Dundalk Gravel GWB Group: Summary of Initial Characterisation.

Hydrometric Area Local Authority	Associated surface water features	Associated terrestrial ecosystem(s)	Area (km^2)
06 Louth Co. Co.	**Rivers**: Castletown (Dundalk) and Castletown Harbour, Blackwater, Flurry, Castletown (Riverstown). Unnamed lakes.	Dundalk Bay (IE0000455)	13.3

Topography		The GWB group is situated at the northern end of Donegal Bay and around Donegal Harbour. The location and boundaries are shown in Figure 1. This GWB group comprises six sand/gravel deposits. The individual sands/gravels are considered together because they have a similar configuration, i.e., similar morphology, located within the same catchment and (in the main) in low-lying areas. The majority of the GWB Group is situated adjacent to the coast/tidal flats at elevations of 30 mAOD or less. The elevation of the bodies increases eastwards, and the three easternmost (and smallest) sand/gravel aquifers are situated on the hillslope rising from the coast, at elevations between 20 mAOD and 110 mAOD. Drainage in the very low-lying areas can be poor, but is good on more elevated areas.
Geology and Aquifers	**Aquifer categories**	The deposits are between 0.5 and 8 km^2. Accordingly, the deposits are classified as **Locally Important Sand and Gravel Aquifers (Lg)** (DELG/EPA/GSI (1999). The five aquifers that lie north of Dundalk Harbour overlie a limestone bedrock aquifer that is Generally Moderately Productive (Lm). The sands/gravels east of Dundalk overlie a bedrock aquifer that is Generally Unproductive except for Local Zones (Pl).
	Main aquifer lithologies	In the western part of this GWB group, the sand/gravel deposits are predominantly mapped as marine gravel (MGr) (Meehan, 2004). In the sand/gravel deposit east of Dundalk city, there are also small areas of Lower Palaezoic Sandstone and Shale Gravels (GLPSsS). Figure 4 shows well logs of deposits east of Dundalk. In the elongate deposit that lies along the north side of Dundalk Bay, beach/raised beach (Mbs) sands are found in addition to marine gravel. In the eastern part of the elongate body, the gravels derive from weathering of granite (GGr). The three easternmost sand/gravel deposits derive from granites (GGr) or Lower Palaeozoic sandstones and shales (GLPSsS).
	Key structures	N/A
	Key properties	At Ardtully, in the east of the Cooley Peninsula, a transmissivity of about 1000 m^2/d and a specific yield of 0.1 are reported (NERDO, 1981). The groundwater gradient is estimated as 1:60, or about 0.015 (NERDO, 1981). In 1978-79, the annual water level variation was approximately 1.6 m. At Dundalk, the marine sands and gravels have high but variable transmissivities which range from 3-1000 m^2/d (NERDO, 1981). This equates to bulk permeabilities of between 1-40 m/d. Maximum natural water level variation at the Harp Brewery was about 3.6 m in the period 1978-79. The groundwater gradient in the eastern, higher transmissivity, part of the deposits is about 0.001. Groundwater gradients in the elongate sand/gravel deposit on the north shore of Dundalk Bay are unknown, but are likely to be between 0.01 and 0.001. Transmissivities are likely to be similar to those at Ardtully. In the deposits of glacial origin (gravel tills), groundwater is likely to be unconfined. Marine gravel deposits, such as those at Dundalk, may be partially confined by associated overlying fine-grained materials (see Figure 4).
	Thickness	In the deposit around Dundalk city, depths to rock are in the range 20-25 m. Figure 4 shows borehole logs. In the easternmost deposits, around Ardtully, depths to rock range from 20-30 m. At Cooley, 71 m of sands and gravels was drilled at the Cooley Alcohol Factory (NERDO, 1981). Depths to rock in the largest sand/gravel deposit in this GWB range from >20 m in the east (Figure 2) to probably around 10 m in the west.
Overlying Strata	**Lithologies**	At Dundalk, fine-grained sediments (silts and clays) overlie the sands and gravels (NERDO, 1981). Made Ground overlies the western part of this deposit (Meehan, 2004).
	Thickness	The fine-grained sediments overlying the sands and gravels at Dundalk range from approximately 1-12 m.
	% area aquifer near surface	*[Further information to be added at a later date]*
	Vulnerability	*[Further information to be added at a later date]*
Recharge	**Main recharge mechanisms**	Diffuse recharge occurs via rainfall percolating through the unsaturated sand/gravel. In general, due to the high permeability of sand/gravel, a high proportion of the available recharge will percolate down to the water table. However, in areas where groundwater is close to the surface and/or the sands/gravels are overlain by fine-grained sediments, recharge will be inhibited.
	Est. recharge rates	*[Information to be added to and checked]*
Discharge	**Large springs and large known abstractions (m^3/d)**	Harp Brewery (??); Cooley Alcohol Company (??).
	Main discharge mechanisms	Groundwater discharges to rivers/streams that flow through the deposits and to the estuaries and sea.

