



Company Announcement, November 9<sup>th</sup>, 2015

## **Tetra Tech Proteus Wins International Award for Innovative Work on Kvanefjeld Project**

Greenland Minerals and Energy Limited ('GMEL' of 'the Company') is pleased to advise that Tetra Tech Proteus has won the 'Bentley Be Inspired' award for Innovation in Mining 2015, for work conducted on the Kvanefjeld Project.

The award was presented on November 4<sup>th</sup> in London at the Bentley Awards ceremony, following presentations by finalists, and recognises the innovative three-dimensional modelling work conducted by Tetra Tech Proteus for the Kvanefjeld Feasibility Study (see the Tetra Tech Proteus Kvanefjeld presentation attached).

The 'Bentley Be Inspired' awards have global scope, with categories that cover all types of infrastructure projects. Tetra Tech Proteus was the main contributing independent consultant for the Kvanefjeld Feasibility Study. Tetra Tech Proteus are a global engineering company based in North America that have extensive experience in developing mining and infrastructure projects in cold climate environments.

Bentley is a global leader in the provision of design software for architects, engineers, geospatial and constructors around the world. It has comprehensive software solutions for mine and infrastructure development.

GMEL is extremely pleased to have key aspects of the Kvanefjeld feasibility program recognised in such a prestigious forum. The Company would like to thank Tetra Tech Proteus for the high level of engineering skill contributed to the Kvanefjeld Project, and acknowledge Bentley for the award.

The Kvanefjeld Feasibility Study, completed in Q2 2015, forms a key part of the mining license application for the Kvanefjeld Project.

Further information is available on twitter via both the Bentley Systems site and the Tetra Tech site.



**TETRA TECH**



-ENDS-



## **ABOUT GREENLAND MINERALS AND ENERGY LTD.**

Greenland Minerals and Energy Ltd (ASX: GGG) is an exploration and development company focused on developing high-quality mineral projects in Greenland. The Company's flagship project is the Kvanefjeld multi-element deposit (rare earth elements, uranium, zinc), that stands to be the world's premier specialty metals project. A pre-feasibility study was finalised in 2012, and a comprehensive feasibility study was completed in May, 2015. The studies demonstrate the potential for a large-scale, long-life, cost-competitive, multi-element mining operation. Through 2015, GMEL is focussed on completing a mining license application in order to commence project permitting, in parallel to advancing commercial discussions with development partners. For further information on Greenland Minerals and Energy visit <http://www.ggg.gl> or contact:

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Greenland Minerals and Energy Ltd will continue to advance the Kvanefjeld project in a manner that is in accord with both Greenlandic Government and local community expectations, and looks forward to being part of continued stakeholder discussions on the social and economic benefits associated with the development of the Kvanefjeld Project.

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### **Competent Person Statement – Mineral Resources and Ore Reserves**

*The information in this report that relates to Mineral Resources is based on information compiled by Mr Robin Simpson, a Competent Person who is a Member of the Australian Institute of Geoscientists. Mr Simpson is employed by SRK Consulting (UK) Ltd ("SRK"), and was engaged by Greenland Minerals and Energy Ltd on the basis of SRK's normal professional daily rates. SRK has no beneficial interest in the outcome of the technical assessment being capable of affecting its independence. Mr Simpson has sufficient experience that is relevant to the style of mineralisation and type of deposit under consideration and to the activity being undertaken to qualify as a Competent Person as defined in the 2012 Edition of the 'Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves'. Robin Simpson consents to the inclusion in the report of the matters based on his information in the form and context in which it appears.*

*The information in the statement that relates to the Ore Reserves Estimate is based on work completed or accepted by Mr Damien Krebs of Greenland Minerals and Energy Ltd and Mr Scott McEwing of SRK Consulting (Australasia) Pty Ltd.*

*Damien Krebs is a Member of The Australasian Institute of Mining and Metallurgy and has sufficient experience that is relevant to the type of metallurgy and scale of project under consideration, and to the activity he is undertaking, to qualify as Competent Persons in terms of The Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves (JORC Code, 2012 edition). The Competent Persons consent to the inclusion of such information in this report in the form and context in which it appears.*

*Scott McEwing is a Fellow and Chartered Professional of The Australasian Institute of Mining and Metallurgy and has sufficient experience that is relevant to the style of mineralisation and type of deposit under consideration, and to the activity he is undertaking, to qualify as Competent Persons in terms of The Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves (JORC Code, 2012 edition). The Competent Persons consent to the inclusion of such information in this report in the form and context in which it appears.*

The mineral resource estimate for the Kvanefjeld Project was updated and released in a Company Announcement on February 12<sup>th</sup>, 2015. The ore reserve estimate was released in a Company Announcement on June 3<sup>rd</sup>, 2015. There have been no material changes to the resource estimate, or ore reserve since the release of these announcements.

