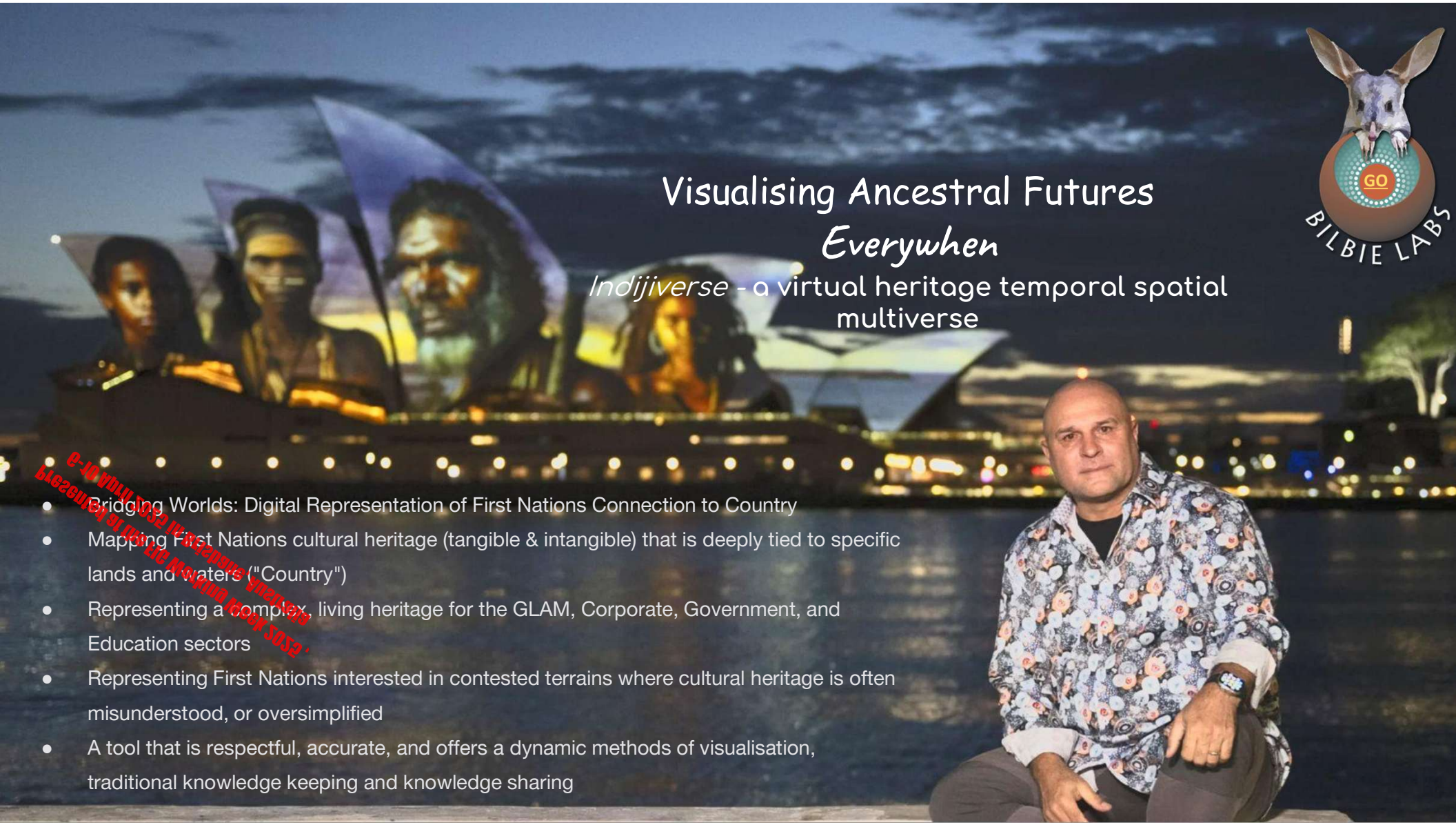
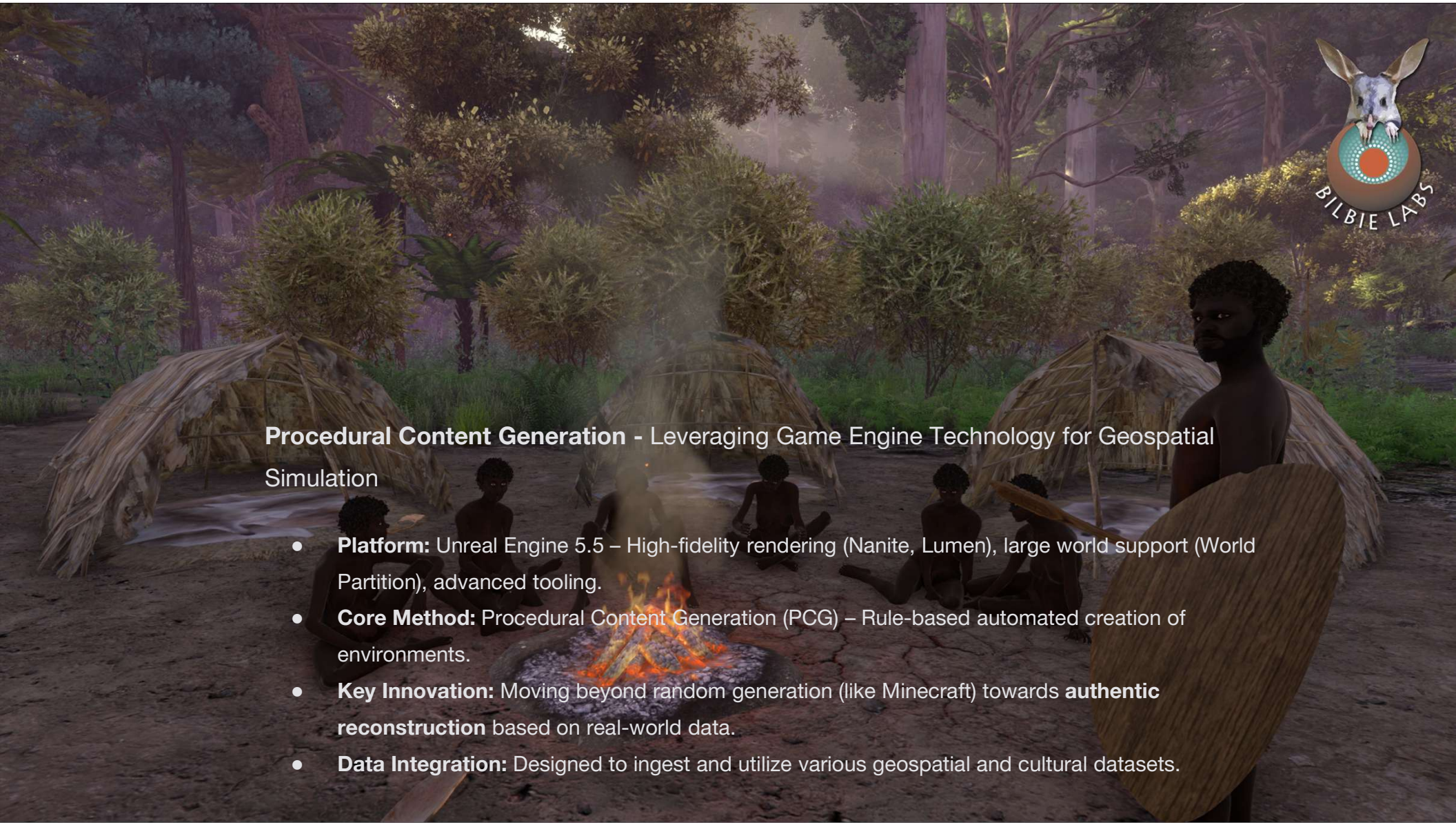