	Hydrochemical Signature	At Bellurgan and Ardtully, hardness varies from 136-710 mg/l as $CaCO_3$. The highest hardness is associated with a sulphate concentration of 440 mg/l (NERDO, 1981). At Dundalk, groundwater is very hard, with high Mn and Fe (NERDO, 1981). Average values of 20 samples near Dundalk are: conductivity – 815 μS/cm; alkalinity – 289 mg/l $CaCO_3$; 372 mg/l $CaCO_3$; Mn – 2.05 mg/l; Fe – 1.17 mg/l; Sulphate – 91 mg/l; Chloride – 52 mg/l.
Groundwater Flow Paths		Groundwater flow path length depends on the size and dimensions of the sand/gravel deposit, and also upon the spacing of internal groundwater divides and the distance between streams. Due to the geometry of the bodies, flow path lengths are generally less than about 1000 m, and will often be <500 m. In the three western deposits, groundwater will flow overall towards the estuary/coast. Groundwater flow directions may vary locally if groundwater discharges to rivers/streams. In the eastern three deposits, groundwater flow is to the south, in the direction of the ground surface slope. Generally the drainage density is low over sand/gravel areas, however, drainage can be poor where the water table is close to the surface and/or where low permeability sediments overlie the sands/gravels.
Groundwater & Surface water interactions		Groundwater discharges to the streams/rivers flowing through the sands/gravels, and to the estuaries and to the sea. Hydraulic connection between the groundwater in the aquifer and the streams/rivers is generally expected to be high, thus water will be able move into and out of the aquifer depending on the river stage. The exception is where sands/gravels are overlain by low permeability fine-grained deposits. Groundwater also supports lake water levels within the deposits.
Conceptual model		• The GWB Group consists of six sand/gravel deposits in the north Dundalk Bay area. • Three of the deposits are located next to the coast, adjacent to the estuary or sea, and are situated at elevations ranging from a few metres to just over 30 mAOD. The three easternmost deposits are located on hillslopes about 2 km inland, at elevations between 20 mAOD and 110 mAOD. • Overall, the surface drainage is towards the estuary/sea. Drainage in the very low-lying areas can be poor, but is good on more elevated areas. • The aquifers in the west of the GWB group are comprised of marine sands and gravels and raised beach sands. In the east of the GWB, the gravel is derived from glacial depositional processes. • Pumping test data and the depositional processes of the sands/gravels indicate that the permeability of the deposits is high in the eastern part of the GWB group, and high but variable in the eastern part of the GWB group. • The thickness of the deposits ranges from about 10 m to over 70 m. Available data indicate that 20 m is a typical thickness. • In the east of the GWB group, groundwater gradients are approximately 0.015. In the very flat-lying areas in the west of the GWB, groundwater gradients are 0.001. Overall, groundwater is unconfined, but it may be partially confined in areas where fine-grained low permeability subsoils overlie the sands/gravels (e.g., east of Dundalk). • Diffuse recharge occurs via rainfall percolating through the unsaturated sand/gravel. Low drainage densities indicate that actual recharge is a high proportion of potential recharge. Higher drainage densities indicate that recharge is inhibited by high water table conditions and/or low permeability subsoils. • Groundwater discharges to the rivers and streams that flow through and adjacent to the deposits, and to the estuary/sea. Groundwater flow is roughly eastwards/southwards towards the coast, except in areas of the aquifers where rivers/streams cross or neighbour the deposits. • Due to the geometry of the deposits, groundwater flow paths are likely to be less than about 1000 m, and often <500 m. • The groundwater is hard. East of Dundalk, manganese and iron concentrations are elevated.
Attachments		Figure 1: location map; Figure 2: Map of depth to rock on Cooley Peninsula; Figure 3: Groundwater level variation in well at Ardtully; Figure 4: Dundalk UDC borehole logs; Figure 5: Groundwater level variation at Harp Lager Brewery, Dundalk; Figure 6: Groundwater contours in sand/gravel deposits around Dundalk.
Instrumentation		Stream gauges: 06042 Possible monitoring points (are outside the defined gravel areas, but are close to): LOU022 (Groundwater level and chemistry); LOU095 (Groundwater level).
Information Sources		An Foras Forbartha & Geological Survey Office (1981) Groundwater Resources in the NE (RDO) Region. DELG/EPA/GSI (1999) *Groundwater Protection Schemes.* Department of the Environment and Local Government, Environmental Protection Agency and Geological Survey of Ireland. Meehan, R.T., (2004) *Subsoils Map for County Louth*. Map produced as part of EPA Soil and Subsoil Mapping Project (formerly FIPS-IFS). Teagasc, Kinsealy. O' Riain, G., (2004). *Water Dependent Ecosystems and Subtypes Draft Report.* WFD Support Projects. Compass Informatics in association with National Wildlife and Parks Service (DEHLG). O'Suilleabháin, C., (2000). *Assessing the boundary between high and moderately permeable subsoils.* Unpublished MSc., University of Dublin. Department of Civil, Structural and Environmental Engineering, Trinity College Dublin.
Disclaimer		Note that all calculations and interpretations presented in this report represent estimations based on the information sources described above and established hydrogeological formulae

