DEPARTMENT OF THE
1926-28
No. 136-4

1928.

THE PARLIAMENT OF THE COMMONWEALTH OF AUSTRALIA

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7th March, 1928

PARLIAMENTARY STANDING COMMITTEE ON PUBLIC WORKS.

REPORT

TOGETHER WITH

MINUTES OF EVIDENCE

RELATING TO THE PROPOSED CONSTRUCTION OF A

NORTH-WESTERN INTERCEPTING SEWER

AT

CANBERRA.

By Authority:
H. J. GREEN, GOVERNMENT PRINTER, CANBERRA.

F.1508.

MEMBERS OF THE PARLIAMENTARY STANDING COMMITTEE ON PUBLIC WORKS.

(Fifth Committee.)

GEORGE HUGH MACKAY, ESQ., M.P., Chairman.

Senate.	*House of Representatives.*
Senator John Barnes.	Malcolm Duncan Cameron, Esq., M.P.§
Senator Patrick Joseph Lynch.*	Robert Cook, Esq., M.P.
Senator Herbert James Mockford Payne.†	The Honorable Henry Gregory, M.P.‡
Senator Matthew Reid.	Andrew William Lacey, Esq., M.P.
	David Charles McGrath, Esq., M.P.
	Alfred Charles Seabrook, Esq., M.P.

* Resigned 30th June, 1926. † Appointed 1st July, 1926. ‡ Resigned 2nd March, 1927. § Appointed 24th March, 1927.

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EXTRACT FROM THE VOTES AND PROCEEDINGS OF THE HOUSE OF REPRESENTATIVES.

No. 135, DATED 5TH DECEMBER, 1927.

3. PUBLIC WORKS COMMITTEE—REFERENCE OF WORK—FEDERAL CAPITAL—NORTH-WESTERN INTERCEPTING SEWER.—Mr. Marr (Minister for Home and Territories) moved, by leave, That, in accordance with the provisions of the *Commonwealth Public Works Committee Act* 1913-1921, the following proposed work be referred to the Parliamentary Standing Committee on Public Works for investigation and report, viz.—Federal Capital—Extension of the Sewer from the Northern Main Sewer on Garden Circuit to Inter Range Avenue, to serve the North-Western portion of the City.

Mr. Marr having laid on the Table plans, &c., in connexion with the proposed work—

Question—put and passed.

LIST OF WITNESSES.

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NORTH-WESTERN INTERCEPTING SEWER, CANBERRA.

REPORT.

THE PARLIAMENTARY STANDING COMMITTEE ON PUBLIC WORKS, to which the House of Representatives referred for investigation and Report the question of the Extension of the Sewer at Canberra from the Northern Main Sewer on Garden Circuit to Inter-Range-avenue, to serve the North-Western portion of the city, has the honour to report as follows:—

INTRODUCTORY.

1. The Parliamentary Standing Committee on Public Works has already investigated and submitted to Parliament reports recommending the construction at Canberra of:—

(*a*) The Main Outfall Sewer;
(*b*) The Main Intercepting Sewer within the City Boundary;
(*c*) The Main Sewer serving the Southern portion of the City;
(*d*) The Northern Main Sewer; and
(*e*) The Sewage Treatment Works at Western Creek.

2. These works, covering 8½ miles of main and intercepting sewers and 26 miles of reticulation, comprise the major portion of the main sewers and are all completed and in successful operation.

3. The Committee is informed that when the project now under consideration is completed there will then remain only the extension of the Northern Intercepting Sewer past the English Church towards Duntroon to complete the main sewerage system of the city; and that there does not appear to be any likelihood of the extension of this Northern sewer being mooted for some years to come.

PRESENT PROPOSAL.

4. The proposal now submitted aims at the construction of what is known as the North-Western Intercepting Sewer, to commence in Garden Circuit a little south of Civic Centre, just to the north of the Commonwealth-avenue Bridge, thence extending generally parallel to and west of Northbourne-avenue to a point on Inter-Range-avenue about a quarter of a mile north of the transverse plantation. It is designed to serve an area of approximately 1,300 acres extending roughly for about three-quarters of a mile west of Northbourne-avenue, including all the proposed developments due west of the northern part of Canberra-avenue, as well as North-East Ainslie.

5. It is proposed that the work shall be proceeded with in sections: Section A extending from the intersection of Commonwealth-avenue and Garden Circuit to a point north of its intersection with Terrace-avenue; Section B, from that point northerly for a distance of about 1,000 feet; and Section C, for a further distance of a little over a mile, and finishing at Inter-Range-avenue.

6. The total length of this sewer will be 10,000 feet, made up of 5,220 feet of 18-in. pipe, and 4,780 feet of 15-in. pipe.

ESTIMATED COST.

7. The estimated cost of the proposal as submitted to the Committee is as follows:—

	£ s. d.	£ s. d.
Section A—		
18-inch diameter concrete pipe sewer with concrete surround, 3,000 lineal feet at £7 4s. 6d.	= 21,675 0 0	
8 manholes, 274 lineal feet at £3 10s. ..	= 959 0 0	
1 Penstock	78 10 0	
1 Flushing chamber	250 0 0	
Contingencies 5 per cent., say	1,037 10 0	
		24,000 0 0
Section B—		
18-inch diameter concrete pipe sewer, 1,275 lineal feet at £7	= 8,925 0 0	
6 manholes, 150 lineal feet at £3 10s.	525 0 0	
1 Penstock	80 0 0	
1 Flushing chamber	250 0 0	
Contingencies 5 per cent.	490 0 0	
		10,270 0 0
Section C—		
18-inch diameter concrete pipe sewer, 945 lineal feet at £3 12s. 9d.	= 3,437 8 0	
15-inch diameter concrete pipe sewer, 4,780 lineal feet at £3 12s. 2d.	= 17,247 16 0	
1 Flushing chamber	250 0 0	
Contingencies and plant charges	1,794 16 0	
		22,730 0 0
Total		57,000 0 0

COMMITTEE'S INVESTIGATION.

8. The Committee took evidence from the Chief Commissioner, Federal Capital Commission, the Acting Chief Engineer, and the Engineer for Water Supply and Sewerage, examined plans, sections and details of the sewer suggested, and generally placed itself in possession of full particulars of the proposal.

Location.

9. The sewer suggested would extend from a little north of Commonwealth-avenue bridge, generally north and north-easterly to Inter-Range-avenue, and is designed to follow as nearly as possible the line of the streets.

Construction.

10. The construction proposed is reinforced and spun concrete pipes manufactured in Canberra under the Hume process by the Monier Pipe Coy. The pipes will be made in 3 feet and 6 feet lengths as required and in the deep sections will be surrounded by 6 inches of 6 to 1 concrete to strengthen the pipe against possible damage by subsidence or earth movements after the pipe has been laid.

11. The first portion of the sewer will consist of an 18-inch diameter pipe 5,220 feet in length. The slope or fall of the sewer will be 1 foot in 360, the average depth below the surface, 17 ft. 6 in., the maximum depth 42 feet, and the minimum depth 10 feet. The capacity of the 18-inch pipe will be :—

	Gallons in 12 hours.	Cubic feet per minute.	Velocity in feet per second.
When running full ..	1,476,000 ..	328 ..	3·1
When running $\frac{3}{4}$ full ..	1,350,000 ..	300 ..	3·52
When running $\frac{1}{2}$ full ..	202,300 ..	45 ..	2·
When running $\frac{1}{3}$ full ..	346,300 ..	77 ..	2·5
When running $\frac{1}{6}$ full ..	81,000 ..	18 ..	1·58

12. The 15-inch diameter sewer will be 4,780 feet in length. The slope or fall will be 1 foot in 350. The average depth below the surface will be 16 ft. 6 in., the maximum depth 21 feet and the minimum depth 10 feet. The capacity of the 15-inch pipe will be :—

	Gallons in 12 hours.	Cubic feet per minute.	Velocity in feet per second.
When running $\frac{3}{4}$ full ..	864,000 ..	192 ..	3·14
When running $\frac{1}{3}$ full ..	217,000 ..	48·25 ..	2·18
When running $\frac{1}{4}$ full ..	131,000 ..	29·64 ..	1·77
When running $\frac{1}{6}$ full ..	52,704 ..	11·42 ..	1·37

13. The maximum space between manholes will be 530 feet; the minimum 130 feet, and the average about 400 feet. No provision is being made for vent stacks, the intention being to provide ventilation for each house.

Capacity of the Sewer.

14. It was stated in evidence that the valley to be served by this sewer is capable of being inhabited by 24,000 people and that the sewer as designed would carry the sewage from a total population of 27,000. The sewage from 3,000 people would be sufficient to carry the solids along the sewer, but until the population of the district reached that figure it would be necessary to periodically flush the sewer.

Nature of the Country.

15. The evidence obtained indicated that no constructional difficulties are expected to be encountered and that the class of material likely to be met includes clay, schist and limestone.

Time for Completion.

16. It was explained in evidence that, although authority is being asked for the construction of the three sections, A, B, and C, already described, it is the desire of the Federal Capital Commission to proceed immediately only with Section A, estimated to cost £24,000, leaving Sections B, estimated at £10,270, and C, estimated at £22,730, to be commenced at some future time when the areas they are designed to serve will have developed sufficiently to warrant the extension of the sewerage system thereto.

It was declared that Section A could be completed if required in six months, and that if necessary the whole of the three sections A, B, C, could be completed in from fifteen to eighteen months.

Prospective Development.

17. The Committee was informed in evidence that up to the present there is no population on the area proposed to be served by this sewer and it is not the intention of the Federal Capital Commission to build any new cottages in the area. Under the scheme of development, however, it is intended to proceed shortly with the erection of a number of buildings for the Council for Scientific and Industrial Research, to be followed later by the first of the University buildings. There will probably be also a Fire Brigade building, and perhaps a Trades Hall, and it is in contemplation to make available at an early date further minor industrial blocks.