- Bridging Worlds: Digital Representation of First Nations Connection to Country
- Mapping First Nations cultural heritage (tangible & intangible) that is deeply tied to specific lands and waters ("Country")
- Representing a complex, living heritage for the GLAM, Corporate, Government, and Education sectors
- Representing First Nations interested in contested terrains where cultural heritage is often misunderstood, or oversimplified
- A tool that is respectful, accurate, and offers a dynamic methods of visualisation, traditional knowledge keeping and knowledge sharing

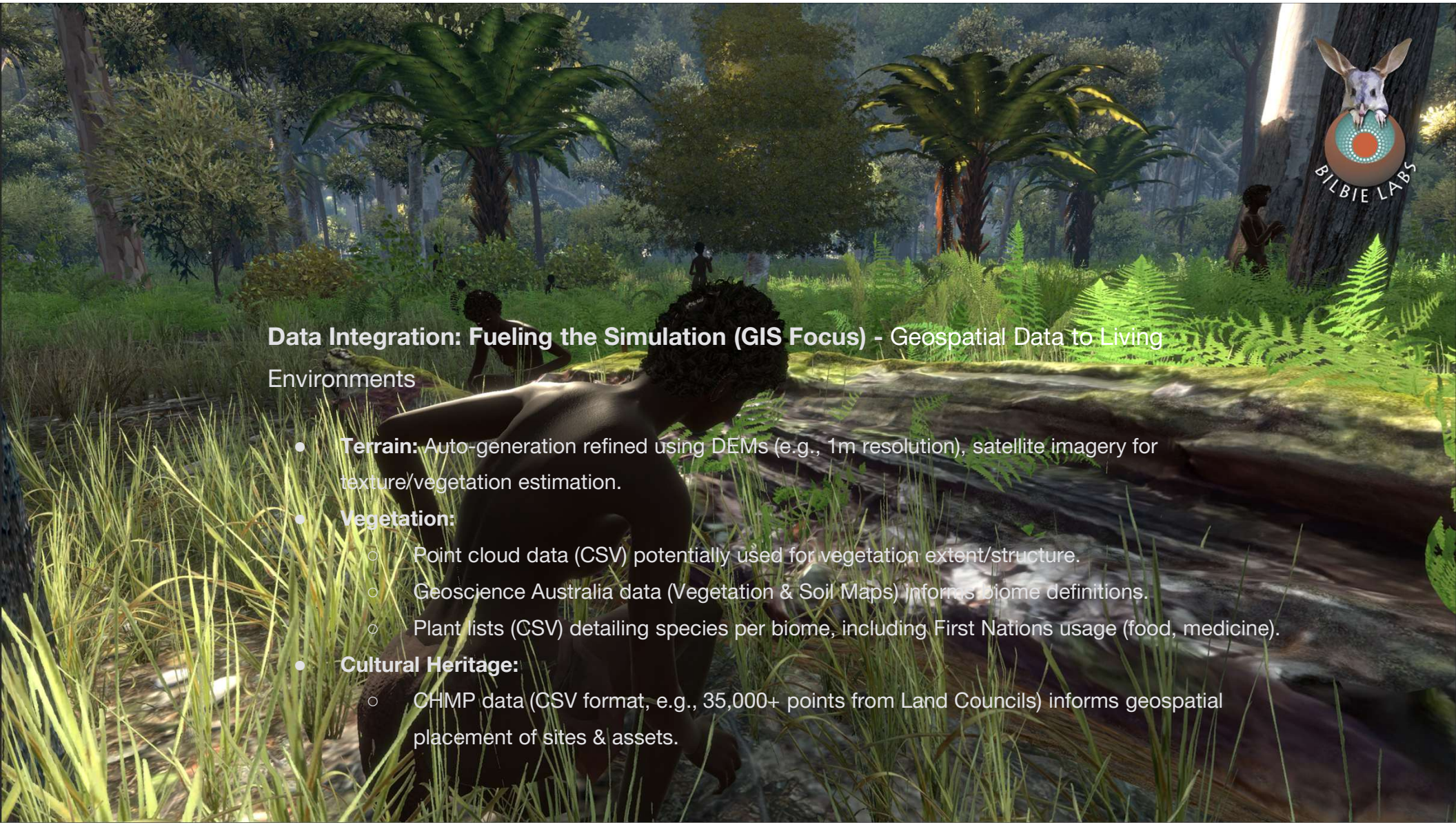
Virtual Placemaking using the Virtual Songlines Digital Twin as a dynamic, georeferenced simulation of country & culture

- **Goal:** Resolve contestation through respectful presentation, production, reconstruction, and promotion of traditional knowledge systems within a geospatial framework.
