# APPENDIX A

## DELIVERY ORDER REPORTS

**(available in the USACE project web site:**

**http://www.saj.usace.army.mil**

**Double-click on "Critical Projects" button on left hand side of screen; Double-click on "Florida Keys Carrying Capacity Study" on left hand side of screen)**

# APPENDIX B

# PUBLIC INFORMATION AND INVOLVEMENT PLAN PREPARED BY THE MARKET SHARE COMPANY

# PIIP REPORT PREPARED BY THE MARKET SHARE COMPANY

At the outset of the Florida Keys Carrying Capacity Study (FKCCS) public involvement efforts, The Market Share Company (TMSC) prepared a Public Information and Involvement Plan (PIIP) in accordance with the FKCCS Scope of Work. TMSC presented a draft for Study Team review within three weeks of date of award. Following three additional revisions, the Study Team approved the PIIP. TMSC has continuously referred to the approved PIIP for direction throughout the course of the Study.

## 1. Preparation of PIIP Plan

The PIIP addressed the following issues:

- Informing the citizens of the Study
- Involving the community in the CCIAM development process
- Creating a Stakeholder's database
- Identifying and involving local media
- Creating a plan to identify and correct misinformation in local media and from the public
- Creating a Speakers Bureau
- Creating a Traveling Exhibit that contains educational information about the FKCCS
- Developing a productive relationship with local stakeholders
- Utilizing non-traditional public involvement methods and public outreach efforts to include avenues to reach traditionally non-verbal members of the community

In accordance with the Scope of Work and as directed in the PIIP, the following draft of the PIIP Report summarizes all public information and involvement activities to date.

The program included the following components:

## A. Research

For purposes of foundational background for the Study Team's research, sub-consultant R. Brooks White compiled a bibliography of previous public opinion surveys taken in the Florida Keys.

### *(1) Previous Public Survey Compil ation*

All sources of public opinion surveys were researched, both public and private. The list contained 21 previous surveys. A digital version of the list was provided by TMSC. The Previous Public Survey Report (option #1) was not exercised.

The following areas of public surveys were researched: natural resources, wastewater, stormwater, water quality, ecosystems and species of concern, human infrastructure, transportation and hurricane evacuation, social environment, socio-economics, sustainable tourism, quality of life, community character, rate of growth and land use regulations.

In researching the availability of such studies, three methods were utilized to collect data. A list of special-interest organizations in the Florida Keys that may have had access to private studies was compiled and a request was sent out to each of these groups asking for their input. Secondly, a search was conducted on the Internet for references to possible surveys. Finally, local agencies were contacted including Monroe County libraries and local college libraries, county and municipal planning departments, Emergency Management, Federal Marine Sanctuary, United States Navy, various conservation organizations, chambers of commerce, tourism development groups, various departments of the state of Florida such as Transportation, Department of Community Affairs, Environmental Protection, Everglades Management, and the South Florida Water Management District.

For all previous surveys that were identified, the following information was captured: date, title, location, purpose, responsible agency of organization, current point of contact, approximate sample size and sample methodology.

Upon review of the list of previous public opinion surveys and the accompanying pertinent information, TMSC and the Study Partners made a professional determination that these surveys did not contain information that would be usable for the purposes of the study. This was determined by virtue of the following:

- The Final Management Plan survey was conducted in 1966 and contained outdated information.
- The Lower SE Florida Hurricane Evacuation Study survey was conducted in 1983 and contained outdated information.
- The Importance and Satisfaction Ratings by Recreating Visitors to the Florida Keys and Key West survey, the Occupancy and Travel Average Daily Rates

survey, the Visitor Profile survey, the Origin and Destination survey, and the Gay and Lesbian Visitor survey were all conducted with tourists as the only people surveyed, leaving the data void of local community character.

- The Economic Contribution of Recreating Visitors survey and the Non-market Economic User Values survey were conducted with 73.5% of the responses coming from tourists, leaving the local community character data skewed.

- The Key West Citizen Poll survey consisted of a different question that was published daily in a newspaper that is mainly distributed to the Lower Keys and Key West. Not all of the phoned-in responses to the question were published. There was no control on the system to prevent the same individuals from calling in repeatedly on any given day.

- The Monroe County Sanitary Wastewater Master Plan, which was listed as a survey, was actually an inventory of wastewater facilities.

- The US One Arterial Travel Time and Delay Study was listed as a survey, but was actually an observation of automobiles at 24 locations throughout the Keys.

- The Socio-Economic Analysis of Alternatives had a sample size of only 16 people.

- The Water Quality Report survey had a sample size of only 300 people.

- The Noise Complaint Analysis of Air Traffic survey had a sample size of only 100 people. The only people surveyed were those calling in to complain.

- The Central Office Code Utilization survey listed its purpose as telephones and its sample size as not applicable.

- The Voter Survey of Tourism Impacts was mailed only to registered voters of Monroe County. Individuals who stated that they had not received their copy in the mail were given additional surveys. The survey was widely criticized by the business community because of the methodology used and because citizens felt the survey was worded in such a manner as to lead the person completing it to certain conclusions.

- The Comprehensive Plan, Appendix A survey, applied only to the Village of Islamorada.

- The Marathon Incorporation survey applied only to the city of Marathon.

- The Livable CommuniKeys Program Newsletters survey applied only to Big Pine Key and No Name Key.

- The Origin and Destination survey applied only to Big Pine Key and No Name Key.

### *(2) Formal Random Public Survey*

The Formal Random Public Survey (option #2) was not exercised.

## B. Media Program

The media has served as the primary method through which TMSC has shared information regarding the FKCCS with the public.

### *(1) Media Contac t*

TMSC developed and maintained a comprehensive list of media contacts within the community that included both print and broadcast, which was updated on a regular basis – see attachment #1. At the outset of media coordination efforts, TMSC informed all key members of the media about the FKCCS.

### *(2) Media Coordination*

Media coordination efforts also included the arrangement of press and radio opportunities for Study Team members prior to public meetings. Throughout the timeline of the Scope of Work, TMSC has served as the primary contact for media requests for the Study Team and has coordinated, documented and responded to all requests – see attachment #2.

### *(3) Newspaper Article Clipping Service*

As a vehicle for tracking applicable and significantly related issues, as well as identifying misinformation about the FKCCS, TMSC monitored and clipped 23 volumes of articles to date from all Keys' publications, including newsletters and special interest group publications. This service included but was not limited to the following publications:

- The Miami Herald
- The Key West Citizen
- Celebrate
- El Faro
- Solares Hill

- Island News (no longer in publication)
- Lower Keys Barometer
- Lower Keys Free Press Navigator
- Keynoter
- Free Press (Marathon)
- The Reporter (Tavernier)
- Upper Keys Independent
- Free Press (Islamorada)
- Free Press (Ocean Reef)
- The Breeze

This service included but was not limited to articles and editorials that addressed the following topics:

- Social Environment
- Land Use/Growth
- Tourism
- Transportation
- Stormwater
- Water Quality
- Wastewater
- Ecosystems
- Species of Concern
- Hurricane Evacuation
- Florida Keys Carrying Capacity Study

TMSC maintains an extensive library of clippings that reflect the diversity of issues, opinions, and community character that make up the Florida Keys. Copies of each clipping have been sent to the Study Partners on a weekly basis. The Study Team was notified by fax and e-mail of any

articles or Letters to the Editor with misinformation about the FKCCS that required immediate response.

### *(4) News Media Coverage*

Extensive research was performed to identify appropriate opportunities for the Study Team. Monroe County has no major television network affiliates. Radio interviews with study team members were coordinated to correspond with major milestones within the FKCCS. At the first series of public meetings, U.S. 1 Radio and SUN 103 conducted interviews. At the second series of public meetings milestone, radio interviews were arranged with US 1 Radio and SUN 103. At the Scenario Development Workshop in June '01, radio interviews were arranged with U.S. 1 Radio and SUN 103.

In September 2001, the opportunity for the FKCCS to be the subject of a Waterways program was identified by TMSC and forwarded to the Study Partners. Waterways is a half-hour TV program with an environmental focus and 3 million viewers in South Florida, according to producer Erik Hutchins. Waterways Executive Producer Cheva Heck is the public relations spokesperson for the FKNMS. Waterways is broadcast in the Florida Keys on Channel 19 and also sent to approximately 50 different organizations including schools, according to Hutchins. Waterways is financed by the EPA, the FKNMS, and the Everglades National Park, according to Hutchins. With the approval of Study Team members, the producer of the program has been given the appropriate contact information.

### *(5) Identify and Correct Media Misinformation and Inaccuracies*

As a result of the strength and the execution of the PIIP, TMSC has rarely been called upon to correct media misinformation. To date, misinformation has appeared in the media only four times during the entire course of the Study. In each case immediate action was taken to correct it.

### *(6) News Releases*

TMSC identified and developed news release story ideas in accordance with the Study's budgetary constraints. TMSC submitted each release for approval to the Study Team in a timely fashion. TMSC has written and distributed press releases and public notices. To date, 104 stories or references to the FKCCS have appeared in the local press including various chamber and other special interest organization newsletters.

### *(7) Guest Editorial Columns*

TMSC was available to produce guest editorial columns as requested throughout the Study. To date, the Study Team has requested one guest editorial column, which was published in the local

media on September 22, 2000. A copy of the editorial was forwarded to the Study Team in accordance with the Scope of Work.

### *(8) Website*

TMSC reviewed the existing FKCCS Website and provided suggestions and recommendations to the Study Team in the PIIP. TMSC continues to monitor the Website as the Study progresses. At the request of the Study Team, TMSC has provided information for the FKCCS Website.

### *(9) Video*

At the outset of the study, TMSC provided the Study Team with the cost of producing a basic educational video (option #4) and that option has not been exercised. More recently, TMSC has identified an opportunity to accomplish this through the Waterways television programming at no cost to the project.

## C. Meetings and Workshops

TMSC provided support in the monitoring of local meetings on topics relevant to the Study. Agendas for meetings of the local government municipalities, chambers of commerce and special interest groups were reviewed for references to the FKCCS. TMSC set up and attended the Traveling Exhibit, which includes brochures and other printed materials, as requested by the Study Team.

### *(1) Public Meetings*

The first series of public meetings were held in:

| | |
|---|---|
| Key Largo | July 18, 2000 |
| Marathon | July 19, 2000 |
| Key West | July 20, 2000 |

As a result of the first series of public meetings an additional meeting and location was incorporated in the second series of public meetings to accommodate the diversity of needs within the Florida Keys.

The second series of public meetings were held in:

| | |
|---|---|
| Marathon | March 20, 2001 |
| Islamorada | March 21, 2001 (5:30 p.m.) |

| | |
|---|---|
| Key Largo | March 21, 2001 (7:30 p.m.) |
| Key West | March 22, 2001 |

A third series of public meetings will be held in January 2002.

| | |
|---|---|
| Marathon | January 15, 2002 |
| Key Largo | January 16, 2002 |
| Key West | January 17, 2002 |

To accomplish the crucial goal of getting the word out to the general public and to engage minority communities, TMSC utilized the FKCCS Traveling Exhibit to announce public meetings at such areas as public housing facilities, libraries, and community banks. In addition to the traditional media outlets, news releases were also distributed to the community's only Spanish newspaper and to special interest groups for inclusion in their newsletters, such as the Gay and Lesbian Center and the Business Guild. TMSC also arranged for special interest groups to announce the dates of the FKCCS public meetings at their organization's meetings.

**(a)** For each series of public meetings TMSC performed pre-meeting planning and logistics including procurement of meetings sites that did not require a rental fee, security from the Monroe County Sheriff's office and the hiring of Paul Clayton of Paul E. Clayton & Associates to serve as facilitator at the first and second series of public meetings. TMSC also provided support to the Study Team at the meetings.

**(b)** TMSC created press kits and speaker cards for the FKCCS series of public meetings.

**(c)** TMSC prepared an agenda with input and final approval from the Study Team for the series of public meetings.

**(d)** TMSC prepared and published public notices for each series of public meetings pursuant to USACE and DCA requirements.

**(e)** TMSC prepared and distributed press releases for each series of public meetings. A media kit was prepared for each series of public meetings, which also included a Fact Sheet and a Frequently Asked Question sheet — see attachment #3 and #4.

**(f)** TMSC documented video and audio records of the meetings and provided minutes from the meetings in hard copy and electronic format. All tapes were turned over to the Study Team.

**(g)** Following the meetings, TMSC provided the study team with a synopsis of public comments and concerns in accordance with the Scope of Work. At the public

meetings, citizens were given a verbal and a written opportunity to voice their concerns. An extensive Comment Tracking System was created by TMSC to record this information. It is regularly updated.

### *(2) Community Meetings*

Throughout the duration of the Study, ample opportunities were developed by TMSC to provide an avenue for the Study Team to furnish information to the public and enhance public awareness and understanding of the FKCCS. TMSC arranged for members of the Study Team to speak directly to community groups through the establishment of the FKCCS Speakers Bureau.

### *(3) Study Team/Working Group Meetings*

In an effort to both advise the Study Team and working group members on public information and involvement activities and to ensure TMSC stayed up to date and informed on the progress of the Study, TMSC representatives have attended study team/working group meetings and participated in bi-weekly teleconference meetings as requested by the Study Team.

TMSC representatives have attended the following meetings:

| | |
|---|---|
| March 22 and 23, 2000 | Study Team Workshop |
| October 4, 2000 | Working Group Meeting |
| November 15, 2000 | Working Group Meeting |
| January 9 and 10, 2001 | Technical Wrap-up Workshop |
| February 21, 2001 | Working Group Meeting |
| June 19, 2001 | Scenario Workshop |
| August 20, 2001 | Scenario Follow-up Workshop |
| October 15, 2001 | Scenario Workshop |

In addition, the public was invited to a series of Scenario Development Workshop meetings held for local land planners. An opportunity for public questions and comments were provided at the end of each workshop. In addition to being publicized through press releases and PSAs in local media, meeting notices were mailed to approximately 6,000 stakeholders inviting them to attend the Scenario Development Workshop in October.

### *(4) Government Meetings*

TMSC was available to attend all government meetings as directed by the Study Team and contacted Monroe County and all local municipalities to arrange receipt of commission meeting agendas on a monthly basis.

## D. Stakeholder Relations

### *(1) Mailing List*

TMSC developed a computerized stakeholder mailing list that consisted of individuals, elected officials, local, state, and federal government agencies, citizen groups, community organizations, and key members of minority communities that have an interest in the FKCCS and the future of the Florida Keys. The list is capable of being subdivided and sorted. It is updated on a regular basis and currently includes approximately 6,000 names and addresses.

### *(2) Comment Tracking System*

TMSC has created a database for public comment and maintains a tracking system that records verbal and written comments from public meetings and during the public comment portion of workshops, meetings and Speaker Bureau presentations, written comments received by mail, email and on the FKCCS website, telephone comments and all other public input received on the FKCCS during the course of the Study. The Study Team has been provided with regular updates as comments are recorded in the Comment Tracking System. To date, the database contains 134 public comments. TMSC has also converted the database into HTML for use on the FKCCS Website.

## E. Public Information/Education/Awareness

As stated in the beginning of this report, TMSC has identified FKCCS information to be exchanged and prepared public information materials to accomplish this goal. As part of the Public Information and Involvement Plan, TMSC was tasked with providing community character/quality of life information for the Florida Keys. In addition to the Comment Tracking System, Clipping Service and Stakeholder Database, TMSC developed a variety of methods to gather community character information for the FKCCS.

### *(1) Information Exchange Program*

The PIIP plan identified public information objectives, information to be provided to and obtained from stakeholders, groups, or interests with whom information must be exchanged, circumstances that may affect the selection of public information techniques and methods

utilized to accomplish these goals. Key issues of the Study were addressed in public information materials prepared by TMSC.

At the first series of public meetings, TMSC collected qualitative community character information — see attachment #5. From the qualitative information, which was provided by the public, TMSC developed a quantitative ranking system for 17 issues of public concern specific to the Keys in an attempt to establish and document an understanding of community character for inclusion in the Study — see attachment #6.

Technical advisors to the Study Team assisted the TMSC in the undertaking of the gathering community character information were Dr. Gary Machlis, visiting chief social scientist, National Park Service and Dr. Frank T. McAndrew of Knox College in Galesburg, IL.

Due to the FKCCS time frame, it was not possible for TMSC to produce and document the results of a formal, statistically valid survey. However, it is our professional opinion that while the information gathered does not reflect the opinions of every citizen in Florida Keys, it still provides a picture of community character issues and concerns.

### *(2) Public Information Materials*

TMSC prepared public information materials in accordance with the Scope of Work and with the approval of the Study Team.

#### (a) Brochures

TMSC was tasked to develop three brochures at key progress points in the Study. The goal of the first brochure, of which 2000 copies were produced in August 2000, was to provide an introduction to the FKCCS. It served as a part of the FKCCS Traveling Exhibit and contained an overview of the FKCCS, an explanation of the purpose of the Study, biographies of the Study Team and information on how the public could become involved in the Study. See attachment #7.

The second brochure was produced by TMSC prior to the March 2001 series of public meetings. It contains information on the Study goal, the Study history, the CCIAM, the Routine Planning Tool, the opportunities for public involvement, the timeline, the FKCCS Website and the Study Team contact information. It was mailed to approximately 6,000 stakeholders as an announcement and invitation to attend the second series of public meetings. It has also served to update the general public on the progress of the Study as an integral part of the FKCCS Traveling Exhibit. See attachment #8.

The third brochure is projected for production immediately prior to the completion of the draft FKCCS report to summarize the Study process and

results. It will continue to serve as an integral part of the FKCCS Traveling Exhibit and update the public on the progress of the Study.

**(b) Speaker's Bureau**

The FKCCS Speaker's Bureau was developed by TMSC to give the Study Partners an avenue of direct communication to the varied organizations throughout the Florida Keys that have an interest in the Study. Participating groups were civic organizations, homeowner's associations, Chambers of commerce, business organizations, service clubs, environmental groups and other special interest groups.

TMSC developed and maintained background information on these various community groups, which were used by speakers to tailor the message to the needs and interests of the organization they were addressing. Information included names, goals and locations of organizations, names of key individuals, number of members and the organization's concerns with the FKCCS, or views on matters of interest to the Study Team.

Each FKCCS speaker provided an introduction of the Study Team members and in-depth knowledge and brief history of the Study process at each presentation. During each opportunity, local relevance for each area was characterized. An explanation of the draft FKCCS report, including transfer of the model and Study outputs to the Florida Department of Community Affairs, Monroe County and incorporated areas was included. The speaker's mission was to educate and enhance public awareness. At the end of each session, there was an opportunity for questions and comments from the public.

See attachment #9 for Speaker's Bureau schedule and attachment #10 for Speaker's Bureau comparisons.

**(c) Traveling Exhibit**

The FKCCS Traveling Exhibit was designed for public information and outreach in a colorful, easy-to-read format that combines text with photography and handouts. A four-foot by three-foot, freestanding poster, it has been displayed at banks, libraries, government and civic meetings, events and festivals throughout the Florida Keys. Brochures and business cards for Study Team and the FKCCS Website address have accompanied the exhibit in its travels.

The Traveling Exhibit started touring in November 2000 and has maintained a consistent schedule for a one-week display at various locations throughout the Florida Keys. It has also been displayed at various trade shows, meetings, and festivals – see attachment #11.

The first Traveling Exhibit illustrated how the FKCCS was being done in order to maintain the beauty of the islands and the quality of life and to learn how much future land development the Florida Keys can sustain. It explained how the Monroe County Year 2010 Comprehensive Plan highlighted specific areas of the Florida Keys that have already exceeded carrying capacity thresholds. It also explained the goal of the Study, the objectives, the timeline, and what the Study will and will not do. It listed the products that will be the outcome of the Study including the CCIAM, the Geographic Information System Database and a literature database.

FKCCS categories were illustrated including ecosystems, species of concern, water quality, regional economy, fiscal impacts, community character, quality of life, population forecast, hurricane evacuation, wastewater, stormwater, traffic circulation and marinas, port and heavily traveled channels. The Traveling Exhibit also incorporated how the public could get involved, and Website and contact information for the FKCCS team.

The FKCCS Traveling Exhibit was updated in August 2001 to reflect progress made on the project. Additionally, the original format was re-evaluated and replaced with a sturdier display board that is capable of being changed without the need for full panel replacement and specialty printing services. This was presented to and approved by the Study Partners at the August Scenario Development Workshop.

The FKCCS will continue to be displayed throughout the Florida Keys and updated as needed in accordance with the Scope of Work.

**(d) Interpretive Booths**

One of the strengths of the FKCCS Traveling Exhibit is its ability to serve as a stand-alone communication tool. However, with the addition of a representative from TMSC and the series of FKCCS documents, it has provided additional opportunities for community outreach. When a representative from TMSC has accompanied the Traveling Exhibit, they brought with them the opportunity for public questions and to provide comments. Additionally, it has enabled the public to order copies of the documentation that supports the FKCCS.

**(e) Newsletters**

TMSC designed a newsletter format that included graphics, layout, and column headlines for the FKCCS that met with the criteria established in the Scope of Work. The first newsletter, produced in July 2000, contained the Study categories, public meeting information, background information on the Carrying Capacity Study and biographies of the Study Team members — see attachment #12.

The first newsletter was mailed to the entire Stakeholder List, which contained approximately 6,000 names. The timing of a second and third newsletter is dependent upon the completion of the draft CCIAM and the draft FKCCS report.

**(f) Hotline**

Option #5 was not exercised.

## 2. PIIP Review and Update

TMSC has prepared the draft PIIP plan in accordance with the Scope of Work and consults with the Study Team to obtain guidance for updating and adjusting the PIIP.

## 3. PIIP Plan Execution

TMSC has executed the activities specified in the approved PIIP and provided logistics and supplies to accomplish them. In summary, the TMSC has followed the Scope of Work and the PIIP to create an in-depth Public Information and Involvement Program for the FKCCS.

## 4. PIIP Report

TMSC has prepared a draft of the PIIP Report for submission in the Public Information/Involvement section of the FKCCS by the date specified in the Scope of Work. TMSC expects to receive comments from the Study Team and will provide final PIIP section for FKCCS report in accordance with the Scope of Work.

# APPENDIX C

# CANAL IMPACT ASSESSMENT TOOL

# FLORIDA KEYS
# CARRYING CAPACITY STUDY

## CANAL IMPACT ASSESSMENT MODULE

## Draft

This report was prepared by URS Corporation (formerly Dames & Moore, Inc.), for the U.S. Army Corps of Engineers and the Florida Department of Community Affairs. Funds for this study were provided under U.S. Army Corps of Engineers Contract No. DACW17-99-D-0058, Delivery Order 12.

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# 1 INTRODUCTION

This report describes the development, testing and subsequent integration into the Carrying Capacity Impact Assessment Model (CCIAM) of a comparative analysis tool for evaluating the impacts of wastewater effluents and stormwater discharges into tidally-flushed dead-end canals.

Available literature for the Florida Keys documents water quality problems in dead-end and plugged canals in the FKCCS Study Area (reviewed in Kruczynski and McMannus 2002). Additionally, anecdotal data suggests the presence of a "nutrient aura" in nearshore waters at the mouths of canals. This aura has been attributed to the concentration and discharge of wastewater effluents from on-site wastewater systems to adjacent canals.

Review comments on the Test CCIAM identified the need to develop an additional module of the CCIAM to assess differential impacts of alternative scenarios on canals. The Florida Department of Community Affairs (DCA) is funding a study to identify existing canals, characterize their known physical attributes, identify the availability of existing water quality data, classify the canals based upon a number of characteristics, and suggest generic types of engineering measures for specific classes of canals. At the time of this effort, the canal study was partially developed; its GIS coverage and database were adopted for use in the Canal Impacts Module.

The Canal Module is intended to assess relative impacts of wastewater and stormwater management decisions on nutrient concentrations in representative canals in the Study Area. Pathogens and fecal coliform, while of much human interest, were omitted from the model due to lack of pertinent data. This work included the following:

- Review and assess pertinent physical and water quality data;
- Select representative canals in the Study Area;
- Develop a tidal characteristics database;
- Develop an ambient nearshore water quality database;
- Define canal segments, contributing watersheds and receiving water discharge zone elements;
- Develop and test a simplified canal impacts model;
- Integrate the canal impacts model into CCIAM; and
- Prepare a summary report.

# 2 DATA COLLECTION, REVIEW & DEVELOPMENT

The Canal Module of the CCIAM is a steady-state, tidal-flushing model that estimates pollutant concentrations in canals based on pollutant loads from stormwater and wastewater and pollutant concentrations in nearshore waters. To develop the model, data acquisition efforts targeted previous canal water quality studies, nearshore water quality data, and tidal fluctuation.

## 2.1 Previous Canal Water Quality Studies

The following eight studies were identified and reviewed:

- Proposed Designation of the Waters of the Florida Keys as Outstanding Florida Waters. FDER, March 1985. A total of 165 stations were sampled for a few parameters from Key Largo to Key West from January 8, 1985 to February 20, 1985. Background stations at 1/4 mile offshore show no violations of dissolved oxygen standards, while one to seven oceanside stations and one to five bayside stations violated the standard and showed higher levels of nitrogen and phosphorous.

- Water Quality Assessment of Five Selected Pollutant Sources in Marathon, Florida Keys. FDER. Heatwole, July 1987. The study measured 32 water quality parameters at twelve nearshore sites in Marathon during 1984. Five primary sampling sites were located in canals and marina basins with a representative pollution source; five secondary sampling sites were located in areas adjacent to these primary sites to monitor the pollutant dilution, and two stations were located as background stations. Results varied by pollution source, and by seasonal changes in weather and population densities.

- Boot Key Harbor Study. FDER, December 1990. Fourteen stations located in canals and the harbor basin were monitored during a year in Boot Key Harbor. Low dissolved oxygen levels in the canals were attributed to poor flushing characteristics that resulted in them serving as sinks for organic matter.

- Florida Bay Watch Annual Reports. The Nature Conservancy, 1995 –2001. The reports summarized the data collected during the sample year and presented monthly means for certain parameters over the entire data collection history. Data results varied among stations because of the location differences between sampling sites.

- Effects of Installing Flow-Through Culverts on Canal Water Quality and Benthic Communities at Jolly Roger Estates. The Nature Conservancy. Fogarty, Keller & Dye, April 2001. Weekly benthic and water quality data was collected for about ten months before and after culverts were installed at dead end canals on Little Torch Key. Water quality improved after the

culverts were installed, and very little change was observed in the benthic community.

- Effects of Stormwater Nutrient Discharges on Eutrophication Processes in Nearshore Waters of the Florida Keys. LaPointe & Matzie, June 1996. Stormwater discharges were characterized by continuously sampling (30 minutes interval) water quality parameters along an offshore eutrophication gradient prior to and following heavy rainfall during the 1992 rainfall season. The gradient included a station in a developed canal system on Big Pine Key (Port Pine Heights).

- Nutrient Inputs from the Watershed and Coastal Eutrophication in the Florida Keys. LaPointe & Clark, December 1992. Thirty stations throughout inner-shelf waters (<10 m depth) were measured for water quality parameters during summer and winter. Sampling at each site was done along an onshore-offshore transect. The authors found a gradient in nutrients from inshore to offshore and concluded that the widespread use of septic tanks increases the nutrient concentrations of limestone groundwaters that discharge into shallow nearshore waters, resulting in coastal eutrophication.

- Water Quality Concerns in the Florida Keys: Sources, Effects and Solutions. USEPA, Kruczynski, 1999. The report reviews several previous published studies and reports in the study area.

## 2.2 Existing Data Acquisition

The following data sets were acquired and assimilated:

- Monroe County Residential Canal Inventory and Assessment (90% Draft). A total of 480 canals were included in the draft database.

- FKNMS Water Quality Protection Program Data. 155 fixed stations were monitored for water quality parameters for the period of record of March 1995 to December 2001.

- Village of Islamorada, Periodic Water Quality Sampling Program Data. 24 Stations were sampled for the period of record of April 2001 to April 2002.

- The Florida Bay Watch Ambient Water Quality Program Data. The Nature Conservancy. 101 stations were monitored for water quality parameters for the period of record of November 1994 to December 2001. Of these stations 51 were located at canals.

- The Little Venice Canals Water Quality Monitoring Data. USEPA. 9 stations were sampled for the period of record of May 2001 to January 2002.

## 2.3 Tidal Database

The current NOAA tide gauge network consists of more than 170 tidal stations in the vicinity of the Florida Keys. An inventory of tide stations for the Florida Keys was collected from the Center for Operational Oceanographic Products and Services (CO-OPS) web site (Table 1). The inventory consists of 172 stations from Virginia Key to the Dry Tortugas, and included the latitude and longitude of each station. Location data was input into a GIS coverage for the CCIAM.

**TABLE 1**
**NOAA TIDE STATION INVENTORY – FLORIDA KEYS**

| Sta. # | Station Name | Mean Tide (feet) | | Time Difference (hrs) ($TD_H/TD_L$) | | Height Adjustments ($H_{adj}/L_{adj}$) | | Ref. Station |
|---|---|---|---|---|---|---|---|---|
| | | Range | Level | High | Low | High | Low | |
| 1 | Bear Cut, Virginia Key | 2.05 | 1.16 | 0.817 | 0.867 | 0.82 | 0.82 | Miami Harbor Entrance |
| 2 | Key Biscayne Yacht Club, Biscayne Bay | 2.00 | 1.13 | 1.117 | 1.583 | 0.80 | 0.81 | Miami Harbor Entrance |
| 3 | Coral Shoal, Biscayne Channel | 2.05 | 1.15 | 0.567 | 0.683 | 0.82 | 0.81 | Miami Harbor Entrance |
| 4 | Cutler, Biscayne Bay | 1.98 | 1.13 | 1.383 | 2.000 | 0.79 | 0.88 | Miami Harbor Entrance |
| 5 | Soldier Key | 1.90 | 1.00 | 0.883 | 1.333 | 0.74 | 0.75 | Miami Harbor Entrance |
| 6 | Fowey Rocks | 2.40 | 1.40 | 0.017 | 0.050 | 0.97 | 0.94 | Miami Harbor Entrance |
| 7 | Ragged Keys, Biscayne Bay | 1.65 | 0.95 | 1.117 | 1.417 | 0.66 | 0.66 | Miami Harbor Entrance |
| 8 | Boca Chita Key, Biscayne Bay | 1.57 | 0.94 | 1.400 | 1.717 | 0.63 | 0.63 | Miami Harbor Entrance |
| 9 | Sands Key, northwest point, Biscayne Bay | 1.46 | 0.82 | 1.800 | 2.500 | 0.58 | 0.56 | Miami Harbor Entrance |
| 10 | Coon Point, Elliott Key, Biscayne Bay | 1.44 | 0.82 | 2.300 | 3.000 | 0.57 | 0.57 | Miami Harbor Entrance |
| 11 | Elliott Key Harbor, Elliott Key, Biscayne Bay | 1.48 | 0.83 | 2.317 | 3.067 | 0.59 | 0.56 | Miami Harbor Entrance |
| 12 | Turkey Point, Biscayne Bay | 1.64 | 0.94 | 2.550 | 3.417 | 0.65 | 0.65 | Miami Harbor Entrance |
| 13 | Billys Point, south of, Elliott Key, Biscayne Bay | 1.46 | 0.82 | 2.517 | 3.400 | 0.58 | 0.56 | Miami Harbor Entrance |
| 14 | Sea Grape Point, Elliott Key | 2.30 | 1.39 | 0.633 | 0.650 | 0.92 | 0.92 | Miami Harbor Entrance |
| 15 | Christmas Point, Elliott Key | 1.82 | 1.06 | 0.600 | 0.683 | 0.73 | 0.73 | Miami Harbor Entrance |
| 16 | Adams Key, south end, Biscayne Bay | 1.52 | 0.90 | 1.400 | 1.200 | 0.61 | 0.61 | Miami Harbor Entrance |
| 17 | Totten Key, west side, Biscayne Bay | 1.26 | 0.71 | 2.700 | 3.417 | 0.50 | 0.50 | Miami Harbor Entrance |
| 18 | East Arsenicker, Card Sound | 0.91 | 0.54 | 2.817 | 3.217 | 0.36 | 0.36 | Miami Harbor Entrance |
| 19 | Card Sound, western side | 0.68 | 0.40 | 3.233 | 3.733 | 0.27 | 0.27 | Miami Harbor Entrance |
| 20 | Pumpkin Key, south end, Card Sound | 0.63 | 0.43 | 2.967 | 2.933 | 0.25 | 0.25 | Miami Harbor Entrance |
| 21 | Wednesday Point, Key Largo, Card Sound | 0.77 | 0.46 | 3.017 | 3.567 | 0.31 | 0.31 | Miami Harbor Entrance |
| 22 | Cormorant Point, Key Largo, Card Sound | 0.73 | 0.43 | 3.133 | 3.083 | 0.29 | 0.29 | Miami Harbor Entrance |
| 23 | Little Card Sound bridge | 0.53 | 0.32 | 3.850 | 4.267 | 0.21 | 0.21 | Miami Harbor Entrance |
| 24 | Ocean Reef Harbor, Key Largo | 2.33 | 1.37 | 0.217 | 0.300 | 0.93 | 0.93 | Miami Harbor Entrance |
| 25 | Main Key, Barnes Sound | 0.41 | 0.26 | 5.450 | 6.333 | 0.16 | 0.16 | Miami Harbor Entrance |
| 26 | Manatee Creek, Manatee Bay, Barnes Sound | 0.39 | 0.25 | 5.617 | 6.400 | 0.16 | 0.16 | Miami Harbor Entrance |
| 27 | Carysfort Reef | 2.34 | 1.36 | 0.700 | 0.717 | 0.93 | 0.93 | Miami Harbor Entrance |
| 28 | Garden Cove, Key Largo | 2.16 | 1.24 | 0.367 | 0.483 | 0.86 | 0.86 | Miami Harbor Entrance |
| 29 | Largo Sound, Key Largo | 0.80 | 0.47 | 2.600 | 3.117 | 0.32 | 0.32 | Miami Harbor Entrance |
| 30 | Key Largo, South Sound, Key Largo | 1.55 | 0.85 | 0.767 | 1.883 | 0.61 | 0.56 | Miami Harbor Entrance |
| 31 | Rock Harbor, Key Largo | 2.10 | 1.23 | 0.717 | 0.683 | 0.84 | 0.84 | Miami Harbor Entrance |
| 32 | Rock Harbor, Key Largo | 2.14 | 1.24 | 0.750 | 0.667 | 0.85 | 0.85 | Miami Harbor Entrance |
| 33 | Mosquito Bank | 2.20 | 1.20 | 0.367 | 0.517 | 0.85 | 0.88 | Miami Harbor Entrance |
| 34 | Molasses Reef | 2.20 | 1.20 | 0.233 | 0.200 | 0.88 | 0.88 | Miami Harbor Entrance |
| 35 | Tavernier Harbor, Hawk Channel | 2.09 | 1.23 | 0.517 | 0.483 | 0.83 | 0.83 | Miami Harbor Entrance |
| 36 | Tavernier Creek, Hwy. 1 bridge, Hawk Channel | 1.32 | 0.81 | 0.800 | 0.933 | 0.53 | 0.53 | Miami Harbor Entrance |
| 37 | Crane Keys, north side, Florida Bay | 0.40 | 0.24 | 3.317 | 4.667 | 0.16 | 0.16 | Miami Harbor Entrance |
| 38 | East Key, southern end, Florida Bay | 0.52 | 0.28 | 3.100 | 4.167 | 0.21 | 0.21 | Miami Harbor Entrance |
| 39 | Plantation Key, Hawk Channel | 2.20 | 1.27 | 0.467 | 0.267 | 0.88 | 0.88 | Miami Harbor Entrance |
| 40 | Yacht Harbor, Cowpens Anchorage, Plantation Key | 0.53 | 0.31 | 3.133 | 4.067 | 0.21 | 0.21 | Miami Harbor Entrance |
| 41 | Snake Creek, Hwy. 1 bridge, Windley Key | 1.07 | 0.61 | 1.200 | 1.000 | 0.43 | 0.43 | Miami Harbor Entrance |
| 42 | Snake Creek, USCG Station, Plantation Key | 0.82 | 0.48 | 1.517 | 2.000 | 0.33 | 0.33 | Miami Harbor Entrance |
| 43 | Whale Harbor, Windley Key, Hawk Channel | 1.56 | 0.83 | 0.500 | 0.917 | 0.62 | 0.62 | Miami Harbor Entrance |
| 44 | Whale Harbor Channel, Hwy. 1 bridge, Windley Key | 1.36 | 0.78 | 0.650 | 1.067 | 0.54 | 0.54 | Miami Harbor Entrance |
| 45 | Upper Matecumbe Key, Hawk Channel | 1.98 | 1.16 | 0.950 | 0.883 | 0.79 | 0.79 | Miami Harbor Entrance |
| 46 | Alligator Reef, Hawk Channel | 1.93 | 1.15 | 0.517 | 0.467 | 0.77 | 0.77 | Miami Harbor Entrance |

**TABLE 1 (Continued)**
**NOAA TIDE STATION INVENTORY – FLORIDA KEYS**

| Sta. # | Station Name | Mean Tide (feet) | | Time Difference (hrs) ($TD_H/TD_L$) | | Height Adjustments ($H_{adj}/L_{adj}$) | | Ref. Station |
|---|---|---|---|---|---|---|---|---|
| | | Range | Level | High | Low | High | Low | |
| 47 | Flamingo, Florida Bay | 2.02 | 1.27 | 5.467 | 7.333 | 1.47 | 1.08 | Key West |
| 48 | Upper Matecumbe Key, west end, Hawk Channel | 1.44 | 0.80 | -1.000 | 0.233 | 0.98 | 0.33 | Key West |
| 49 | Indian Key, Hawk Channel | 1.84 | 1.09 | -0.300 | 0.083 | 1.30 | 0.71 | Key West |
| 50 | Shell Key Channel, Florida Bay | 1.02 | 0.58 | 0.333 | 0.750 | 0.78 | 0.78 | Key West |
| 51 | Lignumvitae Key, NE side, Florida Bay | 0.68 | 0.37 | 0.150 | 1.517 | 0.52 | 0.52 | Key West |
| 52 | Lignumvitae Key, west side, Florida Bay | 0.62 | 0.35 | 0.533 | 1.900 | 0.47 | 0.47 | Key West |
| 53 | Little Basin, Upper Matecumbe Key, Florida Bay | 0.80 | 0.40 | 0.133 | 1.250 | 0.61 | 0.61 | Key West |
| 54 | Shell Key, northwest side, Lignumvitae Basin | 0.60 | 0.33 | 0.517 | 1.950 | 0.46 | 0.46 | Key West |
| 55 | Islamorada, Upper Matecumbe Key, Florida Bay | 0.49 | 0.30 | 0.650 | 2.117 | 0.37 | 0.37 | Key West |
| 56 | Indian Key Anchorage, Lower Matecumbe Key | 1.94 | 1.20 | -0.783 | -0.250 | 1.40 | 0.96 | Key West |
| 57 | Matecumbe Bight, Lower Matecumbe Key, Fla. Bay | 0.77 | 0.48 | 0.417 | 0.583 | 0.55 | 0.38 | Key West |
| 58 | Matecumbe Harbor, Lower Matecumbe Key, Fla. Bay | 0.83 | 0.50 | 0.250 | 0.383 | 0.59 | 0.33 | Key West |
| 59 | Channel Two, east, Lower Matecumbe Key, Fla. Bay | 1.18 | 0.72 | -0.150 | -0.033 | 0.85 | 0.54 | Key West |
| 60 | Channel Two, west side, Hawk Channel | 1.55 | 0.96 | -0.433 | -0.233 | 1.12 | 0.75 | Key West |
| 61 | Channel Five, east side, Hawk Channel | 1.25 | 0.77 | -0.233 | -0.033 | 0.90 | 0.58 | Key West |
| 62 | Channel Five, west side, Hawk Channel | 1.39 | 0.85 | -0.300 | -0.017 | 1.00 | 0.67 | Key West |
| 63 | Jewfish Hole, Long Key, Florida Bay | 0.56 | 0.37 | 0.483 | 1.533 | 0.42 | 0.38 | Key West |
| 64 | Long Key Bight, Long Key | 1.44 | 0.87 | -0.317 | -0.050 | 1.03 | 0.62 | Key West |
| 65 | Long Key Lake, Long Key | 0.85 | 0.53 | 0.550 | 0.950 | 0.62 | 0.46 | Key West |
| 66 | Long Key, western end | 1.19 | 0.67 | -0.350 | -0.233 | 0.82 | 0.33 | Key West |
| 67 | Conch Key, eastern end | 1.18 | 0.72 | -0.483 | -0.083 | 0.85 | 0.54 | Key West |
| 68 | Toms Harbor Cut | 0.48 | 0.33 | -0.650 | 0.167 | 0.37 | 0.38 | Key West |
| 69 | Duck Key, Hawk Channel | 1.37 | 0.81 | -0.517 | 0.000 | 0.96 | 0.50 | Key West |
| 70 | Toms Harbor Channel, Hwy. 1 bridge | 0.50 | 0.45 | 5.117 | 4.817 | 0.38 | 0.38 | Key West |
| 71 | Grassy Key, north side, Florida Bay | 0.87 | 0.70 | 5.683 | 6.817 | 0.66 | 0.66 | Key West |
| 72 | Grassy Key, south side, Hawk Channel | 1.72 | 1.03 | -0.200 | 0.233 | 1.22 | 0.71 | Key West |
| 73 | Fat Deer Key, Florida Bay | 1.14 | 0.82 | 5.150 | 6.433 | 0.87 | 0.87 | Key West |
| 74 | Vaca Key-Fat Deer Key bridge | 1.31 | 0.83 | -0.517 | 0.067 | 0.95 | 0.71 | Key West |
| 75 | Key Colony Beach | 1.69 | 1.05 | -0.617 | -0.217 | 1.22 | 0.83 | Key West |
| 76 | VACA KEY, USCG STATION, FLORIDA BAY | 0.75 | 0.52 | 0.000 | 0.000 | 1.00 | 1.00 | Vaca Key |
| 77 | Boot Key Harbor bridge, Boot Key | 1.57 | 0.96 | -0.383 | 0.050 | 1.13 | 0.75 | Key West |
| 78 | Sombrero Key, Hawk Channel | 1.64 | 1.01 | -0.383 | 0.017 | 1.18 | 0.79 | Key West |
| 79 | Knight Key Channel, Knight Key, Florida Bay | 0.72 | 0.48 | 0.633 | 0.367 | 0.54 | 0.50 | Key West |
| 80 | Pigeon Key, south side, Hawk Channel | 1.14 | 0.69 | -0.250 | 0.233 | 0.81 | 0.50 | Key West |
| 81 | Pigeon Key, north side, Florida Bay | 0.60 | 0.44 | 0.500 | 0.750 | 0.46 | 0.46 | Key West |
| 82 | Molasses Key Channel, Molasses Keys | 1.10 | 0.67 | -0.267 | 0.400 | 0.79 | 0.50 | Key West |
| 83 | Money Key | 0.76 | 0.54 | 0.050 | 1.283 | 0.58 | 0.58 | Key West |
| 84 | Little Duck Key, east end, Hawk Channel | 0.88 | 0.60 | -0.150 | 0.083 | 0.67 | 0.67 | Key West |
| 85 | East Bahia Honda Key, south end, Florida Bay | 0.90 | 0.77 | 4.067 | 2.817 | 0.69 | 0.69 | Key West |
| 86 | Cocoanut Key, Florida Bay | 0.72 | 0.66 | 3.867 | 2.833 | 0.55 | 0.55 | Key West |
| 87 | West Bahia Honda Key | 1.27 | 0.88 | 3.983 | 4.017 | 0.97 | 1.00 | Key West |
| 88 | Horseshoe Keys, south end | 1.09 | 0.79 | 3.900 | 3.150 | 0.86 | 1.00 | Key West |
| 89 | Johnson Keys, south end | 0.88 | 0.67 | 3.600 | 2.550 | 0.72 | 0.96 | Key West |
| 90 | Johnson Keys, north end | 1.70 | 1.18 | 3.583 | 4.367 | 1.31 | 1.38 | Key West |
| 91 | Missouri Key-Little Duck Key Channel | 0.98 | 0.60 | -0.200 | 0.600 | 0.70 | 0.46 | Key West |
| 92 | Missouri Key-Ohio Key Channel, west side | 1.08 | 0.66 | -0.117 | 0.300 | 0.77 | 0.50 | Key West |
| 93 | Ohio Key-Bahia Honda Key Channel, west side | 1.10 | 0.70 | -0.283 | 0.433 | 0.81 | 0.62 | Key West |
| 94 | Bahia Honda Key, Bahia Honda Channel | 1.19 | 0.74 | -0.083 | 0.217 | 0.86 | 0.62 | Key West |
| 95 | Big Pine Key, Spanish Harbor | 1.07 | 0.64 | -0.067 | 0.617 | 0.75 | 0.42 | Key West |
| 96 | Big Pine Key, Doctors Arm, Bogie Channel | 0.80 | 0.57 | 0.683 | 1.783 | 0.63 | 0.71 | Key West |
| 97 | Big Pine Key, Bogie Channel Bridge | 0.80 | 0.60 | 2.167 | 2.183 | 0.65 | 0.83 | Key West |
| 98 | No Name Key, east side, Bahia Honda Channel | 0.70 | 0.55 | 1.583 | 1.550 | 0.58 | 0.83 | Key West |
| 99 | Little Pine Key, south end | 0.68 | 0.53 | 1.117 | 1.117 | 0.56 | 0.79 | Key West |
| 100 | Porpoise Key, Big Spanish Channel | 0.88 | 0.68 | 3.383 | 2.483 | 0.72 | 1.00 | Key West |
| 101 | Water Key, west end, Big Spanish Channel | 1.00 | 0.75 | 3.383 | 2.617 | 0.81 | 1.04 | Key West |
| 102 | Mayo Key, Big Spanish Channel | 1.17 | 0.85 | 3.583 | 3.017 | 0.92 | 1.08 | Key West |
| 103 | Little Pine Key, north end | 1.33 | 0.96 | 3.633 | 3.467 | 1.05 | 1.21 | Key West |
| 104 | Big Pine Key, northeast shore | 1.08 | 0.80 | 3.317 | 2.500 | 0.86 | 1.08 | Key West |
| 105 | Crawl Key, Big Spanish Channel | 1.74 | 1.19 | 3.567 | 4.217 | 1.33 | 1.33 | Key West |

**TABLE 1 (Continued)**
**NOAA TIDE STATION INVENTORY – FLORIDA KEYS**

| Sta. # | Station Name | Mean Tide (feet) | | Time Difference (hrs) ($TD_H/TD_L$) | | Height Adjustments ($H_{adj}/L_{adj}$) | | Ref. Station |
|---|---|---|---|---|---|---|---|---|
| | | Range | Level | High | Low | High | Low | |
| 106 | Big Pine Key, north end | 1.29 | 0.85 | 4.400 | 5.933 | 0.96 | 0.83 | Key West |
| 107 | Annette Key, north end, Big Spanish Channel | 1.92 | 1.27 | 3.500 | 4.550 | 1.44 | 1.29 | Key West |
| 108 | Little Spanish Key, Spanish Banks | 2.30 | 1.54 | 3.417 | 4.500 | 1.74 | 1.62 | Key West |
| 109 | Big Spanish Key | 2.69 | 1.71 | 3.317 | 4.483 | 1.97 | 1.50 | Key West |
| 110 | Munson Island, Newfound Harbor Channel | 1.36 | 0.84 | 0.000 | 0.467 | 0.98 | 0.67 | Key West |
| 111 | Ramrod Key, Newfound Harbor | 1.28 | 0.76 | -0.017 | 0.083 | 0.90 | 0.50 | Key West |
| 112 | Middle Torch Key, Torch Ramrod Channel | 0.98 | 0.58 | 0.400 | 1.483 | 0.69 | 0.38 | Key West |
| 113 | Little Torch Key, Torch Channel | 0.80 | 0.48 | 0.183 | 1.750 | 0.57 | 0.33 | Key West |
| 114 | Big Pine Key, Newfound Harbor Channel | 1.16 | 0.69 | 0.517 | 0.733 | 0.82 | 0.46 | Key West |
| 115 | Big Pine Key, Coupon Bight | 1.22 | 0.74 | 0.333 | 0.817 | 0.87 | 0.54 | Key West |
| 116 | Little Torch Key, Pine Channel Bridge, south side | 0.97 | 0.56 | 0.417 | 0.950 | 0.68 | 0.33 | Key West |
| 117 | Little Torch Key, Pine Channel Bridge, south side | 0.98 | 0.58 | 0.450 | 0.900 | 0.69 | 0.38 | Key West |
| 118 | Big Pine Key, Pine Channel Bridge, south side | 0.96 | 0.56 | 0.450 | 1.050 | 0.67 | 0.33 | Key West |
| 119 | Big Pine Key, Pine Channel Bridge, north side | 0.81 | 0.49 | 0.050 | 1.733 | 0.57 | 0.33 | Key West |
| 120 | Big Pine Key, west side, Pine Channel | 0.71 | 0.45 | 0.350 | 1.867 | 0.52 | 0.42 | Key West |
| 121 | Howe Key, south end, Harbor Channel | 0.96 | 0.63 | 4.717 | 4.817 | 0.72 | 0.62 | Key West |
| 122 | Big Torch Key, Harbor Channel | 2.14 | 1.38 | 3.783 | 5.850 | 1.58 | 1.29 | Key West |
| 123 | Water Keys, south end, Harbor Channel | 2.11 | 1.29 | 3.700 | 5.683 | 1.52 | 1.00 | Key West |
| 124 | Howe Key, northwest end | 2.28 | 1.46 | 3.483 | 5.367 | 1.68 | 1.33 | Key West |
| 125 | Summerland Key, Niles Channel South | 1.14 | 0.74 | 0.067 | 0.183 | 0.85 | 0.71 | Key West |
| 126 | Summerland Key, Niles Channel Bridge | 0.90 | 0.59 | 0.500 | 0.933 | 0.67 | 0.58 | Key West |
| 127 | Ramrod Key, Niles Channel Bridge | 0.93 | 0.58 | 0.450 | 1.200 | 0.67 | 0.46 | Key West |
| 128 | Big Torch Key, Niles Channel | 0.77 | 0.56 | 3.250 | 2.083 | 0.61 | 0.71 | Key West |
| 129 | Knockemdown Key, north end | 1.80 | 1.19 | 3.500 | 4.900 | 1.35 | 1.21 | Key West |
| 130 | Raccoon Key, east side | 2.04 | 1.31 | 3.333 | 5.150 | 1.50 | 1.21 | Key West |
| 131 | Content Keys, Content Passage | 2.86 | 1.87 | 2.783 | 3.833 | 2.13 | 1.83 | Key West |
| 132 | Key Lois, southeast end | 1.46 | 0.91 | -0.583 | -0.083 | 1.06 | 0.75 | Key West |
| 133 | Sugarloaf Key, east side, Tarpon Creek | 1.24 | 0.76 | -0.017 | 0.250 | 0.89 | 0.58 | Key West |
| 134 | Gopher Key, Cudjoe Bay | 1.22 | 0.78 | -0.100 | 0.283 | 0.90 | 0.71 | Key West |
| 135 | Sugarloaf Key, Pirates Cove | 0.74 | 0.55 | -0.133 | 1.683 | 0.59 | 0.75 | Key West |
| 136 | Cudjoe Key, Cudjoe Bay | 1.18 | 0.76 | 0.033 | 0.683 | 0.87 | 0.71 | Key West |
| 137 | Summerland Key, southwest side, Kemp Channel | 1.12 | 0.69 | 0.233 | 0.833 | 0.81 | 0.54 | Key West |
| 138 | Cudjoe Key, north end, Kemp Channel | 2.17 | 1.43 | 3.533 | 4.667 | 1.63 | 1.46 | Key West |
| 139 | Sugarloaf Key, northeast side, Bow Channel | 1.40 | 0.87 | 3.783 | 3.400 | 1.01 | 0.71 | Key West |
| 140 | Cudjoe Key, Pirates Cove | 1.01 | 0.69 | 3.833 | 2.917 | 0.77 | 0.79 | Key West |
| 141 | Sugarloaf Key, north end, Bow Channel | 1.82 | 1.09 | 3.617 | 5.333 | 1.29 | 0.75 | Key West |
| 142 | Pumpkin Key, Bow Channel | 2.14 | 1.35 | 3.283 | 4.650 | 1.56 | 1.17 | Key West |
| 143 | Sawyer Key, outside, Cudjoe Channel | 2.32 | 1.28 | 2.750 | 5.400 | 1.57 | 0.50 | Key West |
| 144 | Sawyer Key, inside, Cudjoe Channel | 2.10 | 1.17 | 2.617 | 5.317 | 1.43 | 0.50 | Key West |
| 145 | Johnston Key, southwest end, Turkey Basin | 1.59 | 0.92 | 3.433 | 5.633 | 1.10 | 0.50 | Key West |
| 146 | Upper Sugarloaf Sound – Perky | 0.42 | 0.23 | 5.617 | 8.417 | 0.28 | 0.08 | Key West |
| 147 | Upper Sugarloaf Sound - Park Channel Bridge | 0.34 | 0.24 | 5.783 | 8.550 | 0.26 | 0.29 | Key West |
| 148 | Upper Sugarloaf Sound - North Harris Channel | 0.33 | 0.22 | 5.533 | 8.067 | 0.25 | 0.25 | Key West |
| 149 | Upper Sugarloaf Sound - Tarpon Creek | 0.46 | 0.32 | 0.183 | 0.283 | 0.35 | 0.38 | Key West |
| 150 | Snipe Keys, southeast end, Inner Narrows | 1.79 | 1.10 | 3.417 | 5.650 | 1.28 | 0.83 | Key West |
| 151 | Snipe Keys, Middle Narrows | 1.42 | 0.87 | 3.733 | 5.900 | 1.02 | 0.67 | Key West |
| 152 | Snipe Keys, Snipe Point | 2.31 | 1.47 | 2.250 | 3.550 | 1.69 | 1.29 | Key West |
| 153 | Waltz Key, Waltz Key Basin | 1.36 | 0.91 | 3.883 | 5.550 | 1.03 | 0.96 | Key West |
| 154 | Duck Key Point, Duck Key, Waltz Key Basin | 1.61 | 1.03 | 3.450 | 4.950 | 1.19 | 0.96 | Key West |
| 155 | O'Hara Key, north end, Waltz Key Basin | 1.40 | 0.90 | 3.883 | 5.650 | 1.03 | 0.83 | Key West |
| 156 | Saddlebunch Keys, Channel No. 5 | 0.76 | 0.65 | 4.533 | 6.967 | 0.66 | 1.12 | Key West |
| 157 | Saddlebunch Keys, Channel No. 4 | 0.76 | 0.45 | 4.583 | 5.600 | 0.54 | 0.29 | Key West |
| 158 | Saddlebunch Keys, Channel No. 3 | 0.62 | 0.36 | 1.733 | 0.500 | 0.43 | 0.21 | Key West |
| 159 | Bird Key, Similar Sound | 0.82 | 0.51 | 0.317 | 1.050 | 0.59 | 0.42 | Key West |
| 160 | Shark Key, southeast end, Similar Sound | 0.70 | 0.46 | 0.300 | 1.850 | 0.52 | 0.46 | Key West |
| 161 | Saddlebunch Keys, Similar Sound | 0.52 | 0.31 | 0.650 | 2.683 | 0.37 | 0.21 | Key West |
| 162 | Big Coppitt Key, northeast side, Waltz Key Basin | 1.22 | 0.69 | 4.350 | 6.900 | 0.84 | 0.33 | Key West |
| 163 | Rockland Key, Rockland Channel Bridge | 0.97 | 0.69 | 5.033 | 6.100 | 0.76 | 0.88 | Key West |
| 164 | Boca Chica Key, Long Point | 1.28 | 0.81 | 3.900 | 5.367 | 0.94 | 0.71 | Key West |

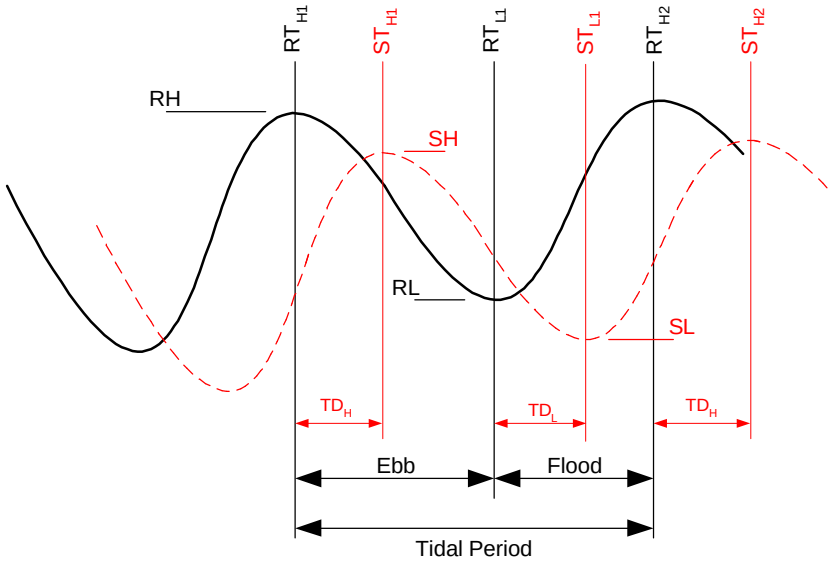
**TABLE 1 (Continued)**
**NOAA TIDE STATION INVENTORY – FLORIDA KEYS**

| Sta. # | Station Name | Mean Tide (feet) | | Time Difference (hrs) ($TD_H/TD_L$) | | Height Adjustments ($H_{adj}/L_{adj}$) | | Ref. Station |
|---|---|---|---|---|---|---|---|---|
| | | Range | Level | High | Low | High | Low | |
| 165 | Channel Key, west side | 0.91 | 0.62 | 3.150 | 3.117 | 0.70 | 0.71 | Key West |
| 166 | Boca Chica Channel Bridge | 0.72 | 0.52 | 1.383 | 1.483 | 0.57 | 0.67 | Key West |
| 167 | Key Haven - Stock Island Channel | 0.94 | 0.66 | 2.417 | 2.950 | 0.73 | 0.79 | Key West |
| 168 | Sigsbee Park, Garrison Bight Channel | 1.04 | 0.73 | 1.983 | 2.100 | 0.81 | 0.88 | Key West |
| 169 | Key West, south side, Hawk Channel | 1.44 | 0.94 | -0.200 | 0.167 | 1.07 | 0.92 | Key West |
| 170 | KEY WEST | 1.31 | 0.90 | 0.000 | 0.000 | 1.00 | 1.00 | Key West |
| 171 | Sand Key Lighthouse, Sand Key Channel | 1.26 | 0.82 | -0.383 | 0.017 | 0.94 | 0.79 | Key West |
| 172 | Garden Key, Dry Tortugas | 1.14 | 0.89 | 0.483 | 0.550 | 0.94 | 1.33 | Key West |

Source: http://www.co-ops.nos.noaa.gov/tides

The time and height adjustment factors for the high and low tides (Table 1) with respect to the reference station are used to determine the tidal characteristics of each tide station (Figure 1).

**FIGURE 1**
**SECONDARY TIDAL STATION ADJUSTMENTS**




## 2.3.1 Reference Stations

The time and height adjustments are applied to the reference station to predict the time and height of the high and low tides at the selected subordinate station. Of the 172 tide stations in the Keys, only three are reference stations (Miami Harbor Entrance, Vaca Key, and Key West). The remaining 169 are subordinate stations that rely on one of the reference stations for tidal

predictions. The Miami Harbor Entrance station is the reference station for 45 stations and Key West is the reference for 124 stations. Vaca Key is not used as a reference by any subordinate station.

### 2.3.2 High/Low Tide Time Adjustments

To determine the time of high tide ($ST_H$) or low tide ($ST_L$) at a subordinate station, the appropriate time adjustment value ($TD_H$ or $TD_L$) is added to the time of the high ($RT_H$) or low tide ($RT_L$) for the reference station. The equations used to compute these time values at a secondary station are as follows:

$$ST_H = RT_H + TD_H \qquad \text{(Time of high tide at secondary station)}$$

or: $$ST_L = RT_L + TD_L \qquad \text{(Time of low tide at secondary station)}$$

Positive time adjustment values indicate that the tide at the subordinate station occurs later than at the reference station, negative values indicate that the tide occurs earlier.

### 2.3.3 High/Low Tide Height Adjustments

To calculate the high (SH) or low tide (SL) elevations at a subordinate station, the high (RH) or low (RL) tide elevation at the reference station is multiplied by the appropriate adjustment factor ($H_{adj}/L_{adj}$), as follows:

$$SH = RH \times H_{adj} \qquad \text{(High tide elevation at secondary station)}$$

or: $$SL = RL \times L_{adj} \qquad \text{(Low tide elevation at secondary station)}$$

### 2.3.4 Tide Cycle Durations

The ebb tide cycle (Ebb) is the time required to move from high tide to low tide; the flood tide cycle (Flood) is the time required to move from low tide to high tide. A tidal period (Period) is the duration of any two consecutive tide cycles. The equations used to compute these durations, expressed in hours, at a reference station, are as follows:

$$Ebb_{ref} = RT_{L1} - RT_{H1} \qquad \text{(Duration from high to low tide)}$$

$$Flood_{ref} = RT_{H2} - RT_{L1} \qquad \text{(Duration from low to high tide)}$$

$$Period = RT_{H2} - RT_{H1} \qquad \text{(Duration from high to high tide)}$$

or: $$Period = RT_{L2} - RT_{L1} \qquad \text{(Duration from low to low tide)}$$

or: $$Period = Ebb_{ref} + Flood_{ref}$$

At secondary stations, the Ebb and Flood durations can be calculated directly from the adjustment factors in Table 1, as follows:

$Ebb_{sec} = Ebb_{ref} + TD_L - TD_H$ (Duration from high to low tide)

$Flood_{sec} = Flood_{ref} + TD_H - TD_L$ (Duration from low to high tide)

$Period_{sec} = Ebb_{sec} + Flood_{sec}$ (Duration from high to high or low to low tide)

Data regarding the tidal periods and the duration of ebb and flood tides was not available on the CO-OPs site. To estimate these values, a year of daily predicted tidal data values were downloaded for each of the three reference stations. These values were assessed to determine the range and average duration for the tidal period ebb tide, and flood tide (Table 2).

**TABLE 2**
**REFERENCE STATION TIDE CYCLE DURATIONS**

| | Miami Harbor Ent. | | | Vaca Key | | | Key West | | |
|---|---|---|---|---|---|---|---|---|---|
| | **Min** | **Max** | **Avg.** | **Min** | **Max** | **Avg.** | **Min** | **Max** | **Avg.** |
| Ebb Tide (hrs) | 5.4 | 6.5 | 6.2 | 0.8 | 12.3 | 4.7 | 3.2 | 7.9 | 5.8 |
| Flood Tide (hrs) | 5.8 | 6.9 | 6.2 | 2.3 | 19.1 | 8.7 | 5.8 | 7.4 | 6.7 |
| Tidal Period (hrs) | 11.9 | 13.1 | 12.4 | 3.4 | 27.7 | 13.3 | 10.2 | 15.3 | 12.4 |

## 2.4 Nearshore Water Quality Database

Two main data sources were used to compile the ambient nearshore water quality to reflect the tidal input into the canals during flood tides, the FKNMS Water Quality Protection Program (WQPP) and Baywatch. The geometric means of the TN and TP data were interpolated to obtain representative TN and TP ambient concentrations at 250 feet offshore from the mouth of each canal. This distance was selected as the edge of the mixing zone (the nutrient aura) for the mdel.

Little analytical data regarding biochemical oxygen demand (BOD) or total suspended solids (TSS) was available to characterize the spatial variation of these two parameters. The only information found came from a study published in July of 1987 for the Marathon area called the *Water Quality Assessment of Five Selected Pollutant Sources in Marathon, Florida Keys*. The limited information from that study was used to develop standardized values of BOD and TSS to represent the nearshore water quality data for the flushing model. Geometric means were developed for each secondary station and the average value of the geometric means of these stations were calculated for TSS (5.6 mg/l) and BOD (0.7 mg/l). These values were used to represent the nearshore water quality for all canals, regardless of their distance from Marathon.

# 3 DEVELOPMENT OF THE CANAL IMPACTS ASSESSMENT MODULE (CIAM)

## 3.1 Objectives and Assumptions of the CIAM

The CIAM simulates the dilution of stormwater and wastewater pollutant loads discharged into canals and, subsequently, from canals into the nearshore waters. The module was developed as a spreadsheet model with appropriate macros to aid in calculating a pollutant concentration for each canal segment and discharge zone under a specific land use or development scenario. The module includes tidal fluctuation, nearshore water quality, stormwater loads (affected by land use or development), and wastewater loads (affected by the type of wastewater treatment).

The CIAT uses a two-step (flood and ebb) tidal flushing model, based upon the following concepts:

- Fully mixed exchange between the defined segments of both the canal and the discharge zone segments;
- Interconnected canal segments;
- One-dimensional, bi-directional flow within the canal segments and discharge zone segments; and
- Defined interface elements in the adjacent nearshore waters that interact with the canal.

To develop a tool that reflects the impacts of various land use and wastewater treatment scenarios, within the constraints of a spreadsheet model, the Technical Contractor made several enabling assumptions. These included:

- Tidal flows are idealized as a single time-step from low tide directly to high tide and vice-versa;
- Flows and their associated pollutant loads passed between canal segments are assumed to be completely mixed with the fluid volume and pollutant load of the receiving segment prior to being passed to subsequent canal/discharge zone segments;
- The selected pollutants (TN, TP, BOD, and TSS) are idealized as conservative, uniformly mixed, neutrally buoyant particles that do not volatilize or settle out of the water column;
- The volume of stormwater or wastewater discharged into each segment is negligible and will not affect the tidal volume entering or exiting the canal;

- Parcels with offsite wastewater treatment types do not contribute wastewater loads or flows to the canal;
- The only forcing function recognized is tidal fluctuation. Wind, temperature, stormwater flow, wastewater flow and other potential driving factors are not considered;
- Utilize a steady-state approach (i.e., annual or monthly averages for input values), rather than event simulations; and
- Model is a comparative tool (i.e., results compared between two scenarios) rather than predictive

## 3.2 Selection of Representative Canals

Ten representative canals were selected for model development and testing. Along with USACE and DCA, the EPA (Dr. Bill Kruczynski), FDEP (Mr. Gus Rios) and Monroe County (Mr. George Garrett) collaborated with the Technical Contractor to select the 10 canals. The most important selection criteria were the availability of water quality data and the presence of representative sources of wastewater and stormwater pollutant loadings, including residential and commercial sources.

Only canals with one opening were considered. Therefore, 44 canals in the *Monroe County Residential Canal Inventory* were removed from further consideration because they had no openings (20 canals) or had multiple openings (24 canals).

Water quality data was obtained from previous studies for 41 canals. Additional characteristics (Table 3) were documented for each canal to assist in the selection (Table 4). In general, the 10 selected canals represent the diversity of canal length, complexity, and location of canals in the Keys (Table 5, Figure 2a,b). The review group added an additional canal, Canal #246 in Marathon.

**TABLE 3**
**CANDIDATE CANAL DATA FIELDS**

| Database Field | Description |
|---|---|
| Land Use [(1)] – Residential | Developed from the parcels GIS coverage intersected with the wastesheds coverage. Included four (4) subcategories: high-density residential, low-density residential, medium-density residential, and vacant residential. |
| Land Use [(1)] – Commercial | Developed from the parcels GIS coverage intersected with the wastesheds coverage. Included seven (7) subcategories: hotel/ motel, institutional, office, public facilities & services, retail, service, and vacant commercial |
| Land Use [(1)] – Industrial | Developed from the parcels GIS coverage intersected with the wastesheds coverage. Included two (2) subcategories: light industrial and marinas. |
| Land Use [(1)] – Other | Developed from the parcels GIS coverage intersected with the wastesheds coverage. Included two (2) subcategories: open space & recreation and submerged lands. |

**TABLE 3 (CONTINUED)**
**CANDIDATE CANAL DATA FIELDS**

| Database Field | Description |
|---|---|
| Wastewater Plants [2] – Permit # | Developed with GIS using 150' offset from canal boundaries. Permit numbers taken from previously developed GIS coverage. |
| WQ Stations [3] | Locations from various sources. Assigned visually since locations are approximate and don't always fall within the canal boundary. |
| Degree of Convolution [4] | Numerical value assigned (visually) based on the number of 90-degree turns. A full 90º turn has a value of 1. |
| Key Segment [2] | Developed using GIS. Canals north of US-1 were assigned a bay side attribute, canals south of US-1 were assigned an ocean side attribute. Assignment to upper, middle or lower Keys done using previously developed GIS coverage of those boundaries. |

Data Source: (1) Monroe County Property Appraiser's Tax Roll Data, July 2001.
(2) GIS operation/selection using previously developed GIS coverages.
(3) Nature Conservancy's Baywatch program, the Village of Islamorada, and the Little Venice Canals water quality investigation.
(4) Monroe County Residential Canal Inventory and Assessment 90% GIS Deliverable, March 22, 2002.

**TABLE 4**
**CANDIDATE CANALS**

| Canal No. | Key Name | Land Use Residential | Land Use Commercial | Land Use Industrial | Land Use Other | WW Plants (Permit #) | WQ Stations | Degree of Convolution | Key Segment |
|---|---|---|---|---|---|---|---|---|---|
| 31 | Key Largo | 94.8% | 5.2% | 0.0% | 0.0% | | BW-85 | 1.5 | Upper-Bayside |
| 44 | Key Largo | 85.8% | 4.6% | 0.0% | 9.6% | | BW-48 | 0.3 | Upper-Bayside |
| 47 | Key Largo | 88.1% | 4.9% | 0.0% | 7.1% | | BW-32 | 5.0 | Upper-Bayside |
| 50 | Key Largo | 17.7% | 0.0% | 0.0% | 82.3% | | BW-62 | 4.0 | Upper-Oceanside |
| 59 | Key Largo | 100.0% | 0.0% | 0.0% | 0.0% | | BW-83 | 1.0 | Upper-Bayside |
| 60 | Key Largo | 79.9% | 11.0% | 3.3% | 5.9% | FLA014746, FLA014811, FLA014865 | BW-131 | 11.0 | Upper-Oceanside |
| 61 | Key Largo | 99.5% | 0.4% | 0.0% | 0.1% | | BW-95 | 0.0 | Upper-Oceanside |
| 69 | Rock Harbor | 99.2% | 0.0% | 0.0% | 0.8% | | BW-12 | 4.0 | Upper-Oceanside |
| 70 | Rock Harbor | 96.6% | 2.6% | 0.0% | 0.8% | | BW-22 | 0.0 | Upper-Bayside |
| 114 | Plantation Key | 81.2% | 16.8% | 0.0% | 2.0% | FLA014881 | VI-1 | 0.6 | Upper-Oceanside |
| 117 | Plantation Key | 98.5% | 0.0% | 0.0% | 1.5% | | BW-6 | 0.0 | Upper-Bayside |
| 120 | Plantation Key | 86.1% | 4.0% | 0.0% | 9.9% | FLA014787 | BW-17,VI-3 | 9.0 | Upper-Bayside |
| 135 | Plantation Key | 100.0% | 0.0% | 0.0% | 0.0% | | VI-5,VI-30 | 0.0 | Upper-Bayside |
| 136 | Plantation Key | 100.0% | 0.0% | 0.0% | 0.0% | | BW-44 | 0.0 | Upper-Bayside |
| 140 | Plantation Key | 84.7% | 0.0% | 0.0% | 15.3% | | VI-19 | 0.0 | Upper-Bayside |
| 145 | Lower Matecumbe Key | 92.7% | 2.1% | 0.0% | 5.2% | | VI-26 | 1.0 | Upper-Oceanside |
| 148 | Lower Matecumbe Key | 97.9% | 0.0% | 0.0% | 2.1% | | VI-25 | 0.0 | Upper-Oceanside |
| 150 | Lower Matecumbe Key | 76.8% | 1.2% | 0.0% | 22.0% | | VI-28,VI-32 | 16.0 | Upper-Bayside |
| 152 | Lower Matecumbe Key | 96.2% | 0.2% | 0.0% | 3.6% | | VI-12 | 4.0 | Upper-Bayside |
| 157 | Lower Matecumbe Key | 69.8% | 21.2% | 0.3% | 8.8% | | VI-11,VI-14 | 1.5 | Upper-Oceanside |
| 171 | Marathon | 100.0% | 0.0% | 0.0% | 0.0% | | BW-126 | 2.0 | Middle-Bayside |
| 185 | Marathon | 81.4% | 3.1% | 0.0% | 15.5% | | BW-129 | 0.0 | Middle-Oceanside |
| 204 | Marathon | 58.4% | 36.7% | 0.0% | 4.9% | FLA014738 | LV-2,LV-4,LV-5 | 2.0 | Middle-Oceanside |
| 208 | Marathon | 93.3% | 5.9% | 0.0% | 0.9% | | LV-6,LV-7 | 0.0 | Middle-Oceanside |
| 224 | Marathon | 75.2% | 4.5% | 0.0% | 20.4% | | LV-8,LV-9 | 0.0 | Middle-Oceanside |
| 229 | Big Pine Key | 66.7% | 0.0% | 0.0% | 33.3% | | BW-87 | 11.0 | Lower-Bayside |
| 278 | Big Pine Key | 86.7% | 0.1% | 0.0% | 13.2% | FLA014843, FLA014844, FLA014816 | BW-43,BW-68,BW-76 | 25.0 | Lower-Bayside |
| 281 | Little Torch Key | 100.0% | 0.0% | 0.0% | 0.0% | | BW-3 | 1.0 | Lower-Bayside |
| 285 | Little Torch Key | 100.0% | 0.0% | 0.0% | 0.0% | | BW-2 | 2.0 | Lower-Bayside |
| 288 | Big Pine Key | 81.5% | 1.3% | 0.0% | 17.2% | | BW-74 | 0.0 | Lower-Bayside |
| 292 | Little Torch Key | 98.3% | 0.3% | 0.0% | 1.3% | | BW-42 | 9.0 | Lower-Bayside |
| 296 | Big Pine Key | 98.0% | 0.0% | 0.0% | 2.0% | | BW-75 | 0.0 | Lower-Bayside |
| 309 | Big Pine Key | 63.9% | 5.2% | 1.9% | 29.0% | | BW-120,BW-121 | 12.0 | Lower-Oceanside |
| 324 | Cudjoe Key | 83.2% | 9.7% | 0.0% | 7.2% | | BW-92 | 0.0 | Lower-Oceanside |
| 329 | Cudjoe Key | 91.6% | 4.1% | 0.0% | 4.3% | | BW-71 | 8.0 | Lower-Oceanside |
| 332 | Cudjoe Key | 100.0% | 0.0% | 0.0% | 0.0% | | BW-72 | 0.0 | Lower-Oceanside |

**TABLE 6 (CONTINUED)**
**CANDIDATE CANALS**

| Canal No. | Key Name | Land Use Residential | Land Use Commercial | Land Use Industrial | Land Use Other | WW Plants (Permit #) | WQ Stations | Degree of Convolution | Key Segment |
|---|---|---|---|---|---|---|---|---|---|
| 335 | Cudjoe Key | 96.8% | 3.2% | 0.0% | 0.0% | FLA014946 | BW-21 | 5.0 | Lower-Oceanside |
| 339 | Little Torch Key | 90.3% | 3.6% | 0.0% | 6.2% | | BW-111 | 7.0 | Lower-Oceanside |
| 340 | Cudjoe Key | 100.0% | 0.0% | 0.0% | 0.0% | | BW-94 | 0.0 | Lower-Oceanside |
| 344 | Cudjoe Key | 96.8% | 1.5% | 1.7% | 0.0% | | BW-93 | 2.0 | Lower-Oceanside |
| 350 | Ramrod Key | 77.1% | 3.9% | 0.0% | 19.1% | FLA014808 | BW-51,BW-84,BW-139 | 18.0 | Lower-Oceanside |

**TABLE 5**
**SELECTED CANALS**

| Canal No. | Key Name | WQ Stations | Key Segment |
|---|---|---|---|
| 50 | Key Largo | BW-62 | Upper-Oceanside |
| 69 | Rock Harbor | BW-12 | Upper-Oceanside |
| 70 | Rock Harbor | BW-22 | Upper-Bayside |
| 117 | Plantation Key | BW-6 | Upper-Bayside |
| 152 | Lower Matecumbe Key | VI-12 | Upper-Bayside |
| 204 | Marathon | LV-2, LV-4, LV-5 | Middle-Oceanside |
| 208 | Marathon | LV-6, LV-7 | Middle-Oceanside |
| 246 | Marathon | | Middle-Oceanside |
| 288 | Big Pine Key | BW-74 | Lower-Bayside |
| 339 | Little Torch Key | BW-111 | Lower-Oceanside |

## 3.3 Definition of Canal Segments, Contributing Basins and Discharge Zones

For each canal, the Technical Contractor delineated canal segments, drainage boundaries and receiving water discharge zone segments, and defined the spatial relationships between these elements. This mapping process provided the basis for estimating pollutant loads into each canal segment.

