PROGRESSION ENGINEERING LIMITED

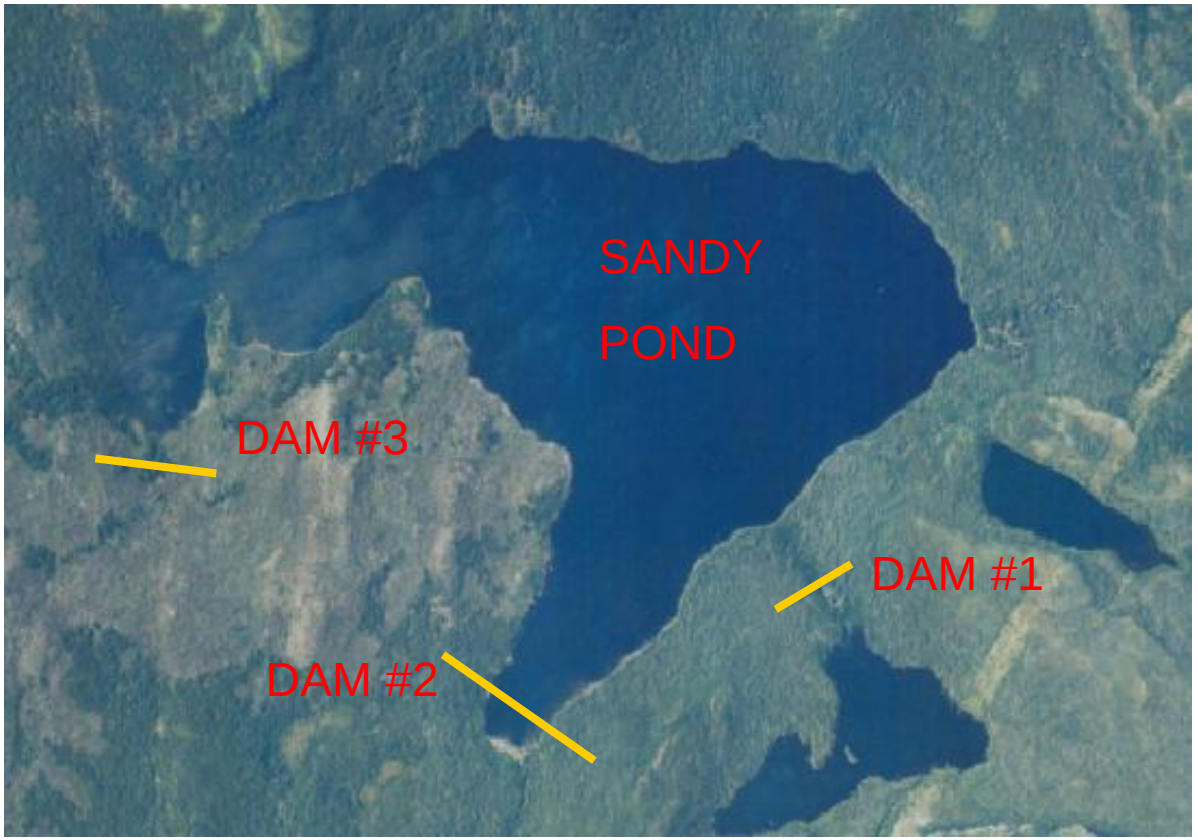
"Providing solutions to civil and structural engineering problems"

Dam Construction Analysis

Voisey's Bay Commercial Processing Plant
Long Harbour, NL

DAM LOCATION

Figure 1:
Aerial Photo



DELIVERABLES

- Curtain Grouting
- Impermeable Core Design
    - Lab Testing Results
- Design Criteria
    - Erosion Protection
    - Dam Layer Design
- Roller Compacted Concrete Alternative

