Lane No.	Mov No.	Dem Flow (veh /h)	Cap (veh /h)	Deg. Satn x	Aver. Delay (sec)	Eff. Stop Rate	Queue Cycle (vehs)	Queue Aver. (m)	Short Lane (m)
South: c. Cometa S									
1 LR	1, 3	417	1857	0.225	8.7	0.71	0.0	0	
East: c. Embarcadero E									
1 T	4	209	601	0.348	15.3	1.01	0.3	2	

01 Int c. Cometa y c. Embarcadero
Pico PM Sabado Futuro
Intersection ID: 1
Stop Sign Controlled Intersection

Table S.8A - LANE FLOW AND CAPACITY INFORMATION

Lane No.	Mov No.	Dem Flow (veh/h) Lef	Thru	Rig	Tot	Min Cap (veh /h)	Tot Cap (veh /h)	Deg. Satn x	Lane Util %
South: c. Cometa S									
1 LR	1, 3	276	0	141	417	417	1857	0.225	100
East: c. Embarcadero E									
1 T	4	0	209	0	209	120	601	0.348	100

The capacity value for priority and continuous movements is obtained by adjusting the basic saturation flow for heavy vehicle and turning vehicle effects. Saturation flow scale applies if specified.

01 Int c. Cometa y c. Embarcadero
Pico PM Sabado Futuro
Intersection ID: 1
Stop Sign Controlled Intersection

Table S.12A - FUEL CONSUMPTION, EMISSIONS AND COST - TOTAL

Mov No.	Fuel Total L/h	Cost Total $/h	HC Total kg/h	CO Total kg/h	NOX Total kg/h	CO2 Total kg/h
South: c. Cometa S						
1 L	18.9	109.28	0.083	4.02	0.115	47.1
3 R	9.4	54.95	0.040	1.92	0.057	23.4
	28.2	164.24	0.123	5.94	0.172	70.6

East: c. Embarcadero E						
4 T	14.9	90.95	0.066	3.13	0.090	37.3
	14.9	90.95	0.066	3.13	0.090	37.3
INTERSECTION:	43.2	255.19	0.189	9.07	0.262	107.9

PARAMETERS USED IN COST CALCULATIONS

Pump price of fuel ($/L)	=	0.900
Fuel resource cost factor	=	0.50
Ratio of running cost to fuel cost	=	3.0
Average income ($/h)	=	27.00
Time value factor	=	0.60
Average occupancy (persons/veh)	=	1.5
Light vehicle mass (1000 kg)	=	1.4
Heavy vehicle mass (1000 kg)	=	11.0
Light vehicle idle fuel rate (L/h)	=	1.350
Heavy vehicle idle fuel rate (L/h)	=	2.000

The idle fuel and vehicle mass parameters given above are the default values (data given in RIDES may override some of these parameters).

---

01 Int c. Cometa y c. Embarcadero
Pico PM Sabado Futuro
Intersection ID: 1
Stop Sign Controlled Intersection

Table S.14 - SUMMARY OF INPUT AND OUTPUT DATA

Lane No.	Demand Flow (veh/h) L	T	R	Tot	%HV	Adj. Basic Satf.	Eff Grn (secs) 1st	2nd	Deg Sat x	Aver. Delay (sec)	Longest Queue (m)	Shrt Lane (m)
South: c. Cometa S												
1 LR	276		141	417	0				0.225	8.7	0	
	276	0	141	417	0				0.225	8.7		
East: c. Embarcadero E												
1 T		209		209	0				0.348	15.3	2	
	0	209	0	209	0				0.348	15.3	2	
ALL VEHICLES				Total Flow 626	% HV 0				Max X 0.348	Aver. Delay 10.9	Max Queue 2	

Total flow period = 60 minutes. Peak flow period = 15 minutes.

Queue values in this table are mean cycle-average queue (metres).

Note: Basic Saturation Flows are not adjusted at roundabouts or sign-controlled intersections and apply only to continuous lanes.

---

01 Int c. Cometa y c. Embarcadero
Pico PM Sabado Futuro
Intersection ID: 1
Stop Sign Controlled Intersection

Table S.15 - CAPACITY AND LEVEL OF SERVICE

Mov No.	Mov Typ	Total Flow (veh /h)	Total Cap. (veh /h)	Deg. of Satn (v/c)	Aver. Delay (sec)	LOS	Longest Queue Cycle (vehs)	Aver. (m)
South: c. Cometa S								
1	L	276	1229	0.225	8.9	A	0.0	0
3	R	141	628	0.225	8.2	A	0.0	0
		417		0.225	8.7	A	0.0	0
East: c. Embarcadero E								
4	T	209	601	0.348*	15.3	C	0.3	2
		209		0.348	15.3	C	0.3	2
ALL VEHICLES:		626		0.348	10.9	NA	0.3	2

Level of Service calculations are based on
average control delay including geometric delay (HCM criteria),
independent of the current delay definition used.
For the criteria, refer to the "Level of Service" topic in the
aaSIDRA Output Guide or the Output section of the on-line help.

NA Not Applicable - Intersection Level of Service is not calculated at two-way stop control or give-way/yield controlled intersections.

* Maximum v/c ratio, or critical green periods

--- End of aaSIDRA Output ---

C:\Documents and Settings\Carlos M Contreras\My Documents\aaTraffic\aaSIDRA Projects\Marina Puerto Real Rev06\01_Cometa y Embarcadero_FPMSat.OUT
Produced by aaSIDRA 2.1.3.356
Copyright 2000-2004
Akcelik & Associates Pty Ltd

Generated 1:21 PM, 10 Apr 2006

Traffic Consulting Group

Sr. José Mercado
Marina Puerto Real

2 de julio de 2001

RE : Estudio de Transito Marina Puerto Real, Fajardo, P.R.

Estimado señor Mercado:

Luego de concluir la evaluación de impacto del transito del proyecto de referencia podemos llegar a las siguientes conclusiones:

1. Las intersecciones que dan acceso al proyecto cuentan con la capacidad necesaria para manejar el incremento en viajes que generara el mismo una vez este operando.

2. El principal problema del área bajo estudio es el estacionamiento en las calles circundantes. Esto trae como consecuencia una disminución en la capacidad de las vías y por lo tanto ocasiona problemas de congestionamiento en determinadas fechas o circunstancias. El tránsito que generara el proyecto bajo estudio es uno que no habrá de contribuir a este fenómeno dado que los usuarios de la marina cuentan con espacios de estacionamiento suficiente en las facilidades de la misma.

3. Aunque el comienzo de operaciones del desarrollo propuesto esta previsto para el año 2003, llevamos nuestros estimados al 2005 como medida preventiva para analizar un escenario donde el desarrollo este trabajando a capacidad. A su vez, bajo estas condiciones estamos analizando un escenario con un mayor numero de vehiculos, lo que nos presenta un escenario más restrictivo para el nuevo desarrollo. Aun así nuestros modelos de análisis nos demuestran que las vías de acceso al proyecto tienen la capacidad para manejar el impacto del proyecto propuesto.

4. Ante la realidad del estacionamiento ilegal en varias de las calles del área bajo estudio, es nuestra recomendación que el municipio debe reforzar el cumplimiento de las reglamentaciones vigentes concernientes al estacionamiento en las calles con el fin de procurar un mejor desempeño de las vías.

398 JESÚS T. PIÑERO AVENUE • NATO REY, PR 00918
PHONE: (787) 765-0927 EXT. 382 • FAX: (787) 765-3885

Es muy importante señalar que para propósitos de nuestro estudio la situación futura en cuanto al comportamiento esperado de las intersecciones se realizo modelando para el peor de los escenarios, aun así las intersecciones tienen la capacidad para manejar el incremento en trafico que producirá el proyecto. Es pues nuestra opinión profesional que el proyecto en cuestión no tendrá un impacto negativo en las vías circundantes al mismo.

De necesitar mayor información de nuestra parte, comuníquese con nosotros a su mejor conveniencia.

Atentamente,

Paxie G. Córdova.

Presidente

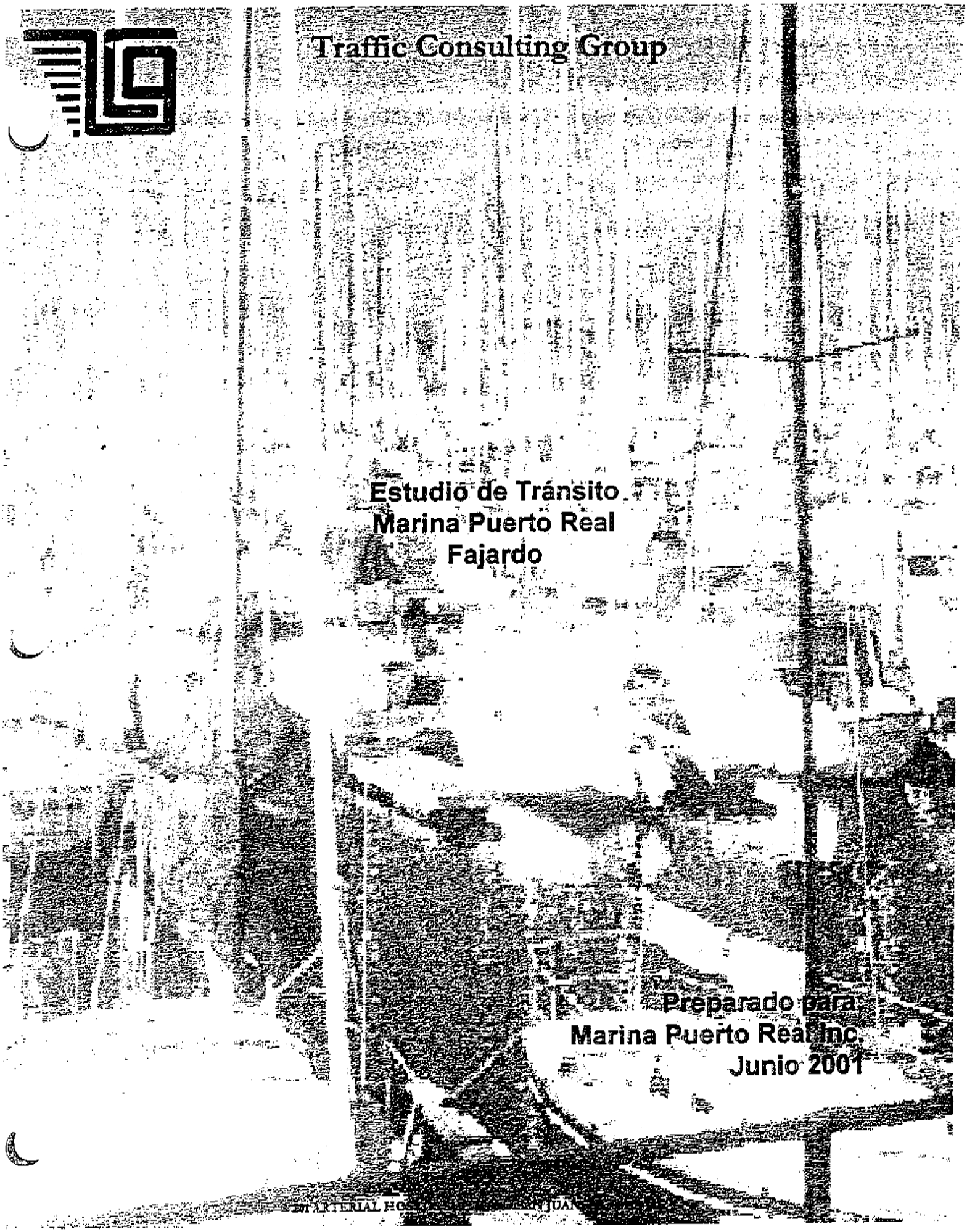
APÉNDICE 5

ESTUDIO DE TRANSITO

Traffic Consulting Group

Estudio de Tránsito
Marina Puerto Real
Fajardo

Preparado para
Marina Puerto Real Inc.
Junio 2001



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1 INTRODUCCIÓN

El siguiente informe presenta un estudio de tránsito en el área destinada para la construcción de las facilidades de la Marina Puerto Real, en el barrio Puerto Real de Fajardo, PR. Este informe evalúa las condiciones presentes del área y el impacto que tendrá la acción propuesta. Se modelará el funcionamiento de las intersecciones afectadas por el nuevo desarrollo mediante el uso del programa de computadoras para el análisis de intersecciones "Signalised & unsignalised Intersection Design & Research Aid", con el fin de determinar el efecto final del mismo en las intersecciones de interés. También se evaluará el efecto de las mejoras geométricas que sean necesarias para mitigar el efecto del proyecto.

2 LOCALIZACIÓN Y DESCRIPCIÓN DE LA ACCIÓN PROPUESTA

Marina Puerto Real Inc. propone la construcción de una marina en el sector Maternillo del barrio Puerto Real de Fajardo. Dicha marina se encontraría aledaña al muelle del Ferry que da acceso a Isleta Marina y cerca del muelle de la Autoridad de los Puertos con servicio hacia y desde Vieques y Culebra. El área es accesada utilizando la carretera PR-195, la cual es de dos vías. Una vez se termina la carretera PR-195, la calle Cometa es la calle que permite el acceso hacia la calle del embarcadero, la cual discurre paralela a la costa. Para salir de esta zona, es necesario tomar la calle Unión, la cual corre en una sola dirección hacia la carretera PR-195. La figura 1 muestra el mapa de localización proyecto.

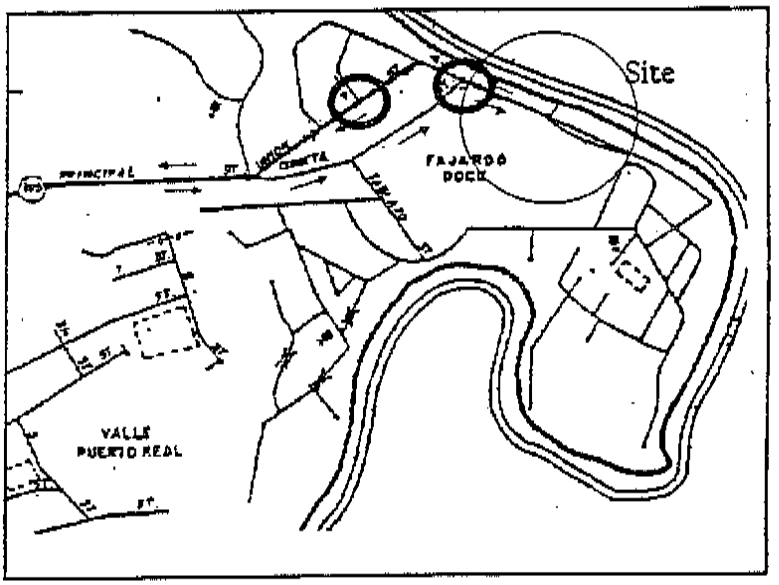


Figura 1 Mapa de Localización.

La marina contaría con un total de 193 espacios para lanchas en el agua, y 350 espacios estibados en tierra ("Dry Stack").

3 METODOLOGÍA PARA LA EVALUACIÓN DEL IMPACTO EN EL TRÁNSITO DEBIDO A LA ACCIÓN PROPUESTA

1. El día jueves 10 de mayo de 2001 se realizaron conteos de vehículos en el área de estudio durante las 12 horas de mayor afluencia vehicular, de 6:00 AM a 6:00 PM. Esto se hizo para determinar el número de vehículos, usuarios de las vías de tránsito cercanas al área de desarrollo propuesta. Las intersecciones medidas fueron la de la calle Cometa y la de la calle del Embarcadero, y la intersección de la calle Unión y la calle secundaria de salida del embarcadero. Estas fueron seleccionadas debido a que son las intersecciones mas próximas al proyecto propuesto, y están limitadas en el número de carriles que poseen, lo que limita su capacidad. Estas intersecciones aparecen circuladas en la figura 1.

2. Debido a que el proyecto propuesto requiere cierto tiempo para su construcción, los flujos obtenidos fueron expandidos a una situación futura en el año 2005, utilizando un aumento en el tráfico de 1.5% anual.

3. Utilizando como referencia el Manual de Generación de Viajes del Instituto de Ingenieros de Transportación se estimó el número de viajes que se generarían desde y hacia el proyecto propuesto.

4. Con toda la data recopilada se procedió a analizar las intersecciones en cuestión. Para realizar este análisis se utilizó el programa de computadoras SIDRA. Las situaciones estudiadas fueron los períodos pico de la mañana y de la tarde con los flujos existentes, y las mismas situaciones al añadirse los flujos generados por el nuevo proyecto mas el crecimiento normal anual esperados en el tránsito de la zona. Las intersecciones bajo estudio son las que se mencionaron anteriormente.

4 TEORÍA

4.1 Evaluación sobre el Nivel de Servicio (LOS) para una intersección:

El nivel de servicio es la metodología más conocida utilizada para la evaluación de una facilidad. El nivel de servicio representa las condiciones de operación de las intersecciones: el nivel de servicio "A" representa las condiciones excelentes de tránsito y el nivel "F", las peores condiciones. Tanto las intersecciones semaforizadas como las no semaforizadas pueden ser categorizadas utilizando esta metodología. Estos niveles de servicio a su vez se encuentran basados en las demoras promedio que tienen los vehículos en las intersecciones. A continuación se definen las categorías para cada nivel de servicio.

LOS A: Excelente

Esta es una condición de flujo libre, acompañada por bajos volúmenes de tránsito y altas velocidades. Hay poca o ninguna restricción en maniobrabilidad del conductor y los conductores pueden mantener sus deseadas velocidades con poco o ningún retraso.

LOS B: Muy Buena

En esta condición, las velocidades de operación comienzan a estar restringidas un tanto por las condiciones del tránsito. Los conductores aún tienen una libertad considerable para seleccionar su velocidad y carril de operación.

LOS C: Buena

Las velocidades y maniobrabilidad se vuelven más controladas por volúmenes de tránsito más altos. La mayoría de los conductores están restringidos en su libertad para seleccionar su propia velocidad, cambiar de carril o pasar.

LOS D: Aceptable

Este nivel de servicio se acerca a un flujo inestable, con velocidades operacionales tolerables siendo mantenidas, aunque considerablemente afectadas por los cambios en las condiciones operacionales. Los conductores tienen poca libertad para maniobrar y la comodidad y conveniencia son bajas.

LOS E: Capacidad

El flujo de tránsito se vuelve inestable y podría haber paradas momentáneas.

LOS F: Mala

En esta condición, la velocidad operacional podría bajar a cero y resultar en colas de tránsito.

4.2 Relación entre demoras y Nivel de Servicio

La tabla #1, muestra las diferentes relaciones entre el nivel de servicio y las demoras promedio por cada vehículo en las intersecciones controladas ya sea por semáforo, señales de PARE o CEDA, o en rotondas. (Manual de SIDRA 5). Estas demoras tienen como componentes la demora de viajar a través de la intersección mas la demora de la detención como consecuencia de la intersección.

Tabla 1 Criterio del Nivel de Servicio para intersecciones

NIVEL DE SERVICIO	DEMORA DE VEHÍCULOS (SEG.)	
	Semáforo y Rotonda	PARE y CEDA
A	$d \leq 10$	$d \leq 10$
B	$10 < d \leq 20$	$10 < d \leq 15$
C	$20 < d \leq 35$	$15 < d \leq 25$
D	$35 < d \leq 55$	$25 < d \leq 35$
E	$55 < d \leq 80$	$35 < d \leq 50$
F	$80 < d$	$50 < d$

5 ANÁLISIS DE TRÁNSITO

5.1 Afluencia vehicular

A modo de determinar el patrón de viajes actuales del sector se realizó un conteo manual en la intersección de la calle Cometa y la calle del Embarcadero, y en la intersección de la Calle Unión y una calle secundaria que alimenta a la calle Unión desde el norte de la calle del Embarcadero. Dichos conteos se efectuaron el jueves 10 de mayo de 2001, en el periodo entre las 6:00 de la mañana y las 6:00 de la tarde. Las tablas en el apéndice 1 ilustran el flujo vehicular obtenido mediante dichos conteos manuales. Los flujos mostrados en el apéndice 1 están identificados por dos letras separadas por un guión. La primera representa el acceso de procedencia del movimiento en inglés: North, South, East & West. La segunda letra representa el tipo de movimiento: Left, Thru & Right.

Para determinar la hora pico se buscaron los cuatro periodos consecutivos de 15 minuto con más flujo. Una vez se encontraba esta hora en los periodos AM y PM, se buscaba el período de 15 minutos con mayor flujo, y este valor multiplicado por cuatro era el que se utilizaba para la modelación. Dado que ya se está usando el valor del periodo de 15 minutos mas alto, el factor de hora pico a utilizarse es 1.0.

Las siguientes tablas muestran los flujos por acceso de las intersecciones de la calle Cometa y la calle del Embarcadero, y de la calle Unión y la calle secundaria respectivamente.

Tabla 2 Flujos Horas Pico c. Cometa y Embarcadero (2001)

	S-T	W-L	W-R	Total
Pico AM	96	324	104	524
Pico PM	132	548	72	752

Tabla 3 Flujos Horas Pico c. Unión y secundaria (2001)

	E-T	N-R	Total
Pico AM	324	220	544
Pico PM	300	132	432

5.2 Crecimiento anual

Los flujos obtenidos en el año 2001 fueron expandidos al año 2005, cuando entendemos que la marina deberá estar operando a capacidad. Los flujos de la zona fueron expandidos utilizando un factor de 1.5% de crecimiento anual. Para este cómputo se utilizó la siguiente ecuación:

$$F=P(1+i)^n$$

Donde:
F= Valor de flujo futuro
P= Valor de flujo presente
i= Factor de crecimiento anual. (En nuestro caso 1.5%)
n= Número de años (En nuestro caso 4 años)

5.3 Generación de Viajes

El proyecto contempla la construcción de una marina con cabida para 543 lanchas. De estas, 193 estarán en el agua y las restantes 350 estarán almacenadas fuera del agua, y son movidas al agua cuando lo requieren sus propietarios. Típicamente, las lanchas que están fuera del agua son usadas con menos frecuencia que las que se encuentran en el agua.

