# ESTUDIO HIDROLÓGICO-HIDRÁULICO
# PROYECTO RESIDENCIAL MONTE SIERRA
# MAYAGÜEZ, PUERTO RICO

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# ESTUDIO HIDROLÓGICO-HIDRÁULICO
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Menar Hydrosystems Engineering
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## I. INTRODUCCIÓN

### General

El Sr. Orlando Pérez, desarrollador, está planificando la construcción de un proyecto residencial en una propiedad localizada en el kilómetro 1.1 de la Carretera Estatal PR-349, Bo. Quebrada Grande, del Municipio de Mayagüez. El área de la finca se estima en 59.33 acres (ver la Figura 3). La Figura 1 presenta la localización de la finca en los cuadrángulos topográficos de Mayagüez y Rosario, publicados por el Servicio Geológico de los Estados Unidos [USGS, 1982].

Dos quebradas discurren a través de la propiedad, estas no se encuentran identificadas con ningún nombre. La finca no está clasificada como inundable durante el evento de inundación de 100-años de frecuencia según se indica en el Mapa de Seguros contra Inundaciones Número 985H publicado por la Agencia Federal para el Manejo de Emergencias (FEMA por sus siglas en inglés). Copia parcial de este mapa se presenta en la Figura 2. A pesar de esto, se presumió que la finca es inundable durante el evento de inundación de 100-años y se aplicaron los requerimientos del Reglamento de Planificación Número 13 de la Junta de Planificación (JP). Es decir, los niveles de inundación de 100 años a lo largo de las quebradas a ser estudiadas no serán aumentados más de 0.15 metro por encima de los niveles existentes (presumiendo un

área urbana) en ninguna sección como consecuencia del proyecto propuesto. Además, se hará un análisis de mitigación de flujo en cumplimiento con el Reglamento de Planificación Número 3 de la Junta de Planificación (JP).

El plano topográfico existente y el plano conceptual del desarrollo propuesto se incluyen en el Apéndice F. El plano conceptual del desarrollo propuesto fue preparado previo a la realización de este estudio. Por esta razón, dicho plano se incluye como información general, pero no considera las recomendaciones de este estudio por lo cual no constituye el desarrollo propuesto final.

**Autorización**

El Sr. Orlando Pérez, representante de Orlando Pérez Contratista, Inc, autorizó este estudio, mediante un acuerdo con el Sr. Miguel Menar Figueroa, PE, representante de Menar Hydrosystems Engineering P.S.C.

**Alcance del Estudio**

El alcance de este estudio incluye las siguientes tareas.

- Visita al área para determinar las condiciones hidrológicas e hidráulicas existentes.
- Simulación hidrológica e hidráulica de las condiciones existentes y propuestas.
- Cálculo del perfil hidráulico para la inundación de 100-años para cada condición en las quebradas existentes en la finca.

- Cálculo de las velocidades de flujo en el valle inundable y en el canal principal para cada condición en ambas quebradas.
- Determinar las dimensiones mínimas de las estructuras de mitigación de flujo requeridas, para cumplir con el Reglamento de Planificación Número 3 de la Junta de Planificación (JP).

Este estudio se divide en dos fases: 1) análisis hidrológico 2) análisis hidráulico. Por lo tanto, los resultados mostrados en la sección de Análisis Hidrológico serán descritos para las sub-cuencas del proyecto, ***Proyecto 1 Norte (PRO1N), Proyecto 1 Sur (PRO1S), Proyecto 2 (PROJ2), Proyecto 3 (PROJ3), Proyecto 4 (PROJ4)*** y dos sub-cuencas externas llamadas ***Externa 1 (EXT1)*** y ***Externa 2 (EXT2)***. El análisis hidráulico se divide en dos secciones: 1) perfiles de inundación y, 2) análisis de mitigación de flujo.

## II. ANÁLISIS HIDROLÓGICO

### Metodología

Se realizó un análisis hidrológico para determinar las descargas correspondientes a los eventos de lluvia de 2- y 100-años de frecuencia. Este análisis empleó el Método del Hidrograma Unitario, desarrollado por el Servicio de Conservación de Suelos de los Estados Unidos, según contenido en el programa de computadora HEC-1 (Versión 4.1) [USACE, 1998], desarrollado por el Cuerpo de Ingenieros de los Estados Unidos. Se computó la descarga en la salida de cada una de las cuencas analizadas.

Los números de curva (NC) asociados con la cuenca total y la cuenca del proyecto se determinaron usando la clasificación y los mapas de suelo publicados en el Catástro de Suelos de Mayagüez preparado por el Servicio Nacional de Conservación de Suelos [NSCS, 1977]. Los valores de NC estimados para cada cuenca se muestran en la Tabla 2 (para la condición de humedad antecedente II).

**Descripción de la Cuenca**

La Figura 3 presenta los límites de las cuencas establecidas para las condiciones existentes y propuestas. Las cuencas fueron delimitadas en los cuadrángulos topográficos de Mayagüez y Rosario a escala 1:20,000.

Para las condiciones existentes y propuestas el área del proyecto recibe escorrentía externa de dos cuencas. Éstas fueron nombradas como ***Cuenca Externa 1*** (***EXT1***) y ***Cuenca Externa 2*** (***EXT2***). El área del proyecto fue dividida en 4 sub-cuencas estás fueron ***Proyecto 1 Norte*** (***PRO1N***), ***Proyecto 1 Sur*** (***PRO1S***), ***Proyecto 2*** (***PROJ2***), ***Proyecto 3*** (***PROJ3***) y **Proyecto 4** (***PROJ4***).

Para las condición Existente, las cuencas ***Proyecto 1 Norte y Proyecto 1 Sur*** se combinan con la ***Cuenca Externa 1***. De otro lado la cuenca ***Proyecto 2*** recibe la escorrentía de la ***Cuenca Externa 2***. Las cuencas ***Proyecto 3*** y **Proyecto 4** drenan fuera del área del proyecto.

Durante la condición propuesta la cuenca ***Proyecto 3*** se combina con las cuencas ***Proyecto 1 Norte y Proyecto 1 Sur***, recibiendo igualmente la escorrentía de la ***Cuenca Externa 1***. Además, durante esta condición, la cuenca ***Proyecto 4*** se combina con la ***Proyecto 2*** y la ***Cuenca Externa 2***.

**Historial de Inundación**

En la investigación realizada durante la preparación de este estudio no se identificó ningún estudio hidrológico-hidráulico preparado con anterioridad en el cuál se considerara el desarrollo de la finca en cuestión. Tampoco fueron identificadas otras publicaciones oficiales que documenten inundaciones históricas.

**Datos de Lluvia**

Los datos de lluvia promedio para los eventos de 2- y 100-Años fueron obtenidos del Atlas 14, Volumen 3 del Servicio Nacional de Meteorología (NOAA por sus siglas en ingles), disponible en Internet [U.S. Department of Commerce, et. al 2006]. Estos datos son incluidos en el Apéndice B.

Para el modelo hidrológico se utilizó una tormenta hipotética utilizando los datos presentados en la Tabla 1. La lluvia es distribuida automáticamente para cada profundidad y duración en cada una de las frecuencias para los eventos de 2- y 100-Años.

Tabla 1. Profundidades de lluvia acumuladas usadas en el modelo HEC-1.

| Duración, hr | 0.083 | 0.25 | 1 | 2 | 3 | 6 | 12 | 24 |
|---|---|---|---|---|---|---|---|---|
| Lluvia (pulg.), 100-años | 0.95 | 1.66 | 3.95 | 5.42 | 6.22 | 8.27 | 11.65 | 15.22 |
| Lluvia (pulg.), 2-años | 0.61 | 1.08 | 2.56 | 3.22 | 3.37 | 3.77 | 4.16 | 4.69 |

**Tiempo de Concentración**

La descarga máxima depende del tiempo requerido para que la escorrentía llegue desde el punto más remoto de la cuenca hasta la salida de la cuenca. Este se define como el tiempo de concentración y fue estimado usando la ecuación de Kirpich. El Apéndice A incluye los cálculos de este parámetro para cada cuenca y condición analizada.

**Descargas Máximas**

El modelo de HEC-1 fue desarrollado usando: 1) las profundidades de lluvia; 2) el área total; 3) los números de curva y; 4) el tiempo de concentración de cada cuenca. La descarga máxima para los eventos de frecuencia de 2- y 100-años fue calculada en la salida de cada cuenca. Las Tabla 2 y 3 presentan los resultados de este análisis para las frecuencias de 2- y 100-años respectivamente. Los resultados detallados del modelo hidrológico se incluyen en el Apéndice C.

Tabla 2. Descargas máximas para el evento de 2-años de frecuencia.

| CONDICIÓN | CUENCA | ÁREA, ac ($mi^2$) | CN | $T_C$, min | Q, pcs (mcs) |
|---|---|---|---|---|---|
| EXISTENTE | PRO1N | 22.30 (0.0348) | 76 | 5 | 85 (2.41) |
| | PRO1S | 20.11 (0.0314) | 76 | 5 | 77 (2.18) |
| | EXT1 | 23.90 (0.0373) | 74 | 5 | 84 (2.38) |
| | COMB1 | PRO1N + PRO1S + EXT1 | | | 246 (6.97) |
| | PROJ2 | 6.14 (0.0096) | 79 | 5 | 26 (0.73) |
| | EXT2 | 54.17 (0.0846) | 66 | 5 | 130 (3.68) |
| | COMB2 | PROJ2 + EXT2 | | | 157 (4.44) |
| | PROJ3 | 7.38 (0.0115) | 79 | 5 | 31 (0.88) |
| | PROJ4 | 3.40 (0.0053) | 76 | 5 | 13 (0.37) |
| | | | | | |
| PROPUESTA | PRO1N | 22.30 (0.0348) | 91 | 5 | 132 (3.74) |
| | PRO1S | 20.11 (0.0314) | 91 | 5 | 119 (3.37) |
| | PROJ3 | 7.38 (0.0115) | 92 | 5 | 44 (1.25) |
| | COMBP1 | PRO1N + PRO1S + PROJ3 | | | 295 (8.35) |
| | EXT1 | 23.90 (0.0373) | 74 | 5 | 84 (2.37) |
| | COMB1 | COMBP1 + EXT1 | | | 379 (10.73) |
| | PROJ2 | 6.14 (0.0096) | 92 | 5 | 37 (1.05) |
| | PROJ4 | 3.40 (0.0053) | 92 | 5 | 20 (0.57) |
| | COMBP2 | PROJ2 + PRJ4 | | | 58 (1.64) |
| | EXT2 | 54.17 (0.0846) | 66 | 5 | 130 (3.68) |
| | COMB2 | COMBP2 +EXT2 | | | 188 (5.32) |

Tabla 3. Descargas máximas para el evento de 100-años de frecuencia.

| CONDICIÓN | CUENCA | ÁREA, ac ($mi^2$) | CN | $T_C$, min | Q, pcs (mcs) |
|---|---|---|---|---|---|
| EXISTENTE | PRO1N | 22.30 (0.0348) | 76 | 5 | 205 (5.80) |
| | PRO1S | 20.11 (0.0314) | 76 | 5 | 185 (5.24) |
| | EXT1 | 23.90 (0.0373) | 74 | 5 | 216 (6.12) |
| | COMB1 | PRO1N + PRO1S + EXT1 | | | 606 (17.16) |
| | PROJ2 | 6.14 (0.0096) | 79 | 5 | 58 (1.64) |
| | EXT2 | 54.17 (0.0846) | 66 | 5 | 446 (12.63) |
| | COMB2 | PROJ2 + EXT2 | | | 504 (14.27) |
| | PROJ3 | 7.38 (0.0115) | 79 | 5 | 70 (1.98) |
| | PROJ4 | 3.40 (0.0053) | 76 | 5 | 31 (0.87) |
| | | | | | |
| PROPUESTA | PRO1N | 22.30 (0.0348) | 91 | 5 | 224 (6.34) |
| | PRO1S | 20.11 (0.0314) | 91 | 5 | 202 (5.72) |
| | PROJ3 | 7.38 (0.0115) | 92 | 5 | 74 (2.10) |
| | COMBP1 | PRO1N + PRO1S + PROJ3 | | | 500 (14.16) |
| | EXT1 | 23.90 (0.0373) | 74 | 5 | 216 (6.12) |
| | COMB1 | COMBP1 + EXT1 | | | 716 (20.27) |
| | PROJ2 | 6.14 (0.0096) | 92 | 5 | 62 (1.75) |
| | PROJ4 | 3.40 (0.0053) | 92 | 5 | 34 (0.96) |
| | COMBP2 | PROJ2 + PRJ4 | | | 96 (2.72) |
| | EXT2 | 54.17 (0.0846) | 66 | 5 | 446 (12.62) |
| | COMB2 | COMBP2 +EXT2 | | | 542 (15.35) |

# III. ANÁLISIS HIDRÁULICO

## Metodología

El análisis hidráulico fue realizado para las dos quebradas que drenan a través del proyecto, estas fueron nombradas ***Quebrada 1*** y ***Quebrada 2***.

La ***Quebrada 1*** recoge la escorrentía de las sub-cuencas ***Externa 1***, ***Proyecto 1 Norte*** y ***Proyecto 1 Sur*** bajo la condición existente. Bajo la condición propuesta, esta quebrada recibe además la escorrentía de la sub-cuenca ***Proyecto 3***, por lo tanto las obras de mitigación propuestas (siguiente sección), deben asegurar que el flujo de la ***Quebrada 1*** sea menor o igual al flujo existente.

En la condición existente la ***Quebrada 2*** recibe la escorrentía de las sub-cuencas ***Externa 2*** y ***Proyecto 2***. Para la condición propuesta la sub-cuenca ***Proyecto 4*** drenará también hacia esta quebrada. Igualmente las obras de mitigación propuestas para estas sub-cuencas deberán asegurar un flujo menor o igual a la condición existente.

El análisis hidráulico para ambas quebradas fue realizado usando el modelo de computadora HEC-RAS, desarrollado por el Cuerpo de Ingenieros de los Estados Unidos [USACE, 2005].

Dos modelos fueron hidráulicos fueron desarrollados para cada quebrada con el fin de simular las condiciones existentes y propuestas. El nivel inicial de la superficie del

agua en la sección inicial para el evento de 100-años fue presumido igual a la profundidad crítica para ambas condiciones, existente y propuesta en ambas quebradas.

Un total de trece (13) secciones transversales fueron medidas en el campo para la ***Quebrada 1***. La sección 9.5 fue interpolada entre las secciones 9 y 10. Para la ***Quebrada 2*** seis (6) secciones transversales fueron tomadas del cuadrángulo topográfico de Mayagüez. La Figura 4 presenta la localización de las secciones transversales.

El Estudio de Campo fue realizado por el Agr. Wilfredo Cruzado Albi. Una copia certificada de este estudio se incluye en el Apéndice F.

**Coeficientes Hidráulicos**

Los coeficientes de rugosidad de Manning fueron determinados de acuerdo a la inspección visual del área. Los valores utilizados para la condición existente fueron 0.04 en el canal principal y 0.06 en la planicie inundable. En el caso de los coeficientes de contracción y expansión se utilizaron 0.1 y 0.3 respectivamente en transiciones graduales y, 0.2 y 0.4 en transiciones abruptas (atarjeas).

## Quebrada 1

### Modelo de Condición Existente

La ***Quebrada 1*** nace fuera del proyecto y está caracterizada por un canal bien definido y alguna vegetación. Su cauce no es muy profundo y tiene una pendiente severa. No existe ninguna estructura hidráulica a lo largo del tramo de quebrada estudiado. Los niveles de agua y las velocidades calculadas en cada sección transversal a lo largo de la ***Quebrada 1*** se presentan en la Tabla 4. La Figura 5 presenta el perfil de inundación para el evento de 100-años. Los datos de entrada y salida del modelo HEC-RAS (geometría: Quebrada 1 EXIS) se incluyen en el Apéndice D.

Tabla 4. Resultados del modelo hidráulico para la Quebrada 1: 100-años: condición existente.

| SECCIÓN | Q Total ($m^3/s$) | ELEV. MIN. CANAL (m) | NIVEL DE AGUA (m) | VEL. CANAL (m/s) |
|---|---|---|---|---|
| 1 | 17.16 | 64.91 | 65.96 | 4.81 |
| 2 | 17.16 | 66.83 | 67.53 | 5.65 |
| 3 | 17.16 | 68.71 | 69.72 | 6.09 |
| 4 | 17.16 | 71.35 | 72.29 | 5.43 |
| 5 | 17.16 | 73.43 | 74.03 | 4.96 |
| 6 | 17.16 | 77.04 | 77.52 | 11.28 |
| 7 | 17.16 | 85.05 | 86.25 | 2.71 |
| 8 | 17.16 | 86.17 | 87.09 | 4.74 |
| 9 | 17.16 | 89.03 | 89.88 | 4.66 |
| 9.5 | 17.16 | 92.90 | 93.20 | 6.63 |

Tabla 4. Resultados del modelo hidráulico para la Quebrada 1: 100-años: condición existente (continuación).

| SECCIÓN | Q Total ($m^3/s$) | ELEV. MIN. CANAL (m) | NIVEL DE AGUA (m) | VEL. CANAL (m/s) |
|---|---|---|---|---|
| 10 | 17.16 | 96.76 | 97.26 | 2.16 |
| 9.9 | 17.16 | 96.76 | 97.16 | 2.93 |
| 11 | 17.16 | 101.83 | 102.07 | 10.00 |
| 12 | 17.16 | 109.05 | 110.32 | 2.81 |
| 13 | 17.16 | 123.73 | 125.22 | 2.48 |

**Modelo de Condición Propuesta**

El modelo de condición existente para esta quebrada fue modificado para considerar la atarjea propuesta entre las secciones 9.9 y 9.5. Los niveles de inundación calculados y las velocidades en cada sección transversal a lo largo de la quebrada se indican en la Tabla 5. La Figura 6 muestra el perfil de inundación para el evento de 100-años. Los datos de entrada y salida del modelo de HEC-RAS (geometría: Quebrada 1 PROP) se incluyen en el Apéndice D.

La estructura propuesta consiste de dos atarjeas rectangulares de hormigón de 3.66 x 1.83m (largo x alto) entre las secciones 9.5 y 9.9. La Figura 8 presenta la localización de esta estructura.

Para asegurar el nivel de operación de las atarjeas propuestas durante el evento de inundación de 100-años es necesario proveer alerones en la entrada de la atarjea (sección 6) y suavizar los bordes 1/12 de la dimensión de la caja según corresponda.

Tabla 5. Resultados del modelo hidráulico para la Quebrada 1: 100-años: condición propuesta.

| SECCIÓN | Q Total ($m^3/s$) | ELEV. MIN. CANAL (m) | NIVEL DE AGUA (m) | VEL. CANAL (m/s) |
|---|---|---|---|---|
| 1 | 17.16 | 64.91 | 65.96 | 4.81 |
| 2 | 17.16 | 66.83 | 67.53 | 5.65 |
| 3 | 17.16 | 68.71 | 69.72 | 6.09 |
| 4 | 17.16 | 71.35 | 72.29 | 5.43 |
| 5 | 17.16 | 73.43 | 74.03 | 4.96 |
| 6 | 17.16 | 77.04 | 77.52 | 11.27 |
| 7 | 17.16 | 85.05 | 86.24 | 2.72 |
| 8 | 17.16 | 86.17 | 87.17 | 4.15 |
| 9 | 17.16 | 89.03 | 89.69 | 6.56 |
| 9.5 | 17.16 | 92.40 | 93.19 | 2.37 |
| 9.8 | Atarjea | | | |
| 9.9 | 17.16 | 95.76 | 97.18 | 0.66 |
| 10 | 17.16 | 96.76 | 97.16 | 2.93 |
| 11 | 17.16 | 101.83 | 102.07 | 10.00 |
| 12 | 17.16 | 109.05 | 110.32 | 2.81 |
| 13 | 17.16 | 123.73 | 125.22 | 2.48 |

El remanso en la **Quebrada 1** provocado por el proyecto propuesto es menor que 0.15 metro (0.08m sección 8.0) que es el máximo permitido por el Reglamento de Planificación Número 13 de la JP. Aunque la quebrada analizada no está clasificada como inundable se aplicó dicho reglamento según lo requiere el Departamento de Recursos Naturales y Ambientales (DRNA) para estos casos.

**Quebrada 2**

**Modelo de Condición Existente**

La **Quebrada 2** nace en el lado este de la finca y está caracterizada por un canal bien definido y alguna vegetación. Su cauce no es muy profundo y tiene una pendiente considerada como severa. No existe ninguna estructura hidráulica a lo largo del tramo de quebrada estudiado.

Tabla 6. Resultados del modelo hidráulico para la Quebrada 2: 100-años: condición existente.

| SECCIÓN | Q Total ($m^3/s$) | ELEV. MIN. CANAL (m) | NIVEL DE AGUA (m) | VEL. CANAL (m/s) |
|---|---|---|---|---|
| 0 | 14.27 | 45.00 | 46.13 | 4.49 |
| 1 | 14.27 | 50.00 | 51.13 | 6.22 |
| 2 | 14.27 | 65.00 | 65.71 | 10.19 |
| 3 | 14.27 | 90.00 | 90.90 | 4.52 |
| 4 | 14.27 | 105.00 | 105.83 | 7.36 |
| 5 | 14.27 | 110.00 | 111.32 | 2.55 |

Los niveles de agua calculados y las velocidades en cada sección transversal a lo largo de la **Quebrada 2** se indican en la Tabla 6. La Figura 7 presenta el perfil de inundación para el evento de 100-años. Los datos de entrada y salida del modelo HEC-RAS para esta condición (geometría: Quebrada 2 EXIS) se incluyen en el Apéndice D.

**Modelo de Condición Propuesta**

El desarrollo propuesto no contempla obra de canalización alguna a lo largo del tramo de la quebrada que pasa por la propiedad. Por lo tanto, el modelo hidráulico para esta condición es el mismo que el modelo de la condición existente. Los datos de entrada y salida del modelo de HEC-RAS para esta condición (geometría: Quebrada 2 EXIS) se incluyen en el Apéndice D.

## IV. ANÁLISIS DE MITIGACIÓN DE FLUJO

Para el diseño del sistema pluvial del proyecto se consideró un 100 por ciento de desarrollo en las cuencas del proyecto, esto es aproximadamente 59.33 acres. La mitigación fue dividida en ***Oeste*** y ***Este***.

Para este análisis se desarrolló un segundo modelo usando el programa de computadora HydroCAD. La razón para usar este programa fue aprovechar las opciones y recursos gráficos disponibles para el diseño de una estructura de detención de flujo. Por ejemplo, el volumen de almacenaje requerido puede ser determinado sin

la necesidad de cálculos externos directos o indirectos. El uso de este modelo se describe a continuación.

El primer paso fue reproducir los modelos de HEC-1 desarrollados en el análisis original (sólo los resultados del modelo de condición propuesta fueron reproducidos). Debido a que HydroCAD no incluye la opción de distribuir la profundidad de lluvia utilizando la distribución balanceada fue necesario modificar los números de curva para reproducir los resultados de HEC-1. Los valores de NC usados en HydroCAD se presentan en la Tabla 7.

Tabla 7. Número de curva equivalente entre los modelos HEC-1 y HydroCAD.

| CUENCA | CONDICIÓN | NC | | | |
|---|---|---|---|---|---|
| | | HEC-1 | | HydroCAD | |
| | | 100-años | 2-años | 100-años | 2-años |
| PRO1N | PROPUESTA | 91 | 91 | 40 | 89 |
| PRO1S | PROPUESTA | 91 | 91 | 40 | 89 |
| EXT1 | EXISTENTE | 74 | 74 | 38 | 72 |
| PROJ 2 | PROPUESTA | 92 | 92 | 40 | 89 |
| EXT2 | EXISTENTE | 66 | 66 | 36 | 64 |
| PROJ 3 | PROPUESTA | 92 | 92 | 40 | 89 |
| PROJ 4 | PROPUESTA | 92 | 92 | 40 | 88 |

**Mitigación Oeste**

Este análisis de mitigación fue conceptualizado como la combinación de los flujos de las cuencas ***PRO1N***, ***PRO1S*** *y* ***PROJ3*** drenando en un punto localizado al sur de la

cuenca ***PRO1N***. El incremento de flujo es de 606 a 716 pcs y de 295 a 379 pcs para las frecuencias de 2- y 100-años respectivamente en la combinación de los flujos al sur de la cuenca ***PRO1S*** (***COMB1)***. Por esta razón, será necesario proveer una estructura de mitigación de flujo dentro de los límites del área. Las dimensiones de dicha estructura serán determinadas con la aplicación del programa de computadora HydroCAD.

Con ese objetivo, una estructura de mitigación (charca abierta) fue dimensionada en el extremo sur de la cuenca ***PRO1N*** dentro de los límites de la propiedad (ver Figura 8). Dicha estructura fue diseñada considerando las elevaciones existentes y la elevación del nivel de agua calculado para la Quebrada 1 en la sección 2 para la condición propuesta (67.53m "msl"). Esta estructura fue dimensionada en función de la estructura de salida y con una profundidad de 3.5 metros.

La estructura resultante es una charca abierta de forma irregular con un área en el tope de 0.668 acre y un área de fondo de 0.325 acre. Las estructuras de salida se componen de un orificio vertical de 2.0 x 2.0 pies (ancho x alto), un orificio horizontal 4.00 x 4.00 pies (ancho x largo) y dos tuberías paralelas de hormigón de 48 pulgadas de diámetro (D.I.) con una pendiente mínima de 1 por ciento. La Tabla 8 muestra los resultados del análisis de mitigación. La Figura 9 muestra un esquema conceptual de esta estructura.

Tabla 8. Resultados del análisis de mitigación Oeste.

| Estructura | charca irregular |
|---|---|
| Flujo Existente, pcs (2-años) [100-años] | (295) [606] |
| Flujo Propuesto, pcs (2-años) [100-años] | (379) [716] |
| Flujo mitigado, pcs (2-años) [100-años] | (245) [470] |
| Área de Tope, acre | 0.668 |
| Área de Fondo, acre | 0.325 |
| Profundidad, m | 3.5 |
| Volumen de Almacenaje, $m^3$ | 7,031 |
| Nivel Máximo Agua, m (2-años) [100-años] | (70.05) [70.62] |
| Estructura de Salida Primaria | Orificio Vertical de 2.00'x2.00' Invertida = 68.11m |
| Estructura de Salida Secundaria | Orificio Horizontales de 4.00'x 4.00' @ Invertida = 70.20m |
| Tubería de Salida | (2) Tubos de Hormigón de 48", pendiente 1%, Invertida = 68.11m |

Todos los datos de entrada y salida generados por el modelo de HydroCAD se incluyen en el apéndice E.

**Mitigación Este**

Este análisis de mitigación fue conceptualizado como la combinación de los flujos de las cuencas ***PROJ2***, y ***PROJ4*** drenando en un punto localizado al sur de la cuenca ***PROJ2***. El aumento es de 504 a 542 pcs y de 157 a 188 pcs para las condiciones de 2- y 100-años respectivamente en la combinación de los flujos al sur de la cuenca ***PROJ2*** (***COMB2***). Por esta razón, será necesario proveer una estructura de mitigación

de flujo dentro de los límites del área. Las dimensiones de dicha estructura fueron determinadas con la aplicación del programa de computadora HydroCAD.

Con ese objetivo, una estructura de mitigación (charca abierta) fue dimensionada en el extremo sur de la cuenca ***PROJ2*** dentro de los límites de la propiedad (ver la Figura 8). Dicha estructura fue diseñada considerando las elevaciones existentes y la elevación en la sección 1 para la **Quebrada 2**, durante la condición propuesta (50.00m "msl"). La charca fue dimensionada en función de la estructura de salida y con una profundidad de 3 metros.

La estructura resultante es una charca abierta de forma irregular con un área en el tope de 0.272 acre y un área de fondo de 0.116 acre. Las estructuras de salida se componen de un orificio vertical de 1.50 x 1.50 pies (ancho x alto), un orificio horizontal de 2.00 x 2.00 pies (ancho x largo) y una tubería de hormigón de 48 pulgadas de diámetro (D.I.) con pendiente mínima de 1 por ciento. La Tabla 9 presenta los resultados del análisis de mitigación para la charca Este. La Figura 10 presenta un esquema conceptual de esta estructura.

Tabla 9. Resultados del análisis de mitigación Este.

| Estructura | charca irregular |
|---|---|
| Flujo Existente, pcs (2-años) [100-años] | (157) [504] |
| Flujo Propuesto, pcs (2-años) [100-años] | (188) [542] |
| Flujo mitigado, pcs (2-años) [100-años] | (156) [479] |
| Área de Tope, acres | 0.272 |

Tabla 9. Resultados del análisis de mitigación Este (continuación).

| | |
|---|---|
| Área de Fondo, acres | 0.116 |
| Profundidad, m | 3 |
| Volumen de Almacenaje, $m^3$ | 2,355 |
| Nivel Máximo Agua, m (2-años) [100-años] | (51.73) [52.30] |
| Estructura de Salida Primaria | Orificio Vertical de 1.50'x1.50' Invertida = 50.26m |
| Estructura de Salida Secundaria | Orificio Horizontales de 2.00'x 2.00' Invertida = 52.07m |
| Tubería de Salida | (1) Tubo Hormigón de 48", pendiente 1%, Invertida = 50.26m |

Todos los datos de entrada y salida generados por el modelo de HydroCAD se incluyen en el apéndice E.

# V. CONCLUSIONES Y RECOMENDACIONES

## Conclusiones

1. El desarrollo propuesto aumentará las descargas existentes que se producen en la finca que se propone desarrollar. Los aumentos serán de 295 a 379 pcs y de 606 a 716 pcs para los eventos de 2- y 100-años de frecuencia respectivamente en el lado Oeste. Para el lado Este serán de 157 a 188 pcs y 504 a 542 para 2- y 100-años respectivamente. Por lo tanto, dos estructuras de mitigación de flujo deberán ser construidas dentro de los límites de la finca.

2. El aumento máximo en los niveles de las quebradas analizadas durante la condición propuesta es menor a 0.15 metro que es el máximo permitido por el Reglamento de Planificación Número 13 de la Junta de Planificación. Aunque las áreas estudiadas no se clasifican como inundables, los requerimientos de dicha reglamentación fueron aplicados según requerido por el Departamento de Recursos Naturales y Ambientales (DRNA).

3. La estructura de mitigación recomendada para el lado Oeste reducirá la descarga de flujo máximo de 716 a 470 pcs, que es menor que los 606 pcs que se generan durante la condición existente. En el caso del evento de 2-años se reducirá de 379 a 245 pcs, que es menor que los 295 pcs que se generan durante la condición existente. Por lo tanto, la mitigación propuesta cumple con

el Reglamento de Planificación Número 3 de la Junta de Planificación. Las especificaciones de esta estructura se indican en la Tabla 8.

4. La estructura de mitigación recomendada para el lado Este reducirá la descarga de flujo máximo de 542 a 479 pcs, que es menor que los 504 pcs que se generan durante la condición existente. En el caso del evento de 2-años se reduce de 188 a 156 pcs, que es menor que los 157 pcs que se generan durante la condición existente. Por lo tanto, la mitigación propuesta cumple con el Reglamento de Planificación Número 3 de la Junta de Planificación. Las especificaciones de esta estructura se indican en la Tabla 9.

**Recomendaciones**

1. La estructura de mitigación mínima requerida en el lado Oeste es una charca abierta de forma irregular con un área en el tope de 0.668 acre y un área de fondo de 0.325 acre. Las estructuras de salida son un orificio vertical de 2.00 x 2.00 pies (ancho x alto), un orificio horizontal 4.00 x 4.00 pies (ancho x largo) y dos tuberías paralelas de hormigón de 48 pulgadas de diámetro (D.I.) con una pendiente mínima de 1 por ciento.

2. La estructura de mitigación mínima requerida en el lado Este es una charca abierta de forma irregular con un área en el tope de 0.272 acre y un área de fondo de 0.116 acre. Las estructuras de salida son un orificio vertical de 1.50 x

1.50 pies (ancho x alto), un orificio horizontal de 2.00 x 2.00 pies (ancho x largo) y una tubería de hormigón de 48 pulgadas de diámetro (D.I.) con pendiente mínima de 1 por ciento.

3. Las estructuras de detención recomendadas deberán tener las especificaciones que se indican en las Tablas 8 y 9. Sus localizaciones se indican en la Figura 8. Las Figuras 9 y 10 presentan los esquemas conceptuales de cada estructura.

4. Las dimensiones de la charca propuesta para el lado Oeste pueden ser modificadas según lo requiera el diseñador civil del proyecto. Sin embargo, se deberá proveer el volumen de almacenaje mínimo recomendado (7,031 $m^3$). Se deberá consultar con nuestra oficina, de surgir algún cambio, para obtener nuestra recomendación.

5. Las dimensiones de la charca propuesta para el lado Este pueden ser modificadas según lo requiera el diseñador civil del proyecto. Sin embargo, se deberá proveer el volumen de almacenaje mínimo recomendado (2,355 $m^3$). Se deberá consultar con nuestra oficina, de surgir algún cambio, para obtener nuestra recomendación.

6. El modelo de condición existente para la **Quebrada 1** fue modificado para considerar la atarjea propuesta. Esta consiste de dos cajas rectangulares de hormigón reforzado de 3.66 x 1.83m (largo x alto). El largo de la atarjea es de

aproximadamente 25 metros. La localización de la atarjea se presenta en la Figura 8.

7. Para asegurar el nivel de operación de la atarjea propuesta durante el evento de inundación de 100-años es necesario proveer alerones en su entrada y suavizar los bordes 1/12 de la dimensión de la caja, según corresponda. También se deberá proveer una protección contra la socavación en la entrada y salida de la atarjea. Dicha protección debe proveerse por un largo mínimo de 5 metros antes de la entrada y después de la salida.

8. El nivel final de piso mínimo de las residencias propuestas en el área del proyecto deberá ser establecida a un mínimo de 0.6 metro por encima de la elevación para el flujo de 100-años, es decir, 71.62 metros ("msl") en el lado Oeste y 53.18 metros ("msl") en el lado Este. En las calles y áreas comunes los niveles finales deben ser determinados añadiendo 0.30 metro al nivel de inundación de 100-años en cada sección transversal de las quebradas según corresponda.

9. El diseño del sistema pluvial deberá proveer pocetos con suficiente capacidad de entrada al sistema para minimizar la inundación en las calles durante eventos de inundación extremos.

10. El relleno a lo largo de las quebradas deberá ser limitado a una distancia mínima de 5 metros medidos desde los bancos del canal en todas las secciones (exigencia de franja verde del DRNA).

11. Los planos finales para el proyecto propuesto deben tomar en consideración todas las recomendaciones de este estudio.

12. El Municipio de Mayagüez deberá establecer un programa de inspección y de mantenimiento rutinario una vez que las instalaciones hayan sido completadas y puestas en servicio. Las inspecciones deberán ser conducidas en periodos anuales o semestrales, así como después de eventos de lluvia extremos. Éstas deben ser debidamente documentadas. Se deberá registrar la fecha de la inspección, deficiencias, tanto menores como mayores, y áreas donde se podrían registrar problemas futuros. Cuando se realice cualquier trabajo de reparación éste deberá ser documentado.

**Limitaciones del Estudio**

Todas las recomendaciones indicadas deben ser puestas en práctica para asegurar el nivel de operación de las estructuras hidráulicas recomendadas. Los resultados de este estudio están basados en condiciones de flujo libre a través de las estructuras hidráulicas recomendadas. Se requiere un mantenimiento apropiado para que se garantice esta condición. La acumulación de basura y/o escombros puede obstruir el libre flujo de las aguas pluviales, produciendo un remanso mayor que el indicado en

este estudio. Este análisis está basado en el estudio de campo realizado por el Agr. Wilfredo Cruzado Albi. Variaciones en dicho estudio podrían invalidar total o parcialmente los resultados y recomendaciones indicadas en este estudio.

## VI. CERTIFICACIÓN

Certifico que el estudio hidrológico hidráulico presentado aquí fue realizado por mí y la información es verdadera, correcta, y completa según mi conocimiento. Conozco y acepto las consecuencias de incluir y someter información incompleta, inconclusa o falsa en este documento. Para que así conste, firmo la presente certificación en Carolina, Puerto Rico, el 30 de mayo de 2007.

Miguel Menar Figueroa, MSCE, PE
Licencia #13051

## VII. REFERENCIAS

Applied Microcomputer Systems, 2006. *HydroCAD, Stormwater Modeling System.* Chocorua, NH. Version 8.0.

P.R. Planning Board, 2005a. *Reglamento sobre Áreas Especiales de Riesgo a Inundación.* Reglamento de Planificación Número 13. Estado Libre Asociado de Puerto Rico, Oficina del Gobernador. Sexta Revisión. 31 de diciembre de 2005.

P.R. Planning Board, 2005b. *Reglamento de Lotificación y Urbanización.* Reglamento de Planificación Número 3. Estado Libre Asociado de Puerto Rico, Oficina del Gobernador. Revisado 30 de junio de 2005.

Soil Conservation Service, 1977. *Soil Survey of Mayagüez Area of Western Puerto Rico.* United States Department of Agriculture.

U.S. Army Corps of Engineers, 1998. *Flood Hydrograph Package (HEC-1).* Hydrologic Engineering Center. Davis, California.

U.S. Army Corps of Engineers, 2005. *River Analysis System (HEC-RAS)* Version 3.1.3. Hydrologic Engineering Center. Davis, California.

U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Weather Service, Silver Spring, 2006. NOAA Atlas 14: Precipitation-Frequency Atlas of the United States, Volume 3 Version 3.0: Puerto Rico and the U.S. Virgin Islands.

United States Geological Survey, 1982. Topographic Quadrangle Maps. 1:20,000, 7.5 minutes.

# FIGURAS

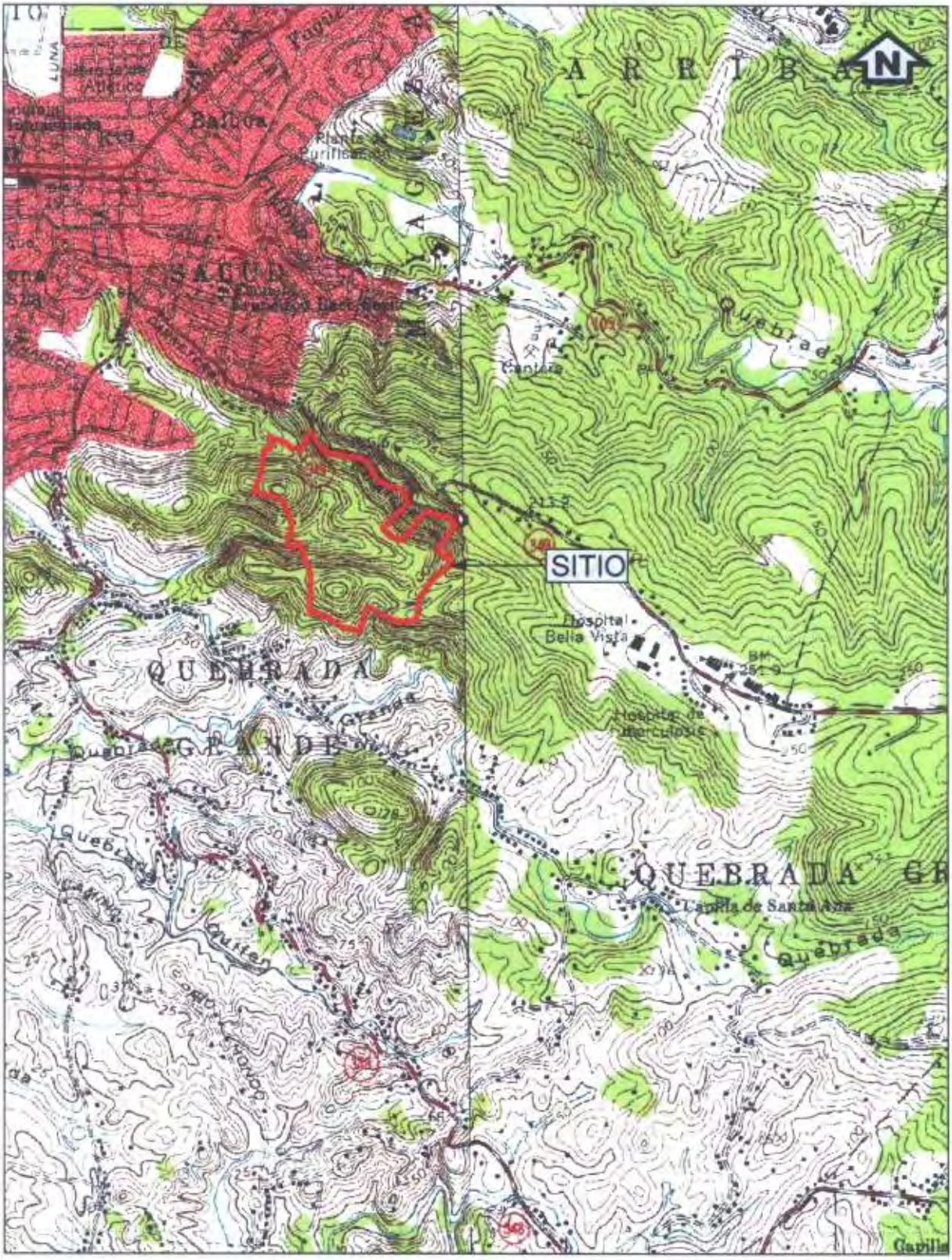


Figura 1. Localización del proyecto en los cuadrángulos topográficos de Mayagüez y Rosario (escala 1:20,000).

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Figura 2. Copia parcial del Mapa de Seguros contra Inundaciones Número 985H (escala 1:10,000).

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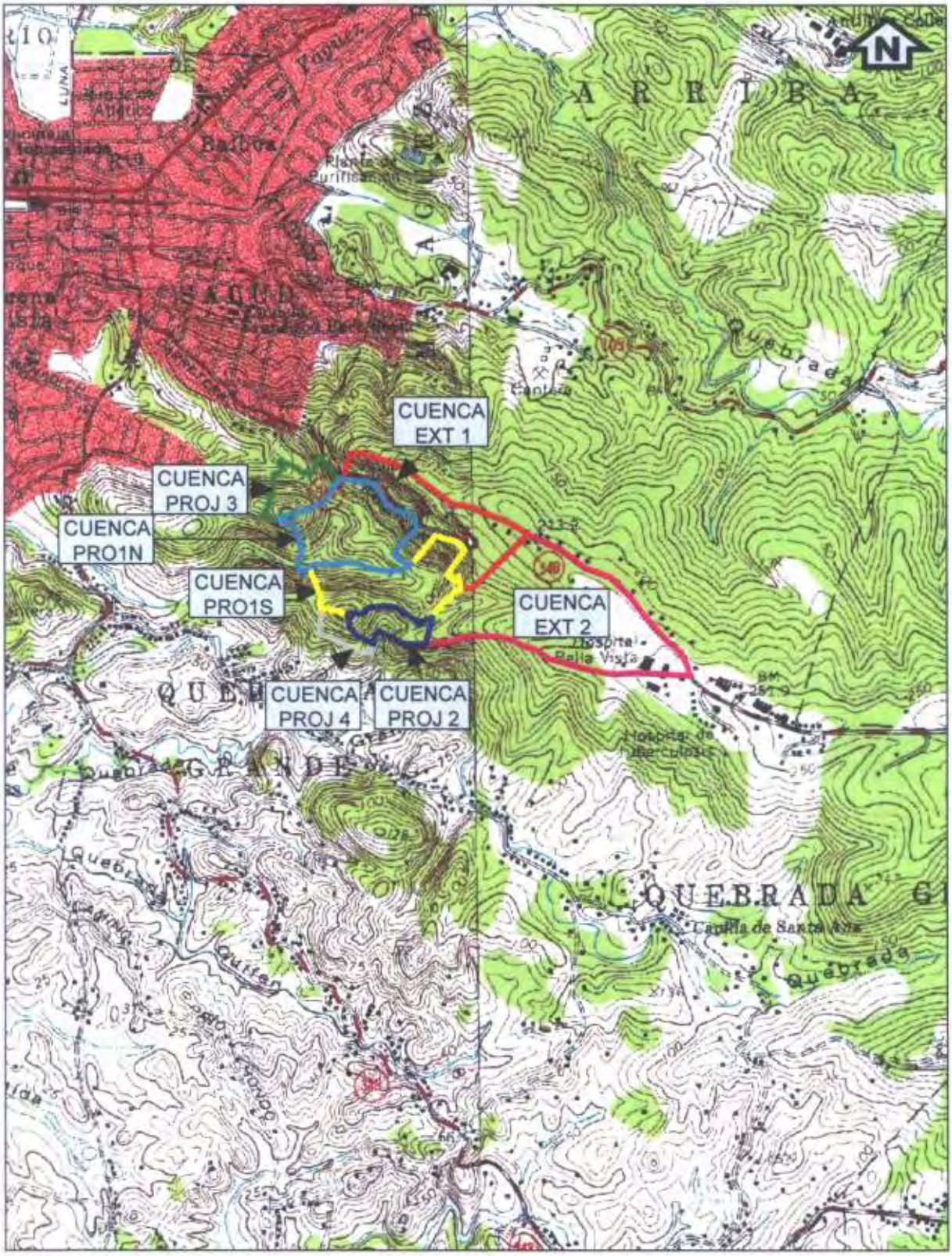


Figura 3. Limites de las cuencas de drenaje para las condiciones existentes y propuestas (escala 1:20,000).

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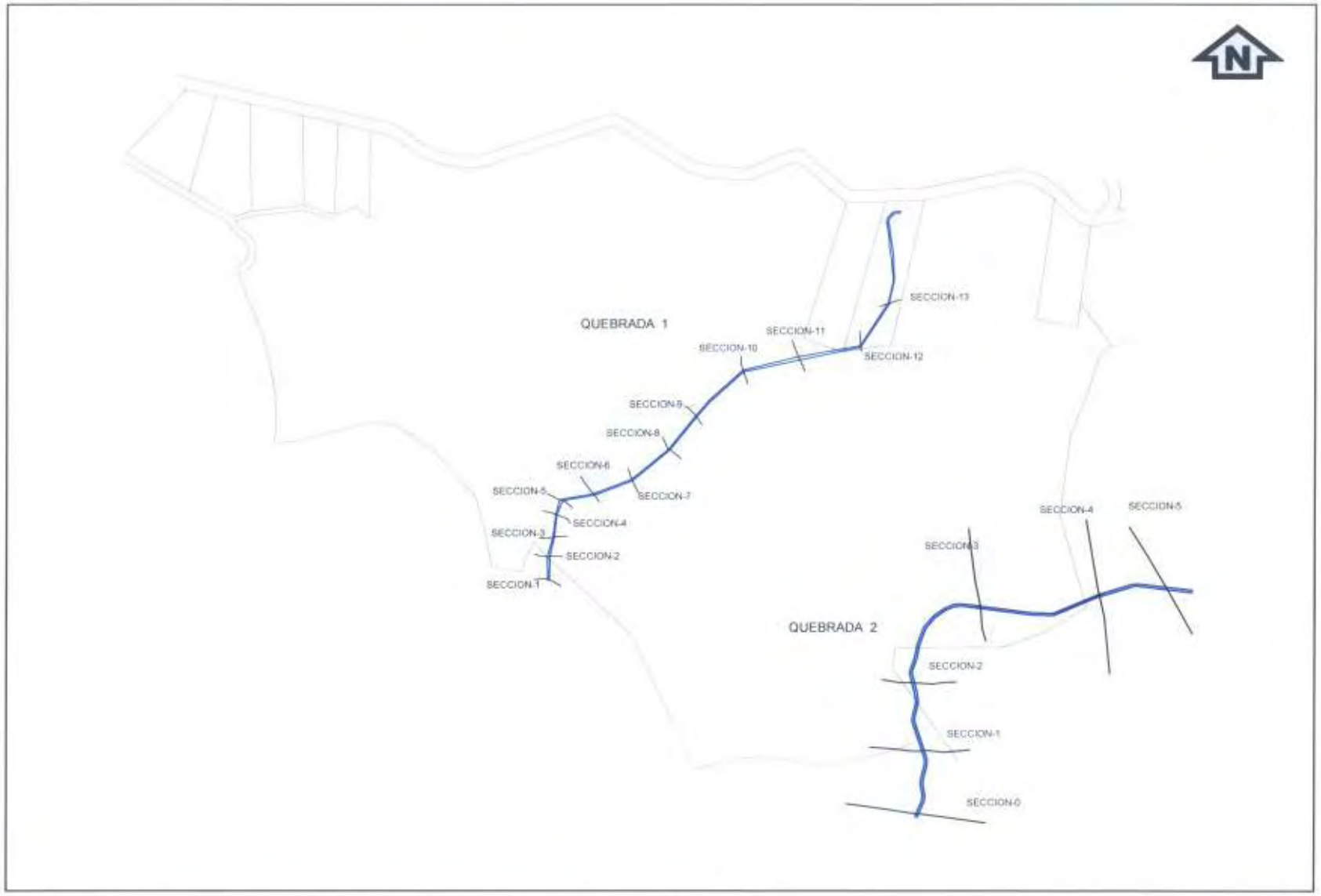


Figura 4. Localización de las secciones transversales (escala 1:5,000).

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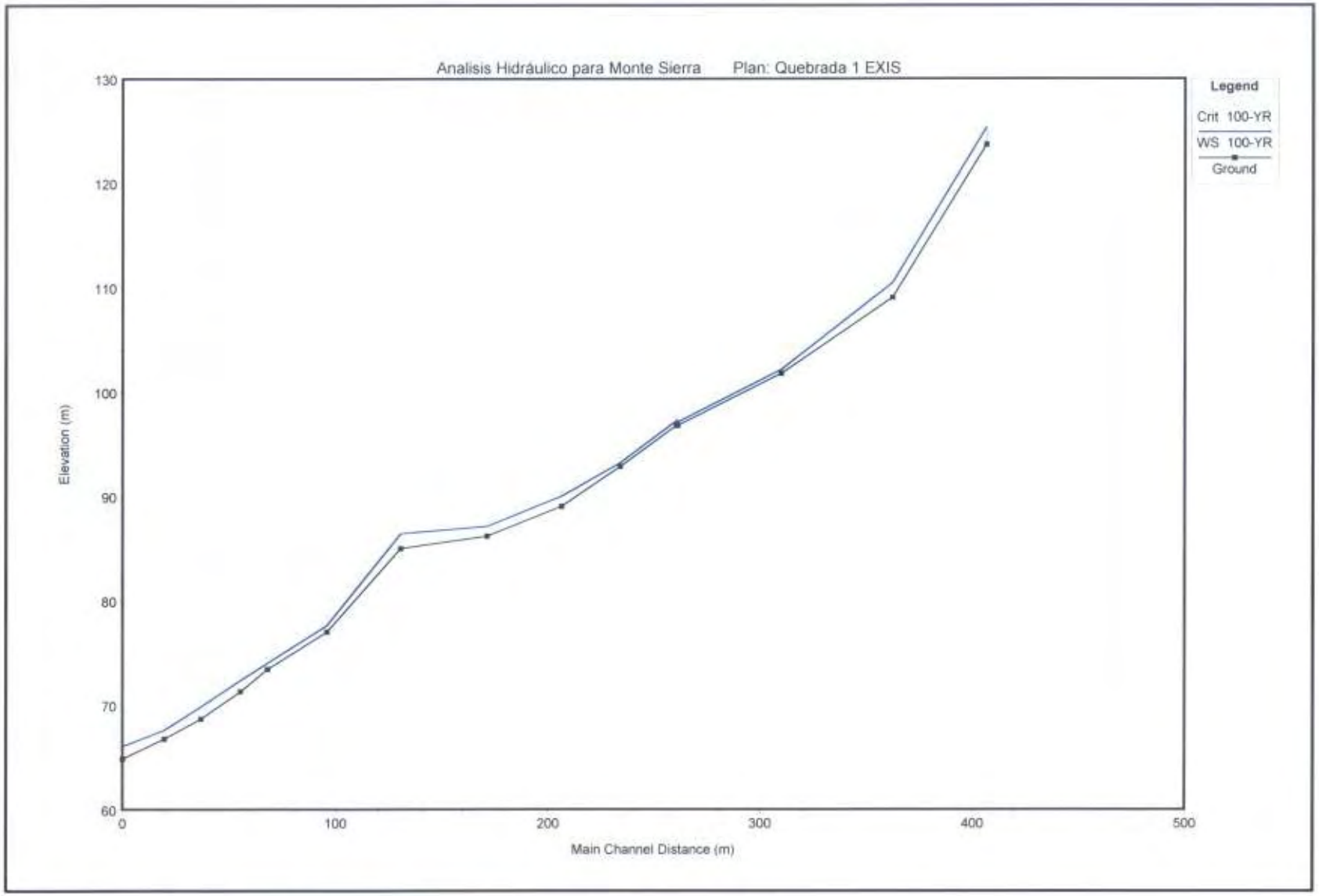


Figura 5. Perfil de inundación para la condición existente: Quebrada 1: 100-años (escala según mostrado).

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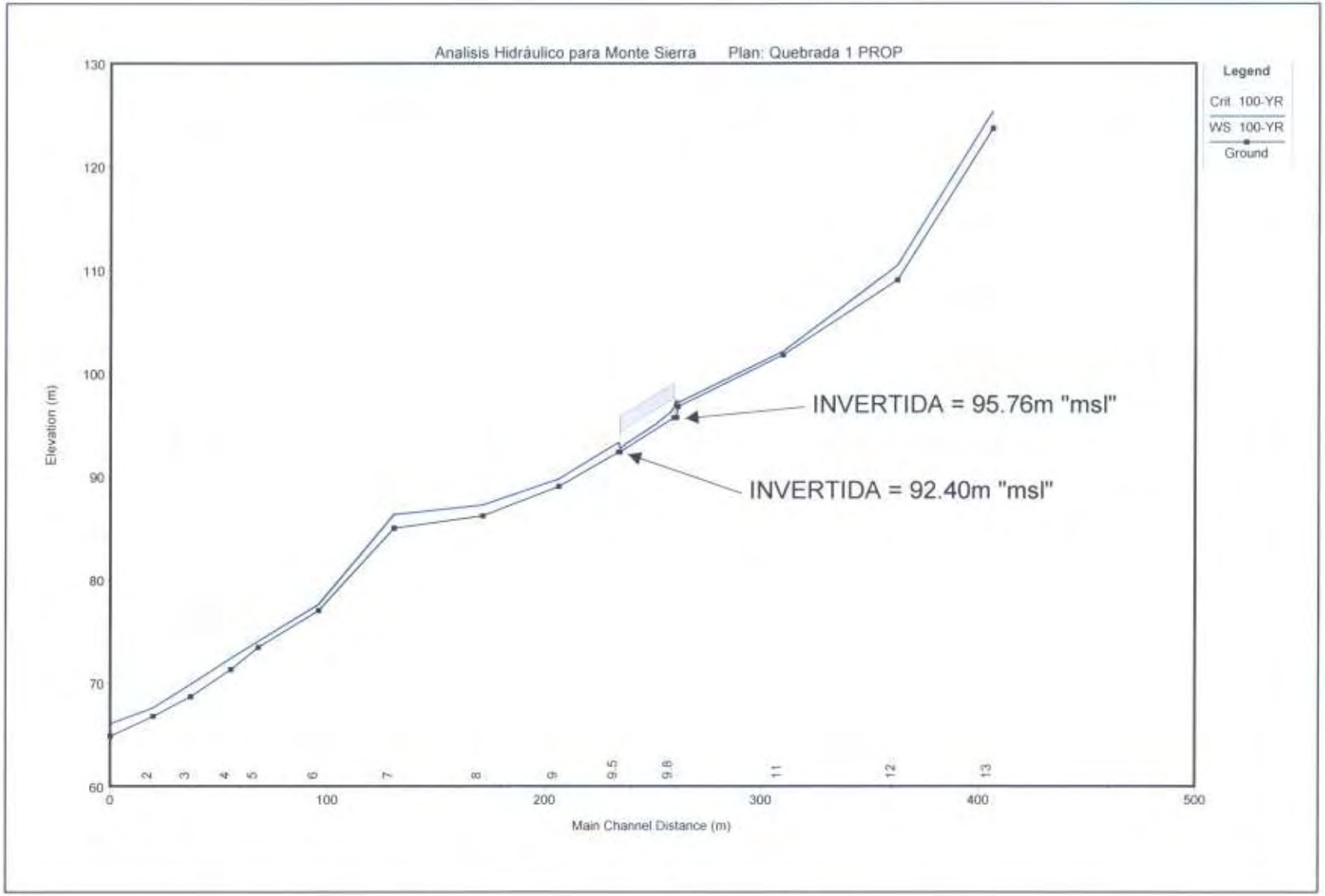


Figura 6. Perfil de inundación para la condición propuesta: Quebrada 1: 100-años (escala según mostrado).