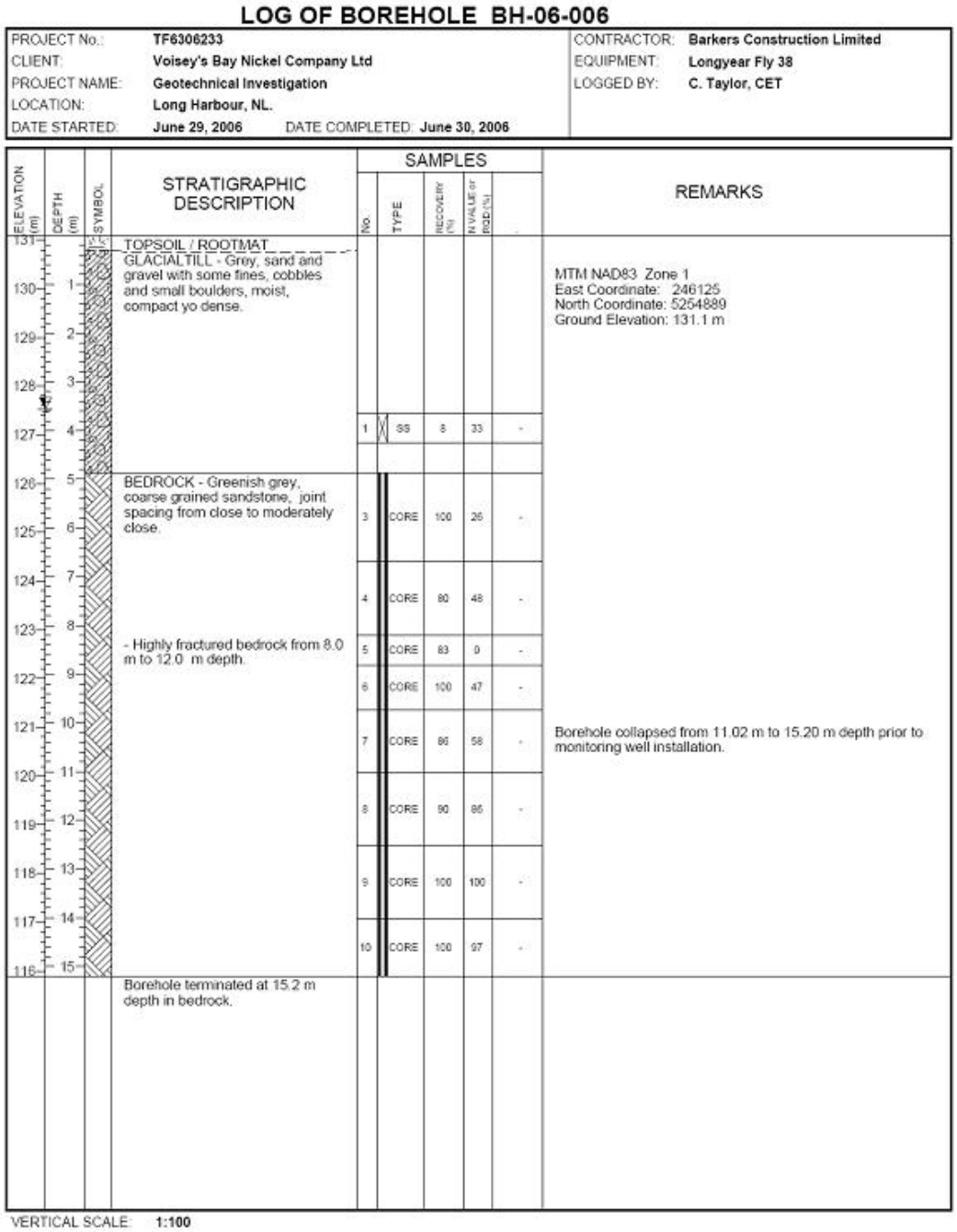
CURTAIN GROUTING

- Dam to be constructed directly on bedrock once existing overburden is removed
- Curtain grouting:

  The process of pressure injecting grout into adjacent boreholes in the bedrock foundation

  Creates a continuous curtain that prevents seepage through the bedrock beneath the structure

Figure 2:
Borehole
Log (AMEC)



LOG OF BOREHOLE BH-06-006

PROJECT No.:	TF6306233	CONTRACTOR:	Barkers Construction Limited
CLIENT:	Voisey's Bay Nickel Company Ltd	EQUIPMENT:	Longyear Fly 38
PROJECT NAME:	Geotechnical Investigation	LOGGED BY:	C. Taylor, CET
LOCATION:	Long Harbour, NL.		
DATE STARTED:	June 29, 2006 DATE COMPLETED: June 30, 2006		

ELEVATION (m)	DEPTH (m)	SYMBOL	STRATIGRAPHIC DESCRIPTION	SAMPLES No.	TYPE	RECOVERY (%)	N VALUE or RQD (%)		REMARKS
131	0		TOPSOIL / ROOTMAT						
130	1		GLACIALTILL - Grey, sand and gravel with some fines, cobbles and small boulders, moist, compact yo dense.						MTM NAD83 Zone 1 East Coordinate: 246125 North Coordinate: 5254889 Ground Elevation: 131.1 m
129	2								
128	3								
127	4			1	SS	8	33	-	
126	5		BEDROCK - Greenish grey, coarse grained sandstone, joint spacing from close to moderately close.	3	CORE	100	26	-	
125	6								
124	7			4	CORE	80	48	-	
123	8		- Highly fractured bedrock from 8.0 m to 12.0 m depth.	5	CORE	83	0	-	
122	9			6	CORE	100	47	-	
121	10			7	CORE	86	58	-	Borehole collapsed from 11.02 m to 15.20 m depth prior to monitoring well installation.
120	11								
119	12			8	CORE	90	86	-	
118	13			9	CORE	100	100	-	
117	14								
116	15			10	CORE	100	97	-	
			Borehole terminated at 15.2 m depth in bedrock.						

VERTICAL SCALE: 1:100

CURTAIN GROUTING

- The foundation is to be grouted to a depth of 10m (Provided by AMEC)
- Grout types being considered:
  - Hydraulic Cements
  - Clays
  - Bentonite
  - Final Grout selection will be based on availability, cost, and properties of grout material

CORE DESIGN

- Impervious Core would preferably utilize existing glacial Till due to its availability
- Laboratory testing by AMEC has found this material to be unsuitable in native form due to low silt content
- In order to use the material, it has to be made richer in terms of fines content
- There are several ways of achieving this:
  - Increase silt content
  - Supplementary filler materials

