

# GNSS Navigation for the Magdalena River





Panamá

Panamericana

Antioquia

Bolivar

MEDELLIN

Choco

Caldas

BOGOTÁ

Arauca

VENEZUELA

CARACAS

Santa Maria

BARRANQUILLA

ISOLEDAD

Cartagena

SINCELEJO

Monteria

Urrea Dam

Magangué

BARRANCABERMEJA

ENVIGADO

ITAGUI

Manizales

ARMENIA

BUENAVENTURA

CALI

VALLEDUPAR

Chiquina

El Banco

Aguachica

Abrego

Pamplona

San Gil

Chiquiquira

Facatativa

Uribe

Chafarrav

LA CONCEPCION

MACHIQUE

Encontrados

Cucuta

Abrego

Bucaramanga

S. Vicente

Socha

OTUNJA

SOGAMOSO

VILLAVIGENCIO

MARACAIBO

BARIMAS

OUQUAD OJEDA

La Soñita

La Forca

Merida

S. Cristobal

Guastalla

Araca

Pto. Rondón

Lago Uva

Barquisimeto

Acari

Trujillo

Valera

Barrinas

Cravo Norte

Nueva Anzoategui

S. José de Ouré

Arrecifal

Sta. Rosa

Valencia

Maracay

S. Juan de los Morros

San Carlos

El Tocuyo

El Baul

El Yagual

El Yagual

S. Fernando

El Yagual

Sta. Br

# MAGDALENA RIVER



Libertad y Orden

	1998	1999	2000	2001	2002
--	------	------	------	------	------

PASSENGERS (Persons)	1.849.518	1.745.973	1.856.110	1.789.103	2.690.536
LIVESTOCK (head of cattle)	24.807	28.684	26.837	22.661	22.076

## PRODUCTS

SUBTOTAL ( t. )	1.870.478	1.756.044	1.942.711	1.354.525	1.316.015
-----------------	-----------	-----------	-----------	-----------	-----------

## hydrocarbon

SUBTOTAL ( t. )	1.868.724	2.823.429	2.700.861	2.075.350	2.505.384
-----------------	-----------	-----------	-----------	-----------	-----------

TOTAL CARGO (ton.)	3.739.202	4.579.473	4.643.572	3.429.875	3.821.399
--------------------	-----------	-----------	-----------	-----------	-----------

INCIDENTS	8	7	7	5	6
ACCIDENTS	7	3	6	4	5
CASUALTIES	6	2	1	7	0

Inspecciones: Girardot, Puerto Salgar, Puerto Berrio, B/bermeja, Gamarra, El Banco,

Magangué, Calamar, Cartagena, Barranquilla.



# Main Components of the System



- Route information system
- Navigation
- Surveillance
- Communications



# Route Information System

- GIS Actualization
- River-bed (graphical indication of the navigable course)
- Daily information for the inland navigation as: water level, depth, and their change prediction.
- Route information: others constrains as: security problems, meteorological conditions, etc.



# Waterway Survey



- Two motorboats full time through the most complicated sectors of the river (Bocas de Ceniza - Puerto de Barranquilla and Bahía de Cartagena - Canal del Dique).
- Four Rover motorboats for River-bed surveying four times per year.
  - January, February, March.
  - September.
  - Raining time (twice a year, lasting a month each)
- Waterway Survey during the journey of some of the boats.
- Automatic Hydrometrical Stations.