# Innovation in Mining

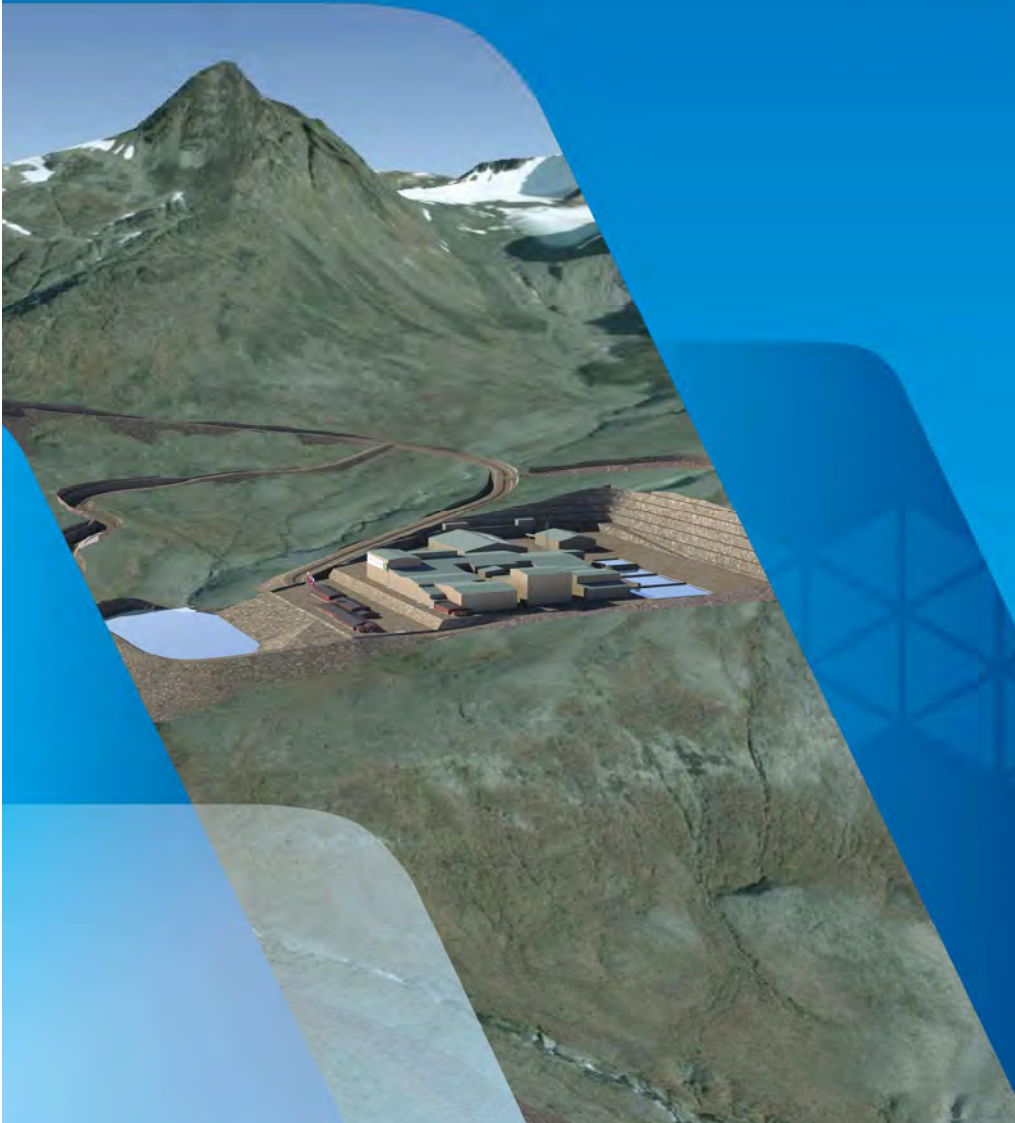
## Kvanefjeld Rare Earths Project

Stewart Phillis

November 3, 2015  
11.30-12.00am GMT



TETRA TECH PROTEUS



# TETRA TECH PROTEUS



A champion  
Australian  
team

# TETRA TECH PROTEUS



Another  
champion  
Australian  
team!