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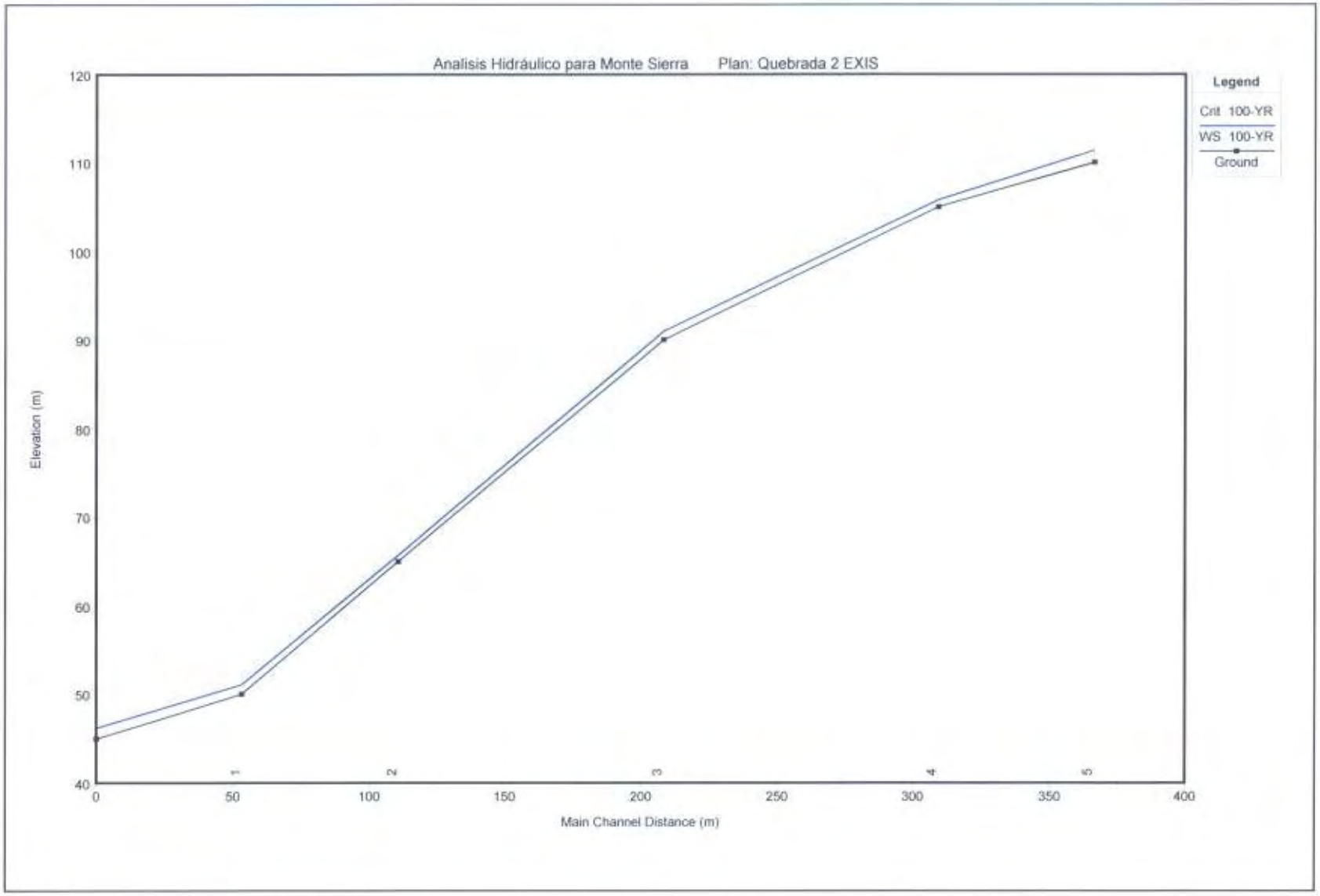


Figura 7. Perfil de inundación para la condición existente: Quebrada 2: 100-años (escala según mostrado).

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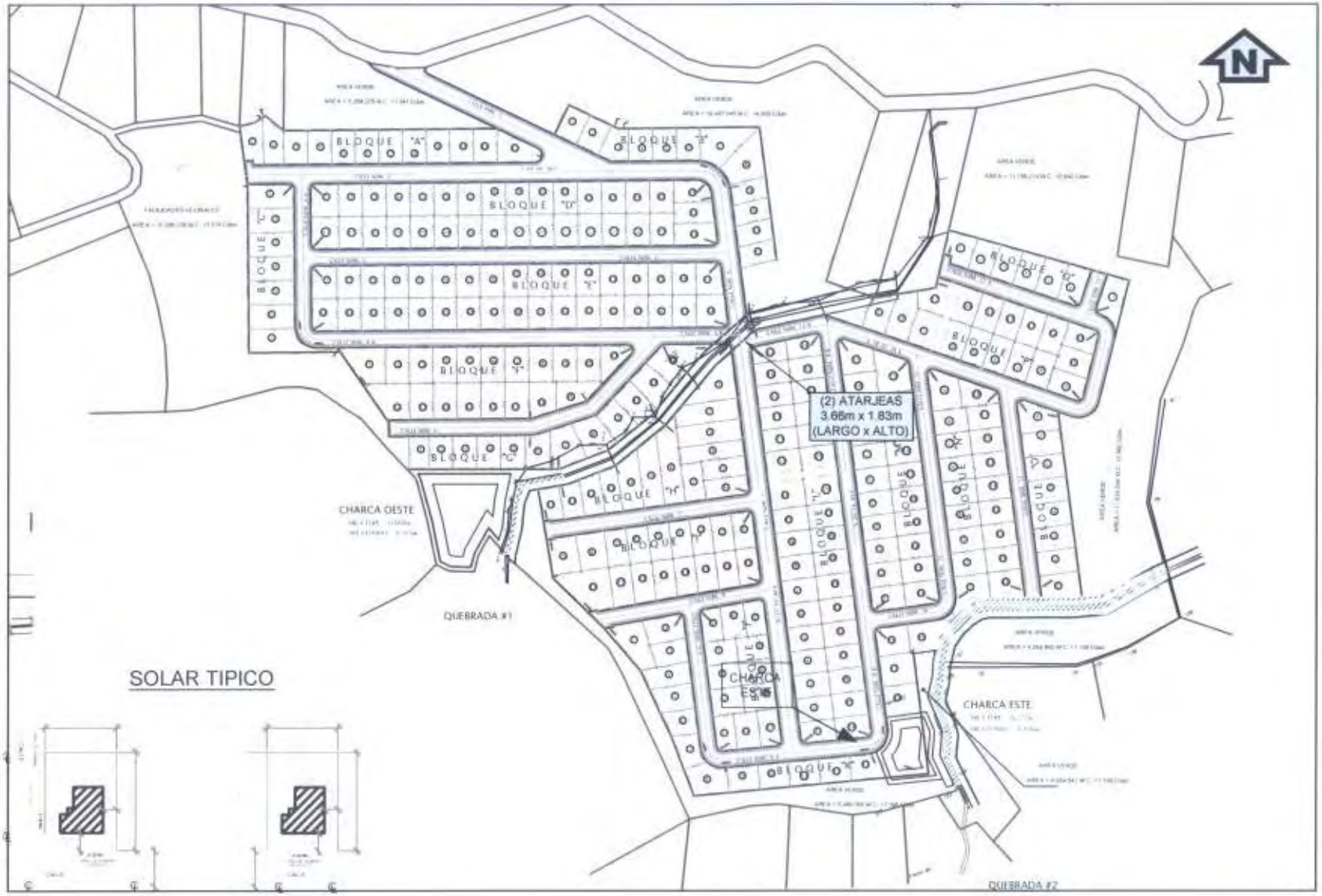


Figura 8. Localización de las estructuras propuestas (escala 1:4,000).

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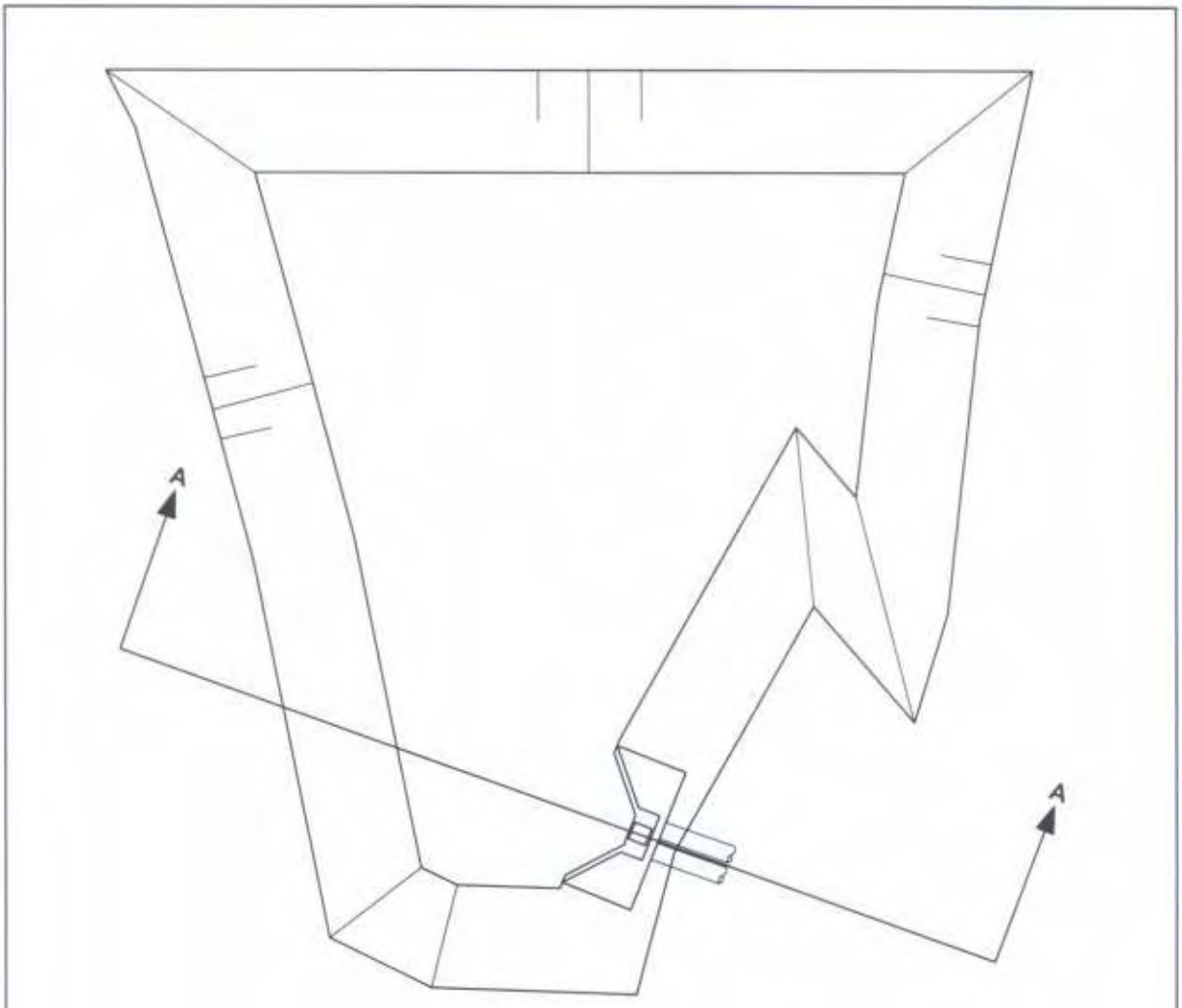
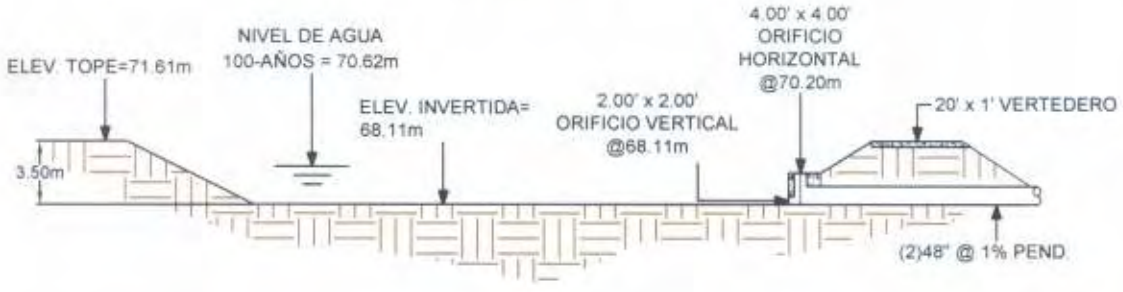



**PLANTA**




**SECCION A-A**

Figura 9 . Detalles conceptuales de la estructura de detención propuesta: ***OESTE*** (escala 1:500).

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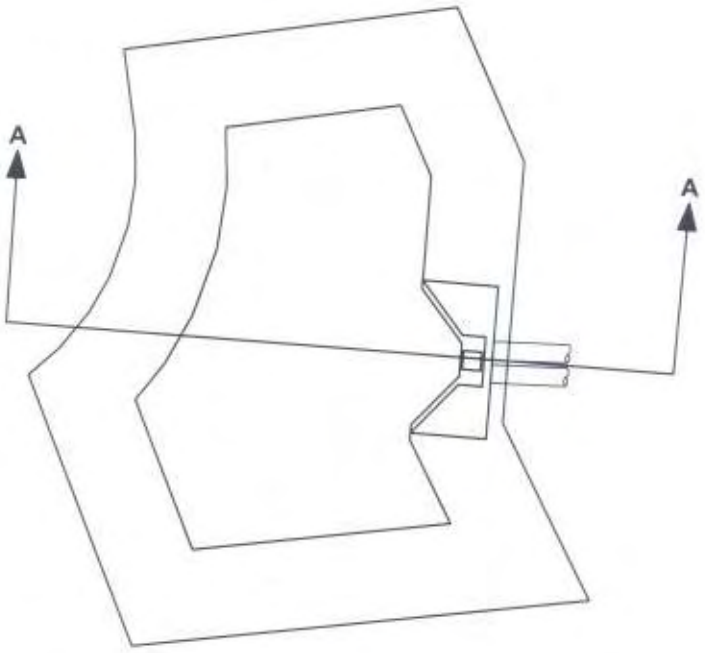


**PLANTA**

**SECCION A-A**

Figura 10 . Detalles conceptuales de la estructura de detención propuesta: ***ESTE*** (escala 1:500).

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# APÉNDICE A

Parámetros Hidrológicos

**MENAR HYDROSYSTEMS ENGINEERING, P.S.C.**
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## HOJA DE CÁLCULO: NÚMERO DE CURVA

| | | | | | |
|---|---|---|---|---|---|
| Projecto: | Monte Sierra | Por: | LHR | Fecha: | 18 de mayo de 2006 |
| Localización: | Mayagüez | Verificado: | MMF | Fecha: | 18 de mayo de 2006 |

**CUENCA:** **EXTERNA 1** **CONDICIÓN:** **EXISTENTE**

**ÁREA (Ac) =** 23.90

**ÁREA ($mi^2$) =** 0.0373

| SUELO (SÍMBOLO), GRUPO HIDROLÓGICO | USO DE TERRENO | NC* | ÁREA, (Ac) | PRODUCTO AREA x NC |
|---|---|---|---|---|
| Nipe Clay (NcD2), B | Grama | 65 | 7.37 | 479.05 |
| Rosario Clay (RsD2), C | Bosque | 73 | 3.82 | 278.86 |
| Serpentenite outcrop (So), D | Bosque | 79 | 12.71 | 1004.09 |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | Totals | 23.9 | 1762 |

| NC | 74 |
|---|---|

* Condición de humedad antecedente II

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## HOJA DE CÁLCULO: NÚMERO DE CURVA

| | | | | | |
|---|---|---|---|---|---|
| Projecto: | Monte Sierra | Por: | LHR | Fecha: | 18 de mayo de 2006 |
| Localización: | Mayagüez | Verificado: | MMF | Fecha: | 18 de mayo de 2006 |

**CUENCA:** **EXTERNA 2** **CONDICIÓN:** **EXISTENTE**

**ÁREA (Ac) =** 54.17

**ÁREA ($mi^2$) =** 0.0846

| SUELO (SÍMBOLO), GRUPO HIDROLÓGICO | USO DE TERRENO | NC2 | ÁREA, (Ac) | PRODUCTO AREA x NC |
|---|---|---|---|---|
| Nipe Clay (NcD2), B | Grama | 65 | 9.44 | 613.6 |
| Nipe Clay (NcD2), B | Bosque | 60 | 25.8 | 1548 |
| Rosario Clay (RsD2), C | Bosque | 73 | 12.20 | 890.6 |
| Serpentenite outcrop (So), D | Bosque | 79 | 6.73 | 531.67 |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | Totals | 54.17 | 3583.87 |

| NC | 66 |
|---|---|

[2] Condición de humedad antecedente II

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## HOJA DE CÁLCULO: NÚMERO DE CURVA

| | | | | | |
|---|---|---|---|---|---|
| Projecto: | Monte Sierra | Por: | LHR | Fecha: | 18 de mayo de 2006 |
| Localización: | Mayagüez | Verificado: | MMF | Fecha: | 18 de mayo de 2006 |

**CUENCA:** **PROYECTO 1** **CONDICIÓN:** **EXISTENTE**

**ÁREA (Ac) =** 42.41

**ÁREA ($mi^2$) =** 0.0663

| SUELO (SÍMBOLO), GRUPO HIDROLÓGICO | USO DE TERRENO | NC* | ÁREA, (Ac) | PRODUCTO AREA x NC |
|---|---|---|---|---|
| Mucara clay (MxE2), D | Bosque | 79 | 8 | 632 |
| Rosario Clay (RsD2), C | Bosque | 73 | 18.69 | 1364.37 |
| Serpentenite outcrop (So), D | Bosque | 79 | 15.72 | 1241.88 |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | Totals | 42.41 | 3238.25 |

| NC | 76 |
|---|---|

* Condición de humedad antecedente II

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## HOJA DE CÁLCULO: NÚMERO DE CURVA

| | | | | | |
|---|---|---|---|---|---|
| Projecto: | Monte Sierra | Por: | LHR | Fecha: | 18 de mayo de 2006 |
| Localización: | Mayagüez | Verificado: | MMF | Fecha: | 18 de mayo de 2006 |

**CUENCA:** **PROYECTO 2** **CONDICIÓN:** **EXISTENTE**

**ÁREA (Ac) =** 6.14

**ÁREA ($mi^2$) =** 0.0096

| SUELO (SÍMBOLO), GRUPO HIDROLÓGICO | USO DE TERRENO | NC* | ÁREA, (Ac) | PRODUCTO AREA x NC |
|---|---|---|---|---|
| Serpentenite outcrop (So), D | Bosque | 79 | 6.14 | 485.06 |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | Totals | 6.14 | 485.06 |

| NC | 79 |
|---|---|

* Condición de humedad antecedente II

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## HOJA DE CÁLCULO: NÚMERO DE CURVA

| | | | | | |
|---|---|---|---|---|---|
| Projecto: | Monte Sierra | Por: | LHR | Fecha: | 18 de mayo de 2006 |
| Localización: | Mayagüez | Verificado: | MMF | Fecha: | 18 de mayo de 2006 |

**CUENCA:** **PROYECTO 3** **CONDICIÓN:** **EXISTENTE**

**ÁREA (Ac) =** 7.38

**ÁREA ($mi^2$) =** 0.0115

| SUELO (SÍMBOLO), GRUPO HIDROLÓGICO | USO DE TERRENO | NC* | ÁREA, (Ac) | PRODUCTO AREA x NC |
|---|---|---|---|---|
| Mucara clay (MxE2), D | Bosque | 79 | 3.69 | 291.51 |
| Serpentenite outcrop (So), D | Bosque | 79 | 3.69 | 291.51 |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | Totals | 7.38 | 583.02 |

| NC | 79 |
|---|---|

* Condición de humedad antecedente II

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## HOJA DE CÁLCULO: NÚMERO DE CURVA

| | | | | | |
|---|---|---|---|---|---|
| Projecto: | Monte Sierra | Por: | LHR | Fecha: | 18 de mayo de 2006 |
| Localización: | Mayagüez | Verificado: | MMF | Fecha: | 18 de mayo de 2006 |

**CUENCA:** **PROYECTO 4** **CONDICIÓN:** **EXISTENTE**

**ÁREA (Ac) =** 3.40

**ÁREA ($mi^2$) =** 0.0053

| SUELO (SÍMBOLO), GRUPO HIDROLÓGICO | USO DE TERRENO | NC* | ÁREA, (Ac) | PRODUCTO AREA x NC |
|---|---|---|---|---|
| Quebrada silty clay (QuE2), C | Bosque | 72 | 1.35 | 97.2 |
| Serpentenite outcrop (So), D | Bosque | 79 | 2.05 | 161.95 |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | Totals | 3.4 | 259.15 |

| NC | 76 |
|---|---|

* Condición de humedad antecedente II

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## HOJA DE CÁLCULO: NÚMERO DE CURVA

| | | | | | |
|---|---|---|---|---|---|
| Projecto: | Monte Sierra | Por: | LHR | Fecha: | 18 de mayo de 2006 |
| Localización: | Mayagüez | Verificado: | MMF | Fecha: | 18 de mayo de 2006 |

**CUENCA:** **PROYECTO 1** **CONDICIÓN:** **PROPUESTA**

**ÁREA (Ac) =** 42.41

**ÁREA ($mi^2$) =** 0.0663

| SUELO (SÍMBOLO), GRUPO HIDROLÓGICO | USO DE TERRENO | NC* | ÁREA, (Ac) | PRODUCTO AREA x NC |
|---|---|---|---|---|
| Mucara clay (MxE2), D | Residencial | 92 | 8 | 736 |
| Rosario Clay (RsD2), C | Residencial | 90 | 18.69 | 1682.1 |
| Serpentenite outcrop (So), D | Residencial | 92 | 15.72 | 1446.24 |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | Totals | 42.41 | 3864.34 |

| NC | 91 |
|---|---|

* Condición de humedad antecedente II

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## HOJA DE CÁLCULO: NÚMERO DE CURVA

| | | | | | |
|---|---|---|---|---|---|
| Projecto: | Monte Sierra | Por: | LHR | Fecha: | 18 de mayo de 2006 |
| Localización: | Mayagüez | Verificado: | MMF | Fecha: | 18 de mayo de 2006 |

**CUENCA:** **PROYECTO 2** **CONDICIÓN:** **PROPUESTA**

**ÁREA (Ac) =** 6.14

**ÁREA ($mi^2$) =** 0.0096

| SUELO (SÍMBOLO), GRUPO HIDROLÓGICO | USO DE TERRENO | NC* | ÁREA, (Ac) | PRODUCTO AREA x NC |
|---|---|---|---|---|
| Serpentenite outcrop (So), D | Residencial | 92 | 6.14 | 564.88 |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | Totals | 6.14 | 564.88 |

| NC | 92 |
|---|---|

* Condición de humedad antecedente II

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## HOJA DE CÁLCULO: NÚMERO DE CURVA

| | | | | | |
|---|---|---|---|---|---|
| Projecto: | Monte Sierra | Por: | LHR | Fecha: | 18 de mayo de 2006 |
| Localización: | Mayagüez | Verificado: | MMF | Fecha: | 18 de mayo de 2006 |

**CUENCA:** **PROYECTO 3** **CONDICIÓN:** **PROPUESTA**

**ÁREA (Ac) =** 7.38

**ÁREA ($mi^2$) =** 0.0115

| SUELO (SÍMBOLO), GRUPO HIDROLÓGICO | USO DE TERRENO | NC* | ÁREA, (Ac) | PRODUCTO AREA x NC |
|---|---|---|---|---|
| Mucara clay (MxE2), D | Residencial | 92 | 3.69 | 339.48 |
| Serpentenite outcrop (So), D | Residencial | 92 | 3.69 | 339.48 |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | Totals | 7.38 | 678.96 |

| NC | 92 |
|---|---|

* Condición de humedad antecedente II

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## HOJA DE CÁLCULO: NÚMERO DE CURVA

| | | | | | |
|---|---|---|---|---|---|
| Projecto: | Monte Sierra | Por: | LHR | Fecha: | 18 de mayo de 2006 |
| Localización: | Mayagüez | Verificado: | MMF | Fecha: | 18 de mayo de 2006 |

**CUENCA:** **PROYECTO 4** **CONDICIÓN:** **PROPUESTA**

**ÁREA (Ac) =** 3.40

**ÁREA ($mi^2$) =** 0.0053

| SUELO (SÍMBOLO), GRUPO HIDROLÓGICO | USO DE TERRENO | NC* | ÁREA, (Ac) | PRODUCTO AREA x NC |
|---|---|---|---|---|
| Quebrada silty clay (QuE2), C | Residencial | 90 | 0.78 | 70.2 |
| Serpentenite outcrop (So), D | Residencial | 92 | 2.62 | 241.04 |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | Totals | 3.4 | 311.24 |

| NC | 92 |
|---|---|

* Condición de humedad antecedente II

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## HOJA DE CÁLCULO: TIEMPO DE CONCENTRACIÓN (Tc)

**CONDICIÓN: EXISTENTE** **CUENCA: EXTERNA 1**

L = 207.1 meters x 3.28 = 679.46 feet

S = 211.6 (top) – 156.9 (bottom) = 54.70 ÷ 207.1 = 0.2641

Equation

$$Tc = \frac{0.00013L^{0.77}}{S^{0.385}}$$

$$Tc = 0.00013 \times \frac{(\ 679.46\ )^{0.77}}{(\ 0.2641\ )^{0.385}}$$

Total = 0.033 x 60 = 1.98 minutes*

Tc = 5 minutes

*si el total es menor de 5 minutos, se utiliza 5 min.

## LLUVIA EN PULGADAS

**Latitud: 18.19118333N** **Longitud: 67.12842222W**

| Duración, hr | 0.083 | 0.25 | 1 | 2 | 3 | 6 | 12 | 24 |
|---|---|---|---|---|---|---|---|---|
| Lluvia, pulg. 100 YR | 0.95 | 1.66 | 3.95 | 5.42 | 6.22 | 8.27 | 11.65 | 15.22 |
| Lluvia pulg. 2 YR | 0.61 | 1.08 | 2.56 | 3.22 | 3.37 | 3.77 | 4.16 | 4.69 |

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## HOJA DE CÁLCULO: TIEMPO DE CONCENTRACIÓN (Tc)

**CONDICIÓN: EXISTENTE** **CUENCA: EXTERNA 2**

L = 261.4 meters x 3.28 = 857.61 feet

S = 270.5 (top) – 119.7 (bottom) = 150.80 ÷ 261.4 = 0.5769

Equation

$$Tc = \frac{0.00013L^{0.77}}{S^{0.385}}$$

$$Tc = 0.00013 \times \frac{(857.61)^{0.77}}{(0.5769)^{0.385}}$$

Total = 0.029 x 60 = 1.74 minutes*

Tc = 5 minutes

*si el total es menor de 5 minutos, se utiliza 5 min.

## LLUVIA EN PULGADAS

**Latitud: 18.19118333N** **Longitud: 67.12842222W**

| Duración, hr | 0.083 | 0.25 | 1 | 2 | 3 | 6 | 12 | 24 |
|---|---|---|---|---|---|---|---|---|
| Lluvia, pulg. 100 YR | 0.95 | 1.66 | 3.95 | 5.42 | 6.22 | 8.27 | 11.65 | 15.22 |
| Lluvia pulg. 2 YR | 0.61 | 1.08 | 2.56 | 3.22 | 3.37 | 3.77 | 4.16 | 4.69 |

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## HOJA DE CÁLCULO: TIEMPO DE CONCENTRACIÓN (Tc)

**CONDICIÓN: EXISTENTE** **CUENCA: PROYECTO 1**

L = 476.3 meters x 3.28 = 1,562.66 feet

S = 118.7 (top) – 67 (bottom) = 51.70 ÷ 476.3 = 0.1085

Equation

$$Tc = \frac{0.00013L^{0.77}}{S^{0.385}}$$

$$Tc = 0.00013 \times \frac{(\ 1{,}562.66\ )^{0.77}}{(\ 0.1085\ )^{0.385}}$$

Total = 0.088 x 60 = 5.28 minutes*

Tc = 5 minutes

*si el total es menor de 5 minutos, se utiliza 5 min.

## LLUVIA EN PULGADAS

**Latitud: 18.19118333N** **Longitud: 67.12842222W**

| Duración, hr | 0.083 | 0.25 | 1 | 2 | 3 | 6 | 12 | 24 |
|---|---|---|---|---|---|---|---|---|
| Lluvia, pulg. 100 YR | 0.95 | 1.66 | 3.95 | 5.42 | 6.22 | 8.27 | 11.65 | 15.22 |
| Lluvia pulg. 2 YR | 0.61 | 1.08 | 2.56 | 3.22 | 3.37 | 3.77 | 4.16 | 4.69 |

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## HOJA DE CÁLCULO: TIEMPO DE CONCENTRACIÓN (Tc)

**CONDICIÓN: EXISTENTE** **CUENCA: PROYECTO 2**

L = 252.7 meters x 3.28 = 829.07 feet

S = 119.4 (top) – 78.7 (bottom) = 40.70 ÷ 252.7 = 0.1611

Equation

$$Tc = \frac{0.00013L^{0.77}}{S^{0.385}}$$

$$Tc = 0.00013 \times \frac{(\ 829.07\ )^{0.77}}{(\ 0.1611\ )^{0.385}}$$

Total = 0.046 x 60 = 2.76 minutes*

Tc = 5 minutes

*si el total es menor de 5 minutos, se utiliza 5 min.

## LLUVIA EN PULGADAS

**Latitud: 18.19118333N** **Longitud: 67.12842222W**

| Duración, hr | 0.083 | 0.25 | 1 | 2 | 3 | 6 | 12 | 24 |
|---|---|---|---|---|---|---|---|---|
| Lluvia, pulg. 100 YR | 0.95 | 1.66 | 3.95 | 5.42 | 6.22 | 8.27 | 11.65 | 15.22 |
| Lluvia pulg. 2 YR | 0.61 | 1.08 | 2.56 | 3.22 | 3.37 | 3.77 | 4.16 | 4.69 |

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## HOJA DE CÁLCULO: TIEMPO DE CONCENTRACIÓN (Tc)

**CONDICIÓN: EXISTENTE** **CUENCA: PROYECTO 3**

L = 149.9 meters x 3.28 = 491.80 feet

S = 82.9 (top) – 60.9 (bottom) = 22.00 ÷ 149.9 = 0.1468

Equation

$$Tc = \frac{0.00013L^{0.77}}{S^{0.385}}$$

$$Tc = 0.00013 \times \frac{(491.80)^{0.77}}{(0.1468)^{0.385}}$$

Total = 0.032 x 60 = 1.92 minutes*

Tc = 5 minutes

*si el total es menor de 5 minutos, se utiliza 5 min.

## LLUVIA EN PULGADAS

**Latitud: 18.19118333N** **Longitud: 67.12842222W**

| Duración, hr | 0.083 | 0.25 | 1 | 2 | 3 | 6 | 12 | 24 |
|---|---|---|---|---|---|---|---|---|
| Lluvia, pulg. 100 YR | 0.95 | 1.66 | 3.95 | 5.42 | 6.22 | 8.27 | 11.65 | 15.22 |
| Lluvia pulg. 2 YR | 0.61 | 1.08 | 2.56 | 3.22 | 3.37 | 3.77 | 4.16 | 4.69 |

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## HOJA DE CÁLCULO: TIEMPO DE CONCENTRACIÓN (Tc)

**CONDICIÓN: EXISTENTE** **CUENCA: PROYECTO 4**

L = 55.4 meters x 3.28 = 181.76 feet

S = 75.2 (top) – 59.2 (bottom) = 16.00 ÷ 55.4 = 0.2888

Equation

$$Tc = \frac{0.00013L^{0.77}}{S^{0.385}}$$

$$Tc = 0.00013 \times \frac{(181.71)^{0.77}}{(0.2888)^{0.385}}$$

Total = 0.012 x 60 = 0.72 minutes*

Tc = 5 minutes

*si el total es menor de 5 minutos, se utiliza 5 min.

## LLUVIA EN PULGADAS

**Latitud: 18.19118333N** **Longitud: 67.12842222W**

| Duración, hr | 0.083 | 0.25 | 1 | 2 | 3 | 6 | 12 | 24 |
|---|---|---|---|---|---|---|---|---|
| Lluvia, pulg. 100 YR | 0.95 | 1.66 | 3.95 | 5.42 | 6.22 | 8.27 | 11.65 | 15.22 |
| Lluvia pulg. 2 YR | 0.61 | 1.08 | 2.56 | 3.22 | 3.37 | 3.77 | 4.16 | 4.69 |

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**PROJECTO:** **Monte Sierra**

**LOCALIZACIÓN:** **Mayagüez**

**FECHA:** **18 de mayo de 2006**

## HYDROLOGIC DATA RESULTS
## EXISTENTE 100 AÑOS

| CONDICIÓN | CUENCA | ÁREA, ac ($mi^2$) | CN | $T_C$, min | Q, pcs (mcs) |
|---|---|---|---|---|---|
| EXISTENTE | PRO1N | 22.30 (0.0348) | 76 | 5 | 205 (5.80) |
| | PRO1S | 20.11 (0.0314) | 76 | 5 | 185 (5.24) |
| | EXT1 | 23.90 (0.0373) | 74 | 5 | 216 (6.12) |
| | COMB1 | PRO1N + PRO1S + EXT1 | | | 606 (17.16) |
| | PROJ2 | 6.14 (0.0096) | 79 | 5 | 58 (1.64) |
| | EXT2 | 54.17 (0.0846) | 66 | 5 | 446 (12.63) |
| | COMB2 | PROJ2 + EXT2 | | | 504 (14.27) |
| | PROJ3 | 7.38 (0.0115) | 79 | 5 | 70 (1.98) |
| | PROJ4 | 3.40 (0.0053) | 76 | 5 | 31 (0.87) |

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**PROJECTO:** **Monte Sierra**

**LOCALIZACIÓN:** **Mayagüez**

**FECHA:** **18 de mayo de 2006**

## HYDROLOGIC DATA RESULTS
## PROPUESTO 100 AÑOS

| CONDICIÓN | CUENCA | ÁREA, ac ($mi^2$) | CN | $T_C$, min | Q, pcs (mcs) |
|---|---|---|---|---|---|
| PROPUESTA | PRO1N | 22.30 (0.0348) | 91 | 5 | 224 (6.34) |
| | PRO1S | 20.11 (0.0314) | 91 | 5 | 202 (5.72) |
| | PROJ3 | 7.38 (0.0115) | 92 | 5 | 74 (2.10) |
| | COMBP1 | PRO1N + PRO1S + PROJ3 | | | 500 (14.16) |
| | EXT1 | 23.90 (0.0373) | 74 | 5 | 216 (6.12) |
| | COMB1 | COMBP1 + EXT1 | | | 716 (20.27) |
| | PROJ2 | 6.14 (0.0096) | 92 | 5 | 62 (1.75) |
| | PROJ4 | 3.40 (0.0053) | 92 | 5 | 34 (0.96) |
| | COMBP2 | PROJ2 + PRJ4 | | | 96 (2.72) |
| | EXT2 | 54.17 (0.0846) | 66 | 5 | 446 (12.62) |
| | COMB2 | COMBP2 +EXT2 | | | 542 (15.35) |

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**PROJECTO:** **Monte Sierra**

**LOCALIZACIÓN:** **Mayagüez**

**FECHA:** **18 de mayo de 2006**

## HYDROLOGIC DATA RESULTS
## EXISTENTE 2 AÑOS

| CONDICIÓN | CUENCA | ÁREA, ac ($mi^2$) | CN | $T_C$, min | Q, pcs (mcs) |
|---|---|---|---|---|---|
| EXISTENTE | PRO1N | 22.30 (0.0348) | 76 | 5 | 85 (2.41) |
| | PRO1S | 20.11 (0.0314) | 76 | 5 | 77 (2.18) |
| | EXT1 | 23.90 (0.0373) | 74 | 5 | 84 (2.38) |
| | COMB1 | PRO1N + PRO1S + EXT1 | | | 246 (6.97) |
| | PROJ2 | 6.14 (0.0096) | 79 | 5 | 26 (0.73) |
| | EXT2 | 54.17 (0.0846) | 66 | 5 | 130 (3.68) |
| | COMB2 | PROJ2 + EXT2 | | | 157 (4.44) |
| | PROJ3 | 7.38 (0.0115) | 79 | 5 | 31 (0.88) |
| | PROJ4 | 3.40 (0.0053) | 76 | 5 | 13 (0.37) |

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**PROJECTO:** **Monte Sierra**

**LOCALIZACIÓN:** **Mayagüez**

**FECHA:** **18 de mayo de 2006**

## HYDROLOGIC DATA RESULTS
## PROPUESTO 2 AÑOS

| CONDICIÓN | CUENCA | ÁREA, ac ($mi^2$) | CN | $T_C$, min | Q, pcs (mcs) |
|---|---|---|---|---|---|
| PROPUESTA | PRO1N | 22.30 (0.0348) | 91 | 5 | 132 (3.74) |
| | PRO1S | 20.11 (0.0314) | 91 | 5 | 119 (3.37) |
| | PROJ3 | 7.38 (0.0115) | 92 | 5 | 44 (1.25) |
| | COMBP1 | PRO1N + PRO1S + PROJ3 | | | 295 (8.35) |
| | EXT1 | 23.90 (0.0373) | 74 | 5 | 84 (2.37) |
| | COMB1 | COMBP1 + EXT1 | | | 379 (10.73) |
| | PROJ2 | 6.14 (0.0096) | 92 | 5 | 37 (1.05) |
| | PROJ4 | 3.40 (0.0053) | 92 | 5 | 20 (0.57) |
| | COMBP2 | PROJ2 + PRJ4 | | | 58 (1.64) |
| | EXT2 | 54.17 (0.0846) | 66 | 5 | 130 (3.68) |
| | COMB2 | COMBP2 +EXT2 | | | 188 (5.32) |

# APÉNDICE B

Datos de Precipitación
(NOAA ATLAS 14, VOL 3, VERSION 3.0)

# POINT PRECIPITATION FREQUENCY ESTIMATES FROM NOAA ATLAS 14

**Puerto Rico 18.19118333 N 67.12842222 W 269 feet**

from "Precipitation-Frequency Atlas of the United States" NOAA Atlas 14, Volume 3, Version 3
G.M. Bonnin, D. Martin, B. Lin, T. Parzybok, M.Yekta, and D. Riley
NOAA, National Weather Service, Silver Spring, Maryland, 2006

Extracted: Tue May 29 2007

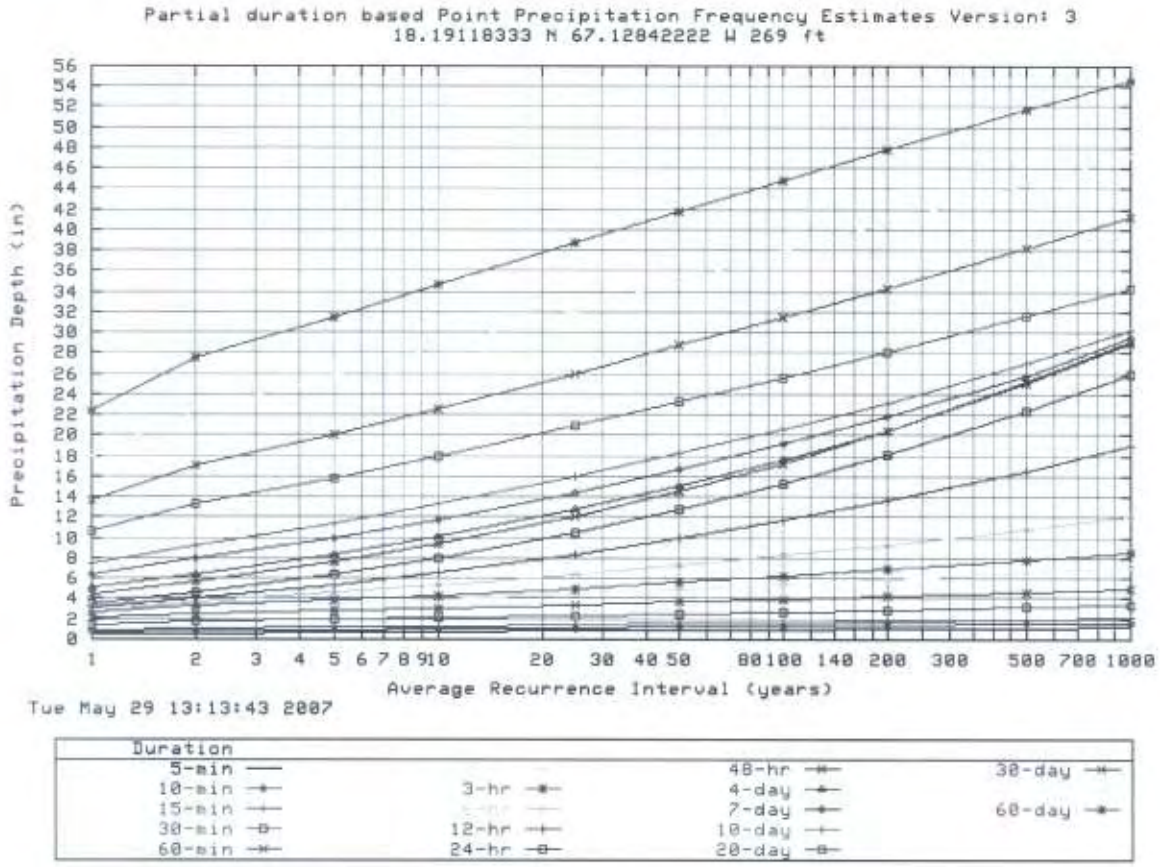
Confidence Limits | Seasonality | Location Maps | Other Info. | GIS data | Maps | Help | Docs | U.S. Map

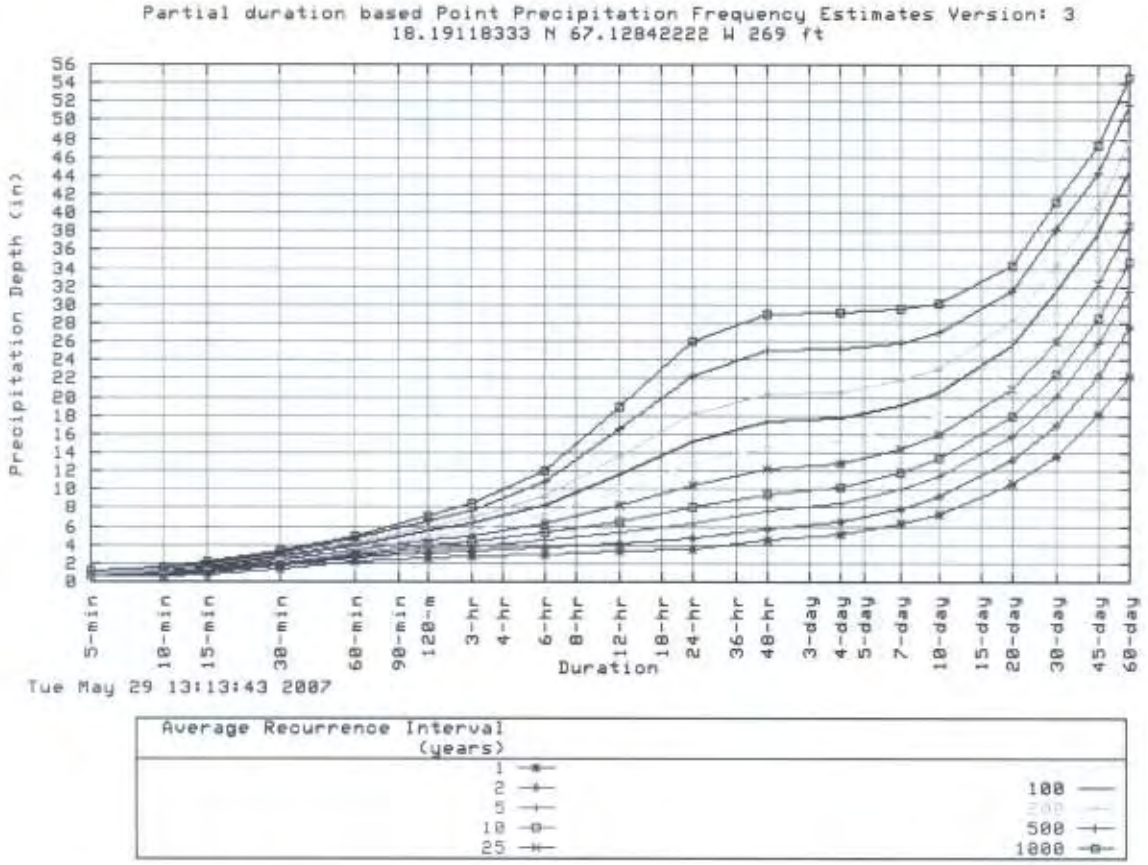
**Precipitation Frequency Estimates (inches)**

| ARI* (years) | 5 min | 10 min | 15 min | 30 min | 60 min | 120 min | 3 hr | 6 hr | 12 hr | 24 hr | 48 hr | 4 day | 7 day | 10 day | 20 day | 30 day | 45 day | 60 day |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.51 | 0.69 | 0.89 | 1.42 | 2.10 | 2.65 | 2.75 | 3.03 | 3.26 | 3.63 | 4.49 | 5.07 | 6.33 | 7.39 | 10.69 | 13.69 | 18.08 | 22.33 |
| 2 | 0.61 | 0.84 | 1.08 | 1.72 | 2.56 | 3.22 | 3.37 | 3.77 | 4.16 | 4.69 | 5.74 | 6.46 | 7.98 | 9.27 | 13.29 | 17.00 | 22.34 | 27.57 |
| 5 | 0.67 | 0.92 | 1.18 | 1.89 | 2.80 | 3.61 | 3.85 | 4.56 | 5.35 | 6.39 | 7.60 | 8.38 | 10.00 | 11.44 | 15.82 | 20.03 | 25.78 | 31.49 |
| 10 | 0.73 | 1.00 | 1.28 | 2.05 | 3.04 | 3.96 | 4.31 | 5.30 | 6.51 | 7.99 | 9.37 | 10.16 | 11.81 | 13.33 | 17.97 | 22.57 | 28.59 | 34.64 |
| 25 | 0.81 | 1.11 | 1.43 | 2.28 | 3.38 | 4.52 | 5.03 | 6.38 | 8.31 | 10.50 | 12.13 | 12.81 | 14.47 | 16.02 | 20.92 | 26.04 | 32.27 | 38.70 |
| 50 | 0.88 | 1.20 | 1.54 | 2.47 | 3.67 | 4.97 | 5.61 | 7.30 | 9.89 | 12.72 | 14.57 | 15.10 | 16.72 | 18.23 | 23.27 | 28.77 | 35.10 | 41.79 |
| 100 | 0.95 | 1.30 | 1.66 | 2.66 | 3.95 | 5.42 | 6.22 | 8.27 | 11.65 | 15.22 | 17.29 | 17.65 | 19.14 | 20.58 | 25.66 | 31.52 | 37.87 | 44.76 |
| 200 | 1.02 | 1.39 | 1.79 | 2.86 | 4.25 | 5.90 | 6.85 | 9.33 | 13.60 | 18.05 | 20.36 | 20.51 | 21.79 | 23.10 | 28.15 | 34.37 | 40.69 | 47.76 |
| 500 | 1.12 | 1.53 | 1.96 | 3.14 | 4.66 | 6.55 | 7.75 | 10.83 | 16.53 | 22.32 | 24.98 | 25.23 | 25.85 | 27.01 | 31.64 | 38.22 | 44.40 | 51.65 |
| 1000 | 1.19 | 1.63 | 2.10 | 3.35 | 4.98 | 7.05 | 8.46 | 12.06 | 18.99 | 25.97 | 28.93 | 29.22 | 29.51 | 30.18 | 34.39 | 41.30 | 47.24 | 54.59 |

Text version of table

* These precipitation frequency estimates are based on a partial duration series. **ARI** is the Average Recurrence Interval. Please refer to the documentation for more information. NOTE: Formatting forces estimates near zero to appear as zero.


Partial duration based Point Precipitation Frequency Estimates Version: 3
18.19118333 N 67.12842222 W 269 ft
Precipitation Depth (in)
Average Recurrence Interval (years)
Tue May 29 13:13:43 2007
Duration
5-min
10-min
15-min
30-min
60-min
3-hr
12-hr
24-hr
48-hr
4-day
7-day
10-day
20-day
30-day
60-day




## Confidence Limits -

| * Upper bound of the 90% confidence interval Precipitation Frequency Estimates (inches) | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ARI** (years) | 5 min | 10 min | 15 min | 30 min | 60 min | 120 min | 3 hr | 6 hr | 12 hr | 24 hr | 48 hr | 4 day | 7 day | 10 day | 20 day | 30 day | 45 day | 60 day |
| 1 | 0.53 | 0.73 | 0.94 | 1.50 | 2.22 | 2.80 | 2.94 | 3.31 | 3.67 | 4.11 | 5.01 | 5.58 | 6.86 | 7.96 | 11.42 | 14.61 | 19.14 | 23.60 |
| 2 | 0.65 | 0.88 | 1.14 | 1.82 | 2.70 | 3.51 | 3.69 | 4.24 | 4.63 | 5.29 | 6.40 | 7.12 | 8.69 | 10.04 | 14.24 | 18.16 | 23.73 | 29.20 |
| 5 | 0.74 | 1.02 | 1.31 | 2.09 | 3.10 | 3.99 | 4.30 | 5.23 | 6.00 | 7.23 | 8.52 | 9.28 | 10.91 | 12.41 | 16.97 | 21.41 | 27.40 | 33.35 |
| 10 | 0.78 | 1.07 | 1.37 | 2.20 | 3.26 | 4.43 | 4.88 | 6.15 | 7.35 | 9.06 | 10.56 | 11.29 | 12.93 | 14.49 | 19.31 | 24.18 | 30.43 | 36.73 |
| 25 | 0.88 | 1.20 | 1.53 | 2.46 | 3.65 | 5.14 | 5.79 | 7.58 | 8.39 | 12.03 | 13.86 | 14.41 | 16.00 | 17.56 | 22.65 | 28.08 | 34.52 | 41.25 |
| 50 | 0.95 | 1.30 | 1.68 | 2.68 | 3.98 | 5.74 | 6.57 | 8.85 | 9.99 | 14.73 | 16.88 | 17.21 | 18.70 | 20.18 | 25.34 | 31.22 | 37.72 | 44.72 |
| 100 | 1.04 | 1.42 | 1.83 | 2.92 | 4.34 | 6.38 | 7.43 | 10.26 | 11.76 | 17.83 | 20.39 | 20.42 | 21.68 | 23.02 | 28.18 | 34.47 | 40.99 | 48.18 |
| 200 | 1.13 | 1.54 | 1.98 | 3.17 | 4.71 | 7.06 | 8.37 | 11.86 | 13.74 | 21.42 | 24.42 | 24.67 | 25.01 | 26.11 | 31.24 | 37.94 | 44.41 | 51.75 |
| 500 | 1.26 | 1.72 | 2.20 | 3.53 | 5.24 | 8.00 | 9.72 | 14.19 | 16.69 | 26.95 | 30.64 | 30.94 | 31.25 | 31.57 | 35.58 | 42.79 | 48.97 | 56.55 |
| 1000 | 1.36 | 1.85 | 2.38 | 3.81 | 5.66 | 8.77 | 10.82 | 16.15 | 19.18 | 31.73 | 36.08 | 36.44 | 36.80 | 37.17 | 39.09 | 46.73 | 52.59 | 60.23 |

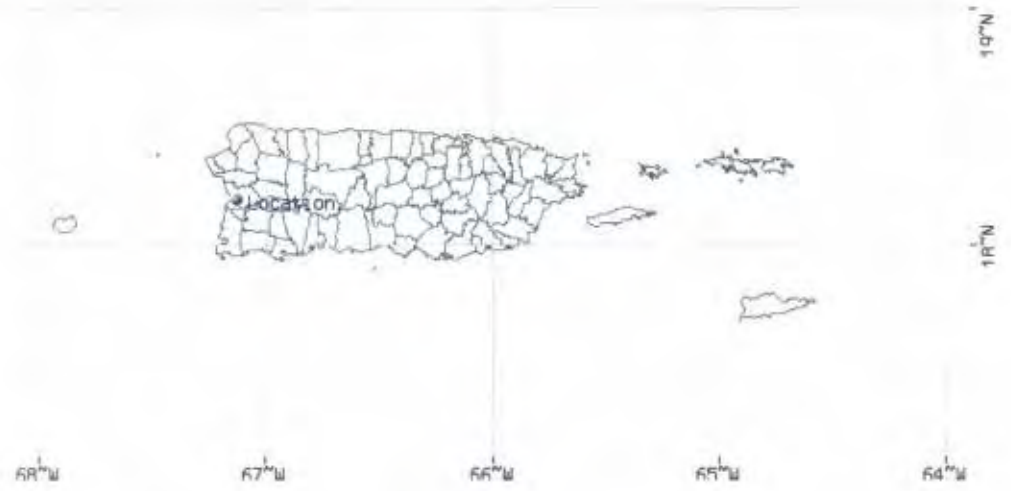
* The upper bound of the confidence interval at 90% confidence level is the value which 5% of the simulated quantile values for a given frequency are **greater** than.
** These precipitation frequency estimates are based on a partial duration series. ARI is the Average Recurrence Interval.
Please refer to the documentation for more information. NOTE: Formatting prevents estimates near zero to appear as zero.

| * Lower bound of the 90% confidence interval Precipitation Frequency Estimates (inches) | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ARI** (years) | 5 min | 10 min | 15 min | 30 min | 60 min | 120 min | 3 hr | 6 hr | 12 hr | 24 hr | 48 hr | 4 day | 7 day | 10 day | 20 day | 30 day | 45 day | 60 day |
| 1 | 0.48 | 0.65 | 0.84 | 1.34 | 1.99 | 2.49 | 2.58 | 2.80 | 2.93 | 3.26 | 4.07 | 4.66 | 5.88 | 6.88 | 10.04 | 12.89 | 17.08 | 21.14 |
| 2 | 0.58 | 0.79 | 1.01 | 1.62 | 2.40 | 3.03 | 3.15 | 3.47 | 3.72 | 4.21 | 5.18 | 5.93 | 7.40 | 8.64 | 12.48 | 16.01 | 21.14 | 26.10 |
| 5 | 0.67 | 0.91 | 1.17 | 1.87 | 2.77 | 3.38 | 3.57 | 4.16 | 4.74 | 5.66 | 6.81 | 7.63 | 9.22 | 10.62 | 14.82 | 18.81 | 24.34 | 29.76 |
| 10 | 0.72 | 0.99 | 1.27 | 2.03 | 3.01 | 3.69 | 3.96 | 4.76 | 5.67 | 6.99 | 8.28 | 9.14 | 10.79 | 12.27 | 16.73 | 21.09 | 26.89 | 32.62 |
| 25 | 0.76 | 1.03 | 1.33 | 2.13 | 3.16 | 4.17 | 4.55 | 5.62 | 7.04 | 8.96 | 10.45 | 11.29 | 12.99 | 14.55 | 19.25 | 24.06 | 30.12 | 36.22 |
| 50 | 0.81 | 1.11 | 1.43 | 2.29 | 3.40 | 4.54 | 5.02 | 6.30 | 8.18 | 10.65 | 12.28 | 13.08 | 14.79 | 16.37 | 21.22 | 26.35 | 32.56 | 38.90 |
| 100 | 0.87 | 1.19 | 1.52 | 2.44 | 3.62 | 4.90 | 5.48 | 6.99 | 9.37 | 12.48 | 14.24 | 14.99 | 16.66 | 18.23 | 23.17 | 28.62 | 34.89 | 41.43 |
| 200 | 0.92 | 1.26 | 1.62 | 2.60 | 3.85 | 5.28 | 5.96 | 7.73 | 10.67 | 14.50 | 16.38 | 17.07 | 18.68 | 20.17 | 25.16 | 30.90 | 37.20 | 43.90 |
| 500 | 1.00 | 1.36 | 1.75 | 2.80 | 4.16 | 5.77 | 6.60 | 8.75 | 12.51 | 17.41 | 19.49 | 20.08 | 21.67 | 23.12 | 27.82 | 33.85 | 40.15 | 47.02 |
| 1000 | 1.06 | 1.44 | 1.85 | 2.97 | 4.40 | 6.14 | 7.10 | 9.54 | 13.97 | 19.81 | 22.02 | 22.50 | 24.03 | 25.47 | 29.88 | 36.16 | 42.34 | 49.35 |

* The **lower** bound of the confidence interval at 90% confidence level is the value which 5% of the simulated quantile values for a given frequency are **less** than.
** These precipitation frequency estimates are based on a partial duration maxima series. **ARI** is the Average Recurrence Interval.