Para determinar la generación de viajes se utilizó la categoría 420 del Manual de Generación de Viajes del Instituto de Ingenieros de Transportación (ITE, por sus siglas en inglés). Esta categoría tiene la clasificación de Marina, y esta compuesta por estudios previos realizados en marinas, públicas y privadas, que varían en tamaño desde los 108 hasta los 1,750 espacios de lanchas. Algunas de las

facilidades que formaron parte del estudio de ITE poseen espacio para actividades sociales, tiendas pequeñas y restaurantes.

La siguiente tabla muestra los resultados de este análisis.

Tabla 4 Generación de Viajes

Uso	Categoría	Muelles	ADT			Pico AM			Pico PM		
			Total	In	Out	Total	In	Out	Total	In	Out
Marina	430	543	1437	719	719	43	14	29	103	62	41

Como se puede observar, este proyecto no es uno de una generación alta de viajes.

5.4 Distribución de Viajes

Para la distribución de los viajes se asumió que todos los viajes llegarían al proyecto usando la intersección de la calle Cometa y la calle del embarcadero. En realidad los vehículos también podrían llegar al proyecto virando a la derecha hacia la calle Tablazo, sin tener que llegar a la mencionada intersección. Sin embargo, decidimos llevar a todos los vehículos hasta la intersección evaluada, ya que este sería un escenario mas restrictivo para la operación del desarrollo propuesto y es nuestra intención analizar el peor de los posibles escenarios futuros. Para salir del proyecto, los vehículos tienen que dirigirse hacia el norte por la calle del embarcadero, pasando por la intersección con la calle Cometa, y luego virando a la izquierda en la calle Unión, la cual conecta con la carretera PR-195.

5.5 Tránsito Futuro

Para obtener el flujo que se utilizó para modelar la condición futura del área, se tomó el flujo actual, y se expandió de acuerdo al procedimiento descrito en la sección de crecimiento anual. Luego se añadió el flujo obtenido en la generación de

viajes, de acuerdo a la distribución esperada, El resultado de este proceso se muestra en las siguientes tablas.

Tabla 5 Flujos Horas Pico c. Unión y secundaria (2005)

	S-T	W-L	W-R	Total
Pico AM	131	344	124	599
Pico PM	181	582	138	901

Tabla 6 Flujos Horas Pico c. Unión y secundaria (2001)

	E-T	N-R	Total
Pico AM	373	233	606
Pico PM	359	140	500

5.6 Modelación de Tránsito

Para la evaluación de las intersecciones afectadas se utilizó el programa SIDRA (v. 5.2b). Se realizaron modelaciones para los períodos pico de la mañana y de la tarde para la situación actual y para el año 2005.

5.6.1 Intersección calle Cometa y calle Embarcadero

La calle Cometa discurre desde la carretera PR-195 en el oeste hasta la calle del Embarcadero en el este. La calle Cometa tiene un carril con estacionamiento a ambos lados. Al llegar a la calle del Embarcadero, los vehículos tienen dos opciones: Virar a la derecha, hacia donde se encontraría la marina propuesta, o hacia la izquierda.

La situación del estacionamiento en las calles es la que ocasiona problemas en ciertos momentos, ya que aunque existen áreas de estacionamientos en el área, muchas personas optan por estacionarse en la calle para no tener que pagar por el estacionamiento. En el proceso de búsqueda de estacionamiento, los conductores

tienden a disminuir su velocidad, lo que resulta en una reducción de capacidad en la vía, así como la obstrucción al tránsito que ocurre al momento de un vehículo abandonar el estacionamiento, y otro vehículo ocupar el espacio. En muchas ocasiones, los conductores que desean un estacionamiento, al observar que una persona va caminando a buscar su vehículo, se detienen para tratar de conseguir el estacionamiento que liberará la persona. Al contar la calle con un solo carril, esta detención ocasiona un bloqueo del flujo de la carretera.

La siguiente tabla muestra los resultados de la modelación en SIDRA de esta intersección.

Tabla 7 Resultados modelación SIDRA c. Cometa y Embarcadero

	DEMORA PROMEDIO POR VEHÍCULO [SEG.] Y NIVEL DE SERVICIO (LOS)				
	Acceso Sur c. Embarcadero	Acceso Este	Acceso Norte	Acceso Oeste c. Cometa	Total Int
Base 2001					
AM	16.4 C	N/A	N/A	10.2 B	11.3 B
PM	21.8 C	N/A	N/A	10.3 B	12.3 B
Futuro 2005					
AM	17.3 C	N/A	N/A	10.2 B	11.7 B
PM	26.2 D	N/A	N/A	10.2 B	13.4 B

Como se puede observar en la tabla, La intersección no presenta, ni presentará en el futuro, una vez se encuentre en operación la marina, problemas de capacidad.

5.6.2 Intersección calle Unión y calle secundaria

Esta intersección tipo "T" es una sencilla que opera con un pare. Tiene dos accesos de un solo carril cada uno. La vía principal corre de este a oeste (Calle Unión), y es intersecada por una calle secundaria que corre de norte a sur .

La siguiente tabla muestra los resultados para las distintas situaciones modeladas.

Tabla 8 Resultados modelación SIDRA PR-188 y c. 1 PISI

	DEMORA PROMEDIO POR VEHÍCULO [SEG.] Y NIVEL DE SERVICIO (LOS)				
	Acceso Sur	Acceso Este C. Unión	Acceso Norte c. Secundaria	Acceso Oeste	Total Int
Base 2001					
AM	N/A	0.0 A	17.4 C	N/A	7.0 A
PM	N/A	0.0 A	16.2 C	N/A	4.9 A
Futuro 2005					
AM	N/A	0.0 A	18.9 C	N/A	7.3 A
PM	N/A	0.0 A	17.2 C	N/A	4.8 A

Al igual que la intersección anterior, ésta tampoco presenta problemas de capacidad, por lo que no se amerita ninguna mejora una vez construido el proyecto propuesto.

En el Apéndice 2 presentamos las corridas del programa SIDRA para las intersecciones discutidas anteriormente.

6 CONCLUSIONES Y RECOMENDACIONES

Una vez terminados todos los análisis de los datos y de las modelaciones podemos aseverar lo siguiente:

1. Las intersecciones que dan acceso al proyecto cuentan con la capacidad necesaria para manejar el incremento en viajes que generara el mismo una vez este operando.

2. El principal problema del área bajo estudio es el estacionamiento en las calles circundantes. Esto trae como consecuencia una disminución en la capacidad de las vías y por lo tanto ocasiona problemas de congestionamiento en determinadas fechas o circunstancias. El tránsito que generara el proyecto bajo estudio es uno que no habrá de contribuir a este fenómeno dado que los usuarios de la marina cuentan con espacios de estacionamiento suficiente en las facilidades de la misma.

3. Aunque el comienzo de operaciones del desarrollo propuesto esta previsto para el año 2003, llevamos nuestros estimados al 2005 como medida preventiva para analizar un escenario donde el desarrollo este trabajando a capacidad. A su vez, bajo estas condiciones estamos analizando un escenario con un mayor numero de vehículos, lo que nos presenta un escenario mas restrictivo para el nuevo desarrollo. Aun así nuestros modelos de análisis nos demuestran que las vías de acceso al proyecto tienen la capacidad para manejar el impacto del proyecto propuesto.

4. Ante la realidad del estacionamiento ilegal en varias de las calles del área bajo estudio, es nuestra recomendación que el municipio debe reforzar el cumplimiento de las reglamentaciones vigentes concernientes al estacionamiento en las calles con el fin de procurar un mejor desempeño de las vías.

7 CERTIFICACIÓN

Certifico que la información presentada en este estudio es cierta, correcta y completa, y que fue obtenida utilizando los criterios de la practica usual y aceptada de la ingeniería de transito

Ing. Carlos M. Contreras
Lic. 13395

8 REFERENCIAS

1. Trip Generation Manual, Institute of Transportation Engineers, 6th edition, 1997
2. "Signalised & unsignalised Intersection Design & Research Aid". SIDRA

9 APÉNDICES

APÉNDICE 1:

Flujos Obtenidos Mediante Conteos Manuales

Conteos Cometa y calle Embarcadero 10 de mayo de 2001

Beginning of Period	S-T	W-L	W-R	Total	
6:00	8	8	11	27	
6:15	15	29	9	53	
6:30	10	27	8	45	
6:45	5	42	9	56	181
7:00	5	32	15	52	206
7:15	3	11	2	16	169
7:30	14	89	8	111	235
7:45	20	66	14	100	279
8:00	**24**	**81**	**26**	**131**	358
8:15	18	62	4	84	426
8:30	17	92	10	119	434
8:45	14	75	12	101	**435**
9:00	10	70	8	88	392
9:15	16	55	14	85	393
9:30	21	37	9	67	341
9:45	15	27	10	52	292
10:00	19	25	8	52	256
10:15	21	33	11	65	236
10:30	15	41	9	65	234
10:45	20	32	0	52	234
11:00	18	38	12	68	250
11:15	17	41	8	66	251
11:30	17	52	20	89	275
11:45	22	51	17	90	313
12:00	17	67	12	96	341
12:15	9	63	13	85	360
12:30	21	72	13	106	377
12:45	23	70	10	103	390
13:00	21	66	12	99	393
13:15	22	61	11	94	402
13:30	14	65	16	95	391
13:45	9	67	15	91	379
14:00	17	89	11	117	397
14:15	18	97	9	124	427
14:30	11	62	16	89	421
14:45	19	81	17	117	447
15:00	12	86	13	111	441
15:15	8	60	14	82	399
15:30	14	86	24	124	434
15:45	29	95	11	135	452
16:00	**33**	**137**	**18**	**188**	529
16:15	21	133	10	164	**611**
16:30	13	57	12	82	569
16:45	10	48	23	81	515
17:00	4	42	16	62	389
17:15	5	52	10	67	292
17:30	5	44	9	58	268
17:45	2	50	12	64	251

Conteos Unión y calle secundaria 10 de mayo de 2001

Beginning of Period	E-T	N-R	Total	
6:00	16	4	20	
6:15	34	1	35	
6:30	21	8	29	
6:45	23	6	29	113
7:00	19	9	28	121
7:15	27	14	41	127
7:30	40	17	57	155
7:45	53	23	76	202
8:00	51	30	81	255
8:15	59	65	124	338
8:30	**81**	**55**	**136**	417
8:45	64	39	103	**444**
9:00	48	28	76	439
9:15	69	35	104	419
9:30	67	20	87	370
9:45	63	12	75	342
10:00	59	18	77	343
10:15	51	23	74	313
10:30	48	19	67	293
10:45	56	24	80	298
11:00	58	15	73	294
11:15	55	12	67	287
11:30	47	28	75	295
11:45	57	17	74	289
12:00	80	27	107	323
12:15	50	12	62	318
12:30	63	34	97	340
12:45	67	35	102	368
13:00	56	20	76	337
13:15	62	23	85	360
13:30	39	14	53	316
13:45	44	21	65	279
14:00	**75**	**33**	**108**	311
14:15	57	28	85	311
14:30	46	27	73	331
14:45	55	37	92	**358**
15:00	61	21	82	332
15:15	33	22	55	302
15:30	35	14	49	278
15:45	36	14	50	236
16:00	71	20	91	245
16:15	62	24	86	276
16:30	46	9	55	282
16:45	40	9	49	281
17:00	33	12	45	235
17:15	39	3	42	191
17:30	33	6	39	175
17:45	35	4	39	165

APÉNDICE 2:

Resultados corridas de SIDRA

ARRB Transport Research Ltd - SIDRA 5.20b

Cordova & McCadney
TCG Registered User No. M0276
Time and Date of Analysis 2:38 PM, 29 Jun 2001

Calle Cometa y Embarcadero * PRINAMB *
Pico AM Base 2001
Intersection ID: 1
Stop Sign Controlled Intersection

RUN INFORMATION

* Basic Parameters:
  Intersection Type: Unsignalised - Two-Way Stop Control
  Driving on the right-hand side of the road
  Input data specified in Metric units
  Default Values File No. 30
  Peak flow period (for performance): 15 minutes
  Unit time (for volumes): 60 minutes (Total Flow Period)
  Delay definition: Control delay
  Geometric delay included
  Delay formula: SIDRA standard
  Level of Service based on: Delay (HCM)
  Queue definition: Back of queue, 95th_Percentile

Calle Cometa y Embarcadero * PRINAMB *
Pico AM Base 2001
Intersection ID: 1
Stop Sign Controlled Intersection

Table S.0 - TRAFFIC FLOW DATA (Flows in veh/hour as used by the program)

Mov No.	Left LV	Left HV	Through LV	Through HV	Right LV	Right HV	Flow Scale	Peak Flow Factor
South: Calle Embarcadero Sur								
1	0	0	96	0	0	0	1.00	1.00
West: Calle Principal								
10	324	0	0	0	0	0	1.00	1.00
12	0	0	0	0	104	0	1.00	1.00

Based on unit time = 60 minutes.
Flow Scale and Peak Hour Factor effects included in flow values.

Calle Cometa y Embarcadero * PRINAMB *
Pico AM Base 2001
Intersection ID: 1
Stop Sign Controlled Intersection

Table S.2 - MOVEMENT CAPACITY PARAMETERS

Mov No.	Arv Flow (veh /h)	Total Opng Flow (veh/h)	%HV	Adjust. Opng Flow (pcu/h)	Total Cap. (veh /h)	Prac. Deg. Satn xp	Prac. Spare Cap. (%)	Lane Util (%)	Deg. Satn x
South: Calle Embarcadero Sur									

1	T	96	376+	0.0	376	529	0.80	341	100	0.181

West: Calle Principal

10	L	324	0			1406	0.80	247	100	0.230
12	R	104	0			451	0.80	247	100	0.231*

\+ Percentage of exiting flow included in total opposing flow

---

Calle Cometa y Embarcadero * PRINAMB *
Pico AM Base 2001
Intersection ID: 1
Stop Sign Controlled Intersection

Table S.3 - INTERSECTION PARAMETERS

Degree of saturation (highest)	=	0.231
Practical Spare Capacity (lowest)	=	247 %
Total vehicle flow (veh/h)	=	524
Total vehicle capacity, all lanes (veh/h)	=	2386
Average intersection delay (s)	=	11.3
Largest average movement delay (s)	=	16.4
Total vehicle delay (veh-h/h)	=	1.65
Largest back of queue, 95% (m)	=	5
Performance Index	=	14.23
Total fuel (L/h)	=	58.8
Total cost ($/h)	=	296.86
Intersection Level of Service	=	B
Worst movement Level of Service	=	C

---

lle Cometa y Embarcadero * PRINAMB *
co AM Base 2001
ıtersection ID: 1
Stop Sign Controlled Intersection

Table S.5 - MOVEMENT PERFORMANCE

Mov Nc.		Total Delay (veh-h/h)	Aver. Delay (sec)	Prop. Queued	Eff. Stop Rate	Longest Queue 95% Back (vehs)	(m)	Perf. Index	Aver. Speed (km/h)
South: Calle Embarcadero Sur									
1	T	0.44	16.4	0.50	0.97	0.8	5	3.07	49.4
West: Calle Principal									
10	L	0.92	10.2	0.00	0.75	0.0	0	8.48	52.2
12	R	0.29	10.2	0.00	0.68	0.0	0	2.69	52.7

Calle Cometa y Embarcadero * PRINAMB *
Pico AM Base 2001
Intersection ID: 1
Stop Sign Controlled Intersection

le S.6 - INTERSECTION PERFORMANCE

ɔtal Flow (veh/h)	Total Delay (veh-h/h)	Aver. Delay (sec)	Prop. Queued	Eff. Stop Rate	Perf. Index	Aver. Speed (km/h)
South: Calle Embarcadero Sur						

96	0.44	16.4	0.504	0.97	3.07	49.4
West: Calle Principal						
428	1.21	10.2	0.000	0.73	11.16	52.3
IERSECTION:						
524	1.65	11.3	0.092	0.78	14.23	51.7

Calle Cometa y Embarcadero * PRINAMB *
Pico AM Base 2001
Intersection ID: 1
Stop Sign Controlled Intersection

Table S.7 - LANE PERFORMANCE

Lane No.	Mov No.	Arv Flow (veh /h)	Cap (veh /h)	Deg. Satn x	Aver. Delay (sec)	Eff. Stop Rate	Queue 95% Back (vehs)	Queue 95% Back (m)	Short Lane (m)
South: Calle Embarcadero Sur									
1 T	1	96	529	0.181	16.4	0.97	0.8	5	
West: Calle Principal									
1 LR	10, 12	428	1857	0.230	10.2	0.73	0.0	0	

le Cometa y Embarcadero * PRINAMB *
co AM Base 2001
ntersection ID: 1
Stop Sign Controlled Intersection

Table S.8 - LANE FLOW AND CAPACITY INFORMATION

Lan No.	Mov No.	Arv Flow (veh/h) Lef	Thru	Rig	Tot	Lane Width (m)	Saturation Flow Adj. Basic (tcu)	Aver 1st (veh)	Aver 2nd (veh)	Min Cap (veh /h)	Tot Cap (veh /h)	Deg. Satn x	Lane Util %
South: Calle Embarcadero Sur													
1 T	1	0	96	0	96	3.30N	-	-	-	60	529	0.181	100
West: Calle Principal													
1 LR	10, 12	324	0	104	428	3.30N	1950	-	-	428	1857	0.230	100

N Width value was not used for saturation flow adjustment in this case. (Lane width adjustment does not apply at sign-controlled intersections or to gap-acceptance capacities at signalised intersections).

Basic Saturation Flow in this table is adjusted for lane width, approach ade, parking manoeuvres and number of buses stopping. Saturation flow cale applies if specified.

Calle Cometa y Embarcadero * PRINAMB *
Pico AM Base 2001
Intersection ID: 1

Stop Sign Controlled Intersection

Table S.10 - MOVEMENT CAPACITY AND PERFORMANCE SUMMARY

Mov No.	Mov Typ	Arv Flow (veh /h)	Total Cap. (veh /h)	Lane Util (%)	Deg. Satn x	Aver. Delay (sec)	Eff. Stop Rate	95% Back of Queue (veh)	Perf. Index
South: Calle Embarcadero Sur									
1	T	96	529	100	0.181	16.4	0.97	0.8	3.07
West: Calle Principal									
10	L	324	1406	100	0.230	10.2	0.75	0.0	8.48
12	R	104	451	100	0.231*	10.2	0.68	0.0	2.69

* Maximum degree of saturation

Calle Cometa y Embarcadero * PRINAMB *
Pico AM Base 2001
Intersection ID: 1
Stop Sign Controlled Intersection

Table S.12A - FUEL CONSUMPTION, EMISSIONS AND COST - TOTAL

Mov No.		Fuel Total L/h	Cost Total $/h	HC Total kg/h	CO Total kg/h	NOX Total kg/h	CO2 Total kg/h	Lead Total kg/h
South: Calle Embarcadero Sur								
1	T	11.0	57.47	0.036	1.19	0.050	27.5	0.00088
		11.0	57.47	0.036	1.19	0.050	27.5	0.00088
West: Calle Principal								
10	L	36.3	181.85	0.119	4.06	0.168	90.7	0.00290
12	R	11.5	57.55	0.037	1.25	0.053	28.8	0.00092
		47.8	239.40	0.156	5.31	0.220	119.5	0.00382
INTERSECTION:		58.8	296.86	0.192	6.50	0.271	147.0	0.00470

Calle Cometa y Embarcadero * PRINAMB *
Pico AM Base 2001
Intersection ID: 1
Stop Sign Controlled Intersection

Table S.14 - SUMMARY OF INPUT AND OUTPUT DATA

Lane No.	Arrival Flow (veh/h) L	T	R	Tot	%HV	Adj. Basic Satf.	Eff Grn (secs) 1st	2nd	Deg Sat x	Aver. Delay (sec)	95% Queue (m)	Shrt Lane (m)
South: Calle Embarcadero Sur												
	0	96	0	96	0				0.181	16.4	5	
	0	96	0	96	0				0.181	16.4	5	

West: Calle Principal

1 LR	324	0	104	428	0	0.230	10.2	0
	324	0	104	428	0	0.230	10.2	0

ALL VEHICLES	Tot Arv.	% HV	Max X	Aver. Delay	Max Queue
	524	0	0.231	11.3	5

Total flow period = 60 minutes. Peak flow period = 15 minutes.

Note: Basic Saturation Flows are not adjusted at roundabouts or sign-controlled intersections and apply only to continuous lanes.

Values printed in this table are back of queue.

