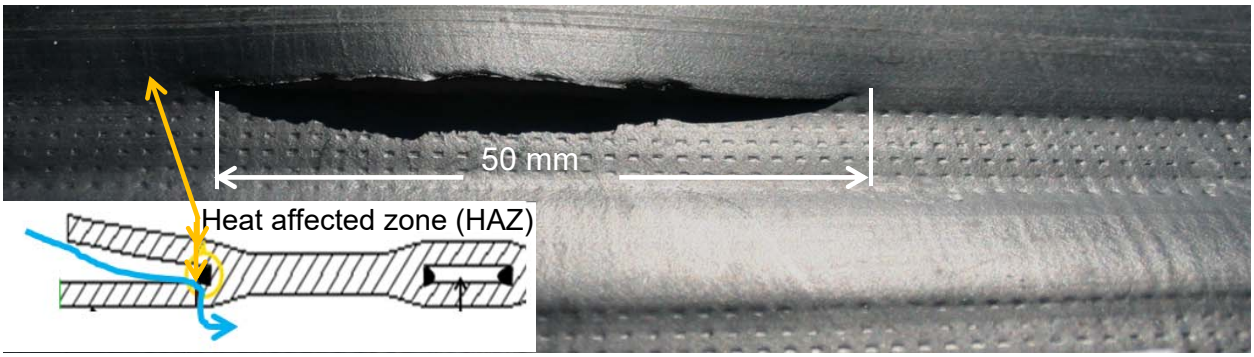

Figure 1: 50 mm-long tear in underside of a white (upper surface) geomembrane adjacent to the weld (not visible to the inspector without lifting the flap) and not detected by a weld pressure test or some ELLS methods

Figure 2: Wrinkles in geomembrane being covered (photo reproduced with permission of R. Thiel)

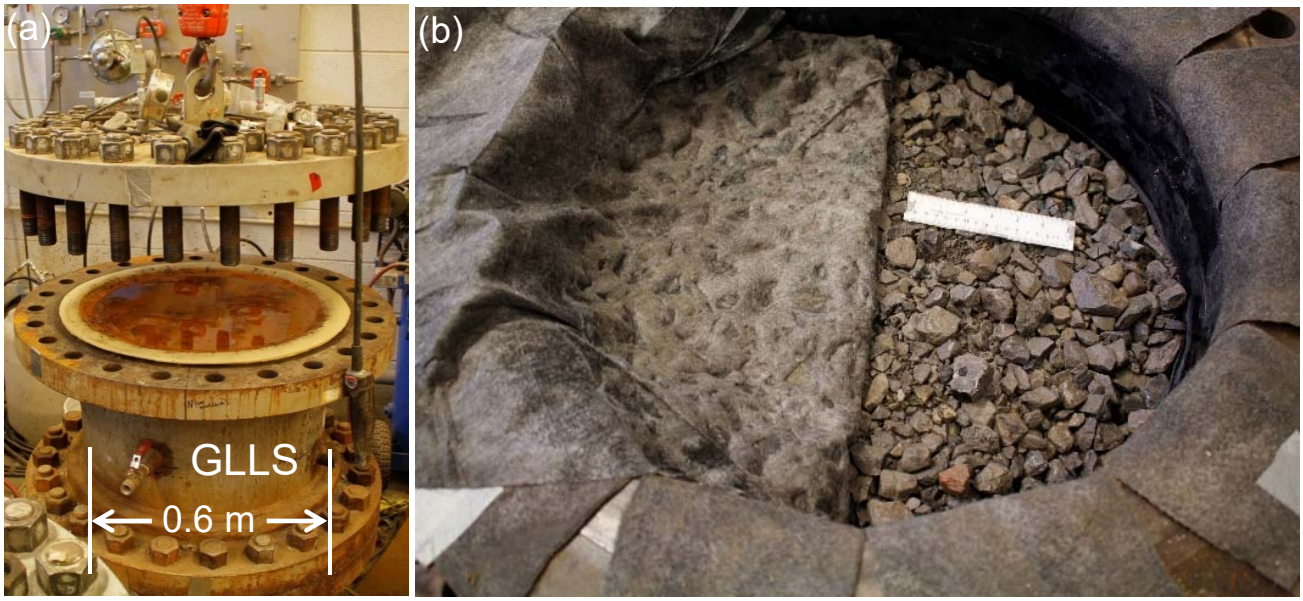

Figure 3: Geosynthetic liner longevity simulator (GLLS) (a) one of the 54 simulators ranging between 0.6m & 1m diameter [capacity of up to 3000kPa vertical pressure, up to 180 m of head above the liner], (b) Assembled cell at start of exhumation of the cover soil [material on sides is part of a special multilayer friction treatment to minimize friction loss on side walls to less than 5%]

Figure 4: Three of the subgrades (underliners) considered by Rowe et al. (2013) and in Table 1

Figure 5: Geomembranes in dams (a) exposed black geomembrane in a dam in Argentina (photo reproduced with permission K Embree, Knight Piesold) (b) covered white geomembrane at Sir Adam beck Pump storage Scheme (photo reproduced with permission of Ontario Power Generation); (c) tailings storage facility (photo reproduced with permission of H. McLeod, KCB)

