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As the desire of legislatures of states in the northern part of the U.S. require local utility providers to make renewable energy a larger part of their electricity generation facility portfolios, more solar power projects will be developed where there is a potential for frost heave to occur. The traditional approach to account for frost heave loads on foundation elements has been to use helical

piles, however, these piles are many times more expensive in both material costs and installation compared with driven W-section piles. As the margins to develop solar projects has become tighter, innovation on how to account for actual frost heave forces and mitigation of said forces have been required.

Summary of Issues:

- Solar projects are being developed in areas of the country where the ground freezes
- Frozen ground along with a shallow groundwater table can produce frost heave (ice jacking) of shallow foundation elements
- Margins on solar development continue to get tighter which leads to the need for innovation in assessment and mitigation or frost heave forces.
- Current rules of thumb for pile embedment depths are generally without engineering support

Innovation in geotechnical exploration:

- Preliminary assessment of potential sites using existing public data and Terracon proprietary subsurface information
- Supplemental exploration to confirm the frost susceptibility of the subsurface soils

Solutions:

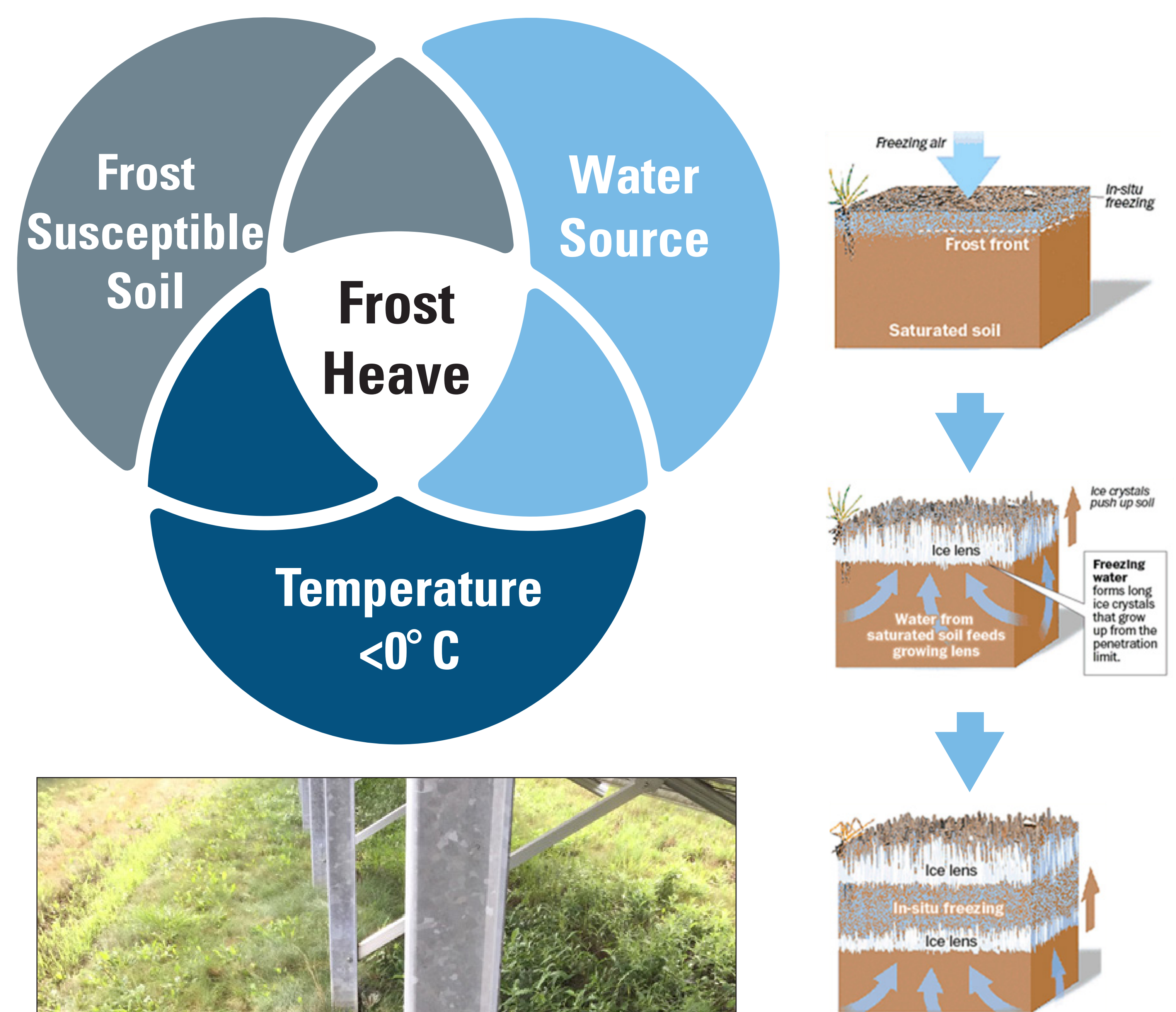
- Evaluation of adfreeze values for different soil types
- Evaluation of frost depth

Innovation in mitigation of frost heave forces on piles:

- Isolate high adfreeze soils from contact with pile
- Use engineering principals to design embedment depts to withstand frost heave forces

Conclusion:

- Site specific soils information has the potential to save \$M in pile material and installation costs
- Site specific soils information together with engineering evaluation can turn a project from non-viable to viable
- Site specific soils information together with engineering analyses may reduce loads on piles by reducing adfreeze values or reducing frost depths
- Reduction of adfreeze soils in contact with pile will reduce frost heave forces on pile



◀ Example of pile having been uplifted due to frost heave. This pile is slowly being "ice jacked" out of the ground.



▲ PVC sleeve filled with pea gravel. PVC with pea gravel isolation of pile from adfreeze soil in frost zone.