EarthShield: Concealed Earthing for Theft-Resilient Pole-Top Assets

INTSA Application

© Vector Limited 2026

Contents

1. Introduction & Context 3
2. Project Specific Information 5
   - 2.1 Project Details 5
   - 2.2 Purpose 5
   - 2.3 Project Scope and delivery flow 6
   - 2.4 Forecast costs 7
   - 2.5 Vector INTSA Financial Summary 8
   - 2.6 Project Benefits 8
   - 2.7 Impact on DPP4 SAIDI / SAIFI 9
   - 2.8 Collaboration 9
     - 2.8.1 Learning Dissemination 9
     - 2.8.2 Project Partners 9
3. Eligibility 10
4. Additional Information 11
   - 4.1 Building on Prior Learning 11
   - 4.2 Replicable in NZ 11

1. Introduction & Context

EarthShield responds to a clear and growing network risk: visible copper earth conductors can be removed quickly, yet their loss creates immediate safety, reliability and cost consequences. This section establishes the scale of the problem, Vector's continuing safety duty and the opportunity to address the root cause through a concealed-earthing design.

Why action is urgent. Copper theft from network earthing is now a material public-safety and reliability problem, not a minor asset-loss issue. Internal public-safety reporting recorded **587 stolen-earth events in the 12 months to 30 June 2026**. A missing earth is treated as a P0 defect requiring immediate reactive replacement, and the current average reinstatement cost is approximately **NZ$1,000 per affected site**. The scrap return is small relative to the response cost, but indicative Auckland prices of NZ$12–14/kg for bare bright copper sustain the incentive to target visible conductors.