---

* PRINAMB *

Calle Cometa y Embarcadero
Pico AM Base 2001
Intersection ID: 1
Stop Sign Controlled Intersection

Table S.15 - CAPACITY AND LEVEL OF SERVICE (HCM STYLE)

Mov No.	Mov Typ	Total Flow (veh /h)	Total Cap. (veh /h)	Deg. of Satn (v/c)	Aver. Delay (sec)	LOS
South: Calle Embarcadero Sur						
1	T	96	529	0.181	16.4	C
		96	529	0.181	16.4	C
West: Calle Principal						
10	L	324	1406	0.230	10.2	B
12	R	104	451	0.231*	10.2	B
		428	1857	0.231	10.2	B
ALL VEHICLES:		524	2386	0.231	11.3	B
INTERSECTION:		524	2386	0.231	11.3	B

Level of Service calculations are based on
average control delay including geometric delay (HCM criteria),
independent of the current delay definition used.
For the criteria, refer to the "Level of Service" topic in
the SIDRA Output Guide or the Output section of the on-line help.
* Maximum v/c ratio, or critical green periods

---

* PRINAMB *

Calle Cometa y Embarcadero
Pico AM Base 2001
Intersection ID: 1
Stop Sign Controlled Intersection

Table D.1 - LANE DELAYS

Lane No.	Mov No.	Deg. Satn x	Stop-line Delay 1st d1	2nd d2	Total dSL	Acc. Dec. dn	Queuing Total dq	MvUp dqm	Stopd (Idle) di	Geom dig	Control dic
			Delay (seconds/veh)								
South: Calle Embarcadero Sur											

1 T	1	0.181	4.1	0.0	4.1	1.5	2.6	0.0	2.6	12.3	16.4
West: Calle Principal											
1 LR	10, 12	0.230	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.4 9.5	10.2

dn is average stop-start delay for all vehicles queued and unqueued

--- End of SIDRA Output ---

ARRB Transport Research Ltd - SIDRA 5.20b

Cordova & McCadney
TCG Registered User No. M0276
Time and Date of Analysis 2:39 PM, 29 Jun 2001

Calle Cometa y Embarcadero * PRINPMB *
Pico PM Base 2001
Intersection ID: 1
Stop Sign Controlled Intersection

RUN INFORMATION

* Basic Parameters:
  Intersection Type: Unsignalised - Two-Way Stop Control
  Driving on the right-hand side of the road
  Input data specified in Metric units
  Default Values File No. 30
  Peak flow period (for performance): 15 minutes
  Unit time (for volumes): 60 minutes (Total Flow Period)
  Delay definition: Control delay
  Geometric delay included
  Delay formula: SIDRA standard
  Level of Service based on: Delay (HCM)
  Queue definition: Back of queue, 95th_Percentile

Calle Cometa y Embarcadero * PRINPMB *
Pico PM Base 2001
Intersection ID: 1
Stop Sign Controlled Intersection

Table S.0 - TRAFFIC FLOW DATA (Flows in veh/hour as used by the program)

Mov No.	Left LV	Left HV	Through LV	Through HV	Right LV	Right HV	Flow Scale	Peak Flow Factor
South: Calle Embarcadero Sur								
1	0	0	132	0	0	0	1.00	1.00
West: Calle Principal								
10	548	0	0	0	0	0	1.00	1.00
12	0	0	0	0	72	0	1.00	1.00

Based on unit time = 60 minutes.
Flow Scale and Peak Hour Factor effects included in flow values.

Calle Cometa y Embarcadero * PRINPMB *
Pico PM Base 2001
Intersection ID: 1
Stop Sign Controlled Intersection

Table S.2 - MOVEMENT CAPACITY PARAMETERS

Mov No.	Arv Flow (veh /h)	Total Opng Flow (veh/h)	%HV	Adjust. Opng Flow (pcu/h)	Total Cap. (veh /h)	Prac. Deg. Satn xp	Prac. Spare Cap. (%)	Lane Util (%)	Deg. Satn x
South: Calle Embarcadero Sur									

1 T	132	584+	0.0	584	370	0.80	124	100	0.357*
West: Calle Principal									
10 L	548	0			1641	0.80	140	100	0.334
12 R	72	0			216	0.80	140	100	0.333

+ Percentage of exiting flow included in total opposing flow

Calle Cometa y Embarcadero * PRINPMB *
Pico PM Base 2001
Intersection ID: 1
Stop Sign Controlled Intersection

Table S.3 - INTERSECTION PARAMETERS

Degree of saturation (highest)	=	0.357
Practical Spare Capacity (lowest)	=	124 %
Total vehicle flow (veh/h)	=	752
Total vehicle capacity, all lanes (veh/h)	=	2227
Average intersection delay (s)	=	12.3
Largest average movement delay (s)	=	21.8
Total vehicle delay (veh-h/h)	=	2.57
Largest back of queue, 95% (m)	=	12
Performance Index	=	21.01
Total fuel (L/h)	=	84.8
Total cost ($/h)	=	430.22
Intersection Level of Service	=	B
Worst movement Level of Service	=	C

.le Cometa y Embarcadero * PRINPMB *
co PM Base 2001
tersection ID: 1
Stop Sign Controlled Intersection

Table S.5 - MOVEMENT PERFORMANCE

Mov No.	Total Delay (veh-h/h)	Aver. Delay (sec)	Prop. Queued	Eff. Stop Rate	Longest Queue 95% Back (vehs)	(m)	Perf. Index	Aver. Speed (km/h)
South: Calle Embarcadero Sur								
1 T	0.80	21.8	0.69	1.08	2.1	12	4.80	46.7
West: Calle Principal								
10 L	1.56	10.3	0.00	0.75	0.0	0	14.35	52.2
12 R	0.21	10.3	0.00	0.68	0.0	0	1.86	52.7

Calle Cometa y Embarcadero * PRINPMB *
Pico PM Base 2001
Intersection ID: 1
Stop Sign Controlled Intersection

.le S.6 - INTERSECTION PERFORMANCE

ɔtal Flow (veh/h)	Total Delay (veh-h/h)	Aver. Delay (sec)	Prop. Queued	Eff. Stop Rate	Perf. Index	Aver. Speed (km/h)
South: Calle Embarcadero Sur						

132	0.80	21.8	0.691	1.08	4.80	46.7
West: Calle Principal						
620	1.77	10.3	0.000	0.74	16.22	52.2
TERSECTION:						
752	2.57	12.3	0.121	0.80	21.01	51.2

Calle Cometa y Embarcadero * PRINPMB *
Pico PM Base 2001
Intersection ID: 1
Stop Sign Controlled Intersection

Table S.7 - LANE PERFORMANCE

Lane No.	Mov No.	Arv Flow (veh /h)	Cap (veh /h)	Deg. Satn x	Aver. Delay (sec)	Eff. Stop Rate	Queue 95% Back (vehs)	Queue 95% Back (m)	Short Lane (m)
South: Calle Embarcadero Sur									
1 T	1	132	370	0.357	21.8	1.08	2.1	12	
West: Calle Principal									
1 LR	10, 12	620	1857	0.334	10.3	0.74	0.0	0	

lle Cometa y Embarcadero * PRINPMB *
co PM Base 2001
ntersection ID: 1
Stop Sign Controlled Intersection

Table S.8 - LANE FLOW AND CAPACITY INFORMATION

Lan No.	Mov No.	Arv Flow (veh/h) Lef	Thru	Rig	Tot	Lane Width (m)	Saturation Flow Adj. Basic (tcu)	Aver 1st (veh)	Aver 2nd (veh)	Min Cap (veh /h)	Tot Cap (veh /h)	Deg. Satn x	Lane Util %
South: Calle Embarcadero Sur													
1 T	1	0	132	0	132	3.30N	-	-	-	60	370	0.357	100
West: Calle Principal													
1 LR	10, 12	548	0	72	620	3.30N	1950	-	-	620	1857	0.334	100

N Width value was not used for saturation flow adjustment in this case. (Lane width adjustment does not apply at sign-controlled intersections or to gap-acceptance capacities at signalised intersections).

Basic Saturation Flow in this table is adjusted for lane width, approach rade, parking manoeuvres and number of buses stopping. Saturation flow scale applies if specified.

Calle Cometa y Embarcadero * PRINPMB *
Pico PM Base 2001
Intersection ID: 1

Stop Sign Controlled Intersection

Table S.10 - MOVEMENT CAPACITY AND PERFORMANCE SUMMARY

Mov No.	Mov Typ	Arv Flow (veh /h)	Total Cap. (veh /h)	Lane Util (%)	Deg. Satn x	Aver. Delay (sec)	Eff. Stop Rate	95% Back of Queue (veh)	Perf. Index
South: Calle Embarcadero Sur									
1	T	132	370	100	0.357*	21.8	1.08	2.1	4.80
West: Calle Principal									
10	L	548	1641	100	0.334	10.3	0.75	0.0	14.35
12	R	72	216	100	0.333	10.3	0.68	0.0	1.86

* Maximum degree of saturation

Calle Cometa y Embarcadero * PRINPMB *
Pico PM Base 2001
Intersection ID: 1
Stop Sign Controlled Intersection

Table S.12A - FUEL CONSUMPTION, EMISSIONS AND COST - TOTAL

Mov No.		Fuel Total L/h	Cost Total $/h	HC Total kg/h	CO Total kg/h	NOX Total kg/h	CO2 Total kg/h	Lead Total kg/h
South: Calle Embarcadero Sur								
1	T	15.5	82.81	0.051	1.66	0.070	38.6	0.00124
		15.5	82.81	0.051	1.66	0.070	38.6	0.00124
West: Calle Principal								
10	L	61.3	307.57	0.201	6.87	0.283	153.3	0.00491
12	R	8.0	39.84	0.026	0.86	0.037	19.9	0.00064
		69.3	347.41	0.227	7.73	0.320	173.3	0.00555
INTERSECTION:		84.8	430.22	0.278	9.40	0.390	211.9	0.00678

Calle Cometa y Embarcadero * PRINPMB *
Pico PM Base 2001
Intersection ID: 1
Stop Sign Controlled Intersection

Table S.14 - SUMMARY OF INPUT AND OUTPUT DATA

Lane No.	Arrival Flow (veh/h) L	T	R	Tot	%HV	Adj. Basic Satf.	Eff Grn (secs) 1st	2nd	Deg Sat x	Aver. Delay (sec)	95% Queue (m)	Shrt Lane (m)
South: Calle Embarcadero Sur												
T	0	132	0	132	0				0.357	21.8	12	
	0	132	0	132	0				0.357	21.8	12	
West: Calle Principal												

1	LR	548	0	72	620	0	0.334	10.3	0
		548	0	72	620	0	0.334	10.3	0

ALL VEHICLES	Tot Arv.	% HV	Max X	Aver. Delay	Max Queue
	752	0	0.357	12.3	12

Total flow period = 60 minutes. Peak flow period = 15 minutes.

Note: Basic Saturation Flows are not adjusted at roundabouts or sign-controlled intersections and apply only to continuous lanes.

Values printed in this table are back of queue.

Calle Cometa y Embarcadero * PRINPMB *
Pico PM Base 2001
Intersection ID: 1
Stop Sign Controlled Intersection

Table S.15 - CAPACITY AND LEVEL OF SERVICE (HCM STYLE)

Mov No.	Mov Typ	Total Flow (veh /h)	Total Cap. (veh /h)	Deg. of Satn (v/c)	Aver. Delay (sec)	LOS
South: Calle Embarcadero Sur						
1	T	132	370	0.357*	21.8	C
		132	370	0.357	21.8	C
est: Calle Principal						
10	L	548	1641	0.334	10.3	B
12	R	72	216	0.333	10.3	B
		620	1857	0.334	10.3	B
ALL VEHICLES:		752	2227	0.357	12.3	B
INTERSECTION:		752	2227	0.357	12.3	B

Level of Service calculations are based on average control delay including geometric delay (HCM criteria), independent of the current delay definition used.
For the criteria, refer to the "Level of Service" topic in the SIDRA Output Guide or the Output section of the on-line help.
* Maximum v/c ratio, or critical green periods

Calle Cometa y Embarcadero * PRINPMB *
Pico PM Base 2001
Intersection ID: 1
Stop Sign Controlled Intersection

Table D.1 - LANE DELAYS

Lane No.	Mov No.	Deg. Satn x	Stop-line Delay 1st d1	2nd d2	Total dSL	Acc. Dec. dn	Queuing Total dq	MvUp dqm	Stopd (Idle) di	Geom dig	Control dic
South: Calle Embarcadero Sur											

1 T	1	0.357	8.6	0.9	9.5	2.1	7.4	1.8	5.6	12.3	21.8
West: Calle Principal											
1 LR	10, 12	0.334	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.4 9.5	10.3

dn is average stop-start delay for all vehicles queued and unqueued

--- End of SIDRA Output ---

ARRB Transport Research Ltd - SIDRA 5.20b

Cordova & McCadney
TCG Registered User No. M0276
Time and Date of Analysis 3:55 PM, 26 Jun 2001

Calle Union y sec * UNIONBAM
Pico PM Base
Intersection ID: 2
Stop Sign Controlled Intersection

RUN INFORMATION

* Basic Parameters:
  Intersection Type: Unsignalised - Two-Way Stop Control
  Driving on the right-hand side of the road
  Input data specified in Metric units
  Default Values File No. 30
  Peak flow period (for performance): 15 minutes
  Unit time (for volumes): 60 minutes (Total Flow Period)
  Delay definition: Control delay
  Geometric delay included
  Delay formula: SIDRA standard
  Level of Service based on: Delay (HCM)
  Queue definition: Back of queue, 95th_Percentile

Calle Union y sec * UNIONBAM
Pico PM Base
Intersection ID: 2
Stop Sign Controlled Intersection

Table S.0 - TRAFFIC FLOW DATA (Flows in veh/hour as used by the program)

Mov No.	Left LV	Left HV	Through LV	Through HV	Right LV	Right HV	Flow Scale	Peak Flow Factor
East: Calle Union E								
4	0	0	324	0	0	0	1.00	1.00
North: North Approach								
9	0	0	0	0	220	0	1.00	1.00

Based on unit time = 60 minutes.
Flow Scale and Peak Hour Factor effects included in flow values.

Calle Union y sec * UNIONBAM
Pico PM Base
Intersection ID: 2
Stop Sign Controlled Intersection

Table S.2 - MOVEMENT CAPACITY PARAMETERS

Mov No.	Arv Flow (veh /h)	Total Opng Flow (veh/h)	%HV	Adjust. Opng Flow (pcu/h)	Total Cap. (veh /h)	Prac. Deg. Satn xp	Prac. Spare Cap. (%)	Lane Util (%)	Deg. Satn x
East: Calle Union E									
4 T	324	0			1950	0.80	381	100	0.166

North: North Approach									
9.R	220	324	0.0	324	651	0.80	137	100	0.338*

* UNIONBAM

Calle Union y sec
Pico PM Base
Intersection ID: 2
Stop Sign Controlled Intersection

Table S.3 - INTERSECTION PARAMETERS

Degree of saturation (highest)	=	0.338
Practical Spare Capacity (lowest)	=	137 %
Total vehicle flow (veh/h)	=	544
Total vehicle capacity, all lanes (veh/h)	=	2601
Average intersection delay (s)	=	7.0
Largest average movement delay (s)	=	17.4
Total vehicle delay (veh-h/h)	=	1.06
Largest back of queue, 95% (m)	=	15
Performance Index	=	13.43
Total fuel (L/h)	=	55.4
Total cost ($/h)	=	276.84
Intersection Level of Service	=	A
Worst movement Level of Service	=	C

* UNIONBAM

Calle Union y sec
Pico PM Base
Intersection ID: 2
Stop Sign Controlled Intersection

Table S.5 - MOVEMENT PERFORMANCE

Mov No.	Total Delay (veh-h/h)	Aver. Delay (sec)	Prop. Queued	Eff. Stop Rate	Longest Queue 95% Back (vehs)	(m)	Perf. Index	Aver. Speed (km/h)
East: Calle Union E								
4 T	0.00	0.0	0.00	0.00	0.0	0	6.14	60.0
North: North Approach								
9 R	1.06	17.4	0.60	0.96	2.6	15	7.29	48.8

* UNIONBAM

Calle Union y sec
Pico PM Base
Intersection ID: 2
Stop Sign Controlled Intersection

Table S.6 - INTERSECTION PERFORMANCE

Total flow (veh/h)	Total Delay (veh-h/h)	Aver. Delay (sec)	Prop. Queued	Eff. Stop Rate	Perf. Index	Aver. Speed (km/h)
East: Calle Union E						
324	0.00	0.0	0.000	0.00	6.14	60.0
North: North Approach						
220	1.06	17.4	0.602	0.96	7.29	48.8

```
-----------------------------------------------------
INTERSECTION:
  544      1.06     7.0  0.244  0.39     13.43     54.9
-----------------------------------------------------
```

---

alle Union y sec * UNIONBAM
ico PM Base
Intersection ID: 2
Stop Sign Controlled Intersection

Table S.7 - LANE PERFORMANCE

Lane No.	Mov No.	Arv Flow (veh /h)	Cap (veh /h)	Deg. Satn x	Aver. Delay (sec)	Eff. Stop Rate	Queue 95% Back (vehs)	Queue 95% Back (m)	Short Lane (m)
East: Calle Union E									
1 T	4	324	1950	0.166	0.0	0.00	0.0	0	
North: North Approach									
1 R	9	220	651	0.338	17.4	0.96	2.6	15	

Calle Union y sec * UNIONBAM
Pico PM Base
Intersection ID: 2
Stop Sign Controlled Intersection

ble S.8 - LANE FLOW AND CAPACITY INFORMATION

Lan No.	Mov No.	Arv Flow (veh/h) Lef	Thru	Rig	Tot	Lane Width (m)	Saturation Flow Adj. Basic (tcu)	Aver 1st (veh)	Aver 2nd (veh)	Min Cap (veh /h)	Tot Cap (veh /h)	Deg. Satn x	Lane Util %
East: Calle Union E													
1 T	4	0	324	0	324	3.30N	1950	-	-	324	1950	0.166	100
North: North Approach													
1 R	9	0	0	220	220	3.30N	-	-	-	60	651	0.338	100

N Width value was not used for saturation flow adjustment in this case. (Lane width adjustment does not apply at sign-controlled intersections or to gap-acceptance capacities at signalised intersections).

Basic Saturation Flow in this table is adjusted for lane width, approach grade, parking manoeuvres and number of buses stopping. Saturation flow scale applies if specified.

Calle Union y sec * UNIONBAM
ico PM Base
ersection ID: 2
Stop Sign Controlled Intersection

Table S.10 - MOVEMENT CAPACITY AND PERFORMANCE SUMMARY

Mov	Mov	Arv	Total	Lane	Deg.	Aver.	Eff.	95%	Perf.

No.	Typ	Flow (veh /h)	Cap. (veh /h)	Util (%)	Satn x	Delay (sec)	Stop Rate	Back of Queue (veh)	Index
East: Calle Union E									
4	T	324	1950	100	0.166	0.0	0.00	0.0	6.14
North: North Approach									
9	R	220	651	100	0.338*	17.4	0.96	2.6	7.29

* Maximum degree of saturation

Calle Union y sec * UNIONBAM
Pico PM Base
Intersection ID: 2
Stop Sign Controlled Intersection

Table S.12A - FUEL CONSUMPTION, EMISSIONS AND COST - TOTAL

Mov No.	Fuel Total L/h	Cost Total $/h	HC Total kg/h	CO Total kg/h	NOX Total kg/h	CO2 Total kg/h	Lead Total kg/h
East: Calle Union E							
4 T	30.0	143.65	0.088	1.72	0.115	75.1	0.00240
	30.0	143.65	0.088	1.72	0.115	75.1	0.00240
North: North Approach							
9 R	25.4	133.19	0.084	2.81	0.117	63.6	0.00203
	25.4	133.19	0.084	2.81	0.117	63.6	0.00203
INTERSECTION:	55.4	276.84	0.172	4.53	0.232	138.6	0.00444

Calle Union y sec * UNIONBAM
Pico PM Base
Intersection ID: 2
Stop Sign Controlled Intersection

Table S.14 - SUMMARY OF INPUT AND OUTPUT DATA

Lane No.	Arrival Flow (veh/h) L	T	R	Tot	%HV	Adj. Basic Satf.	Eff Grn (secs) 1st	2nd	Deg Sat x	Aver. Delay (sec)	95% Queue (m)	Shrt Lane (m)
East: Calle Union E												
1 T	0	324	0	324	0				0.166	0.0	0	
	0	324	0	324	0				0.166	0.0	0	
North: North Approach												
1 R	0	0	220	220	0				0.338	17.4	15	
	0	0	220	220	0				0.338	17.4	15	

ALL VEHICLES	Tot Arv.	% HV	Max X	Aver. Delay	Max Queue
	544	0	0.338	7.0	15

Total flow period = 60 minutes. Peak flow period = 15 minutes.

Note: Basic Saturation Flows are not adjusted at roundabouts or sign-controlled intersections and apply only to continuous lanes.

Values printed in this table are back of queue.

Calle Union y sec * UNIONBAM
Pico PM Base
Intersection ID: 2
Stop Sign Controlled Intersection

Table S.15 - CAPACITY AND LEVEL OF SERVICE (HCM STYLE)

Mov No.	Mov Typ	Total Flow (veh /h)	Total Cap. (veh /h)	Deg. of Satn (v/c)	Aver. Delay (sec)	LOS
East: Calle Union E						
4	T	324	1950	0.166	0.0	A
		324	1950	0.166	0.0	A
North: North Approach						
9	R	220	651	0.338*	17.4	C
		220	651	0.338	17.4	C
ALL VEHICLES:		544	2601	0.338	7.0	A
NTERSECTION:		544	2601	0.338	7.0	A

Level of Service calculations are based on average control delay including geometric delay (HCM criteria), independent of the current delay definition used.
For the criteria, refer to the "Level of Service" topic in the SIDRA Output Guide or the Output section of the on-line help.
* Maximum v/c ratio, or critical green periods

Calle Union y sec * UNIONBAM
Pico PM Base
Intersection ID: 2
Stop Sign Controlled Intersection

Table D.1 - LANE DELAYS

Lane No.	Mov No.	Deg. Satn x	Delay (seconds/veh) Stop-line Delay 1st d1	2nd d2	Total dSL	Acc. Dec. dn	Queuing Total dq	MvUp dqm	Stopd (Idle) di	Geom dig	Control dic
East: Calle Union E											
1 T	4	0.166	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
rth: North Approach											
R	9	0.338	4.4	0.3	4.8	1.5	3.3	0.7	2.6	12.6	17.4

dn is average stop-start delay for all vehicles queued and unqueued

--- End of SIDRA Output ---

ARRB Transport Research Ltd - SIDRA 5.20b

Cordova & McCadney
TCG Registered User No. M0276
Time and Date of Analysis 3:54 PM, 26 Jun 2001

Calle Union y sec * UNIONBPM
Pico PM Base
Intersection ID: 2
Stop Sign Controlled Intersection

RUN INFORMATION

* Basic Parameters:
  Intersection Type: Unsignalised - Two-Way Stop Control
  Driving on the right-hand side of the road
  Input data specified in Metric units
  Default Values File No. 30
  Peak flow period (for performance): 15 minutes
  Unit time (for volumes): 60 minutes (Total Flow Period)
  Delay definition: Control delay
  Geometric delay included
  Delay formula: SIDRA standard
  Level of Service based on: Delay (HCM)
  Queue definition: Back of queue, 95th_Percentile

Calle Union y sec * UNIONBPM
Pico PM Base
Intersection ID: 2
Stop Sign Controlled Intersection

Table S.0 - TRAFFIC FLOW DATA (Flows in veh/hour as used by the program)

Mov No.	Left LV	Left HV	Through LV	Through HV	Right LV	Right HV	Flow Scale	Peak Flow Factor
East: Calle Union E								
4	0	0	300	0	0	0	1.00	1.00
North: North Approach								
9	0	0	0	0	132	0	1.00	1.00

Based on unit time = 60 minutes.
Flow Scale and Peak Hour Factor effects included in flow values.