### 3.3.1 Definition of Canal Segments

Canal segments were defined for each of the 10 representative canals based upon geometry, connectivity, and tidal connection. Where possible, segments were of equal length (approximately 150 feet); but segment lengths were varied to accommodate canal geometry, branches, and turns (see Appendix C-A for canal figures).

**FIGURE 2A**
**UPPER KEYS SELECTED CANALS**

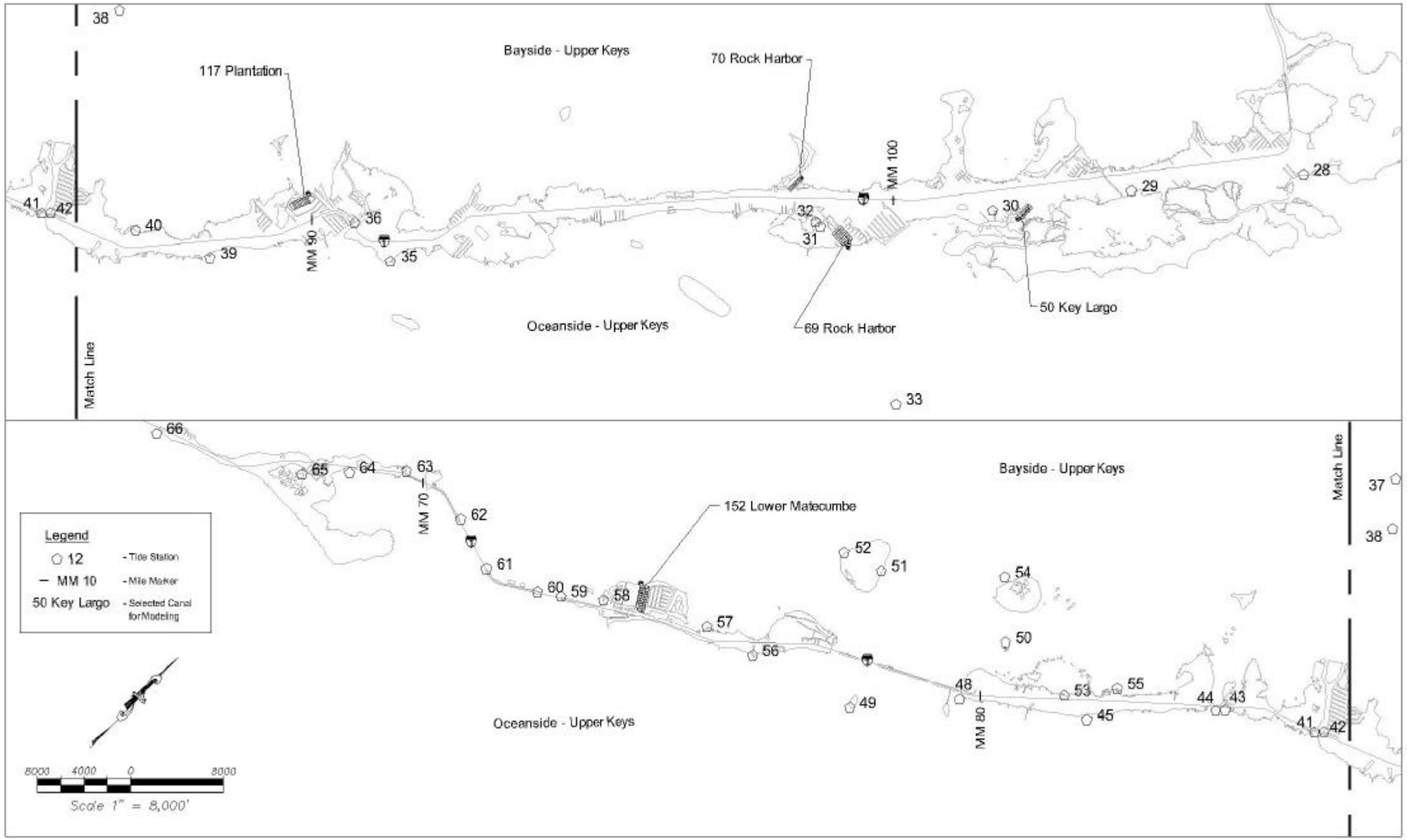
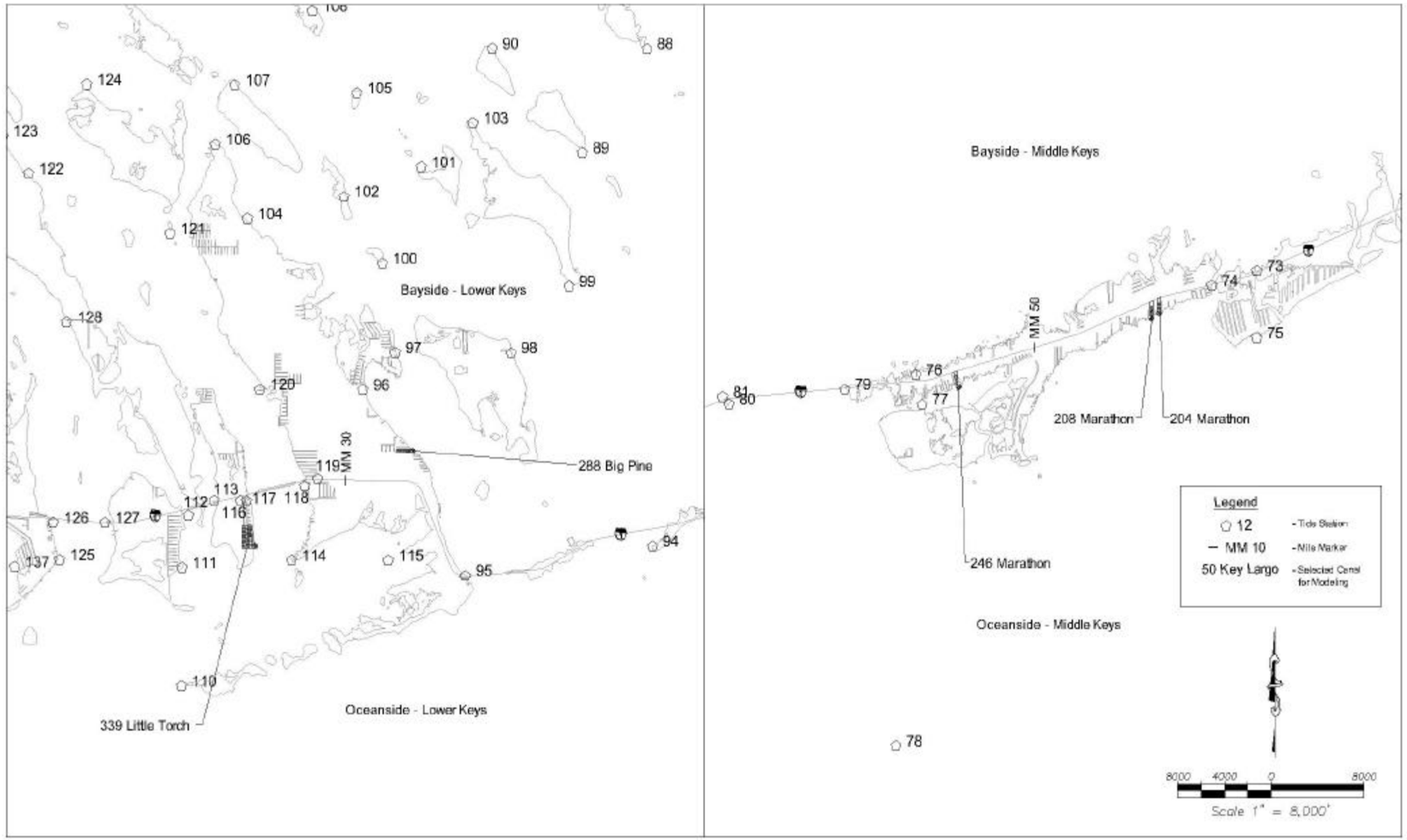


**Figure 2B**

**MIDDLE AND LOWER KEYS SELECTED CANALS**



### 3.3.2 Canal Segment Drainage Areas

Canal segment drainage areas were delineated based on 1999 digital orthographic quarter-quads (DOQQs) aerials available for the Study Area (Appendix C-A). Roads were typically used to delineate drainage divides. The proximity of adjacent canals or other water bodies were often used to estimate split areas between the canal of interest and the adjacent canal/water body.

### 3.3.3 Canal Segment Discharge Zone Segments

For the model, the Technical Contractor assumed a 250-foot-wide discharge zone (mixing zone or nutrient aura). Receiving water segments were defined for each of the 10 canals using a 250-foot radial distance from the canal's mouth (Appendix C-A). This radial line represents the boundary between the nearshore water and the end of the discharge zone associated with the canal (i.e., the canal would not affect water quality beyond 250 feet from its outlet). The water quality at this boundary was used to characterize the quality of the source water (i.e., nearshore water) during flood tides. The nearshore values for TN and TP (Table 6) were obtained through interpolation (see Section 2.4).

**TABLE 6**
**TN AND TP VALUES AT THE 250-FOOT**
**CANAL DISCHARGE ZONE BOUNDARIES**

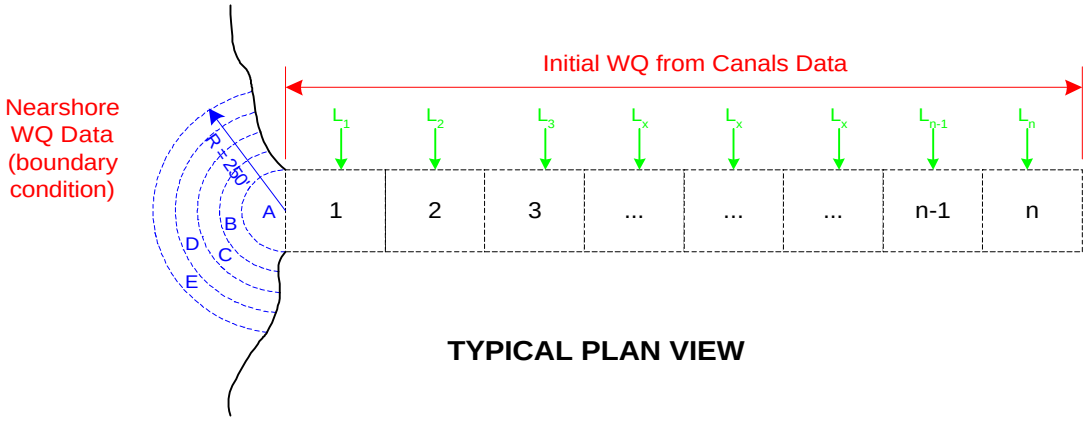
| Canal # | Key Name | Total Nitrogen (TN) | | | Total Phosphorous (TP) | | |
|---|---|---|---|---|---|---|---|
| | | Min (mg/l) | Max (mg/l) | Avg (mg/l) | Min (mg/l) | Max (mg/l) | Avg (mg/l) |
| 50 | Key Largo | 0.3336 | 0.3336 | 0.3336 | 0.0090 | 0.0090 | 0.0090 |
| 70 | Rock Harbor | 0.4190 | 0.4190 | 0.4190 | 0.0094 | 0.0095 | 0.0094 |
| 69 | Rock Harbor | 0.4285 | 0.4285 | 0.4285 | 0.0093 | 0.0094 | 0.0093 |
| 117 | Plantation Key | 0.3435 | 0.3435 | 0.3435 | 0.0088 | 0.0088 | 0.0088 |
| 152 | Lower Matecumbe Key | 0.1965 | 0.1965 | 0.1965 | 0.0068 | 0.0068 | 0.0068 |
| 204 | Marathon | 0.2132 | 0.2132 | 0.2132 | 0.0097 | 0.0097 | 0.0097 |
| 208 | Marathon | 0.2132 | 0.2132 | 0.2132 | 0.0096 | 0.0096 | 0.0096 |
| 246 | Marathon | 0.2447 | 0.2447 | 0.2447 | 0.0086 | 0.0087 | 0.0087 |
| 288 | Big Pine Key | 0.3030 | 0.3030 | 0.3030 | 0.0100 | 0.0101 | 0.0100 |
| 339 | Little Torch Key | 0.3007 | 0.3007 | 0.3007 | 0.0101 | 0.0101 | 0.0101 |

## 3.4 Module Algorithms

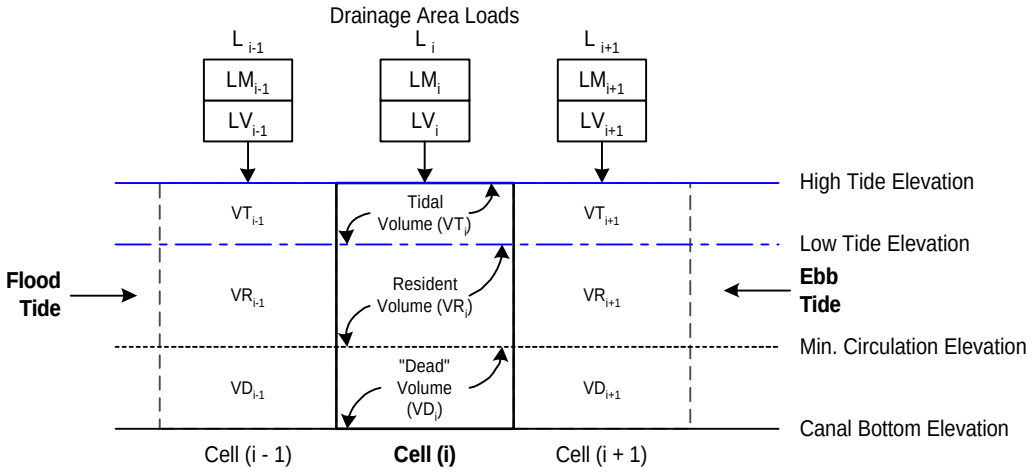
### 3.4.1 Variables

Initial conditions include the pollutant concentration at the edge of the discharge zone and an initial water quality for each segment, taken from the water quality monitoring data discussed previously (Figure 3). Each segment receives a drainage area load (L).

**FIGURE 3**
**MODEL ELEMENTS**




**TYPICAL PLAN VIEW**




**PROFILE ILLUSTRATION**

A typical canal segment (i) is associated with receiving and discharge segments to either side of it (i+1 and i-1; Figure 3). A minimum circulation elevation is assumed, since it has been suggested that deeper canals will stratify due to the presence of a shallow entrance into the canal and water will not circulate throughout the entire volume. A minimum circulation elevation of negative five (-5) feet was adopted for each canal. For all the selected canals – the depth of the canal (bottom elevation) is unknown and was assumed to be –15 feet.

Loads (L) from canal segment drainage areas are comprised of two parts: the mass of pollutants (LM) and the volume of water (LV) carrying LM into the canal segment (Figure 3). The tidal volume (VT) is the volume in the canal segment between low and high tide. The resident volume (VR) is the volume in the canal segment between low tide and the minimum circulation elevation. VT and VR are the only volumes considered by the model for mixing, or for computing pollutant mass/concentration in a segment at any time.

Canal segments are numbered in an upstream order (i.e., canal segment 1 is located at the canal entrance, segment n is located at the canal terminus). Flood tides enter the canal segment (i) from the downstream segment (i-1) and are discharged into the upstream segment (i+1). Ebb tides enter the canal segment (i) from the upstream segment (i+1) and are discharged into the downstream segment (i-1).

### 3.4.2 Model Time Steps and Iterations

The model uses one tide period as the time step. With the exception of the Vaca Key tide station at 13.32 hours, tidal periods in the Keys average 12.42 hours at all tide stations. There is however, substantial variation in the durations of average flood and ebb tides among the Keys tide stations. Average flood tide durations range from 3.87 hours (Upper Sugarloaf Sound - Perky) to 8.65 hours (Vaca Key, USCG Station, Florida Bay). Average ebb tide durations range from 4.50 hours (East Bahia Honda Key, south end, Florida Bay) to 8.55 hours (Upper Sugarloaf Sound - Perky). The model calculates flood tides and ebb tides separately in each tidal period.

Although the CCIAM provides a daily average load, this daily load is reduced to an average hourly rate to address tide cycle duration. Thus, different loads (L, LV and LM) are used by the model for ebb and flood tides.

### 3.4.3 Flood Tide Algorithms

To simulate a flood tide, the initial volume (IV in cubic feet, cft) in a canal segment is set as the volume at low tide. This is calculated as the resident volume (VR) plus the dead volume (VD):

$$IV(f)_i = VR_i + VD_i$$

Where (f) indicates a flood tide value.

The volume of water (VI) that flows into a canal segment is equal to the tidal volume (VT) of the canal segment plus that of all upstream segments. It also includes the load volume (LV) that flows into the segment over the flood tide duration:

$$VI(f)_i = \sum_{i}^{n} VT_i + LV(f)_i$$

The volume of water that flows out of a canal segment (VO) is equal to the tidal volume (VT) of all the upstream segments:

$$VO(f)_i = \sum_{i+1}^{n} VT_i$$

The final volume (FV) in a canal segment is computed as the initial volume (IV) plus the volume in (VI) minus the volume out (VO). The equation used to compute this value at each canal segment (i) is as follows:

$$FV(f)_i = IV(f)_i + VI(f)_i - VO(f)_i$$

The total volume used in the mixing calculation (MV) for a canal segment is the initial volume (IV) minus the dead volume (VD) plus the volume in (VI):

$$MV(f)_i = IV(f)_i - VD_i + VI(f)_i$$

The initial mass of a pollutant in a canal segment is computed as the resident volume (VR) of the cell times the concentration (Conc in mg/l) of the pollutant. The model tracks mass in units of pounds (lbs.) and concentration in units of milligrams per liter (mg/l). Note that the dead volume (VD) is not included in the mass calculations. The equation used to compute this value at each canal segment (i) is as follows:

$$IM(f)_i = VR_i \times Conc_i \times (28.317\ l/cft \div 453{,}592\ mg/lb)$$

The mass of a pollutant discharged into a canal segment (MI) is computed as the mass out of the downstream cell ($MO_{i-1}$) plus the load mass (LM) discharged by the segment drainage area. Flood tide calculations are performed in an upstream order, so $MO_{i-1}$ is computed prior to $MI_i$. The equation used to compute this value at each canal segment (i) is as follows:

$$MI(f)_i = MO(f)_{i-1} + LM(f)_i$$

alternately:

$$MI(f)_i = [VO(f)_{i-1} \times Conc_{i-1} \times (28.317\ l/cft \div 453{,}592\ mg/lb)] + LM(f)_i$$

The mass used in the mixing calculation (MM) is the initial mass (IM) plus the mass in (MI):

$$MM(f)_i = IM(f)_i + MI(f)_i$$

The mixed pollutant concentration (MC) is the mixed mass (MM) divided by the mixing volume (MV):

$$MC(f)_i = MM(f)_i \div MV(f)_i \times (453{,}592\ mg/lb \div 28.317\ l/cft)$$

The mass discharged out (MO) is the mixed concentration (MC) times the volume out (VO):

$$MO(f)_i = MC(f)_i \times VO(f)_i \times (28.317\ l/cft \div 453{,}592\ mg/lb)$$

The final mass (FM) in a canal segment is computed as the initial mass (IM) plus the mass in (MI) minus the mass out (MO):

$$FM(f)_i = IM(f)_i + MI(f)_i - MO(f)_i$$

### 3.4.4 Ebb Tide Algorithms

Ebb tide algorithms are the same as those for flood tide, but the flow direction is reversed. To simulate an ebb tide, the initial volume (IV) in a canal segment is set as the volume at high tide. This was calculated in the flood tide computations as the Final Volume ($FV_f$); this value is carried down to represent the initial volume for the ebb tide computations. Thus:

$$IV(e)_i = FV(f)_i$$

Where (e) indicates an ebb tide value.

## 3.5 Inputs from CCIAM

The canal segment drainage areas were entered into the CCIAM to calculate the stormwater and wastewater loads for each canal segment drainage area. Load volumes are computed by the CCIAM in units of gallons per day (gpd). This is converted to cubic-feet per day (cfd) by dividing by 7.48 gallons per cubic-foot for use in the canal model. On the other hand, load mass is computed by the CCIAM in units of pounds per day (lbs/day). This requires no unit conversion for use as model input. Stormwater loads included both surface runoff and groundwater runoff components, while wastewater volume and loads included only a groundwater flow component.

The CCIAM outputs the stormwater and wastewater loads by canal segment drainage area to a loading spreadsheet for use as input data in the canal model spreadsheets. The loading spreadsheet contains the pollutant loading data for any particular scenario in the CCIAM. Changes to it are reflected in the canal models when they are next opened in Excel.

## 3.6 Description of the CIAM

Each canal model consists of a single spreadsheet with three calculation tabs: Setup, Model, and Results. Five additional tabs in the spreadsheet are used to display and assess the results. These are: Schematic, TN Profile, TP Profile, BOD Profile, and TSS Profile.

A second spreadsheet is common to all the canal models. It contains the database of tide stations along with their associated values. The tide database is linked to the canal model through the Setup tab, which links in the tide station data when the user selects a station name from a pull-down selection box.

A third spreadsheet common to all the canal models is the loading spreadsheet. The CCIAM interfaces with the CIAT through the loading spreadsheet. Separate loading spreadsheets can be created and stored to simulate various scenarios. The appropriate loading spreadsheet is specified in the Setup tab.

The final common spreadsheet is the Model Results Summary spreadsheet. This file has multiple tabs, one for each scenario along with the Active Model tab. The Active Model tab has links to the canal models to pull in and summarize the results for each canal segment. The other tabs are copies of the values from the Active Model tab for previously run scenarios. They are used for comparison purposes and are the source of the comparison data for the Profile tabs. Additional scenario tabs can be created at any time by copying the Active Model tab and pasting over the references with their values (Paste Special – Values).

### 3.6.1 Setup Tab

The Setup tab of the model contains all the information that describes the canal to be modeled. User input cells are shaded gray and, in addition to the tide database link described above, they also include:

- The identification number of the canal and the name of the scenario. These are used as interface keys with the CCIAM. The scenario entry is used to identify the loading file, which contains the pollutant load data for the canal segment drainage areas as generated by the CCIAM. The identification number of the canal enables the model to search through the loading file for the appropriate canal segment drainage area loads.

- The sector angle and radial increments to be used for the five discharge zone segments in the model. The discharge zone segments are idealized as semi-circular bands described by an inner and outer radius, along with a sector angle to define the surface area of each segment.

- Water quality settings (mg/l) for the nearshore water and the initial canal water. Parameters included in the model are currently limited to TN, TP,

BOD, and TSS. The nearshore water quality is used to characterize the incoming load of pollutants during a flood tide and will have a substantial effect on the model results. The initial water quality is only used as a starting point for calculations and has no effect on the final result.

- Canal and discharge zone segment geometry is described using four input lines: Bottom Elevation, Cell Width, Cell Length and Minimum Circulation Elevation, all expressed in feet (ft). Canal segments require entries in all four lines, while discharge zone segments only require a Bottom Elevation entry.

### 3.6.2 Model Tab

The Model tab contains the algorithms and macros used to compute the model results. There is only one user input on this tab, Tolerance, which is expressed in mg/l. This is the precision to which the computations will be run. Once a model iteration fails to have any parameter change by more than the Tolerance value, the model assumes steady-state has been reached and ends the run.

The Model tab also includes all the linkage information for the segments. The user must take care to be sure that the equations with in the cells, particularly at branch junctions, are properly linked to the appropriate downstream/upstream cells. This represents the most challenging part of developing a specific canal model.

Finally, the Model tab has two buttons located at the top-left portion of the sheet. These two buttons (Reset and Run) are linked to macros that either reset the model to the initial conditions, or run the model algorithms until the Tolerance value has been reached. These macros must be modified slightly for different canals, based on the number of columns (segments) in the Model tab. An example of each of these macros is shown in Figure 4 and 5. The ending column in the range statement on line 31 of the Flushing Model Macro and line 13 of the Reset Macro must be modified to reflect the number of columns in the Model tab.

**FIGURE 4**
**EXAMPLE OF FLUSHING MODEL MACRO**

```
Sub Flush_Model()
'
' Flush_Model Macro

' Turn off screen updates to speed up model run
Application.ScreenUpdating = False
'Set cursor to hourglass to indicate busy status
Application.Cursor = xlWait
   Dim counter As Integer
   Dim tolerance As Double
   Dim test As Double
   tolerance = Worksheets("Model").Cells(5, 1).Value
   test = Worksheets("Results").Cells(5, 2).Value
   counter = 0
'=========================================================
' Start Model Iterations
'=========================================================
While test > tolerance
'=========================================================
' Update Counter Value on Results Sheet
' Update test value to the maximum change in results matrix
' When test < tolerance, the model will stop iterations
'=========================================================
   Worksheets("Results").Cells(2, 2).Value = counter
   counter = counter + 1
   test = Worksheets("Results").Cells(5, 2).Value
'=========================================================
' Update Model Inputs for Next Iteration (Tide Period)
'=========================================================
   Sheets("Model").Select
   Range("C111:W114").Select
   Application.CutCopyMode = False
   Selection.Copy
'Paste Flood Result Values into Ebb Input Values
   Range("C16").Select
   Selection.PasteSpecial Paste:=xlValues, Operation:=xlNone, SkipBlanks:= _
      False, Transpose:=False
   Application.CutCopyMode = False
Wend
'=========================================================
' Run Finished - Alert User and Reset Application Settings
'=========================================================
Application.ScreenUpdating = True
Application.Cursor = xlDefault
Beep
Beep
End Sub
```

**FIGURE 5**
**EXAMPLE OF RESET MACRO**

```
1.      Sub Model_Reset()
2.      '
3.      ' Model_Reset Macro
4.
5.      'Set Model Display to Hide Reset Process
6.          Sheets("Model").Select
7.          Application.ScreenUpdating = False
8.          Application.Cursor = xlWait
9.      '=======================================================
10.     ' Copy Initial WQ Conditions from the Setup Sheet
11.     '=======================================================
12.         Sheets("Setup").Select
13.         Range("E12:Y15").Select
14.         Selection.Copy
15.         Sheets("Model").Select
16.         Range("C16").Select
17.         Selection.PasteSpecial Paste:=xlValues, Operation:=xlNone, SkipBlanks:= _
18.             False, Transpose:=False
19.         Application.CutCopyMode = False
20.     ' Reset Model Iteration to 0
21.         Sheets("Results").Select
22.         Range("B2").Select
23.         Selection.ClearContents
24.     'Reset Model Display to default conditions
25.         Sheets("Model").Select
26.         Application.ScreenUpdating = True
27.         Application.Cursor = xlDefault
28.
29.     End Sub
```

### 3.6.3 Results Tab

The Results tab is used to hold the interim results at each iteration. The Flushing Model Macro compares the maximum change at each iteration in the Results tab with the Tolerance value to identify when calculations can cease. Once this occurs, the interim results stored in the Results tab are considered to be the final results.

The top of the Results tab contains the stationing values for the Profile tabs, as well as charting data for any water quality monitoring station associated with the canal. The Number of Columns value is used by the CCIAM to retrieve the results data from the canal model.

The bottom of the Results tab contains the references to the comparison scenario. Cell C31 is a user input for the name of the scenario tab in the Model Results Summary spreadsheet. Once a valid entry is made here, the scenario results are pulled in and plotted on the Profile tabs. This allows the user to make rapid visual assessments of different scenarios in comparison to the scenario currently modeled.

### 3.6.4 Schematic Tab

The Schematic tab allows a quick look at the results of the model run in a schematic layout similar to the geometric configuration of the canal being modeled. The user can select, using radio buttons, one of the four parameters for display under either high or low tide conditions. Figure 6 shows an example of the Schematic tab.

### 3.6.5 Profile Tabs

There is at least one Profile tab for each parameter included in the model: TN, TP, BOD, and TSS. There may be additional Profile tabs in a model if there are too many branches to show on a single Profile tab. Any water quality monitoring station associated with the canal can be included in the profile plot along with the basic statistics from the data collected for that station (minimum, maximum and average).

The Profile tabs chart the change in the computed steady-state concentration of a parameter along the length of the canal and through the discharge zones. If the user has entered a valid scenario name for comparison on the Results tab, the profile for that scenario will also be included in the chart. Figure 7 shows an example of a Profile tab.

## 3.7 Application of CIAM to Selected Canals

A canal model spreadsheet was developed for each of the ten (10) canals selected for modeling. The drainage area segments were digitized into GIS to estimate the stormwater/ wastewater loads and volumes input data for each canal segment. The digital delineations were then shifted to best match the parcels coverage.

The Setup tab, Model tab, and Results tab in each model were developed to include a column for each defined canal segment and discharge zone segment with corresponding changes made to the range values in the macros.

The geometry of the canal segments (length and width) was measured from the 1999 DOQQ maps. Depths could not be determined from any source, including the *Monroe County Residential Canal Inventory* and the canal bottom elevation for all segments was set at –15 feet. Observation of the canals using the recent DOQQ maps showed that the entrance to the canals in the discharge zone appeared to be substantially shallower. The discharge zone bottom elevation was set at –5 feet for all canals and all segments. Based on this assumption, the minimum circulation elevation was also set at –5 feet for all canal segments. Volumes below this elevation were not included in the mixing calculations of the model.

**FIGURE 6**
**EXAMPLE OF SCHEMATIC TAB**

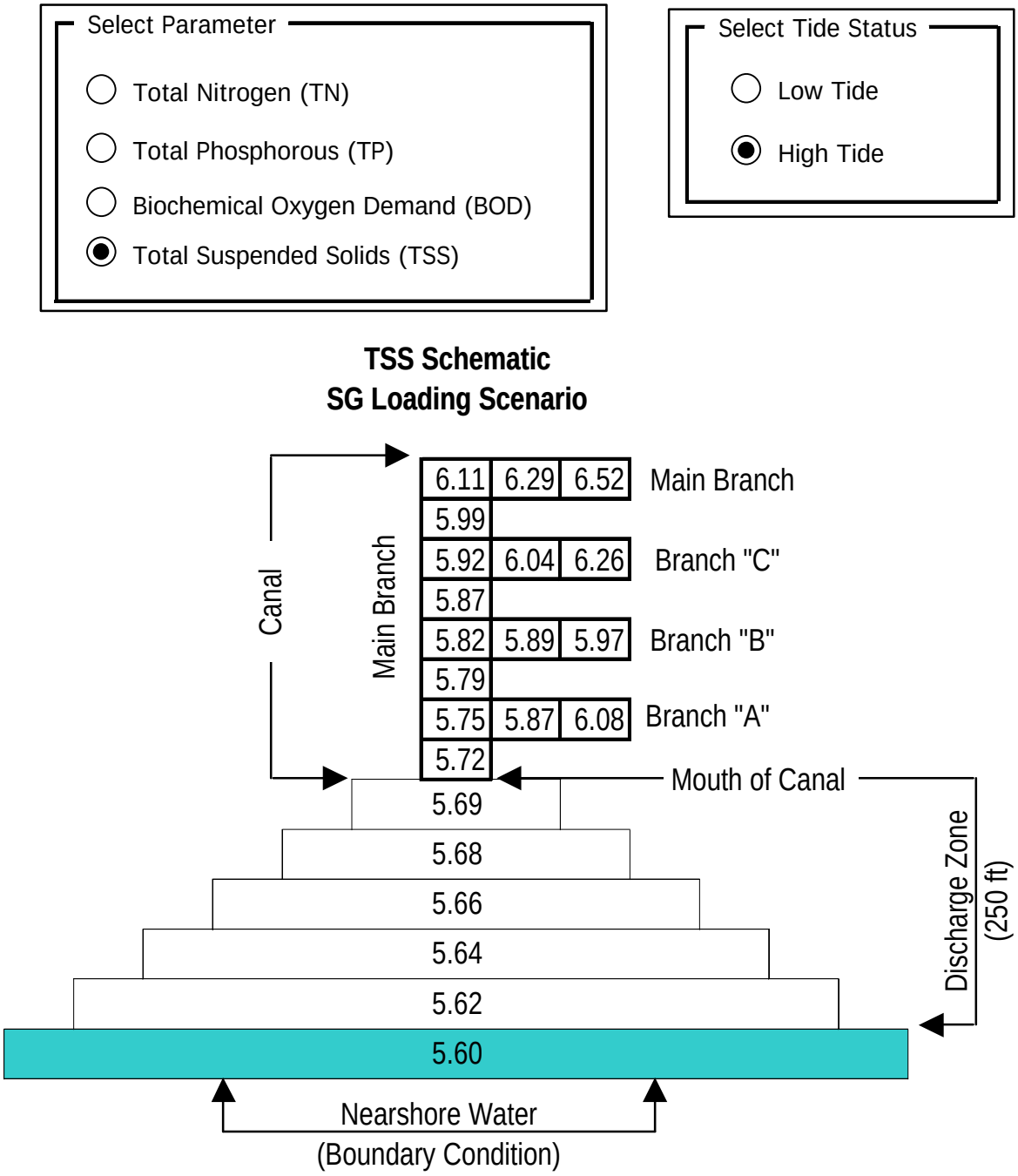
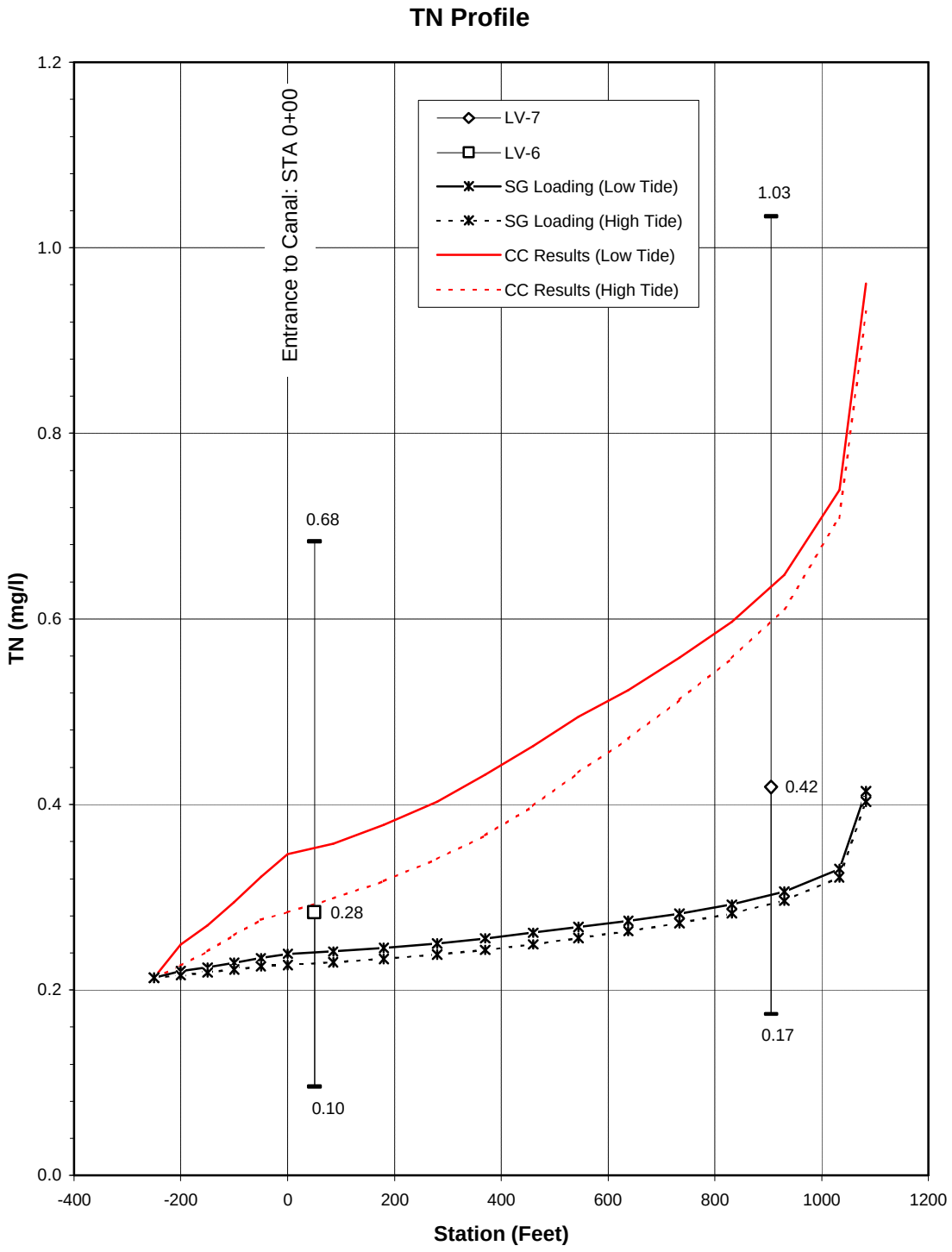


**FIGURE 7**
**EXAMPLE OF A PROFILE TAB**



The ambient water quality in the canals was taken from the associated water quality monitoring stations. The geometric mean of the data was selected for input, but the maximum and minimum values were included for charting on the Profile tabs.

The ambient water quality in the nearshore waters (source water under flood tide) was taken from Table 6. The BOD and TSS values were taken from geometric means of the data presented in the 1987 Marathon study (5.6 mg/l for TSS and 0.7 mg/l for BOD). Table 7 shows a brief set up summary for each of the ten canals.

**TABLE 7**
**SELECTED CANALS SET UP SUMMARY**

| Canal ID | | No. of Seg. | Total Length of Seg. (ft) | Canal Splits | Longest Distance (ft) | Nearshore Water Quality | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | TN (mg/l) | TP (mg/l) | BOD (mg/l) | TSS (mg/l) |
| 50 | Key Largo | 16 | 2,250 | 3 | 1,590 | 0.334 | 0.009 | 0.7 | 5.6 |
| 69 | Rock Harbor | 27 | 4,930 | 2 | 1,920 | 0.429 | 0.009 | 0.7 | 5.6 |
| 70 | Rock Harbor | 12 | 1,330 | 0 | 1,330 | 0.419 | 0.009 | 0.7 | 5.6 |
| 117 | Plantation Key | 14 | 1,923 | 0 | 1,923 | 0.344 | 0.009 | 0.7 | 5.6 |
| 152 | Lower Matecumbe Key | 30 | 6,214 | 2 | 3,244 | 0.197 | 0.007 | 0.7 | 5.6 |
| 204 | Marathon | 6 | 795 | 0 | 795 | 0.213 | 0.010 | 0.7 | 5.6 |
| 208 | Marathon | 12 | 1,083 | 0 | 1,083 | 0.213 | 0.010 | 0.7 | 5.6 |
| 246 | Marathon | 8 | 1,150 | 1 | 1,030 | 0.245 | 0.009 | 0.7 | 5.6 |
| 288 | Big Pine Key | 12 | 1,314 | 0 | 1,314 | 0.303 | 0.010 | 0.7 | 5.6 |
| 339 | Little Torch Key | 44 | 6,185 | 6 | 2,580 | 0.301 | 0.010 | 0.7 | 5.6 |

The connectivity of each canal was incorporated into the Model tab, with the appropriate algorithms and connections made between each upstream and down stream segment. A tolerance value of 0.001 mg/l was adopted for application to all canal models.

## 3.8 CIAM Constraints and Limitations

The CIAM is set up as a canal-specific spreadsheet model. It assumes a long-term steady-state influx of pollutant loads and volumes. It does not include or account for a number of variables that may have a significant impact on observed canal water quality. Some of these potential factors include:

- Sea level rise;
- Water column stratification;
- Wind effects;
- Thermal gradients;

- Surge tides associated with tropical storms or hurricanes;
- Interactions between the benthic/sediment zone and the active water column;
- nutrient uptake/release by marine plants
- Washed in seagrasses and similar sources;
- Direct input of water volumes and pollutant loads attributable to precipitation or atmospheric dryfall deposition;
- Water volume losses attributable to evaporation or transpiration; and
- Direct pollutant inputs related to marine vessel discharges and illicit discharges.

# 4 RESULTS AND DISCUSSION

Stormwater loads remain essentially unchanged, while the wastewater loads are dramatically reduced under the Smart Growth scenario (Table 8). Stormwater pollutants were reduced by about 1% on average, while wastewater pollutants averaged 90% reductions.

Under the Current Conditions scenario, wastewater is the source of about 80% of the nutrient load (TN and TP), half of the BOD, and about a quarter of the TSS (Table 9). As a volume, it comprises about a quarter of the flow. The remainder comes from stormwater.

**TABLE 8**
**POLLUTANT LOADS FROM STORMWATER AND WASTEWATER**

| Canal | Daily SW Load | | | | | Daily WW Load | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | TN (lbs) | TP (lbs) | BOD (lbs) | TSS (lbs) | Flow (cft) | TN (lbs) | TP (lbs) | BOD (lbs) | TSS (lbs) | Flow (cft) |
| **50 Key Largo** | | | | | | | | | | |
| Current Conditions Scenario: | 0.19 | 0.04 | 1.19 | 3.26 | 2,125 | 1.09 | 0.11 | 0.44 | 0.44 | 698 |
| Smart Growth Scenario: | 0.18 | 0.03 | 1.10 | 2.99 | 2,314 | 0.60 | 0.03 | 0.60 | 0.60 | 966 |
| Percent Change: | -6% | -5% | -8% | -8% | 9% | -45% | -72% | 39% | 39% | 39% |
| **69 Rock Harbor** | | | | | | | | | | |
| Current Conditions Scenario: | 0.38 | 0.08 | 2.48 | 6.89 | 4,655 | 2.68 | 0.27 | 1.07 | 1.07 | 1,714 |
| Smart Growth Scenario: | 0.38 | 0.08 | 2.48 | 6.90 | 4,666 | 0.00 | 0.00 | 0.00 | 0.00 | 0 |
| Percent Change: | 0% | 0% | 0% | 0% | 0% | -100% | -100% | -100% | -100% | -100% |
| **70 Rock Harbor** | | | | | | | | | | |
| Current Conditions Scenario: | 0.14 | 0.02 | 1.03 | 1.99 | 1,362 | 1.07 | 0.11 | 0.43 | 0.43 | 683 |
| Smart Growth Scenario: | 0.14 | 0.02 | 1.01 | 1.95 | 1,391 | 0.00 | 0.00 | 0.00 | 0.00 | 0 |
| Percent Change: | -1% | -1% | -1% | -2% | 2% | -100% | -100% | -100% | -100% | -100% |
| **117 Plantation Key** | | | | | | | | | | |
| Current Conditions Scenario: | 0.49 | 0.09 | 3.50 | 8.04 | 4,582 | 3.38 | 0.33 | 5.45 | 5.23 | 2,024 |
| Smart Growth Scenario: | 0.48 | 0.09 | 3.43 | 7.85 | 4,715 | 0.00 | 0.00 | 0.00 | 0.00 | 0 |
| Percent Change: | -2% | -1% | -2% | -2% | 3% | -100% | -100% | -100% | -100% | -100% |
| **152 Lower Matecumbe Key** | | | | | | | | | | |
| Current Conditions Scenario: | 0.37 | 0.07 | 2.22 | 5.82 | 5,489 | 3.03 | 0.30 | 1.53 | 1.39 | 1,931 |
| Smart Growth Scenario: | 0.37 | 0.07 | 2.22 | 5.82 | 5,489 | 0.00 | 0.00 | 0.00 | 0.00 | 0 |
| Percent Change: | 0% | 0% | 0% | 0% | 0% | -100% | -100% | -100% | -100% | -100% |
| **204 Marathon** | | | | | | | | | | |
| Current Conditions Scenario: | 0.12 | 0.02 | 1.01 | 2.18 | 1,150 | 0.83 | 0.08 | 2.58 | 2.58 | 469 |
| Smart Growth Scenario: | 0.12 | 0.02 | 1.00 | 2.16 | 1,166 | 0.00 | 0.00 | 0.00 | 0.00 | 0 |
| Percent Change: | -1% | -1% | -1% | -1% | 1% | -100% | -100% | -100% | -100% | -100% |
| **208 Marathon** | | | | | | | | | | |
| Current Conditions Scenario: | 0.11 | 0.02 | 0.62 | 1.53 | 1,025 | 0.82 | 0.08 | 2.06 | 2.06 | 463 |
| Smart Growth Scenario: | 0.11 | 0.02 | 0.62 | 1.53 | 1,025 | 0.00 | 0.00 | 0.00 | 0.00 | 0 |
| Percent Change: | 0% | 0% | 0% | 0% | 0% | -100% | -100% | -100% | -100% | -100% |
| **246 Marathon** | | | | | | | | | | |
| Current Conditions Scenario: | 0.16 | 0.03 | 1.62 | 3.75 | 1,515 | 0.56 | 0.05 | 2.44 | 2.44 | 282 |
| Smart Growth Scenario: | 0.16 | 0.03 | 1.62 | 3.75 | 1,515 | 0.18 | 0.01 | 0.18 | 0.18 | 282 |
| Percent Change: | 0% | 0% | 0% | 0% | 0% | -69% | -82% | -93% | -93% | 0% |
| **288 Big Pine Key** | | | | | | | | | | |
| Current Conditions Scenario: | 0.11 | 0.02 | 0.83 | 1.99 | 1,118 | 0.57 | 0.06 | 0.23 | 0.23 | 365 |

**TABLE 8 (CONTINUED)**
**POLLUTANT LOADS FROM STORMWATER AND WASTEWATER**

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Smart Growth Scenario: | 0.11 | 0.02 | 0.82 | 1.97 | 1,133 | 0.00 | 0.00 | 0.00 | 0.00 | 0 |
| Percent Change: | -1% | -1% | -1% | -1% | 1% | -100% | -100% | -100% | -100% | -100% |
| **339 Little Torch Key** | | | | | | | | | | |
| Current Conditions Scenario: | 0.38 | 0.08 | 2.74 | 7.40 | 4,439 | 2.31 | 0.23 | 0.94 | 0.94 | 1,512 |
| Smart Growth Scenario: | 0.38 | 0.08 | 2.74 | 7.40 | 4,439 | 0.00 | 0.00 | 0.00 | 0.00 | 0 |
| Percent Change: | 0% | 0% | 0% | 0% | 0% | -100% | -100% | -100% | -100% | -100% |
| **Minimum % Change:** | -6.4% | -5.1% | -7.8% | -8.4% | 0.0% | -100% | -100% | -100% | -100% | -100% |
| **Maximum % Change:** | 0.1% | 0.1% | 0.3% | 0.0% | 8.9% | -45% | -72% | 39% | 39% | 39% |
| **Average % Change:** | -1.1% | -0.9% | -1.2% | -1.5% | 1.7% | -91% | -96% | -85% | -85% | -76% |

**TABLE 9**
**CONTRIBUTION OF WASTEWATER TOTAL LOADS**

| | | WW Portion of Total Load | | | | |
|---|---|---|---|---|---|---|
| | | **TN** | **TP** | **BOD** | **TSS** | **Flow** |
| **CURRENT CONDITIONS SCENARIO** | | | | | | |
| | **Maximum:** | 89% | 82% | 77% | 57% | 33% |
| | **Minimum:** | 78% | 66% | 22% | 10% | 16% |
| | **Average:** | 86% | 77% | 44% | 27% | 27% |
| **SMART GROWTH SCENARIO** | | | | | | |
| | **Maximum:** | 77% | 47% | 35% | 17% | 29% |
| | **Minimum:** | 0% | 0% | 0% | 0% | 0% |
| | **Average:** | 13% | 7% | 5% | 2% | 5% |

In the Smart Growth scenario, much of the onsite wastewater sources are eliminated and the bulk of the pollutant loads to the canals become stormwater based, although the actual stormwater loads remain relatively unchanged between the two scenarios. The wastewater portion of the load for nutrients falls to about 10% of the total, while BOD, TSS, and flow are reduced to 5% or less of the load.

For all canals, model results show pollutant concentrations increase with distance from the canal mouth (see Appendix C-B for profiles for each canal and each pollutant). On the average, nutrient concentrations (TN and TP) were approximately 50% lower in Smart Growth (Table 10). BOD concentrations were reduced by about a quarter and TSS concentrations showed a minor reduction (6%). This is in line with the reductions and proportions of wastewater and stormwater loads. Discharged loads (pounds) were also reduced similarly, but to a slightly lesser extent. Nutrients fell by about 45%, BOD by about 20%, and TSS less than 5%.

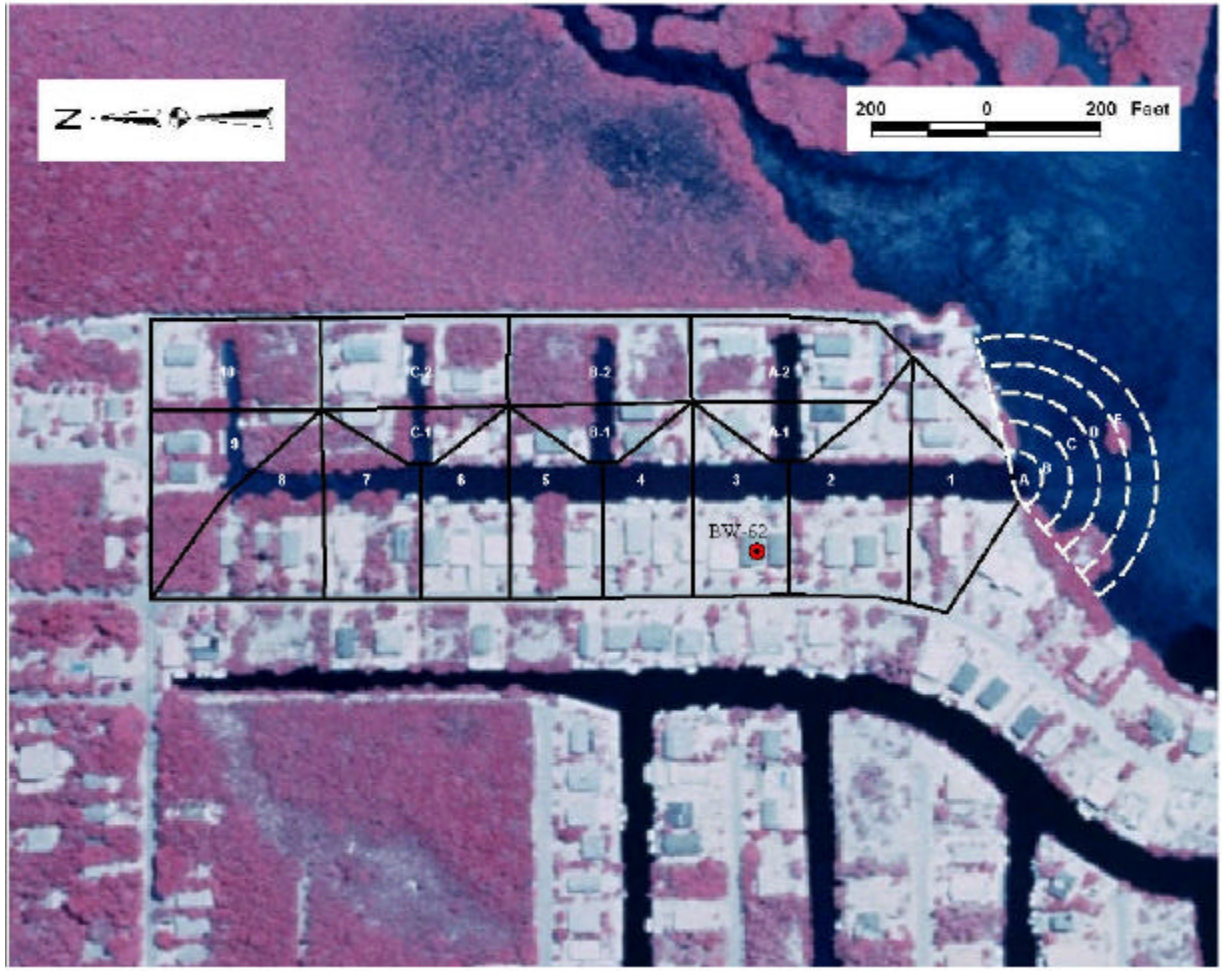
**TABLE 10**
**SCENARIO RESULTS COMPARISON**

| Canal | | Average Canal Concentration (mg/l) | | | | Canal Discharge (lbs/day) | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | TN | TP | BOD | TSS | TN | TP | BOD | TSS |
| **50** | **Key Largo** | | | | | | | | |
| | Current Conditions Scenario: | 0.51 | 0.030 | 0.95 | 6.06 | 9.94 | 0.471 | 18.88 | 133.84 |
| | Smart Growth Scenario: | 0.45 | 0.019 | 0.96 | 6.00 | 9.01 | 0.322 | 19.00 | 133.50 |
| | Percent Change: | -12.4% | -37.3% | 1.1% | -1.0% | -9.3% | -31.7% | 0.6% | -0.3% |
| **69** | **Rock Harbor** | | | | | | | | |
| | Current Conditions Scenario: | 0.51 | 0.019 | 0.79 | 5.76 | 38.34 | 1.248 | 60.48 | 453.27 |
| | Smart Growth Scenario: | 0.44 | 0.011 | 0.77 | 5.75 | 34.36 | 0.847 | 58.92 | 451.96 |
| | Percent Change: | -14.8% | -40.2% | -3.6% | -0.2% | -10.4% | -32.1% | -2.6% | -0.3% |
| **70** | **Rock Harbor** | | | | | | | | |
| | Current Conditions Scenario: | 1.28 | 0.105 | 1.73 | 6.92 | 5.85 | 0.409 | 8.20 | 40.77 |
| | Smart Growth Scenario: | 0.51 | 0.027 | 1.44 | 6.75 | 3.00 | 0.121 | 7.07 | 39.91 |
| | Percent Change: | -60.4% | -74.6% | -17.1% | -2.4% | -48.8% | -70.5% | -13.9% | -2.1% |
| **117** | **Plantation Key** | | | | | | | | |
| | Current Conditions Scenario: | 2.53 | 0.250 | 5.64 | 11.76 | 12.76 | 1.081 | 28.51 | 89.86 |
| | Smart Growth Scenario: | 0.57 | 0.059 | 2.57 | 9.15 | 4.79 | 0.304 | 15.59 | 77.99 |
| | Percent Change: | -77.5% | -76.4% | -54.4% | -22.2% | -62.5% | -71.9% | -45.3% | -13.2% |
| **152** | **Lower Matecumbe Key** | | | | | | | | |
| | Current Conditions Scenario: | 0.62 | 0.054 | 1.13 | 6.19 | 13.2 | 0.9 | 31.0 | 204.3 |
| | Smart Growth Scenario: | 0.24 | 0.016 | 0.96 | 6.11 | 7.42 | 0.366 | 28.12 | 202.26 |
| | Percent Change: | -62.0% | -71.1% | -15.5% | -1.3% | -43.6% | -61.1% | -9.2% | -1.0% |
| **204** | **Marathon** | | | | | | | | |
| | Current Conditions Scenario: | 0.55 | 0.043 | 2.05 | 7.26 | 3.5 | 0.3 | 12.4 | 51.6 |
| | Smart Growth Scenario: | 0.25 | 0.016 | 1.08 | 6.33 | 1.85 | 0.108 | 7.27 | 46.58 |
| | Percent Change: | -53.4% | -62.1% | -47.2% | -12.8% | -47.2% | -58.5% | -41.4% | -9.7% |
| **208** | **Marathon** | | | | | | | | |
| | Current Conditions Scenario: | 0.51 | 0.040 | 1.52 | 6.61 | 4.3 | 0.3 | 13.5 | 73.7 |
| | Smart Growth Scenario: | 0.25 | 0.015 | 0.90 | 6.05 | 2.76 | 0.147 | 9.55 | 69.80 |
| | Percent Change: | -50.8% | -61.4% | -40.4% | -8.6% | -36.2% | -50.3% | -29.4% | -5.2% |
| **246** | **Marathon** | | | | | | | | |
| | Current Conditions Scenario: | 0.62 | 0.050 | 2.96 | 8.73 | 2.98 | 0.207 | 12.60 | 47.24 |
| | Smart Growth Scenario: | 0.41 | 0.028 | 1.76 | 7.54 | 2.20 | 0.123 | 7.99 | 42.63 |
| | Percent Change: | -33.1% | -44.0% | -40.5% | -13.7% | -26.2% | -40.6% | -36.6% | -9.8% |
| **288** | **Big Pine Key** | | | | | | | | |
| | Current Conditions Scenario: | 0.86 | 0.077 | 1.63 | 7.18 | 3.19 | 0.244 | 6.06 | 33.11 |
| | Smart Growth Scenario: | 0.39 | 0.029 | 1.45 | 7.07 | 1.80 | 0.104 | 5.51 | 32.68 |
| | Percent Change: | -54.4% | -61.7% | -11.1% | -1.5% | -43.6% | -57.5% | -9.1% | -1.3% |
| **339** | **Little Torch Key** | | | | | | | | |
| | Current Conditions Scenario: | 0.55 | 0.040 | 1.04 | 6.23 | 16.20 | 0.942 | 33.06 | 226.34 |
| | Smart Growth Scenario: | 0.33 | 0.018 | 0.96 | 6.20 | 12.05 | 0.529 | 31.41 | 225.07 |
| | Percent Change: | -40.3% | -55.2% | -8.1% | -0.6% | -25.6% | -43.9% | -5.0% | -0.6% |
| | **Minimum % Change:** | -77.5% | -76.4% | -54.4% | -22.2% | -62.5% | -71.9% | -45.3% | -13.2% |
| | **Maximum % Change:** | -12.4% | -37.3% | 1.1% | -0.2% | -9.3% | -31.7% | 0.6% | -0.3% |
| | **Average % Change:** | -45.9% | -58.4% | -23.7% | -6.4% | -35.4% | -51.8% | -19.2% | -4.3% |

# CANAL IMPACTS ASSESSMENT TOOL

# APPENDIX C-A
# CANAL FIGURES

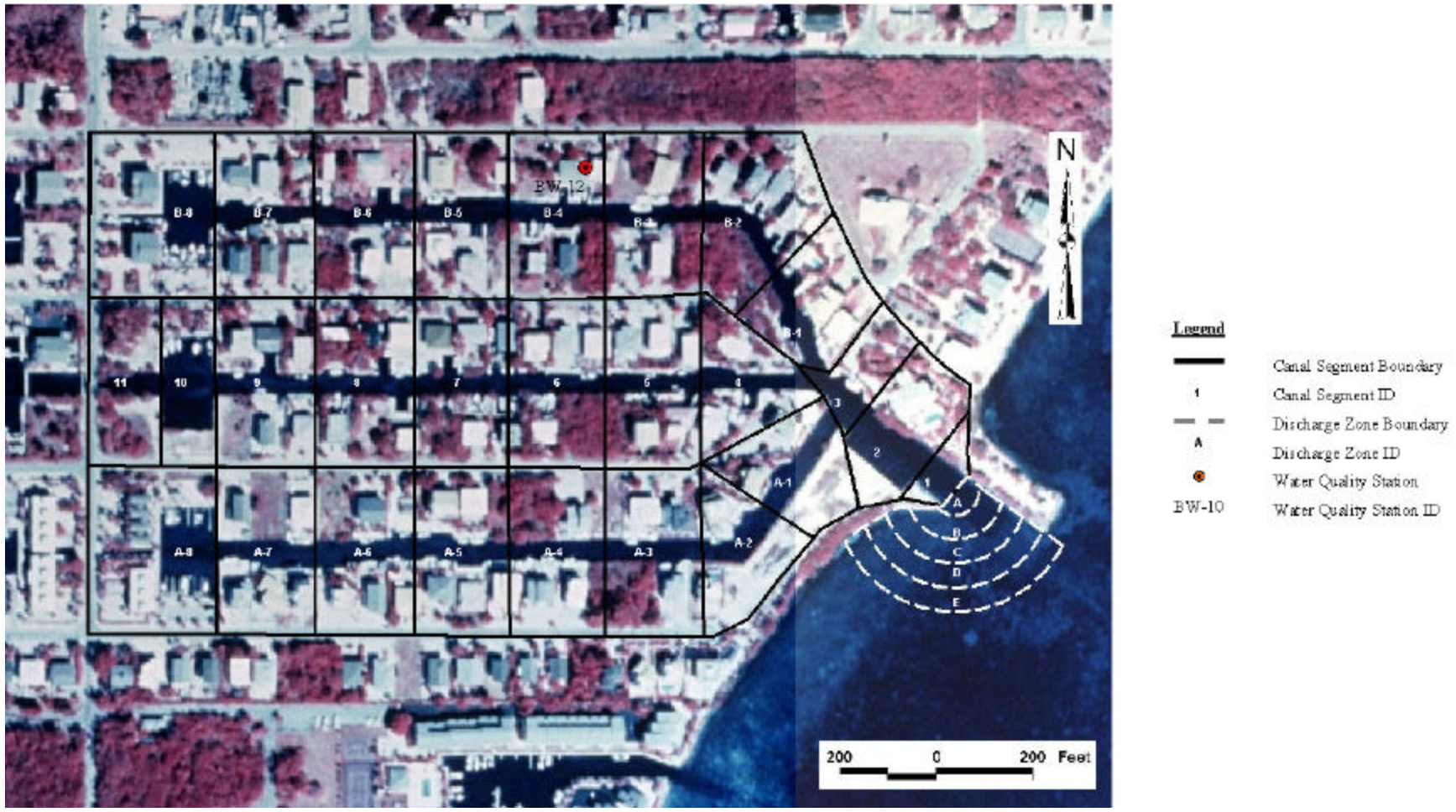
CANAL 50: KEY LARGO



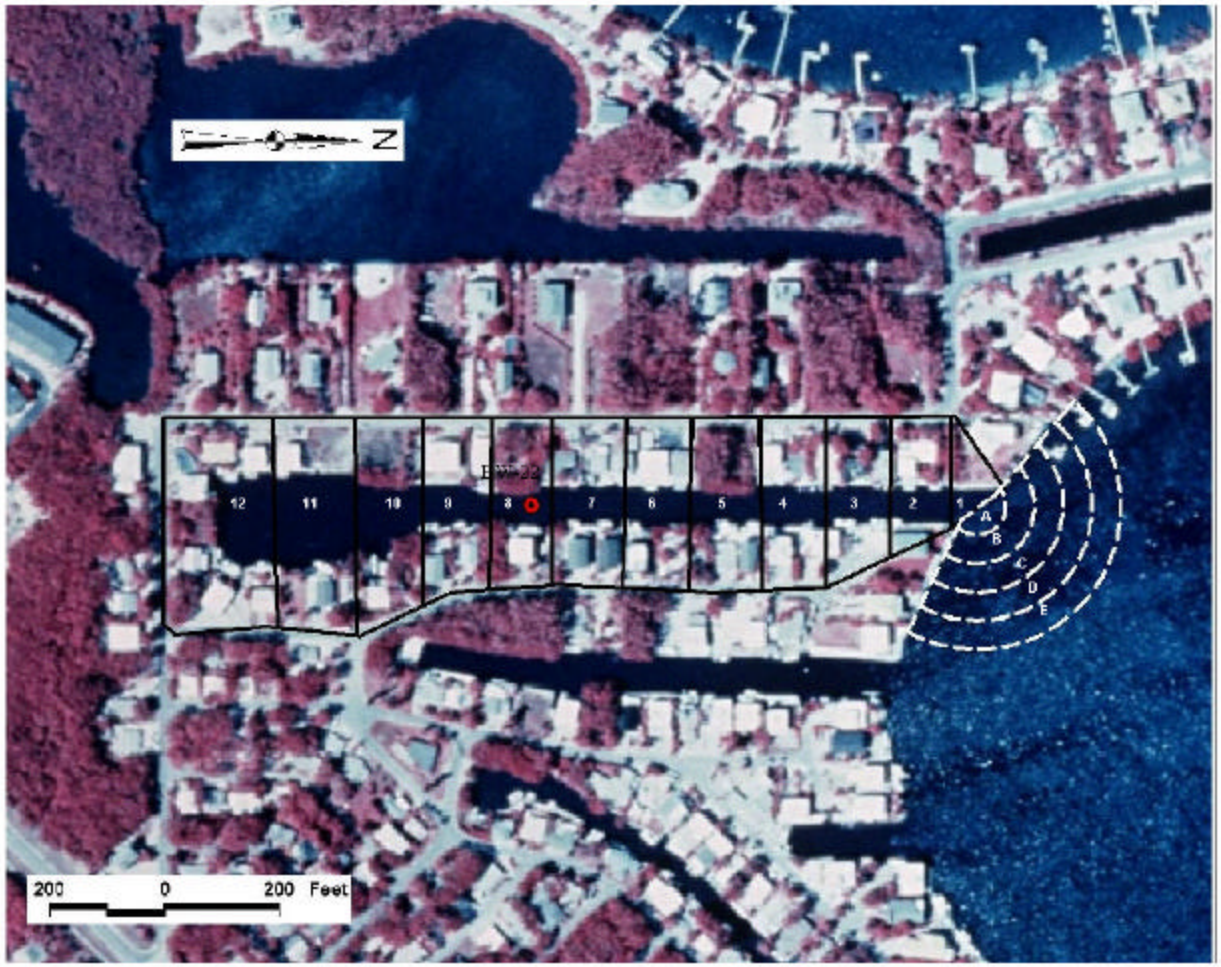

**Legend**

| | |
|---|---|
| | Canal Segment Boundary |
| 1 | Canal Segment ID |
| | Discharge Zone Boundary |
| A | Discharge Zone ID |
| | Water Quality Station |
| BW-10 | Water Quality Station ID |

CANAL 69: ROCK HARBOR



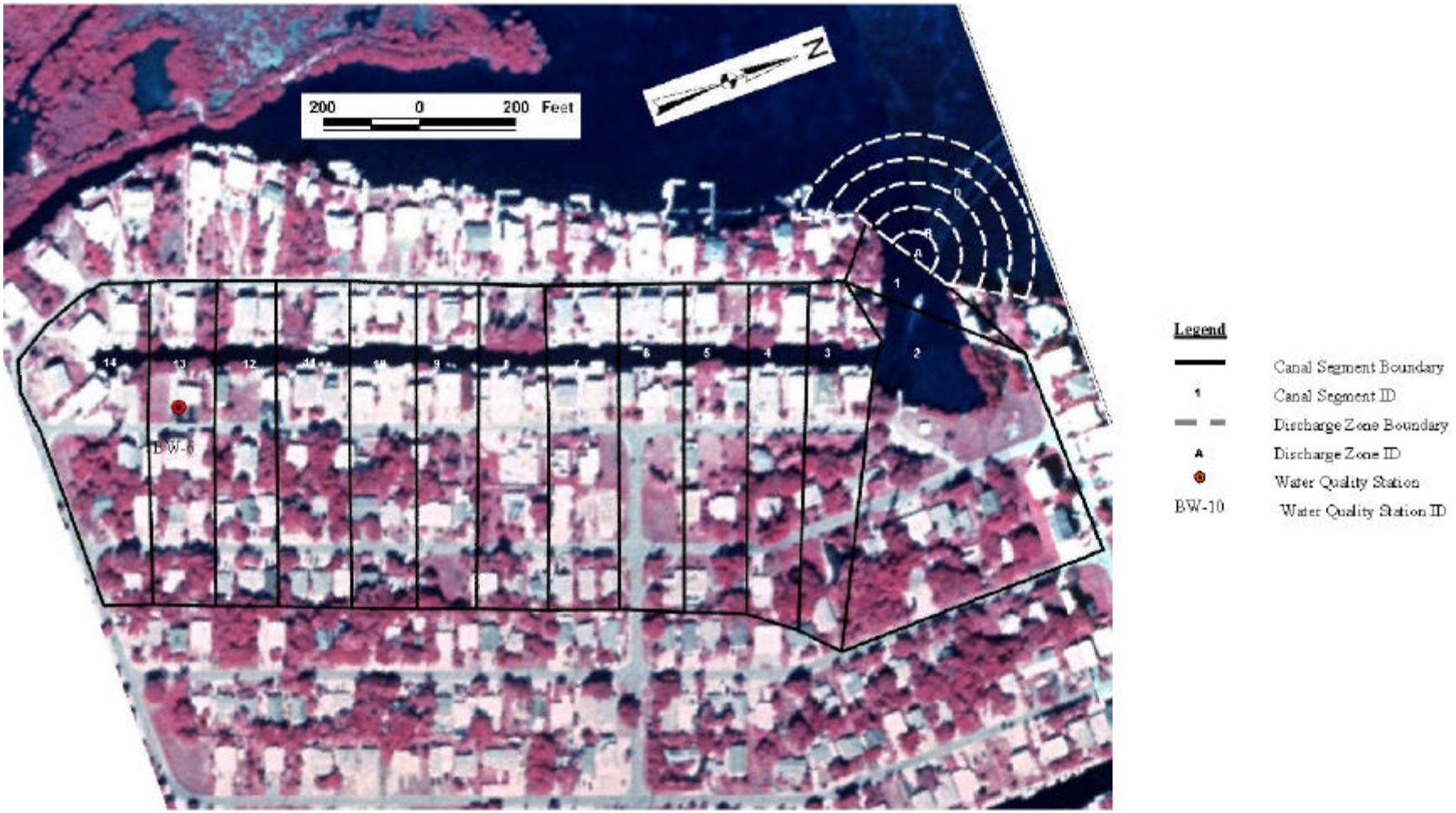
CANAL 70: ROCK HARBOR



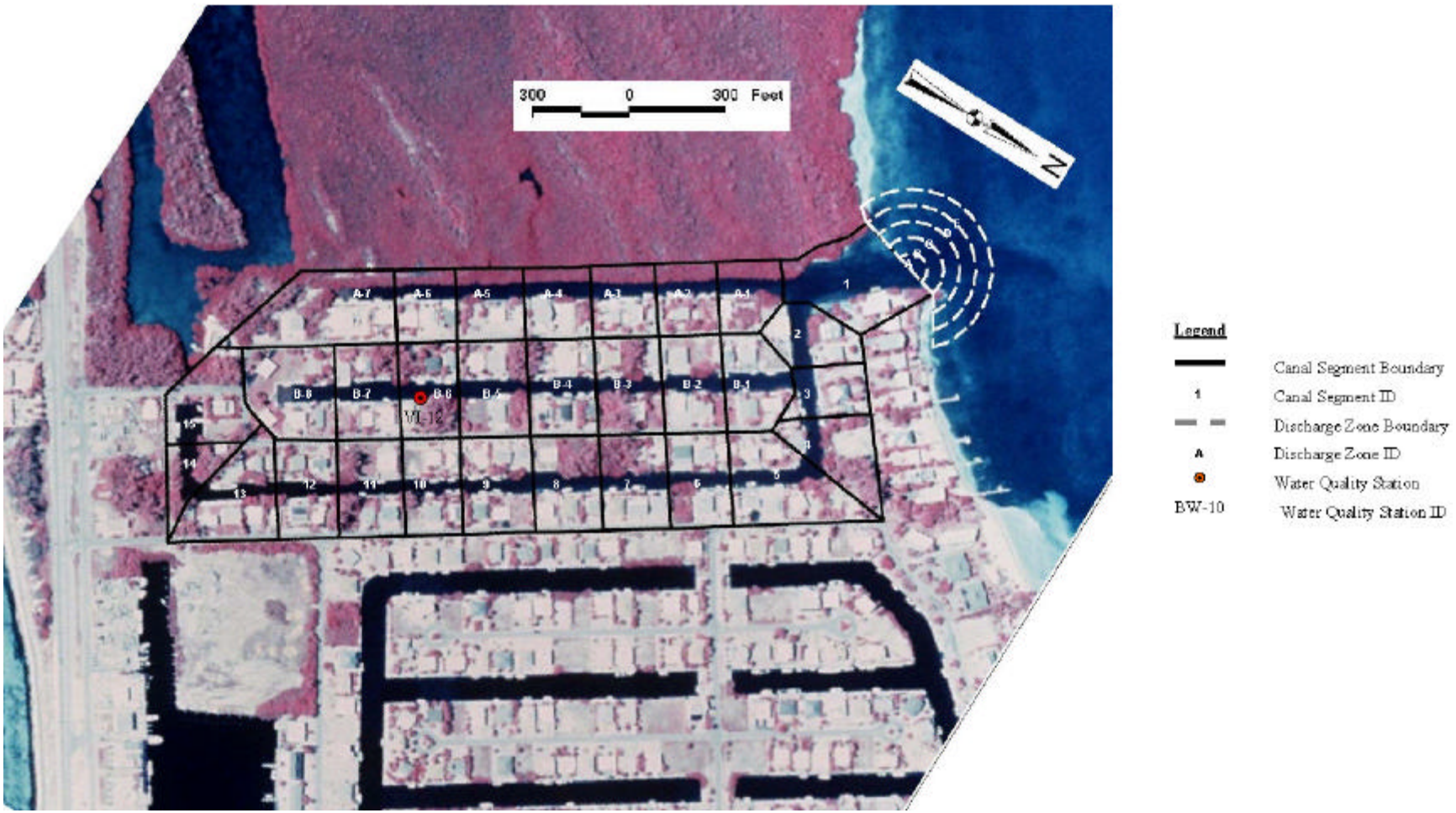

Legend

| | |
|---|---|
| | Canal Segment Boundary |
| 1 | Canal Segment ID |
| | Discharge Zone Boundary |
| A | Discharge Zone ID |
| | Water Quality Station |
| BW-10 | Water Quality Station ID |

