ADAA International Symposium 2024

Ash Development Association of Australia

Planning for the Future of CCP Beneficial Use

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Introduction/Agenda

- Introduction
- Getting Started
- Regulatory Framework & Discussion
- Closure Innovation to Support Future Harvesting
- Forward-Looking Strategies
- Sustainability
- Challenges and Solutions
- Conclusion

Introduction

Why begin planning for the future of BU today?

- Availability of fresh production fly ash is decreasing as coal fired units are retired
- Demand for ash for use in concrete will continue to increase
- Harvesting CCR can supplement declining production ash supply
- CCR closures are approaching more rapidly than market demand increase in some areas
- Currently there is not a regulatory mechanism to extend regulatory closure deadlines for closing CCR Units
- Strategic closure will enhance future harvesting efficiency

Getting Started – Key Considerations

* Follow ASTM Standard Guide for Harvesting Coal Combustion Products Stored in Active and Inactive Storage Areas for Beneficial Use

Regulatory Framework - Limitations

US EPA Example

- 160+ acre Ash Pond will complete closure in 12 years via closure by removal and beneficial use of excavated CCR in a cement kiln.
  - "The Agency **(does not) believe that a contractual obligation** constitutes a technical infeasibility that justifies a later closure deadline under the regulations"
  - "(Owner) has not explained why, for example, it cannot **construct alternative storage** for the excavated CCR and thereby reduce the closure timeline without requiring a change to the amount of time necessary to beneficially use all the CCR in cement production"

Regulatory Framework – Potential Pathways

- CCR Rule Post Closure Plan Provisions

"**Any other disturbance is allowed** if the owner or operator of the CCR unit **demonstrates that disturbance** of the final cover, liner, or other component of the containment system, including any removal of CCR, **will not increase the potential threat to human health or the environment**."

- US EPA Smart Sectors Research
- State Agency's Adoption of the CCR Rule
- Potential for removing post-closure care requirements

Regulatory – Path Forward

Owner Path Forward to address regulatory challenges

- Initiating discussions:
  - US EPA Smart Sectors
  - US EPA
  - State Agencies
- Clarification on content for demonstration:
  - “potential threat to human health or the environment”
- Include future harvesting in closure permit application

Closure Planning & Innovation to Support Harvesting

Planning & Design

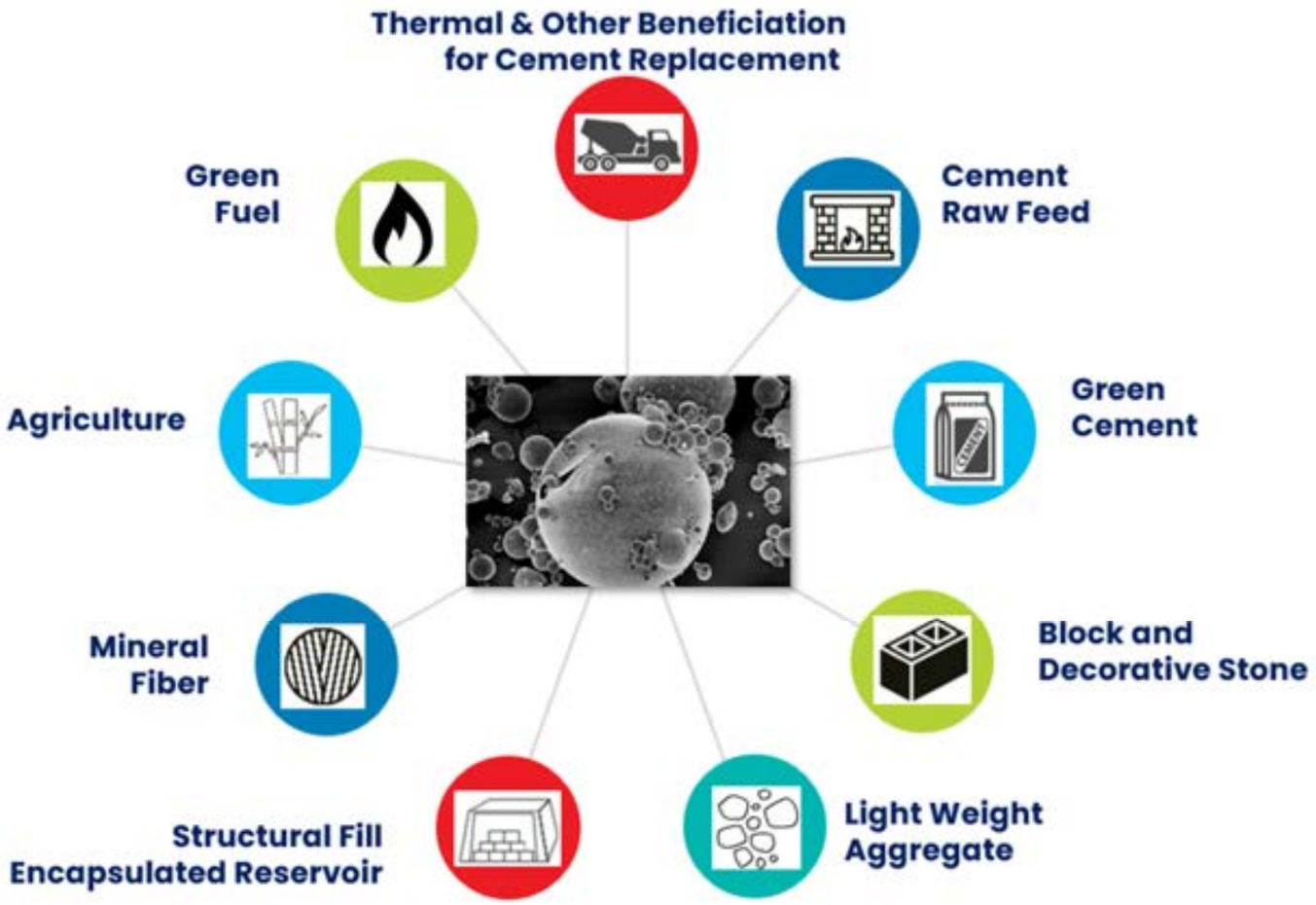
Harvesting

Post Harvesting

Closure Planning Today

- Strategic closures
  - Grades and infrastructure – for closure and harvesting
  - Innovative Closure Technologies
- Maintaining Existing Permits
- Conveyance:
  - Systems
  - Routes
- Infrastructure
  - Wheel washes
  - Scales
  - Rail access
- Power Service
- Closure As-builts

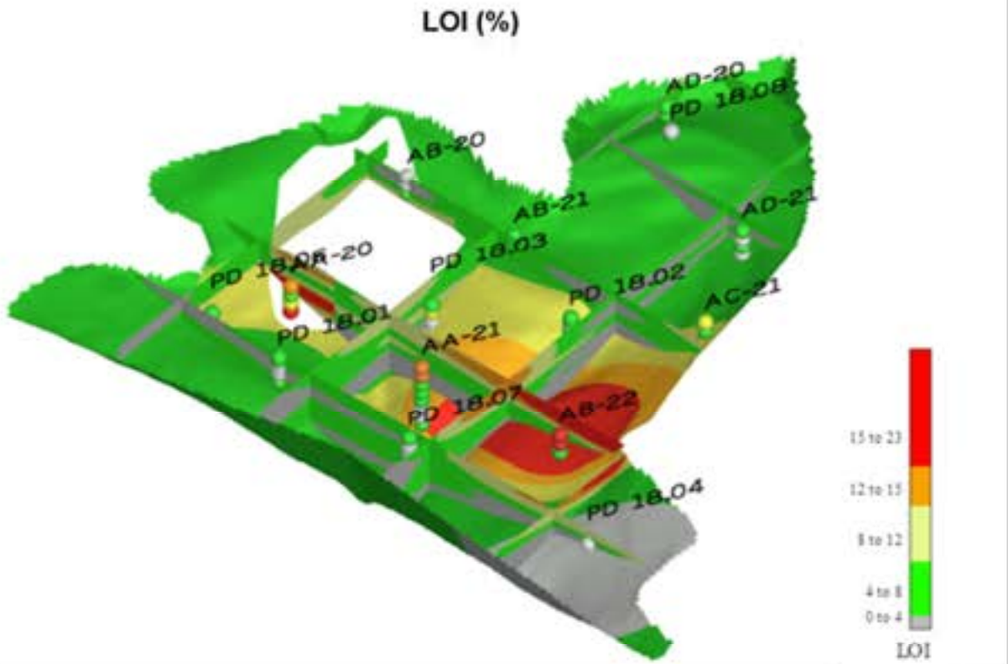
Material Management Forward-Looking Strategies

