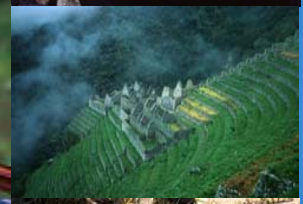


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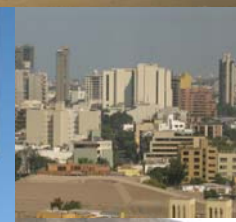
TICLIO
LUGAR TURISTICO
4,818 msnm




Soyuz
AREQUIPA


COOPERACIÓN
ESPAÑOLA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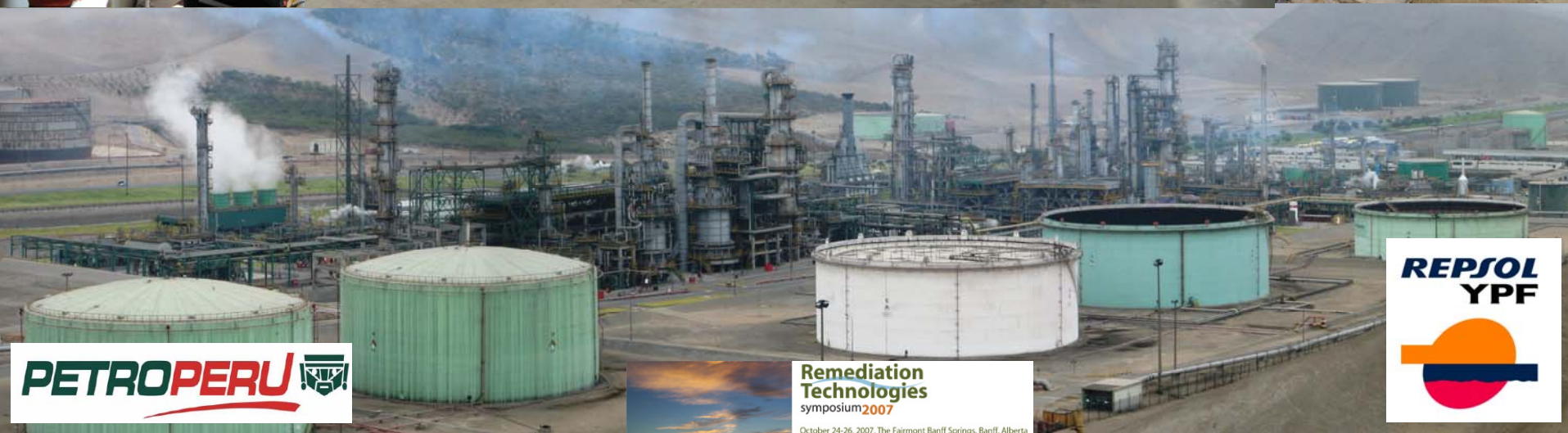
KOMATSU
HAZCO del Peru S.A.

Management of Environmental Liability & Remediation of the La Pampilla Oil Refinery, Lima, Peru



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Remediation Technologies symposium2007

October 24-26, 2007, The Fairmont Banff Springs, Banff, Alberta

REPSOL YPF

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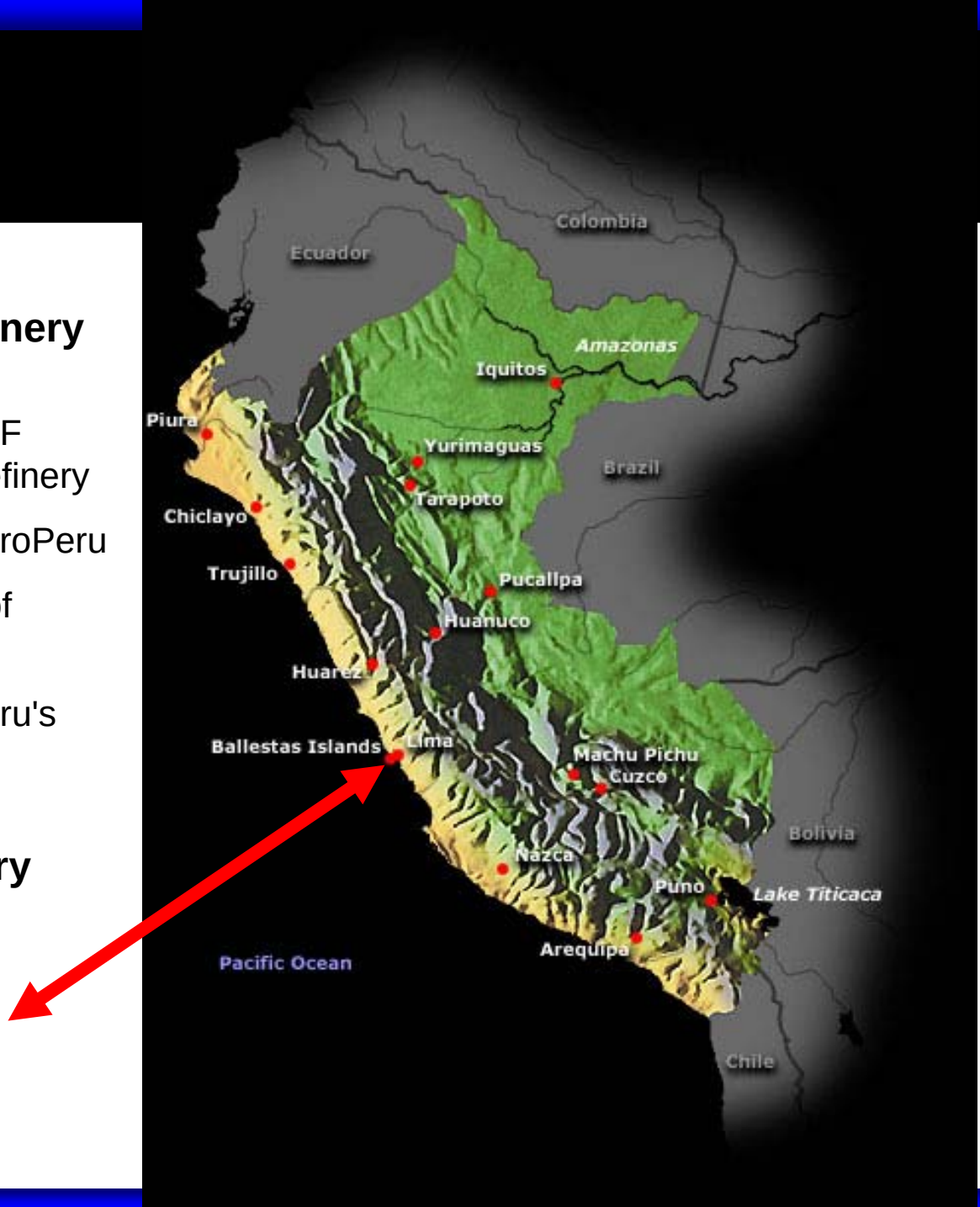
La Pampilla Oil Refinery
Lima, Peru