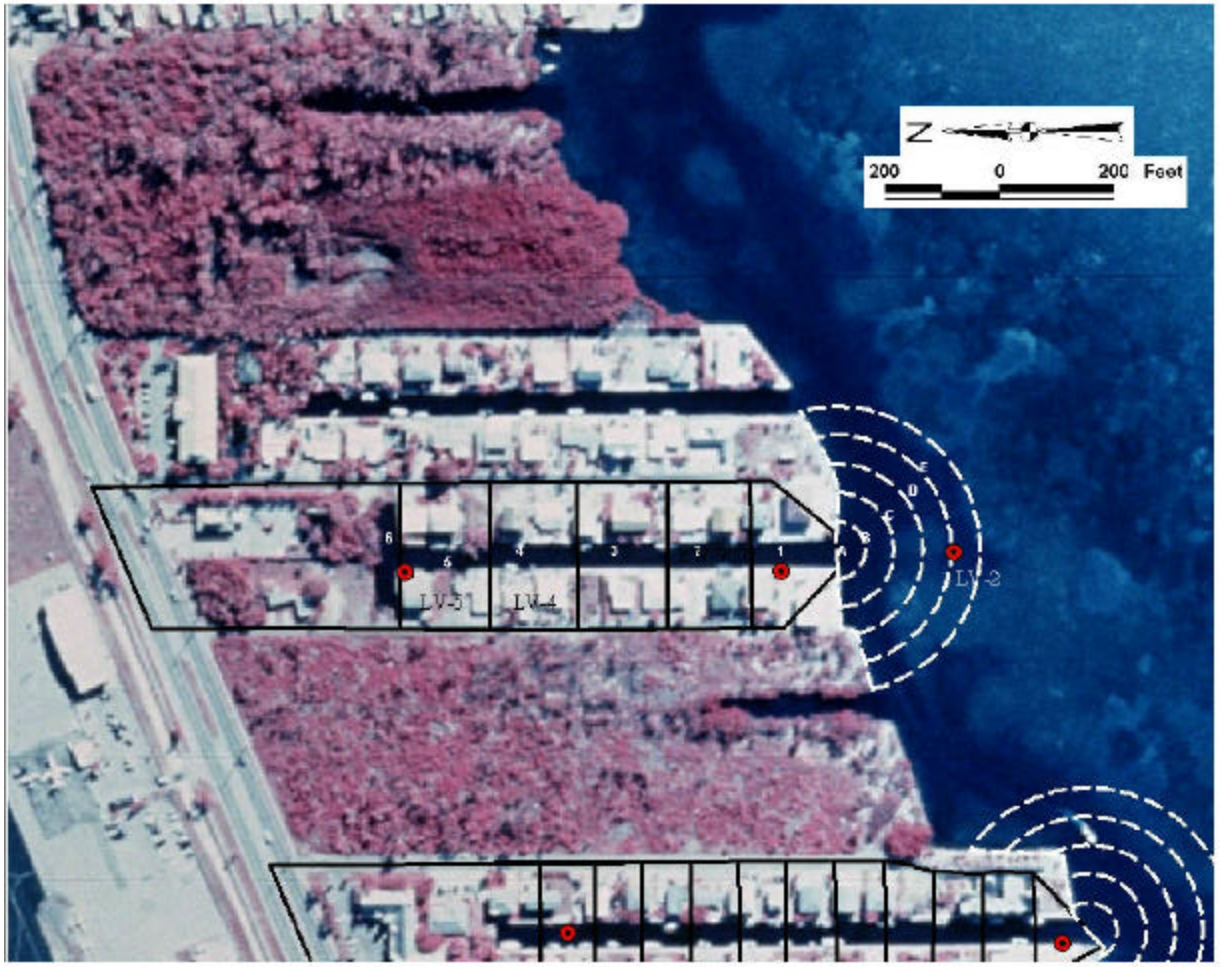
CANAL 117: PLANTATION KEY



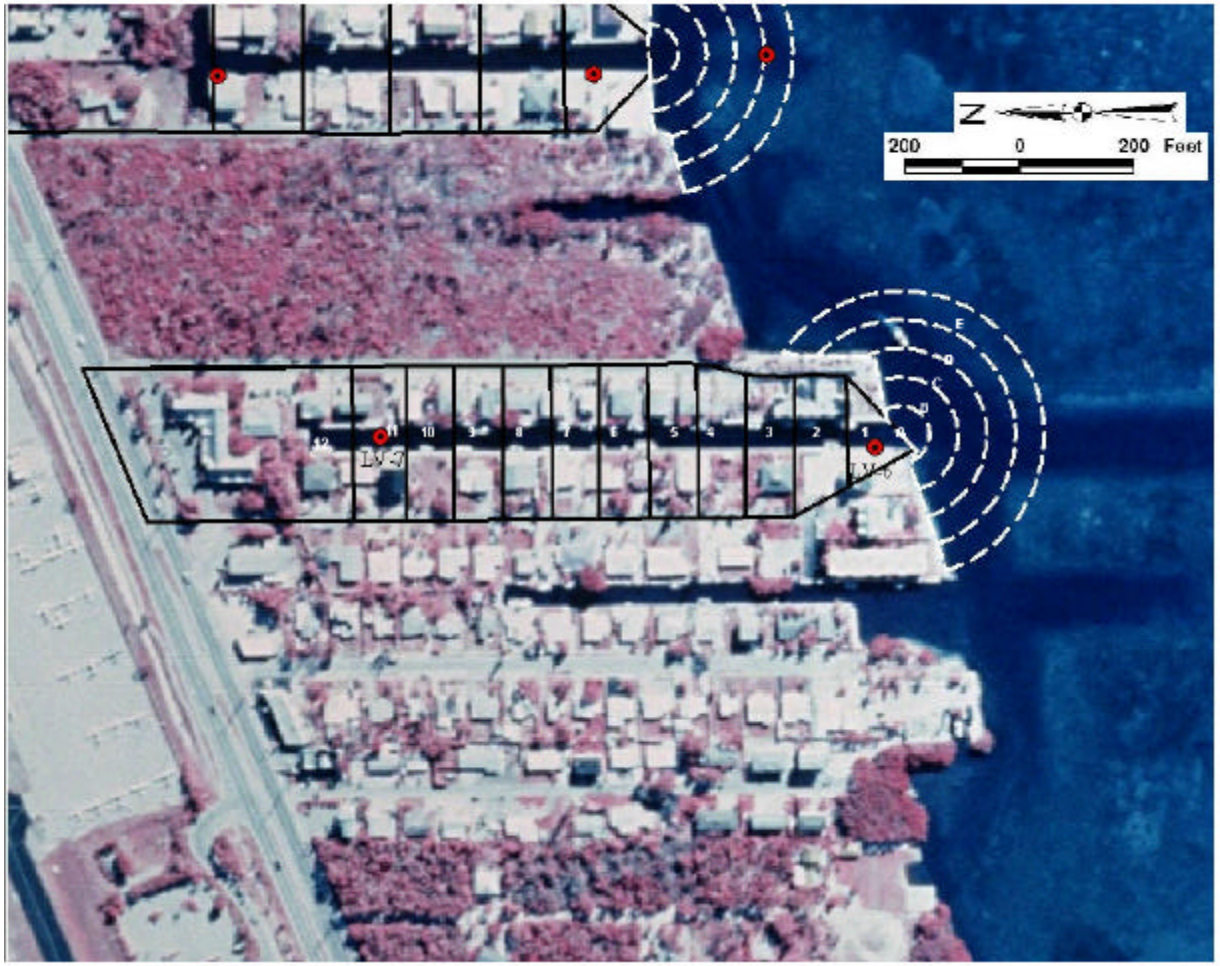
CANAL 152: LOWER MATECUMBE KEY



CANAL 204: MARATHON



CANAL 208: MARATHON




Legend

Canal Segment Boundary

1 Canal Segment ID

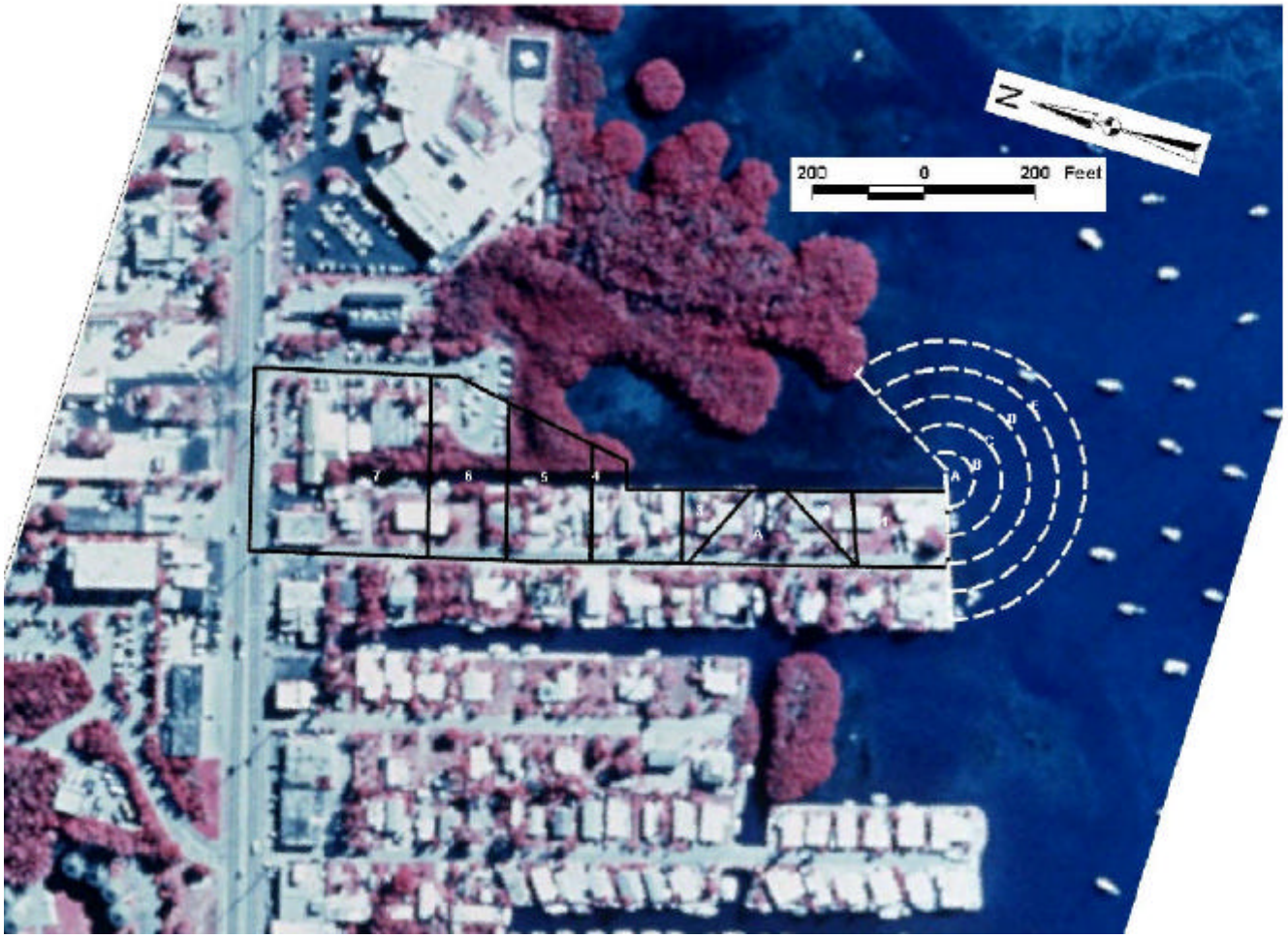
Discharge Zone Boundary

A Discharge Zone ID

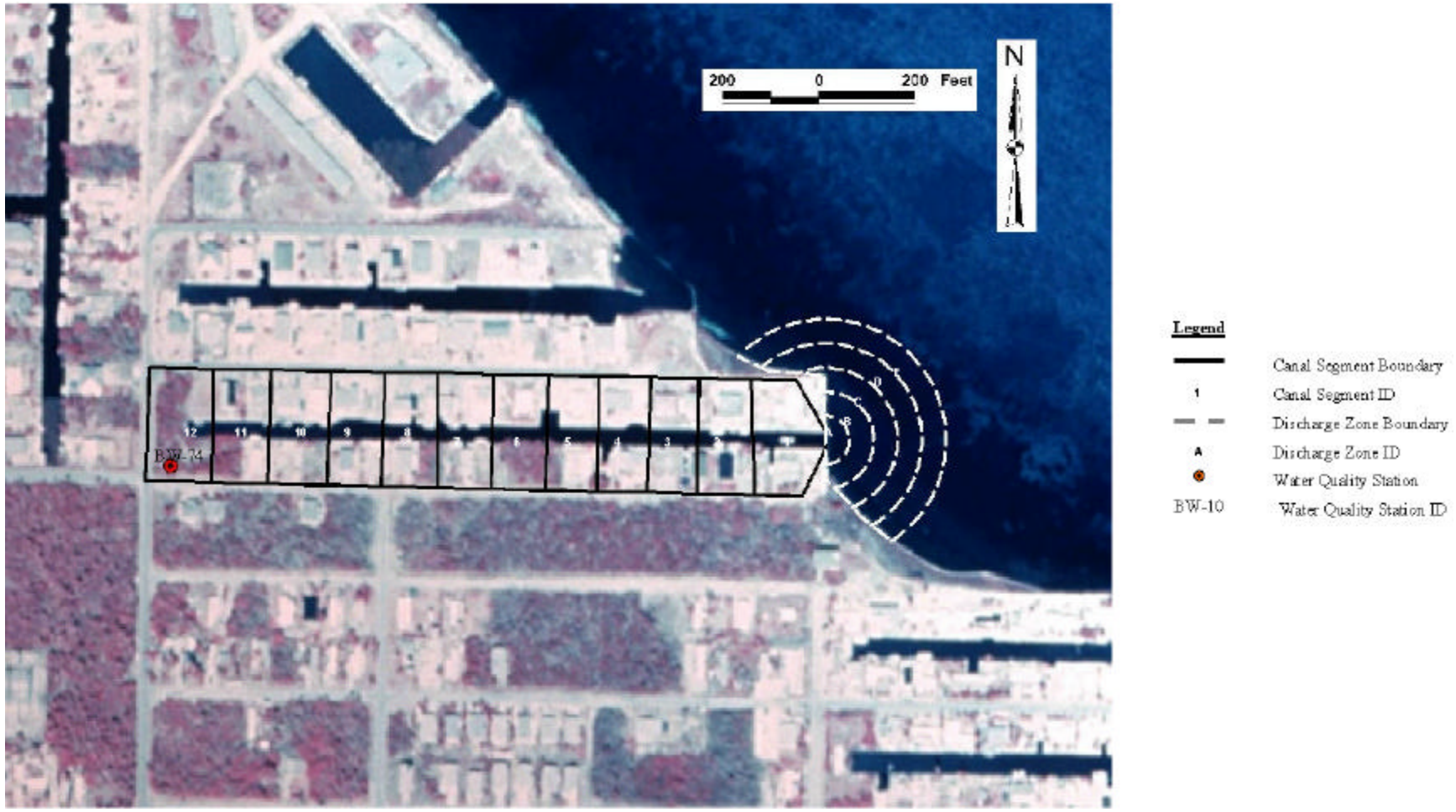
Water Quality Station

BW-10 Water Quality Station ID

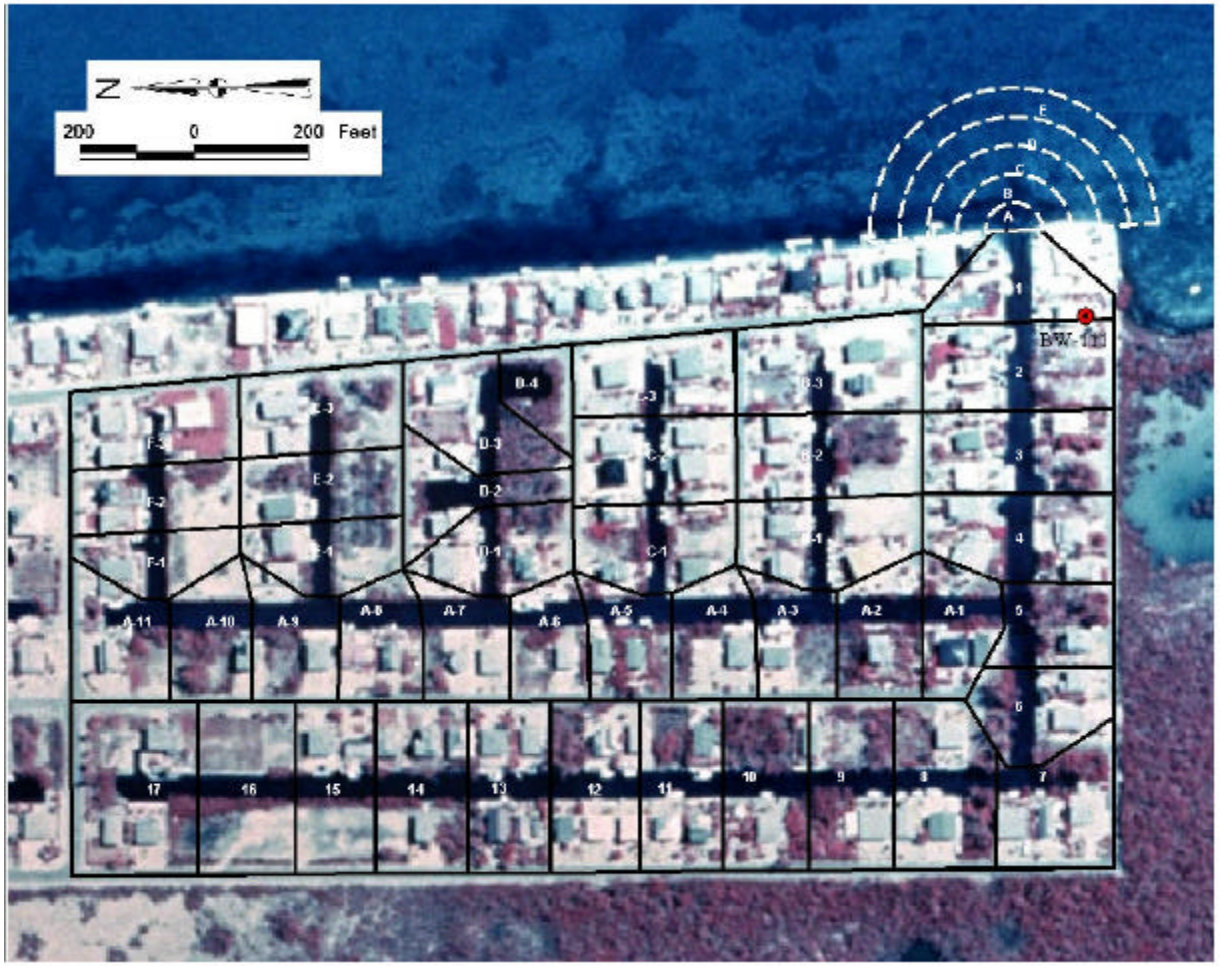
CANAL 246: MARATHON



CANAL 288: BIG PINE KEY

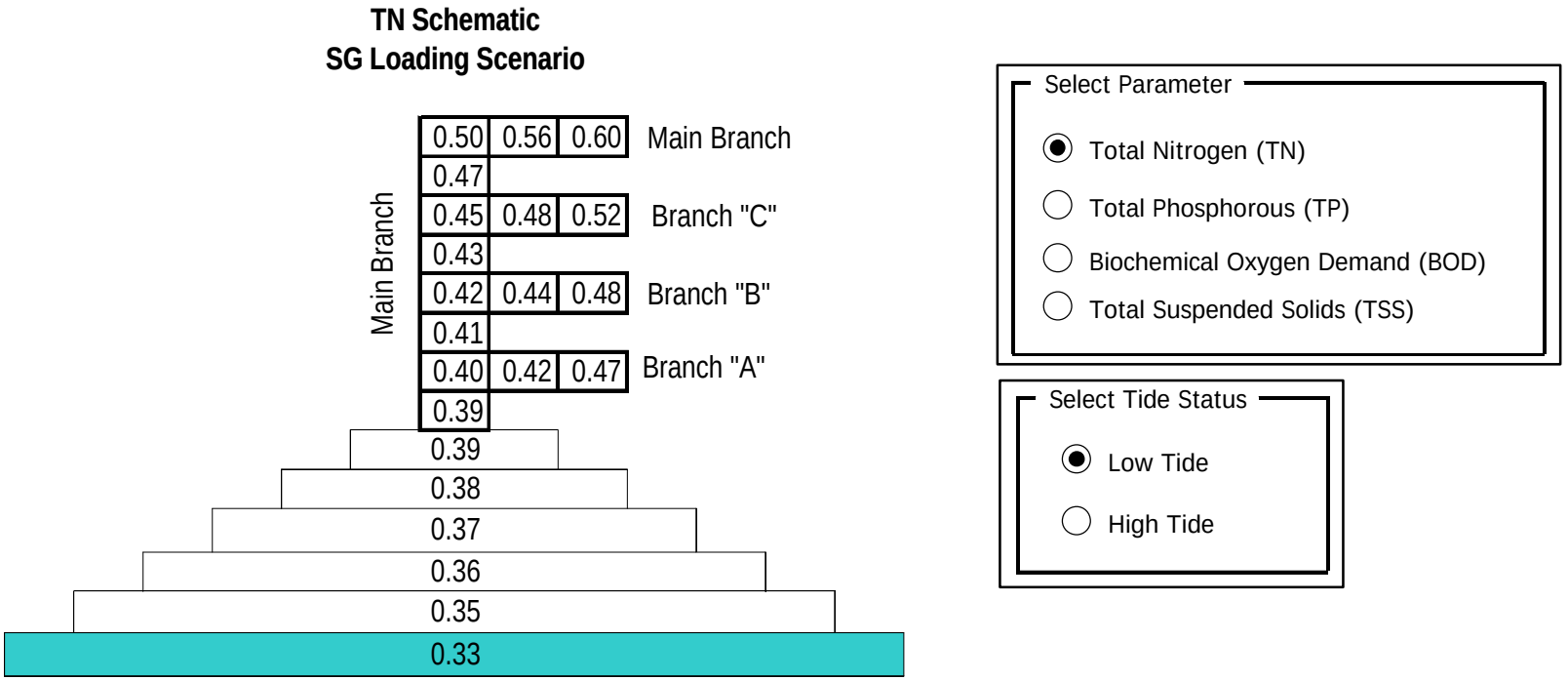


CANAL 339: LITTLE TORCH KEY

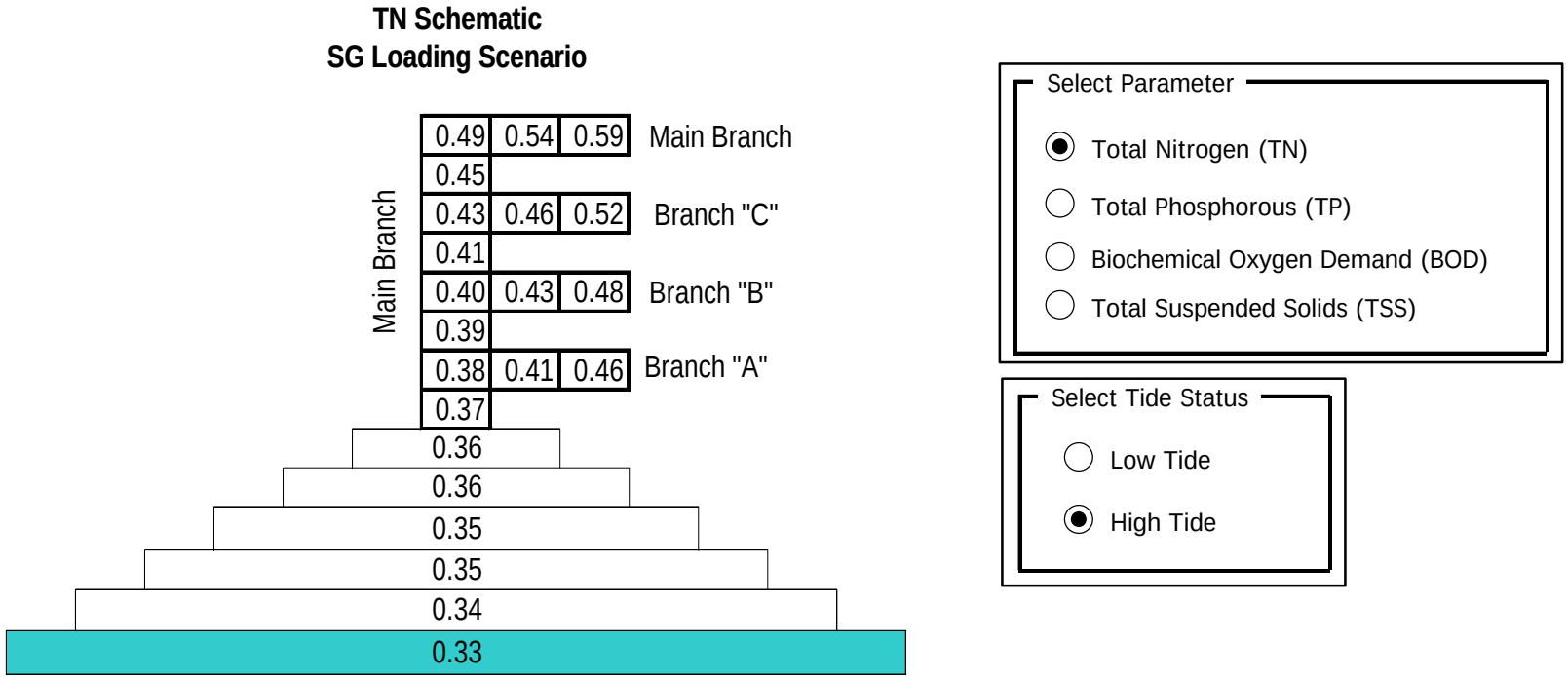


# CANAL IMPACTS ASSESSMENT TOOL

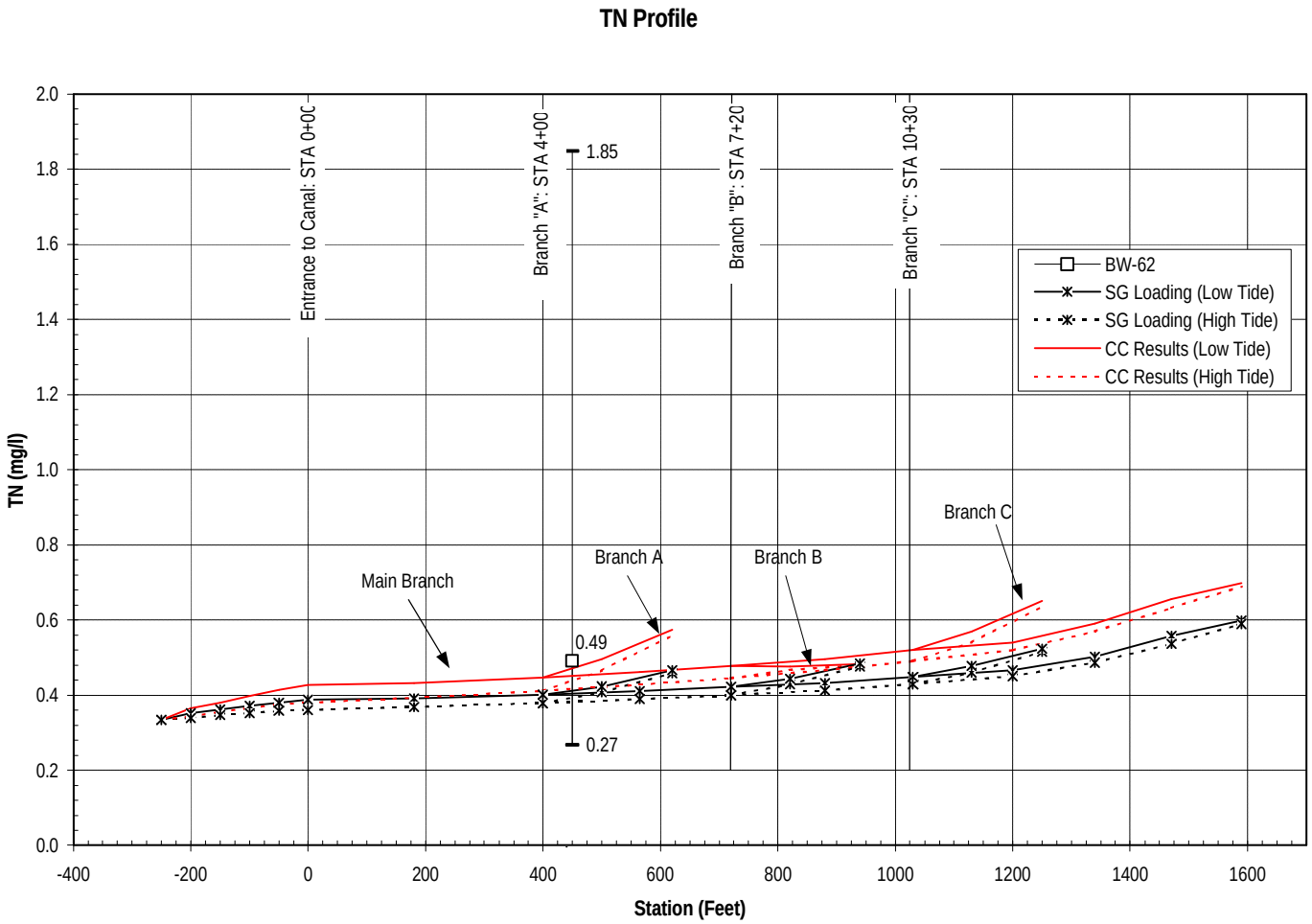
# APPENDIX C-B
# MODEL OUTPUT



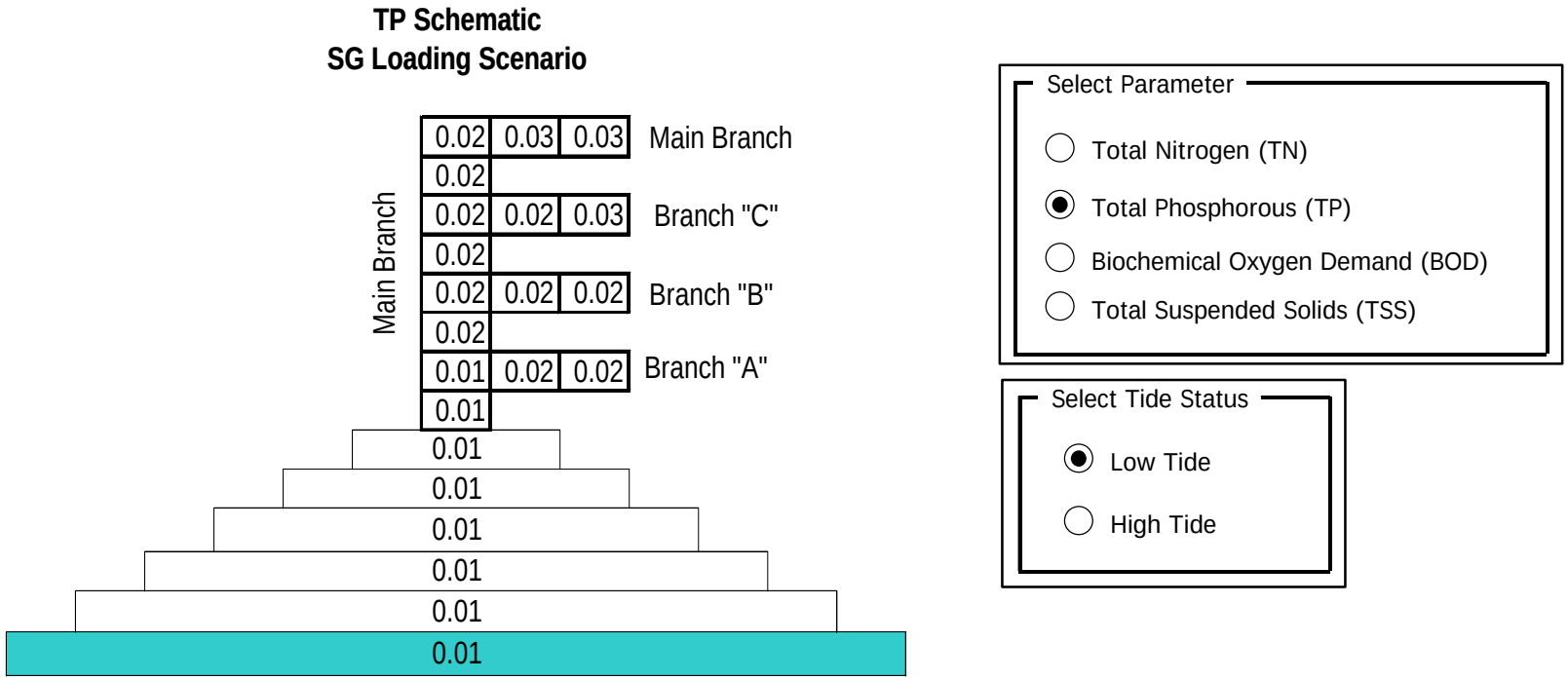

Canal #50, Key Largo Model Output: TN, low tide



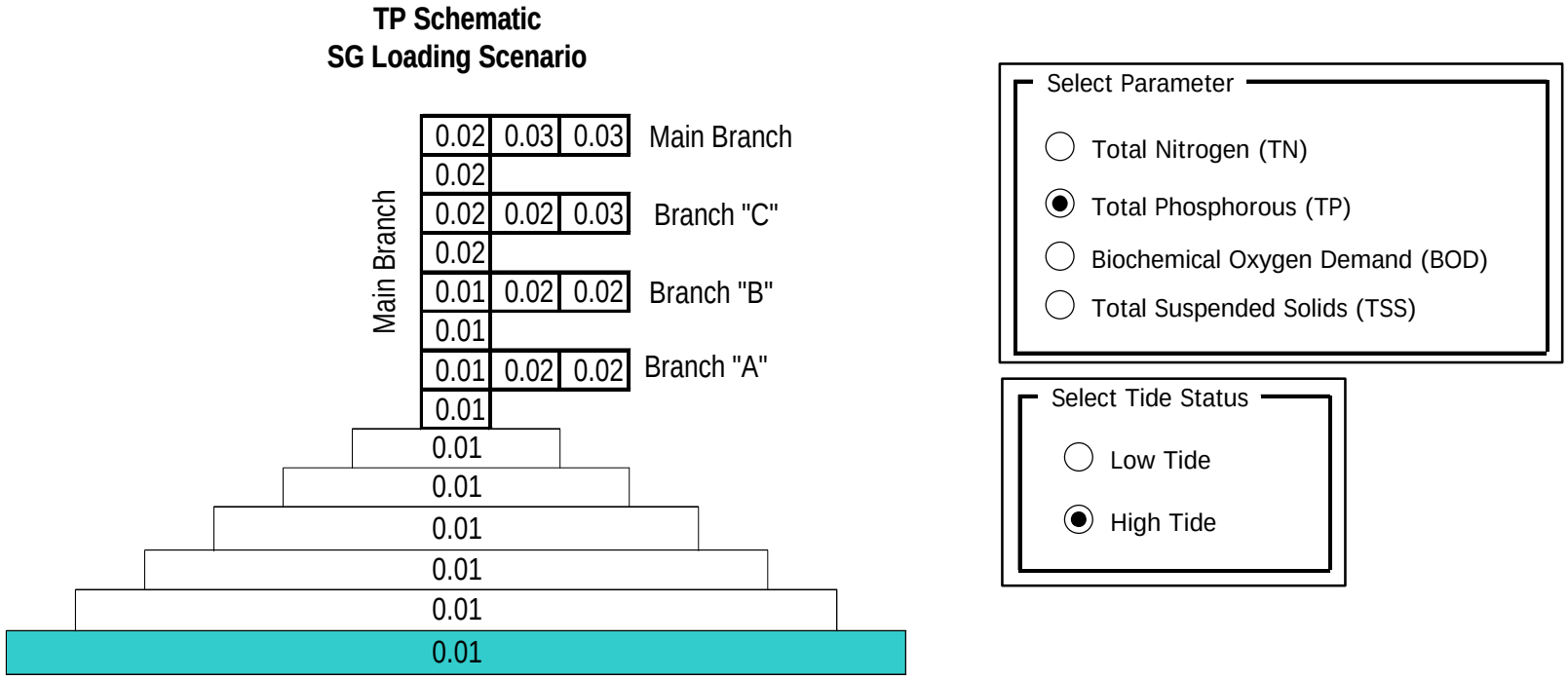

Canal #50, Key Largo Model Output: TN, high tide



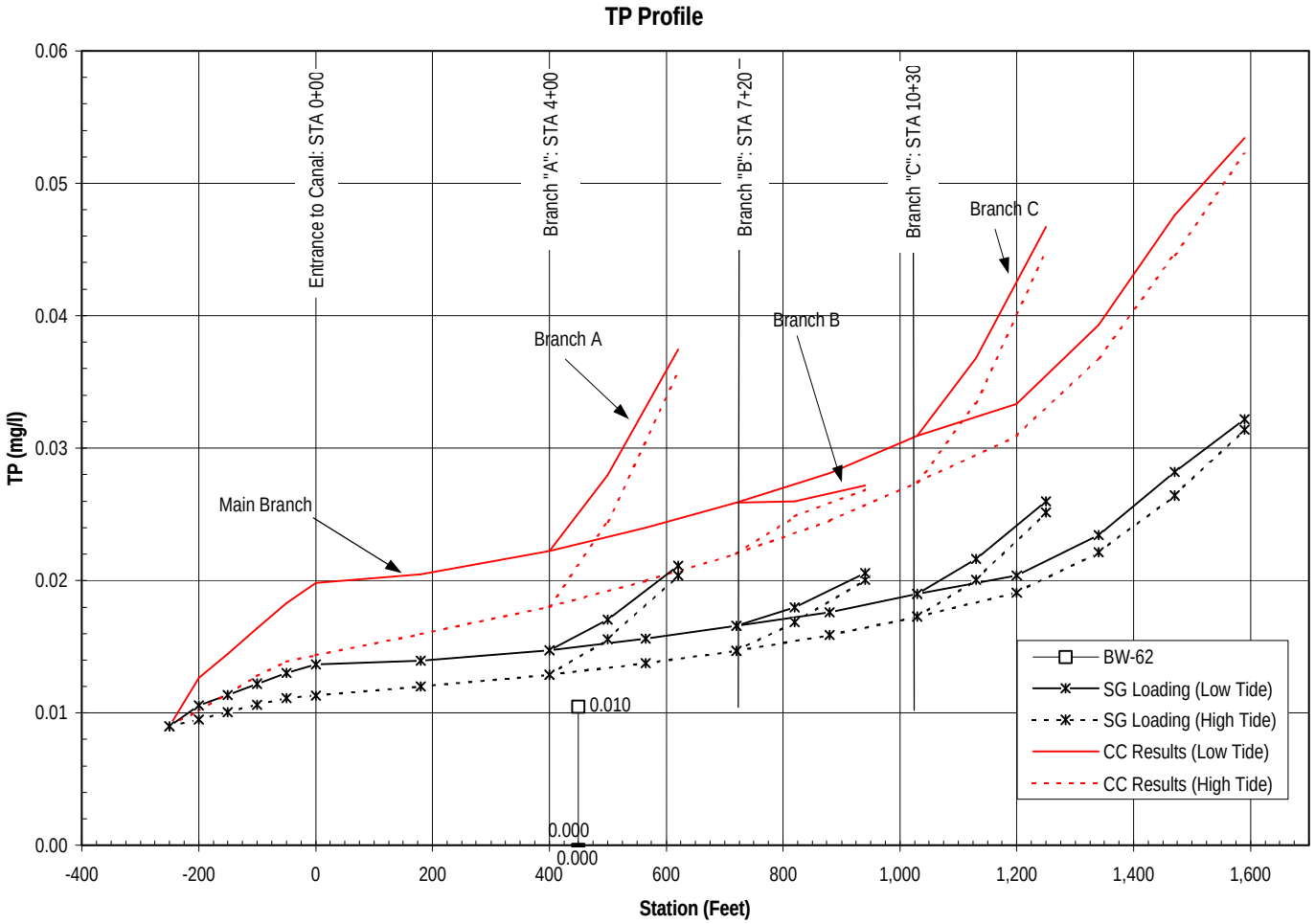

Canal #50, Key Largo Model Output: TN Profile



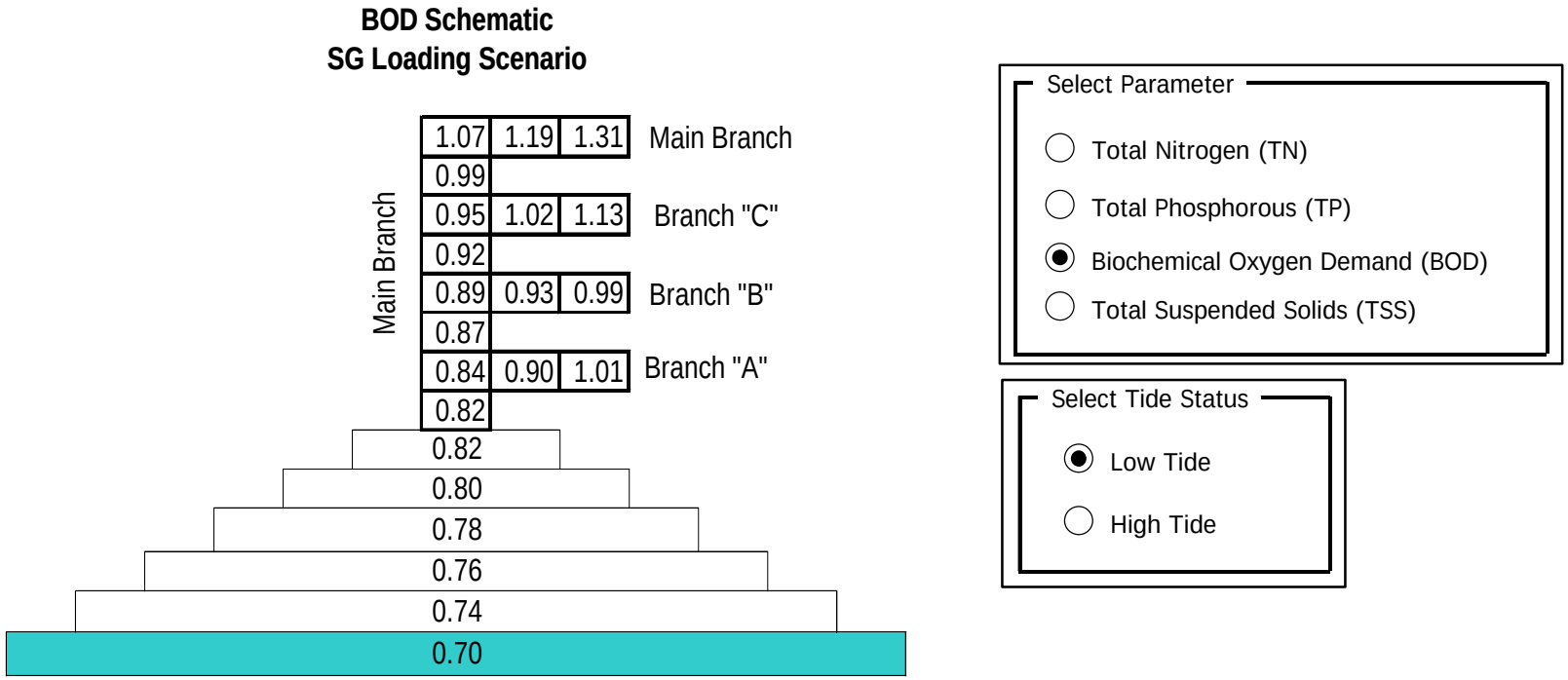

Canal #50, Key Largo Model Output: TP, low tide



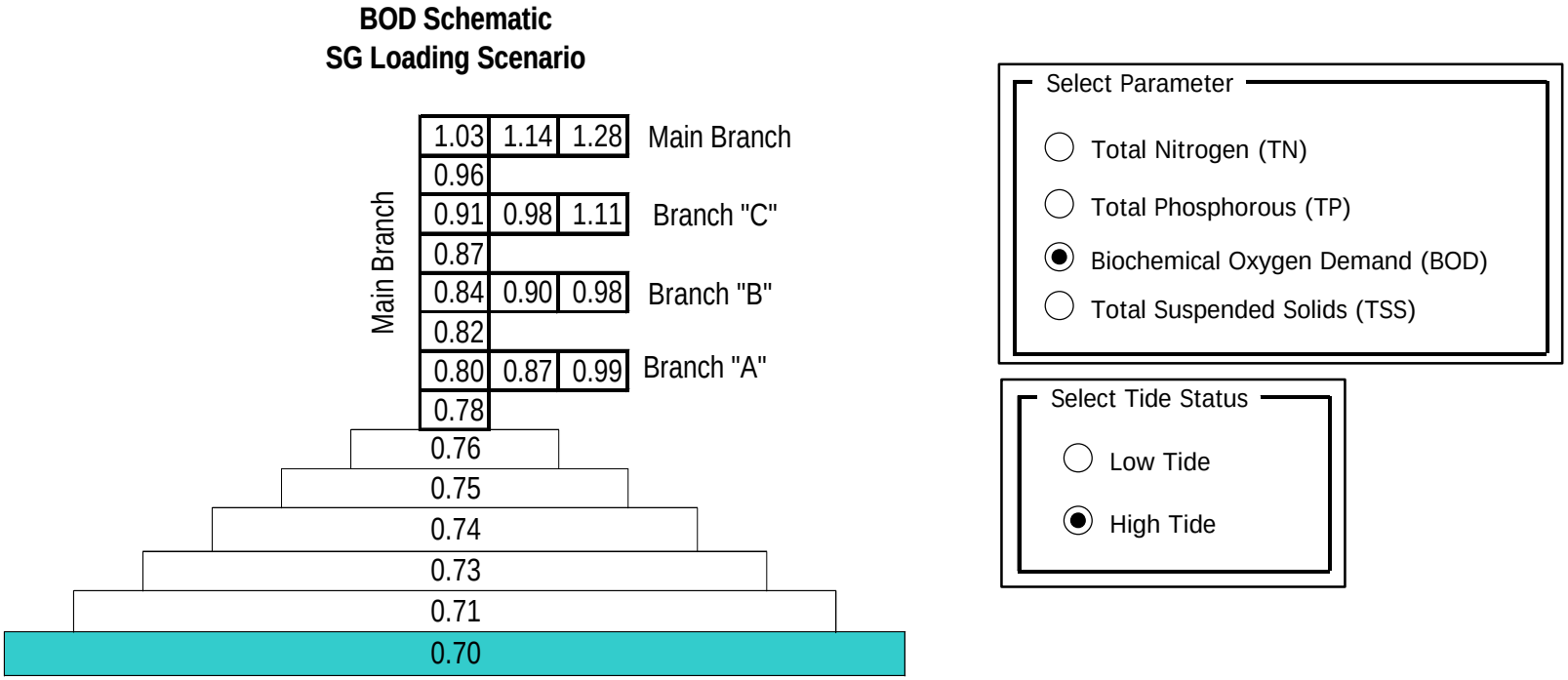

Canal #50, Key Largo Model Output, TP, high tide



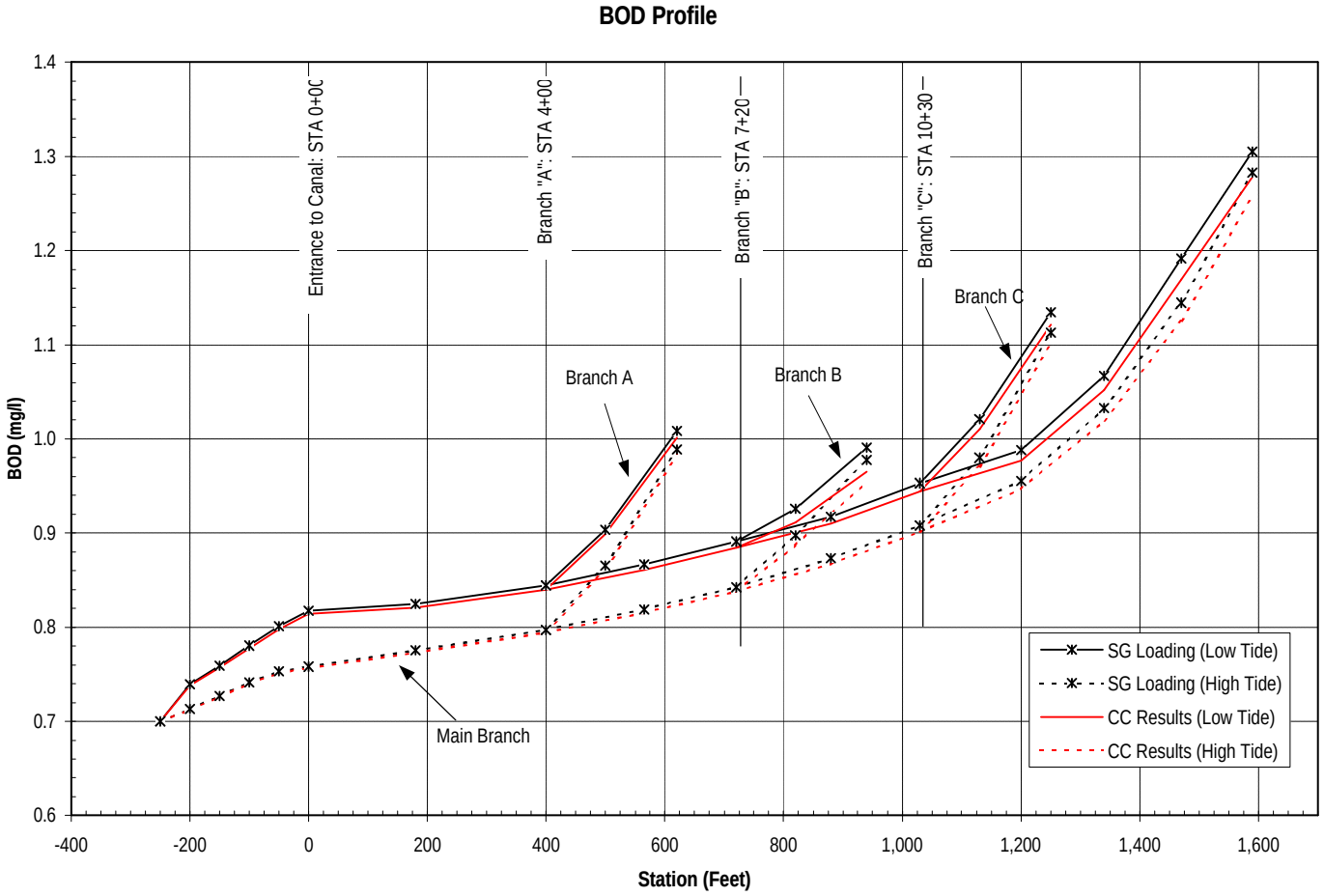

Canal #50, Key Largo Model Output: TP Profile



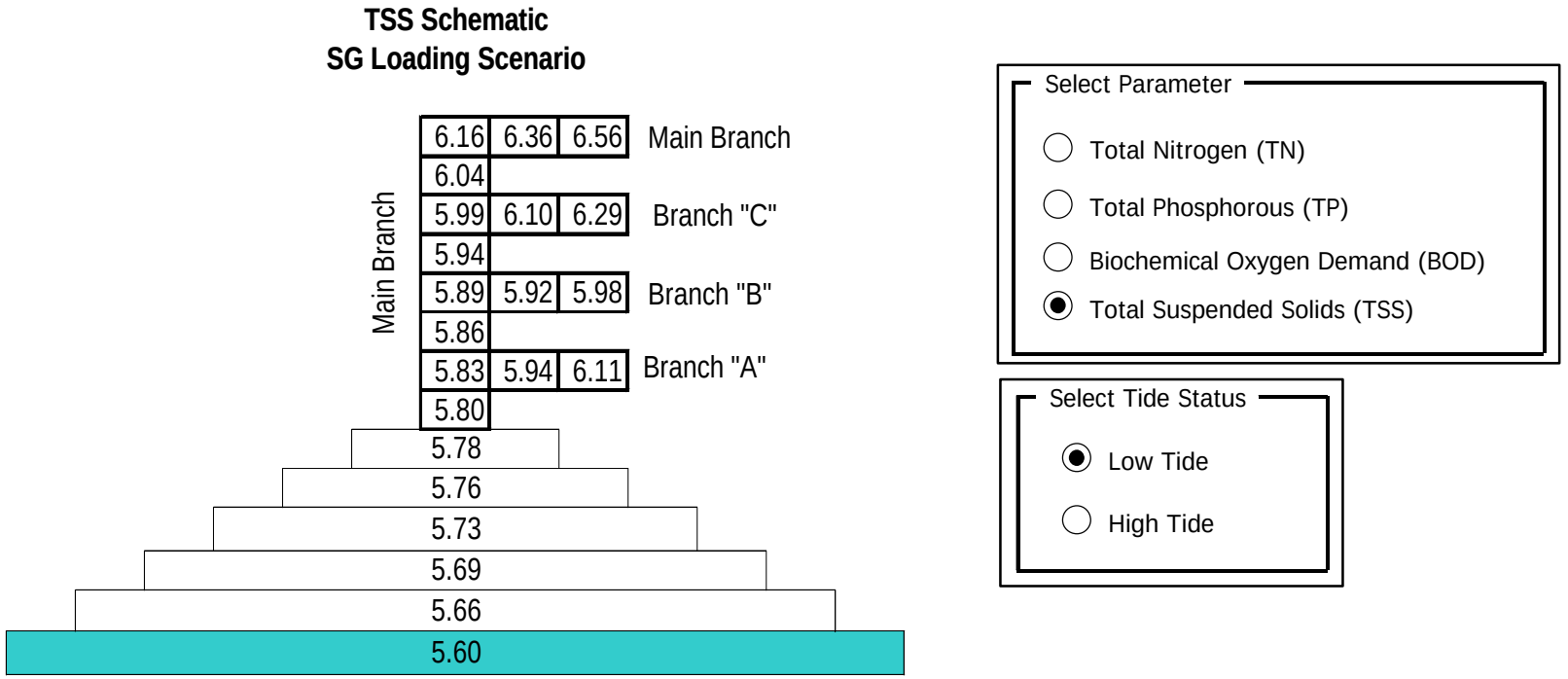

Canal #50, Key Largo Model Output, BOD, low tide



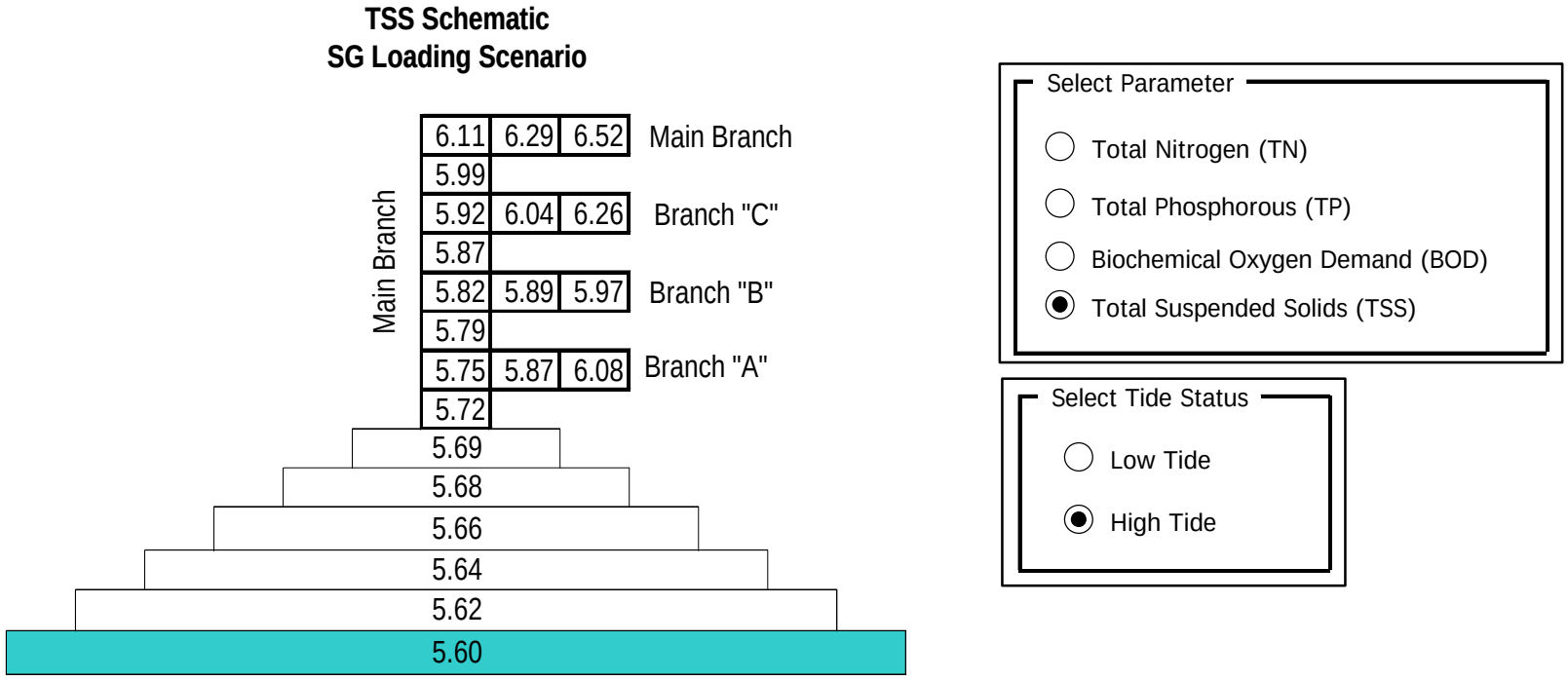

Canal #50, Key Largo Model Output: BOD, high tide



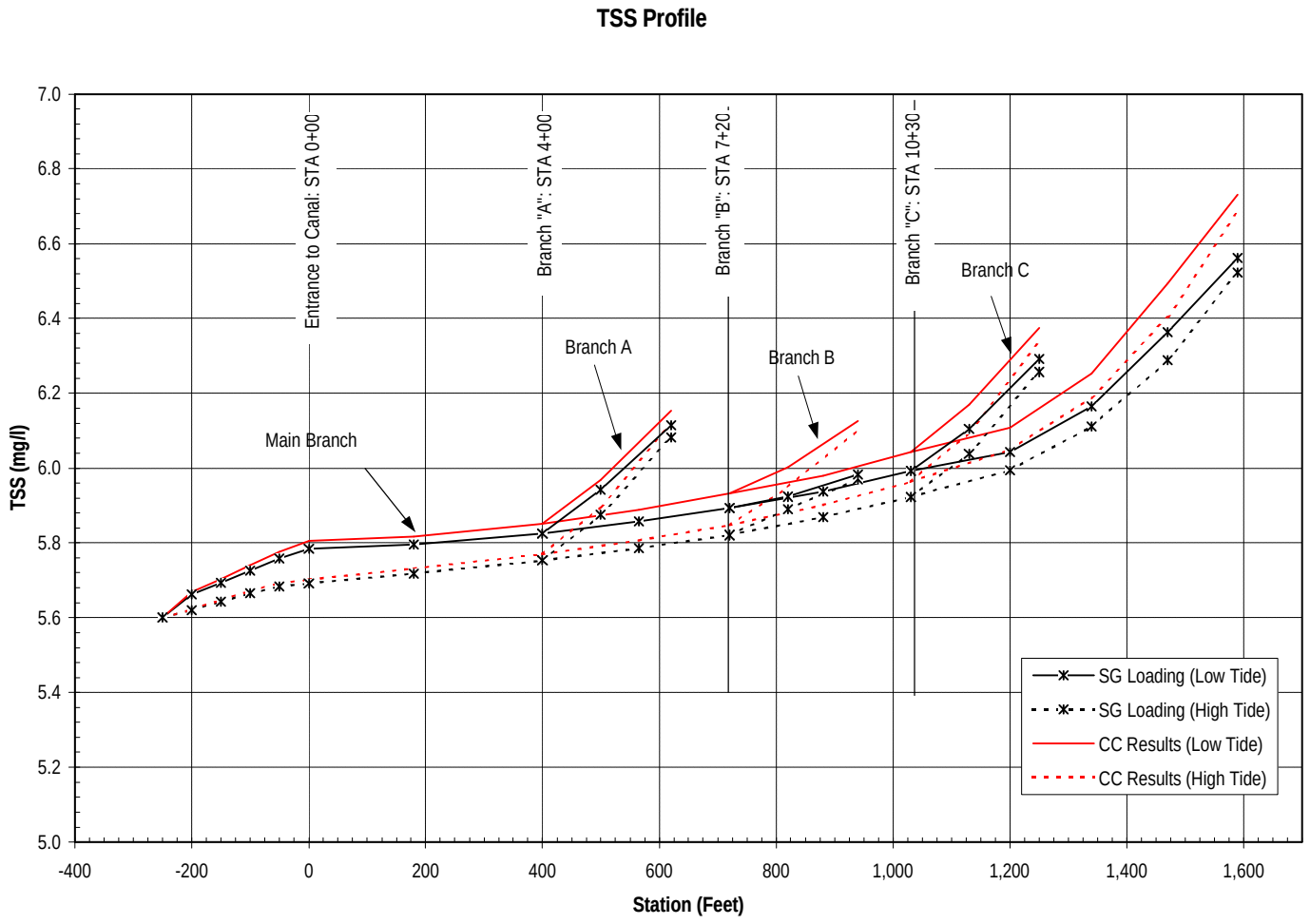

Canal #50, Key Largo Model Output: BOD Profile



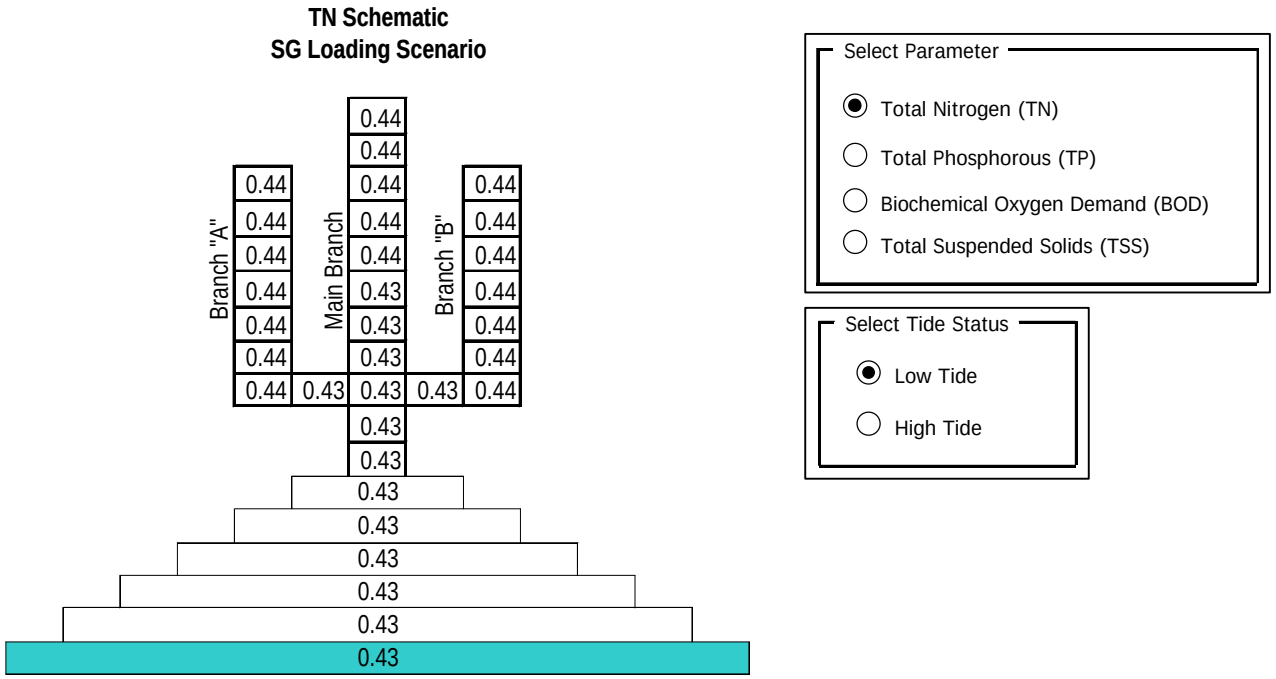

Canal #50, Key Largo Model Output: TSS, low tide



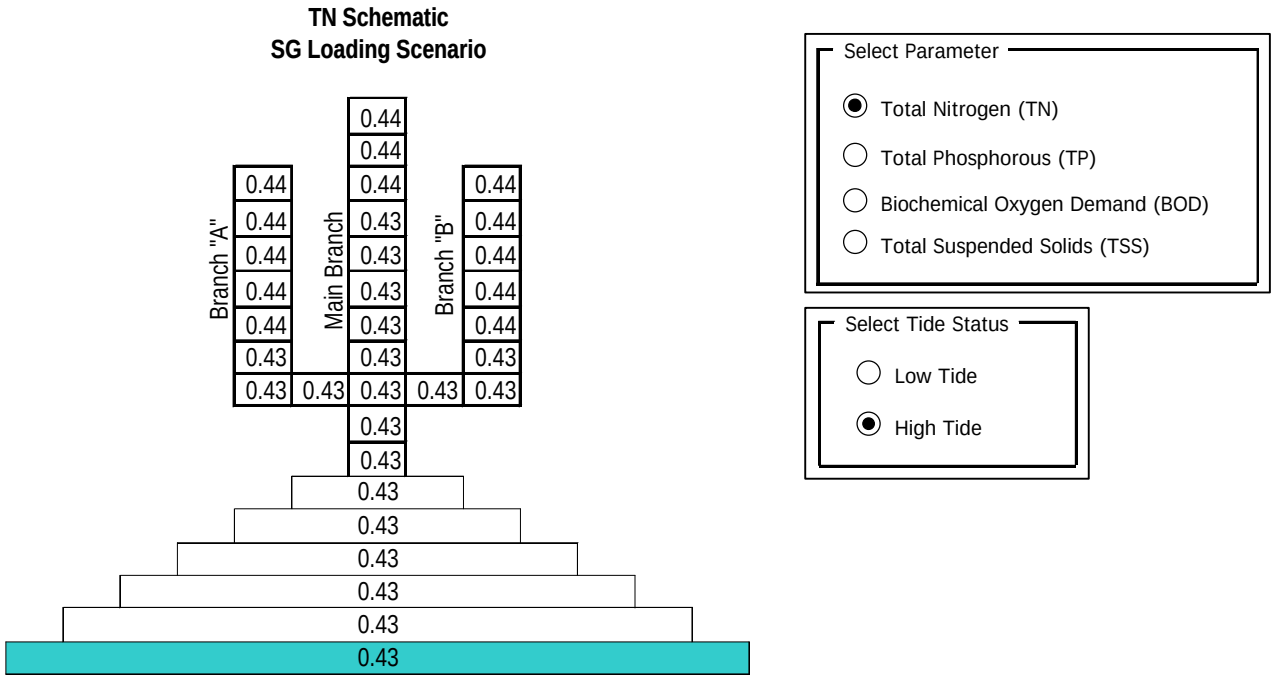

Canal #50, Key Largo Model Output, TSS, high tide



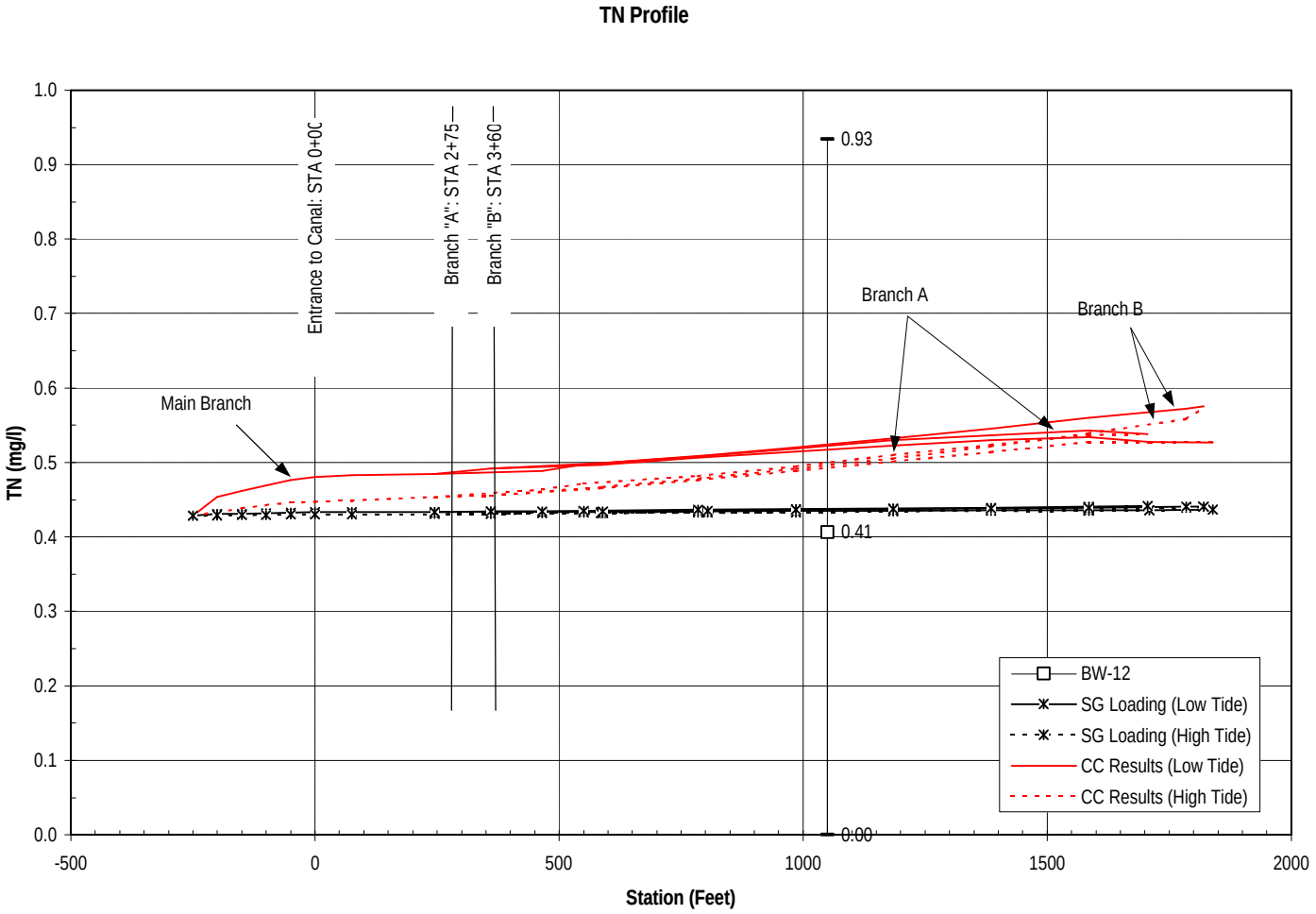

Canal #50, Key Largo Model Output: TSS Profile



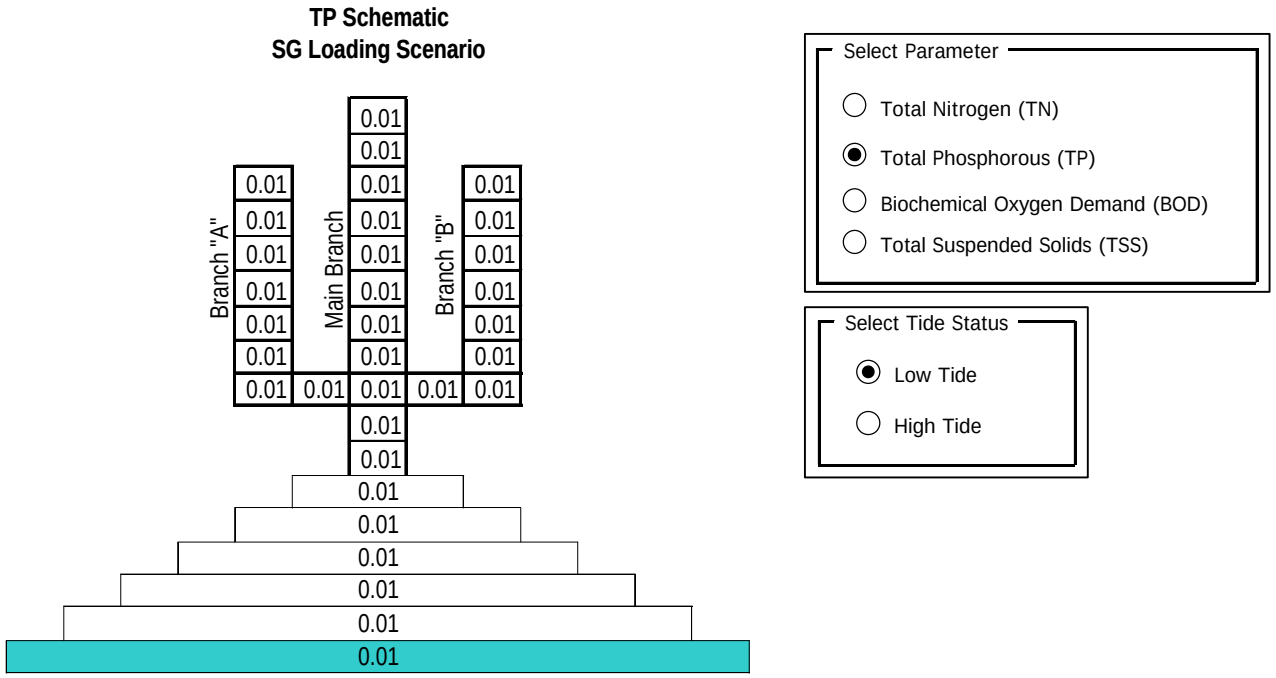

Canal #69, Rock Harbor Model Output: TN, low tide



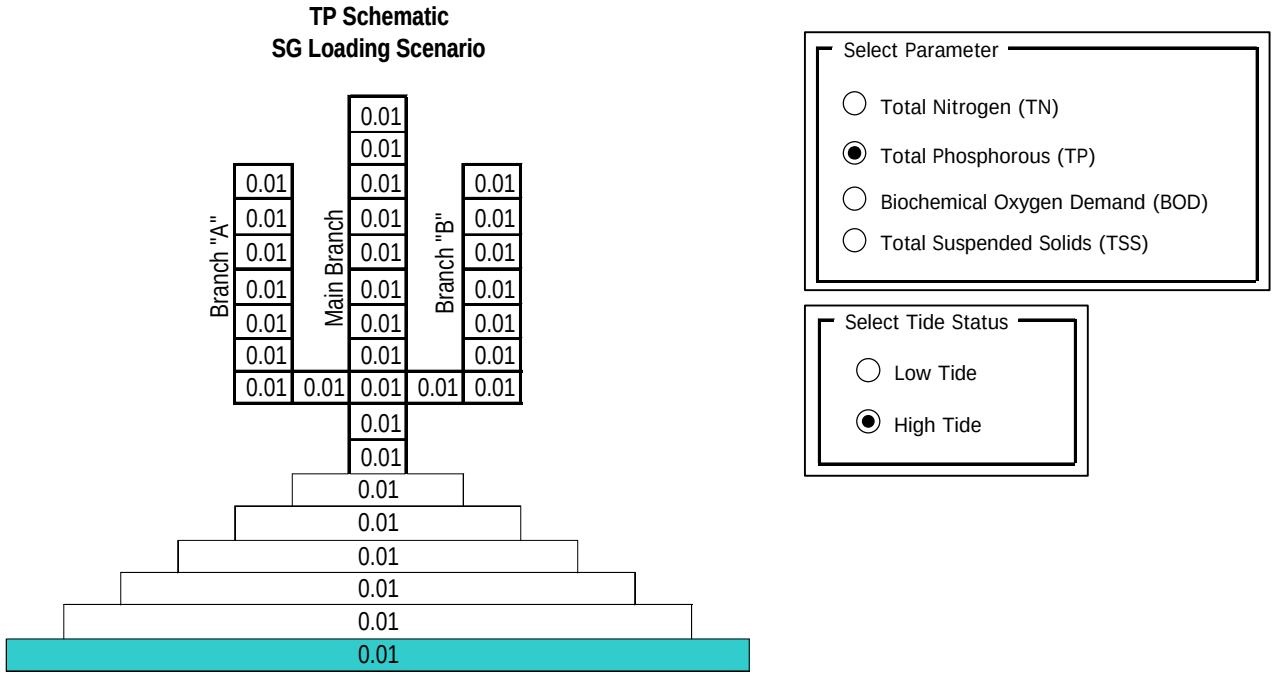

Canal #69, Rock Harbor Model Output: TN, high tide



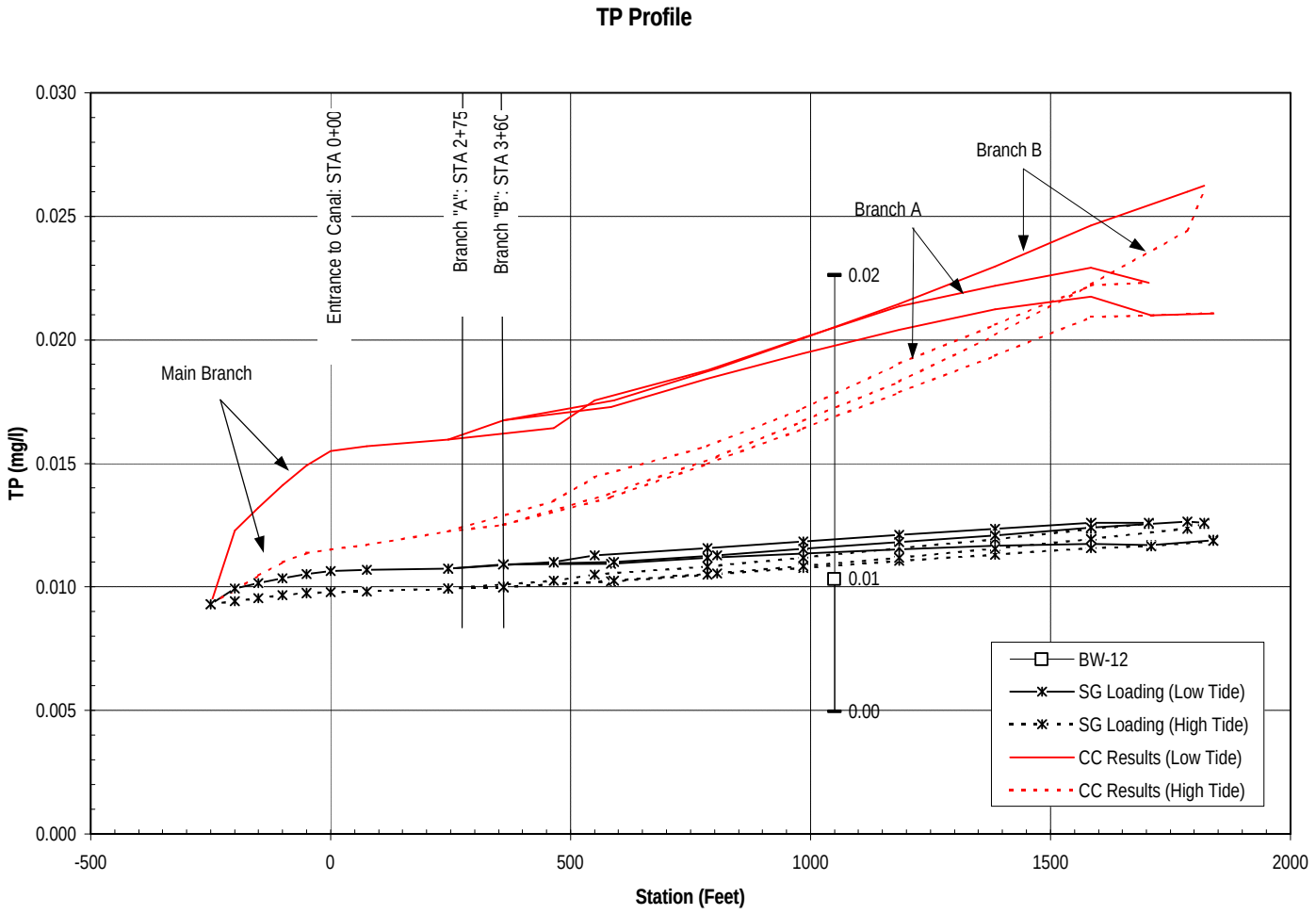

Canal #69, Rock Harbor Model Output: TN Profile



