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Sept. 26/84
NEDO visit

TELKWA COAL PROJECT

888628

PRESENTATION OUTLINE

- **MARKETING PROGRAM**
- **PROJECT LOCATION**
- **RESERVE EVALUATION**
- **MINING**
- **COAL PREPARATION**
- **TRANSPORTATION**
- **ENVIRONMENTAL**
- **SOCIO ECONOMIC**
- **PROJECT SCHEDULE**
- **SUMMARY**

MARKETING PROGRAM

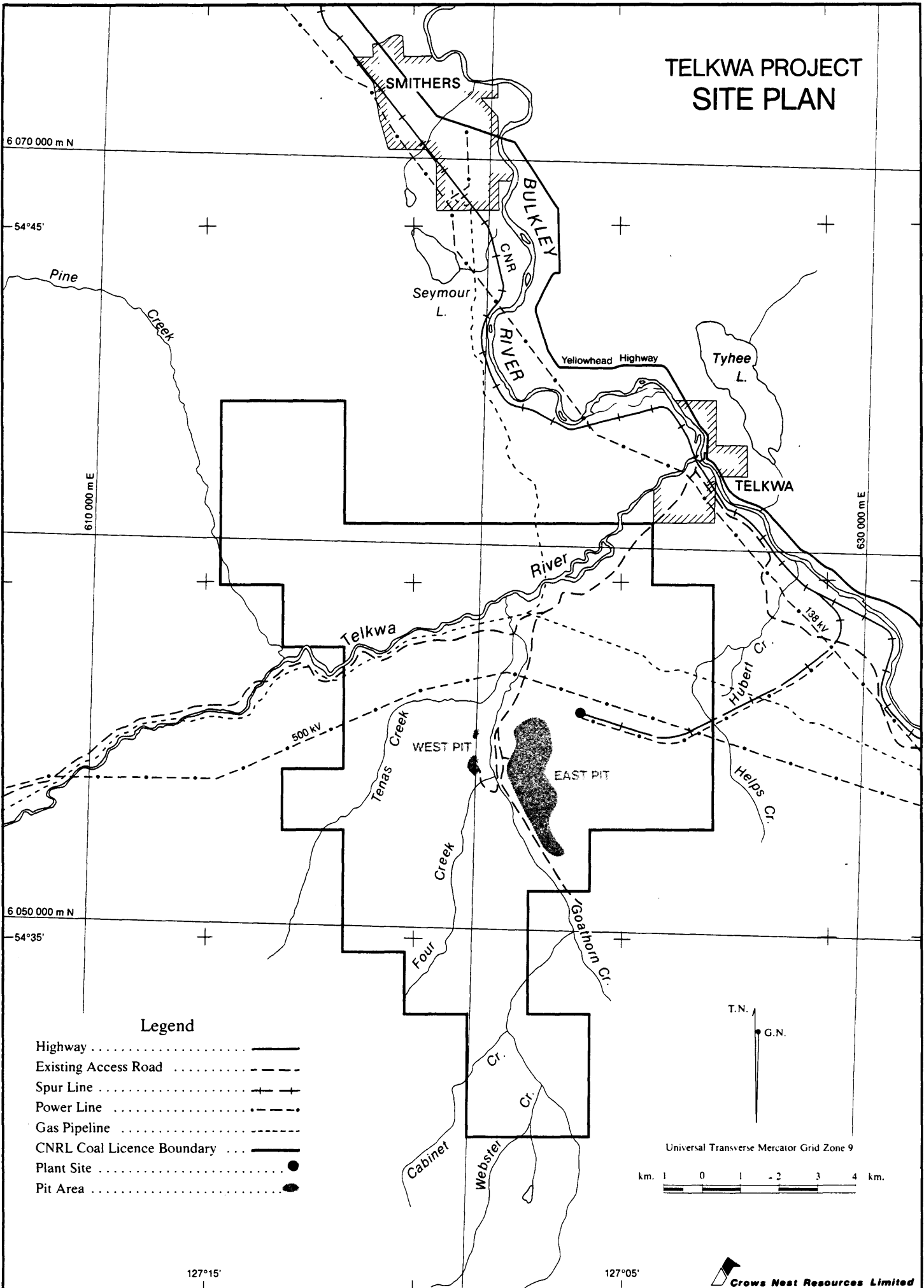
OBJECTIVES

- **Provide consumers with project background information.**
- **Outline technical/economic feasibility.**
- **Keep consumers up-to-date on project progress and respond to information requests.**
- **Establish consumer confidence in project.**
- **Confirm consumer demand.**
- **Initiate early discussion on coal purchase arrangement.**
- **Provide support for early CNRL capital commitment.**



**TELKWA PROJECT
LOCATION MAP**

TELKWA PROJECT SITE PLAN

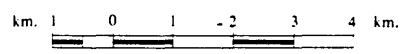


Legend

- Highway ———
- Existing Access Road - - - - -
- Spur Line + + + + +
- Power Line ·····
- Gas Pipeline - · - · - · - · - ·
- CNRL Coal Licence Boundary — · — · — · — · — ·
- Plant Site ●
- Pit Area ●

T.N.
G.N.

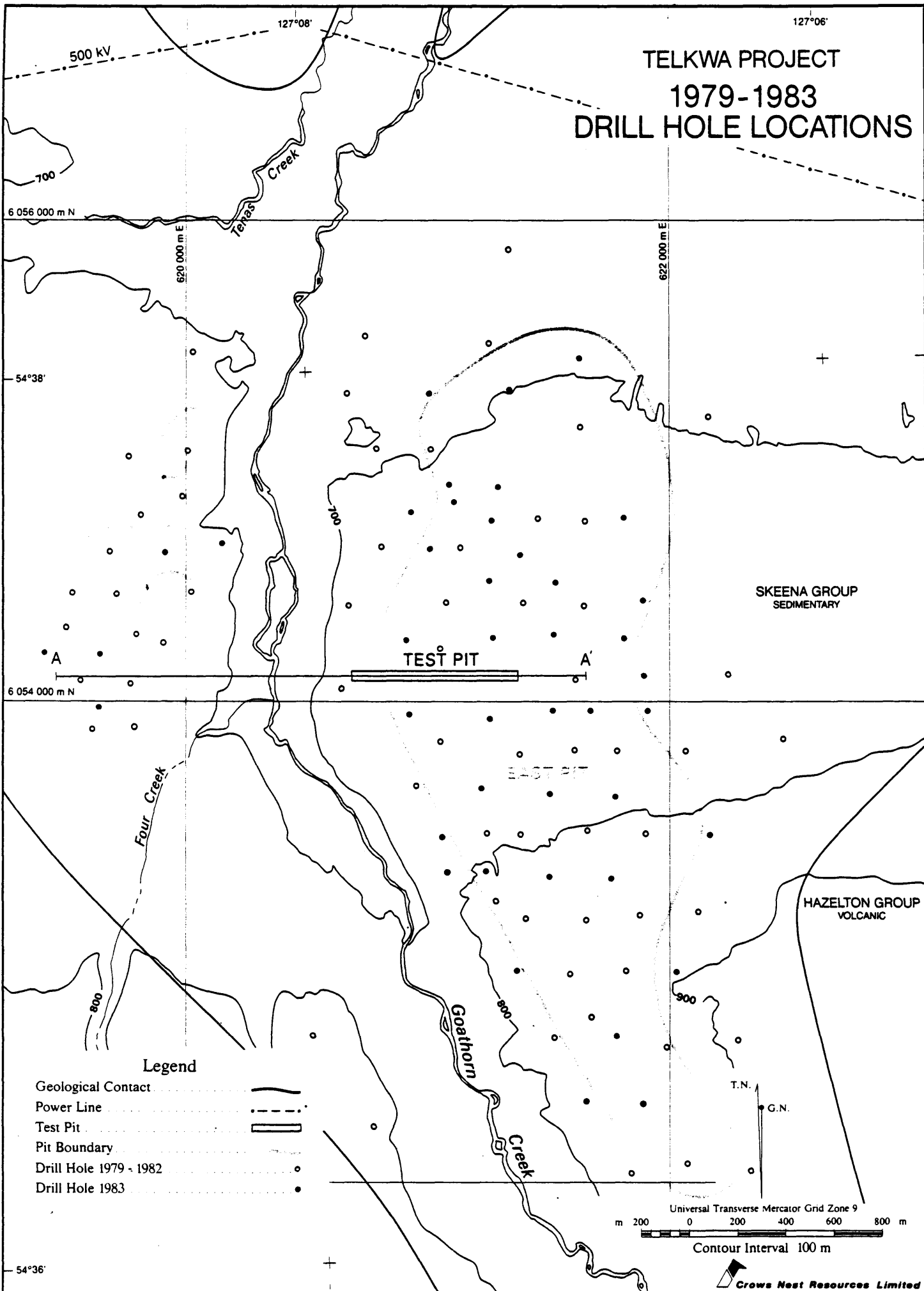
Universal Transverse Mercator Grid Zone 9