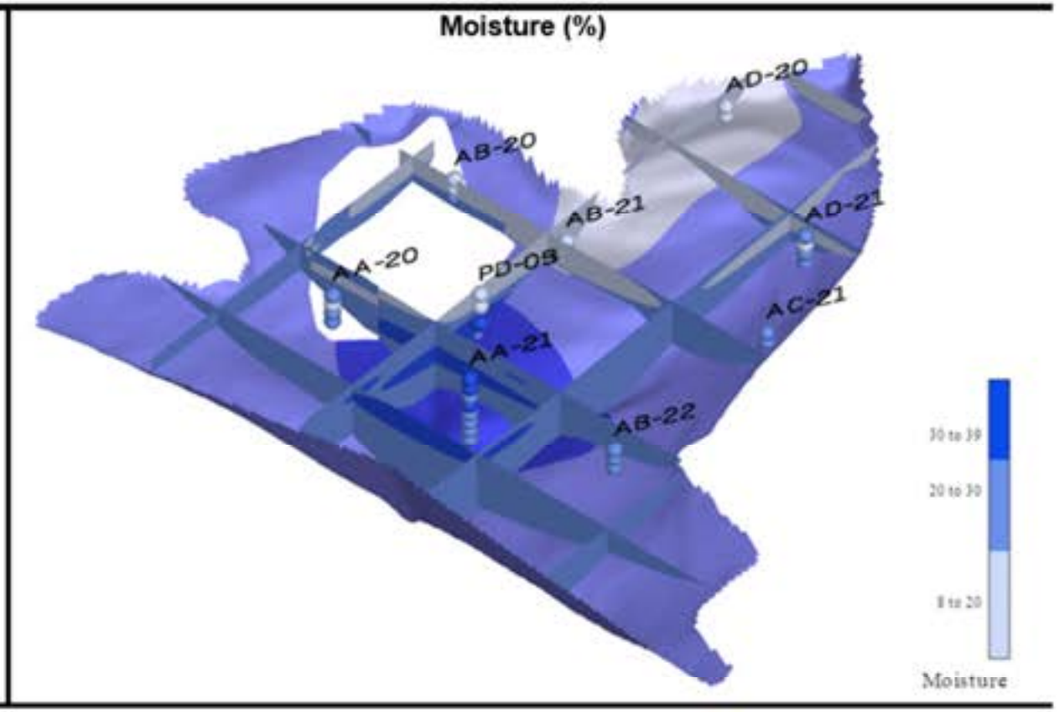


Forward looking strategies to consider where feasible:

- Ash sampling and investigating to determine ash quality and location
- Log material quality as part of typical QA/QC
- Resource mapping with 3D modeling and dashboard visualization
- Proactive market engagement and material application awareness
- Federal & state regulatory compliance

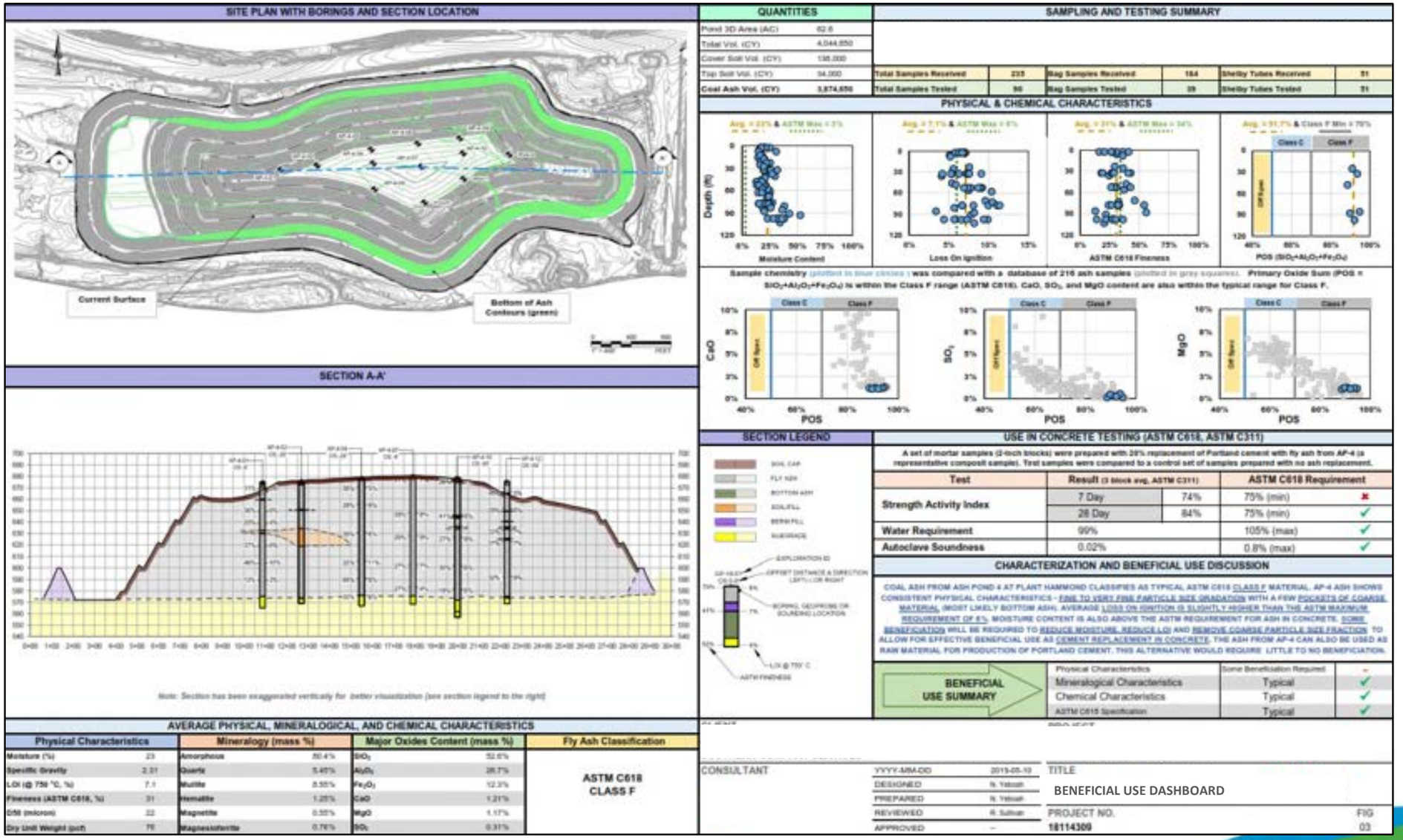
Example Ash Pond Characterization 3D Modeling





Coal Ash Characteristics	Average	Min	Max	ASTM C618 Criteria
LOI (%)	6.37	0.56	23.66	Max 6 for Class F/C
Fineness (%)	45.18	10.88	93.27	Max 34
Moisture (%)	22.72	8.14	39	-
D_{50} (Micron)	86.20	18.63	234.1	-
POS (%)	93.48	86	127.52	Min 50 for Class F/C
CaO (%)	1.39	1.09	2.44	Max 18 for Class F, Min 18 for Class C
SO_3 (%)	0.23	0.21	0.47	Max 5 for Class F/C