- **Concept:** A "Digital Twin" simulating specific Australian environments linked to First Nations cultural knowledge.
- **"Everywhen":** Capable of representing different points in time – past, present, potential futures.
- **Foundation:** Built on principles of **deep collaboration and co-design** with First Nations communities & knowledge holder



Procedural Content Generation - Leveraging Game Engine Technology for Geospatial Simulation

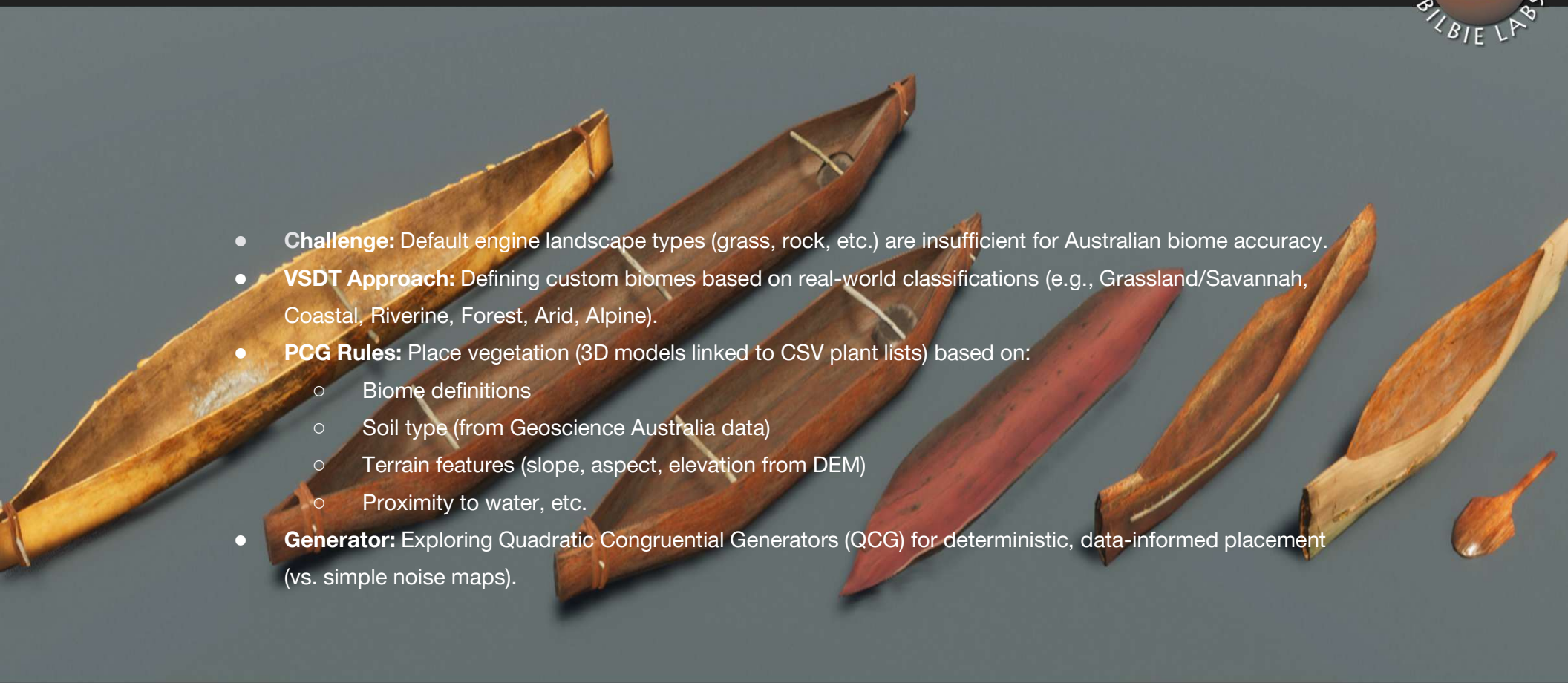
- **Platform:** Unreal Engine 5.5 – High-fidelity rendering (Nanite, Lumen), large world support (World Partition), advanced tooling.
- **Core Method:** Procedural Content Generation (PCG) – Rule-based automated creation of environments.
- **Key Innovation:** Moving beyond random generation (like Minecraft) towards **authentic reconstruction** based on real-world data.
- **Data Integration:** Designed to ingest and utilize various geospatial and cultural datasets.