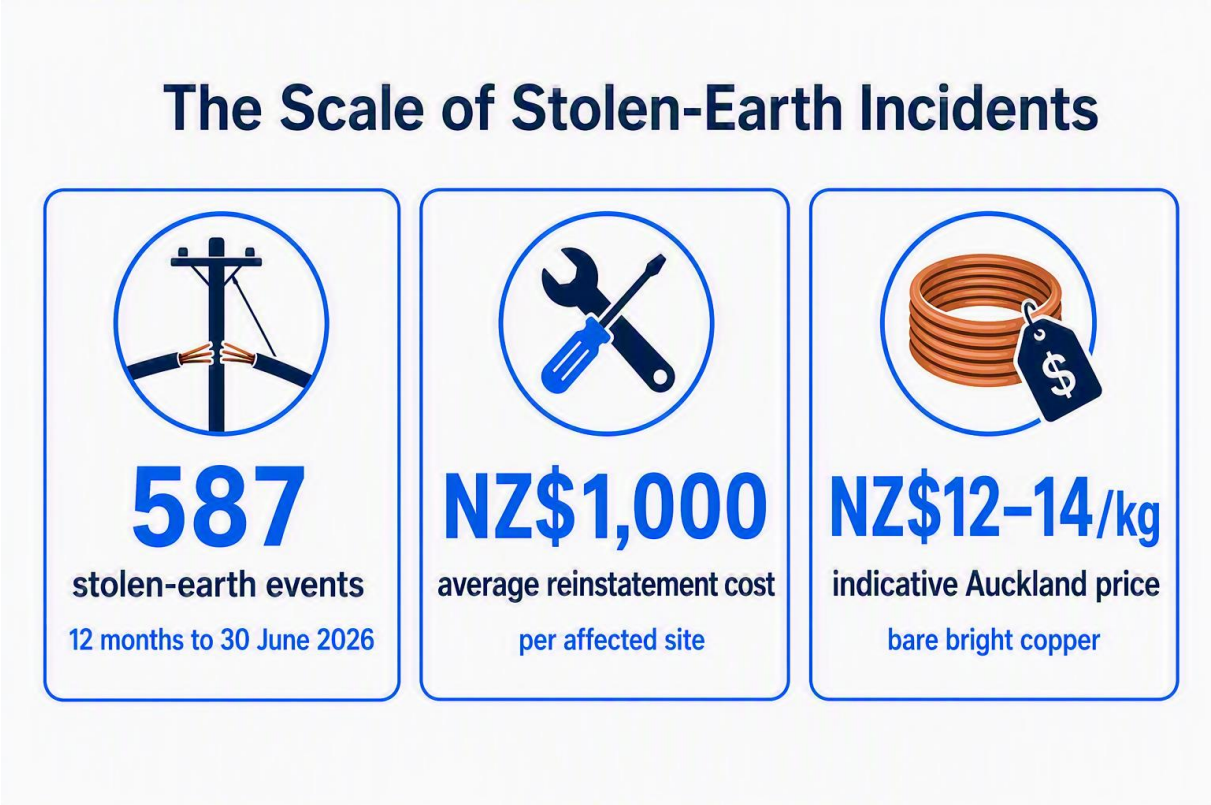


Figure 1: Scale of stolen-earth incidents, reinstatement cost and the economic incentive created by copper value.

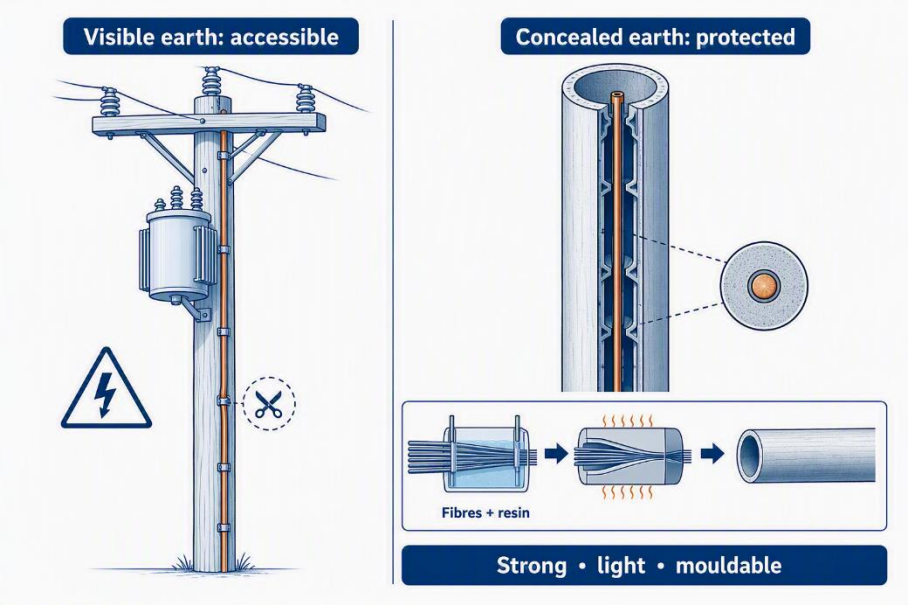
The safety duty remains. Theft does not remove Vector's obligation to keep its works electrically safe. The Electricity (Safety) Regulations 2010 require safe use and operation of works, minimisation of contact with live conductive parts, safe systems of supply and protection against fault currents. Cutting an earth exposes the offender to electric shock, burns and fall hazards, can leave unsafe conditions for the public and responders, and may force equipment isolation or an outage until the asset is inspected and made safe. As electrification increases reliance on electricity for transport, heating, commerce and essential services, the consequence of preventable loss of supply grows.



Figure 2: Six field examples of stolen or damaged external earths, showing cut conductors, empty conduits and exposed terminations that require an immediate make-safe response.

EarthShield brings this pressing operational problem together with a technology capable of removing the theft opportunity. Fibre-reinforced polymer poles combine continuous reinforcing fibres with liquid resin to form a strong, lightweight, durable and hollow structure. Unlike solid wood or concrete, the pole can be engineered so the earth runs through its centre while retaining accessible test points. The project will prove a common design across eight pole-top transformers and six overhead switches, then determine whether it can be standardised for Vector and other EDBs. Section 2 sets out how that concept will be designed, delivered, tested and evaluated.

INTSA funding allows Vector to test a targeted, lower-cost design response as opposed to OIP expenditure to more extensive alternatives. Converting existing pole-top transformers and switches to ground-mounted assets would require new sites, foundations, secure enclosures, underground cable connections, civil works and consenting, making it a materially more expensive and disruptive intervention that may not be practical at many locations. EarthShield instead seeks to retain the existing overhead asset configuration while removing the accessible copper conductor that creates the theft opportunity. Innovation funding is therefore justified to establish whether this approach can deliver comparable safety and resilience benefits at a lower whole-of-life cost before any wider network investment decision is made.