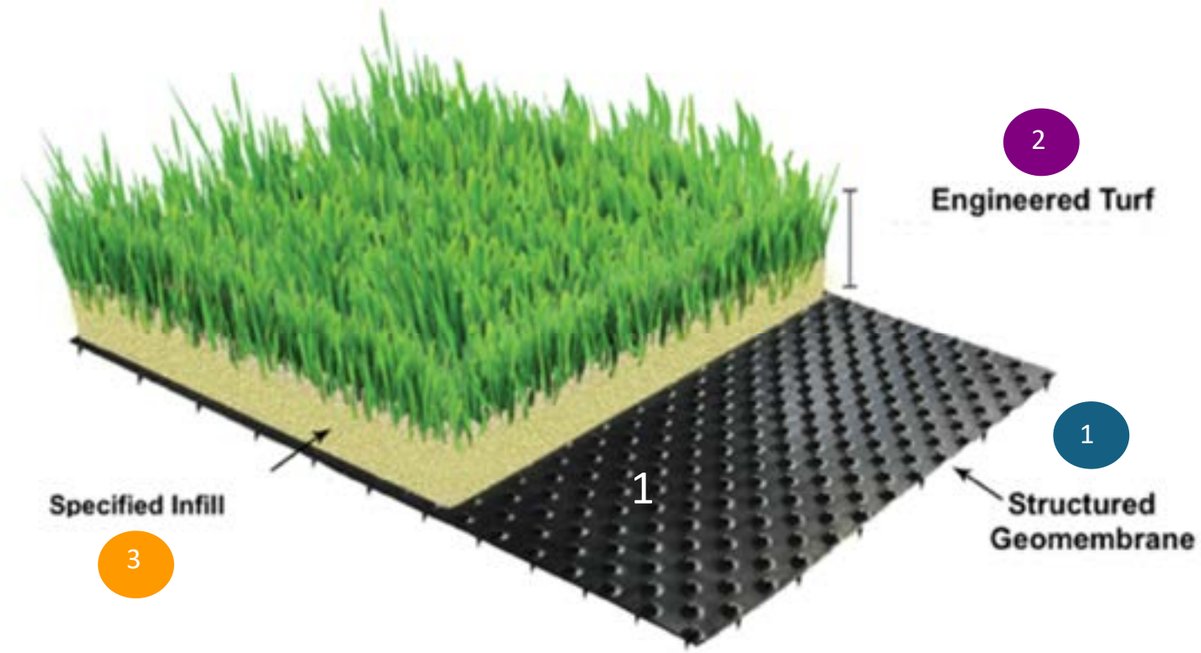
Example Beneficial Use Dashboard

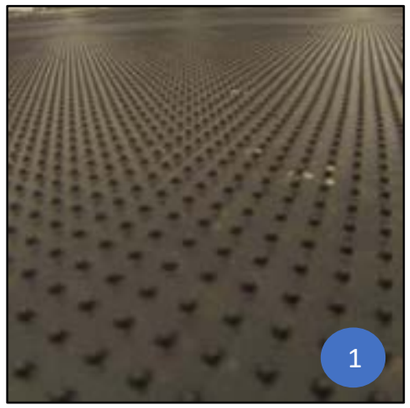


Closure Innovation to Support Harvesting

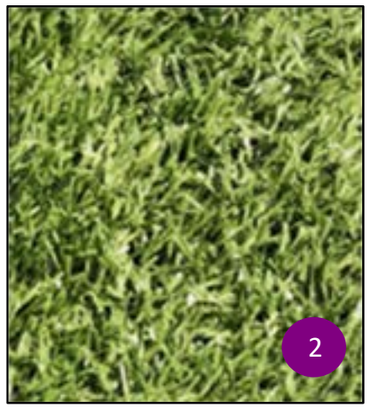
Harvesting Challenges	Innovative Approach	Description
Stormwater Management/Permitting (Non-Contact)	Engineered Turf Cover (ETC) for enhanced Stormwater Management	Ability to Harvest Under Existing SW Permits
Contact Water Management/Permitting	Reuse of ETC or other Technologies for Interim Cover to Minimize	Minimize Contact Water Generation/Treatment
Regulatory Approval	Post-Closure Demonstration Under CCR Rule	CCR Rule Allows Demonstration for CCP Harvesting
Too Costly	Reuse and Recycling of ETC	Proper Planning Can Reduce Costs
Mixing of CCP with Soil	Utilization of ETC for Interim Cover with Geotextile	Significant Reduction in Soil and Potential Mixing

Engineered Turf Covers (ETC)





Structured Geomembrane



Engineered Turf

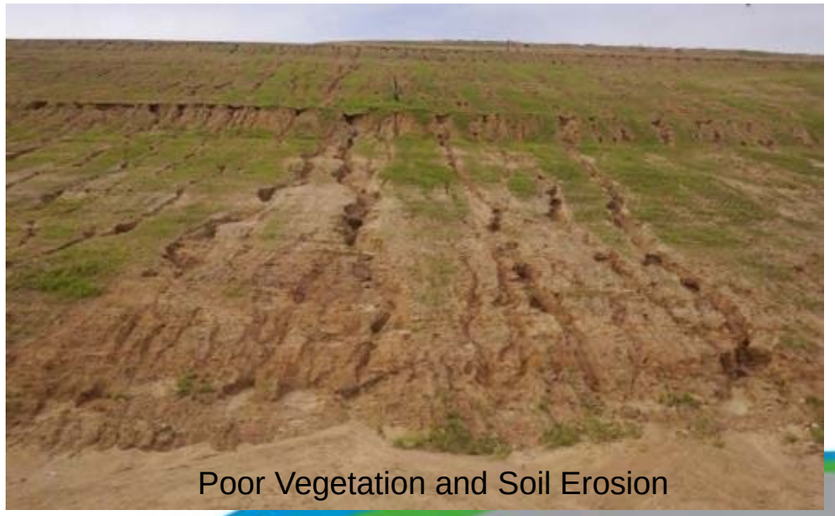
Specified Infill

ETC vs Traditional Cover

Advantages of ETC in comparison to Traditional Covers Systems

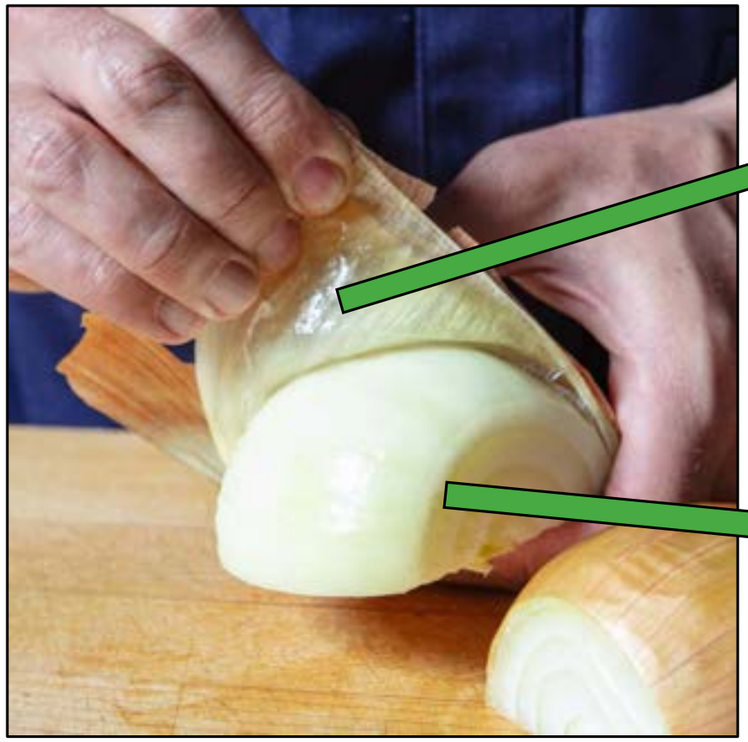
- No soil required
- Reduction/elimination of maintenance events which my hinder harvest
- Improved stormwater quality/management
- Detention of storm water rather than retention - smaller pond volume
- Reduction of diversion berms and down chutes
- Placed directly on CCP, preventing CCP quality impacts
- Relatively easy removal without damage to cap

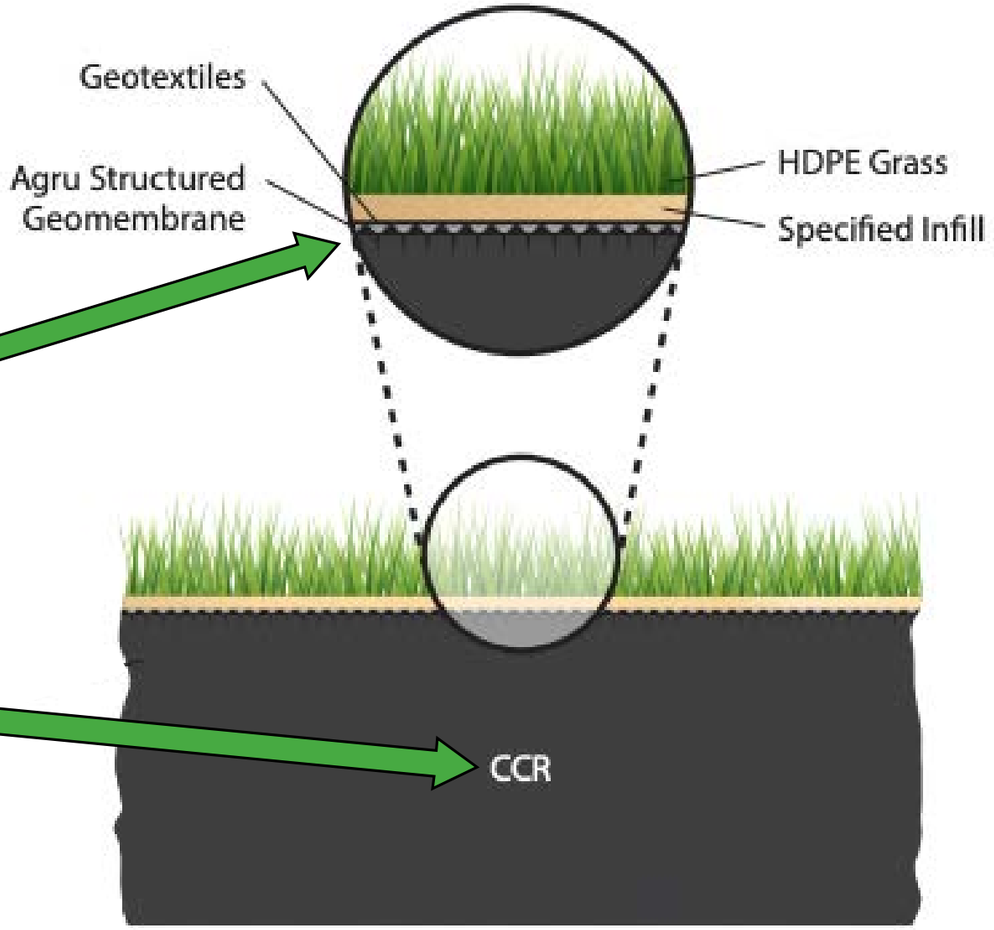
Veneer Slope Failure – Soil Cover



Poor Vegetation and Soil Erosion

Why ETC for Harvesting?