- June of 1996 Repsol YPF purchased 60% of the refinery
- initial privatization of PetroPeru
- refinery has a capacity of 102,000 barrels per day
- supplies over 50% of Peru's petroleum products

La Pampilla Refinery



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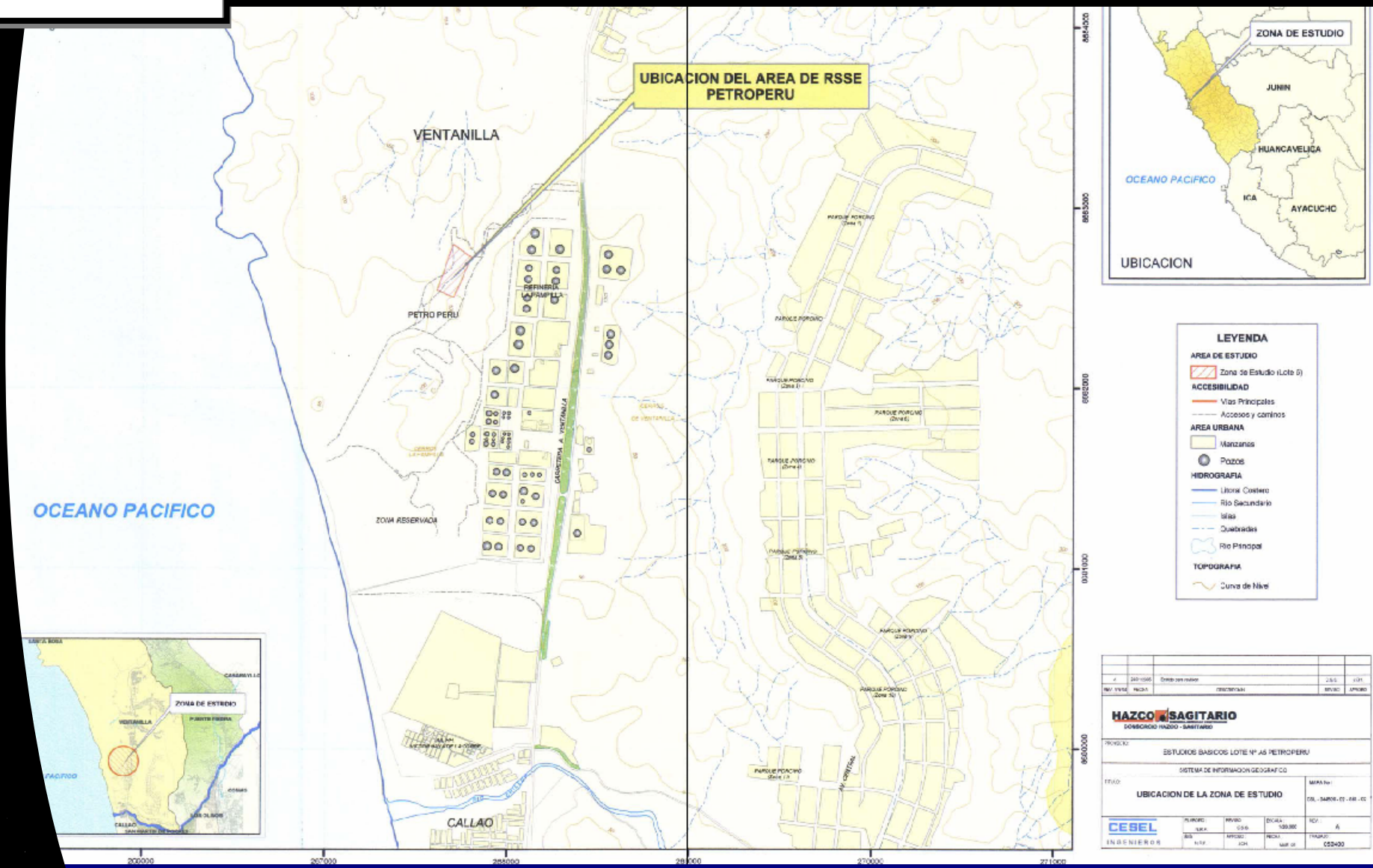
Refinery Diagram



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Before (circa 1994)

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Before cont… (circa 1994)

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Before cont… (circa 1994)

Before cont… (circa 2000)

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After (2006)

After (2007)