Calle Union y sec * UNIONBPM
Pico PM Base
Intersection ID: 2
Stop Sign Controlled Intersection

Table S.2 - MOVEMENT CAPACITY PARAMETERS

Mov No.	Arv Flow (veh /h)	Total Opng Flow (veh/h)	%HV	Adjust. Opng Flow (pcu/h)	Total Cap. (veh /h)	Prac. Deg. Satn xp	Prac. Spare Cap. (%)	Lane Util (%)	Deg. Satn x
East: Calle Union E									
4 T	300	0			1950	0.80	420	100	0.154

North: North Approach									
9 R	132	300	0.0	300	679	0.80	312	100	0.194*

* UNIONBPM

.le Union y sec
.ico PM Base
Intersection ID: 2
Stop Sign Controlled Intersection

Table S.3 - INTERSECTION PARAMETERS

Degree of saturation (highest)	=	0.194
Practical Spare Capacity (lowest)	=	312 %
Total vehicle flow (veh/h)	=	432
Total vehicle capacity, all lanes (veh/h)	=	2629
Average intersection delay (s)	=	4.9
Largest average movement delay (s)	=	16.2
Total vehicle delay (veh-h/h)	=	0.59
Largest back of queue, 95% (m)	=	7
Performance Index	=	9.86
Total fuel (L/h)	=	43.0
Total cost ($/h)	=	212.02
Intersection Level of Service	=	A
Worst movement Level of Service	=	C

* UNIONBPM

Calle Union y sec
Pico PM Base
tersection ID: 2
Stop Sign Controlled Intersection

Table S.5 - MOVEMENT PERFORMANCE

Mov No.	Total Delay (veh-h/h)	Aver. Delay (sec)	Prop. Queued	Eff. Stop Rate	Longest Queue 95% Back (vehs)	(m)	Perf. Index	Aver. Speed (km/h)
East: Calle Union E								
4 T	0.00	0.0	0.00	0.00	0.0	0	5.68	60.0
North: North Approach								
9 R	0.59	16.2	0.53	0.90	1.2	7	4.17	49.4

* UNIONBPM

Calle Union y sec
Pico PM Base
Intersection ID: 2
Stop Sign Controlled Intersection

Table S.6 - INTERSECTION PERFORMANCE

Total low h/h)	Total Delay (veh-h/h)	Aver. Delay (sec)	Prop. Queued	Eff. Stop Rate	Perf. Index	Aver. Speed (km/h)
st: Calle Union E						
300	0.00	0.0	0.000	0.00	5.68	60.0
North: North Approach						
132	0.59	16.2	0.539	0.90	4.17	49.4

INTERSECTION: 432	0.59	4.9	0.165	0.27	9.86	56.3

alle Union y sec * UNIONBPM
Pico PM Base
Intersection ID: 2
Stop Sign Controlled Intersection

Table S.7 - LANE PERFORMANCE

Lane No.	Mov No.	Arv Flow (veh /h)	Cap (veh /h)	Deg. Satn x	Aver. Delay (sec)	Eff. Stop Rate	Queue 95% Back (vehs)	Queue 95% Back (m)	Short Lane (m)
East: Calle Union E									
1 T	4	300	1950	0.154	0.0	0.00	0.0	0	
North: North Approach									
1 R	9	132	679	0.194	16.2	0.90	1.2	7	

Calle Union y sec * UNIONBPM
Pico PM Base
Intersection ID: 2
Stop Sign Controlled Intersection

able S.8 - LANE FLOW AND CAPACITY INFORMATION

Lan No.	Mov No.	Arv Flow (veh/h) Lef	Thru	Rig	Tot	Lane Width (m)	Saturation Flow Adj. Basic (tcu)	Aver 1st (veh)	Aver 2nd (veh)	Min Cap (veh /h)	Tot Cap (veh /h)	Deg. Satn x	Lane Util %
East: Calle Union E													
1 T	4	0	300	0	300	3.30N	1950	-	-	300	1950	0.154	100
North: North Approach													
1 R	9	0	0	132	132	3.30N	-	-	-	60	679	0.194	100

N Width value was not used for saturation flow adjustment in this case. (Lane width adjustment does not apply at sign-controlled intersections or to gap-acceptance capacities at signalised intersections).

Basic Saturation Flow in this table is adjusted for lane width, approach grade, parking manoeuvres and number of buses stopping. Saturation flow scale applies if specified.

Calle Union y sec * UNIONBPM
ico PM Base
tersection ID: 2
Stop Sign Controlled Intersection

Table S.10 - MOVEMENT CAPACITY AND PERFORMANCE SUMMARY

Mov	Mov	Arv	Total	Lane	Deg.	Aver.	Eff.	95%	Perf.

No.	Typ	Flow (veh /h)	Cap. (veh /h)	Util (%)	Satn x	Delay (sec)	Stop Rate	Back of Queue (veh)	Index
East: Calle Union E									
4	T	300	1950	100	0.154	0.0	0.00	0.0	5.68
North: North Approach									
9	R	132	679	100	0.194*	16.2	0.90	1.2	4.17

* Maximum degree of saturation

Calle Union y sec * UNIONBPM
Pico PM Base
Intersection ID: 2
Stop Sign Controlled Intersection

Table S.12A - FUEL CONSUMPTION, EMISSIONS AND COST - TOTAL

Mov No.	Fuel Total L/h	Cost Total $/h	HC Total kg/h	CO Total kg/h	NOX Total kg/h	CO2 Total kg/h	Lead Total kg/h
East: Calle Union E							
4 T	27.8	133.01	0.082	1.59	0.107	69.5	0.00222
	27.8	133.01	0.082	1.59	0.107	69.5	0.00222
North: North Approach							
9 R	15.2	79.01	0.050	1.67	0.070	37.9	0.00121
	15.2	79.01	0.050	1.67	0.070	37.9	0.00121
INTERSECTION:	43.0	212.02	0.132	3.26	0.176	107.4	0.00344

Calle Union y sec * UNIONBPM
Pico PM Base
Intersection ID: 2
Stop Sign Controlled Intersection

Table S.14 - SUMMARY OF INPUT AND OUTPUT DATA

Lane No.	Arrival Flow (veh/h) L	T	R	Tot	%HV	Adj. Basic Satf.	Eff Grn (secs) 1st	2nd	Deg Sat x	Aver. Delay (sec)	95% Queue (m)	Shrt Lane (m)
East: Calle Union E												
1 T	0	300	0	300	0				0.154	0.0	0	
	0	300	0	300	0				0.154	0.0	0	
North: North Approach												
R	0	0	132	132	0				0.194	16.2	7	
	0	0	132	132	0				0.194	16.2	7	

ALL VEHICLES	Tot Arv.	% HV	Max X	Aver. Delay	Max Queue
	432	0	0.194	4.9	7

Total flow period = 60 minutes. Peak flow period = 15 minutes.

Note: Basic Saturation Flows are not adjusted at roundabouts or sign-controlled intersections and apply only to continuous lanes.

Values printed in this table are back of queue.

Calle Union y sec * UNIONBPM
Pico PM Base
Intersection ID: 2
Stop Sign Controlled Intersection

Table S.15 - CAPACITY AND LEVEL OF SERVICE (HCM STYLE)

Mov No.	Mov Typ	Total Flow (veh /h)	Total Cap. (veh /h)	Deg. of Satn (v/c)	Aver. Delay (sec)	LOS
East: Calle Union E						
4	T	300	1950	0.154	0.0	A
		300	1950	0.154	0.0	A
North: North Approach						
9	R	132	679	0.194*	16.2	C
		132	679	0.194	16.2	C
ALL VEHICLES:		432	2629	0.194	4.9	A
INTERSECTION:		432	2629	0.194	4.9	A

Level of Service calculations are based on average control delay including geometric delay (HCM criteria), independent of the current delay definition used.
For the criteria, refer to the "Level of Service" topic in the SIDRA Output Guide or the Output section of the on-line help.
* Maximum v/c ratio, or critical green periods

Calle Union y sec * UNIONBPM
Pico PM Base
Intersection ID: 2
Stop Sign Controlled Intersection

Table D.1 - LANE DELAYS

Lane No.	Mov No.	Deg. Satn x	Delay (seconds/veh) Stop-line Delay 1st d1	2nd d2	Total dSL	Acc. Dec. dn	Queuing Total dq	MvUp dqm	Stopd (Idle) di	Geom dig	Control dic
East: Calle Union E											
1 T	4	0.154	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
rth: North Approach											
R	9	0.194	3.6	0.0	3.6	1.3	2.2	0.0	2.2	12.6	16.2

dn is average stop-start delay for all vehicles queued and unqueued

--- End of SIDRA Output ---

ARRB Transport Research Ltd - SIDRA 5.20b

Cordova & McCadney
TCG
Registered User No. M0276
Time and Date of Analysis 2:39 PM, 29 Jun 2001

Calle Cometa y Embarcadero * PRINAMF *
Pico AM Futuro 2005
Intersection ID: 1
Stop Sign Controlled Intersection

RUN INFORMATION

* Basic Parameters:
  Intersection Type: Unsignalised - Two-Way Stop Control
  Driving on the right-hand side of the road
  Input data specified in Metric units
  Default Values File No. 30
  Peak flow period (for performance): 15 minutes
  Unit time (for volumes): 60 minutes (Total Flow Period)
  Delay definition: Control delay
  Geometric delay included
  Delay formula: SIDRA standard
  Level of Service based on: Delay (HCM)
  Queue definition: Back of queue, 95th_Percentile

Calle Cometa y Embarcadero * PRINAMF *
Pico AM Futuro 2005
Intersection ID: 1
Stop Sign Controlled Intersection

Table S.0 - TRAFFIC FLOW DATA (Flows in veh/hour as used by the program)

Mov No.	Left LV	Left HV	Through LV	Through HV	Right LV	Right HV	Flow Scale	Peak Flow Factor
South: Calle Embarcadero Sur								
1	0	0	131	0	0	0	1.00	1.00
West: Calle Principal								
10	344	0	0	0	0	0	1.00	1.00
12	0	0	0	0	124	0	1.00	1.00

Based on unit time = 60 minutes.
Flow Scale and Peak Hour Factor effects included in flow values.

Calle Cometa y Embarcadero * PRINAMF *
Pico AM Futuro 2005
Intersection ID: 1
Stop Sign Controlled Intersection

Table S.2 - MOVEMENT CAPACITY PARAMETERS

Mov No.	Arv Flow (veh /h)	Total Opng Flow (veh/h)	%HV	Adjust. Opng Flow (pcu/h)	Total Cap. (veh /h)	Prac. Deg. Satn xp	Prac. Spare Cap. (%)	Lane Util (%)	Deg. Satn x
South: Calle Embarcadero Sur									

1 T	131	406+	0.0	406	504	0.80	208	100	0.260*
West: Calle Principal									
10 L	344	0			1365	0.80	217	100	0.252
12 R	124	0			492	0.80	217	100	0.252

+ Percentage of exiting flow included in total opposing flow

Calle Cometa y Embarcadero * PRINAMF *
Pico AM Futuro 2005
Intersection ID: 1
Stop Sign Controlled Intersection

Table S.3 - INTERSECTION PARAMETERS

Degree of saturation (highest)	=	0.260
Practical Spare Capacity (lowest)	=	208 %
Total vehicle flow (veh/h)	=	599
Total vehicle capacity, all lanes (veh/h)	=	2361
Average intersection delay (s)	=	11.7
Largest average movement delay (s)	=	17.3
Total vehicle delay (veh-h/h)	=	1.95
Largest back of queue, 95% (m)	=	8
Performance Index	=	16.51
Total fuel (L/h)	=	67.3
Total cost ($/h)	=	340.69
Intersection Level of Service	=	B
Worst movement Level of Service	=	C

---

lle Cometa y Embarcadero * PRINAMF *
co AM Futuro 2005
ntersection ID: 1
Stop Sign Controlled Intersection

Table S.5 - MOVEMENT PERFORMANCE

Mov No.	Total Delay (veh-h/h)	Aver. Delay (sec)	Prop. Queued	Eff. Stop Rate	Longest Queue 95% Back (vehs)	(m)	Perf. Index	Aver. Speed (km/h)
South: Calle Embarcadero Sur								
1 T	0.63	17.3	0.54	1.01	1.3	8	4.30	49.0
West: Calle Principal								
10 L	0.97	10.2	0.00	0.75	0.0	0	9.00	52.2
12 R	0.35	10.2	0.00	0.68	0.0	0	3.20	52.7

Calle Cometa y Embarcadero * PRINAMF *
Pico AM Futuro 2005
Intersection ID: 1
Stop Sign Controlled Intersection

le S.6 - INTERSECTION PERFORMANCE

otal Flow (veh/h)	Total Delay (veh-h/h)	Aver. Delay (sec)	Prop. Queued	Eff. Stop Rate	Perf. Index	Aver. Speed (km/h)
South: Calle Embarcadero Sur						

131	0.63	17.3	0.542	1.01	4.30	49.0
West: Calle Principal						
468	1.32	10.2	0.000	0.73	12.20	52.3
NTERSECTION:						
599	1.95	11.7	0.119	0.79	16.51	51.5

Calle Cometa y Embarcadero * PRINAMF *
Pico AM Futuro 2005
Intersection ID: 1
Stop Sign Controlled Intersection

Table S.7 - LANE PERFORMANCE

Lane No.	Mov No.	Arv Flow (veh /h)	Cap (veh /h)	Deg. Satn x	Aver. Delay (sec)	Eff. Stop Rate	Queue 95% Back (vehs)	Queue 95% Back (m)	Short Lane (m)
South: Calle Embarcadero Sur									
1 T	1	131	504	0.260	17.3	1.01	1.3	8	
West: Calle Principal									
1 LR	10, 12	468	1857	0.252	10.2	0.73	0.0	0	

---

alle Cometa y Embarcadero * PRINAMF *
ico AM Futuro 2005
ntersection ID: 1
Stop Sign Controlled Intersection

Table S.8 - LANE FLOW AND CAPACITY INFORMATION

Lan No.	Mov No.	Arv Flow (veh/h) Lef	Thru	Rig	Tot	Lane Width (m)	Saturation Flow Adj. Basic (tcu)	Aver 1st (veh)	Aver 2nd (veh)	Min Cap (veh /h)	Tot Cap (veh /h)	Deg. Satn x	Lane Util %
South: Calle Embarcadero Sur													
1 T	1	0	131	0	131	3.30N	-	-	-	60	504	0.260	100
West: Calle Principal													
1 LR	10, 12	344	0	124	468	3.30N	1950	-	-	468	1857	0.252	100

N Width value was not used for saturation flow adjustment in this case. (Lane width adjustment does not apply at sign-controlled intersections or to gap-acceptance capacities at signalised intersections).

Basic Saturation Flow in this table is adjusted for lane width, approach grade, parking manoeuvres and number of buses stopping. Saturation flow scale applies if specified.

Calle Cometa y Embarcadero * PRINAMF *
Pico AM Futuro 2005
Intersection ID: 1

Stop Sign Controlled Intersection

Table S.10 - MOVEMENT CAPACITY AND PERFORMANCE SUMMARY

Mov No.	Mov Typ	Arv Flow (veh /h)	Total Cap. (veh /h)	Lane Util (%)	Deg. Satn x	Aver. Delay (sec)	Eff. Stop Rate	95% Back of Queue (veh)	Perf. Index
South: Calle Embarcadero Sur									
1	T	131	504	100	0.260*	17.3	1.01	1.3	4.30
West: Calle Principal									
10	L	344	1365	100	0.252	10.2	0.75	0.0	9.00
12	R	124	492	100	0.252	10.2	0.68	0.0	3.20

* Maximum degree of saturation

Calle Cometa y Embarcadero * PRINAMF *
Pico AM Futuro 2005
Intersection ID: 1
Stop Sign Controlled Intersection

Table S.12A - FUEL CONSUMPTION, EMISSIONS AND COST - TOTAL

Mov No.	Fuel Total L/h	Cost Total $/h	HC Total kg/h	CO Total kg/h	NOX Total kg/h	CO2 Total kg/h	Lead Total kg/h
outh: Calle Embarcadero Sur							
1 T	15.1	79.00	0.049	1.63	0.069	37.7	0.00121
	15.1	79.00	0.049	1.63	0.069	37.7	0.00121
West: Calle Principal							
10 L	38.5	193.07	0.126	4.31	0.178	96.3	0.00308
12 R	13.7	68.62	0.044	1.49	0.063	34.3	0.00110
	52.2	261.69	0.171	5.80	0.241	130.6	0.00418
INTERSECTION:	67.3	340.69	0.220	7.43	0.310	168.3	0.00538

Calle Cometa y Embarcadero * PRINAMF *
Pico AM Futuro 2005
Intersection ID: 1
Stop Sign Controlled Intersection

Table S.14 - SUMMARY OF INPUT AND OUTPUT DATA

Lane No.	Arrival Flow (veh/h) L	T	R	Tot	%HV	Adj. Basic Satf.	Eff Grn (secs) 1st	2nd	Deg Sat x	Aver. Delay (sec)	95% Queue (m)	Shrt Lane (m)
outh: Calle Embarcadero Sur												
T	0	131	0	131	0				0.260	17.3	8	
	0	131	0	131	0				0.260	17.3	8	
West: Calle Principal												

1 LR	344	0	124	468	0	0.252	10.2	0
	344	0	124	468	0	0.252	10.2	0

ALL VEHICLES	Tot Arv.	% HV	Max X	Aver. Delay	Max Queue
	599	0	0.260	11.7	8

Total flow period = 60 minutes. Peak flow period = 15 minutes.

Note: Basic Saturation Flows are not adjusted at roundabouts or sign-controlled intersections and apply only to continuous lanes.

Values printed in this table are back of queue.

Calle Cometa y Embarcadero * PRINAMF *
Pico AM Futuro 2005
Intersection ID: 1
Stop Sign Controlled Intersection

Table S.15 - CAPACITY AND LEVEL OF SERVICE (HCM STYLE)

Mov No.	Mov Typ	Total Flow (veh /h)	Total Cap. (veh /h)	Deg. of Satn (v/c)	Aver. Delay (sec)	LOS
South: Calle Embarcadero Sur						
1	T	131	504	0.260*	17.3	C
		131	504	0.260	17.3	C
West: Calle Principal						
10	L	344	1365	0.252	10.2	B
12	R	124	492	0.252	10.2	B
		468	1857	0.252	10.2	B
ALL VEHICLES:		599	2361	0.260	11.7	B
INTERSECTION:		599	2361	0.260	11.7	B

Level of Service calculations are based on average control delay including geometric delay (HCM criteria), independent of the current delay definition used.
For the criteria, refer to the "Level of Service" topic in the SIDRA Output Guide or the Output section of the on-line help.
* Maximum v/c ratio, or critical green periods

Calle Cometa y Embarcadero * PRINAMF *
Pico AM Futuro 2005
Intersection ID: 1
Stop Sign Controlled Intersection

Table D.1 - LANE DELAYS

Lane No.	Mov No.	Deg. Satn x	Delay (seconds/veh): Stop-line Delay 1st d1	2nd d2	Total dSL	Acc. Dec. dn	Queuing Total dq	MvUp dqm	Stopd (Idle) di	Geom dig	Control dic
South: Calle Embarcadero Sur											

1 T	1	0.260	4.9	0.1	5.0	1.7	3.3	0.3	3.1	12.3	17.3
West: Calle Principal											
1 LR	10, 12	0.252	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.4 9.5	10.2

dn is average stop-start delay for all vehicles queued and unqueued

--- End of SIDRA Output ---

ARRB Transport Research Ltd - SIDRA 5.20b

Cordova & McCadney
TCG Registered User No. M0276
Time and Date of Analysis 2:40 PM, 29 Jun 2001

Calle Cometa y Embarcadero * PRINPMF *
Pico PM Futuro 2005
Intersection ID: 1
Stop Sign Controlled Intersection

RUN INFORMATION

* Basic Parameters:
  Intersection Type: Unsignalised - Two-Way Stop Control
  Driving on the right-hand side of the road
  Input data specified in Metric units
  Default Values File No. 30
  Peak flow period (for performance): 15 minutes
  Unit time (for volumes): 60 minutes (Total Flow Period)
  Delay definition: Control delay
  Geometric delay included
  Delay formula: SIDRA standard
  Level of Service based on: Delay (HCM)
  Queue definition: Back of queue, 95th_Percentile

Calle Cometa y Embarcadero * PRINPMF *
Pico PM Futuro 2005
Intersection ID: 1
Stop Sign Controlled Intersection

Table S.0 - TRAFFIC FLOW DATA (Flows in veh/hour as used by the program)

Mov No.	Left LV	Left HV	Through LV	Through HV	Right LV	Right HV	Flow Scale	Peak Flow Factor
South: Calle Embarcadero Sur								
1	0	0	181	0	0	0	1.00	1.00
West: Calle Principal								
10	582	0	0	0	0	0	1.00	1.00
12	0	0	0	0	138	0	1.00	1.00

Based on unit time = 60 minutes.
Flow Scale and Peak Hour Factor_effects included in flow values.