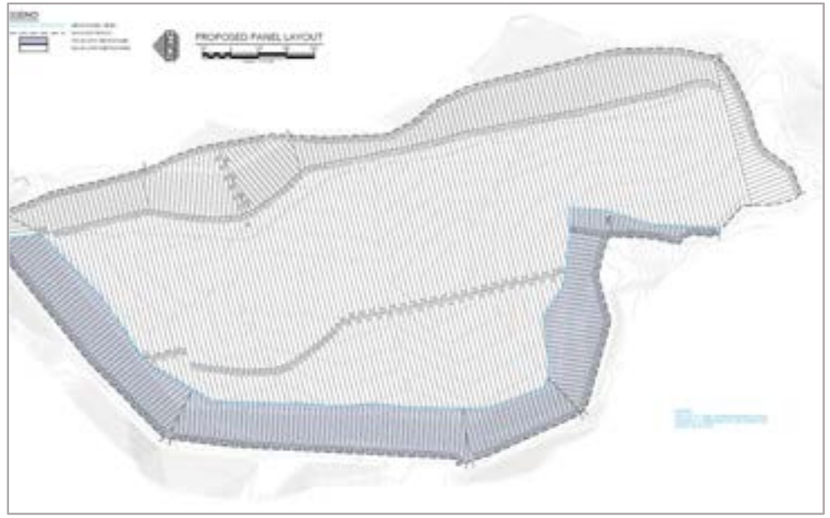
ClosureTurf® Application

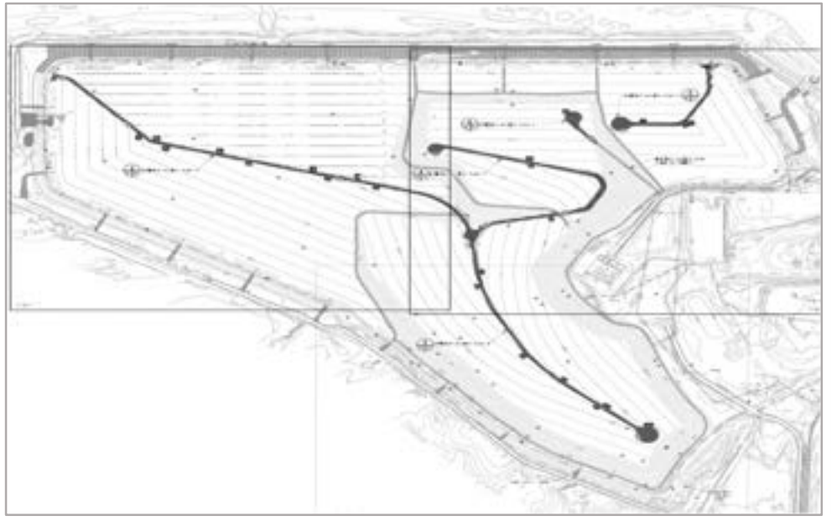
ETC Design Considerations

- Slopes - 3H:1V or flatter for access
- Drainage Features - limit drainage features/benches
- Down Chutes – flexible fiber reinforced concrete liner HydroTurf®
- Energy Dissipation – non-permanent energy dissipation
- Access Roads

ETC Design Considerations

- Panel/Access Road Layout
- Separation Geotextile/Cover Soil
- Clean Geomembrane





Prepare a geomembrane / engineered turf panel layout drawing for future harvesting.

Use geotextile below the ClosureTurf® system to prevent CCR from contacting the geomembrane liner on top deck.

ETC Harvesting Approach

1

Remove Infill using a Redexim Eliminator or other equipment, remove access road, and store in covered stockpile on-site for use in sand bags or other project needs.

2

Cut Turf and Geomembrane along seams.

3

Remove Turf and Geomembrane, roll and utilize as diversion berm or store in similar fashion to installation.

Cut and remove geotextile in-contact with CCR, roll and utilize as contact water diversion berm.

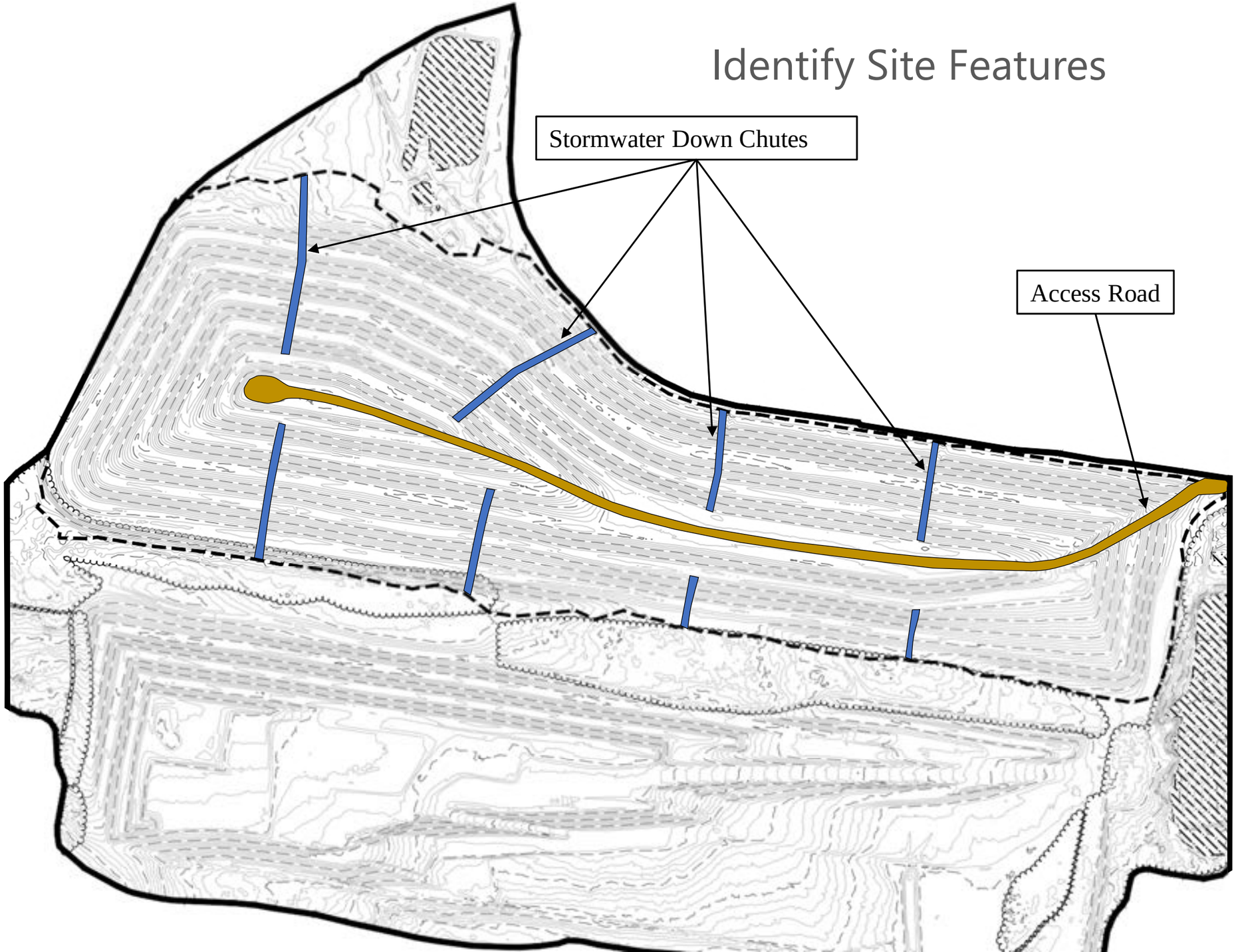
4

During excavation / harvesting, place geotextile and reuse geomembrane with sand bags as interim cover to minimize contact water.