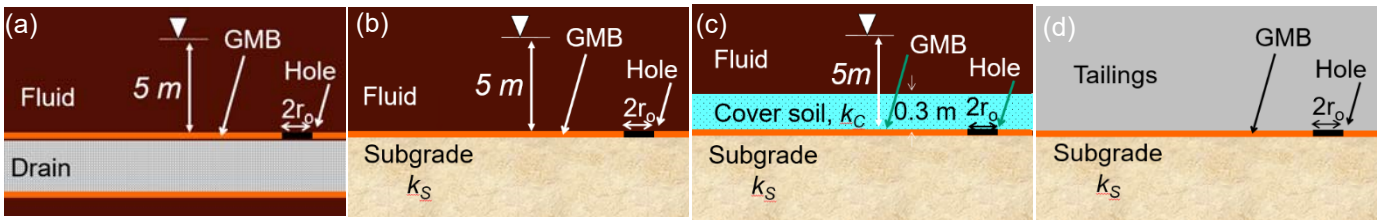

Figure 6: Four configurations for a single geomembrane liner in a pond/dam: (a) permeable drain below a single primary liner (in a double liner system); (b) Subgrade with hydraulic conductivity (e.g., Figure 5a), k_s, below geomembrane; (c) 0.3 m of cover soil above geomembrane and subgrade below geomembrane (e.g., Figure 5b); (d) geomembrane on a subgrade and covered by a significant thickness of tailings with water ponded above the tailings

Figure 7: Stress cracking in a wrinkle in an exposed geomembrane in a pond (photo reproduced with permission of I.D. Peggs).

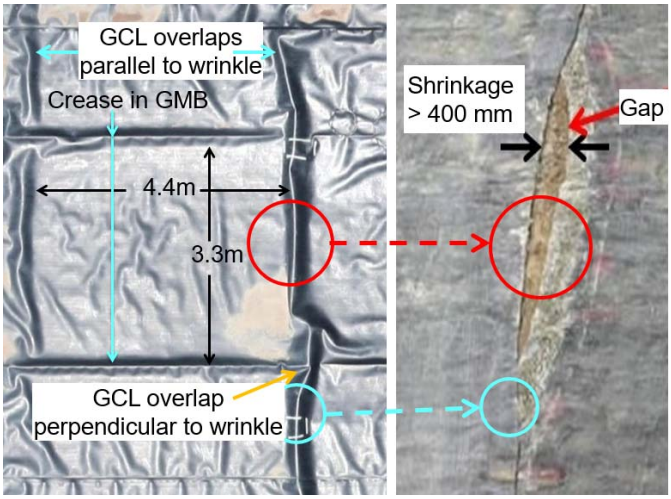

Figure 8: Wrinkle network with wrinkles running parallel and directly over overlaps, wrinkles at creases in geomembrane running perpendicular to wrinkles and an example with total (over a distance of 5 m) and partial loss of GCL overlap (modified from Rowe et al. 2012 & 2018).

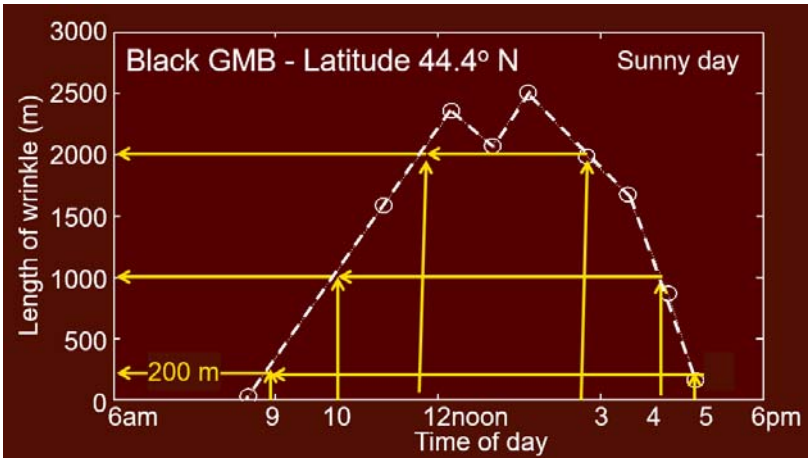

Figure 9: Change in length of longest connected wrinkle in a smooth, black, 1.5-mm-thick HDPE geomembrane over a 55 m by 140 m (0.77 ha) area on 11 June just north of Toronto Canada when the maximum air temperature was 26ºC and maximum geomembrane temperature measured was 55ºC (plotted from data given by Chappell et al. 2012a)