Calle Cometa y Embarcadero * PRINPMF *
Pico PM Futuro 2005
Intersection ID: 1
Stop Sign Controlled Intersection

Table S.2 - MOVEMENT CAPACITY PARAMETERS

Mov No.	Arv Flow (veh /h)	Total Opng Flow (veh/h)	%HV	Adjust. Opng Flow (pcu/h)	Total Cap. (veh /h)	Prac. Deg. Satn xp	Prac. Spare Cap. (%)	Lane Util (%)	Deg. Satn x
South: Calle Embarcadero Sur									

1 T	181	651+	0.0	651	325	0.80	44	100	0.557*

West: Calle Principal

10 L	582	0		1501	0.80	106	100	0.388
12 R	138	0		356	0.80	106	100	0.388

+ Percentage of exiting flow included in total opposing flow

Calle Cometa y Embarcadero * PRINPMF *
Pico PM Futuro 2005
Intersection ID: 1
Stop Sign Controlled Intersection

Table S.3 - INTERSECTION PARAMETERS

Degree of saturation (highest)	=	0.557
Practical Spare Capacity (lowest)	=	44 %
Total vehicle flow (veh/h)	=	901
Total vehicle capacity, all lanes (veh/h)	=	2182
Average intersection delay (s)	=	13.4
Largest average movement delay (s)	=	26.2
Total vehicle delay (veh-h/h)	=	3.36
Largest back of queue, 95% (m)	=	25
Performance Index	=	26.15
Total fuel (L/h)	=	102.0
Total cost ($/h)	=	521.19
Intersection Level of Service	=	B
Worst movement Level of Service	=	D

Calle Cometa y Embarcadero * PRINPMF *
Pico PM Futuro 2005
Intersection ID: 1
Stop Sign Controlled Intersection

Table S.5 - MOVEMENT PERFORMANCE

Mov No.	Total Delay (veh-h/h)	Aver. Delay (sec)	Prop. Queued	Eff. Stop Rate	Longest Queue 95% Back (vehs)	(m)	Perf. Index	Aver. Speed (km/h)
South: Calle Embarcadero Sur								
1 T	1.32	26.2	0.80	1.21	4.1	25	7.35	44.7
West: Calle Principal								
10 L	1.65	10.2	0.00	0.75	0.0	0	15.23	52.2
12 R	0.39	10.2	0.00	0.68	0.0	0	3.57	52.7

Calle Cometa y Embarcadero * PRINPMF *
Pico PM Futuro 2005
Intersection ID: 1
Stop Sign Controlled Intersection

Table S.6 - INTERSECTION PERFORMANCE

Total Flow (veh/h)	Total Delay (veh-h/h)	Aver. Delay (sec)	Prop. Queued	Eff. Stop Rate	Perf. Index	Aver. Speed (km/h)
South: Calle Embarcadero Sur						

181	1.32	26.2	0.800	1.21	7.35	44.7
West: Calle Principal						
720	2.04	10.2	0.000	0.74	18.80	52.3
NTERSECTION:						
901	3.36	13.4	0.161	0.83	26.15	50.5

Calle Cometa y Embarcadero * PRINPMF *
Pico PM Futuro 2005
Intersection ID: 1
Stop Sign Controlled Intersection

Table S.7 - LANE PERFORMANCE

Lane No.	Mov No.	Arv Flow (veh /h)	Cap (veh /h)	Deg. Satn x	Aver. Delay (sec)	Eff. Stop Rate	Queue 95% Back (vehs)	Queue 95% Back (m)	Short Lane (m)
South: Calle Embarcadero Sur									
1 T	1	181	325	0.557	26.2	1.21	4.1	25	
West: Calle Principal									
1 LR	10, 12	720	1857	0.388	10.2	0.74	0.0	0	

lle Cometa y Embarcadero * PRINPMF *
.co PM Futuro 2005
ntersection ID: 1
Stop Sign Controlled Intersection

Table S.8 - LANE FLOW AND CAPACITY INFORMATION

Lan No.	Mov No.	Arv Flow (veh/h) Lef	Thru	Rig	Tot	Lane Width (m)	Saturation Flow Adj. Basic (tcu)	Aver 1st (veh)	Aver 2nd (veh)	Min Cap (veh /h)	Tot Cap (veh /h)	Deg. Satn x	Lane Util %
South: Calle Embarcadero Sur													
1 T	1	0	181	0	181	3.30N	-	-	-	60	325	0.557	100
West: Calle Principal													
1 LR	10, 12	582	0	138	720	3.30N	1950	-	-	720	1857	0.388	100

N Width value was not used for saturation flow adjustment in this case. (Lane width adjustment does not apply at sign-controlled intersections or to gap-acceptance capacities at signalised intersections).

Basic Saturation Flow in this table is adjusted for lane width, approach grade, parking manoeuvres and number of buses stopping. Saturation flow scale applies if specified.

Calle Cometa y Embarcadero * PRINPMF *
Pico PM Futuro 2005
Intersection ID: 1

Stop Sign Controlled Intersection

Table S.10 - MOVEMENT CAPACITY AND PERFORMANCE SUMMARY

Mov No.	Mov Typ	Arv Flow (veh /h)	Total Cap. (veh /h)	Lane Util (%)	Deg. Satn x	Aver. Delay (sec)	Eff. Stop Rate	95% Back of Queue (veh)	Perf. Index
South: Calle Embarcadero Sur									
1	T	181	325	100	0.557*	26.2	1.21	4.1	7.35
West: Calle Principal									
10	L	582	1501	100	0.388	10.2	0.75	0.0	15.23
12	R	138	356	100	0.388	10.2	0.68	0.0	3.57

* Maximum degree of saturation

Calle Cometa y Embarcadero * PRINPMF *
Pico PM Futuro 2005
Intersection ID: 1
Stop Sign Controlled Intersection

Table S.12A - FUEL CONSUMPTION, EMISSIONS AND COST - TOTAL

Mov No.		Fuel Total L/h	Cost Total $/h	HC Total kg/h	CO Total kg/h	NOX Total kg/h	CO2 Total kg/h	Lead Total kg/h
South: Calle Embarcadero Sur								
1	T	21.6	118.17	0.072	2.32	0.097	54.0	0.00173
		21.6	118.17	0.072	2.32	0.097	54.0	0.00173
West: Calle Principal								
10	L	65.1	326.65	0.214	7.30	0.301	162.9	0.00521
12	R	15.3	76.36	0.049	1.65	0.070	38.2	0.00122
		80.4	403.01	0.263	8.95	0.371	201.1	0.00643
INTERSECTION:		102.0	521.19	0.335	11.27	0.468	255.1	0.00816

Calle Cometa y Embarcadero * PRINPMF *
Pico PM Futuro 2005
Intersection ID: 1
Stop Sign Controlled Intersection

Table S.14 - SUMMARY OF INPUT AND OUTPUT DATA

Lane No.	Arrival Flow (veh/h) L	T	R	Tot	%HV	Adj. Basic Satf.	Eff Grn (secs) 1st	2nd	Deg Sat x	Aver. Delay (sec)	95% Queue (m)	Shrt Lane (m)
South: Calle Embarcadero Sur												
	0	181	0	181	0				0.557	26.2	25	
	0	181	0	181	0				0.557	26.2	25	
West: Calle Principal												

1 LR	582	0	138	720	0	0.388	10.2	0
	582	0	138	720	0	0.388	10.2	0

ALL VEHICLES	Tot Arv.	% HV	Max X	Aver. Delay	Max Queue
	901	0	0.557	13.4	25

Total flow period = 60 minutes. Peak flow period = 15 minutes.

Note: Basic Saturation Flows are not adjusted at roundabouts or sign-controlled intersections and apply only to continuous lanes.

Values printed in this table are back of queue.

Calle Cometa y Embarcadero * PRINPMF *
Pico PM Futuro 2005
Intersection ID: 1
Stop Sign Controlled Intersection

Table S.15 - CAPACITY AND LEVEL OF SERVICE (HCM STYLE)

Mov No.	Mov Typ	Total Flow (veh /h)	Total Cap. (veh /h)	Deg. of Satn (v/c)	Aver. Delay (sec)	LOS
South: Calle Embarcadero Sur						
1	T	181	325	0.557*	26.2	D
		181	325	0.557	26.2	D
est: Calle Principal						
10	L	582	1501	0.388	10.2	B
12	R	138	356	0.388	10.2	B
		720	1857	0.388	10.2	B
ALL VEHICLES:		901	2182	0.557	13.4	B
INTERSECTION:		901	2182	0.557	13.4	B

Level of Service calculations are based on average control delay including geometric delay (HCM criteria), independent of the current delay definition used.
For the criteria, refer to the "Level of Service" topic in the SIDRA Output Guide or the Output section of the on-line help.
* Maximum v/c ratio, or critical green periods

Calle Cometa y Embarcadero * PRINPMF *
Pico PM Futuro 2005
Intersection ID: 1
Stop Sign Controlled Intersection

Table D.1 - LANE DELAYS

			Delay (seconds/veh)								
			Stop-line Delay			Acc.	Queuing		Stopd		
Lane No.	Mov No.	Deg. Satn x	1st d1	2nd d2	Total dSL	Dec. dn	Total dq	MvUp dqm	(Idle) di	Geom dig	Control dic
South: Calle Embarcadero Sur											

1 T	1	0.557	11.3	2.6	14.0	2.5	11.5	4.7	6.8	12.3	26.2
West: Calle Principal											
1 LR	10, 12	0.388	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.4 9.5	10.2

dn is average stop-start delay for all vehicles queued and unqueued

--- End of SIDRA Output ---

ARRB Transport Research Ltd - SIDRA 5.20b

Cordova & McCadney
TCG Registered User No. M0276
Time and Date of Analysis 9:39 AM, 27 Jun 2001

Calle Union y sec * UNIONFAM
Pico PM Futuro 2005
Intersection ID: 2
Stop Sign Controlled Intersection

RUN INFORMATION

* Basic Parameters:
  Intersection Type: Unsignalised - Two-Way Stop Control
  Driving on the right-hand side of the road
  Input data specified in Metric units
  Default Values File No. 30
  Peak flow period (for performance): 15 minutes
  Unit time (for volumes): 60 minutes (Total Flow Period)
  Delay definition: Control delay
  Geometric delay included
  Delay formula: SIDRA standard
  Level of Service based on: Delay (HCM)
  Queue definition: Back of queue, 95th_Percentile

Calle Union y sec * UNIONFAM
Pico PM Futuro 2005
Intersection ID: 2
Stop Sign Controlled Intersection

Table S.0 - TRAFFIC FLOW DATA (Flows in veh/hour as used by the program)

Mov No.	Left LV	Left HV	Through LV	Through HV	Right LV	Right HV	Flow Scale	Peak Flow Factor
East: Calle Union E								
4	0	0	373	0	0	0	1.00	1.00
North: North Approach								
9	0	0	0	0	233	0	1.00	1.00

Based on unit time = 60 minutes.
Flow Scale and Peak Hour Factor effects included in flow values.

Calle Union y sec * UNIONFAM
Pico PM Futuro 2005
Intersection ID: 2
Stop Sign Controlled Intersection

Table S.2 - MOVEMENT CAPACITY PARAMETERS

Mov No.	Arv Flow (veh /h)	Total Opng Flow (veh/h)	%HV	Adjust. Opng Flow (pcu/h)	Total Cap. (veh /h)	Prac. Deg. Satn xp	Prac. Spare Cap. (%)	Lane Util (%)	Deg. Satn x
East: Calle Union E									
4 T	373	0			1950	0.80	318	100	0.191

North: North Approach									
9 R	233	373	0.0	373	597	0.80	105	100	0.390*

alle Union y sec * UNIONFAM
ico PM Futuro 2005
Intersection ID: 2
Stop Sign Controlled Intersection

Table S.3 - INTERSECTION PARAMETERS

Degree of saturation (highest)	=	0.390
Practical Spare Capacity (lowest)	=	105 %
Total vehicle flow (veh/h)	=	606
Total vehicle capacity, all lanes (veh/h)	=	2547
Average intersection delay (s)	=	7.3
Largest average movement delay (s)	=	18.9
Total vehicle delay (veh-h/h)	=	1.22
Largest back of queue, 95% (m)	=	20
Performance Index	=	15.20
Total fuel (L/h)	=	61.7
Total cost ($/h)	=	308.59
Intersection Level of Service	=	A
Worst movement Level of Service	=	C

Calle Union y sec * UNIONFAM
Pico PM Futuro 2005
Intersection ID: 2
Stop Sign Controlled Intersection

Table S.5 - MOVEMENT PERFORMANCE

Mov No.	Total Delay (veh-h/h)	Aver. Delay (sec)	Prop. Queued	Eff. Stop Rate	Longest Queue 95% Back (vehs)	(m)	Perf. Index	Aver. Speed (km/h)
East: Calle Union E								
4 T	0.00	0.0	0.00	0.00	0.0	0	7.07	60.0
North: North Approach								
9 R	1.22	18.9	0.65	1.04	3.4	20	8.13	48.0

Calle Union y sec * UNIONFAM
Pico PM Futuro 2005
Intersection ID: 2
Stop Sign Controlled Intersection

Table S.6 - INTERSECTION PERFORMANCE

Total Flow h/h)	Total Delay (veh-h/h)	Aver. Delay (sec)	Prop. Queued	Eff. Stop Rate	Perf. Index	Aver. Speed (km/h)
st: Calle Union E						
373	0.00	0.0	0.000	0.00	7.07	60.0
North: North Approach						
233	1.22	18.9	0.650	1.04	8.13	48.0

INTERSECTION:						
606	1.22	7.3	0.250	0.40	15.20	54.7

alle Union y sec * UNIONFAM
ico PM Futuro 2005
Intersection ID: 2
Stop Sign Controlled Intersection

Table S.7 - LANE PERFORMANCE

Lane No.	Mov No.	Arv Flow (veh /h)	Cap (veh /h)	Deg. Satn x	Aver. Delay (sec)	Eff. Stop Rate	Queue 95% Back (vehs)	Queue 95% Back (m)	Short Lane (m)
East: Calle Union E									
1 T	4	373	1950	0.191	0.0	0.00	0.0	0	
North: North Approach									
1 R	9	233	597	0.390	18.9	1.04	3.4	20	

Calle Union y sec * UNIONFAM
Pico PM Futuro 2005
Intersection ID: 2
Stop Sign Controlled Intersection

ble S.8 - LANE FLOW AND CAPACITY INFORMATION

Lan No.	Mov No.	Arv Flow (veh/h) Lef	Thru	Rig	Tot	Lane Width (m)	Saturation Flow Adj. Basic (tcu)	Aver 1st (veh)	Aver 2nd (veh)	Min Cap (veh /h)	Tot Cap (veh /h)	Deg. Satn x	Lane Util %
East: Calle Union E													
1 T	4	0	373	0	373	3.30N	1950	-	-	373	1950	0.191	100
North: North Approach													
1 R	9	0	0	233	233	3.30N	-	-	-	60	597	0.390	100

N Width value was not used for saturation flow adjustment in this case. (Lane width adjustment does not apply at sign-controlled intersections or to gap-acceptance capacities at signalised intersections).

Basic Saturation Flow in this table is adjusted for lane width, approach grade, parking manoeuvres and number of buses stopping. Saturation flow scale applies if specified.

Calle Union y sec * UNIONFAM
Pico PM Futuro 2005
ersection ID: 2
Stop Sign Controlled Intersection

Table S.10 - MOVEMENT CAPACITY AND PERFORMANCE SUMMARY

Mov	Mov	Arv	Total	Lane	Deg.	Aver.	Eff.	95%	Perf.

No.	Typ	Flow (veh /h)	Cap. (veh /h)	Util (%)	Satn x	Delay (sec)	Stop Rate	Back of Queue (veh)	Index
East: Calle Union E									
4	T	373	1950	100	0.191	0.0	0.00	0.0	7.07
North: North Approach									
9	R	233	597	100	0.390*	18.9	1.04	3.4	8.13

* Maximum degree of saturation

Calle Union y sec * UNIONFAM
Pico PM Futuro 2005
Intersection ID: 2
Stop Sign Controlled Intersection

Table S.12A - FUEL CONSUMPTION, EMISSIONS AND COST - TOTAL

Mov No.	Fuel Total L/h	Cost Total $/h	HC Total kg/h	CO Total kg/h	NOX Total kg/h	CO2 Total kg/h	Lead Total kg/h
East: Calle Union E							
4 T	34.6	165.38	0.102	1.98	0.132	86.4	0.00276
	34.6	165.38	0.102	1.98	0.132	86.4	0.00276
North: North Approach							
9 R	27.1	143.21	0.090	3.00	0.124	67.9	0.00217
	27.1	143.21	0.090	3.00	0.124	67.9	0.00217
INTERSECTION:	61.7	308.59	0.191	4.98	0.257	154.3	0.00494

Calle Union y sec * UNIONFAM
Pico PM Futuro 2005
Intersection ID: 2
Stop Sign Controlled Intersection

Table S.14 - SUMMARY OF INPUT AND OUTPUT DATA

Lane No.	Arrival Flow (veh/h) L	T	R	Tot	%HV	Adj. Basic Satf.	Eff Grn (secs) 1st	2nd	Deg Sat x	Aver. Delay (sec)	95% Queue (m)	Shrt Lane (m)
East: Calle Union E												
1 T	0	373	0	373	0				0.191	0.0	0	
	0	373	0	373	0				0.191	0.0	0	
North: North Approach												
1 R	0	0	233	233	0				0.390	18.9	20	
	0	0	233	233	0				0.390	18.9	20	

ALL VEHICLES	Tot Arv.	% HV	Max X	Aver. Delay	Max Queue
	606	0	0.390	7.3	20

Total flow period = 60 minutes. Peak flow period = 15 minutes.

Note: Basic Saturation Flows are not adjusted at roundabouts or sign-controlled intersections and apply only to continuous lanes.

Values printed in this table are back of queue.

Calle Union y sec * UNIONFAM
Pico PM Futuro 2005
Intersection ID: 2
Stop Sign Controlled Intersection

Table S.15 - CAPACITY AND LEVEL OF SERVICE (HCM STYLE)

Mov No.	Mov Typ	Total Flow (veh /h)	Total Cap. (veh /h)	Deg. of Satn (v/c)	Aver. Delay (sec)	LOS
East: Calle Union E						
4	T	373	1950	0.191	0.0	A
		373	1950	0.191	0.0	A
North: North Approach						
9	R	233	597	0.390*	18.9	C
		233	597	0.390	18.9	C
ALL VEHICLES:		606	2547	0.390	7.3	A
INTERSECTION:		606	2547	0.390	7.3	A

Level of Service calculations are based on average control delay including geometric delay (HCM criteria), independent of the current delay definition used.
For the criteria, refer to the "Level of Service" topic in the SIDRA Output Guide or the Output section of the on-line help.
* Maximum v/c ratio, or critical green periods

Calle Union y sec * UNIONFAM
Pico PM Futuro 2005
Intersection ID: 2
Stop Sign Controlled Intersection

Table D.1 - LANE DELAYS

Lane No.	Mov No.	Deg. Satn x	Stop-line Delay 1st d1	2nd d2	Total dSL	Acc. Dec. dn	Queuing Total dq	MvUp dqm	Stopd (Idle) di	Geom dig	Control dic
			Delay (seconds/veh)								
East: Calle Union E											
1 T	4	0.191	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
North: North Approach											
R	9	0.390	5.5	0.9	6.3	1.6	4.7	1.6	3.1	12.6	18.9

dn is average stop-start delay for all vehicles queued and unqueued

--- End of SIDRA Output ---

ARRB Transport Research Ltd - SIDRA 5.20b

Cordova & McCadney
TCG Registered User No. M0276
Time and Date of Analysis 9:44 AM, 27 Jun 2001

Calle Union y sec * UNIONFPM
Pico PM Futuro 2005
Intersection ID: 2
Stop Sign Controlled Intersection

RUN INFORMATION

* Basic Parameters:
  Intersection Type: Unsignalised - Two-Way Stop Control
  Driving on the right-hand side of the road
  Input data specified in Metric units
  Default Values File No. 30
  Peak flow period (for performance): 15 minutes
  Unit time (for volumes): 60 minutes (Total Flow Period)
  Delay definition: Control delay
  Geometric delay included
  Delay formula: SIDRA standard
  Level of Service based on: Delay (HCM)
  Queue definition: Back of queue, 95th_Percentile

Calle Union y sec * UNIONFPM
Pico PM Futuro 2005
Intersection ID: 2
Stop Sign Controlled Intersection

Table S.0 - TRAFFIC FLOW DATA (Flows in veh/hour as used by the program)

Mov No.	Left LV	Left HV	Through LV	Through HV	Right LV	Right HV	Flow Scale	Peak Flow Factor
East: Calle Union E								
4	0	0	359	0	0	0	1.00	1.00
North: North Approach								
9	0	0	0	0	140	0	1.00	1.00

Based on unit time = 60 minutes.
Flow Scale and Peak Hour Factor effects included in flow values.