COMMITTEE'S DECISION.

18. It is recognized that it is a sound principle that sewerage development should precede settlement, and, after carefully considering all the evidence received, the Committee is of opinion that the North-western Intercepting Sewer is necessary to provide for the progressive development of the Canberra city area to the west of Northbourne-avenue. As, however, the indications are that the main buildings on the area proposed to be served will be of such a character that they may take several years to build, while the first section of the proposed sewer can be constructed in six months, the Committee has unanimously agreed to recommend that the commencement of this sewerage work be deferred until, say, nine months before the completion of the first section of the building programme for the area.

E. H. Mackay

Chairman.

Office of the Parliamentary Standing Committee on Public Works,
Parliament House, Canberra.
24th February, 1928.

MINUTES OF EVIDENCE.

(Taken at Canberra.)

WEDNESDAY, 7TH DECEMBER, 1927.

Present:

Mr. MACKAY, Chairman;

Senator Payne	Mr. Lacey
Senator Reid	Mr. McGrath
Mr. Cameron	Mr. Seabrook.
Mr. Cook	

Sir John Henry Butters, M.Inst.C.E., M.Am.Soc.C.E., M.I.E., Aust., Chief Commissioner, Federal Capital Commission, sworn and examined.

1. *To the Chairman.*—The proposal before the committee is for the construction of what is known as the north-western intercepting sewer to commence in Garden Circuit, a little south of what is known as Civic Centre, just to the north of the Commonwealth-avenue bridge, thence extending generally parallel to and west of Northbourne-avenue, to a point on Inter-range-avenue about a quarter of a mile north of the transverse plantation. It will serve an area of approximately 1,300 acres, extending roughly over about three-quarters of a mile west of Northbourne-avenue, including all proposed development due west of the northern part of Canberra-avenue as well as in North and East Ainslie. Development has been concentrated in North and South Ainslie to date largely with the object of saving money on such services as roads, sewerage, electric light, water supply, and a large amount of storm-water drainage. We must be prepared for further developments to the west to balance the general scheme. Up to the present all the development has been to the east of Northbourne-avenue. Practically nothing has been done on the west, and nothing substantial can be done without the construction of a special intercepting sewer. We contemplate proceeding shortly with a number of buildings for the Council for Scientific and Industrial Research, to be followed later by the first of the University buildings. A laboratory will be built there in close proximity to and in association with the proposed university. There will also be a fire brigade station, the site being very suitable for that purpose, and there has been an application for a site there for a Trades Hall. Further development must proceed all around City Circuit, but we cannot do anything to the western half until we have the main intercepting sewer laid. The intention is to proceed with the first section of this work immediately. I submit plans showing the three sections. The first section will be from the intersection of Commonwealth-avenue and Garden Circuit up to a point north of its intersection with Terrace-avenue. The second section will probably include about 1,000 feet of sewer main, and the third section, to complete the work, will be a little over a mile in length, finishing at Inter Range-avenue. I am responsible for the presentation of this scheme. The Commission regards it as urgent, because until it is put in hand we shall not be able to proceed with the buildings contemplated west of Northbourne-avenue, and we have been warned that a requirement there is imminent. We are anxious also to start work so that we may transfer our trained sewer gangs from the south-eastern sewer work, which is approaching completion, and keep them intact. The work could be completed within six months if necessary, but probably it will take about nine months. The first section is estimated to cost £24,000, the second section £10,370, and the third £22,730. This estimate is the net constructional cost. It is presented in this way so as to bring it into line with estimates that come before the committee from other departments in respect of public works. To that amount must be added about 8 per cent. for overhead charges. This percentage is being reviewed in the light of our experience during the last two years. We must allow also for interest on capital cost during the construction period at a rate of from 5¼ to 5¾ per cent. At present there is no population in the area proposed to be served by the sewer. A big constructional camp there is served by a septic tank. Early in the new year we contemplate making available further minor industrial blocks. Already we have disposed of a number of such blocks on the eastern side as far as the plantation which lies across Northbourne-avenue. There has been a certain demand for these blocks there during the last month or two. I doubt if there will be a great population in that area for some time. The sewer is required rather for the special purpose buildings, such as the University, the buildings for the Council for Scientific and Industrial Research, and the fire brigade. Probably there will not be any other buildings there for a year or two. I believe that the proposed sewer will meet the full needs of the area. The south-eastern intercepting sewer is the only other work of that nature now being carried out in the Territory. I cannot say off-hand how many men will be employed on this proposed new work. So far as I know, there has been no departure from the scheme drawn up by the Federal Capital Advisory Committee and the Department of Works and Railways. The work will be done by day labour. No test holes have been sunk along the line of sewer, but we know from other work that has been carried out in that portion of the city area that the country is not particularly difficult. The variation in the estimated cost for the respective sections is due to the varying depths. This will be explained by the engineer, who will be able to furnish the committee with the full details. It will not be necessary to lay any pipes under the river in connexion with this scheme. The treatment works at the main outfall at Western Creek are functioning particularly well. We do not contemplate any enlargement of those works consequent upon the construction of this proposed intercepting sewer. The whole of the sewage is dealt with at Western Creek. This is the only important sewerage work which we contemplate carrying out next year. It will not be necessary to take any precautions to deal with chemicals that may be discharged into the sewer from the institutions which it will serve. I cannot say definitely what industrial developments will take place in the area, but they will be minor industries and

innocuous in regard to the nature of their sewage. At present the whole of the sewerage scheme is working satisfactorily in every department. I submit for the information of the committee the following statement relating to the proposed work, together with short specifications:—

In March, 1915, the Parliamentary Standing Committee on Public Works submitted to Parliament a report on a *proposal* to *construct* a main outfall sewer from the western boundary of the city to the outfall works at Western Creek, and the *committee recommended* that the work be proceeded with.

In April, 1922, the *construction of the* main intercepting sewer to connect the outfall sewer with the centre of the city was similarly approved.

In August, 1924, the construction of the *southern intercepting* sewer was similarly approved.

In November, 1924, *the northern* intercepting sewer and the sewage treatment works were considered by the committee and were similarly approved of.

The above works comprise the major *portion of the* main sewers and are all constructed and in successful operation. When this project is considered there will *then remain* only *the extension* of the northern intercepting sewer past Ainslie church toward Duntroon to complete the *main sewerage system* of the city, and there does not appear to be any likelihood of the extension of this northern sewer being *mooted for* some years to come.

Generally these *intercepting sewers follow* the three main valleys in the city area, and the subdivisions are reticulated to them.

It is now proposed to proceed with the *intercepting* sewer *controlling* the Canberra valley, including all that area to the north of Garden circuit, west of Commonwealth-avenue and *Northbourne*-avenue, and bounded on the north by Inter Range-avenue, in length 10,000 feet, being made up of 5,220 feet of 18-*inch pipe* and 4,780 feet of 15-inch.

Estimated cost, £57,000.

F.C.C. drawing No. S.D. II, showing *plan, section,* and *detail of* sewer is submitted.

Construction.—This *section is to* be constructed with reinforced and spun concrete pipes, after Hume patent, manufactured in Canberra, surrounded *in tunnel* with 6 inches of concrete 6 to 1.

The 18-*inch diameter* pipe, in length 5,220 feet.
Slope or fall, 1 in 300.
Average depth *below* surface, 17 feet 6 inches.
Maximum depth, 42 feet.
Minimum depth, 10 feet.

Capacity when running.	Gallons in 12 hours.	Cubic feet per minute.	Velocity in ft. per second.
Full	1,470,000	328	3.16
Three-quarters	1,350,000	300	3.52
Quarter ..	202,300	45	2.09
One-third ..	346,300	77	2.50
One-sixth ..	81,000	18	1.58

The sewer would serve 27,000 people, while the valley is *estimated to have* 24,000 residents thereon. It is estimated that the sewerage from 3,000 people will be sufficient *to carry* the solids *along* the sewer.

The 15-inch diameter pipe, in *length* 4,780 feet.
Slope or fall, 1 in 350.
Average depth below surface, 16 *feet 6 inches.*
Maximum depth, 21 feet.
Minimum depth, 10 feet.

Capacity when running.	Gallons in 12 hours.	Population served.	Cubic ft. per minute.	Velocity in feet per second.
Three-quarters full	864,000	17,280	192.00	3.14
One-third "	217,000	4,340	48.25	2.18
Quarter "	131,000	2,620	29.04	1.77
One-sixth "	52,704	1,054	11.42	1.37

SECTIONAL PROGRESS PROPOSALS.

It is proposed to divide the work into three sections marked on the drawing A, B, & C, coloured *red, blue* and green *respectively*, and the areas tinted shew the area that can be reticulated into the various sections.

The section "A" it is proposed to proceed with immediately at an estimated *cost of £24,000*, and to be constructed in from six to twelve months, depending upon the urgency. The other sections—"B" *estimated to* cost £10,270, and "C" estimated to cost £22,730—will only be proceeded with when development warrants it.

Section "A."

Will provide for reticulation to the area tinted red, including *Hotel Acton, University* Area, National Museum of Australian Zoology, Royal College of Surgeons, Trades Hall and Fire Station.

Size of sewer, 18 inches.
Average Depth, 34 feet 6 inches.
Maximum depth, 42 feet.
Minimum depth, 27 feet.
Length, 3,000 feet.
Estimated cost, £24,000.

Section "B."

Will provide for the area tinted blue, which includes *residential sites and portion* of minor industrial area.

Size of sewer, 18 inches diameter.
Average depth, 26 feet 6 inches.
Maximum depth, 31 feet.
Minimum depth, 17 feet.
Length, 1,275 feet.
Estimated cost, £10,270, at £8.

Section "C."