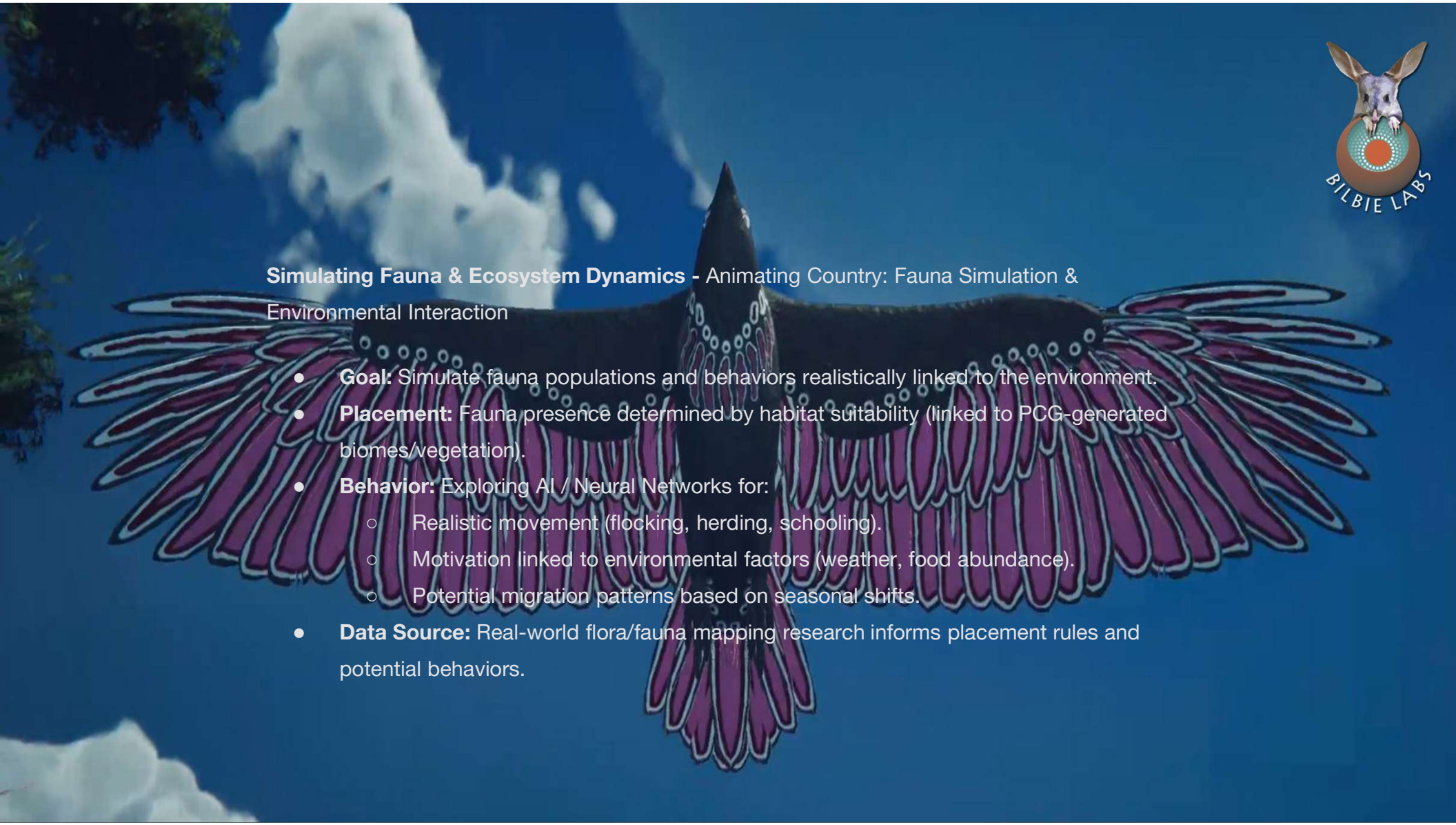
Data Integration: Fueling the Simulation (GIS Focus) - Geospatial Data to Living Environments