Figure 1 Location and extent of Dundalk Gravel Group

Figure 2: depth to bedrock in Cooley Peninsula area (from NERDO report, 1981)

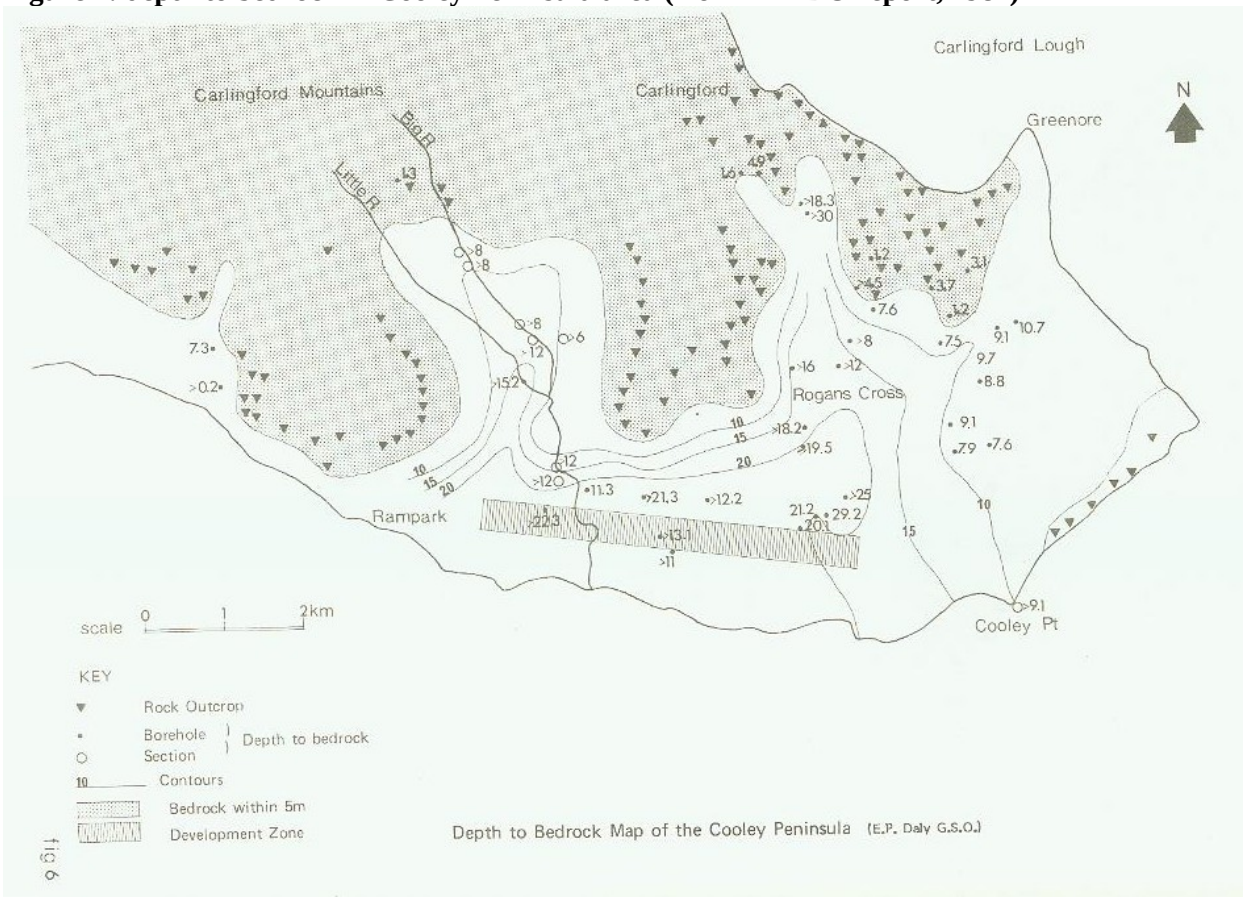


Figure 3: groundwater level variation in a well at Ardtully (from NERDO report, 1981)