# TETRA TECH PROTEUS

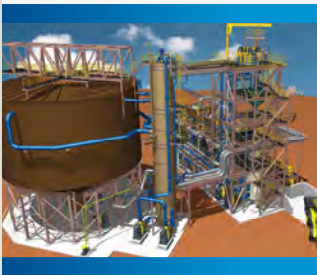


- Tetra Tech Proteus  
Established 1986
- Used Bentley software for  
25 years
- Efficient workflow  
integrated with Bentley  
products
- 18 years of 3D modelling
- Extensive Model catalogue

# OUR SERVICES

## FEASIBILITY STUDIES

- Scoping / Identification
- Pre-Feasibility / Selection
- Definitive Feasibility / Definition



## EPCM & EPC DELIVERY

- Planning & Implementation
- HSEC Management
- Risk Management
- HR/IR Management
- Scope, Cost, Time Management
- Project Progress Reporting
- Project Close Out



## PROCESS & ENGINEERING DESIGN

- Process - metallurgical & chemical
- Mechanical / Piping Civil / Structural
- Electrical / Instrumentation
- Controls



## PROCUREMENT & CONTROLS

- Supply & Construction Contracts
- Equipment & Bulk Material Control
- Off site QA/QC
- Scope, Cost & Schedule Management
- Key System Reports



## CONSTRUCTION / COMMISSIONING

- Construction Management
- HSEC Management
- Site Establishment
- QA/QC incl. MDR Management
- Construction Reporting & Close out
- Commissioning & Handover



# TETRA TECH

**\$2.5BN REVENUE**

**13,000 EMPLOYEES WORLDWIDE**

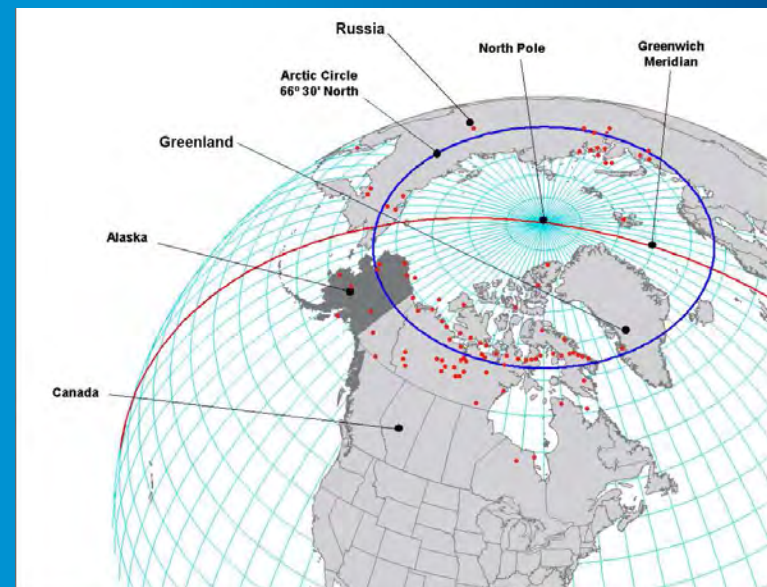
## MARKETS SERVICED

- Water
- Environment
- Mining
- Energy

## THE ARCTIC CHALLENGE

- Remote locations
- Limited access
- Extreme climate
- Fragile and complex environment
- Traditional use and land ownership
- Effects of ice and the impact of building on frozen ground

- Arctic Engineering since 1968
- Maintained a staff of more than 20 employees dedicated to arctic engineering for 35 years
- Over 65 professionals currently engaged in Arctic Engineering





# THE KVANEFJELD RARE EARTHS PROJECT



Greenland Minerals & Energy (GMEL)

## FEASIBILITY STUDY

- Est. US\$1.36Bn
- Mine site
- Concentrator
- Refinery
- Access road
- Tailings Storage Facility