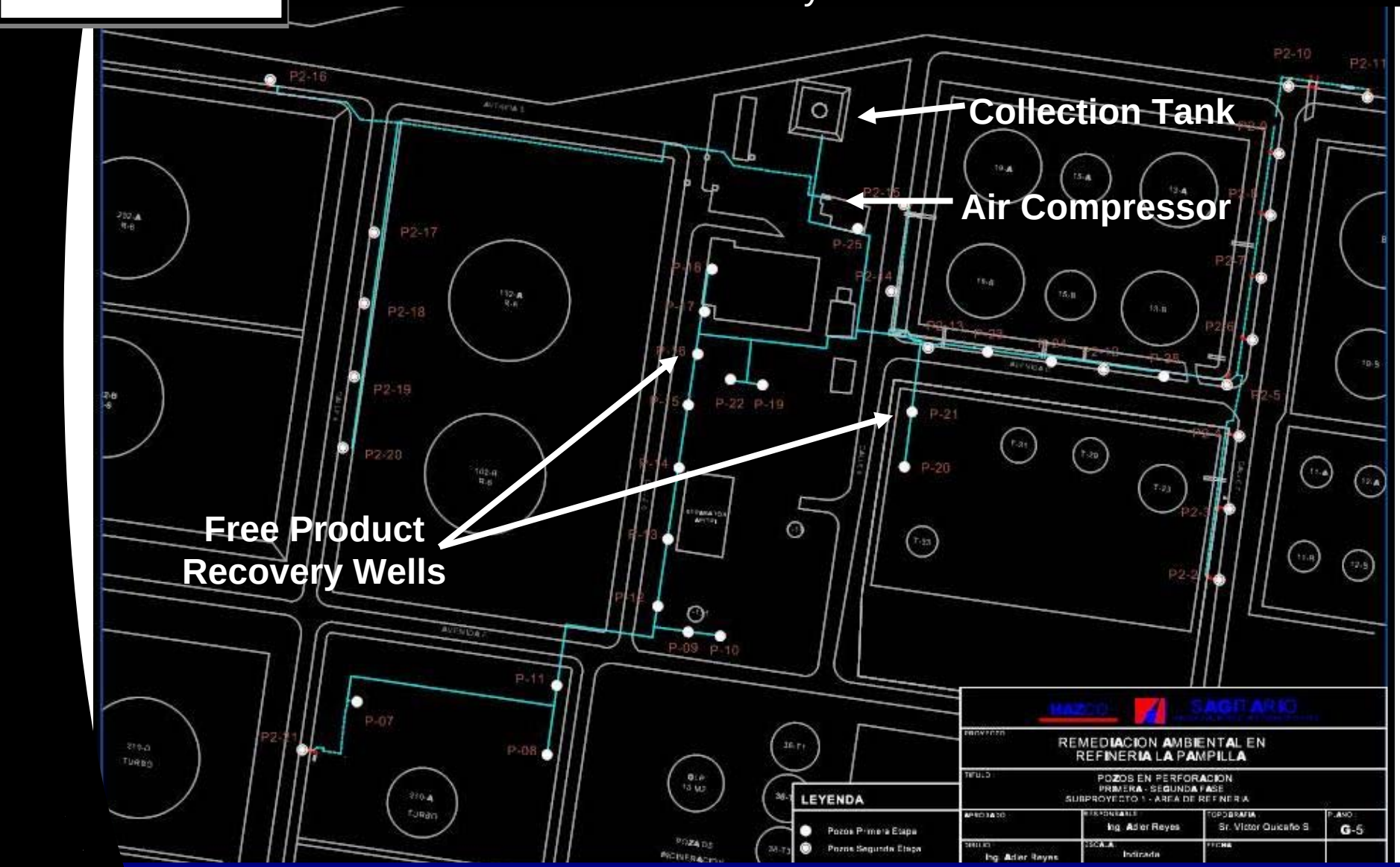
Remediation Begins in 2001

La Pampilla Refinery Project

- Project divided into 5 Sub-Projects
- Task oriented sub-projects
  - SP1 - Free product recovery in refinery area
  - SP2 - Free product recovery in beach area
  - SP3 - Secure industrial/hazardous landfill
  - SP4 - Bioremediation of treatable soil contamination
  - SP5 - Characterization, handling and shipping of hazardous historical waste

Sub-Project 1

Free Product Recovery “Refinery”
Recovery well locations



Sub-Project 1

Skimmer System

Pneumatic Skimmer

Used for free product recovery in the refinery area.

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Sub-Project 1

Construction

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Sub-Project 1

Operation

REPSOL YPF

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Sub-Project 1

Scope

Volumes

- 33,000 bbls contractual volume
- Estimated product thickness < 1 cm by the environmental assessment

- 40, 200 mm diameter, 18 m deep recovery wells
- 20 skimmer pumps, optimum pump rotation
- 24 hr avg = 214 bbls

- contractually recovery was 9 years
- 33,000 bbls recovered in 3.5 years

Final Disposal

- sent to PetroPeru Conchan refinery

Sub-Project 1

Technical Challenges and Solutions

Technical Challenges

- Submersible electrical draw down pump.
- Water extraction and infiltration system.
- Pilot test for hydrocarbon recovery.
- Hydrocarbon recovery is equal not using submersible pumps.

Technical Solutions

- Optimization of the skimmer pumps.
- Product recovery rate.