Calle Union y sec * UNIONFPM
Pico PM Futuro 2005
Intersection ID: 2
Stop Sign Controlled Intersection

Table S.2 - MOVEMENT CAPACITY PARAMETERS

Mov No.	Arv Flow (veh /h)	Total Opng Flow (veh/h)	%HV	Adjust. Opng Flow (pcu/h)	Total Cap. (veh /h)	Prac. Deg. Satn xp	Prac. Spare Cap. (%)	Lane Util (%)	Deg. Satn x
East: Calle Union E									
4 T	359	0			1950	0.80	335	100	0.184

North: North Approach									
9 R	140	359	0.0	359	612	0.80	250	100	0.229*

alle Union y sec * UNIONFPM
ico PM Futuro 2005
Intersection ID: 2
Stop Sign Controlled Intersection

Table S.3 - INTERSECTION PARAMETERS

Degree of saturation (highest)	=	0.229
Practical Spare Capacity (lowest)	=	250 %
Total vehicle flow (veh/h)	=	499
Total vehicle capacity, all lanes (veh/h)	=	2562
Average intersection delay (s)	=	4.8
Largest average movement delay (s)	=	17.2
Total vehicle delay (veh-h/h)	=	0.67
Largest back of queue, 95% (m)	=	8
Performance Index	=	11.33
Total fuel (L/h)	=	49.4
Total cost ($/h)	=	243.67
Intersection Level of Service	=	A
Worst movement Level of Service	=	C

Calle Union y sec * UNIONFPM
Pico PM Futuro 2005
Intersection ID: 2
Stop Sign Controlled Intersection

Table S.5 - MOVEMENT PERFORMANCE

Mov No.	Total Delay (veh-h/h)	Aver. Delay (sec)	Prop. Queued	Eff. Stop Rate	Longest Queue 95% Back (vehs)	(m)	Perf. Index	Aver. Speed (km/h)
East: Calle Union E								
4 T	0.00	0.0	0.00	0.00	0.0	0	6.80	60.0
North: North Approach								
9 R	0.67	17.2	0.59	0.93	1.4	8	4.53	48.9

Calle Union y sec * UNIONFPM
Pico PM Futuro 2005
Intersection ID: 2
Stop Sign Controlled Intersection

Table S.6 - INTERSECTION PERFORMANCE

Total Flow (veh/h)	Total Delay (veh-h/h)	Aver. Delay (sec)	Prop. Queued	Eff. Stop Rate	Perf. Index	Aver. Speed (km/h)
East: Calle Union E						
359	0.00	0.0	0.000	0.00	6.80	60.0
North: North Approach						
140	0.67	17.2	0.590	0.93	4.53	48.9

INTERSECTION:						
499	0.67	4.8	0.166	0.26	11.33	56.4

alle Union y sec * UNIONFPM
Pico PM Futuro 2005
Intersection ID: 2
Stop Sign Controlled Intersection

Table S.7 - LANE PERFORMANCE

Lane No.	Mov No.	Arv Flow (veh /h)	Cap (veh /h)	Deg. Satn x	Aver. Delay (sec)	Eff. Stop Rate	Queue 95% Back (vehs)	Queue 95% Back (m)	Short Lane (m)
East: Calle Union E									
1 T	4	359	1950	0.184	0.0	0.00	0.0	0	
North: North Approach									
1 R	9	140	612	0.229	17.2	0.93	1.4	8	

Calle Union y sec * UNIONFPM
Pico PM Futuro 2005
Intersection ID: 2
Stop Sign Controlled Intersection

ble S.8 - LANE FLOW AND CAPACITY INFORMATION

Lan No.	Mov No.	Arv Flow (veh/h) Lef	Thru	Rig	Tot	Lane Width (m)	Saturation Flow Adj. Basic (tcu)	Aver 1st (veh)	Aver 2nd (veh)	Min Cap (veh /h)	Tot Cap (veh /h)	Deg. Satn x	Lane Util %
East: Calle Union E													
1 T	4	0	359	0	359	3.30N	1950	-	-	359	1950	0.184	100
North: North Approach													
1 R	9	0	0	140	140	3.30N	-	-	-	60	612	0.229	100

N Width value was not used for saturation flow adjustment in this case. (Lane width adjustment does not apply at sign-controlled intersections or to gap-acceptance capacities at signalised intersections).

Basic Saturation Flow in this table is adjusted for lane width, approach grade, parking manoeuvres and number of buses stopping. Saturation flow scale applies if specified.

Calle Union y sec * UNIONFPM
Pico PM Futuro 2005
tersection ID: 2
Stop Sign Controlled Intersection

Table S.10 - MOVEMENT CAPACITY AND PERFORMANCE SUMMARY

Mov	Mov	Arv	Total	Lane	Deg.	Aver.	Eff.	95%	Perf.

No.	Typ	Flow (veh /h)	Cap. (veh /h)	Util (%)	Satn x	Delay (sec)	Stop Rate	Back of Queue (veh)	Index
East: Calle Union E									
4	T	359	1950	100	0.184	0.0	0.00	0.0	6.80
North: North Approach									
9	R	140	612	100	0.229*	17.2	0.93	1.4	4.53

* Maximum degree of saturation

Calle Union y sec * UNIONFPM
Pico PM Futuro 2005
Intersection ID: 2
Stop Sign Controlled Intersection

Table S.12A - FUEL CONSUMPTION, EMISSIONS AND COST - TOTAL

Mov No.	Fuel Total L/h	Cost Total $/h	HC Total kg/h	CO Total kg/h	NOX Total kg/h	CO2 Total kg/h	Lead Total kg/h
East: Calle Union E							
4 T	33.3	159.17	0.098	1.90	0.127	83.2	0.00266
	33.3	159.17	0.098	1.90	0.127	83.2	0.00266
North: North Approach							
9 R	16.1	84.50	0.053	1.78	0.074	40.3	0.00129
	16.1	84.50	0.053	1.78	0.074	40.3	0.00129
INTERSECTION:	49.4	243.67	0.151	3.68	0.201	123.5	0.00395

Calle Union y sec * UNIONFPM
Pico PM Futuro 2005
Intersection ID: 2
Stop Sign Controlled Intersection

Table S.14 - SUMMARY OF INPUT AND OUTPUT DATA

Lane No.	Arrival Flow (veh/h) L	T	R	Tot	%HV	Adj. Basic Satf.	Eff Grn (secs) 1st	2nd	Deg Sat x	Aver. Delay (sec)	95% Queue (m)	Shrt Lane (m)
East: Calle Union E												
1 T	0	359	0	359	0				0.184	0.0	0	
	0	359	0	359	0				0.184	0.0	0	
North: North Approach												
1 R	0	0	140	140	0				0.229	17.2	8	
	0	0	140	140	0				0.229	17.2	8	

ALL VEHICLES	Tot Arv.	% HV	Max X	Aver. Delay	Max Queue
	499	0	0.229	4.8	8

Total flow period = 60 minutes. Peak flow period = 15 minutes.

Note: Basic Saturation Flows are not adjusted at roundabouts or sign-controlled intersections and apply only to continuous lanes.

Values printed in this table are back of queue.

Calle Union y sec * UNIONFPM
Pico PM Futuro 2005
Intersection ID: 2
Stop Sign Controlled Intersection

Table S.15 - CAPACITY AND LEVEL OF SERVICE (HCM STYLE)

Mov No.	Mov Typ	Total Flow (veh /h)	Total Cap. (veh /h)	Deg. of Satn (v/c)	Aver. Delay (sec)	LOS
East: Calle Union E						
4	T	359	1950	0.184	0.0	A
		359	1950	0.184	0.0	A
North: North Approach						
9	R	140	612	0.229*	17.2	C
		140	612	0.229	17.2	C
ALL VEHICLES:		499	2562	0.229	4.8	A
NTERSECTION:		499	2562	0.229	4.8	A

Level of Service calculations are based on average control delay including geometric delay (HCM criteria), independent of the current delay definition used.
For the criteria, refer to the "Level of Service" topic in the SIDRA Output Guide or the Output section of the on-line help.
* Maximum v/c ratio, or critical green periods

Calle Union y sec * UNIONFPM
Pico PM Futuro 2005
Intersection ID: 2
Stop Sign Controlled Intersection

Table D.1 - LANE DELAYS

Lane No.	Mov No.	Deg. Satn x	Delay (seconds/veh): Stop-line Delay 1st d1	2nd d2	Total dSL	Acc. Dec. dn	Queuing Total dq	MvUp dqm	Stopd (Idle) di	Geom dig	Control dic
East: Calle Union E											
1 T	4	0.184	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
orth: North Approach											
R	9	0.229	4.6	0.0	4.6	1.4	3.1	0.0	3.1	12.6	17.2

dn is average stop-start delay for all vehicles queued and unqueued

--- End of SIDRA Output ---

Apéndice 11: Estudio Histórico Batimétrico y su Relación con la Geomorfología de la Bahía de Fajardo

ESTUDIO HISTORICO BATIMETRICO Y SU RELACION

CON LA GEOMORFOLOGÍA DE LA BAHIA DE FAJARDO

Kurt Grove

Frank Torres
Ecosystems and Associates
13 Port Road
Palmas del Mar
Humacao, Puerto Rico, 00791-6051

March 12, 2001

Dear Frank;

Find enclosed a brief report on the bathymetry of the Bahia de Fajardo area. The report includes a description of the survey histories, 10 figures and archived data and figures on a CD. The CD is organized into 6 directories: 1900, 1964, 2000, NOS images, raw Garmin data and data.

NOS images: These are images of the Fajardo area taken by the National Ocean Survey and downloaded from several web sites. The images can be viewed and edited using shareware like paintshop pro which can be obtained on the internet from www.shareware.com. The images were combined into figure 1 (figure1.wpd) which can be read with wordperfect and (figure 1.doc) read by Word.

1900: This directory contains the 1900 NOS survey data, grids and contour plots. Figures 2 and 3 are plots created using SURFER by Golden Software (.srf) files, (.dxf) formats were also created for AutoCad applications. The 10 meter by 10 meter grids were used to create the countour. The interpolated depth values used to create the grid were based on NOS smooth sheet data stored in;
H2476pr.csv
Minsho2476pr.csv
Obispo2476pr.csv
Zancudo2476pr.csv

Additional data of elevations from the USGS topographic quadrangle maps was also included;
Fprtopopr.csv

The composite used for gridding is;
Fpr1900griddata.csv

All this files are converted to Puerto Rico State Plane coordinates in meters referenced to the NAD27 datum. Water depths are also in meters referenced to mean lower low water. Shorelines are referenced to mean high water. All these files are also included in an Excel workbook (fpr1900pr.xls)

1964: This directory contains the 1964 NOS survey data, grids and contour plots. Figures 4 and 5 are plots created using SURFER by Golden Software (.srf) files, (.dxf) formats were also created for AutoCad applications.
Smooth sheet data files are;
Hs8813pr.csv

Fpr1964mainsopr.csv
Fpr1964obispopr.csv
Fpr1964zancupr.csv
Isla12prusgs.csv
Isla4prusgs.csv
All stored in fpr1964.xls
Composite used for griding is fpr1964griddata.csv

Fig 8 is also included in this directory. A difference in depths was calculated from the grids for 1900 and 1964 for the area around the proposed marina. The difference contours plotted in fig 8. are related to the sediment accumulation or erosion.

2000: This directory contains the 2000 survey data collected with the Garmin 235 map along with grids and contour plots. Figures 6 and 7 are plots created using SURFER by Golden Software (.srf) files, (.dxf) formats were also created for AutoCad applications.
Data files are;
Fpr2000pr.csv
Mainsoprusgs.csv
Obispoprusgs.csv
Zancuprusgs.csv
All stored in fpr2000pr.xls
Composite used for griding fpr2000griddata.csv

Figures 9 and 10 are also included in this directory. A difference in depths was calculated from the grids for 1900 -2000 and 1964-2000 for the area around the proposed marina. The difference contours plotted in fig 9 and 10 respectively. The contours are related to the sediment accumulation or erosion.

Frank, I hope that this is the information you wanted Please let me know if you would like some of the figures modified in any way.

Best Regards,
Kurt

General Features

The Fajardo Harbor is situated off northeastern Puerto Rico about three miles south of Cabo San Juan. The Harbor is bound west and south by "Playa de Fajardo" and to the east by two offshore cays "Cayo Obispo" and "Cayo Zancudo". The harbor is open to the north. A direction partially protected from large swell by the main island and the line of small islands refered to as "La Cordillera". These islands extend from Culebra in the east to Icacos and Las Cucarachas in the west.

Cayo Obispo is the northern most of a line of islands and shoals that parallel the east coast of Puerto Rico from Ceiba to Fajardo. The barrier creates a channel that permits entrance to the harbor from the south and southeast. Coastal currents and the ebb and flood of the tide moving through the channel should accelerate the flushing of the harbors environment. Punta Fajardo is created were the coast turns south. Rocks characterize the near-shore at this point and about 300 meters to the south the small river "Rio Fajardo" enters the channel between mainland and barrier. Aerial photography for1999 and 1992 taken by the National Ocean Survey (NOS) (Fig.1 a and b) (NOS1999-5428.jpg and NOS1992-5wgr7187.gif) show the mentioned features as well as the urbanization of the coast

Bathymetry

The earliest soundings for the shelf off Fajardo come from a survey conducted by the U.S. Coast and Geodetic Survey (CGS), Hydrographic Survey HS-2476 (Boutelle et. al., 1900). More recently the CGS now part of the NOS re-surveyed in 1964 (HS-8813). These data have been evaluated and digitized by Mercado (1993).

The digitized data for HS-2476 is plotted in figure 2 (. The depths along with shoreline and some elevation measurement digitized from the USGS topographic sheet for Fajardo were used to interpolate a grid of evenly spaced depths and elevations used to create the depth contours presented in figure 3. All positions digitized and measured are referenced to the Puerto Rico Datum for 1927 in meters. This is the same as the North American Datum for 1927 (NAD27). Depths are referenced to mean lower low water (MLLW) and reported in meters

At the turn of the twentieth century the deepest part of the bay was around 5-6 meters. These depths are from a n-s trending trough west of Cayo Obispo and Cayo Zancudo. The trough is an extension of the channel between barrier and mainland to the south. Off Punta Fajardo, just north of the mouth of the Rio Fajardo, a wide shallow rocky shoal is present. This rocky area marks the beginning of Fajardo beach which continues west and north to the rocky Punta Bateria. Most of the harbor provided anchorage for vessels with a draft less than 4 meters. The report by Boutelle et. al. (1900) refers to the harbor sediment type as soft.

The data for the 1964 survey is presented in figure 4. The depth contours (figure 5) show the same general features as those of the 1900 survey. However the 1964 data extends further south and provides information on the barrier created by Cayo Ahogado and Isla de Ramos. The trough is from 6 to 8 meters deep. Where the Rio Fajardo enters the channel a submerged delta is

present. The delta is composed of river sediment (gravel, sand and mud) deposited as the river losses velocity upon entering a larger body of water. The arched shape of the delta is similar on both northern and southern sides.

In addition to the existing data a survey was conducted off the site of the proposed marina. The data was collected with a Garmin Map235 with a sounder on December 18, 1999. The navigation has an accuracy of ± 15 meters and depth to 0.1 meter. Positions are referenced to NAD27 Datum and depths to MLLW. The data shown in figure 6 was used to create a 10 m x 10 m grid between 237370 to 237700 meters east and 55620 to 56580 meters north. The contours on interpolated for this grid are shown in figure 7.

Sediment Transport and History of Sedimentation

The history of sedimentation in the area off the proposed marina was evaluated by calculating the difference between grid values for 1900, 1964 and 2000. Each difference grid was contoured in order to detect areas of significant accumulation (positive values) or erosion (negative values). Contours for the 1900 - 1964, 1900 - 2000, and 1964 - 2000 are presented in figures 8, 9, and 10. The most significant changes occurred in the area of the trough while most of the area exhibits changes between ±0.5 meters.

No sediment transport directions have been evaluated along the Fajardo coastline. However, some indication of transport direction can be obtained from the NOS images. The 1992 image figure 1b is uncommonly clear and shows sediment features off the river mouth. The delta has a dendritic pattern of channels with no preferred direction north or south. This suggests a week or balanced transport north and south along the shoreline. The 1999 image (figure 1a) shows a more common turbid condition. Red brown sediment color is seen both north into the Fajardo Harbor and south. The amount of sand moving west and north along the shoreline is not sufficient enough to create noticeable accumulation on any given side of the harbor docks that should be acting as groins.

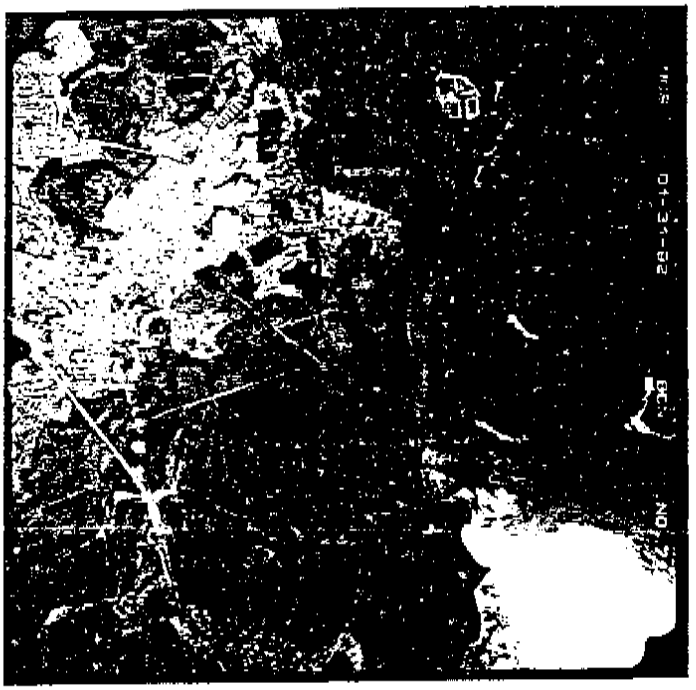


Figure 1a. NOS 1992 image coastal waters unusually clear. Channels as visible in submerged delta of the Rio Fajardo. The symmetric form of the delta is notable, red sediments distribute north and south of the river mouth. (5wgr7187.gif)

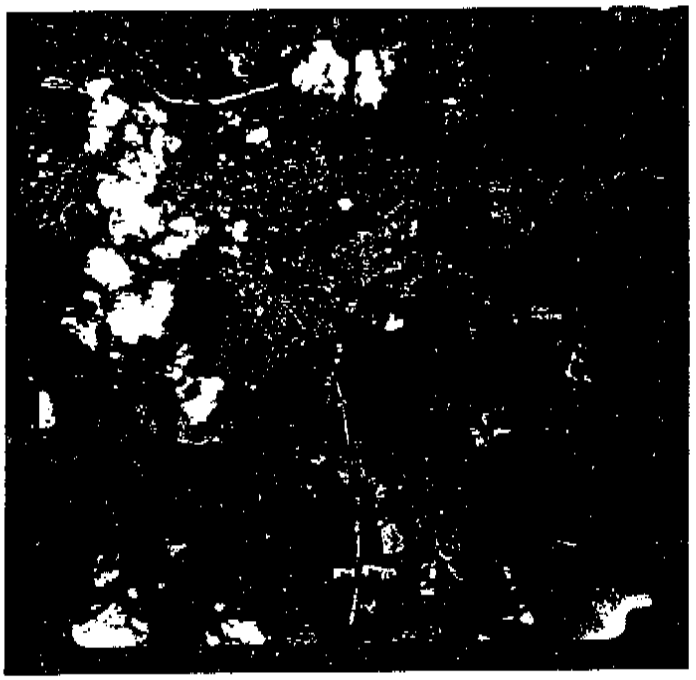


Figure 1b. NOS image taken in November 1999 shows turbid coastal waters. Iron rich (reddish) sediment at the mouth of the Rio Fajardo appear to be moving into Fajardo Bay. Bottom detail is lost due to the turbidity. (5417.jpg)