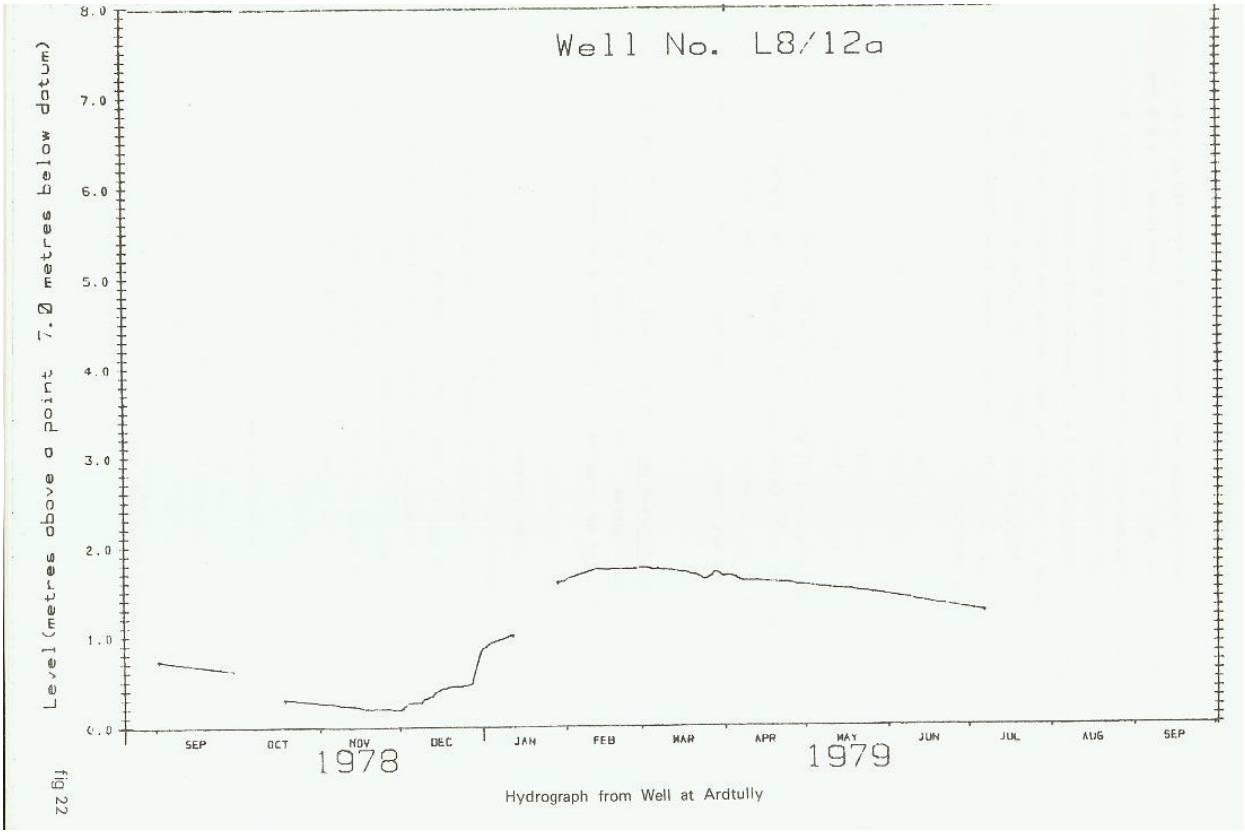


Figure 4: borehole logs for wells drilled for Dundalk UDC Ardtully (from NERDO report, 1981)