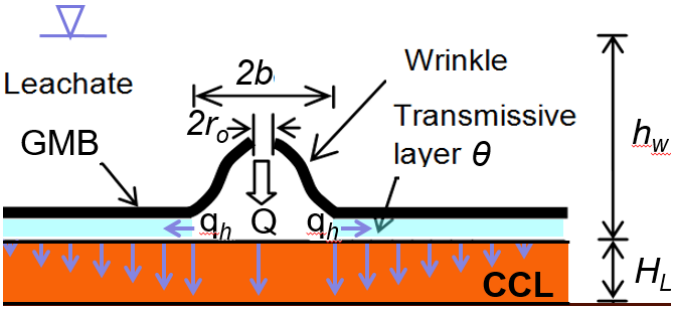

Figure 10: Leakage, Q, through a hole (r_o) in a wrinkle for a composite liner with flow in the clay liner beneath the wrinkle and lateral flow q_h in the interface (transmissivity θ) either side of the winkle and down through the clay liner over the wetted distance from the hole (modified from Rowe 1998)

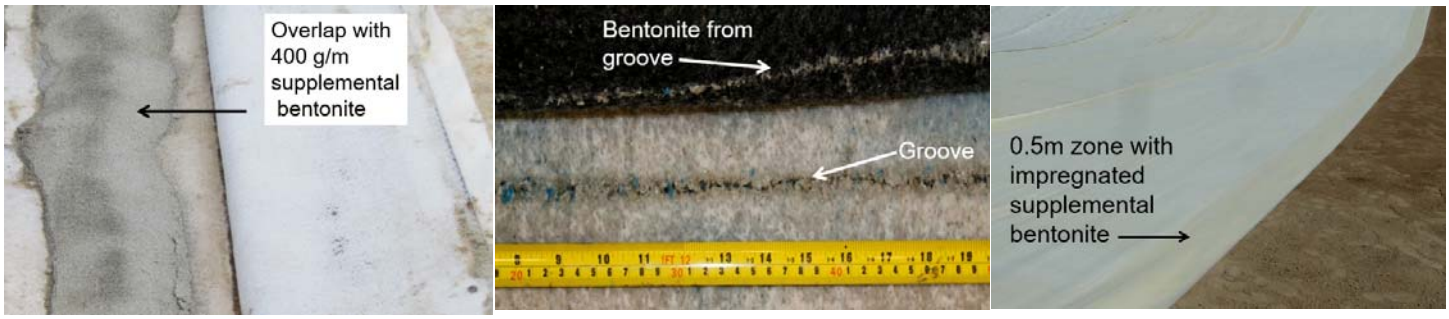

Figure 11. Three forms of supplemental bentonite between overlapped panels: (a) 400 g/m of field applied supplemental bentonite, (b) the use of the bentonite in a groove in one of the geotextiles, (c) bentonite impregnated in the nonwoven geotextile near the edges of the roll.

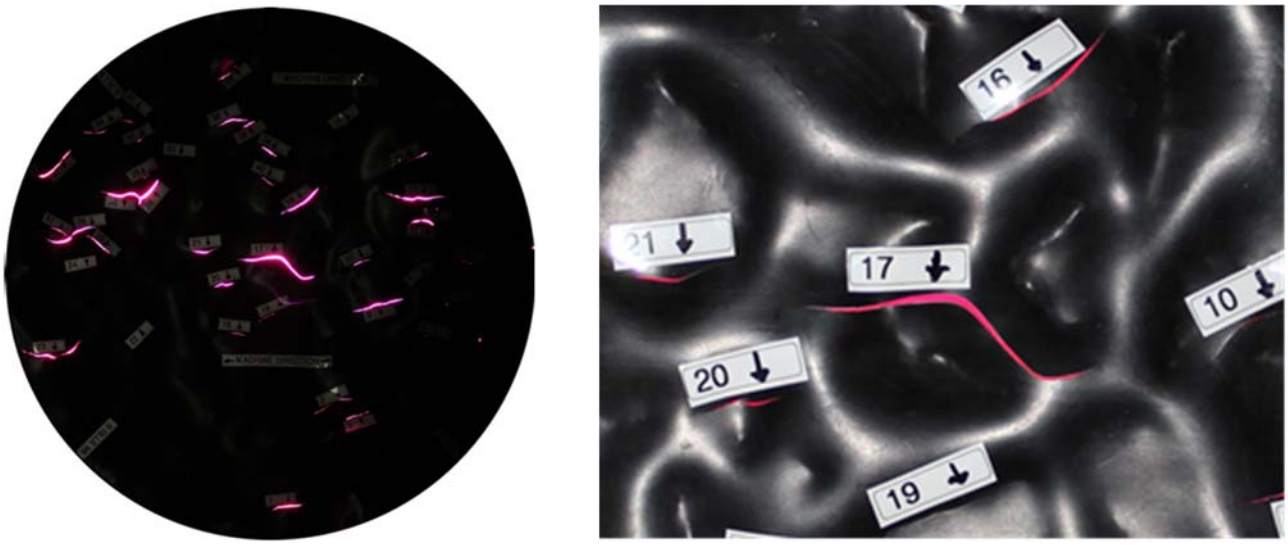

Figure 12. Photographs of ruptured GMB samples: (a) 40 stress cracks with light shining through larger cracks (0.59 m-diameter image is approximately), (b) Rupture length beneath a gravel contact (#21) or at indentation slope (#20) was limited by the individual indentation/gravel particle size, 100 mm-long rupture between indentations (#17) passed by several indentations). (Modified from Ewais et al. 2014a)