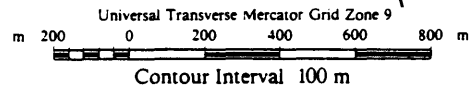
PROJECT LOCATION

- **Transportation Services:**
 - Regional airport at Smithers; daily service from Vancouver.
 - CN Rail mainline to Prince Rupert passes through Telkwa and Smithers.
 - 6 km spur line connecting onto mainline 5 km east of Telkwa.
 - Excellent highway to Prince Rupert and Vancouver.
- **Site Services:**
 - Established communities of Smithers and Telkwa.
 - Electricity tapped from 138 kV powerline 6 km from plantsite.
 - Natural Gas connection to gas pipeline.
 - Access to project site; 16 km highway Smithers to Telkwa, 8 km all weather road Telkwa to project site.
 - Water supply from wells and supplemented from Goathorn Creek.
- **Coal Licence Area:**
 - Total 12,622 hectares; 90% Crown coal holdings, 10% freehold.

TELKWA PROJECT 1979-1983 DRILL HOLE LOCATIONS



- Legend**
- Geological Contact
 - Power Line
 - Test Pit
 - Pit Boundary
 - Drill Hole 1979 - 1982
 - Drill Hole 1983



RESERVE EVALUATION

EXPLORATION SUMMARY 1979-1983

HOLES DRILLED		
ROTARY	18	2 900 m
DIAMOND	119	19 800 m
NUMBER OF SAMPLES ANALYZED 950		
BULK SAMPLES	4	150 mm CORES
	1	TEST PIT

- Holes drilled to delineate mining areas and intersect all coal seams.
- Rotary holes—reverse circulation chip samples.
- Diamond holes—core samples.
- All holes logged geophysically and geotechnically.
- Analyses include proximate, calorific value and sulphur for each coal increment.
- Drill hole spacing 200 m centers in mining area.
- 150 mm core hole samples used to extend test pit washability data to north and south in mining area and sample seams 4 and 5 which were not accessible in test pit.
- Test pit provided bulk samples for coal characterization, combustion trials, and data on mining method applications.

RESERVES

MINIMUM PROVEN RAW COAL	35 MMt
MINIMUM CLEAN COAL	24 MMt
ANTICIPATED ANNUAL PRODUCTION	
— STAGED DEVELOPMENT	0.7 TO 1.2 MMt

- Within mining areas only.
- Mining and geological losses 15%
- Plant yield 80-85%.
- Project life—20 years.

TELKWA PROJECT POTENTIAL RESERVES

6 070 000 m N

54°45'

