1. Scope

Heidelberg Materials purpose for this report was to consider the long term options of stabilising the banks at Swanage Green Seafront and have reached out to industry leaders in ground engineering and referring to the WSP Feasibility Study from 2022

The WSP document itself referenced 2 independent assessments;

- Supplementary Survey Report, Smith Foster (June 2016)
- Geotechnical Assessment, South West Geotechnical (SWG) (June 2021) - 2021 Ground Investigation & Geomorphological Survey

2. Considerations

Longevity

Cost

Drainage

Buildabilty

Continued public accessibility

Maintaining the aesthetics of historical masonry features

3. Methodology

Slope Regrading

Slope regrading is a civil engineering process to reshape the surface of a slope to enhance stability, control drainage, or prepare for construction. It is generally used to open a site for development, erosion control, and landslide prevention. Additional options include benching the existing bank, importation of granular fill to strengthen sub soils.

The existing slope is excavated to a specific ground engineering design and reinstated with the fill and compacted.

Designs should be able to cater for existing site layout and maintain accessibility but also could result in new structures being introduced as retaining walls or stepped features therefore reducing full accessibility and changing the appearance of the slope.

Drainage can be improved with relatively simple counterfort trenches but again these can alter the aesthetics of the surface and restrict accessibility.

Large excavations are required which can result in high disposal costs as well as increased HGV traffic exporting waste material and importing fill.

Due to the limited access to Swanage for HGV's the cut/fill exercise would take longer than preferred resulting in higher costs for similar exercises.

Works are more susceptible to inclement weather than other options and would need to be scheduled appropriately.

Soil Nails

Soil nailing is a technique for reinforcing slopes and retaining walls by drilling grouted steel bars (nails) into the soil to increase its stability. The nails resist tensile forces, strengthening the ground to prevent failure or slippage.

Soil nails are a passive solution that are mobilised when the slope starts to experience small displacements, in the order of a few millimetres.

With being constructed in a grid, soil nailing offers flexibility to avoid existing features, e.g. utilities, small retaining walls, pathways and drainage.

Where designed specifically for slope stabilisation soil nails can have corrosion protection achieving 100-year design life, or stainless steel nails and components in exceptional circumstances to extend beyond that.

Treatment with soil nails would not impact public accessibility and the existing slope profile maintained whereas sheet piled structures could introduce steep banks/drops and removal of existing wall features.

Sheet Piles

Sheet piling is a construction technique that uses interlocking sheets of steel that are driven into the ground forming a continuous wall that is used for earth retention in civil engineering projects.

Sheet piles are a stiffer solution to soil nailing and can be better if no slope movement is required, but a full continuous wall must be built.

Stability of the sheet pile structure relies on passive resistance and are designed to take the full active pressure plus ground water pressure which will make it a heavier solution than soil nails.

In a marine environment such as Swanage an unprotected exposed sheet pile could have a design life as short as 5 years. Coated piles could have a design life of 15 years. Cathodic protection can be employed with anodes having design lives of up to 20 years or anode systems can be used - which are an expensive lifetime solution but will provide longevity. The steel can also be designed with a sacrificial thickness, which will require larger sections and therefore, impact it's cost effectiveness.

Heidelberg Materials have installed sheet piles within a marine environment in recent years to achieve 50 years design life.

Multiple piled locations will be required as a piled wall at the toe of the slope (adjacent to the road) will not provide stability of the slope for its entire length.

Such walls will also interfere with the drainage of groundwater through the slope, potentially causing build up of water (pressure) behind the walls.

A sheet pile could have continuous cathodic protection to prevent rusting, with an ongoing cost. In terms of the solution itself the sheet piles will need to be designed to retain the full active and groundwater pressures, which is not usually as cost-effective as a soil nail option being a passive solution that works with the slope.

Dependent upon the ground then there can be other disadvantages of sheet piling. eg Hard driving, granular materials damaging coatings during driving, cutting off of ground water flow and increasing ground water pressures.

4. Summary

With the slope gradient extending to 16' in places it would need further engineering methods to remain stable other than simply regrading. This could be as minimal as installing geogrid reinforcement to counterfort trenches or terracing with new retaining walls which is all likely to impact the accessibility of the bank and restrict being an inclusive area.

It is feasible to suggest that multiple rows of intermediate sheet pile walls will cost considerately more than a series of soil nails.

Soil nailing is the standard approach for slope stabilisation works while sheet piles are more often used for constructing retaining structures.

Soil nails are an accepted solution for slope stabilisation and can have double corrosion protection designed to achieve 100-year design life, or stainless steel nails and components in exceptional circumstances, while sheet piles without additional measures, typically, continuous cathodic protection will rust overtime.

The slope appears to be moving partially due to increasing groundwater pressures from the existing drainage failing. A soil nailed solution including the installation of sub horizontal drains would mitigate this and still be cost effective

In terms of installation the soil nails require smaller rigs, which have a smaller impact to the slope and require smaller working platforms improving the cost-effectiveness of the solution.

5. Conclusion

Referencing all the above points with the 3 quoted documents and Swanage Town Council wishes for continued future use of the area Soil Nailing is our recommended approach.