# LARGE RESOURCE

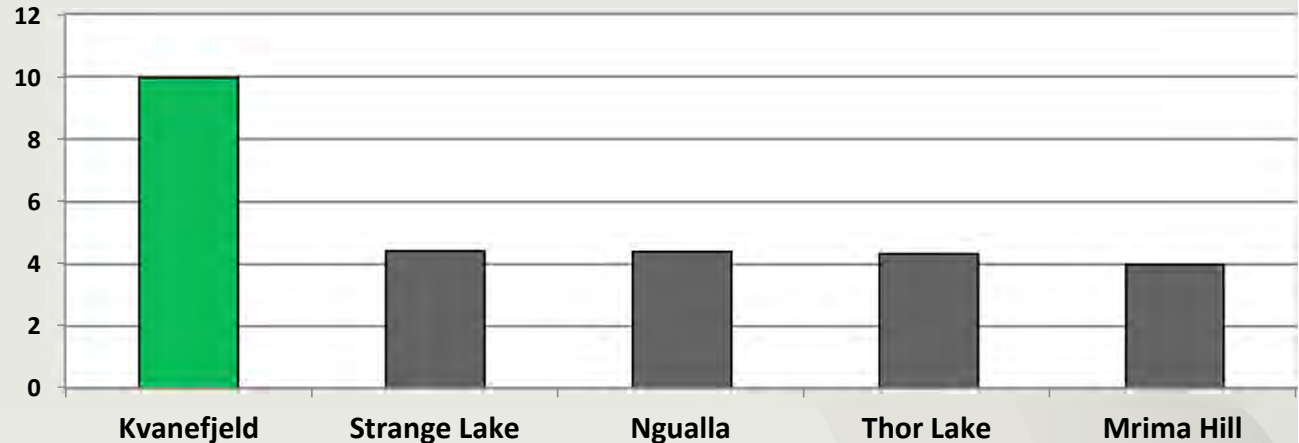


**Greenland Minerals & Energy (GMEL)**

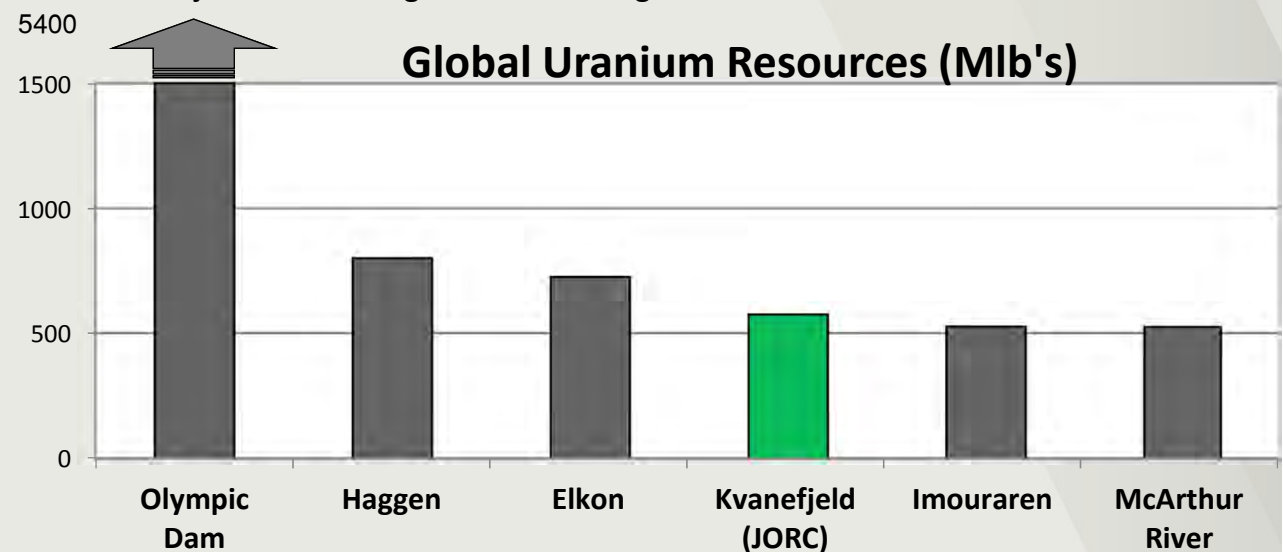
## GMEL'S RARE EARTH AND URANIUM DEPOSIT

- Initial 108Mt ore reserve for 37 year mine life
- Twice the resource of the nearest emerging rare earths producers
- Significant Uranium deposit

**Rare Earth Oxide Resource (Mt)**



**Global Uranium Resources (Mlb's)**



# BENEFITS OF THE PROJECT

## RARE EARTH ELEMENTS

- World's strongest magnets
- Rechargeable batteries
- Catalysts
- Advanced Electronics