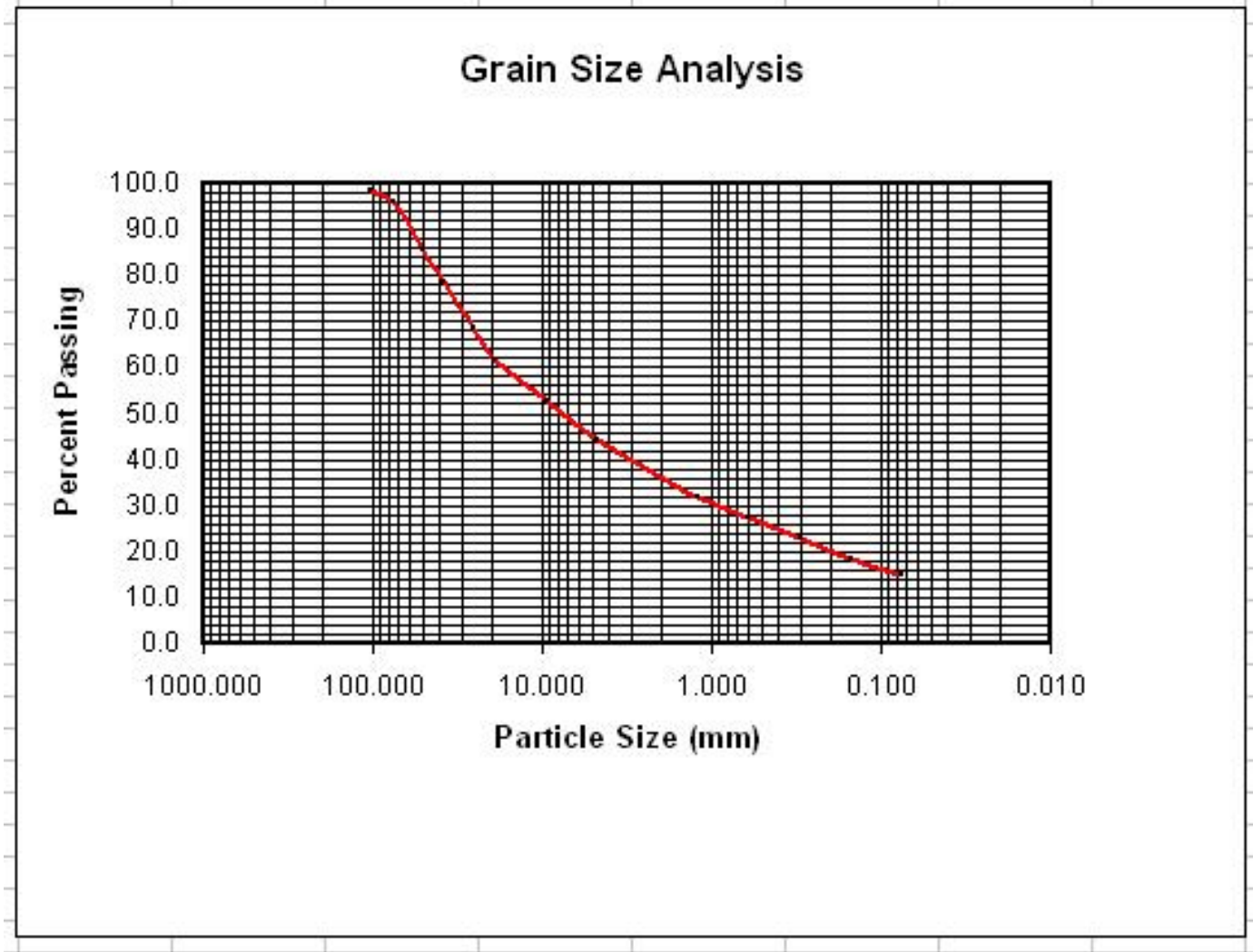
CORE DESIGN

- A representative sample was compiled from several areas of the site (as collected by AMEC)
- The sample was thoroughly mixed and comparative tests were performed. These included:
  - Sieve Analysis
  - Standard Proctor test

Figure 3: Soil Mixing

Figure 4:
Sieve Analysis

Project No.:	PEL01	**Date:**	10-Feb-07
Project:	Long Hr. Earth Dam Project	**Tested By:**	G. Smith
Sample No.:	LH01 (Composite sample)		

