A SUMMARY OF THE UNDERMINING OF SOUTH DUNEDIN'S DRAINAGE SYSTEM **N.P. Johnstone CP Eng ret**	**COMMENTARY** **29 AUGUST 2024**
Circa **1938** R.H.C. Galbraith assessed the area to be drained was 1075.81 acres (435 ha), of which 34% (**148 ha**) were deemed impermeable.	This led to the design of the box culverts along Anderson's Bay Road to accommodate 174 cusecs (4.93 m3/s.
1948 Tenders were called – but never actioned – for the supply of 7 main electrical pumps and 2 diesel pumps having a total capacity of 400 cusecs (11.3 m^3/s)	These are considered likely to have been split roughly 8/3 m^3/s.
1949 Ritchie and Kingsland undertook "further investigations". They accepted Galbraith's gross catchment area, but identified a higher impermeability factor of 41.6%, making **181 ha** impermeable. They suggested a reduced capacity of the pump station of 300 cusecs, being 250* cusecs (7.1 m^3/s) electric and 50 cusecs (1.4 m^3/s) emergency diesel.	*Seemingly the approximate average of 232 and 273 cusecs. Very significantly, Ritchie was of the opinion that, having regard to the sizes and gradients of the pipes and conduits, a flow of over 300 cusecs could not be justified. This suggests that the pump station's design capacity was dictated by existing limited feeder pipe capacities despite impermeability being on the rise, and reclamation pending.
1958 J.E. Berry made "entirely new calculations". He assessed the catchment area as 1169 acres, and the impermeability factor as 44.3%, giving an impermeable area of 518 ac (**210 ha**), the increases in area and impermeability likely to be a result of reclamation allowances.	Berry's estimates of increased hard areas might have been expected to require a further increase in both conduit and pumping capacity, but he extraordinarily based his design storm hydrograph on an event lasting only 43 minutes, and therefore assuming that there would be insufficient flow volume to fill the pipe network to capacity. He was thus able to suggest a pump capacity of 210 cusecs (5.95 m^3/s) which essentially remains the station's capacity 66 years later.** To make matters worse, Berry also used the convenience of a short design storm to disregard the impact of any foreign flood flows arriving from St Clair or elsewhere, and Drainage Engineer George Armstrong (1959) assumed that "*It is unlikely that the overall impermeability will increase to any extent as, although there may be some further industrial development, re-building of the present rather high-density residential districts is likely to be at a lower density than at present*".

	** 6.3 m^3/s electric and 2.5 m^3/s diesel standby

The above historical contributions from Galbraith, Ritchie and Berry are summarised in the December **1959** report of George Armstrong who was then Drainage Engineer. **1968** Now City Engineer, George Armstrong reported briefly on the March 9, 1968 flood event that inundated some 100 South Dunedin homes and businesses. Included in his report was his view that, *the reticulation system became overloaded because the rainfall was much more intense and of longer duration than it was designed for, and also because there were heavy overflows from adjacent catchments*.	These admissions seriously discredited the design assumptions, yet no improvements were forthcoming. There was no reassessment of catchment impermeability, and there was a curious claim that the design of the pumping station was "sound", despite it only passing 85% of its capacity; this surely indicating that there were bottlenecks, or worse in the system.
2011 The ICMP for the South Dunedin catchment (Beca, URS) reported that the impermeability of the South Dunedin catchment was now assessed at approximately 60%.	There was no accompanying recognition that, because this study included Chisolm Park in its derivation of catchment area (thus increasing the catchment to 570 ha), then the impervious area had in fact grown to **342** ha.
2015 McElhone and Stokes in their flawed reporting of the performance of infrastructure during the major flooding of June 3-4 2015, reported the 60% figure, but also failed to assess - or report - its significance.	My ongoing analyses indicate that the area of impermeable ground has continued to increase since 2011 at a near-constant rate to approaching double its value on which the pumping station and reticulation design relied. Refer the attached chart. **The design of the Portobello Pumping Station and associated infrastructure is therefore, as a result of a failure to properly assess increasing impermeabilities and of a totally unjustified original choice of design storm duration, grossly underdesigned and long overdue for urgent upgrade. Home owners and businesses across South Dunedin remain at risk while being poorly informed.**

NOTE: Richard Hugh Courtney Galbraith: Reg Civil Engineer Dunedin, died 1991 aged 86

George Kent Armstrong: Reg City Engineer. Died 1982, aged 67