## REDUCED EMISSIONS

- Nuclear power from Uranium – zero greenhouse gas emission



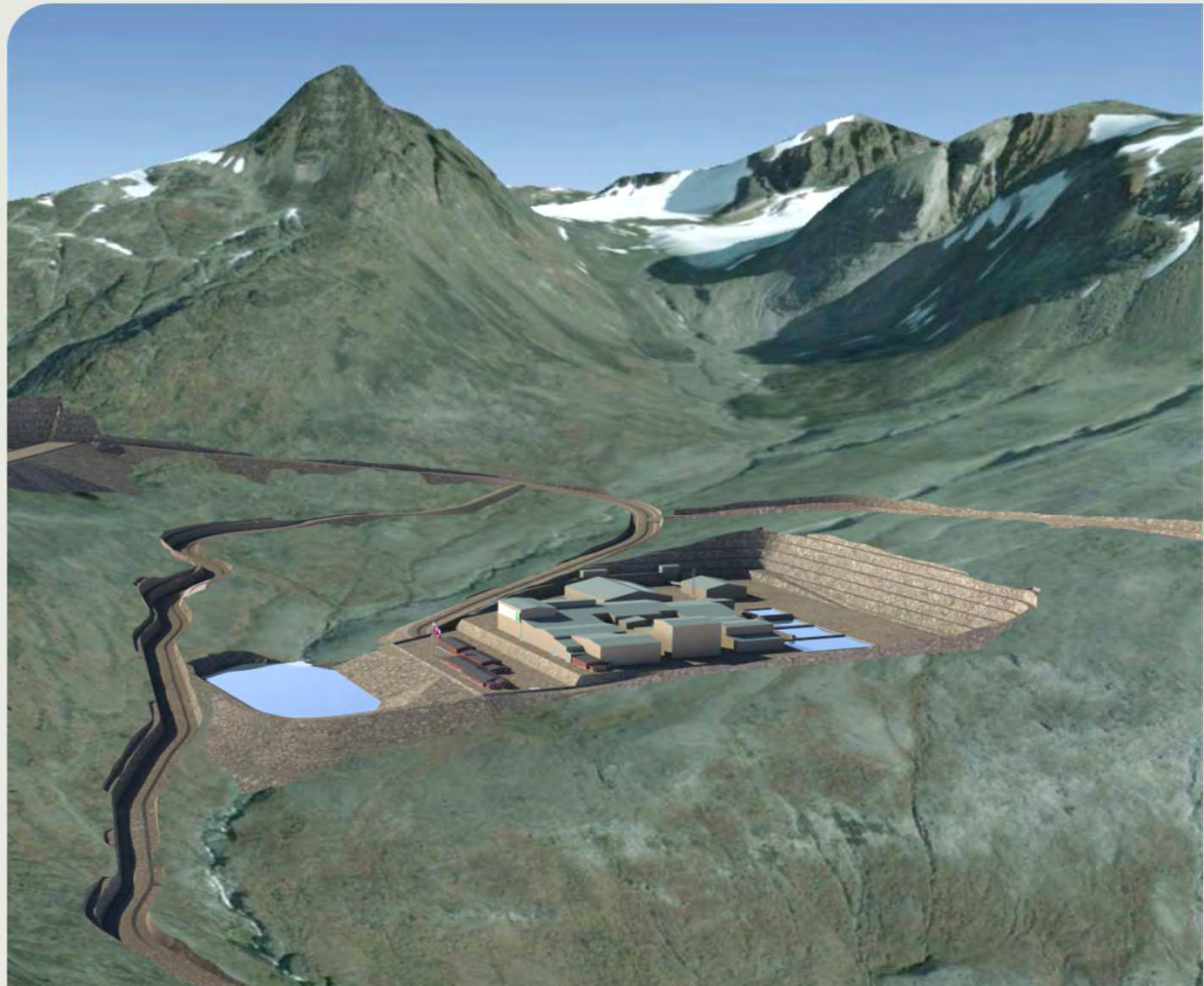
## ECONOMIC BENEFITS

- Royalties
- Community training & employment



# FEASIBILITY STUDY GOALS

- Demonstrate Project Economics
- Reduce Project Execution Risks
- Secure Community Acceptance
- Minimise Environmental Impact