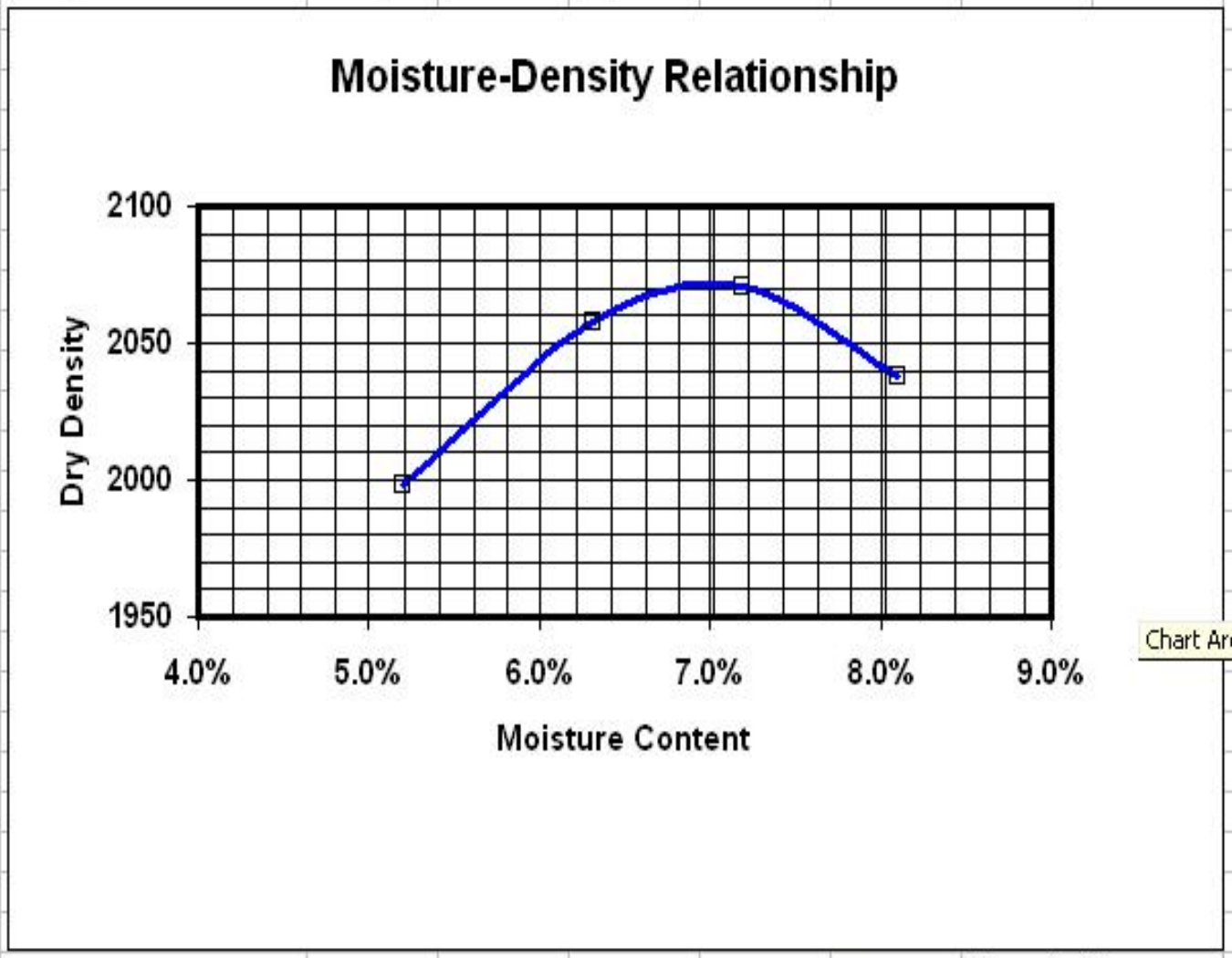


P.E.L. Representative:

Glenn Smith
Senior Engineering Technologist

Figure 5:
Proctor Results

Project No.:	PEL01	**Date:**	10-Feb-07
Project:	Long Hr. Earth Dam Project	**Tested By**	G. Smith
Sample No.:	LH01 (Composite sample)		



P.E.L. Representative:

Glenn Smith
Senior Engineering Technologist

CORE DESIGN

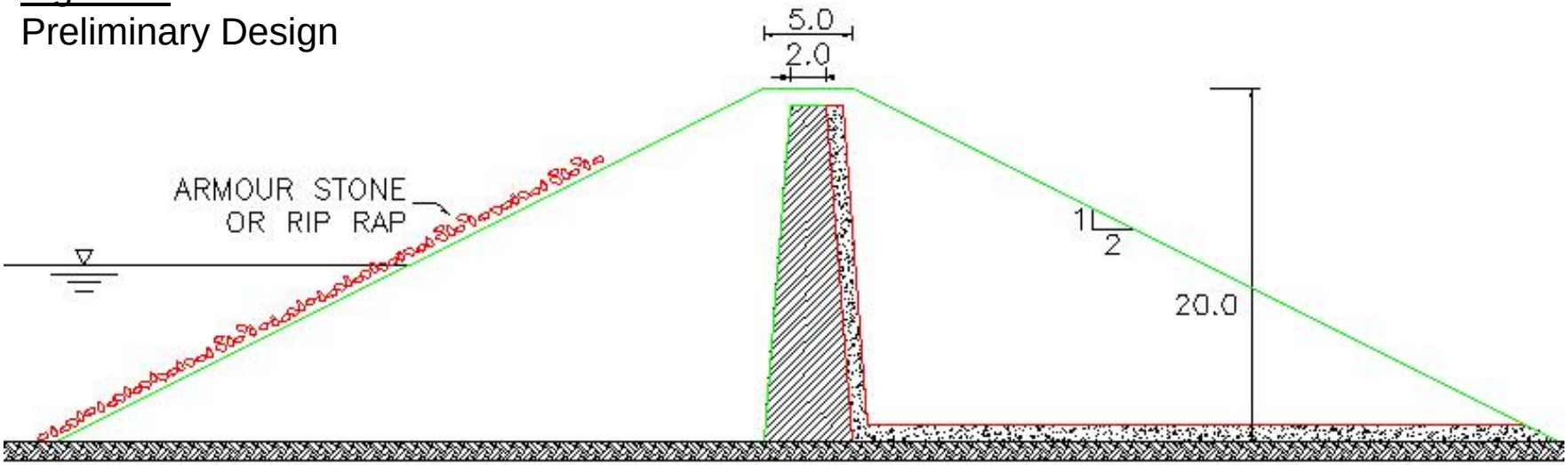
- Laboratory test results were comparable to those as tested by AMEC
- PEL will now proceed to the next phase to determine minimal achievable level of permeability
- Falling Head Permeability tests will be conducted on trial mixes using:
  - Additional silt
  - Sodium Bentonite filler
- Optimal mix design chosen as core material

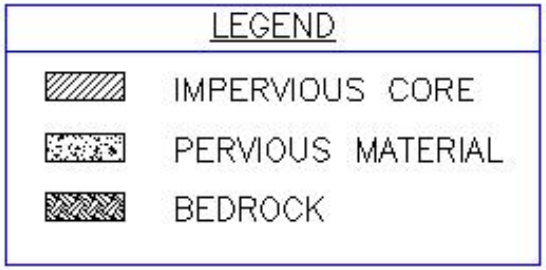
DESIGN CRITERIA

- Impervious core
- Stable embankments for construction and operations
- Seepage must not exert excessive forces on the structure
- Dam height must allow for settlement as well as wave action

DESIGN CRITERIA

Figure 6:
Preliminary Design





DESIGN CRITERIA

Armour Stone on upstream side of dam

- Large angular rock pieces
- Dissipate energy from water flows
- Erosion protection for intermediate layers and bedrock