Sub-Project 1

Milestones

Success

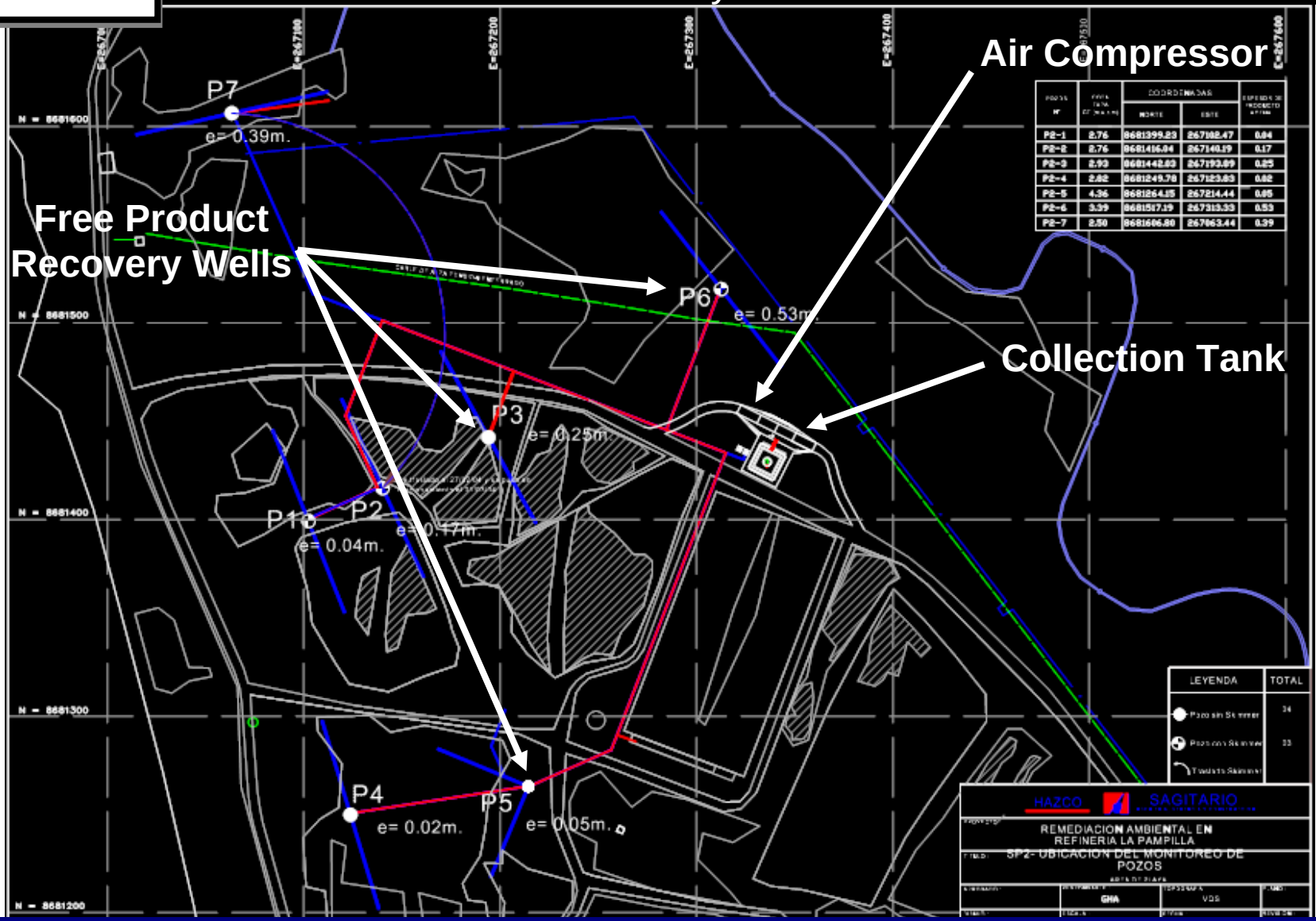
- Expedited recovery of 33,000 bbls free product.
- To date we have recovered 49,400 bbls.
- 150% of the contracted volume.

Project Future

- Applying to client for project extension to January 2009.
- Product thickness on the ground water table is remaining stable.

Sub-Project 2

Free Product Recovery “Beach”
Recovery well locations



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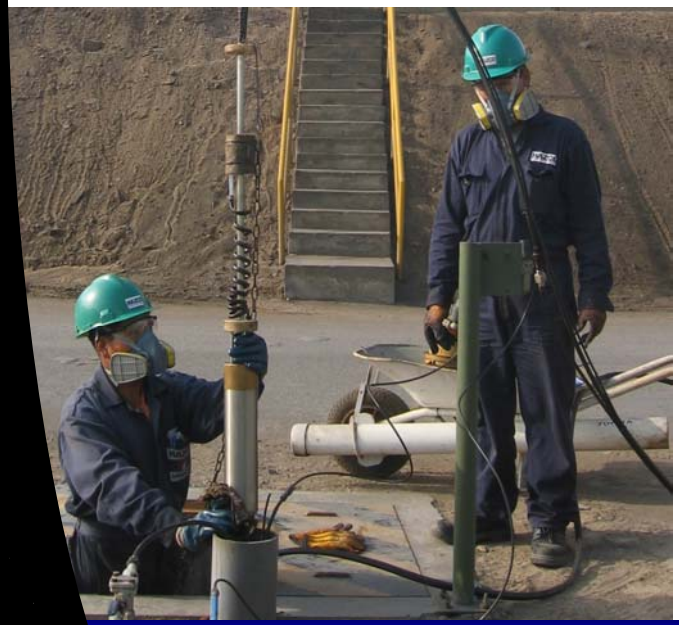
Sub-Project 2

Operation



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Sub-Project 2

Scope

Volumes

- 2000 bbls contractual volume
- estimated product thickness < 1 cm by the environmental assessment

- 7, 200 mm diameter, 6 m deep recovery wells
- 2 skimmer pumps
- Manual pump recovery (2 hand pumps)

- contractually recovery was 2 years, 2000 bbls
- 2000 bbls recovered in 22 months

Final Disposal

- sent to PetroPeru Conchan refinery

Sub-Project 2

Technical Challenges and Solutions

Technical Challenges

- Slow recovery of the extraction wells.
- Viscosity of the product was variable.
- Irregular cycles of recovery using skimmer pumps.

Technical Solutions

- Use of the manual recovery pumps.
- Economics of manual extraction vs. automated.
- Manual product recovery rate > automated recovery rates.