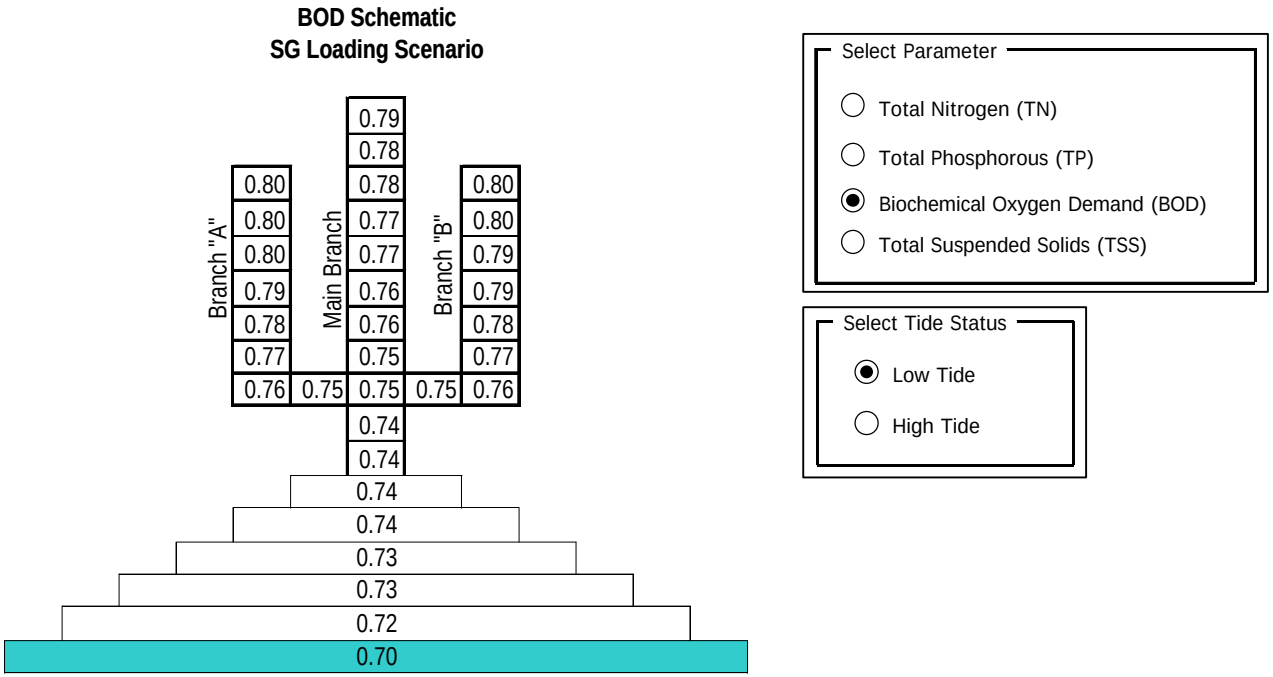

Canal #69, Rock Harbor Model Output: TP, low tide



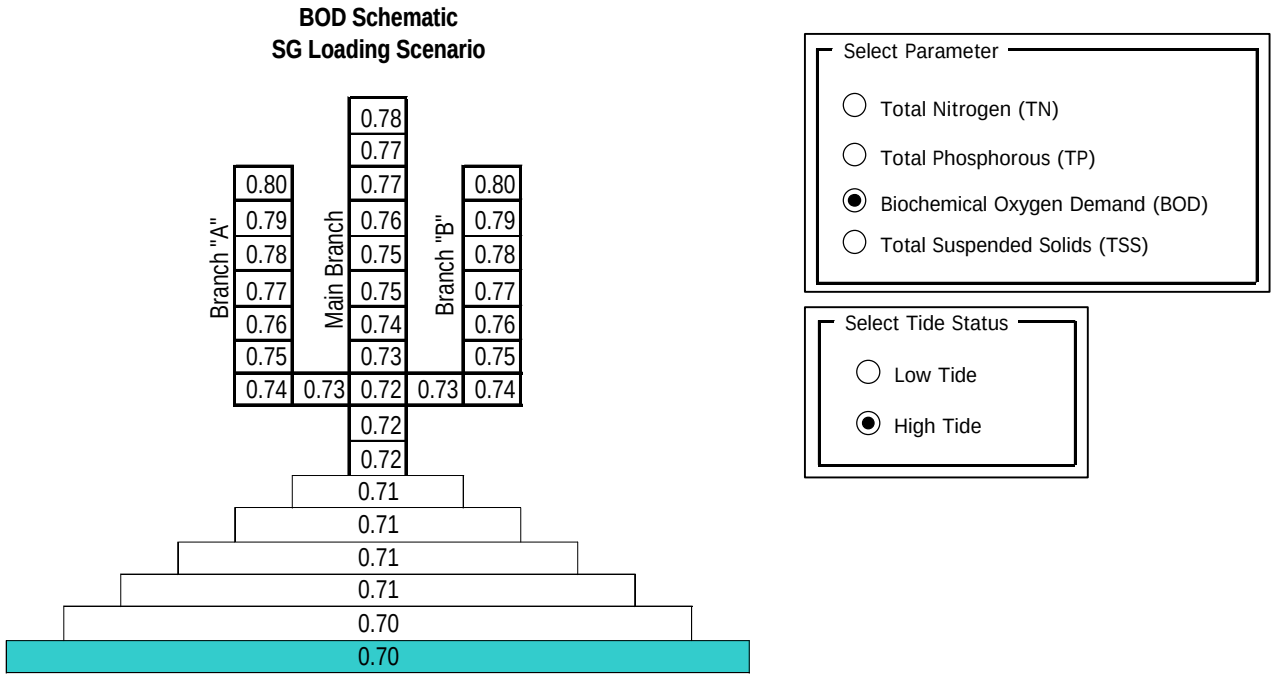

Canal #69, Rock Harbor Model Output: TP, high tide



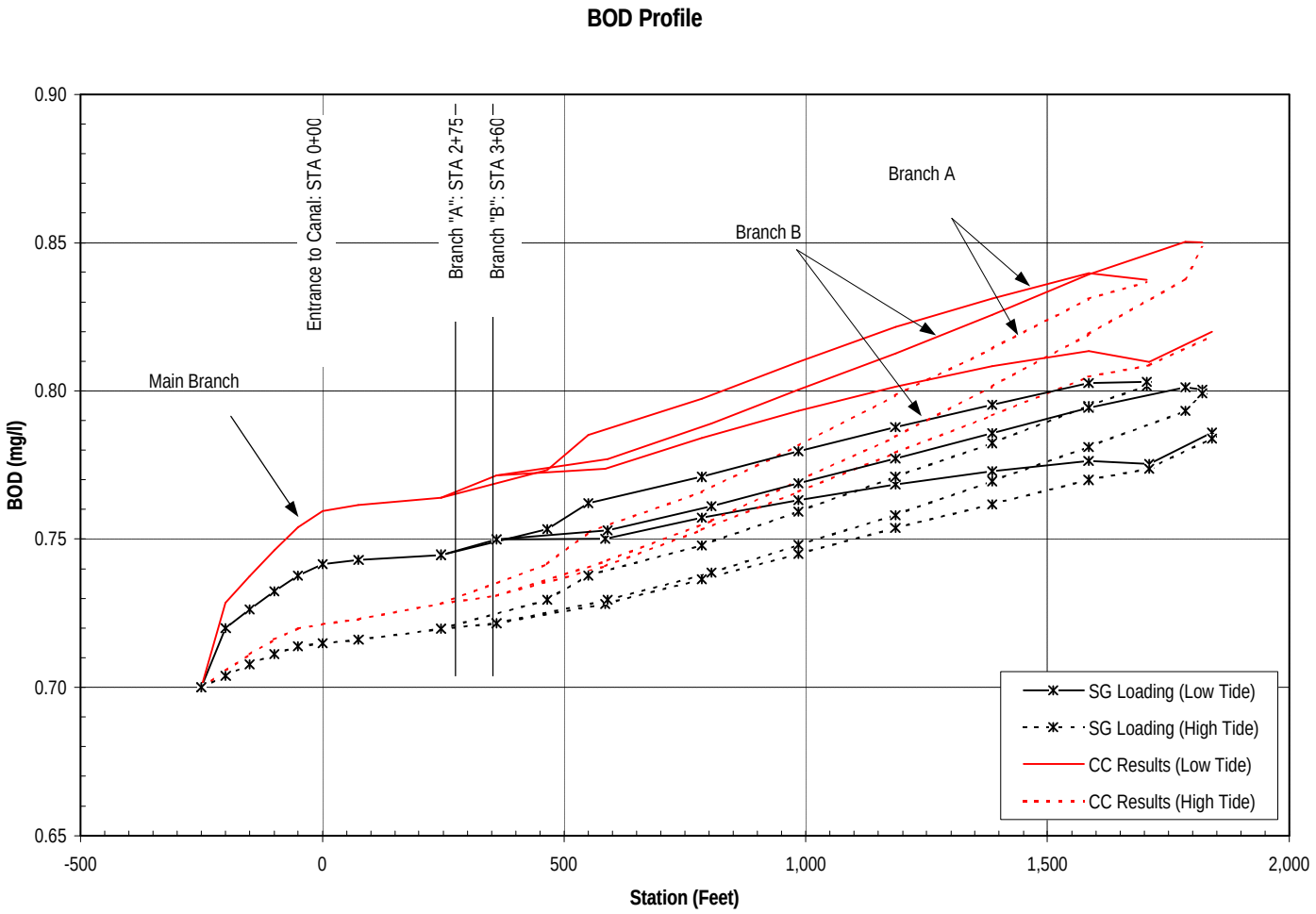

Canal #69, Rock Harbor Model Output, TP Profile



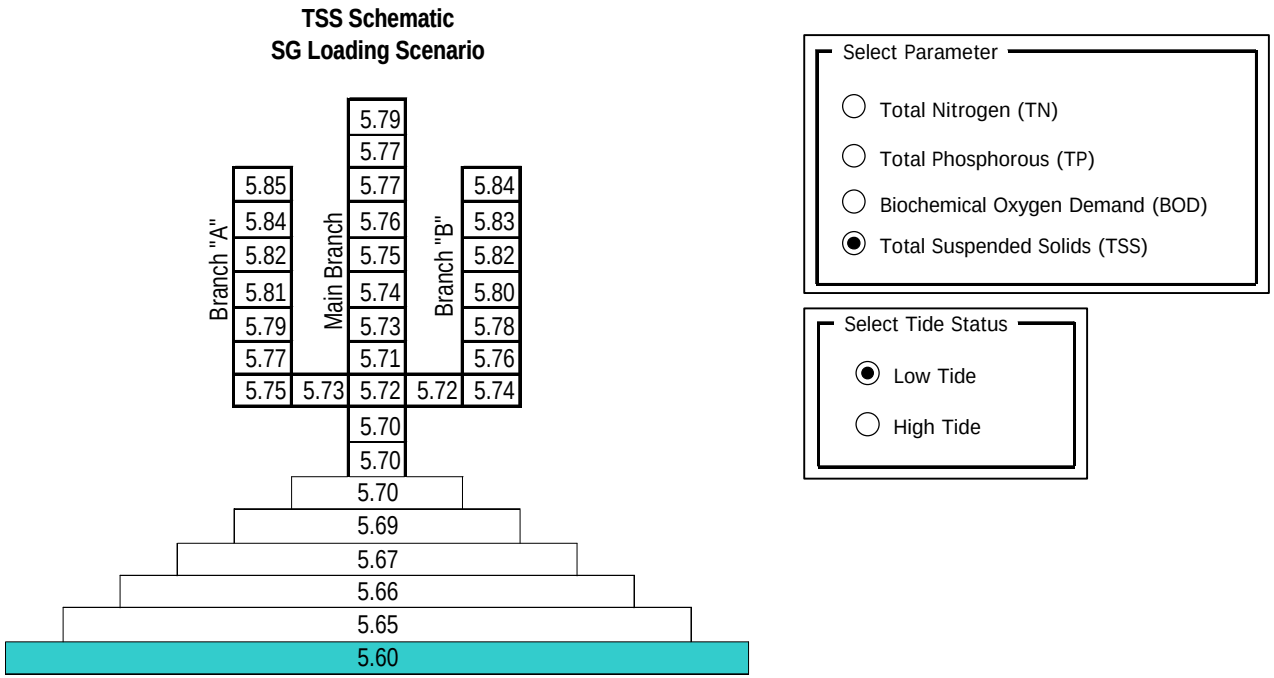

Canal #69, Rock Harbor Model Output, BOD, low tide



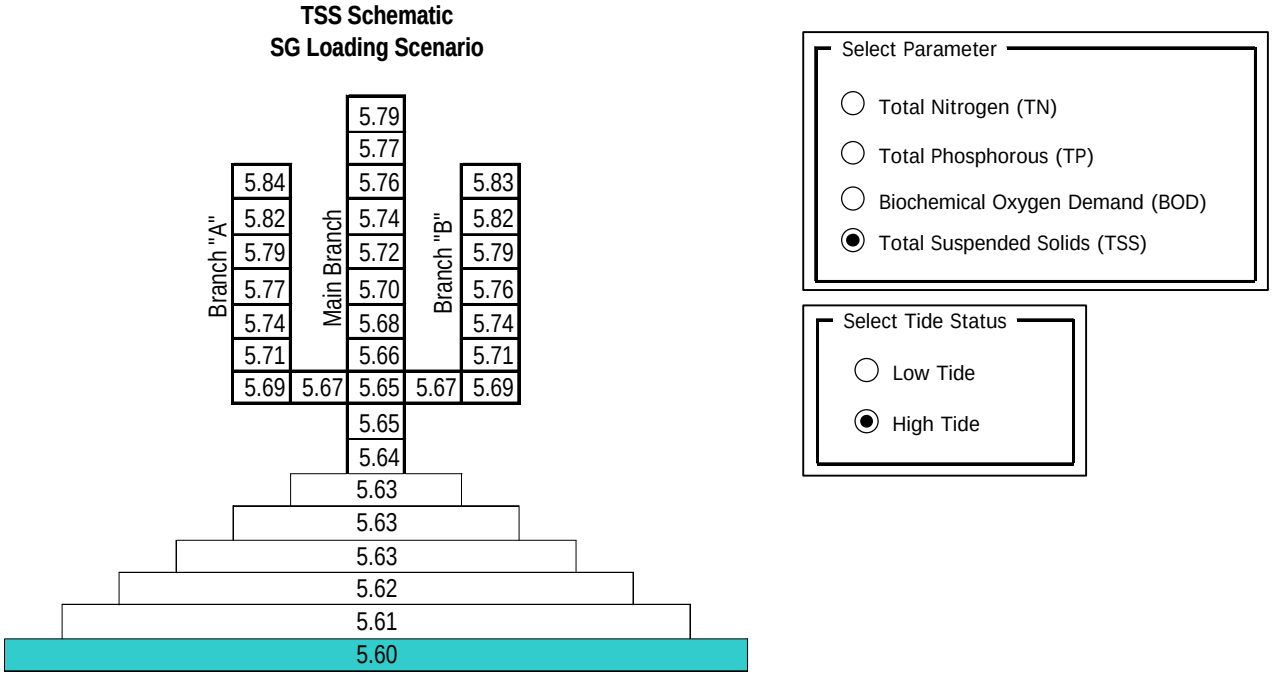

Canal #69, Rock Harbor Model Output, BOD, high tide



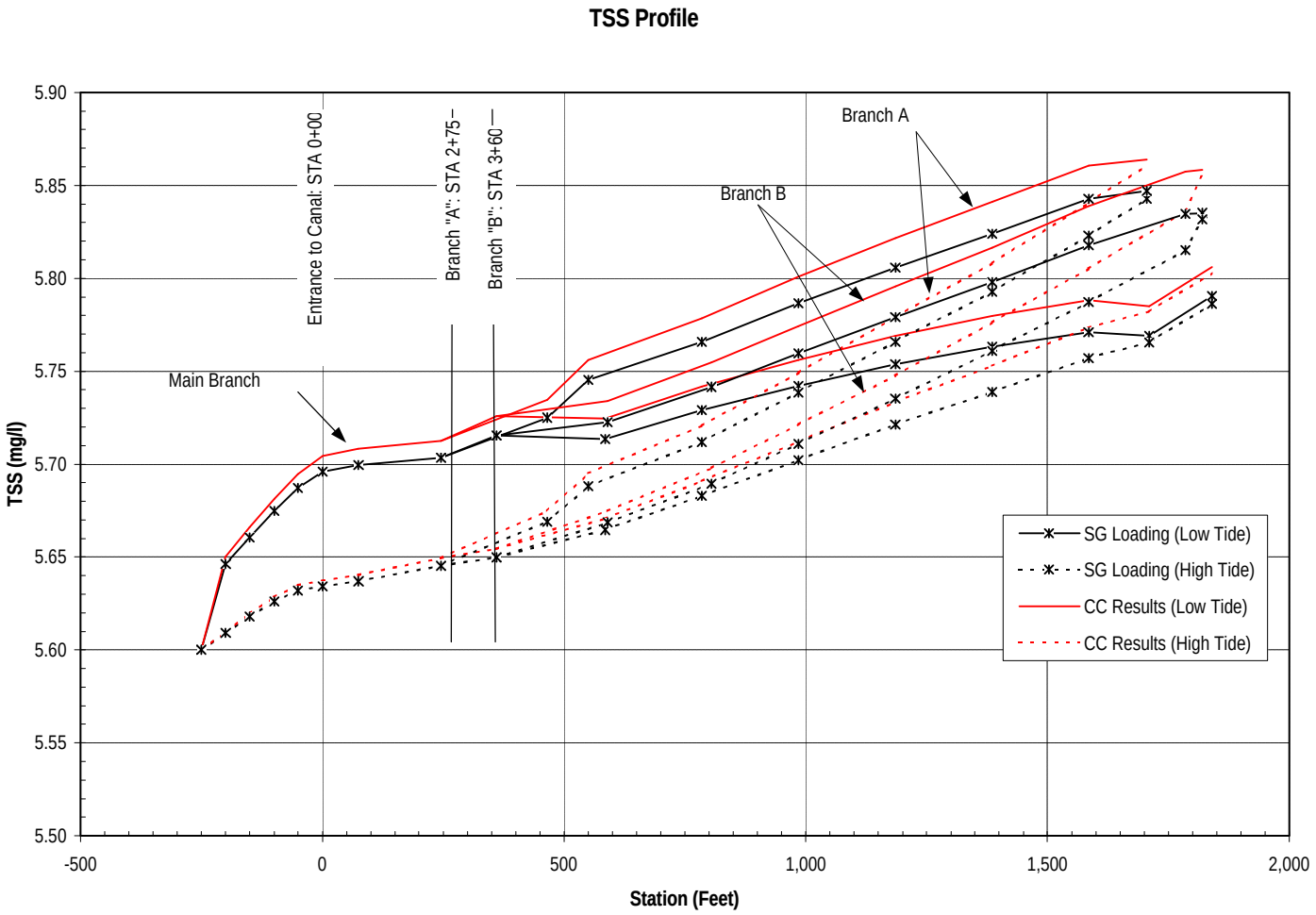

Canal #69, Rock Harbor Model Output: BOD Profile



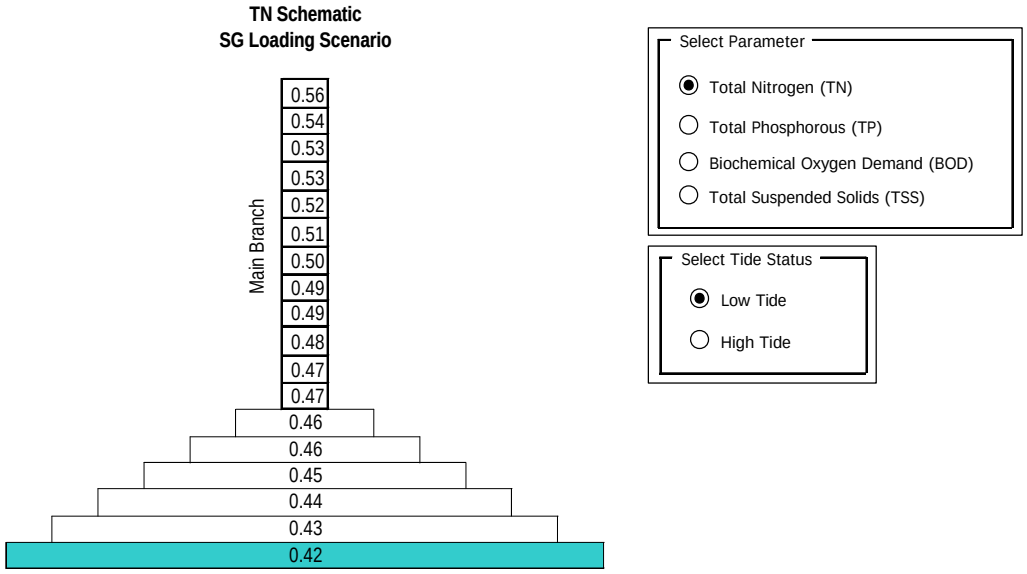

Canal #69, Rock Harbor Model Output, TSS, low tide



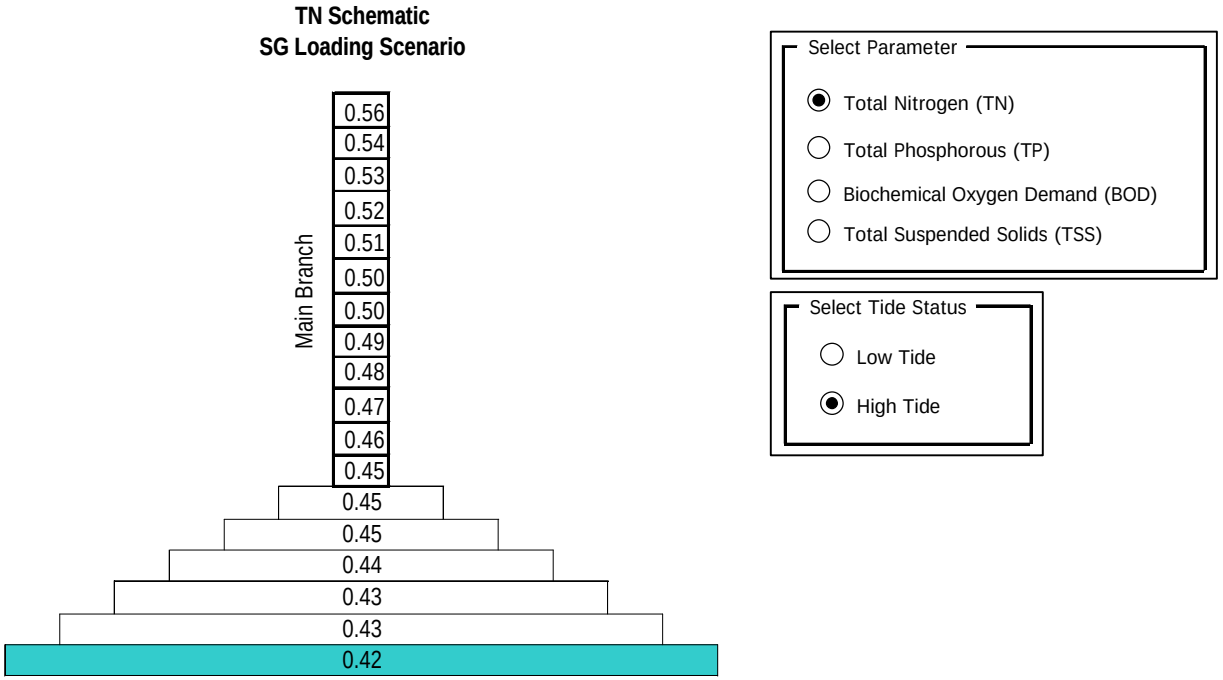

Canal #69, Rock Harbor Model Output, TSS, high tide



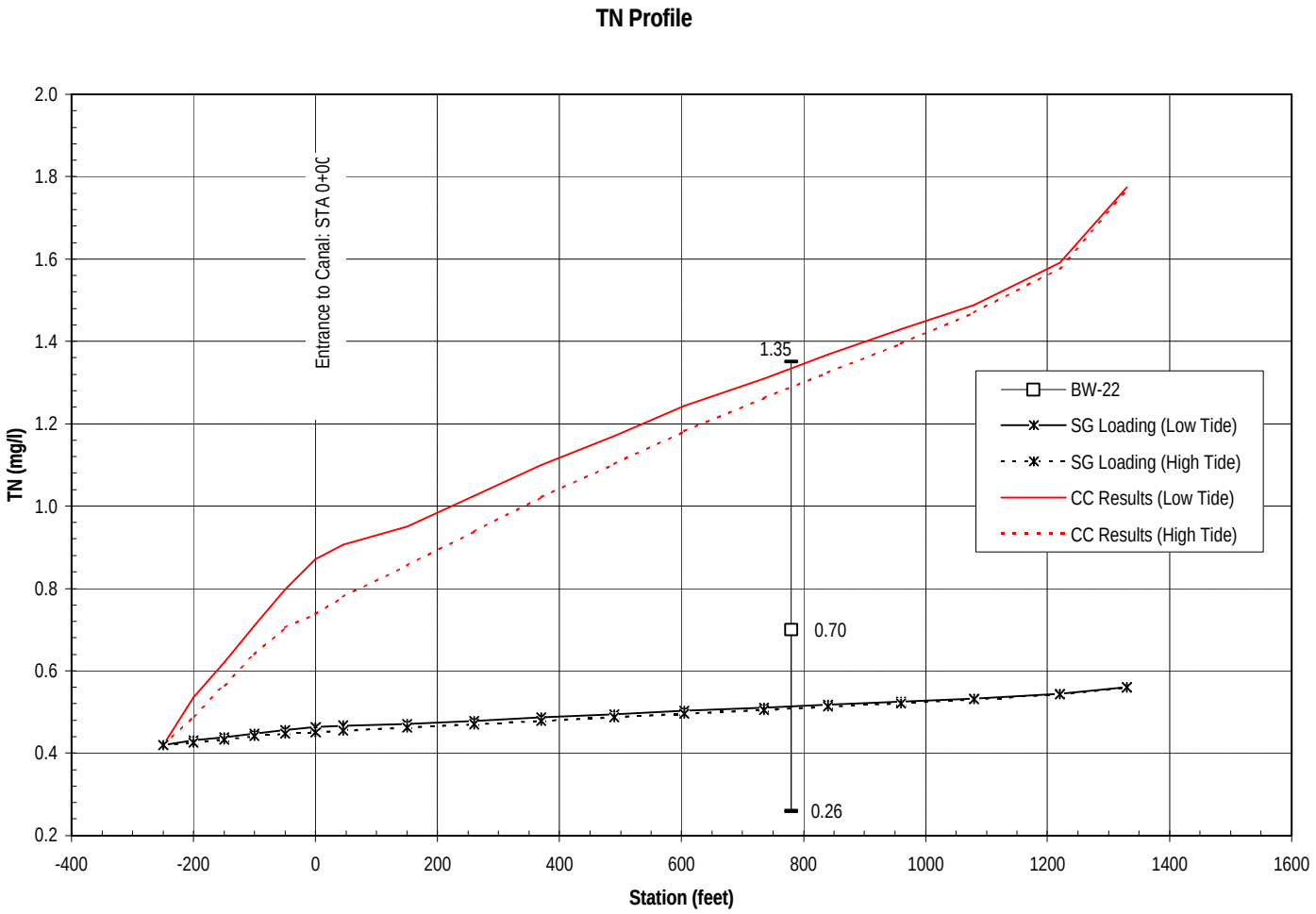

Canal #69, Rock Harbor Model Output, TSS Profile



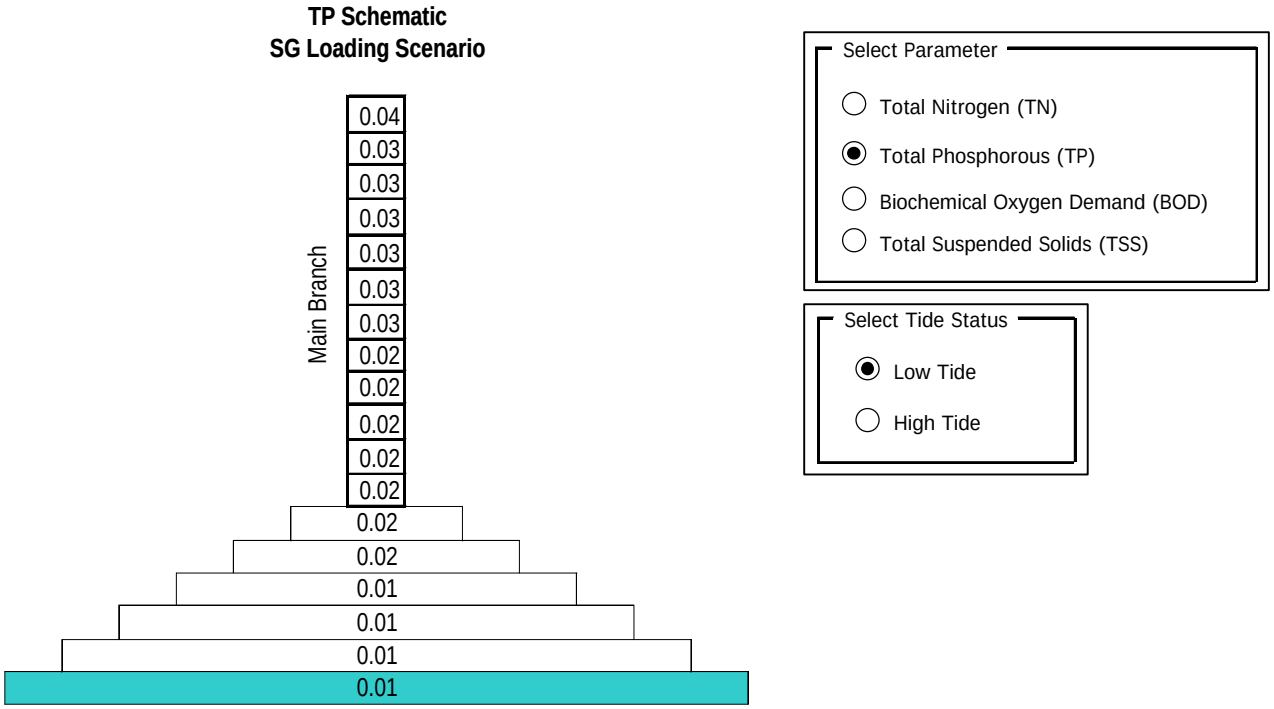

Canal #70, Rock Harbor Model Output: TN, low tide



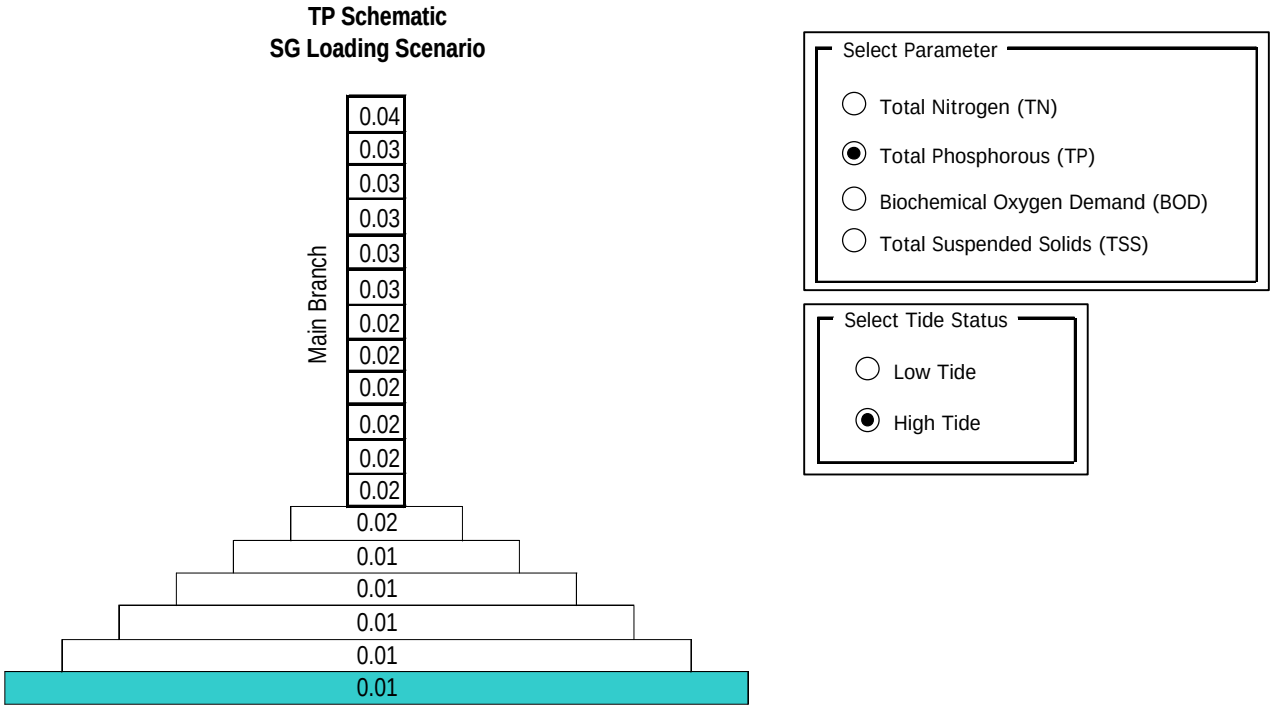

Canal #70, Rock Harbor Model Output: TN, high tide



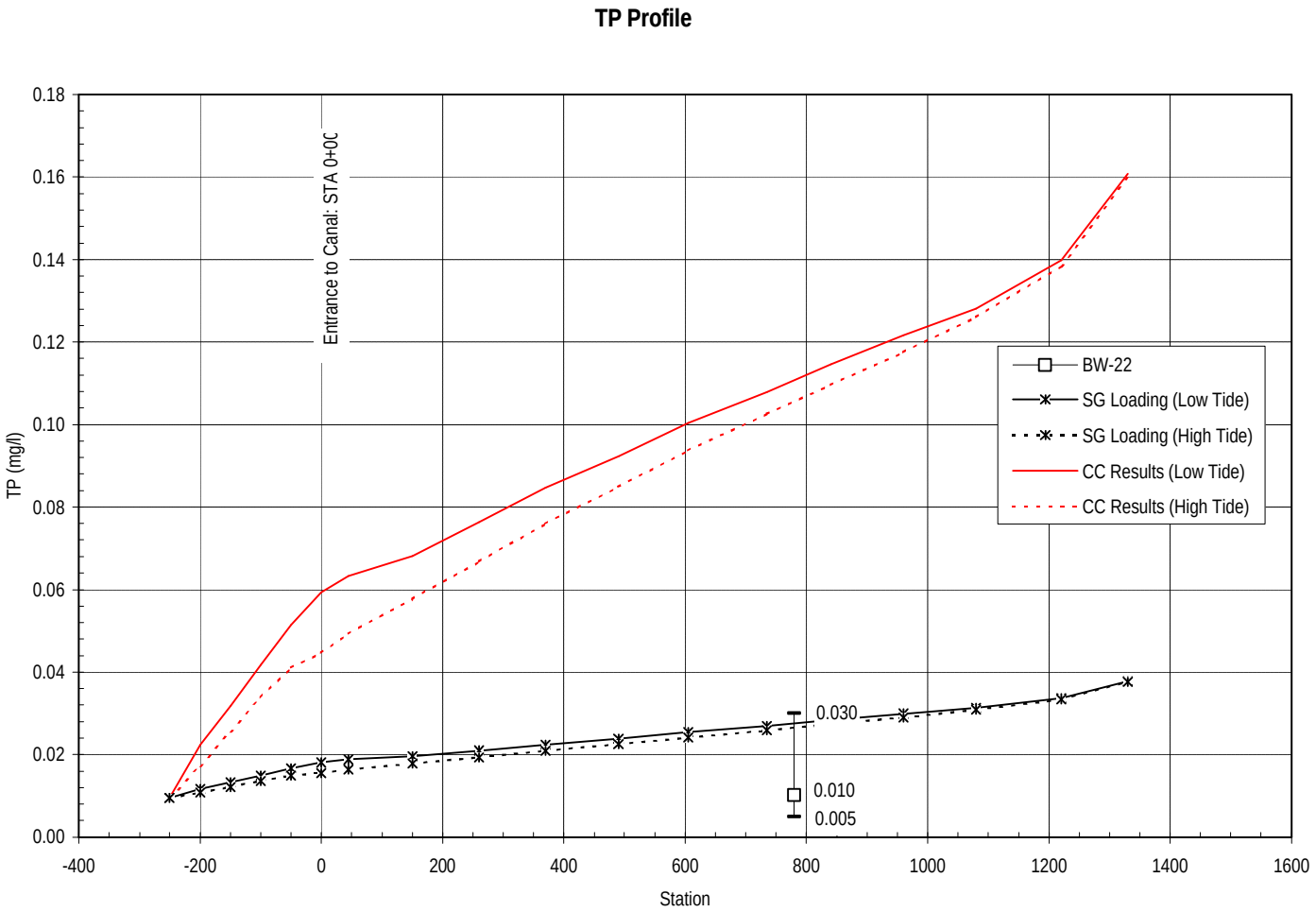

Canal #70, Rock Harbor Model Output: TN Profile



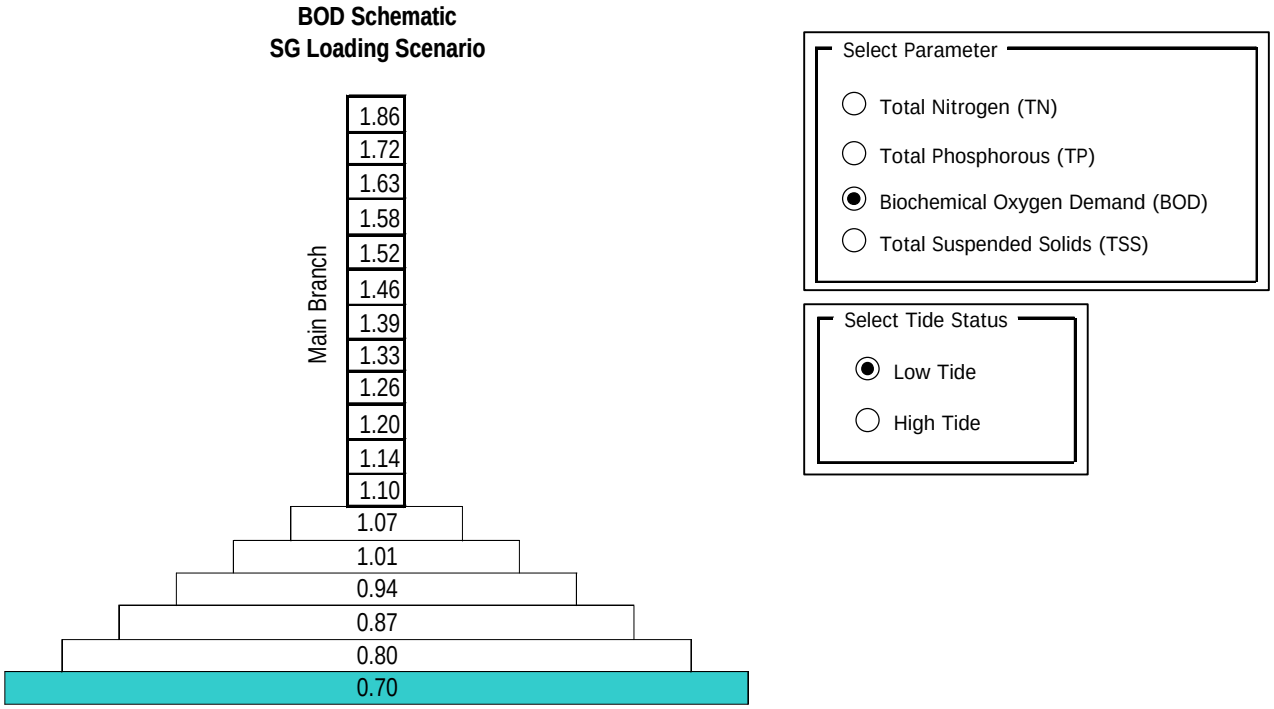

Canal #70, Harbor Rock Model Output: TN, low tide



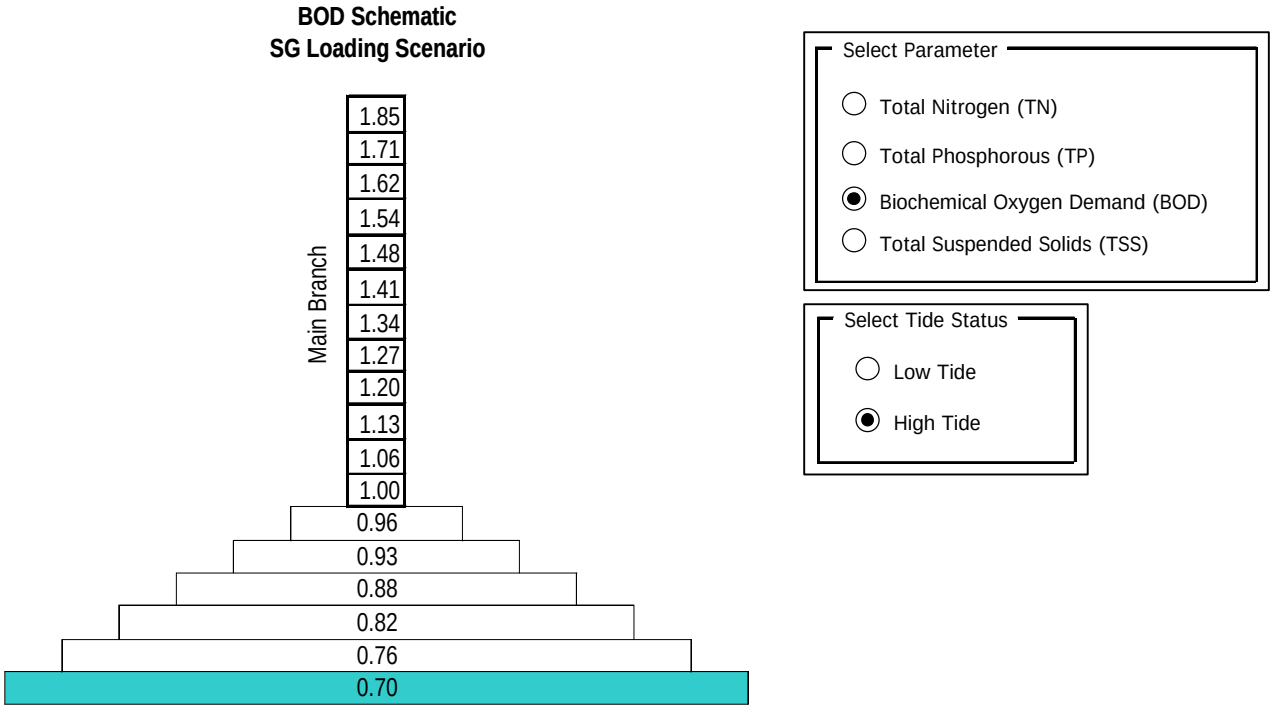

Canal #70, Rock Harbor Model Output: TP, high tide



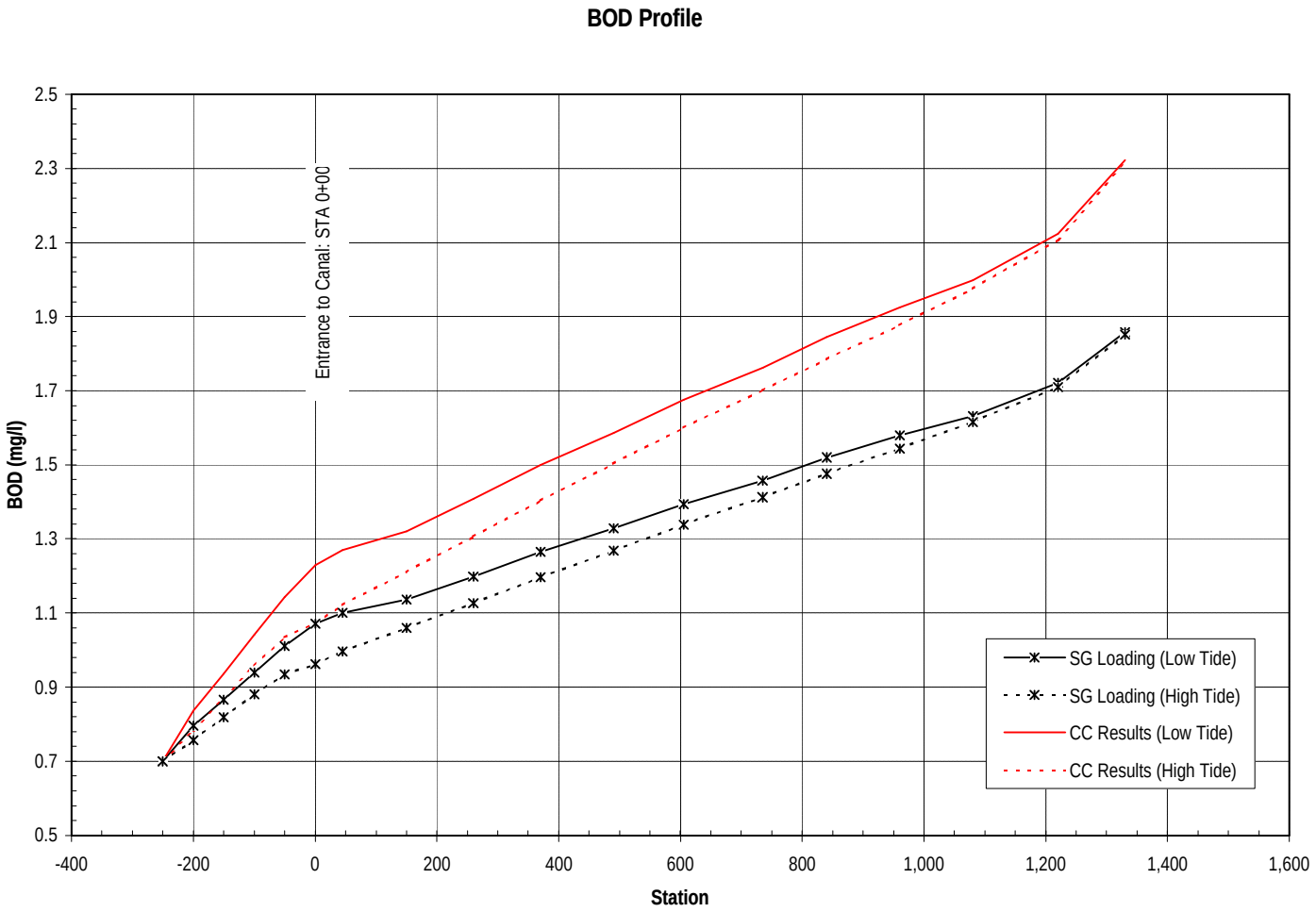

Canal #70, Rock Harbor Model Output: TP Profile



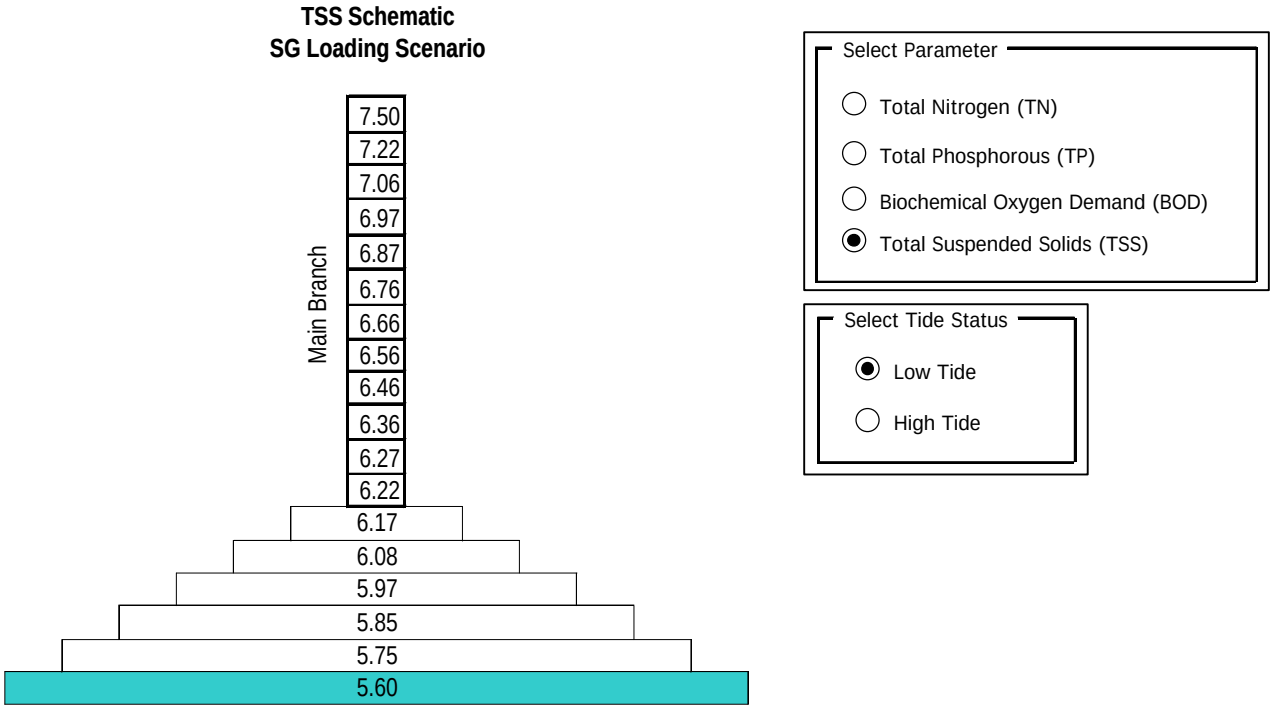

Canal #70, Rock Harbor Model Output: BOD, low tide



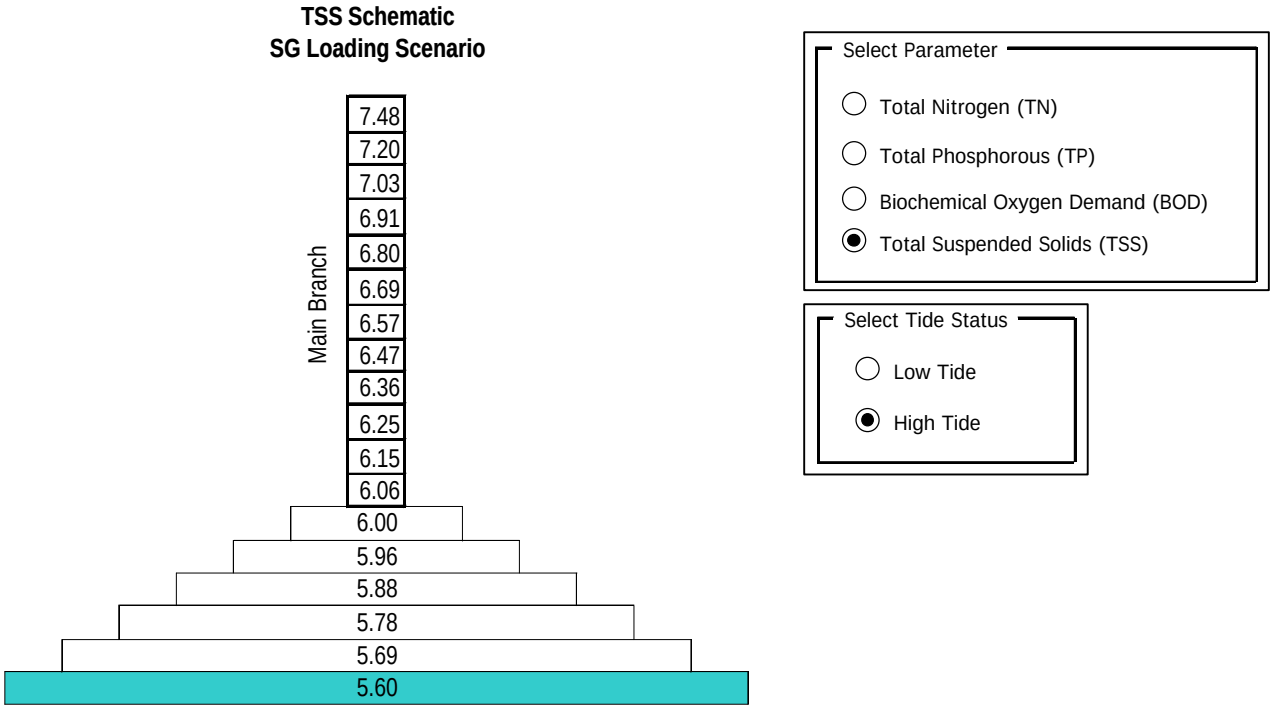

Canal #70, Rock Harbor Model Output: BOD, high tide



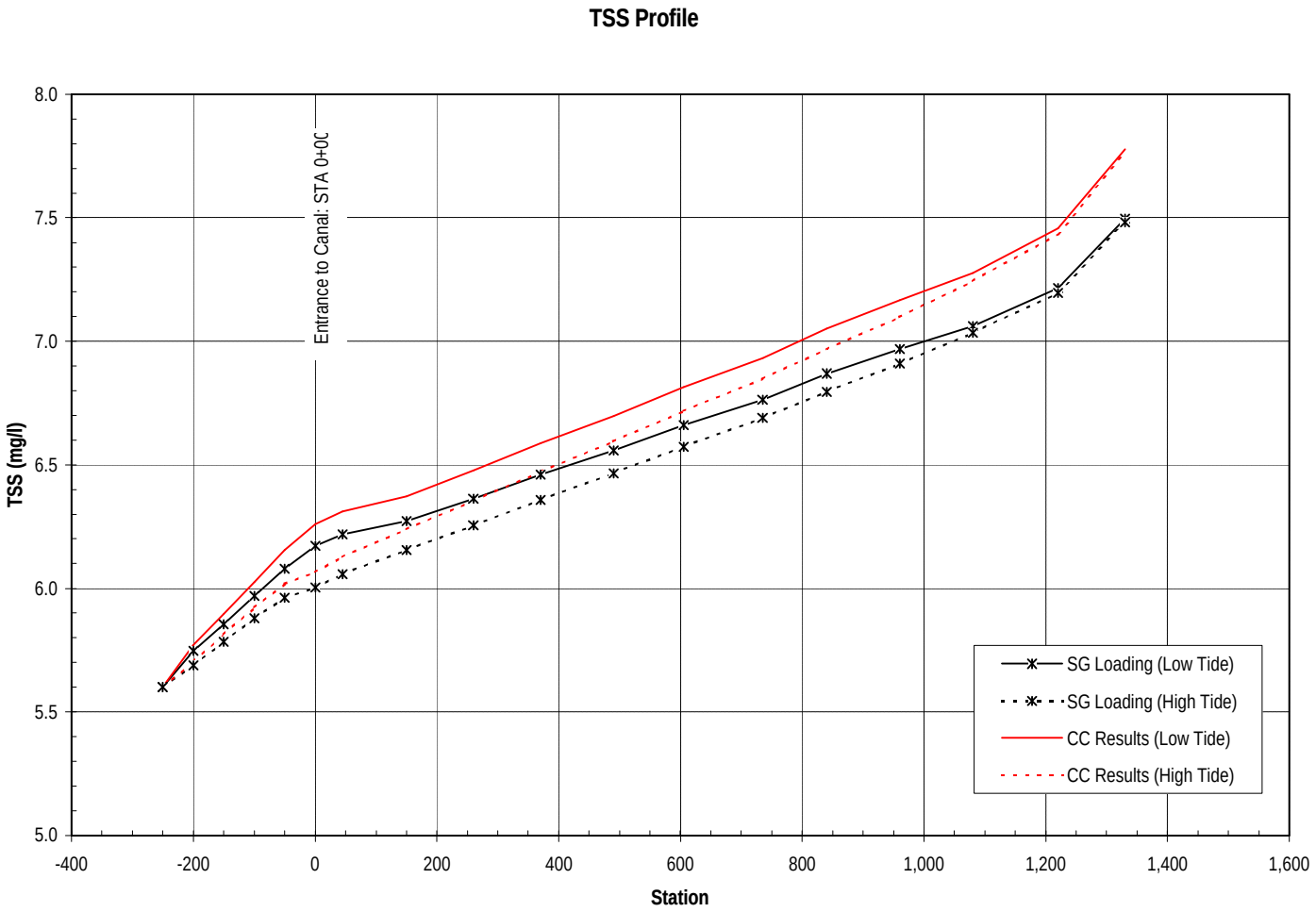

Canal #70, Rock Harbor Model Output: BOD Profile



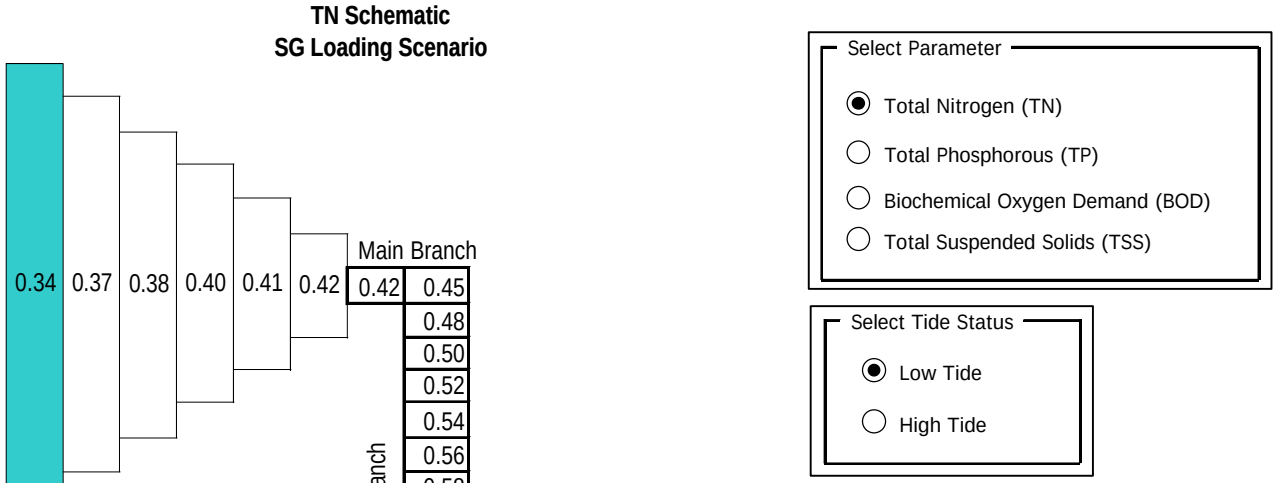

Canal #70, Rock Harbor Model Output: TSS, low tide



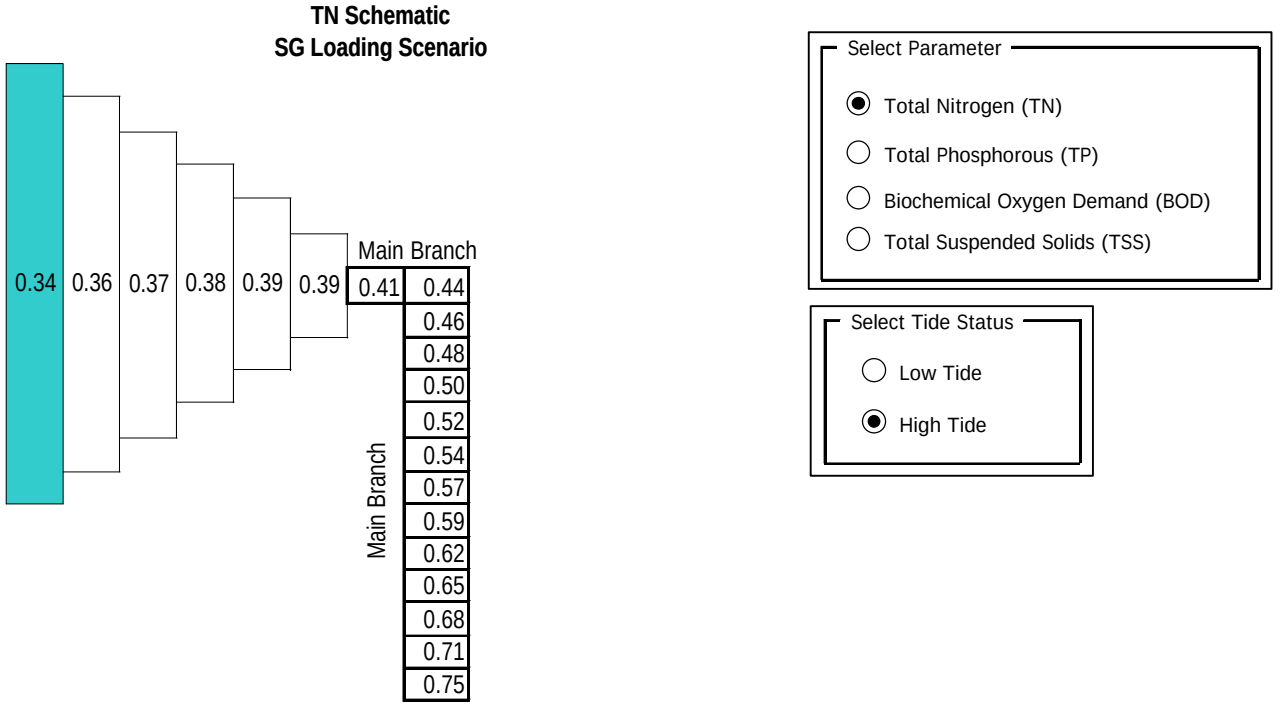

Canal #70, Rock Harbor Model Output: TSS, high tide



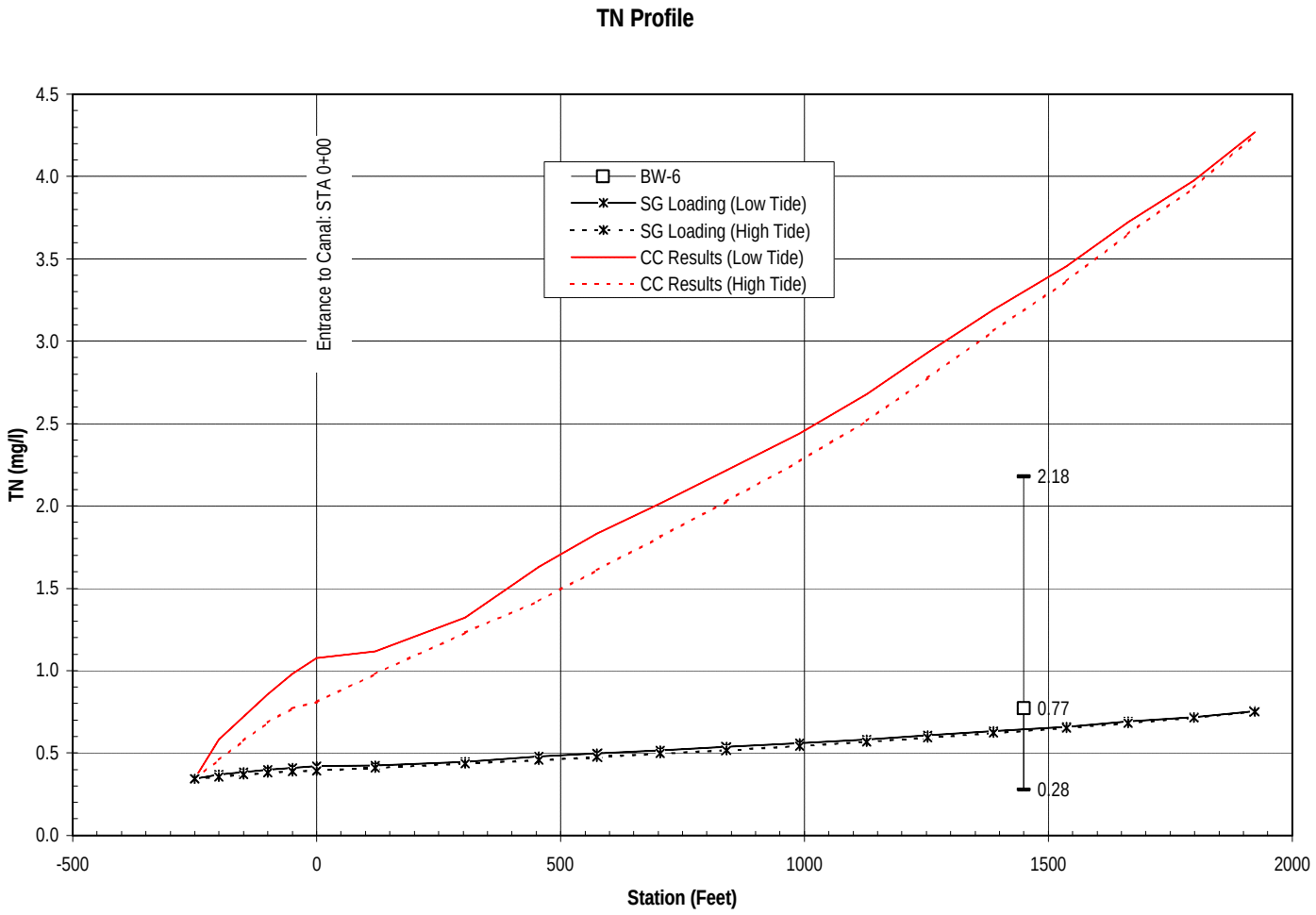

Canal #70, Rock Harbor Model Output, TSS Profile



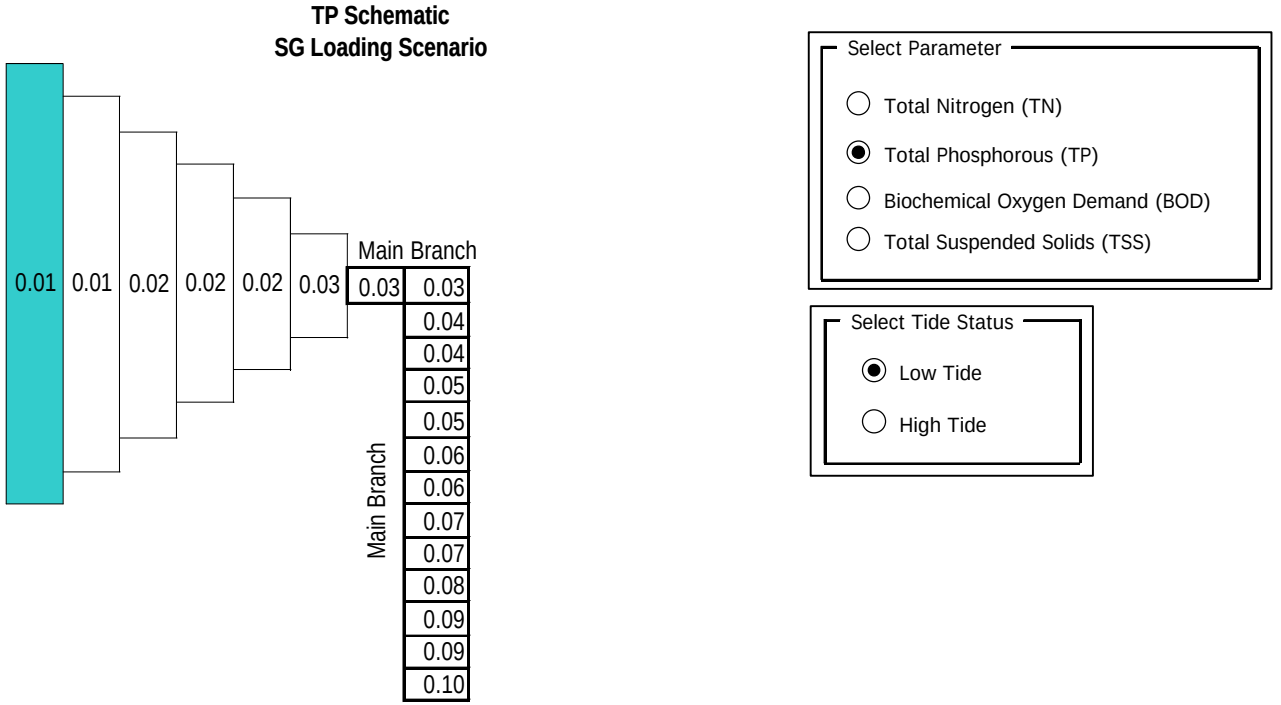

Canal #117 Plantation Model Output: TN, low tide