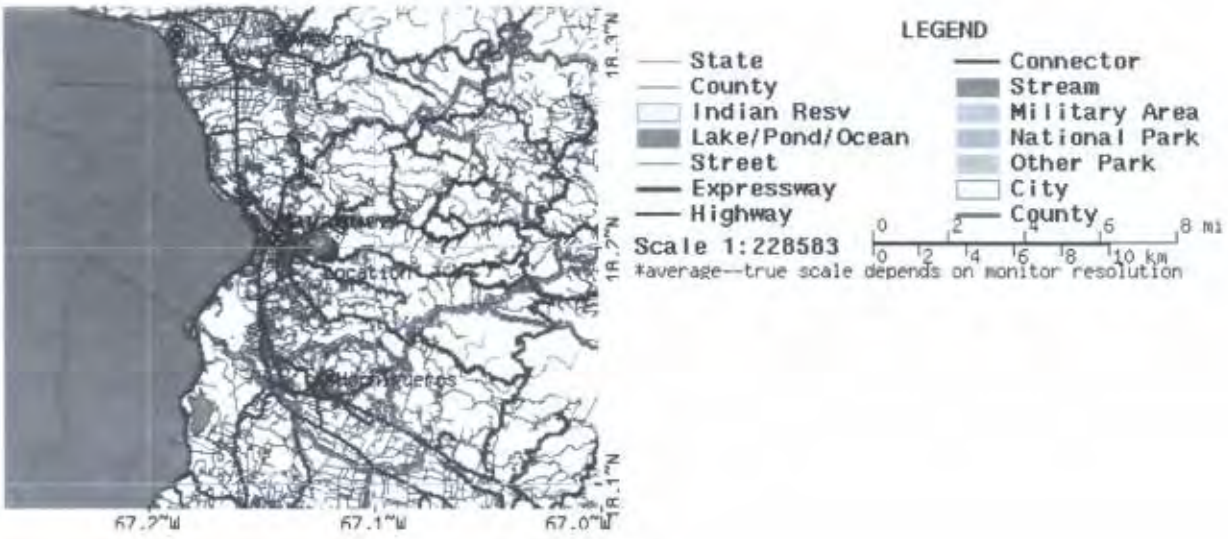
Please refer to the documentation for more information. NOTE: Formatting prevents estimates near zero to appear as zero.

## Maps -




These maps were produced using a direct map request from the U.S. Census Bureau Mapping and Cartographic Resources **Tiger Map Server**.

*Please read disclaimer for more information.*




## Other Maps/Photographs -

**View USGS digital orthophoto quadrangle (DOQ)** covering this location from TerraServer; **USGS Aerial Photograph** may also be available from this site. A DOQ is a computer-generated image of an aerial photograph in which image displacement caused by terrain relief and camera tilts has been removed. It combines the image characteristics of a photograph with the geometric qualities of a map. Visit the USGS for more information.

## Watershed/Stream Flow Information -

Find the Watershed for this location using the U.S. Environmental Protection Agency's site.

## Climate Data Sources -

*Precipitation frequency results are based on data from a variety of sources, but largely NCDC. The following links provide general information about observing sites in the area, regardless of if their data was used in this study. For detailed information about the stations used in this study, please refer to our documentation.*

Using the **National Climatic Data Center's (NCDC)** station search engine, locate other climate stations within:

+/-30 minutes ...OR... +/-1 degree of this location (18.19118333/-67.12842222). Digital ASCII data can be obtained directly from **NCDC**.

---

**Hydrometeorological Design Studies Center**
**DOC/NOAA/National Weather Service**
**1325 East-West Highway**
**Silver Spring, MD 20910**

**(301) 713-1669**
Questions?: HDSC.Questions@noaa.gov

Disclaimer

# APÉNDICE C

Datos de Entrada y Salida de HEC-1

## CONDICIÓN EXISTENTE (2-AÑOS): EXIS2.DAT

```
1*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*             JUN  1998                 *
*           VERSION 4.1                 *
*                                       *
*  RUN DATE   29MAY07  TIME  13:24:29   *
*                                       *
*****************************************
```

```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
*        DAVIS, CALIFORNIA 95616        *
*           (916) 756-1104              *
*                                       *
*****************************************
```

```
X     X  XXXXXXX   XXXXX          X
X     X  X        X     X        XX
X     X  X        X              X
XXXXXXX  XXXX     X        XXXXX  X
X     X  X        X              X
X     X  X        X     X        X
X     X  XXXXXXX   XXXXX         XXX
```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 01. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL  LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM



```
LINE          ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  1           ID        ANALYSIS HIDROLOGICO PARA MONTE SIERRA, INC.,MAYAGUEZ
  2           ID        CONDICION EXISTENTE
  3           ID        ABRIL 2006: FILENAME=EXIS2.DAT: MENAR HYDROSYSTEMS
  4           ID        24-HOUR BALANCED STORM DISTRIBUTION : AMC II
  5           ID        2-YEAR FREQUENCY STORM
  6           IT      1 18ABR06       0     300 18ABR06    2400
  7           IO      4
              *
              *DIAGRAMA
              *
              *  CUENCA PROYECTO 1 NORTE
              *
  8           KK   PRO1N
  9           BA  0.0348
 10           LS       0      76
 11           UD    0.05
 12           PH       0       0    0.61    1.08    2.56    3.22    3.37    3.77    4.16    4.69
              *
              *  CUENCA PROYECTO 1 SUR
              *
 13           KK   PRO1S
 14           BA  0.0314
 15           LS       0      76
 16           UD    0.05
              *
              *  CUENCA EXTERNA 1
              *
 17           KK    EXT1
 18           BA  0.0373
 19           LS       0      74
 20           UD    0.05
              *
 21           KK   COMB1
 22           HC       3
              *
              *  CUENCA PROYECTO 2
              *
 23           KK   PROJ2
 24           BA  0.0096
 25           LS       0      79
 26           UD    0.05
              *
              *  CUENCA EXTERNA 2
              *
```



```
LINE          ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

 27           KK    EXT2
 28           BA  0.0846
 29           LS       0      66
 30           UD    0.05
              *
 31           KK   COMB2
 32           HC       2
              *
              *  CUENCA PROYECTO 3
              *
 33           KK   PROJ3
```

```
            34           BA  0.0115
            35           LS       0      79
            36           UD    0.05
                         *
                         *  CUANCA PROYECTO 4
                         *

            37           KK   PROJ4
            38           BA  0.0053
            39           LS       0      76
            40           UD    0.05
                         *
                         *
            41           ZZ
1
                SCHEMATIC DIAGRAM OF STREAM NETWORK
 INPUT
  LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

   NO.      (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

     8       PRO1N
                .
                .
    13          .        PRO1S
                .          .
                .          .
    17          .          .        EXT1
                .          .          .
                .          .          .
    21       COMB1.........................
                .
                .
    23          .        PROJ2
                .          .
                .          .
    27          .          .        EXT2
                .          .          .
                .          .          .
    31          .        COMB2.............
                .          .
                .          .
    33          .          .        PROJ3
                .          .          .
                .          .          .
    37          .          .          .        PROJ4

 (***) RUNOFF ALSO COMPUTED AT THIS LOCATION
1*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*             JUN  1998                 *
*           VERSION 4.1                 *
*                                       *
*  RUN DATE   29MAY07  TIME  13:24:29   *
*                                       *
*****************************************

*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
*       DAVIS, CALIFORNIA 95616         *
*           (916) 756-1104              *
*                                       *
*****************************************

                            ANALYSIS HIDROLOGICO PARA MONTE SIERRA, INC.,MAYAGUEZ
                            CONDICION EXISTENTE
                            ABRIL 2006: FILENAME=EXIS2.DAT: MENAR HYDROSYSTEMS
                            24-HOUR BALANCED STORM DISTRIBUTION : AMC II
                            2-YEAR FREQUENCY STORM

   ? IO          OUTPUT CONTROL VARIABLES
                      IPRNT          4  PRINT CONTROL
                      IPLOT          0  PLOT CONTROL
                      QSCAL         0.  HYDROGRAPH PLOT SCALE

     IT          HYDROGRAPH TIME DATA
                      NMIN           1  MINUTES IN COMPUTATION INTERVAL
                      IDATE     18ABR 6  STARTING DATE
                      ITIME        0000  STARTING TIME
                        NQ         1441  NUMBER OF HYDROGRAPH ORDINATES
                     NDDATE      19    6  ENDING DATE
                     NDTIME         0000  ENDING TIME
                     ICENT            19  CENTURY MARK

                   COMPUTATION INTERVAL      .02 HOURS
                       TOTAL TIME BASE    24.00 HOURS

          ENGLISH UNITS
               DRAINAGE AREA          SQUARE MILES
               PRECIPITATION DEPTH    INCHES
               LENGTH, ELEVATION      FEET
               FLOW                   CUBIC FEET PER SECOND
               STORAGE VOLUME         ACRE-FEET
               SURFACE AREA           ACRES
               TEMPERATURE            DEGREES FAHRENHEIT

*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

               **************
               *            *
    8 KK       *     PRO1N  *
               *            *
               **************
```

```
              SUBBASIN RUNOFF DATA

  9 BA          SUBBASIN CHARACTERISTICS
                     TAREA          .03  SUBBASIN AREA

                PRECIPITATION DATA

 12 PH                                 DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
                5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                  .61    1.08    2.56    3.22    3.37    3.77    4.16    4.69     .00     .00     .00     .00

                                                     STORM AREA =      .03

 10 LS          SCS LOSS RATE
                     STRTL          .63  INITIAL ABSTRACTION
                    CRVNBR        76.00  CURVE NUMBER
                     RTIMP          .00  PERCENT IMPERVIOUS AREA

 11 UD          SCS DIMENSIONLESS UNITGRAPH
                      TLAG          .05  LAG

                                                          ***

VALUE EXCEEDS TABLE IN LOGLOG          .01667         .01667       24.00000

                                                     UNIT HYDROGRAPH
                                                 17 END-OF-PERIOD ORDINATES
                51.      175.      278.      278.      217.      130.       81.       52.       33.       20.
                13.        8.        5.        3.        2.        1.        0.


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
 13 KK      *     PRO1S  *
            *            *
            **************

              SUBBASIN RUNOFF DATA

 14 BA          SUBBASIN CHARACTERISTICS
                     TAREA          .03  SUBBASIN AREA

                PRECIPITATION DATA

 12 PH                                 DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
                5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                  .61    1.08    2.56    3.22    3.37    3.77    4.16    4.69     .00     .00     .00     .00

                                                     STORM AREA =      .03

 15 LS          SCS LOSS RATE
                     STRTL          .63  INITIAL ABSTRACTION
                    CRVNBR        76.00  CURVE NUMBER
                     RTIMP          .00  PERCENT IMPERVIOUS AREA

 16 UD          SCS DIMENSIONLESS UNITGRAPH
                      TLAG          .05  LAG

                                                          ***

VALUE EXCEEDS TABLE IN LOGLOG          .01667         .01667       24.00000

                                                     UNIT HYDROGRAPH
                                                 17 END-OF-PERIOD ORDINATES
                46.      158.      251.      251.      196.      117.       73.       47.       29.       18.
                12.        7.        5.        3.        2.        1.        0.


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
 17 KK      *      EXT1  *
            *            *
            **************

              SUBBASIN RUNOFF DATA

 18 BA          SUBBASIN CHARACTERISTICS
                     TAREA          .04  SUBBASIN AREA

                PRECIPITATION DATA

 12 PH                                 DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
                5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                  .61    1.08    2.56    3.22    3.37    3.77    4.16    4.69     .00     .00     .00     .00

                                                     STORM AREA =      .04

 19 LS          SCS LOSS RATE
                     STRTL          .70  INITIAL ABSTRACTION
                    CRVNBR        74.00  CURVE NUMBER
                     RTIMP          .00  PERCENT IMPERVIOUS AREA

 20 UD          SCS DIMENSIONLESS UNITGRAPH
                      TLAG          .05  LAG
```

```
                                                    ***

VALUE EXCEEDS TABLE IN LOGLOG          .01667         .01667      24.00000

                                                 UNIT HYDROGRAPH
                                            17 END-OF-PERIOD ORDINATES
              55.       187.      298.      298.      232.      139.       87.       56.       35.       22.
              14.         9.        5.        3.        2.        1.        0.


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

          **************
          *            *
  21 KX   *    COMB1   *
          *            *
          **************

  22 HC        HYDROGRAPH COMBINATION
                     ICOMP          3  NUMBER OF HYDROGRAPHS TO COMBINE

                                                    ***


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

          **************
          *            *
  23 KX   *    PROJ2   *
          *            *
          **************

             SUBBASIN RUNOFF DATA

  24 BA        SUBBASIN CHARACTERISTICS
                     TAREA          .01  SUBBASIN AREA

               PRECIPITATION DATA

  12 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
              ..... HYDRO-35 ......   ................ TP-40 ................   ............ TP-49 ............
              5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                .61    1.08    2.56    3.22    3.37    3.77    4.16    4.69     .00     .00     .00     .00

                                               STORM AREA =       .01

  25 LS        SCS LOSS RATE
                     STRTL          .53  INITIAL ABSTRACTION
                    CRVNBR        79.00  CURVE NUMBER
                     RTIMP          .00  PERCENT IMPERVIOUS AREA

  26 UD        SCS DIMENSIONLESS UNITGRAPH
                      TLAG          .05  LAG

                                                    ***

VALUE EXCEEDS TABLE IN LOGLOG          .01667         .01667      24.00000

                                                 UNIT HYDROGRAPH
                                            17 END-OF-PERIOD ORDINATES
              14.        48.       77.       77.       60.       36.       22.       14.        9.        6.
               4.         2.        1.        1.        1.        0.        0.


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

          **************
          *            *
  27 KK   *     EXT2   *
          *            *
          **************

             SUBBASIN RUNOFF DATA

  28 BA        SUBBASIN CHARACTERISTICS
                     TAREA          .08  SUBBASIN AREA

               PRECIPITATION DATA

  12 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
              ..... HYDRO-35 ......   ................ TP-40 ................   ............ TP-49 ............
              5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                .61    1.08    2.56    3.22    3.37    3.77    4.16    4.69     .00     .00     .00     .00

                                               STORM AREA =       .08

  29 LS        SCS LOSS RATE
                     STRTL         1.03  INITIAL ABSTRACTION
                    CRVNBR        66.00  CURVE NUMBER
                     RTIMP          .00  PERCENT IMPERVIOUS AREA

  30 UD        SCS DIMENSIONLESS UNITGRAPH
                      TLAG          .05  LAG

                                                    ***

VALUE EXCEEDS TABLE IN LOGLOG          .01667         .01667      24.00000
```

```
                                                    UNIT HYDROGRAPH
                                                17 END-OF-PERIOD ORDINATES
          124.      425.      676.      676.      527.      316.      196.      127.       79.       50.
           31.       20.       12.        8.        5.        3.        1.

*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

          **************
          *            *
 31 KK    *    COMB2   *
          *            *
          **************

 32 HC        HYDROGRAPH COMBINATION
                  ICOMP          2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                          ***

*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

          **************
          *            *
 33 KK    *    PROJ3   *
          *            *
          **************

            SUBBASIN RUNOFF DATA

 34 BA        SUBBASIN CHARACTERISTICS
                  TAREA          .01  SUBBASIN AREA

              PRECIPITATION DATA

 12 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
              ..... HYDRO-35 ......  ................ TP-40 ................  ........... TP-49 ...........
              5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                .61    1.08    2.56    3.22    3.37    3.77    4.16    4.69     .00     .00     .00     .00

                                                  STORM AREA =      .01

 35 LS        SCS LOSS RATE
                  STRTL          .53  INITIAL ABSTRACTION
                 CRVNBR        79.00  CURVE NUMBER
                  RTIMP          .00  PERCENT IMPERVIOUS AREA

 36 UD        SCS DIMENSIONLESS UNITGRAPH
                   TLAG          .05  LAG

                                                          ***

VALUE EXCEEDS TABLE IN LOGLOG          .01667         .01667       24.00000

                                                    UNIT HYDROGRAPH
                                                17 END-OF-PERIOD ORDINATES
           17.       58.       92.       92.       72.       43.       27.       17.       11.        7.
            4.        3.        2.        1.        1.        0.        0.

*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

          **************
          *            *
 37 KK    *    PROJ4   *
          *            *
          **************

            SUBBASIN RUNOFF DATA

 38 BA        SUBBASIN CHARACTERISTICS
                  TAREA          .01  SUBBASIN AREA

              PRECIPITATION DATA

 12 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
              ..... HYDRO-35 ......  ................ TP-40 ................  ........... TP-49 ...........
              5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                .61    1.08    2.56    3.22    3.37    3.77    4.16    4.69     .00     .00     .00     .00

                                                  STORM AREA =      .01

 39 LS        SCS LOSS RATE
                  STRTL          .63  INITIAL ABSTRACTION
                 CRVNBR        76.00  CURVE NUMBER
                  RTIMP          .00  PERCENT IMPERVIOUS AREA

 40 UD        SCS DIMENSIONLESS UNITGRAPH
                   TLAG          .05  LAG

                                                          ***

VALUE EXCEEDS TABLE IN LOGLOG          .01667         .01667       24.00000

                                                    UNIT HYDROGRAPH
                                                17 END-OF-PERIOD ORDINATES
            8.       27.       42.       42.       33.       20.       12.        8.        5.        3.
            2.        1.        1.        0.        0.        0.        0.
```

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

| | OPERATION | STATION | PEAK FLOW | TIME OF PEAK | AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR | 24-HOUR | 72-HOUR | BASIN AREA | MAXIMUM STAGE | TIME OF MAX STAGE |
|---|---|---|---|---|---|---|---|---|---|---|
| + | HYDROGRAPH AT | PRO1N | 85. | 12.07 | 8. | 2. | 2. | .03 | | |
| + | HYDROGRAPH AT | PRO1S | 77. | 12.07 | 7. | 2. | 2. | .03 | | |
| + | HYDROGRAPH AT | EXT1 | 84. | 12.07 | 8. | 2. | 2. | .04 | | |
| + | 3 COMBINED AT | COMB1 | 246. | 12.07 | 22. | 6. | 6. | .10 | | |
| + | HYDROGRAPH AT | PROJ2 | 26. | 12.07 | 2. | 1. | 1. | .01 | | |
| + | HYDROGRAPH AT | EXT2 | 130. | 12.07 | 12. | 3. | 3. | .08 | | |
| + | 2 COMBINED AT | COMB2 | 157. | 12.07 | 14. | 4. | 4. | .09 | | |
| + | HYDROGRAPH AT | PROJ3 | 31. | 12.07 | 3. | 1. | 1. | .01 | | |
| + | HYDROGRAPH AT | PROJ4 | 13. | 12.07 | 1. | 0. | 0. | .01 | | |

*** NORMAL END OF HEC-1 ***

## CONDICIÓN PROPUESTA (2-AÑOS): PROP2.DAT

```
1*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*             JUN  1998                 *
*          VERSION 4.1                  *
*                                       *
*  RUN DATE   29MAY07  TIME  13:26:34   *
*                                       *
*****************************************
```

```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
*        DAVIS, CALIFORNIA 95616        *
*            (916) 756-1104             *
*                                       *
*****************************************
```

```
X     X  XXXXXXX   XXXXX           X
X     X  X        X     X         XX
X     X  X        X               X
XXXXXXX  XXXX     X         XXXXX X
X     X  X        X               X
X     X  X        X     X         X
X     X  XXXXXXX   XXXXX          XXX
```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL  LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM



```
LINE          ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  1           ID        ANALYSIS HIDROLOGICO PARA MONTE SIERRA, INC.,MAYAGUEZ
  2           ID        CONDICION PROPUESTA
  3           ID        ABRIL 2006: FILENAME=PROP2.DAT: MENAR HYDROSYSTEMS
  4           ID        24-HOUR BALANCED STORM DISTRIBUTION : AMC II
  5           ID        2-YEAR FREQUENCY STORM
  6           IT       1 18ABR06       0     300 18ABR06    2400
  7           IO       4
              *
              *DIAGRAMA
              *
              *  CUENCA PROYECTO 1 NORTE
              *
  8           KK   PRO1N
  9           BA  0.0348
 10           LS        0      91
 11           UD     0.05
 12           PH        0       0    0.61    1.08    2.56    3.22    3.37    3.77    4.16    4.69
              *
              *  CUENCA PROYECTO 1 SUR
              *
 13           KK   PRO1S
 14           BA  0.0314
 15           LS        0      91
 16           UD     0.05
              *
              *  CUENCA PROYECTO 3 NORTE
              *
 17           KK   PROJ3
 18           BA  0.0115
 19           LS        0      92
 20           UD     0.05
              *
 21           KK  COMBP1
 22           HC        3
              *
              *  CUENCA EXTERNA 1
              *
 23           KK    EXT1
 24           BA  0.0373
 25           LS        0      74
 26           UD     0.05
              *
 27           KK   COMB1
 28           HC        2
              *
              *  CUENCA PROYECTO 2
              *
```



```
LINE          ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

 29           KK   PROJ2
 30           BA  0.0096
 31           LS        0      92
 32           UD     0.05
              *
              *  CUENCA PROYECTO 4
              *
 33           KK   PROJ4
```

```
34          BA  0.0053
35          LS       0      92
36          UD    0.05
            *

37          KK  COMBP2
38          HC       2
            *
            *  CUENCA EXTERNA 2
            *

39          KK    EXT2
40          BA  0.0846
41          LS       0      66
42          UD    0.05
            *

43          KK   COMB2
44          HC       2
            *
45          ZZ
```

1

SCHEMATIC DIAGRAM OF STREAM NETWORK

```
INPUT
 LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

  NO.      (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

    8       PRO1N
            .
            .
   13       .       PRO1S
            .       .
            .       .
   17       .       .       PROJ3
            .       .       .
            .       .       .
   21      COMBP1.....................
            .
            .
   23       .       EXT1
            .       .
            .       .
   27       COMB1.............
            .
            .
   29       .       PROJ2
            .       .
            .       .
   33       .       .       PROJ4
            .       .       .
            .       .       .
   37       .      COMBP2.............
            .       .
            .       .
   39       .       .        EXT2
            .       .        .
            .       .        .
   43       .       COMB2.............
```

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
1*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*              JUN  1998                *
*           VERSION 4.1                 *
*                                       *
* RUN DATE   29MAY07  TIME  13:26:34    *
*                                       *
*****************************************
```

```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*         609 SECOND STREET             *
*       DAVIS, CALIFORNIA 95616         *
*           (916) 756-1104              *
*                                       *
*****************************************
```

ANALYSIS HIDROLOGICO PARA MONTE SIERRA, INC.,MAYAGUEZ
CONDICION PROPUESTA
ABRIL 2006: FILENAME=PROP2.DAT: MENAR HYDROSYSTEMS
24-HOUR BALANCED STORM DISTRIBUTION : AMC II
2-YEAR FREQUENCY STORM

```
 7 IO          OUTPUT CONTROL VARIABLES
                    IPRNT          4  PRINT CONTROL
                    IPLOT          0  PLOT CONTROL
                    QSCAL          0.  HYDROGRAPH PLOT SCALE

   IT           HYDROGRAPH TIME DATA
                     NMIN           1  MINUTES IN COMPUTATION INTERVAL
                    IDATE     18ABR 6  STARTING DATE
                    ITIME        0000  STARTING TIME
                      NQ         1441  NUMBER OF HYDROGRAPH ORDINATES
                   NDDATE      19    6  ENDING DATE
                   NDTIME         0000  ENDING TIME
                   ICENT            19  CENTURY MARK

                 COMPUTATION INTERVAL      .02 HOURS
                     TOTAL TIME BASE    24.00 HOURS

        ENGLISH UNITS
             DRAINAGE AREA          SQUARE MILES
             PRECIPITATION DEPTH    INCHES
             LENGTH, ELEVATION      FEET
             FLOW                   CUBIC FEET PER SECOND
             STORAGE VOLUME         ACRE-FEET
             SURFACE AREA           ACRES
```

```
          TEMPERATURE          DEGREES FAHRENHEIT

*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

          **************
          *            *
  8 KK    *    PRO1N   *
          *            *
          **************

            SUBBASIN RUNOFF DATA

  9 BA        SUBBASIN CHARACTERISTICS
                  TAREA          .03  SUBBASIN AREA

              PRECIPITATION DATA

 12 PH                          DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
              ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
              5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                .61    1.08    2.56    3.22    3.37    3.77    4.16    4.69     .00     .00     .00     .00

                                                  STORM AREA =      .03

 10 LS        SCS LOSS RATE
                  STRTL          .20  INITIAL ABSTRACTION
                 CRVNBR        91.00  CURVE NUMBER
                  RTIMP          .00  PERCENT IMPERVIOUS AREA

 11 UD        SCS DIMENSIONLESS UNITGRAPH
                   TLAG          .05  LAG

                                                          ***

VALUE EXCEEDS TABLE IN LOGLOG          .01667         .01667       24.00000

                                                     UNIT HYDROGRAPH
                                                 17 END-OF-PERIOD ORDINATES
             51.      175.      278.      278.      217.      130.       81.       52.       33.       20.
             13.        8.        5.        3.        2.        1.        0.

*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

          **************
          *            *
 13 KK    *    PRO1S   *
          *            *
          **************

            SUBBASIN RUNOFF DATA

 14 BA        SUBBASIN CHARACTERISTICS
                  TAREA          .03  SUBBASIN AREA

              PRECIPITATION DATA

 12 PH                          DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
              ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
              5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                .61    1.08    2.56    3.22    3.37    3.77    4.16    4.69     .00     .00     .00     .00

                                                  STORM AREA =      .03

 15 LS        SCS LOSS RATE
                  STRTL          .20  INITIAL ABSTRACTION
                 CRVNBR        91.00  CURVE NUMBER
                  RTIMP          .00  PERCENT IMPERVIOUS AREA

 16 UD        SCS DIMENSIONLESS UNITGRAPH
                   TLAG          .05  LAG

                                                          ***

VALUE EXCEEDS TABLE IN LOGLOG          .01667         .01667       24.00000

                                                     UNIT HYDROGRAPH
                                                 17 END-OF-PERIOD ORDINATES
             46.      158.      251.      251.      196.      117.       73.       47.       29.       18.
             12.        7.        5.        3.        2.        1.        0.

*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

          **************
          *            *
 17 KK    *    PROJ3   *
          *            *
          **************

            SUBBASIN RUNOFF DATA

 18 BA        SUBBASIN CHARACTERISTICS
                  TAREA          .01  SUBBASIN AREA

              PRECIPITATION DATA

 12 PH                          DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
```

```
                ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
                5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                  .61    1.08    2.56    3.22    3.37    3.77    4.16    4.69     .00     .00     .00     .00

                                                  STORM AREA =      .01

 19 LS          SCS LOSS RATE
                      STRTL          .17  INITIAL ABSTRACTION
                     CRVNBR        92.00  CURVE NUMBER
                      RTIMP          .00  PERCENT IMPERVIOUS AREA

 20 UD          SCS DIMENSIONLESS UNITGRAPH
                       TLAG          .05  LAG

                                                                  ***

VALUE EXCEEDS TABLE IN LOGLOG          .01667          .01667        24.00000

                                                        UNIT HYDROGRAPH
                                                    17 END-OF-PERIOD ORDINATES
                17.       58.       92.       92.       72.       43.       27.       17.       11.        7.
                 4.        3.        2.        1.        1.        0.        0.


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
 21 KK      *    COMBP1  *
            *            *
            **************

 22 HC          HYDROGRAPH COMBINATION
                      ICOMP           3  NUMBER OF HYDROGRAPHS TO COMBINE

                                                                  ***


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
 23 KK      *      EXT1  *
            *            *
            **************

               SUBBASIN RUNOFF DATA

 24 BA          SUBBASIN CHARACTERISTICS
                      TAREA          .04  SUBBASIN AREA

                PRECIPITATION DATA

 12 PH                                  DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
                5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                  .61    1.08    2.56    3.22    3.37    3.77    4.16    4.69     .00     .00     .00     .00

                                                  STORM AREA =      .04

 25 LS          SCS LOSS RATE
                      STRTL          .70  INITIAL ABSTRACTION
                     CRVNBR        74.00  CURVE NUMBER
                      RTIMP          .00  PERCENT IMPERVIOUS AREA

 26 UD          SCS DIMENSIONLESS UNITGRAPH
                       TLAG          .05  LAG

                                                                  ***

VALUE EXCEEDS TABLE IN LOGLOG          .01667          .01667        24.00000

                                                        UNIT HYDROGRAPH
                                                    17 END-OF-PERIOD ORDINATES
                55.      187.      298.      298.      232.      139.       87.       56.       35.       22.
                14.        9.        5.        3.        2.        1.        0.


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
 27 KK      *     COMB1  *
            *            *
            **************

 28 HC          HYDROGRAPH COMBINATION
                      ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                                  ***


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
 29 KK      *     PROJ2  *
```

```
          *           *
          *************

            SUBBASIN RUNOFF DATA

 30 BA        SUBBASIN CHARACTERISTICS
                 TAREA          .01  SUBBASIN AREA

              PRECIPITATION DATA

 12 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
              ..... HYDRO-35 .....   ..... TP-40 .....   ..... TP-49 .....
              5-MIN  15-MIN  60-MIN   2-HR   3-HR   6-HR   12-HR  24-HR  2-DAY  4-DAY  7-DAY  10-DAY
                .61    1.08    2.56   3.22   3.37   3.77   4.16   4.69    .00    .00    .00    .00

                                              STORM AREA =      .01

 31 LS        SCS LOSS RATE
                 STRTL          .17  INITIAL ABSTRACTION
                CRVNBR        92.00  CURVE NUMBER
                 RTIMP          .00  PERCENT IMPERVIOUS AREA

 32 UD        SCS DIMENSIONLESS UNITGRAPH
                 TLAG          .05  LAG

                                                    ***

VALUE EXCEEDS TABLE IN LOGLOG           .01667         .01667       24.00000

                                                UNIT HYDROGRAPH
                                             17 END-OF-PERIOD ORDINATES
              14.       48.       77.       77.       60.       36.       22.       14.        9.        6.
               4.        2.        1.        1.        1.        0.        0.

*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

          **************
          *            *
 33 KK    *     PROJ4  *
          *            *
          **************

            SUBBASIN RUNOFF DATA

 34 BA        SUBBASIN CHARACTERISTICS
                 TAREA          .01  SUBBASIN AREA

              PRECIPITATION DATA

 12 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
              ..... HYDRO-35 .....   ..... TP-40 .....   ..... TP-49 .....
              5-MIN  15-MIN  60-MIN   2-HR   3-HR   6-HR   12-HR  24-HR  2-DAY  4-DAY  7-DAY  10-DAY
                .61    1.08    2.56   3.22   3.37   3.77   4.16   4.69    .00    .00    .00    .00

                                              STORM AREA =      .01

 35 LS        SCS LOSS RATE
                 STRTL          .17  INITIAL ABSTRACTION
                CRVNBR        92.00  CURVE NUMBER
                 RTIMP          .00  PERCENT IMPERVIOUS AREA

 36 UD        SCS DIMENSIONLESS UNITGRAPH
                 TLAG          .05  LAG

                                                    ***

VALUE EXCEEDS TABLE IN LOGLOG           .01667         .01667       24.00000

                                                UNIT HYDROGRAPH
                                             17 END-OF-PERIOD ORDINATES
               8.       27.       42.       42.       33.       20.       12.        8.        5.        3.
               2.        1.        1.        0.        0.        0.        0.

*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

          **************
          *            *
 37 KK    *    COMBP2  *
          *            *
          **************

 38 HC        HYDROGRAPH COMBINATION
                 ICOMP          2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                    ***

*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

          **************
          *            *
 39 KK    *      EXT2  *
          *            *
          **************

            SUBBASIN RUNOFF DATA
```

```
 40 BA          SUBBASIN CHARACTERISTICS
                      TAREA         .08  SUBBASIN AREA

                PRECIPITATION DATA

 12 PH                                   DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                ...... HYDRO-35 ......   ................ TP-40 ................   ............ TP-49 ............
                5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                  .61    1.08    2.56    3.22    3.37    3.77    4.16    4.69     .00     .00     .00     .00

                                                      STORM AREA =     .08

 41 LS          SCS LOSS RATE
                      STRTL        1.03  INITIAL ABSTRACTION
                     CRVNBR       65.00  CURVE NUMBER
                      RTIMP         .00  PERCENT IMPERVIOUS AREA

 42 UD          SCS DIMENSIONLESS UNITGRAPH
                       TLAG         .05  LAG

                                                                 ***

VALUE EXCEEDS TABLE IN LOGLOG          .01667          .01667       24.00000

                                                          UNIT HYDROGRAPH
                                                    17 END-OF-PERIOD ORDINATES
             124.       425.       676.       676.       527.       316.       196.       127.        79.        50.
              31.        20.        12.         8.         5.         3.         1.


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

            **************
            *            *
 43 KK      *   COMB2    *
            *            *
            **************

 44 HC          HYDROGRAPH COMBINATION
                      ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                                 ***
1
```

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

| | OPERATION | STATION | PEAK FLOW | TIME OF PEAK | AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR | 24-HOUR | 72-HOUR | BASIN AREA | MAXIMUM STAGE | TIME OF MAX STAGE |
|---|---|---|---|---|---|---|---|---|---|---|
| + | HYDROGRAPH AT | PRO1N | 132. | 12.07 | 12. | 3. | 3. | .03 | | |
| + | HYDROGRAPH AT | PRO1S | 119. | 12.07 | 11. | 3. | 3. | .03 | | |
| + | HYDROGRAPH AT | PROJ3 | 44. | 12.07 | 4. | 1. | 1. | .01 | | |
| + | 3 COMBINED AT | COMBP1 | 295. | 12.07 | 27. | 8. | 8. | .08 | | |
| + | HYDROGRAPH AT | EXT1 | 84. | 12.07 | 8. | 2. | 2. | .04 | | |
| + | 2 COMBINED AT | COMB1 | 379. | 12.07 | 34. | 10. | 10. | .12 | | |
| + | HYDROGRAPH AT | PROJ2 | 37. | 12.07 | 3. | 1. | 1. | .01 | | |
| + | HYDROGRAPH AT | PROJ4 | 20. | 12.07 | 2. | 1. | 1. | .01 | | |
| + | 2 COMBINED AT | COMBP2 | 58. | 12.07 | 5. | 2. | 2. | .01 | | |
| + | HYDROGRAPH AT | EXT2 | 130. | 12.07 | 12. | 3. | 3. | .08 | | |
| + | 2 COMBINED AT | COMB2 | 188. | 12.07 | 17. | 5. | 5. | .10 | | |

*** NORMAL END OF HEC-1 ***

# CONDICIÓN EXISTENTE (100-AÑOS): EXIS.DAT

```
1*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*              JUN  1998                *
*            VERSION 4.1                *
*                                       *
*  RUN DATE   29MAY07  TIME  13:23:11   *
*                                       *
*****************************************
```

```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*         609 SECOND STREET             *
*       DAVIS, CALIFORNIA 95616         *
*           (916) 756-1104              *
*                                       *
*****************************************
```

```
X     X  XXXXXXX   XXXXX          X
X     X  X        X     X        XX
X     X  X        X              X
XXXXXXX  XXXX     X        XXXXX  X
X     X  X        X              X
X     X  X        X     X        X
X     X  XXXXXXX   XXXXX         XXX
```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL  LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM



```
LINE          ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

   1          ID        ANALYSIS HIDROLOGICO PARA MONTE SIERRA, INC.,MAYAGUEZ
   2          ID        CONDICION EXISTENTE
   3          ID        ABRIL 2006: FILENAME=EXIS.DAT: MENAR HYDROSYSTEMS
   4          ID        24-HOUR BALANCED STORM DISTRIBUTION : AMC II
   5          ID        100-YEAR FREQUENCY STORM
   6          IT       1 18ABR06       0     300 18ABR06    2400
   7          IO       4
              *
              *DIAGRAMA
              *
              *  CUENCA PROYECTO 1 NORTE
              *

   8          KK   PRO1N
   9          BA  0.0348
  10          LS       0      76
  11          UD    0.05
  12          PH       0       0    0.95    1.66    3.95    5.42    6.22    8.27   11.65   15.22
              *
              *  CUENCA PROYECTO 1 SUR
              *

  13          KK   PRO1S
  14          BA  0.0314
  15          LS       0      76
  16          UD    0.05
              *
              *  CUENCA EXTERNA 1
              *

  17          KK    EXT1
  18          BA  0.0373
  19          LS       0      74
  20          UD    0.05
              *

  21          KK   COMB1
  22          HC       3
              *
              *  CUENCA PROYECTO 2
              *

  23          KK   PROJ2
  24          BA  0.0096
  25          LS       0      79
  26          UD    0.05
              *
              *  CUENCA EXTERNA 2
              *
```



```
LINE          ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  27          KK    EXT2
  28          BA  0.0846
  29          LS       0      66
  30          UD    0.05
              *

  31          KK   COMB2
  32          HC       2
              *
              *  CUENCA PROYECTO 3
              *

  33          KK   PROJ3
```

```
          34           BA  0.0115
          35           LS     0      79
          36           UD    0.05
                       *
                       *  CUANCA PROYECTO 4
                       *

          37           KK   PROJ4
          38           BA  0.0053
          39           LS     0      76
          40           UD    0.05
                       *
                       *
          41           ZZ
1
                SCHEMATIC DIAGRAM OF STREAM NETWORK
 INPUT
  LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

   NO.      (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

     8      PRO1N
              .
              .
    13        .        PRO1S
              .          .
              .          .
    17        .          .        EXT1
              .          .          .
              .          .          .
    21      COMB1.....................
              .
              .
    23        .        PROJ2
              .          .
              .          .
    27        .          .        EXT2
              .          .          .
              .          .          .
    31        .        COMB2.............
              .          .
              .          .
    33        .          .        PROJ3
              .          .          .
              .          .          .
    37        .          .          .       PROJ4

 (***) RUNOFF ALSO COMPUTED AT THIS LOCATION
1****************************************
*                                      *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *
*             JUN  1998                *
*          VERSION 4.1                 *
*                                      *
* RUN DATE   29MAY07  TIME  13:23:11   *
*                                      *
****************************************

****************************************
*                                      *
*   U.S. ARMY CORPS OF ENGINEERS       *
*   HYDROLOGIC ENGINEERING CENTER      *
*         609 SECOND STREET            *
*       DAVIS, CALIFORNIA 95616        *
*           (916) 756-1104             *
*                                      *
****************************************

                            ANALYSIS HIDROLOGICO PARA MONTE SIERRA, INC.,MAYAGUEZ
                            CONDICION EXISTENTE
                            ABRIL 2006; FILENAME=EXIS.DAT; MENAR HYDROSYSTEMS
                            24-HOUR BALANCED STORM DISTRIBUTION : AMC II
                            100-YEAR FREQUENCY STORM

   7 IO          OUTPUT CONTROL VARIABLES
                      IPRNT          4  PRINT CONTROL
                      IPLOT          0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE

     IT          HYDROGRAPH TIME DATA
                       NMIN          1  MINUTES IN COMPUTATION INTERVAL
                      IDATE     18ABR 6  STARTING DATE
                      ITIME       0000  STARTING TIME
                         NQ       1441  NUMBER OF HYDROGRAPH ORDINATES
                      NDDATE     19    6  ENDING DATE
                      NDTIME       0000  ENDING TIME
                      ICENT         19  CENTURY MARK

                   COMPUTATION INTERVAL      .02 HOURS
                       TOTAL TIME BASE    24.00 HOURS

          ENGLISH UNITS
               DRAINAGE AREA         SQUARE MILES
               PRECIPITATION DEPTH   INCHES
               LENGTH, ELEVATION     FEET
               FLOW                  CUBIC FEET PER SECOND
               STORAGE VOLUME        ACRE-FEET
               SURFACE AREA          ACRES
               TEMPERATURE           DEGREES FAHRENHEIT


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


               **************
               *            *
    8 KK       *     PRO1N  *
               *            *
               **************
```

```
            SUBBASIN RUNOFF DATA

  9 BA          SUBBASIN CHARACTERISTICS
                      TAREA         .03  SUBBASIN AREA

                PRECIPITATION DATA

 12 PH                                DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                ..... HYDRO-35 .....   ................ TP-40 ................   ............ TP-49 ............
                5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                  .95    1.66    3.95    5.42    6.22    8.27   11.65   15.22     .00     .00     .00     .00

                                             STORM AREA =      .03

 10 LS          SCS LOSS RATE
                      STRTL         .63  INITIAL ABSTRACTION
                     CRVNBR       76.00  CURVE NUMBER
                      RTIMP         .00  PERCENT IMPERVIOUS AREA

 11 UD          SCS DIMENSIONLESS UNITGRAPH
                      TLAG         .05  LAG

                                                  ***

VALUE EXCEEDS TABLE IN LOGLOG          .01667         .01667       24.00000

                                               UNIT HYDROGRAPH
                                            17 END-OF-PERIOD ORDINATES
              51.      175.      278.      278.      217.      130.       81.       52.       33.       20.
              13.        8.        5.        3.        2.        1.        0.

*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

            **************
            *            *
 13 KK      *     PRO1S  *
            *            *
            **************

            SUBBASIN RUNOFF DATA

 14 BA          SUBBASIN CHARACTERISTICS
                      TAREA         .03  SUBBASIN AREA

                PRECIPITATION DATA

 12 PH                                DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                ..... HYDRO-35 .....   ................ TP-40 ................   ............ TP-49 ............
                5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                  .95    1.66    3.95    5.42    6.22    8.27   11.65   15.22     .00     .00     .00     .00

                                             STORM AREA =      .03

 15 LS          SCS LOSS RATE
                      STRTL         .63  INITIAL ABSTRACTION
                     CRVNBR       76.00  CURVE NUMBER
                      RTIMP         .00  PERCENT IMPERVIOUS AREA

 16 UD          SCS DIMENSIONLESS UNITGRAPH
                      TLAG         .05  LAG

                                                  ***

VALUE EXCEEDS TABLE IN LOGLOG          .01667         .01667       24.00000

                                               UNIT HYDROGRAPH
                                            17 END-OF-PERIOD ORDINATES
              46.      158.      251.      251.      196.      117.       73.       47.       29.       18.
              12.        7.        5.        3.        2.        1.        0.

*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

            **************
            *            *
 17 KK      *     EXT1   *
            *            *
            **************

            SUBBASIN RUNOFF DATA

 18 BA          SUBBASIN CHARACTERISTICS
                      TAREA         .04  SUBBASIN AREA

                PRECIPITATION DATA

 12 PH                                DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                ..... HYDRO-35 .....   ................ TP-40 ................   ............ TP-49 ............
                5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                  .95    1.66    3.95    5.42    6.22    8.27   11.65   15.22     .00     .00     .00     .00

                                             STORM AREA =      .04

 19 LS          SCS LOSS RATE
                      STRTL         .70  INITIAL ABSTRACTION
                     CRVNBR       74.00  CURVE NUMBER
                      RTIMP         .00  PERCENT IMPERVIOUS AREA

 20 UD          SCS DIMENSIONLESS UNITGRAPH
                      TLAG         .05  LAG
```

***

VALUE EXCEEDS TABLE IN LOGLOG .01667 .01667 24.00000

UNIT HYDROGRAPH
17 END-OF-PERIOD ORDINATES

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 55. | 187. | 298. | 298. | 232. | 139. | 87. | 56. | 35. | 22. |
| 14. | 9. | 5. | 3. | 2. | 1. | 0. | | | |

*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

**********
* *
21 KK * COMB1 *
* *
**********

22 HC HYDROGRAPH COMBINATION
ICOMP 3 NUMBER OF HYDROGRAPHS TO COMBINE

***

*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

**********
* *
23 KK * PROJ2 *
* *
**********

SUBBASIN RUNOFF DATA

24 BA SUBBASIN CHARACTERISTICS
TAREA .01 SUBBASIN AREA

PRECIPITATION DATA

12 PH DEPTHS FOR 0-PERCENT HYPOTHETICAL STORM

| ..... HYDRO-35 ..... | | | ..... TP-40 ..... | | | | | ..... TP-49 ..... | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 5-MIN | 15-MIN | 60-MIN | 2-HR | 3-HR | 6-HR | 12-HR | 24-HR | 2-DAY | 4-DAY | 7-DAY | 10-DAY |
| .95 | 1.66 | 3.95 | 5.42 | 6.22 | 8.27 | 11.65 | 15.22 | .00 | .00 | .00 | .00 |

STORM AREA = .01

25 LS SCS LOSS RATE
STRTL .53 INITIAL ABSTRACTION
CRVNBR 79.00 CURVE NUMBER
RTIMP .00 PERCENT IMPERVIOUS AREA

26 UD SCS DIMENSIONLESS UNITGRAPH
TLAG .05 LAG

***

VALUE EXCEEDS TABLE IN LOGLOG .01667 .01667 24.00000

UNIT HYDROGRAPH
17 END-OF-PERIOD ORDINATES

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 14. | 48. | 77. | 77. | 60. | 36. | 22. | 14. | 9. | 6. |
| 4. | 2. | 1. | 1. | 1. | 0. | 0. | | | |

*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

**********
* *
27 KK * EXT2 *
* *
**********

SUBBASIN RUNOFF DATA

28 BA SUBBASIN CHARACTERISTICS
TAREA .08 SUBBASIN AREA

PRECIPITATION DATA

12 PH DEPTHS FOR 0-PERCENT HYPOTHETICAL STORM

| ..... HYDRO-35 ..... | | | ..... TP-40 ..... | | | | | ..... TP-49 ..... | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 5-MIN | 15-MIN | 60-MIN | 2-HR | 3-HR | 6-HR | 12-HR | 24-HR | 2-DAY | 4-DAY | 7-DAY | 10-DAY |
| .95 | 1.66 | 3.95 | 5.42 | 6.22 | 8.27 | 11.65 | 15.22 | .00 | .00 | .00 | .00 |

STORM AREA = .08

29 LS SCS LOSS RATE
STRTL 1.03 INITIAL ABSTRACTION
CRVNBR 66.00 CURVE NUMBER
RTIMP .00 PERCENT IMPERVIOUS AREA

30 UD SCS DIMENSIONLESS UNITGRAPH
TLAG .05 LAG

***

VALUE EXCEEDS TABLE IN LOGLOG .01667 .01667 24.00000

```
                                                    UNIT HYDROGRAPH
                                                17 END-OF-PERIOD ORDINATES
          124.      425.      676.      676.      527.      316.      196.      127.       79.       50.
           31.       20.       12.        8.        5.        3.        1.

*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

          **************
          *            *
 31 KK    *     COMB2  *
          *            *
          **************

 32 HC          HYDROGRAPH COMBINATION
                     ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                                  ***

*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

          **************
          *            *
 33 KK    *     PROJ3  *
          *            *
          **************

             SUBBASIN RUNOFF DATA

 34 BA          SUBBASIN CHARACTERISTICS
                     TAREA          .01  SUBBASIN AREA

                PRECIPITATION DATA

 12 PH                                 DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
                5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                  .95    1.66    3.95    5.42    6.22    8.27   11.65   15.22     .00     .00     .00     .00

                                                  STORM AREA =      .01

 35 LS          SCS LOSS RATE
                     STRTL          .53  INITIAL ABSTRACTION
                    CRVNBR        79.00  CURVE NUMBER
                     RTIMP          .00  PERCENT IMPERVIOUS AREA

 36 UD          SCS DIMENSIONLESS UNITGRAPH
                      TLAG          .05  LAG

                                                                  ***

VALUE EXCEEDS TABLE IN LOGLOG          .01667          .01667        24.00000

                                                    UNIT HYDROGRAPH
                                                17 END-OF-PERIOD ORDINATES
           17.       58.       92.       92.       72.       43.       27.       17.       11.        7.
            4.        3.        2.        1.        1.        0.        0.

*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

          **************
          *            *
 37 KK    *     PROJ4  *
          *            *
          **************

             SUBBASIN RUNOFF DATA

 38 BA          SUBBASIN CHARACTERISTICS
                     TAREA          .01  SUBBASIN AREA

                PRECIPITATION DATA

 12 PH                                 DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
                5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                  .95    1.66    3.95    5.42    6.22    8.27   11.65   15.22     .00     .00     .00     .00

                                                  STORM AREA =      .01

 39 LS          SCS LOSS RATE
                     STRTL          .63  INITIAL ABSTRACTION
                    CRVNBR        76.00  CURVE NUMBER
                     RTIMP          .00  PERCENT IMPERVIOUS AREA

 40 UD          SCS DIMENSIONLESS UNITGRAPH
                      TLAG          .05  LAG

                                                                  ***
```

VALUE EXCEEDS TABLE IN LOGLOG .01667 .01667 24.00000

UNIT HYDROGRAPH
17 END-OF-PERIOD ORDINATES

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 8. | 27. | 42. | 42. | 33. | 20. | 12. | 8. | 5. | 3. |
| 2. | 1. | 1. | 0. | 0. | 0. | 0. | | | |

1

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

| | OPERATION | STATION | PEAK FLOW | TIME OF PEAK | AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR | 24-HOUR | 72-HOUR | BASIN AREA | MAXIMUM STAGE | TIME OF MAX STAGE |
|---|---|---|---|---|---|---|---|---|---|---|
| + | HYDROGRAPH AT | PRO1N | 205. | 12.07 | 28. | 11. | 11. | .03 | | |
| + | HYDROGRAPH AT | PRO1S | 185. | 12.07 | 25. | 10. | 10. | .03 | | |
| + | HYDROGRAPH AT | EXT1 | 216. | 12.07 | 29. | 12. | 12. | .04 | | |
| + | 3 COMBINED AT | COMB1 | 606. | 12.07 | 82. | 33. | 33. | .10 | | |
| + | HYDROGRAPH AT | PROJ2 | 58. | 12.07 | 8. | 3. | 3. | .01 | | |
| + | HYDROGRAPH AT | EXT2 | 446. | 12.07 | 61. | 24. | 24. | .08 | | |
| + | 2 COMBINED AT | COMB2 | 504. | 12.07 | 69. | 27. | 27. | .09 | | |
| + | HYDROGRAPH AT | PROJ3 | 70. | 12.07 | 9. | 4. | 4. | .01 | | |
| + | HYDROGRAPH AT | PROJ4 | 31. | 12.07 | 4. | 2. | 2. | .01 | | |

*** NORMAL END OF HEC-1 ***

# CONDICIÓN PROPUESTA (100-AÑOS): PROP.DAT

```
1*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*             JUN  1998                 *
*           VERSION 4.1                 *
*                                       *
*  RUN DATE   29MAY07  TIME  13:25:36   *
*                                       *
*****************************************
```

```
*****************************************
*                                       *
*   U.S. ARMY CORPS OF ENGINEERS        *
*   HYDROLOGIC ENGINEERING CENTER       *
*        609 SECOND STREET              *
*      DAVIS, CALIFORNIA 95616          *
*         (916) 756-1104                *
*                                       *
*****************************************
```

```
X     X  XXXXXXX   XXXXX          X
X     X  X        X     X        XX
X     X  X        X              X
XXXXXXX  XXXX     X        XXXXX  X
X     X  X        X              X
X     X  X        X     X        X
X     X  XXXXXXX   XXXXX         XXX
```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL  LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1 HEC-1 INPUT PAGE 1

```
LINE          ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10
   1          ID        ANALYSIS HIDROLOGICO PARA MONTE SIERRA, INC.,MAYAGUEZ
   2          ID        CONDICION PROPUESTA
   3          ID        ABRIL 2006: FILENAME=PROP.DAT: MENAR HYDROSYSTEMS
   4          ID        24-HOUR BALANCED STORM DISTRIBUTION : AMC II
   5          ID        100-YEAR FREQUENCY STORM
   6          IT      1 18ABR06       0     300 18ABR06    2400
   7          IO      4
                      *
                      *DIAGRAMA
                      *
                      *  CUENCA PROYECTO 1 NORTE
                      *
   8          KK   PRO1N
   9          BA  0.0348
  10          LS       0      91
  11          UD    0.05
  12          PH       0       0    0.95    1.66    3.95    5.42    6.22    8.27   11.65   15.22
                      *
                      *  CUENCA PROYECTO 1 SUR
                      *
  13          KK   PRO1S
  14          BA  0.0314
  15          LS       0      91
  16          UD    0.05
                      *
                      *  CUENCA PROYECTO 3 NORTE
                      *
  17          KK   PROJ3
  18          BA  0.0115
  19          LS       0      92
  20          UD    0.05
                      *
  21          KK  COMBP1
  22          HC       3
                      *
                      *  CUENCA EXTERNA 1
                      *
  23          KK    EXT1
  24          BA  0.0373
  25          LS       0      74
  26          UD    0.05
                      *
  27          KK   COMB1
  28          HC       2
                      *
                      *  CUENCA PROYECTO 2
                      *
```

1 HEC-1 INPUT PAGE 2

```
LINE          ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10
  29          KK   PROJ2
  30          BA  0.0096
  31          LS       0      92
  32          UD    0.05
                      *
                      *  CUENCA PROYECTO 4
                      *
  33          KK   PROJ4
```