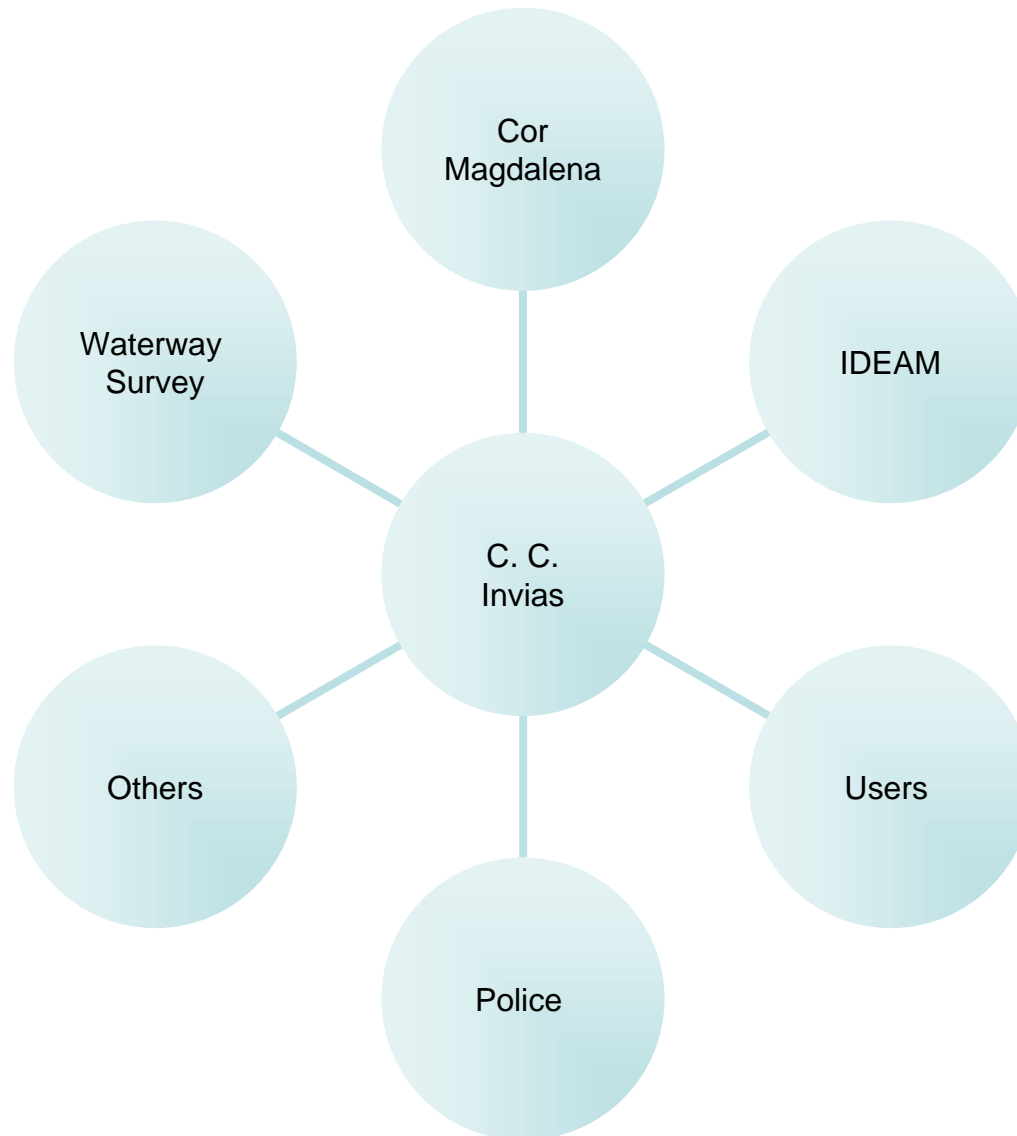
# Ground Stations



- Minimum maritime user requirements for general navigation (Horizontal Precision = 1 - 2, vertical = , integrity =  $10^{-5}$ , continuity = 99.97, Availability = 99.8,).
- DGPS stations along the river.
  - GPS integrity monitoring and message broadcasting in the places where exists infrastructure.