Sub-Project 2

Milestones

Success

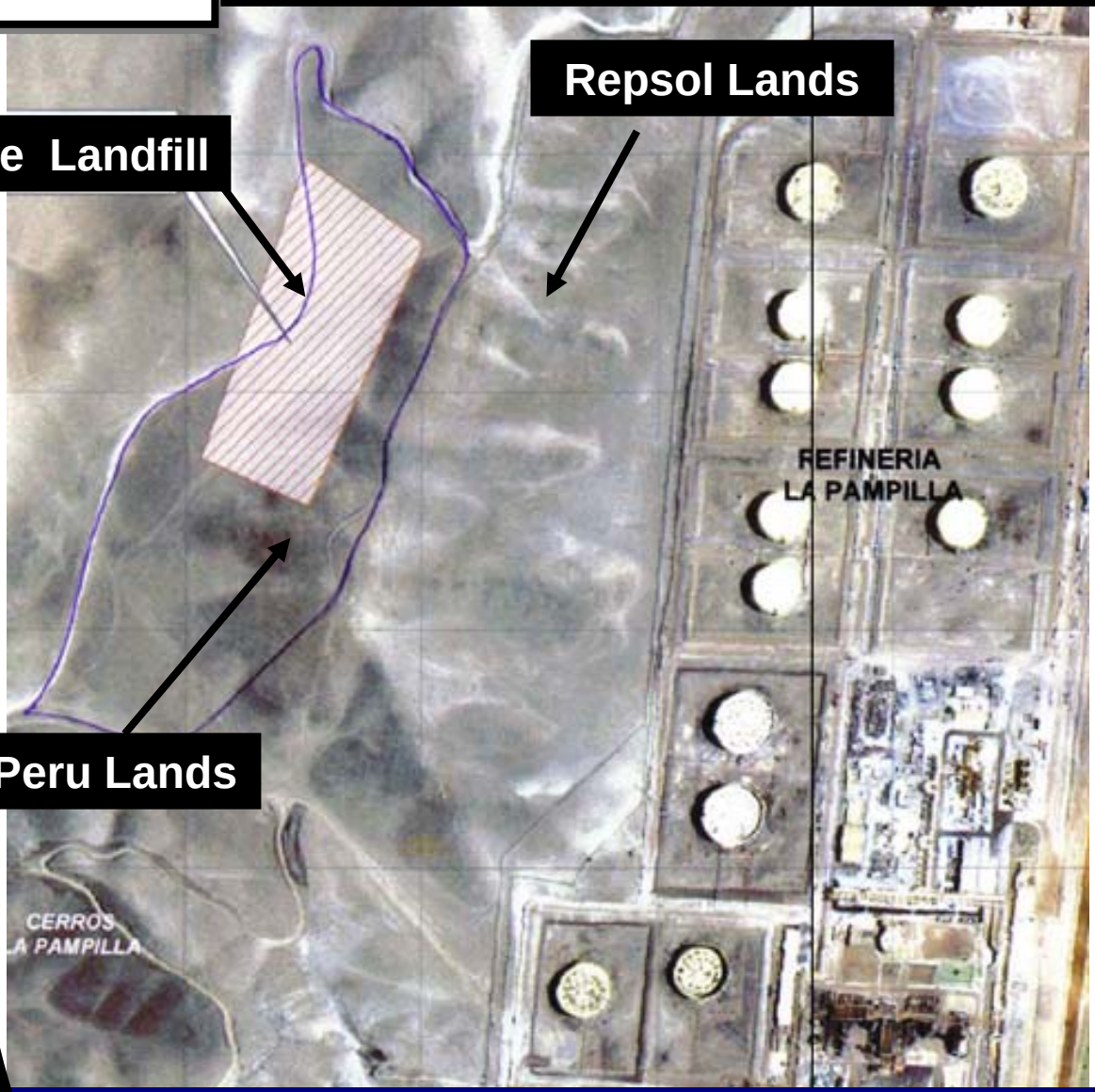
- Expedited recovery of 2000 bbls free product.
- To date we have recovered 3095 bbls.
- 160% of the contracted volume.

Project Future

- Applying to client for project extension to January 2009.
- Product thickness on the ground water table is remaining stable.