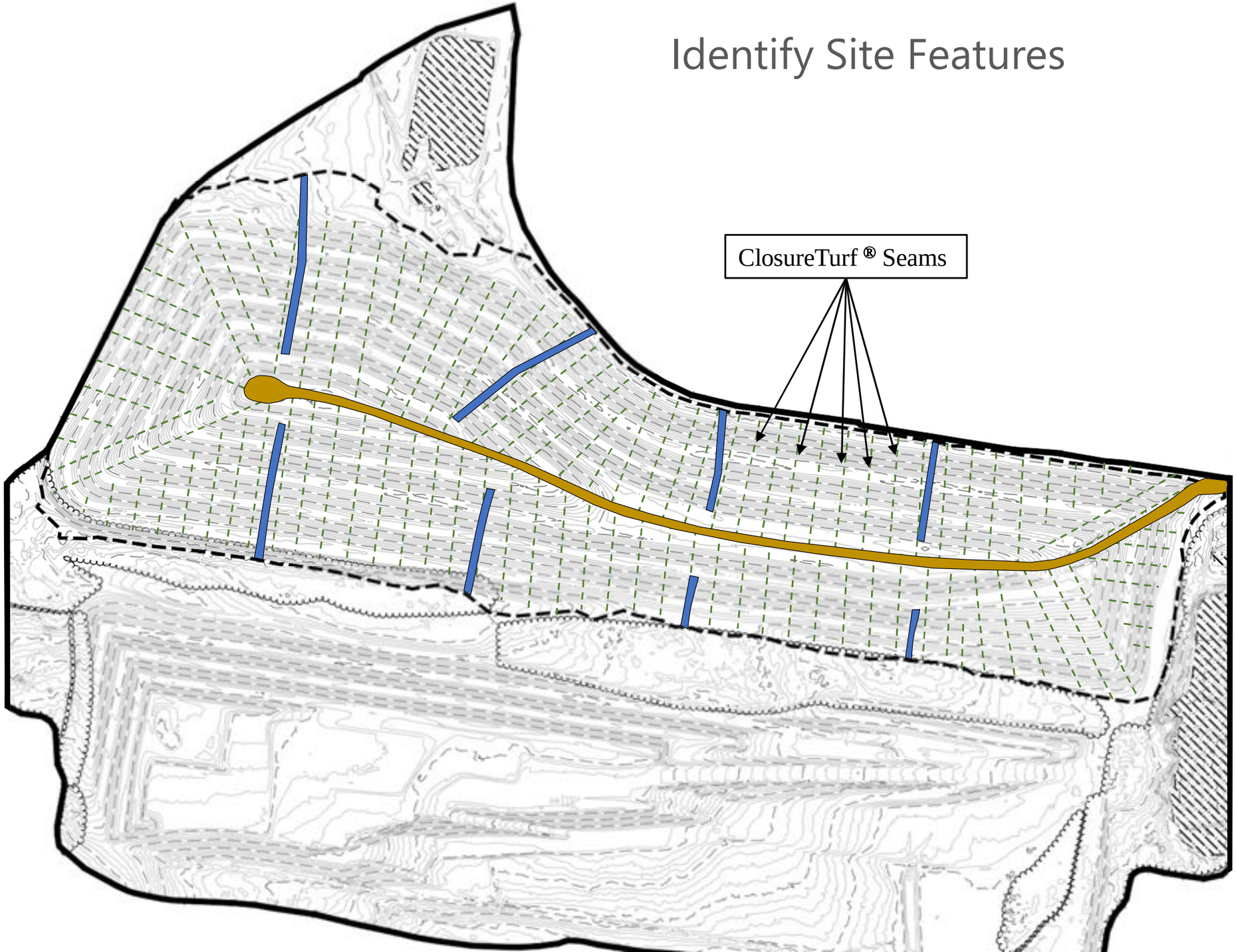
ETC Harvesting Approach Example

- 110 Acre CCR landfill installed with ETC
- Slope benches and down chutes for Stormwater
- Combined contact water/leachate management

