Design Option	High level reasoning for considering this option	Practicality for Pukekiwiriki Pā (site topography, construction methodology/access, etc.)
Steel helical screw piles as the foundation (galvanised)	Steel helical screw piles as the foundation can minimise disturbance of important cultural heritage NZ manufactured, galvanised steel screw footings are considered the least intrusive mechanism for placing sustainable and durable foundations to support the boardwalk.	Screw-piles and helical anchors are generally limited to installation in soils. They are not suited for rock fixing. Attempting to use these particularly on the upper walkway section could fracture off the edge of the limestone cliff. Generally on the preliminary design, where suitable, Framegroup Ltd have shown 20mm holes drilled into the rock and a grouted bar fixing. This detail was chosen because of the minimal ground penetration required for installation, and would only be suitable where multiple piles are braced together.
Superstructure	The use of a steel superstructure reduces the number of piles required (increased span width) and consequently reduces the visual bulk of the superstructure required. Steel substructures are visually light structure, with the ability to be recycled at end-of-life.	Although a welded steel structure could reduce the number of piles required for ground fixing, this causes some concern with the design. Eliminating the middle sets of piles (under the landing) would result in all the loading being transferred to the top at the narrow bench on the limestone cliff. In addition to an excavated concrete pad that would be required in this location, a Geotechnical Engineering investigation would then be recommended to ensure there is no risk of collapse. This large welded steel structure would then need to be transferred to the site by truck and trailer, and lifted mechanically into place. It would be possible to construct a welded steel staircase in two pre-fabricated sections, each with a top landing. This would eliminate the need to have a geotechnical engineering investigation; however would require a central pier under the middle landing. As bracing multiple piles together in this location would not be an option, it would be necessary to drill and concrete this piles set into the rock. Although this option would be lighter than a single welded steel structure, vehicle access and mechanical lifting is still likely required. A benefit of a timber structure is that it can be built on site piece by piece, and lifted into place

		by manual labour. It is also noted that there would be a cost increase for both the design and construction components of a steel structure (compared to a timber structure).
Decking material options	A combination of timber and if possible steel decking materials to provide a recessive and visually permeable structure in the landscape. Consider usage of Totara or Forest Stewardship Council certified hardwood as a decking material due to its sustainability properties. Chromated copper arsenate (CCA) treated timber not encouraged around sites of significant ecological value, wetlands and waterways and sites of cultural significance.	Steel decking is loud and very unnatural sounding. Hardwood decking is an option with the normal increased cost and availability problems. It is noted that CCA leaching can occur from treated pine timber, but this is particularly from freshly treated material. Allowing the contractor time to order and have timber dry before use reduces this to only slightly above natural occurring background levels. Some hardwood timbers have issues with stainability and will require pre-cutting. Research will be required to ensure a suitable timber is chosen that meets the lifespan requirements as per the NZ Building Code.
On-grade options	Monoslope tracks of compacted gravel with a high clay content, grade dips to manage water flow, soft retaining structures (not retaining walls), boxed steps or stringer boxed steps where required, no timber edging.	The preliminary design shows edge boards in the following two locations: 1) At the track entrance to enable the track to be filled over exposed roots. It would be possible to eliminate this edge board if additional fill was used and battered onto the cross fall. 2) Between the stringer boxed steps near the top of the site. This is only a short length (up to 200mm high) required to fill the track formation to obtain the minimum track width. Timber is preferred as it that will blend with the proposed timber boxed step at both ends and does not require reshaping where the subbase is rutted. Other options such as filled bags would require additional earthworks formation on the track edge for support; therefore have not been considered.

Proposal is to use ground penetrating radar (GPR)	Use GPR before using screw in foundations.	Boxed step and edge board fixing is shown on the preliminary design with either driven pegs or drilled bars into the rock. Staircase pile fixing is shown as drilled bars into the rock or in one location a shallow 400mm deep pile into the rock. In most locations the ground consists of a shallow layer of soil/leaf litter over the limestone rock formation; therefore GPR would have little use. For the small amount of earthworks required at the staircase it is believed that the Archaeological Discovery Protocol to be outlined in the specification documents will be suitable.