Figure 2. Data Digitized from
NOS Survey HS2476

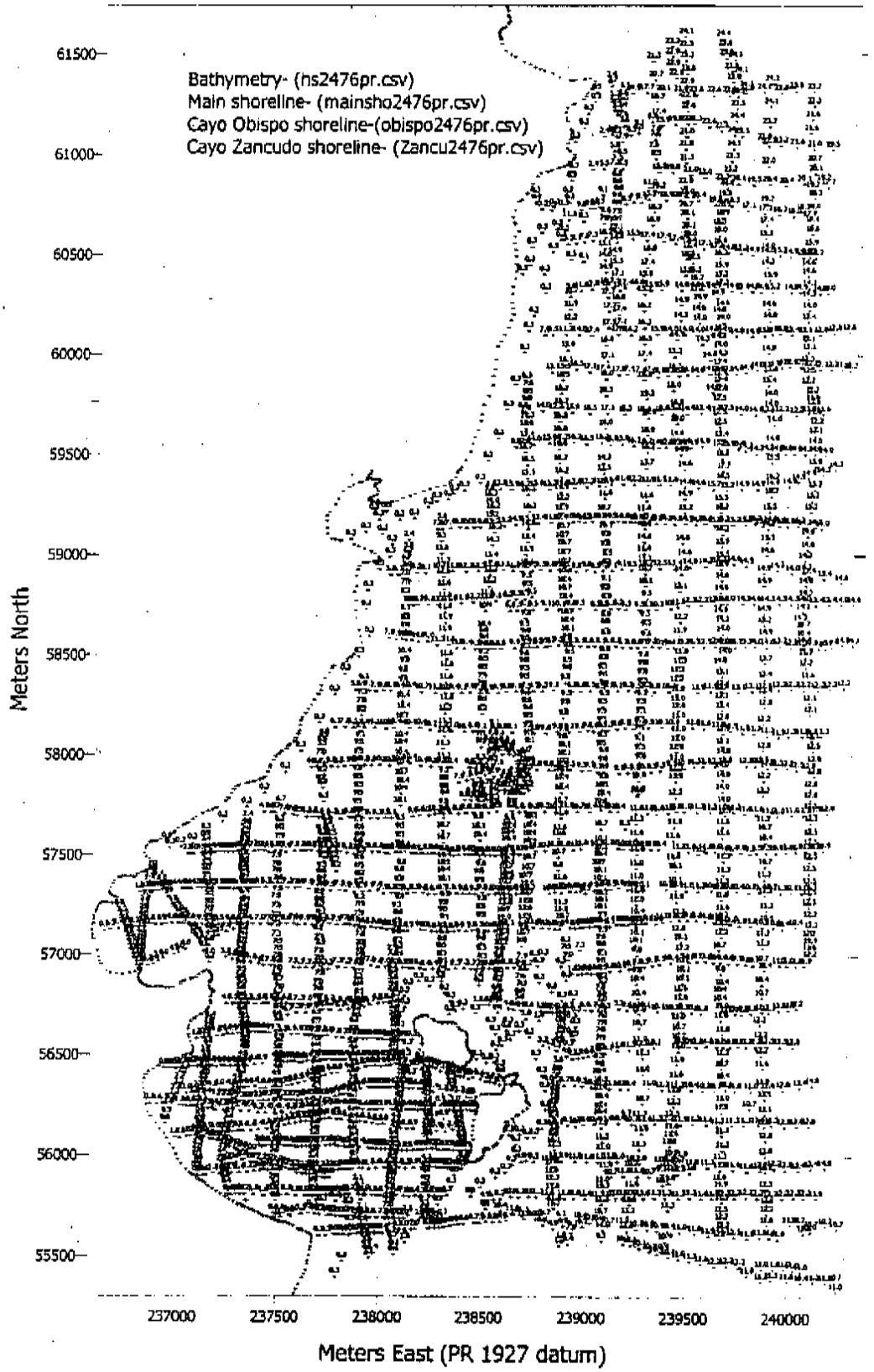


Figure 3. Fajardo Area
NOS Survey HS2476
Year 1900

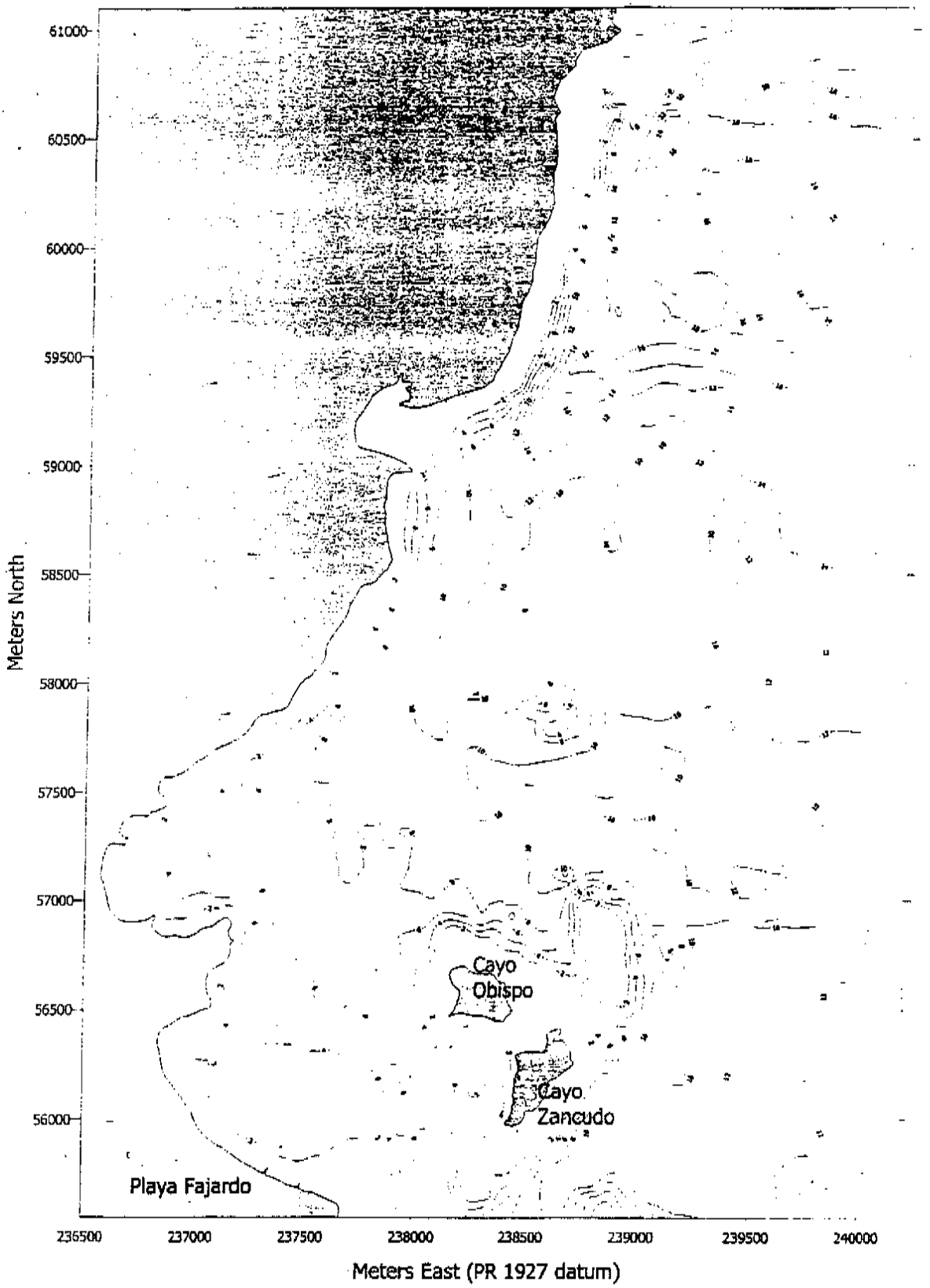


Figure 4. Data Digitized from
NOS Survey HS8813

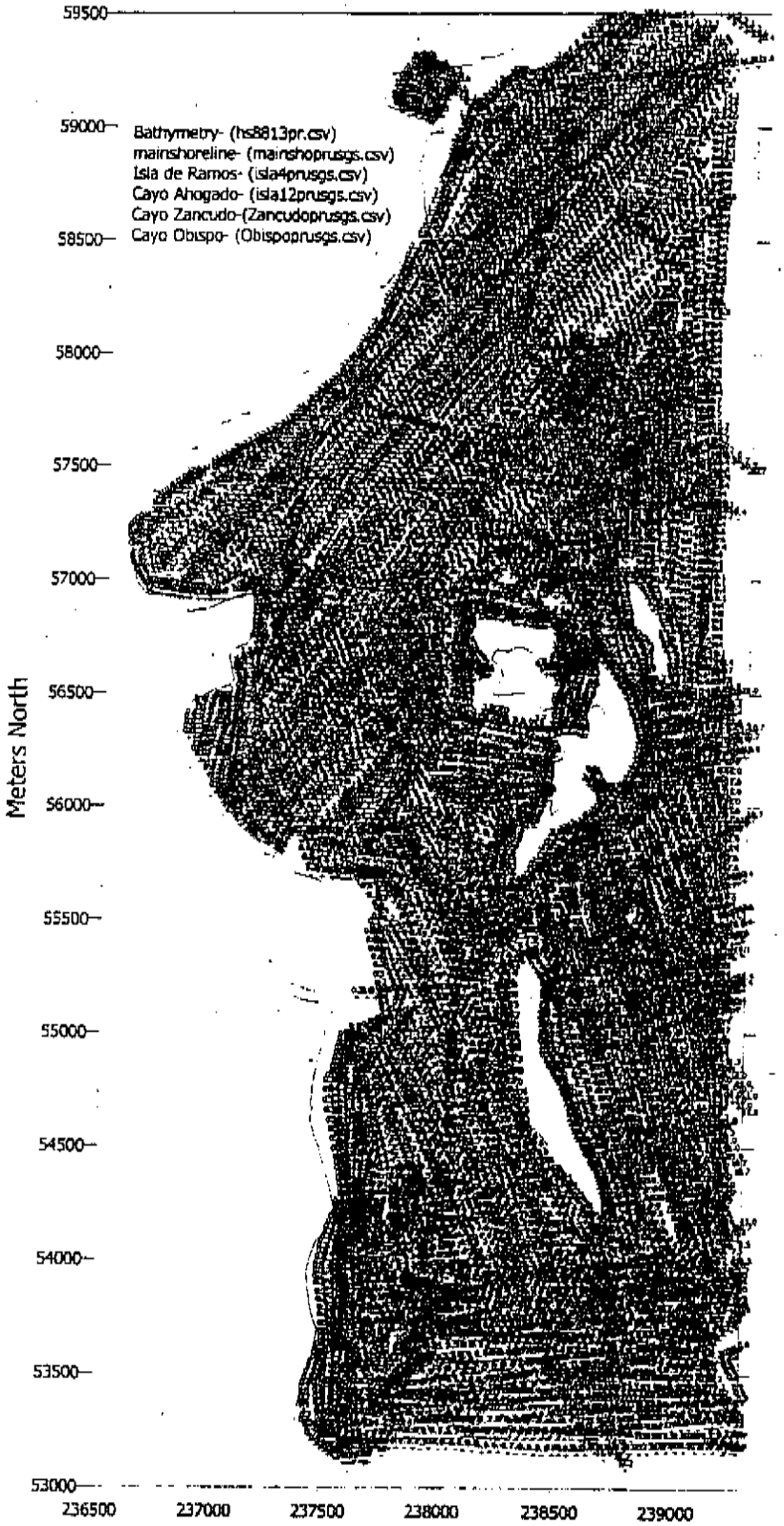


Figure 5. Fajardo Area
NOS Survey HS8813
Year 1964

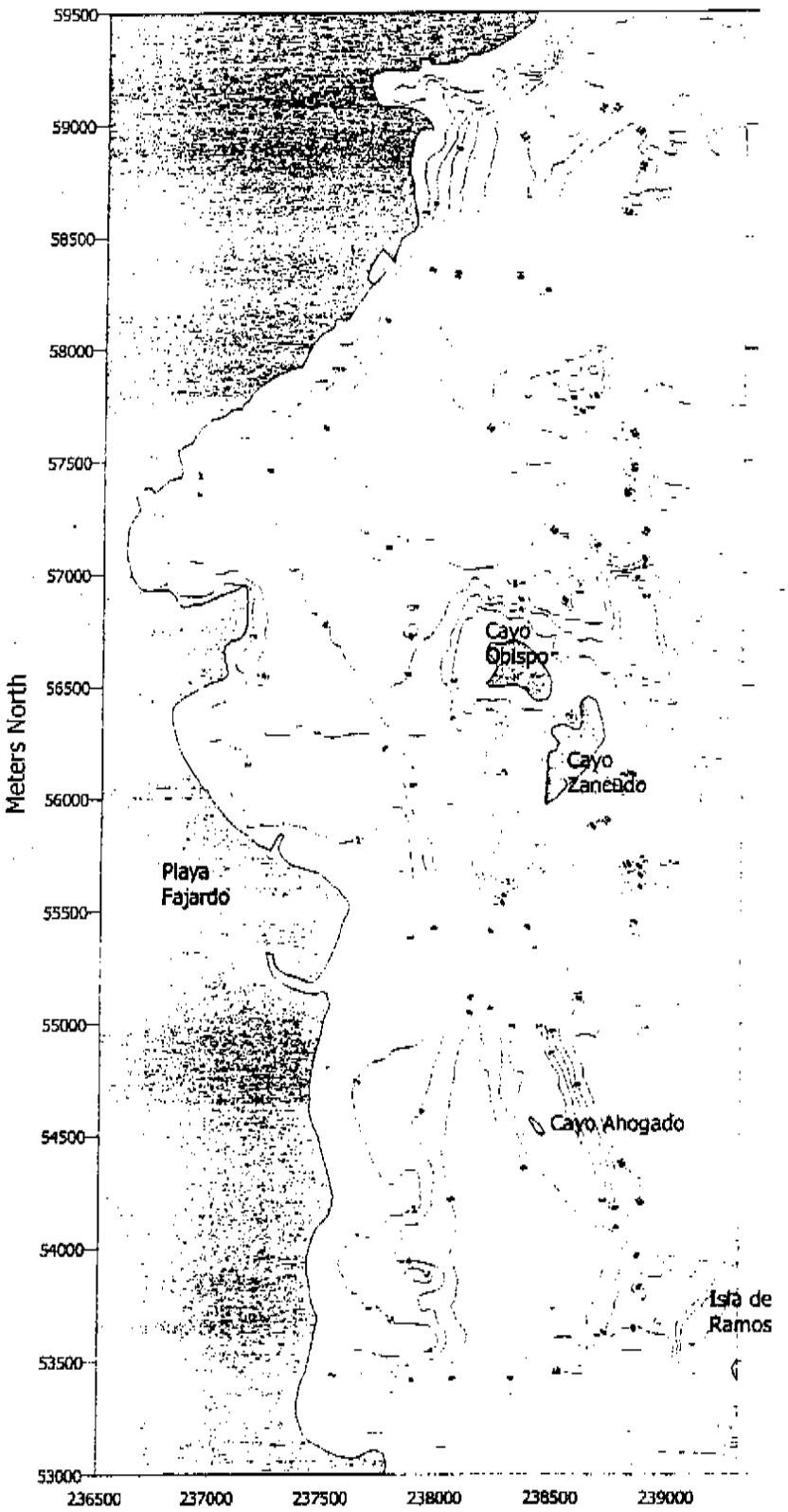


Figure 6. Bathymetric Survey
Area de Fajardo
Year 2000

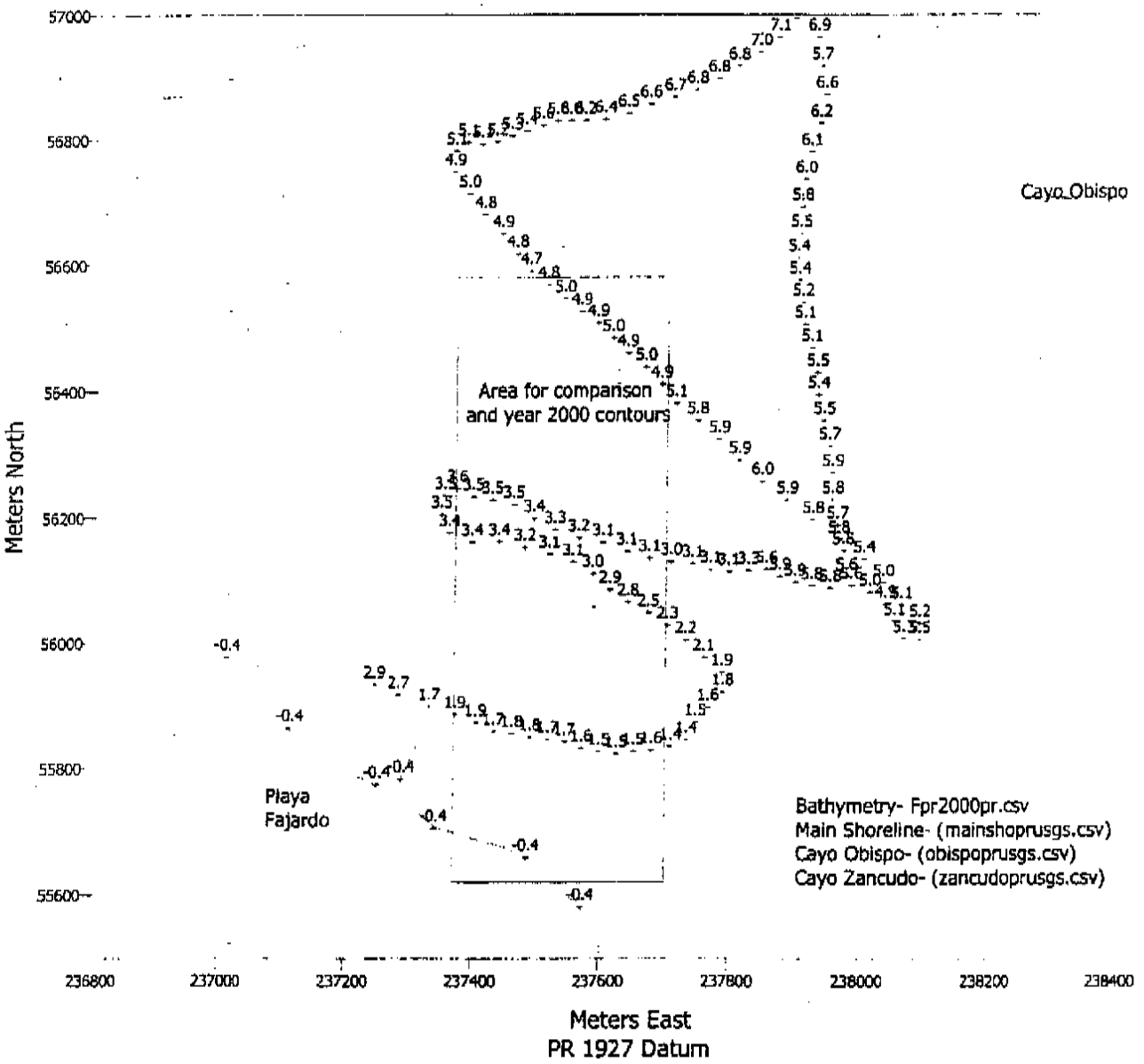


Figure 7. Bathymetry off the Fajardo docks, 2000

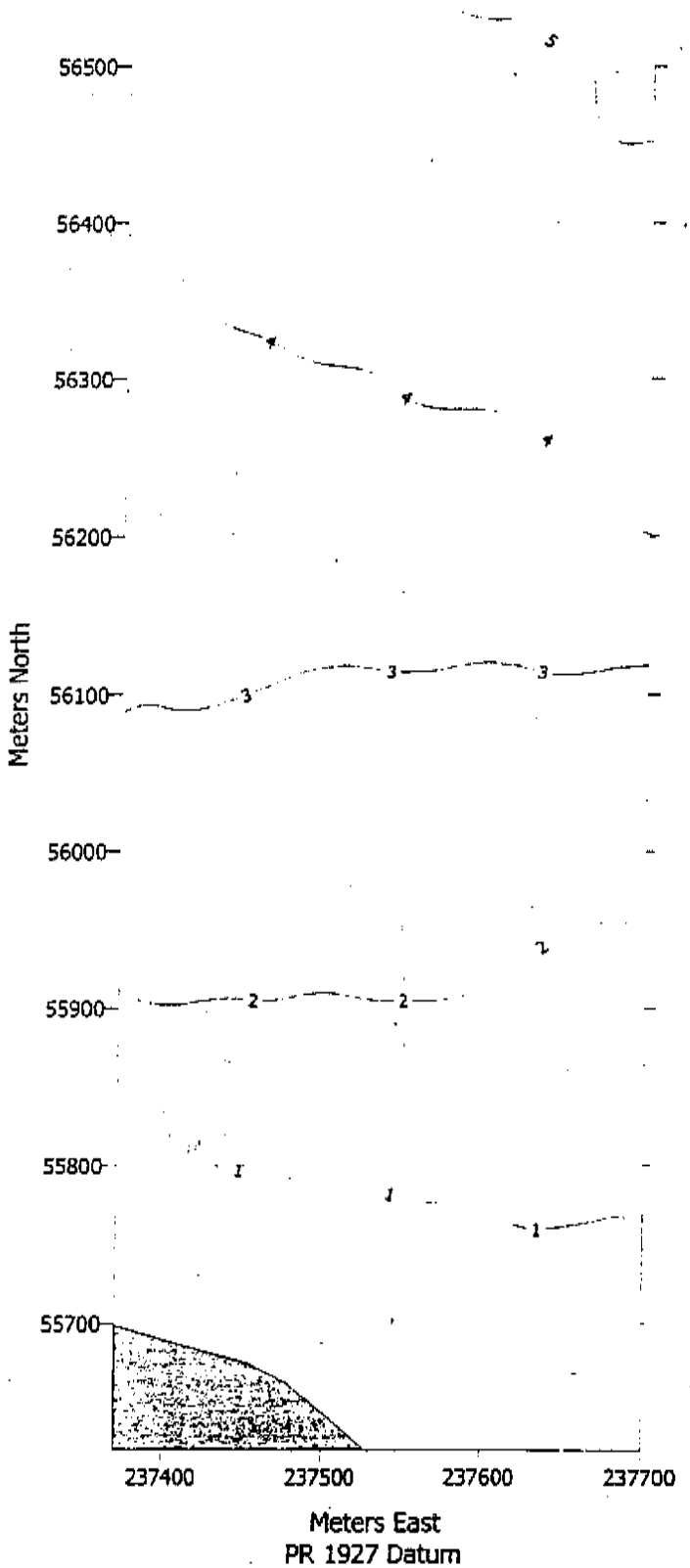


Figure 8. Sediment Accumulation
1900-1964

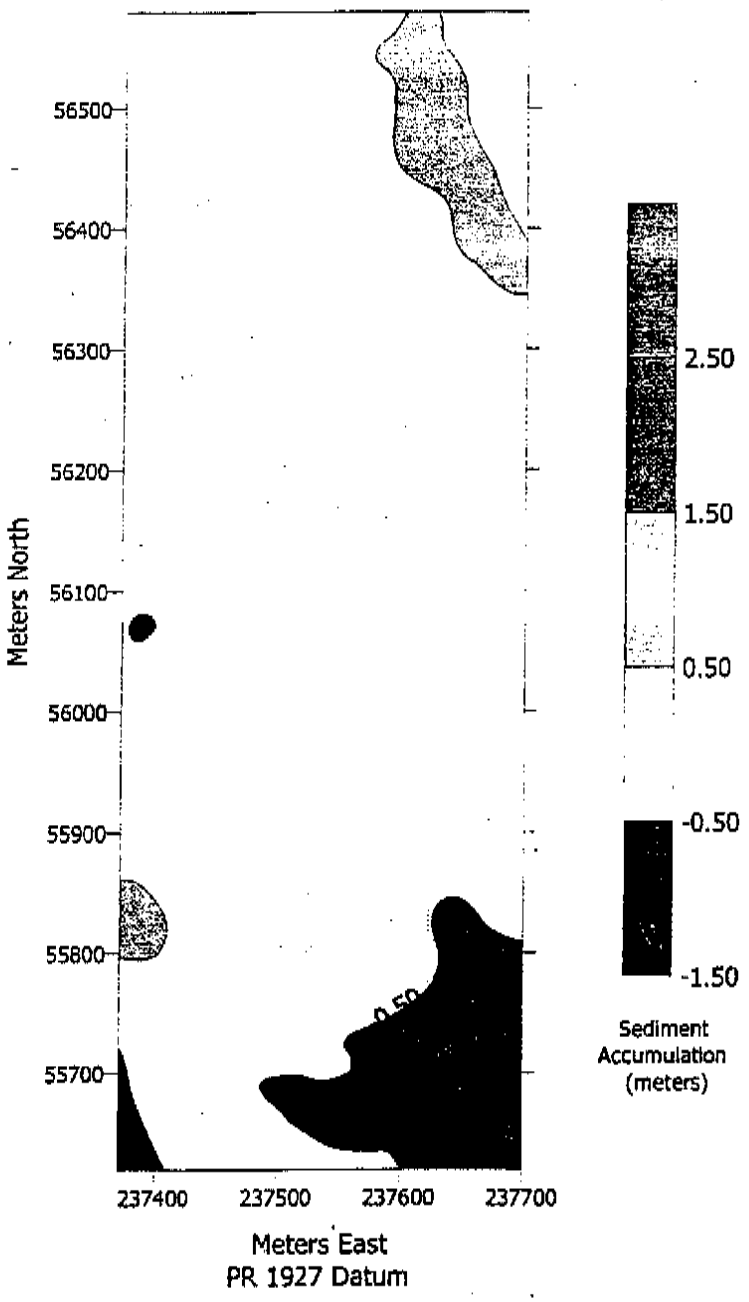


Figure 9. Sediment Accumulation
1900 - 2000

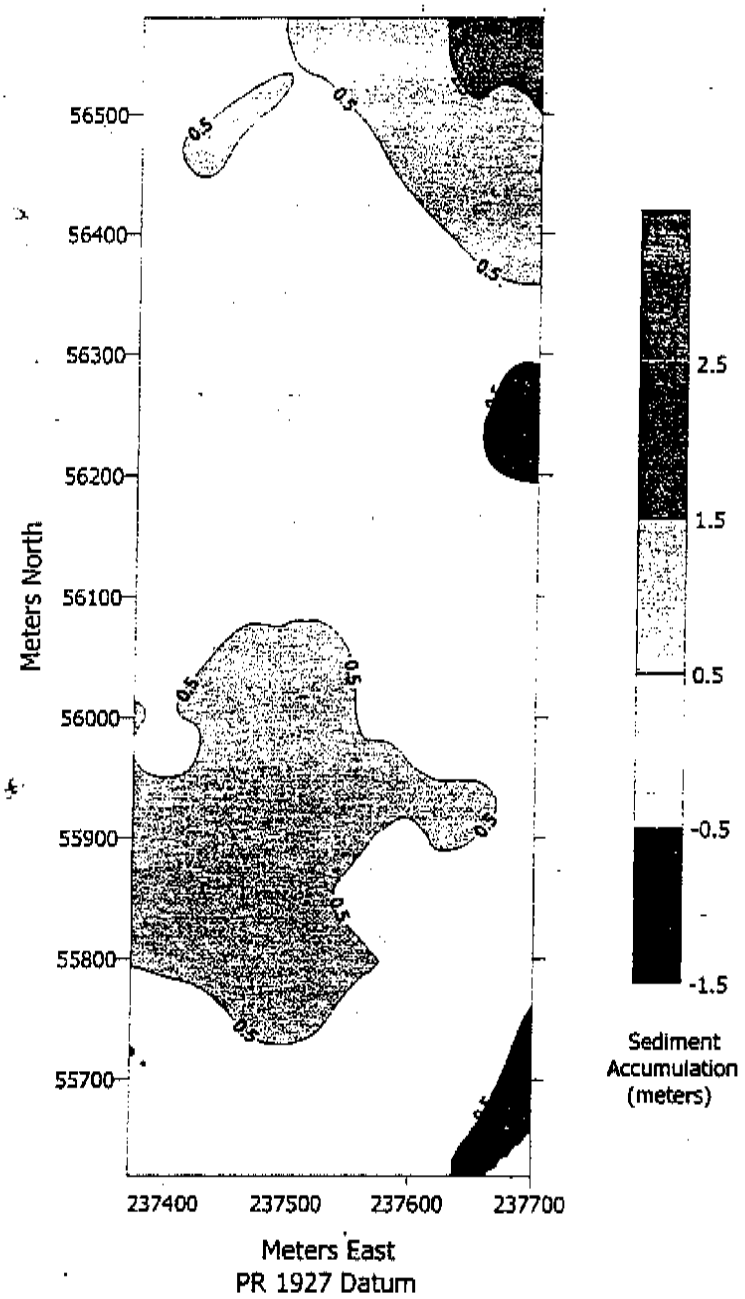
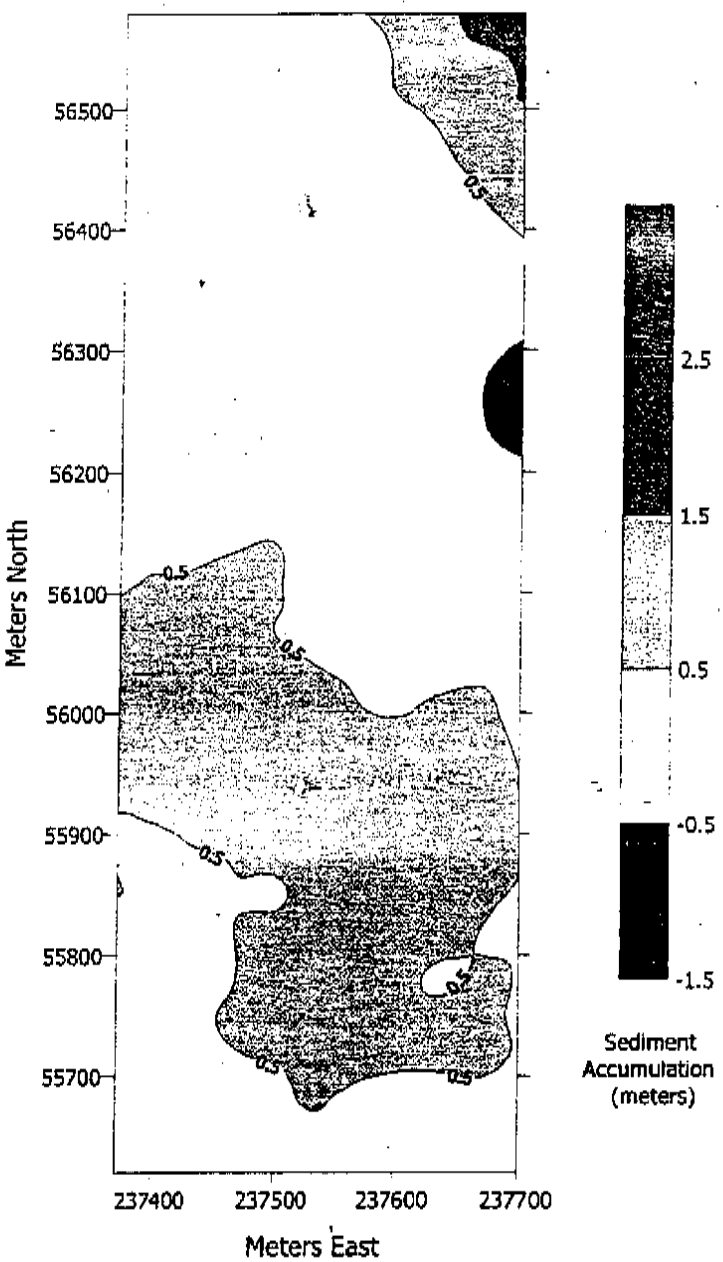


Figure 10. Sediment Accumulation
1964 - 2000



Apéndice 12: Estudio Oceanográfico

Marina Puerto Real
Oceanographic Studies

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Submitted to

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Overview

Marine currents, tides, and waves were monitored at Bahía de Fajardo in Fajardo, Puerto Rico (PR) during May-June 2001 (Table 1). This work was contracted by Mr. Frank Torres of Eco Systems and Associates, Humacao PR and is designed to meet design/regulatory/permitting requirements associated with development concepts for the Marina Puerto Real marina project (MPR).

Table 1: Marina Puerto Real deployments.

Event	Start	End	Lat	Lon	Instruments
1	2-May-01	14-Jun-01	18 20.051°N	65 37.566°W	RCM9, SBE26
2	23-May-01	14-Jun-01	18 20.100°N	65 37.433°W	S4

Oceanographic Instrumentation

Currents were measured with an S4 current meter from InterOcean Systems and an RCM9 current meter from AANDERAA Instruments.. Instrument description and brief technical specifications are provided at the end of this document. Additional information is available in the S4 web page http://www.interoceansystems.com/s4main.htm and the RCM9 web page http://www.aanderaa.com/PDF_Files/RCM9Mk2D328.pdf.

Surface wave and tidal elevation data were collected with a Sea-Bird Electronics, Inc. (SBE) SBE26 SEAGAUGE Wave and Tide Recorder. SBE's web site capsule description of this instrument reads as follows:

> "The SEAGAUGE is a wave & tide recorder which integrates water level measurements and characterizes waves with interleaved bursts of sampling at up to 4 Hz. The SBE 26 combines a Digiquartz® pressure sensor, accurate clock, precision thermometer, and optional conductivity sensor to provide water level, wave, temperature, and salinity data with high resolution and accuracy. Sampling intervals, wave burst-sampling rate, and duration are easily programmable. Data analysis software is also included."

Additional information and technical specifications are found in the SBE26 web page at http://www.seabird.com/products/spec_sheets/26data.htm.

These instruments were leased from the Department of Marine Sciences of the University of Puerto Rico where they have been extensively used in oceanographic research. These are all solid-state instruments, no moving parts, and are internally calibrated to factory standards. This suite of instruments is ideally suited for coastal work in the warm waters around Puerto Rico were biofouling is usually very heavy.

Deployment Locations

Figure 1 and Table 1 indicate the instrument deployment locations in Bahía de Fajardo, between the Playa de Fajardo - Punta Fajardo coastline and Isleta Marina. All positions are

from differential GPS measurements. The RCM9 and the SBE26 were bottom mounted in the same mooring, as shown in Plate 1, and positioned at a depth of 1.5 m (5 ft), about 100 m to the west of an old relict vessel shown in Plate 2. The bottom at this location is sandy-mud with a sparse covering of *Thallassia* and other green algae. The most prominent feature was the smothering coverage by a type of red - brown algae (unk nown species) whose clumps covered most of the bottom surface (including the bottom rooted vegetation) up to about a foot in thickness. The abundant presence of this free drifting species is indicative of a low energy regime at this location during the monitoring period.

The S4 taut-wire mooring was deployed at a depth of 5.5 m (18 ft) with the S4 positioned at a depth of 2.4 m (8 ft). The mooring was located over a sandy-mud bottom, offshore from the RCM9-SBE26 mooring, at a point along the base of the western slope of the "deep" channel between Punta Fajardo and Isleta Marina, as shown in Figure 1. Little floral and faunal bottom coverage was observed at this location.

Instrument Configuration

The S4 sampled during one minute every ten minutes, at an internal sampling frequency of 2 Hz. Each recorded measurement is therefore an average of 120 instantaneous measurements over the one-minute sampling interval. The vector-averaging capabilities of modern current meters like the S4 and the RCM9 greatly reduce the frequency aliasing problem exhibited by older instruments, therefore preventing the contamination of the data by higher frequency noise. The data presented herein consist of time series of current speed and direction, and water temperature at 10 minute intervals.

The RCM9 was set to sample at a 20 minute time step. During each interval the acoustic Doppler sensor emits 600 pings so the vector averaged data is generated from 600 instantaneous measurements sampled at 2 second intervals. The data presented herein consist of time series of current speed and direction, and water temperature at 20 minute intervals.

The SBE26 was configured to average continuous measurements of sea surface elevation and water temperature every 20 minutes to generate tide and temperature time series. Every six hours a wave burst was obtained, each burst consisting of 1024 wave measurements at a 0.25 second time step (4 Hz).

Results

The total monitoring period was extended over that allowed by individual instrument power and data storage limitations by staggering the deployment intervals of the two moorings while allowing for a significant overlap. SBE26 temperature, tide, and wave data extend from May 2 to May 23, at which time battery power was exhausted as per predeployment calculations. The S4 sampled from May 23 to June 14, at which time both moorings were retrieved.

On the date the second mooring was deployed, May 23, the first mooring was also inspected. At this time we confirmed that both the SBE26 and the RCM9 were in good condition, albeit growing some healthy biofouling, but a large bag was found attached to

the base of the mooring. The bag and the heaviest growth were removed at this time. Upon retrieval of the moorings the RCM9 data was found to be bad over the period from May 2 to May 22, the only good data points extend from May 23 to May 28, at which time battery power was exhausted, as expected. I suspect that the bag found attached to the base of the mooring on May 23 wrapped itself around the RCM9 sensor pod early in the deployment due to the oscillatory tidal currents and caused the malfunction.

S4 and RCM9 temperature and current vector data and the predicted tide overlap over the five day period from May 23 to May 28, SBE26 and predicted tide data overlap from May 2 to May 23, while S4 data and the predicted tide overlap from May 23 to June 14. Due to the strong tidal modulation of the signal in the current time series, the good correlation between the observed and the predicted tide, and the correspondence between the temperature time series from all three sensors, the overlap periods are, however, sufficient to form a coherent picture of the oceanographic conditions at the study site over the total monitoring period.

Currents and Tides

Tidal elevations at the MPR SBE26 mooring are presented in Figure 2; the predicted tide at Playa de Fajardo is also plotted for comparison. The agreement in amplitude and phase between the observed and the predicted tides is quite good but not exact; the observed tide is synoptic with the predicted tide whereas their amplitudes differ slightly. Note that sea-level pressure effects are not considered in the processing of the SBE26 tide time series. Three weeks of tidal observations span slightly over one and a half a fortnightly tidal cycles (a fortnightly cycle is 14 days, half a lunar cycle) and the effect of lunar declination on the relative amplitude of the semidiurnal tidal peaks is clearly observed. The tide along the west and north coasts of PR is mixed, principally semidiurnal, which means that two tidal cycles occur each day (Fig. 2). Due to asymmetric forcing from the effect of lunar declination during a fortnight we observe a shift from two cycles of equal amplitude to two cycles of unequal amplitude (one big and one small, approaching a diurnal tide). This trend is observed in Figure 2 where the tidal peaks are of nearly the same amplitude at the beginning of the record on May 4 and later on May 18, progressively shifting to asymmetrical peaks around May 11 and by the end of the record on May 23.

Plotted in Figure 3 are the S4 and RCM9 meridional (V, north-south) current component, the observed SBE26 tide, and the predicted tide over the observation overlap period. Time lag and amplitude relationships between the observed and the predicted tide are more clearly illustrated in this expanded-time view than in Figure 2. Focus should be placed on the total tidal ranges, not on the slight vertical offset apparent in this short data section as the predicted tide elevations are reported relative to the long-term Mean Low Low Water (MLLW) datum whereas the observed tide has been calculated about the record mean. Bottom contours at the study site are aligned along a predominantly north-south axis, so the meridional current component is dominant.

Note that while the surface tide in Figure 3 exhibits two highly asymmetrical peaks over a 24 hour period, the tidal current peaks are nearly symmetrical at both locations. Peak flow to the north occurs during peak ebb tide while peak flow to the south is closely synoptic