Will provide for residential sites on the area tinted green.
Size of sewer, 18 inch and *15 inch diameter.*

Average depth, 13 feet for 945 feet and average depth 16 feet for *4,780 feet.*

Total length, 5,725 feet.
Maximum depth, 21 feet.
Minimum depth, 10 feet.
Estimated cost, £22,730, at £3 19s.

North-Western Intercepting Sewer—Short Specification.

Plans.—Plans S.D.11, G.385, and C.382 accompany this specification.

Extent of Work.—The work to be done embraces—

(*a*) Shaft sinking.
(*b*) Tunnelling.
(*c*) Scabbling floor.
(*d*) Laying concrete base.
(*e*) Providing and laying concrete pipes.
(*f*) Surrounding pipes with concrete.
(*g*) *Back filling.*
(*h*) Building manholes.
(*i*) *Penstocks.*
(*j*) Flushing Chambers.
(*k*) *Cleaning up.*

including the provision of all labour, *plant* and material, *the protection* of works, lighting, dewatering and supervision.

Shaft Sinking and Tunnelling.—Shafts will be sunk where shown on plans and timbered where necessary. When grade level is reached headings will be *driven* from each shaft and excavated to the dimensions shown on the drawings. Drives will be timbered as directed.

Scabbling Floor.—On completion of the tunnelling the floor of the drives will be *scabbled* to the correct level and grade for reception of the concrete base.

Jarrah planking, if required by wet conditions, will be put down before the concrete floor is laid.

Laying Concrete Pipes and Concrete Surround.—The concrete floor will be laid 6 in. thick with *concrete* mixed in the *proportions* of one part of cement to six parts of mixed aggregate and finished true to grade and *levels.*

Reinforced concrete pipes (made locally by the Hume process) will then be laid *on the* concrete floor and properly jointed.

The joints will be made with serim and wire mesh, bonded and finished with cement mortar, mixed in the *proportions* of one part of *cement* to two parts of sand.

The remainder of the concrete *surround*, of concrete mixed *in the* same proportions as given above for the floor, will be placed in position and completed *to the* dimensions as *shown* on the drawings.

Back Filling.—After the *concrete* in the floor and surround has properly set, the remaining unfilled excavated space in the drives will be filled with the *material* previously excavated, *thoroughly* packed and consolidated in place to completely fill the tunnel.

Manholes.—Manholes will be constructed generally *to* dimensions and *details as* shown on drawing No. C.385.

Concrete used will be mixed in the *proportions* of one part of *cement* to six parts of mixed aggregate, inverts will be formed and finished in cement mortar, *mixed in the* proportions of *one part* of cement to two parts of sand.

Penstocks.—Penstocks will be built in where indicated on *drawings.*

Flushing Chambers.—Flushing Chambers of 5,000 gallons capacity, constructed generally on the lines shown on Drawing No. C.382 will be installed *where* shown on the drawings.

Cleaning-Up.—Surplus soil will be carted away and deposited where directed. *Plant dismantled* and removed, and the whole of the works left in a clean and tidy condition.

Section "A"—			
18-in. diameter concrete pipe sewer with concrete surround, 3,000 lineal feet at £7 4s. 6d. ..	£21,075 0 0		
Eight manholes, 274 lineal feet at £3 10s. ..	959 0 0		
One penstock	78 10 0		
One flushing chamber ..	250 0 0		
Contingencies 5 per cent., say	1,037 10 0		
		£24,000 0 0	
Section "B"—			
18-in. diameter concrete pipe sewer, 1,275 lineal feet at £7	£8,925 0 0		
Six manholes, 150 lineal feet at £3 10s. ..	525 0 0		
One penstock	80 0 0		
One flushing chamber ..	250 0 0		
Contingencies, 5 per cent.	490 0 0		
		£10,270 0 0	
Section "C"—			
18-in. diameter concrete pipe sewer, 945 lineal feet at £3 12s. 3d. ..	£3,437 8 0		
15-in. diameter concrete pipe sewer, 4,780 lineal feet at £3 12s. 2d. ..	£17,247 16 0		
One flushing chamber ..	250 0 0		
Contingencies and plant charges	1,794 16 0		
		£22,730 0 0	
Grand Total ..		£57,000 0 0	

2. *To Senator Reid.*—We have separate sewerage and storm water systems. Storm water is discharged into the river at different points. Up to the present it has not been necessary to consider any pumping proposal in connexion with *sewerage problems.* Sometimes, but only in special cases, it is more economical *to handle* it in that way; but that is not likely to be necessary in Canberra. The sewer will be laid through limestone and schist, the strata being similar in character to those *met with elsewhere.* Judging by every check which we have put upon our work, we find that we are able to carry out sewer construction by day labour cheaper than by contract. We invited tenders for one big section of the work some time ago, but our *estimate was below* the lowest tenderer and we were able to carry out the work at a cost below our own estimate. Day labour work on sewers has been quite satisfactory in Canberra. *Contractors feel* that they have to provide for a big margin of risk in *underground work,* whereas we can meet the risk when it comes. We are satisfied that we are getting better results from the day labour system. The practice is to lay the main sewers and *afterwards provide* reticulations from the buildings and areas to be served. *Wherever possible,* we endeavour to avoid any interference with roads already constructed, or any other works. The main sewerage is so deep that it does not effect the roads at all. *Sometimes we have to wait* until certain buildings are completed before we can *put in the* water main. The trouble recently at Wellington House was due, I understand, to faults in the drainage system. I think, also, that the disturbance of work already *done at the Post Office* was in connexion with the laying, subsequently, of departmental underground services. Sometimes such interference is unavoidable. The Commission has laid it down that, so far as possible, there shall be complete *co-ordination in the carrying out* of all public works in the Federal Capital Territory.

3. *To Mr. Cook.*—Our engineers periodically visit Melbourne and Sydney and confer with *engineers in* those cities as to the cost of similar works being carried *out there. In this way* we are able to say whether or not we are getting value for expenditure in the Territory. Generally speaking, we are quite satisfied that we are. As professional *men, it is the duty of* such officers to make full *allowance for any difference* in the nature of the country met with in sewer con*struction in those cities,* and form a general opinion as to what similar works should cost in Canberra. The deep sewers in the Territory are constructed through compacted schists, *limestone, and mudstone.* Under the river, hard rock was met with, but I do not think *that it* was abnormally hard. Sewer construction through sandy country should be cheaper than through limestone or granite country, and it would have to be carried *out in a different way.* Our engineers, from their knowledge of the adjoining area, are able to form a fairly accurate opinion as to the character of the country likely to be met with *along the line* of this sewer. I understand that the foundation work at the *administrative buildings* is coming out better than was anticipated. The cost of sewer work varies according to the character of the country and the depth. Some of our big sewers *worked out at about* £7 4s. 6d. a foot, but where the country was particu*larly hard, it was as* much as £11 and £12 a foot. Our engineers are in a position to give a reliable estimate. We believe that the cost of this sewer would compare favourably with the *cost of other similar* work carried out in the Territory. The proposed new *work will not* provide additional employment. We have still about 45 or 50 empty houses in the sewered area, but they are liable to be filled as soon as those public servants whose *families are still in Melbourne,* arrange for their transfer. We have given them a *reasonable time* within which to make up their minds. We do not contemplate at present building any new cottages in the area to be served by this sewer, but, as I have said, we *are contemplating the* erection of buildings almost immediately for the Council for *Scientific* and Industrial Research, and on the site for the fire brigade station.

4. *To Mr. McGrath.*—We regard the work as urgent. It would not be wise to depart from the city plan by *erecting in any other suburbs the buildings* contemplated on the area to be served by this sewer. Within about eighteen months we shall be proceeding with other development plans in this area. The *industries* likely to be established there will be of minor character. We *are getting demands* for sites for such industries as laundries, motor garages and service stations. We do not anticipate that large factories will be established there. So far as I know, *only two members* of Parliament, excluding the Prime Minister, have *established homes* in Canberra, viz., Dr. Nott and Mr. Marr. On the whole, day labour has proved more satisfactory than the contract system for sewerage construction. We do not *contemplate the adoption* of the contract system for this class of work. We *have had quite satisfactory* results on the whole, and have not had evidence of much "go-slow" tactics on the part of the men employed. The residence of the Governor-General is *sewered by septic tanks.* There was a septic tank there before the place was converted *into a residence* for the Governor-General, but it was not adequate to meet the larger demands. The cost of this and other services is included in the £70,000 debited *against the vice-regal residence.* If the committee recommends the carrying out of this work, we *shall take* immediate steps to commence to transfer our plant from the south-eastern section, which is nearly completed, and get ready to start work very quickly. In this way we shall be able to keep our sewer gangs together.

5. *To Senator Payne.*—I can give no estimate of *the population that will be in the area* to be served by this sewer in three or four years' time. I omitted to say in answer to the Chairman that the main sewer is necessary for the *development of the area to the* north-east of Inter Range-avenue. That area will be *industrial and it will* include the permanent abattoirs.

There will also be the race-course and show grounds, and one of the cemeteries. Eventually the area will be filled with residential premises and minor industrial concerns as well as the scientific and university buildings. I attribute the success of the day labour system on sewer work to the fact that we have good gangs of men working under good foremen. One reason why our costs are below tender prices is that contractors must make a big allowance for the unknown risks. We deem it advisable to keep our sewer gangs together so as to ensure continuity of good work. If we had to start de novo we should, of course, meet with many of the troubles that are inevitable in the carrying out of this class of work.