- **Terrain:** Auto-generation refined using DEMs (e.g., 1m resolution), satellite imagery for texture/vegetation estimation.
- **Vegetation:**
  - Point cloud data (CSV) potentially used for vegetation extent/structure.
  - Geoscience Australia data (Vegetation & Soil Maps) informs biome definitions.
  - Plant lists (CSV) detailing species per biome, including First Nations usage (food, medicine).
- **Cultural Heritage:**
  - CHMP data (CSV format, e.g., 35,000+ points from Land Councils) informs geospatial placement of sites & assets.

Authentic Biome Reconstruction: Procedural Generation Driven by Ecological & Cultural Data



- **Challenge:** Default engine landscape types (grass, rock, etc.) are insufficient for Australian biome accuracy.
- **VSDT Approach:** Defining custom biomes based on real-world classifications (e.g., Grassland/Savannah, Coastal, Riverine, Forest, Arid, Alpine).
- **PCG Rules:** Place vegetation (3D models linked to CSV plant lists) based on:
    - Biome definitions
    - Soil type (from Geoscience Australia data)
    - Terrain features (slope, aspect, elevation from DEM)
    - Proximity to water, etc.
- **Generator:** Exploring Quadratic Congruential Generators (QCG) for deterministic, data-informed placement (vs. simple noise maps).



Simulating Fauna & Ecosystem Dynamics - Animating Country: Fauna Simulation & Environmental Interaction

- **Goal:** Simulate fauna populations and behaviors realistically linked to the environment.
- **Placement:** Fauna presence determined by habitat suitability (linked to PCG-generated biomes/vegetation).
- **Behavior:** Exploring AI / Neural Networks for:
  - Realistic movement (flocking, herding, schooling).
  - Motivation linked to environmental factors (weather, food abundance).
  - Potential migration patterns based on seasonal shifts.
- **Data Source:** Real-world flora/fauna mapping research informs placement rules and potential behaviors.

Integrating Cultural Heritage & Activity by placemaking and simulation of cultural to reflect its significance

Site Placement: Georeferenced placement of cultural heritage sites (static/dynamic 3D assets) based on CHMP CSV data.

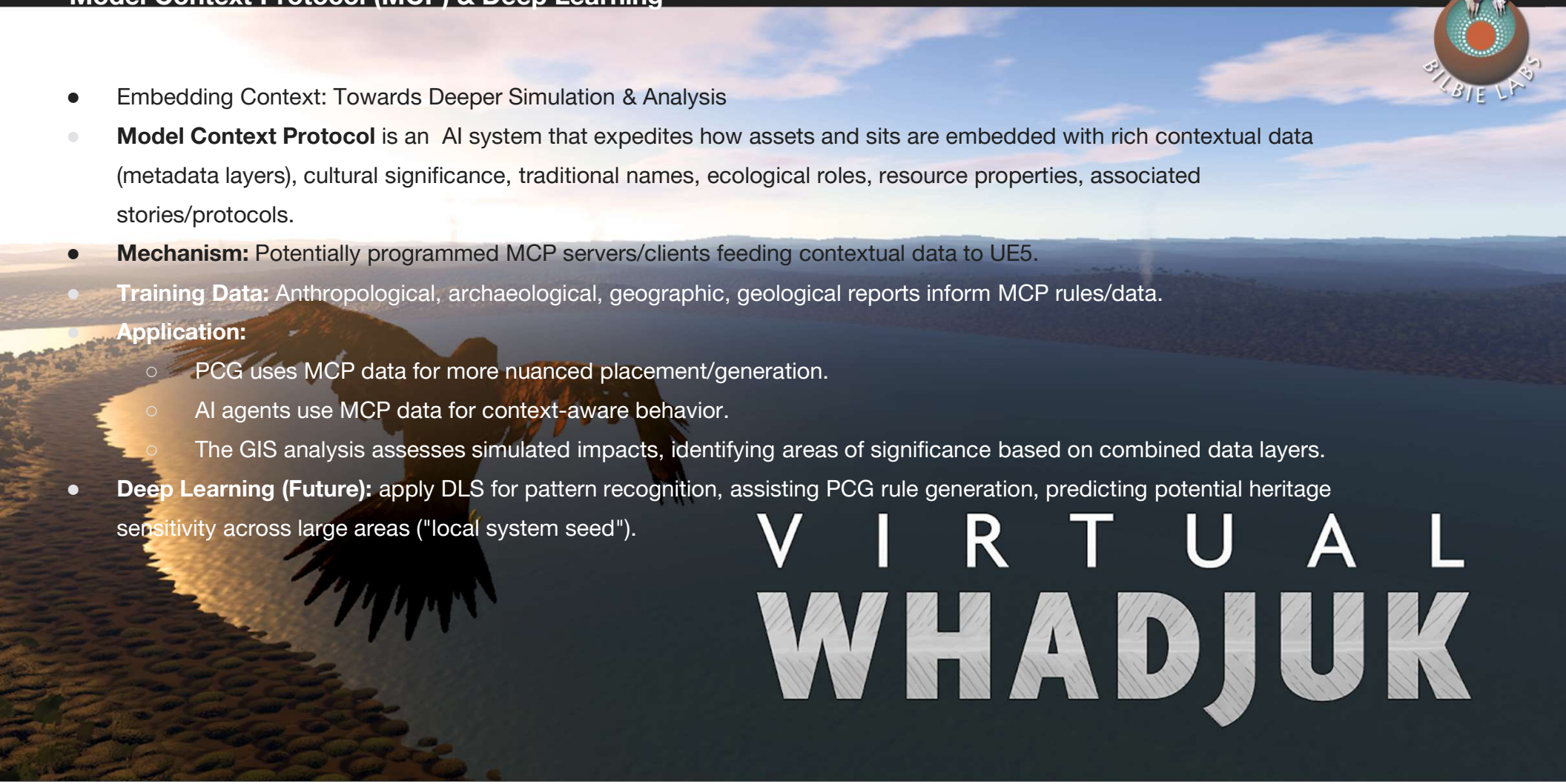
Simulating Activity: Exploring AI Agents guided by a "Cultural Rules Framework":