Sub-Project 3

Industrial/Hazardous Landfill

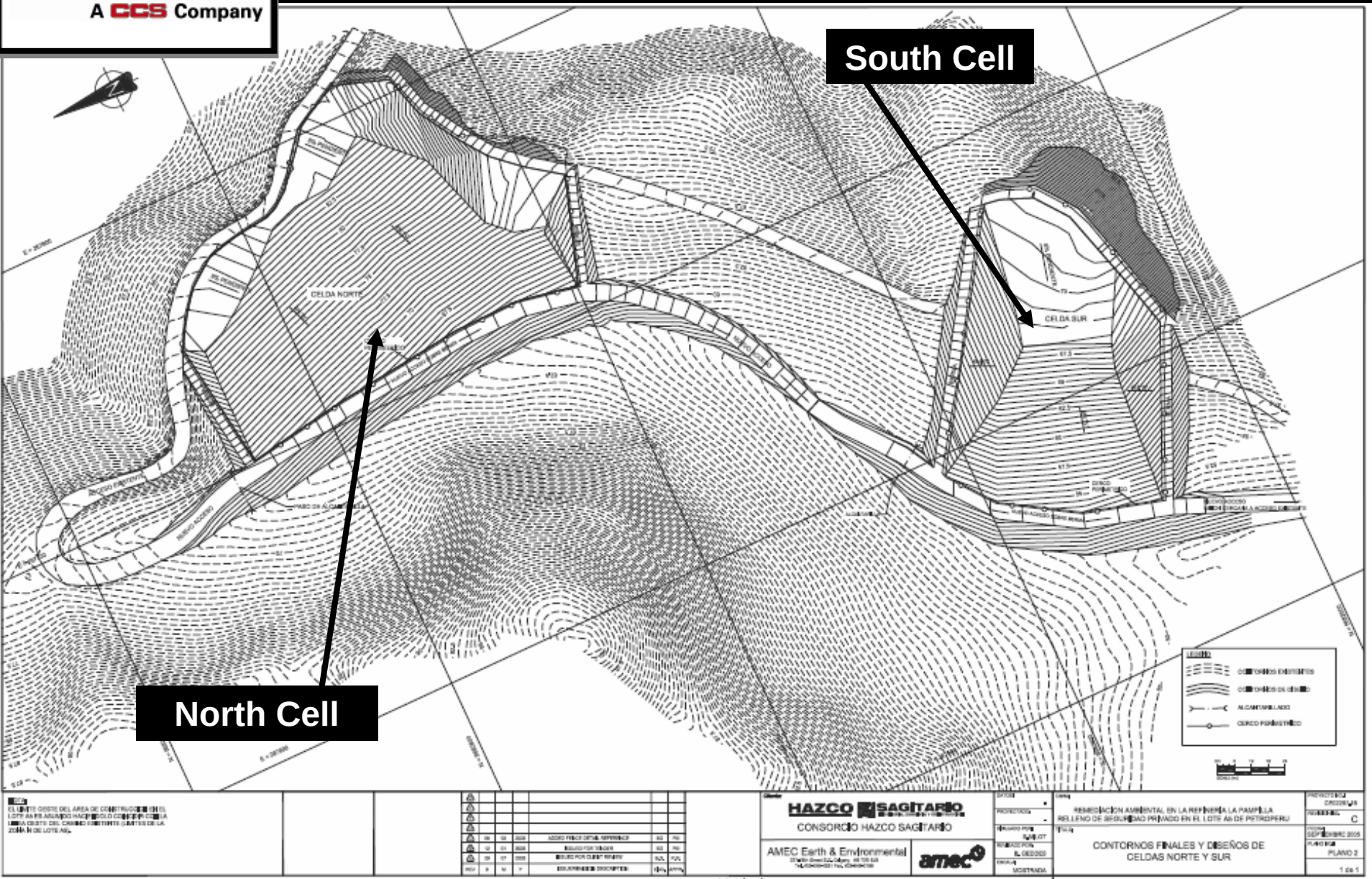


Landfill Scope

- 2 Landfill cells
- North cell 50,000 m3
- South Cell 30,000 m3
- 0.3g earthquake design
- sited on PetroPeru property
- 140,000 tonnes total