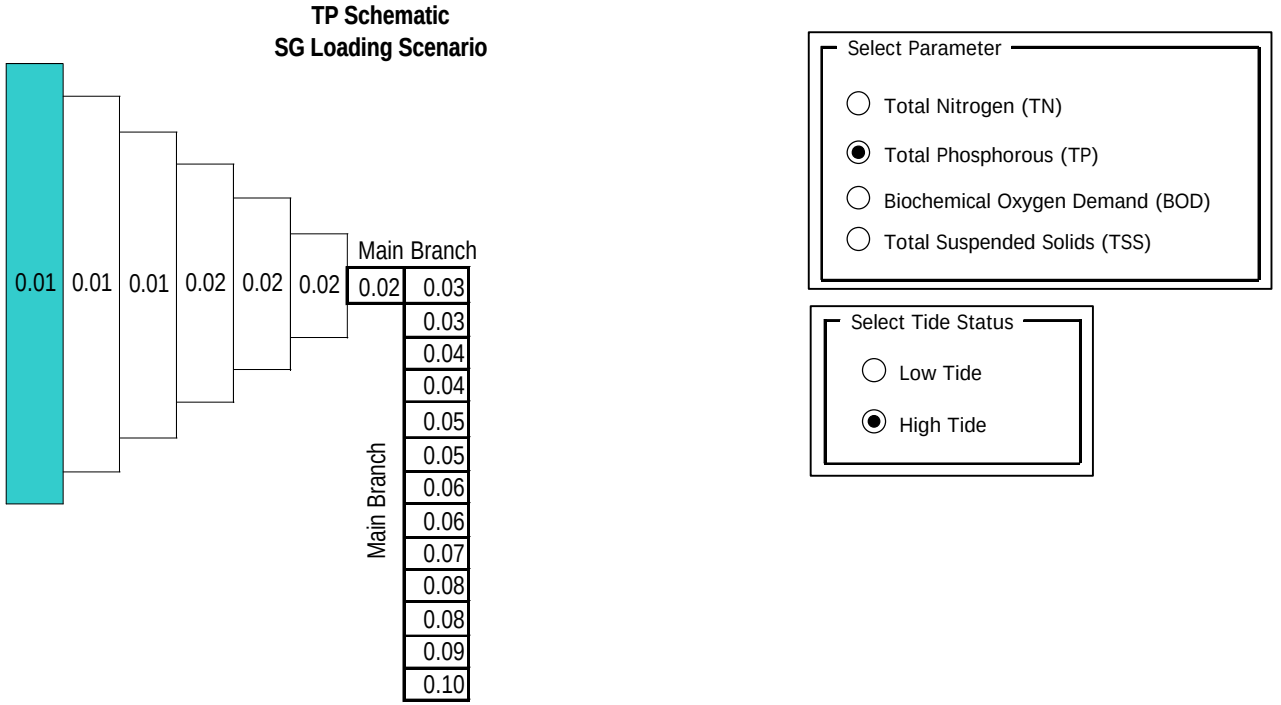

Canal #117, Plantation Model Output: TN, high tide



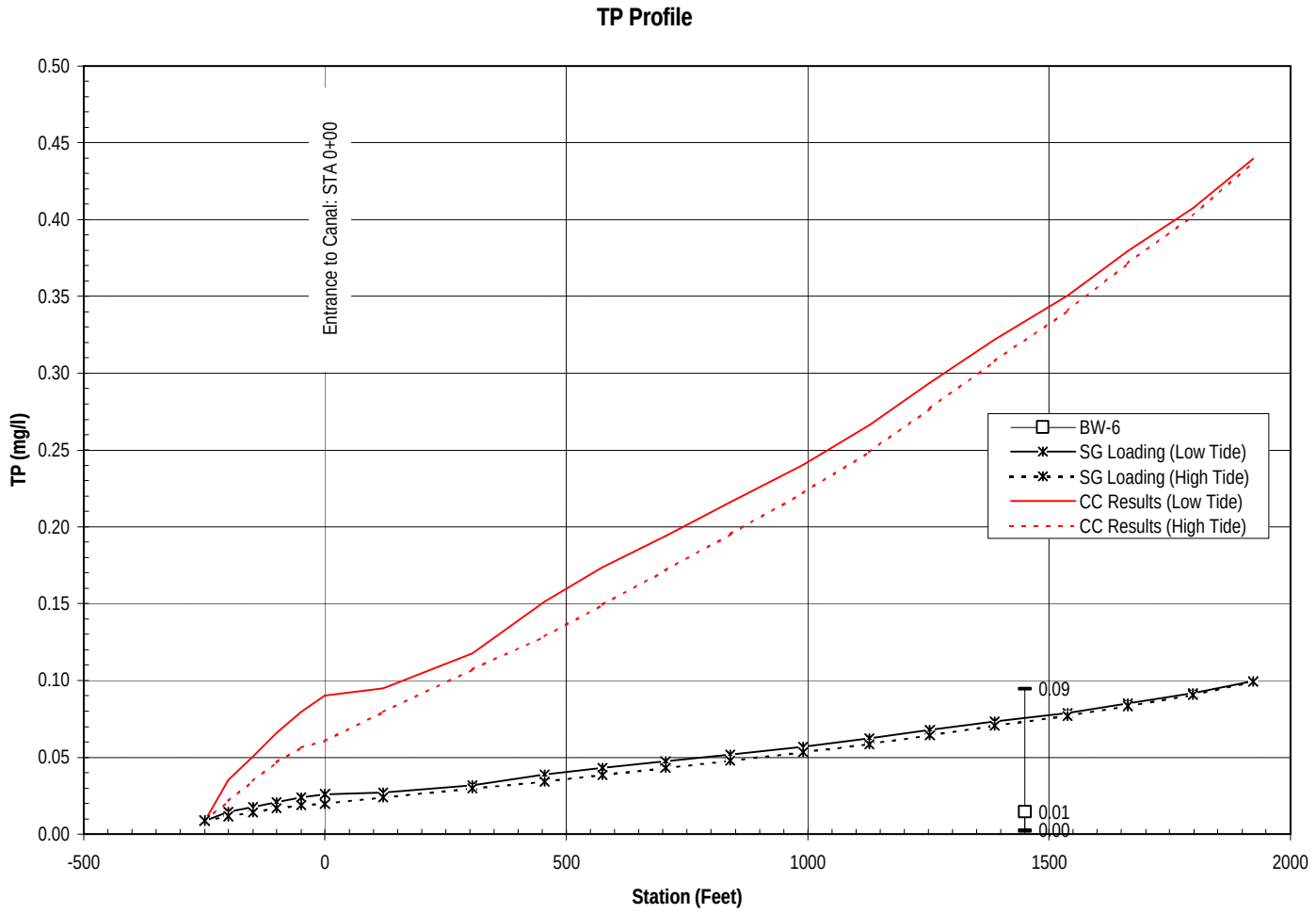

Canal #117, Plantation Model Output: TN Profile



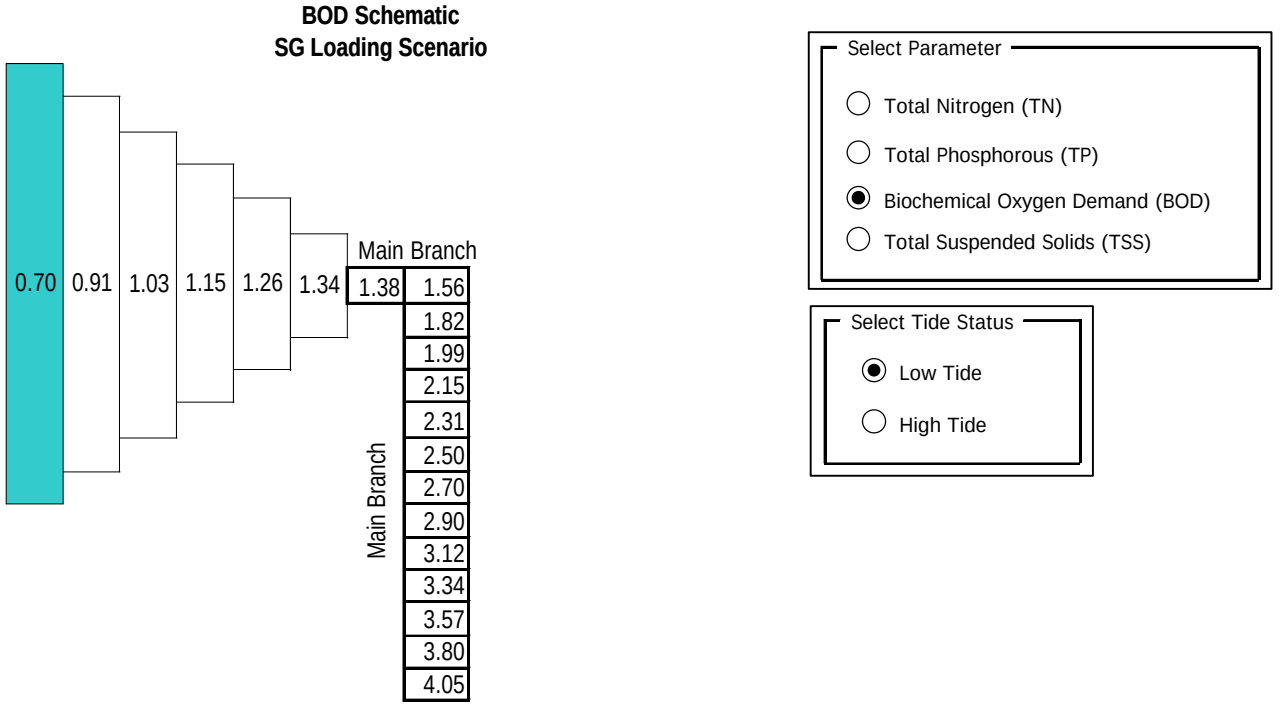

Canal #117, Plantation Model Output: TP, low tide



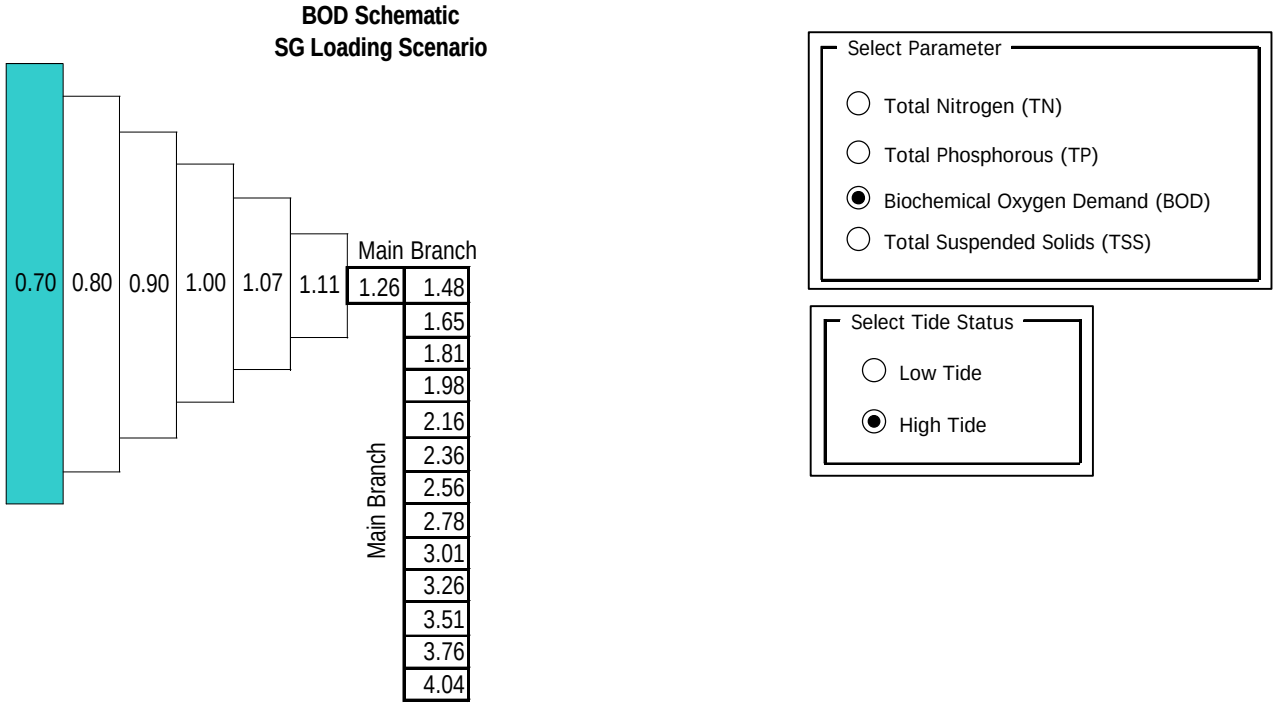

Canal #117 Plantation Model Output: TP, high tide



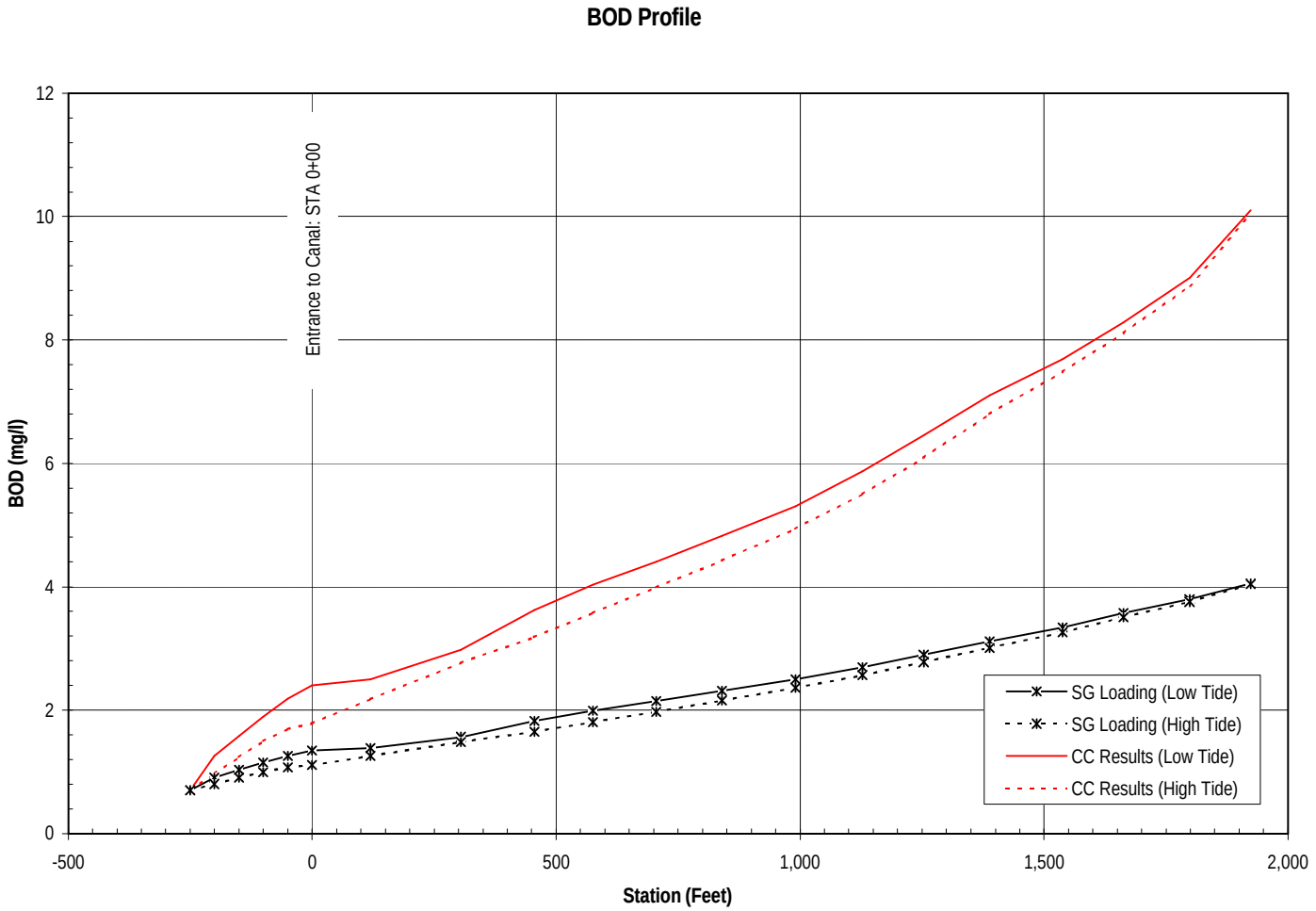

Canal #117, Plantation Model Output: TP Profile



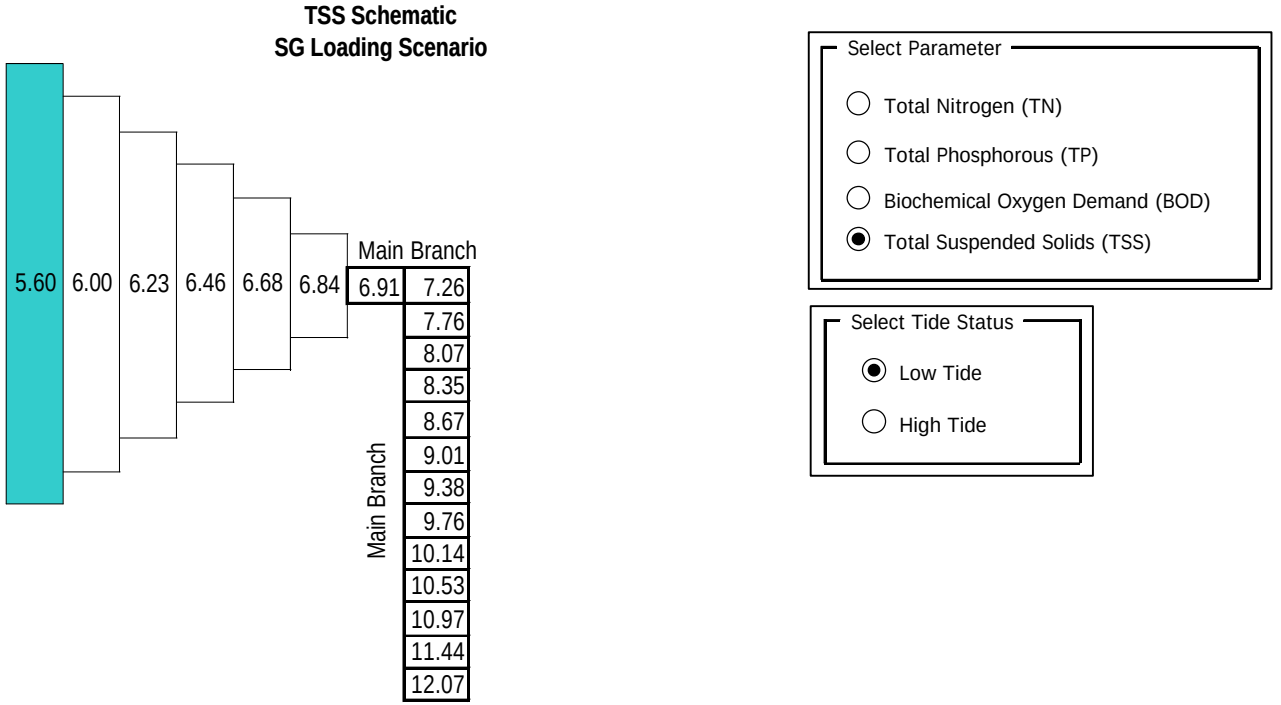

Canal #117, Plantation Model Output: BOD, low tide



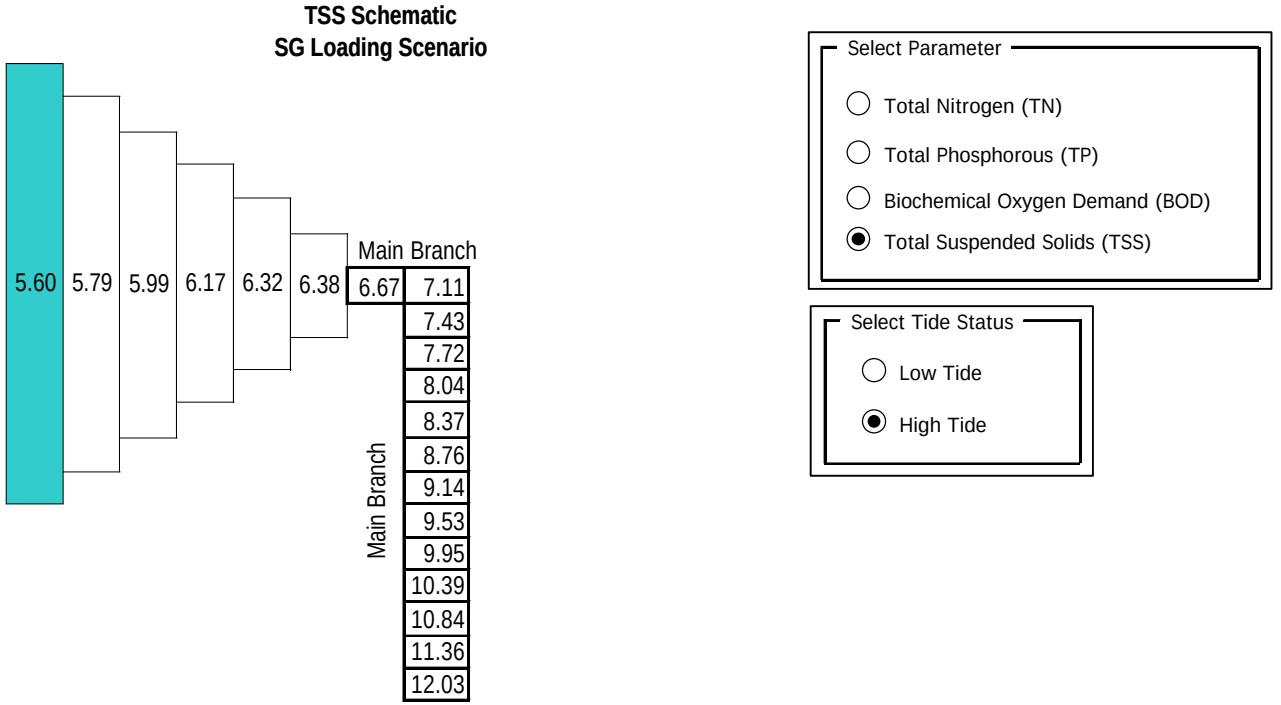

Canal #117, Plantation Model Output: BOD, high tide



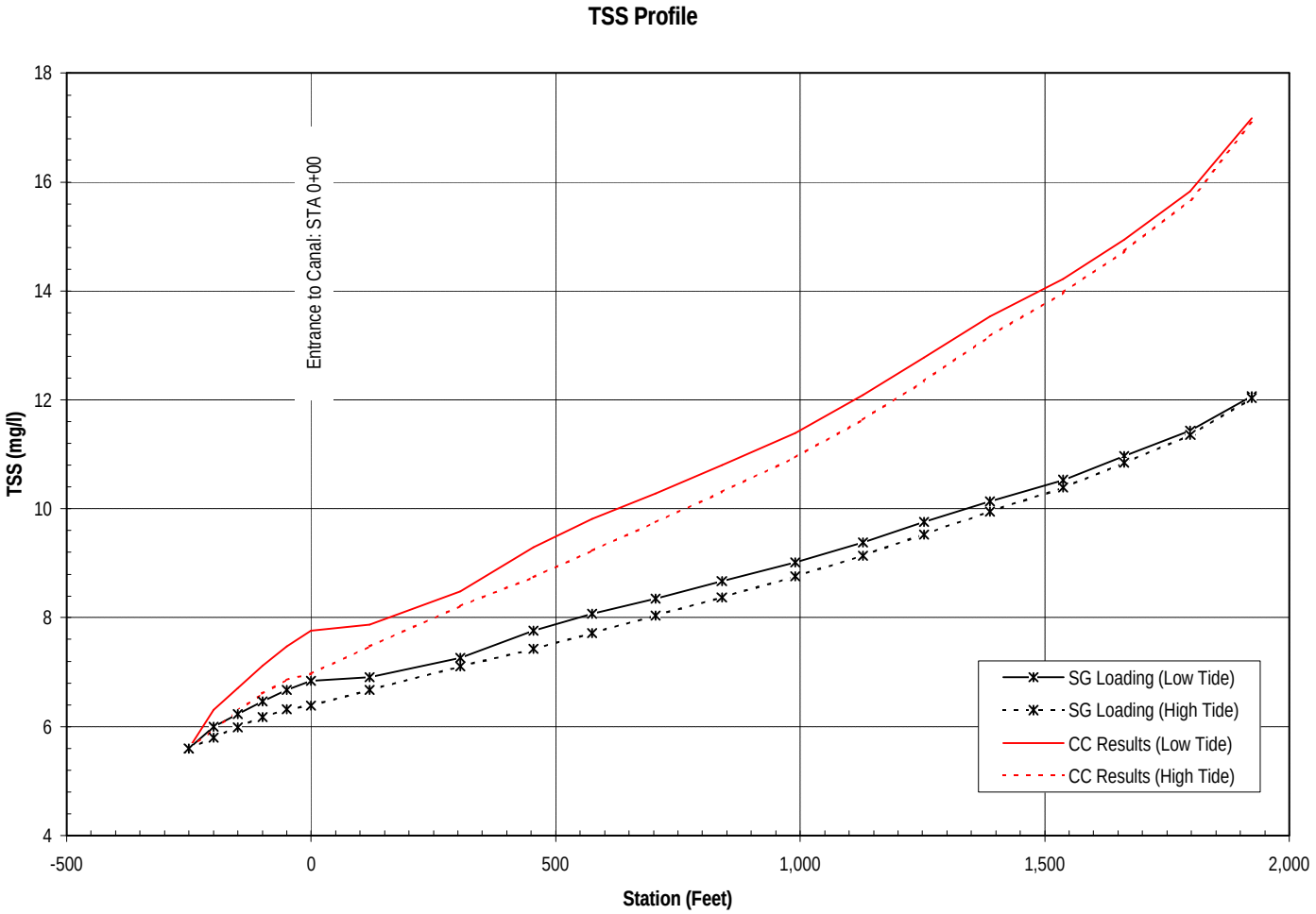

Canal #117, Plantation Model Output: BOD Profile



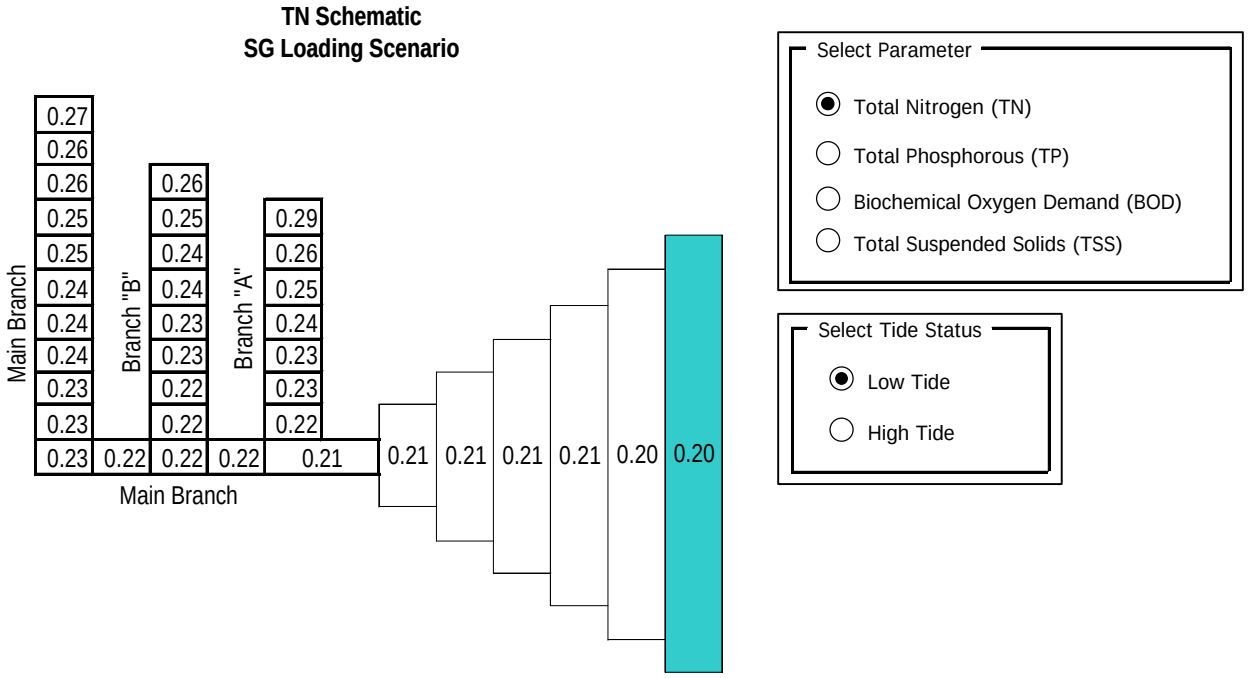

Canal #70, Plantation Model Output: TSS, low tide



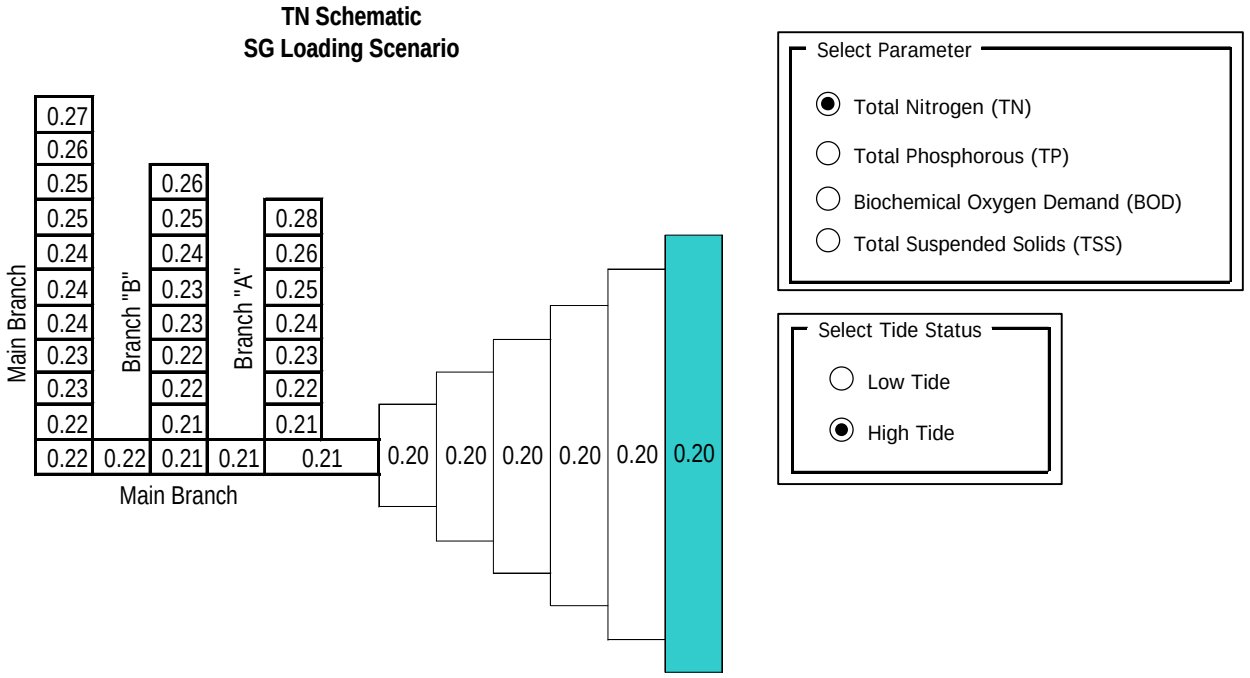

Canal #117, Plantation Model Output: TSS, high tide



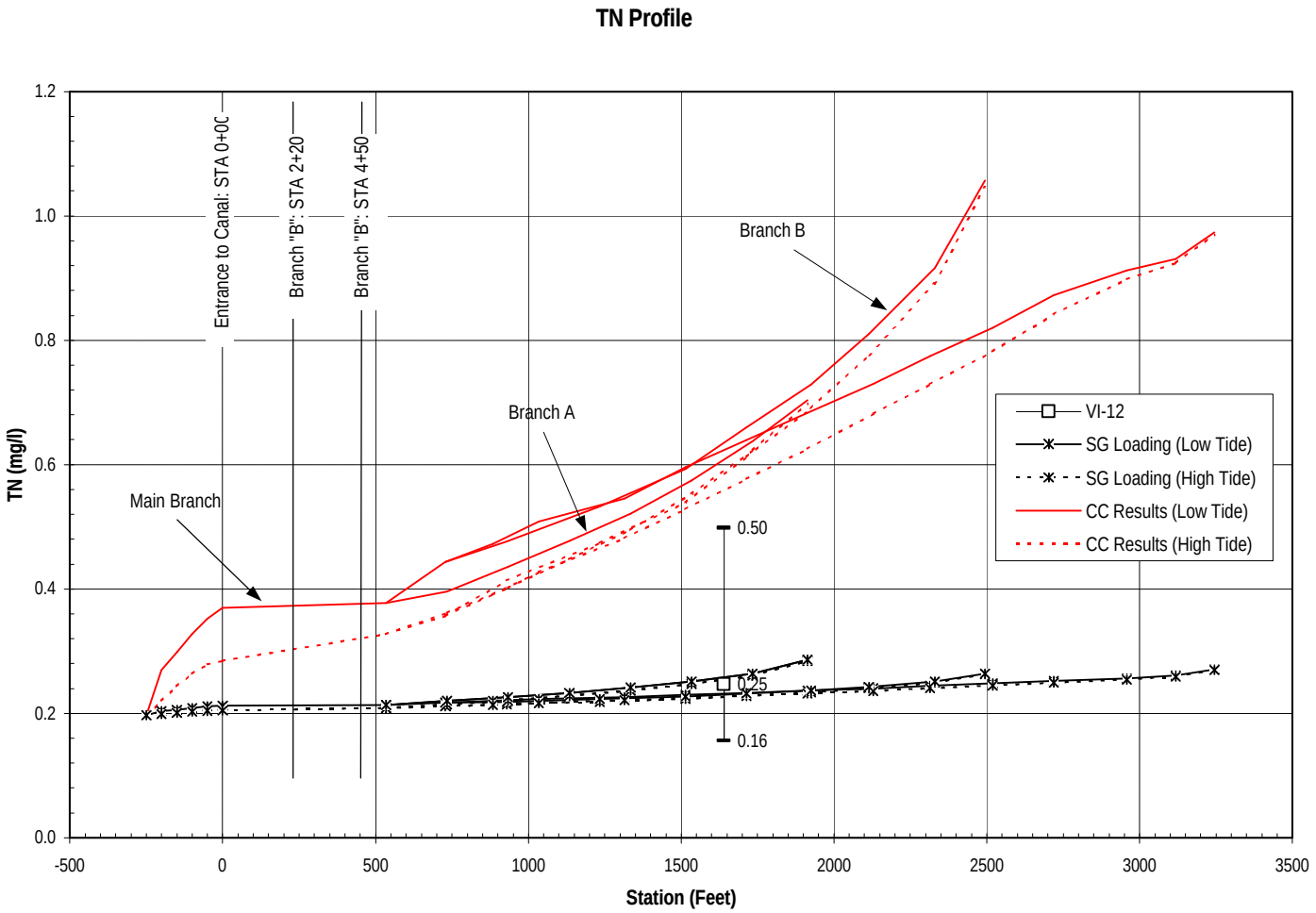

Canal #117, Plantation Model Output: TSS Profile



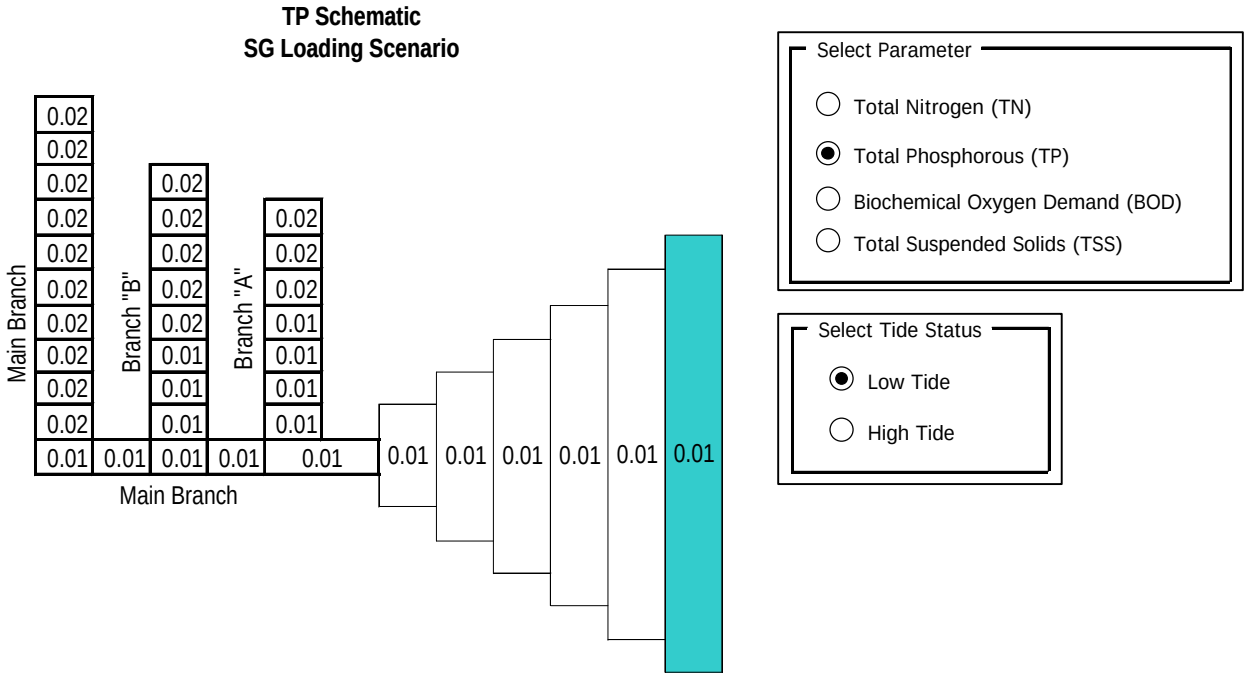

Canal #152, Lower Matecumbe Model Output, TN, low tide



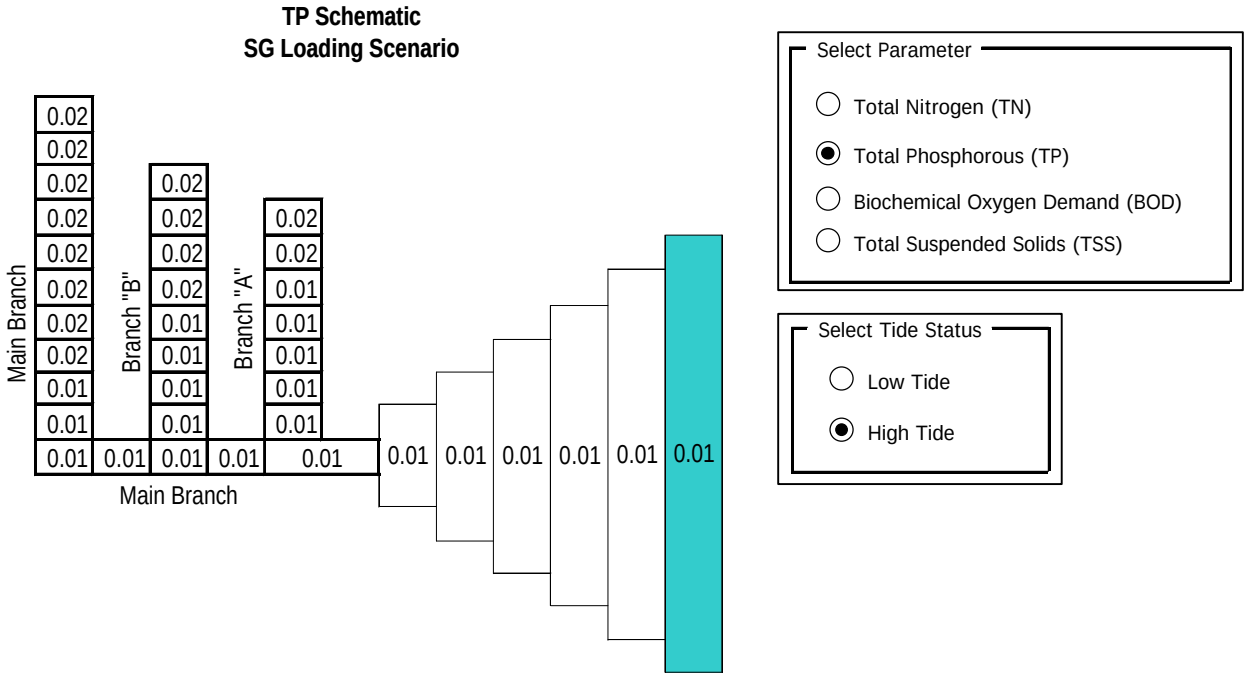

Canal #152, Lower Matecumbe Model Output: TN, high tide



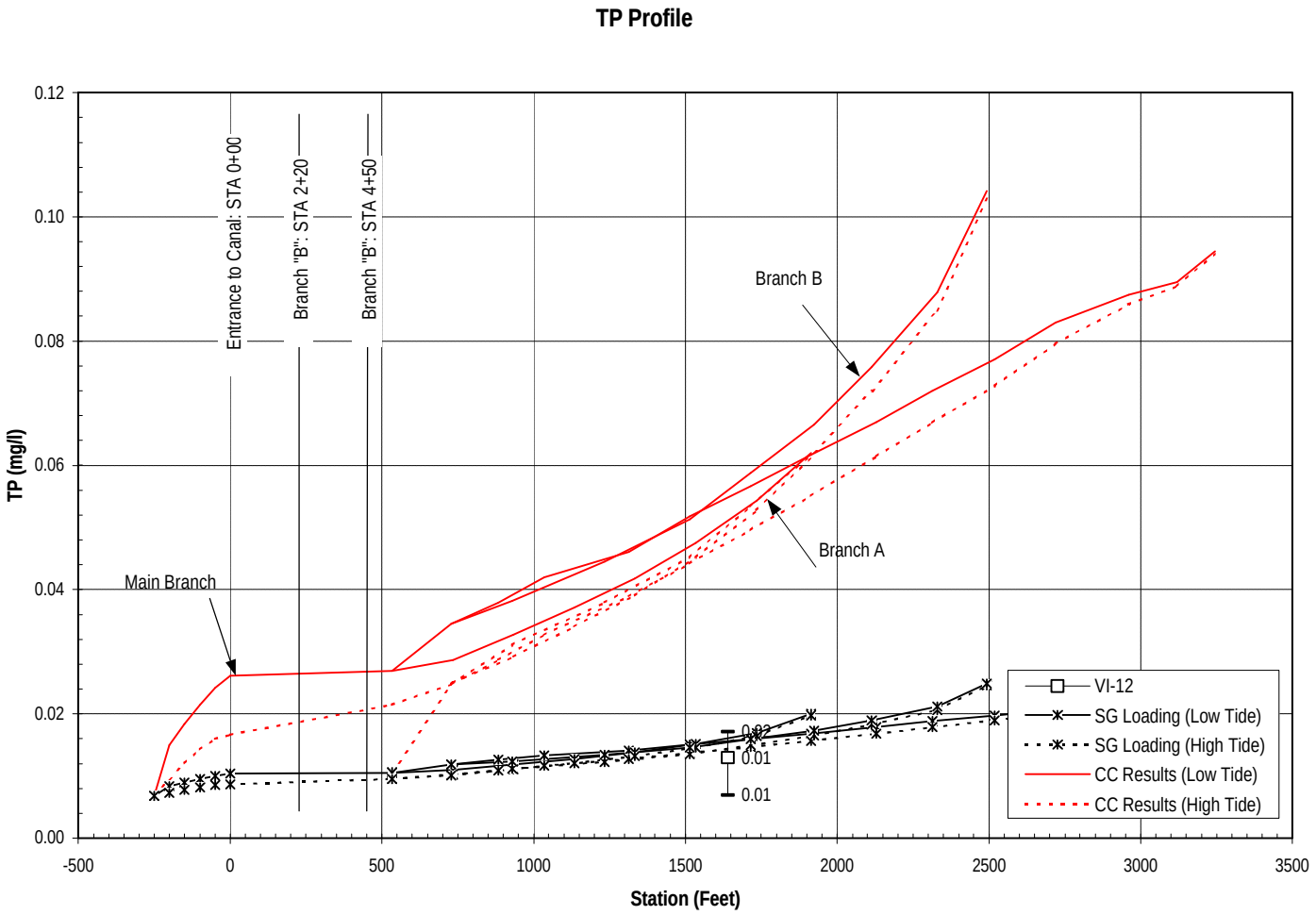

Canal #152, Matecumbe Model Output: TN Profile



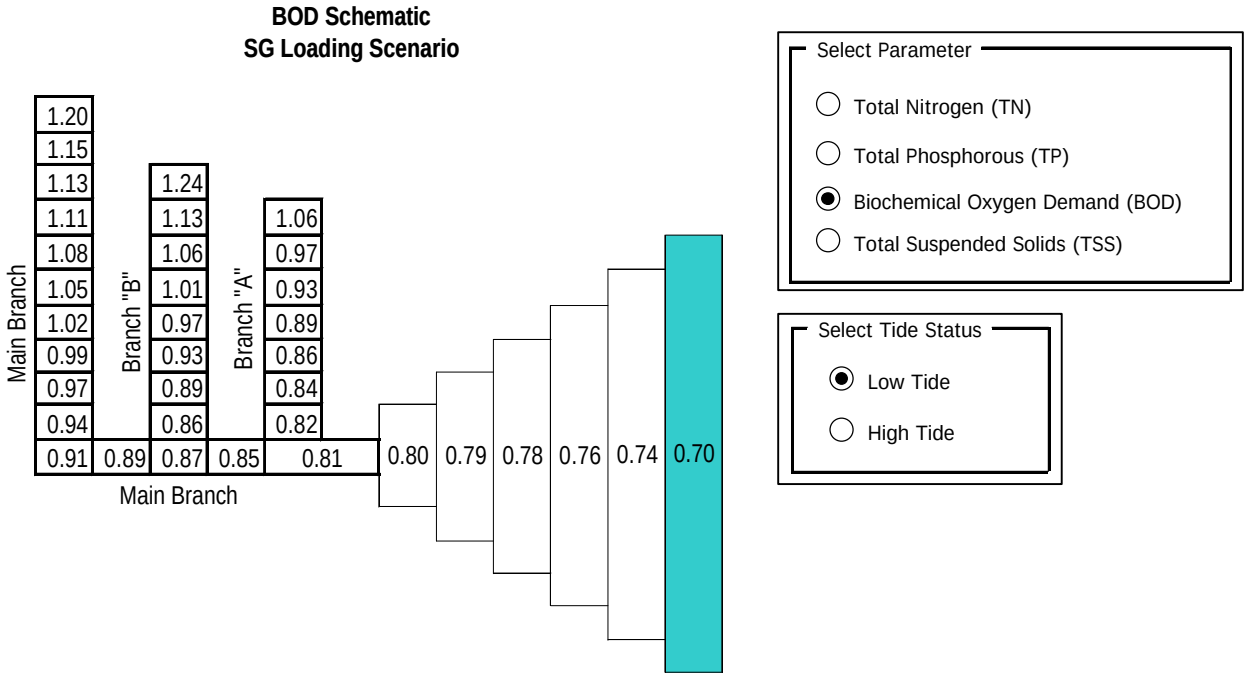

Canal #152, Lower Matecumbe Model Output: TP, low tide



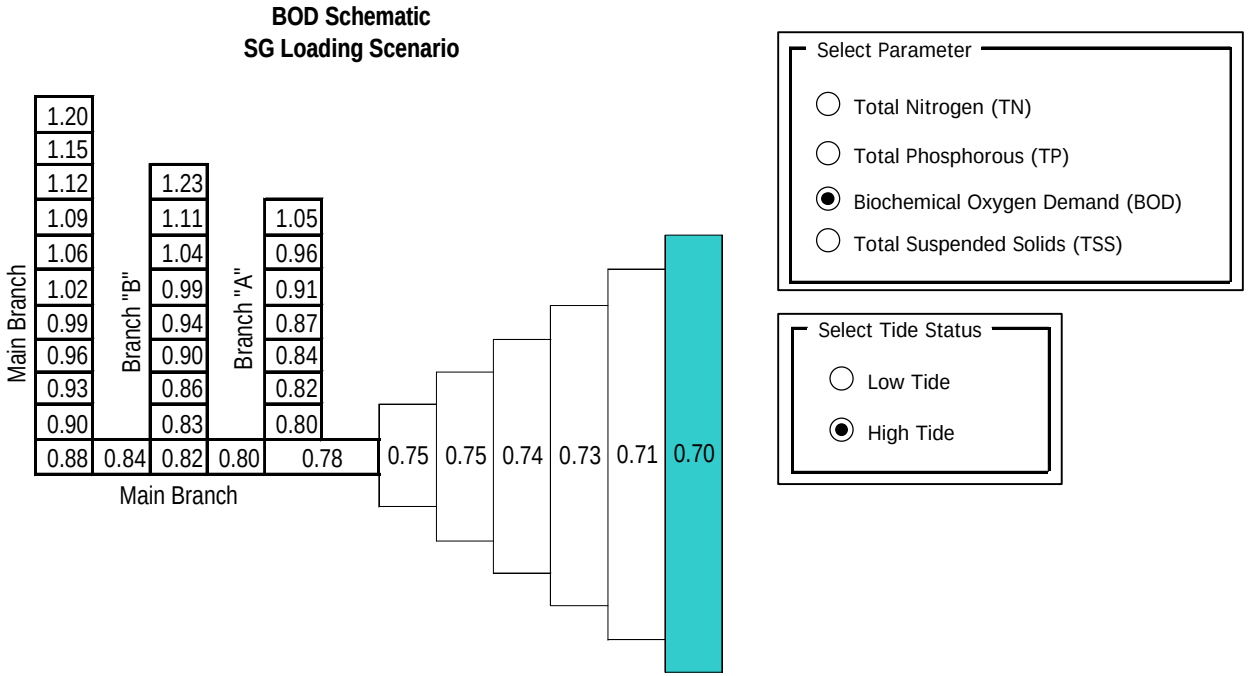

Canal #152, Lower Matecumbe Model Output: TP, high tide



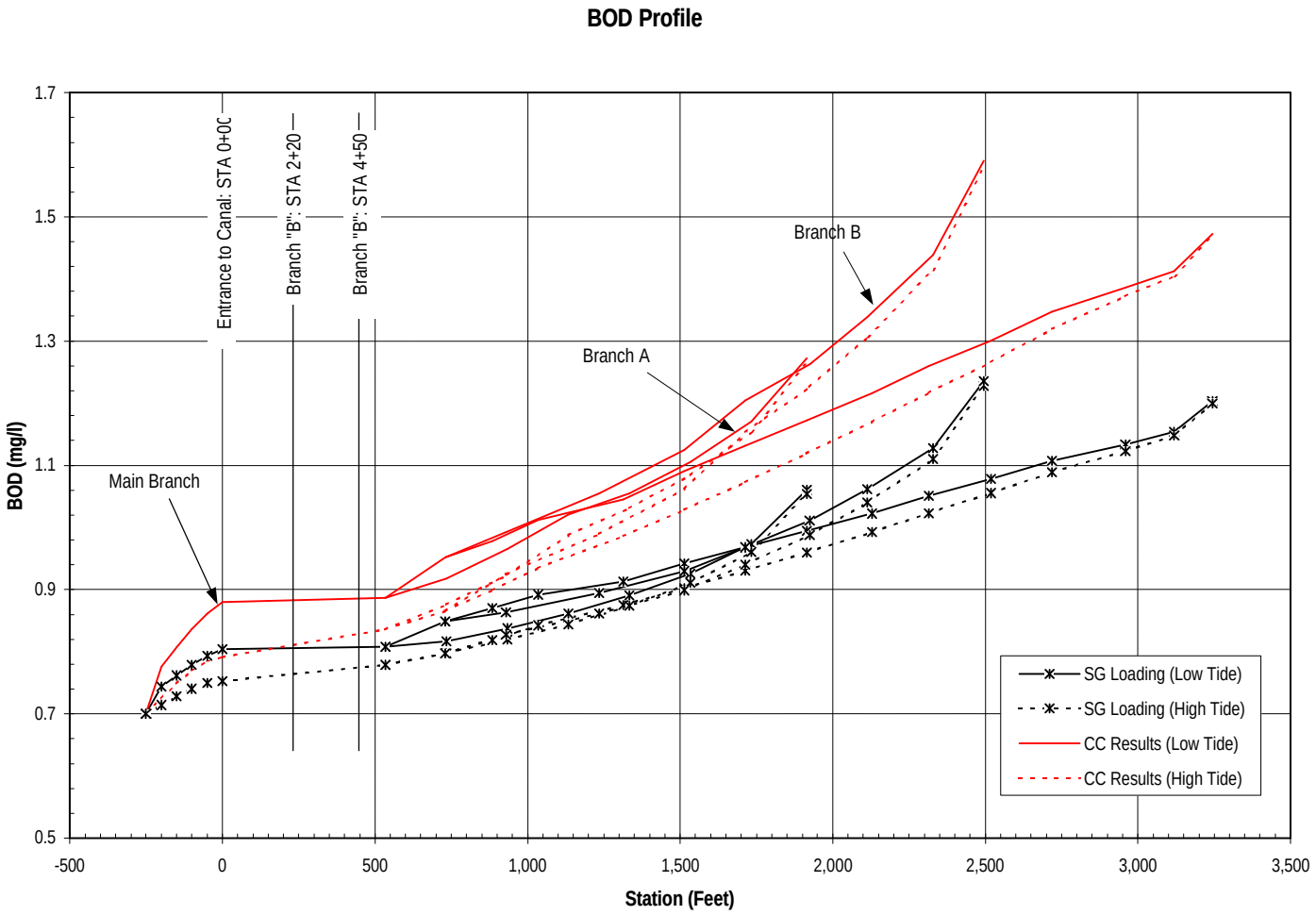

Canal #152, Lower Matecumbe Model Output: TP Profile



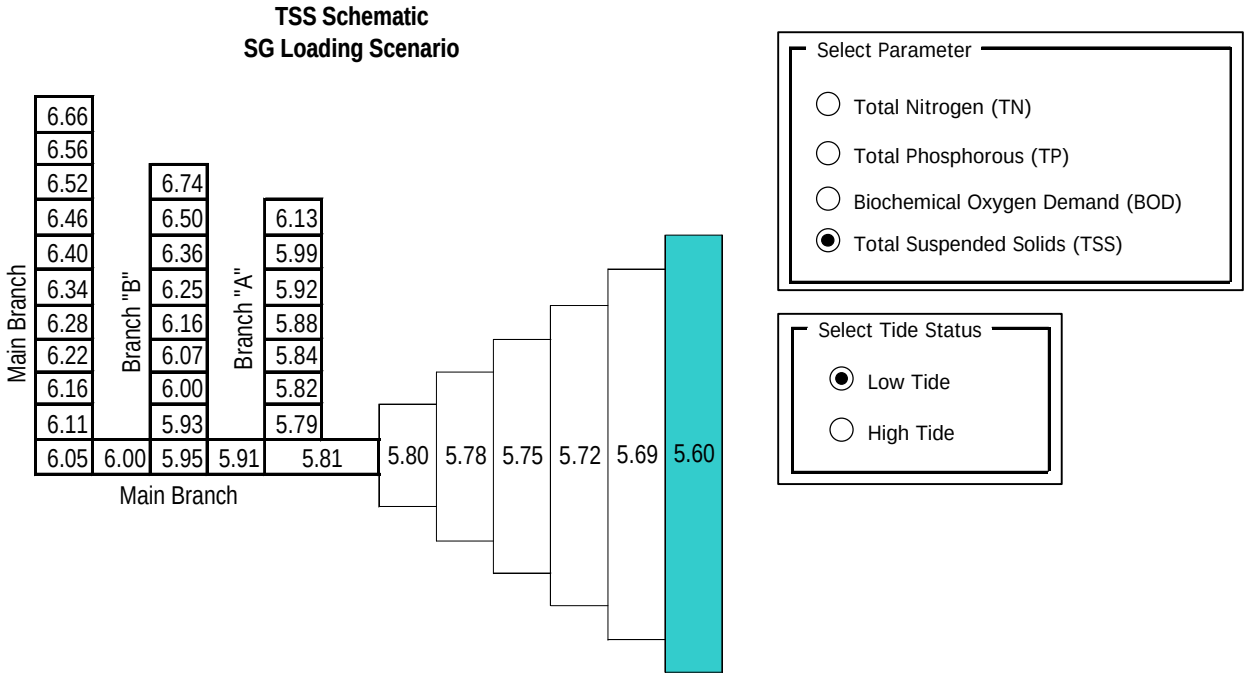

Canal #152, Lower Matecumbe Model Output: BOD, low tide



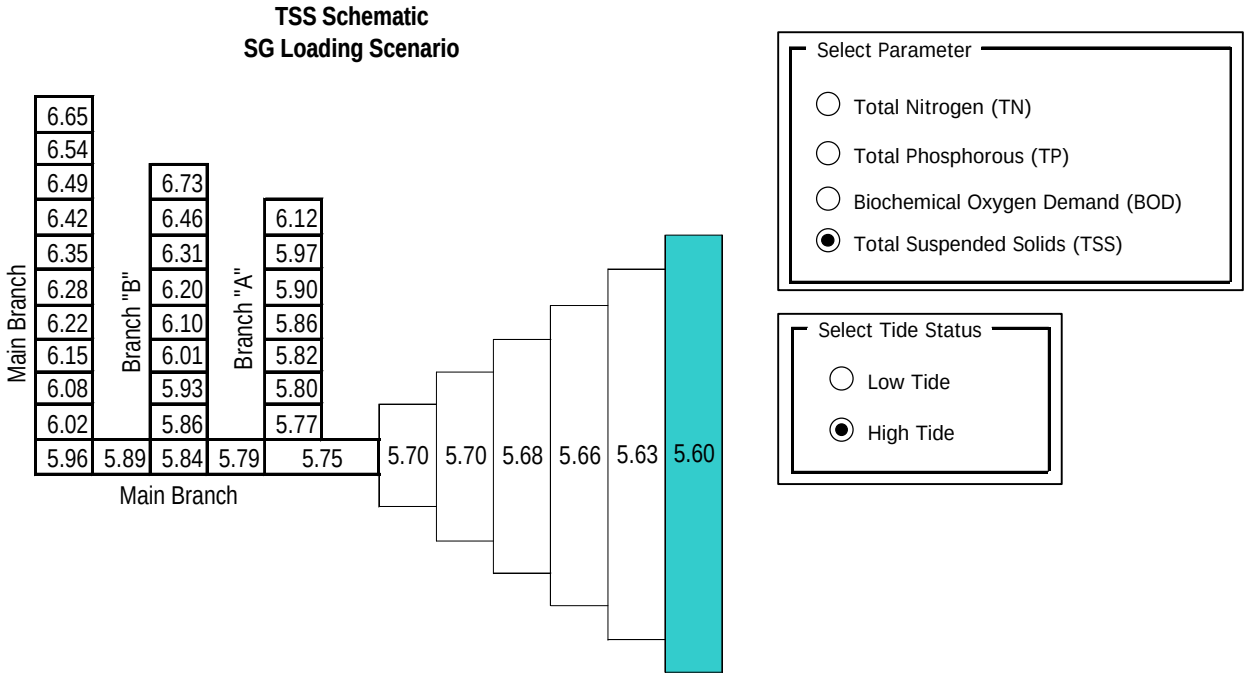

Canal #152, Lower Matecumbe Model Output: BOD, high tide



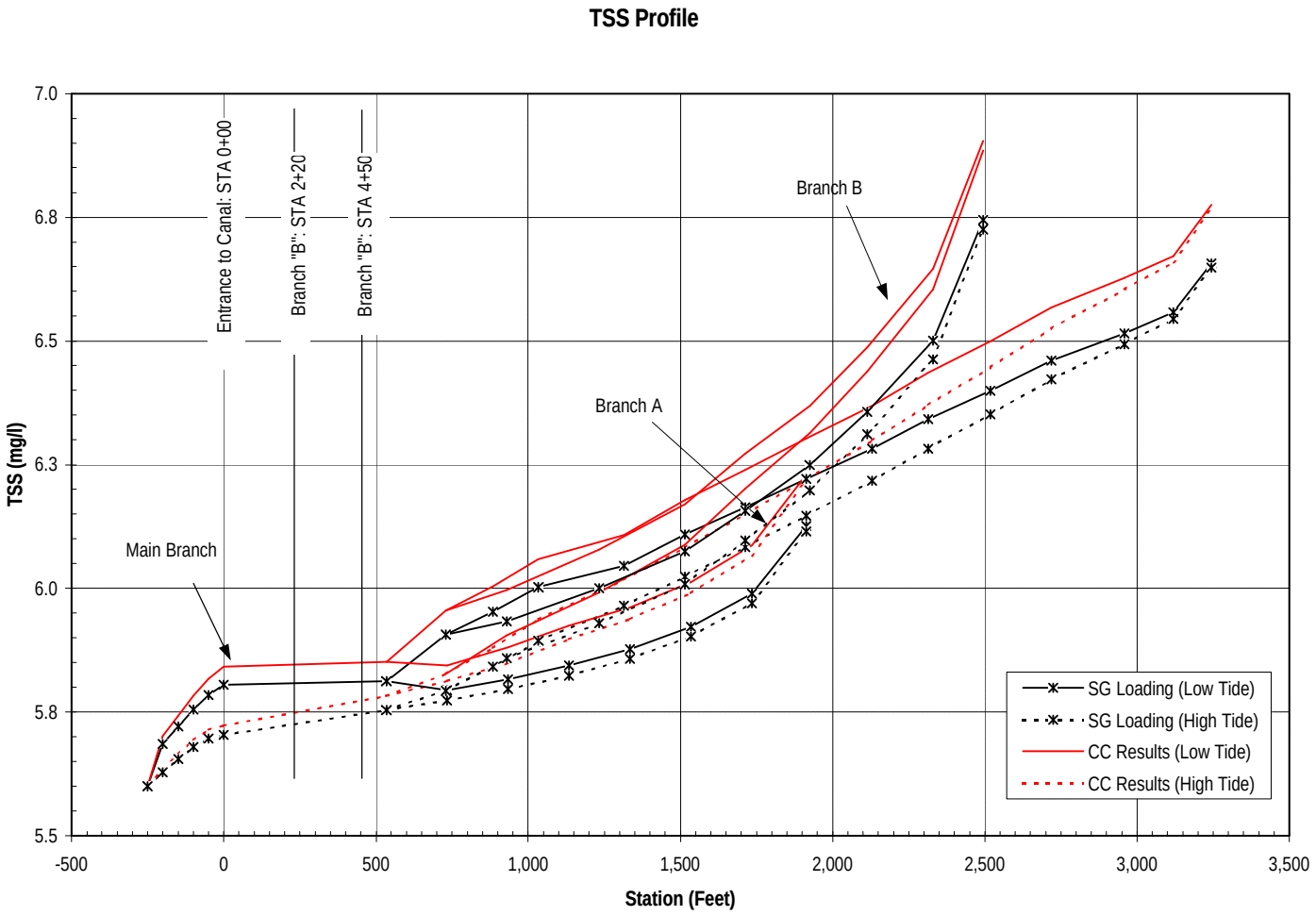

Canal #152, Lower Matecumbe Model Output: BOD Profile



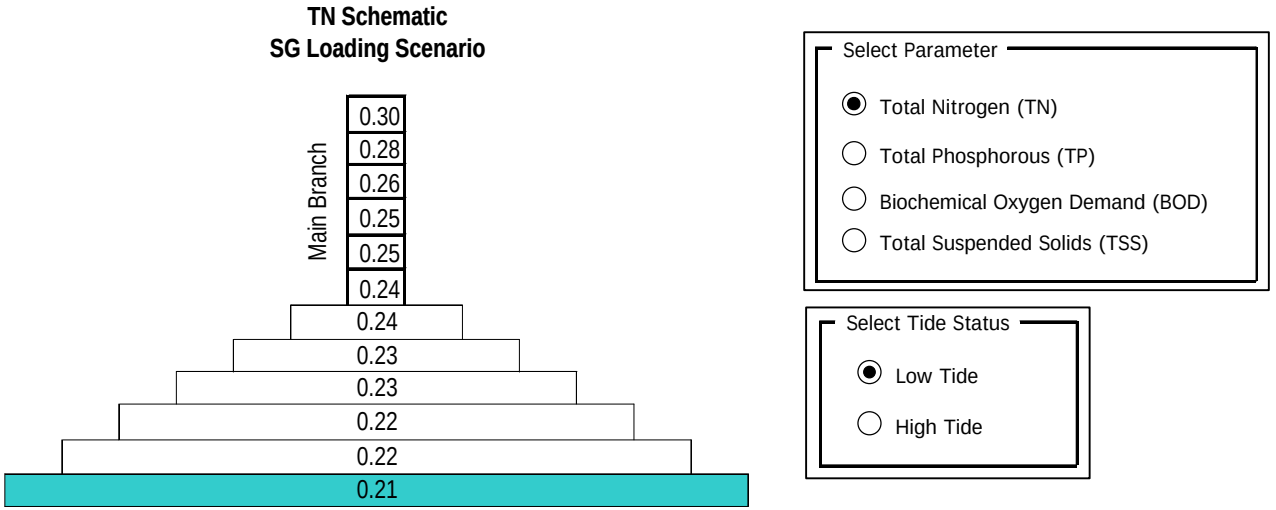

Canal #152, Lower Matecumbe Model Output: TSS, low tide



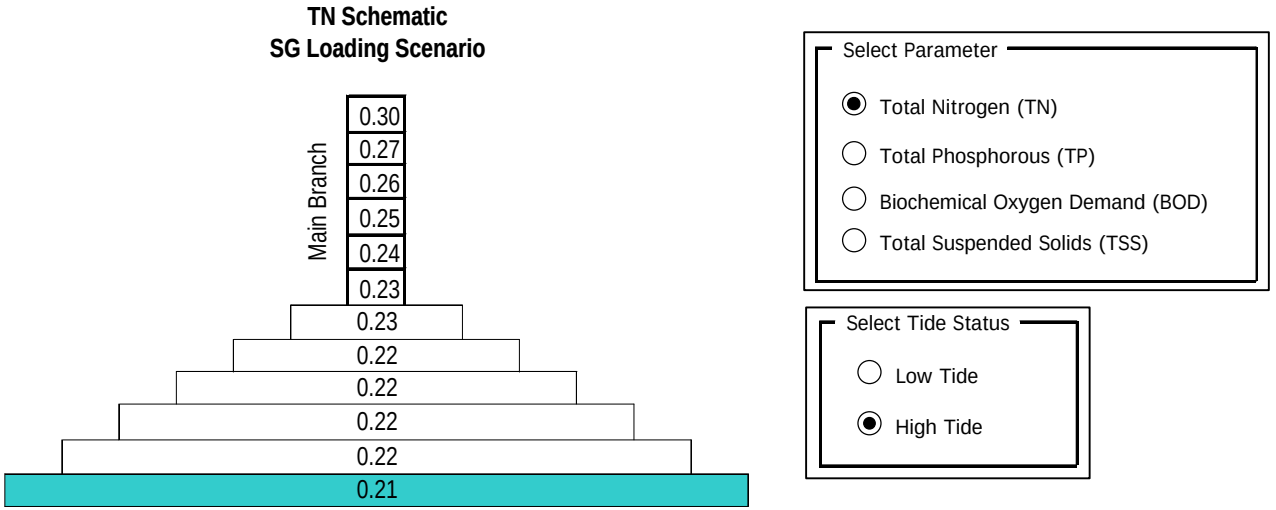