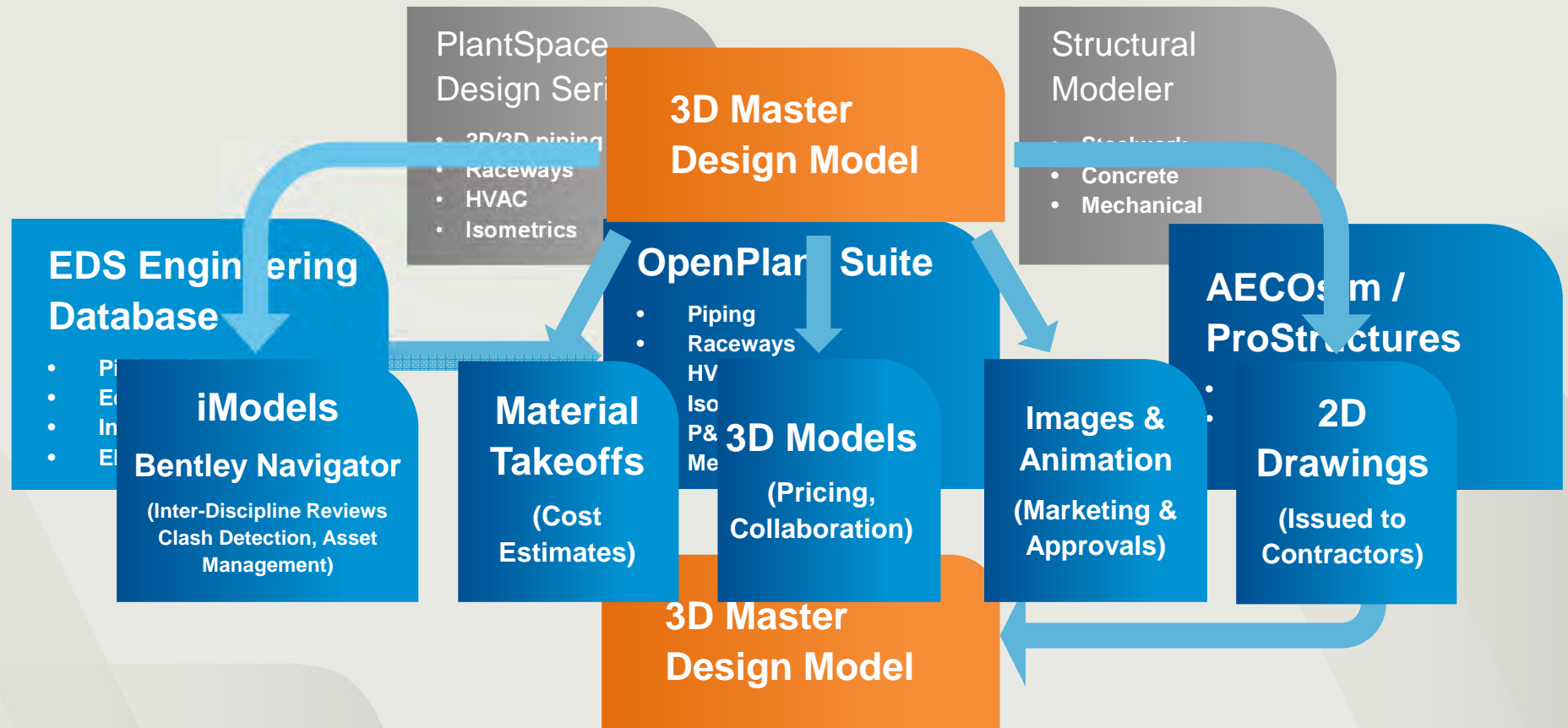


# PROJECT CHALLENGES

- Maximise engineering productivity
- Lower project cost
- Reduce risk
- Improve stakeholder communication
- Increase investor confidence