6. *To Mr. Cameron.*—I am expecting to get instructions concerning the erection of the scientific buildings almost immediately. Sketch plans are being prepared for Dr. Tillyard, the entomologist who has been engaged by the Commonwealth Government. The plans for the fire brigade station are ready, and we shall be inviting tenders shortly. I should say that there will never be more than fifteen or twenty persons living there in connexion with the fire brigade; but eventually there will probably be 1000 at the university, though that will be many years hence. The camp behind Beauchamp House is served by a septic tank. It would not be advisable to put in that system for the scientific buildings. To do that would only mean postponing sewerage construction for about six months, because the next development to the north must be to the west of Northbourne-avenue, and there must be further extensions to the north to Inter Range-avenue. We are anxious to proceed at once with this work because we wish to have the sewerage ready in time for the public buildings mentioned, and we desire also to transfer our trained sewer gangs from the south-eastern intercepting sewer. I am aware that there may be some difficulty about finance, and that some people may urge that this work should be deferred for a few years; but if we throw the development of the city out of balance it will be difficult to restore it. In my judgment it would be fatal to erect any more temporary buildings in temporary locations. The money to meet capital expenditure will be obtained from loans and the Commission will be debited with it as it is drawn. I cannot say off-hand what rate of wages is paid to men employed on sewer work.

7. *To Mr. Seabrook.*—The area coloured red on the plan before the committee to the west of Civic Centre and below Terrace-avenue, will be occupied by the university, the scientific buildings, the zoological museum and the institute for the College of Surgeons, as well as the fire brigade. In the event of the other area being built upon within the next few years the sewage shall be handled by reticulation mains connecting with the main sewer. It will all be fairly deep work; there will be no open cuts. The sewer pipes will be of reinforced concrete. Most of them will be made at the State Monier works at Eastlake. The concrete pipes that are being used near the convent are the ordinary storm water drain pipes. They are not intended for sewer work. They are much cheaper, but are regarded as quite suitable for storm water drainage. The sewer pipes are made on the spun process and they have proved entirely satisfactory.

8. *To Mr. Cameron.*—The whole of the residential buildings in Canberra are sewered before occupation. We have had requests from persons outside the Public Service for homes, and as we have met the Public Service demand, with the exception of the remaining few who have not yet transferred their families to Canberra, we propose to sell or let any houses that are left over. Land for residential purposes may be purchased over the counter at the Commission offices. All buildings must be erected under regulations drawn up by the Commission.

(Taken at Canberra.)

THURSDAY, 8TH DECEMBER, 1927.

Present:

Mr. MACKAY, Chairman;

Senator Reid	Mr. Lacey
Senator Payne	Mr. McGrath
Mr. M. Cameron	Mr. Seabrook.
Mr. Cook	

William Elmhirst Potts, M.B.E., B.E., A.M.Inst.C.E., A.M.I.E., Aust., Acting Chief Engineer, Federal Capital Commission, Canberra, sworn and examined.

9. *To the Chairman.*—I have held my present position of acting chief engineer to the Federal Capital Commission, Canberra, since 1st August, 1927. I am aware that the committee is investigating the proposal to construct a north-west intercepting sewer at Canberra. If this work is approved, I shall be responsible for supervising its construction. I have had experience in sewer construction work in Canberra for two and a half years. Before the war I was employed for several years in the service of the Sydney Metropolitan Board of Water Supply, Sewerage and Drainage, and after that I had experience in England, in the Birmingham Tame and Rea Drainage Board. The area proposed to be sewered is shown on the plan which I now submit marked S.D.11. The proposed sewer branches from the present northern intercepting sewer near Garden Circuit, to the north of the Molonglo, then proceeds in a north-westerly direction to Terrace-avenue, and then north to Inter-Range-avenue. The districts to be served by the various proposed sections of the sewer are shown in red, blue and green on the plan. The first section will serve an area of 445 acres, which embraces the proposed university area and other building sites proposed to be developed by the Commission. The second and third sections will serve any future developments on areas of 162 acres and 666 acres respectively which the Commission may desire to carry out. It is not proposed to proceed with the second and third sections until such time as the areas develop sufficiently to warrant an extension. The first portion of the sewer will consist of an 18-in. diameter pipe 5,220 feet in length. The slope or fall of the sewer will be 1 foot in 360, the average depth below the surface 17 ft. 6 in., the maximum depth 42 feet, and the minimum depth 10 feet. The capacity of the 18-in. pipe when running full will be 1,476,000 gallons in twelve hours, discharging with a velocity of 3.10 feet per second. The capacity when running three-quarters full will be 1,350,000 gallons in 12 hours, discharging with a velocity of 3.52 feet per second; the capacity when running half full will be 202,300 gallons in twelve hours, discharging with a velocity of 2.00 feet per second; the capacity when running one-third full will be 346,300 gallons in twelve hours, discharging at a velocity of 2.5 feet per second; the capacity when running one-sixth full will be 81,000 gallons in twelve hours, discharging with a velocity of 1.58 feet per second. The 15-in diameter sewer will be 4,780 feet in length. The slope, or fall will be 1 foot in 350. The average depth below the surface will be 16 ft. 6 in., the maximum depth 21 feet, and the minimum depth 10 feet. The capacity of the 15-in pipe when running three-quarter full will be 864,000 gallons in 12 hours, discharging at a velocity of 3.14 feet per second; the capacity when running one-third full will be 217,000 gallons in twelve hours discharging at a velocity of 2.18 feet per second; the capacity when running one-quarter full will be 131,000 gallons in twelve hours, discharging at a velocity of 1.77 feet per second; the capacity when running one-sixth full will be 52,704 gallons in twelve hours' discharging at a velocity of 1.37 feet per second.

The foregoing description covers the two sizes of pipe comprised in the length of sewer. The first section is to consist of 18-in. pipe, the second section of 18-in. pipe, and the third section partly of 18-in. and partly of 15-in. pipe. The sections are set out having regard to the areas to be served. It is proposed to divide the work into three sections, marked on the drawing A, B, and C, and coloured red, blue, and green respectively. The areas similarly tinted can be reticulated into the respective sections. It is proposed to proceed immediately with section A if the work is approved by the committee, the estimated cost of which is £24,000. The Commission expects to construct this section of the work in from six to twelve months, depending upon its urgency. Section B is estimated to cost £10,270, and section C is estimated to cost £22,730; but these will only be proceeded with when development warrants it. These estimates are exclusive of overhead and interest charges during construction, which is, I think, the usual practice adopted. The first section (A) includes the Hotel Acton, University area, National Museum of Australian Zoology, the site for the Royal College of Surgeons, and a proposed Trades Hall and Fire Station. The diameter of the sewer is to be 18 inches, average depth 34 ft. 6 in., maximum depth 42 feet, minimum depth 27 feet, length 3,000 feet. Section B includes residential sites and a projected minor industrial area. The minor industrial area will be symmetrical in design to that on the east of Northbourne-avenue. The diameter of the sewer will be 18 inches, average depth 26 ft. 6 in., maximum depth 31 feet, minimum depth 17 feet, length 1,275 feet. Section C will provide for residential sites on the area tinted green. The sewer is to consist of pipes 18 inches and 15 inches in diameter—the junction of the two pipes occurring in the section—average depth 13 feet for 945 feet, and 16 feet for 4,780 feet, or a total length of 5,725 feet. The maximum depth is to be 21 feet, minimum depth 10 feet. I desire to point out in connexion with the proposed construction of this sewer, that at the time the district and reticulating sewers to serve the shopping centre development at Civic Centre were constructed the levels were so fixed that in the event of necessity it would be possible to drain into them a small area to the west of Northbourne-avenue. This area includes the site of the fire station, projected minor industrial development, and other possible development, and represents about the possible limit of drainage diversion to the Northern Intercepting Sewer systems in that region. The estimated cost of its reticulation as above is £19,625. The sewers run against the contour of the country, and consequently are very deep. To reticulate the same area into the proposed north-west sewer is estimated to cost £10,125. In regard to the population the sewer will serve, provision has been made for 27,000 people with the sewer running three-fourths full. The usual practice is to design for a discharge of 50 gallons per head per day discharged in twelve hours, with the sewer running about two-thirds full. The original calculations of the Federal Capital Advisory Committee provided for a population living within the area on the city plan covered by the original design. The sewer will serve the area to the north of the Molonglo river and lying generally to the west of Commonwealth-avenue and Northbourne-avenue. This area includes the portions tinted green, pink, and light yellow on the plan of the city and environs which I produce. The total estimated population within the city area to be served is 16,000 people, and the number outside the city area is 11,000. The density of population is assumed at approximately sixteen persons to the acre. Similar proposals have been placed before the committee previously, all of which have been approved. The city boundaries have now been altered, and embrace a larger area than was originally contemplated. I shall supply the committee with a plan showing the difference in the boundaries. The city formerly comprised, roughly, 15 square miles. Generally speaking, the boundary line ran from Mount Ainslie west to Black Mountain, thence south to Red Hill, easterly to a point near Eastlake circle, and then north again to Ainslie. The additions have been made particularly to the north and to the south. The estimated population on the area tinted red on the plan is 22,000, as that is the extent to which it is expected to develop. The grades of the sewer are 1 in 360 and 1 in 350, and are considered quite satisfactory to meet all requirements. Flushing to ensure the transport of solids along the sewer will be required until the flow is equivalent to that from a population of 3,000 persons. The velocity usually adopted as sufficient for the purpose is 1.8 feet per second. The manholes are spaced in accordance with the usual practice. The distance varies, the maximum being 520 feet and the minimum as low as 140 feet. The closer spacing in some cases is necessary in order to pick up the reticulation sewers. No provision has been made for the ventilation of the sewer other than through the house vents, as up to the present that has not been found necessary in Canberra. If, however, any nuisance should arise in the future, ventilation becomes merely a matter of providing vent shafts on the highest point in the neighbourhood of such nuisance. We propose to use concrete pipes manufactured in Canberra under the Hume process by the Monier Pipe Company. The 15-inch pipes cost 5s. per lineal foot, and the 18-inch pipe 8s. per lineal foot. These pipes are made in 3 feet and 6 feet lengths as desired. We find that pipes 21 inches and 24 inches in diameter are awkward to handle in the tunnel, in the 6-feet lengths. There is no difficulty in having the pipes cut at any time to the length desired. The concrete pipes consist of a mixture of cement, sand and gravel, the exact proportions of which I cannot give at the moment, but I think they are 1 part of cement to 3 of the aggregate. Our contract specifies exactly what is to be provided. A pressure test is specified, and we have been fully satisfied with the pipes supplied by the Monier Company. The pipes are inspected during the course of manufacture, and are then properly seasoned or cured, before being put into use. The percentage of cement in the aggregate is uniform, but the reinforcement varies. The pipes are made by the spinning process. As shown on the plan, the pipes in the deep sections are surrounded by 6 inches of concrete. The object of this concrete surround is to strengthen the pipe against possible damage by subsidence or earth movement after the pipe has been laid. It is found far better to strengthen the pipe in this way than to be compelled later on to open up the surface and repair the sewer at a great depth. The stringers shown under the concrete are used only when the ground is soft or wet, in order to allow the concrete to set. In the third section the 15-inch pipes are not to have a concrete surround. As the sewer in this section is placed at a comparatively shallow depth, it will be more economical, if trouble should occur, to open up the ground to repair a fault than to incur the expense of casing the pipe in concrete. Up to the present we have not had any trouble in connexion with any of the sewers constructed under these methods, and the design we are following is standard all over the world. It is the same as has been approved by the committee in connexion with similar sewers. The object of the flushing chambers is to supplement the sewage until there is a sufficient flow in the sewer to ensure efficient transportation of the solids. The arrangement consists of a concrete chamber which is filled at intervals by a tap, the water being discharged when the chamber is full by means of a