Canal #152, Lower Matecumbe Model Output: TSS, high tide



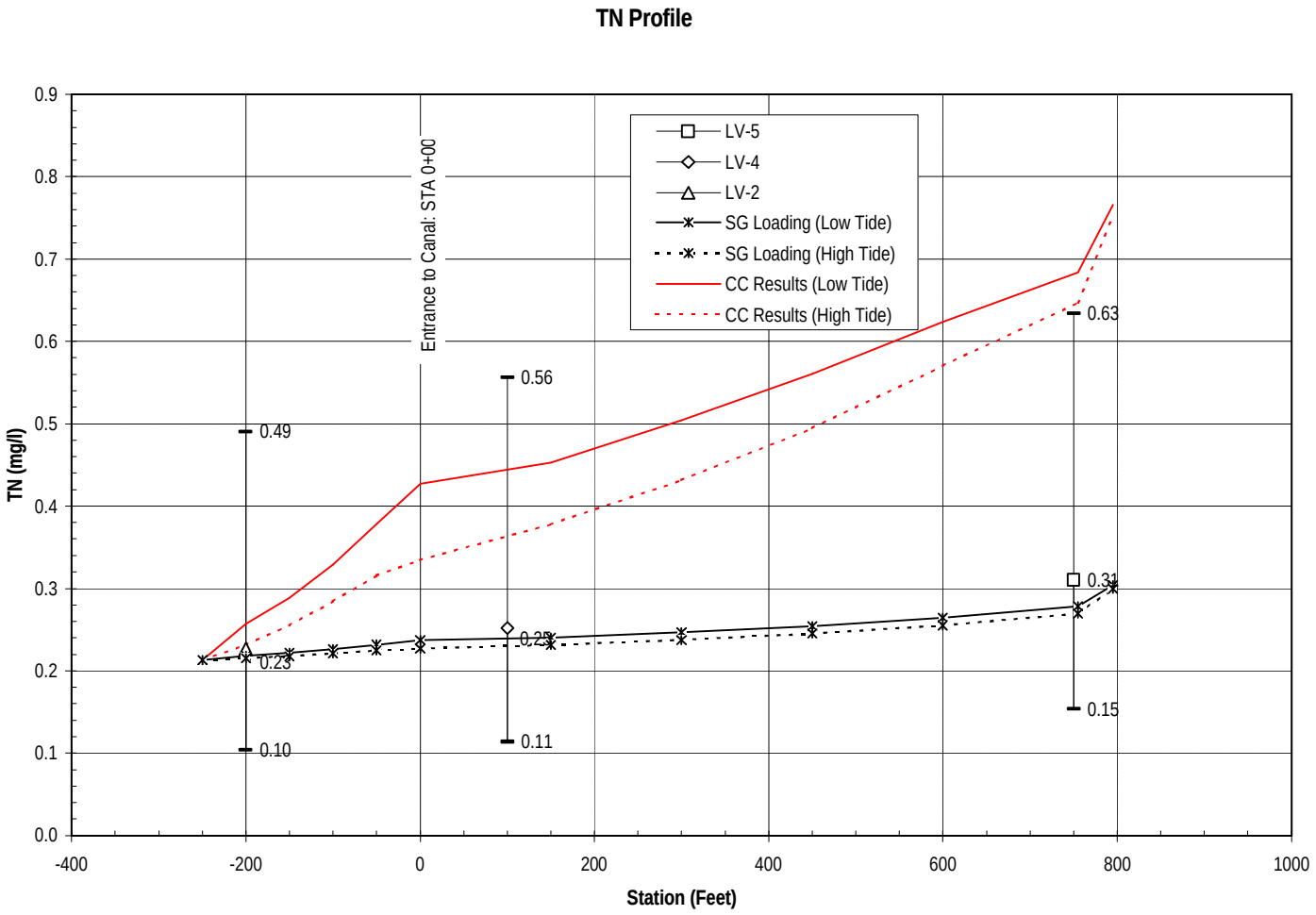

Canal #152, Lower Matecumbe Model Output: TSS Profile



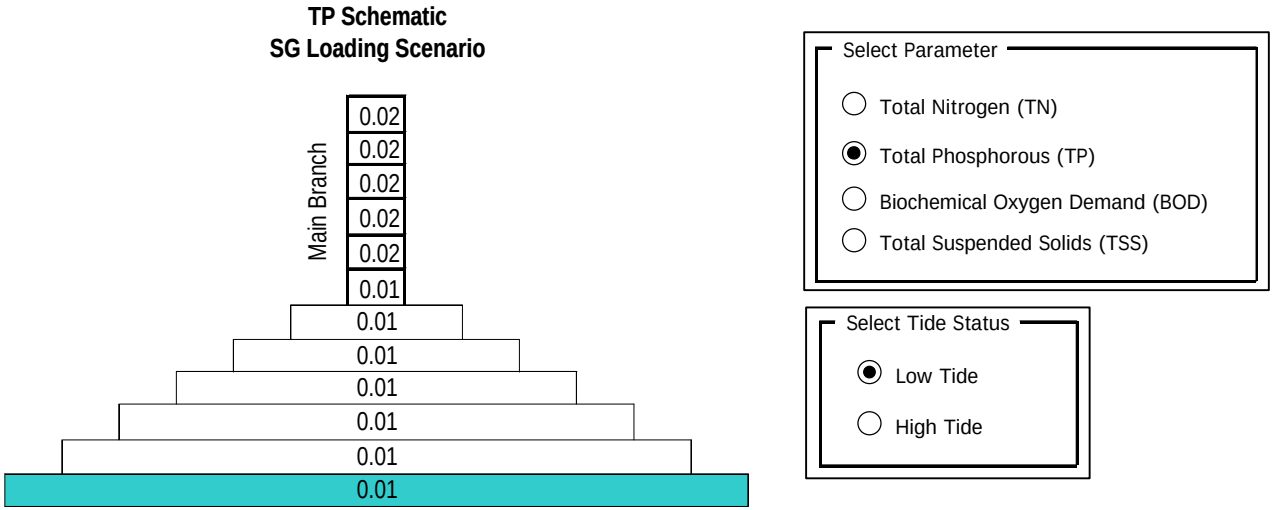

Canal #204, Marathon Model Output: TN, low tide



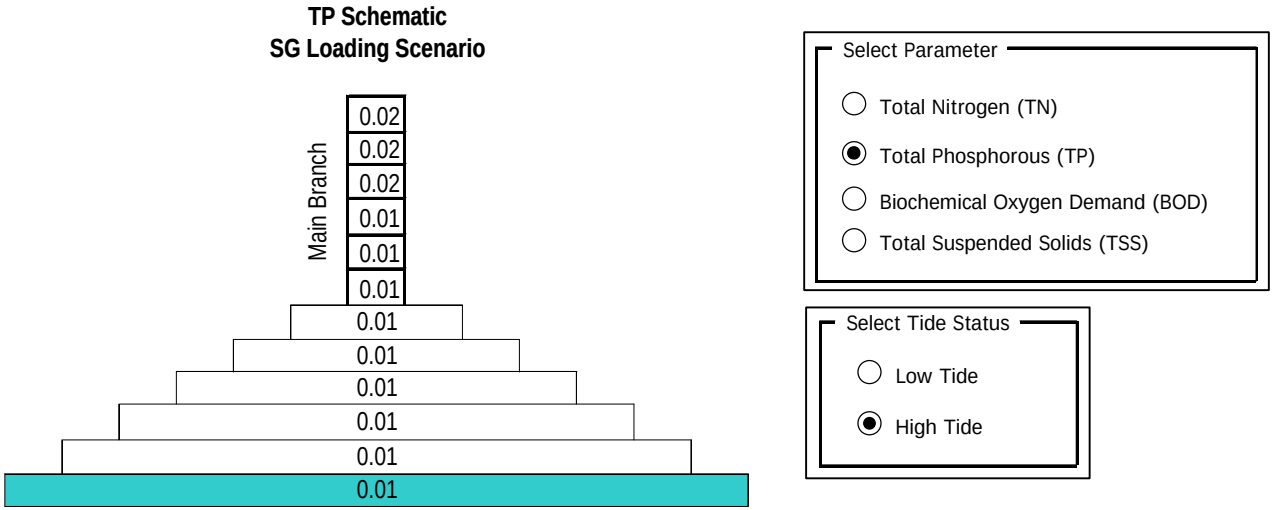

Canal #204, Marathon Model Output: TN, high tide



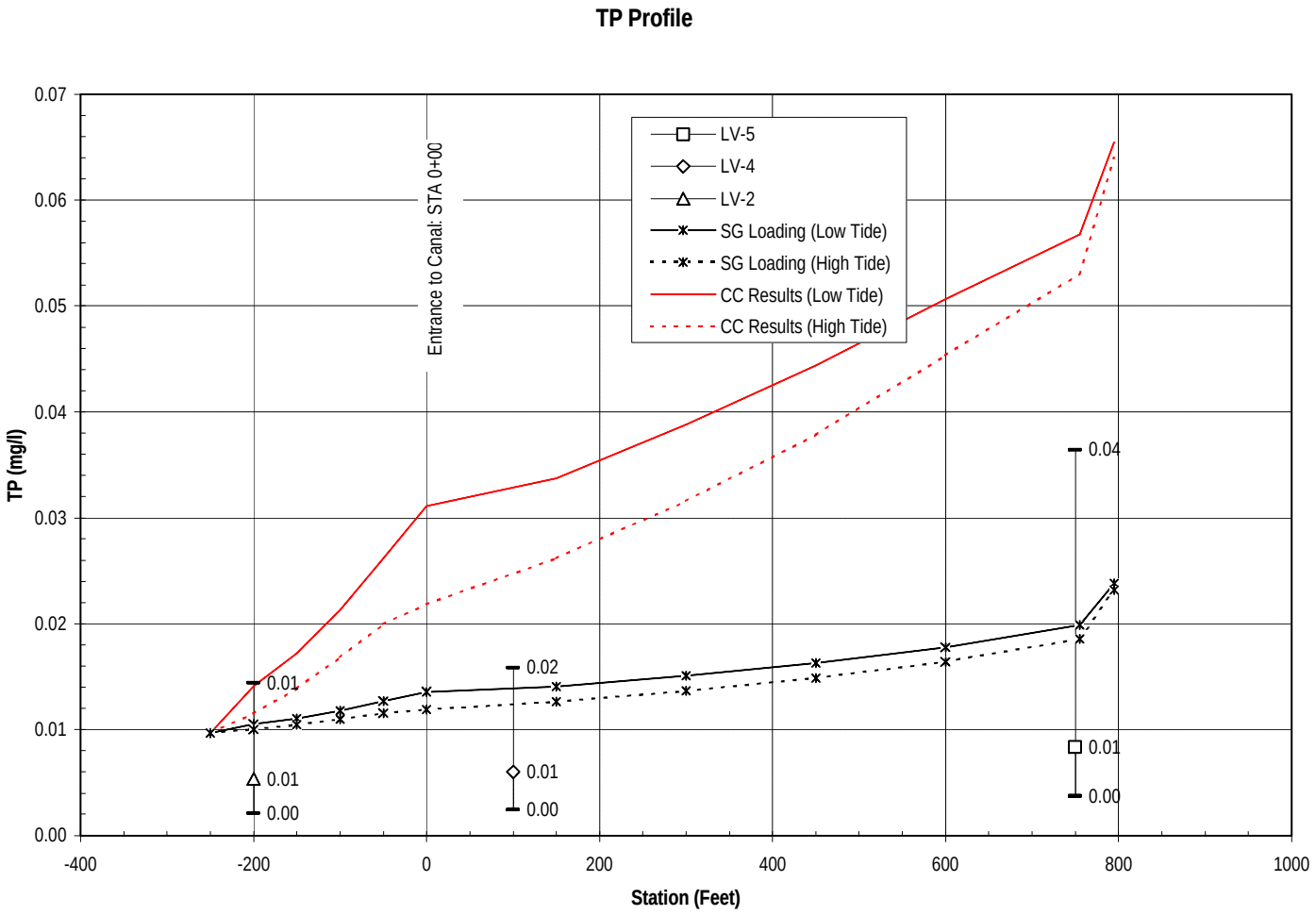

Canal #204, Marathon Model Output: TN Profile



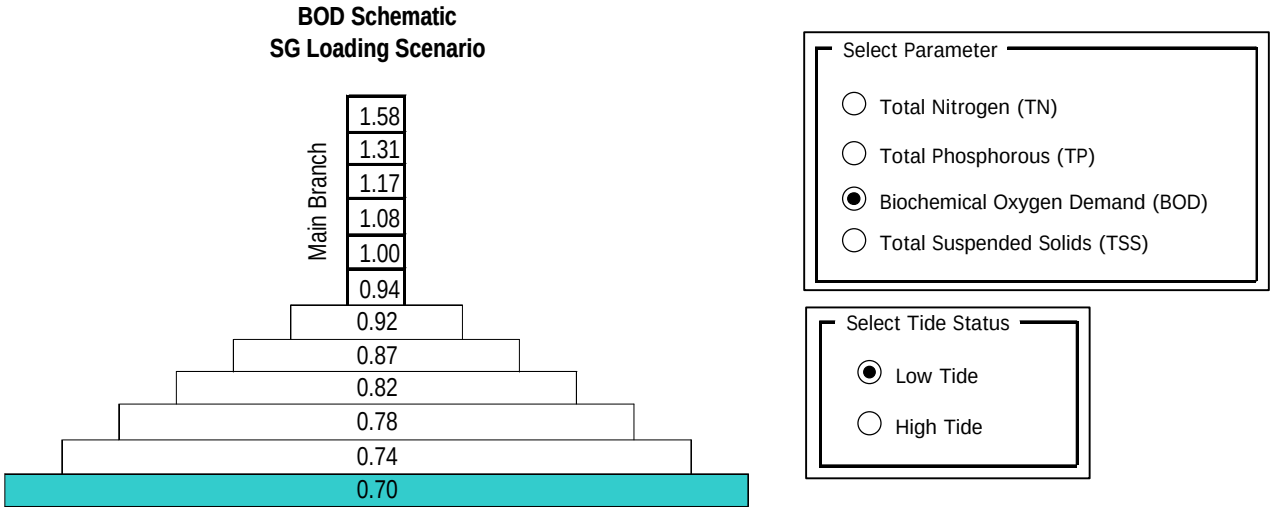

Canal #204, Marathon Model Output: TP, low tide



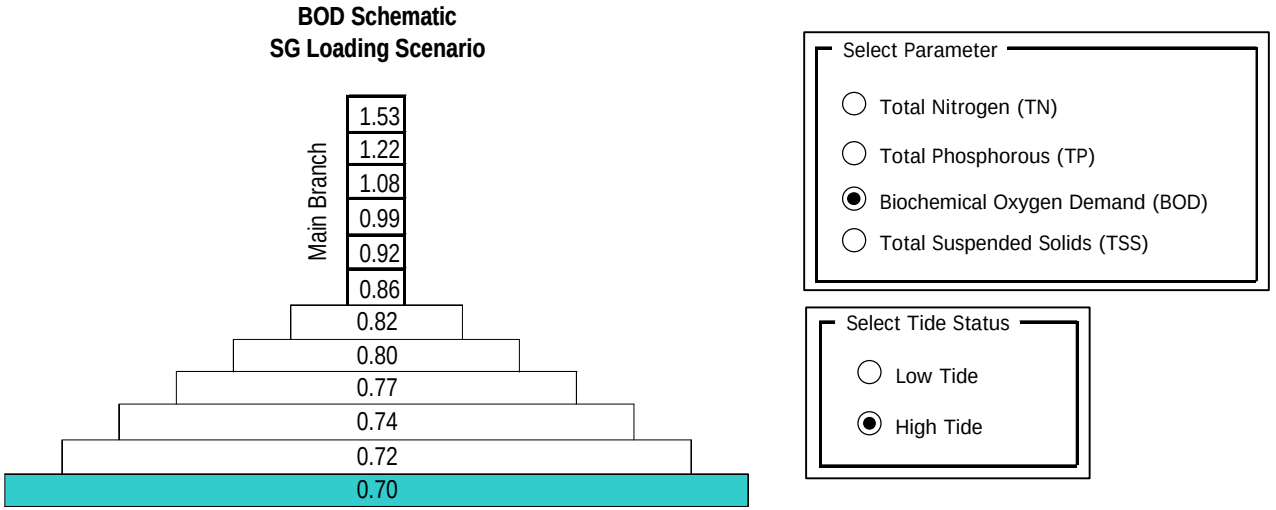

Canal #204, Marathon Model Output: TP, high tide



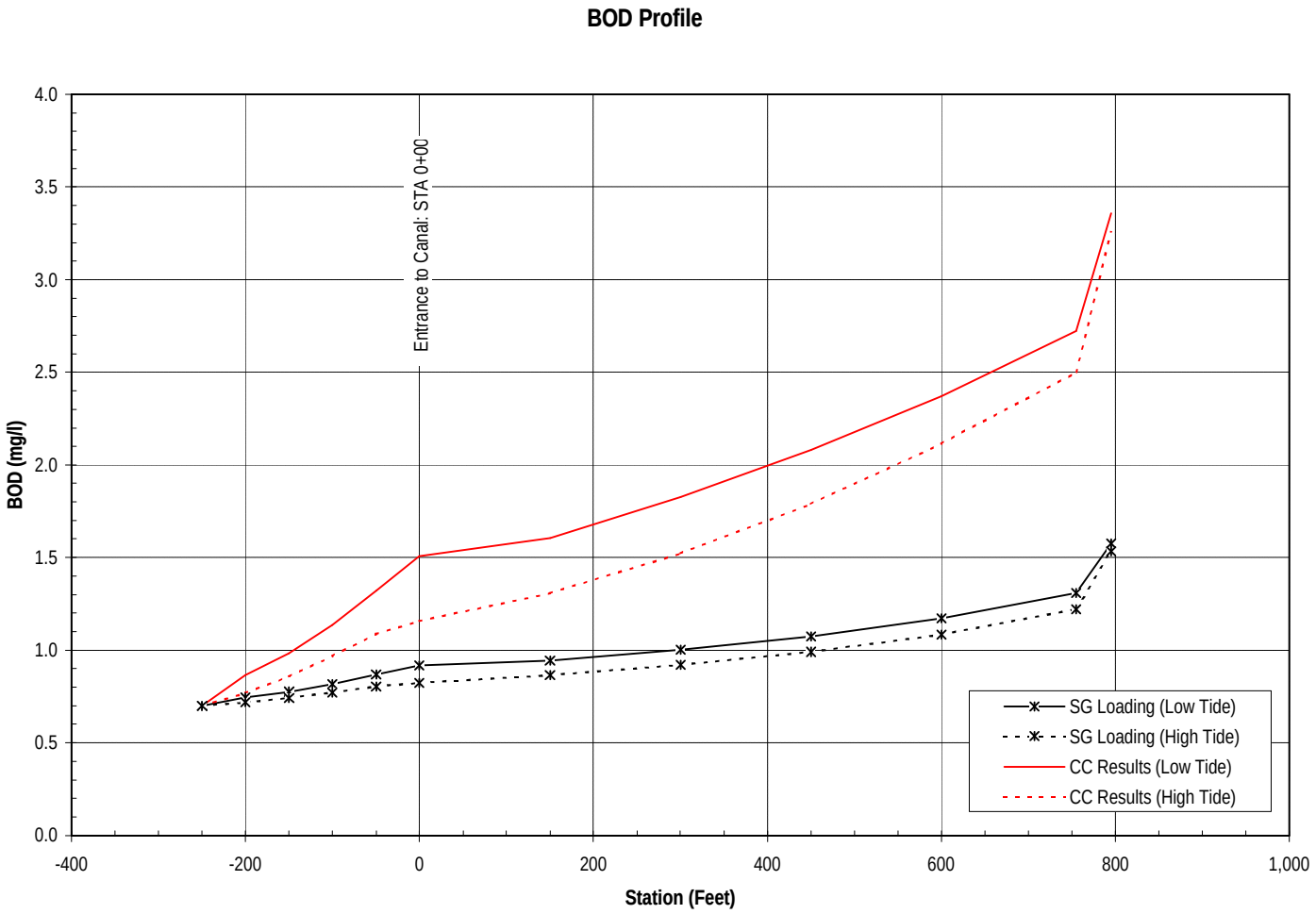

Canal #204, Marathon Model Output: TP Profile



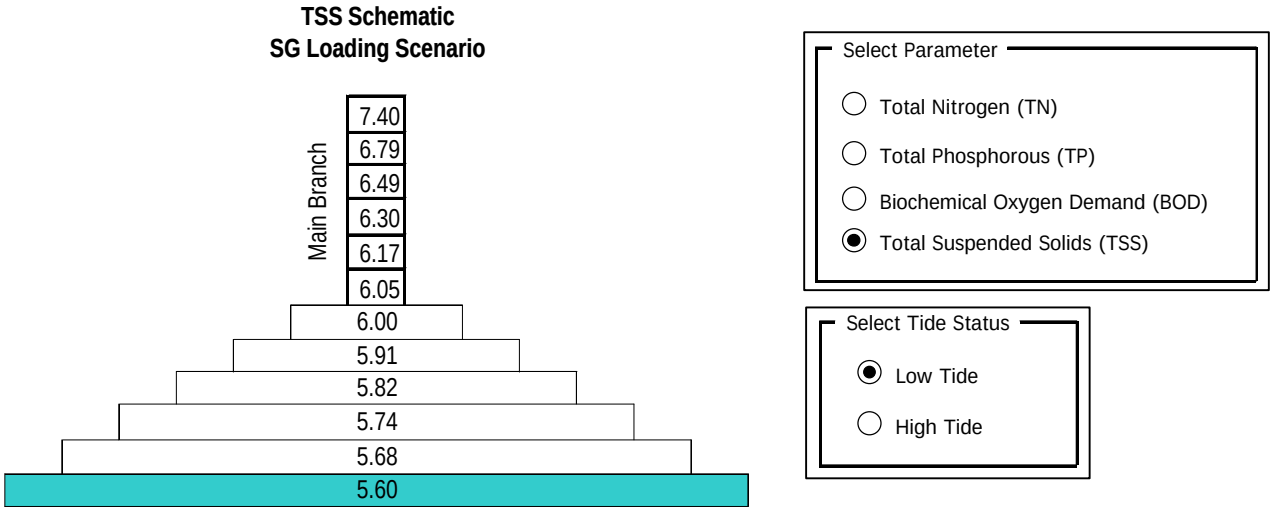

Canal #204, Marathon Model Output: BOD, low tide



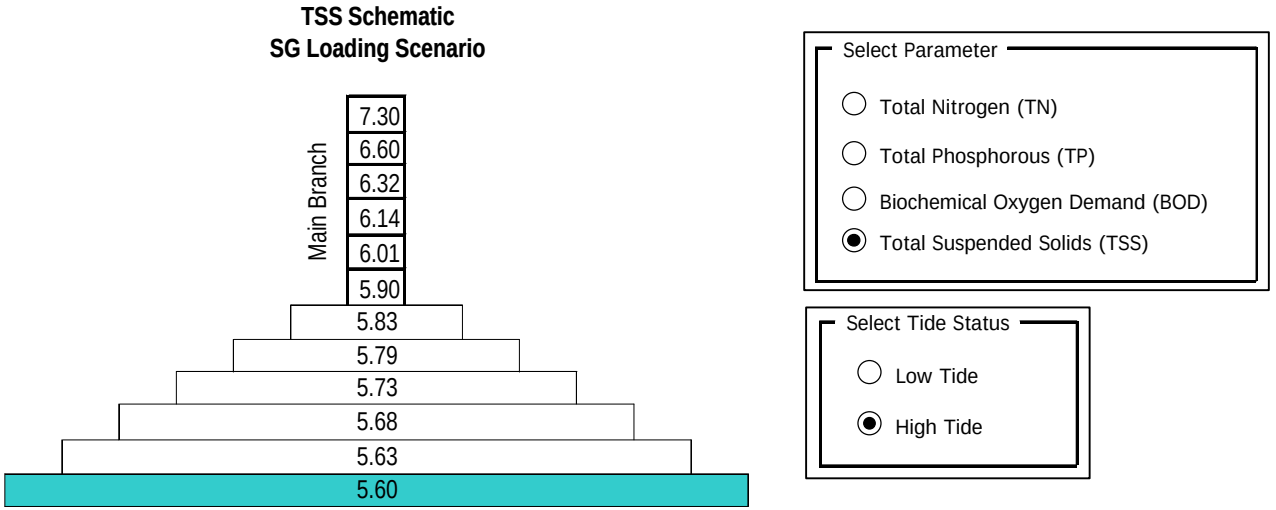

Canal #204, Marathon Model Output: BOD, high tide



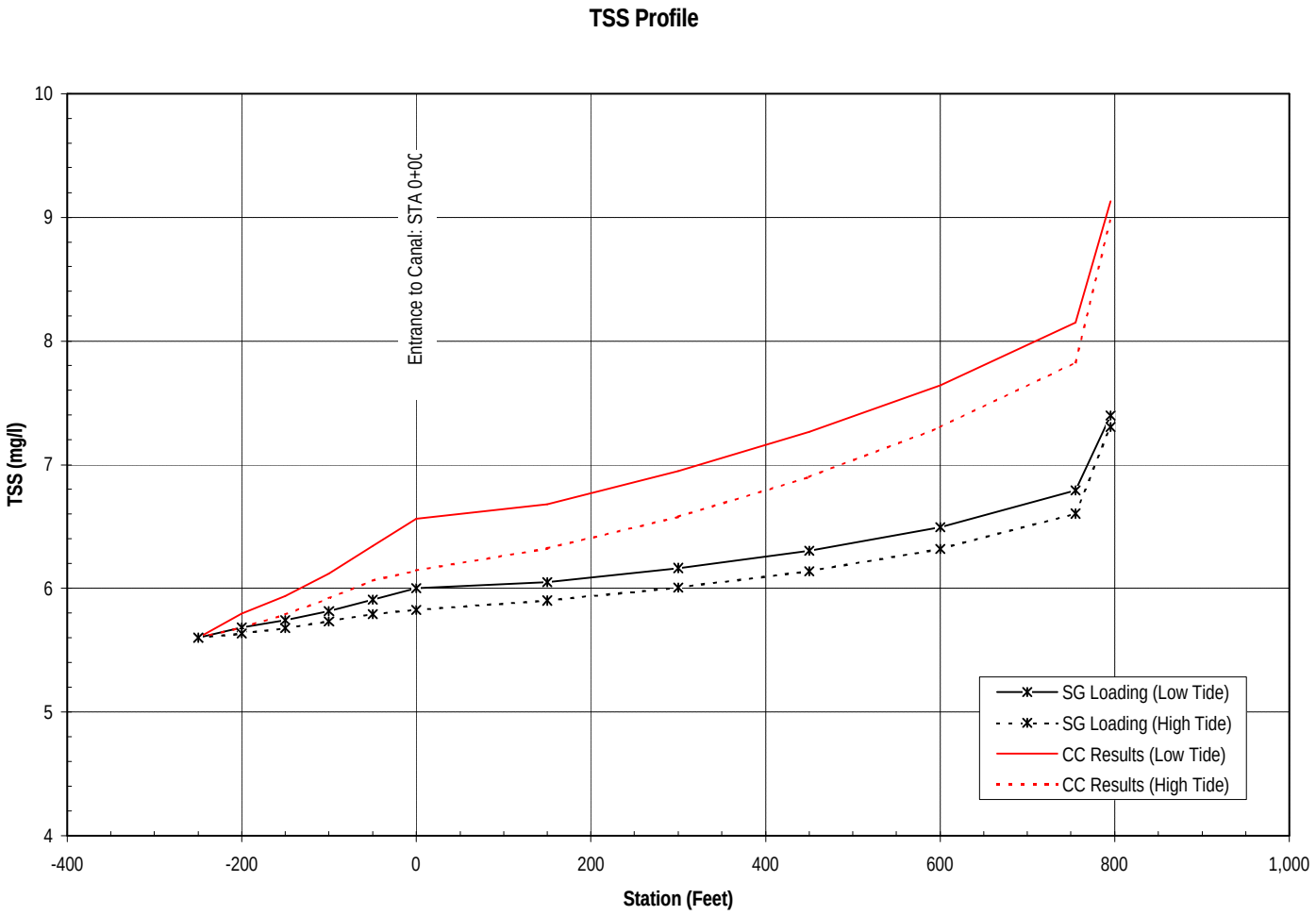

Canal #204, Marathon Model Output: BOD Profile



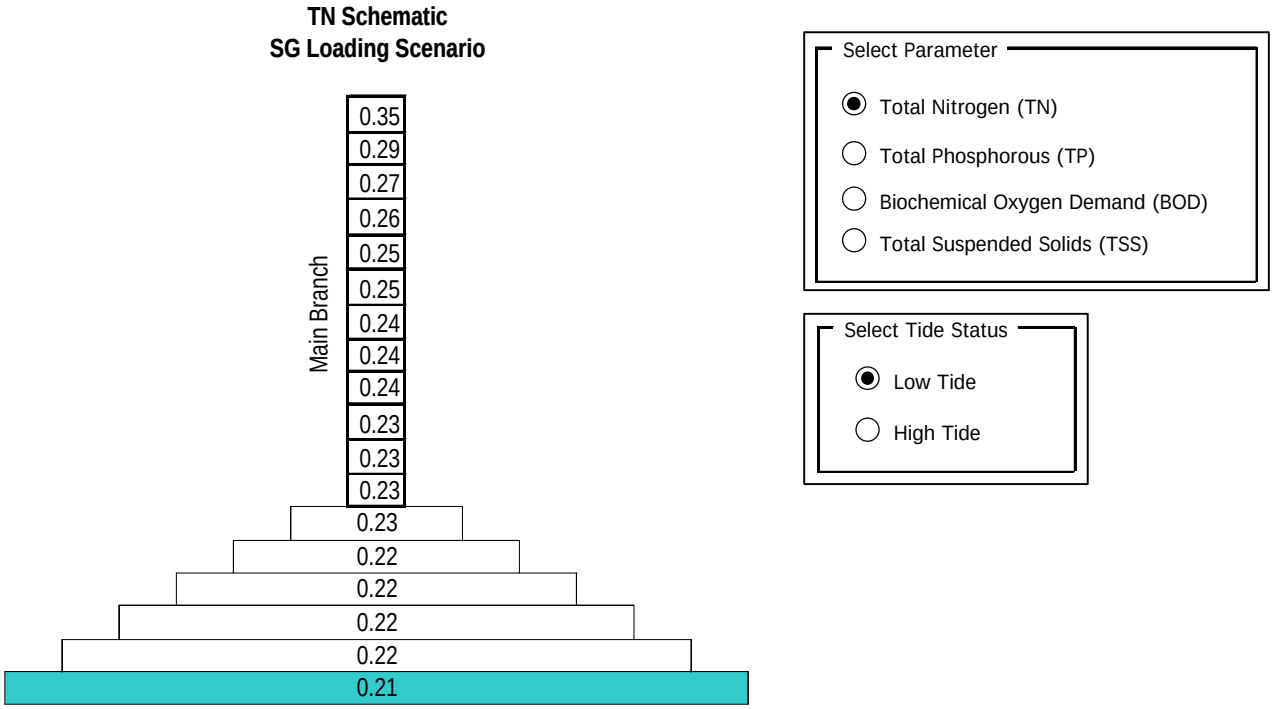

Canal #204, Marathon Model Output: TSS, low tide



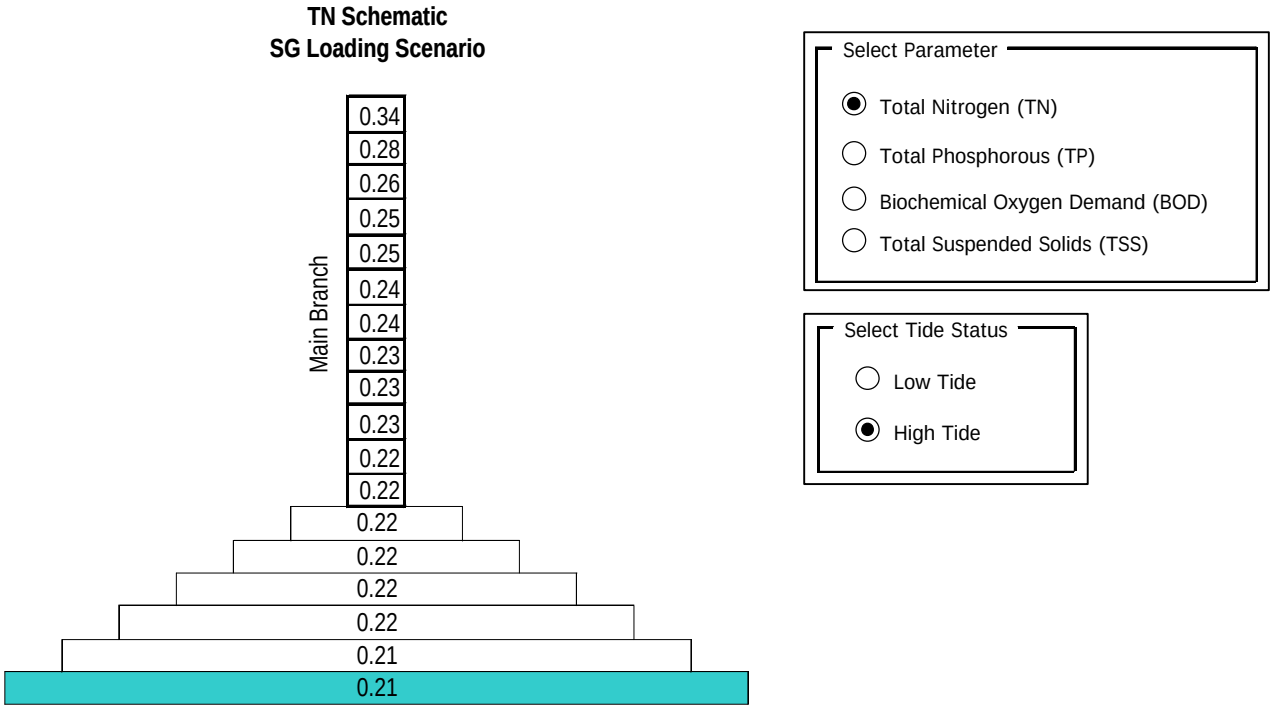

Canal #204, Marathon Model Output: TSS, high tide



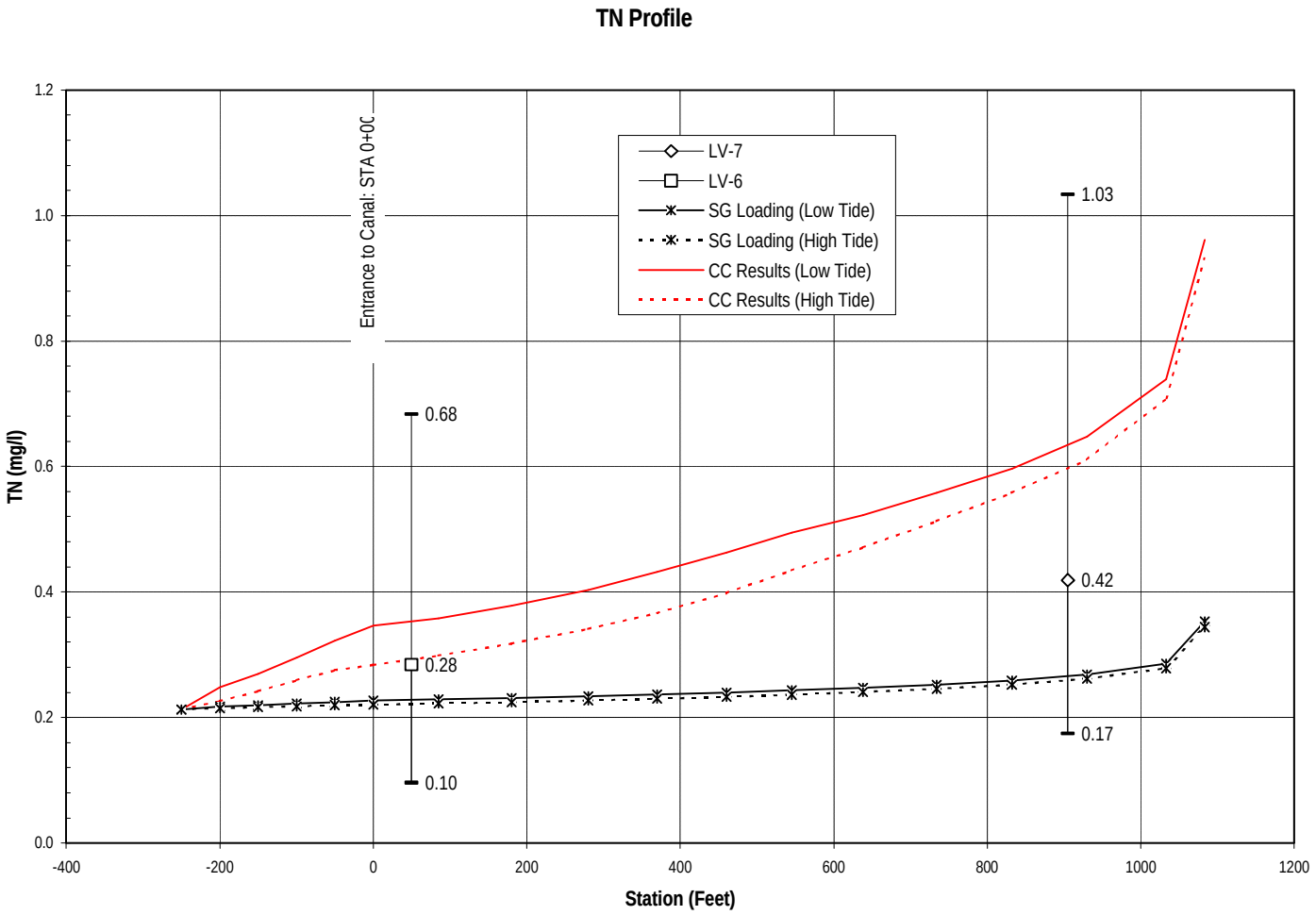

Canal #204, Marathon Model Output: TSS Profile



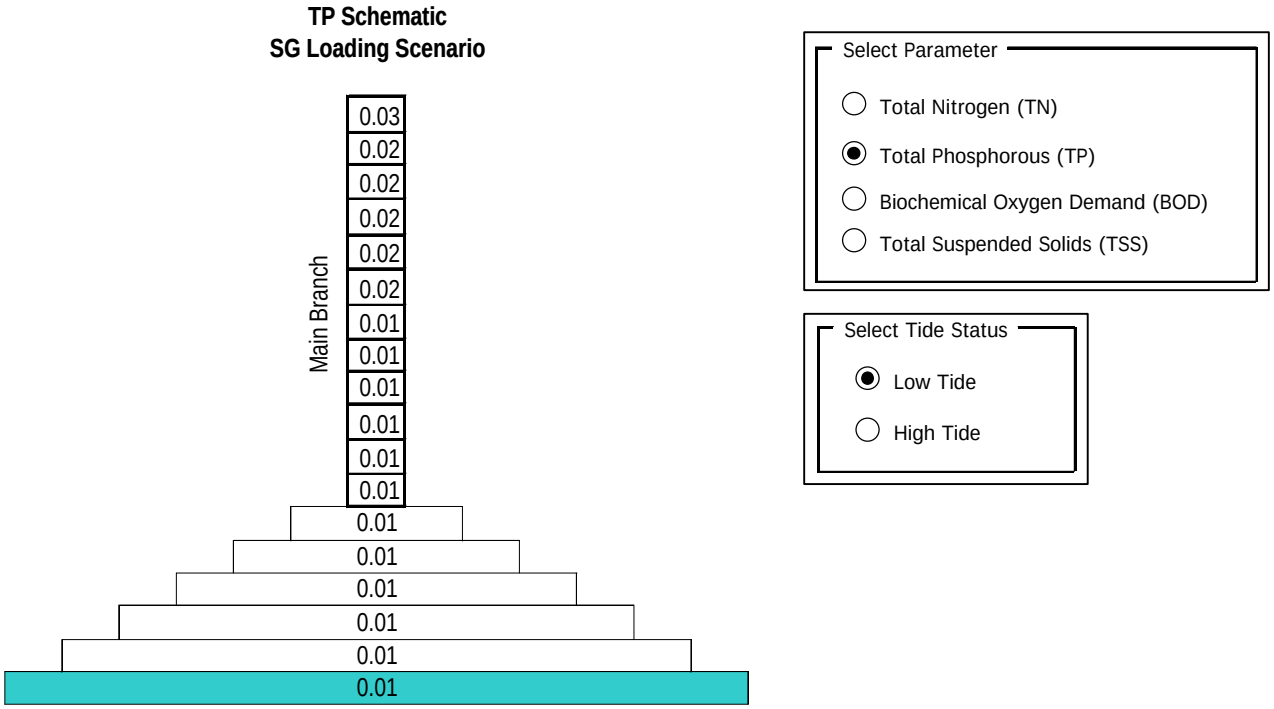

Canal #208, Marathon Model Output: TN, low tide



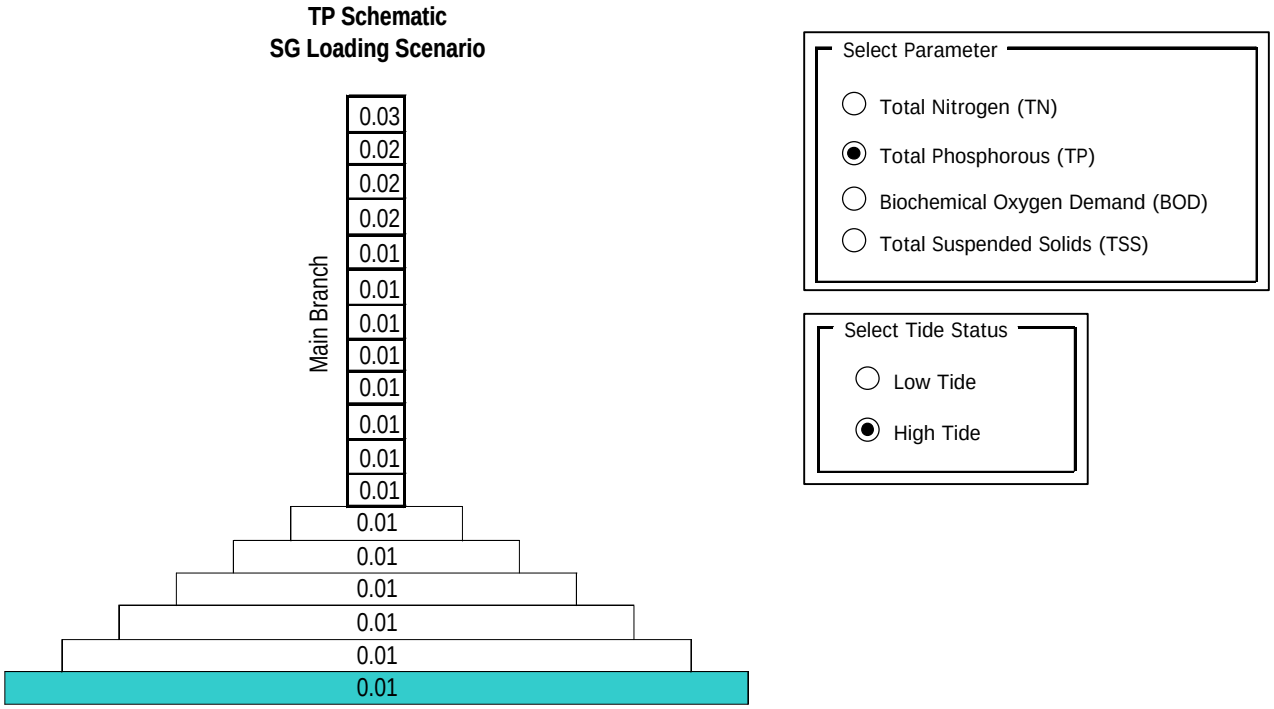

Canal #208, Marathon Model Output: TN, high tide



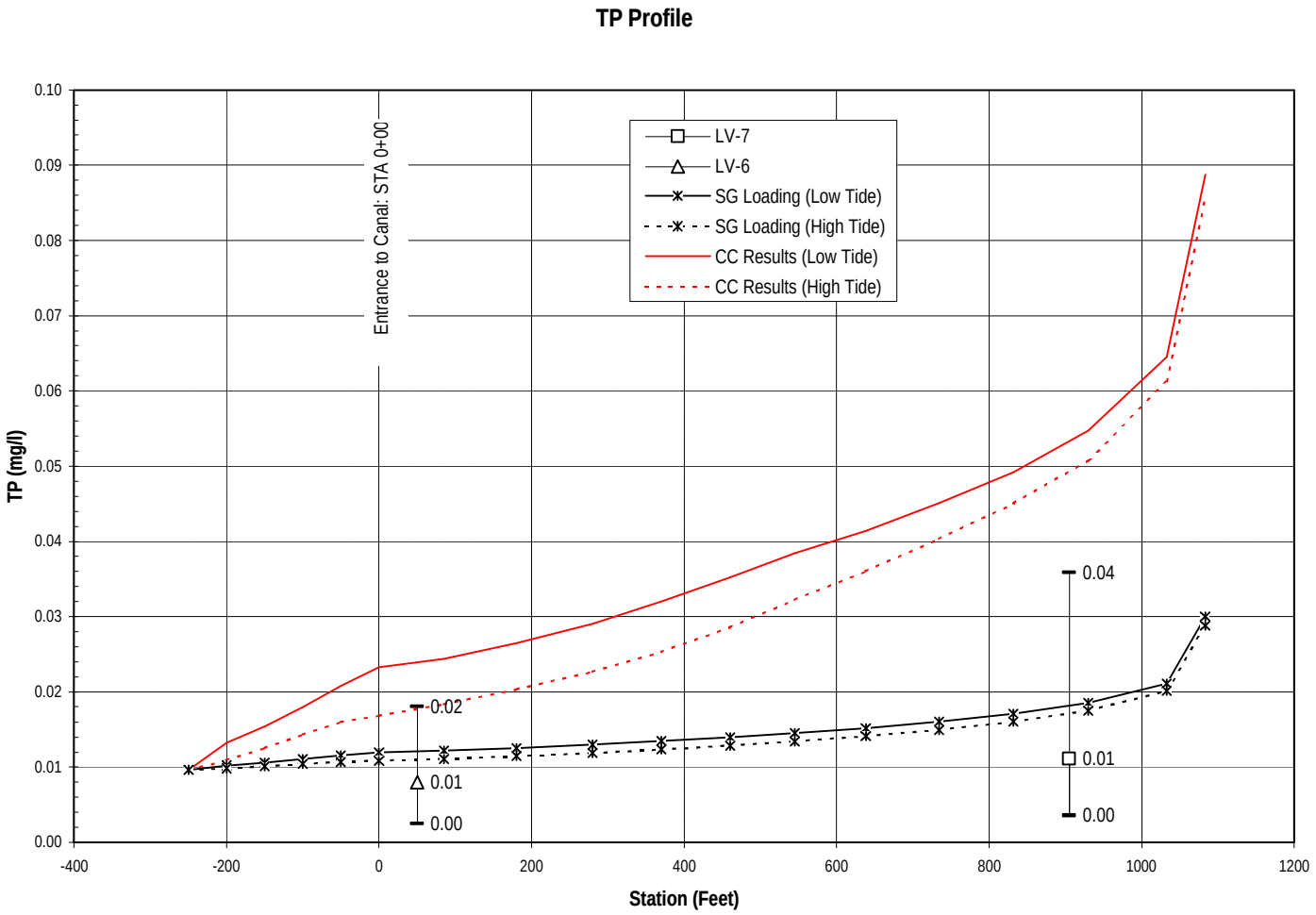

Canal #208, Marathon Model Output: TN Profile



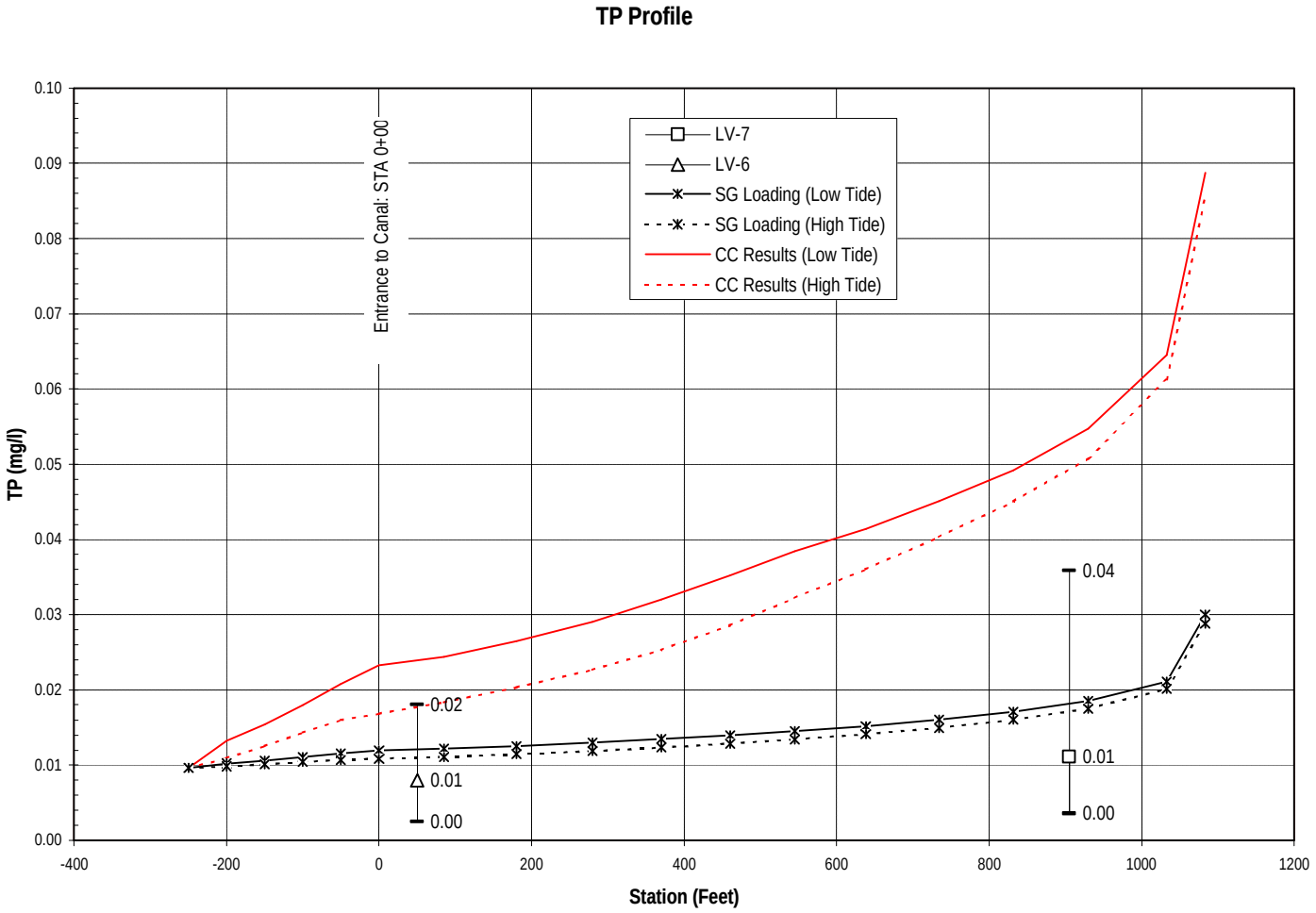

Canal #208, Marathon Model Output: TP, low tide



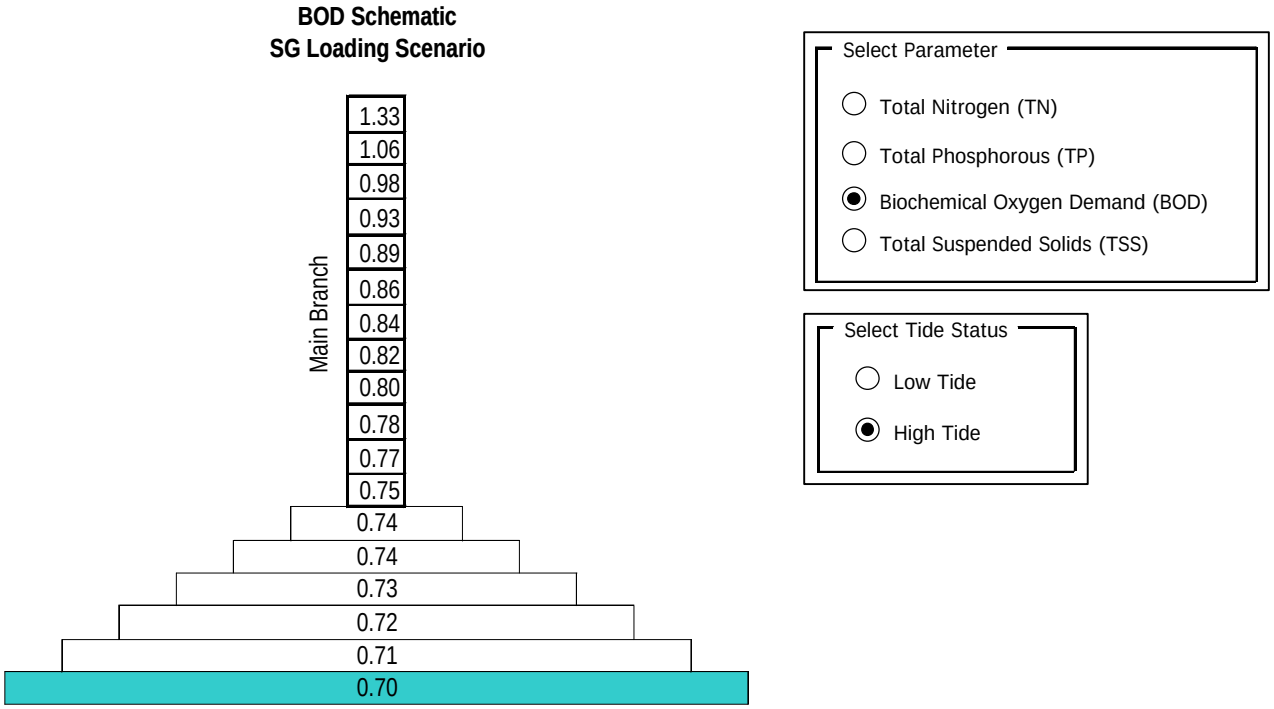

Canal #208, Marathon Model Output: TP, high tide



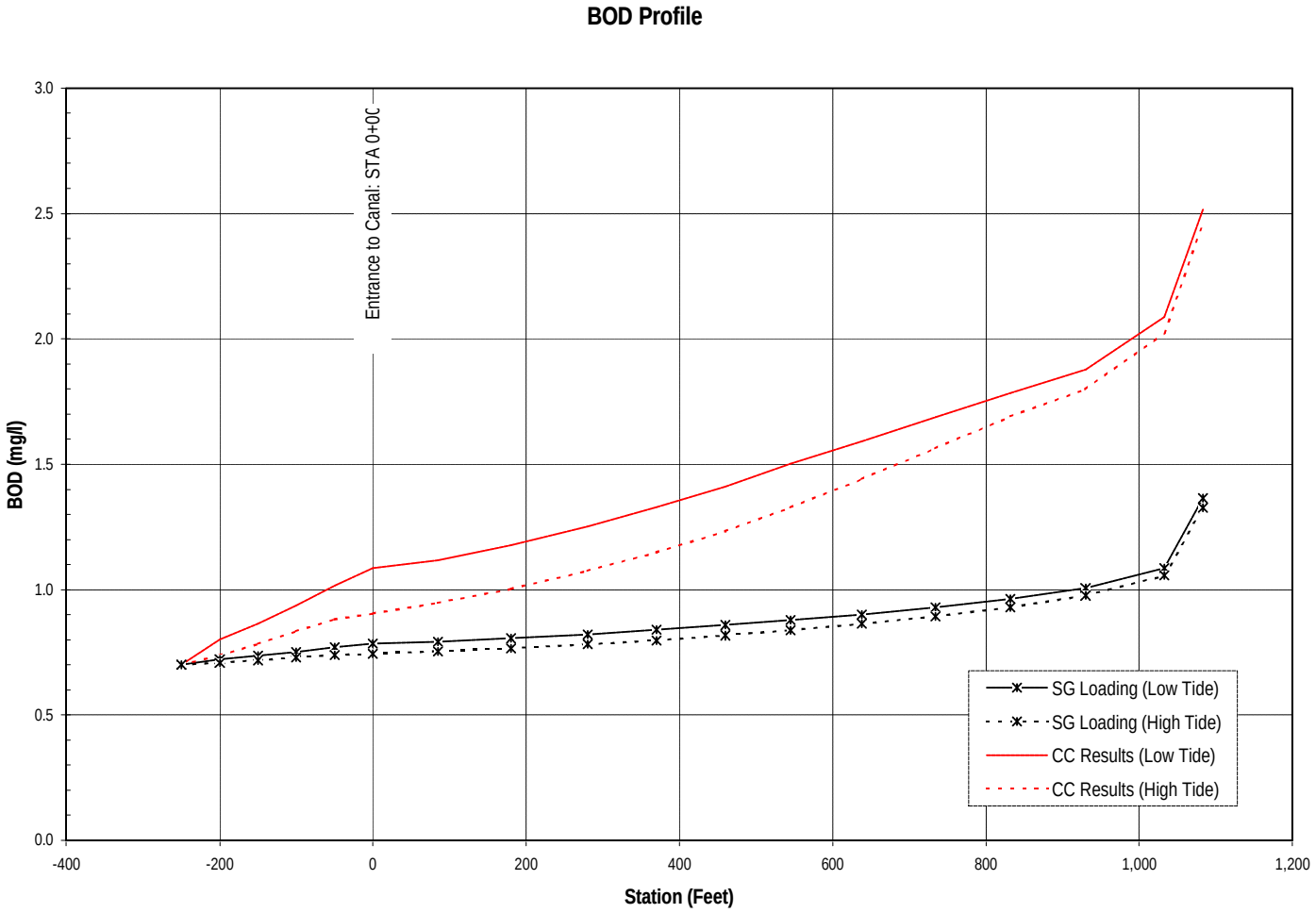

Canal #208, Marathon Model Output: TP Profile



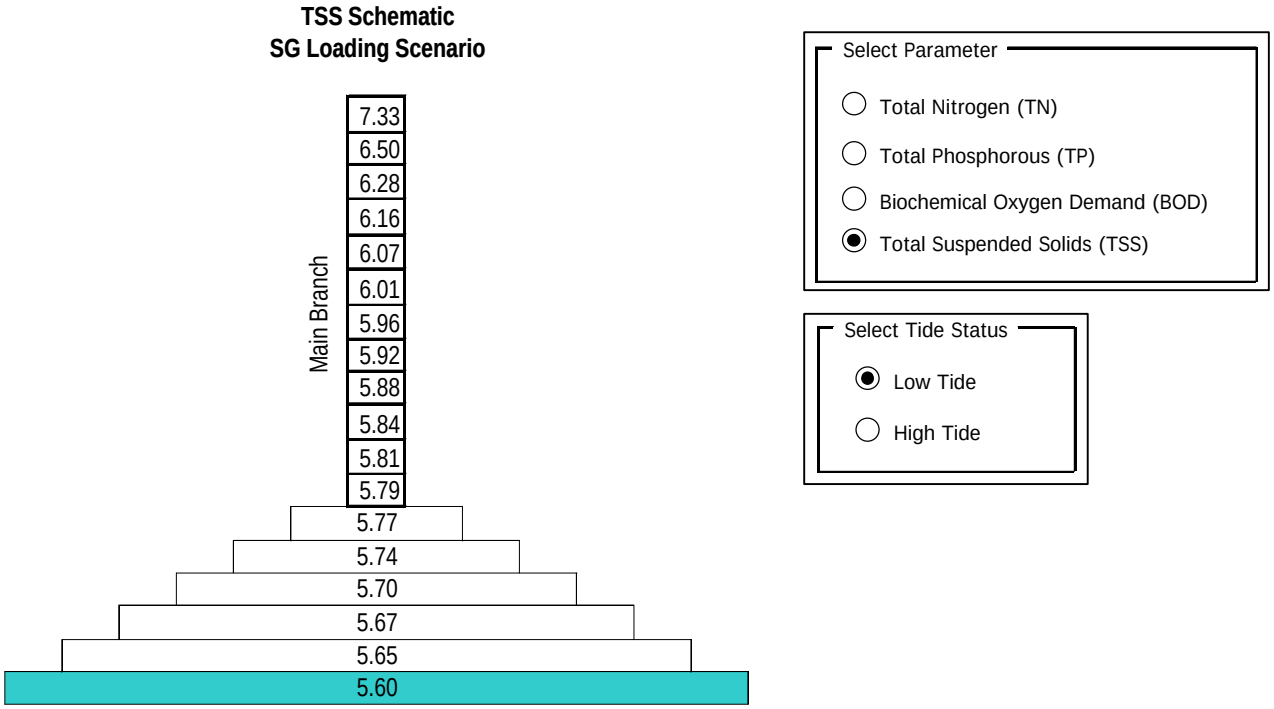

Canal #208, Marathon Model Output: BOD, low tide



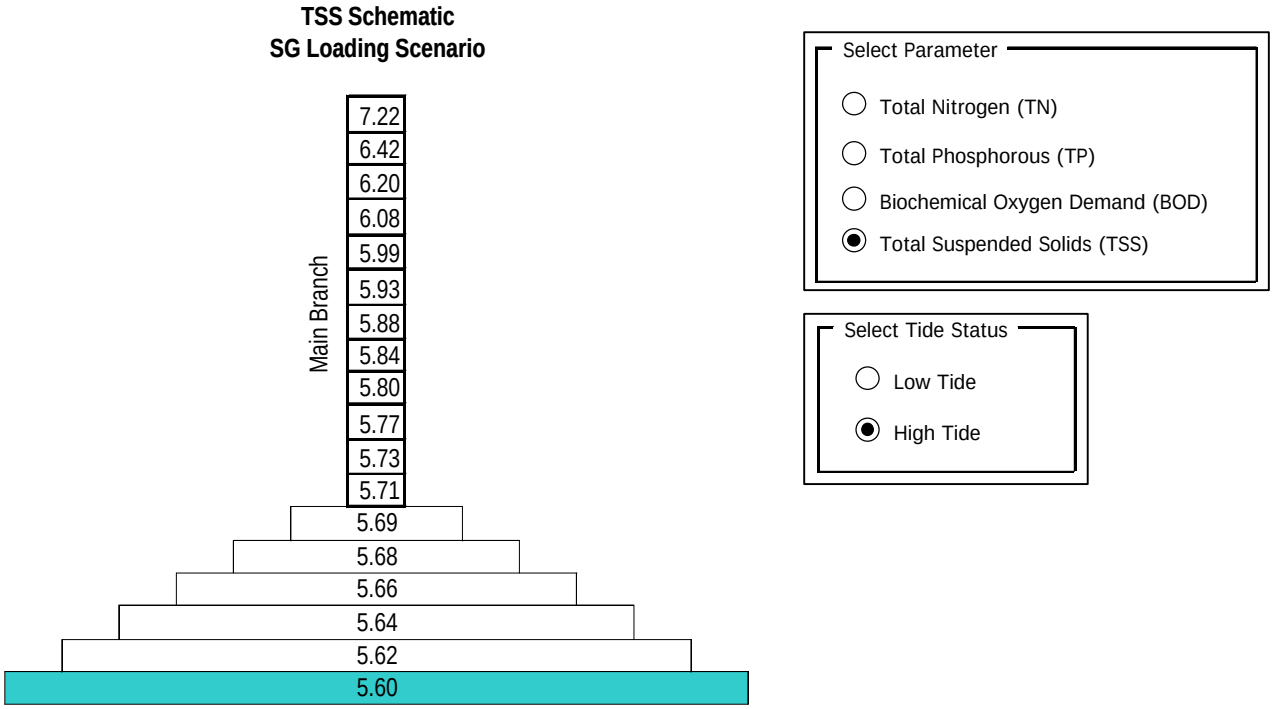

Canal #208, Marathon Model Output: BOD, high tide



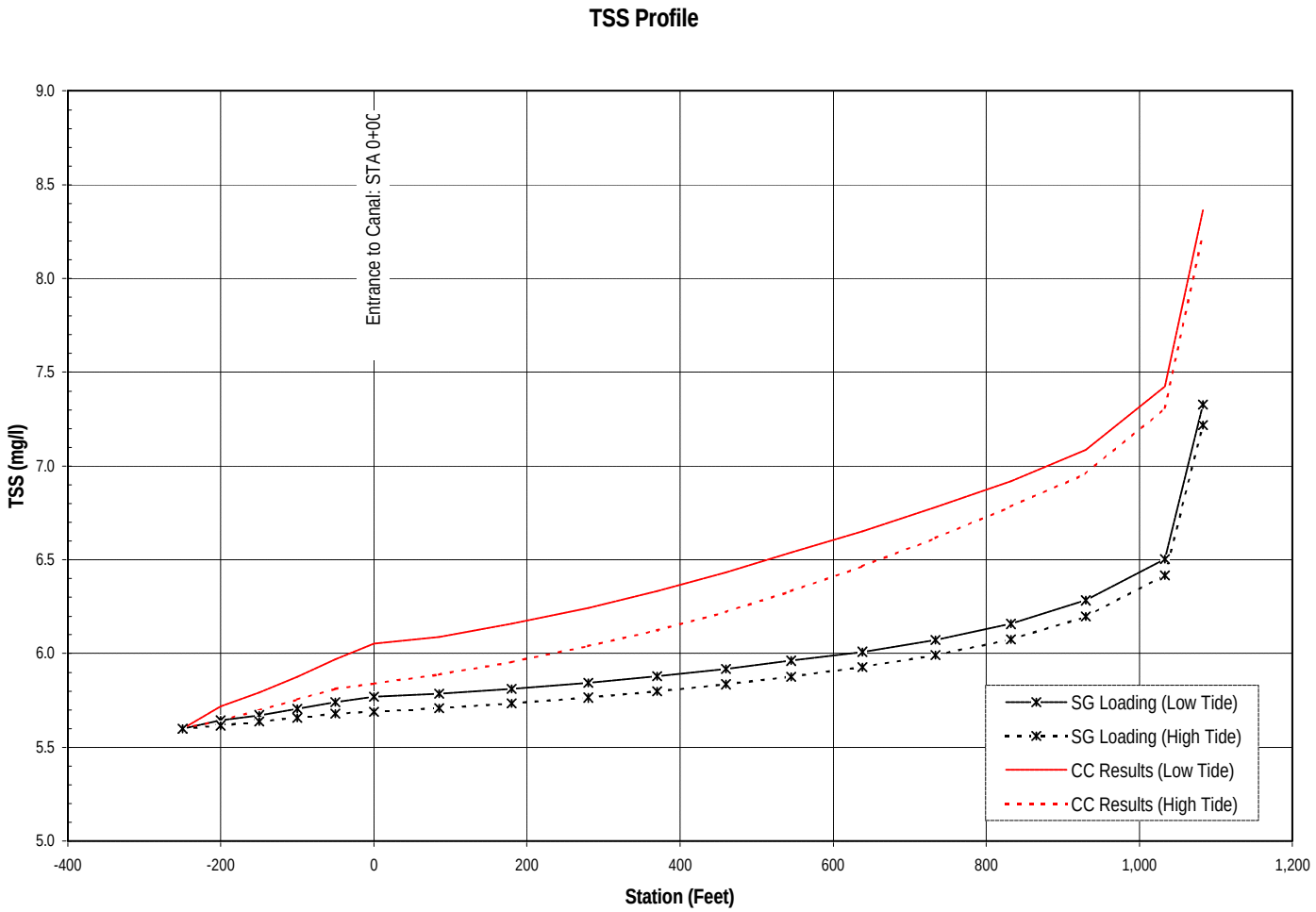

Canal #208, Marathon Model Output: BOD Profile



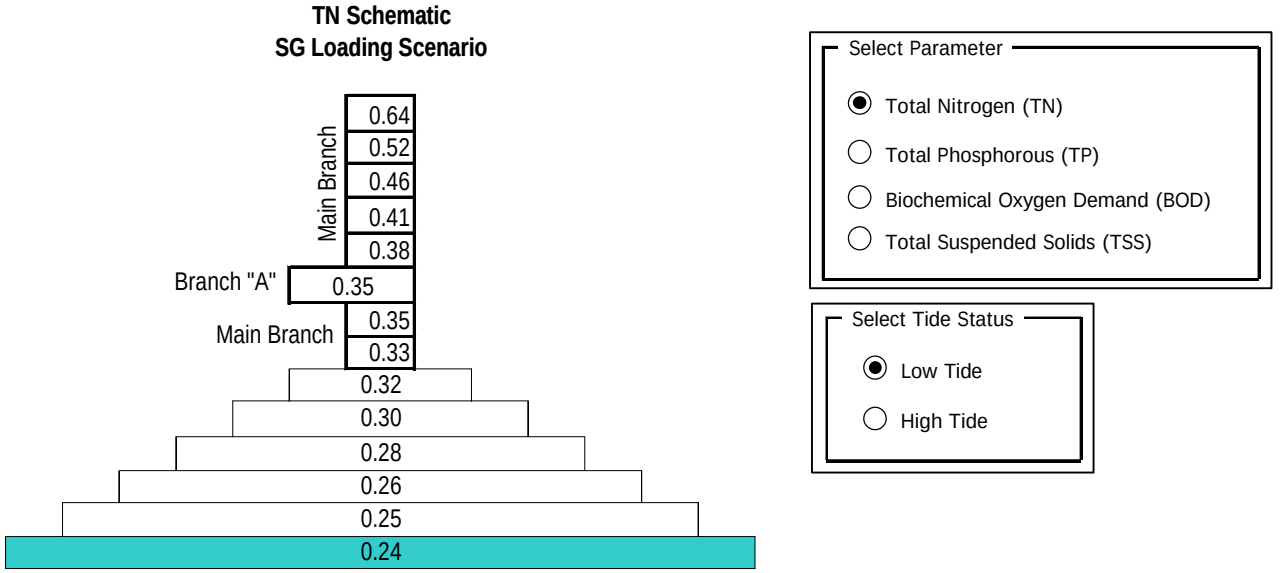