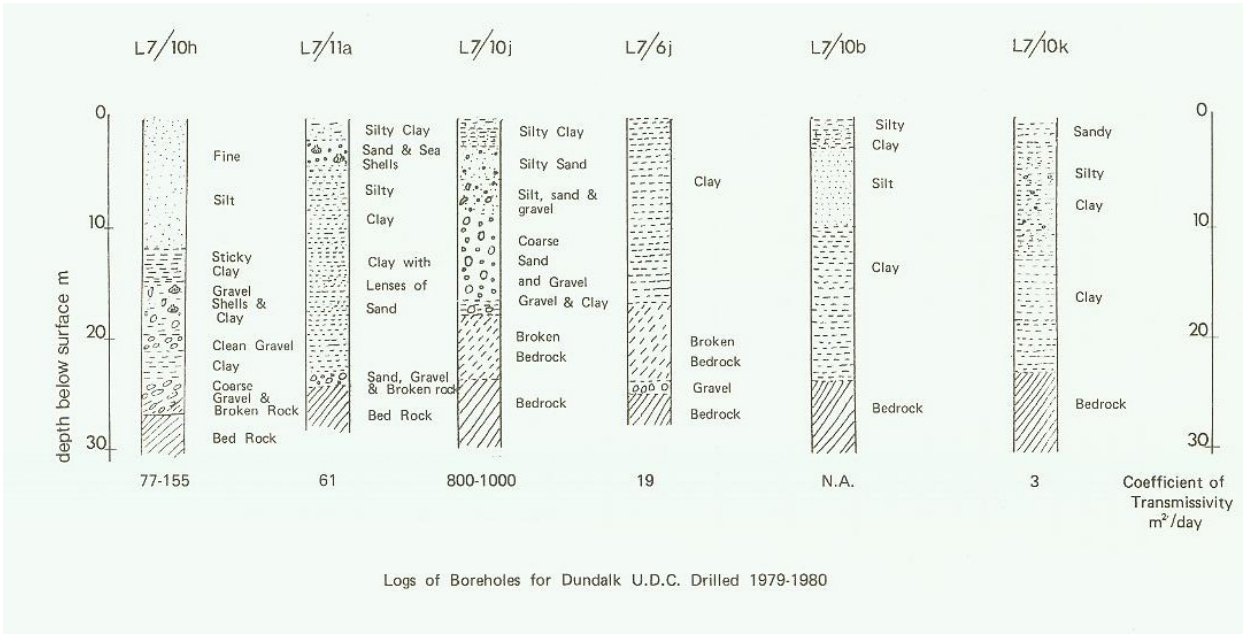


Figure 5: groundwater level variation at Harp Lager Brewery, Dundalk (from NERDO report, 1981)