syphon into the sewer. The tanks are simple in design and we have already installed a number in Canberra, all of which are working satisfactorily. It is also proposed to install two penstocks, or valves, the object of which is to allow of the closing off of a section when it is to be inspected or cleansed. No borings have been sunk on the route of the sewer as, after considerable experience in Canberra, it has been shown that the class of the country chiefly met with alternates between clay, schist, and limestone. Experience in the past in similar country has been to the effect that usually all three are encountered. Unless borings are put down at very frequent intervals we cannot get a true idea of the actual nature of the country. It is not expected that much water will be encountered. It is anticipated that the first section could be completed within from six to twelve months from the date on which a commencement was made. The second and third sections could be completed within twelve months. I could not say whether the work can be regarded as urgent. That depends upon the extent to which the Commission proposes to carry on its developmental work in the area. Should it proceed with development as outlined, the work can be regarded as urgent. Although this proposal embraces the Hotel Acton, that building is already served by a reticulation sewer. The usual procedure in connexion with sewerage construction is to reticulate a district after it has become partially settled, but a better practice is to provide a service before the population arrives. The sewerage construction at present being undertaken embraces reticulation at various points in the city, but only in a small way. The southern intercepting sewer is being extended about 1,200 feet past Eastlake, the estimated cost of which is £7 7s. per foot, or approximately £10,000. About 300 men are employed on water services and sewerage work, but at the moment I could not apportion that number between water supply and sewerage works. I have a table showing the rates of wages paid to the men engaged on sewerage work, which I hand in for the information of the committee. It is as follows:—

5th December, 1927.

WAGE AWARDS FOR MAIN SEWERS.

Classification.	Rate per hour.	Rate per week.	Hours per week.	Remarks.
	s. d.	£ s. d.		
Foreman		10 0 0	44	Foreman Dillon.
Shift boss	3 1.1/11	6 10 0	44	
Miner, underground ..	3 4.1/3	6 1 0	36	
Miner, other ..	2 9	6 1 0	44	
Boodler, underground	3 1	5 11 0	36	
Boodler, other ..	2 9.3/11	5 11 0	44	
Bracceman	2 10.10/11	6 1 0	44	
Winchman	2 9½	6 2 10	44	
Compressor driver ..	3 2	6 10 4	44	
Plumber	2 9	6 1 0	44	
Timberman	3 0.7/11	6 14 4	44	
Blacksmith	2 7.17/22	5 16 6	44	
Tool sharpener ..				
Tool sharpener machine drill ..	3 1.1/11	6 16 0	44	
Horse and dray—				
(a) Driver ..	2 4.10/11	5 6 0	44	Total, 3s. 3.6/11d. per hour or £7 5s. per week
(b) Horse and dray	0 10 7/11	1 19 0	44	
Concrete packer ..	2 6.6/11	5 12 0	44	
Concrete labourer ..	2 4 10/11	5 6 0	44	

We always hire horses and drays, but I could not say whether it is more profitable than using our own. If the scheme is approved by the committee, work would be commenced shortly after Christmas. The first step would be to assemble the plant on the ground and erect the derricks, which would take some little time. By the time that work is completed, we can transfer the gang on the southern intercepting sewer to the proposed work. The length of intercepting sewer which has been undertaken up to the present includes the main outfall sewer, which is about 3 miles long; the main intercepting sewer, about 10,430 feet long; the southern intercepting sewer, the construction of which is not yet finished, 10,184 feet long; and the northern intercepting sewer, 8,103 feet long, exclusive of the syphon section, which is 960 feet long. The length of reticulation amounts to many miles. I have no knowledge of the cost of the main outfall sewer. That work was done before I came to Canberra, and I do not know if the records of cost are available. The main intercepting sewer cost approximately £116,000. This, I am informed, was estimated to cost £11 10s. per foot, but the actual cost was £11 per foot. The lowest tender for the work was £145,000. The southern intercepting sewer was estimated to cost £7 per foot, and the actual cost was £8 per foot. The estimated cost of the section we are now constructing is £7 7s. per foot. The northern intercepting sewer cost £8 per foot, exclusive of the syphon, which cost £61,000. I could not say whether in every case the estimates have been exceeded. The only estimate for which I have been responsible is for the extension of the southern intercepting sewer. Our experience is that we are carrying out the work very close to the estimated cost. It is difficult to state definitely how it will actually turn out. Our estimates are based on country of the nature we expect to find. In Canberra, except for the outfall sewer, which was through solid rock, we find that the country consists mainly of limestone, clay, schist and a little sand. We do not expect to encounter much water in the length we now propose to undertake. That was our experience on the same side of the river. When the work is completed we will be able to dispense with the septic tank now under construction to serve the extension to the hospital. In sewering the White City camp, it is also proposed to put in a local treatment plant until reticulation is available. It would not pay to extend the reticulation solely to sewer that spot. The material used in the construction of a septic tank must eventually be scrapped as it cannot be used in connexion with any permanent work. In cities the depths at which sewers are placed correspond very closely to what we are doing here. The regulations provide that the sewer pipes shall be at least 10 or 12 feet deep under roadways, but in rights-of-way the minimum depth is 6 feet. Our minimum depth on the north-western sewer is 10 feet, but even then the sewer will be in open country, and not under a roadway. The details of cost per foot for section A are made up in this way—

Details at per foot run.	Labour.	Material.
	s. d.	s. d.
Shaft sinking and tunnelling ..	64 0	5 0
Electricity and plant	—	6 0
Concrete pipe and laying ..	6 6	9 0
Concrete base	9 0	5 0
Concrete surrounds	12 0	8 0
Back filling	20 0	—
	111 6	33 0
Material	33 0	
Total	144 6	

Section B would be £7, the slight difference between A and B being accounted for by the shallower depth of shaft sinking in the latter section and the less depth of manholes to be constructed. Section C will be constructed by the pot and drive method. The rates for the different sections are—(A) £7 4s. 6d.; (B) £7, and (C) £3 12s. 9d. per foot. We have never experienced any difficulty after the tunnels have been properly back filled. We always exercise special care with the back filling. I cannot at the moment give definite information as to the adequacy of the present water supply to meet all future sewerage developments, but I should say that it is ample for all purposes. I shall supply the committee with definite information upon this point. The waste of water which sometimes occurs owing to leakages is due largely to the high pressure. An effort is now

being made to prevent waste. Reducing valves have been installed in some buildings, but we have not yet been able to obtain one which has been able to satisfactorily reduce the pressure. We have tried a valve manufactured by John Danks & Son, of Melbourne, but it has not given the results we anticipated. We do not use a great deal of water from the Cotter for flushing, as most of that required for this purpose is pumped from the river. That cannot be done in connexion with the proposed sewer.

10. *To Mr. McGrath.*—We have not experienced any trouble in connexion with our sewerage system in Canberra. It is impossible for me to say when 10,000 people are likely to be living in the area to be reticulated. There is no development there at present. A horse dray driver receives £5 0s. per week, and the horse and dray are paid for at the rate of £1 10s. per week, making a total of £7 5s., which is the award rate. I have not had any experience of this work being done under contract, although I have inspected work of this nature being done under that system. As to the relative merits of the two systems, personally I prefer the day labour method for work of this kind. As a responsible officer all I look for is a good job. I do not say the same results cannot be obtained under the contract system, but owing to the necessity of getting a good job, I prefer the day labour method. I have had opportunities of watching men working under the day labour system, but I have not in Canberra been in close contact with them as the responsible engineer. From observations I am led to believe that the "go-slow" method is adopted only in isolated cases. Generally speaking, I think the men here want to do a full day's work for the Commission.

11. *To Mr. Lacey.*—In designing a sewerage system we have to consider the service that must ultimately be provided and the demand which is likely to be made upon it if the city fully develops. In putting down a main sewer of this character it would be unwise to do anything else, as it would lead to a waste of money, as has occurred in a small way in connexion with local treatment works. I do not think a shallower minimum depth should be provided. If it were, the area to be served would have to be decreased. As to the sewers which have been in position some time from which we could form an opinion as to the reliability of the work done, I will say that the main outfall sewer proposal was placed before this committee in 1915—I believe work was held up during the war, and construction was not proceeded with for the time being. The main intercepting sewer was before the committee in 1922, and the northern and southern intercepting sewers in 1924, and construction was immediately proceeded with. These systems have now been completed, and have been in position sufficiently long to gauge the efficiency of the back filling. The work and materials have been of the best, and I do not think there will be any trouble in the future. The materials specified in this instance are sufficient for the purpose.