```
34          BA  0.0053
35          LS       0       92
36          UD    0.05
            *

37          KK  COMBP2
38          HC       2
            *
            *  CUENCA EXTERNA 2
            *

39          KK    EXT2
40          BA  0.0846
41          LS       0       66
42          UD    0.05
            *

43          KK   COMB2
44          HC       2
            *
45          ZZ
```

1

```
              SCHEMATIC DIAGRAM OF STREAM NETWORK
 INPUT
  LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

   NO.      (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

     8       PRO1N
                .
                .
    13          .        PRO1S
                .            .
                .            .
    17          .            .        PROJ3
                .            .            .
                .            .            .
    21      COMBP1........................
                .
                .
    23          .         EXT1
                .            .
                .            .
    27       COMB1............
                .
                .
    29          .        PROJ2
                .            .
                .            .
    33          .            .        PROJ4
                .            .            .
                .            .            .
    37          .      COMBP2............
                .            .
                .            .
    39          .            .         EXT2
                .            .            .
                .            .            .
    43          .        COMB2............
```

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
1*****************************************
 *                                       *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
 *              JUN   1998               *
 *           VERSION 4.1                 *
 *                                       *
 *  RUN DATE   29MAY07  TIME  13:25:36   *
 *                                       *
 *****************************************
```

```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
*       DAVIS, CALIFORNIA 95616         *
*           (916) 756-1104              *
*                                       *
*****************************************
```

```
                         ANALYSIS HIDROLOGICO PARA MONTE SIERRA, INC.,MAYAGUEZ
                         CONDICION PROPUESTA
                         ABRIL 2006: FILENAME=PROP.DAT: MENAR HYDROSYSTEMS
                         24-HOUR BALANCED STORM DISTRIBUTION : AMC II
                         100-YEAR FREQUENCY STORM

   7 IO          OUTPUT CONTROL VARIABLES
                      IPRNT           4  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE

     IT          HYDROGRAPH TIME DATA
                       NMIN           1  MINUTES IN COMPUTATION INTERVAL
                      IDATE     18ABR 6  STARTING DATE
                      ITIME        0000  STARTING TIME
                         NQ        1441  NUMBER OF HYDROGRAPH ORDINATES
                     NDDATE     19    6  ENDING DATE
                     NDTIME        0000  ENDING TIME
                     ICENT           19  CENTURY MARK

                 COMPUTATION INTERVAL     .02 HOURS
                      TOTAL TIME BASE   24.00 HOURS

          ENGLISH UNITS
               DRAINAGE AREA          SQUARE MILES
               PRECIPITATION DEPTH    INCHES
               LENGTH, ELEVATION      FEET
               FLOW                   CUBIC FEET PER SECOND
               STORAGE VOLUME         ACRE-FEET
               SURFACE AREA           ACRES
```

```
            TEMPERATURE          DEGREES FAHRENHEIT

*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

          **************
          *            *
  8 KK    *    PRO1N   *
          *            *
          **************

            SUBBASIN RUNOFF DATA

  9 BA        SUBBASIN CHARACTERISTICS
                  TAREA          .03  SUBBASIN AREA

              PRECIPITATION DATA

 12 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
              ..... HYDRO-35 ......  ............... TP-40 ...............  ........... TP-49 ...........
              5-MIN  15-MIN  60-MIN   2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                .95    1.66    3.95   5.42    6.22    8.27   11.65   15.22     .00     .00     .00     .00

                                                  STORM AREA =      .03

 10 LS        SCS LOSS RATE
                  STRTL          .20  INITIAL ABSTRACTION
                 CRVNBR        91.00  CURVE NUMBER
                  RTIMP          .00  PERCENT IMPERVIOUS AREA

 11 UD        SCS DIMENSIONLESS UNITGRAPH
                   TLAG          .05  LAG

                                                          ***

VALUE EXCEEDS TABLE IN LOGLOG          .01667         .01667       24.00000

                                                     UNIT HYDROGRAPH
                                                 17 END-OF-PERIOD ORDINATES
              51.      175.      278.      278.      217.      130.       81.       52.       33.       20.
              13.        8.        5.        3.        2.        1.        0.

*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

          **************
          *            *
 13 KK    *    PRO1S   *
          *            *
          **************

            SUBBASIN RUNOFF DATA

 14 BA        SUBBASIN CHARACTERISTICS
                  TAREA          .03  SUBBASIN AREA

              PRECIPITATION DATA

 12 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
              ..... HYDRO-35 ......  ............... TP-40 ...............  ........... TP-49 ...........
              5-MIN  15-MIN  60-MIN   2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                .95    1.66    3.95   5.42    6.22    8.27   11.65   15.22     .00     .00     .00     .00

                                                  STORM AREA =      .03

 15 LS        SCS LOSS RATE
                  STRTL          .20  INITIAL ABSTRACTION
                 CRVNBR        91.00  CURVE NUMBER
                  RTIMP          .00  PERCENT IMPERVIOUS AREA

 16 UD        SCS DIMENSIONLESS UNITGRAPH
                   TLAG          .05  LAG

                                                          ***

VALUE EXCEEDS TABLE IN LOGLOG          .01667         .01667       24.00000

                                                     UNIT HYDROGRAPH
                                                 17 END-OF-PERIOD ORDINATES
              46.      158.      251.      251.      196.      117.       73.       47.       29.       18.
              12.        7.        5.        3.        2.        1.        0.

*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

          **************
          *            *
 17 KK    *    PROJ3   *
          *            *
          **************

            SUBBASIN RUNOFF DATA

 18 BA        SUBBASIN CHARACTERISTICS
                  TAREA          .01  SUBBASIN AREA

              PRECIPITATION DATA

 12 PH                              DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
```

```
                ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
                5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                  .95    1.66    3.95    5.42    6.22    8.27   11.65   15.22     .00     .00     .00     .00

                                                  STORM AREA =      .01

 19 LS          SCS LOSS RATE
                      STRTL         .17  INITIAL ABSTRACTION
                     CRVNBR       92.00  CURVE NUMBER
                      RTIMP         .00  PERCENT IMPERVIOUS AREA

 20 UD          SCS DIMENSIONLESS UNITGRAPH
                       TLAG         .05  LAG

                                                                  ***

VALUE EXCEEDS TABLE IN LOGLOG          .01667         .01667       24.00000

                                                        UNIT HYDROGRAPH
                                                    17 END-OF-PERIOD ORDINATES
                17.       58.       92.       92.       72.       43.       27.       17.       11.        7.
                 4.        3.        2.        1.        1.        0.        0.


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
 21 KK      *    COMBP1  *
            *            *
            **************

 22 HC          HYDROGRAPH COMBINATION
                      ICOMP           3  NUMBER OF HYDROGRAPHS TO COMBINE

                                                                  ***


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
 23 KK      *      EXT1  *
            *            *
            **************

               SUBBASIN RUNOFF DATA

 24 BA          SUBBASIN CHARACTERISTICS
                      TAREA         .04  SUBBASIN AREA

                PRECIPITATION DATA

 12 PH                                 DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
                5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                  .95    1.66    3.95    5.42    6.22    8.27   11.65   15.22     .00     .00     .00     .00

                                                  STORM AREA =      .04

 25 LS          SCS LOSS RATE
                      STRTL         .70  INITIAL ABSTRACTION
                     CRVNBR       74.00  CURVE NUMBER
                      RTIMP         .00  PERCENT IMPERVIOUS AREA

 26 UD          SCS DIMENSIONLESS UNITGRAPH
                       TLAG         .05  LAG

                                                                  ***

VALUE EXCEEDS TABLE IN LOGLOG          .01667         .01667       24.00000

                                                        UNIT HYDROGRAPH
                                                    17 END-OF-PERIOD ORDINATES
                55.      187.      298.      298.      232.      139.       87.       56.       35.       22.
                14.        9.        5.        3.        2.        1.        0.


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
 27 KK      *     COMB1  *
            *            *
            **************

 28 HC          HYDROGRAPH COMBINATION
                      ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                                  ***


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
 29 KK      *     PROJ2  *
```

```
          *           *
          *************

            SUBBASIN RUNOFF DATA

 30 BA        SUBBASIN CHARACTERISTICS
                    TAREA         .01  SUBBASIN AREA

              PRECIPITATION DATA

 12 PH                                DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
              ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
              5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                .95    1.66    3.95    5.42    6.22    8.27   11.65   15.22     .00     .00     .00     .00

                                              STORM AREA =      .01

 31 LS        SCS LOSS RATE
                   STRTL         .17  INITIAL ABSTRACTION
                  CRVNBR       92.00  CURVE NUMBER
                   RTIMP         .00  PERCENT IMPERVIOUS AREA

 32 UD        SCS DIMENSIONLESS UNITGRAPH
                    TLAG         .05  LAG

                                                    ***

VALUE EXCEEDS TABLE IN LOGLOG          .01667         .01667       24.00000

                                                UNIT HYDROGRAPH
                                             17 END-OF-PERIOD ORDINATES
              14.       48.       77.       77.       60.       36.       22.       14.        9.        6.
               4.        2.        1.        1.        1.        0.        0.

*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

          **************
          *            *
 33 KK    *     PROJ4  *
          *            *
          **************

            SUBBASIN RUNOFF DATA

 34 BA        SUBBASIN CHARACTERISTICS
                    TAREA         .01  SUBBASIN AREA

              PRECIPITATION DATA

 12 PH                                DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
              ..... HYDRO-35 .....   ............... TP-40 ...............   ........... TP-49 ...........
              5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                .95    1.66    3.95    5.42    6.22    8.27   11.65   15.22     .00     .00     .00     .00

                                              STORM AREA =      .01

 35 LS        SCS LOSS RATE
                   STRTL         .17  INITIAL ABSTRACTION
                  CRVNBR       92.00  CURVE NUMBER
                   RTIMP         .00  PERCENT IMPERVIOUS AREA

 36 UD        SCS DIMENSIONLESS UNITGRAPH
                    TLAG         .05  LAG

                                                    ***

VALUE EXCEEDS TABLE IN LOGLOG          .01667         .01667       24.00000

                                                UNIT HYDROGRAPH
                                             17 END-OF-PERIOD ORDINATES
               8.       27.       42.       42.       33.       20.       12.        8.        5.        3.
               2.        1.        1.        0.        0.        0.        0.

*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

          **************
          *            *
 37 KK    *    COMBP2  *
          *            *
          **************

 38 HC        HYDROGRAPH COMBINATION
                   ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                    ***

*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

          **************
          *            *
 39 KK    *      EXT2  *
          *            *
          **************

            SUBBASIN RUNOFF DATA
```

```
 40 BA          SUBBASIN CHARACTERISTICS
                    TAREA          .08  SUBBASIN AREA

                PRECIPITATION DATA

 12 PH                                DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                ..... HYDRO-35 .....   ..............  TP-40 ..............   ..........  TP-49 ..........
                5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                  .95    1.66    3.95    5.42    6.22    8.27   11.65   15.22     .00     .00     .00     .00

                                                  STORM AREA =      .08

 41 LS          SCS LOSS RATE
                    STRTL         1.03  INITIAL ABSTRACTION
                   CRVNBR        66.00  CURVE NUMBER
                    RTIMP          .00  PERCENT IMPERVIOUS AREA

 42 UD          SCS DIMENSIONLESS UNITGRAPH
                    TLAG          .05  LAG

                                                  ***

VALUE EXCEEDS TABLE IN LOGLOG          .01667         .01667       24.00000

                                                UNIT HYDROGRAPH
                                            17 END-OF-PERIOD ORDINATES
              124.      425.      676.      676.      527.      316.      196.      127.       79.       50.
               31.       20.       12.        8.        5.        3.        1.

*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

                **************
                *            *
 43 KK          *     COMB2  *
                *            *
                **************

 44 HC          HYDROGRAPH COMBINATION
                    ICOMP          2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                  ***
1
                                                RUNOFF SUMMARY
                                        FLOW IN CUBIC FEET PER SECOND
                                        TIME IN HOURS,  AREA IN SQUARE MILES

                                                                                                                                  PEAK      TIME OF      AVERAGE FLOW FOR MAXIMUM PERIOD                BASIN      MAXIMUM      TIME OF
+                                       OPERATION                STATION                                                          FLOW      PEAK         6-HOUR      24-HOUR      72-HOUR           AREA       STAGE      MAX STAGE

+                                       HYDROGRAPH AT            PRO1N                                                            224.      12.07          31.          13.          13.           .03
+                                       HYDROGRAPH AT            PRO1S                                                            202.      12.07          28.          12.          12.           .03
+                                       HYDROGRAPH AT            PROJ3                                                             74.      12.07          10.           4.           4.           .01
+                                       3 COMBINED AT            COMBP1                                                           500.      12.07          68.          29.          29.           .08
+                                       HYDROGRAPH AT            EXT1                                                             216.      12.07          29.          12.          12.           .04
+                                       2 COMBINED AT            COMB1                                                            716.      12.07          97.          41.          41.           .12
+                                       HYDROGRAPH AT            PROJ2                                                             62.      12.07           8.           4.           4.           .01
+                                       HYDROGRAPH AT            PROJ4                                                             34.      12.07           5.           2.           2.           .01
+                                       2 COMBINED AT            COMBP2                                                           96.      12.07          13.           6.           6.           .01
+                                       HYDROGRAPH AT            EXT2                                                             446.      12.07          61.          24.          24.           .08
+                                       2 COMBINED AT            COMB2                                                            542.      12.07          74.          29.          29.           .10

*** NORMAL END OF HEC-1 ***
```

# APÉNDICE D

Datos de Entrada y Salida de HEC-RAS
Archivo: Sierra.prj

# GEOMETRÍA: QUEBRADA 1 EXIS

HEC-RAS Version 3.1.3 May 2005
U.S. Army Corp of Engineers
Hydrologic Engineering Center
609 Second Street
Davis, California

```
X     X  XXXXXX    XXXX        XXXX       XX      XXXX
X     X  X        X    X      X   X     X  X    X
X     X  X        X           X   X     X    X   X
XXXXXXX  XXXX     X       XXX  XXXX     XXXXXX   XXXX
X     X  X        X           X  X      X    X       X
X     X  X        X    X      X   X     X    X       X
X     X  XXXXXX    XXXX       X    X    X    X   XXXXX
```

**********

PROJECT DATA
Project Title: Analisis Hidráulico para Monte Sierra
Project File : Sierra.prj
Run Date and Time: 5/29/2007 3:29:47 PM

Project in SI units

Project Description:
& RAnalisis Hidráaulico Monte Sierra, Mayaguez

**********

PLAN DATA

Plan Title: Quebrada 1 EXIS
Plan File : C:\Trabajos en proceso\Sierra\RAS\2007\Sierra.p07

Geometry Title: Quebrada 1 EXIS
Geometry File : C:\Trabajos en proceso\Sierra\RAS\2007\Sierra.g07

Flow Title : Quebrada 1 EXIS
Flow File : C:\Trabajos en proceso\Sierra\RAS\2007\Sierra.f07

Plan Summary Information:
Number of: Cross Sections = 15 Multiple Openings = 0
Culverts = 0 Inline Structures = 0
Bridges = 0 Lateral Structures = 0

Computational Information
Water surface calculation tolerance = 0.003
Critical depth calculation tolerance = 0.003
Maximum number of iterations = 20
Maximum difference tolerance = 0.1
Flow tolerance factor = 0.001

Computation Options
Critical depth computed only where necessary
Conveyance Calculation Method: At breaks in n values only
Friction Slope Method: Average Conveyance
Computational Flow Regime: Mixed Flow

**********

FLOW DATA

Flow Title: Quebrada 1 EXIS
Flow File : C:\Trabajos en proceso\Sierra\RAS\2007\Sierra.f07

Flow Data (m3/s)

| River | Reach | RS | 100-YR |
|---|---|---|---|
| Quebrada 1 | Quebrada 1 | 13 | 17.16 |

Boundary Conditions

| River | Reach | Profile | Upstream | Downstream |
|---|---|---|---|---|
| Quebrada 1 | Quebrada 1 | 100-YR | Critical | Critical |

**********

GEOMETRY DATA

Geometry Title: Quebrada 1 EXIS
Geometry File : C:\Trabajos en proceso\Sierra\RAS\2007\Sierra.g07

CROSS SECTION

RIVER: Quebrada 1
REACH: Quebrada 1 RS: 13

INPUT
Description: XS-13
Station Elevation Data num= 9

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 129.22 | 10 | 128.22 | 28 | 124.72 | 30 | 123.81 | 31 | 123.73 |
| 32 | 124.44 | 40 | 125.81 | 46 | 126.56 | 59 | 127.06 | | |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|

```
*************************************************
      0     .06      10     .04      40     .06

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
           10      40              54.4   44.38   26.68             .1        .3

CROSS SECTION OUTPUT  Profile #100-YR
*****************************************************************************************
* E.G. Elev (m)        *  125.53  * Element              *  Left OB *  Channel * Right OB *
* Vel Head (m)         *    0.31  * Wt. n-Val.           *          *   0.040  *          *
* W.S. Elev (m)        *  125.22  * Reach Len. (m)       *   54.40  *   44.38  *   26.68  *
* Crit W.S. (m)        *  125.22  * Flow Area (m2)       *          *    6.93  *          *
* E.G. Slope (m/m)     *0.019698  * Area (m2)            *          *    6.93  *          *
* Q Total (m3/s)       *   17.16  * Flow (m3/s)          *          *   17.16  *          *
* Top Width (m)        *   11.14  * Top Width (m)        *          *   11.14  *          *
* Vel Total (m/s)      *    2.48  * Avg. Vel. (m/s)      *          *    2.48  *          *
* Max Chl Dpth (m)     *    1.49  * Hydr. Depth (m)      *          *    0.62  *          *
* Conv. Total (m3/s)   *   122.3  * Conv. (m3/s)         *          *   122.3  *          *
* Length Wtd. (m)      *   44.38  * Wetted Per. (m)      *          *   11.68  *          *
* Min Ch El (m)        *  123.73  * Shear (N/m2)         *          *  114.56  *          *
* Alpha                *    1.00  * Stream Power (N/m s) *          *  283.74  *          *
* Frctn Loss (m)       *    0.85  * Cum Volume (1000 m3) *          *    1.66  *          *
* C & E Loss (m)       *    0.01  * Cum SA (1000 m2)     *          *    3.45  *          *
*****************************************************************************************

Warning: The energy equation could not be balanced within the specified number of iterations.  The
         program used critical depth for the water surface and continued on with the calculations.
Warning: The energy loss was greater than 1.0 ft (0.3 m), between the current and previous cross
         section.  This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical
         depth, the calculated water surface came back below critical depth.  This indicates that there
         is not a valid subcritical answer.  The program defaulted to critical depth.

CROSS SECTION


RIVER: Quebrada 1
REACH: Quebrada 1          RS: 12

INPUT
Description: XS-12
Station Elevation Data     num=      10
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
*****************************************************************************************
       0  116.03      20  113.11      23  110.88      27  109.05      29  109.05
      33  110.81      38  113.04      45  114.65      52  114.92      57  115.32

Manning's n Values         num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
*************************************************
       0     .06      23     .04      33     .06

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
           23      33              50.14   52.12   56.66             .1        .3

CROSS SECTION OUTPUT  Profile #100-YR
*****************************************************************************************
* E.G. Elev (m)        *  110.72  * Element              *  Left OB *  Channel * Right OB *
* Vel Head (m)         *    0.40  * Wt. n-Val.           *          *   0.040  *          *
* W.S. Elev (m)        *  110.32  * Reach Len. (m)       *   50.14  *   52.12  *   56.66  *
* Crit W.S. (m)        *  110.32  * Flow Area (m2)       *          *    6.12  *          *
* E.G. Slope (m/m)     *0.018592  * Area (m2)            *          *    6.12  *          *
* Q Total (m3/s)       *   17.16  * Flow (m3/s)          *          *   17.16  *          *
* Top Width (m)        *    7.65  * Top Width (m)        *          *    7.65  *          *
* Vel Total (m/s)      *    2.81  * Avg. Vel. (m/s)      *          *    2.81  *          *
* Max Chl Dpth (m)     *    1.27  * Hydr. Depth (m)      *          *    0.80  *          *
* Conv. Total (m3/s)   *   125.9  * Conv. (m3/s)         *          *   125.9  *          *
* Length Wtd. (m)      *   52.12  * Wetted Per. (m)      *          *    8.19  *          *
* Min Ch El (m)        *  109.05  * Shear (N/m2)         *          *  136.10  *          *
* Alpha                *    1.00  * Stream Power (N/m s) *          *  381.79  *          *
* Frctn Loss (m)       *    1.00  * Cum Volume (1000 m3) *          *    1.37  *          *
* C & E Loss (m)       *    0.04  * Cum SA (1000 m2)     *          *    3.03  *          *
*****************************************************************************************

Warning: The energy equation could not be balanced within the specified number of iterations.  The
         program used critical depth for the water surface and continued on with the calculations.
Warning: The energy loss was greater than 1.0 ft (0.3 m), between the current and previous cross
         section.  This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical
         depth, the calculated water surface came back below critical depth.  This indicates that there
         is not a valid subcritical answer.  The program defaulted to critical depth.

CROSS SECTION


RIVER: Quebrada 1
REACH: Quebrada 1          RS: 11

INPUT
Description: XS-11
Station Elevation Data     num=       9
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
*****************************************************************************************
       0  106.66       8  105.54      16  104.74      21  101.83      27  101.83
      29  102.13      36   102.9      43  103.71      55  105.66

Manning's n Values         num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
*************************************************
       0     .06      16     .04      36     .06

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
           16      36              49.17   48.31   45.22             .1        .3

CROSS SECTION OUTPUT  Profile #100-YR
```

| E.G. Elev (m) | 107.16 | Element | Left OB | Channel | Right OB |
|---|---|---|---|---|---|
| Vel Head (m) | 5.09 | Wt. n-Val. | | 0.040 | |
| W.S. Elev (m) | 102.07 | Reach Len. (m) | 49.17 | 48.31 | 45.22 |
| Crit W.S. (m) | 102.60 | Flow Area (m2) | | 1.72 | |
| E.G. Slope (m/m) | *1.272098 | Area (m2) | | 1.72 | |
| Q Total (m3/s) | 17.16 | Flow (m3/s) | | 17.16 | |
| Top Width (m) | 8.05 | Top Width (m) | | 8.05 | |
| Vel Total (m/s) | 10.00 | Avg. Vel. (m/s) | | 10.00 | |
| Max Chl Dpth (m) | 0.24 | Hydr. Depth (m) | | 0.21 | |
| Conv. Total (m3/s) | 15.2 | Conv. (m3/s) | | 15.2 | |
| Length Wtd. (m) | 48.31 | Wetted Per. (m) | | 8.13 | |
| Min Ch El (m) | 101.83 | Shear (N/m2) | | *2633.02 | |
| Alpha | 1.00 | Stream Power (N/m s) | | *26318.95 | |
| Frctn Loss (m) | 3.09 | Cum Volume (1000 m3) | | 1.17 | |
| C & E Loss (m) | 0.47 | Cum SA (1000 m2) | | 2.62 | |

Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross sections.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.

CROSS SECTION

RIVER: Quebrada 1
REACH: Quebrada 1 RS: 10

INPUT
Description: XS-10
Station Elevation Data num= 8

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 99.19 | 7 | 98.19 | 19 | 96.76 | 30 | 96.76 | 41 | 97.83 |
| 45 | 99.01 | 52 | 101.93 | 58 | 103.53 | | | | |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 0 | .06 | 7 | .04 | 45 | .06 |

| Bank Sta: Left | Right | Lengths: Left Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|
| 7 | 45 | 1 | 1 | .1 | .3 |

CROSS SECTION OUTPUT Profile #100-YR

| E.G. Elev (m) | 97.59 | Element | Left OB | Channel | Right OB |
|---|---|---|---|---|---|
| Vel Head (m) | 0.44 | Wt. n-Val. | | 0.040 | |
| W.S. Elev (m) | 97.16 | Reach Len. (m) | 1.00 | 1.00 | 1.00 |
| Crit W.S. (m) | 97.29 | Flow Area (m2) | | 5.87 | |
| E.G. Slope (m/m) | *0.063270 | Area (m2) | | 5.87 | |
| Q Total (m3/s) | 17.16 | Flow (m3/s) | | 17.16 | |
| Top Width (m) | 18.44 | Top Width (m) | | 18.44 | |
| Vel Total (m/s) | 2.93 | Avg. Vel. (m/s) | | 2.93 | |
| Max Chl Dpth (m) | 0.40 | Hydr. Depth (m) | | 0.32 | |
| Conv. Total (m3/s) | 68.2 | Conv. (m3/s) | | 68.2 | |
| Length Wtd. (m) | 1.00 | Wetted Per. (m) | | 18.48 | |
| Min Ch El (m) | 96.76 | Shear (N/m2) | | 196.90 | |
| Alpha | 1.00 | Stream Power (N/m s) | | 576.06 | |
| Frctn Loss (m) | 8.17 | Cum Volume (1000 m3) | | 0.98 | |
| C & E Loss (m) | 1.40 | Cum SA (1000 m2) | | 1.98 | |

Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross sections.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.

CROSS SECTION

RIVER: Quebrada 1
REACH: Quebrada 1 RS: 9.9

INPUT
Description: XS-10 COPY
Station Elevation Data num= 8

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 99.19 | 7 | 98.19 | 19 | 96.76 | 30 | 96.76 | 41 | 97.83 |
| 45 | 99.01 | 52 | 101.93 | 58 | 103.53 | | | | |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 0 | .06 | 7 | .04 | 45 | .06 |

| Bank Sta: Left | Right | Lengths: Left Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|
| 7 | 45 | 24.97 | 26.42 30.92 | .1 | .3 |

CROSS SECTION OUTPUT Profile #100-YR

| E.G. Elev (m) | 97.50 | Element | Left OB | Channel | Right OB |
|---|---|---|---|---|---|
| Vel Head (m) | 0.24 | Wt. n-Val. | | 0.040 | |
| W.S. Elev (m) | 97.26 | Reach Len. (m) | 24.97 | 26.42 | 30.92 |
| Crit W.S. (m) | 97.29 | Flow Area (m2) | | 7.93 | |
| E.G. Slope (m/m) | *0.026554 | Area (m2) | | 7.93 | |
| Q Total (m3/s) | 17.16 | Flow (m3/s) | | 17.16 | |
| Top Width (m) | 20.42 | Top Width (m) | | 20.42 | |
| Vel Total (m/s) | 2.16 | Avg. Vel. (m/s) | | 2.16 | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| * Max Chl Dpth (m) | 0.50 | * Hydr. Depth (m) | | | 0.39 | | |
| * Conv. Total (m3/s) | 105.3 | * Conv. (m3/s) | | | 105.3 | | |
| * Length Wtd. (m) | 26.42 | * Wetted Per. (m) | | | 20.48 | | |
| * Min Ch El (m) | 96.76 | * Shear (N/m2) | | | 100.83 | | |
| * Alpha | 1.00 | * Stream Power (N/m s) | | | 218.23 | | |
| * Frctn Loss (m) | 0.03 | * Cum Volume (1000 m3) | | | 0.98 | | |
| * C & E Loss (m) | 0.07 | * Cum SA (1000 m2) | | | 1.96 | | |

Warning: The energy equation could not be balanced within the specified number of iterations. The program selected the water surface that had the least amount of error between computed and assumed values.
Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross sections.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.

CROSS SECTION

RIVER: Quebrada 1
REACH: Quebrada 1 RS: 9.5

INPUT
Description: Interpolate Section
Station Elevation Data num= 12

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 99.1 | 7.6 | 97.9 | 16.5 | 94.9 | 21.9 | 93.2 | 26 | 92.9 |
| 31.5 | 92.9 | 38.1 | 94 | 40.5 | 94.9 | 51 | 97.8 | 53.2 | 98.3 |
| 57 | 99.2 | 60 | 99.8 | | | | | | |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 0 | .06 | 16.5 | .04 | 40.5 | .06 |

| Bank Sta: Left | Right | Lengths: Left Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|
| 16.5 | 40.5 | 25.97 | 27.415 | 31.92 | .1 | .3 |

CROSS SECTION OUTPUT Profile #100-YR

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| * E.G. Elev (m) | 95.44 | * Element | | Left OB | Channel | Right OB | |
| * Vel Head (m) | 2.24 | * Wt. n-Val. | | | 0.040 | | |
| * W.S. Elev (m) | 93.20 | * Reach Len. (m) | | 25.97 | 27.41 | 31.92 | |
| * Crit W.S. (m) | 93.59 | * Flow Area (m2) | | | 2.59 | | |
| * E.G. Slope (m/m) | *0.511800 | * Area (m2) | | | 2.59 | | |
| * Q Total (m3/s) | 17.16 | * Flow (m3/s) | | | 17.16 | | |
| * Top Width (m) | 11.44 | * Top Width (m) | | | 11.44 | | |
| * Vel Total (m/s) | 6.63 | * Avg. Vel. (m/s) | | | 6.63 | | |
| * Max Chl Dpth (m) | 0.30 | * Hydr. Depth (m) | | | 0.23 | | |
| * Conv. Total (m3/s) | 24.0 | * Conv. (m3/s) | | | 24.0 | | |
| * Length Wtd. (m) | 27.41 | * Wetted Per. (m) | | | 11.48 | | |
| * Min Ch El (m) | 92.90 | * Shear (N/m2) | | | 1132.00 | | |
| * Alpha | 1.00 | * Stream Power (N/m s) | | | 7501.68 | | |
| * Frctn Loss (m) | 1.06 | * Cum Volume (1000 m3) | | | 0.84 | | |
| * C & E Loss (m) | 0.20 | * Cum SA (1000 m2) | | | 1.54 | | |

Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross sections.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.

CROSS SECTION

RIVER: Quebrada 1
REACH: Quebrada 1 RS: 9

INPUT
Description: XS-9
Station Elevation Data num= 9

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 98.99 | 12 | 96.99 | 26 | 91.67 | 30 | 89.06 | 33 | 89.03 |
| 36 | 90.7 | 53 | 94.31 | 58 | 95.43 | 62 | 95.98 | | |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 0 | .06 | 26 | .04 | 36 | .06 |

| Bank Sta: Left | Right | Lengths: Left Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|
| 26 | 36 | 33.69 | 35.62 | 32.02 | .1 | .3 |

CROSS SECTION OUTPUT Profile #100-YR

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| * E.G. Elev (m) | 90.99 | * Element | | Left OB | Channel | Right OB | |
| * Vel Head (m) | 1.11 | * Wt. n-Val. | | | 0.040 | | |
| * W.S. Elev (m) | 89.88 | * Reach Len. (m) | | 33.69 | 35.62 | 32.02 | |
| * Crit W.S. (m) | 90.23 | * Flow Area (m2) | | | 3.68 | | |
| * E.G. Slope (m/m) | *0.070539 | * Area (m2) | | | 3.68 | | |
| * Q Total (m3/s) | 17.16 | * Flow (m3/s) | | | 17.16 | | |
| * Top Width (m) | 5.79 | * Top Width (m) | | | 5.79 | | |
| * Vel Total (m/s) | 4.66 | * Avg. Vel. (m/s) | | | 4.66 | | |
| * Max Chl Dpth (m) | 0.85 | * Hydr. Depth (m) | | | 0.64 | | |
| * Conv. Total (m3/s) | 64.6 | * Conv. (m3/s) | | | 64.6 | | |
| * Length Wtd. (m) | 35.62 | * Wetted Per. (m) | | | 6.26 | | |
| * Min Ch El (m) | 89.03 | * Shear (N/m2) | | | 406.99 | | |
| * Alpha | 1.00 | * Stream Power (N/m s) | | | 1897.41 | | |
| * Frctn Loss (m) | 4.11 | * Cum Volume (1000 m3) | | | 0.75 | | |
| * C & E Loss (m) | 0.34 | * Cum SA (1000 m2) | | | 1.31 | | |

```
**********************************************************************************************

Warning: The velocity head has changed by more than 0.5 ft (0.15 m).  This may indicate the need for
         additional cross sections.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than
         0.7 or greater than 1.4.  This may indicate the need for additional cross sections.
Warning: The energy loss was greater than 1.0 ft (0.3 m), between the current and previous cross
         section.  This may indicate the need for additional cross sections.

CROSS SECTION


RIVER: Quebrada 1
REACH: Quebrada 1          RS: 8

INPUT
Description: XS-8
Station Elevation Data    num=      10
    Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
**********************************************************************************
      0  100.59       7   99.19      18   93.41      30   87.64      33   86.17
     35   86.31      40   87.76      44   88.23      56   91.34      61   92.94

Manning's n Values        num=      3
     Sta   n Val      Sta   n Val      Sta   n Val
***********************************************
       0     .06       30     .04       40     .06

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
            30      40             45.96   40.98   39.74             .1       .3

CROSS SECTION OUTPUT  Profile #100-YR
**********************************************************************************************
* E.G. Elev (m)       *   88.24  * Element             *  Left OB *  Channel * Right OB *
* Vel Head (m)        *    1.14  * Wt. n-Val.          *          *    0.040 *          *
* W.S. Elev (m)       *   87.09  * Reach Len. (m)      *   45.96  *   40.98  *   39.74  *
* Crit W.S. (m)       *   87.45  * Flow Area (m2)      *          *    3.62  *          *
* E.G. Slope (m/m)    *0.084900  * Area (m2)           *          *    3.62  *          *
* Q Total (m3/s)      *   17.16  * Flow (m3/s)         *          *   17.16  *          *
* Top Width (m)       *    6.57  * Top Width (m)       *          *    6.57  *          *
* Vel Total (m/s)     *    4.74  * Avg. Vel. (m/s)     *          *    4.74  *          *
* Max Chl Dpth (m)    *    0.92  * Hydr. Depth (m)     *          *    0.55  *          *
* Conv. Total (m3/s)  *    58.9  * Conv. (m3/s)        *          *    58.9  *          *
* Length Wtd. (m)     *   40.98  * Wetted Per. (m)     *          *    6.90  *          *
* Min Ch El (m)       *   86.17  * Shear (N/m2)        *          *  436.75  *          *
* Alpha               *    1.00  * Stream Power (N/m s) *          * 2069.34  *          *
* Frctn Loss (m)      *    2.75  * Cum Volume (1000 m3) *          *    0.62  *          *
* C & E Loss (m)      *    0.00  * Cum SA (1000 m2)     *          *    1.09  *          *
**********************************************************************************************

Warning: The energy loss was greater than 1.0 ft (0.3 m), between the current and previous cross
         section.  This may indicate the need for additional cross sections.

CROSS SECTION


RIVER: Quebrada 1
REACH: Quebrada 1          RS: 7

INPUT
Description: XS-7
Station Elevation Data    num=      10
    Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
**********************************************************************************
      0   97.85       9   96.85      19   91.61      30   87.41      33   85.33
     36   85.05      45   87.57      52   89.47      56   92.03      64   93.63

Manning's n Values        num=      3
     Sta   n Val      Sta   n Val      Sta   n Val
***********************************************
       0     .06       30     .04       45     .06

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
            30      45             33.54   34.44   40.02             .1       .3

CROSS SECTION OUTPUT  Profile #100-YR
**********************************************************************************************
* E.G. Elev (m)       *   86.62  * Element             *  Left OB *  Channel * Right OB *
* Vel Head (m)        *    0.38  * Wt. n-Val.          *          *    0.040 *          *
* W.S. Elev (m)       *   86.25  * Reach Len. (m)      *   33.54  *   34.44  *   40.02  *
* Crit W.S. (m)       *   86.25  * Flow Area (m2)      *          *    6.32  *          *
* E.G. Slope (m/m)    *0.019003  * Area (m2)           *          *    6.32  *          *
* Q Total (m3/s)      *   17.16  * Flow (m3/s)         *          *   17.16  *          *
* Top Width (m)       *    8.59  * Top Width (m)       *          *    8.59  *          *
* Vel Total (m/s)     *    2.71  * Avg. Vel. (m/s)     *          *    2.71  *          *
* Max Chl Dpth (m)    *    1.20  * Hydr. Depth (m)     *          *    0.74  *          *
* Conv. Total (m3/s)  *   124.5  * Conv. (m3/s)        *          *   124.5  *          *
* Length Wtd. (m)     *   34.44  * Wetted Per. (m)     *          *    9.05  *          *
* Min Ch El (m)       *   85.05  * Shear (N/m2)        *          *  130.17  *          *
* Alpha               *    1.00  * Stream Power (N/m s) *          *  353.17  *          *
* Frctn Loss (m)      *    0.66  * Cum Volume (1000 m3) *          *    0.42  *          *
* C & E Loss (m)      *    0.00  * Cum SA (1000 m2)     *          *    0.78  *          *
**********************************************************************************************

Warning: The energy equation could not be balanced within the specified number of iterations.  The
         program used critical depth for the water surface and continued on with the calculations.
Warning: The energy loss was greater than 1.0 ft (0.3 m), between the current and previous cross
         section.  This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical
         depth, the calculated water surface came back below critical depth.  This indicates that there
         is not a valid subcritical answer.  The program defaulted to critical depth.

CROSS SECTION
```

RIVER: Quebrada 1
REACH: Quebrada 1 RS: 6

INPUT
Description: XS-6
Station Elevation Data num= 10

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 93.53 | 10 | 89.66 | 22 | 83.31 | 25 | 77.23 | 28 | 77.04 |
| 42 | 81.94 | 56 | 88.35 | 59 | 88.65 | 60 | 88.8 | 67 | 93.51 |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 1 | .06 | 22 | .04 | 42 | .06 |

| Bank Sta: Left | Right | Lengths: Left Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|
| 22 | 42 | 22.84 | 27.3 | .1 | .3 |

CROSS SECTION OUTPUT Profile #100-YR

| | | | | |
|---|---|---|---|---|
| E.G. Elev (m) | 84.00 | Element | Left OB | Channel | Right OB |
| Vel Head (m) | 6.48 | Wt. n-Val. | | 0.040 | |
| W.S. Elev (m) | 77.52 | Reach Len. (m) | 22.84 | 27.30 | 31.45 |
| Crit W.S. (m) | 78.29 | Flow Area (m2) | | 1.52 | |
| E.G. Slope (m/m) | 0.940726 | Area (m2) | | 1.52 | |
| Q Total (m3/s) | 17.16 | Flow (m3/s) | | 17.16 | |
| Top Width (m) | 4.53 | Top Width (m) | | 4.53 | |
| Vel Total (m/s) | 11.28 | Avg. Vel. (m/s) | | 11.28 | |
| Max Chl Dpth (m) | 0.48 | Hydr. Depth (m) | | 0.34 | |
| Conv. Total (m3/s) | 17.7 | Conv. (m3/s) | | 17.7 | |
| Length Wtd. (m) | 27.30 | Wetted Per. (m) | | 4.80 | |
| Min Ch El (m) | 77.04 | Shear (N/m2) | | 2925.89 | |
| Alpha | 1.00 | Stream Power (N/m s) | | 32995.14 | |
| Frctn Loss (m) | 2.01 | Cum Volume (1000 m3) | | 0.28 | |
| C & E Loss (m) | 0.61 | Cum SA (1000 m2) | | 0.55 | |

Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross sections.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Warning: The energy loss was greater than 1.0 ft (0.3 m), between the current and previous cross section. This may indicate the need for additional cross sections.

CROSS SECTION

RIVER: Quebrada 1
REACH: Quebrada 1 RS: 5

INPUT
Description: XS-5
Station Elevation Data num= 12

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 87.41 | 6 | 85.81 | 19 | 76.81 | 23 | 75.03 | 29 | 73.53 |
| 34 | 73.43 | 39 | 77.24 | 42 | 77.36 | 45 | 78.96 | 52 | 82.54 |
| 60 | 85.63 | 65 | 86.38 | | | | | | |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 0 | .06 | 19 | .04 | 39 | .06 |

| Bank Sta: Left | Right | Lengths: Left Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|
| 19 | 39 | 13.04 | 13.18 | .1 | .3 |

CROSS SECTION OUTPUT Profile #100-YR

| | | | | |
|---|---|---|---|---|
| E.G. Elev (m) | 75.28 | Element | Left OB | Channel | Right OB |
| Vel Head (m) | 1.25 | Wt. n-Val. | | 0.040 | |
| W.S. Elev (m) | 74.03 | Reach Len. (m) | 13.04 | 13.18 | 14.98 |
| Crit W.S. (m) | 74.39 | Flow Area (m2) | | 3.46 | |
| E.G. Slope (m/m) | 0.120980 | Area (m2) | | 3.46 | |
| Q Total (m3/s) | 17.16 | Flow (m3/s) | | 17.16 | |
| Top Width (m) | 7.77 | Top Width (m) | | 7.77 | |
| Vel Total (m/s) | 4.96 | Avg. Vel. (m/s) | | 4.96 | |
| Max Chl Dpth (m) | 0.60 | Hydr. Depth (m) | | 0.45 | |
| Conv. Total (m3/s) | 49.3 | Conv. (m3/s) | | 49.3 | |
| Length Wtd. (m) | 13.18 | Wetted Per. (m) | | 8.03 | |
| Min Ch El (m) | 73.43 | Shear (N/m2) | | 511.00 | |
| Alpha | 1.00 | Stream Power (N/m s) | | 2534.24 | |
| Frctn Loss (m) | 7.16 | Cum Volume (1000 m3) | | 0.21 | |
| C & E Loss (m) | 1.57 | Cum SA (1000 m2) | | 0.38 | |

Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross sections.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Warning: The energy loss was greater than 1.0 ft (0.3 m), between the current and previous cross section. This may indicate the need for additional cross sections.

CROSS SECTION

RIVER: Quebrada 1
REACH: Quebrada 1 RS: 4

INPUT
Description: XS-4
Station Elevation Data num= 11

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 87.34 | 11 | 85.34 | 27 | 75.34 | 34 | 71.35 | 36 | 71.47 | | |
| 42 | 74.75 | 45 | 74.99 | 47 | 77.51 | 53 | 80.61 | 60 | 83.77 | | |
| 66 | 85.77 | | | | | | | | | | |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 0 | .06 | 27 | .04 | 42 | .06 |

| Bank Sta: Left | Right | Lengths: Left Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|
| 27 | 42 | 11.19 | 18.23 | 22.85 | .1 | .3 |

CROSS SECTION OUTPUT Profile #100-YR

| | | | | |
|---|---|---|---|---|
| E.G. Elev (m) | 73.80 | Element | Left OB | Channel | Right OB |
| Vel Head (m) | 1.50 | Wt. n-Val. | | 0.040 | |
| W.S. Elev (m) | 72.29 | Reach Len. (m) | 11.19 | 18.23 | 22.85 |
| Crit W.S. (m) | 72.75 | Flow Area (m2) | | 3.16 | |
| E.G. Slope (m/m) | *0.101770 | Area (m2) | | 3.16 | |
| Q Total (m3/s) | 17.16 | Flow (m3/s) | | 17.16 | |
| Top Width (m) | 5.16 | Top Width (m) | | 5.16 | |
| Vel Total (m/s) | 5.43 | Avg. Vel. (m/s) | | 5.43 | |
| Max Chl Dpth (m) | 0.94 | Hydr. Depth (m) | | 0.61 | |
| Conv. Total (m3/s) | 53.8 | Conv. (m3/s) | | 53.8 | |
| Length Wtd. (m) | 18.23 | Wetted Per. (m) | | 5.62 | |
| Min Ch El (m) | 71.35 | Shear (N/m2) | | 561.10 | |
| Alpha | 1.00 | Stream Power (N/m s) | | 3048.34 | |
| Frctn Loss (m) | 1.46 | Cum Volume (1000 m3) | | 0.17 | |
| C & E Loss (m) | 0.03 | Cum SA (1000 m2) | | 0.30 | |

Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross sections.
Warning: The energy loss was greater than 1.0 ft (0.3 m), between the current and previous cross section. This may indicate the need for additional cross sections.

CROSS SECTION

RIVER: Quebrada 1
REACH: Quebrada 1 RS: 3

INPUT
Description: XS-3
Station Elevation Data num= 11

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 81.43 | 11 | 78.41 | 27 | 73.01 | 34 | 69.13 | 36 | 68.71 |
| 44 | 73.31 | 47 | 73.31 | 50 | 75.24 | 57 | 78.48 | 64 | 82.63 |
| 73 | 84.23 | | | | | | | | |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 0 | .06 | 27 | .04 | 44 | .06 |

| Bank Sta: Left | Right | Lengths: Left Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|
| 27 | 44 | 17.32 | 17.14 | 14.33 | .1 | .3 |

CROSS SECTION OUTPUT Profile #100-YR

| | | | | |
|---|---|---|---|---|
| E.G. Elev (m) | 71.61 | Element | Left OB | Channel | Right OB |
| Vel Head (m) | 1.89 | Wt. n-Val. | | 0.040 | |
| W.S. Elev (m) | 69.72 | Reach Len. (m) | 17.32 | 17.14 | 14.33 |
| Crit W.S. (m) | 70.25 | Flow Area (m2) | | 2.82 | |
| E.G. Slope (m/m) | *0.137562 | Area (m2) | | 2.82 | |
| Q Total (m3/s) | 17.16 | Flow (m3/s) | | 17.16 | |
| Top Width (m) | 4.83 | Top Width (m) | | 4.83 | |
| Vel Total (m/s) | 6.09 | Avg. Vel. (m/s) | | 6.09 | |
| Max Chl Dpth (m) | 1.01 | Hydr. Depth (m) | | 0.58 | |
| Conv. Total (m3/s) | 46.3 | Conv. (m3/s) | | 46.3 | |
| Length Wtd. (m) | 17.14 | Wetted Per. (m) | | 5.30 | |
| Min Ch El (m) | 68.71 | Shear (N/m2) | | 717.33 | |
| Alpha | 1.00 | Stream Power (N/m s) | | &365.65 | |
| Frctn Loss (m) | 2.14 | Cum Volume (1000 m3) | | 0.12 | |
| C & E Loss (m) | 0.04 | Cum SA (1000 m2) | | 0.21 | |

Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross sections.
Warning: The energy loss was greater than 1.0 ft (0.3 m), between the current and previous cross section. This may indicate the need for additional cross sections.

CROSS SECTION

RIVER: Quebrada 1
REACH: Quebrada 1 RS: 2

INPUT
Description: XS-2
Station Elevation Data num= 10

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 78.64 | 11 | 76.64 | 13 | 71.91 | 23 | 67.03 | 27 | 66.83 |
| 37 | 73.26 | 40 | 74 | 43 | 76.06 | 51 | 78.56 | 61 | 80.16 |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 0 | .06 | 13 | .04 | 37 | .06 |

| Bank Sta: Left | Right | Lengths: Left Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|
| 13 | 37 | 25.17 | 19.77 | 21.02 | .1 | .3 |

CROSS SECTION OUTPUT  Profile #100-YR

| | | | | | |
|---|---|---|---|---|---|
| E.G. Elev (m) | 69.16 | Element | Left OB | Channel | Right OB |
| Vel Head (m) | 1.63 | Wt. n-Val. | | 0.040 | |
| W.S. Elev (m) | 67.53 | Reach Len. (m) | 25.17 | 19.77 | 21.02 |
| Crit W.S. (m) | 67.98 | Flow Area (m2) | | 3.04 | |
| E.G. Slope (m/m) | *0.139755 | Area (m2) | | 3.04 | |
| Q Total (m3/s) | 17.16 | Flow (m3/s) | | 17.16 | |
| Top Width (m) | 6.13 | Top Width (m) | | 6.13 | |
| Vel Total (m/s) | 5.65 | Avg. Vel. (m/s) | | 5.65 | |
| Max Chl Dpth (m) | 0.70 | Hydr. Depth (m) | | 0.50 | |
| Conv. Total (m3/s) | 45.9 | Conv. (m3/s) | | 45.9 | |
| Length Wtd. (m) | 19.77 | Wetted Per. (m) | | 6.45 | |
| Min Ch El (m) | 66.83 | Shear (N/m2) | | 644.63 | |
| Alpha | 1.00 | Stream Power (N/m s) | | 3643.79 | |
| Frctn Loss (m) | 2.38 | Cum Volume (1000 m3) | | 0.07 | |
| C & E Loss (m) | 0.08 | Cum SA (1000 m2) | | 0.11 | |

Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross sections.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.

CROSS SECTION

RIVER: Quebrada 1
REACH: Quebrada 1  RS: 1

INPUT
Description: XS-1
Station Elevation Data  num=  11

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 81.09 | 11 | 78.29 | 22 | 72.53 | 24 | 71.8 | 34 | 64.91 |
| 36 | 65 | 39 | 66.81 | 42.5 | 68.5 | 46 | 69.56 | 57 | 72.76 |
| 62 | 74.36 | | | | | | | | |

Manning's n Values  num=  3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 0 | .06 | 24 | .04 | 46 | .06 |

| Bank Sta: Left | Right | Lengths: Left Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|
| 24 | 46 | 0 | 0 | .1 | .3 |

CROSS SECTION OUTPUT  Profile #100-YR

| | | | | | |
|---|---|---|---|---|---|
| E.G. Elev (m) | 67.14 | Element | Left OB | Channel | Right OB |
| Vel Head (m) | 1.18 | Wt. n-Val. | | 0.040 | |
| W.S. Elev (m) | 65.96 | Reach Len. (m) | | | |
| Crit W.S. (m) | 66.34 | Flow Area (m2) | | 3.57 | |
| E.G. Slope (m/m) | *0.069190 | Area (m2) | | 3.57 | |
| Q Total (m3/s) | 17.16 | Flow (m3/s) | | 17.16 | |
| Top Width (m) | 5.11 | Top Width (m) | | 5.11 | |
| Vel Total (m/s) | 4.81 | Avg. Vel. (m/s) | | 4.81 | |
| Max Chl Dpth (m) | 1.05 | Hydr. Depth (m) | | 0.70 | |
| Conv. Total (m3/s) | 65.2 | Conv. (m3/s) | | 65.2 | |
| Length Wtd. (m) | | Wetted Per. (m) | | 5.71 | |
| Min Ch El (m) | 64.91 | Shear (N/m2) | | 424.26 | |
| Alpha | 1.00 | Stream Power (N/m s) | | 2040.05 | |
| Frctn Loss (m) | 1.89 | Cum Volume (1000 m3) | | | |
| C & E Loss (m) | 0.13 | Cum SA (1000 m2) | | | |

Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross sections.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.

SUMMARY OF MANNING'S N VALUES

River:Quebrada 1

| Reach | River Sta. | n1 | n2 | n3 |
|---|---|---|---|---|
| Quebrada 1 | 13 | .06 | .04 | .06 |
| Quebrada 1 | 12 | .06 | .04 | .06 |
| Quebrada 1 | 11 | .06 | .04 | .06 |
| Quebrada 1 | 10 | .06 | .04 | .06 |
| Quebrada 1 | 9.9 | .06 | .04 | .06 |
| Quebrada 1 | 9.5 | .06 | .04 | .06 |
| Quebrada 1 | 9 | .06 | .04 | .06 |
| Quebrada 1 | 8 | .06 | .04 | .06 |
| Quebrada 1 | 7 | .06 | .04 | .06 |
| Quebrada 1 | 6 | .06 | .04 | .06 |
| Quebrada 1 | 5 | .06 | .04 | .06 |
| Quebrada 1 | 4 | .06 | .04 | .06 |
| Quebrada 1 | 3 | .06 | .04 | .06 |
| Quebrada 1 | 2 | .06 | .04 | .06 |
| Quebrada 1 | 1 | .06 | .04 | .06 |

SUMMARY OF REACH LENGTHS

River: Quebrada 1

| Reach | River Sta. | Left | Channel | Right |
|---|---|---|---|---|
| Quebrada 1 | 13 | 54.4 | 44.38 | 26.68 |

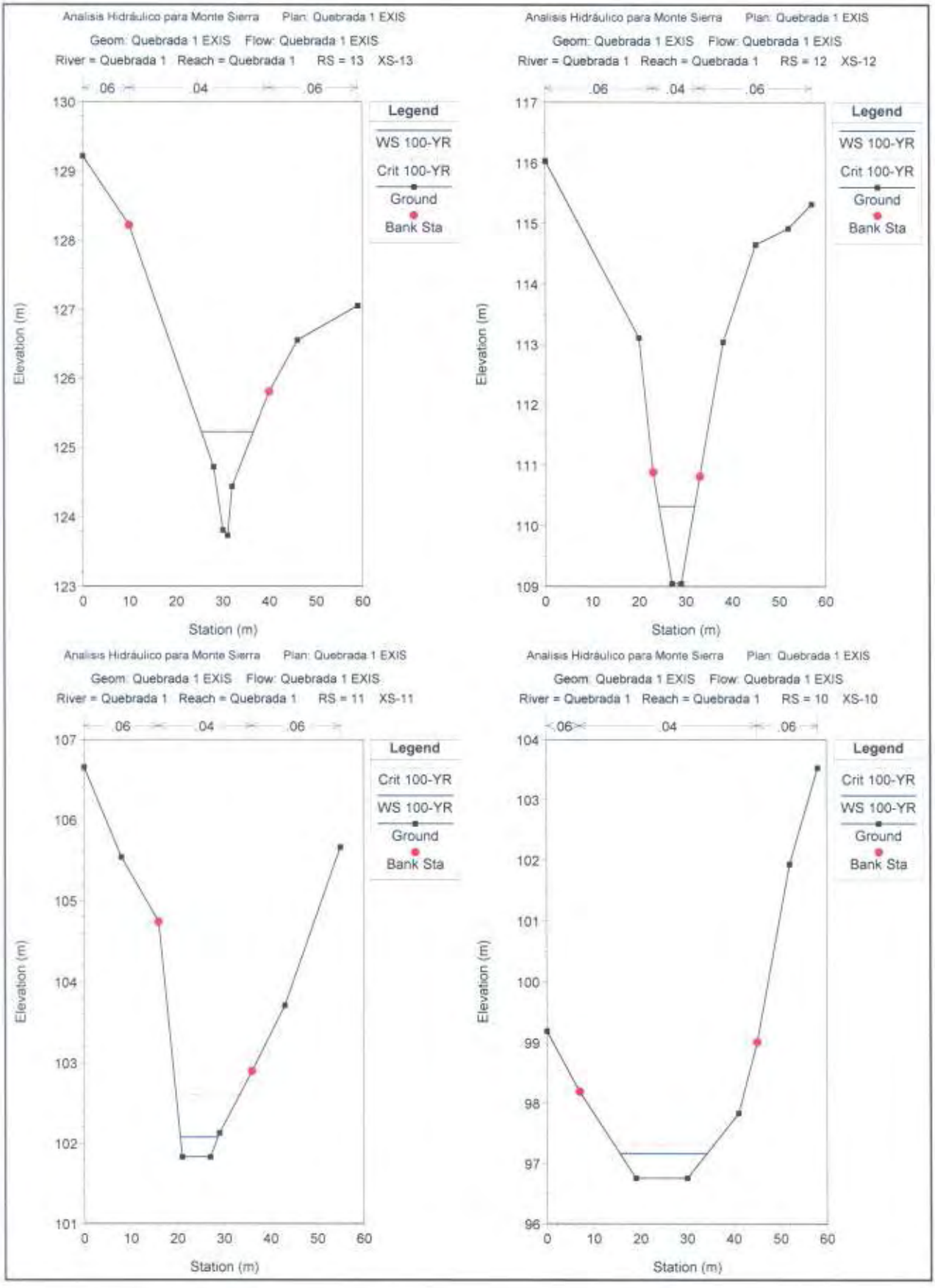
| | | | | | |
|---|---|---|---|---|---|
| *Quebrada 1 | * | 12 | * | 50.14* | 52.12* | 56.66* |
| *Quebrada 1 | * | 11 | * | 49.17* | 48.31* | 45.22* |
| *Quebrada 1 | * | 10 | * | 1* | 1* | 1* |
| *Quebrada 1 | * | 9.9 | * | 24.97* | 26.42* | 30.92* |
| *Quebrada 1 | * | 9.5 | * | 25.97* | 27.415* | 31.92* |
| *Quebrada 1 | * | 9 | * | 33.69* | 35.62* | 32.02* |
| *Quebrada 1 | * | 8 | * | 45.96* | 40.98* | 39.74* |
| *Quebrada 1 | * | 7 | * | 33.54* | 34.44* | 40.02* |
| *Quebrada 1 | * | 6 | * | 22.84* | 27.3* | 31.45* |
| *Quebrada 1 | * | 5 | * | 13.04* | 13.18* | 14.98* |
| *Quebrada 1 | * | 4 | * | 11.19* | 18.23* | 22.85* |
| *Quebrada 1 | * | 3 | * | 17.32* | 17.14* | 14.33* |
| *Quebrada 1 | * | 2 | * | 25.17* | 19.77* | 21.02* |
| *Quebrada 1 | * | 1 | * | 0* | 0* | 0* |

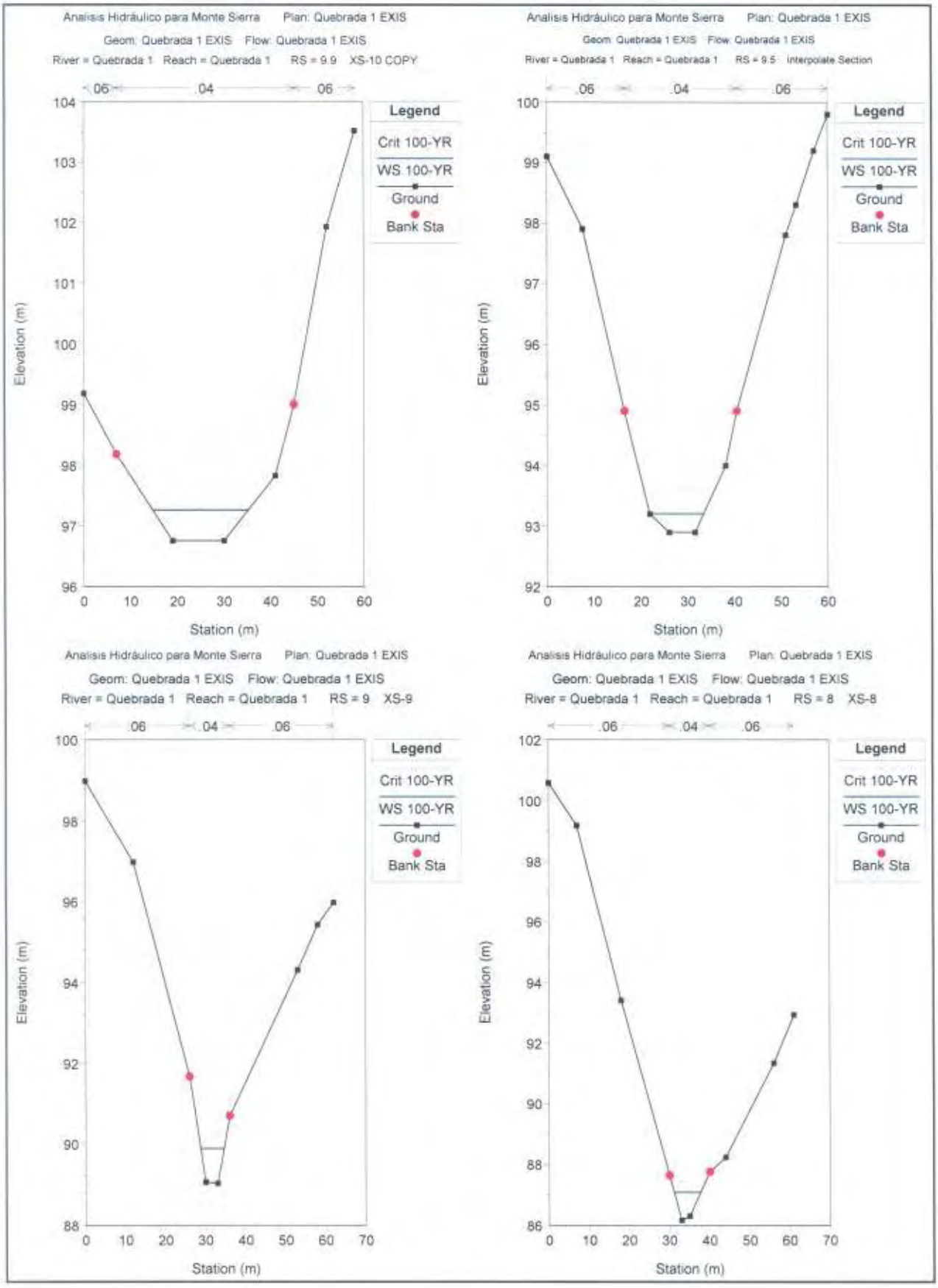
SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS
River: Quebrada 1

