.O.*	*Height of gauge above sea level in feet*	*Duration of records*
Surfleet Reservoir .. .. ..*		TF 280.293	156328	12	4 years
Oundle (Nene Wharf) .. ..*		TL 044.888	163092	66	35 years
Oundle (Head Office) .. ..*		TL 042.883	163091	106	3 years
Wellingborough (Nene Wharf) ..*		SP 899.664	160801	136	35 years
Northampton (South Bridge)		SP 755.595	—	197	35 years

RECORDS SUPPLIED TO THE AUTHORITY BY OTHER PERSONS OR ORGANIZATIONS

Hovenden House .. .. ..* A. H. Worth (Fleet) Ltd.		TF 398.262	156940	15	8 years
Bingham Lodge, Mr. F. H. Bowser ..		TF 391.322	157045	10	35 years
Manor Farm, Mr. F. H. Bowser ..		TF 355.241	156677	10	35 years
Fosdyke (Major's Farm) .. ..*† H. C. C. Tinsley, Ltd.		TF 346.310	156836	12	13 years
Algarkirk, Messrs. Denis's Farms Ltd...		TF 311.355	—	12	4 years
Spalding, South Holland Land Drainage Boards	*	TF 259.239	154773	10	11 years
Weston, Mr. C. Ostler .. ..*		TF 275.184	166114	10	24 years
Pode Hole. Deeping Fen, Spalding and Pinchbeck I.D.B.		TF 214.219	154720	12	140 years
Tongue End. Deeping Fen, Spalding and Pinchbeck I.D.B.		TF 151.185	156194	11	20 years
Deeping St. Nicholas, T. R. Pick, Ltd. †		TF 213.157	154528	10	48 years
Peterborough S. Works, Peterborough Corporation †		TF 201.984	164364	10	33 years
Sutton Bridge, South Holland D.B. ..*†		TF 476.201	166869	21	53 years
Norfolk House Farm, Mr. J. E. Piccaver		TF 441.287	—	11	8 years
Sutton St. James, ... South Holland Drainage Board		TF 389.181	166569	5	1 year
Gedney Hill, Mr. A. Depear		TF 337.118	—	8	4 years
Deeping St. James, Mr. W. Holden ..*		TF 148.096	153837	21	2 years[1]
Marholm, Mr. Smedley		TF 155.024	—	50	4 years
Ufford, Mr. G. W. Vergette .. ..*		TF 095.040	153905	120	4 years
Wilsthorpe, Peterborough Corporation..		TF 081.148	—	50	6 years
Lound, South Kesteven R.D.C. ..*		TF 079.194	156215	134	6 years
Welby, Miss R. A. Mitchell .. ..*		SK 975.383	155491	330	5 years[2]
Ropsley, Mr. R. Doughty .. ..*		SK 993.341	155588	251	3 years[3]