Vector's normal asset-management programme can replace stolen earths using proven standards, but it cannot justify adopting an unproven concealed-earthing design across the network. The proposed solution requires feasibility assessment, engineering validation, field trials and performance monitoring to confirm its safety, effectiveness, buildability and maintainability before it can become a standard asset-management response.

2. Project Specific Information

2.1 Project Details

Project Title	**EarthShield: Concealed Earthing for Theft-Resilient Pole-Top Assets**		
Project Start	September 2026	**INTSA Funding Sought**	$1,200,00
Project End	June 2027	**Vector Contact**	Jason Gray

2.2 Purpose

- The primary purpose of this project is to test whether redesigning pole-top assets so that earths are concealed or inaccessible can materially reduce copper theft at high-risk locations.
- The project also aims to confirm that this approach can maintain safe earthing performance, support practical installation and maintenance requirements, and be applied consistently across both transformers and overhead switches.
- A further objective is to develop a repeatable standard design that can be used by Vector on similar assets and, if successful, adapted more broadly across the electricity distribution sector.

- The current average cost of replacing stolen earth banks at these sites is approximately $1,000 per site, so the project will also test whether the proposed solution can reduce repeat repair costs and ongoing reactive maintenance.
- Success would include demonstrating that the design reduces theft opportunity, improves safety and reliability outcomes, and provides a practical basis for wider implementation and industry collaboration, including with Essential Energy in Australia.

2.3 Project Scope and delivery flow

Vector proposes to work with Wagners Composite Fibre Technologies (CFT), for reasons outlined in 2.8.2 of this application, to develop a composite pole solution that routes the earths through the centre of the pole so they are inaccessible and less vulnerable to theft. The work will begin with a feasibility assessment to confirm the technical requirements, identify any design constraints, determine how the solution can be applied across both pole-top transformers and overhead switches using a standard configuration, and ensuring the solution is cost efficient. This will be followed by detailed design, including the development of installation requirements, maintenance access arrangements, and testing provisions to ensure the solution remains safe and practical for field use.

In partnership with our field service providers, Vector will review the design to confirm it supports practical construction, safe testing points, and efficient inspection and maintenance once installed. Input from delivery teams will help ensure the solution can be retrofitted where appropriate and deployed consistently at targeted sites. Vector also intends to involve Unison in New Zealand and Essential Energy in Australia in the working group so the final design is informed by broader operational experience and has the potential to support wider industry adoption.

Once the design has been completed and verified, Vector intends to install the solution at selected locations with a known history of copper theft and monitor its performance in service. This monitoring will assess whether the design reduces theft opportunity, maintains safe earthing performance, and supports reliable operation of the associated assets. The results will be used to determine whether the approach should be standardised more broadly across similar assets on Vector's network and whether the design could be shared or adapted for use by other electricity distribution businesses.

Figure: Project delivery flow

1. Feasibility Confirm technical requirements, pole strength, constraints, target asset types, and total cost of ownership.	→	**2. Detailed design** Develop concealed earthing, installation, testing, maintenance	→	**3. Field review** Validate buildability, safe testing points, inspection needs, retrofit options, and maintainability.	→	**4. Install trial sites** Deploy at selected high-theft-risk transformer and overhead switch locations.

		access, and standard configuration.				
			↓			
7. Standardise or adapt Decide whether to adopt more broadly across Vector and share with other EDBs.	←	**6. Closeout report** Document findings, lessons, effectiveness, and recommended next steps.	←	**5. Monitor performance** Assess theft reduction, safe earthing performance, reliability, and maintenance practicality.	←	**Installed solution** Concealed earths routed through composite pole and ready for in-service assessment.

Title		Milestones/Deliverables
Feasibility Complete	*30 October 2026*	Ensure the standard poles supplied have the required strength to enable poletop equipment to be mounted.
Design	*30 November 2026*	In consultation with Maintenance Contractors and Suppliers we will standardise the design ensuring safety, buildability, and maintainability is addressed through the design stage.
Installation	*30 March 2027*	Various installation sites on both the Unison and Vector networks carried out
Monitoring Report and Close	*1 April – 30 June 2027*	Sites monitored for minimum three months with a closeout report drafted and findings presented.