- NPCs performing culturally relevant actions (resource gathering based on plant knowledge, tool making, shelter construction).
- Activities informed by land use patterns detailed in CHMPs or anthropological data.

PCG for Material Culture: procedurally generating tools, shelters based on locally available resources (placed by biome/resource PCG.

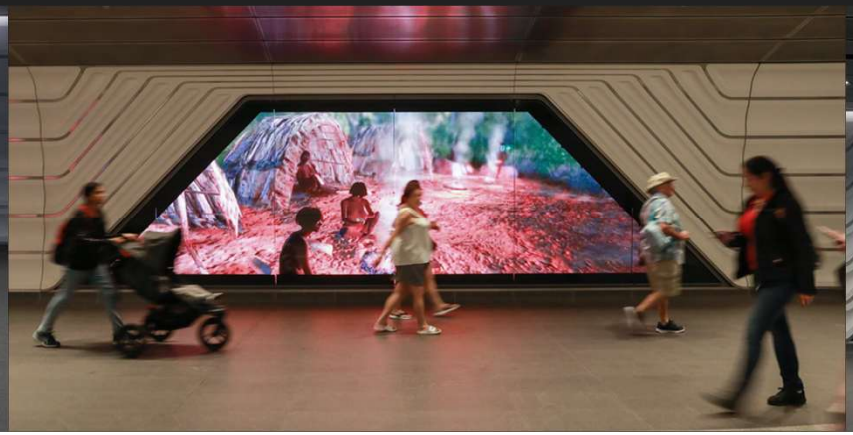
Model Context Protocol (MCP) & Deep Learning

- Embedding Context: Towards Deeper Simulation & Analysis
- **Model Context Protocol** is an AI system that expedites how assets and sits are embedded with rich contextual data (metadata layers), cultural significance, traditional names, ecological roles, resource properties, associated stories/protocols.
- **Mechanism:** Potentially programmed MCP servers/clients feeding contextual data to UE5.
- **Training Data:** Anthropological, archaeological, geographic, geological reports inform MCP rules/data.
- **Application:**
    - PCG uses MCP data for more nuanced placement/generation.
    - AI agents use MCP data for context-aware behavior.
    - The GIS analysis assesses simulated impacts, identifying areas of significance based on combined data layers.
- **Deep Learning (Future):** apply DLS for pattern recognition, assisting PCG rule generation, predicting potential heritage sensitivity across large areas ("local system seed").



Interaction & The Human Element - Engaging with Local Heritage: Interrogating Simulated Environments through Virtual Custodians

- **Multi-Modal Exploration:** User can investigate the environment via various camera modes (1st/3rd person, isometric, plan view, free-form). Fast-travel/query system for focused exploration.
- **Virtual Custodians:**
  - Using Metahumans to represent apical ancestors or knowledge holders (respectfully, with community guidance).
  - Conversational AI (integrating OpenAI/similar LLMs) empowered with authentic backstories and local context.
  - Goal: Allow users to ask questions and receive culturally relevant responses grounded in the simulated environment. (Inspired by UE5 Matrix Demo AI agents).
  - Potential for AI Custodians to demonstrate intelligent land management activities based on cultural responsibilities.


Applications & Potential Impact (GIS Focus) - VSDT: A Tool for Understanding, Planning, and Preservation

- **Cultural Heritage Management:** Visualising CHMP data in context, simulating potential impacts of development, aiding significance assessment (using MCP).
- **Education & Training:** Immersive learning about specific First Nations cultures, Connection to Country, and traditional ecological knowledge.
- **Land Use Planning:** Simulating different land management scenarios and their environmental/cultural implications.
- **Community Engagement:** A tool for First Nations communities to share and preserve knowledge, tell stories, and visualize aspirations for Country.
- **Cross-Sector Collaboration:** Bridging understanding between First Nations communities and GLAM, corporate, government sectors.