610 000 m E

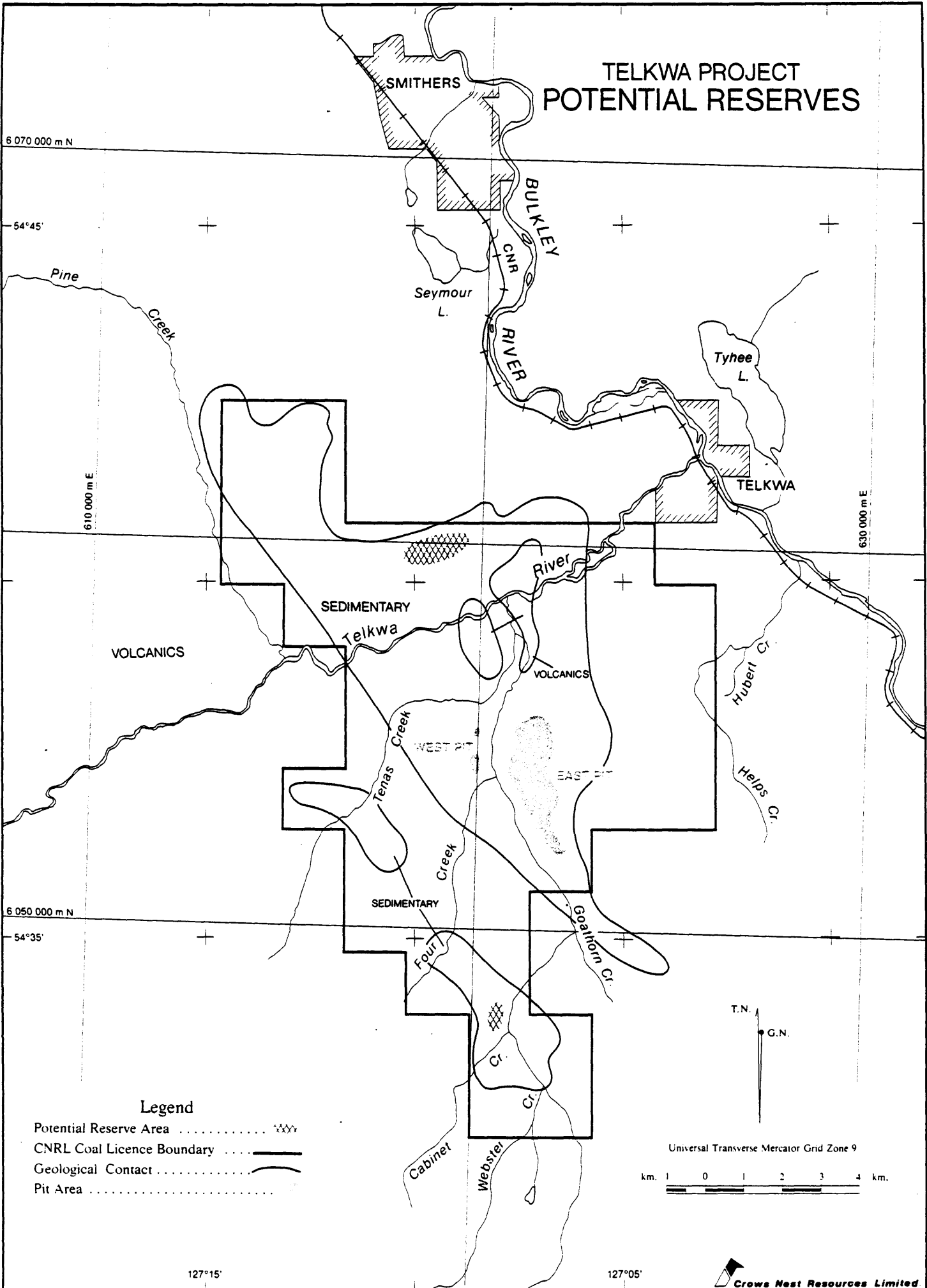
630 000 m E

6 050 000 m N





54°35'

127°15'

127°05'



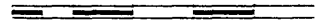
Legend

- Potential Reserve Area 
- CNRL Coal Licence Boundary 
- Geological Contact 
- Pit Area 



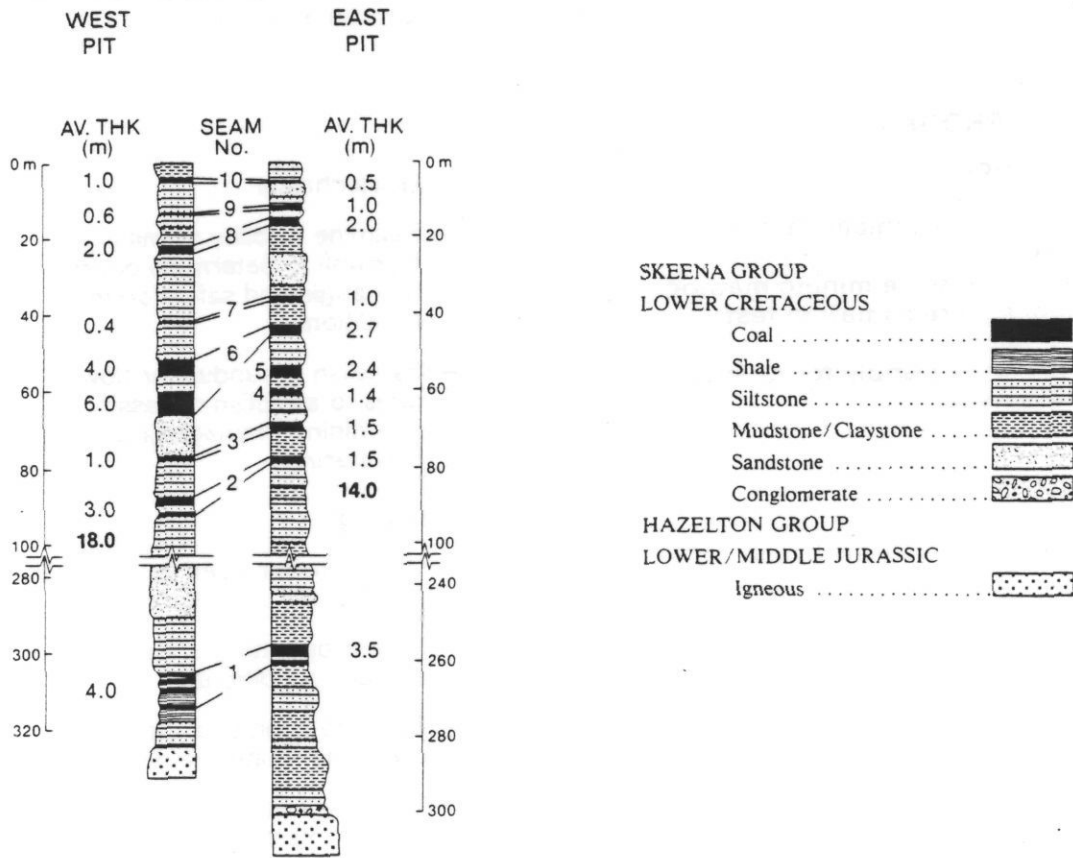
Universal Transverse Mercator Grid Zone 9

km. 1 0 1 2 3 4 km.

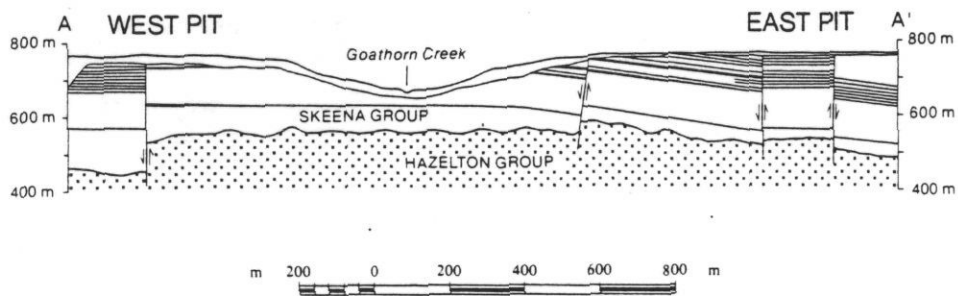


TELKWA PROJECT CROSS SECTION AND STRATIGRAPHIC SECTION

STRATIGRAPHIC SECTION



CROSS SECTION



MINING

An extensive test pit program was developed to simulate a small mining operation and to meet the objectives outlined.

TEST PIT PROGRAM

OBJECTIVES:

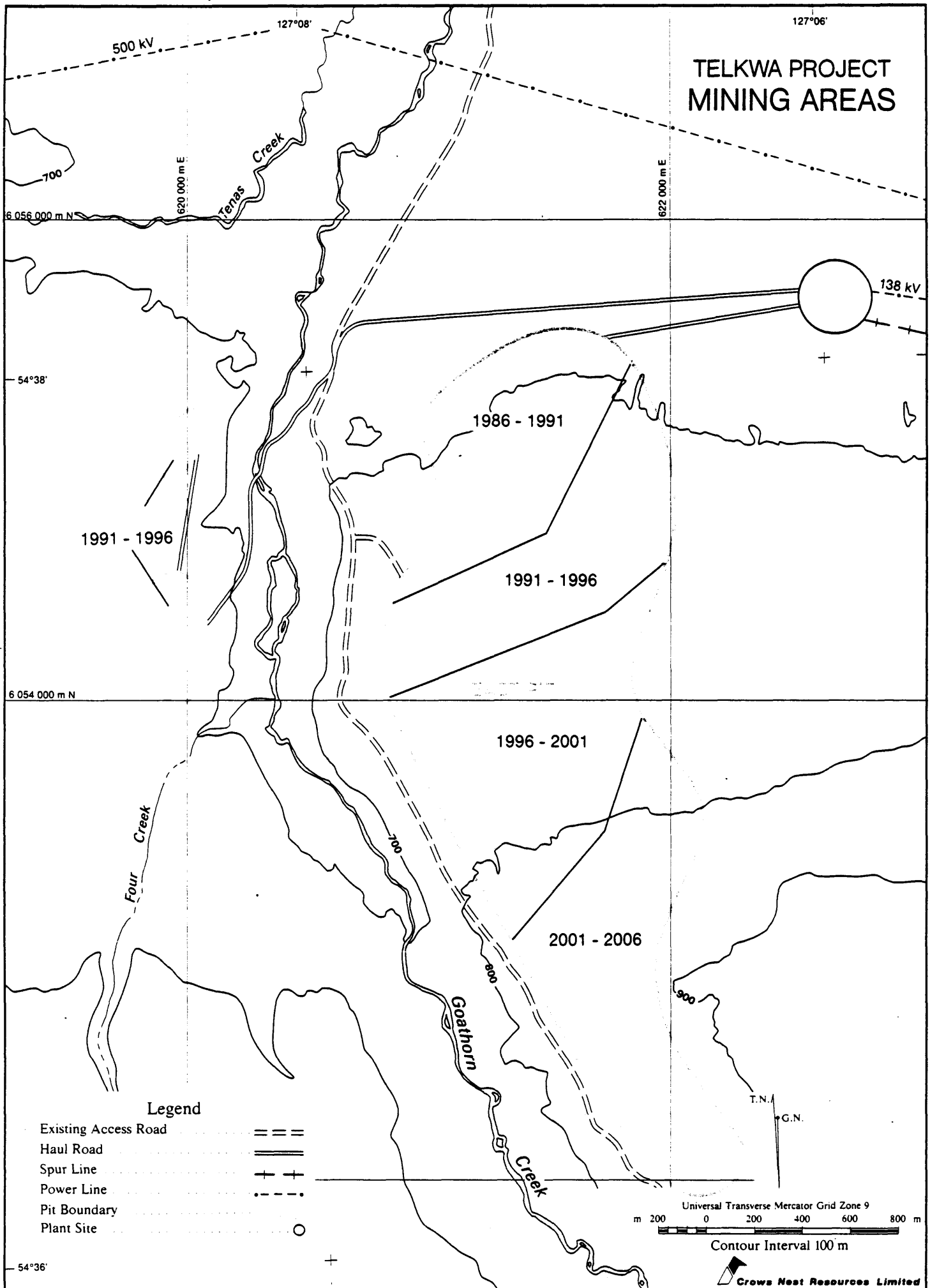
- Obtain geotechnical data for mine design.
 - Assess full scale mining methods
 - Establish a reclamation test program.
 - Obtain bulk sample for quality assessment.
- Geotechnical:
 - Examine stability of mining highwall to determine optimum wall angle and safe working conditions.
 - Establish groundwater flow rates to establish necessity of pre-mining drainage or in pit dewatering.
 - Mining:
 - Utilize similar sized equipment to full scale operation.
 - Assess operating under wet and dry conditions.
 - Evaluate in pit coal cleaning capability (minimize dilution).
 - Evaluate waste removal without blasting and confirm backfilling sequence.
 - Evaluate equipment performance for mine operations.
 - Reclamation:
 - Fulfill conditions of B.C. government.
 - Examine alternative methods of replacing overburden.
 - Evaluate regrowth of various types of vegetation and trees.

- Bulk Sample:
 - Determined amounts of each seam based on seam thicknesses.
 - Each seam sampled and stored separately.
 - Identified mineable and non-mineable seam partings.
 - Established nature of rock to coal contacts, effect on dilution.
 - Further details in section
—COAL PREPARATION.

CONCLUSIONS:

- Confirmed stable mining and ground-water conditions.
- Proved mining method and equipment selection
 - bulldozer/scrapper waste removal
 - no drilling and blasting
- Constructed and planted reclamation plots: established monitoring program.
- Samples seams 2 through 10 - 208 tonnes.

TELKWA PROJECT MINING AREAS



Legend

- Existing Access Road
- Haul Road
- Spur Line +
- Power Line
- Pit Boundary
- Plant Site +

Universal Transverse Mercator Grid Zone 9
m 200 0 200 400 600 800 m

Contour Interval 100 m



Crows Nest Resources Limited

MINE DESIGN:

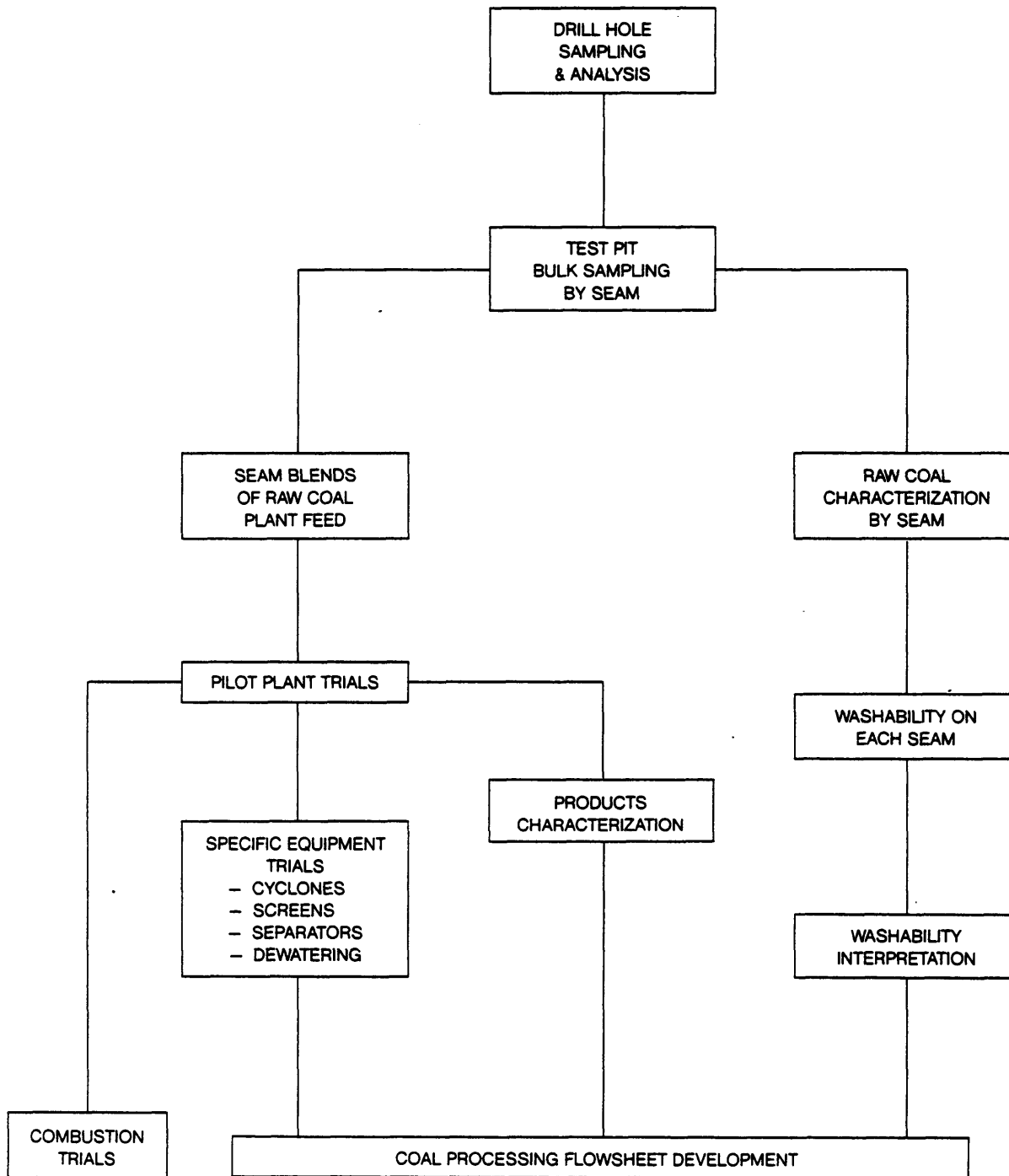
EQUIPMENT SECTION

- Waste Removal** — **Bulldozers/Scrapers
and Shovel/End Dump Trucks**
- Coal Removal** — **Hydraulic Excavator**
- Coal Haulage** — **Front End Loaders**
- Coal Haulage** — **End Dump Trucks**

MINING AREAS

- Mining blocks based on production level of 1.2 MMt per year.

TELKWA PROJECT COAL QUALITY ASSESSMENT



COAL PREPARATION

COAL QUALITY ASSESSMENT

DRILL HOLE SAMPLING AND ANALYSIS

TEST PIT BULK SAMPLING BY SEAM

- Recovery of coal samples from test pit.
- Sample size based on seam thickness:

RAW COAL CHARACTERIZATION BY SEAM

- Analyses:
 - Sample homogenization
 - Proximate analysis and calorific value.
 - Particle size distribution; ash, sulphur, and residual moisture on each size increment.
 - Solids flow property analysis.
- Wet Attrition Testing:
 - Particle size distribution; ash, sulphur, and residual moisture on size increments.
 - Simulate size breakdown in preparation process.

WASHABILITY ON EACH SEAM

- Float/Sink testing:
 - Washability curves
- Flotation Testing

- Products Characterization:
 - Coal: proximate and ultimate analysis, calorific value, hardgrove grindability index, petrography, ash fusion temperatures, mineral ash composition, sulphur, chlorine.
 - Refuse: proximate analysis, calorific value, mineral ash composition, pH, flocculant testing.

WASHABILITY INTERPRETATION

- Identify product coal quality parameters: ash sulphur, moisture, volatile matter, calorific value, process yield

SEAM BLENDS OF RAW COAL PLANT FEED

- Prepare an all seam blend weighted by seam thickness, seams 2 to 10.
- Prepare blends (3) for specific equipment trials

PILOT PLANT TRIALS

- Plant Feed Characterization:
 - Proximate analysis
 - Particle size distribution; ash, sulphur, and residual moisture on size increments

PRODUCTS CHARACTERIZATION

- Coal: proximate and ultimate analysis, calorific value, hardgrove grindability index, petrography, ash fusion temperatures, mineral ash composition, sulphur, chlorine, trace elements, solids flow property analysis, dustiness test, spontaneous combustion test.

SPECIFIC EQUIPMENT TRIALS

- Refuse: proximate analysis, calorific value, mineral ash composition, refuse storage stability
- Cyclones:
 - Heavy media
 - Water only
- Screens:
 - Mogensen Sizer (dry 2-10 mm)
 - Multi-vib screen (wet 0.15 mm)
- Separators:
 - Jeffery jig (100 x 10 mm)
 - McNally Pittsburg jig (100 x 10 mm)
 - Deister tables (10 x 0.6 mm)
 - Reichert Spiral (10 x 0 mm)
 - Humphrey Spiral (10 x 0 mm)
- Dewatering (0.15 x 0 refuse):
 - Wemco H900 Centrifuge (0.6 x 0.15 mm)
 - Enviro—clear thickener
 - Lamella thickener
 - Arus-Andrus filter press
 - Larox filter press
 - Edwards and Jones filter press

COAL PROCESSING

- Compare pilot wash plant program results with washability studies
- Evaluate and apply specific equipment trials.
- Prepare flowsheet diagram.

COMBUSTION TRIALS

- Comminution and Handling:
 - Pulverized particle size distribution
 - Mill grind and wear test

- Combustion Reactivity:
 - Ignition and flame stability
 - Carbon burnout
 - Thermal Gravimetric Analysis (inert and O₂ atmosphere)

- Slagging and Fouling Potential:
 - Elemental ash analyses
 - Ash viscosity/temperature relationship
 - Accepted Empirical Indices (e.g. base: acid ratio, fouling indicators, etc.)
 - Fireside deposits
 - Corrosion potential

- Flue Gas Emissions:
 - Sulphur oxides
 - Sulphur balance (S in ash)
 - Nitrous oxides

- Precipitability of fly ash:
 - Dust loading including particle size distribution
 - Combustible content of fly ash
 - Resistivity
 - Elemental ash analyses

- Abrasiveness:
 - Characterize the abrasiveness of Telkwa coal on mill wear rate
 - Limitation on flue gas velocities

- Combustion performance based on a comparison with other proven coals

COAL ANALYSIS BASED ON PILOT PLANT TRIAL—ALL SEAM BLEND

PROXIMATE ANALYSIS

	Raw Coal	Clean Coal
TOTAL MOISTURE %	7.0	8.0
RESIDUAL MOISTURE % (ADB)	1.5	1.5
ASH % (ADB)	20-25	10-11
VOLATILE MATTER % (ADB)	25-27	27-29
SULPHUR % (ADB)	1.25	1.0
GROSS KCAL/KG (ADB)	6 200 - 6 400	7 000 - 7 200

**ULTIMATE ANALYSIS
(DRY ASH FREE)**

CARBON	85.1	SULPHUR PYRITIC	0.4
HYDROGEN	5.0	ORGANIC	0.7
NITROGEN	1.2	SULPHATE	TRACE
OXYGEN	7.6	TOTAL	1.1

ASH ANALYSIS (%)

SiO ₂	54.02	SO ₃	3.62
Al ₂ O ₃	22.95	Na ₂ O	0.25
Fe ₂ O ₃	9.95	K ₂ O	0.37
TiO ₂	1.10	P ₂ O ₅	1.31
CaO	4.66	Undetermined	0.09
MgO	1.68		

**ASH FUSION TEMPERATURES °C
(REDUCING)**

INITIAL	1 260
SOFTENING	1 310
HEMISPHERICAL	1 349
FLUID	1 416

COAL FIRESIDE BEHAVIOUR

COAL SLAGGING AND FOULING PARAMETERS

	Bituminous	Slagging /Fouling
Ash Type		
Base: Acid Ratio	0.22	Low
Slagging Index R_s	0.22	Low
Fouling Index R_f	0.05	Low
Chlorine Content	0.02	Low
Total Alkali Content	0.05	Low

- Ash Type:

Bituminous if
 $\text{CaO} + \text{MgO} < \text{Fe}_2\text{O}_3$

Lignitic if
 $\text{CaO} + \text{MgO} > \text{Fe}_2\text{O}_3$

- Base/Acid Ratio:

$$\frac{\text{Fe}_2\text{O}_3 + \text{CaO} + \text{MgO} + \text{K}_2\text{O} + \text{Na}_2\text{O}}{\text{Al}_2\text{O}_3 + \text{SiO} + \text{TiO}_2}$$

- Slagging Index, R_s :

Bituminous Type Ash

$R_s = \text{Base/Acid Ratio} \times \%S$
 in coal.