2.4 Forecast costs

This project is seeking 75% INTSA funding to support the feasibility assessment, detailed design, testing, installation, and evaluation of a concealed-earthing solution for pole-top transformers and overhead switches at sites with a high risk of copper theft.

Vector expects this project to have a timeline of up to 24 months in line with the milestone dates provided above.

The cost allocation per financial year has been provided in the table below.

Annual Forecast Costs

FY27: $1,200,000 (capex)	To fund feasibility, detailed design, stakeholder input, and the initial installation of concealed-earthing solutions on targeted pole-top assets.

2.5 Vector INTSA Financial Summary

The proposed concealed-earthing design is a novel and unproven approach within the electricity distribution sector. While the project addresses a clear operational problem, the technical effectiveness, practicality of installation, maintenance requirements, and broader applicability of the design are still uncertain and need to be demonstrated in service. The project is therefore outside Vector's standard investment priorities because the benefits are not yet sufficiently certain to justify full funding through business-as-usual expenditure. INTSA support is needed to enable Vector to test the design, assess whether it materially reduces copper theft while maintaining safe earthing performance, and determine whether the approach can be standardised more broadly across the network and shared with other EDBs.

Financial summary	Collaborative Allowance	Vector Allowance	Value ($)
DPP4 Decision	$7,100,000	$21,300,000	$28,400,000
Applications previously approved	$2,237,000		$6,532,000
Applications Pending Decision	NA	NA	**0**
This application	$1,200,000	0	$1,200,000
Remaining Allowance	$3.663.000	$21,300,000	**$20,668,000**

2.6 Project Benefits

This project will generate new learning about whether concealed-earthing designs can materially reduce copper theft risk while preserving safe earthing performance, maintainability, and practical field deployment. It will also provide insight into the use of composite pole solutions, retrofit applicability, and how a standard design could be developed for broader use across electricity distribution networks. If successful, the findings could inform future design standards and asset protection strategies for theft-prone overhead equipment.

This project will deliver a repeatable standard design for concealing or protecting earthing on pole-top transformers and overhead switches, with provision for both new installations and retrofit application at sites with a known risk of copper theft.

Key Benefits for Consumers:

- Improved public safety by reducing the risk of exposed or compromised equipment caused by stolen earths.
- Better network reliability and fewer unplanned outages by maintaining the integrity of earthing systems on transformers and overhead switches.
- Faster restoration and less repeat disruption for customers in theft-prone areas, as assets are less likely to require repeated repairs.
- Lower long-term operating and replacement costs, helping support more efficient delivery of distribution services for consumers.

Key Benefits for Vector:

- Reduced repeat repair and replacement costs by preventing theft of exposed earths from pole-top assets.
- Improved safety outcomes for field crews and contractors by lowering the likelihood of working on assets with compromised earthing.
- Better network performance and asset reliability through maintaining the integrity of earthing systems on transformers and overhead switches.
- A scalable standard design that can be applied across Vector's network and potentially adopted by other EDBs.
- Stronger operational efficiency by reducing reactive maintenance, repeat site visits, and service restoration activities in theft-prone locations.

2.7 Impact on DPP4 SAIDI / SAIFI

Short planned outages will be required for the installation of the new poles and poletop equipment these will be managed through Vector's planned allowance. Poletop transformers generally have smaller numbers of customers so the impact is smaller.

If this solution is rolled out at scale it is expected that there would be a SAIDI/SAIFI benefit with less customer impacted through reduced outages for repair, in multiple cases this is a repeated scenario.

2.8 Collaboration

The project is proposed as a formal collaborative project for INTSA purposes, Vector intends to involve Unison in New Zealand and Essential Energy in Australia in the working group to help inform the design and support broader industry learning.

2.8.1 Learning Dissemination

Vector will be working with Unison on this project and will publish a paper/host a public webinar ideally through ENA on completion of the project providing learnings.