Challenges & Ethical Considerations

Navigating Complexity and Responsibility

- **Paramount Importance:** Continuous, deep, and ethical collaboration with specific First Nations communities is non-negotiable. Respecting protocols, IP, and data sovereignty.
- **Data Sensitivity:** Handling sacred/restricted knowledge appropriately. Permissions are key.
- **Technical Complexity:** Integrating diverse datasets, developing sophisticated PCG/AI rules, ensuring performance.
- **Authenticity vs. Abstraction:** Balancing accurate representation with the limitations of simulation.
- **Scalability:** Managing the creation and simulation of numerous distinct cultural landscapes (100 terrains goal).

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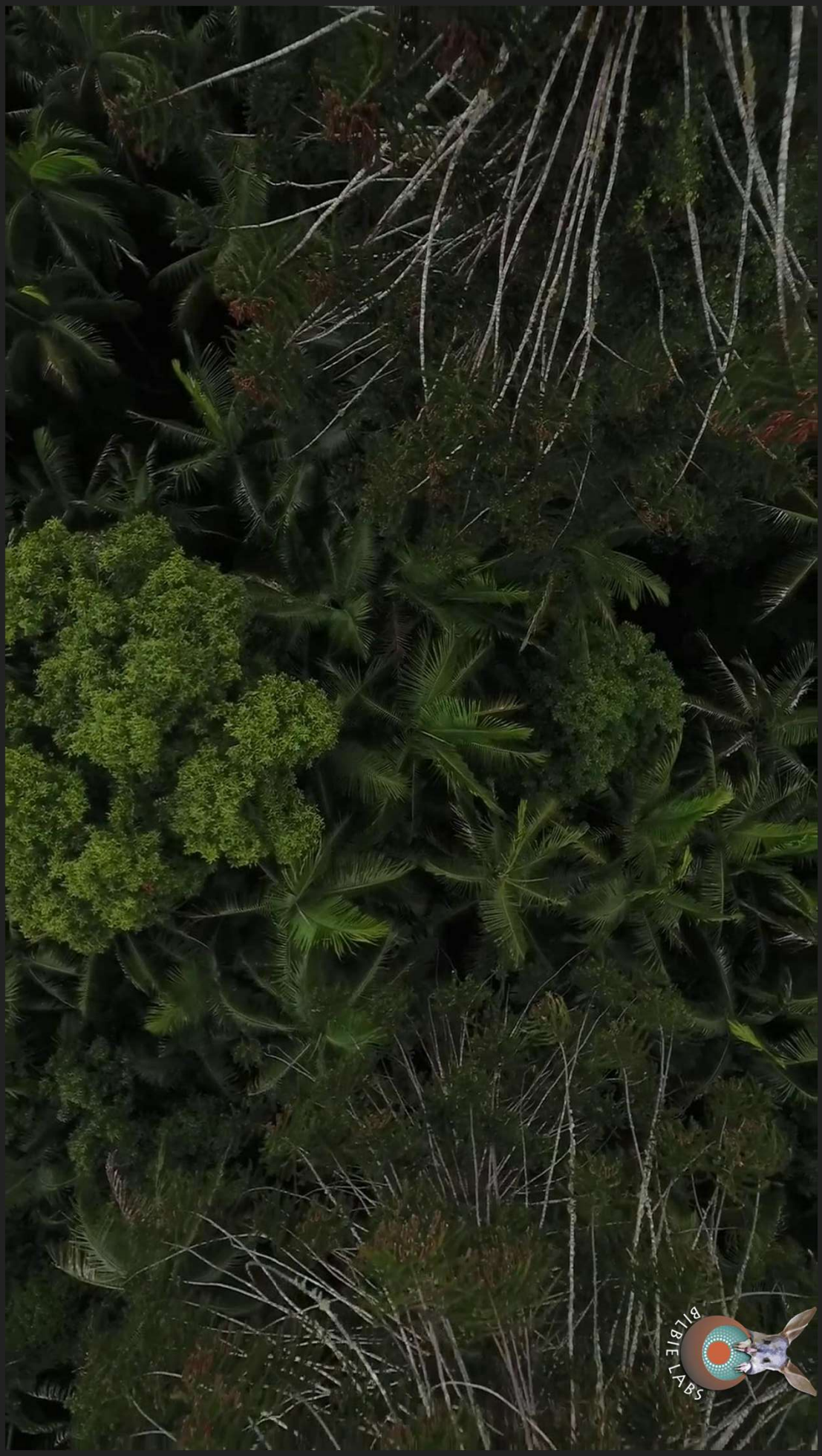