# WORKFLOW WITH BENTLEY

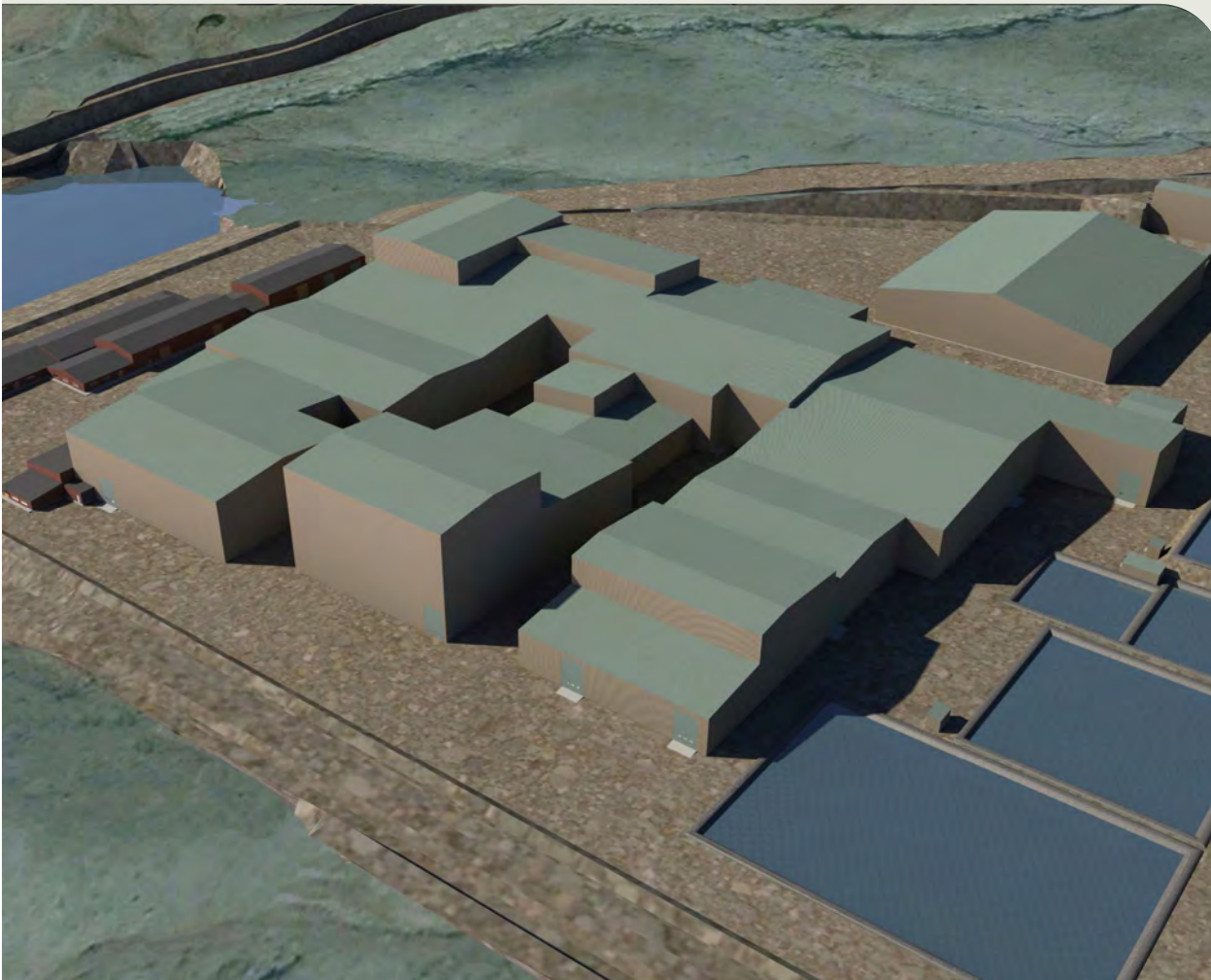


Legacy Software (Discontinued)

Current Software



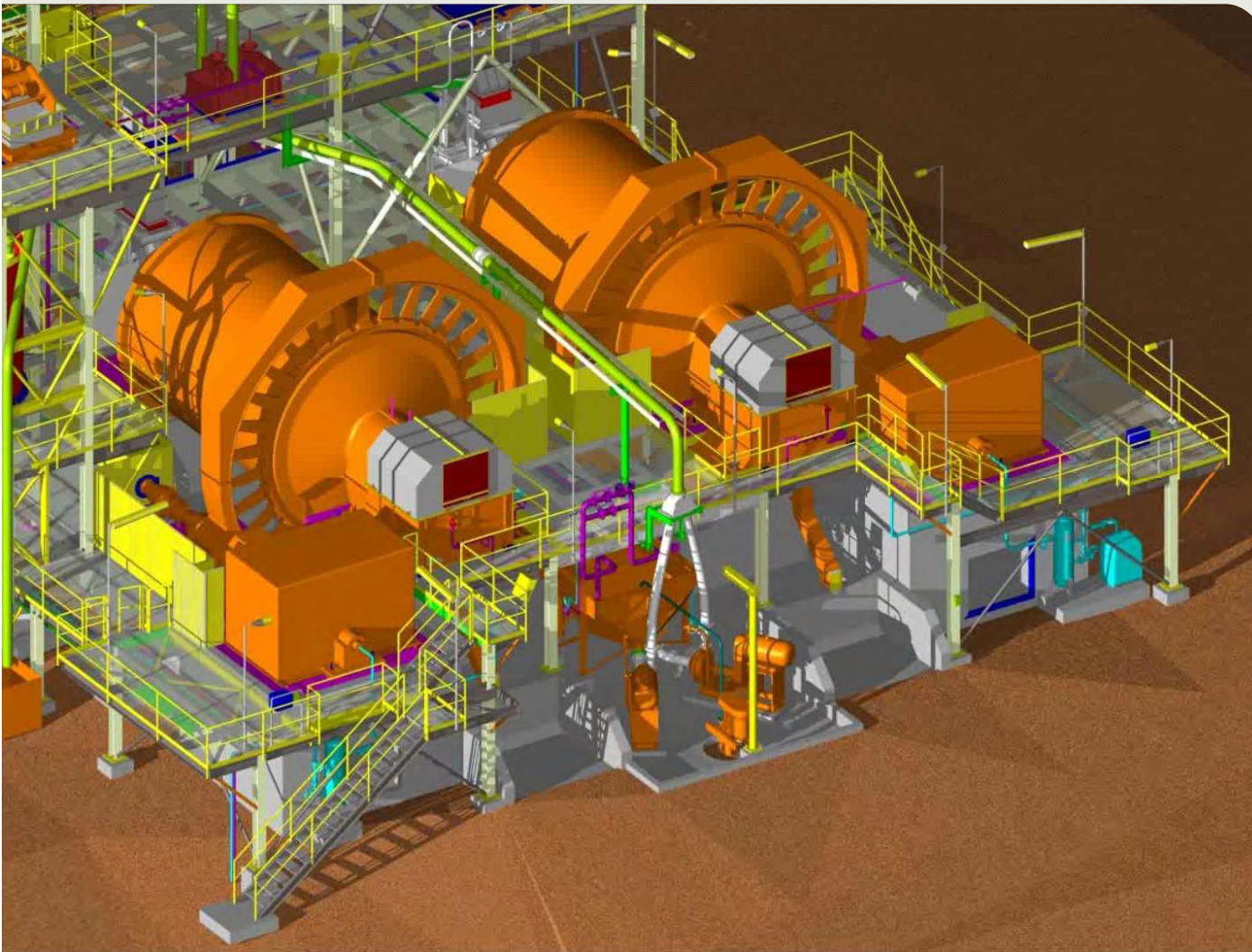
# DESIGN APPROACH



## DESIGN APPROACH

- Define equipment - EDS
- Source 3D models of equipment
- Place equipment in the master model
- Design Earthworks, Concrete and Steel
- Prepare quantity takeoffs for cost estimation