2.8.2 Project Partners

Wagners Composite Fibre Technologies (CFT) has been selected as the project's design, manufacturing and supply partner because it has an established delivery relationship with Vector and demonstrated capability in developing engineered FRP solutions for non-standard network

applications. The partnership extends beyond product supply: Wagners provides structural modelling, full-scale cantilever testing, connection and washer pull-through testing, stay-wire validation, manufacturing control and technical support. This evidence-based approach gives Vector confidence that new configurations can be developed, tested and translated into practical field installations.

Kawau Island demonstrated Wagners' ability to support a highly bespoke structural solution. Vector's design used 15-metre Wagners FRP poles, composite crossarms and an engineered stay arrangement for an approximately 746-metre harbour span. The solution required detailed assessment of pole bending, deflection, conductor and stay loads, and local connection capacity. Wagners supported the design with finite-element and structural modelling, full-scale pole testing, bolt-connection testing, washer pull-through testing and stay-wire testing. The lightweight composite system also enabled helicopter installation where terrain, vegetation and lack of vehicle access made conventional heavy structures impractical.

Dome Valley showed that the partnership can convert material advantages into safer and more efficient construction. Thirteen fully composite H-frame structures combined Wagners FRP poles and crossarms in rugged, difficult-to-access terrain. Factory pre-drilling and ground-level pre-assembly enabled complete structures to be flown into position within helicopter lifting constraints, reducing lifts, field adjustments and work at height. The integrated system was designed for an 80-year life and is believed to be the first FRP pole-and-crossarm H-frame deployment of its kind across Australia and New Zealand.

These projects establish Wagners as a trusted innovation partner for EarthShield. They demonstrate a repeatable way of working: Vector defines the network problem and operating requirements; Wagners converts those requirements into a manufacturable composite configuration; both parties validate structural performance and connection details; and field teams confirm buildability, installation and maintenance needs. EarthShield will apply the same proven collaboration model to a new challenge—using the hollow, configurable form of the composite pole to route the earth conductor internally while retaining safe test access and developing a standard solution for pole-top transformers and overhead switches.

3. Eligibility

Criterion 1 – Related to the supply of electricity	The project directly relates to electricity distribution services because it focuses on pole-top transformers and overhead switches used on Vector's network. It is intended to improve the safety, reliability, and maintainability of these distribution assets by reducing copper theft from exposed earthing systems.
Criterion 2 – Promotes the Part 4 Purpose	The project promotes the Part 4 purpose of the Act by supporting the long-term benefit of consumers through improved safety, more reliable operation of distribution assets, and reduced repeat repair and maintenance costs. If successful, it may also provide a repeatable standard design that improves efficiency and supports wider sector learning.

Criterion 3	**The benefits are sufficiently uncertain that Vector would not carry out the project without INTSA funding** The proposed concealed-earthing design is novel and unproven in this context. While the project addresses a clear operational problem, the effectiveness of the design, its practical installation and maintenance requirements, and its broader applicability across the network remain uncertain and need to be demonstrated in service. **The project is unlikely to deliver financial gains within the next five years** The project is primarily an innovation and learning initiative rather than a conventional business-as-usual investment. Although it may reduce repeat repair costs over time, the financial benefits are uncertain, may not be realised within five disclosure years, and are not yet sufficiently established to justify full funding outside the INTSA framework. **Vector application** Accordingly, the project meets clause 6(c)(ii), and may also meet clause 6(c)(i), because INTSA funding is needed to test and evaluate the design before any wider rollout could be justified.

4. Additional Information

4.1 Building on Prior Learning

Vector is aware of ongoing industry efforts to manage copper theft and improve the security of exposed network assets, but we are not aware of an established standard design in New Zealand for concealing or protecting earthing on pole-top transformers and overhead switches in the manner proposed. This project will build on operational experience with theft-prone sites and field maintenance requirements while testing a new design approach that could provide wider sector value if proven effective.

4.2 Replicable in NZ

If the project is successful, the resulting standard design could be replicated by other New Zealand EDBs facing similar issues with copper theft from pole-top transformers, overhead switches, or other exposed earthing arrangements. The approach may also be adaptable to a broader range of overhead network assets where theft risk and safe earthing performance need to be managed together.