Canal #208, Marathon Model Output: TSS, low tide



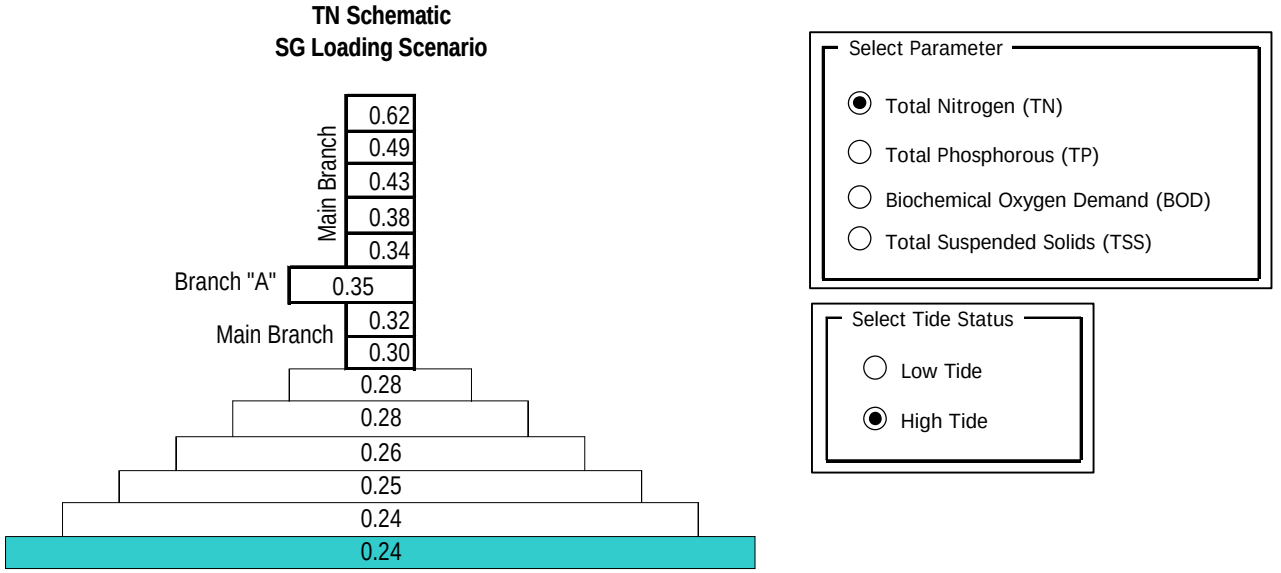

Canal #208, Marathon Model Output: TSS, high tide



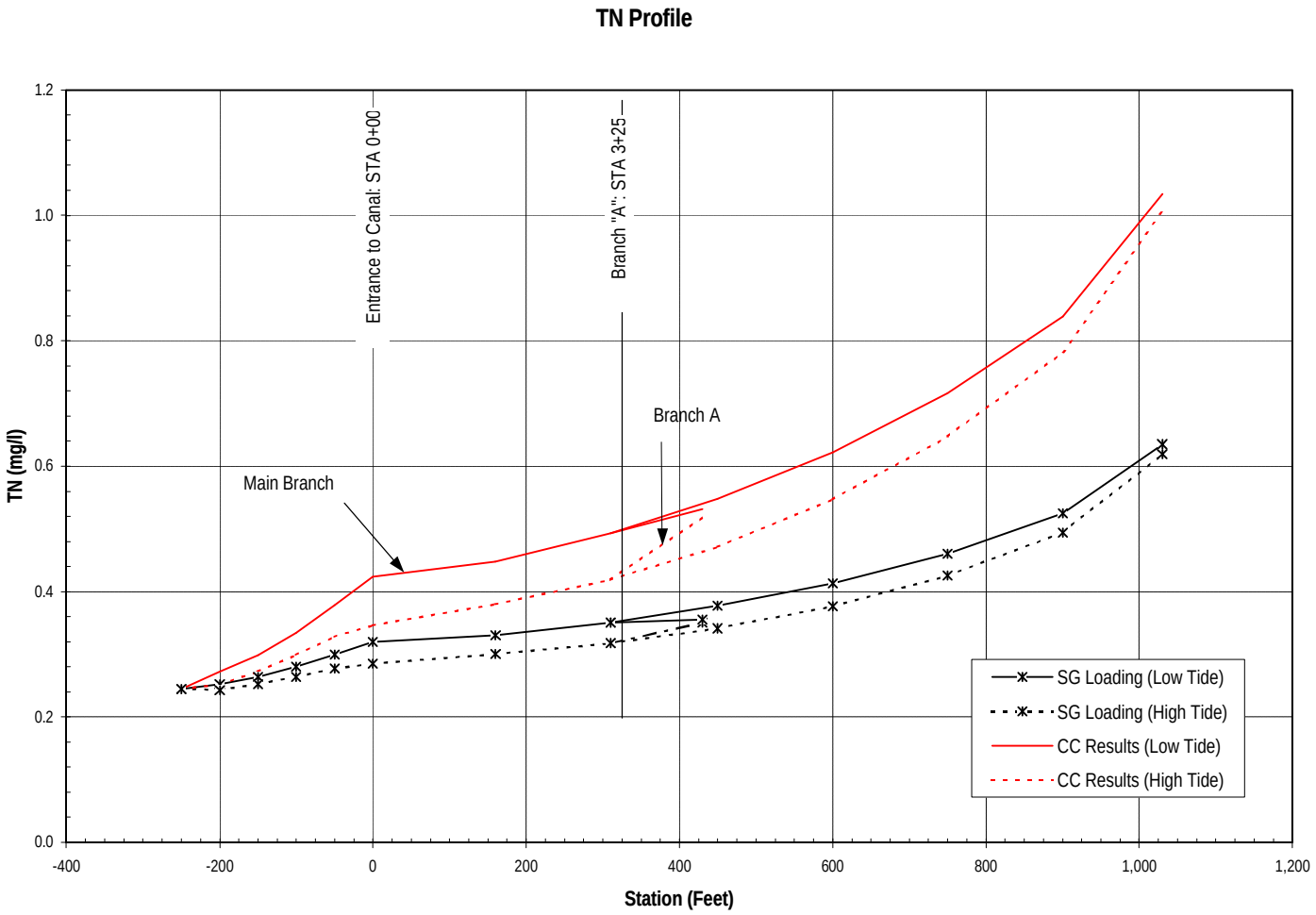

Canal #208, Marathon Model Output: TSS Profile



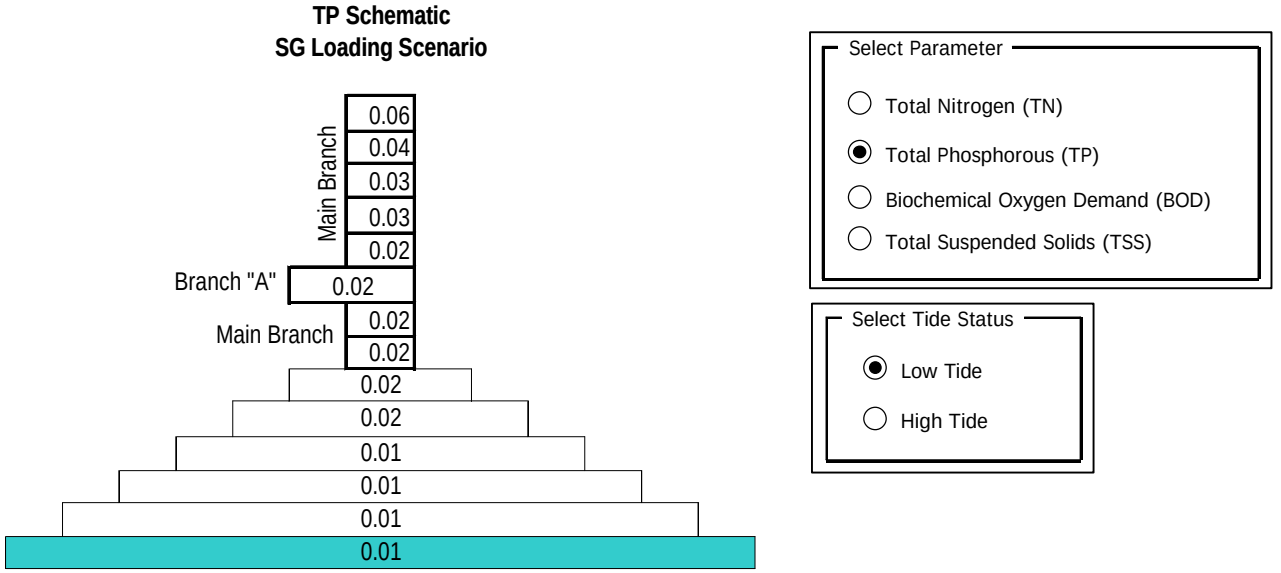

Canal #246, Marathon Model Output: TN, low tide



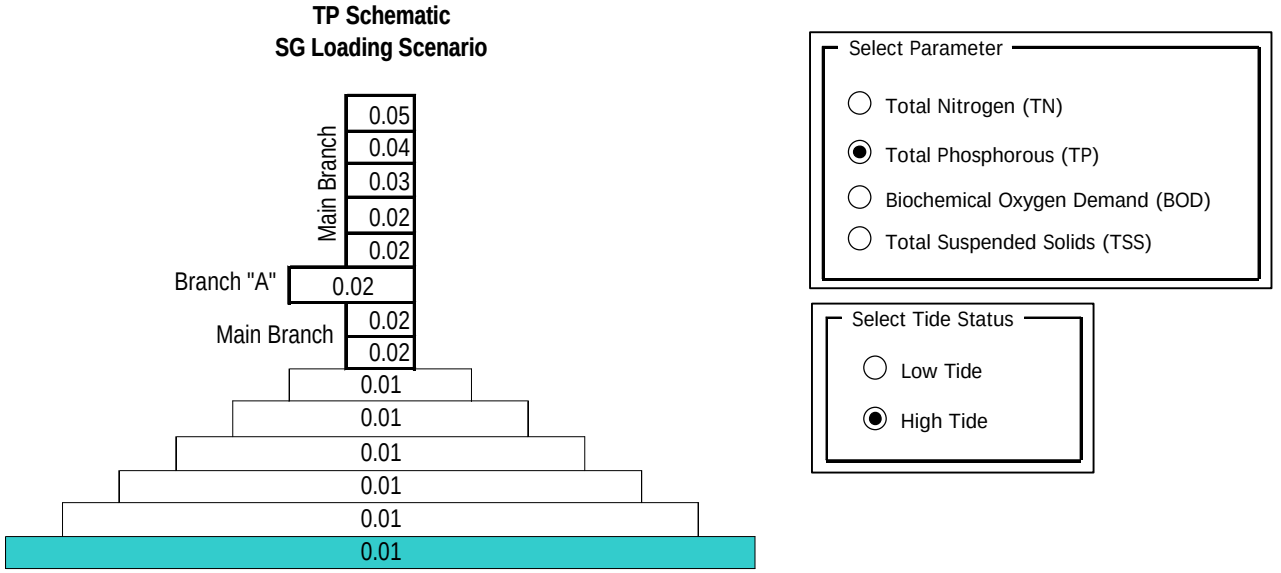

Canal #246, Marathon Model Output: TN, high tide



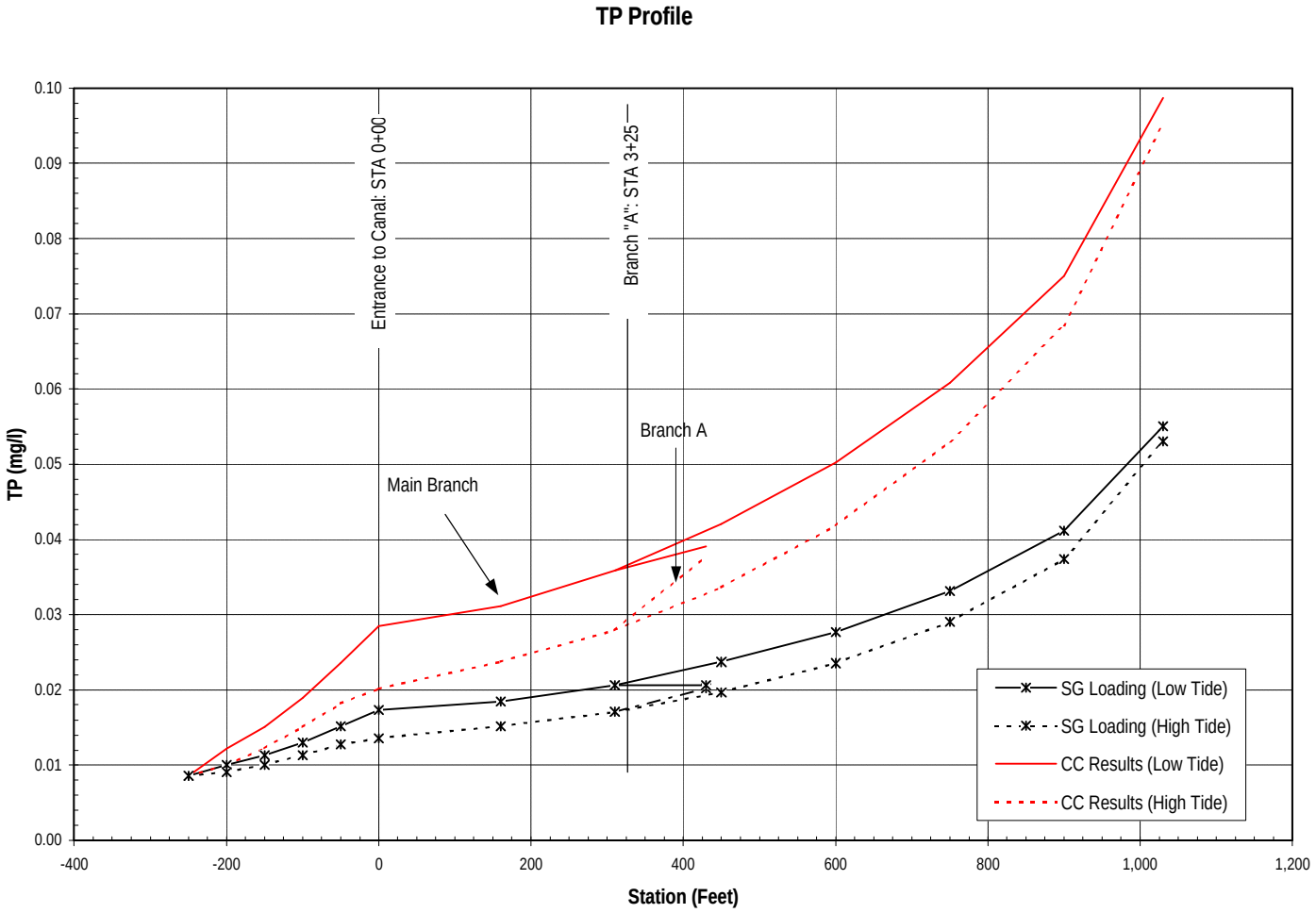

Canal #246, Marathon Model Output: TN Profile



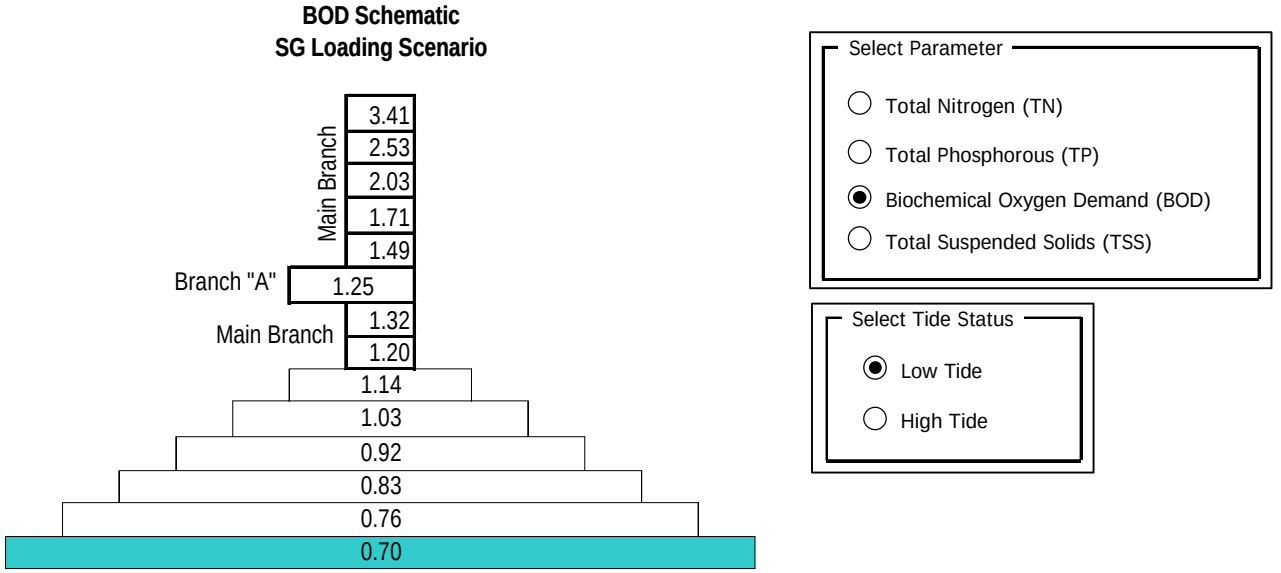

Canal #246, Marathon Model Output: TP, low tide



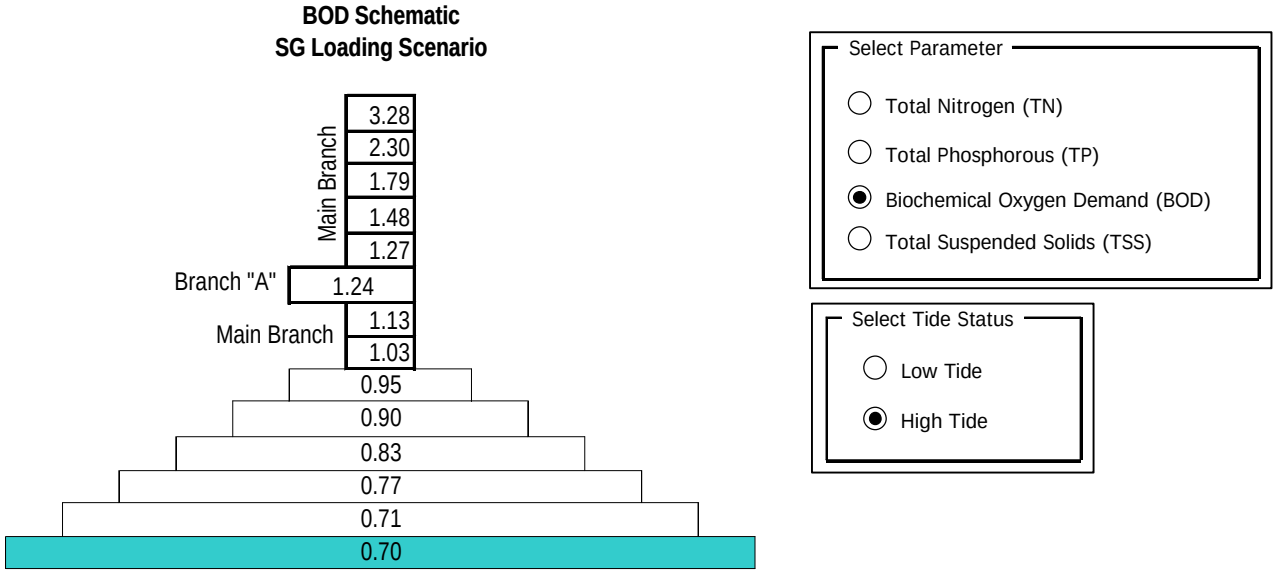

Canal #246, Marathon Model Output: TP, high tide



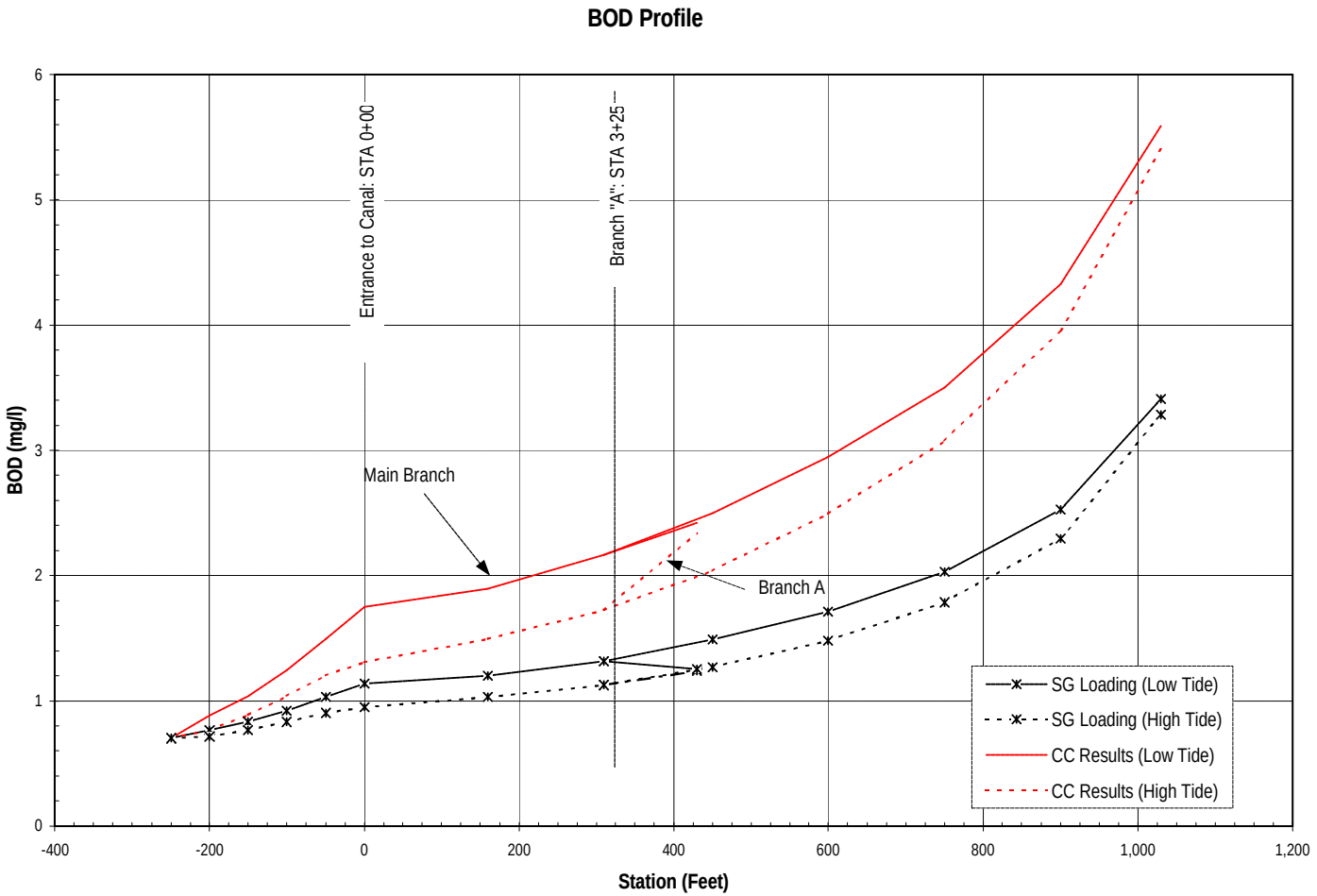

Canal #246, Marathon Model Output: TP Profile



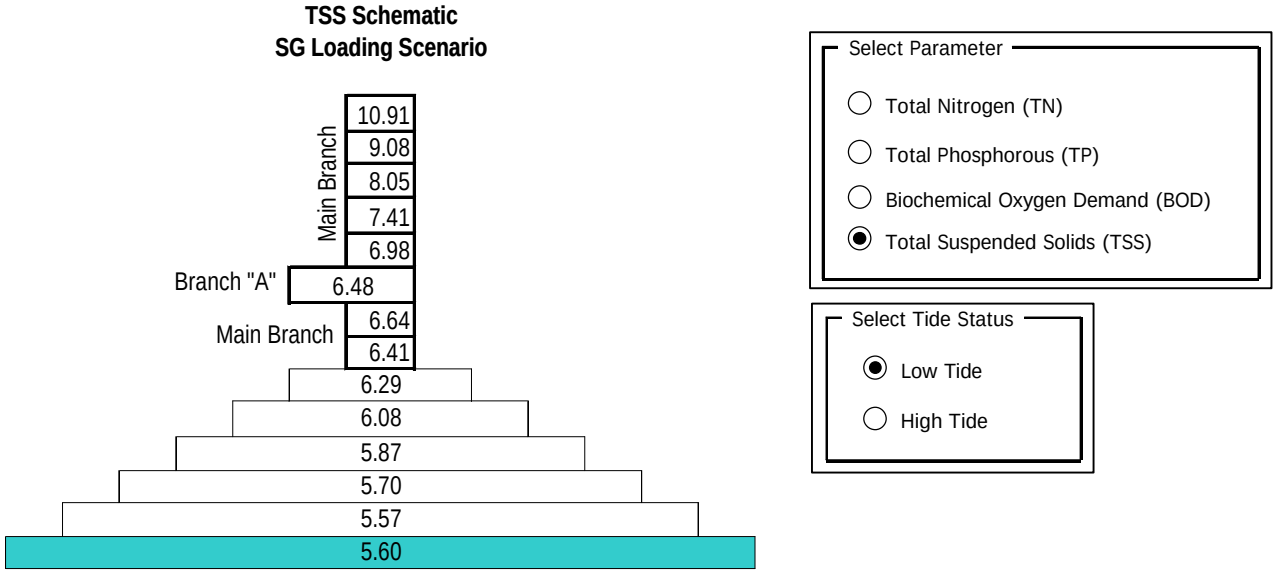

Canal #246, Marathon Model Output: BOD, low tide



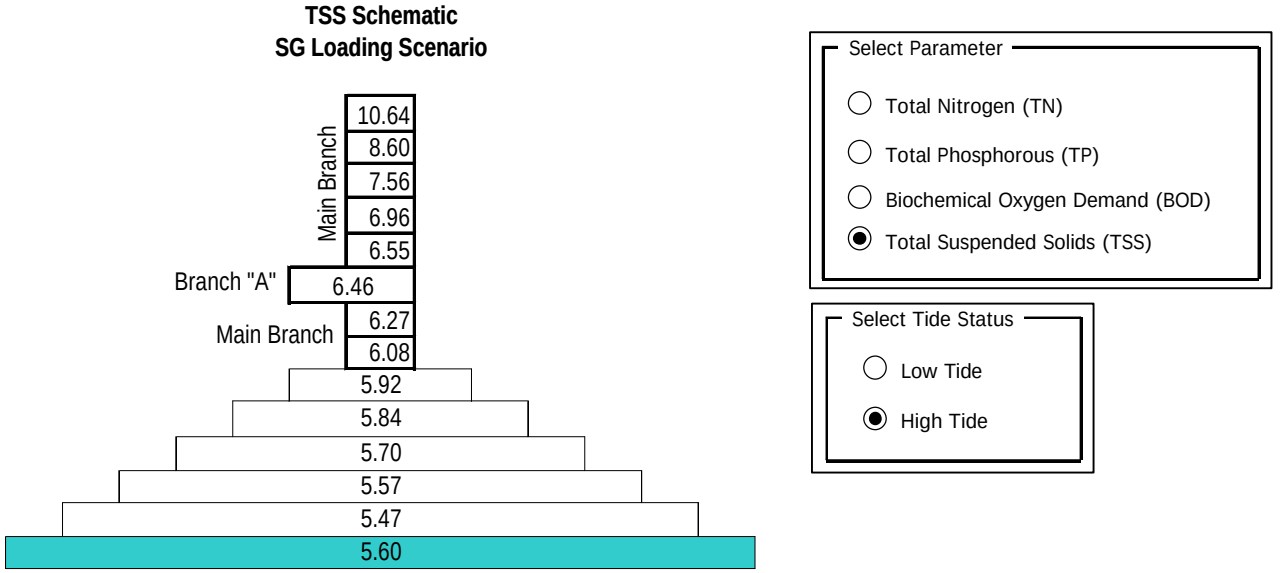

Canal #246, Marathon Model Output: BOD, high tide



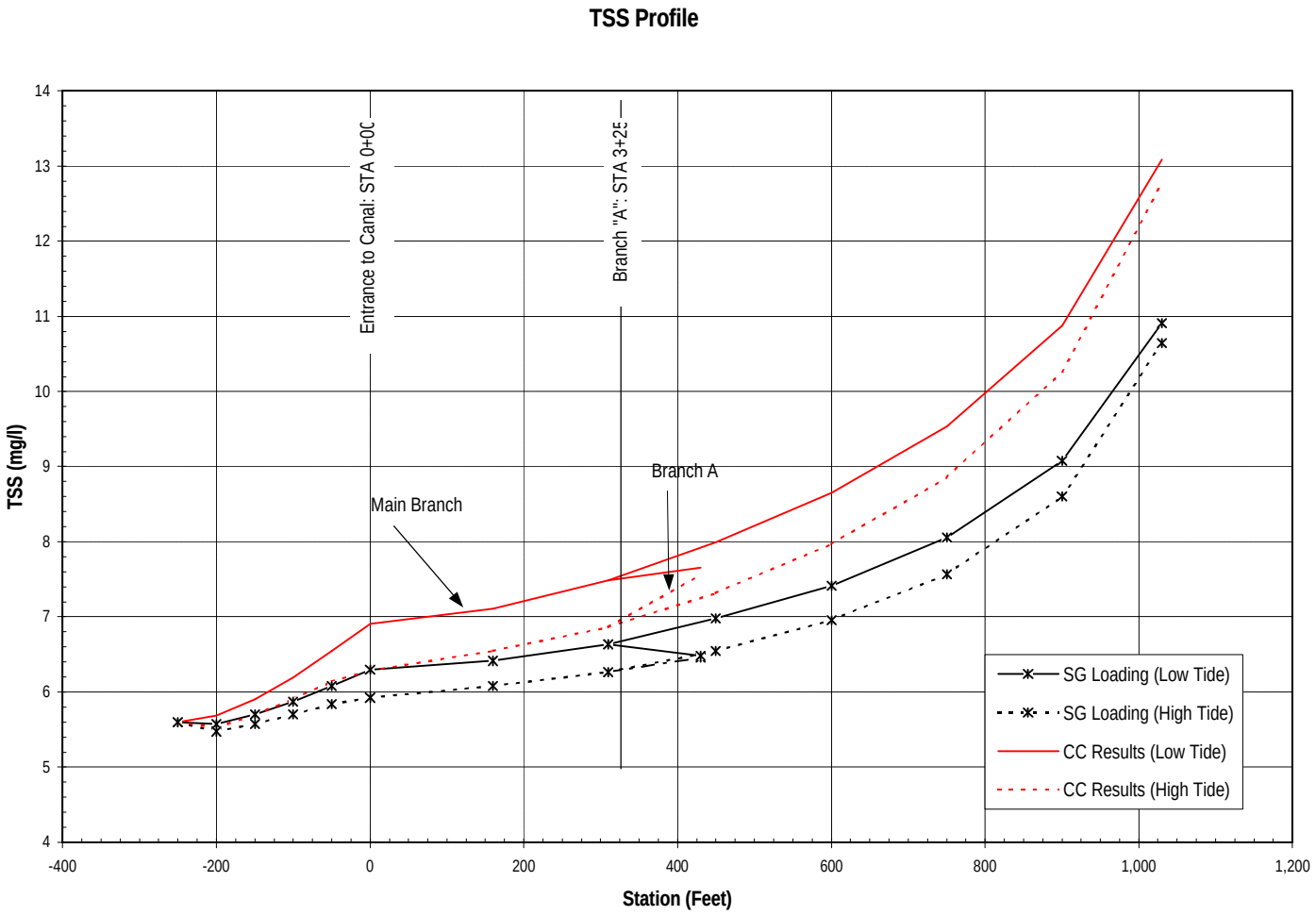

Canal #246, Marathon Model Output: BOD Profile



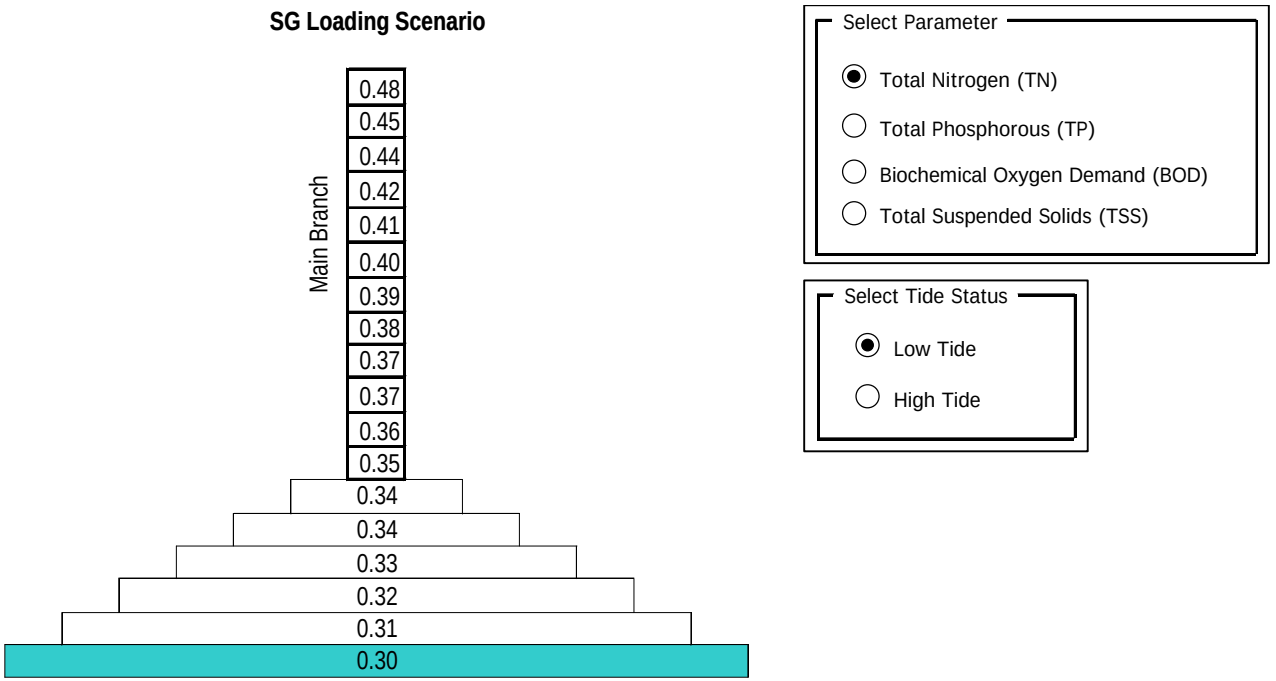

Canal #246, Marathon Model Output: TSS, low tide



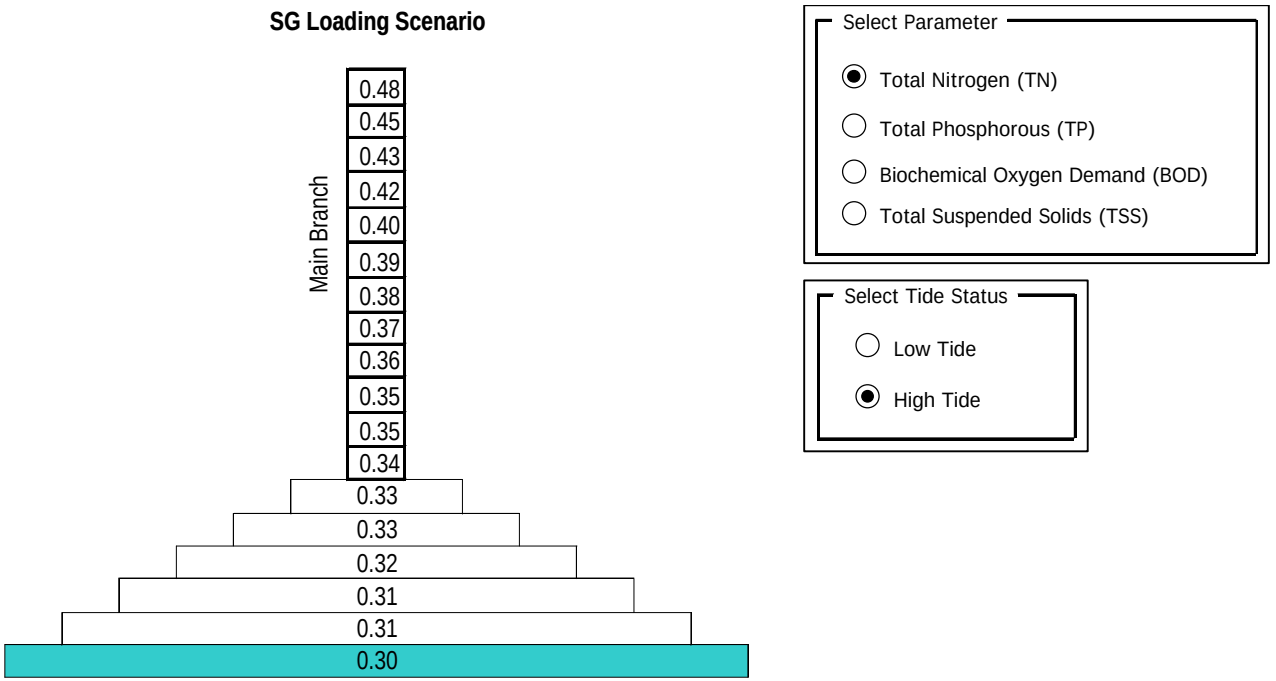

Canal #246, Marathon Model Output: TSS, high tide



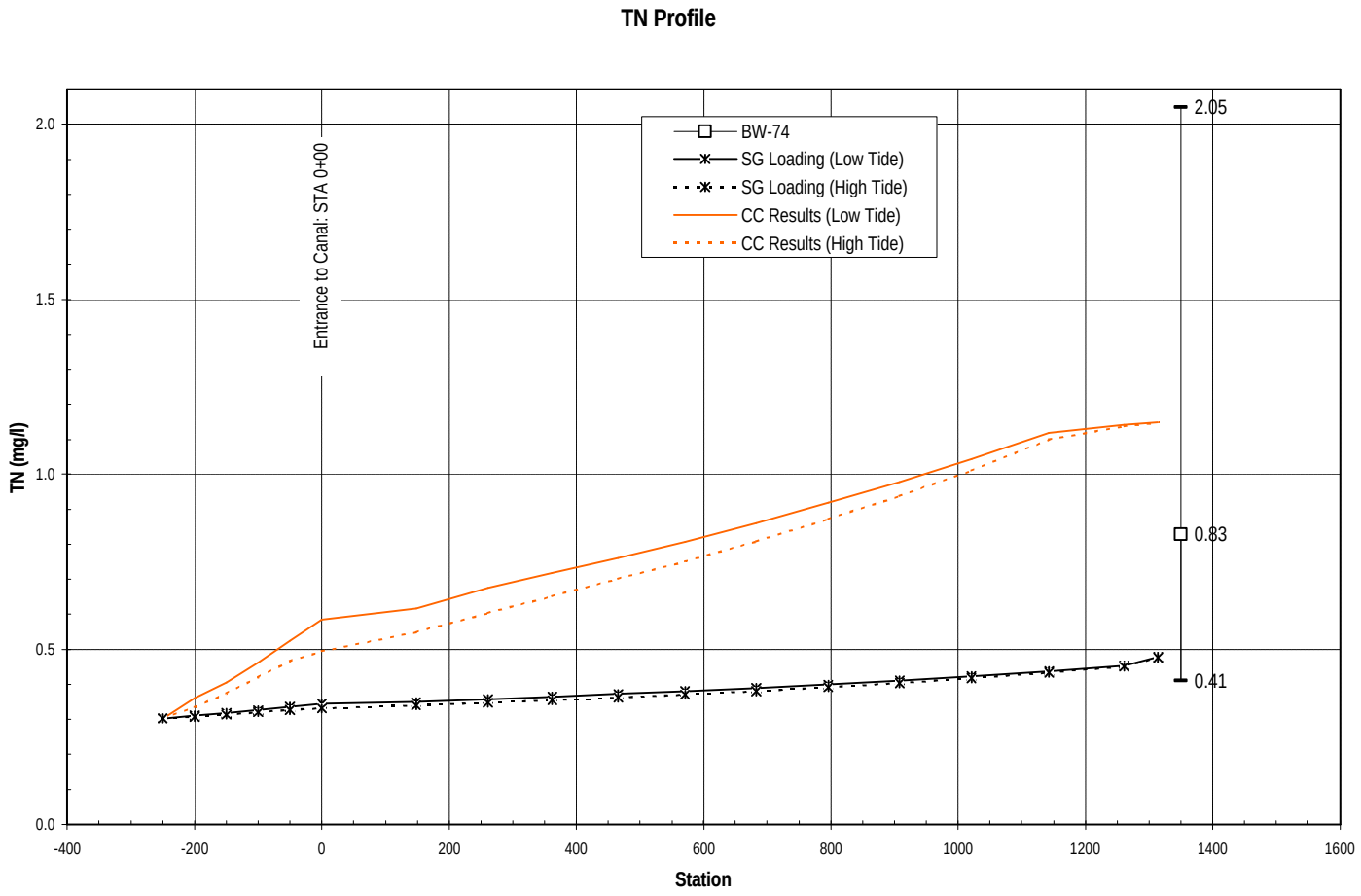

Canal #246, Marathon Model Output: TSS Profile



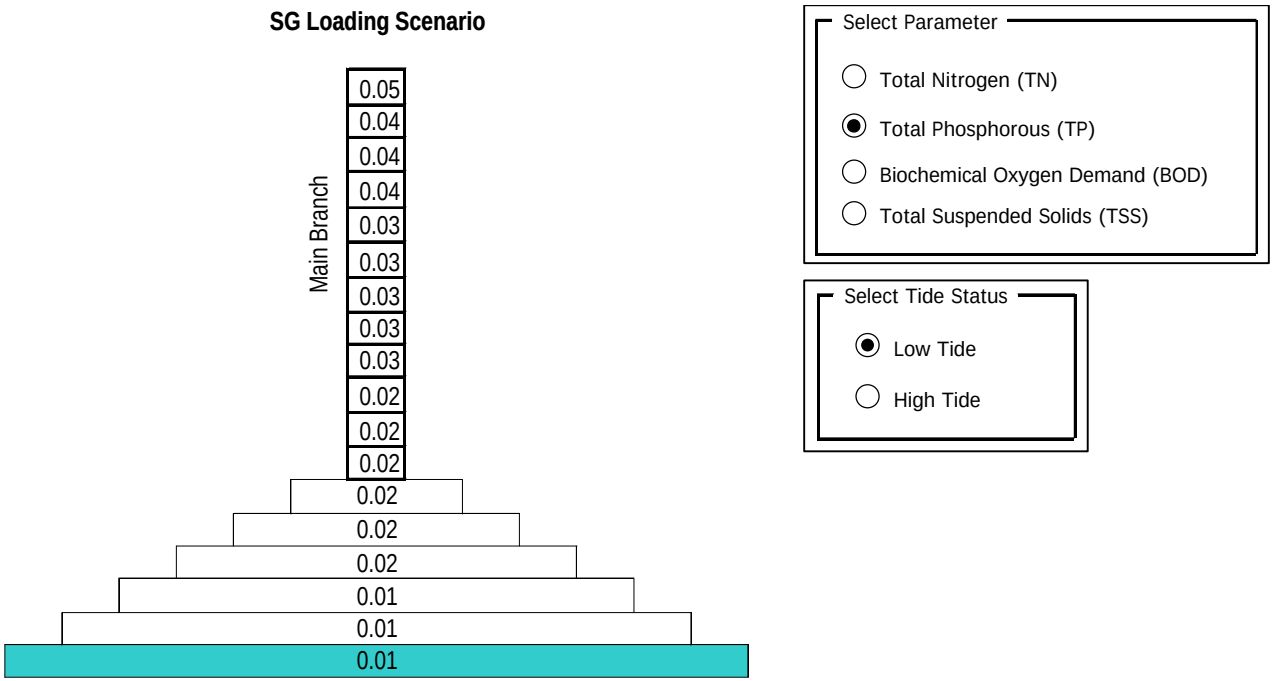

Canal #288, Big Pine Model Output: TN, low tide



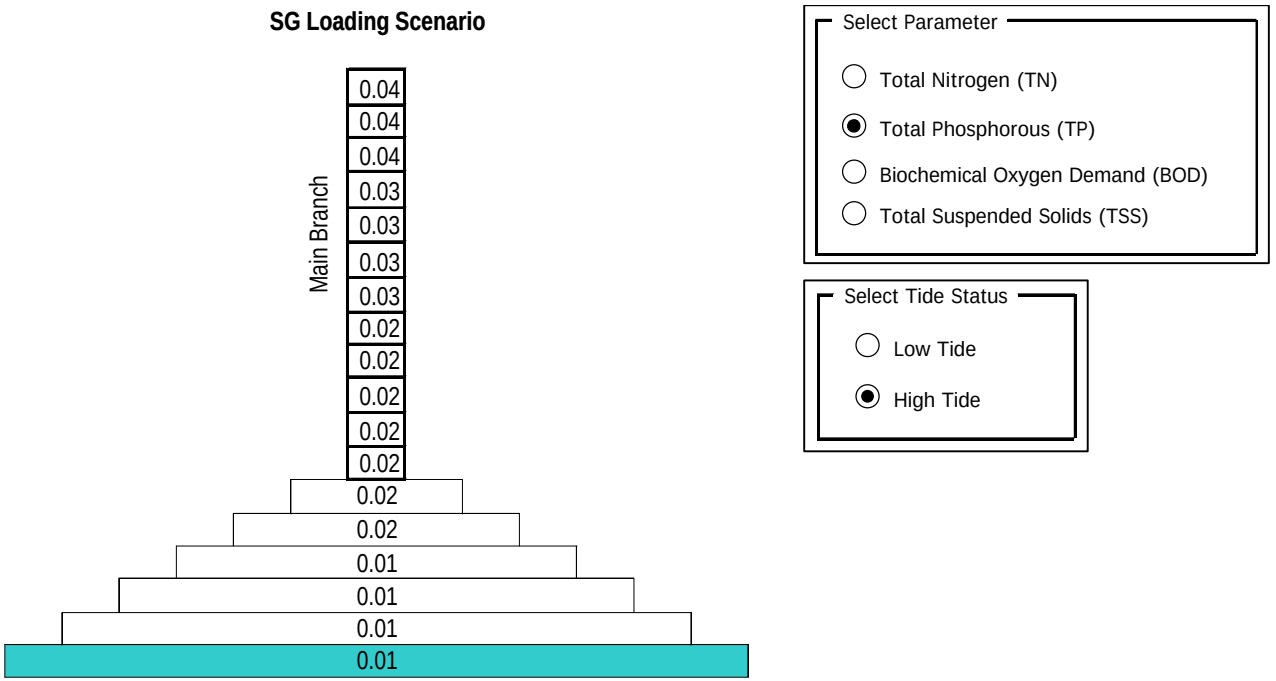

Canal #288, Big Pine Model Output: TN, high tide



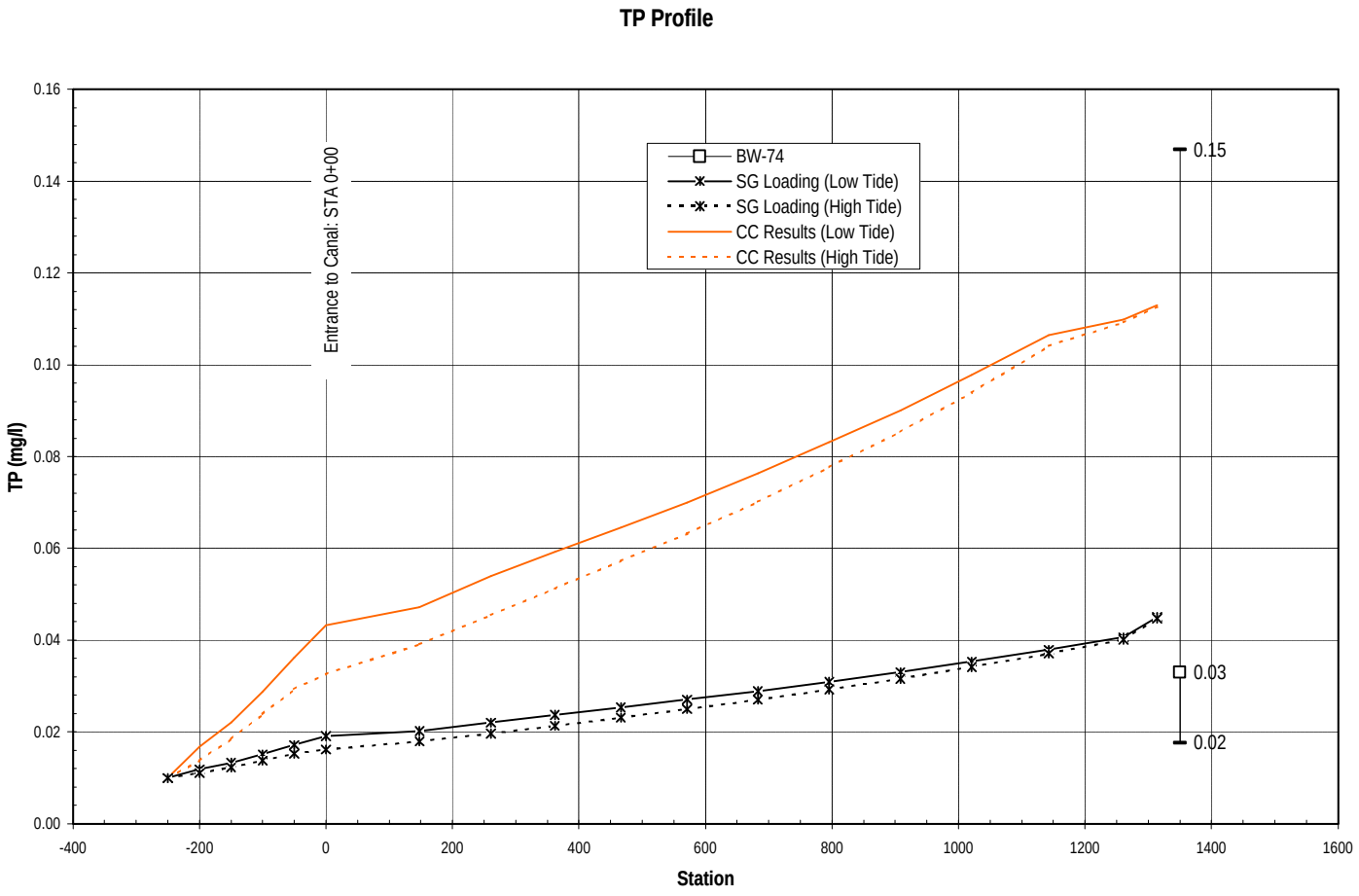

Canal #288, Big Pine Model Output: TN Profile



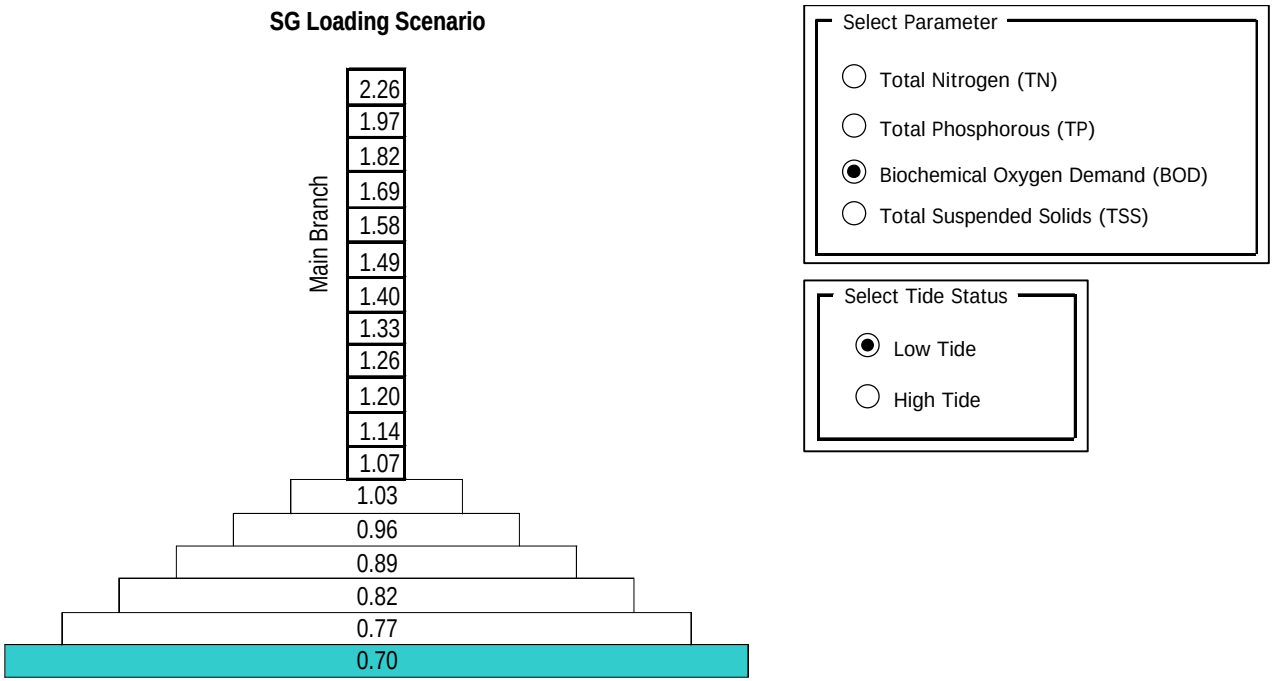

Canal #288, Big Pine Model Output: TP, low tide



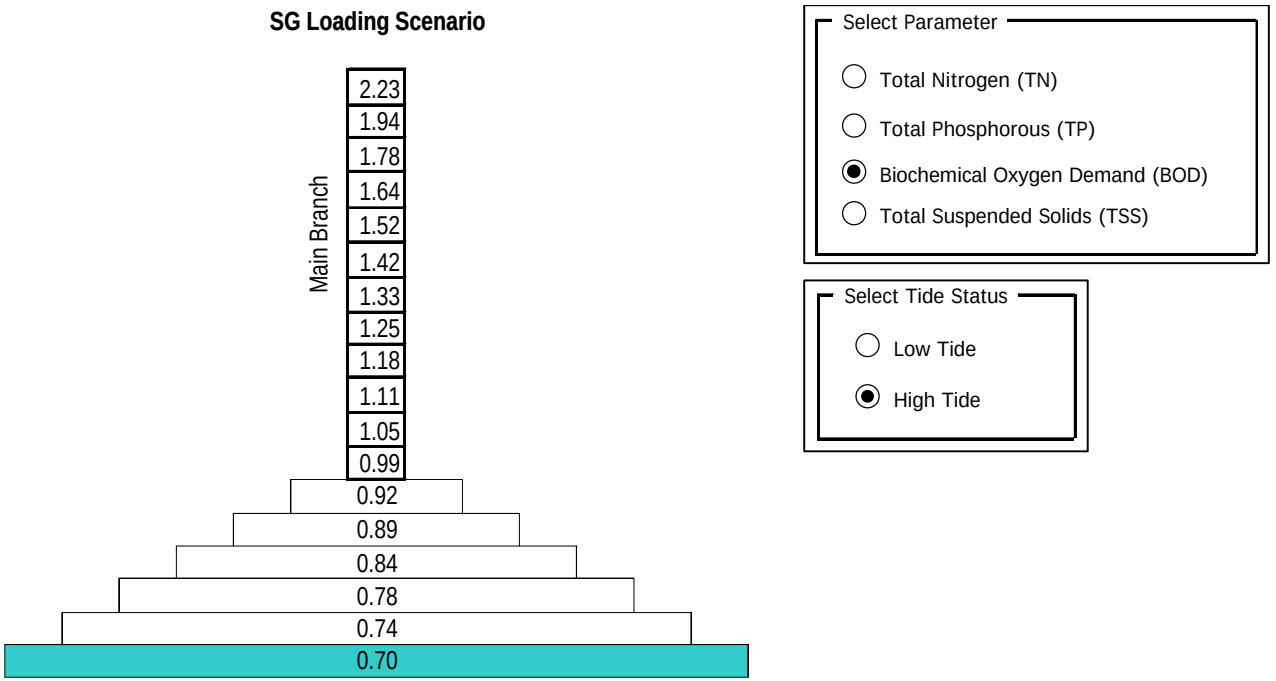

Canal #288, Big Pine Model Output: TP, high tide




Canal #288, Big Pine Model Output: TP Profile




Canal #288, Big Pine Model Output: BOD, low tide

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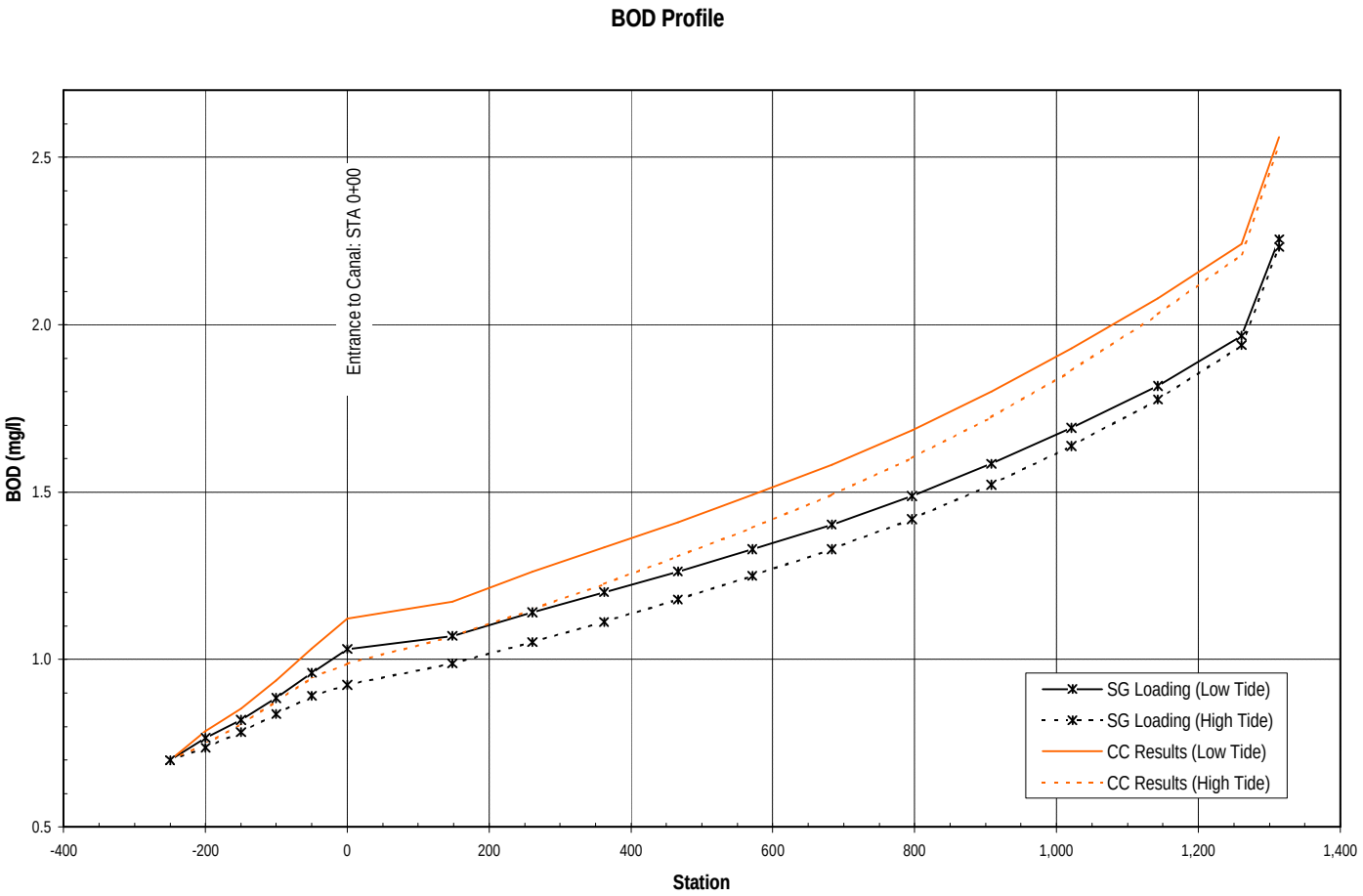
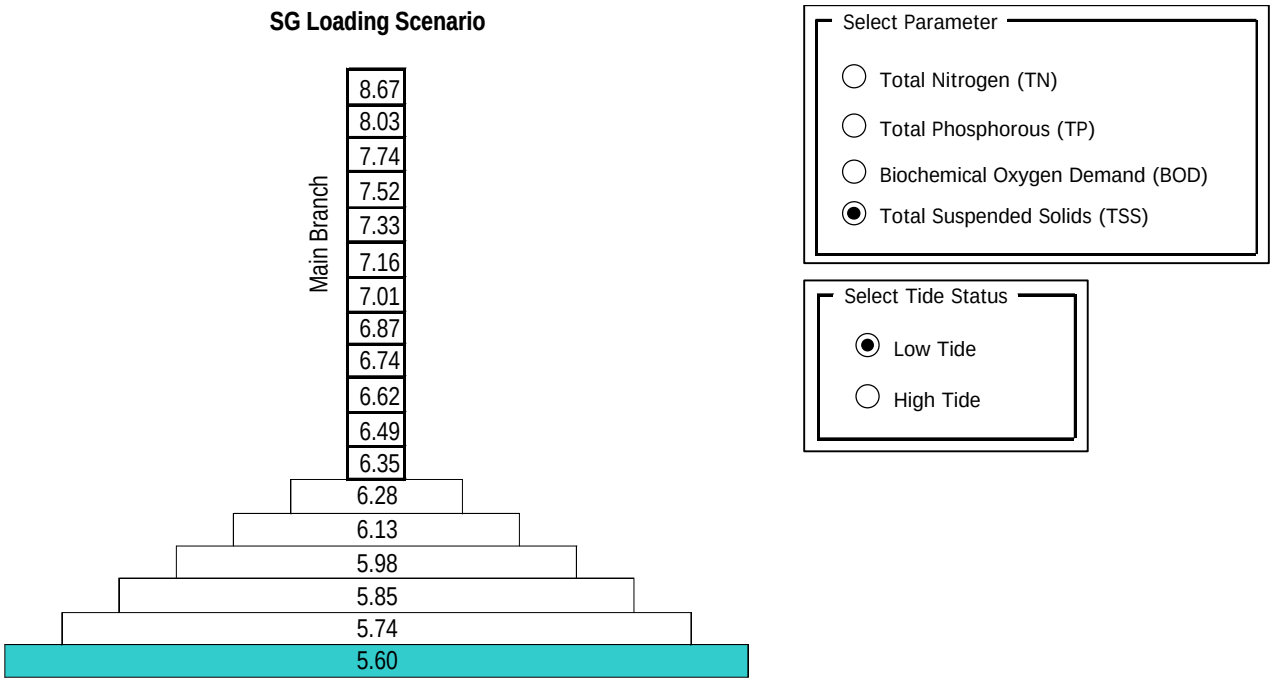
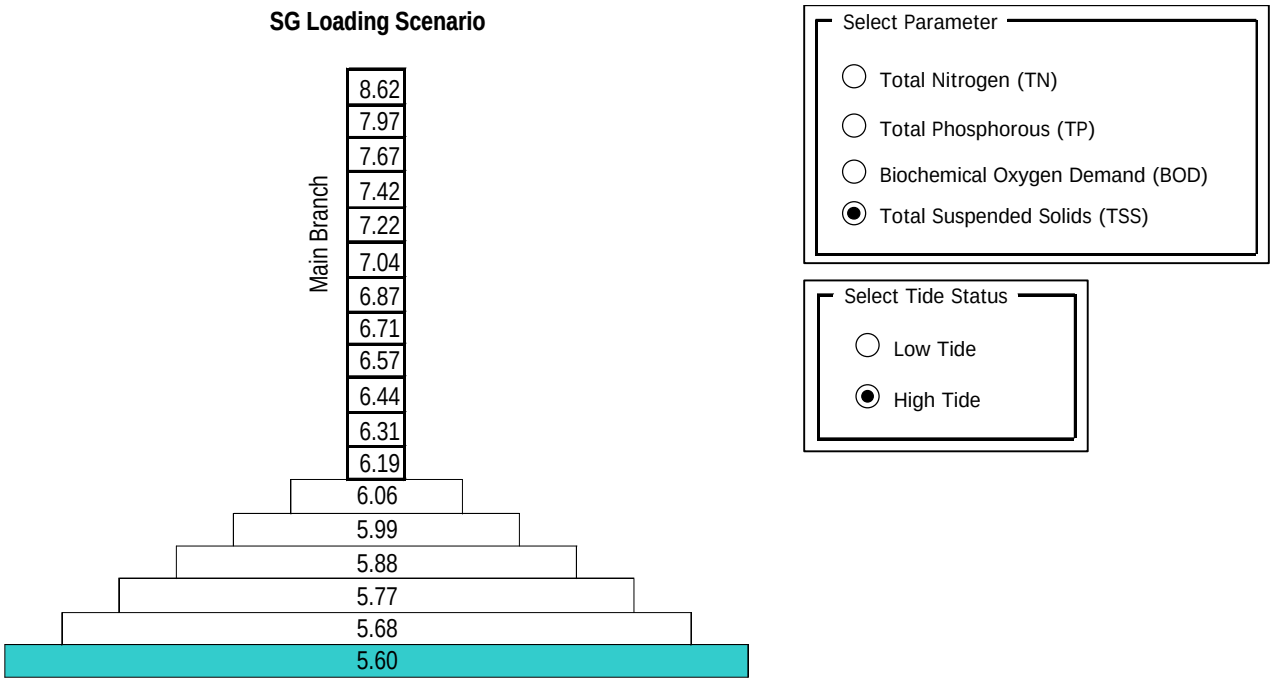