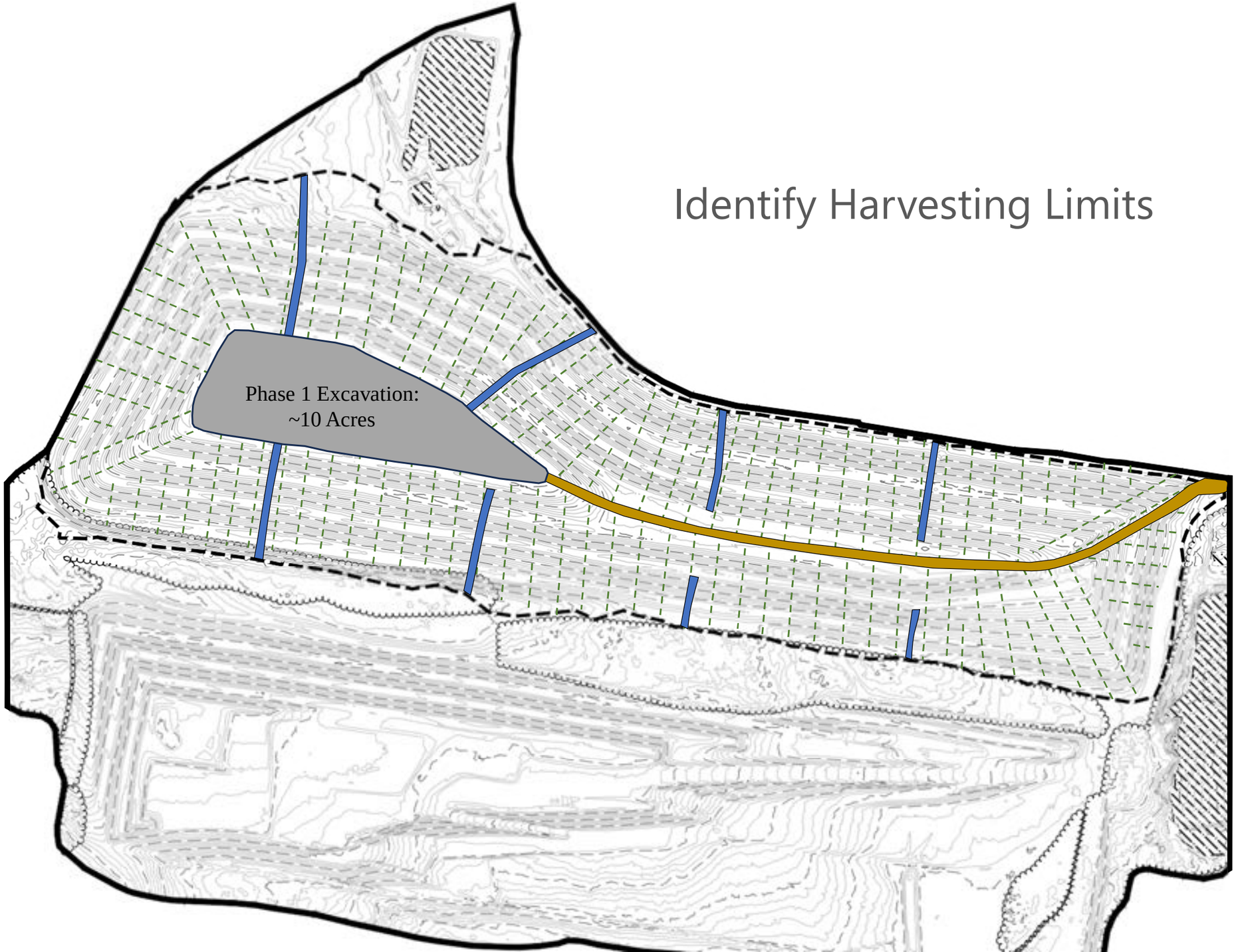
Identify Site Features



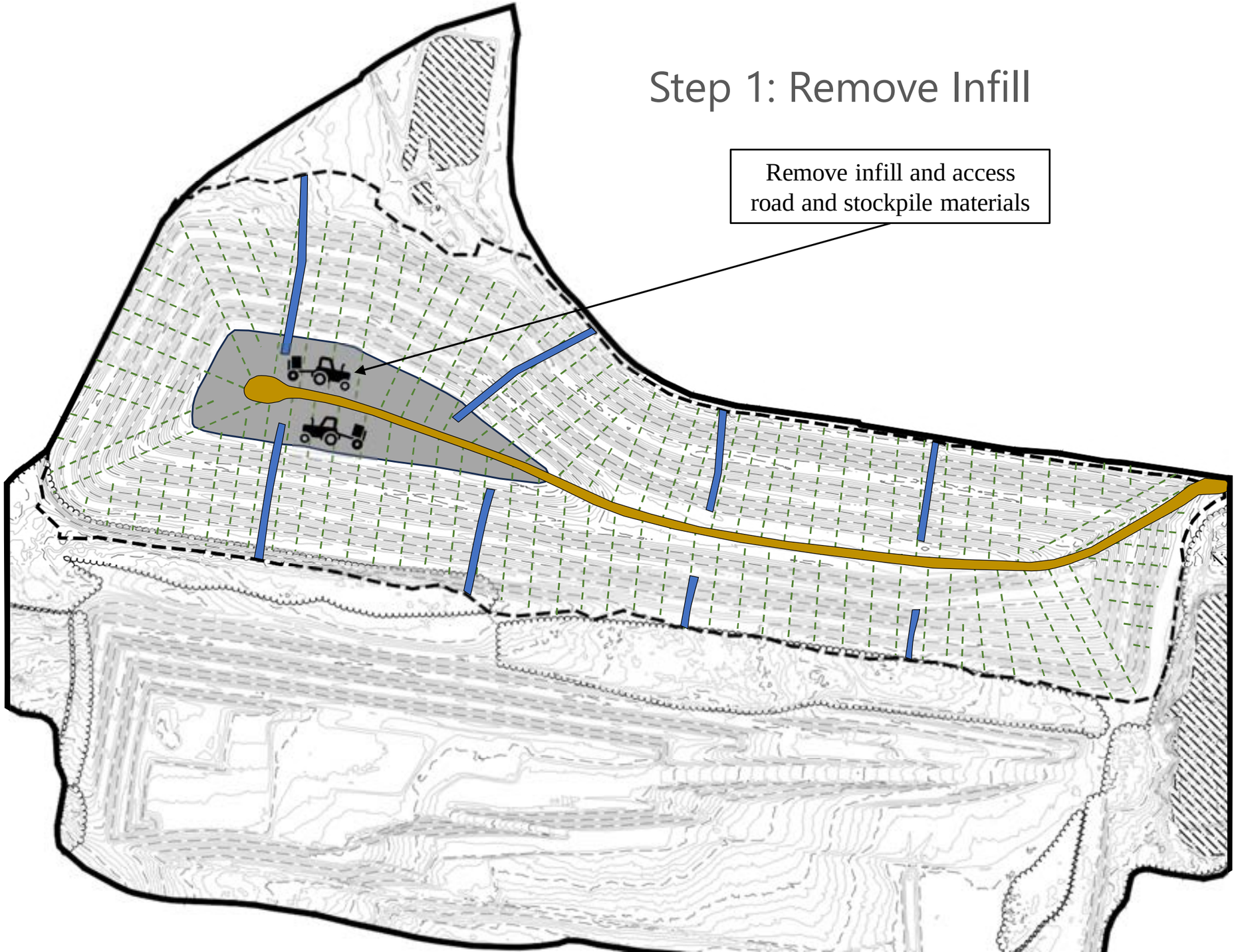
Identify Site Features



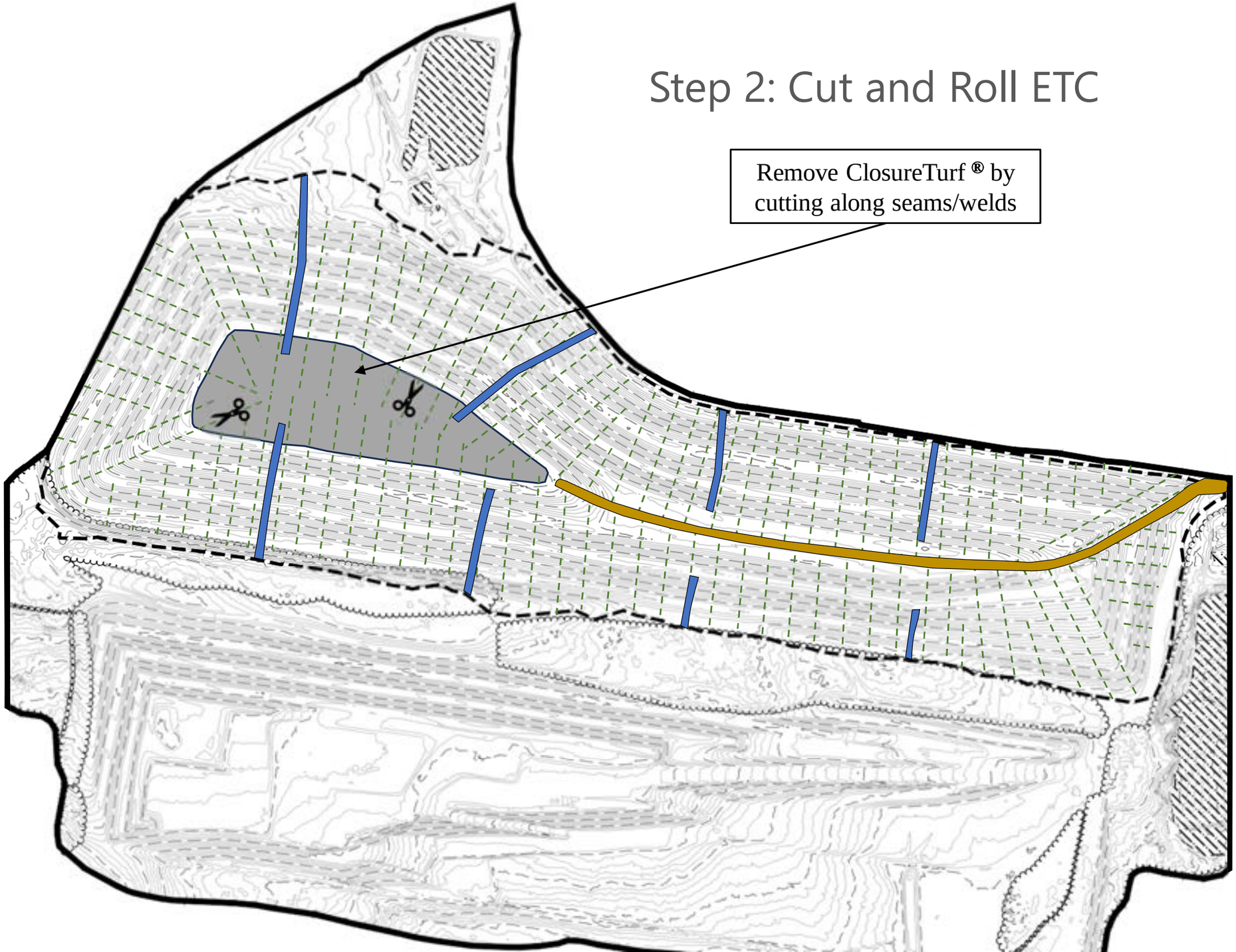
Identify Harvesting Limits



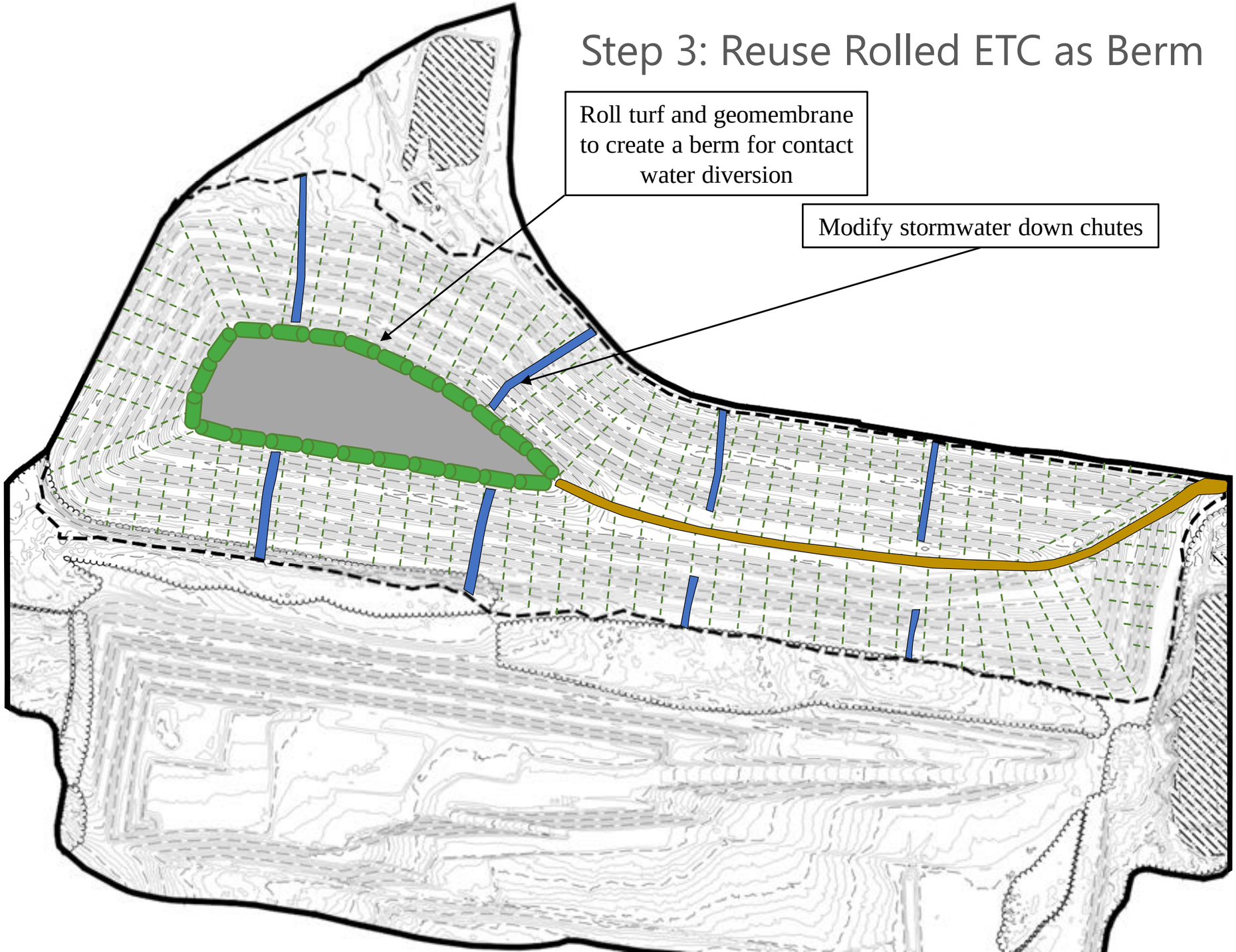
Step 1: Remove Infill

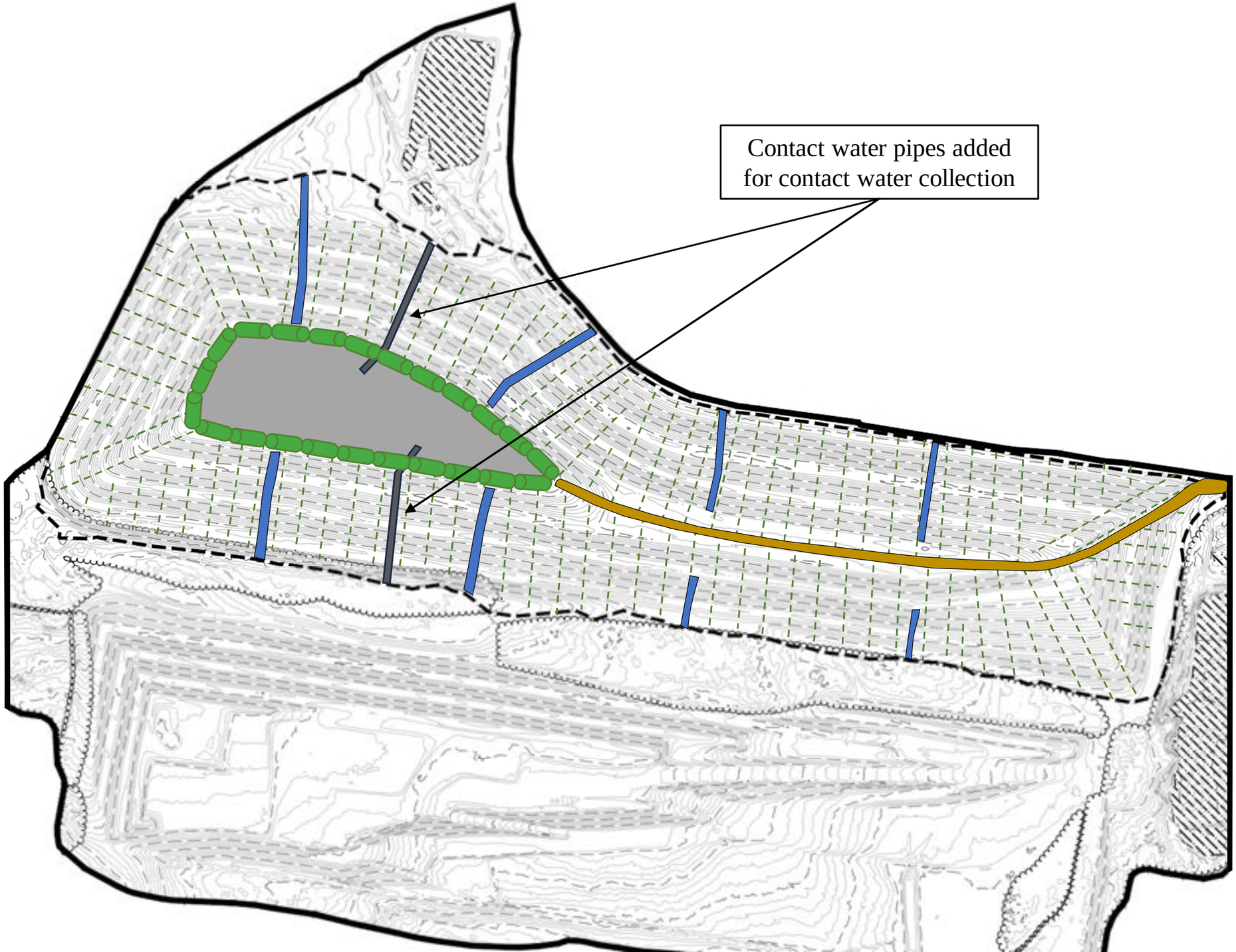


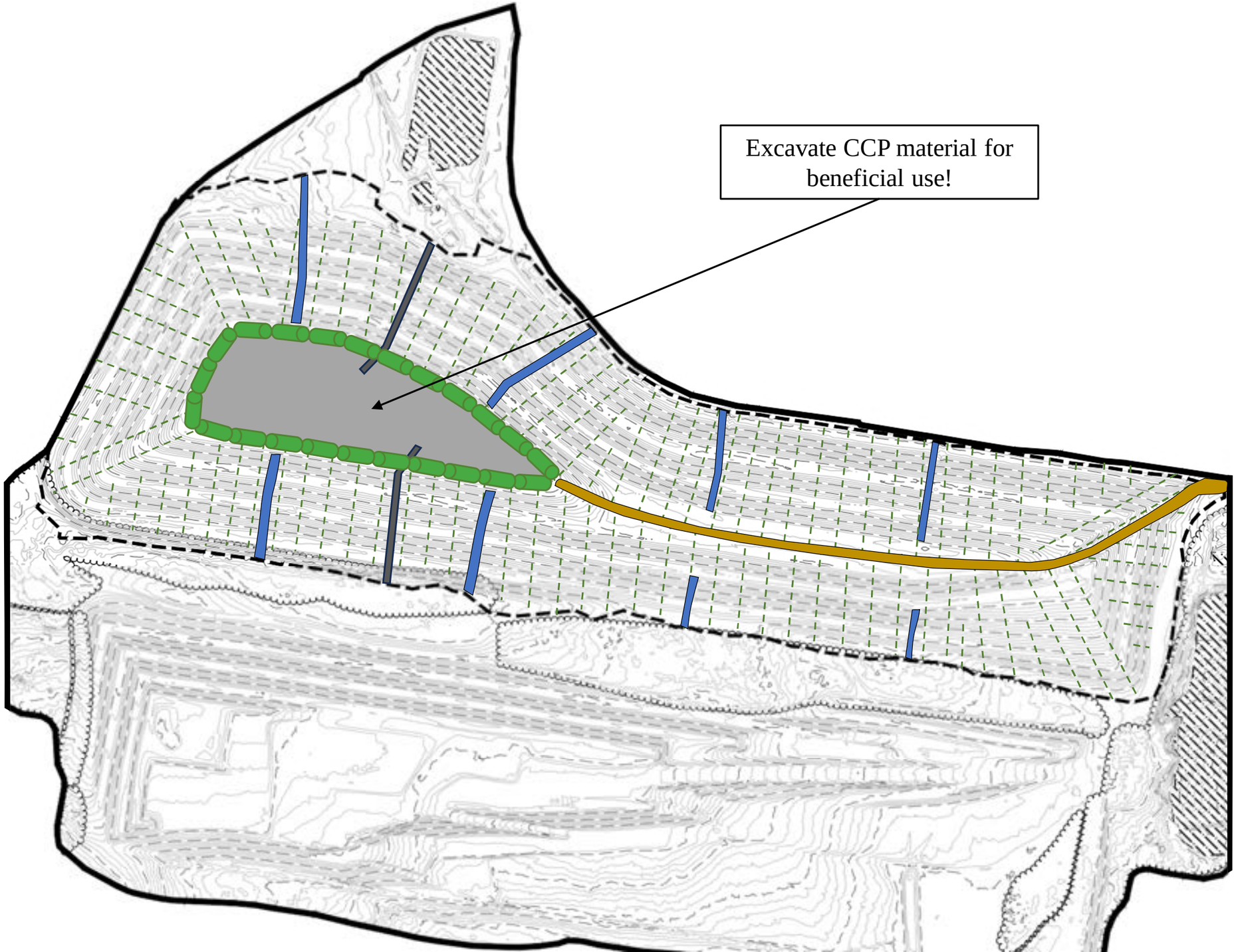
Step 2: Cut and Roll ETC



Step 3: Reuse Rolled ETC as Berm

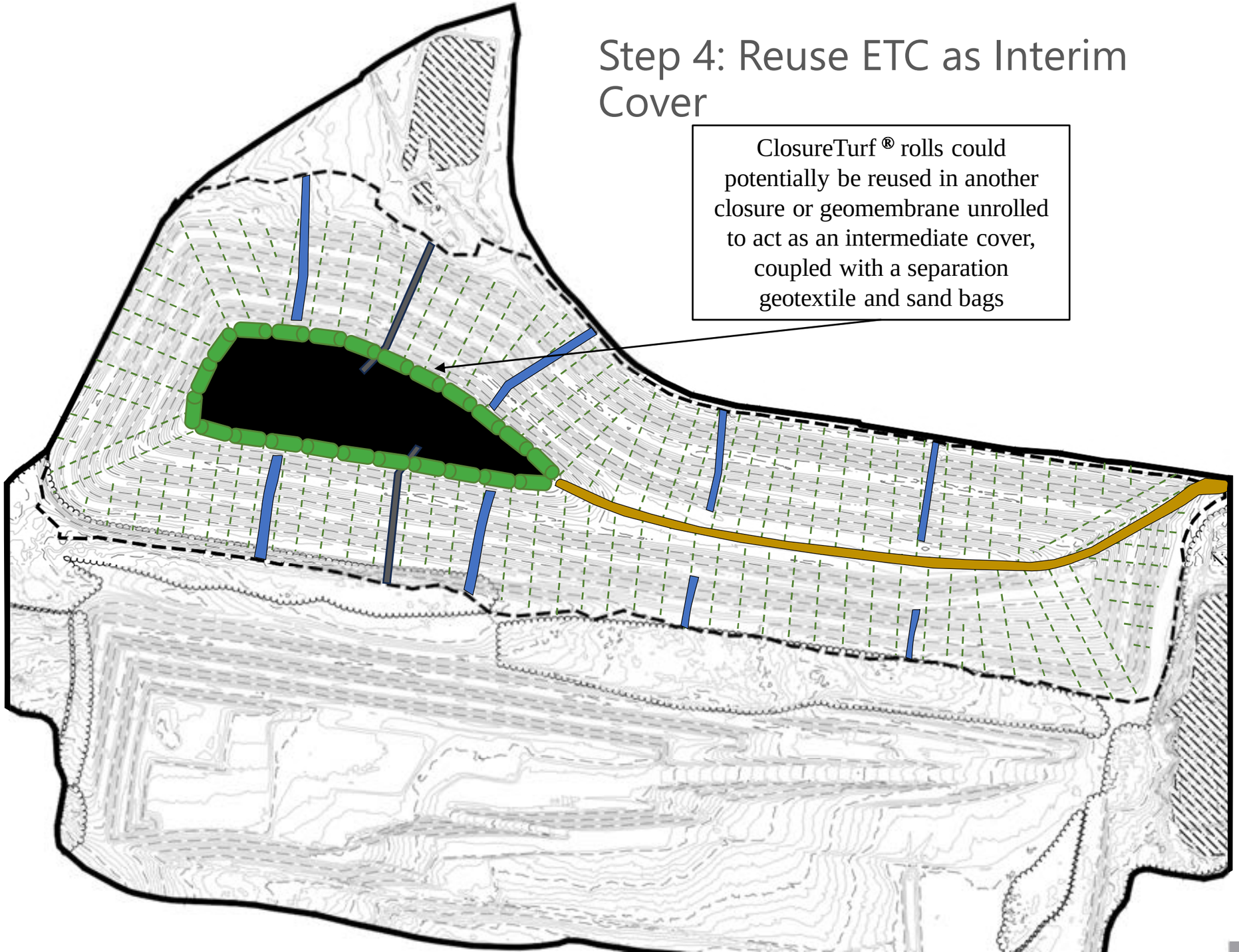



Contact water pipes added
for contact water collection

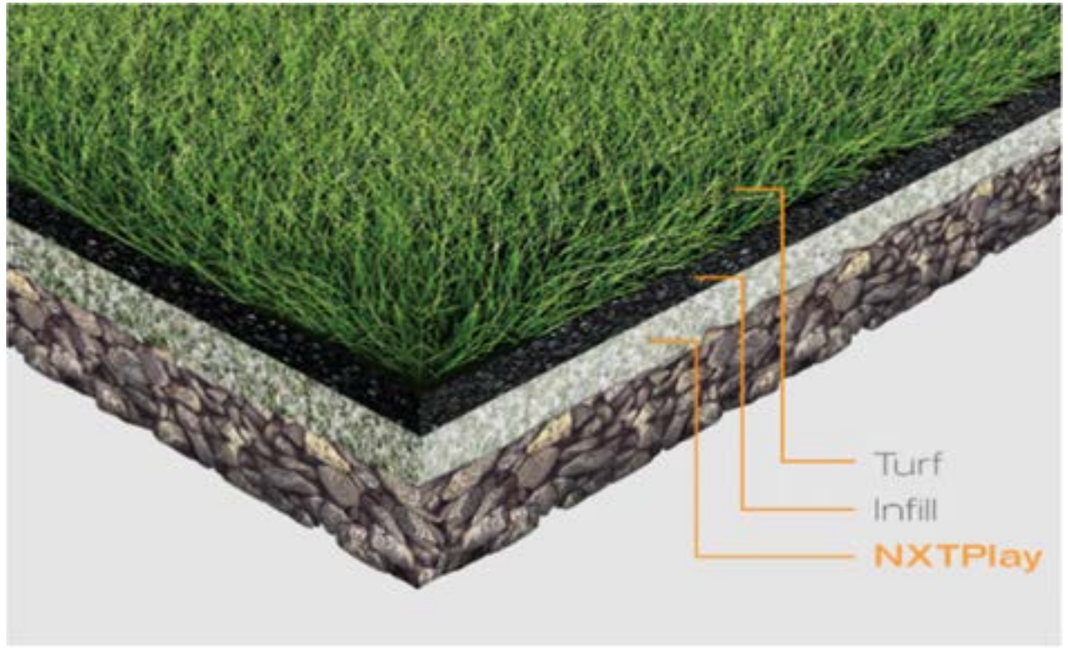

Excavate CCP material for beneficial use!