Station	National Grid Reference	Station No. B.R.O.	Height of gauge above sea level in feet	Duration of records
Irnham, Irnham Estates .. ..*†	TF 022.265	155742	220	27 years[4]
Stamford S. Works, Stamford Corp. ..*	TF 041.075	153155	77	6 years
Tixover, Nene and Ouse Water Board ..	SK 974.001	152742	104	6 years
Seaton, Mr. R. E. Richardson ..*	SP 908.977	152542	150	27 years
Oakham, Agricultural Executive Com. *	SK 863.085	153334	350	26 years
Gunthorpe Hall, Mr. R. Thorpe ..*†	SK 869.057	153244	420	20 years
Uppingham, Mr. G. E. Stokes ..*†	SP 859.998	152367	535	11 years
Caldecott, Messrs. Stewarts & Lloyds Ltd.†	SP 864.932	4341	174	11 years
Hallaton, Mr. W. T. Mowsen.. ..*	SP 789.967	151874	353	4 years
Ashley, Mr. T. Kerby .. ..*	SP 796.908	151845	241	4 years
Great Bowden, Mr. R. J. Oliver ..	SP 746.888	151347	250	7 years
Market Harborough .. .. Mr. A. D. F. Wooldridge	SP 733.879	151238	345	27 years
Market Harborough U.D.C. .. ..†	SP 735.870	151237	260	62 years
Kibworth Harcourt, Mrs. A. M. Briggs †	SP 682.945	151472	408	48 years
Sibbertoft, Mr. E. J. Middleton ..*	SP 681.826	151026	560	4 years
Apethorpe, Messrs. William Tomkins Ltd.*	TL 022.961	163737	128	19 years
Corby, Messrs. Stewarts & Lloyds Ltd. *	SP 901.885	163465	320	31 years
Harrowden Hall, Mr. A. W. Gilbey ..*	SP 882.709	161562	291	24 years
Lamport Hall, Sir Gyles Isham ..*	SP 759.746	159493	481	31 years
Northampton Power Station, Central Electricity Generating Board *	SP 762.598	160204	190	33 years
Orlingbury, Messrs. William Tomkins Ltd.*	SP 843.715	161496	389	11 years
Bugbrooke Mill, Messrs. Heygates Ltd. *	SP 680.588	158802	229	17 years
Litchborough Rectory, Mr. M. Etheridge*‡	SP 633.542	158712	486	31 years
Stanground Sluice, Middle Level Commissioners	TL 209.973	196880	16	62 years
Raunds, Mr. T. C. Smith	SP 991.721	4382	194	27 years
Wollaston, Messrs. Scott Bader & Co. Ltd.*	SP 911.631	160775	277	12 years
Blisworth, British Waterways Board ..	SP 720.550	159147	297	18 years
Norton Junction, British Waterways Bd.	SP 602.657	158443	359	18 years
Badby (Primary School), Mr. N. J. Lucas	SP 559.590	158024	441	9 years[5]
Brigstock, Messrs. Stewarts & Lloyds Minerals Ltd.*	SP 944.852	162681	171	10 years
Kelmarsh Hall, Col. C. G. Lancaster, M.P.*	SP 735.795	160838	413	9 years

Station	National Grid Reference	Station No. B.R.O.	Height of gauge above sea level in feet	Duration of records
Bulwick Hall, Mr. G. T. G. Conant ..*	SP 958.940	163646	225	10 years
Yardley Hastings, Forestry Commission§*	SP 852.572	160521	332	9 years
Flore, Mr. J. Champion .. ..*	SP 649.601	158618	285	44 years
Duston (Primary School) .. .. Mr. F. W. Harrison	SP 717.623	—	327	3 years
Islip Furnaces, Stewarts and Lloyds Ltd.*	SP 970.783	—	163	54 years

[1] Records ceased, December 1967.
[2] Records ceased June 1967.
[3] Records ceased December 1967.
[4] Records ceased December 1967.
[5] Records ceased May 1967.

* Returns from these stations are made to the British Rainfall Organisation.
† Indicates that all records are not available at Head Office.
‡ Break in records, July to December 1964 and June to August 1965.
§ Existing site, records are available for nearby site for previous 9 years.

RAINFALL FOR 1967

River Nene Hydrometric Area

1967	*Above Northampton (Litchborough)*	*Northampton (Hardingstone)*	*Welling-borough (Nene Wharf)*	*Oundle (Nene Wharf)*	*Peterborough (Stanground)*
	inches	*inches*	*inches*	*inches*	*inches*
January	1.24	0.90	0.88	0.92	0.70
February	1.81	1.97	2.16	1.86	2.05
March	1.52	1.55	1.15	1.02	0.86
April	1.78	2.53	2.26	2.59	2.66
May	3.64	5.00	3.97	4.33	3.09
June	1.52	1.14	1.17	1.01	1.52
July	0.85	0.73	0.78	0.94	0.86
August	2.08	1.44	1.75	1.38	1.82
September ..	1.99	1.95	1.30	1.21	0.84
October	4.66	3.88	3.98	3.69	3.20
November ..	1.29	1.07	1.20	1.60	1.68
December ..	2.36	2.15	1.94	1.50	1.40
1967 Total ..	24.74	24.31	22.54	22.05	20.68
1966	31.33	28.91	26.75	28.07	25.82
1965	30.62	26.79	24.09	24.12	25.30
1964	17.42	15.63	15.41	16.68	17.54
1963	22.58	22.13	20.97	22.83	19.74
Average 1916-1950	25.99	22.95	23.07	23.09	21.72

Comparative Table

Year	*Per cent of average*
1967	98
1966	121
1965	112
1964	71
1963	93