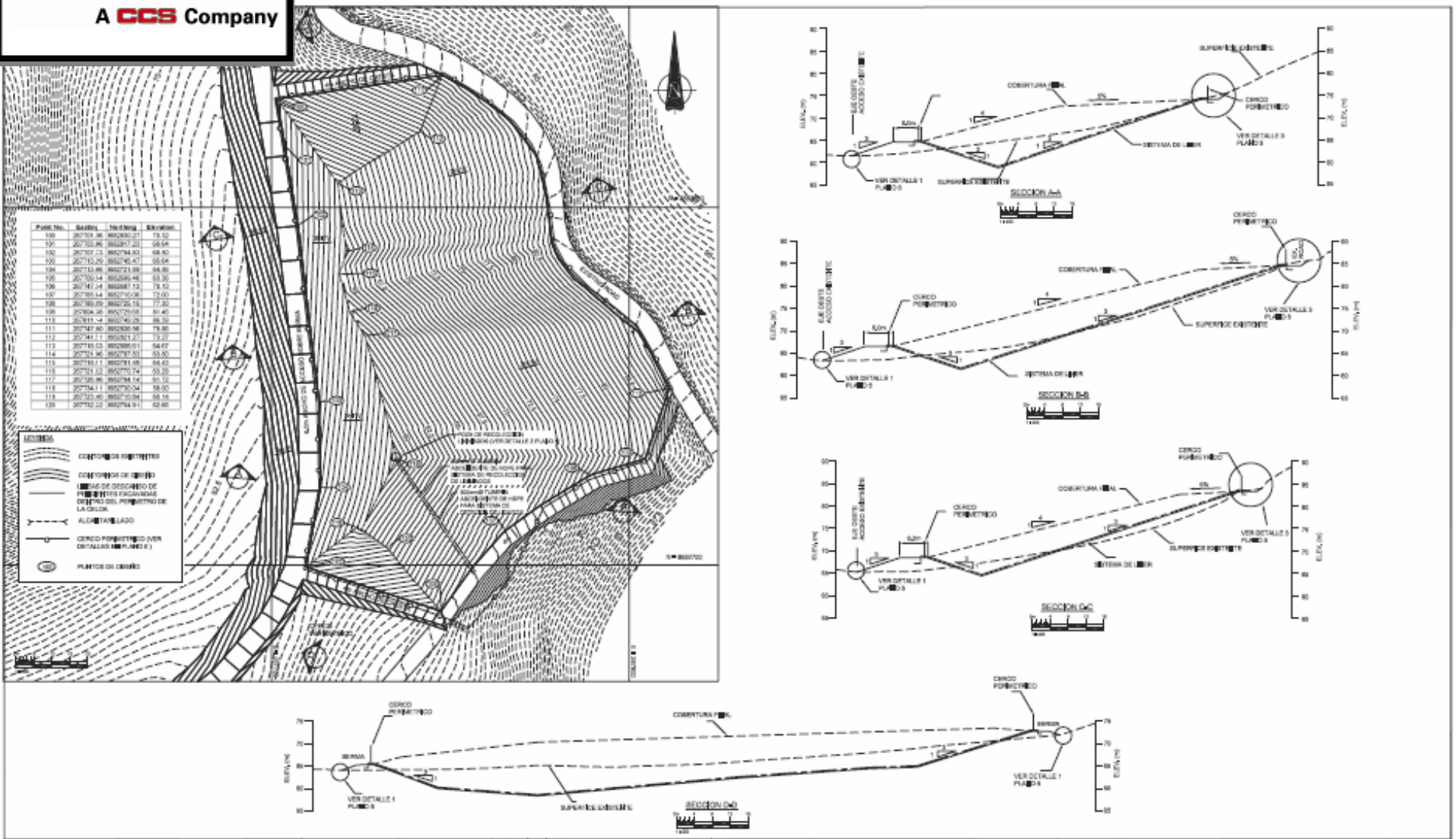
Sub-Project 3

North and South Cell Construction Profiles



Sub-Project 3

North Cell Construction Profile and Cross Section



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Sub-Project 3

Landfill Construction



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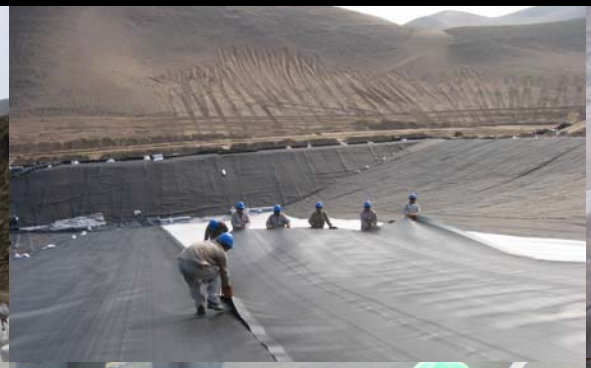
Sub-Project 3

Liner Installation





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Sub-Project 3

Landfill Waste

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REPSOL YPF

Sub-Project 3

Technical Challenges and Solutions

Technical Challenges

- Approval process for a “NEW” technology (4 years).
- Earthquake design adjustments.
- Determination of acceptable material types available.
- Relocation of the HDPE leachate/ leak detection pipes.

Technical Solutions

- Education of regulators on waste mgmt. technologies.
- New 0.3g design changes included in construction.
- Investigation and transport for appropriate base material.
- New location of HDPE pipes based on less traffic.

Sub-Project 3

Milestones

Success

- Secure containment of 140,000 tonnes of hydrocarbon impacted waste.
- Regulatory approval for industrial/hazardous landfill for oilfield waste in Peru.
  - Federal Environment, Energy and Health Ministries
  - Provincial Environment and Health Ministries
  - Municipal government

Project Future

- Landfill closure is on schedule for early 2008.

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Sub-Project 4

Bioremediation of Soils Contaminated with Hydrocarbon

Contaminated soils

- 29 pits to be excavated
  - grid system of excavation
    - 25m x 25m
  - onsite dexsil laboratory
  - offsite Canadian laboratory
  - client sign off
- material is segregated
- heterogeneous soils
- 1% moisture content soils

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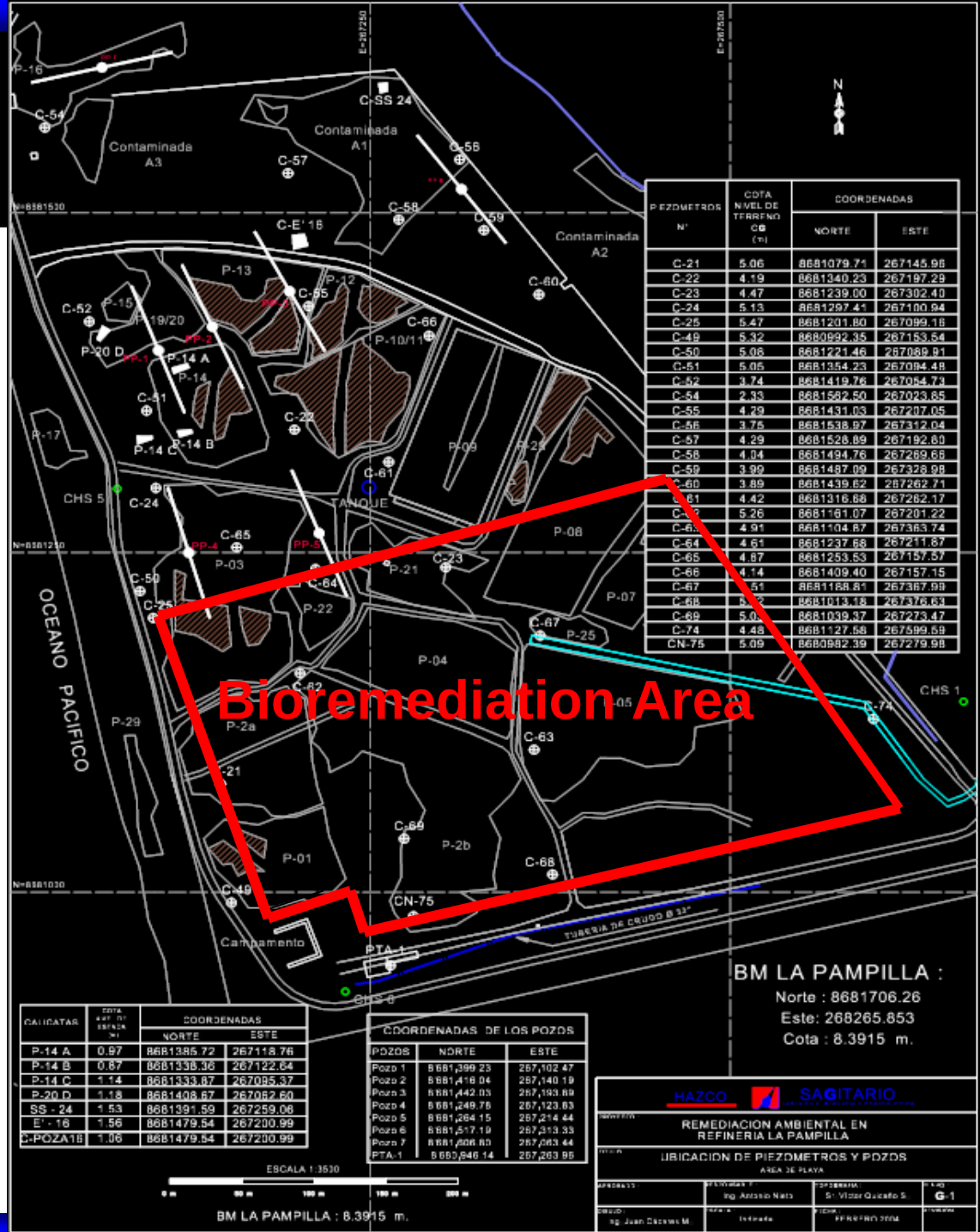