# Control Center





# Onboard Visualization Systems for Route Information

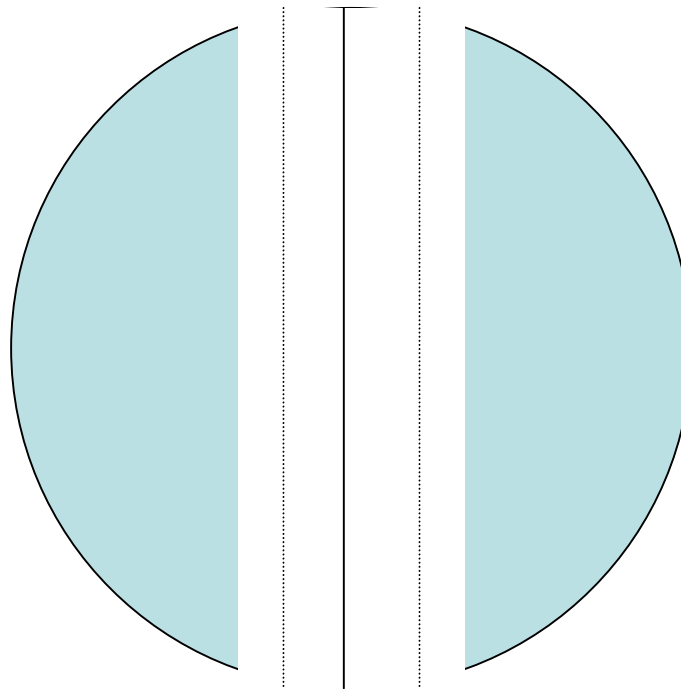


Integrity	Depth	Boat	Sharp bend	Obstacle
<p>SIG with the graphical presentation of the navigable course of the river. (1:10000 )</p>			<p>Current information of the point of navigation: Depth, Water level, Coordinates, Water level prediction by the met agency, etc.</p>	
			<p>Route information: Events that affect the normal navigation (Security constrains, Accidents, Adverse weather conditions, etc.)</p>	

# Navigation Systems



- DGPS stations
- Navigation Display



# Surveillance Systems



- Position Transmission to the control centre in a three hours interval.
- Shorter periods in cases of high-risk approach of two boats and/or alarm report by any boat.
- Alarm button automatically activated (in case of accident) or manually by the crew.
- Report to both navigators and control centre about high-risk approach of two boats and/or high-risk approach of the ship with obstacle identified in the GIS or the River-bed updated.



# Optional.



- Voice Communication systems
- Fleet Management Systems



# Verification and validation of the System



- The bidder should assess the correctness of the systems and compliance of the foregoing described requirements.
- The system should be validated and improved during the period of one year which includes all the relevant seasons of the river.



# Schedule



Id	Nombre de tarea	Duración	p '04		22 nov '04		31 ene '05		11 abr '05		20 jun '05		29 ago '05		07 nov
			L		L	L	L	L	L	L	L	L	L	L	
1	<b>Precontractual process</b>	<b>46 días</b>													
2	Specific requirements	20 días													
3	Terms of reference	10 días													
4	Receipt of proposals	2 días													
5	Evaluation	7 días													
6	Awarding of Contract	7 días													
7	<b>Development of the Contract</b>	<b>120 días</b>													
8	Reference elevation	90 días													
9	Mathematical model of the river	120 días													
10	<b>Installation of the systems</b>	<b>60 días</b>													
11	Automatics Hydrometrical Stations	30 días													
12	DGPS	60 días													
13	Surveillance and Control Centre	60 días													
14	Waterway Survey	30 días													
15	Equipping of the boats	90 días													
16	Test period	120 días													
17	Operation of the systems	1 día?													10/10



# Costs



CANT	DESCRIPTION	COST PESOS COL	COST DOLLARS USA
600 Km	REFERENCE ELEVATION	\$ 300.000.000	\$125.000
4	DGPS	\$ 1.440.000.000	\$600.000
6	AUTOMATIC HYDROMETRICAL STATIONS	\$ 360.000.000	\$150.000
1	SURVEILLANCE AND CONTROL CENTRE	\$ 520.000.000	\$216.667
	INSPECTOR	\$ 131.000.000	\$54.583
	INSTALLATION AND PUT IN SERVICE	\$129.000.000	\$53.750
	<b>TOTAL</b>	<b>\$ 2.880.000.000</b>	<b>\$1.200.000</b>



# Knowledge transfer



- It is expected through this project to involve as much as possible the national industry and R&D groups.
- The National University of Colombia through its R&D groups will be close involved thanks to the great knowledge they have about the situation of the Magdalena river as a result of the waterway survey they have performed.
- It is expected that other institutions with good knowledge with regard to GNSS join the project.





# National Productive Sectors and Industry Expected to Participate in the Project.



- It is expected the close participation of the different sectors of the National industry.
- Several activities could be carried out by national industries:
  - Topographical and Waterway Survey
  - Integrators of technology for the onboard equipment and control center.
  - Experts for our national weather institution and mathematical researchers to work on the mathematical model of the river.
  - Civil Aviation personnel with a good knowledge in GNSS technologies and communication.