R_s	Slagging Factor
<0.6	Low
0.6 - 2.0	Medium
2.0 - 2.6	High
>2.6	Severe

- Fouling Index, R_f :

Bituminous Type Ash

$R_f = \text{Base/Acid Ratio} \times \% \text{Na}_2\text{O}$
 in coal.

The following ranges are applied:

R_s	Slagging Factor
<0.2	Low
0.2 - 0.5	Medium
0.5 - 1.0	High
> 1.0	Severe

- Chlorine Content:

<u>Total % Cl in coal</u>	<u>Fouling Type</u>
<0.2	Low
0.2 - 0.3	Medium
0.3 - 0.5	High
>0.5	Severe

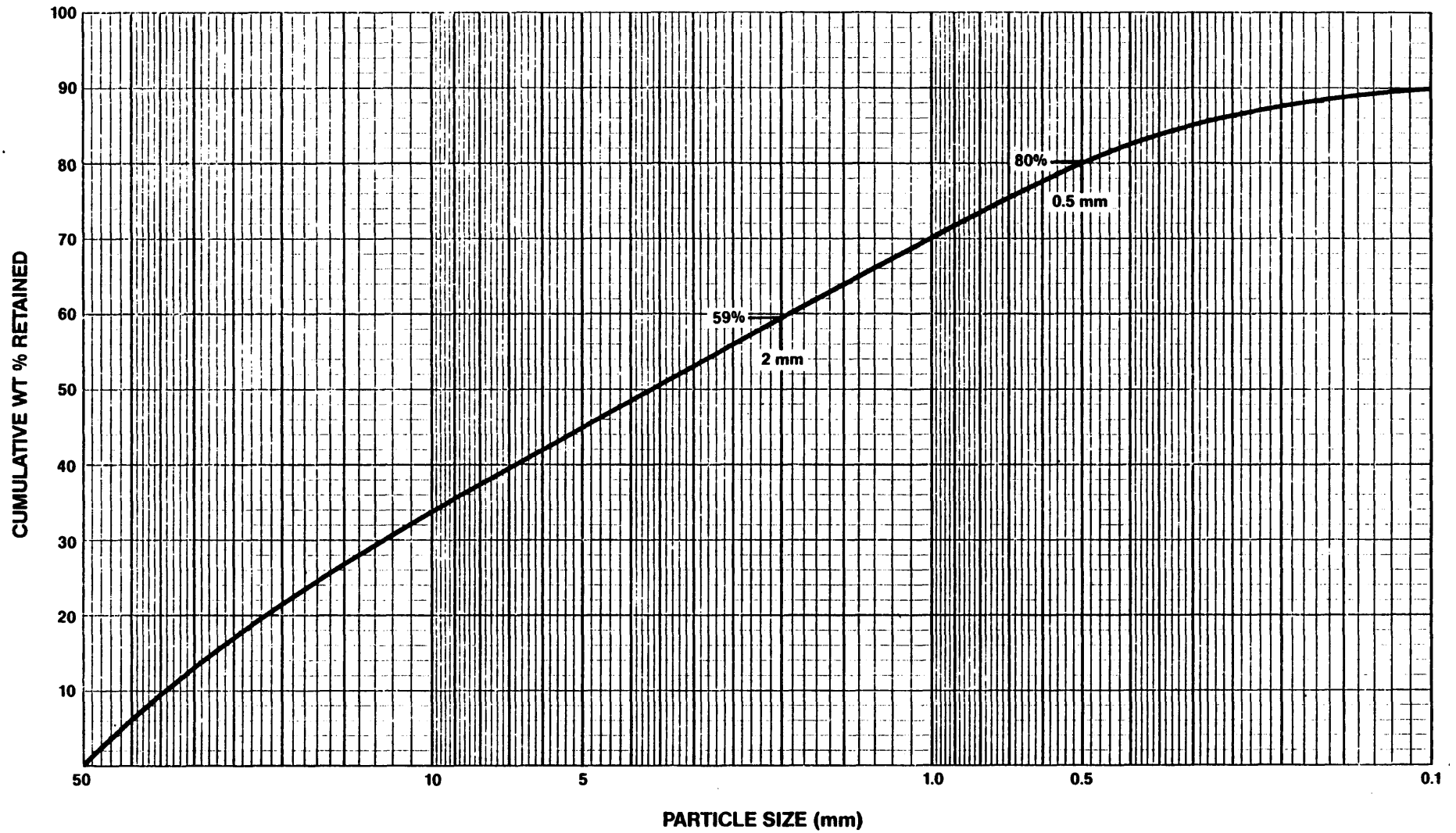
- Total Alkali Content:

Bituminous Type Ash

$$\text{Total Alkali (in coal)} = \frac{\%Na_2O \text{ (in ash)} + .6589 \times \%K_2O \text{ (in ash)} \times \frac{\%Ash}{100}}$$

<u>Total Alkali</u>	<u>Fouling Type</u>
<0.3	Low
0.3 - 0.45	Medium
0.45 - 0.6	High
>0.6	Severe