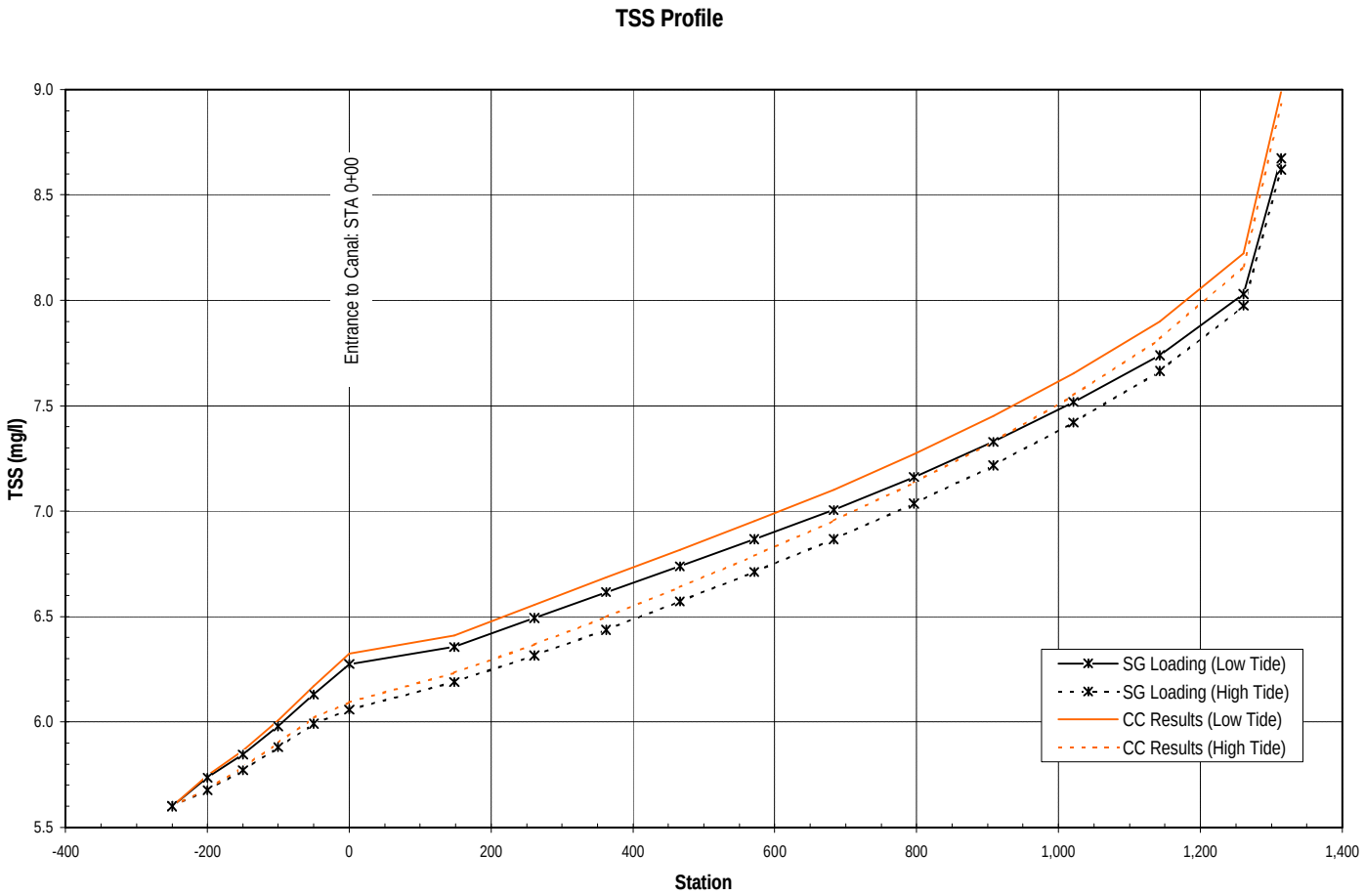

Canal #288, Big Pine Model Output: BOD Profile



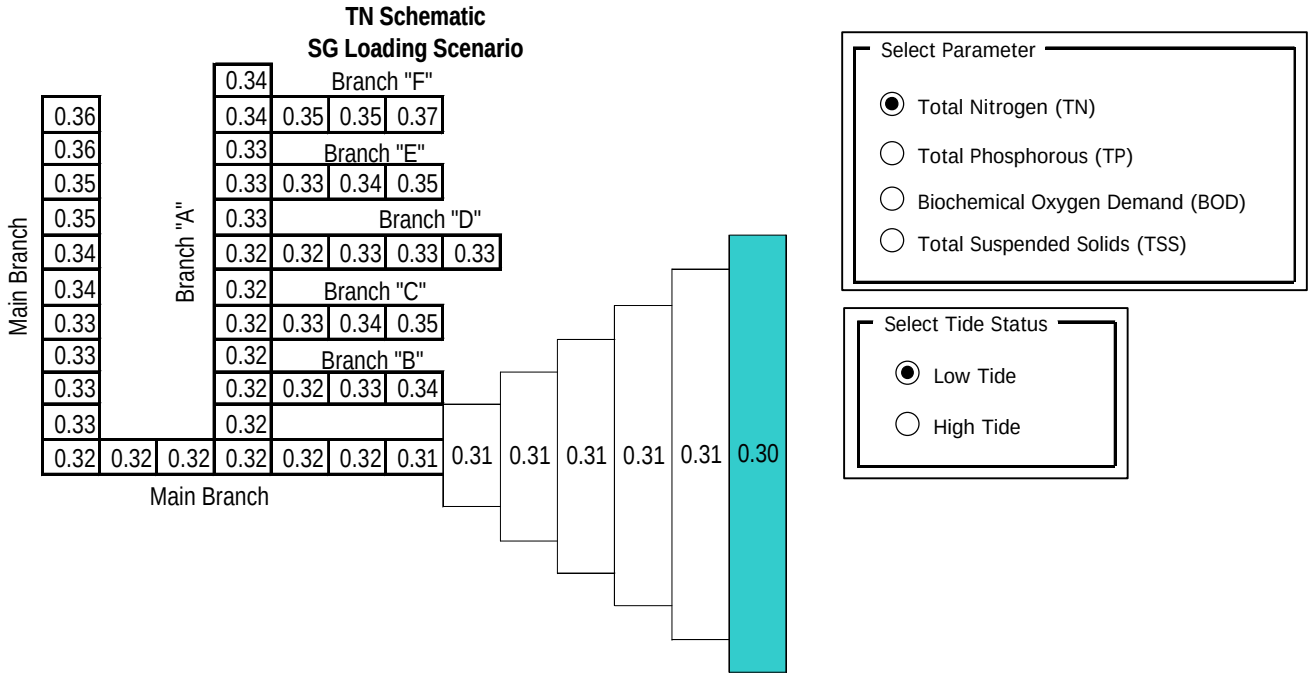

Canal #288, Big Pine Model Output: TSS, low tide



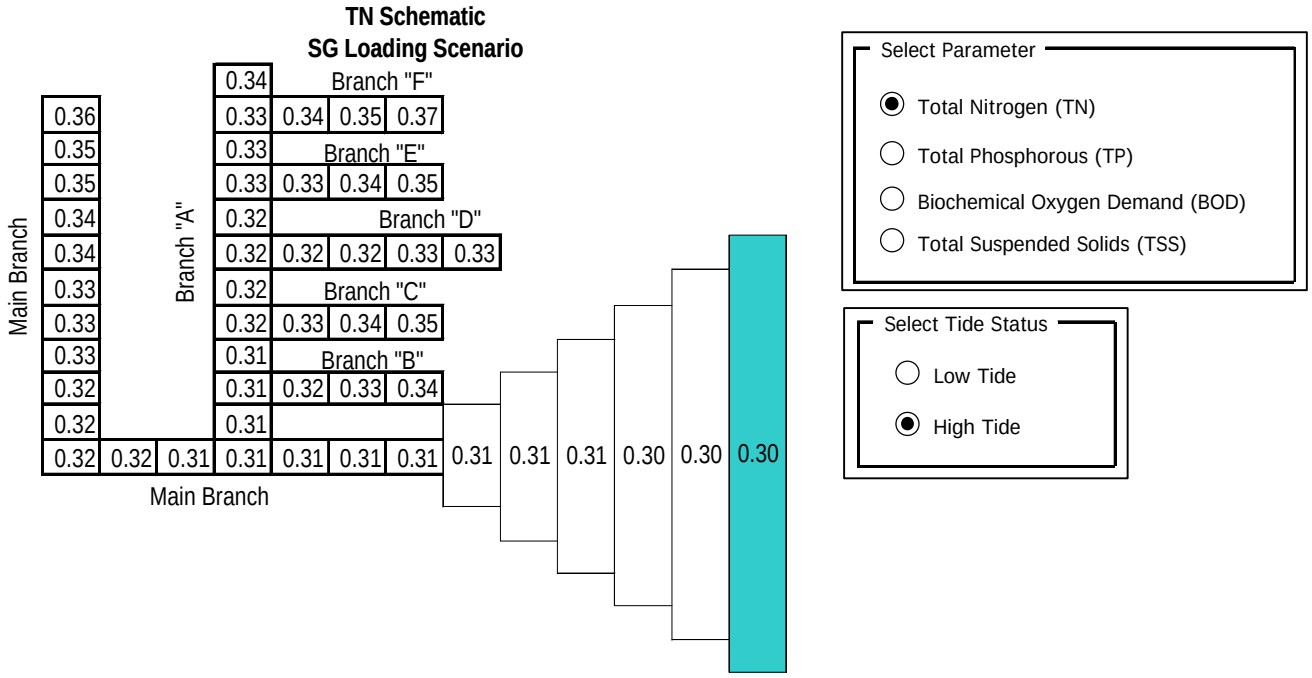

Canal #288, Big Pine Model Output: TSS, high tide



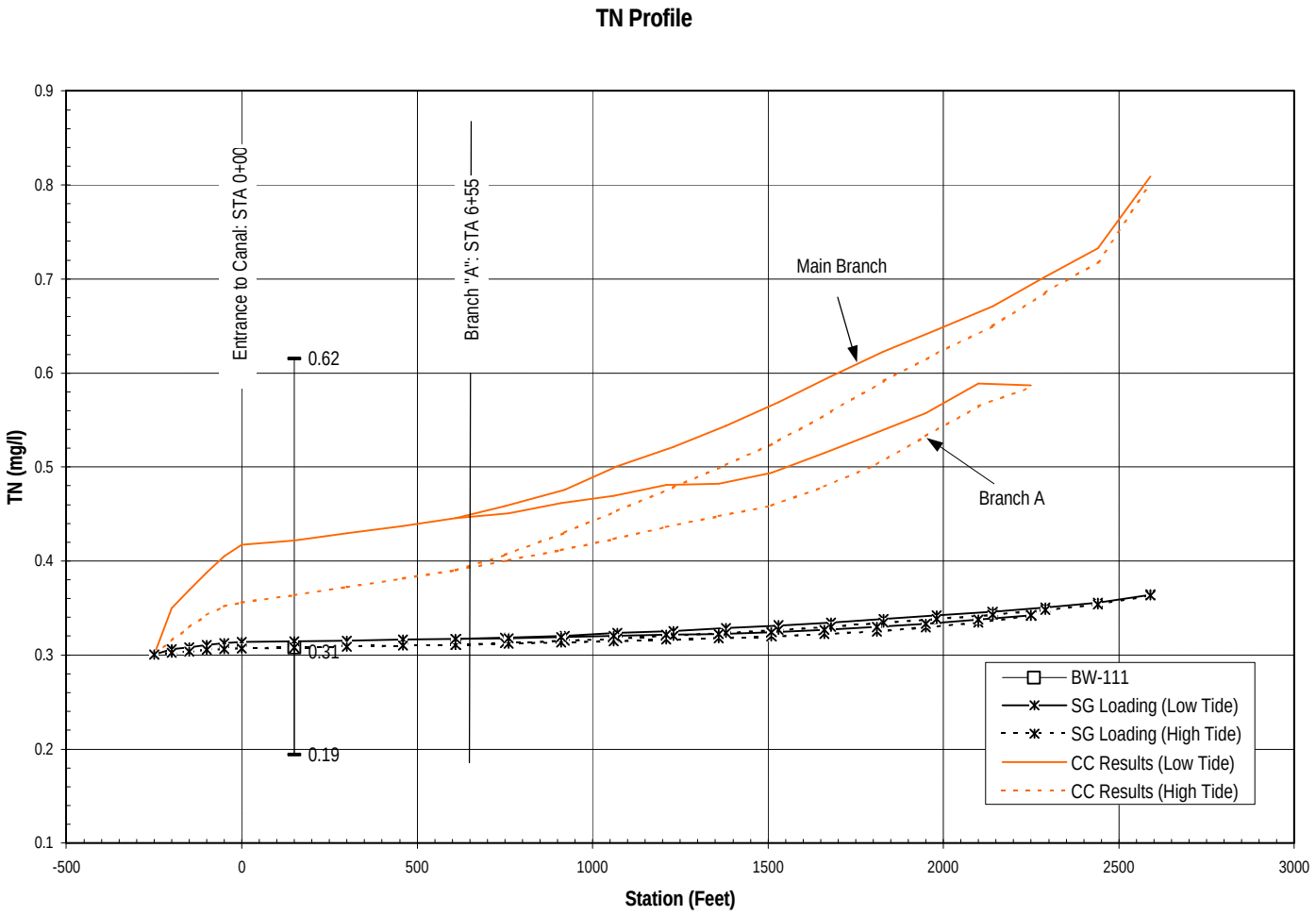

Canal #288, Big Pine Model Output: TSS Profile



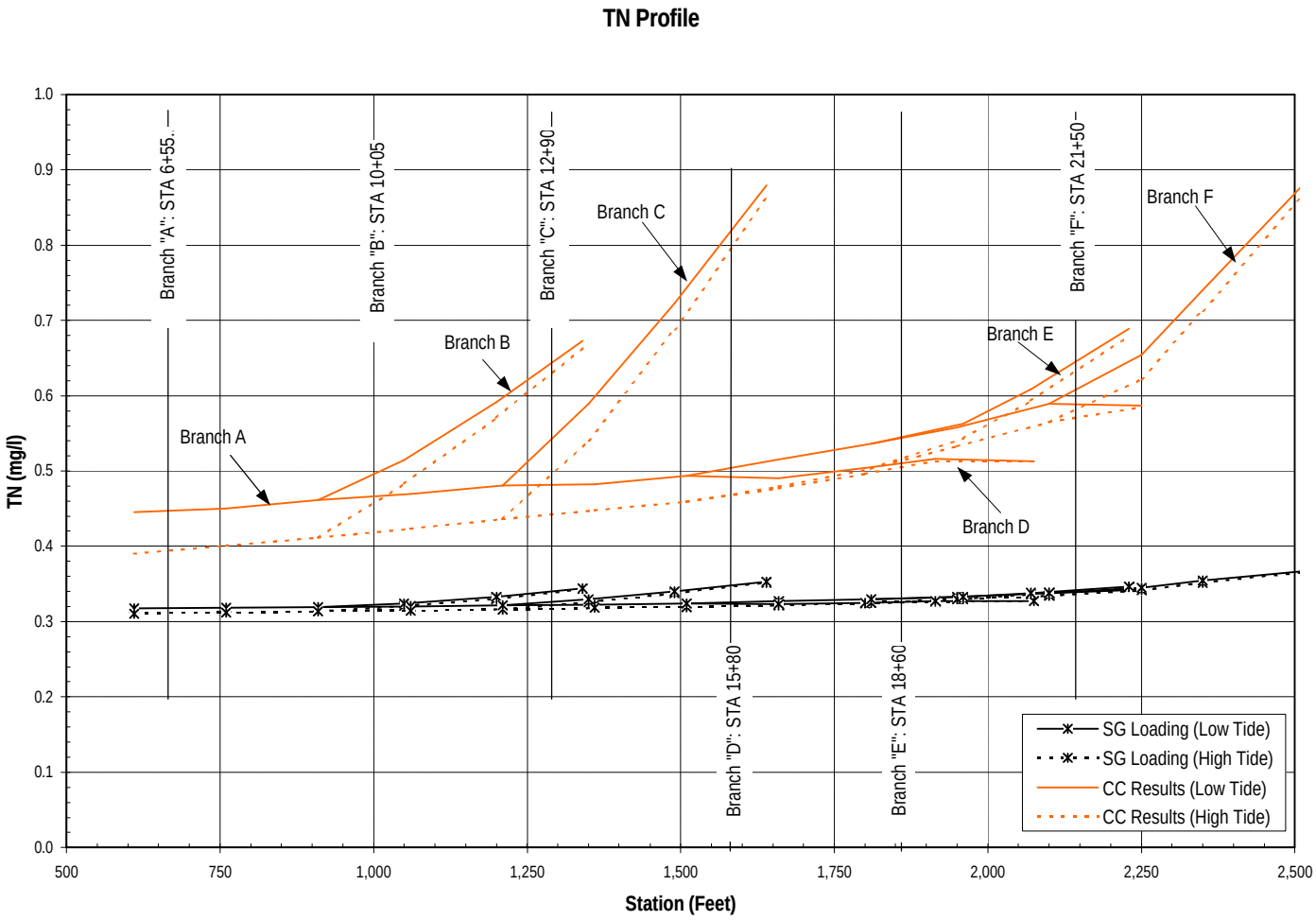

Canal #339, Little Torch Model Output: TN, low tide



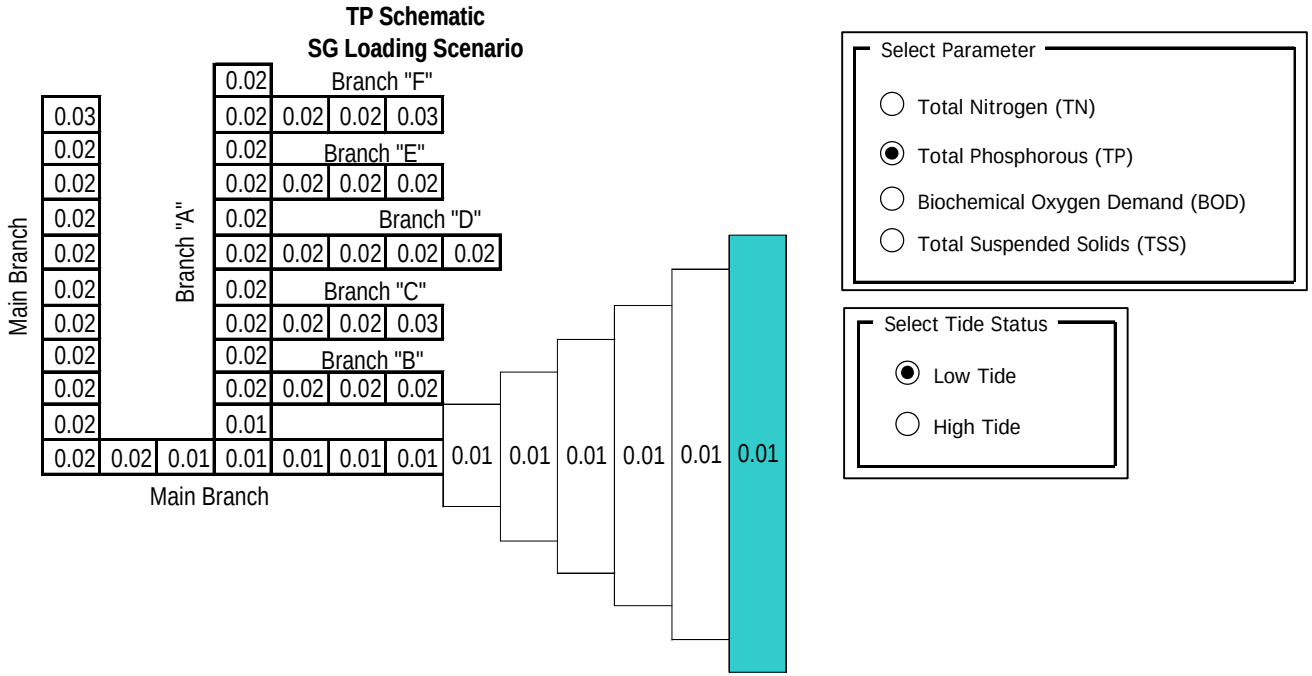

Canal #339, Little Torch Model Output: TN, high tide



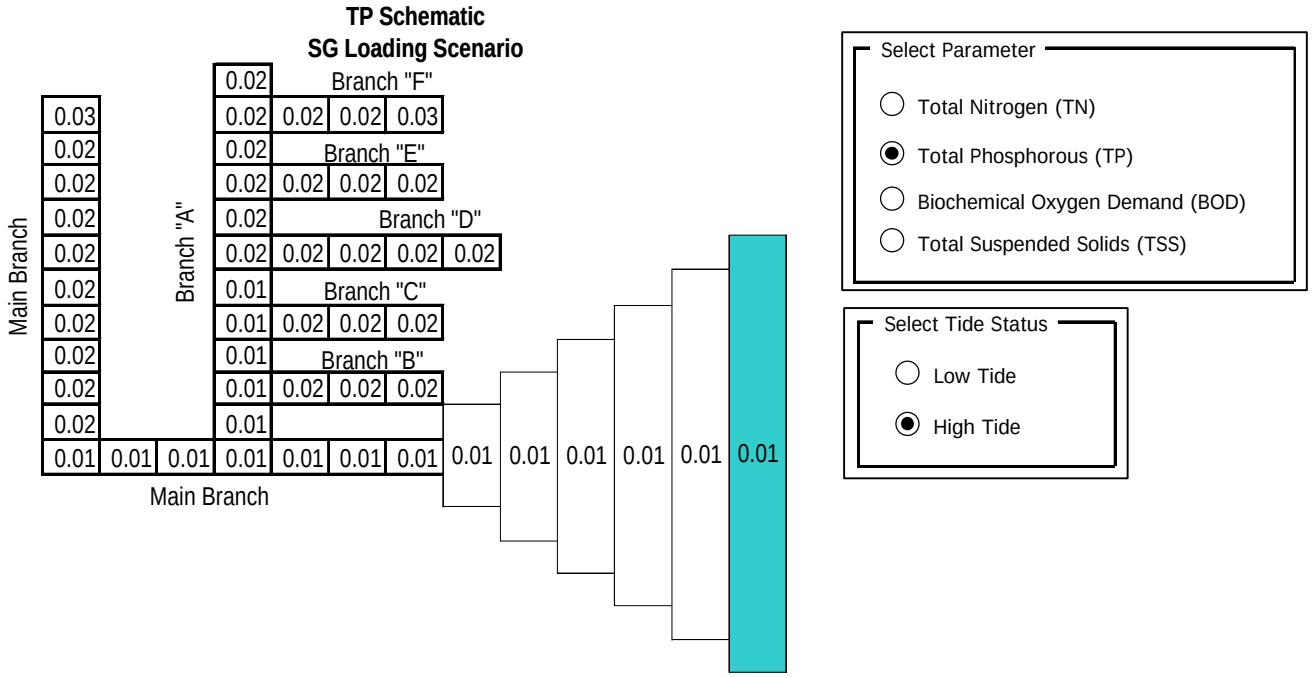

Canal #339, Little Torch Model Output: TN Profile



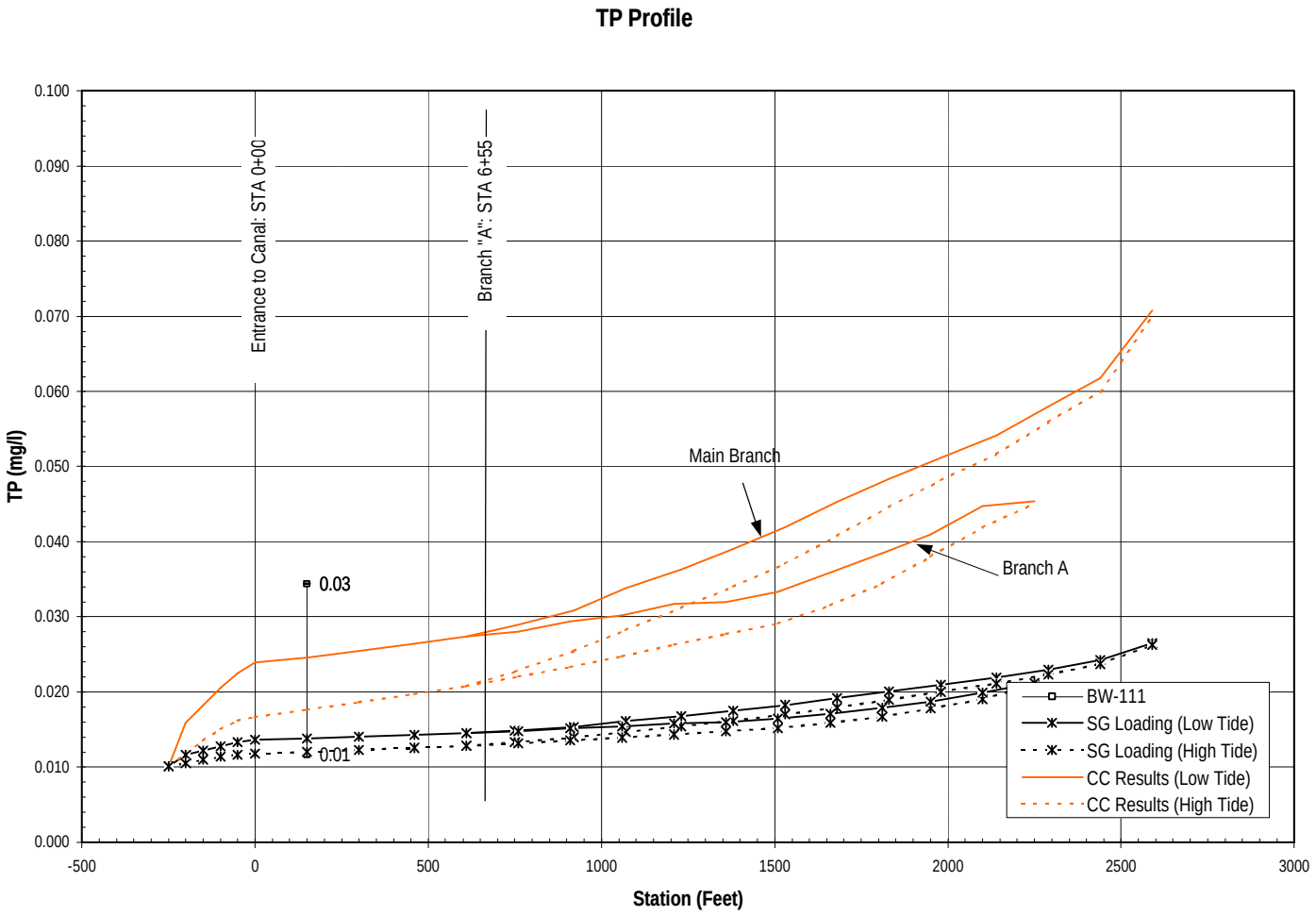

Canal #339, Little Torch Model Output: TN Profile



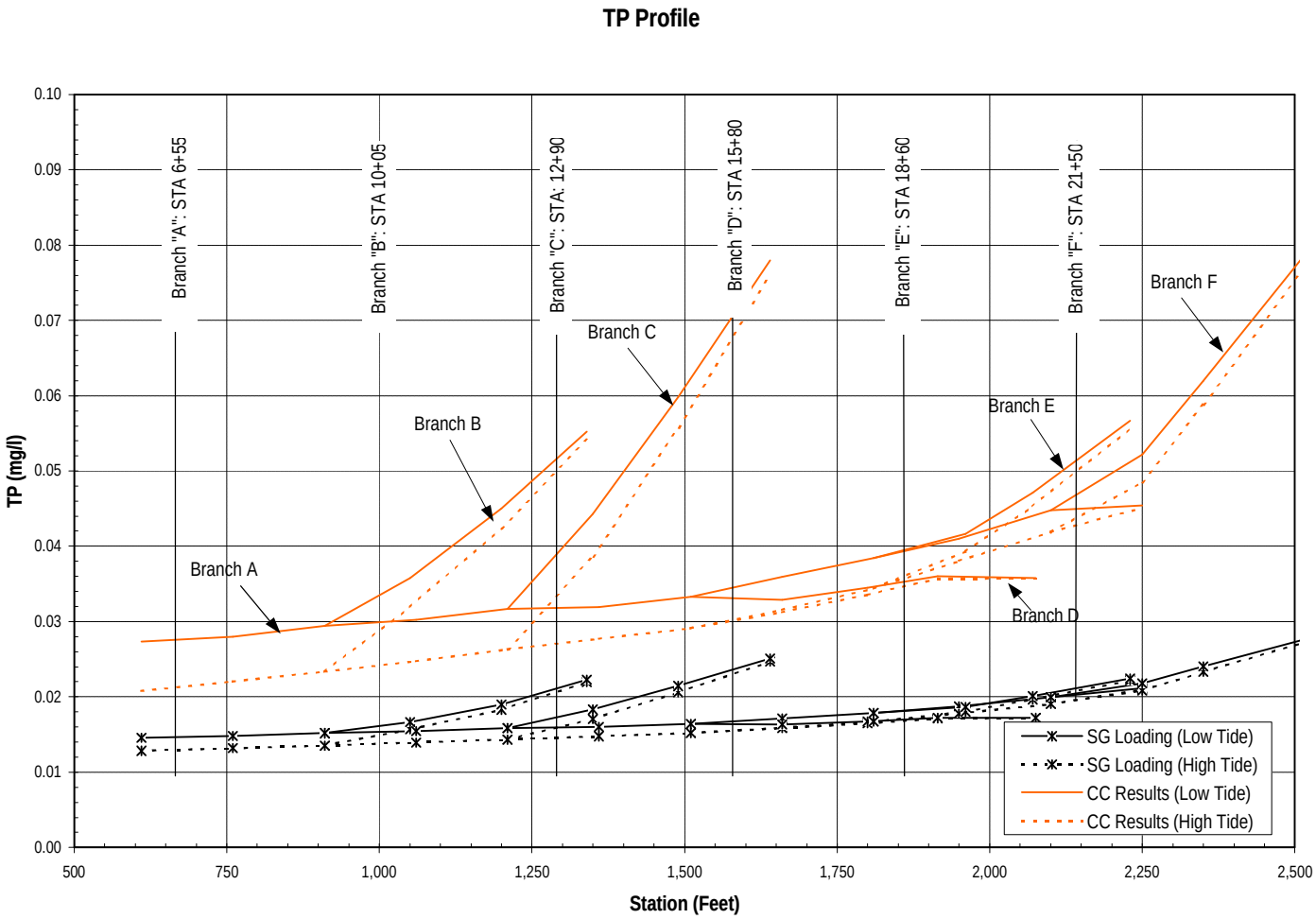

Canal #339, Little Torch Model Output: TP, low tide



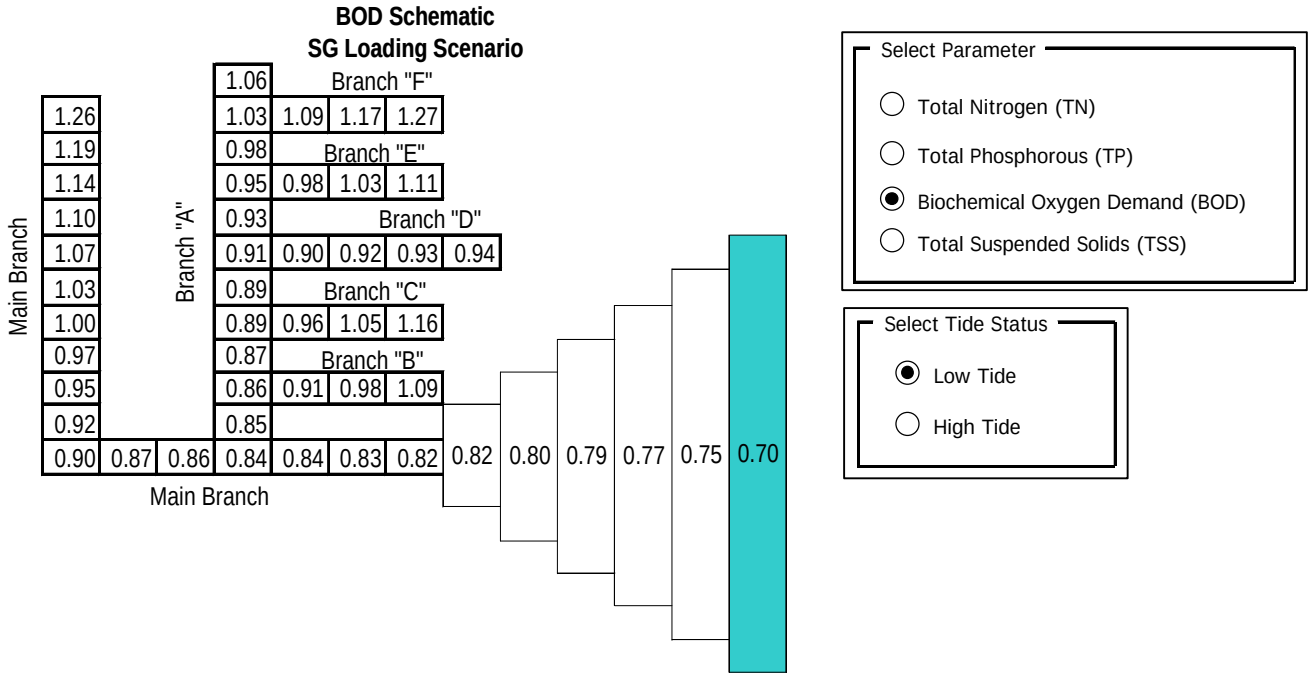

Canal #339, Little Torch Model Output: TP, high tide



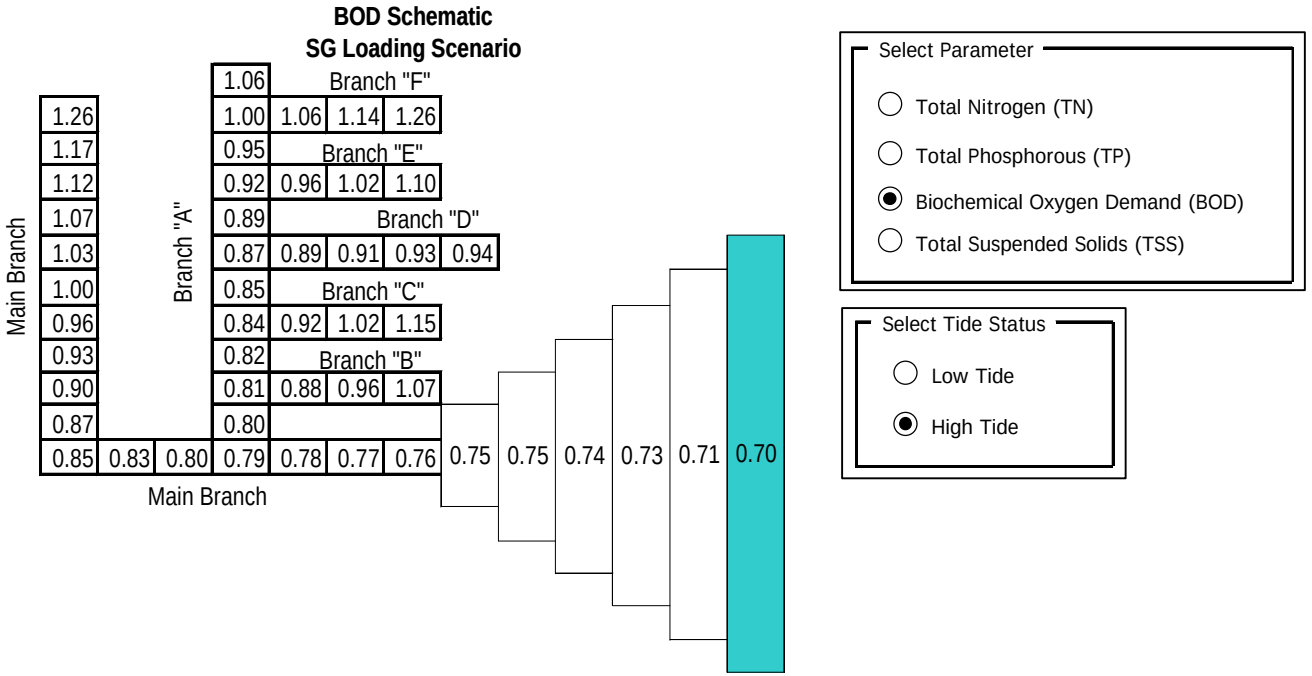

Canal #339, Little Torch Model Output: TP Profile



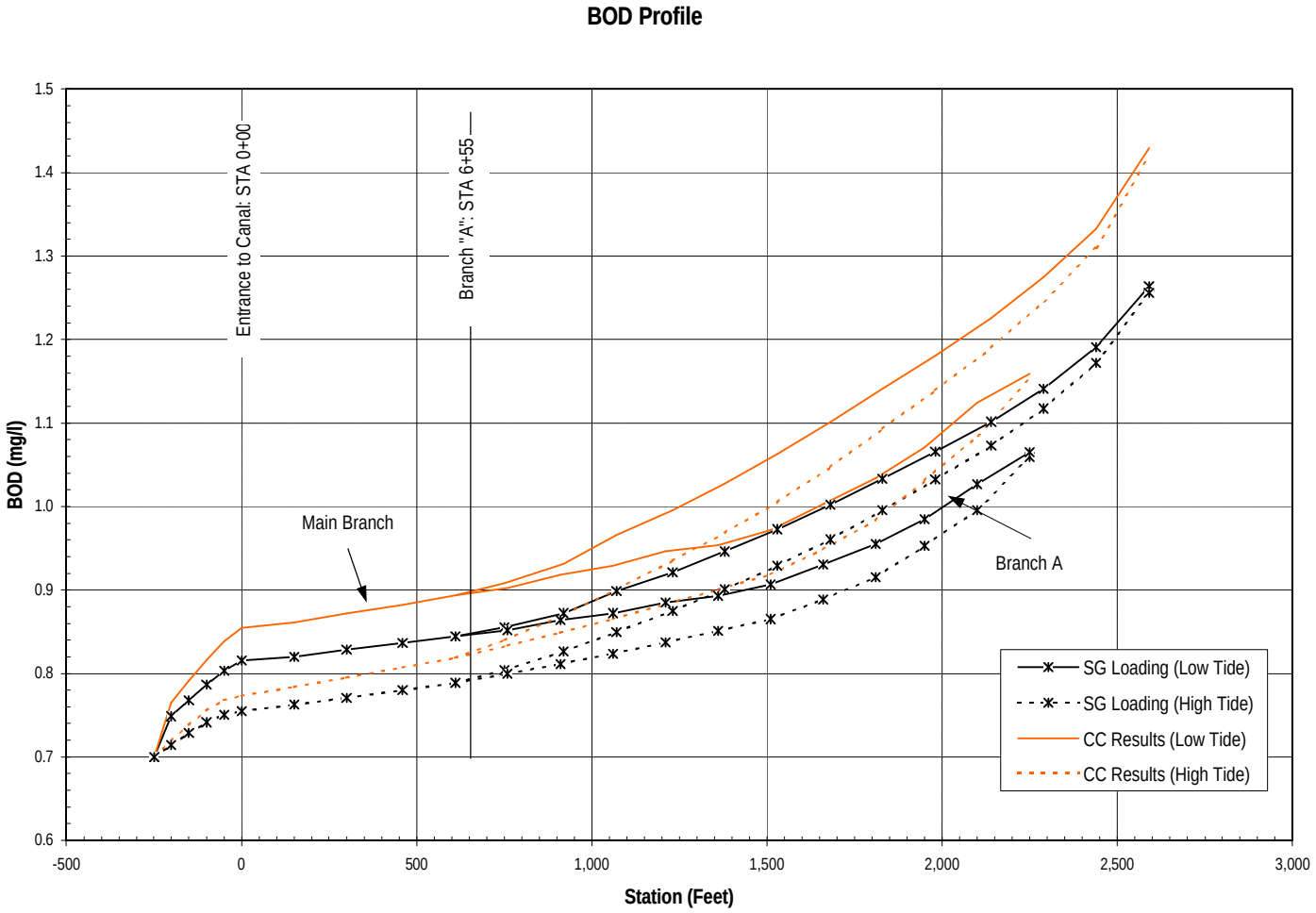

Canal #339, Little Torch Model Output: TP Profile



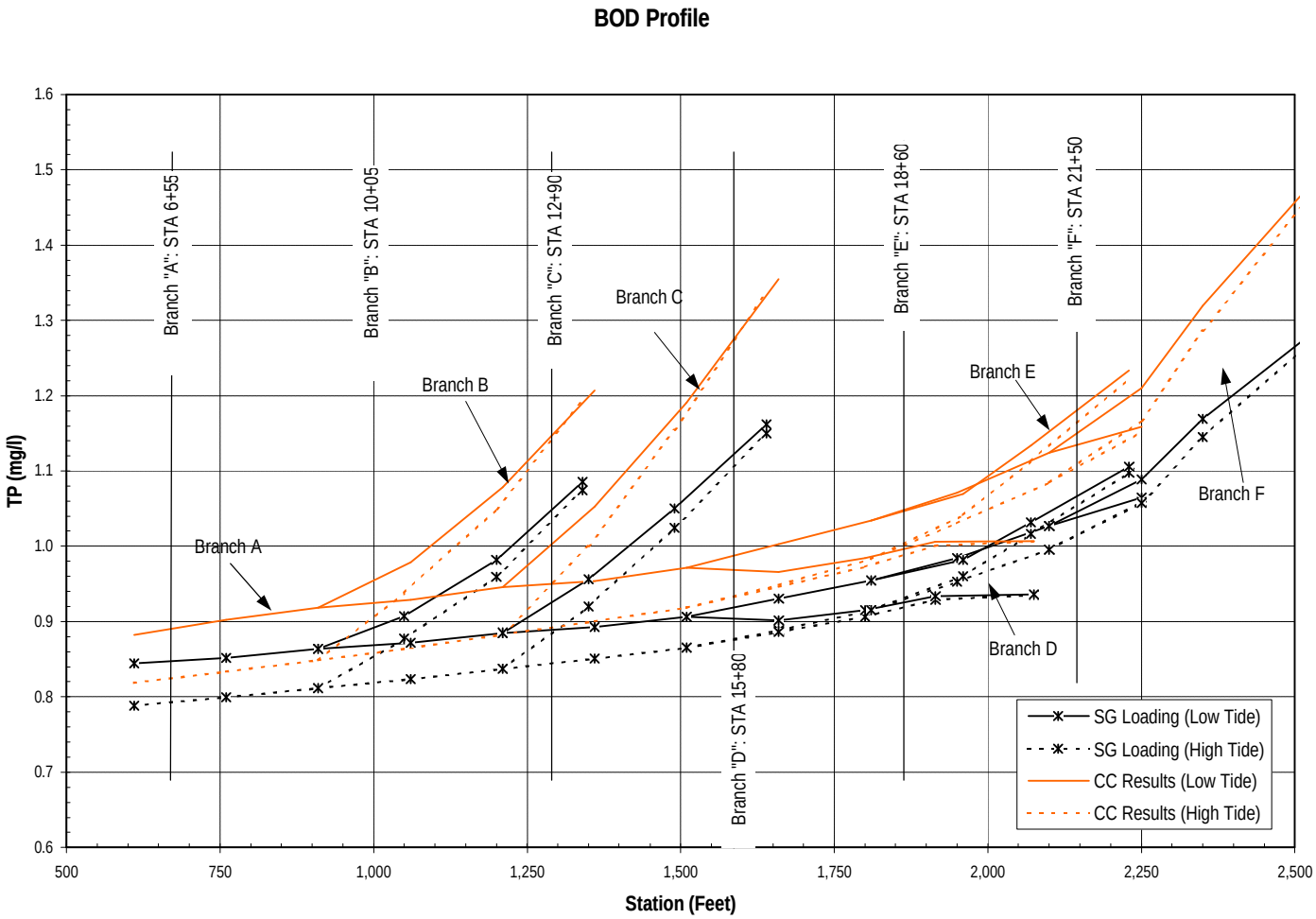

Canal #339, Little Torch Model Output: BOD, low tide



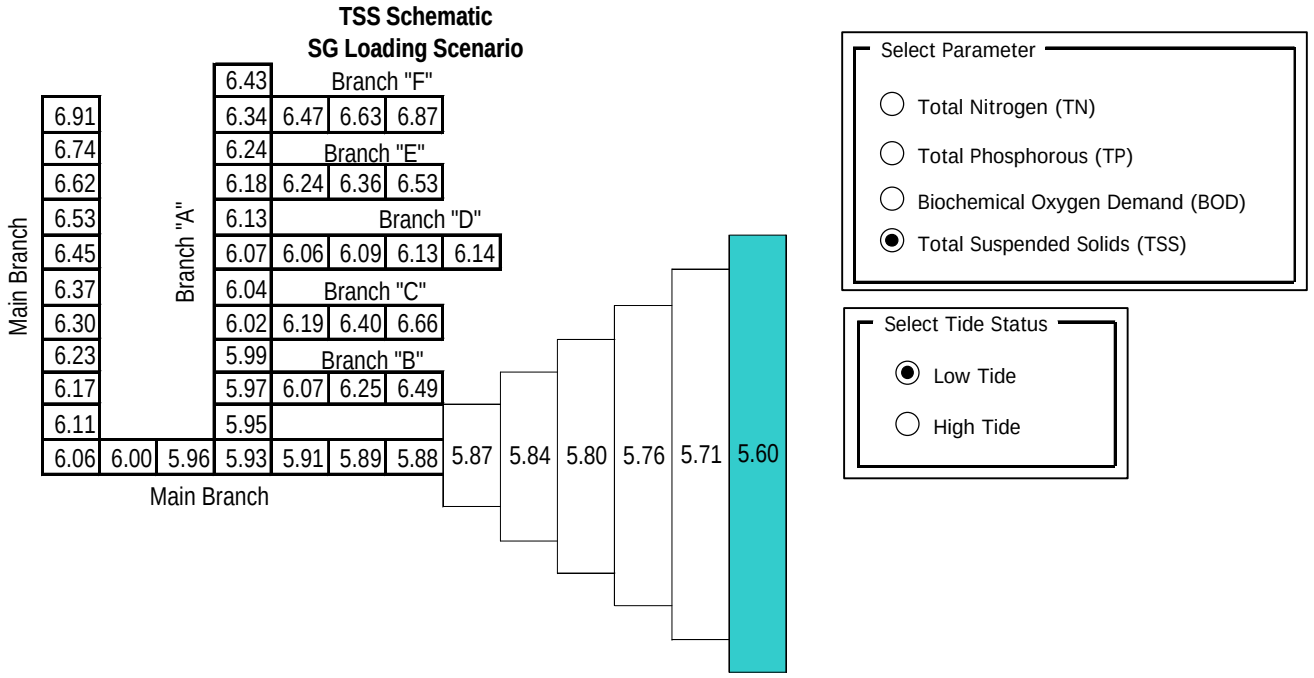

Canal #339, Little Torch Model Output: BOD, high tide



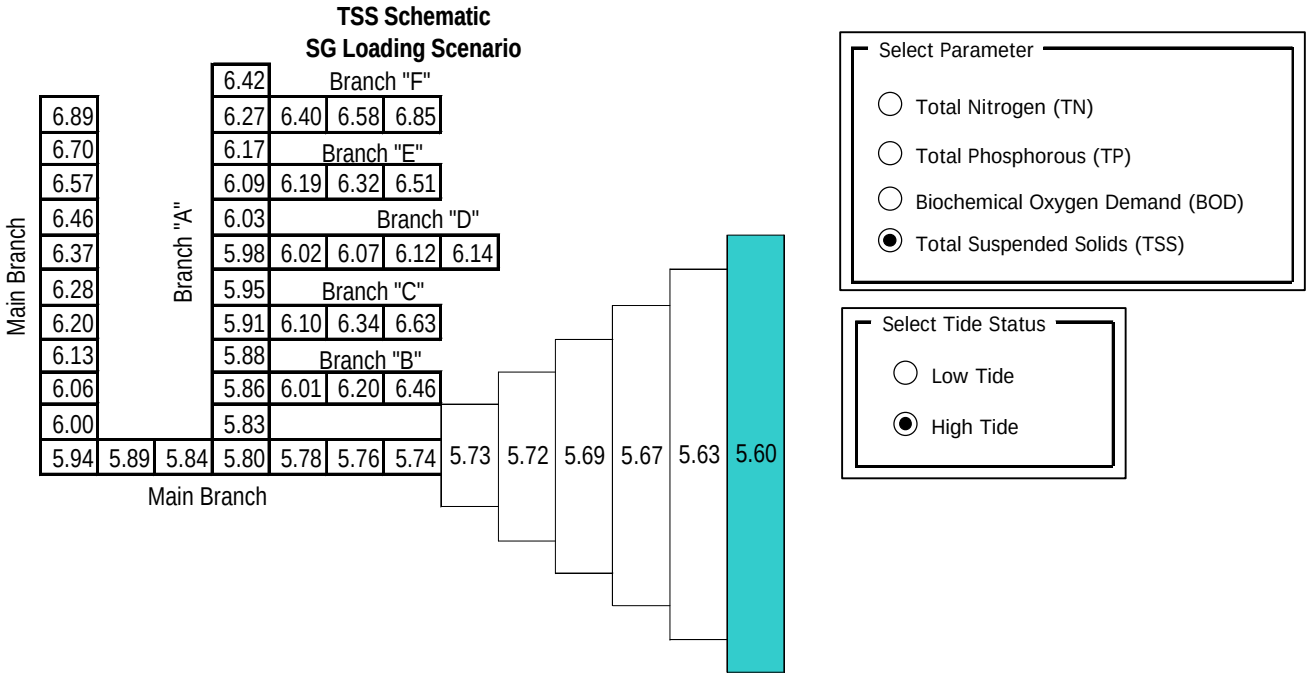

Canal #339, Little Torch Model Output: BOD Profile



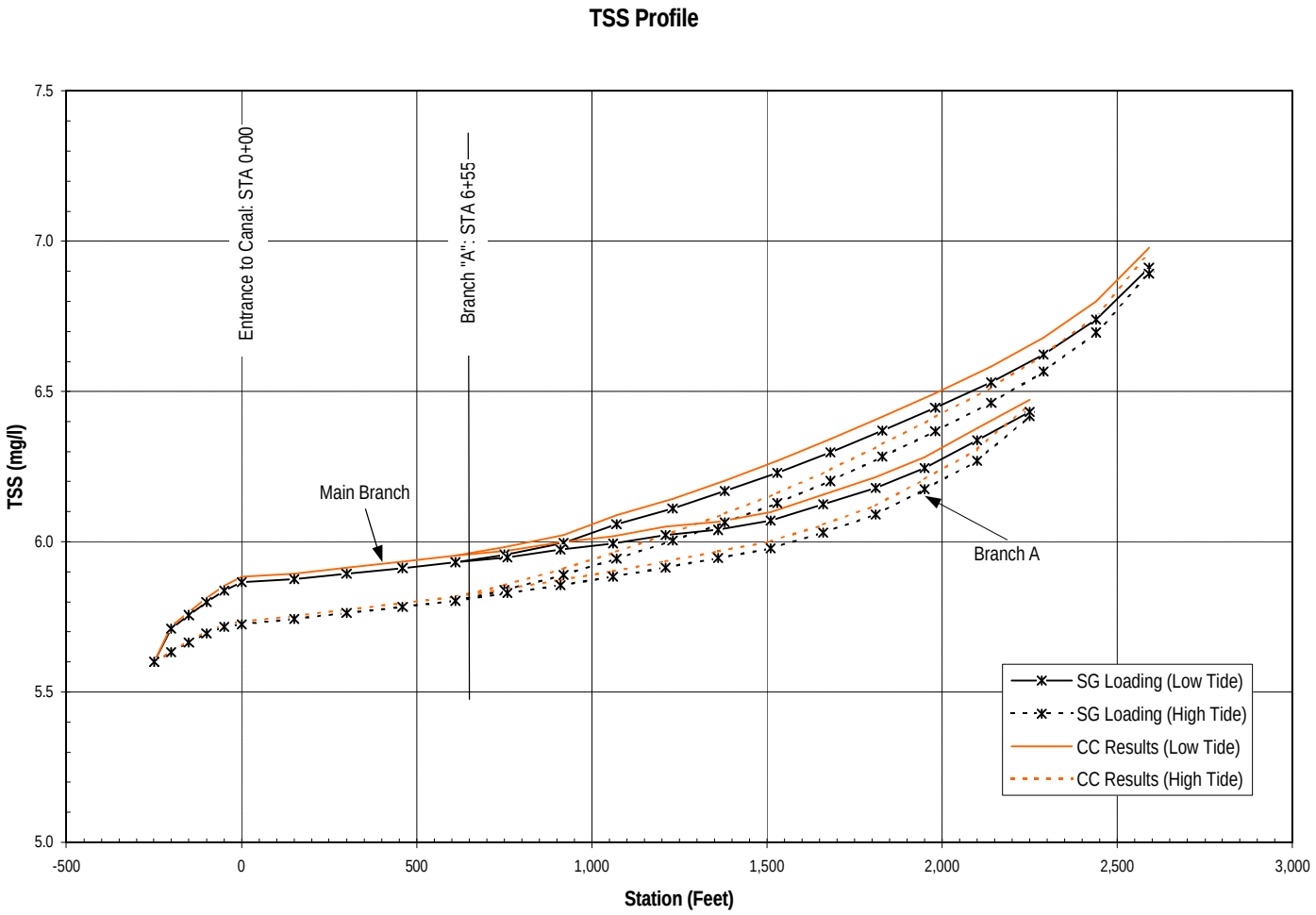

Canal #339, Little Torch Model Output: BOD Profile



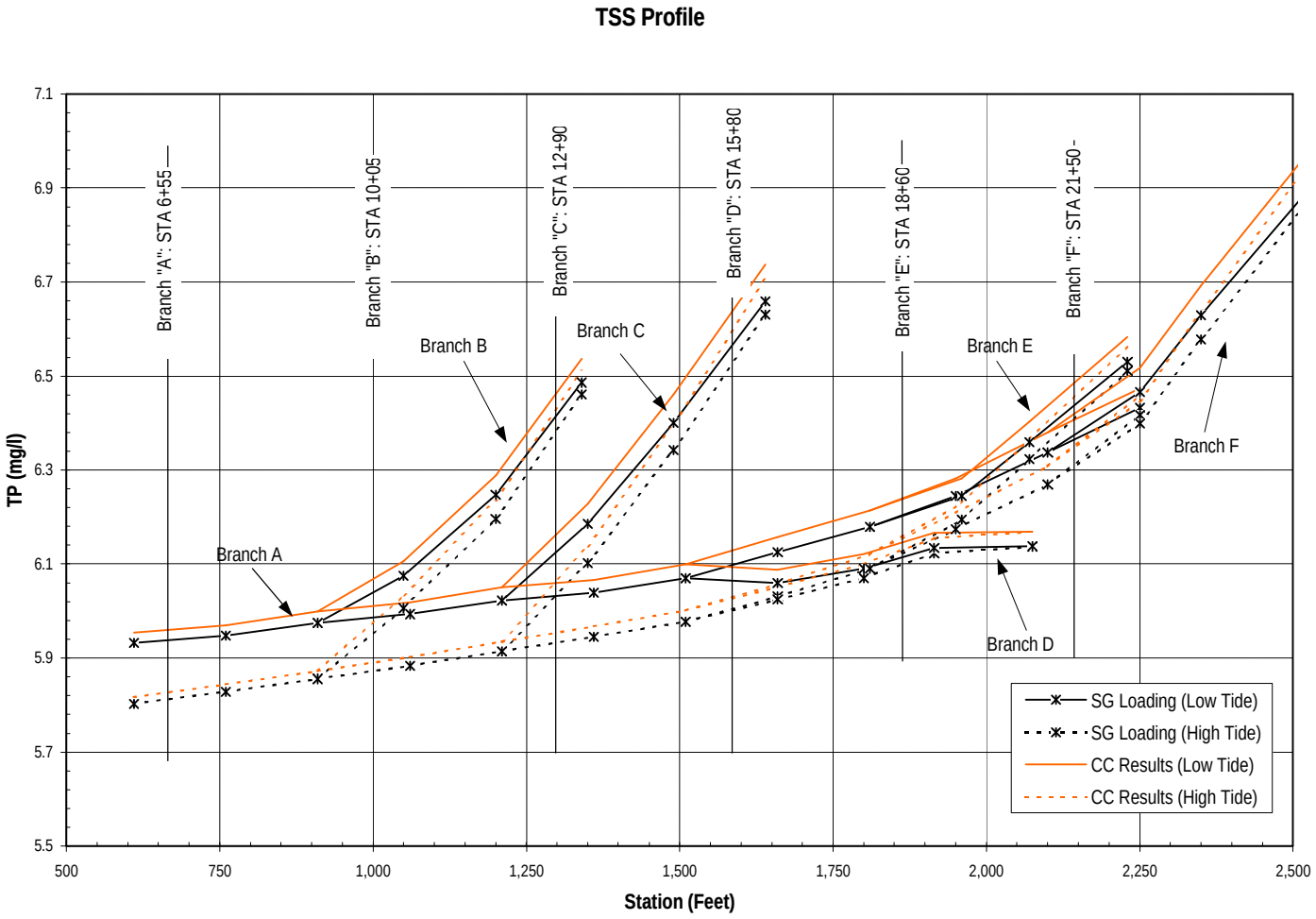

Canal #339, Little Torch Model Output: TSS, low tide




Canal #339, Little Torch Model Output: TSS, high tide




Canal #339, Little Torch Model Output: TSS Profile




Canal #339, Little Torch Model Output: TSS Profile

# APPENDIX D

# ACRONYMS

# ACRONYMS

| | |
|---|---|
| ADID | Advanced Identification of Wetlands |
| ArcIMS | Arc Internet Map Server |
| ASR | Aquifer Storage and Recovery |
| BEBR | Florida Bureau of Business Research |
| BMP | Best Management Practices |
| BOD | Biochemical Oxygen Demand |
| CARL | Conservation and Recreation Lands |
| CCFHR | Center for Coastal Fisheries Habitat Research |
| CCIAM | Carrying Capacity/Impact Assessment Model |
| COM | Component Object Model |
| CPUE | Catch Per Unit Effort |
| DCA | Florida Department of Community Affairs |
| DIN | Dissolved Inorganic Nitrogen |
| DO | Delivery Order |
| DOQQ | Digital Ortho Quarter Quadrangle |
| DXF | Digital Exchange Files |
| EDU | Equivalent Dwelling Unit |
| ELULC | Environmental and Land Use Law Center |
| EMC | Event Mean Concentration |
| EPA | U.S. Environmental Protection Agency |
| ESRI | Environmental Systems Research Institute |
| FAC | Florida Administrative Code |
| FAR | Floor Area Ratio |
| FDEP | Florida Department of Environmental Protection |
| FDOT | Florida Department of Transportation |
| FEMA | Federal Emergency Management Association |
| FIMR | Flood Insurance Rate Maps |
| FIU | Florida International University |
| FKAA | Florida Keys Aqueduct Authority |
| FKCC | Florida Keys Citizens Coalition |
| FKCCS | Florida Keys Carrying Capacity Study |
| FKHES | Florida Keys Hurricane Evacuation Study |
| FKNMS | Florida Keys National Marine Sanctuary |
| FLUCFCS | Florida Land Use, Cover, and Forms Classification System |
| FMRI | Florida Marine Research Institute |
| FWC | Florida Fish and Wildlife Conservation Commission |
| GFA | Gross Floor Area |
| GIS | Geographic Information Systems |
| GUI | Graphic User Interface |
| HCP | Habitat Conservation Plan |
| IAV | Impact Assessment Variables |
| LOS | Level of Service |
| LPWG | Local Planners Working Group |
| mgd | Millions of Gallons Per Day |

| | |
|---|---|
| MM | Milemarker |
| MRFSS | Marine Recreational Fisheries Statistics Surveys |
| NAS | National Academy of Sciences |
| NGO | Non-Governmental Organizations |
| NMFS | National marine Fisheries Service |
| NOAA | National Oceanic and Atmospheric Administration |
| NRC | National Research Council |
| OTFF | 1,000 Friends of Florida |
| OSTD | On-Site Treatment and Disposal |
| PC | Property Code |
| PIIP | Public Involvement and Information Program |
| PVA | Population Viability Analysis |
| ROGO | Rate of Growth Ordinance |
| RPST | Routine Planning Support Tool |
| SC | Steering Committee |
| SFWMD | South Florida Water Management District |
| SOW | Scope of Work |
| SQL | Structured Query Language |
| SRP | Soluable Reactive Phosphorous |
| TAC | Technical Advisory Committee |
| TN | Total Nitrogen |
| TNC | The Nature Conservancy |
| TP | Total Phosphorous |
| TSS | Total Suspended Solids |
| UNA | Users Needs Assessment |
| USACE | U.S. Army Corps of Engineers |
| USFWS | U.S. Fish and Wildlife Service |
| USGS | U.S. Geological Survey |
| VBA | Visual Basic for Applications |
| WQPP | Water Quality Protection Program |

# APPENDIX E

# GLOSSARY

# GLOSSARY

**Affordable Housing Index:** An index number that relates the cost of housing to average income for a community or planning unit. The value of the number expresses the ability of the median population to afford housing in the community.

**Algorithm:** A procedure for solving a mathematical problem in a finite number of steps.

**Arc Info:** A geographic information system (GIS) created and sold by Environmental Systems Research Institute (ESRI). This is the GIS software package being used in the Florida Keys Carrying Capacity Study.

**Assessment Variable:** See Variable (Assessment).

**Available Land:** The amount of land remaining available for a land use change or action in a scenario generation after all applicable constraints have been applied.

**Benefit-Cost Measure:** A ratio comparing the monetary returns or other benefits of a project or action to the costs of implementation. A value over 1 indicates that the benefits are greater than the associated costs.

**Best Management Practices (BMP):** Usually used in referring to stormwater or wastewater treatment practices, this is a set of practices or actions that represents the best available means of controlling flows or composition of discharge waters available for a particular land use or practice. It usually refers to non-structural low cost actions such as street sweeping, fertilizer application guidelines, or education programs.

**Boating Discharge:** Sanitary wastes generated on boats and discharged to the marine environment.

**Capital Improvements**: A permanent addition to the Town's physical assets including structures, infrastructure (sewer and water lines, streets), and other facilities such as parks and playgrounds. May include new construction, reconstruction or renovation that extends the useful life of these assets. The cost of land acquisition, design, construction, renovation, demolition, and equipment are all included when calculating capital expenditures.

**Capital Improvements Program:** A multi-year (usually 5-6 year period) scheduling of public physical improvements, based on studies of available fiscal resources.

**Carrying Capacity:** The amount of use an area, resource, facility or system can sustain without deterioration of its quality.

**Carrying Capacity Impact Analysis Model (CCIAM):** A GIS-based model developed to determine the ability of the Florida Keys ecosystem to withstand all impacts of additional land development activities.

**Carrying Capacity Criteria:** The standards by which the level of land development activities can be assessed (judged) so as to avoid (or at least minimize) further irreversible and/or adverse impacts to the Florida keys ecosystem.

**Carrying Capacity Framework:** A series of thresholds, limiting factors, and other criteria associated with the ecological, socioeconomic and human infrastructure components of the model. These criteria are used to evaluate the results of the analysis and to assess whether modeled scenarios fall within the established framework.

**Carrying Capacity Thresholds:** Three types of thresholds are considered and presented in their order of uncertainty from lowest level of uncertainty to highest:

- Government mandated thresholds – thresholds legislated by local, state, or federal agencies. (i.e., water quality standards),
- Environmental thresholds – a tolerance range for a species or resource, beyond which they are not sustainable (i.e. minimum viable population). See Sustainable Threshold below.
- Socio-economic thresholds – a tolerance range of some socio-economic measure which if exceeded would degrade quality of life (i.e., Affordable Housing Index). See Societal Thresholds below.

**Catch Per Effort Index:** Numerical index used in reporting success or efficiency in fisheries studies, indicating the number or pounds of fish caught per unit effort, such as per hour or per boat.

**Cesspit:** A method of collecting sanitary wastes, usually from single family residential units, similar to a septic tank, but with no finger system or leach field, and little to no treatment capability.

**Coefficient:** A numerical value within a formula or computation that expresses a relationship and is applied in a mathematical function.

**Cluster Development:** Refers to a residential development designed to preserve open space by grouping the homes on a portion of a property only, leaving the remainder as open space. Clustering also allows a developer to develop lots that are smaller than those specified in the zoning ordinance, provided that the land saved is reserved for permanent common uses such as open space or recreation.

**Community Character:** The distinguishing identity or elements of a place, neighborhood, or any other part of the Town. See also "Sense of Place."

**Community Facilities Plan:** A plan, prepared in coordination with outside service providers, to set forth comprehensive policy and strategies regarding programming, cost, management, and performance measures of existing and planned community facilities, including infrastructure.

**Competitive Commerce Index:** An index number comparing the required commercial revenue to disposable income of a community or planning unit, used to estimate whether there is sufficient income to support commercial activities.

**Component:** A discrete subset of inputs, calculations, and outputs of a module. One or more components can create a CCIAM module. Please see module and element.

**Comprehensive Plan:** Refers to a plan, or any portion thereof, as adopted by a local government, to manage the quantity, type, cost, location, timing, and quality of development and redevelopment in the community.

**Concern Threshold:** A threshold value representing a decline in a resource parameter of a level of impact at which the significance of the impact requires attention. Generally, a decline of 10% is slight concern, 30% is moderate concern, and 50% is severe concern for CCIAM IAVs.

**Conservation Development**: An innovative form of residential development that reduces lot sizes so as to set aside a substantial amount of the property as permanently protected open space. Differs from Cluster Development in several ways, particularly in its higher standards for the quantity, quality, and configuration of the resulting open space.

**Conservative:** When used with regulatory standards or describing criteria, a term that refers to the most strict standard or the condition implying the greatest degree of a safety or buffer level.

**Contaminant:** A substance (in water for this study) that can have harmful properties and is not naturally occurring or occurs above natural background levels. For the Marine and Integrated Water Modules, this term refers only to the metals cadmium, copper, lead, and zinc.

**Contiguous Development:** A development or parcel of a designated type which is physically adjacent to a specified parcel or land use category.

**Cost of Services:** The cost for a governmental unit to develop infrastructure and other services to the local community.

**Coverage:** A map layer or digital version of a map in the GIS system, usually associated with one type of feature, such as Land Use.

**Criterion:** A regulatory water quality standard or level of concentration set by USEPA or DEP as the safe level of a constituent in water.

**Degradation:** The decline in the quality and/or ecological functions of an area.

**Demographic:** Relating to populations or population characteristics.

**Density**: The average number of dwelling units allocated per gross acre of land. The density ranges used in the model are adapted from FLUCCS as well as from the Monroe County Comprehensive Plan.

**Density, Gross**: The average number of families, persons or housing units allocated per gross unit of land.

**Density, Net**: The maximum density permitted to be developed per unit of land after deducting any required open space, easements and publicly dedicated rights-of-way.

**Developable Land:** Land available for development that is not constricted or precluded due to physical factors, regulatory restrictions, or public ownership, etc.

**Development:** The process of converting the land cover of a parcel to a different land cover of a higher use and/or intensity.

**Development Pattern:** The configuration or organization of the built environment. (= Development Configuration)

**Development Suitability Ranking:** A measure of the probability that a parcel will be developed relative to other parcels of the same type, based on the presence of development constraints such as wetlands or benefits such as proximity to infrastructure.

**Development Timing:** Related to the provision of public services and facilities to keep pace with and support growth as it comes on line.

**Development Type:** The kind or classification of an existing or proposed land use, such as residential or industrial.

**Direct Impact (Loss):** An impact that is caused by an action with no intermediate step, such as loss of habitat by clearing of land.

**Discharge:** In this study, a term referring to the amount and location of water leaving a wastewater treatment system of stormwater leaving a treatment system or unit of land, usually measured at a specific point (Discharge Point).

**Dwelling Unit:** One or more rooms physically arranged to create a housekeeping establishment for occupancy by one family only.

**Element:** An algorithm, coefficient, or data table that is used within a component. One or more elements can create a component. Please see module and component.

**End Point:** A point marking the completion of a process or stage of a process.

**Epiphyte:** A plant that grows on the surface of another plant, in this case algae which grows on seagrass leaves.

**Eutrophication:** The process of increasing productivity in a water body, eventually leading to senescence and decline of the ecosystem.

**Evacuation Capacity:** In this study, this refers to the ability of the highway system (i.e., US 1) to allow people to leave the keys in a given period of time, when hurricane warnings are issued.

**Event Mean Concentration:** A measure of the concentration of a material or contaminant in stormwater for a specific rainfall event, expressed as an average over time based on the mass concentration and volume and duration of flow over time.

**Exotics Species**: A (usually plant) species introduced into a community that is not normally a constituent of that community (= non-native species).

**Expert Judgment:** A qualified opinion made by a person or persons who are recognized as experts in the specific field of expertise and who are sufficiently familiar with local conditions and the relevant scientific literature to reduce the level of uncertainty.

**Extent:** The scope of an issue, or the range or areal extent of an activity or impact.

**Extent of Development:** A measure of the land area covered by residential, commercial, etc., developments.

**Feature Attribute Table:** A table in the GIS system used to store attribute information for a specific coverage feature class; a basic need for defining characteristics of polygons, points, etc.

**Field:** A term used to define the portion of a database that contains all the data entries for a specified item or parameter, such as all "Land Use Type" entries; analogous to a column in a data table.

**Fishing Pressure:** A measure of the number of fishermen or fishing effort in relation to the fish population in an area. Since fish population is seldom exactly known, this is often expressed as catch per unit effort, number of fishing days, or other more easily calculated level of angler activity in an area.

**Flood Zone**: As defined by FEMA and delineated in the Flood Insurance Rate Maps (FIRM).

**Floor Area Ratio**: The square footage of commercial space per capita. Also, the total floor area of all the buildings on a site, lot or parcel of land, divided by the gross area of the lot or parcel.

**Goal:** Refers to a concise but general statement of a community's aspirations in addressing a problem or an opportunity, in terms of a desired state or process toward which implementation programs are oriented.

**Grid:** A raster-based type of geographic data set for use with the GIS system, based on x,y values.

This is an alternative method of presenting and analyzing data to the arc-based polygon methods in a GIS.

**Grid Cell:** In a GIS, the basic spatial element of a grid, representing a portion of the earth, in a grid-based data set. A group of cells forms a grid. Each grid cell has a value corresponding to the characteristics at that site, such as habitat type.

**Gross Floor Area:** The total commercial or industrial floor area (in square feet) for a facility or area.

**Groundwater:** The volume of water naturally occurring under the land surface.

**Groundwater Recharge:** The movement of surface water into the ground through percolation or direct means, eventually reaching the water table and replenishing the groundwater.

**Growth Capture Rate:** The percent of the total population growth of a region which is taken by a specific sub-area or community. The term is often used in relation to the effect of facilities in attracting population within a certain commute time.

**Growth Management**: A framework developed to address the provision of public facilities and services to support development.

**Growth Projection: (Alternative, Managed, Natural):** A prediction of the percentage or extent of new development of population, as derived from econometric models or other sources. In this study, Alternative Growth Projection refers to the growth prediction of a specified scenario; natural growth refers to projection of growth occurring in the absence of controls or specified conditions; and managed growth refers to growth under specific regulatory constraints.

**Habitat Conversion:** The change of natural habitat to different land uses through the process of clearing for residential, agricultural, or other land uses.

**Habitat Fragmentation:** The dividing of contiguous or whole habitat units, such as forest stands, into smaller units by the conversion of some parts of the habitat to other land uses.

**Historic Baseline:** The set of conditions in the Florida Keys, defining the natural ecosystem, prior to settlement by European colonists.

**Household**: A household includes all the persons who are current residents of a housing unit. The occupants may be a single family, one person living alone, two or more families living together, or a group of related or unrelated persons who share living arrangements.

**Housing Choice:** Refers to the availability of a variety of types and locations of housing. Housing can vary according to size (e.g., number of rooms or stories), styles (e.g., construction frame, etc.), type (e.g., single-family versus duplex or multi-family), location, price, and other characteristics.

**Housing Unit**: A house, an apartment, a mobile home or trailer, a group of rooms or a single room occupied as separate living quarters or, if vacant, intended for occupancy as separate living quarters.

**Hurricane Evacuation:** The movement of all permanent residents and visitors from the Florida Keys to a safe location on the mainland in anticipation of an approaching hurricane. In this study, this refers to evacuation along the road system.

**Hurricane Vulnerability Zone:** The designation of land areas by FEMA, based on elevation, referring to the potential for damage caused by hurricanes, usually based on water and wave impacts.

**Impact Assessment Tool:** A procedure, method, or model (such as CCIAM) which can be used to aid in the prediction or measurements of impacts from specific causes.

**Impact Assessment Variables (IAV):** (Indicator) environmental and socio-economic variables for which assessments will be conducted and final outputs provided. Generally these are outputs from each of the module components.

- **IAV Sustainable Thresholds**: Scientifically derived tolerance range of values, beyond which a natural resource or species is not sustainable.
- **IAV Concern Thresholds**: An impact that results in a 10% decline in the level of a IAV.
- **IAV Societal Thresholds**: A societal threshold is a scientifically derived tolerance range of values, beyond which changes are socially unacceptable.

**Impact, direct:** See Direct Impact.

**Impact, indirect:** See indirect impact.

**Income (Per Capita):** A measure of the average (usually annual) income of a community expressed by dividing the total income of the community by the population.

**Independent Population Projection:** An estimate that has been developed in response to documented demographic and economic trends and conditions, instead of a future physical development scenario.

**Indicator Species:** A plant or animal species for which the responses to a particular stimulus are well documented and which is also typical of other species responses in an area, which can be used as a measure or indicator of the extent of effects on an ecological community or group of species.

**Indirect Impact (Loss):** An impact that occurs as the result of an action, but which is not immediately caused by the action. An example would be loss of habitat for a road needed for a new development. This would be a direct impact of the road, but an indirect impact of the development.

**Infill Development**: Development of the remaining vacant or underutilized properties within a predominantly built-up residential neighborhood or nonresidential area.

**Infrastructure:** The basic facilities and equipment necessary for the effective functioning of the Town, such as the means of providing water service, sewage disposal, electric and gas connections, and the street network. For the CCIAM, adequate data is currently available only for water service and sewage.

**Input:** Data that are entered into the CCIAM.

**Intensity:** The degree to which land is used, generally measured by a combination of the type of land use and the amount of land devoted to that use.

**Integration:** The unification of individual modules within the CCIAM to create a holistic modeling approach, results, and tool.

**Intermediate Result:** A statistical or spatial output that is used in another calculation and is not an end-point in the CCIAM.

**Key Indicator Species:** Those indicator species which are considered to be most representative of the response of a community or which are the most sensitive and therefore provide early warning of effects.

**Land Use:** A description and classification of how land is occupied or utilized, e.g., residential, office, parks, industrial, commercial, etc.

**Level of Service:** The quality and quantity of existing and planned public services and facilities, rated against an established set of standards to compare actual or projected demand with the maximum capacity of the public service or facility in question.

**Location:** In the CCIAM Scenario Generator, this refers to an input condition specifying a geographic area of the study area in which a condition is to be applied.

**Look-Up Table:** A special tabular data file for the GIS containing additional attributes for features stored in an associated feature attribute table, or a table in which numeric item values are classified into categories.

**Lot:** A parcel of land occupied or intended for occupancy by an individual use, including a principal structure and any ancillary/accessory structures.

**Marine Environment:** The salt and brackish waters surrounding the Florida Keys and the organisms and communities within these waters, usually extending shoreward to the mean high tide line.

**Median Income:** Income distribution that is divided into two exactly equal parts, one having incomes above the median and the other having incomes below the median. For households and families, the median income is based on the distribution of the total number of units including those with no income.

**Methodology:** A set of rules and procedures for a given module.

**Minimum Viable Population:** The minimum number of individuals of a population or species within a defined area that is necessary to perpetuate the population or species without damage to the genetic line. This often sets the threshold criteria for survival of a species (and is the criteria used by USFWS to determine endangered status of a species).

**Mitigation:** Actions or measures taken to lessen, alleviate, or decrease the impacts or effects of certain development activities.

**Mixed Use:** Refers to development projects or zoning classifications that provide for more than one use or purpose within a shared building or development area. Mixed use allows the integration of commercial, retail, office, medium to high-density housing, and in some cases light industrial uses. These uses can be integrated either horizontally, or vertically in a single building or structure.

**Model:** A system of data, assumptions, and calculations used to represent and visualize reality. Please see Carrying Capacity Analysis Model.

**Module:** One of several major parts of the Carrying Capacity Analysis Model. A module is comprised of components. Please see component and element.

**Multifamily Residential Unit**: A structure containing three or more dwelling units.

**Net Buildable Area:** That portion of a parcel of land which is developable and is not (a) required open space; (b) required setbacks, or (c) required buffer yards.

**New Development:** Development that occurs in vacant or unoccupied land, as opposed to a change within already developed land.

**Nutrient:** A constituent in water that is necessary for or promotes growth of plants.

**Objective:** A clear and specific statement of planned results, derived from a goal, to be achieved within a stated time period.

**On-Site Treatment System:** A wastewater treatment system which is on the same lot or parcel of land in which the wastes are generated.

**Open Space:** Land devoted to uses characterized by vegetative cover or water bodies, such as agricultural uses, pastures, meadows, parks, recreational areas, lawns, gardens, cemeteries, ponds, streams, etc.

**Open Space Ratio:** Describes the percentage of the total gross area of a parcel that is devoted to open space.

**Output:** A result that is either used as an input to another CCIAM module or as an end-point in an analysis.

**Parameter:** A quantity or constant whose value varies with the circumstances of its application or is used as a referent for determining other variables.

**Parcel:** Any quantity of land and water capable of being described with such definiteness that its location and boundaries may be established and identified.

**Person-days:** A means of reporting total effort, expressed as the number of days spent by all persons in a particular activity.

**Planning Unit:** See Wastewater Planning Unit.

**Plat**: The official map or plan of a piece of land that has been divided into building lots.

**Platted Lot:** A lot that is identified on a plat approved by the local government and duly recorded in the municipality's public records.

**Policy:** The specific approach through which objectives are achieved.

**Polygon:** A multisided feature representing an area on a map, with the boundary of the polygon defined by arcs.

**Population Density:** The number of people or individuals within a specified unit area, such per acre.

**Population, functional:** The sum of permanent and temporary populations in the Florida Keys.

**Population, permanent:** That segment of the population that spends more than half of the year in the Florida Keys.

**Population, seasonal:** That segment of the population that stays in the Keys for 30-180 days usually during the summer or winter "seasons."

**Population, temporary:** The sum of the transient and seasonal population.

**Population, transient:** That segment of the population that stays in the Florida Keys for less than 30 days; they are typically vacationers.

**Population Profile:** A characterization of the demographics or make-up of the population of a community, expressed in such factors as age groups, income levels, and other characteristics.

**Potable Water:** Water that is suitable and approved for human consumption (= drinking water).

**Potable Water Consumption:** The use or rate of water use.

**Public Land:** Refers to land owned by the municipalities in Monroe County, or any other governmental entity or agency thereof.

**Pre-processing:** Preliminary data manipulation prior to CCIAM runs.

**Prop Scar:** A groove or trail in the sea floor usually left by the propeller of a boat, and may also include impacts from the bow. These usually refer to trails left in seagrass beds, in which the seagrasses are killed or removed, leaving a "scar," and decreasing the productivity of the bed.

**Qualitative:** A number that is not based on a discrete number or unit of measure. This is often an estimate and may be expressed on a relative scale of magnitude.

**Quantitative:** A measurement that is based on a number that has known, discrete units of measure.

**Recharge:** The movement of water through the ground and the groundwater.

**Record:** An entry in a database representing one entity. Analogous to a row in a tabular format.

**Redevelopment:** Refers to public and/or private investment made to re-create the fabric of an area that is suffering from physical, social or economic problems related to the age, type, and condition of existing development. Redevelopment can help to meet market needs for residential and/or commercial development in older parts of the Town.

**Regulatory Criteria/Standards:** Criteria used in setting IAV thresholds in the CCIAM model, which are published levels set by governmental agencies under laws or regulatory processes.

**Restoration:** The conversion of non-natural lands into natural areas.

**Retrofit:** The process of changing or adding facilities to an already constructed facility or existing land use development. For CCIAM, this usually refers to wastewater or stormwater treatment facilities.

**Rezoning:** Process by which the authorized uses of a property are changed or modified.

**Routine Planning Support Tool:** An Internet-based mapping tool to support daily planning activities in Monroe County.

**Runoff:** Rain water that moves across the land surface to exit a property or area (=stormwater runoff).

**Scarified:** Refers to an area of land that is cleared of native vegetation, or topographically modified such that the land is not presently in a successional sequence leading to the establishment of vegetative communities that were previously cleared or disturbed.

**Scenario:** A change in land use described by the location, type, extent, and configuration of the land use change. Changes in land use may include new development, redevelopment, and restoration.

**Scenario Generator:** A series of screens, buttons, and menus built within the CCIAM to assist the user in defining a land development scenario.

**Scenario Location:** The portion of the study area for which scenario inputs apply.

**Scenario Type:** The specific kind of land use change of a scenario. It can be development, redevelopment, or restoration.

**Script:** Computer code that is written to automate functions within the CCIAM.

**Seagrass:** A type of submerged vascular plant (as distinguished from algae) that can form dense stands or beds in shallow marine water that are important marine habitats and energy sources for marine animals. Turtle grass is the main seagrass species in the Keys.

**Season, Dry:** The portion of the year in which least rainfall occurs. For Monroe County, this is considered to be from June through November.

**Season, Wet:** The portion of the year in which most rainfall occurs. For Monroe County, this is considered to be from December through May.

**Seasonal Population:** See Population, Seasonal.

**Secondary Impact:** Similar to Indirect Impact, a type of impact which occurs only incidental to an action.

**Sense of Place:** The sum of attributes of a locality, neighborhood, or property that give it a unique and distinctive character.

**Sensitive Lands:** For the CCIAM, this refers to lands that have been identified by government or conservation groups as being of ecological sensitivity, which are proposed for possible public acquisition.

**Single Family Residential Unit**: A building, typically detached, containing one dwelling unit.

**Solid Waste:** Refers to garbage, refuse, sludges, and other discarded materials.

**Species-Weighted Area:** An alternative measure of stating the amount of impact through loss or degradation of an area, produced by multiplying the area of a habitat unit by a factor representing the number or proportion of species using that area. An area with more species use has a higher species- weighted area.

**Sprawl:** Refers to the unplanned or uncontrolled development of open/vacant land.

**Steady State:** A condition that changes only negligibly over time.

**Stormwater Management:** Refers to the natural and/or constructed features of a property which function to treat, collect, convey, channel, hold, inhibit, or divert the movement of surface water.

**Study Area:** The area within the statutorily defined limits of the FKCCS. This includes the non-mainland portion of Monroe County to the outer limits of the Florida Keys National Marine Sanctuary excluding those waters surrounding the Marquesas and Dry Tortugas. For traffic and evacuation study purposes, portions of US 1 on the mainland are included.

**Subdivision:** The division of a lot, tract or parcel of land into two or more lots, plats, sites, or other divisions of land for the purpose, whether immediate or future, of sale, rent, lease or building development for all types of land uses, located on an existing, new, widened, or extended street, and requiring the extension of municipal utilities or construction of private on-site systems. It includes re-subdivision and when appropriate to the context, relates to the process of subdividing or to the land or territory subdivided.

**Suitability**: The inherent or regulated capability of a parcel to support a particular land use. Suitability analysis is employed in the CCIAM to determine the fitness of a given tract of land for a specific use. In this case, the degree of suitability is assessed based on the following factors, for which data are currently available: (a) parcel size; (b) subdivision status (platted vs. non-platted); (c) type of land cover; (d) flood zone classification; (e) accessibility to infrastructure (specifically sewer and water); and (f) location with respect to areas of critical habitat (as defined in the Monroe County Comprehensive Plan).

**Support Population Estimate:** The number of people required to support a given land development scenario.

**Sustainability/Sustainable Growth:** A concept that encourages responsible management of human use of the natural and built environments to yield the greatest sustainable benefit to present generations while maintaining its potential to meet the needs and aspirations of future generations.

**Tax Revenue:** Revenue that is derived from various taxes by governmental agencies.

**Temporal scale:** Refers to a time period for an action or assessment; often relates to a recurring period.

**Terrestrial Environment:** The natural environment occurring above the mean high tide line, including embedded freshwater wetlands, and the terrestrial plant and animal communities and habitats.

**Time Period (Time Frame):** A measure of time duration. The CCIAM model can evaluate changes over 5, 10, and 20 year periods. Can also mean the frequency of time between recurring events.

**Threshold:** A point separating conditions that will produce a given effect from conditions of a higher or lower degree.

**Tourist Related Business:** Any business enterprise that relies mainly on tourist dollars as a source of income or sales.

**Transient Population:** See Population, transient.

**Type (Residential)**: Characterization of housing choices according to occupancy (single family, multifamily) or construction (detached, attached).

**Underdeveloped Subdivision**: For the purpose of crafting restoration scenarios, "underdeveloped" subdivisions are defined as those that meet the following criteria: (a) are less than 33 percent developed; (b) are disturbed habitats; and (c) are located within no more than 300 feet of at least 10 acres of contiguous undisturbed habitat or of a publicly owned conservation area.

**Unfunded Liabilities:** The costs of facilities or actions that a government jurisdiction has responsibility for based on existing regulations or to meet some code or requirement, but which is currently not included in its budget and for which funds are not currently available to cover the item.

**Use:** The specific activity or function for which land, a building, or a structure is designated, arranged, occupied or maintained.

**Vacant Land:** All parcels with a PC code equal to 00, 10, 40, or 70 in the Monroe County Property Appraiser Tax Roll.

**Wasteshed:** The land area above a discharge point that includes all sources of wastewater discharging to that point. In this study, wastesheds have been defined with the same boundaries as watersheds.

**Wastewater:** Waste that is treated through some type of sanitary treatment system.

**Wastewater Planning Unit:** One of twenty-eight areas throughout the Florida Keys that were used in the Monroe County Sanitary Wastewater Master Plan analysis and documentation.

**Wastewater Treatment System:** A facility for processing sanitary wastewater by removing contaminants, nutrients, and pathogens. For example, central treatment systems, septic tanks, and cesspits.

**Water Clarity:** A measure of the transparency of water and a measure of the depth to which sunlight can penetrate water. Depth of sunlight penetration is a key factor in the distribution of seagrasses.

**Water Quality Criteria:** Regulatory criteria setting the maximum or minimum value of water constituents for specific purposes, either within water bodies (ambient water quality) or in a discharge stream (discharge criteria).

**Watershed:** A catchment area that is otherwise draining to a watercourse or contributing flow to a body of water.

**Zoning:** Regulatory mechanism through which the Town regulates the location, size, and use of properties and buildings. Zoning regulations are intended to promote the health, safety, and general welfare of the community, and to lessen congestion, prevent overcrowding, avoid undue concentration of population, and facilitate the adequate provision of transportation, water, sewage, schools, parks, and other public services.