Figure 7:
Armour Stone

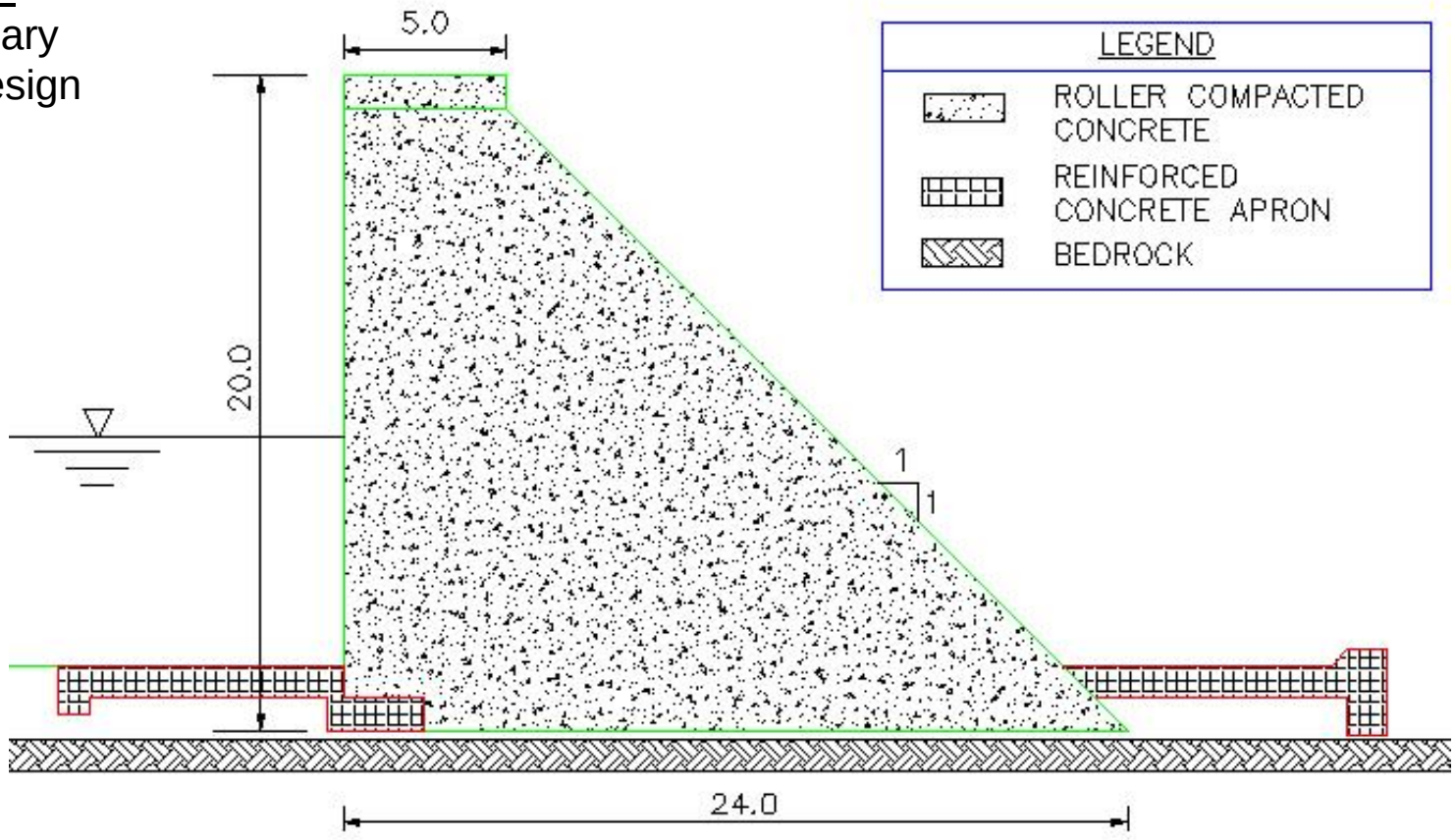
DESIGN CRITERIA

Intermediate Layers

- We will have several intermediate layers between the armour stone and core
- The size and composition of these layers will be dependent on the surrounding borrow areas
- Particle size will vary between layers, with the smaller particles being placed in layers near the core

ROLLER COMPACTED CONCRETE

Figure 8:
Preliminary
RCC Design



REMAINING OBJECTIVES

- Finalize impervious core design
- Cost estimate based on final design
- Final report and recommendations to client

QUESTIONS