TELKWA PROJECT
CLEAN COAL SIZE DISTRIBUTION

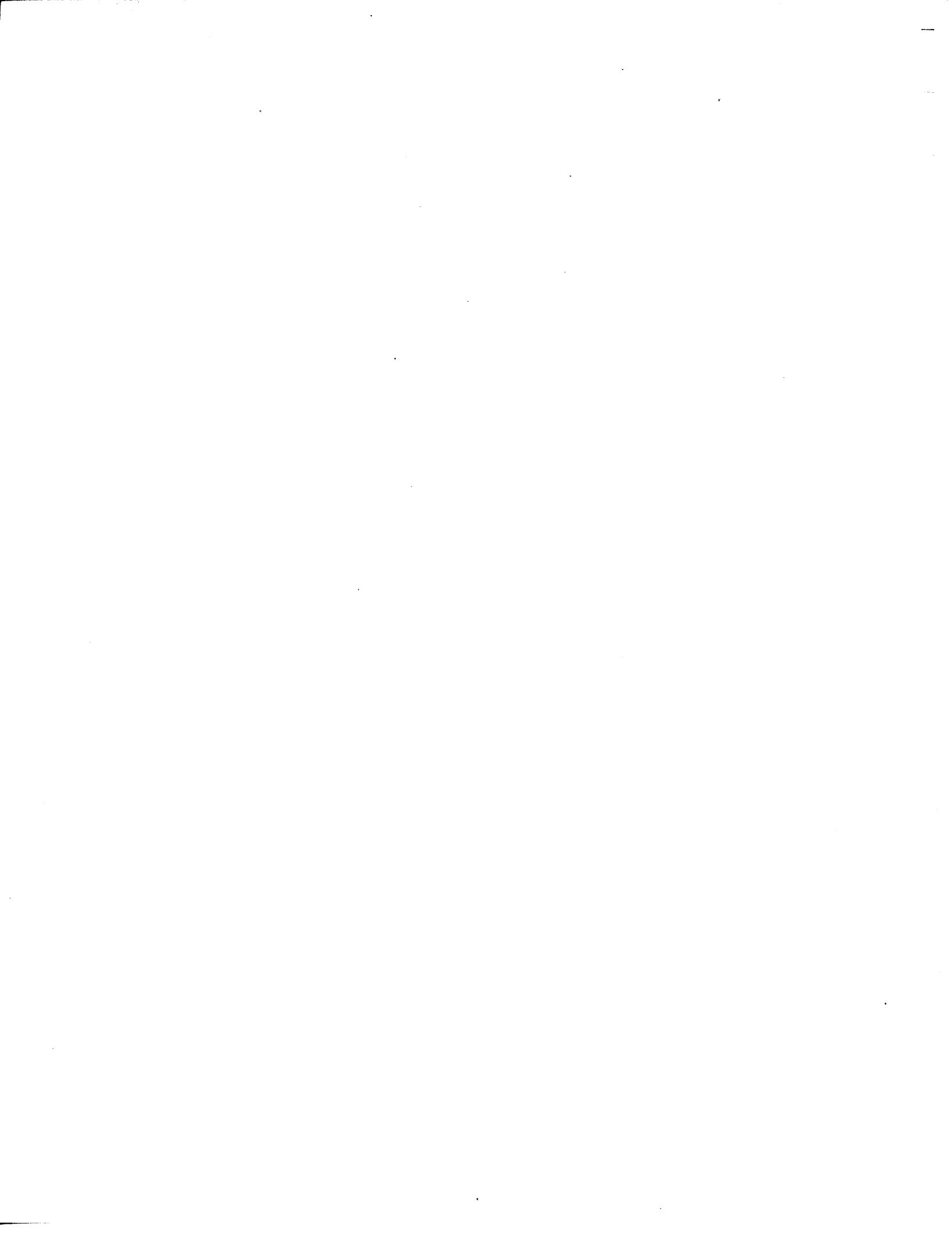


SIZE DISTRIBUTION CLEAN COAL

SIZE (mm)	Wt%	CUMULATIVE
		Wt %
50 x 25	15	15
25 x 12.5	15	30
12.5 x 6	12	42
6 x 3	11	53
3 x 2	6	59
2 x 0.5	21	80
0.5 x 0.15	9	89
0.15 x 0	11	100

• Based on wet attrition test to simulate coal handling from mine to port.

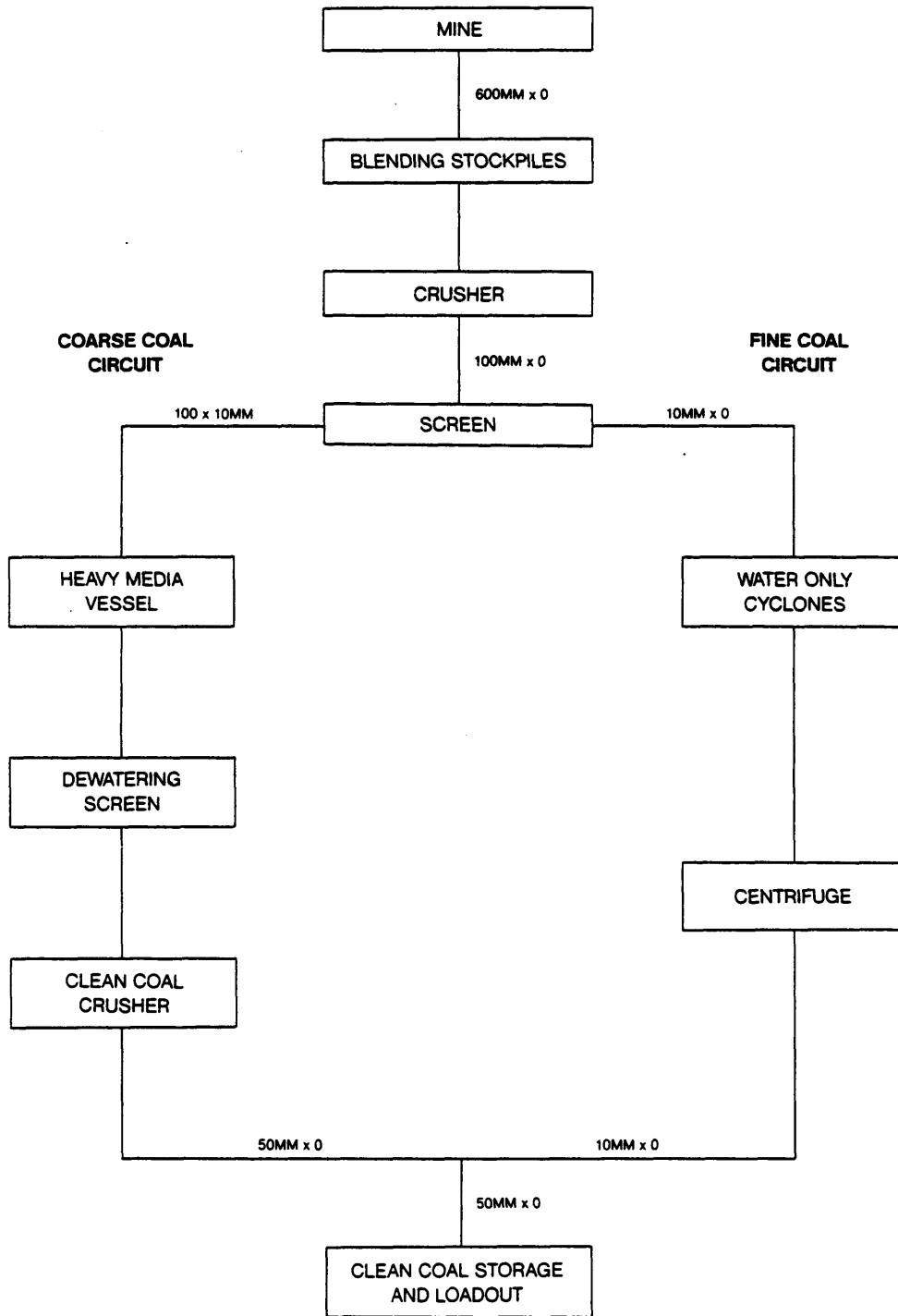
HARDGROVE GRINDABILITY INDEX 60



COAL PERFORMANCE

- Good handleability
- Low Ash; High Calorific value
- High Volatile Matter
 - Good flame stability
 - Good carbon burnout
 - Good turndown flexibility
- Low Slagging and fouling characteristics
- Good Precipitator Performance

TELKWA PROJECT PREPARATION PLANT CONCEPTUAL FLOWSHEET



PREPARATION PLANT CONCEPTUAL FLOWSHEET

Mine

- Several coal mining faces active
- Truck dump at plantsite

Blending Stockpiles

- Stockpile separately coal seams of similar quality

Crusher

- Crush all oversize coal to minus 100 mm.