12. *To Senator Payne.*—The overhead charge levied by the Commission is 8½ per cent., exclusive of interest. The interest usually charged is 6 per cent. on the full sum for one-half of the period of construction, or approximately 3 per cent. for the full time; 8½ per cent. would not represent a high charge. In my department the overhead charge is not equal to 8½ per cent., which represents the total overhead charges of the Commission. That rate also provides for local government services. I do not know what overhead charges private companies levy, but I think they would be in the neighbourhood of the percentage levied by the Commission. In discussing construction work with an unsuccessful tenderer for the foundations of the administrative block at Canberra, he informed me that he was allowing for an overhead charge of 10 per cent. If pipes are properly constructed their life would be difficult to determine. They should increase in strength with age. The water supply from the Cotter can be increased by raising the height of the dam which was provided for in the original plan.

13. *To Mr. M. Cameron.*—We can arrive at the cost per cubic yard for excavations such as are involved in this instance, as detailed costs are kept of every job, and we know exactly what the work is costing. The information I have supplied to the committee is taken out at per lineal foot of sewer, and not per cubic yard of excavation. Our figures are based on standard methods of calculation. We have allowed 50 gallons of sewage per head of population per day, and by ordinary engineering methods calculate the quantity of sewage which will be discharged on a given grade. At present a large quantity of water is not passing through the storage basin on Red Hill. The main line of pipes into the city reticulation system comes from Mount Stromlo, from which there is an 18-inch pipe connecting with Red Hill. The water can be by-passed from this line direct into the city reticulation system. Mount Stromlo is about 2,350 feet, and the level of the city about 1,900 feet above sea level. The difficulties in regard to waste, are very much off-set by the high pressure available for extending the water reticulation system.

14. *To Mr. Seabrook.*—Our estimates have sometimes been exceeded by 50 per cent. on small jobs. In most cases we are very near the mark, sometimes the work is done at less than the estimated cost, but generally speaking we are on the right side. If this work were done under contract, and the cost were greater than estimated, the contractor would have to make up the difference. There is a big element of risk. When work is done by day labour and the estimate is exceeded, the Commission has to make up the difference. In such cases, the Commission would not perhaps feel the added cost, but it would affect me. It is true that I would not have to find the money, but I can hold my position only by carrying out my work efficiently and keeping the cost of jobs very close to my estimates. When, in answer to a question by Mr. McGrath, I said that I preferred day work to the contract system, I was then referring to this particular class of job. The estimates for work of this nature have not been exceeded by 50 per cent. Many of the jobs under my supervision have cost 20 per cent. less than estimated. The sewer we are at present constructing empties at the western creek outfall works. The sewage reaches the Molonglo after passing through the treatment works. The pipes are all reinforced, and are constructed under the spinning system. The Commission does not manufacture pipes for sewerage purposes, but makes pipes under the Kielberg system; these are used only for stormwater drains. Such pipes are not used for sewerage work such as that proposed. The pipes we are using for storm-water work are as good as can be expected, and are quite suitable for the purpose. If I were doing such work on my own account, I would use these pipes. The mixture consists, I think, of one part of cement to three parts of aggregate. I have inspected the sample of the storm-water drain pipe, which I understand was obtained in the vicinity of Manuka, and which you consider consists of inferior material. I do not think there is anything wrong with it, considering the purpose for which the pipes are being used. The chief trouble has been in the collars. I cannot agree with you that they have been made of rubbish, and that in a few years they will have to be pulled up. Pipes made under the same process are being sold commercially, and are being made and used for the same purpose practically everywhere. I know that it is difficult to satisfactorily produce the collars of the pipes under the process used in their manufacture. More cement could be used, but I would

not say that it is justified. The officer in charge has not complained to me concerning their quality. We are using these pipes because we can manufacture them at a lower rate than we can purchase. I have given instructions that defective pipes are not to be used. Similar pipes have been laid elsewhere and I do not anticipate any trouble. It would be extravagant for the Commission to use pipes made under the Hume process for storm-water purposes. Kielberg pipes are not placed under roads or where there is likely to be much stress. We use reinforced pipes under roads. The pipes used for sewerage purposes are tested to a 30-foot head, which is equivalent to about 13 lb. per square inch, which is considered sufficient. It is very desirable to have a concrete surround of 6 inches, such as is being used at the greater depth, in order to resist any stress brought upon the pipes. If any fault should occur, it would be difficult to repair the pipes, and it is therefore considered economical to incur only the one cost. I would be disinclined to reduce the thickness of the surround, which I regard as in the neighbourhood of a minimum thickness. Stringers are used only where the bottom is soft and wet. I have not been in touch with the sewerage authorities in the capital cities for several years, but I understand that much of their deep work in Sydney has been done under the day-labour system, although some of the reticulation work is done by contract. I cannot say what is the present practice. If we received a tender which was below our estimate from a firm capable of carrying out the work to our satisfaction, in accordance with our specifications, there is no reason why the work should not be done by contract. I said that, so far as I knew, there was no record of the costs of the main outfall sewer. That work was done before I came to Canberra. The estimated cost of the main intercepting sewer was £11 10s. per foot, but the actual cost under the day-labour system worked out at £11 per foot. The lowest tender was £145,000, and the actual cost of the work was £116,000. We keep full particulars of the cost of all work, and when a job is actually completed we can give the cost even to a penny. On some jobs where similar work has been undertaken to that for which we have received tenders, we have found that we have been able to do it cheaper. All our mechanical and electrical work in buildings is done by contract. We have called for tenders for road work on a large scale, and the departmental estimates and costs have been considerably cheaper than the lowest tender price received. Guttering and kerbing are being done cheaper by contract than we can do it ourselves. The price of 6s. 6d. per foot is for laying and jointing, so for a pipe 6 feet in length the cost would be 39s., which includes for the actual laying, jointing, and concreting on the bed. The tunnel then has to be filled in.

15. *To the Chairman.*—Our sewer system has never been obstructed in any way.

(*Taken at Canberra.*)

FRIDAY, 9TH DECEMBER, 1927.

Present:

MR. MACKAY, Chairman;

Senator Payne	Mr. Lacey
Senator Reid	Mr. McGrath
Mr. M. Cameron	Mr. Seabrook.
Mr. Cook	

William Scott Brownless, A.M.I.E., Aust., Engineer for Water Supply and Sewerage, sworn and examined.

16. *To the Chairman.*—I have occupied my present position for three and a half years, and, except for eight years spent on railway construction, I have had 27 years' experience of sewerage work. Although I am now responsible for the location of the proposed sewer, I am not responsible for the original design. That was laid down by the Works and Railways engineers in accordance with the city plan. The proposed sewer is complementary to the main sewerage scheme. The 18-inch pipe, when running three-quarters full, has a capacity of 300 cubic feet per minute, and a velocity of 3.52 feet per second. When running a quarter full, the capacity is 45 cubic feet per minute, and the velocity 2 feet per second. The 15-inch pipe, when running three-quarters full, gives 192 cubic feet per minute and a velocity of 3.14 feet per second, and when a quarter full the capacity is 29.64 cubic feet per minute and the velocity 1.77 feet per second. A self-cleansing velocity is from 1.77 to 2 feet per second, so that with an 18-inch sewer it will need about 3,000 people resident on the area to keep the sewage moving at such a velocity that the water will carry the solids along with it. Until 3,000 people live on the area a certain amount of flushing must be done. The total population that the sewer could serve is 27,000, with the pipe three-quarters full and with a twelve-hour flow. That is the basis on which the city sewers are designed, and practically the universal practice of sewerage engineers. We are allowing for a volume of 50 gallons per head of the population over the twelve hours. I cannot say how many people will live in the area when the sewer is brought into use. I do not know what development the Commission has in view. The maximum and minimum depths of the sewer below the surface will be 42 feet and 27 feet respectively for the first section, 31 feet and 17 feet for the second, and 21 feet and 10 feet for the third. There will be roads to cross, and the minimum depth at those points will be 13 feet. The shallowest depth occurs in the middle of a paddock. The fall of the sewer is one in 360 for the first section, and one in 350 for the 15-inch pipe. The septic tank at the hospital will be displaced by the proposed sewer. I regard the work as being urgent in that the land should not be thrown open for building until it is sewered. I am aware that probably half of the suburbs of Sydney are unsewered; but they cannot be called sanitary suburbs. My reading of the reports of the investigations by parliamentary committees of works undertaken at Canberra leads me to believe that the policy is to have the city properly sewered before buildings are erected. In the course of my work, I attend to all sewerage construction and plumbing, and the disposal of night soil and garbage. We do not endeavour to lay down garden water service pipes before garden plots are constructed. The work recently undertaken around the Hotel Kurrajong was necessary in the provision of water for garden purposes. There was no serious disturbance of work already done. When roads are made and gardens are formed, we come along with the garden water service because definite levels are then fixed, and we put our pipes down 15 inches. If we went on with our job before the other works were completed, our pipes would probably be ploughed up in the process of road construction and garden plot formation. The laying of sewers does not destroy other works. We leave the levels exactly as we find them. Although I am responsible for storm water work I did not design it. After last Christmas, however, I took over the construction of storm water work for other departments. Sewerage is provided in almost every case before buildings are foundation high. When we were asked to provide water for buildings at Eastlake recently, we had it in within ten days. The sewerage will be available before the houses are completed. Sewerage was provided at the Hotel Wellington before the completion of the building. The recent disturbance of the ground at the Hotel Wellington was due to storm water work and the provision of garden water similar to the work at the Kurrajong. I could foresee that garden water would be required. Brassey House will require garden