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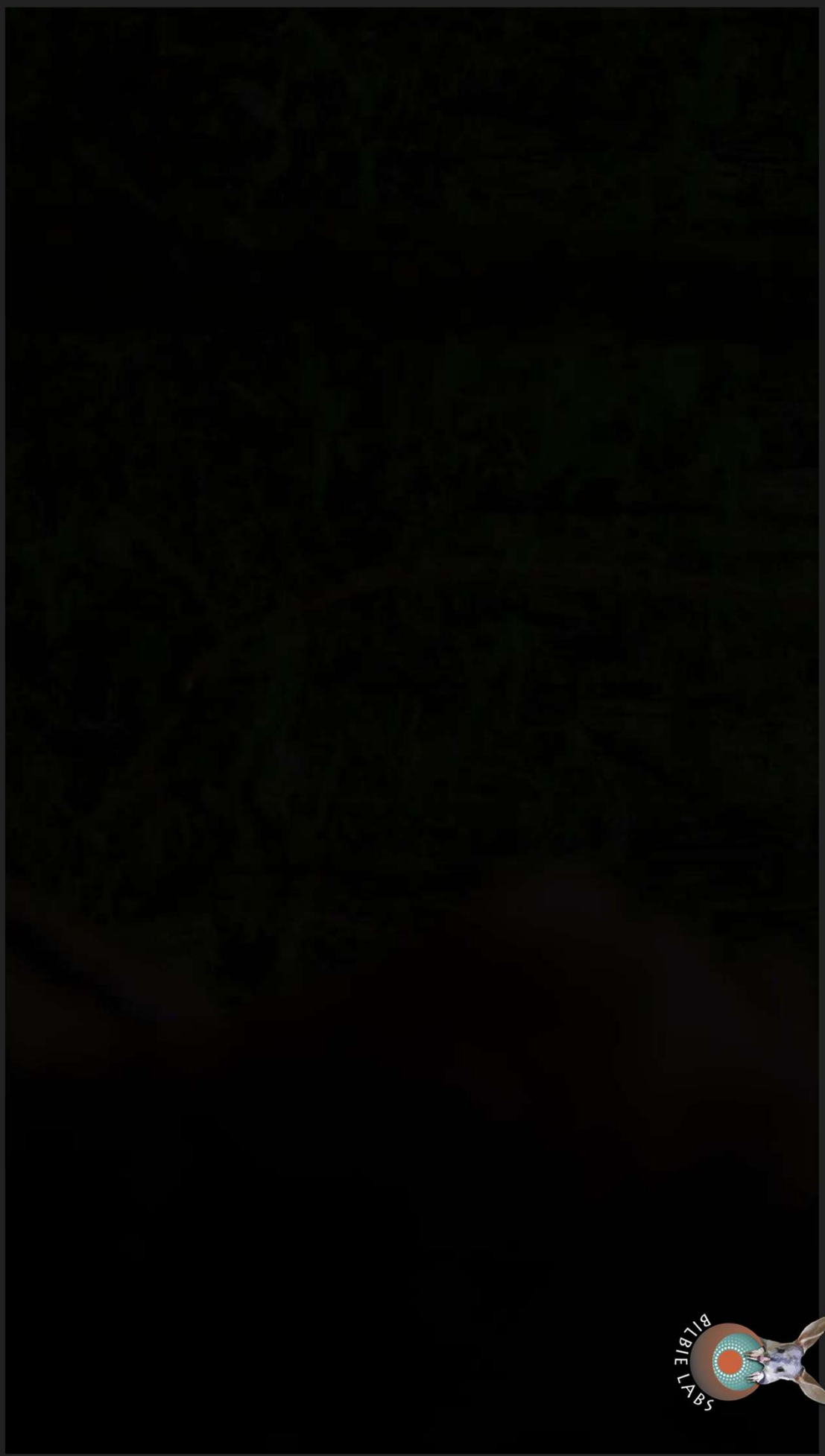

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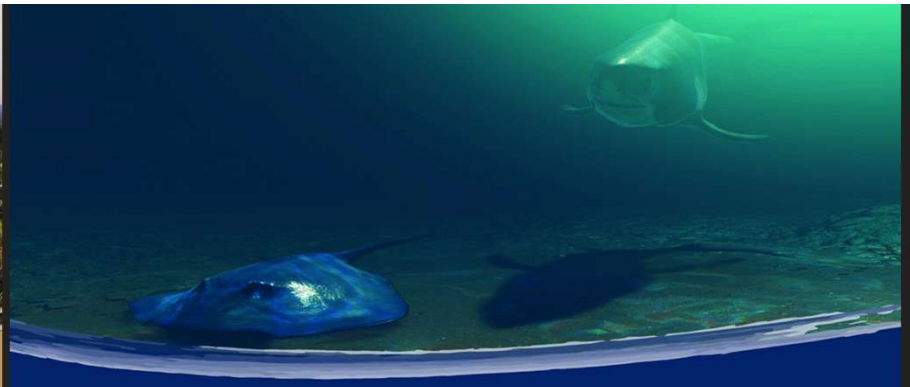

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Q&A: Visualising Ancestral Futures: A Pathway to Understanding

VSDT leverages cutting-edge geospatial and simulation technology (UE5.5, PCG, AI, MCP) to create dynamic, georeferenced digital twins of First Nations Country.

Aims for authentic, respectful representation driven by real-world data and deep community collaboration.

Potential applications span heritage management, education, planning, and cultural revitalisation.

Next Steps: Ongoing development, further community consultation, refining PCG/MCP/AI systems, expanding terrain library and seeking collaboration, data partners, feedback from the GIS community.

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