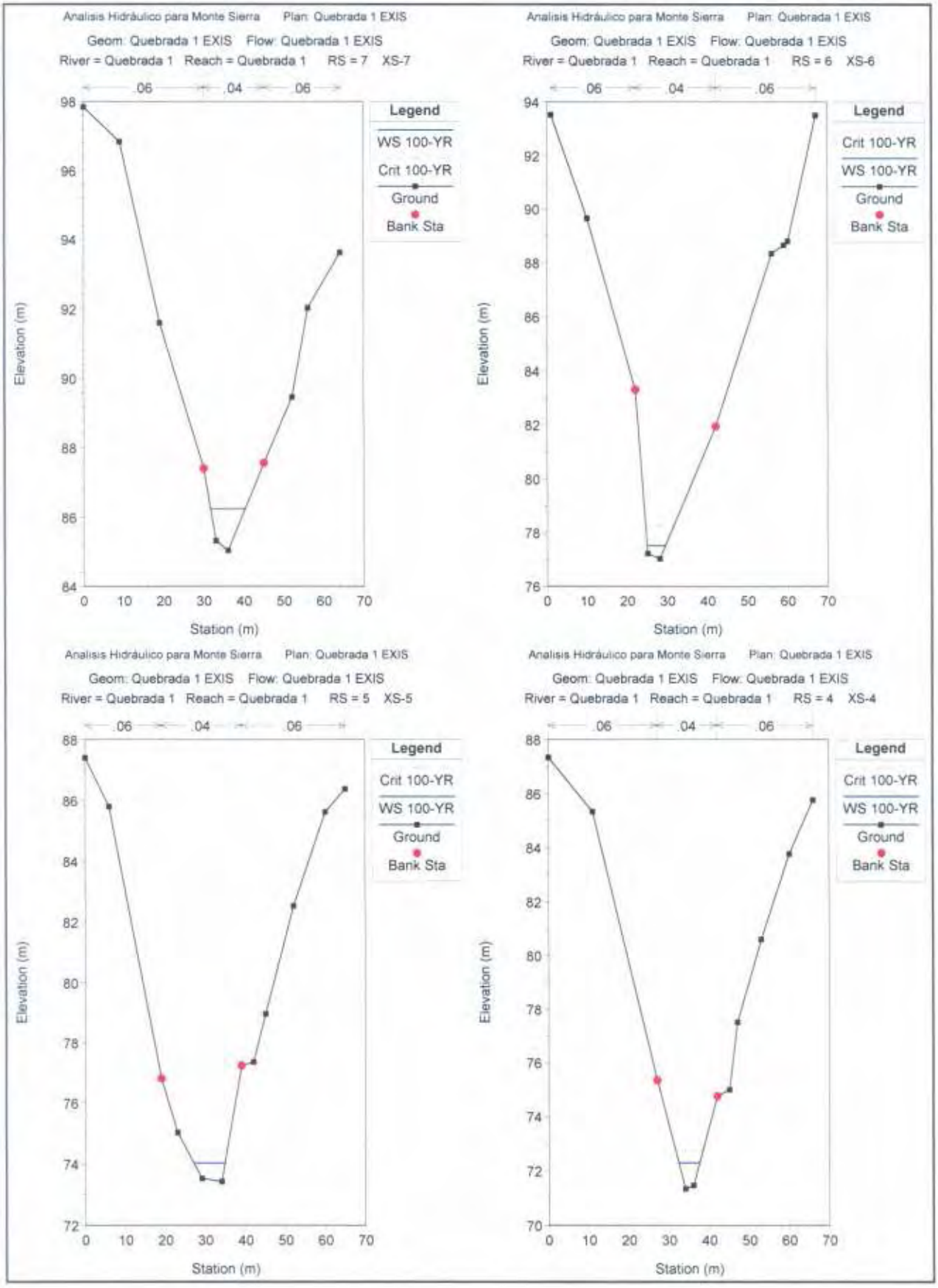
| Reach | River Sta. | Contr. | Expan. |
|---|---|---|---|
| *Quebrada 1 | * 13 | * .1* | .3* |
| *Quebrada 1 | * 12 | * .1* | .3* |
| *Quebrada 1 | * 11 | * .1* | .3* |
| *Quebrada 1 | * 10 | * .1* | .3* |
| *Quebrada 1 | * 9.9 | * .1* | .3* |
| *Quebrada 1 | * 9.5 | * .1* | .3* |
| *Quebrada 1 | * 9 | * .1* | .3* |
| *Quebrada 1 | * 8 | * .1* | .3* |
| *Quebrada 1 | * 7 | * .1* | .3* |
| *Quebrada 1 | * 6 | * .1* | .3* |
| *Quebrada 1 | * 5 | * .1* | .3* |
| *Quebrada 1 | * 4 | * .1* | .3* |
| *Quebrada 1 | * 3 | * .1* | .3* |
| *Quebrada 1 | * 2 | * .1* | .3* |
| *Quebrada 1 | * 1 | * .1* | .3* |

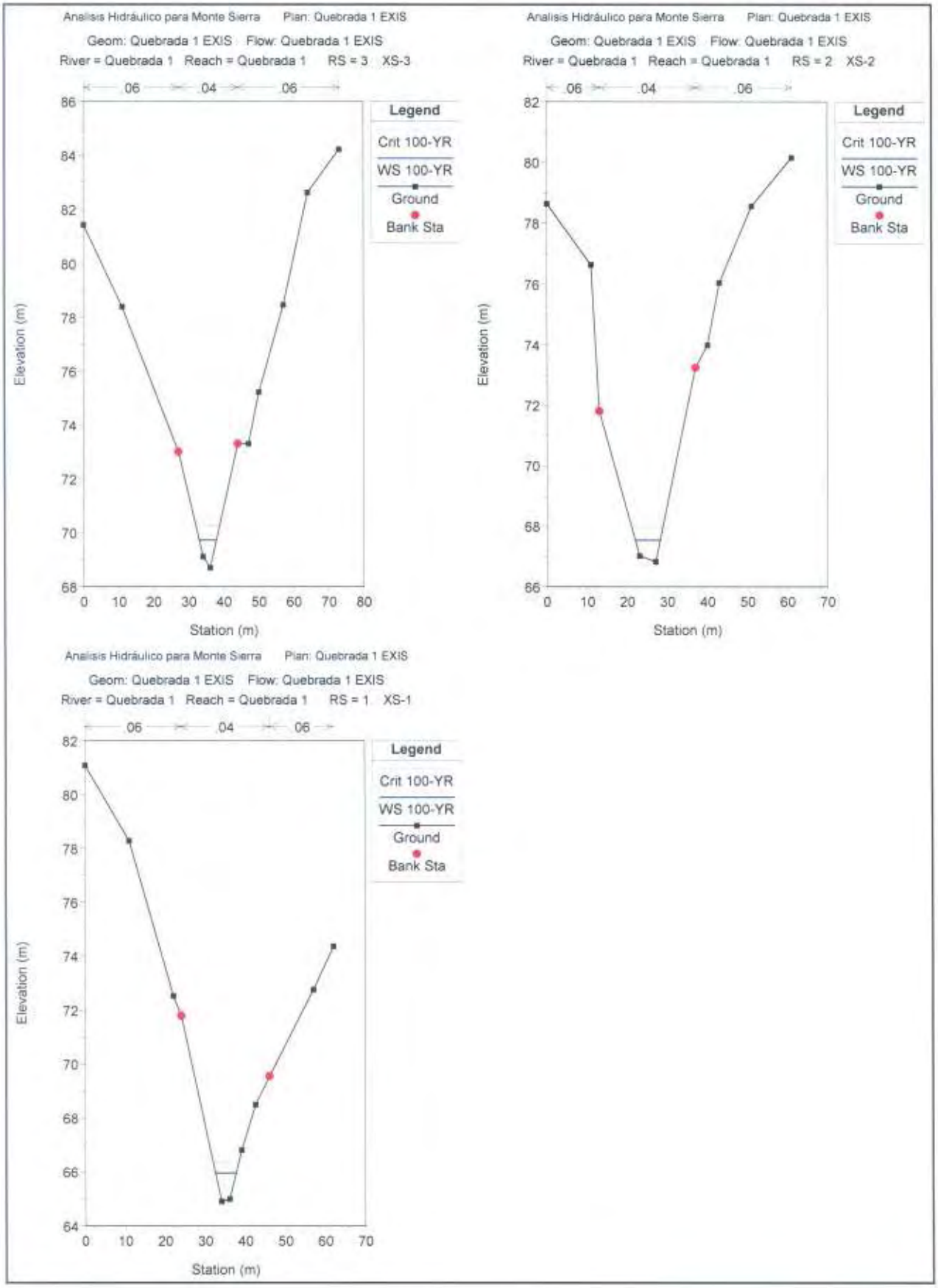
HEC-RAS Plan: queb 1 exis River: Quebrada 1 Reach: Quebrada 1 Profile: 100-YR

| Reach | River Sta | Profile | Q Total | Min Ch El | W.S. Elev | Crit W.S. | E.G. Elev | E.G. Slope | Vel Chnl | Flow Area | Top Width | Froude # Chl |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (m3/s) | (m) | (m) | (m) | (m) | (m/m) | (m/s) | (m2) | (m) | |
| Quebrada 1 | 1 | 100-YR | 17.16 | 64.91 | 65.96 | 66.34 | 67.14 | 0.069190 | 4.81 | 3.57 | 5.11 | 1.84 |
| Quebrada 1 | 2 | 100-YR | 17.16 | 66.83 | 67.53 | 67.98 | 69.16 | 0.139755 | 5.65 | 3.04 | 6.13 | 2.56 |
| Quebrada 1 | 3 | 100-YR | 17.16 | 68.71 | 69.72 | 70.25 | 71.61 | 0.137562 | 6.09 | 2.82 | 4.83 | 2.54 |
| Quebrada 1 | 4 | 100-YR | 17.16 | 71.35 | 72.29 | 72.75 | 73.80 | 0.101770 | 5.43 | 3.16 | 5.16 | 2.22 |
| Quebrada 1 | 5 | 100-YR | 17.16 | 73.43 | 74.03 | 74.39 | 75.28 | 0.120980 | 4.96 | 3.46 | 7.77 | 2.37 |
| Quebrada 1 | 6 | 100-YR | 17.16 | 77.04 | 77.52 | 78.29 | 84.00 | 0.940726 | 11.28 | 1.52 | 4.53 | 6.21 |
| Quebrada 1 | 7 | 100-YR | 17.16 | 85.05 | 86.25 | 86.25 | 86.62 | 0.019003 | 2.71 | 6.32 | 6.59 | 1.01 |
| Quebrada 1 | 8 | 100-YR | 17.16 | 86.17 | 87.09 | 87.45 | 88.24 | 0.084900 | 4.74 | 3.62 | 6.57 | 2.04 |
| Quebrada 1 | 9 | 100-YR | 17.16 | 89.03 | 89.88 | 90.23 | 90.99 | 0.070539 | 4.66 | 3.68 | 5.79 | 1.87 |
| Quebrada 1 | 9.5 | 100-YR | 17.16 | 92.90 | 93.20 | 93.59 | 95.44 | 0.511800 | 6.63 | 2.59 | 11.44 | 4.45 |
| Quebrada 1 | 9.9 | 100-YR | 17.16 | 96.76 | 97.26 | 97.29 | 97.50 | 0.026554 | 2.16 | 7.93 | 20.42 | 1.11 |
| Quebrada 1 | 10 | 100-YR | 17.16 | 96.76 | 97.16 | 97.29 | 97.59 | 0.063270 | 2.93 | 5.87 | 18.44 | 1.66 |
| Quebrada 1 | 11 | 100-YR | 17.16 | 101.83 | 102.07 | 102.60 | 107.16 | 1.272098 | 10.00 | 1.72 | 8.05 | 6.91 |
| Quebrada 1 | 12 | 100-YR | 17.16 | 109.05 | 110.32 | 110.32 | 110.72 | 0.018592 | 2.81 | 6.12 | 7.65 | 1.00 |
| Quebrada 1 | 13 | 100-YR | 17.16 | 123.73 | 125.22 | 125.22 | 125.53 | 0.019698 | 2.48 | 6.93 | 11.14 | 1.00 |


Analisis Hidráulico para Monte Sierra Plan: Quebrada 1 EXIS
Geom: Quebrada 1 EXIS Flow: Quebrada 1 EXIS
River = Quebrada 1 Reach = Quebrada 1 RS = 13 XS-13
.06 .04 .06
Legend
WS 100-YR
Crit 100-YR
Ground
Bank Sta
Elevation (m)
Station (m)
Analisis Hidráulico para Monte Sierra Plan: Quebrada 1 EXIS
Geom: Quebrada 1 EXIS Flow: Quebrada 1 EXIS
River = Quebrada 1 Reach = Quebrada 1 RS = 12 XS-12
.06 .04 .06
Legend
WS 100-YR
Crit 100-YR
Ground
Bank Sta
Elevation (m)
Station (m)
Analisis Hidráulico para Monte Sierra Plan: Quebrada 1 EXIS
Geom: Quebrada 1 EXIS Flow: Quebrada 1 EXIS
River = Quebrada 1 Reach = Quebrada 1 RS = 11 XS-11
.06 .04 .06
Legend
Crit 100-YR
WS 100-YR
Ground
Bank Sta
Elevation (m)
Station (m)
Analisis Hidráulico para Monte Sierra Plan: Quebrada 1 EXIS
Geom: Quebrada 1 EXIS Flow: Quebrada 1 EXIS
River = Quebrada 1 Reach = Quebrada 1 RS = 10 XS-10
.06 .04 .06
Legend
Crit 100-YR
WS 100-YR
Ground
Bank Sta
Elevation (m)
Station (m)


Analisis Hidráulico para Monte Sierra Plan: Quebrada 1 EXIS
Geom: Quebrada 1 EXIS Flow: Quebrada 1 EXIS
River = Quebrada 1 Reach = Quebrada 1 RS = 9.9 XS-10 COPY
.06 .04 .06
Legend
Crit 100-YR
WS 100-YR
Ground
Bank Sta
Elevation (m)
Station (m)
Analisis Hidráulico para Monte Sierra Plan: Quebrada 1 EXIS
Geom: Quebrada 1 EXIS Flow: Quebrada 1 EXIS
River = Quebrada 1 Reach = Quebrada 1 RS = 9.5 Interpolate Section
.06 .04 .06
Legend
Crit 100-YR
WS 100-YR
Ground
Bank Sta
Elevation (m)
Station (m)
Analisis Hidráulico para Monte Sierra Plan: Quebrada 1 EXIS
Geom: Quebrada 1 EXIS Flow: Quebrada 1 EXIS
River = Quebrada 1 Reach = Quebrada 1 RS = 9 XS-9
.06 .04 .06
Legend
Crit 100-YR
WS 100-YR
Ground
Bank Sta
Elevation (m)
Station (m)
Analisis Hidráulico para Monte Sierra Plan: Quebrada 1 EXIS
Geom: Quebrada 1 EXIS Flow: Quebrada 1 EXIS
River = Quebrada 1 Reach = Quebrada 1 RS = 8 XS-8
.06 .04 .06
Legend
Crit 100-YR
WS 100-YR
Ground
Bank Sta
Elevation (m)
Station (m)


Analisis Hidráulico para Monte Sierra Plan: Quebrada 1 EXIS
Geom: Quebrada 1 EXIS Flow: Quebrada 1 EXIS
River = Quebrada 1 Reach = Quebrada 1 RS = 7 XS-7
.06 .04 .06
Legend
WS 100-YR
Crit 100-YR
Ground
Bank Sta
Elevation (m)
Station (m)
Analisis Hidráulico para Monte Sierra Plan: Quebrada 1 EXIS
Geom: Quebrada 1 EXIS Flow: Quebrada 1 EXIS
River = Quebrada 1 Reach = Quebrada 1 RS = 6 XS-6
.06 .04 .06
Legend
Crit 100-YR
WS 100-YR
Ground
Bank Sta
Elevation (m)
Station (m)
Analisis Hidráulico para Monte Sierra Plan: Quebrada 1 EXIS
Geom: Quebrada 1 EXIS Flow: Quebrada 1 EXIS
River = Quebrada 1 Reach = Quebrada 1 RS = 5 XS-5
.06 .04 .06
Legend
Crit 100-YR
WS 100-YR
Ground
Bank Sta
Elevation (m)
Station (m)
Analisis Hidráulico para Monte Sierra Plan: Quebrada 1 EXIS
Geom: Quebrada 1 EXIS Flow: Quebrada 1 EXIS
River = Quebrada 1 Reach = Quebrada 1 RS = 4 XS-4
.06 .04 .06
Legend
Crit 100-YR
WS 100-YR
Ground
Bank Sta
Elevation (m)
Station (m)


Analisis Hidráulico para Monte Sierra Plan: Quebrada 1 EXIS
Geom: Quebrada 1 EXIS Flow: Quebrada 1 EXIS
River = Quebrada 1 Reach = Quebrada 1 RS = 3 XS-3
.06 .04 .06
Legend
Crit 100-YR
WS 100-YR
Ground
Bank Sta
Elevation (m)
Station (m)
Analisis Hidráulico para Monte Sierra Plan: Quebrada 1 EXIS
Geom: Quebrada 1 EXIS Flow: Quebrada 1 EXIS
River = Quebrada 1 Reach = Quebrada 1 RS = 2 XS-2
.06 .04 .06
Legend
Crit 100-YR
WS 100-YR
Ground
Bank Sta
Elevation (m)
Station (m)
Analisis Hidráulico para Monte Sierra Plan: Quebrada 1 EXIS
Geom: Quebrada 1 EXIS Flow: Quebrada 1 EXIS
River = Quebrada 1 Reach = Quebrada 1 RS = 1 XS-1
.06 .04 .06
Legend
Crit 100-YR
WS 100-YR
Ground
Bank Sta
Elevation (m)
Station (m)

## GEOMETRÍA: QUEBRADA 1 PROP

HEC-RAS Version 3.1.3 May 2005
U.S. Army Corp of Engineers
Hydrologic Engineering Center
609 Second Street
Davis, California

```
X     X  XXXXXX    XXXX        XXXX       XX      XXXX
X     X  X        X    X       X   X     X  X    X
X     X  X        X            X   X    X    X   X
XXXXXXX  XXXX     X       XXX  XXXX     XXXXXX    XXXX
X     X  X        X            X  X     X    X        X
X     X  X        X    X       X   X    X    X        X
X     X  XXXXXX    XXXX        X    X   X    X   XXXXX
```

**********

PROJECT DATA
Project Title: Analisis Hidráulico para Monte Sierra
Project File : Sierra.prj
Run Date and Time: 5/29/2007 3:38:59 PM

Project in SI units

Project Description:
& RAnalisis Hidráaulico Monte Sierra, Mayaguez

**********

PLAN DATA

Plan Title: Quebrada 1 PROP
Plan File : C:\Trabajos en proceso\Sierra\RAS\2007\Sierra.p01

Geometry Title: Quebrada 1 PROP
Geometry File : C:\Trabajos en proceso\Sierra\RAS\2007\Sierra.g01

Flow Title : Quebrada 1 PROP
Flow File : C:\Trabajos en proceso\Sierra\RAS\2007\Sierra.f06

Plan Summary Information:

| | | | | | |
|---|---|---|---|---|---|
| Number of: | Cross Sections = | 15 | Multiple Openings = | 0 |
| | Culverts = | 1 | Inline Structures = | 0 |
| | Bridges = | 0 | Lateral Structures = | 0 |

Computational Information

| | |
|---|---|
| Water surface calculation tolerance = | 0.003 |
| Critical depth calculation tolerance = | 0.003 |
| Maximum number of iterations = | 20 |
| Maximum difference tolerance = | 0.1 |
| Flow tolerance factor = | 0.001 |

Computation Options
Critical depth computed only where necessary
Conveyance Calculation Method: At breaks in n values only
Friction Slope Method: Average Conveyance
Computational Flow Regime: Mixed Flow

**********

FLOW DATA

Flow Title: Quebrada 1 PROP
Flow File : C:\Trabajos en proceso\Sierra\RAS\2007\Sierra.f06

Flow Data (m3/s)

| River | Reach | RS | 100-YR |
|---|---|---|---|
| Quebrada 1 | Quebrada 1 | 13 | 17.16 |

Boundary Conditions

| River | Reach | Profile | Upstream | Downstream |
|---|---|---|---|---|
| Quebrada 1 | Quebrada 1 | 100-YR | Critical | Critical |

**********

GEOMETRY DATA

Geometry Title: Quebrada 1 PROP
Geometry File : C:\Trabajos en proceso\Sierra\RAS\2007\Sierra.g01

CROSS SECTION

RIVER: Quebrada 1
REACH: Quebrada 1 RS: 13

INPUT
Description: XS-13
Station Elevation Data num= 9

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 129.22 | 10 | 128.22 | 28 | 124.72 | 30 | 123.81 | 31 | 123.73 |
| 32 | 124.44 | 40 | 125.81 | 46 | 126.56 | 59 | 127.06 | | |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|

```
**********************************************
     0     .06     10     .04     40     .06

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
           10      40              54.4   44.38   26.68            .1       .3

CROSS SECTION OUTPUT  Profile #100-YR
```

| | | | | | |
|---|---|---|---|---|---|
| E.G. Elev (m) | 125.53 | Element | Left OB | Channel | Right OB |
| Vel Head (m) | 0.31 | Wt. n-Val. | | 0.040 | |
| W.S. Elev (m) | 125.22 | Reach Len. (m) | 54.40 | 44.38 | 26.68 |
| Crit W.S. (m) | 125.22 | Flow Area (m2) | | 6.93 | |
| E.G. Slope (m/m) | 0.019698 | Area (m2) | | 6.93 | |
| Q Total (m3/s) | 17.16 | Flow (m3/s) | | 17.16 | |
| Top Width (m) | 11.14 | Top Width (m) | | 11.14 | |
| Vel Total (m/s) | 2.48 | Avg. Vel. (m/s) | | 2.48 | |
| Max Chl Dpth (m) | 1.49 | Hydr. Depth (m) | | 0.62 | |
| Conv. Total (m3/s) | 122.3 | Conv. (m3/s) | | 122.3 | |
| Length Wtd. (m) | 44.38 | Wetted Per. (m) | | 11.68 | |
| Min Ch El (m) | 123.73 | Shear (N/m2) | | 114.56 | |
| Alpha | 1.00 | Stream Power (N/m s) | | 283.74 | |
| Frctn Loss (m) | 0.85 | Cum Volume (1000 m3) | | 2.02 | |
| C & E Loss (m) | 0.01 | Cum SA (1000 m2) | | 3.55 | |

```
Warning: The energy equation could not be balanced within the specified number of iterations.  The
         program used critical depth for the water surface and continued on with the calculations.
Warning: The energy loss was greater than 1.0 ft (0.3 m), between the current and previous cross
         section.  This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical
         depth, the calculated water surface came back below critical depth.  This indicates that there
         is not a valid subcritical answer.  The program defaulted to critical depth.

CROSS SECTION


RIVER: Quebrada 1
REACH: Quebrada 1          RS: 12

INPUT
Description: XS-12
Station Elevation Data    num=      10
     Sta    Elev      Sta    Elev      Sta    Elev      Sta    Elev      Sta    Elev
**********************************************************************************
       0  116.03       20  113.11       23  110.88       27  109.05       29  109.05
      33  110.81       38  113.04       45  114.65       52  114.92       57  115.32

Manning's n Values        num=      3
     Sta   n Val     Sta   n Val     Sta   n Val
**********************************************
       0     .06      23     .04      33     .06

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
           23      33              50.14   52.12   56.66            .1       .3

CROSS SECTION OUTPUT  Profile #100-YR
```

| | | | | | |
|---|---|---|---|---|---|
| E.G. Elev (m) | 110.72 | Element | Left OB | Channel | Right OB |
| Vel Head (m) | 0.40 | Wt. n-Val. | | 0.040 | |
| W.S. Elev (m) | 110.32 | Reach Len. (m) | 50.14 | 52.12 | 56.66 |
| Crit W.S. (m) | 110.32 | Flow Area (m2) | | 6.12 | |
| E.G. Slope (m/m) | 0.018592 | Area (m2) | | 6.12 | |
| Q Total (m3/s) | 17.16 | Flow (m3/s) | | 17.16 | |
| Top Width (m) | 7.65 | Top Width (m) | | 7.65 | |
| Vel Total (m/s) | 2.81 | Avg. Vel. (m/s) | | 2.81 | |
| Max Chl Dpth (m) | 1.27 | Hydr. Depth (m) | | 0.80 | |
| Conv. Total (m3/s) | 125.9 | Conv. (m3/s) | | 125.9 | |
| Length Wtd. (m) | 52.12 | Wetted Per. (m) | | 8.19 | |
| Min Ch El (m) | 109.05 | Shear (N/m2) | | 136.10 | |
| Alpha | 1.00 | Stream Power (N/m s) | | 381.79 | |
| Frctn Loss (m) | 1.00 | Cum Volume (1000 m3) | | 1.73 | |
| C & E Loss (m) | 0.04 | Cum SA (1000 m2) | | 3.13 | |

```
Warning: The energy equation could not be balanced within the specified number of iterations.  The
         program used critical depth for the water surface and continued on with the calculations.
Warning: The energy loss was greater than 1.0 ft (0.3 m), between the current and previous cross
         section.  This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical
         depth, the calculated water surface came back below critical depth.  This indicates that there
         is not a valid subcritical answer.  The program defaulted to critical depth.

CROSS SECTION


RIVER: Quebrada 1
REACH: Quebrada 1          RS: 11

INPUT
Description: XS-11
Station Elevation Data    num=      9
     Sta    Elev      Sta    Elev      Sta    Elev      Sta    Elev      Sta    Elev
**********************************************************************************
       0  106.66        6  105.54       16  104.74       21  101.83       27  101.83
      29  102.13       36   102.9       43  103.71       55  105.66

Manning's n Values        num=      3
     Sta   n Val     Sta   n Val     Sta   n Val
**********************************************
       0     .06      16     .04      36     .06

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
           16      36              49.17   48.31   45.22            .1       .3

CROSS SECTION OUTPUT  Profile #100-YR
```

| | | | | | | |
|---|---|---|---|---|---|---|
| E.G. Elev (m) | 107.16 | Element | Left OB | Channel | Right OB | |
| Vel Head (m) | 5.09 | Wt. n-Val. | | 0.040 | | |
| W.S. Elev (m) | 102.07 | Reach Len. (m) | 49.17 | 48.31 | 45.22 | |
| Crit W.S. (m) | 102.60 | Flow Area (m2) | | 1.72 | | |
| E.G. Slope (m/m) | *1.272098 | Area (m2) | | 1.72 | | |
| Q Total (m3/s) | 17.16 | Flow (m3/s) | | 17.16 | | |
| Top Width (m) | 8.05 | Top Width (m) | | 8.05 | | |
| Vel Total (m/s) | 10.00 | Avg. Vel. (m/s) | | 10.00 | | |
| Max Chl Dpth (m) | 0.24 | Hydr. Depth (m) | | 0.21 | | |
| Conv. Total (m3/s) | 15.2 | Conv. (m3/s) | | 15.2 | | |
| Length Wtd. (m) | 48.31 | Wetted Per. (m) | | 8.13 | | |
| Min Ch El (m) | 101.83 | Shear (N/m2) | | *2633.02 | | |
| Alpha | 1.00 | Stream Power (N/m s) | | *26318.95 | | |
| Frctn Loss (m) | 3.09 | Cum Volume (1000 m3) | | 1.52 | | |
| C & E Loss (m) | 0.47 | Cum SA (1000 m2) | | 2.73 | | |

Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross sections.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Warning: The energy loss was greater than 1.0 ft (0.3 m), between the current and previous cross section. This may indicate the need for additional cross sections.

CROSS SECTION

RIVER: Quebrada 1
REACH: Quebrada 1 RS: 10

INPUT
Description: XS-10
Station Elevation Data num= 8

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 99.19 | 7 | 98.19 | 19 | 96.76 | 30 | 96.76 | 41 | 97.83 |
| 45 | 99.01 | 52 | 101.93 | 58 | 103.53 | | | | |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 0 | .06 | 7 | .04 | 45 | .06 |

| Bank Sta: Left | Right | Lengths: Left Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|
| 7 | 45 | 1 | 1 | .2 | .4 |

CROSS SECTION OUTPUT Profile #100-YR

| | | | | | | |
|---|---|---|---|---|---|---|
| E.G. Elev (m) | 97.59 | Element | Left OB | Channel | Right OB | |
| Vel Head (m) | 0.44 | Wt. n-Val. | | 0.040 | | |
| W.S. Elev (m) | 97.16 | Reach Len. (m) | 1.00 | 1.00 | 1.00 | |
| Crit W.S. (m) | 97.29 | Flow Area (m2) | | 5.87 | | |
| E.G. Slope (m/m) | *0.063270 | Area (m2) | | 5.87 | | |
| Q Total (m3/s) | 17.16 | Flow (m3/s) | | 17.16 | | |
| Top Width (m) | 18.44 | Top Width (m) | | 18.44 | | |
| Vel Total (m/s) | 2.93 | Avg. Vel. (m/s) | | 2.93 | | |
| Max Chl Dpth (m) | 0.40 | Hydr. Depth (m) | | 0.32 | | |
| Conv. Total (m3/s) | 68.2 | Conv. (m3/s) | | 68.2 | | |
| Length Wtd. (m) | 1.00 | Wetted Per. (m) | | 18.48 | | |
| Min Ch El (m) | 96.76 | Shear (N/m2) | | 196.90 | | |
| Alpha | 1.00 | Stream Power (N/m s) | | 576.06 | | |
| Frctn Loss (m) | 8.17 | Cum Volume (1000 m3) | | 1.34 | | |
| C & E Loss (m) | 1.40 | Cum SA (1000 m2) | | 2.09 | | |

Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross sections.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Warning: The energy loss was greater than 1.0 ft (0.3 m), between the current and previous cross section. This may indicate the need for additional cross sections.

CROSS SECTION

RIVER: Quebrada 1
REACH: Quebrada 1 RS: 9.9

INPUT
Description: XS-10 COPY
Station Elevation Data num= 8

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 99.19 | 7 | 98.19 | 19 | 95.76 | 30 | 95.76 | 41 | 97.83 |
| 45 | 99.01 | 52 | 101.93 | 58 | 103.53 | | | | |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 0 | .06 | 7 | .04 | 45 | .06 |

| Bank Sta: Left | Right | Lengths: Left Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|
| 7 | 45 | 24.97 | 26.42 | 30.92 | .2 | .4 |

CROSS SECTION OUTPUT Profile #100-YR

| | | | | | | |
|---|---|---|---|---|---|---|
| E.G. Elev (m) | 97.20 | Element | Left OB | Channel | Right OB | |
| Vel Head (m) | 0.02 | Wt. n-Val. | | 0.040 | | |
| W.S. Elev (m) | 97.18 | Reach Len. (m) | 24.97 | 26.42 | 30.92 | |
| Crit W.S. (m) | 96.33 | Flow Area (m2) | | 25.95 | | |
| E.G. Slope (m/m) | *0.000695 | Area (m2) | | 25.95 | | |
| Q Total (m3/s) | 17.16 | Flow (m3/s) | | 17.16 | | |
| Top Width (m) | 25.56 | Top Width (m) | | 25.56 | | |
| Vel Total (m/s) | 0.66 | Avg. Vel. (m/s) | | 0.66 | | |

```
* Max Chl Dpth (m)      *    1.42  * Hydr. Depth (m)      *          *    1.02  *          *
* Conv. Total (m3/s)    *  650.8   * Conv. (m3/s)         *          *  650.8   *          *
* Length Wtd. (m)       *   26.42  * Wetted Per. (m)      *          *   25.83  *          *
* Min Ch El (m)         *   95.76  * Shear (N/m2)         *          *    6.85  *          *
* Alpha                 *    1.00  * Stream Power (N/m s) *          *    4.53  *          *
* Frctn Loss (m)        *          * Cum Volume (1000 m3) *          *    1.32  *          *
* C & E Loss (m)        *          * Cum SA (1000 m2)     *          *    2.06  *          *
*********************************************************************************************

Note:    Hydraulic jump has occurred between this cross section and the previous upstream section.

CULVERT


RIVER: Quebrada 1
REACH: Quebrada 1          RS: 9.8

INPUT
Description: PROPOSED CULVERT
Distance from Upstream XS =       1
Deck/Roadway Width        =      25
Weir Coefficient          =    1.44
Upstream  Deck/Roadway Coordinates
    num=       2
     Sta Hi Cord Lo Cord      Sta Hi Cord Lo Cord
***********************************************
       0   98.99       95       51   98.99       95

Upstream Bridge Cross Section Data
Station Elevation Data     num=       8
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
*********************************************************************************************
       0   99.19        7   98.19       19   95.76       30   95.76       41   97.83
      45   99.01       52  101.93       58  103.53

Manning's n Values         num=       3
     Sta    n Val      Sta    n Val      Sta    n Val
***********************************************
       0      .06        7      .04       45      .06

Bank Sta: Left   Right    Coeff Contr.   Expan.
             7      45             .2       .4

Downstream  Deck/Roadway Coordinates
    num=       2
     Sta Hi Cord Lo Cord      Sta Hi Cord Lo Cord
***********************************************
       0    95.8       92       51    95.8       92

Downstream Bridge Cross Section Data
Station Elevation Data     num=      12
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
*********************************************************************************************
       0     99.1      7.6     97.9     16.5     94.9     21.9     93.2       26     92.4
    31.5     92.4     38.1       94     40.5     94.9       51     97.8     53.2     98.3
      57     99.2       60     99.8

Manning's n Values         num=       3
     Sta    n Val      Sta    n Val      Sta    n Val
***********************************************
       0      .06     16.5      .04     40.5      .06

Bank Sta: Left   Right    Coeff Contr.   Expan.
          16.5    40.5             .2       .4

Upstream Embankment side slope              =       0 horiz. to 1.0 vertical
Downstream Embankment side slope            =       0 horiz. to 1.0 vertical
Maximum allowable submergence for weir flow =     .95
Elevation at which weir flow begins         =
Energy head used in spillway design         =
Spillway height used in design              =
Weir crest shape                            = Broad Crested

Number of Culverts =  2

Culvert Name      Shape      Rise     Span
Culvert #1            Box    1.83     3.66
FHWA Chart # 8 - flared wingwalls
FHWA Scale # 1 - Wingwall flared 30 to 75 deg.
Solution Criteria = Highest U.S. EG
Culvert Upstrm Dist  Length     Top n  Bottom n  Depth Blocked  Entrance Loss Coef   Exit Loss Coef
                  1      25      .015      .015         0                  .5                 1
Upstream   Elevation =  95.76
           Centerline Station =  22.41
Downstream Elevation =  92.4
           Centerline Station =  25

Culvert Name      Shape      Rise     Span
Culvert #2            Box    1.83     3.66
FHWA Chart # 8 - flared wingwalls
FHWA Scale # 1 - Wingwall flared 30 to 75 deg.
Solution Criteria = Highest U.S. EG
Culvert Upstrm Dist  Length     Top n  Bottom n  Depth Blocked  Entrance Loss Coef   Exit Loss Coef
                  1      25      .015      .015         0                  .5                 1
Upstream   Elevation =  95.76
           Centerline Station =  26.67
Downstream Elevation =  92.4
           Centerline Station =  29.26

CULVERT OUTPUT  Profile #100-YR  Culv Group:  Culvert #1
*********************************************************************
* Q Culv Group (m3/s)  *    8.58  * Culv Full Len (m)    *          *
* # Barrels            *       1  * Culv Vel US (m/s)    *    2.84  *
* Q Barrel (m3/s)      *    8.58  * Culv Vel DS (m/s)    *    7.82  *
* E.G. US. (m)         *   97.20  * Culv Inv El Up (m)   *   95.76  *
```

| | | | | | |
|---|---|---|---|---|---|
| * W.S. US. (m) | * 97.18 | * Culv Inv El Dn (m) | * 92.40 | * | |
| * E.G. DS (m) | * 93.48 | * Culv Frctn Ls (m) | * 1.18 | * | |
| * W.S. DS (m) | * 93.19 | * Culv Exit Loss (m) | * 2.34 | * | |
| * Delta EG (m) | * 3.73 | * Culv Entr Loss (m) | * 0.21 | * | |
| * Delta WS (m) | * 3.99 | * Q Weir (m3/s) | * | * | |
| * E.G. IC (m) | * 96.95 | * Weir Sta Lft (m) | * | * | |
| * E.G. OC (m) | * 97.20 | * Weir Sta Rgt (m) | * | * | |
| * Culvert Control | * Inlet | * Weir Submerg | * | * | |
| * Culv WS Inlet (m) | * 96.58 | * Weir Max Depth (m) | * | * | |
| * Culv WS Outlet (m) | * 92.70 | * Weir Avg Depth (m) | * | * | |
| * Culv Nml Depth (m) | * 0.26 | * Weir Flow Area (m2) | * | * | |
| * Culv Crt Depth (m) | * 0.82 | * Min El Weir Flow (m) | * 98.99 | * | |

Warning: At least one culvert in the culvert group has supercritical flow at the outlet. However, since more than one culvert in the culvert group has flow, the program cannot determine if the downstream cross section should be subcritical or supercritical flow. The program used the downstream subcritical answer, even though it may not be valid.
Warning: During the supercritical analysis, the program could not converge on a supercritical answer in the downstream cross section. The program used the solution with the least error.
Note: The flow in the culvert is entirely supercritical.

CULVERT OUTPUT Profile #100-YR Culv Group: Culvert #2

| | | | | | |
|---|---|---|---|---|---|
| * Q Culv Group (m3/s) | * 8.58 | * Culv Full Len (m) | * | * | |
| * # Barrels | * 1 | * Culv Vel US (m/s) | * 2.84 | * | |
| * Q Barrel (m3/s) | * 8.58 | * Culv Vel DS (m/s) | * 7.82 | * | |
| * E.G. US. (m) | * 97.20 | * Culv Inv El Up (m) | * 95.76 | * | |
| * W.S. US. (m) | * 97.18 | * Culv Inv El Dn (m) | * 92.40 | * | |
| * E.G. DS (m) | * 93.48 | * Culv Frctn Ls (m) | * 1.18 | * | |
| * W.S. DS (m) | * 93.19 | * Culv Exit Loss (m) | * 2.34 | * | |
| * Delta EG (m) | * 3.73 | * Culv Entr Loss (m) | * 0.21 | * | |
| * Delta WS (m) | * 3.99 | * Q Weir (m3/s) | * | * | |
| * E.G. IC (m) | * 96.95 | * Weir Sta Lft (m) | * | * | |
| * E.G. OC (m) | * 97.20 | * Weir Sta Rgt (m) | * | * | |
| * Culvert Control | * Inlet | * Weir Submerg | * | * | |
| * Culv WS Inlet (m) | * 96.58 | * Weir Max Depth (m) | * | * | |
| * Culv WS Outlet (m) | * 92.70 | * Weir Avg Depth (m) | * | * | |
| * Culv Nml Depth (m) | * 0.26 | * Weir Flow Area (m2) | * | * | |
| * Culv Crt Depth (m) | * 0.82 | * Min El Weir Flow (m) | * 98.99 | * | |

Warning: At least one culvert in the culvert group has supercritical flow at the outlet. However, since more than one culvert in the culvert group has flow, the program cannot determine if the downstream cross section should be subcritical or supercritical flow. The program used the downstream subcritical answer, even though it may not be valid.
Warning: During the supercritical analysis, the program could not converge on a supercritical answer in the downstream cross section. The program used the solution with the least error.
Note: The flow in the culvert is entirely supercritical.

CROSS SECTION

RIVER: Quebrada 1
REACH: Quebrada 1 RS: 9.5

INPUT
Description: Interpolate Section
Station Elevation Data num= 12

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 99.1 | 7.6 | 97.9 | 16.5 | 94.9 | 21.9 | 93.2 | 26 | 92.4 |
| 31.5 | 92.4 | 38.1 | 94 | 40.5 | 94.9 | 51 | 97.8 | 53.2 | 98.3 |
| 57 | 99.2 | 60 | 99.8 | | | | | | |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 0 | .06 | 16.5 | .04 | 40.5 | .06 |

| Bank Sta: Left | Right | Lengths: Left Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|
| 16.5 | 40.5 | 25.97 | 27.415 | 31.92 | .2 .4 |

CROSS SECTION OUTPUT Profile #100-YR

| | | | | | |
|---|---|---|---|---|---|
| * E.G. Elev (m) | * 93.48 | * Element | * Left OB | * Channel | * Right OB * |
| * Vel Head (m) | * 0.29 | * Wt. n-Val. | * | * 0.040 | * * |
| * W.S. Elev (m) | * 93.19 | * Reach Len. (m) | * 25.97 | * 27.41 | * 31.92 * |
| * Crit W.S. (m) | * 93.19 | * Flow Area (m2) | * | * 7.24 | * * |
| * E.G. Slope (m/m) | *0.019588 | * Area (m2) | * | * 7.24 | * * |
| * Q Total (m3/s) | * 17.16 | * Flow (m3/s) | * | * 17.16 | * * |
| * Top Width (m) | * 12.81 | * Top Width (m) | * | * 12.81 | * * |
| * Vel Total (m/s) | * 2.37 | * Avg. Vel. (m/s) | * | * 2.37 | * * |
| * Max Chl Dpth (m) | * 0.79 | * Hydr. Depth (m) | * | * 0.56 | * * |
| * Conv. Total (m3/s) | * 122.6 | * Conv. (m3/s) | * | * 122.6 | * * |
| * Length Wtd. (m) | * 27.41 | * Wetted Per. (m) | * | * 12.99 | * * |
| * Min Ch El (m) | * 92.40 | * Shear (N/m2) | * | * 107.10 | * * |
| * Alpha | * 1.00 | * Stream Power (N/m s) | * | * 253.84 | * * |
| * Frctn Loss (m) | * 0.52 | * Cum Volume (1000 m3) | * | * 0.89 | * * |
| * C & E Loss (m) | * 0.03 | * Cum SA (1000 m2) | * | * 1.56 | * * |

Warning: The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning: The energy loss was greater than 1.0 ft (0.3 m), between the current and previous cross section. This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to critical depth.

CROSS SECTION

RIVER: Quebrada 1
REACH: Quebrada 1 RS: 9

INPUT
Description: XS-9
Station Elevation Data num= 9

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 98.99 | 12 | 96.99 | 26 | 91.67 | 30 | 89.06 | 33 | 89.03 |
| 36 | 90.7 | 53 | 94.31 | 58 | 95.43 | 62 | 95.98 | | |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 0 | .06 | 26 | .04 | 36 | .06 |

| Bank Sta: Left | Right | Lengths: Left Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|
| 26 | 36 | 33.69 | 35.62 | 32.02 | .1 | .3 |

CROSS SECTION OUTPUT Profile #100-YR

| | | | | |
|---|---|---|---|---|
| E.G. Elev (m) | 91.88 | Element | Left OB | Channel | Right OB |
| Vel Head (m) | 2.19 | Wt. n-Val. | | 0.040 | |
| W.S. Elev (m) | 89.69 | Reach Len. (m) | 33.69 | 35.62 | 32.02 |
| Crit W.S. (m) | 90.23 | Flow Area (m2) | | 2.62 | |
| E.G. Slope (m/m) | 0.185200 | Area (m2) | | 2.62 | |
| Q Total (m3/s) | 17.16 | Flow (m3/s) | | 17.16 | |
| Top Width (m) | 5.14 | Top Width (m) | | 5.14 | |
| Vel Total (m/s) | 6.56 | Avg. Vel. (m/s) | | 6.56 | |
| Max Chl Dpth (m) | 0.66 | Hydr. Depth (m) | | 0.51 | |
| Conv. Total (m3/s) | 39.9 | Conv. (m3/s) | | 39.9 | |
| Length Wtd. (m) | 35.62 | Wetted Per. (m) | | 5.50 | |
| Min Ch El (m) | 89.03 | Shear (N/m2) | | 864.17 | |
| Alpha | 1.00 | Stream Power (N/m s) | | 5666.59 | |
| Frctn Loss (m) | 1.22 | Cum Volume (1000 m3) | | 0.75 | |
| C & E Loss (m) | 0.38 | Cum SA (1000 m2) | | 1.31 | |

Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross sections.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Warning: The energy loss was greater than 1.0 ft (0.3 m), between the current and previous cross section. This may indicate the need for additional cross sections.

CROSS SECTION

RIVER: Quebrada 1
REACH: Quebrada 1 RS: 8

INPUT
Description: XS-8
Station Elevation Data num= 10

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 100.59 | 7 | 99.19 | 18 | 93.41 | 30 | 87.64 | 33 | 86.17 |
| 35 | 86.31 | 40 | 87.76 | 44 | 88.23 | 56 | 91.34 | 61 | 92.94 |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 0 | .06 | 30 | .04 | 40 | .06 |

| Bank Sta: Left | Right | Lengths: Left Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|
| 30 | 40 | 45.96 | 40.98 | 39.74 | .1 | .3 |

CROSS SECTION OUTPUT Profile #100-YR

| | | | | |
|---|---|---|---|---|
| E.G. Elev (m) | 88.04 | Element | Left OB | Channel | Right OB |
| Vel Head (m) | 0.88 | Wt. n-Val. | | 0.040 | |
| W.S. Elev (m) | 87.17 | Reach Len. (m) | 45.96 | 40.98 | 39.74 |
| Crit W.S. (m) | 87.45 | Flow Area (m2) | | 4.14 | |
| E.G. Slope (m/m) | 0.059141 | Area (m2) | | 4.14 | |
| Q Total (m3/s) | 17.16 | Flow (m3/s) | | 17.16 | |
| Top Width (m) | 6.99 | Top Width (m) | | 6.99 | |
| Vel Total (m/s) | 4.15 | Avg. Vel. (m/s) | | 4.15 | |
| Max Chl Dpth (m) | 1.00 | Hydr. Depth (m) | | 0.59 | |
| Conv. Total (m3/s) | 70.6 | Conv. (m3/s) | | 70.6 | |
| Length Wtd. (m) | 40.98 | Wetted Per. (m) | | 7.35 | |
| Min Ch El (m) | 86.17 | Shear (N/m2) | | 326.56 | |
| Alpha | 1.00 | Stream Power (N/m s) | | 1353.78 | |
| Frctn Loss (m) | 3.44 | Cum Volume (1000 m3) | | 0.63 | |
| C & E Loss (m) | 0.39 | Cum SA (1000 m2) | | 1.09 | |

Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross sections.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Warning: The energy loss was greater than 1.0 ft (0.3 m), between the current and previous cross section. This may indicate the need for additional cross sections.

CROSS SECTION

RIVER: Quebrada 1
REACH: Quebrada 1 RS: 7

INPUT
Description: XS-7
Station Elevation Data num= 10

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 97.85 | 9 | 96.85 | 19 | 91.61 | 30 | 87.41 | 33 | 85.33 |
| 36 | 85.05 | 45 | 87.57 | 52 | 89.47 | 56 | 92.03 | 64 | 93.63 |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 0 | .06 | 30 | .04 | 45 | .06 |

| Bank Sta: Left | Right | Lengths: Left Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|
| 30 | 45 | 33.54 | 34.44 | 40.02 | .1 | .3 |

CROSS SECTION OUTPUT Profile #100-YR

| | | | | | |
|---|---|---|---|---|---|
| E.G. Elev (m) | 86.62 | Element | Left OB | Channel | Right OB |
| Vel Head (m) | 0.38 | Wt. n-Val. | | 0.040 | |
| W.S. Elev (m) | 86.24 | Reach Len. (m) | 33.54 | 34.44 | 40.02 |
| Crit W.S. (m) | 86.25 | Flow Area (m2) | | 6.31 | |
| E.G. Slope (m/m) | *0.019102 | Area (m2) | | 6.31 | |
| Q Total (m3/s) | 17.16 | Flow (m3/s) | | 17.16 | |
| Top Width (m) | 8.58 | Top Width (m) | | 8.58 | |
| Vel Total (m/s) | 2.72 | Avg. Vel. (m/s) | | 2.72 | |
| Max Chl Dpth (m) | 1.19 | Hydr. Depth (m) | | 0.74 | |
| Conv. Total (m3/s) | 124.2 | Conv. (m3/s) | | 124.2 | |
| Length Wtd. (m) | 34.44 | Wetted Per. (m) | | 9.05 | |
| Min Ch El (m) | 85.05 | Shear (N/m2) | | 130.71 | |
| Alpha | 1.00 | Stream Power (N/m s) | | 355.30 | |
| Frctn Loss (m) | 1.27 | Cum Volume (1000 m3) | | 0.42 | |
| C & E Loss (m) | 0.15 | Cum SA (1000 m2) | | 0.77 | |

Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross sections.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Warning: The energy loss was greater than 1.0 ft (0.3 m), between the current and previous cross section. This may indicate the need for additional cross sections.

CROSS SECTION

RIVER: Quebrada 1
REACH: Quebrada 1 RS: 6

INPUT
Description: XS-6
Station Elevation Data num= 10

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 93.53 | 10 | 89.66 | 22 | 83.31 | 25 | 77.23 | 28 | 77.04 |
| 42 | 81.94 | 56 | 88.35 | 59 | 88.65 | 60 | 88.8 | 67 | 93.51 |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 1 | .06 | 22 | .04 | 42 | .06 |

| Bank Sta: Left | Right | Lengths: Left Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|
| 22 | 42 | 22.84 | 27.3 | 31.45 | .1 | .3 |

CROSS SECTION OUTPUT Profile #100-YR

| | | | | | |
|---|---|---|---|---|---|
| E.G. Elev (m) | 83.99 | Element | Left OB | Channel | Right OB |
| Vel Head (m) | 6.47 | Wt. n-Val. | | 0.040 | |
| W.S. Elev (m) | 77.52 | Reach Len. (m) | 22.84 | 27.30 | 31.45 |
| Crit W.S. (m) | 78.29 | Flow Area (m2) | | 1.52 | |
| E.G. Slope (m/m) | *0.939040 | Area (m2) | | 1.52 | |
| Q Total (m3/s) | 17.16 | Flow (m3/s) | | 17.16 | |
| Top Width (m) | 4.53 | Top Width (m) | | 4.53 | |
| Vel Total (m/s) | 11.27 | Avg. Vel. (m/s) | | 11.27 | |
| Max Chl Dpth (m) | 0.48 | Hydr. Depth (m) | | 0.34 | |
| Conv. Total (m3/s) | 17.7 | Conv. (m3/s) | | 17.7 | |
| Length Wtd. (m) | 27.30 | Wetted Per. (m) | | 4.80 | |
| Min Ch El (m) | 77.04 | Shear (N/m2) | | 2921.91 | |
| Alpha | 1.00 | Stream Power (N/m s) | | *32930.20 | |
| Frctn Loss (m) | 2.02 | Cum Volume (1000 m3) | | 0.26 | |
| C & E Loss (m) | 0.61 | Cum SA (1000 m2) | | 0.55 | |

Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross sections.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Warning: The energy loss was greater than 1.0 ft (0.3 m), between the current and previous cross section. This may indicate the need for additional cross sections.

CROSS SECTION

RIVER: Quebrada 1
REACH: Quebrada 1 RS: 5

INPUT
Description: XS-5
Station Elevation Data num= 12

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 87.41 | 6 | 85.81 | 19 | 76.81 | 23 | 75.03 | 29 | 73.53 |
| 34 | 73.43 | 39 | 77.24 | 42 | 77.36 | 45 | 78.96 | 52 | 82.54 |
| 60 | 85.63 | 65 | 86.38 | | | | | | |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 0 | .06 | 19 | .04 | 39 | .06 |

| Bank Sta: Left | Right | Lengths: Left Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|
| 19 | 39 | 13.04 | 13.18 | 14.98 | .1 | .3 |

CROSS SECTION OUTPUT Profile #100-YR

| | | | | | |
|---|---|---|---|---|---|
| E.G. Elev (m) | 75.28 | Element | Left OB | Channel | Right OB |
| Vel Head (m) | 1.25 | Wt. n-Val. | | 0.040 | |
| W.S. Elev (m) | 74.03 | Reach Len. (m) | 13.04 | 13.18 | 14.98 |
| Crit W.S. (m) | 74.39 | Flow Area (m2) | | 3.46 | |
| E.G. Slope (m/m) | *0.120940 | Area (m2) | | 3.46 | |
| Q Total (m3/s) | 17.16 | Flow (m3/s) | | 17.16 | |
| Top Width (m) | 7.77 | Top Width (m) | | 7.77 | |
| Vel Total (m/s) | 4.96 | Avg. Vel. (m/s) | | 4.96 | |
| Max Chl Dpth (m) | 0.60 | Hydr. Depth (m) | | 0.45 | |
| Conv. Total (m3/s) | 49.3 | Conv. (m3/s) | | 49.3 | |
| Length Wtd. (m) | 13.18 | Wetted Per. (m) | | 8.03 | |
| Min Ch El (m) | 73.43 | Shear (N/m2) | | 510.87 | |
| Alpha | 1.00 | Stream Power (N/m s) | | 2533.30 | |
| Frctn Loss (m) | 7.15 | Cum Volume (1000 m3) | | 0.21 | |
| C & E Loss (m) | 1.57 | Cum SA (1000 m2) | | 0.38 | |

Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross sections.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Warning: The energy loss was greater than 1.0 ft (0.3 m), between the current and previous cross section. This may indicate the need for additional cross sections.

CROSS SECTION

RIVER: Quebrada 1
REACH: Quebrada 1 RS: 4

INPUT
Description: XS-4
Station Elevation Data num= 11

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 87.34 | 11 | 85.34 | 27 | 75.34 | 34 | 71.35 | 36 | 71.47 |
| 42 | 74.75 | 45 | 74.99 | 47 | 77.51 | 53 | 80.61 | 60 | 83.77 |
| 66 | 85.77 | | | | | | | | |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 0 | .06 | 27 | .04 | 42 | .06 |

| Bank Sta: Left | Right | Lengths: Left Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|
| 27 | 42 | 11.19 | 18.23 | 22.85 | .1 | .3 |

CROSS SECTION OUTPUT Profile #100-YR

| | | | | | |
|---|---|---|---|---|---|
| E.G. Elev (m) | 73.80 | Element | Left OB | Channel | Right OB |
| Vel Head (m) | 1.50 | Wt. n-Val. | | 0.040 | |
| W.S. Elev (m) | 72.29 | Reach Len. (m) | 11.19 | 18.23 | 22.85 |
| Crit W.S. (m) | 72.75 | Flow Area (m2) | | 3.16 | |
| E.G. Slope (m/m) | *0.101768 | Area (m2) | | 3.16 | |
| Q Total (m3/s) | 17.16 | Flow (m3/s) | | 17.16 | |
| Top Width (m) | 5.16 | Top Width (m) | | 5.16 | |
| Vel Total (m/s) | 5.43 | Avg. Vel. (m/s) | | 5.43 | |
| Max Chl Dpth (m) | 0.94 | Hydr. Depth (m) | | 0.61 | |
| Conv. Total (m3/s) | 53.8 | Conv. (m3/s) | | 53.8 | |
| Length Wtd. (m) | 18.23 | Wetted Per. (m) | | 5.62 | |
| Min Ch El (m) | 71.35 | Shear (N/m2) | | 561.09 | |
| Alpha | 1.00 | Stream Power (N/m s) | | 3048.27 | |
| Frctn Loss (m) | 1.46 | Cum Volume (1000 m3) | | 0.17 | |
| C & E Loss (m) | 0.03 | Cum SA (1000 m2) | | 0.30 | |

Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross sections.
Warning: The energy loss was greater than 1.0 ft (0.3 m), between the current and previous cross section. This may indicate the need for additional cross sections.

CROSS SECTION

RIVER: Quebrada 1
REACH: Quebrada 1 RS: 3

INPUT
Description: XS-3
Station Elevation Data num= 11

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 81.43 | 11 | 78.41 | 27 | 73.01 | 34 | 69.13 | 36 | 68.71 |
| 44 | 73.31 | 47 | 73.31 | 50 | 75.24 | 57 | 78.48 | 64 | 82.63 |
| 73 | 84.23 | | | | | | | | |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 0 | .06 | 27 | .04 | 44 | .06 |

| Bank Sta: Left | Right | Lengths: Left Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|
| 27 | 44 | 17.32 | 17.14 | 14.33 | .1 | .3 |

CROSS SECTION OUTPUT Profile #100-YR

| | | | | | |
|---|---|---|---|---|---|
| E.G. Elev (m) | 71.61 | Element | Left OB | Channel | Right OB |
| Vel Head (m) | 1.89 | Wt. n-Val. | | 0.040 | |
| W.S. Elev (m) | 69.72 | Reach Len. (m) | 17.32 | 17.14 | 14.33 |
| Crit W.S. (m) | 70.25 | Flow Area (m2) | | 2.82 | |
| E.G. Slope (m/m) | *0.137562 | Area (m2) | | 2.82 | |
| Q Total (m3/s) | 17.16 | Flow (m3/s) | | 17.16 | |
| Top Width (m) | 4.83 | Top Width (m) | | 4.83 | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| * Vel Total (m/s) | * | 6.09 | * Avg. Vel. (m/s) | * | * | 6.09 | * | * |
| * Max Chl Dpth (m) | * | 1.01 | * Hydr. Depth (m) | * | * | 0.58 | * | * |
| * Conv. Total (m3/s) | * | 46.3 | * Conv. (m3/s) | * | * | 46.3 | * | * |
| * Length Wtd. (m) | * | 17.14 | * Wetted Per. (m) | * | * | 5.30 | * | * |
| * Min Ch El (m) | * | 68.71 | * Shear (N/m2) | * | * | 717.33 | * | * |
| * Alpha | * | 1.00 | * Stream Power (N/m s) | * | * | 4365.65 | * | * |
| * Frctn Loss (m) | * | 2.14 | * Cum Volume (1000 m3) | * | * | 0.12 | * | * |
| * C & E Loss (m) | * | 0.04 | * Cum SA (1000 m2) | * | * | 0.21 | * | * |

Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross sections.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.