Step 4: Reuse ETC as Interim Cover

ClosureTurf ® rolls could potentially be reused in another closure or geomembrane unrolled to act as an intermediate cover, coupled with a separation geotextile and sand bags



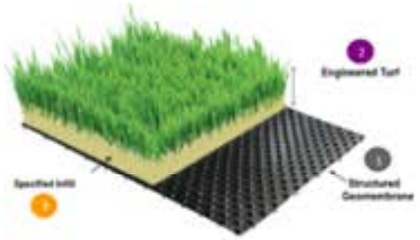
Sustainability



Store and inventory excess materials for reuse.

If turf has reached end of service life, ship to manufacturer for recycling.

Sustainability



or

BU Challenges/Solutions

- Summary of Beneficial Use Challenges and Future Harvesting Solutions

Today's Challenges	Future Harvesting Solution	Approach
Not Enough Time (Regulatory Compliance)	Post-Closure Harvesting	Closure Compliance and Harvest at Market Driven Rate
Too Costly	Market Demand and Technology Innovation May Reduce Costs	Discussions with Technology Providers
Too Difficult	Consider Innovative Technologies Such as Engineered Turf Cover (ETC) to Streamline	Work with Technology Vendors and Incorporate into Closure Plans

Conclusion

- Industry-wide collaboration
- Participate with US EPA Smart Sectors
- Identify sites and develop strategies and framework
- Engage regulators
- Incorporate harvesting into your closure plans