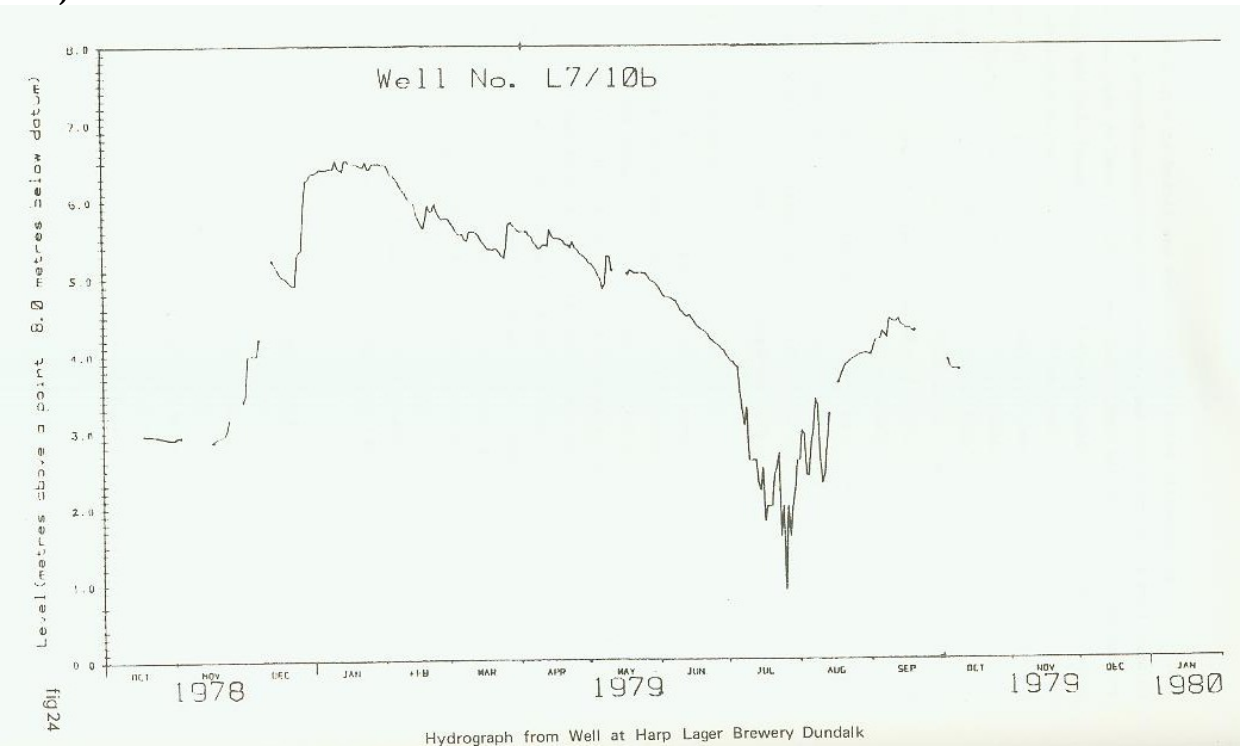
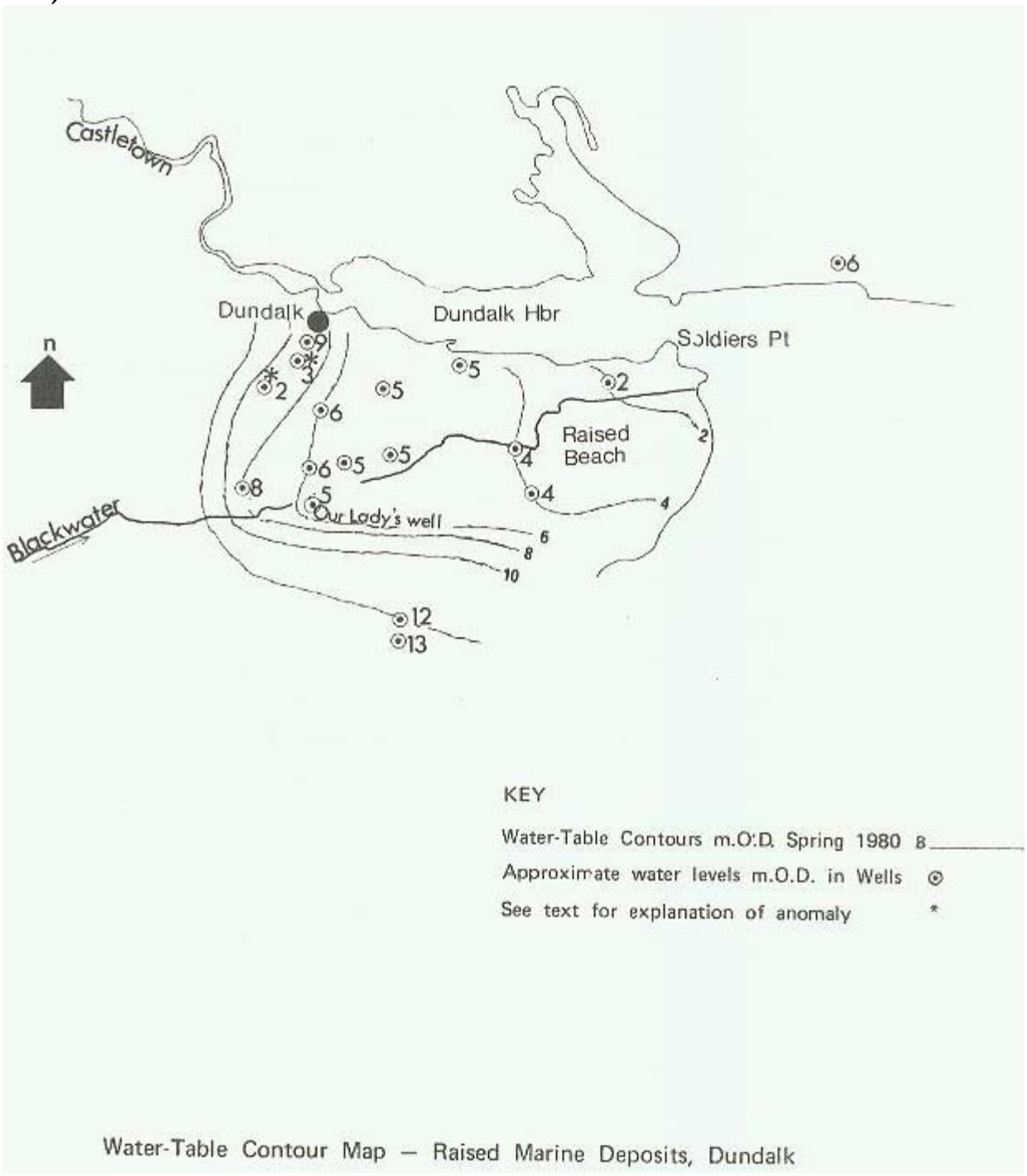


Figure 6: groundwater contours in sand/gravel deposits around Dundalk (from NERDO report, 1981)



Water-Table Contour Map — Raised Marine Deposits, Dundalk