CROSS SECTION

RIVER: Quabrada 1
REACH: Quebrada 1 RS: 2

INPUT
Description: XS-2
Station Elevation Data num= 10

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 78.64 | 11 | 76.64 | 13 | 71.81 | 23 | 67.03 | 27 | 66.83 |
| 37 | 73.26 | 40 | 74 | 43 | 76.06 | 51 | 78.56 | 61 | 80.16 |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 0 | .06 | 13 | .04 | 37 | .06 |

| Bank Sta: Left | Right | Lengths: Left Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|
| 13 | 37 | 25.17 19.77 | 21.02 | .1 | .3 |

CROSS SECTION OUTPUT Profile #100-YR

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| * E.G. Elev (m) | * | 69.16 | * Element | * | Left OB * | Channel | * | Right OB | * |
| * Vel Head (m) | * | 1.63 | * Wt. n-Val. | * | * | 0.040 | * | | * |
| * W.S. Elev (m) | * | 67.53 | * Reach Len. (m) | * | 25.17 * | 19.77 | * | 21.02 | * |
| * Crit W.S. (m) | * | 67.98 | * Flow Area (m2) | * | * | 3.04 | * | | * |
| * E.G. Slope (m/m) | * | 0.139755 | * Area (m2) | * | * | 3.04 | * | | * |
| * Q Total (m3/s) | * | 17.16 | * Flow (m3/s) | * | * | 17.16 | * | | * |
| * Top Width (m) | * | 6.13 | * Top Width (m) | * | * | 6.13 | * | | * |
| * Vel Total (m/s) | * | 5.65 | * Avg. Vel. (m/s) | * | * | 5.65 | * | | * |
| * Max Chl Dpth (m) | * | 0.70 | * Hydr. Depth (m) | * | * | 0.50 | * | | * |
| * Conv. Total (m3/s) | * | 45.9 | * Conv. (m3/s) | * | * | 45.9 | * | | * |
| * Length Wtd. (m) | * | 19.77 | * Wetted Per. (m) | * | * | 6.45 | * | | * |
| * Min Ch El (m) | * | 66.83 | * Shear (N/m2) | * | * | 644.63 | * | | * |
| * Alpha | * | 1.00 | * Stream Power (N/m s) | * | * | 3643.79 | * | | * |
| * Frctn Loss (m) | * | 2.38 | * Cum Volume (1000 m3) | * | * | 0.07 | * | | * |
| * C & E Loss (m) | * | 0.08 | * Cum SA (1000 m2) | * | * | 0.11 | * | | * |

Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross sections.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.

CROSS SECTION

RIVER: Quebrada 1
REACH: Quebrada 1 RS: 1

INPUT
Description: XS-1
Station Elevation Data num= 11

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 81.09 | 11 | 78.29 | 22 | 72.53 | 24 | 71.8 | 34 | 64.91 |
| 36 | 65 | 39 | 66.81 | 42.5 | 68.5 | 46 | 69.56 | 57 | 72.76 |
| 62 | 74.36 | | | | | | | | |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 0 | .06 | 24 | .04 | 46 | .06 |

| Bank Sta: Left | Right | Lengths: Left Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|
| 24 | 46 | 0 0 | 0 | .1 | .3 |

CROSS SECTION OUTPUT Profile #100-YR

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| * E.G. Elev (m) | * | 67.14 | * Element | * | Left OB * | Channel | * | Right OB | * |
| * Vel Head (m) | * | 1.18 | * Wt. n-Val. | * | * | 0.040 | * | | * |
| * W.S. Elev (m) | * | 65.96 | * Reach Len. (m) | * | * | | * | | * |
| * Crit W.S. (m) | * | 66.34 | * Flow Area (m2) | * | * | 3.57 | * | | * |
| * E.G. Slope (m/m) | * | 0.069190 | * Area (m2) | * | * | 3.57 | * | | * |
| * Q Total (m3/s) | * | 17.16 | * Flow (m3/s) | * | * | 17.16 | * | | * |
| * Top Width (m) | * | 5.11 | * Top Width (m) | * | * | 5.11 | * | | * |
| * Vel Total (m/s) | * | 4.81 | * Avg. Vel. (m/s) | * | * | 4.81 | * | | * |
| * Max Chl Dpth (m) | * | 1.05 | * Hydr. Depth (m) | * | * | 0.70 | * | | * |
| * Conv. Total (m3/s) | * | 65.2 | * Conv. (m3/s) | * | * | 65.2 | * | | * |
| * Length Wtd. (m) | * | | * Wetted Per. (m) | * | * | 5.71 | * | | * |
| * Min Ch El (m) | * | 64.91 | * Shear (N/m2) | * | * | 424.26 | * | | * |
| * Alpha | * | 1.00 | * Stream Power (N/m s) | * | * | 2040.05 | * | | * |
| * Frctn Loss (m) | * | 1.89 | * Cum Volume (1000 m3) | * | * | | * | | * |
| * C & E Loss (m) | * | 0.13 | * Cum SA (1000 m2) | * | * | | * | | * |

Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross sections.

Warning: The energy loss was greater than 1.0 ft (0.3 m), between the current and previous cross section. This may indicate the need for additional cross sections.

**********

SUMMARY OF MANNING'S N VALUES

River:Quebrada 1

| Reach | River Sta. | n1 | n2 | n3 |
|---|---|---|---|---|
| Quebrada 1 | 13 | .06 | .04 | .06 |
| Quebrada 1 | 12 | .06 | .04 | .06 |
| Quebrada 1 | 11 | .06 | .04 | .06 |
| Quebrada 1 | 10 | .06 | .04 | .06 |
| Quebrada 1 | 9.9 | .06 | .04 | .06 |
| Quebrada 1 | 9.8 | Culvert | | |
| Quebrada 1 | 9.5 | .06 | .04 | .06 |
| Quebrada 1 | 9 | .06 | .04 | .06 |
| Quebrada 1 | 8 | .06 | .04 | .06 |
| Quebrada 1 | 7 | .06 | .04 | .06 |
| Quebrada 1 | 6 | .06 | .04 | .06 |
| Quebrada 1 | 5 | .06 | .04 | .06 |
| Quebrada 1 | 4 | .06 | .04 | .06 |
| Quebrada 1 | 3 | .06 | .04 | .06 |
| Quebrada 1 | 2 | .06 | .04 | .06 |
| Quebrada 1 | 1 | .06 | .04 | .06 |

**********

SUMMARY OF REACH LENGTHS

River: Quebrada 1

| Reach | River Sta. | Left | Channel | Right |
|---|---|---|---|---|
| Quebrada 1 | 13 | 54.4 | 44.38 | 26.68 |
| Quebrada 1 | 12 | 50.14 | 52.12 | 56.66 |
| Quebrada 1 | 11 | 49.17 | 48.31 | 45.22 |
| Quebrada 1 | 10 | 1 | 1 | 1 |
| Quebrada 1 | 9.9 | 24.97 | 26.42 | 30.92 |
| Quebrada 1 | 9.8 | Culvert | | |
| Quebrada 1 | 9.5 | 25.97 | 27.415 | 31.92 |
| Quebrada 1 | 9 | 33.69 | 35.62 | 32.02 |
| Quebrada 1 | 8 | 45.96 | 40.98 | 39.74 |
| Quebrada 1 | 7 | 33.54 | 34.44 | 40.02 |
| Quebrada 1 | 6 | 22.84 | 27.3 | 31.45 |
| Quebrada 1 | 5 | 13.04 | 13.18 | 14.98 |
| Quebrada 1 | 4 | 11.19 | 18.23 | 22.85 |
| Quebrada 1 | 3 | 17.32 | 17.14 | 14.33 |
| Quebrada 1 | 2 | 25.17 | 19.77 | 21.02 |
| Quebrada 1 | 1 | 0 | 0 | 0 |

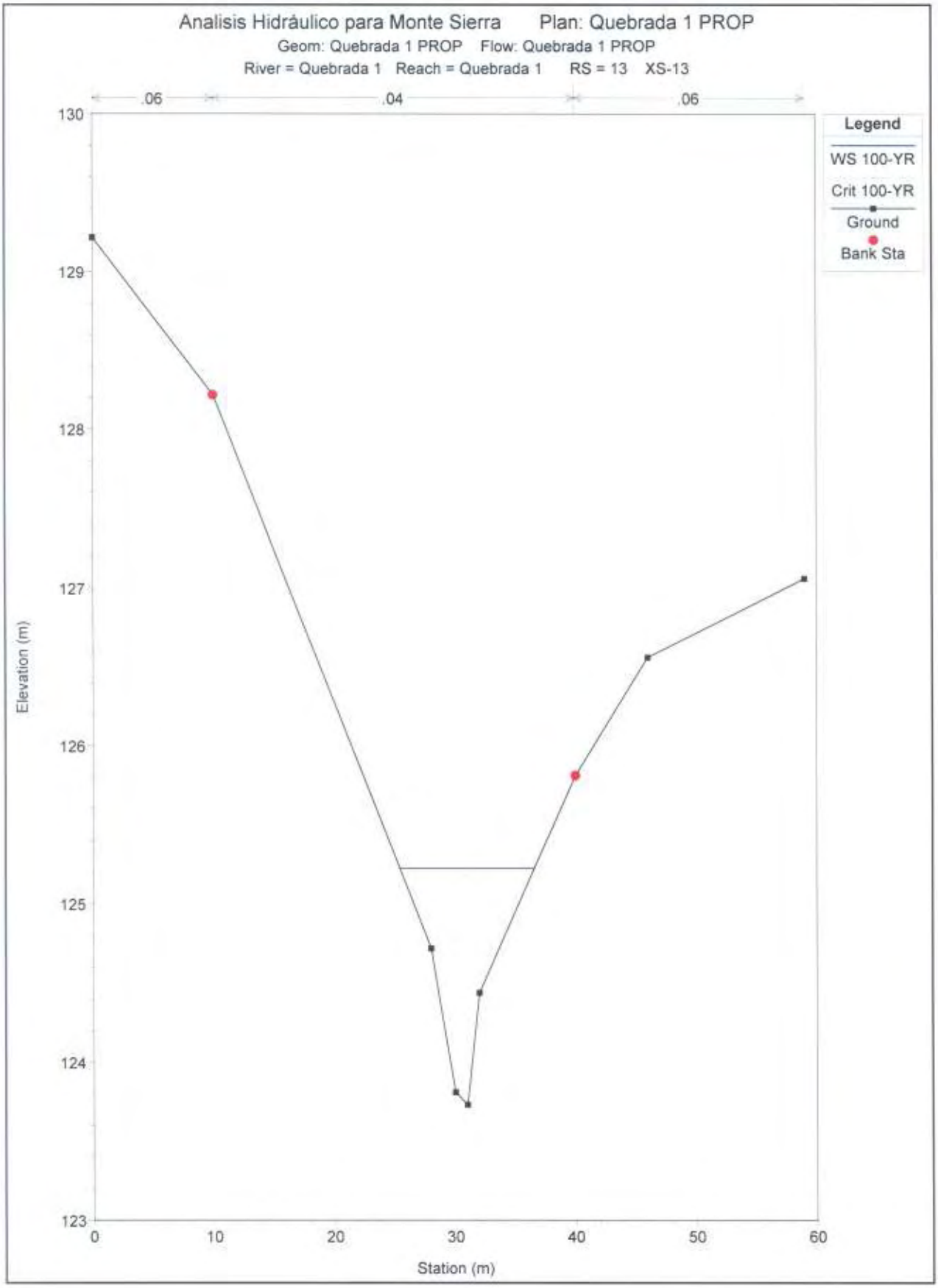
**********

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS
River: Quebrada 1

| Reach | River Sta. | Contr. | Expan. |
|---|---|---|---|
| Quebrada 1 | 13 | .1 | .3 |
| Quebrada 1 | 12 | .1 | .3 |
| Quebrada 1 | 11 | .1 | .3 |
| Quebrada 1 | 10 | .2 | .4 |
| Quebrada 1 | 9.9 | .2 | .4 |
| Quebrada 1 | 9.8 | Culvert | |
| Quebrada 1 | 9.5 | .2 | .4 |
| Quebrada 1 | 9 | .1 | .3 |
| Quebrada 1 | 8 | .1 | .3 |
| Quebrada 1 | 7 | .1 | .3 |
| Quebrada 1 | 6 | .1 | .3 |
| Quebrada 1 | 5 | .1 | .3 |
| Quebrada 1 | 4 | .1 | .3 |
| Quebrada 1 | 3 | .1 | .3 |
| Quebrada 1 | 2 | .1 | .3 |
| Quebrada 1 | 1 | .1 | .3 |

HEC-RAS Plan: QUEB 1 PROP River: Quebrada 1 Reach: Quebrada 1 Profile: 100-YR

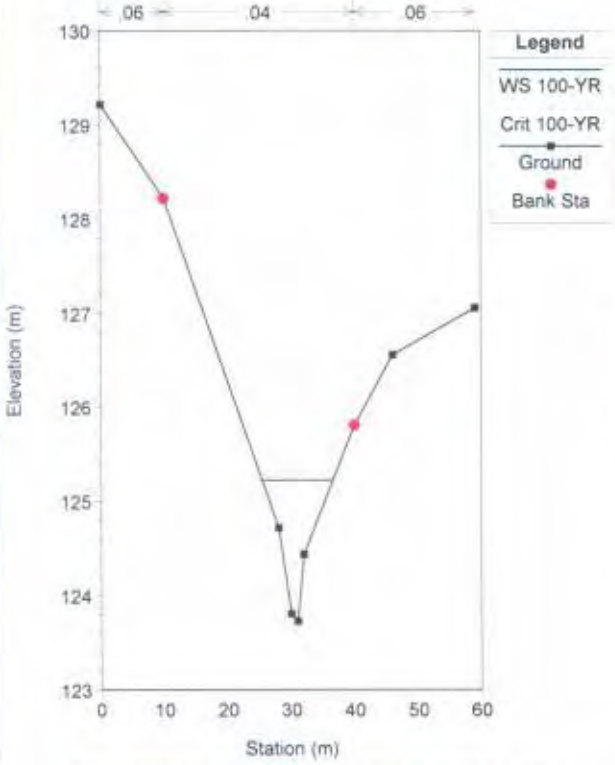
| Reach | River Sta | Profile | Q Total | Min Ch El | W.S. Elev | Crit W.S. | E.G. Elev | E.G. Slope | Vel Chnl | Flow Area | Top Width | Froude # Chl |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (m3/s) | (m) | (m) | (m) | (m) | (m/m) | (m/s) | (m2) | (m) | |
| Quebrada 1 | 1 | 100-YR | 17.16 | 64.91 | 65.96 | 66.34 | 67.14 | 0.069190 | 4.81 | 3.57 | 5.11 | 1.84 |
| Quebrada 1 | 2 | 100-YR | 17.16 | 66.83 | 67.53 | 67.98 | 69.16 | 0.139755 | 5.65 | 3.04 | 6.13 | 2.56 |
| Quebrada 1 | 3 | 100-YR | 17.16 | 68.71 | 69.72 | 70.25 | 71.61 | 0.137562 | 6.09 | 2.82 | 4.83 | 2.54 |
| Quebrada 1 | 4 | 100-YR | 17.16 | 71.35 | 72.29 | 72.75 | 73.80 | 0.101768 | 5.43 | 3.16 | 5.16 | 2.22 |
| Quebrada 1 | 5 | 100-YR | 17.16 | 73.43 | 74.03 | 74.39 | 75.28 | 0.120940 | 4.96 | 3.46 | 7.77 | 2.37 |
| Quebrada 1 | 6 | 100-YR | 17.16 | 77.04 | 77.52 | 78.29 | 83.99 | 0.939040 | 11.27 | 1.52 | 4.53 | 6.20 |
| Quebrada 1 | 7 | 100-YR | 17.16 | 85.05 | 86.24 | 86.25 | 86.62 | 0.019102 | 2.72 | 6.31 | 8.58 | 1.01 |
| Quebrada 1 | 8 | 100-YR | 17.16 | 86.17 | 87.17 | 87.45 | 88.04 | 0.059141 | 4.15 | 4.14 | 6.99 | 1.72 |
| Quebrada 1 | 9 | 100-YR | 17.16 | 89.03 | 89.69 | 90.23 | 91.88 | 0.185200 | 6.56 | 2.62 | 5.14 | 2.93 |
| Quebrada 1 | 9.5 | 100-YR | 17.16 | 92.40 | 93.19 | 93.19 | 93.48 | 0.019588 | 2.37 | 7.24 | 12.81 | 1.01 |
| Quebrada 1 | 9.8 | | Culvert | | | | | | | | | |
| Quebrada 1 | 9.9 | 100-YR | 17.16 | 95.76 | 97.18 | 96.33 | 97.20 | 0.000695 | 0.66 | 25.95 | 25.56 | 0.21 |
| Quebrada 1 | 10 | 100-YR | 17.16 | 96.76 | 97.16 | 97.29 | 97.59 | 0.063270 | 2.93 | 5.87 | 18.44 | 1.66 |
| Quebrada 1 | 11 | 100-YR | 17.16 | 101.83 | 102.07 | 102.60 | 107.16 | 1.272096 | 10.00 | 1.72 | 8.05 | 6.91 |
| Quebrada 1 | 12 | 100-YR | 17.16 | 109.05 | 110.32 | 110.32 | 110.72 | 0.018592 | 2.81 | 6.12 | 7.65 | 1.00 |
| Quebrada 1 | 13 | 100-YR | 17.16 | 123.73 | 125.22 | 125.22 | 125.53 | 0.019698 | 2.48 | 6.93 | 11.14 | 1.00 |


Analisis Hidráulico para Monte Sierra Plan: Quebrada 1 PROP
Geom: Quebrada 1 PROP Flow: Quebrada 1 PROP
River = Quebrada 1 Reach = Quebrada 1 RS = 13 XS-13
.06
.04
.06
Legend
WS 100-YR
Crit 100-YR
Ground
Bank Sta
Elevation (m)
130
129
128
127
126
125
124
123
0
10
20
30
40
50
60
Station (m)

Analisis Hidráulico para Monte Sierra Plan: Quebrada 1 PROP

Geom: Quebrada 1 PROP Flow: Quebrada 1 PROP

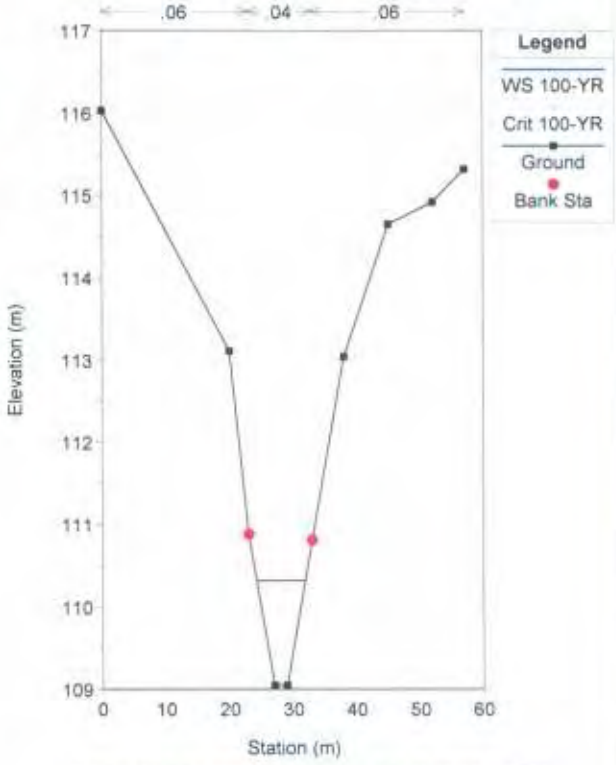
River = Quebrada 1 Reach = Quebrada 1 RS = 13 XS-13




Analisis Hidráulico para Monte Sierra Plan: Quebrada 1 PROP

Geom: Quebrada 1 PROP Flow: Quebrada 1 PROP

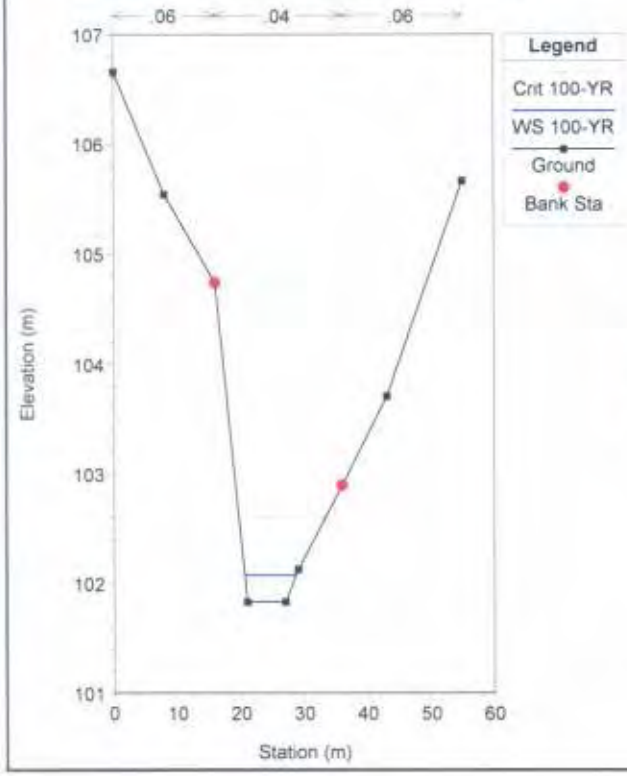
River = Quebrada 1 Reach = Quebrada 1 RS = 12 XS-12




Analisis Hidráulico para Monte Sierra Plan: Quebrada 1 PROP

Geom: Quebrada 1 PROP Flow: Quebrada 1 PROP

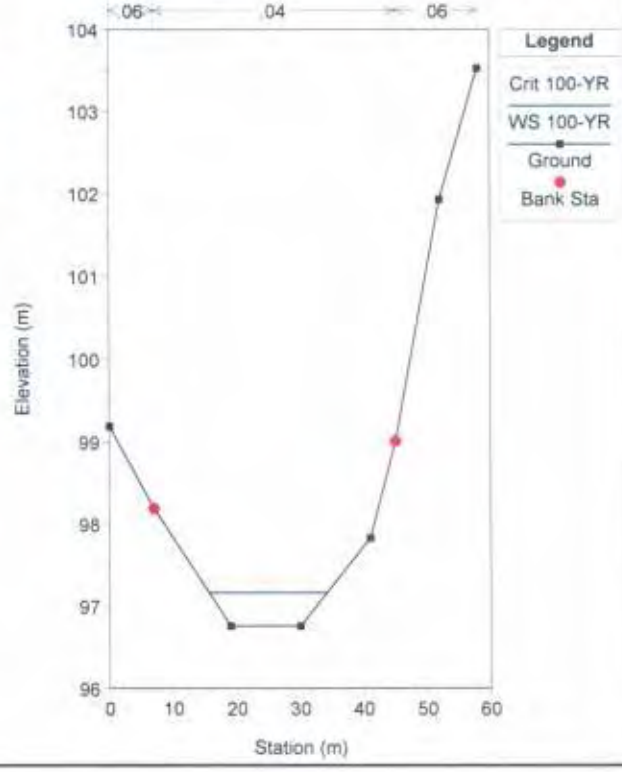
River = Quebrada 1 Reach = Quebrada 1 RS = 11 XS-11

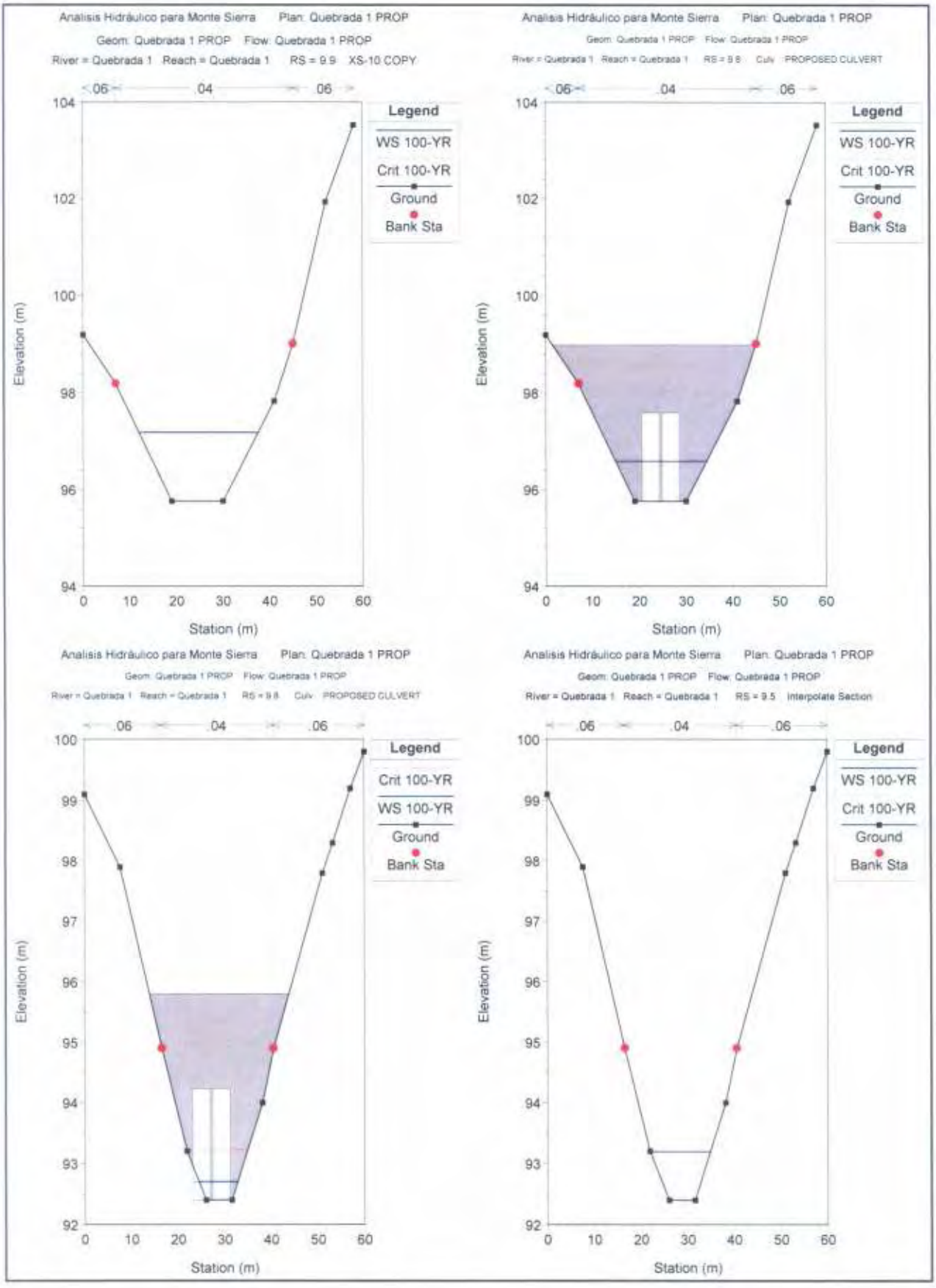


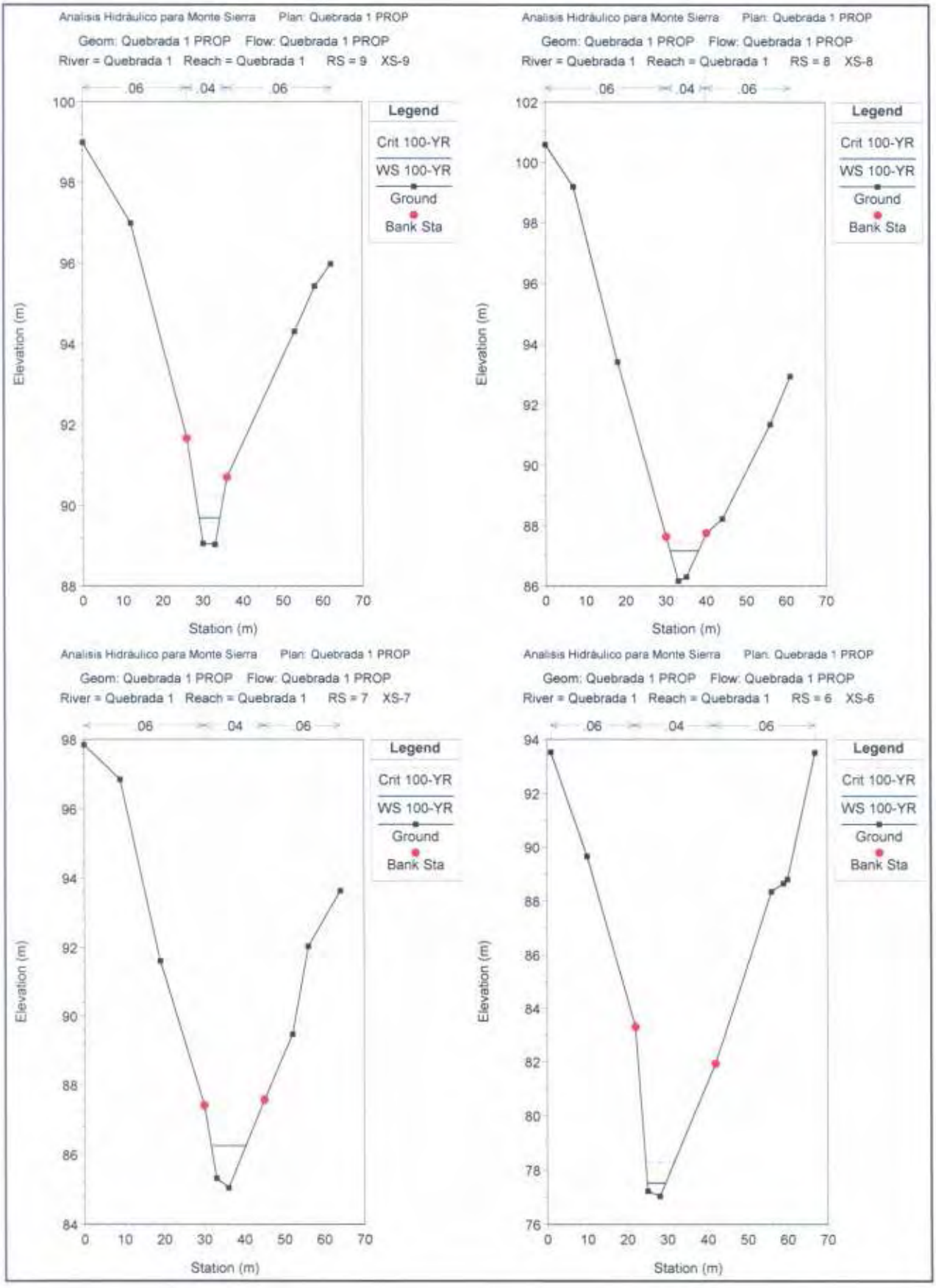

Analisis Hidráulico para Monte Sierra Plan: Quebrada 1 PROP

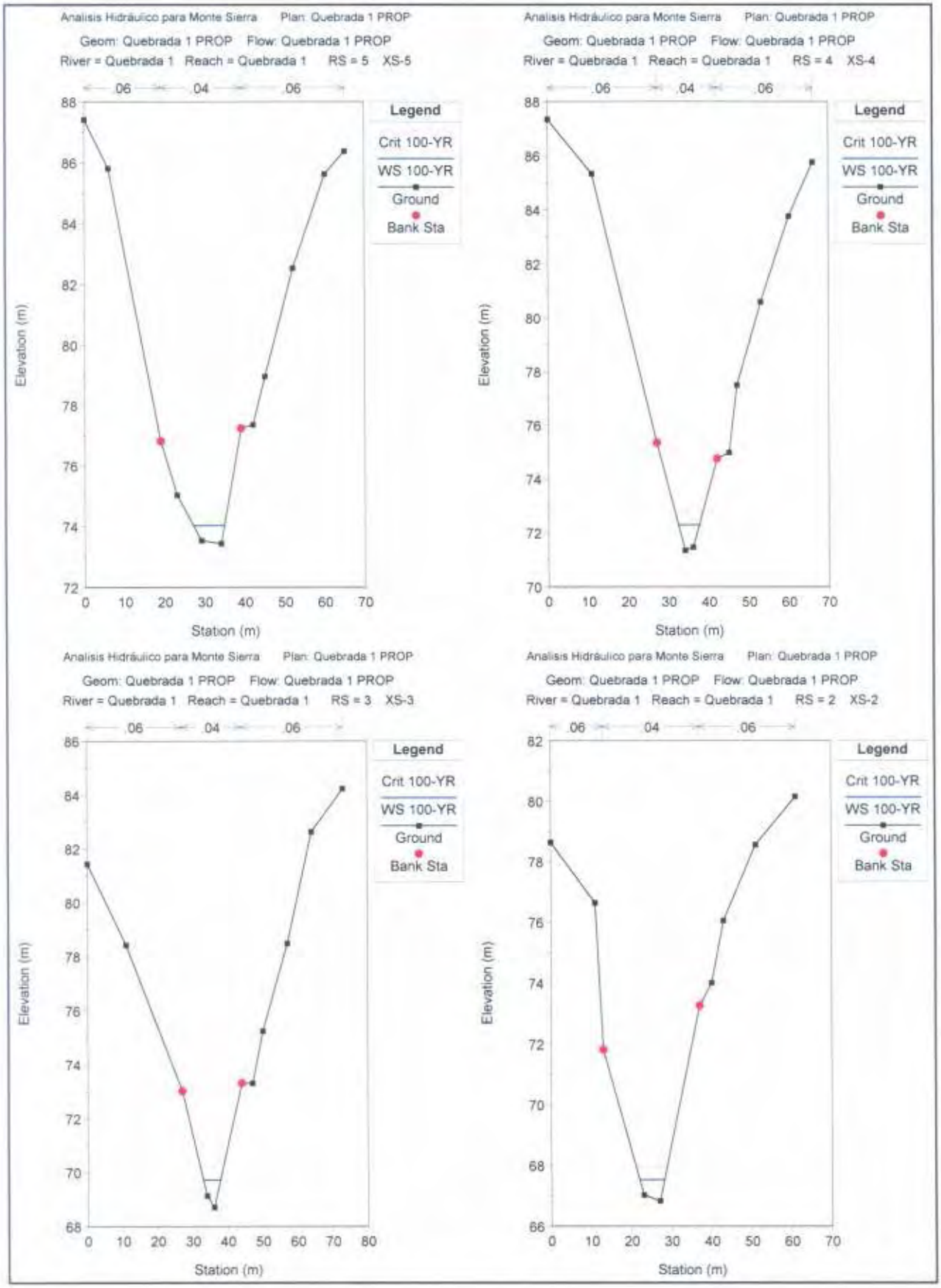
Geom: Quebrada 1 PROP Flow: Quebrada 1 PROP

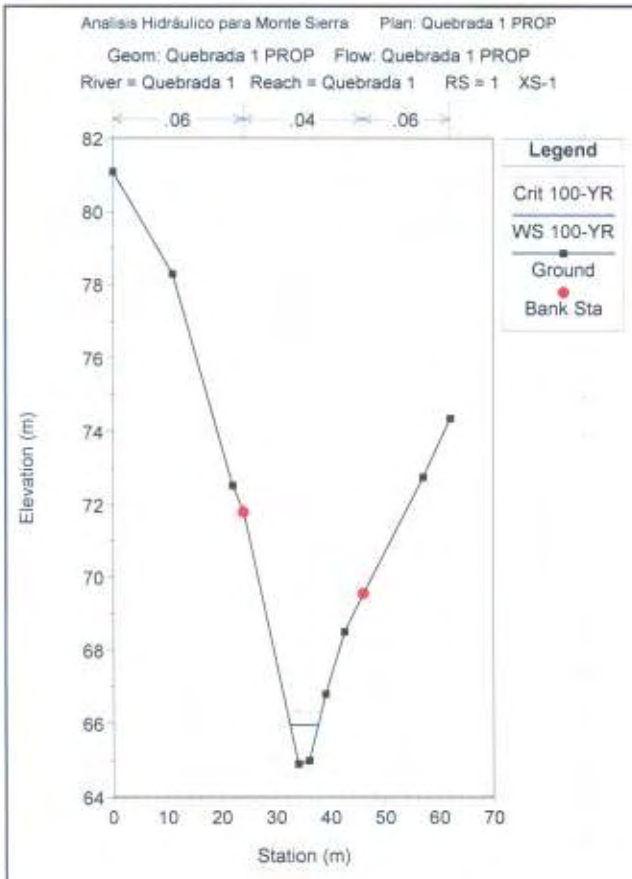
River = Quebrada 1 Reach = Quebrada 1 RS = 10 XS-10




Analisis Hidráulico para Monte Sierra Plan: Quebrada 1 PROP
Geom: Quebrada 1 PROP Flow: Quebrada 1 PROP
River = Quebrada 1 Reach = Quebrada 1 RS = 9.9 XS-10 COPY
Legend
WS 100-YR
Crit 100-YR
Ground
Bank Sta
Elevation (m)
Station (m)
Analisis Hidráulico para Monte Sierra Plan: Quebrada 1 PROP
Geom: Quebrada 1 PROP Flow: Quebrada 1 PROP
River = Quebrada 1 Reach = Quebrada 1 RS = 9.8 Culv PROPOSED CULVERT
Legend
WS 100-YR
Crit 100-YR
Ground
Bank Sta
Elevation (m)
Station (m)
Analisis Hidráulico para Monte Sierra Plan: Quebrada 1 PROP
Geom: Quebrada 1 PROP Flow: Quebrada 1 PROP
River = Quebrada 1 Reach = Quebrada 1 RS = 9.8 Culv PROPOSED CULVERT
Legend
Crit 100-YR
WS 100-YR
Ground
Bank Sta
Elevation (m)
Station (m)
Analisis Hidráulico para Monte Sierra Plan: Quebrada 1 PROP
Geom: Quebrada 1 PROP Flow: Quebrada 1 PROP
River = Quebrada 1 Reach = Quebrada 1 RS = 9.5 Interpolate Section
Legend
WS 100-YR
Crit 100-YR
Ground
Bank Sta
Elevation (m)
Station (m)


Analisis Hidráulico para Monte Sierra Plan: Quebrada 1 PROP
Geom: Quebrada 1 PROP Flow: Quebrada 1 PROP
River = Quebrada 1 Reach = Quebrada 1 RS = 9 XS-9
.06 .04 .06
Legend
Crit 100-YR
WS 100-YR
Ground
Bank Sta
Elevation (m)
Station (m)
Analisis Hidráulico para Monte Sierra Plan: Quebrada 1 PROP
Geom: Quebrada 1 PROP Flow: Quebrada 1 PROP
River = Quebrada 1 Reach = Quebrada 1 RS = 8 XS-8
.06 .04 .06
Legend
Crit 100-YR
WS 100-YR
Ground
Bank Sta
Elevation (m)
Station (m)
Analisis Hidráulico para Monte Sierra Plan: Quebrada 1 PROP
Geom: Quebrada 1 PROP Flow: Quebrada 1 PROP
River = Quebrada 1 Reach = Quebrada 1 RS = 7 XS-7
.06 .04 .06
Legend
Crit 100-YR
WS 100-YR
Ground
Bank Sta
Elevation (m)
Station (m)
Analisis Hidráulico para Monte Sierra Plan: Quebrada 1 PROP
Geom: Quebrada 1 PROP Flow: Quebrada 1 PROP
River = Quebrada 1 Reach = Quebrada 1 RS = 6 XS-6
.06 .04 .06
Legend
Crit 100-YR
WS 100-YR
Ground
Bank Sta
Elevation (m)
Station (m)


Analisis Hidráulico para Monte Sierra Plan: Quebrada 1 PROP
Geom: Quebrada 1 PROP Flow: Quebrada 1 PROP
River = Quebrada 1 Reach = Quebrada 1 RS = 5 XS-5
.06 .04 .06
Legend
Crit 100-YR
WS 100-YR
Ground
Bank Sta
Elevation (m)
Station (m)
Analisis Hidráulico para Monte Sierra Plan: Quebrada 1 PROP
Geom: Quebrada 1 PROP Flow: Quebrada 1 PROP
River = Quebrada 1 Reach = Quebrada 1 RS = 4 XS-4
.06 .04 .06
Legend
Crit 100-YR
WS 100-YR
Ground
Bank Sta
Elevation (m)
Station (m)
Analisis Hidráulico para Monte Sierra Plan: Quebrada 1 PROP
Geom: Quebrada 1 PROP Flow: Quebrada 1 PROP
River = Quebrada 1 Reach = Quebrada 1 RS = 3 XS-3
.06 .04 .06
Legend
Crit 100-YR
WS 100-YR
Ground
Bank Sta
Elevation (m)
Station (m)
Analisis Hidráulico para Monte Sierra Plan: Quebrada 1 PROP
Geom: Quebrada 1 PROP Flow: Quebrada 1 PROP
River = Quebrada 1 Reach = Quebrada 1 RS = 2 XS-2
.06 .04 .06
Legend
Crit 100-YR
WS 100-YR
Ground
Bank Sta
Elevation (m)
Station (m)


Analisis Hidráulico para Monte Sierra Plan: Quebrada 1 PROP
Geom: Quebrada 1 PROP Flow: Quebrada 1 PROP
River = Quebrada 1 Reach = Quebrada 1 RS = 1 XS-1
.06
.04
.06
Legend
Crit 100-YR
WS 100-YR
Ground
Bank Sta
Elevation (m)
Station (m)
82
80
78
76
74
72
70
68
66
64
0
10
20
30
40
50
60
70

# GEOMETRÍA: QUEBRADA 2 EXIS

HEC-RAS Version 3.1.3 May 2005
U.S. Army Corp of Engineers
Hydrologic Engineering Center
609 Second Street
Davis, California

```
X     X  XXXXXX    XXXX        XXXX       XX      XXXX
X     X  X        X    X      X   X     X  X     X
X     X  X        X           X   X     X    X   X
XXXXXXX  XXXX     X       XXX  XXXX     XXXXXX    XXXX
X     X  X        X           X  X      X    X       X
X     X  X        X    X      X   X     X    X       X
X     X  XXXXXX    XXXX       X    X    X    X   XXXXX
```

**********

PROJECT DATA
Project Title: Analisis Hidráulico para Monte Sierra
Project File : Sierra.prj
Run Date and Time: 5/29/2007 3:46:56 PM

Project in SI units

Project Description:
& RAnalisis Hidráaulico Monte Sierra, Mayaguez

**********

PLAN DATA

Plan Title: Quebrada 2 EXIS
Plan File : C:\Trabajos en proceso\Sierra\RAS\2007\Sierra.p08

Geometry Title: Quebrada 2 EXIS
Geometry File : C:\Trabajos en proceso\Sierra\RAS\2007\Sierra.g03

Flow Title : Quebrada 2 EXIS
Flow File : C:\Trabajos en proceso\Sierra\RAS\2007\Sierra.f08

Plan Summary Information:
Number of: Cross Sections = 6 Multiple Openings = 0
Culverts = 0 Inline Structures = 0
Bridges = 0 Lateral Structures = 0

Computational Information
Water surface calculation tolerance = 0.003
Critical depth calculation tolerance = 0.003
Maximum number of iterations = 20
Maximum difference tolerance = 0.1
Flow tolerance factor = 0.001

Computation Options
Critical depth computed only where necessary
Conveyance Calculation Method: At breaks in n values only
Friction Slope Method: Average Conveyance
Computational Flow Regime: Mixed Flow

**********

FLOW DATA

Flow Title: Quebrada 2 EXIS
Flow File : C:\Trabajos en proceso\Sierra\RAS\2007\Sierra.f08

Flow Data (m3/s)

| River | Reach | RS | 100-YR |
|---|---|---|---|
| Quebrada 2 | Quebrada 2 | 5 | 14.27 |
| Quebrada 2 | Quebrada 2 | 4 | 14.27 |
| Quebrada 2 | Quebrada 2 | 3 | 14.27 |
| Quebrada 2 | Quebrada 2 | 2 | 14.27 |
| Quebrada 2 | Quebrada 2 | 1 | 14.27 |

Boundary Conditions

| River | Reach | Profile | Upstream | Downstream |
|---|---|---|---|---|
| Quebrada 2 | Quebrada 2 | 100-YR | Critical | Critical |

**********

GEOMETRY DATA

Geometry Title: Quebrada 2 EXIS
Geometry File : C:\Trabajos en proceso\Sierra\RAS\2007\Sierra.g03

CROSS SECTION

RIVER: Quebrada 2
REACH: Quebrada 2 RS: 5

INPUT
Description:
Station Elevation Data num= 4

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|
| 0 | 120 | 44.76 | 115 | 55.84 | 110 | 76.91 | 115 |

```
Manning's n Values        num=      3
     Sta   n Val     Sta   n Val     Sta   n Val
*********************************************
       0     .06   44.76     .04   76.91     .06

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
          44.76  76.91             77.88  57.12    37            .1       .3

CROSS SECTION OUTPUT  Profile #100-YR
*****************************************************************************************
* E.G. Elev (m)       *  111.65  * Element             *  Left OB *  Channel * Right OB *
* Vel Head (m)        *    0.33  * Wt. n-Val.          *          *    0.040 *          *
* W.S. Elev (m)       *  111.32  * Reach Len. (m)      *   77.88  *   57.12  *   37.00  *
* Crit W.S. (m)       *  111.32  * Flow Area (m2)      *          *    5.60  *          *
* E.G. Slope (m/m)    *0.019328  * Area (m2)           *          *    5.60  *          *
* Q Total (m3/s)      *   14.27  * Flow (m3/s)         *          *   14.27  *          *
* Top Width (m)       *    8.49  * Top Width (m)       *          *    8.49  *          *
* Vel Total (m/s)     *    2.55  * Avg. Vel. (m/s)     *          *    2.55  *          *
* Max Chl Dpth (m)    *    1.32  * Hydr. Depth (m)     *          *    0.66  *          *
* Conv. Total (m3/s)  *   102.6  * Conv. (m3/s)       *          *   102.6  *          *
* Length Wtd. (m)     *   57.12  * Wetted Per. (m)     *          *    8.93  *          *
* Min Ch El (m)       *  110.00  * Shear (N/m2)        *          *  118.94  *          *
* Alpha               *    1.00  * Stream Power (N/m s) *          *  303.02  *          *
* Frctn Loss (m)      *    1.11  * Cum Volume (1000 m3) *          *    0.95  *          *
* C & E Loss (m)      *    0.00  * Cum SA (1000 m2)     *          *    1.99  *          *
*****************************************************************************************

Warning: The energy equation could not be balanced within the specified number of iterations.  The
         program used critical depth for the water surface and continued on with the calculations.
Warning: The energy loss was greater than 1.0 ft (0.3 m), between the current and previous cross
         section.  This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical
         depth, the calculated water surface came back below critical depth.  This indicates that there
         is not a valid subcritical answer.  The program defaulted to critical depth.

CROSS SECTION


RIVER: Quebrada 2
REACH: Quebrada 2         RS: 4

INPUT
Description:
Station Elevation Data    num=      3
     Sta     Elev     Sta     Elev     Sta     Elev
*********************************************
    47.6      110   61.12      105   75.56      110

Manning's n Values        num=      3
     Sta   n Val     Sta   n Val     Sta   n Val
*********************************************
    47.6     .06    47.6     .04   75.56     .06

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
          47.6   75.56             107.82  100.83  99.04         .1       .3

CROSS SECTION OUTPUT  Profile #100-YR
*****************************************************************************************
* E.G. Elev (m)       *  108.60  * Element             *  Left OB *  Channel * Right OB *
* Vel Head (m)        *    2.76  * Wt. n-Val.          *          *    0.040 *          *
* W.S. Elev (m)       *  105.83  * Reach Len. (m)      *  107.82  *  100.83  *   99.04  *
* Crit W.S. (m)       *  106.39  * Flow Area (m2)      *          *    1.94  *          *
* E.G. Slope (m/m)    *0.302580  * Area (m2)           *          *    1.94  *          *
* Q Total (m3/s)      *   14.27  * Flow (m3/s)         *          *   14.27  *          *
* Top Width (m)       *    4.66  * Top Width (m)       *          *    4.66  *          *
* Vel Total (m/s)     *    7.36  * Avg. Vel. (m/s)     *          *    7.36  *          *
* Max Chl Dpth (m)    *    0.83  * Hydr. Depth (m)     *          *    0.42  *          *
* Conv. Total (m3/s)  *    25.9  * Conv. (m3/s)       *          *    25.9  *          *
* Length Wtd. (m)     *  100.83  * Wetted Per. (m)     *          *    4.94  *          *
* Min Ch El (m)       *  105.00  * Shear (N/m2)        *          * 1162.87  *          *
* Alpha               *    1.00  * Stream Power (N/m s) *          * 8563.98  *          *
* Frctn Loss (m)      *    2.81  * Cum Volume (1000 m3) *          *    0.73  *          *
* C & E Loss (m)      *    0.24  * Cum SA (1000 m2)     *          *    1.61  *          *
*****************************************************************************************

Warning: The velocity head has changed by more than 0.5 ft (0.15 m).  This may indicate the need for
         additional cross sections.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than
         0.7 or greater than 1.4.  This may indicate the need for additional cross sections.
Warning: The energy loss was greater than 1.0 ft (0.3 m), between the current and previous cross
         section.  This may indicate the need for additional cross sections.

CROSS SECTION


RIVER: Quebrada 2
REACH: Quebrada 2         RS: 3

INPUT
Description:
Station Elevation Data    num=      6
     Sta     Elev     Sta     Elev     Sta     Elev     Sta     Elev     Sta     Elev
*********************************************************************************
       0      100   11.14       95   29.91       90   49.94       95   79.11      100
   95.71      105

Manning's n Values        num=      3
     Sta   n Val     Sta   n Val     Sta   n Val
*********************************************
       0     .06   11.14     .04   49.94     .06

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
          11.14  49.94             42.38  97.53  152.55         .1       .3
```

CROSS SECTION OUTPUT Profile #100-YR

| | | | | | | |
|---|---|---|---|---|---|---|
| E.G. Elev (m) | 91.94 | Element | Left OB | Channel | Right OB | |
| Vel Head (m) | 1.04 | Wt. n-Val. | | 0.040 | | |
| W.S. Elev (m) | 90.90 | Reach Len. (m) | 42.38 | 97.53 | 152.55 | |
| Crit W.S. (m) | 91.22 | Flow Area (m2) | | 3.16 | | |
| E.G. Slope (m/m) | *0.098783 | Area (m2) | | 3.16 | | |
| Q Total (m3/s) | 14.27 | Flow (m3/s) | | 14.27 | | |
| Top Width (m) | 7.00 | Top Width (m) | | 7.00 | | |
| Vel Total (m/s) | 4.52 | Avg. Vel. (m/s) | | 4.52 | | |
| Max Chl Dpth (m) | 0.90 | Hydr. Depth (m) | | 0.45 | | |
| Conv. Total (m3/s) | 45.4 | Conv. (m3/s) | | 45.4 | | |
| Length Wtd. (m) | 97.53 | Wetted Per. (m) | | 7.23 | | |
| Min Ch El (m) | 90.00 | Shear (N/m2) | | 422.97 | | |
| Alpha | 1.00 | Stream Power (N/m s) | | 1912.75 | | |
| Frctn Loss (m) | 16.14 | Cum Volume (1000 m3) | | 0.47 | | |
| C & E Loss (m) | 0.52 | Cum SA (1000 m2) | | 1.02 | | |

Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross sections.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Warning: The energy loss was greater than 1.0 ft (0.3 m), between the current and previous cross section. This may indicate the need for additional cross sections.

CROSS SECTION

RIVER: Quebrada 2
REACH: Quebrada 2 RS: 2

INPUT
Description:
Station Elevation Data num= 7

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 80 | 10.26 | 75 | 20.24 | 70 | 35.33 | 65 | 48.23 | 70 |
| 62.58 | 75 | 76.38 | 80 | | | | | | |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 0 | .06 | 10.26 | .04 | 62.58 | .06 |

| Bank Sta: Left | Right | Lengths: Left Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|
| 10.26 | 62.58 | 58.06 | 57.63 | .1 | .3 |

CROSS SECTION OUTPUT Profile #100-YR

| | | | | | | |
|---|---|---|---|---|---|---|
| E.G. Elev (m) | 71.00 | Element | Left OB | Channel | Right OB | |
| Vel Head (m) | 5.29 | Wt. n-Val. | | 0.040 | | |
| W.S. Elev (m) | 65.71 | Reach Len. (m) | 58.06 | 57.63 | 57.69 | |
| Crit W.S. (m) | 66.40 | Flow Area (m2) | | 1.40 | | |
| E.G. Slope (m/m) | *0.719918 | Area (m2) | | 1.40 | | |
| Q Total (m3/s) | 14.27 | Flow (m3/s) | | 14.27 | | |
| Top Width (m) | 3.96 | Top Width (m) | | 3.96 | | |
| Vel Total (m/s) | 10.19 | Avg. Vel. (m/s) | | 10.19 | | |
| Max Chl Dpth (m) | 0.71 | Hydr. Depth (m) | | 0.35 | | |
| Conv. Total (m3/s) | 16.8 | Conv. (m3/s) | | 16.8 | | |
| Length Wtd. (m) | 57.63 | Wetted Per. (m) | | 4.21 | | |
| Min Ch El (m) | 65.00 | Shear (N/m2) | | 2350.56 | | |
| Alpha | 1.00 | Stream Power (N/m s) | | *23951.75 | | |
| Frctn Loss (m) | 20.52 | Cum Volume (1000 m3) | | 0.25 | | |
| C & E Loss (m) | 0.42 | Cum SA (1000 m2) | | 0.49 | | |

Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross sections.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Warning: The energy loss was greater than 1.0 ft (0.3 m), between the current and previous cross section. This may indicate the need for additional cross sections.

CROSS SECTION

RIVER: Quebrada 2
REACH: Quebrada 2 RS: 1

INPUT
Description:
Station Elevation Data num= 8

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 65 | 21.38 | 60 | 36.25 | 55 | 45.29 | 50 | 54.15 | 55 |
| 64.35 | 60 | 73.29 | 65 | 84.4 | 70 | | | | |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 0 | .06 | 36.25 | .04 | 54.15 | .06 |

| Bank Sta: Left | Right | Lengths: Left Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|
| 36.25 | 54.15 | 62.5 | 53.03 | 51.48 | .1 | .3 |

CROSS SECTION OUTPUT Profile #100-YR

| | | | | | | |
|---|---|---|---|---|---|---|
| E.G. Elev (m) | 53.10 | Element | Left OB | Channel | Right OB | |
| Vel Head (m) | 1.97 | Wt. n-Val. | | 0.040 | | |
| W.S. Elev (m) | 51.13 | Reach Len. (m) | 62.50 | 53.03 | 51.48 | |
| Crit W.S. (m) | 51.67 | Flow Area (m2) | | 2.30 | | |
| E.G. Slope (m/m) | *0.158130 | Area (m2) | | 2.30 | | |
| Q Total (m3/s) | 14.27 | Flow (m3/s) | | 14.27 | | |
| Top Width (m) | 4.05 | Top Width (m) | | 4.05 | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| * Vel Total (m/s) | 6.22 | * Avg. Vel. (m/s) | | 6.22 | | | |
| * Max Chl Dpth (m) | 1.13 | * Hydr. Depth (m) | | 0.57 | | | |
| * Conv. Total (m3/s) | 35.9 | * Conv. (m3/s) | | 35.9 | | | |
| * Length Wtd. (m) | 53.03 | * Wetted Per. (m) | | 4.64 | | | |
| * Min Ch El (m) | 50.00 | * Shear (N/m2) | | 766.58 | | | |
| * Alpha | 1.00 | * Stream Power (N/m s) | | 4764.63 | | | |
| * Frctn Loss (m) | 16.90 | * Cum Volume (1000 m3) | | 0.15 | | | |
| * C & E Loss (m) | 1.00 | * Cum SA (1000 m2) | | 0.26 | | | |

Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross sections.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Warning: The energy loss was greater than 1.0 ft (0.3 m), between the current and previous cross section. This may indicate the need for additional cross sections.

CROSS SECTION

RIVER: Quebrada 2
REACH: Quebrada 2 RS: 0

INPUT
Description:
Station Elevation Data num= 5

| Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev | Sta | Elev |
|---|---|---|---|---|---|---|---|---|---|
| 41.16 | 55 | 56.49 | 50 | 64.63 | 45 | 81.46 | 50 | 93.43 | 55 |

Manning's n Values num= 3

| Sta | n Val | Sta | n Val | Sta | n Val |
|---|---|---|---|---|---|
| 41.16 | .06 | 41.16 | .04 | 93.43 | .06 |

| Bank Sta: Left | Right | Lengths: Left Channel | Right | Coeff Contr. | Expan. |
|---|---|---|---|---|---|
| 41.16 | 93.43 | 0 | 0 | .1 | .3 |

CROSS SECTION OUTPUT Profile #100-YR

| | | | | | |
|---|---|---|---|---|---|
| * E.G. Elev (m) | 47.15 | * Element | * Left OB * | Channel * | Right OB * |
| * Vel Head (m) | 1.02 | * Wt. n-Val. | | 0.040 | |
| * W.S. Elev (m) | 46.13 | * Reach Len. (m) | | | |
| * Crit W.S. (m) | 46.46 | * Flow Area (m2) | | 3.18 | |
| * E.G. Slope (m/m) | *0.077010 | * Area (m2) | | 3.18 | |
| * Q Total (m3/s) | 14.27 | * Flow (m3/s) | | 14.27 | |
| * Top Width (m) | 5.64 | * Top Width (m) | | 5.64 | |
| * Vel Total (m/s) | 4.49 | * Avg. Vel. (m/s) | | 4.49 | |
| * Max Chl Dpth (m) | 1.13 | * Hydr. Depth (m) | | 0.56 | |
| * Conv. Total (m3/s) | 51.4 | * Conv. (m3/s) | | 51.4 | |
| * Length Wtd. (m) | | * Wetted Per. (m) | | 6.12 | |
| * Min Ch El (m) | 45.00 | * Shear (N/m2) | | 392.58 | |
| * Alpha | 1.00 | * Stream Power (N/m s) | | 1760.82 | |
| * Frctn Loss (m) | 5.67 | * Cum Volume (1000 m3) | | | |
| * C & E Loss (m) | 0.28 | * Cum SA (1000 m2) | | | |

Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross sections.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Warning: The energy loss was greater than 1.0 ft (0.3 m), between the current and previous cross section. This may indicate the need for additional cross sections.