PIEZOMETROS N°	COTA NIVEL DE TERRENO CG (m)	COORDENADAS NORTE	COORDENADAS ESTE
C-21	5.06	8681079.71	267145.96
C-22	4.19	8681340.23	267197.29
C-23	4.47	8681239.00	267302.40
C-24	5.13	8681297.41	267100.94
C-25	5.47	8681201.80	267099.18
C-49	5.32	8680992.35	267153.54
C-50	5.06	8681221.46	267089.91
C-51	5.05	8681354.23	267094.48
C-52	3.74	8681419.76	267054.73
C-54	2.33	8681582.50	267023.85
C-55	4.29	8681431.03	267207.05
C-56	3.75	8681538.97	267312.04
C-57	4.29	8681528.89	267192.80
C-58	4.04	8681494.76	267269.66
C-59	3.99	8681487.09	267328.98
C-60	3.89	8681439.62	267262.71
C-61	4.42	8681316.68	267262.17
C-62	5.26	8681161.07	267201.22
C-63	4.91	8681104.87	267363.74
C-64	4.61	8681237.68	267211.87
C-65	4.87	8681253.53	267157.57
C-66	4.14	8681409.40	267157.15
C-67	4.51	8681188.81	267367.99
C-68	5.12	8681013.18	267378.64
C-69	5.04	8681039.37	267273.47
C-74	4.48	8681127.58	267599.59
CN-75	5.09	8680982.39	267279.98

CALICATAS	COTA BOCA DE CATA (m)	COORDENADAS NORTE	COORDENADAS ESTE
P-14 A	0.97	8681385.72	267118.76
P-14 B	0.87	8681338.36	267122.64
P-14 C	1.14	8681333.87	267085.37
P-20 D	1.18	8681408.67	267087.60
SS - 24	1.53	8681391.59	267259.06
E' - 16	1.56	8681479.54	267200.99
C-POZA18	1.06	8681479.54	267200.99

COORDENADAS DE LOS POZOS		
POZOS	NORTE	ESTE
Pozo 1	8681,399.23	267,102.47
Pozo 2	8681,416.04	267,140.19
Pozo 3	8681,442.03	267,193.89
Pozo 4	8681,249.78	267,123.83
Pozo 5	8681,264.15	267,214.44
Pozo 6	8681,517.19	267,313.33
Pozo 7	8681,606.80	267,063.44
PTA-1	8680,946.14	267,263.95

HAZCO SAGITARIO

APROBADO	REVISADO	DISEÑADO	PLANO
	Ing. Antonio Nieto	Sr. Victor Quicaño S.	G-1
DIBUJO	ESCALA	FECHA	
Ing. Juan Cáceres M.	Indicada	FEBRERO 2004	

Sub-Project 4

Construction/Treatment

Proceso de Zarandeo de Suelos contaminados, luego de su excavación.

Carguio de Suelo Contaminado

Riego de lote en proceso de remediación y un lote donde se está disponiendo suelo contaminado para su remediación.

Homogenización y Aireación de suelo contaminado en un lote.

Proceso de Aireación mediante Arado de Discos

Sub-Project 4

Scope

Volumes

- 426,500 m^3 was the contractual volume
- Initial methodology was:
  - 35 engineered force air biopiles
  - recipe used all organic amendments
  - 10 year time frame

- October 2002 Hazco applied to change methodology
  - comparison (force air vs. mech. aeration)
  - mech. aeration provided faster treatment
- Changed methodology:
  - windrows aerated using mech. means
  - use of inorganic amendments
  - 6 year time frame

Final Disposal

- recycled back onsite

Sub-Project 4

Technical Challenges and Solutions

Technical Challenges

- Engineered force air biopiles treatment was slow.
- Progressive treatment.
- Variability of material.
- Limited probability of success (work space).

Technical Solutions

- Forced air / mech. aeration comparison.
- Excavation of all material to be treated and stockpiled.
- Homogenization of all material to be treated.
- Construction of biopiles/windrows for mechanical turning.
- Better moisture, oxygen and process control.

Sub-Project 4

Milestones

Success

- Expedited treatment of 426,500 m^3.
- Reduced timeframe from 10 to 6 years.
- Final treatment will be for 500,000 m^3.
- 117% of the contracted volume.

Project Future

- Excavated volume to date is 498,000 m3
- Completed treatment of 480,000 m3.
- Currently treating 20,000 m3 that will be complete in March 2008.

Sub-Project 5

Disposal of Industrial/Hazardous Waste

Waste Management

- Classification, waste handling, transport and final disposal of industrial wastes and hazardous wastes.
- Asbestos, soils contaminated with TEL (tetraethyl lead), heavy metal contaminated soil.
- Stabilization and solidification of soils containing metals

Sub-Project 5

Disposal of Industrial/Hazardous Waste

Waste Management

- •. Total volume of solid wastes equal 12000 m^3.
- Approx. 200 Drums and waste containers.

CLOSURE