# 3D DESIGN CATALOGUE



## 3D DESIGN CATALOGUE

- Source Component
- Modify and Adapt
- Place in new design
- Repeated 1600+ times



# MINIMISE COST

## PLANT LAYOUT

- Credible design
- Layout optimization saved 5,000,000m<sup>3</sup> of cut/fill and an estimated +\$100m in earthworks
- Additional optioneering
  - 2 Days
  - 1 Designer
  - +\$100m saved!



# REDUCE RISK

## CONSTRUCTION RISK

- Modularization
- Logistics
- Seasonal Construction



## OPERATIONAL RISK

- Operator access
- Crane access and lift studies
- Snow-melt



## HAZID

- Natural disasters
- Environmental impact
- Utility failure
- Emergency operations
- Operations ease and access



## HAZOP

- Identify hazardous processes
- Data integrity between P&ID's and 3D model



# COMMUNITY ACCEPTANCE



## DEMONSTRATE

- Low visual impact
- Low social impact
- Economic benefits

# DESIGN OUTCOMES

## REDUCED PROJECT DELIVERY TIME

- 1600+ pieces of 3D equipment, concrete & steelwork modelled
- Total project duration - 17 weeks
- Ave 2 designers per week for 4 months
- 3D libraries (data re-use)
- Integrated workflow
- Alignment of data



## COST SAVINGS

- Design review led to +100m savings in earthworks
- Optioneering for additional +\$100m savings



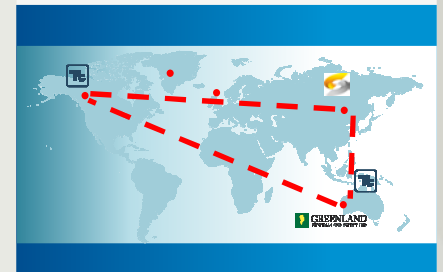
## COMMUNITY ACCEPTANCE

- Minimal visual impact on local village
- Reduced environmental impact
- Plan for training and employment

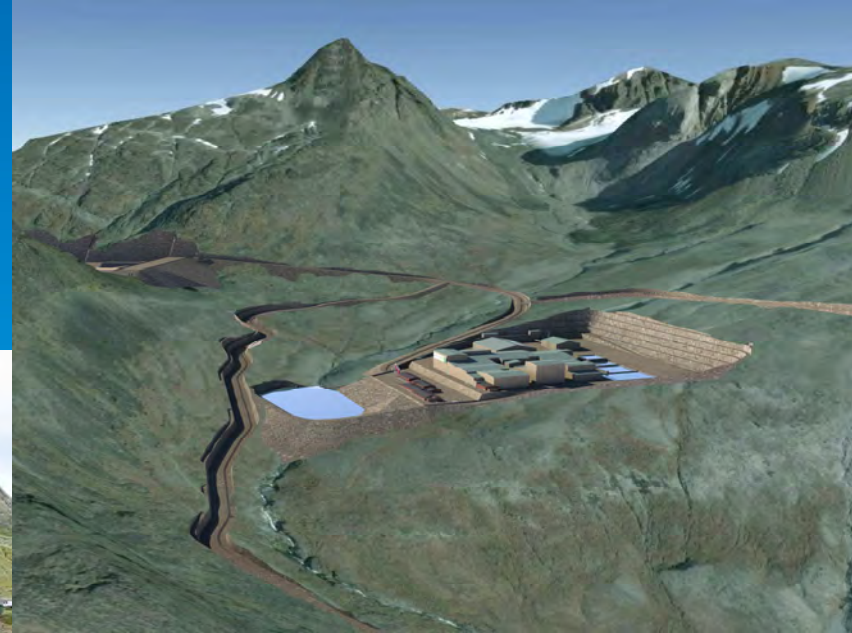


## COMMUNICATION AID

- Visualisation enables early design review
- Global communication with international stakeholders



# Questions



For Further information see  
**Greenland Minerals & Energy**

[www.ggg.gl](http://www.ggg.gl)

**Tetra Tech Proteus**

[www.proteusgroup.com.au](http://www.proteusgroup.com.au)