SUMMARY OF MANNING'S N VALUES

River:Quebrada 2

| Reach | River Sta. | n1 | n2 | n3 |
|---|---|---|---|---|
| Quebrada 2 | 5 | .06 | .04 | .06 |
| Quebrada 2 | 4 | .06 | .04 | .06 |
| Quebrada 2 | 3 | .06 | .04 | .06 |
| Quebrada 2 | 2 | .06 | .04 | .06 |
| Quebrada 2 | 1 | .06 | .04 | .06 |
| Quebrada 2 | 0 | .06 | .04 | .06 |

SUMMARY OF REACH LENGTHS

River: Quebrada 2

| Reach | River Sta. | Left | Channel | Right |
|---|---|---|---|---|
| Quebrada 2 | 5 | 77.88 | 57.12 | 37 |
| Quebrada 2 | 4 | 107.82 | 100.83 | 99.04 |
| Quebrada 2 | 3 | 42.38 | 97.53 | 152.55 |
| Quebrada 2 | 2 | 58.06 | 57.63 | 57.69 |
| Quebrada 2 | 1 | 62.5 | 53.03 | 51.48 |
| Quebrada 2 | 0 | 0 | 0 | 0 |

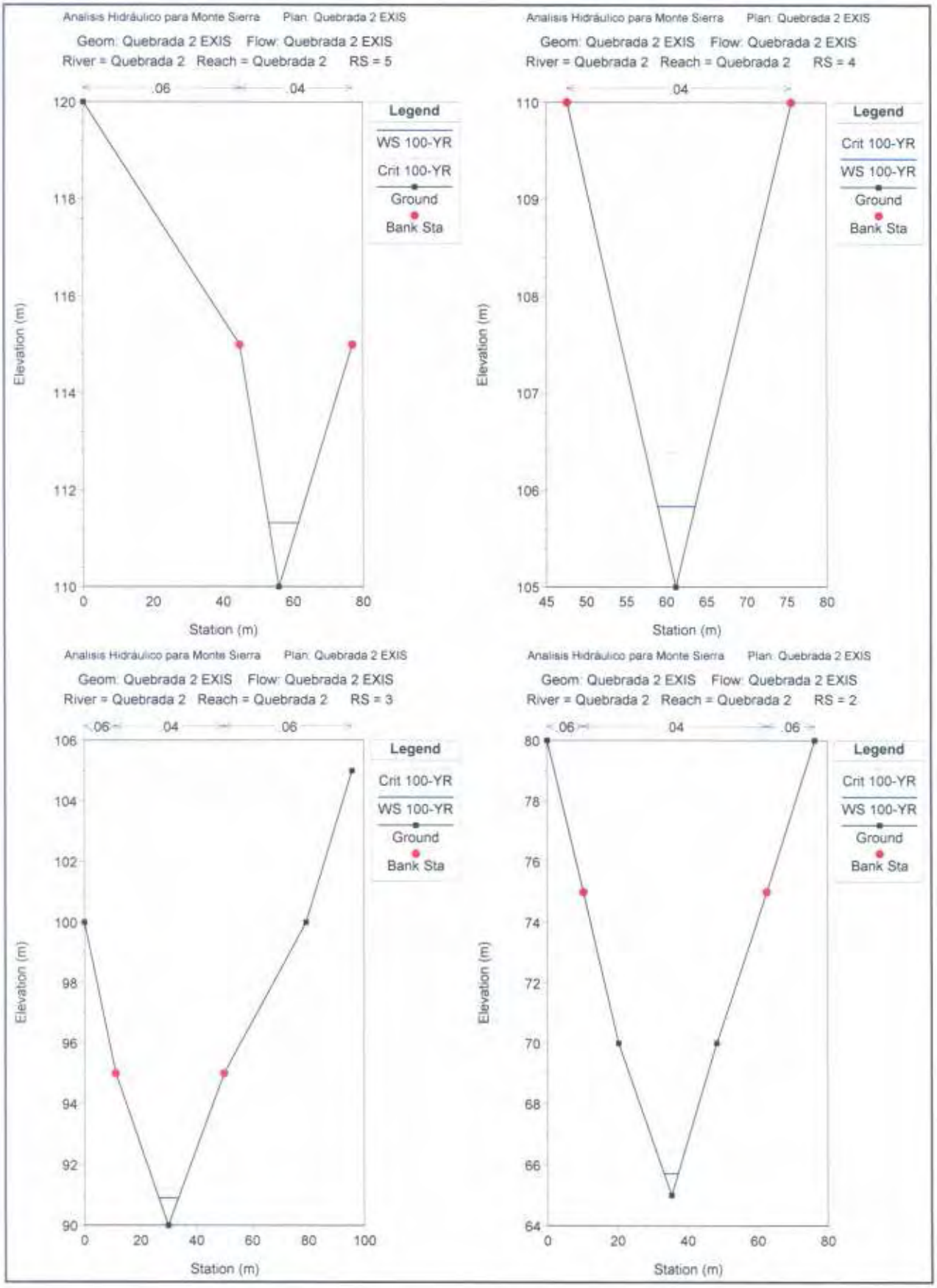
SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS
River: Quebrada 2

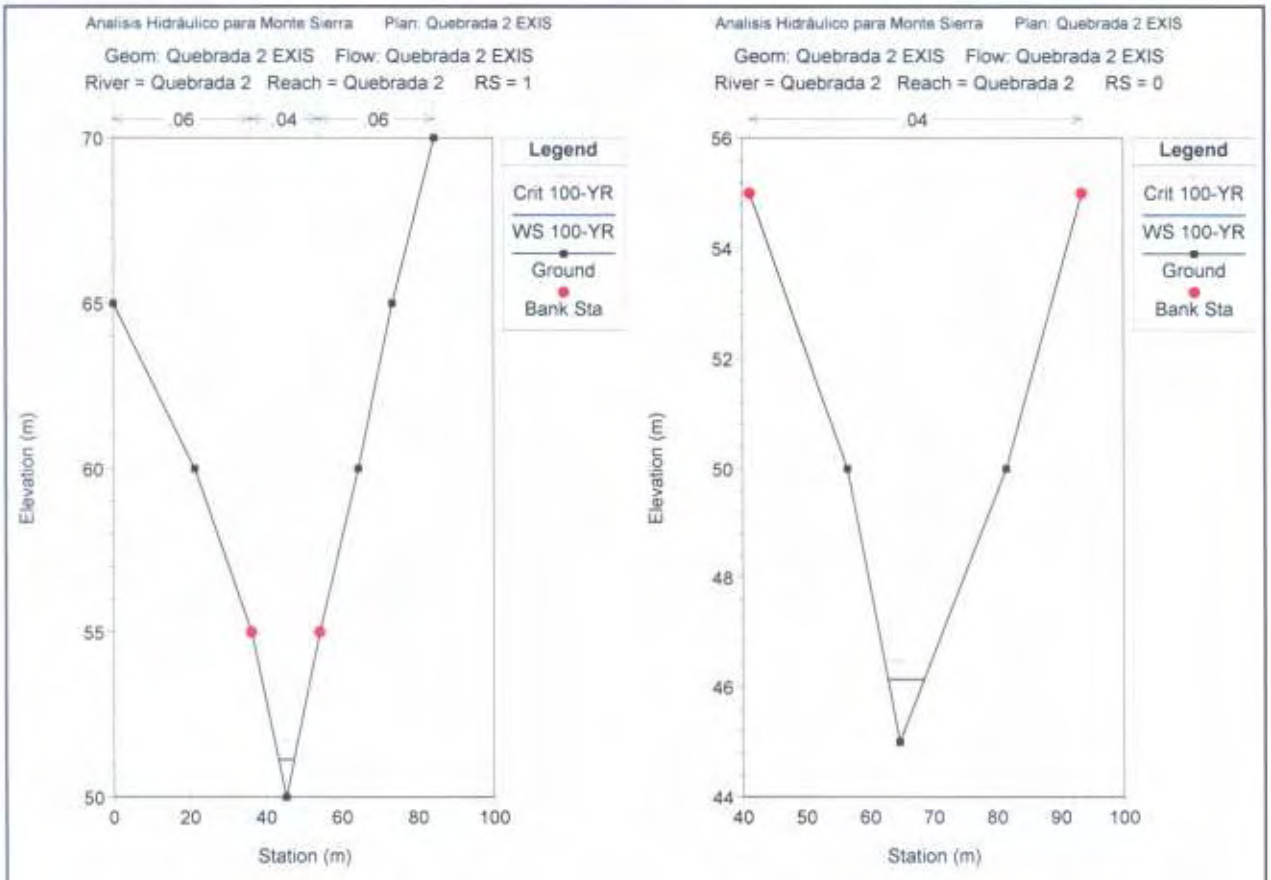
| Reach | River Sta. | Contr. | Expan. |
|---|---|---|---|
| Quebrada 2 | 5 | .1 | .3 |

```
*Quebrada 2      *    4       *       .1*       .3*
*Quebrada 2      *    3       *       .1*       .3*
*Quebrada 2      *    2       *       .1*       .3*
*Quebrada 2      *    1       *       .1*       .3*
*Quebrada 2      *    0       *       .1*       .3*
**********************************************************
```

HEC-RAS Plan: Queb 2 EXIS River: Quebrada 2 Reach: Quebrada 2 Profile: 100-YR

| Reach | River Sta | Profile | Q Total | Min Ch El | W.S. Elev | Crit W.S. | E.G. Elev | E.G. Slope | Vel Chnl | Flow Area | Top Width | Froude # Chl |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (m3/s) | (m) | (m) | (m) | (m) | (m/m) | (m/s) | (m2) | (m) | |
| Quebrada 2 | 0 | 100-YR | 14.27 | 45.00 | 46.13 | 46.46 | 47.15 | 0.077010 | 4.49 | 3.18 | 5.64 | 1.91 |
| Quebrada 2 | 1 | 100-YR | 14.27 | 50.00 | 51.13 | 51.67 | 53.10 | 0.158130 | 6.22 | 2.30 | 4.05 | 2.64 |
| Quebrada 2 | 2 | 100-YR | 14.27 | 65.00 | 65.71 | 66.40 | 71.00 | 0.719918 | 10.19 | 1.40 | 3.96 | 5.47 |
| Quebrada 2 | 3 | 100-YR | 14.27 | 90.00 | 90.90 | 91.22 | 91.94 | 0.098783 | 4.52 | 3.16 | 7.00 | 2.15 |
| Quebrada 2 | 4 | 100-YR | 14.27 | 105.00 | 105.83 | 106.39 | 108.60 | 0.302580 | 7.36 | 1.94 | 4.66 | 3.64 |
| Quebrada 2 | 5 | 100-YR | 14.27 | 110.00 | 111.32 | 111.32 | 111.65 | 0.019328 | 2.55 | 5.60 | 8.49 | 1.00 |

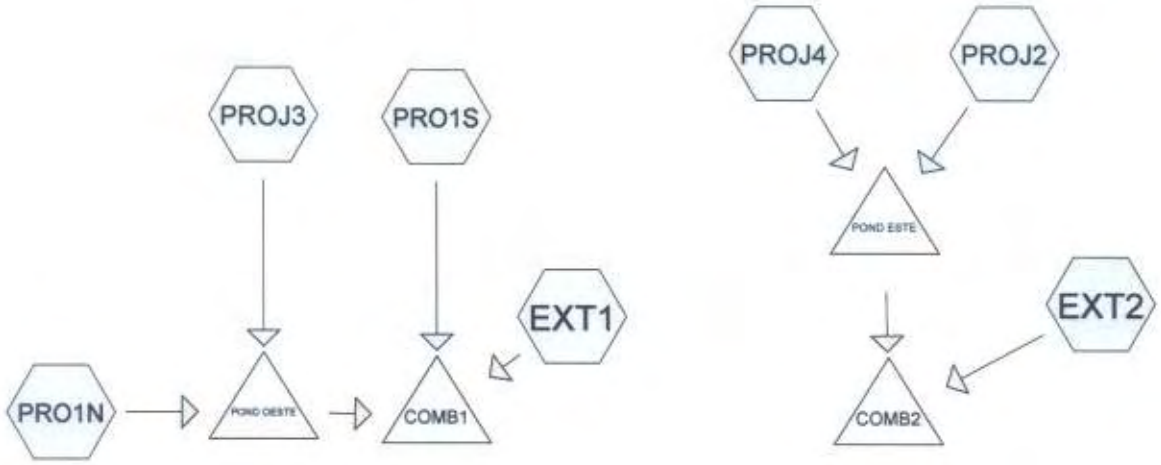

Analisis Hidráulico para Monte Sierra Plan: Quebrada 2 EXIS
Geom: Quebrada 2 EXIS Flow: Quebrada 2 EXIS
River = Quebrada 2 Reach = Quebrada 2 RS = 5
.06
.04
Legend
WS 100-YR
Crit 100-YR
Ground
Bank Sta
Elevation (m)
Station (m)
Analisis Hidráulico para Monte Sierra Plan: Quebrada 2 EXIS
Geom: Quebrada 2 EXIS Flow: Quebrada 2 EXIS
River = Quebrada 2 Reach = Quebrada 2 RS = 4
.04
Legend
Crit 100-YR
WS 100-YR
Ground
Bank Sta
Elevation (m)
Station (m)
Analisis Hidráulico para Monte Sierra Plan: Quebrada 2 EXIS
Geom: Quebrada 2 EXIS Flow: Quebrada 2 EXIS
River = Quebrada 2 Reach = Quebrada 2 RS = 3
.06
.04
.06
Legend
Crit 100-YR
WS 100-YR
Ground
Bank Sta
Elevation (m)
Station (m)
Analisis Hidráulico para Monte Sierra Plan: Quebrada 2 EXIS
Geom: Quebrada 2 EXIS Flow: Quebrada 2 EXIS
River = Quebrada 2 Reach = Quebrada 2 RS = 2
.06
.04
.06
Legend
Crit 100-YR
WS 100-YR
Ground
Bank Sta
Elevation (m)
Station (m)


Analisis Hidráulico para Monte Sierra Plan: Quebrada 2 EXIS
Geom: Quebrada 2 EXIS Flow: Quebrada 2 EXIS
River = Quebrada 2 Reach = Quebrada 2 RS = 1
.06
.04
.06
Legend
Crit 100-YR
WS 100-YR
Ground
Bank Sta
Elevation (m)
Station (m)
70
65
60
55
50
0
20
40
60
80
100
Analisis Hidráulico para Monte Sierra Plan: Quebrada 2 EXIS
Geom: Quebrada 2 EXIS Flow: Quebrada 2 EXIS
River = Quebrada 2 Reach = Quebrada 2 RS = 0
.04
Legend
Crit 100-YR
WS 100-YR
Ground
Bank Sta
Elevation (m)
Station (m)
56
54
52
50
48
46
44
40
50
60
70
80
90
100

# APÉNDICE E

Datos de Entrada y Salida de HydroCAD

# CONDICIÓN DE MITIGACIÓN (100-AÑOS): MITI SIERRA.HCP




Subcat Reach Pond Link

**Drainage Diagram for MITI SIERRA**
Prepared by Menar Hydrosystems Engineering
HydroCAD® 8.00 s/n 001583 © 2006 HydroCAD Software Solutions LLC

## Area Listing (all nodes)

| Area (acres) | CN | Description (subcats) |
|---|---|---|
| 54.170 | 36 | (EXT2) |
| 23.900 | 38 | (EXT1) |
| 59.330 | 40 | (PRO1N,PRO1S,PROJ2,PROJ3,PROJ4) |
| 137.400 | | |

Time span=5.00-20.00 hrs, dt=0.03 hrs, 501 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment EXT1:** Runoff Area=23.900 ac Runoff Depth>4.57"
Tc=5.0 min CN=38 Runoff=221.60 cfs 9.098 af

**Subcatchment EXT2:** Runoff Area=54.170 ac Runoff Depth>4.16"
Tc=5.0 min CN=36 Runoff=455.67 cfs 18.762 af

**Subcatchment PRO1N:** Runoff Area=22.300 ac Runoff Depth>4.97"
Tc=5.0 min CN=40 Runoff=225.33 cfs 9.245 af

**Subcatchment PRO1S:** Runoff Area=20.110 ac Runoff Depth>4.97"
Tc=5.0 min CN=40 Runoff=203.21 cfs 8.337 af

**Subcatchment PROJ2:** Runoff Area=6.140 ac Runoff Depth>4.97"
Tc=5.0 min CN=40 Runoff=62.04 cfs 2.546 af

**Subcatchment PROJ3:** Runoff Area=7.380 ac Runoff Depth>4.97"
Tc=5.0 min CN=40 Runoff=74.57 cfs 3.060 af

**Subcatchment PROJ4:** Runoff Area=3.400 ac Runoff Depth>4.97"
Tc=5.0 min CN=40 Runoff=34.36 cfs 1.410 af

**Pond COMB1:** Inflow=469.55 cfs 29.344 af
Primary=469.55 cfs 29.344 af

**Pond COMB2:** Inflow=478.68 cfs 22.665 af
Primary=478.68 cfs 22.665 af

**Pond POND ESTE:** Peak Elev=171.60' Storage=1.133 af Inflow=96.40 cfs 3.955 af
Primary=43.50 cfs 3.903 af Secondary=0.00 cfs 0.000 af Outflow=43.50 cfs 3.903 af

**Pond POND OESTE:** Peak Elev=231.70' Storage=4.094 af Inflow=299.91 cfs 12.305 af
Primary=138.02 cfs 11.909 af Secondary=0.00 cfs 0.000 af Outflow=138.02 cfs 11.909 af

**Total Runoff Area = 137.400 ac Runoff Volume = 52.456 af Average Runoff Depth = 4.58"**
**100.00% Pervious Area = 137.400 ac 0.00% Impervious Area = 0.000 ac**

## Subcatchment EXT1:

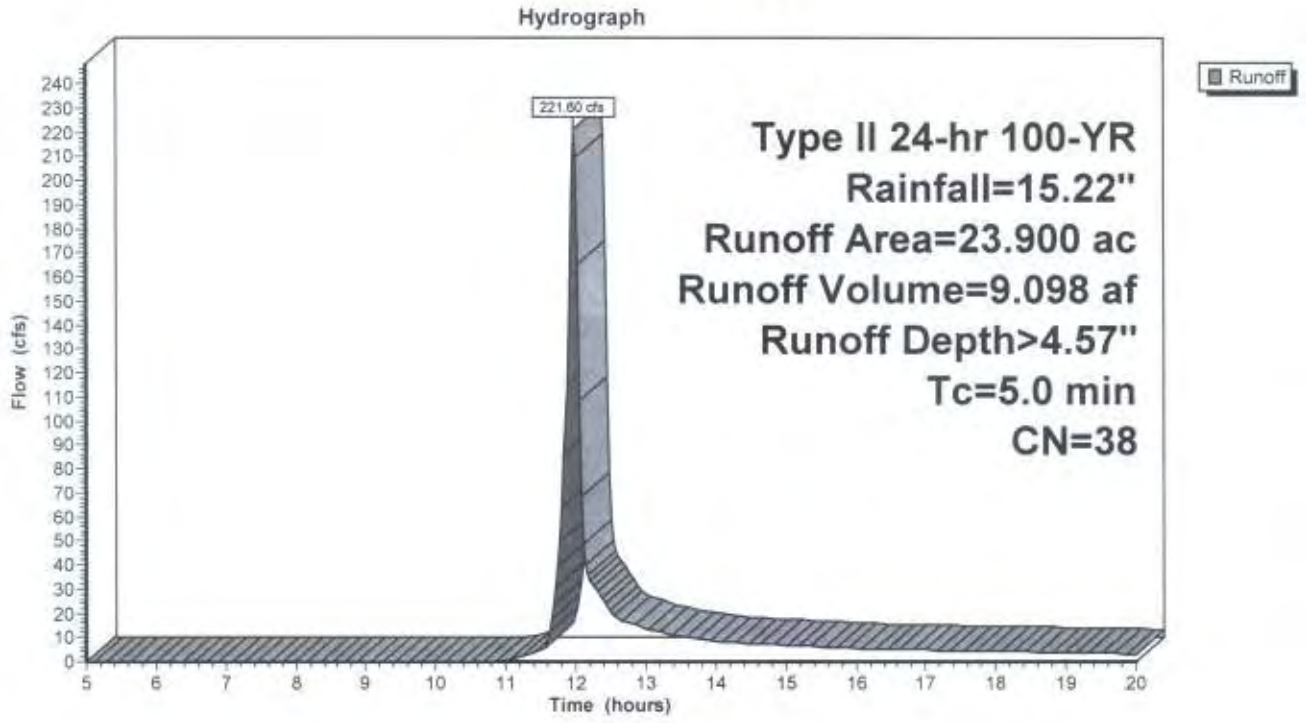
Runoff = 221.60 cfs @ 11.97 hrs, Volume= 9.098 af, Depth> 4.57"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.03 hrs
Type II 24-hr 100-YR Rainfall=15.22"

| Area (ac) | CN | Description |
|---|---|---|
| 23.900 | 38 | |
| 23.900 | | Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.0 | | | | | **Direct Entry,** |

## Subcatchment EXT1:



## Subcatchment EXT2:

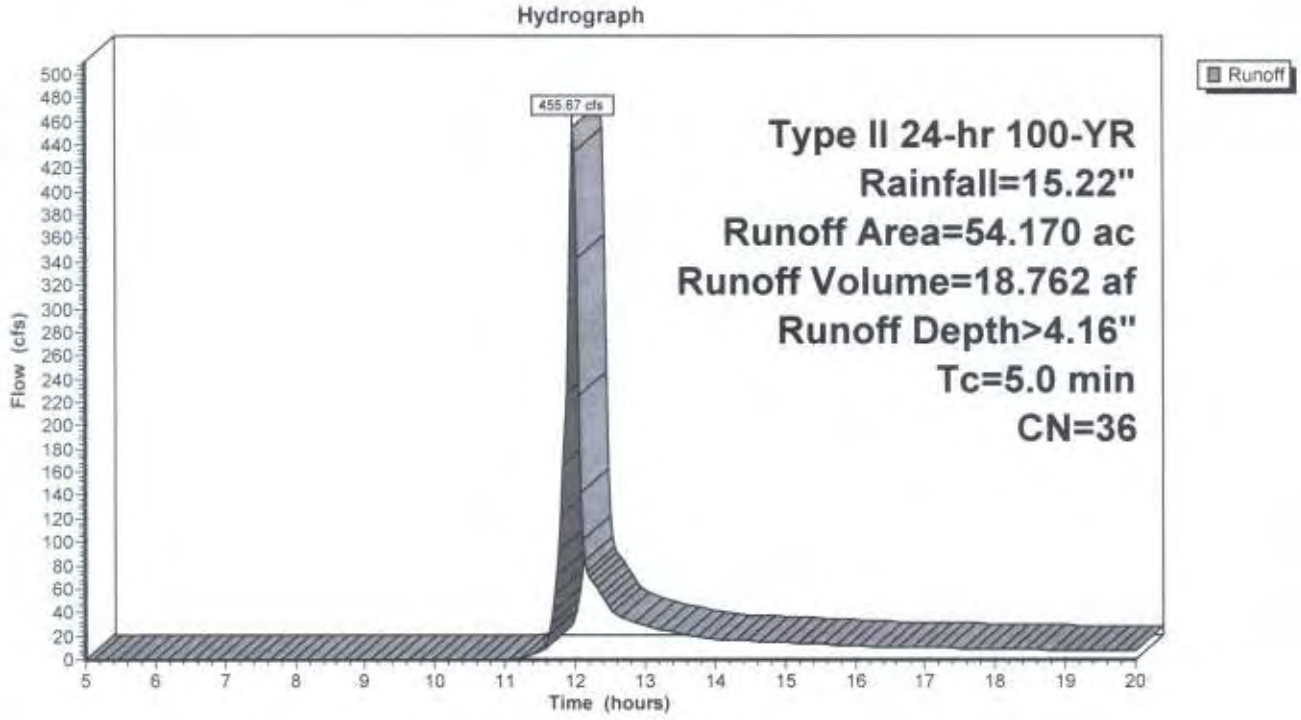
Runoff = 455.67 cfs @ 11.97 hrs, Volume= 18.762 af, Depth> 4.16"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.03 hrs
Type II 24-hr 100-YR Rainfall=15.22"

| Area (ac) | CN | Description |
|---|---|---|
| 54.170 | 36 | |
| 54.170 | | Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.0 | | | | | **Direct Entry,** |

## Subcatchment EXT2:



## Subcatchment PRO1N:

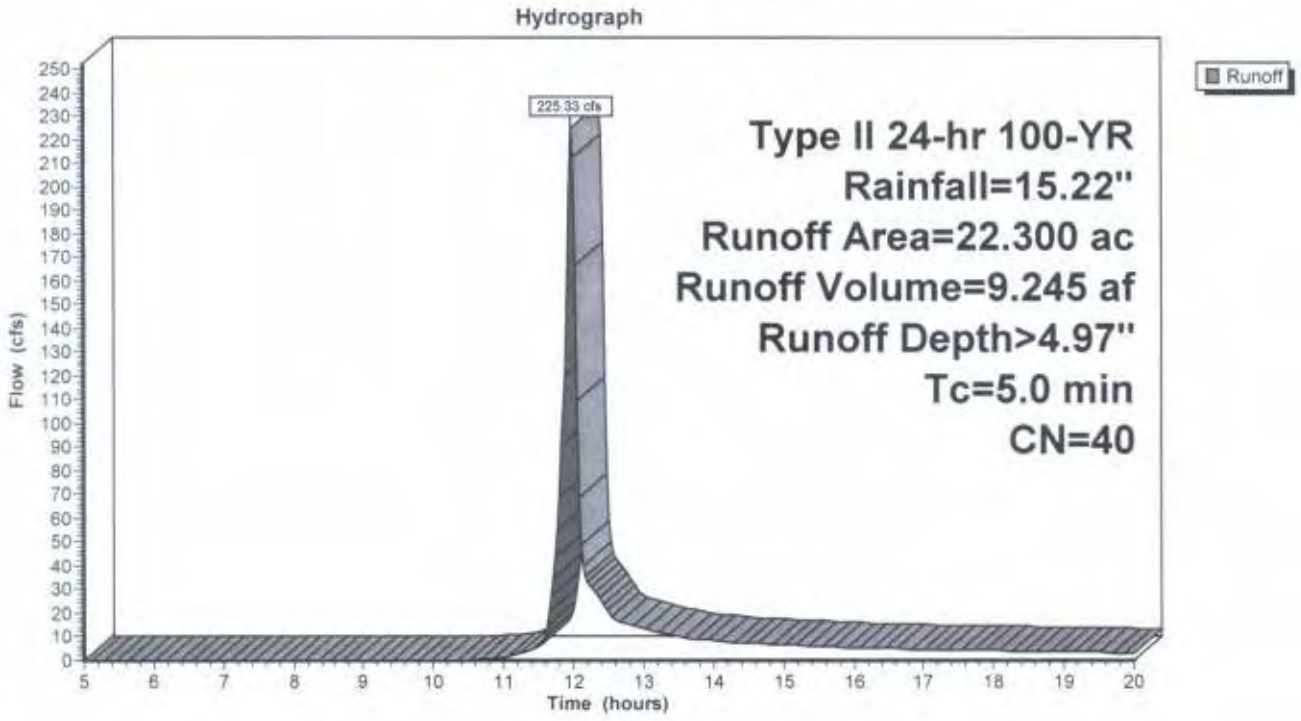
Runoff = 225.33 cfs @ 11.97 hrs, Volume= 9.245 af, Depth> 4.97"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.03 hrs
Type II 24-hr 100-YR Rainfall=15.22"

| Area (ac) | CN | Description |
|---|---|---|
| 22.300 | 40 | |
| 22.300 | | Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.0 | | | | | **Direct Entry,** |

## Subcatchment PRO1N:



## Subcatchment PRO1S:

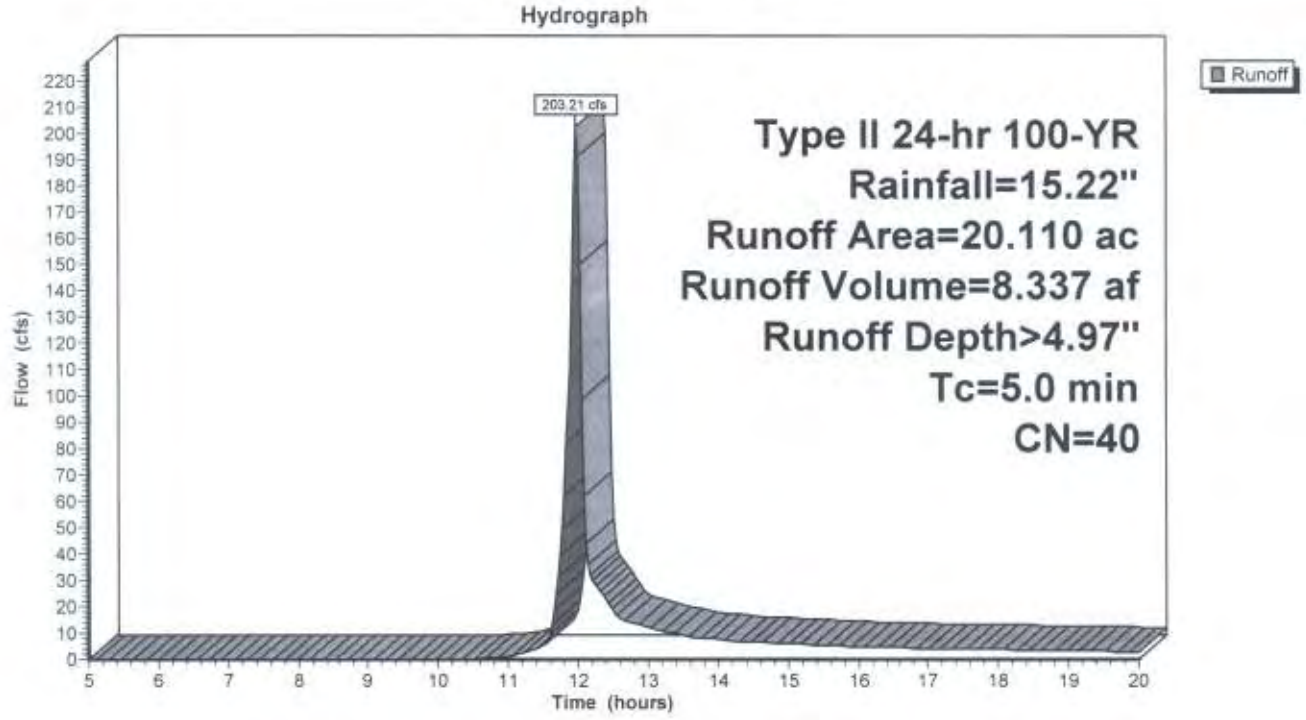
Runoff = 203.21 cfs @ 11.97 hrs, Volume= 8.337 af, Depth> 4.97"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.03 hrs
Type II 24-hr 100-YR Rainfall=15.22"

| Area (ac) | CN | Description |
|---|---|---|
| 20.110 | 40 | |
| 20.110 | | Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.0 | | | | | **Direct Entry,** |

## Subcatchment PRO1S:



## Subcatchment PROJ2:

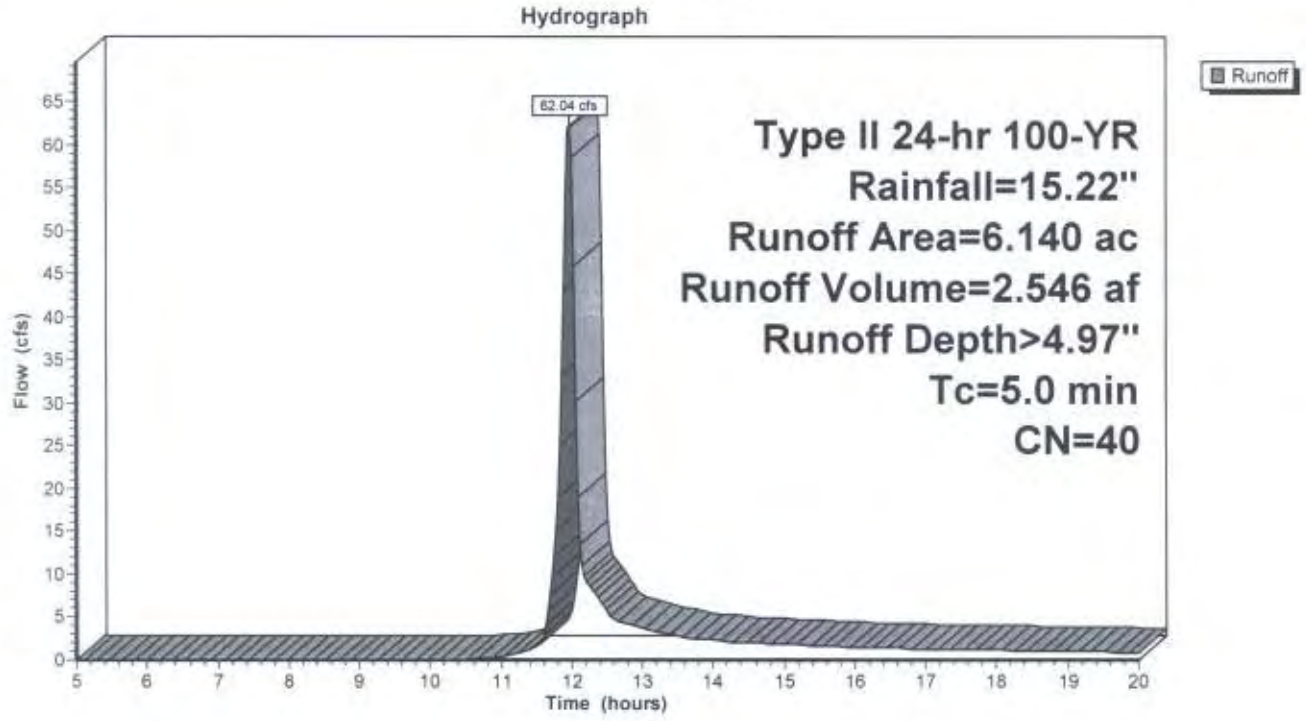
Runoff = 62.04 cfs @ 11.97 hrs, Volume= 2.546 af, Depth> 4.97"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.03 hrs
Type II 24-hr 100-YR Rainfall=15.22"

| Area (ac) | CN | Description |
|---|---|---|
| 6.140 | 40 | |
| 6.140 | | Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.0 | | | | | **Direct Entry,** |

## Subcatchment PROJ2:



## Subcatchment PROJ3:

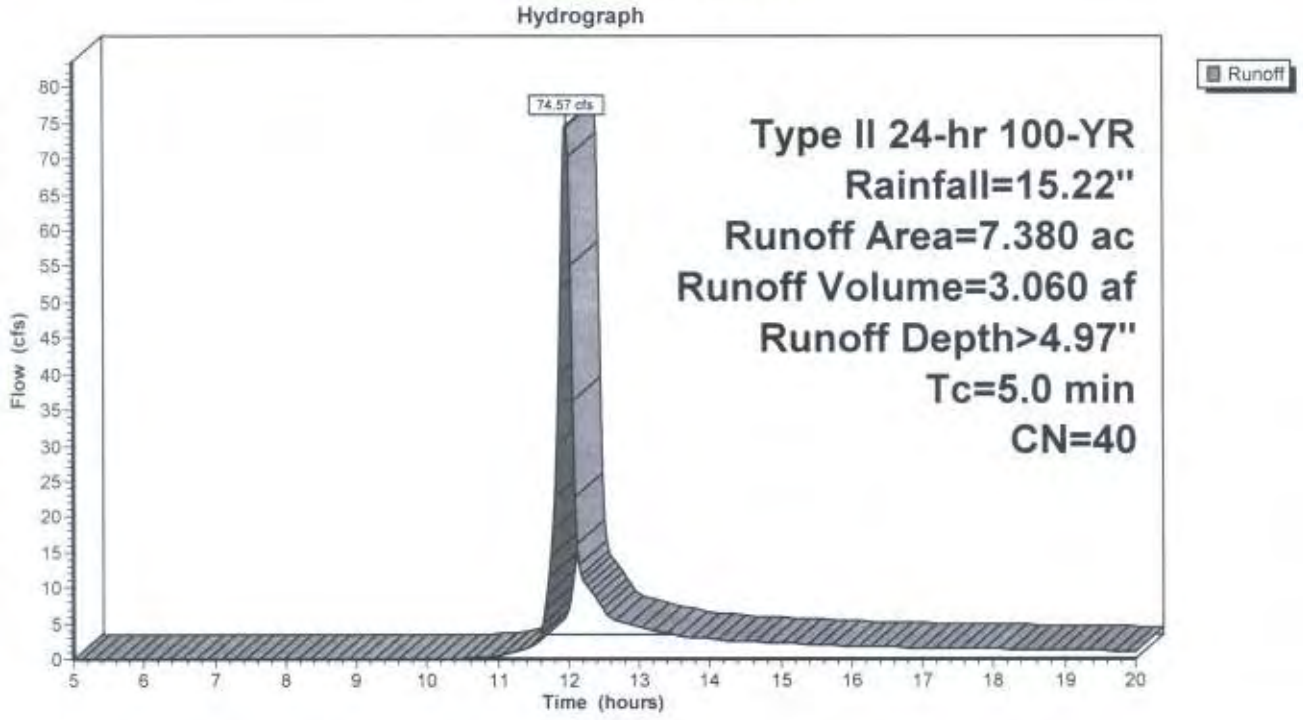
Runoff = 74.57 cfs @ 11.97 hrs, Volume= 3.060 af, Depth> 4.97"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.03 hrs
Type II 24-hr 100-YR Rainfall=15.22"

| Area (ac) | CN | Description |
|---|---|---|
| 7.380 | 40 | |
| 7.380 | | Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.0 | | | | | **Direct Entry,** |

## Subcatchment PROJ3:



## Subcatchment PROJ4:

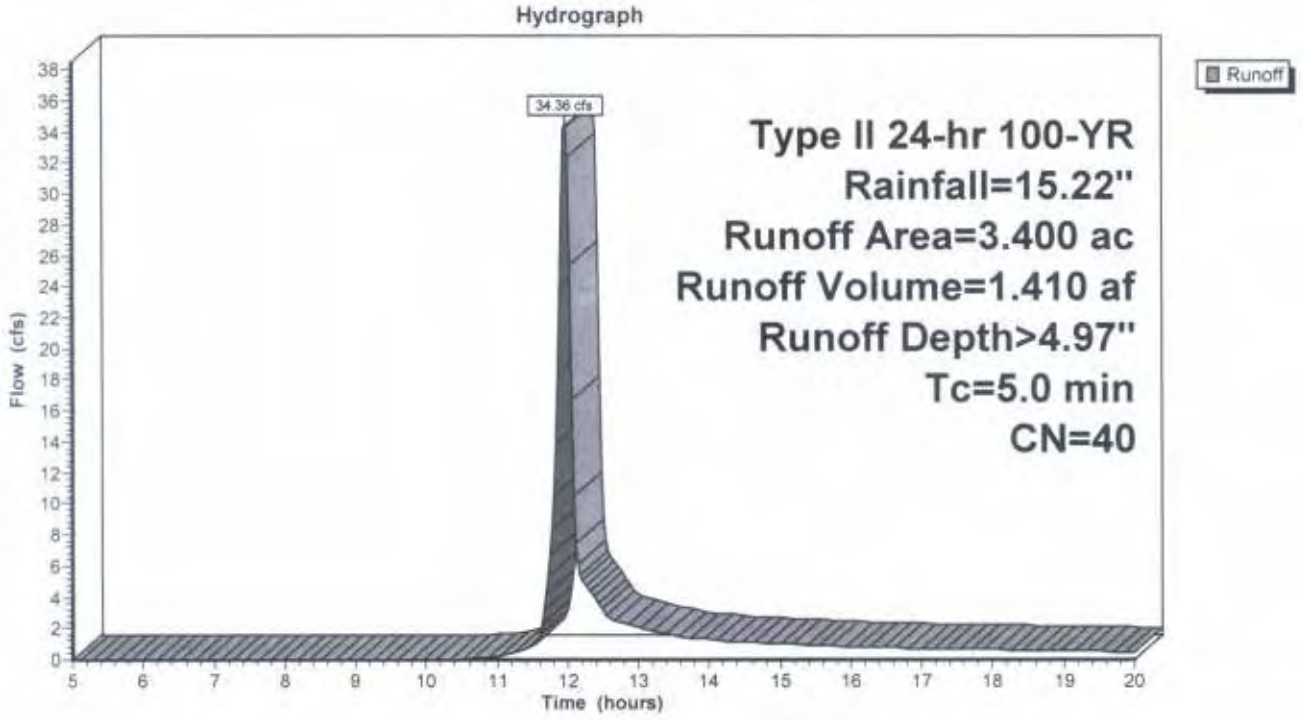
Runoff = 34.36 cfs @ 11.97 hrs, Volume= 1.410 af, Depth> 4.97"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.03 hrs
Type II 24-hr 100-YR Rainfall=15.22"

| Area (ac) | CN | Description |
|---|---|---|
| 3.400 | 40 | |
| 3.400 | | Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.0 | | | | | **Direct Entry,** |

## Subcatchment PROJ4:



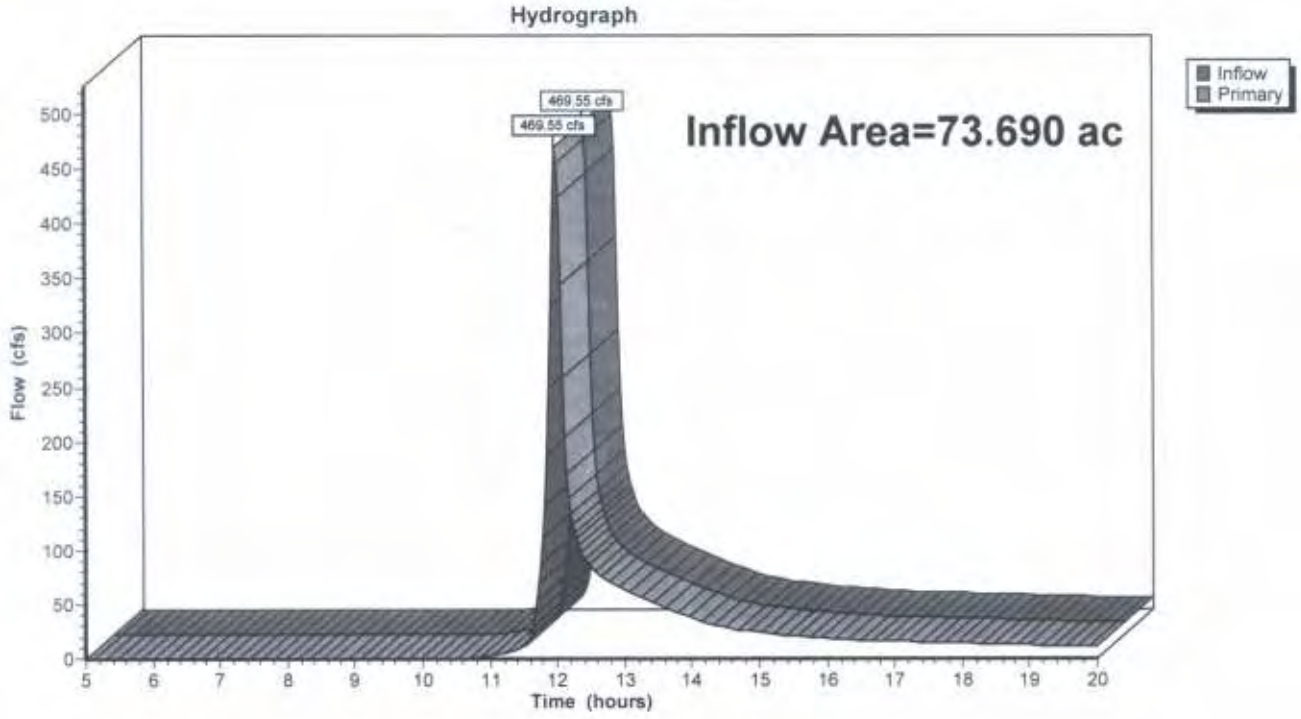
## Pond COMB1:

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 73.690 ac, Inflow Depth > 4.78" for 100-YR event
Inflow = 469.55 cfs @ 11.97 hrs, Volume= 29.344 af
Primary = 469.55 cfs @ 11.97 hrs, Volume= 29.344 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.03 hrs

## Pond COMB1:



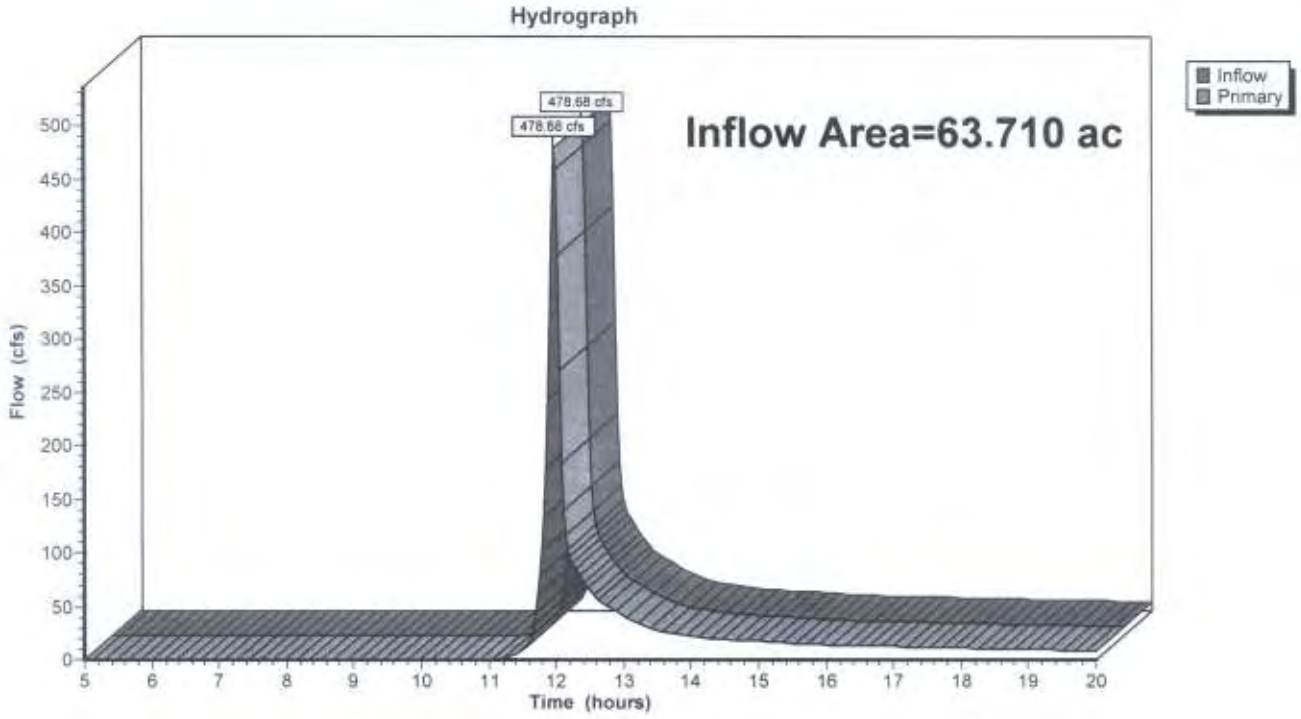
## Pond COMB2:

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 63.710 ac, Inflow Depth > 4.27" for 100-YR event
Inflow = 478.68 cfs @ 11.97 hrs, Volume= 22.665 af
Primary = 478.68 cfs @ 11.97 hrs, Volume= 22.665 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.03 hrs

## Pond COMB2:



## Pond POND ESTE:

Inflow Area = 9.540 ac, Inflow Depth > 4.97" for 100-YR event
Inflow = 96.40 cfs @ 11.97 hrs, Volume= 3.955 af
Outflow = 43.50 cfs @ 12.06 hrs, Volume= 3.903 af, Atten= 55%, Lag= 5.7 min
Primary = 43.50 cfs @ 12.06 hrs, Volume= 3.903 af
Secondary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.03 hrs
Peak Elev= 171.60' @ 12.06 hrs Surf.Area= 0.222 ac Storage= 1.133 af

Plug-Flow detention time= 21.9 min calculated for 3.895 af (98% of inflow)
Center-of-Mass det. time= 16.8 min ( 819.9 - 803.1 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 164.90' | 1.909 af | **Custom Stage Data (Prismatic)** Listed below (Recalc) |

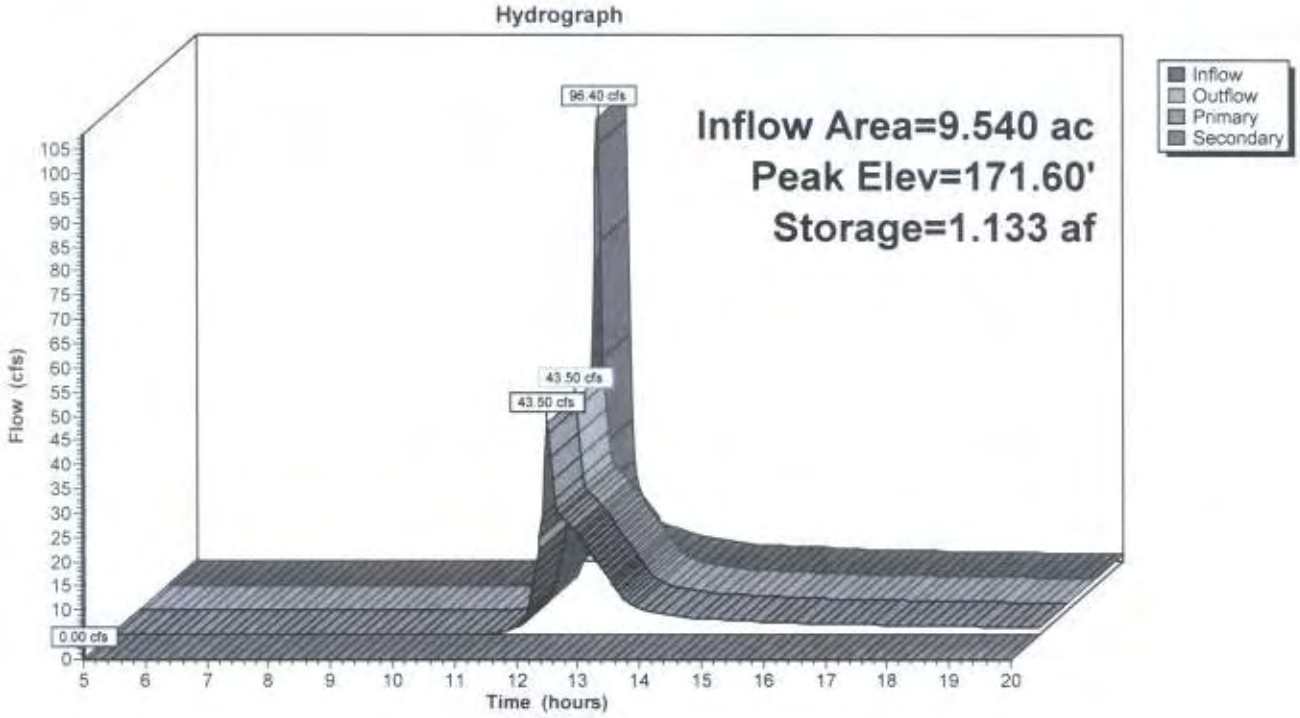
| Elevation (feet) | Surf.Area (acres) | Inc.Store (acre-feet) | Cum.Store (acre-feet) |
|---|---|---|---|
| 164.90 | 0.116 | 0.000 | 0.000 |
| 174.74 | 0.272 | 1.909 | 1.909 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 164.90' | **48.0" x 65.6' long Culvert** RCP, sq.cut end projecting, Ke= 0.500<br>Outlet Invert= 164.24' S= 0.0101 '/' Cc= 0.900 n= 0.015 |
| #2 | Device 1 | 164.90' | **1.50' W x 1.50' H Vert. Orifice/Grate** C= 0.600 |
| #3 | Device 1 | 170.83' | **2.00' x 2.00' Horiz. Orifice/Grate** Limited to weir flow C= 0.600 |
| #4 | Secondary | 173.74' | **20.0' long x 1.0' breadth Broad-Crested Rectangular Weir**<br>Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00<br>Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32 |

**Primary OutFlow** Max=42.92 cfs @ 12.06 hrs HW=171.57' (Free Discharge)
└**1=Culvert** (Passes 42.92 cfs of 130.77 cfs potential flow)
  └**2=Orifice/Grate** (Orifice Controls 26.34 cfs @ 11.71 fps)
  └**3=Orifice/Grate** (Orifice Controls 16.58 cfs @ 4.14 fps)

**Secondary OutFlow** Max=0.00 cfs @ 5.00 hrs HW=164.90' (Free Discharge)
└**4=Broad-Crested Rectangular Weir** ( Controls 0.00 cfs)

## Pond POND ESTE:



## Pond POND OESTE:

Inflow Area = 29.680 ac, Inflow Depth > 4.97" for 100-YR event
Inflow = 299.91 cfs @ 11.97 hrs, Volume= 12.305 af
Outflow = 138.02 cfs @ 12.06 hrs, Volume= 11.909 af, Atten= 54%, Lag= 5.6 min
Primary = 138.02 cfs @ 12.06 hrs, Volume= 11.909 af
Secondary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.03 hrs
Peak Elev= 231.70' @ 12.06 hrs Surf.Area= 0.571 ac Storage= 4.094 af

Plug-Flow detention time= 44.0 min calculated for 11.909 af (97% of inflow)
Center-of-Mass det. time= 31.9 min ( 835.0 - 803.1 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 223.45' | 5.700 af | **Custom Stage Data (Prismatic)** Listed below |

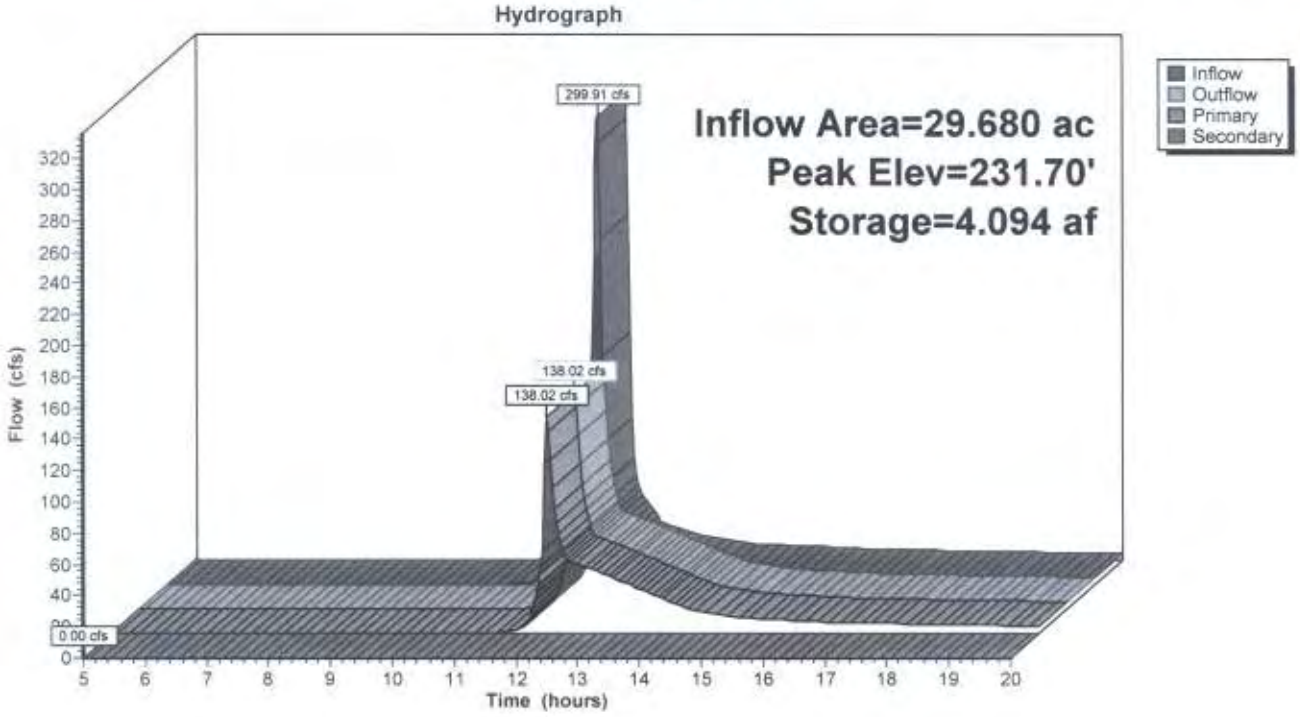
| Elevation (feet) | Surf.Area (acres) | Inc.Store (acre-feet) | Cum.Store (acre-feet) |
|---|---|---|---|
| 223.45 | 0.325 | 0.000 | 0.000 |
| 234.93 | 0.668 | 5.700 | 5.700 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 223.45' | **48.0" x 167.0' long Culvert X 2.00**<br>RCP, sq.cut end projecting, Ke= 0.500<br>Outlet Invert= 221.78' S= 0.0100 '/' Cc= 0.900 n= 0.015 |
| #2 | Device 1 | 223.45' | **2.00' W x 2.00' H Vert. Orifice/Grate** C= 0.600 |
| #3 | Device 1 | 230.30' | **4.00' x 4.00' Horiz. Orifice/Grate** Limited to weir flow C= 0.600 |
| #4 | Secondary | 234.00' | **20.0' long x 1.0' breadth Broad-Crested Rectangular Weir**<br>Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00<br>Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32 |