with the peak flood tide. Currents are dominated by the semidiurnal tidal component which oscillates about a mean northwards flow. Full data time series of the zonal (U, east-west) component, the meridional component (V), current speed, and current direction for the S4 and the RCM9 are presented in Figures 4-7, respectively. The semidiurnal frequency component is observed to be dominant at all times.

Record-mean scalar speed, vector (resultant) speed, and direction are 21.2 cm/s, 15.5 cm/s, and 353°T for the S4 and 6.8 cm/s, 3.0 cm/s, and 338°T for the RCM9 (Tables 1 and 2). The 10, 50, and 90 percentile speeds were 3.7, 16.8, and 43.6 cm/s for the S4 and 2.4, 7.3, and 10.3 cm/s for the RCM9, respectively. Maximum northwards speeds recorded by the S4 along the deep channel are in the order of, and frequently exceeded, one knot (over 50 cm/s). At the location of the S4, currents over the monitoring period can be accurately described as an oscillatory tidal component of ~35 cm/s amplitude superimposed on a mean northwards flow of ~15 cm/s. At the RCM9 location the tidal current amplitude is much lower, at about 6 cm/s that when added to the northwards mean flow results in peak northward speeds of ~10 cm/s.

As shown in Figures 7 and 8, the currents do not flow evenly around the compass but rather persist either to the north or south with rapid jumps among these two modes. Marks were added at each S4 sample point in Figure 8 to remark on the fact that there was no flow at all observed towards 170°-330°T. Only briefly is the flow steered along the eastern quadrant, 0°-90°T. Progressive vector pseudo-trajectories for both current meter time series are presented in Figure 9. The mean northwards flow and the slightly offset tidal current axis are both well defined in this figure. The small difference in the mean direction of the flow at the two current meter locations is due to the different orientation of the bottom contours; the mean flow follows along the axis defined by the bathymetry at both locations. A complementary perspective of the flow is provided by the directional distribution of the volume transport at both sites (Fig. 10). Over 85% of the total transport at the S4 site is towards the 330°-360°T band, whereas close to 65% of the transport at the RCM9 location is towards 300°-345°T.

Distributions of the mean and variance of the V current component vs. rotation angle of the coordinate axis (counterclockwise) are included in Figure 11. The axes of maximum V-variance and maximum V-mean differ by 11°, as is also observed in Figure 9. Maximum variance is attributed to the tidal oscillation whose axis differs only slightly from the direction of the mean flow. At the shallower, closer to shore, RCM9 mooring the difference is 20°. Since the maximum variance and maximum mean axes are oriented approximately parallel to the meridional axis the analysis of the current vector data has been performed on the raw data and axis rotation has not been applied.

The analysis of the main frequencies contributing to flow variance was performed through the use of four different power spectrum estimators: Blackman-Tuckey (correlogram, BT), Maximum Entropy Method (MEM), Multi Taper Method (MTM), and Singular Spectrum Analysis (SSA). The plots included in this report are representative of numerous experiments with window types and sizes for each technique. The S4 and RCM9 BT correlograms (Fig 11.), MEM (not shown), and SSA (not shown) spectral estimates all agree in the general shape of the spectra, which are characterized by a rather low, flat,

energy distribution between periods of 20 (S4 Nyquist) and 100 minutes, and higher power in the lower frequencies resolved in the S4 data (red-shifted spectra). The very energetic, and only significant, peak in these spectra occurs at the semidiurnal frequency (period = 12.4 hr, frequency = 1.34×10^{-5} Hz = 0.08 cycles/hour). The MTM spectra (Figs. 13 and 14) are better able to resolve periodic components in the signal so, in addition to the strong semidiurnal frequency (fundamental) peak, these were able to identify weaker, but significant, peaks corresponding to the 8, 6, 4, and 3 hour tidal harmonics, and to periods between 40 and 29 minutes.

Waves

Power auto-spectra were calculated for each of the wave bursts collected four times a day from May 3-24. Spectra were calculated using the WAVE26 software from SBE. The Nyquist frequency (highest resolved frequency) for these data corresponds to a wave period of 0.5 seconds, given the sampling frequency of 4 Hz. Wave burst data contained 1024 samples and their analysis considered 49 spectral bands, 0.02 Hz in width, with 5 spectral estimates per band for a frequency span from 0.012 to 0.949 Hz. Significant wave heights and periods were also calculated by the SBE26 wave software. These burst spectra exhibit high frequency resolution and extend the low frequency limit beyond storm swell range.

The wave monitoring period was characterized by calm weather that was interrupted by the passage of three low-pressure, high rainfall, systems. No significant northern storm-swell activity occurred during this period. Wave energy levels are very weak at the SBE26 mooring site when compared to measurements taken on the exposed north and northwest coasts under the influence of winter-spring swell. As shown in Figure 15, the first low-pressure system affected PR during May 5-7, when intense precipitation was recorded throughout the island. These systems are usually accompanied by strong winds and are observed to generate waves with periods of around one second and significant wave heights of one foot (Fig. 16 and 17). Two other "vaguadas" passed over our region on May 10-12 and May 21-22, roughly on a weekly basis. Representative wave burst spectra for these events are provided in Figure 17.

The diurnal wave-height cycle induced by the land-breeze effect (with a semidiurnal component) is best observed in Figure 16. Isleta Marina provides shelter from the prevailing easterly winds and only allows wave-fetch from the southeast and northeast quadrants. Personal observations indicate that southeasterly winds generate most of the wave activity at the site.

Water Temperature

The full temperature time series recorded by all three instruments are presented in Figure 19. The three main features in these records are: 1) the diurnal solar heating cycle which is observed to induce temperature fluctuations in the order of two degrees at the SBE26-RCM9 and one degree at the S4, 2) the general increase in water temperature over the observation period from a mean low of 28°C to a mean high of about 29.5°C, and 3) the temperature-lowering effect of the high-rainfall events. A time window showing data subsets from all instruments is expanded in Figure 20. Note that the SBE26 temperatures

are approximately identical to those recorded by the RCM9 at the same mooring. The RCM9 sensor pod of was located half a meter (18 inches) above the bottom while the SBE26 temperature sensor was located 0.2 m (7-8 inches) above the bottom. A pronounced vertical temperature gradient between the warm near-surface waters and cooler waters at depth was felt by the divers working on both moorings.

The diurnal temperature range at the S4 is probably smaller probably due to the fact that this instrument was located in deeper water, at mid-depth, and at a location of much stronger flow. An intense precipitation event, such as that of May 6-8, is observed to lower the mean temperature of waters at the site by about one degree over a period of several days.

Interpretation and Summary

The mean flow of waters along the channel defined by Fajardo-PR and Isleta Marina was observed to be northwards during the monitoring period. The most significant mode of flow variability was that associated with the semidiurnal tide. Near the central axis of this channel, being also the deepest part, the flow may be described as the superimposition of an oscillatory tidal component of ~35 cm/s amplitude on a mean northwards flow of ~15 cm/s, resulting in peak northwards speeds of over 50 cm/s. Closer to the Fajardo coastline, in shallower water, the tidal current and mean flow components are much slower, ~6 cm/s and 3 cm/s, resulting in peak northward speeds of ~10 cm/s. This horizontal shear most be considered in the design of breakwater-marina structures in the area as sediments carried by the strong offshore currents will be deposited in the calm lee side of any sheltering structure. Peak northward currents occur one to two hours after the peak ebb tide whereas peak southward currents follow the peak flood tide.

Short-term Lagrangian current measurements were conducted during mooring deployment and recovery operations on May 2 and June 14, respectively. Small drogues were deployed to follow surface and subsurface waters for periods of about one hour. During May 2 the surface drogues tracked in the direction of the prevailing wind while the subsurface drogues drifted southward as would be expected during peak flood tide (Fig. 2). On June 14 the single surface drifter was not recovered (lost) while the subsurface drifter moved southwards with the tidal flow. Vertical shear in coastal flows due to the antagonistic effects of the wind and tidal current components have been observed at several locations around PR.

Wave activity during the late-spring monitoring period was weak and dominated by one-second waves with maximum significant wave heights of about one third of a meter (one foot). The most significant wave activity accompanied the passage of low-pressure systems over the PR region. I can only speculate on the intensity of the waves at the site that result from large storm swell arriving from the north and those induced by tropical storms and hurricanes. Several shipwrecks in the area and anecdotal information dating to the passage of Hurricane Georges in 1998 attest to the fact that under these conditions extreme wave activity occurs at the study site.