Screen

- Used to direct coal into coarse and fine coal processing circuits.

Coarse and Fine Coal Circuits

- Unit operations shown are typical but may change after specific equipment trials (COAL QUALITY ASSESSMENT)
- Clean coal top size will be 50 mm.

Clean Coal Storage and Loadout

- Clean coal storage capacity and loadout system will be dependent on preparation plant capacity and train turn around time.

TELKWA PROJECT STEAMING TIMES TO JAPAN



TO	FROM PRINCE RUPERT	FROM VANCOUVER
TOMATOATSUMA	11 DAYS	12 DAYS
SHIN ONODA	13 DAYS	14.5 DAYS

TRANSPORTATION

- Unit train from plant to port
 - 6 km spur from plant to CN Rail mainline
 - 385 km of existing track to port (used by unit trains)
 - Ultra modern port and terminal facilities at Ridley Island.
- Unit Trains:
 - 6 km spur line to be constructed on alignment shown
 - 70-80 cars in dedicated service between Telkwa and Ridley Island
 - Present track is upgraded to unit train standards
 - Turn around time - 38 hours.
 - Port:
 - Throughput capacity 12 million tonnes per year
 - Stockpile capacity 1.2 million tonnes
 - Loading rate 2 x 4,000 tonnes per hour
 - Vessel limitations

DWT	250,000 tonnes
length	325 metres
draft	20 metres
beam	50 metres

ENVIRONMENTAL

Reclamation Studies

- Detailed soils and terrain
- Chemical analysis of overburden
- Reclamation test plots

- Existing use is primarily forestry and agriculture
- Major thrust of reclamation will be to restore the forestry and agricultural productivity as well as re-establish wildlife habitats
- 3 studies in progress; details available in Stage I submission.

Baseline Studies

- Air and water quality
- Fish and Wildlife
- Meteorology

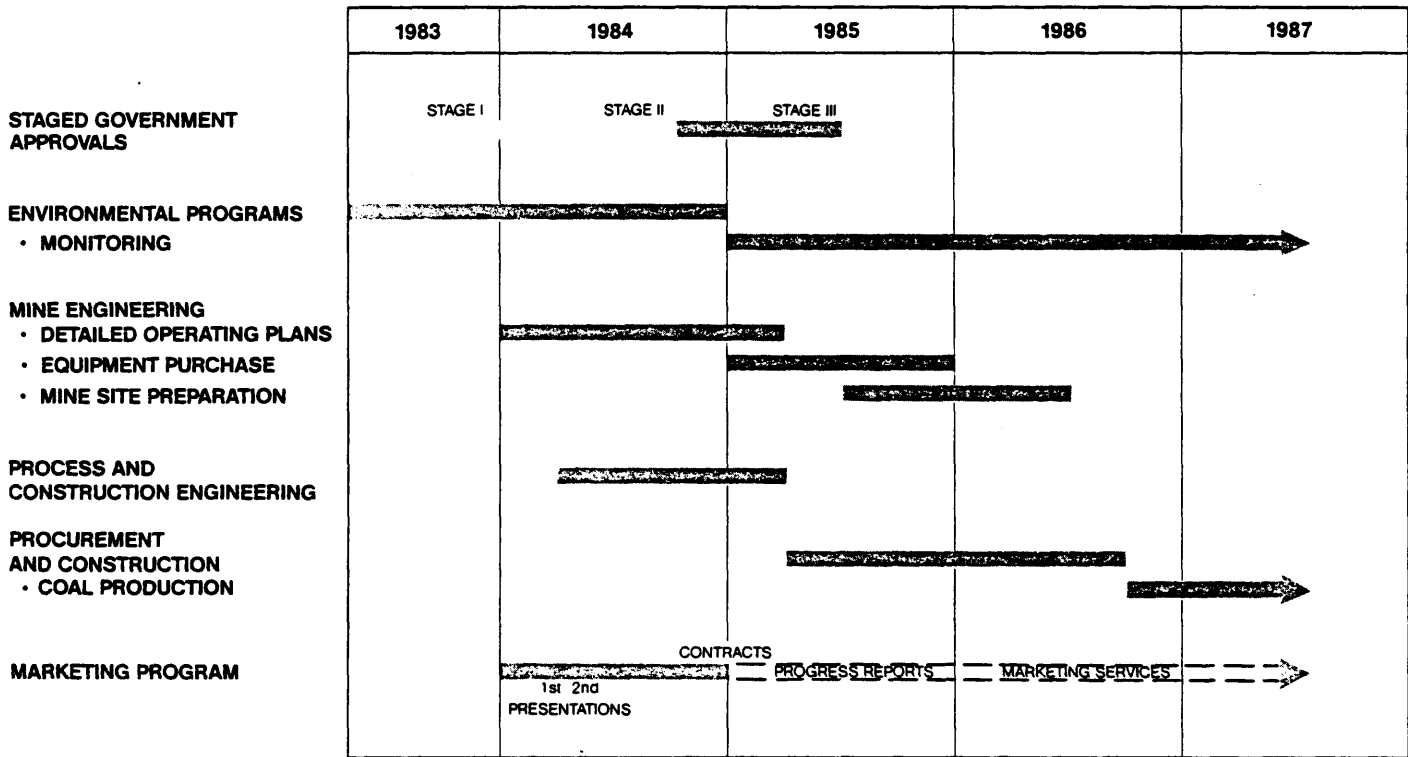
- Identify impact of and interaction between the proposed development and the environment
- Programs initiated in 1982
- Eleven (11) studies in progress; details available in Stage I submission

SOCIO ECONOMIC

Socio Economic Program

- **Community services in place**
 - **Local contractors able to meet increased housing demand**
 - **Skilled manpower available both locally and regionally**
 - **Strong local support for the Telkwa project**
- **Populations: Smithers 4,500; Telkwa 835**
 - **Education, health and social services well established and staffed**
 - **Ample developed land available to meet future needs of residents**
 - **Strong resource based industries, logging, mining, and agriculture providing a skilled manpower pool**
 - **Local residents are well informed about the project activities and welcome project**
 - **Recreational facilities in place (golf course, ski hill, fishing).**

TELKWA PROJECT SCHEDULE



SUMMARY

TELKWA PROJECT

- **Favourable Location**
- **Favourable Mining Conditions**
- **Attractive Coal Quality**
- **Established Infrastructure**

ECONOMICALLY AND TECHNICALLY COMPETITIVE PROJECT

FOLLOW UP PRESENTATION

- **More detailed geological, mining and coal preparation information**
- **Additional coal quality and combustion data**
- **Further definition of purchasing arrangements**