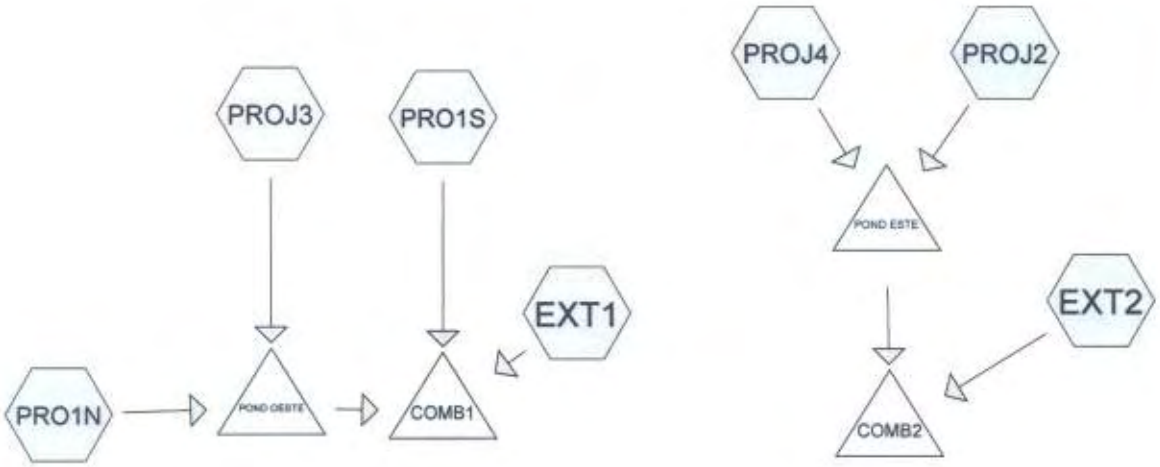
**Primary OutFlow** Max=134.36 cfs @ 12.06 hrs HW=231.66' (Free Discharge)
↑—**1=Culvert** (Passes 134.36 cfs of 301.49 cfs potential flow)
↑—**2=Orifice/Grate** (Orifice Controls 51.66 cfs @ 12.92 fps)
—**3=Orifice/Grate** (Weir Controls 82.69 cfs @ 3.81 fps)

**Secondary OutFlow** Max=0.00 cfs @ 5.00 hrs HW=223.45' (Free Discharge)
↑—**4=Broad-Crested Rectangular Weir** ( Controls 0.00 cfs)

## Pond POND OESTE:



## CONDICIÓN DE MITIGACIÓN (2-AÑOS): MITI SIERRA 2.HCP




Subcat Reach Pond Link

**Drainage Diagram for MITI SIERRA2**
Prepared by Menar Hydrosystems Engineering
HydroCAD® 8.00 s/n 001583 © 2006 HydroCAD Software Solutions LLC

## Area Listing (all nodes)

| Area (acres) | CN | Description (subcats) |
|---|---|---|
| 54.170 | 64 | (EXT2) |
| 23.900 | 72 | (EXT1) |
| 3.400 | 88 | (PROJ4) |
| 55.930 | 89 | (PRO1N,PRO1S,PROJ2,PROJ3) |
| 137.400 | | |

Time span=5.00-20.00 hrs, dt=0.03 hrs, 501 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment EXT1:** Runoff Area=23.900 ac Runoff Depth>1.79"
Tc=5.0 min CN=72 Runoff=86.66 cfs 3.568 af

**Subcatchment EXT2:** Runoff Area=54.170 ac Runoff Depth>1.24"
Tc=5.0 min CN=64 Runoff=135.97 cfs 5.606 af

**Subcatchment PRO1N:** Runoff Area=22.300 ac Runoff Depth>3.26"
Tc=5.0 min CN=89 Runoff=134.44 cfs 6.052 af

**Subcatchment PRO1S:** Runoff Area=20.110 ac Runoff Depth>3.26"
Tc=5.0 min CN=89 Runoff=121.24 cfs 5.458 af

**Subcatchment PROJ2:** Runoff Area=6.140 ac Runoff Depth>3.26"
Tc=5.0 min CN=89 Runoff=37.02 cfs 1.666 af

**Subcatchment PROJ3:** Runoff Area=7.380 ac Runoff Depth>3.26"
Tc=5.0 min CN=89 Runoff=44.49 cfs 2.003 af

**Subcatchment PROJ4:** Runoff Area=3.400 ac Runoff Depth>3.16"
Tc=5.0 min CN=88 Runoff=20.07 cfs 0.895 af

**Pond COMB1:** Inflow=245.32 cfs 16.851 af
Primary=245.32 cfs 16.851 af

**Pond COMB2:** Inflow=155.52 cfs 8.136 af
Primary=155.52 cfs 8.136 af

**Pond POND ESTE:** Peak Elev=169.71' Storage=0.742 af Inflow=57.08 cfs 2.562 af
Primary=21.81 cfs 2.530 af Secondary=0.00 cfs 0.000 af Outflow=21.81 cfs 2.530 af

**Pond POND OESTE:** Peak Elev=229.81' Storage=3.156 af Inflow=178.93 cfs 8.055 af
Primary=44.51 cfs 7.824 af Secondary=0.00 cfs 0.000 af Outflow=44.51 cfs 7.824 af

**Total Runoff Area = 137.400 ac Runoff Volume = 25.250 af Average Runoff Depth = 2.21"**
**100.00% Pervious Area = 137.400 ac 0.00% Impervious Area = 0.000 ac**

## Subcatchment EXT1:

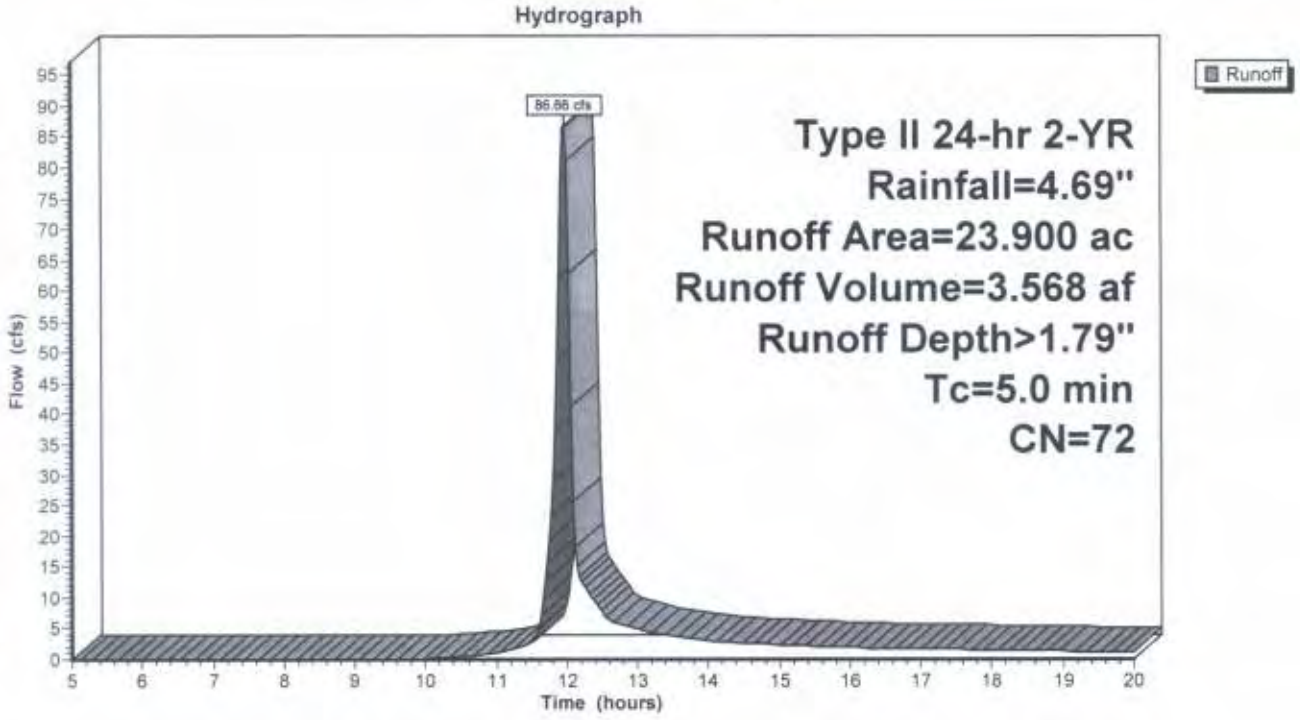
Runoff = 86.66 cfs @ 11.96 hrs, Volume= 3.568 af, Depth> 1.79"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.03 hrs
Type II 24-hr 2-YR Rainfall=4.69"

| Area (ac) | CN | Description |
|---|---|---|
| 23.900 | 72 | |
| 23.900 | | Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.0 | | | | | **Direct Entry,** |

## Subcatchment EXT1:



## Subcatchment EXT2:

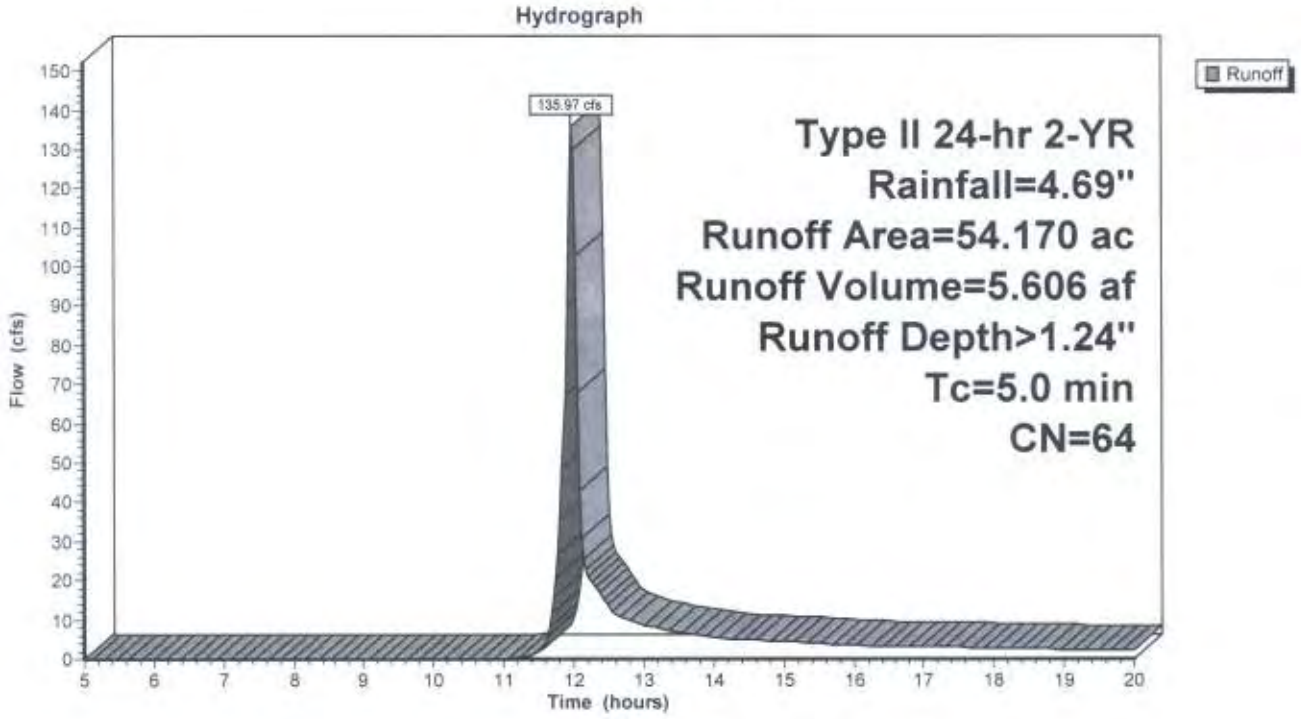
Runoff = 135.97 cfs @ 11.97 hrs, Volume= 5.606 af, Depth> 1.24"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.03 hrs
Type II 24-hr 2-YR Rainfall=4.69"

| Area (ac) | CN | Description |
|---|---|---|
| 54.170 | 64 | |
| 54.170 | | Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.0 | | | | | **Direct Entry,** |

## Subcatchment EXT2:



## Subcatchment PRO1N:

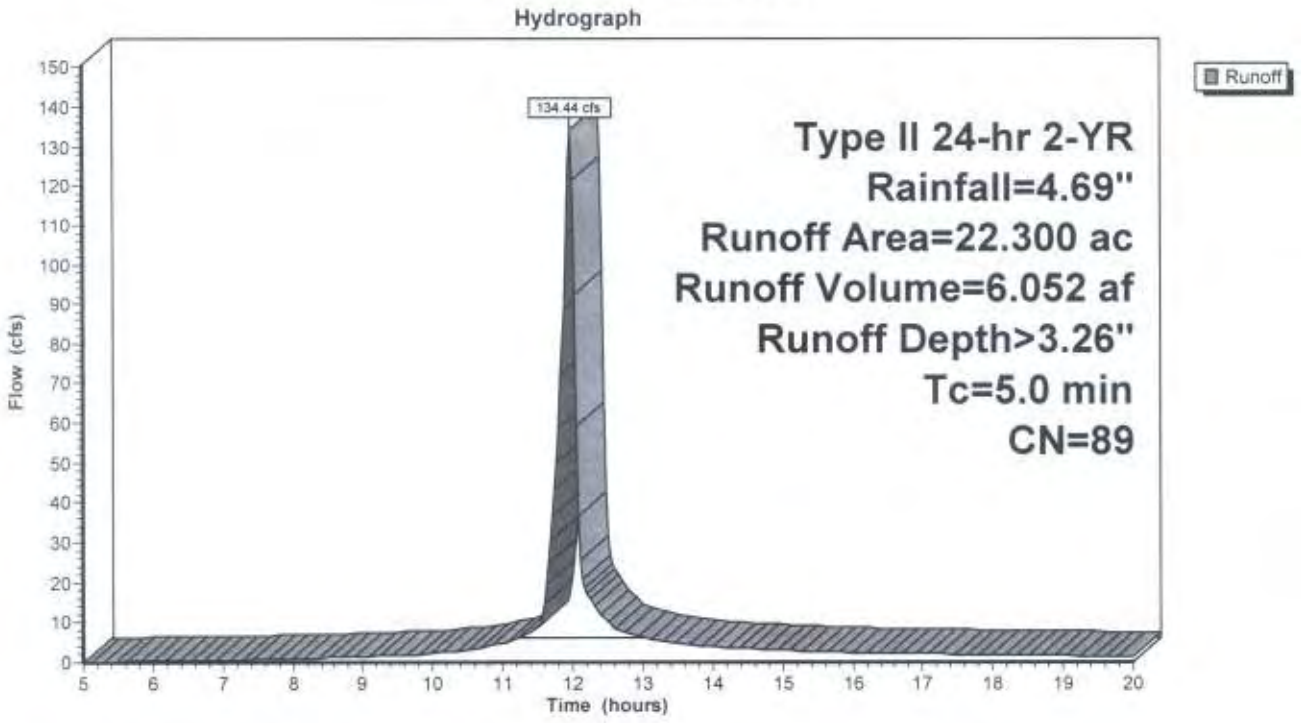
Runoff = 134.44 cfs @ 11.96 hrs, Volume= 6.052 af, Depth> 3.26"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.03 hrs
Type II 24-hr 2-YR Rainfall=4.69"

| Area (ac) | CN | Description |
|---|---|---|
| 22.300 | 89 | |
| 22.300 | | Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.0 | | | | | **Direct Entry,** |

## Subcatchment PRO1N:



## Subcatchment PRO1S:

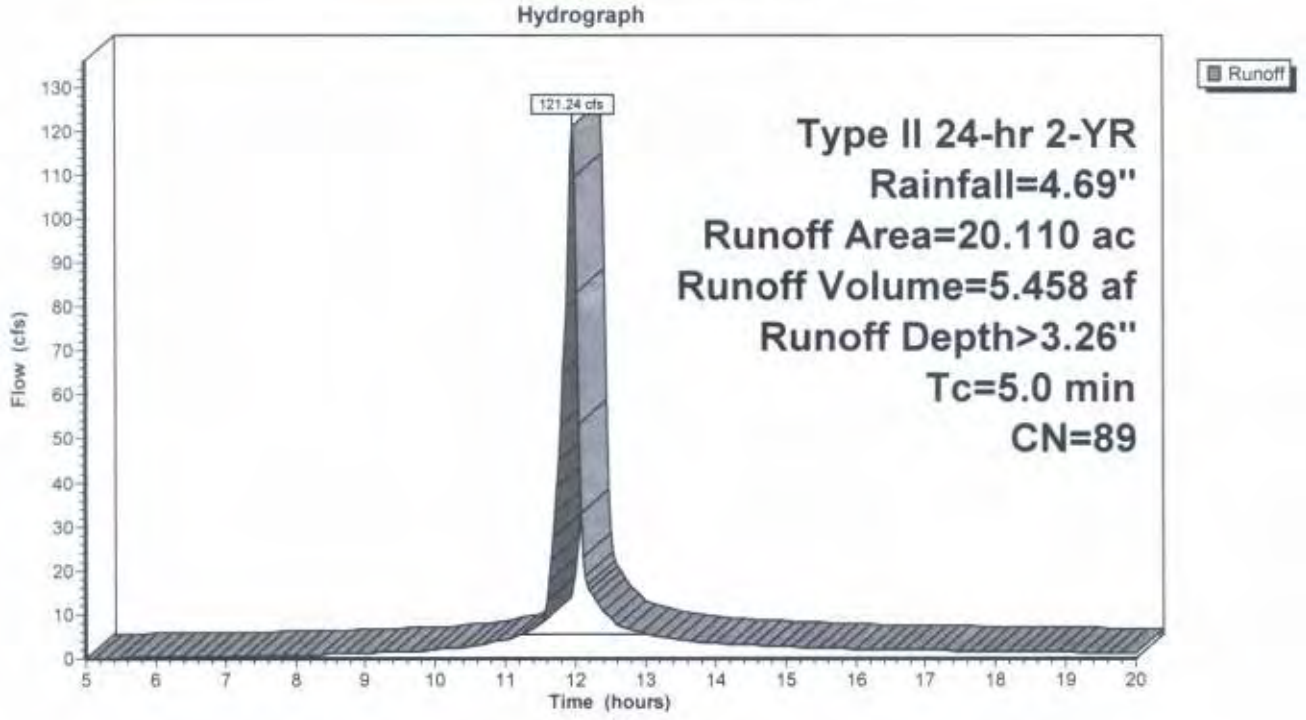
Runoff = 121.24 cfs @ 11.96 hrs, Volume= 5.458 af, Depth> 3.26"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.03 hrs
Type II 24-hr 2-YR Rainfall=4.69"

| Area (ac) | CN | Description |
|---|---|---|
| 20.110 | 89 | |
| 20.110 | | Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.0 | | | | | **Direct Entry,** |

## Subcatchment PRO1S:



## Subcatchment PROJ2:

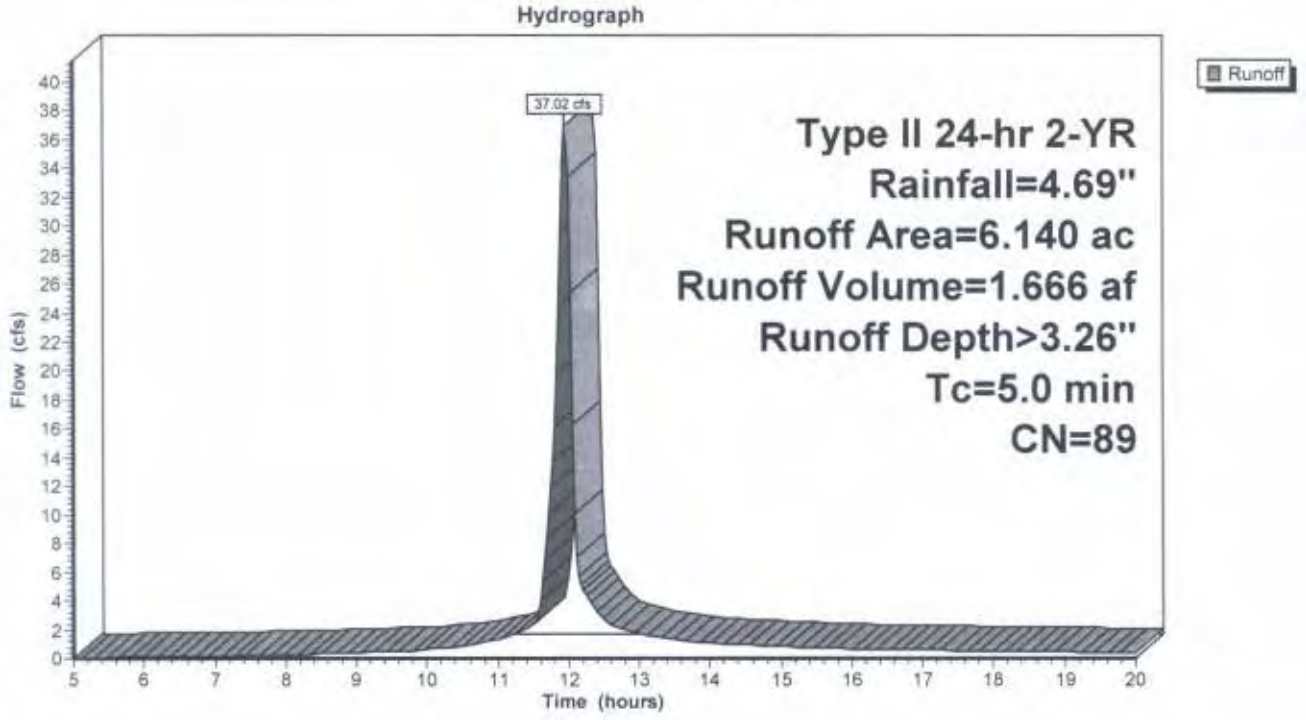
Runoff = 37.02 cfs @ 11.96 hrs, Volume= 1.666 af, Depth> 3.26"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.03 hrs
Type II 24-hr 2-YR Rainfall=4.69"

| Area (ac) | CN | Description |
|---|---|---|
| 6.140 | 89 | |
| 6.140 | | Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.0 | | | | | **Direct Entry,** |

## Subcatchment PROJ2:



## Subcatchment PROJ3:

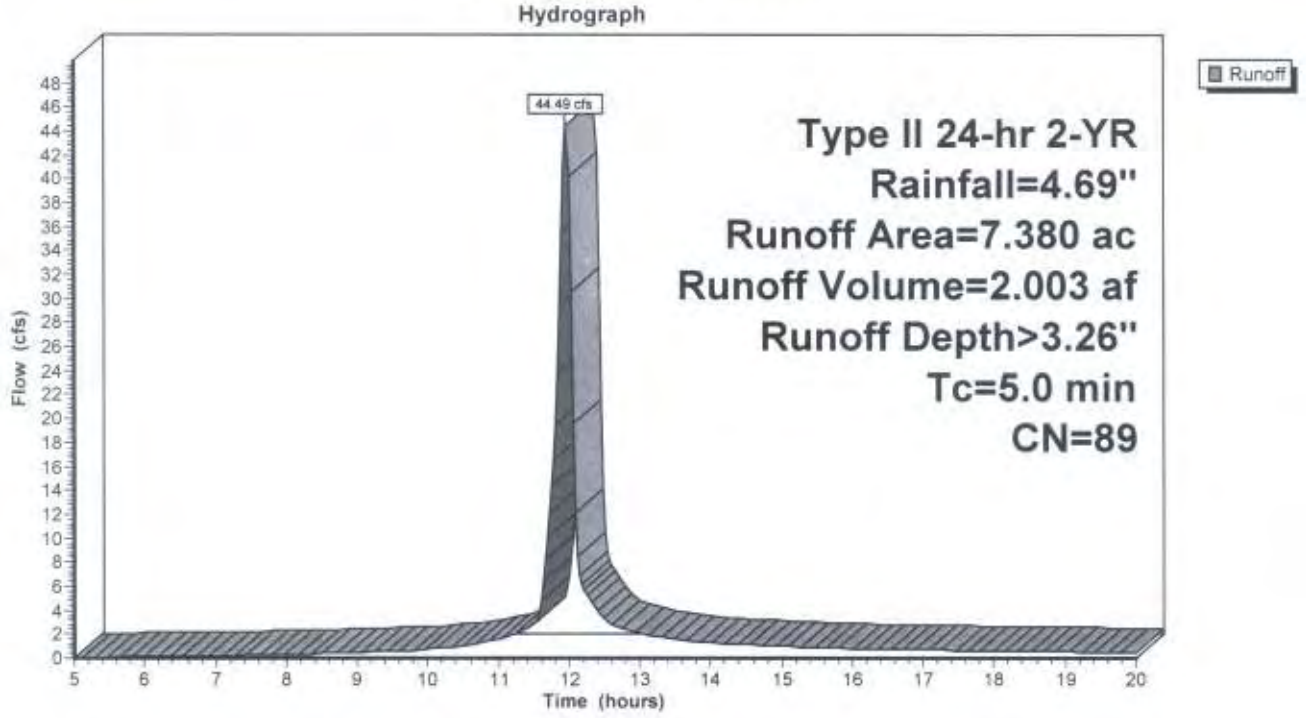
Runoff = 44.49 cfs @ 11.96 hrs, Volume= 2.003 af, Depth> 3.26"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.03 hrs
Type II 24-hr 2-YR Rainfall=4.69"

| Area (ac) | CN | Description |
|---|---|---|
| 7.380 | 89 | |
| 7.380 | | Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.0 | | | | | **Direct Entry,** |

## Subcatchment PROJ3:



## Subcatchment PROJ4:

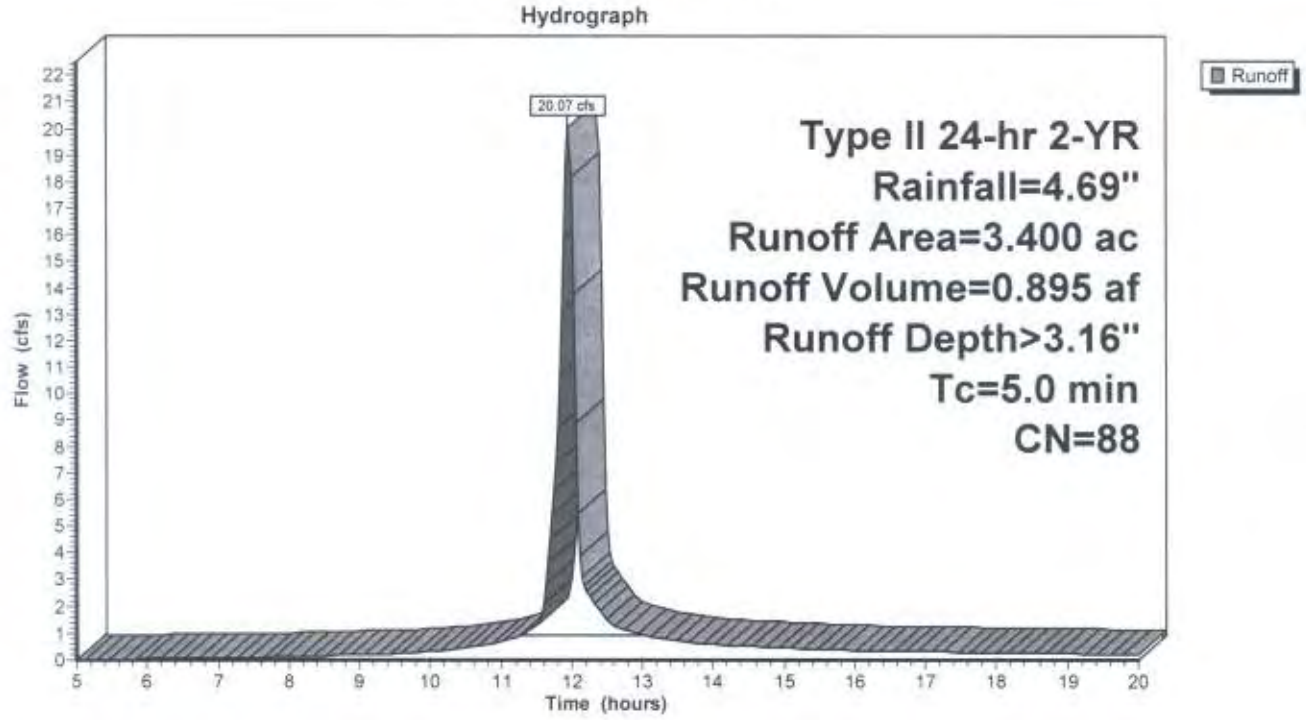
Runoff = 20.07 cfs @ 11.96 hrs, Volume= 0.895 af, Depth> 3.16"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.03 hrs
Type II 24-hr 2-YR Rainfall=4.69"

| Area (ac) | CN | Description |
|---|---|---|
| 3.400 | 88 | |
| 3.400 | | Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.0 | | | | | **Direct Entry,** |

## Subcatchment PROJ4:



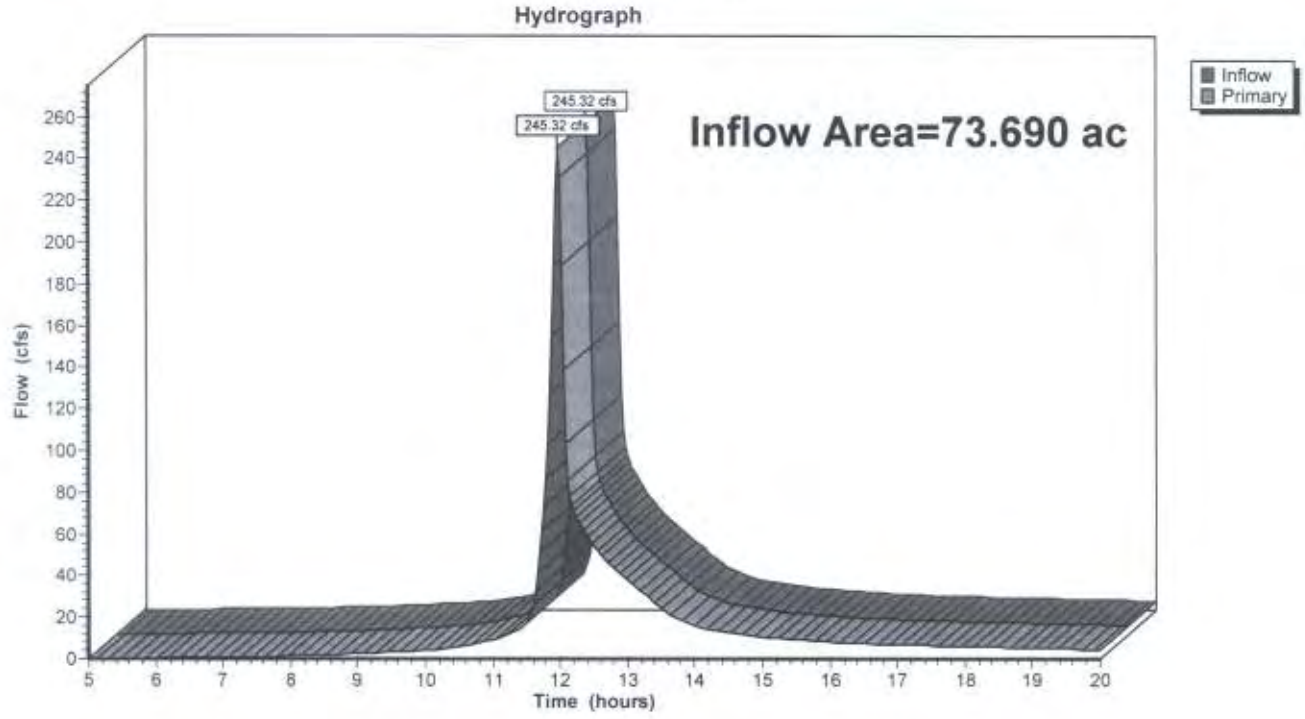
## Pond COMB1:

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 73.690 ac, Inflow Depth > 2.74" for 2-YR event
Inflow = 245.32 cfs @ 11.96 hrs, Volume= 16.851 af
Primary = 245.32 cfs @ 11.96 hrs, Volume= 16.851 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.03 hrs

## Pond COMB1:



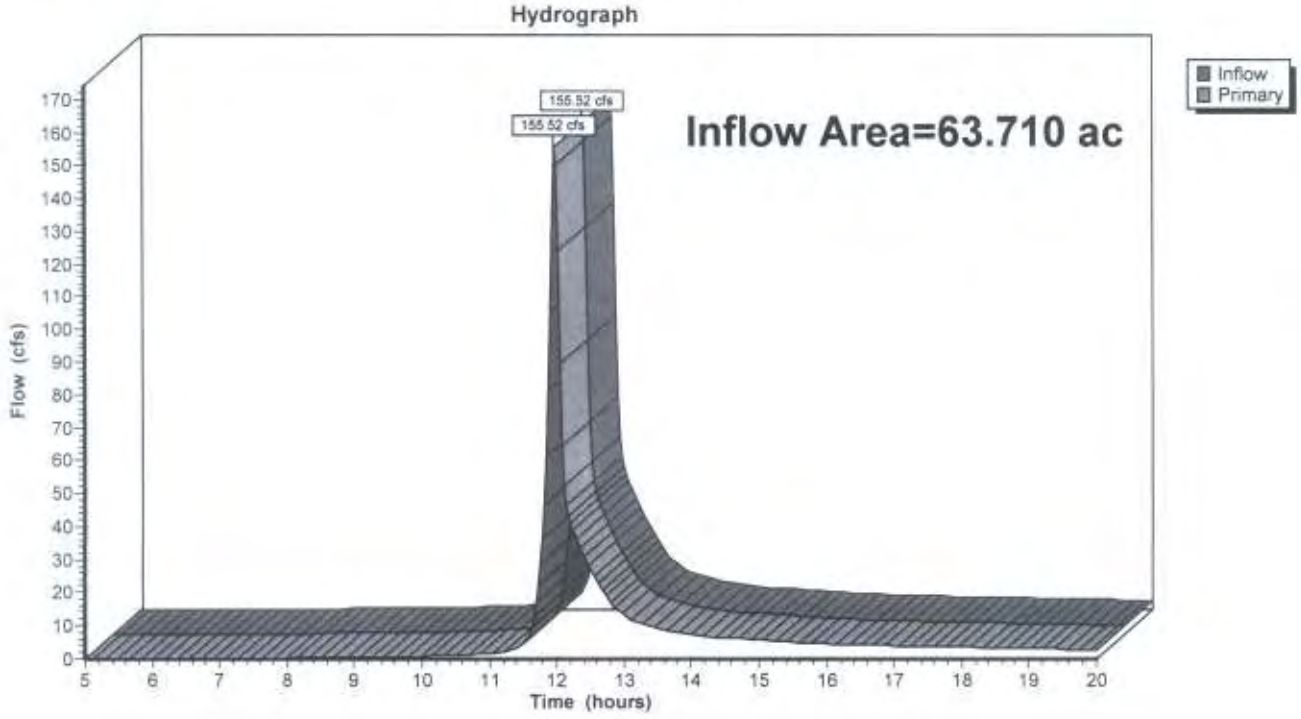
## Pond COMB2:

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 63.710 ac, Inflow Depth > 1.53" for 2-YR event
Inflow = 155.52 cfs @ 11.97 hrs, Volume= 8.136 af
Primary = 155.52 cfs @ 11.97 hrs, Volume= 8.136 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.03 hrs

## Pond COMB2:



## Pond POND ESTE:

Inflow Area = 9.540 ac, Inflow Depth > 3.22" for 2-YR event
Inflow = 57.08 cfs @ 11.96 hrs, Volume= 2.562 af
Outflow = 21.81 cfs @ 12.06 hrs, Volume= 2.530 af, Atten= 62%, Lag= 6.3 min
Primary = 21.81 cfs @ 12.06 hrs, Volume= 2.530 af
Secondary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.03 hrs
Peak Elev= 169.71' @ 12.06 hrs Surf.Area= 0.192 ac Storage= 0.742 af

Plug-Flow detention time= 23.6 min calculated for 2.525 af (99% of inflow)
Center-of-Mass det. time= 18.3 min ( 776.9 - 758.6 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 164.90' | 1.909 af | **Custom Stage Data (Prismatic)** Listed below (Recalc) |

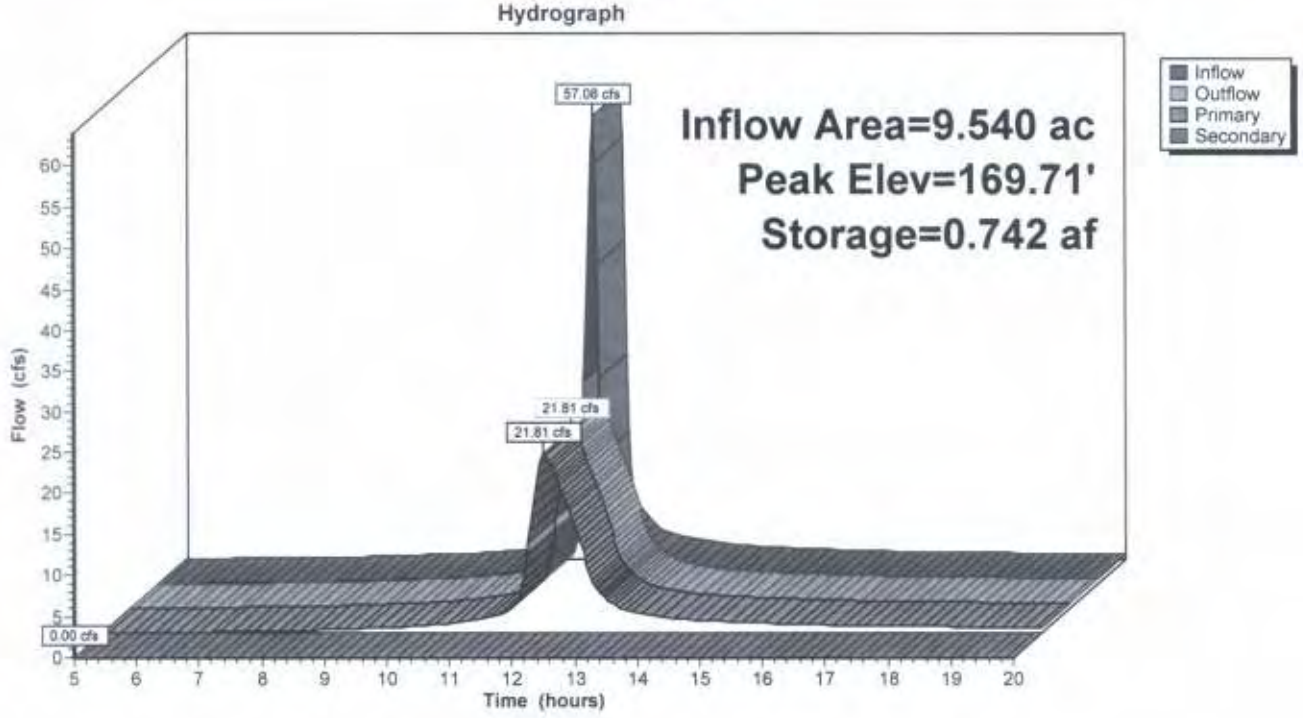
| Elevation (feet) | Surf.Area (acres) | Inc.Store (acre-feet) | Cum.Store (acre-feet) |
|---|---|---|---|
| 164.90 | 0.116 | 0.000 | 0.000 |
| 174.74 | 0.272 | 1.909 | 1.909 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 164.90' | **48.0" x 65.6' long Culvert** RCP, sq.cut end projecting, Ke= 0.500<br>Outlet Invert= 164.24' S= 0.0101 '/' Cc= 0.900 n= 0.015 |
| #2 | Device 1 | 164.90' | **1.50' W x 1.50' H Vert. Orifice/Grate** C= 0.600 |
| #3 | Device 1 | 170.83' | **2.00' x 2.00' Horiz. Orifice/Grate** Limited to weir flow C= 0.600 |
| #4 | Secondary | 173.74' | **20.0' long x 1.0' breadth Broad-Crested Rectangular Weir**<br>Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00<br>Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32 |

**Primary OutFlow** Max=21.76 cfs @ 12.06 hrs HW=169.69' (Free Discharge)
└**1=Culvert** (Passes 21.76 cfs of 95.96 cfs potential flow)
└**2=Orifice/Grate** (Orifice Controls 21.76 cfs @ 9.67 fps)
└**3=Orifice/Grate** ( Controls 0.00 cfs)

**Secondary OutFlow** Max=0.00 cfs @ 5.00 hrs HW=164.90' (Free Discharge)
└**4=Broad-Crested Rectangular Weir** ( Controls 0.00 cfs)

## Pond POND ESTE:



## Pond POND OESTE:

Inflow Area = 29.680 ac, Inflow Depth > 3.26" for 2-YR event
Inflow = 178.93 cfs @ 11.96 hrs, Volume= 8.055 af
Outflow = 44.51 cfs @ 12.09 hrs, Volume= 7.824 af, Atten= 75%, Lag= 8.0 min
Primary = 44.51 cfs @ 12.09 hrs, Volume= 7.824 af
Secondary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.03 hrs
Peak Elev= 229.81' @ 12.09 hrs Surf.Area= 0.515 ac Storage= 3.156 af

Plug-Flow detention time= 51.9 min calculated for 7.808 af (97% of inflow)
Center-of-Mass det. time= 40.2 min ( 797.8 - 757.6 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 223.45' | 5.700 af | **Custom Stage Data (Prismatic)** Listed below |

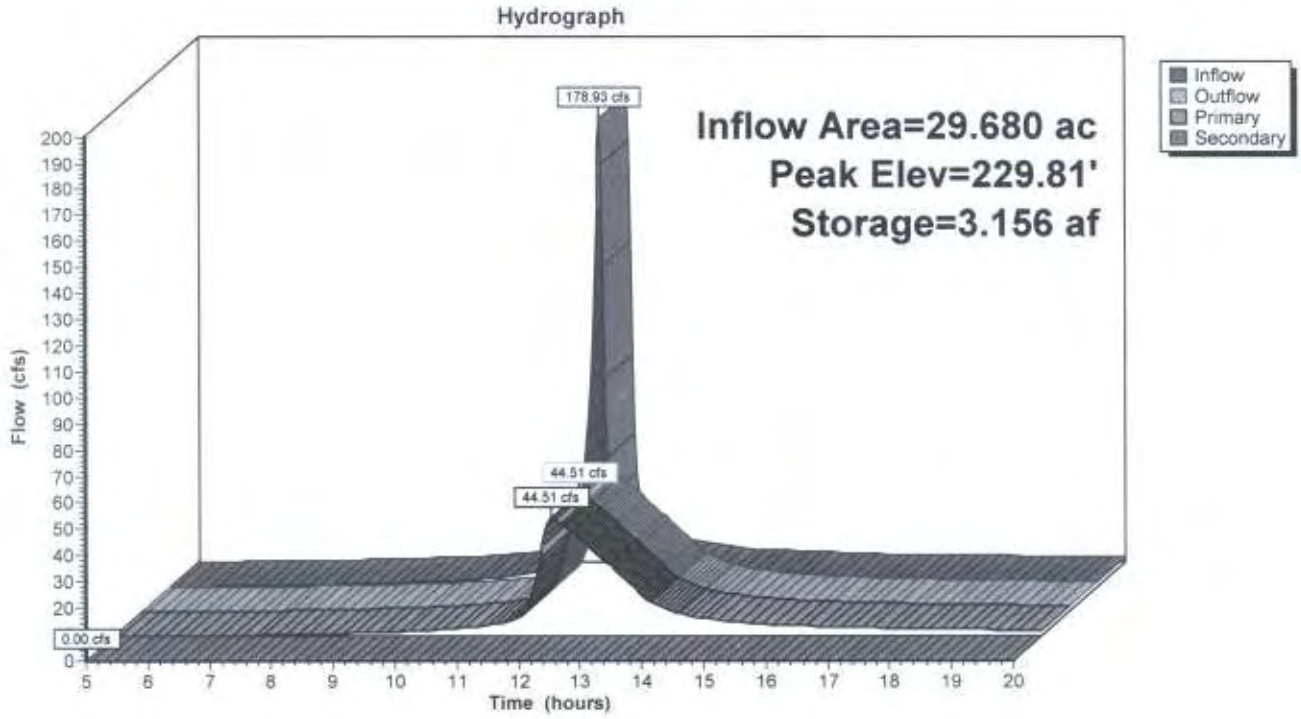
| Elevation (feet) | Surf.Area (acres) | Inc.Store (acre-feet) | Cum.Store (acre-feet) |
|---|---|---|---|
| 223.45 | 0.325 | 0.000 | 0.000 |
| 234.93 | 0.668 | 5.700 | 5.700 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 223.45' | **48.0" x 167.0' long Culvert X 2.00**<br>RCP, sq.cut end projecting, Ke= 0.500<br>Outlet Invert= 221.78' S= 0.0100 '/' Cc= 0.900 n= 0.015 |
| #2 | Device 1 | 223.45' | **2.00' W x 2.00' H Vert. Orifice/Grate** C= 0.600 |
| #3 | Device 1 | 230.30' | **4.00' x 4.00' Horiz. Orifice/Grate** Limited to weir flow C= 0.600 |
| #4 | Secondary | 234.00' | **20.0' long x 1.0' breadth Broad-Crested Rectangular Weir**<br>Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00<br>Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32 |

**Primary OutFlow** Max=44.45 cfs @ 12.09 hrs HW=229.79' (Free Discharge)
└**1=Culvert** (Passes 44.45 cfs of 250.58 cfs potential flow)
  └**2=Orifice/Grate** (Orifice Controls 44.45 cfs @ 11.11 fps)
  └**3=Orifice/Grate** ( Controls 0.00 cfs)

**Secondary OutFlow** Max=0.00 cfs @ 5.00 hrs HW=223.45' (Free Discharge)
└**4=Broad-Crested Rectangular Weir** ( Controls 0.00 cfs)

## Pond POND OESTE:



# APÉNDICE F

Estudio de Campo

# DESARROLLO PROPUESTO

REVISIONES

I.H.J Y ASOCIADOS
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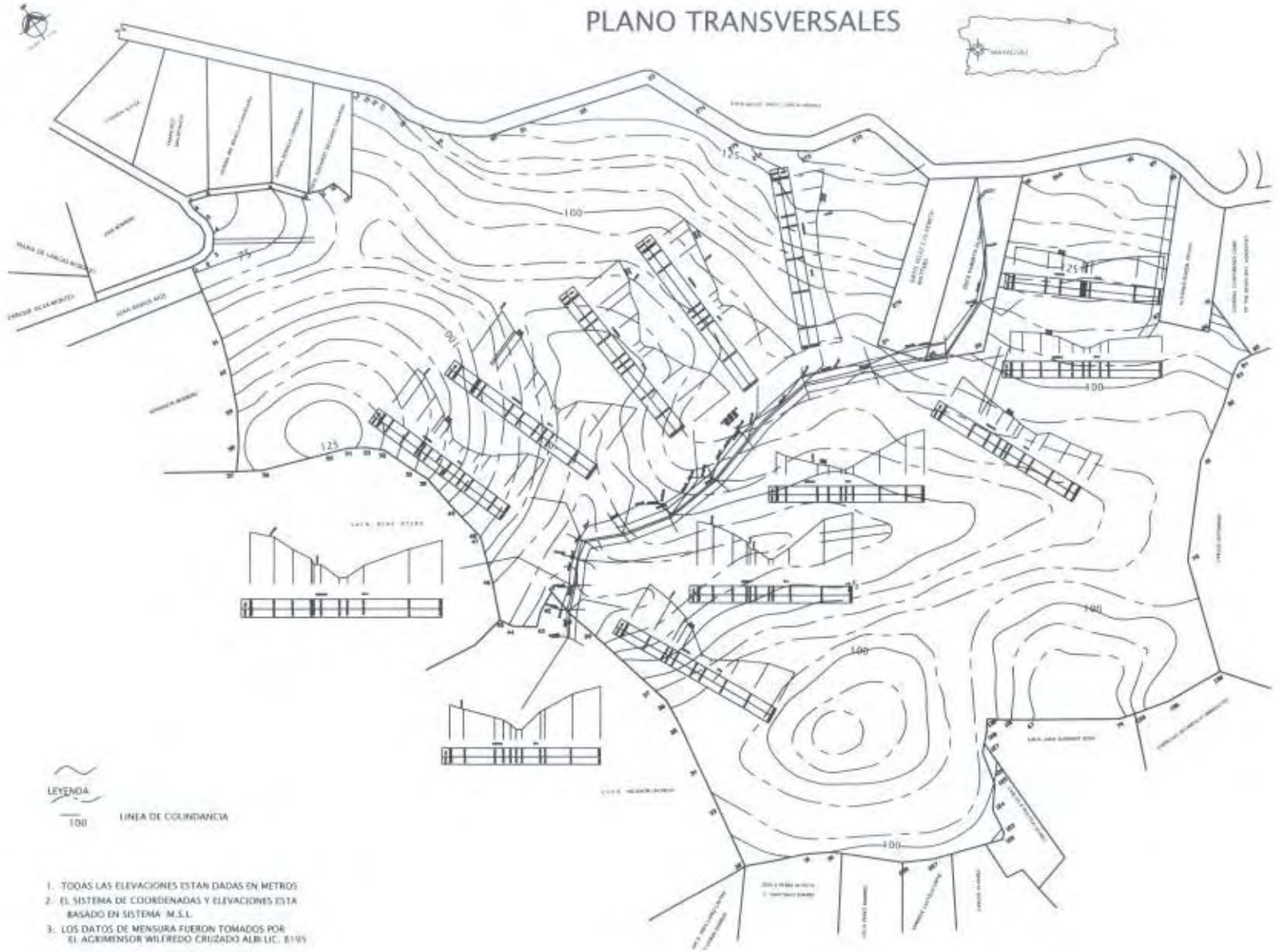
TEL:(787) 832-1122

PROYECTO:
URB. MONTE SIERRA
PLANO DE CONSTRUCCION

URB. MONTE SIERRA INC.
CARR. 349
RIO QUEBRADA GRANDE
MAYAGÜEZ
PUERTO RICO 00680

# PLANO TRANSVERSALES




LEYENDA

100 LINEA DE COLINDANCIA

1. TODAS LAS ELEVACIONES ESTAN DADAS EN METROS
2. EL SISTEMA DE COORDENADAS Y ELEVACIONES ESTA BASADO EN SISTEMA M.S.L.
3. LOS DATOS DE MENSURA FUERON TOMADOS POR EL AGRIMENSOR WILFREDO CRUZADO ALB LIC. 8195

REVISIONES

I.H.J Y ASOCIADOS

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PROYECTO
URB. MONTE SIERRA
PLANO DE CONSTRUCCION

URB. MONTE SIERRA INC.
CARR. 349
BO. QUEBRADA GRANDE
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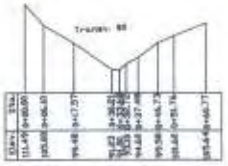
PUERTO RICO 00680

ACRIM. WILFREDO CRUZADO
CARMEN N. PADILLA
14 FEBRERO 2008
1:1 755
M-3

PLANO DE DESC. DE QUEBRADA

1 DE 2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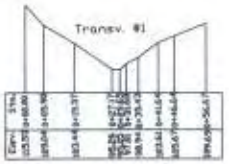
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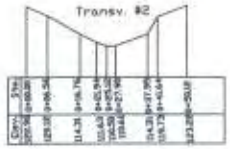
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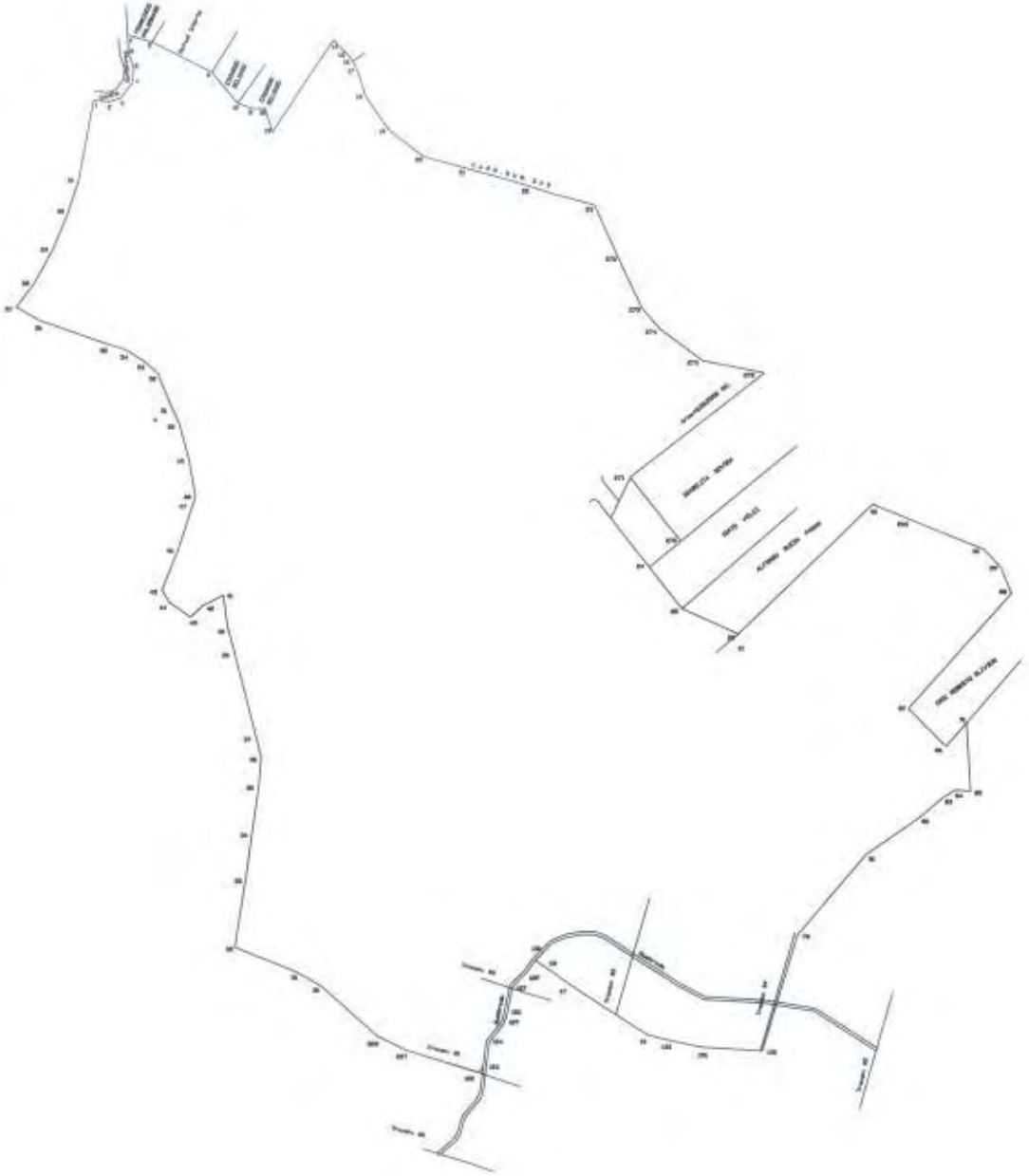

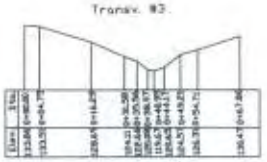
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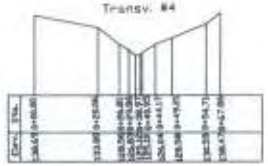
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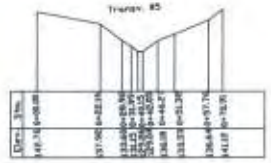
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