water, but I have not been informed exactly how the gardens there are to be laid out. It is no use wasting pipes. Consultation between the gardening staff and my branch is certainly desirable. I see the Superintendent of Parks and Gardens every week and discuss the work. The Commission has had a great deal to do in the preparation of the road levels and the provision of sewerage, storm-water drains and electric light. If all this work had to be completed at the same time the staff would have to be practically doubled in order to get out the designs. The most economical method of providing water services for the gardens is to wait until the other services are completed. I cannot see that any loss will be caused by providing storm water drains after the completion of other works. Some services have to be finished first. We have to adhere to the same levels. It would not pay to put the water pipes deeper in the ground. I am confident that with regard to the water service we are proceeding on the most economical lines. The maximum space between the manholes is 530 feet, and the minimum 130 feet. The average would be about 400 feet. No provision is yet made for vent stacks. The system is to provide ventilation for each house. We should make provision in the paddocks for open covers for the manholes. Vent stacks are not being avoided because they are unsightly, but because the system is correctly designed to give proper cleansing. No gases are likely to accumulate. Our design has been vindicated in that it is working right. I have opened the manholes, and have been very well pleased with the working of the system. Under the Molonglo we have two 9-inch pipes in the form of a siphon. The pipes are large enough for the purposes for which they were designed. When the population increases beyond the limit for which provision has been made under the present scheme, the pipes will not be large enough, but we have made provision for increasing the size of the pipes. The fittings are actually in for the larger pipes. The sewerage will gravitate from all points. The treatment works at Western Creek are functioning satisfactorily. They are capable of providing for a population of 10,000. As the population rises those works will have to be enlarged. From the census taken last year, and such other information as is available to me, I should say that about 7,000 people live in the city.

(*Taken at Canberra.*)

SATURDAY, 10TH DECEMBER, 1927.

Present:

Mr. MACKAY, Chairman;

Senator Payne	Mr. Lacey
Senator Reid	Mr. McGrath
Mr. Malcolm Cameron	Mr. Seabrook.
Mr. Cook	

William Scott Brownless, A.M.I.E. Aust., Engineer for Water and Sewerage, Federal Capital Commission, recalled and further examined.

17. *To the Chairman.*—We have provided a safeguard against anything of a dangerous nature entering either a sewer or the treatment works. One of our standard regulations provides that no fitting shall be connected without the authority and the approval, in writing, of the Commission. Every proposal passes through my office. One of our officers is solely employed on the design of house drainage to connect with the sewer. He is well experienced. He brings every plan to me as soon as he has completed it. Special attention is given to anything outside the ordinary cottage. We install special traps in garages so as to keep the petrol out of the sewer. A similar practice is adopted in connexion with hospitals and chemists' shops. In the case of a chemical laboratory we would have the trap fitted with marble chips to eliminate the acids. Even if the marble chips were a little ineffective, through age or neglect, the trap would be so large that the quantity of water in it would dilute any acids. Furthermore, the sewage reticulation from that place would pass over nearly a quarter of a mile of earthenware or stoneware pipes, which are not affected by acids, before it reached the main sewer. By the time the acid sewage reached the main sewer it would be very highly diluted. Realizing that there are those precautions, we are not occasioned any worry. At the present time the number of men employed on sewerage construction is in the region of 100. They are engaged on the small extension of the southern intercepting sewer on Eastlake-avenue into Lake-avenue; completing the sewerage reticulation, North-East Ainslie; sewerage reticulation at Eastlake-circle; and work relating to rather large house connexions. Those works are all drawing to a close. The excavations for the southern intercepting sewer will be finished before Christmas. The work at North-East Ainslie will be finished at or about Christmas. So far as I know, all that will be left after Christmas is a short extension from the sewer to the railway station, and two subdivisions that have been thrown open in the last month at Eastlake. If this work were approved I could make a commencement with it to-morrow. The men who are at present engaged on sewerage work would go straight on to this job. I regret that I cannot express an opinion as to when the population in this area will be sufficient to warrant the work being begun. I do not know what developments the Commission proposes in that area. If one building were erected on the area I should have to install a septic tank as a temporary expedient, or install nightsoil pans—which we do not want. If the zoological building, the fire station, or the trades hall were erected it would be practically essential to put in the sewer. You cannot put any building on this site unless you make provision for sewerage. There is another reason why it is not advisable to install septic tanks. If you study the area you will see how very flat it is. A septic tank drainage requires a fall, and you would have to go 500 or 600 yards before you would be able to get a run out to put the tank in. It would be rather a difficult job. I appreciate your point of view that there does not seem to be great urgency in view of the fact that some time may elapse before the museum and other large buildings are erected on the site. When we are designing we naturally endeavour to prevent wastage of money. It is our business, as designing engineers, to get as good a return as possible. We are trained in that way, and do not neglect that aspect. So far as I can see it is for the Commission to say what buildings shall be erected there; also whether it will stop building for a certain time and then expedite the work. I cannot say whether the present is the proper time to proceed with building operations. The Commission have considered this scheme many times from a financial point of view. I have been consulted regarding the cost, and I know that the financial aspect has not been lost sight of. Although North Ainslie belongs rightly to the north-western sewerage system, we have put it temporarily into the main northern system. That has been done with the permission in writing of the Chief Commissioner, with the reservation that eventually it will be diverted into the north-western sewer. Our reticulation scheme, which embraces the north-eastern system, is designed to take in North and South Ainslie. When Ainslie is thoroughly built on there will be too much for that sewer to carry, and it will have to go into the north-western sewer. At the present time we would have to run through an unpopulated area to reach a populated area. So far we have not had any obstruction in any of our sewers. Some flushing is required in the early stages because of the small volume of matter that is passing through. We are now flushing the southern sewer. Very little expense is involved in that work; the charge for water

amounts to 10s. a day. You wish me to supply you with particulars of our water-supply system. The Cotter River dam, with the wall 60 feet high, impounds 380,000,000 gallons of water. Taking as a basis the worst season experienced over a period of 25 years, the supply is sufficient to provide 7,000,000 gallons a day. In other words, if we should experience a drought equal to the biggest that Canberra has known in the last 25 years, we would have a safe draught out of that river of 7,000,000 gallons a day, which is sufficient for a population of 70,000 people using 100 gallons a head a day. The dam is now 60 feet high. It was designed for a height of 100 feet, and can be raised to that point. If it were, it would give us a safe draught of 11,000,000 gallons a day, which would be sufficient for a population of 110,000 persons. The pumping plant's efficiency is equal to 100,000 gallons an hour with one pump pumping twenty hours a day. That would give us 2,000,000 gallons a day, which is sufficient for a population of 10,000 persons. With two pumps we could pump to Stromlo sufficient for about 15,000 persons; but as that would leave us without any reserve it would not be safe. For household purposes 100 gallons is a liberal allowance. In Sydney and Melbourne the allowance is about 50 gallons a head. We made the allowance 100 gallons to meet the requirements of the big garden area in the city. The other week, when we had very hot weather, and practically every hose was in use, we were using up to 150 gallons a head. We anticipate being able to reduce that figure to 110 or 100 gallons. In the winter time the consumption will be not more than 50 gallons a head. In that estimate provision has been made for sewerage. The Stromlo reservoir has a capacity of 3,000,000 gallons. That is the highest point to which water is pumped from the Cotter River. The whole of the gravitation into the city is from that reservoir. The reservoir on Red Hill also has a capacity of 3,000,000 gallons, whilst that at Mount Russell has a capacity of 1,000,000 gallons. There are to be two other reservoirs, each with a capacity of 1½ million gallons, one on the west side of Mount Russell and the other to the south-west of the city. Those schemes will be worked out as the city advances. We now have in storage, approximately, 7,000,000 gallons at Stromlo, Red Hill, and Mount Russell. As the years go by, we shall have to increase the pumping plant and the size of the mains, put in duplicate mains, and provide additional reservoirs at different points. A reservoir at Ainslie is projected, to be commenced very shortly. We undoubtedly have made a liberal allowance for the requirements of households, gardens, street watering, and sewering. For a period of eight years I was engaged on railway construction work, during which I had experience of the preparation of estimates. The overhead expenditure on that class of work is different from this. We worked as units, and the office expenditure was applicable to each individual work. We had no maintenance and no upkeep of accountancy staffs; neither had we to take into account any general city government expenditure. The staff consisted of the engineer and his assistant, an accountant, a cost clerk, a timekeeper, a storekeeper, and perhaps one or two others. The overhead embraced only those people. I do not know how much the head office in Melbourne added to the cost of the work for its overhead expenses. About 3 per cent., I suppose, would be the overhead of the staff I have mentioned. It is becoming a matter of policy not to add interest and overhead to the cost of a work. They have not been included in the estimate for this work. The estimates that were submitted to the Works and Railways Department in previous years did not include interest and overhead; but the Commission makes that provision in the estimates that are prepared for its own purposes. The object of not including them in the estimates that are before you is, I believe, to conform to the general principle that has been adopted with regard to the preparation of estimates for the Ministry and the committee, so that you will have an appreciation of the actual cost of the work. The estimate for the first section of this work, without interest and overhead charges, is £24,000. If those charges were added, the cost would be over £25,000. Under the system that has been adopted in regard to other buildings, we could have started that £24,000 work.

18. *To Senator Payne.*—Provision was not made originally for North-East Ainslie to be permanently sewered with the other portions of the Ainslie subdivision, because it happens to be in another valley. When we get the western sewer in, and the houses built on that area, we will turn the sewerage back to its correct line. This is not an afterthought; it was definitely laid down in a memorandum to the Chief Commissioner. He wanted that area thrown open, and he said, "How can it be sewered?" I said, "Only by putting it into a sewer to which it does not belong. I could do that with your permission and proviso that later it shall be transferred into the correct line." The area on which the museum and other public buildings are to be erected is not perfectly level. It could be served temporarily by a septic tank system. A septic tank is only a temporary expedient; you cannot get an effluent from it that is innocuous. You would not put down an expensive plant for a small isolated unit; you can only make it septic. You break up all the organic matter, but the water is dirty looking and slightly offensive. It is not pure enough to turn into the river. In other words, when treating sewage to purify it, the protein and carbohydrates in crude sewage are broken down in the nitrogen cycle to ammonia, nitrites and nitrates. The cycle only commences at the septic tank; you have broken up your solids, and it is pretty much an ammonia sewage. When it has passed through the other two treatments the nitrogen cycle is complete. There is always a certain amount of offensiveness from small septic tanks which it is very hard to get rid of except in isolated places. If you were to put down septic tanks it would mean installing them for each building, and there would be complaints about the odour. Canberra people have wonderful noses. I cannot tell you how the overhead charge of 8 per cent. is arrived at; that is outside my province.

19. *To Mr. Malcolm Cameron.*—The only sewer of a similar nature to be put in will be one from a point opposite the English Church, and down towards Duntroon. Every other valley is catered for. The reticulation pipes have been so laid that they will always be sufficient for the requirements. The water supply mains from the Cotter to Stromlo, from Stromlo to the city, and from the city to one of the reservoirs on the other side, will have to be duplicated. Some of that work will have to be done before the population reaches 20,000 persons. It is a matter which we are very carefully watching. I prepare a graph every month, and make a study of the population, the flow and the consumption. The figures we get at the present time are very unreliable, because the population is changing and fluctuating so much, and the consumption of water is concentrated on gardens and that sort of thing. We have to estimate the supply. The mains were laid down for a population of 25,000, but probably other provision will have to be made before that point is reached so as to cover the requirements at peak periods. The charge for water is not definitely laid down, but at present it is 1s. 3d. a gallon for certain purposes, and 1s. 6d. a gallon for other purposes. I do not think that that is too much. So far as we are able, we supply water to farmers outside of the city area. We would not carry our mains out too far. Wherever there is a farm within a reasonable distance of a pipe line water is supplied to it at the

rate fixed, together with the payment of 6 per cent. or 7 per cent. on the capital cost. We are supplying three farmers at Piallago. Every farm on the way in from the Cotter and on the road to Queanbeyan is supplied. We try to meet every reasonable requirement. We put a pipe down to Queanbeyan under an agreement with the Queanbeyan Council. The population of that town is between 3,000 and 4,000. Allowance for that was made in our estimate, and we are quite satisfied that we are on the right side. By the time the population of Canberra reaches 15,000, our records of actual use will be definite, and we shall know what proposals to make. It is difficult for an engineer to say that only a certain quantity per head will be needed. Considering the figures for every city in Australia, as well as those relating to America, we consider that 100 gallons is a generous allowance for all purposes. We are carefully watching that consumption. If we find that a greater quantity is likely to be used, we shall have to put down other mains.

20. *To Mr. Seabrook.*—At the end of the main sewer we have sedimentation and sludge digestion works. The light sewage passes through in a couple of hours, when it is in such a state of quiesence that any solids or particles drop. The tanks are so shaped that the solids pass through the slit and fall into a big chamber down below. They remain in there for about 24 hours, and are broken down and turned into ammonia. That passes up and gets away. An earthy residue remains which cannot be digested or turned into liquid. That material has to be got rid of. Although the sewage is passing through every day, it is only about once in six months that we pump that on to a sludge drying bench. When it is dry it is a perfectly innocuous cake of earth. I commenced my experience in 1900 in the North of England, where they were experimenting with tanks and treatment work of different kinds. I was fortunate in that I got right on to the spot with an engineer whose main work was sewerage and sewage treatment. I returned after the war, and was connected with the same class of work. I therefore saw all the improvements that had been made. At one time I had charge of as many as twenty sets of treatment works. I can confidently tell you that Western Creek will be as good as the best I have seen. I am quite pleased with it. It is necessary to have 6 inches of concrete round the sewer pipes. When you have to tunnel and mine to get to your sewer, you must take all reasonable precautions to ensure its safety. If the ground cracked, and the sewer was disturbed, or if a subsidence caused it to be broken, the whole system would be blocked. It would take you days with windlasses and miners to get down that 35 or 40 feet, and before you reached the damaged portion the sewage would have backed up and flooded your area. You must safeguard yourself against that, and the only reasonable way is to surround the pipe with a protective coating of concrete. Three inches of concrete without reinforcement would not be an efficient safeguard. It would be much the same as plaster on a wall—a covering, not a structure. All the pipes are reinforced.

21. *To Senator Reid.*—This work has no bearing on the sewerage of the shops at Civic Centre. All those shops are drained into the sewer on the other side. This will take in all the land in the vicinity of the site on which the Town Hall was to have been erected. It is undoubtedly necessary to put in this sewer to develop the industrial area on the west side of Northbourne-avenue. The reason that we do not require ventilators to be attached is that we have adopted a system that has not been followed in the other Australian cities with the exception of Brisbane. We trap the house drains at the head, not at the boundary. Therefore, we get a direct connexion between the ventilators on the house drains and our sewer. No long stretch of sewer that is so drained can be hermetically sealed. Every little branch of sewer has a chance of ventilating itself. The more houses you have the greater the ventilation, and the less chance of foul air accumulating. We have the main sewer ventilated because of its length, and the fact that there are no openings in it. There is no fear of a household being affected at any time. All the experience vindicates this idea. I may mention that this method of sewering originated in Canada, and was due to the cold weather. The boundary traps used to become frozen, causing the sewage to be blocked, and they had to be pulled out. The system is proving quite effective here, and Brisbane also likes it. I said yesterday that we waited until the ground was levelled off before we put in our storm-water drains. Every service is put in on different lines. Some one has to finish first. As far as possible we do our work before the earth is cleaned up; but there are times when that is physically impossible. It is expeditious sometimes to wait until everybody else is out of the road. Take the No. 2 Secretariat, for example. There was the drainage gang, the paving gang, the earth-clearing gang, all trying to get ahead with their work. I sent my water gang there to lay on the water for the gardens. It was a case of "You get out of the road; our men are working there." After a while I took my men away and waited until the others had finished. Although it may not seem right for one gang to tear up after another has cleared the ground, I cannot see how it can be managed otherwise. If I go on to the ground to put in water pipes before the other gang has levelled off, I have to stick pegs all over the place, and mark each one "Go down to 3 ft. 6 in.," "go down 2 ft. 6 in.," and "keep above the ground in inches," as the case may be. When our pipes are laid some may be 3 ft. 6 in. under the ground, and others be resting on top of the ground. When the other gang comes along to clear up, his horses are liable to be tripped by my pipes, and they are liable to be broken. I want to see the ground finished before I get on with that work. All the flushing of the mains is done with Molonglo water. It is pumped at the bridge and down at Eastlake. We flush every day for half an hour or an hour.

22. *To Mr. Cook.*—I started on sewerage work 27 years ago, and with the exception of eight years on railway construction work I have been closely associated with it ever since. The work which has been done here, and the cost, compare favorably with what I have seen anywhere. The explanation of that is that we have been able to introduce more machinery, and go straight forward with the work over bigger areas. The cost of the work here is slightly under that of work which I saw done in 1922 on a big contract near London. Yesterday morning I turned up that contract, for which twenty contractors tendered. The country is similar to that at Canberra. The wages and price of material are known to me. It was for a 6-in. pipe drain, 8 feet deep, through chalk, which is similar to our schist, and it cost 10s. a foot. The wages were £2 12s. a week, and the cost of the pipes was half what we pay. The price at which we do that work is 20s. 6d. a foot, and our wages are £5 12s. a week. If the Queanbeyan area were not sewered it would in time pollute the Molonglo River. That position has been safeguarded against. Under the Seat of Government Act, the State of New South Wales must so sewer the town of Queanbeyan as to prevent the pollution of the river. That provision is not being enforced at the present time. During last summer and winter, when the river was very low, an analysis was taken by our department and the New South Wales department. I do not know how far they proceeded with the matter. I mention the fact merely to show you that it has not been overlooked. The population of Canberra at the present time is approximately 7,000, and all the residents are supplied with water and sewerage facilities. The Chief Commissioner says that he is going to prepare a scheme to develop

the area to be served by this sewer. There is no water laid on at North-West Ainslie. There is no portion of the city which could not be supplied with water within three months. Most of it could be supplied within a week. The first section of this work could be completed in from six to twelve months. I could put men on the second section concurrently, and complete the whole work in from fifteen to eighteen months if I were asked to do so. We have not so far had a failure of the water supply. I am not aware that there have been any house fires.

23. *To Mr. McGrath.*—I have had communications with Mr. Martin regarding his process for making clay pipes for sewerage work. I tried to get him to establish a factory here. He came up, but was not satisfied that the clay was suitable for his process. The labour and electrical costs connected with the pumping of water amount to 6.85d. per 1,000 gallons. There are no buildings on the area covered by this proposed extension. It is not for me to determine whether there are likely to be any in the next two years.

24. *To Mr. Malcolm Cameron.*—If the work were to be held up for three years the loss of the men who are experienced in it would not worry me; but it would if the period were only six months. One likes to keep the men one has selected, no matter what the work may be. When you bring new men on to a job you have to find out what they know, and teach them when their knowledge is deficient. That naturally adds to the cost. I have certain men with whose work I am quite satisfied. In the case of others I do not care whether they go or stop.

25. *To Mr. Cook.*—I have under me now men who have been here from the inception of the work. There is no special advantage in having a man who has been on the work for ten or twenty years. As a matter of fact, it is sometimes a good thing for them to move round.

The witness withdrew.
The committee adjourned.

By Authority: H. J. Green, Government Printer, Canberra.