HIGHLANDS COUNTY BOARD OF COUNTY COMMISSIONERS

Purchasing Division and

Parks and Natural Resources Department

INVITATION TO BID

18-010

Lake Jackson Watershed Hydrology Groundwater, Meteorology and Surface Water/Stream Flow Sensor Station Acquisition and Installation
(Re-bid of ITB 17-031)

October, 2017

SECTION	DESCRIPTION	PAGE #

APPENDIX:

HIGHLANDS COUNTY BOARD OF COUNTY COMMISSIONERS

Purchasing Division and
Parks and Natural Resources Department

DIVISION 0 - SECTION 00010
INVITATION TO BID ("ITB")
ITB 18-010

The Board of County Commissioners ("Board") of Highlands County, Florida ("County") will receive sealed Bids in the Highlands County Purchasing Division ("Purchasing Division") for:

ITB NO. 18-010 **LAKE JACKSON WATERSHED HYDROLOGY GROUNDWATER, METEOROLOGY AND SURFACE WATER/STREAM FLOW SENSOR ACQUISITION AND INSTALLATION (Re-bid of ITB 17-031)**

Specifications may be obtained by downloading from our website: www.hcbcc.net, or by contacting: Jamee Soto, Buyer I, 600 S. Commerce Ave., Sebring, Florida 33870, Phone: 863-402-6526; Fax: 863-402-6735; or E Mail: jasoto@hcbcc.org.

A **MANDATORY PRE-BID meeting will be held at 2:30 P.M. on Wednesday; October 11, 2017**, in the County Engineering Training Room, 505 S. Commerce Ave., Sebring, Florida 33870.

The purpose of this meeting is to provide a forum where the Bidders can further familiarize themselves with the Specifications of the ITB. The County will only accept Bid submittals from Bidders that are represented during the entire pre-bid meeting and are signed in on the sign-in sheet as primary Bidders. The public is invited to attend this meeting. Arrival after 2:30 P.M. will be noted on the sign-in sheet, and Bids will not be accepted from Bidders that were late.

Each submittal shall include one (1) original, one (1) exact paper copy and one (1) exact electronic copy (CD or thumb drive) of the Bid submission packet.

BIDS MUST BE DELIVERED to the Purchasing Division, 600 S. Commerce Ave., Sebring, FL 33870 so as to reach that office no later than **3:00 P.M., Monday; October 23, 2017**, at which time they will be opened. The public is invited to attend this meeting. Bid envelopes must be sealed and marked with the ITB number and name to identify the enclosed Bid. Bids received later than the date and time specified will be rejected. The County will not be responsible for the late deliveries of Bids that are incorrectly addressed, delivered in person, by mail or any other type of delivery service.

One or more County Commissioners may be in attendance at the Bid opening and the Pre-Bid meeting.

The Board's Local Preference Policy ("Local Preference Policy") and the Board's Women/Minority Business Preference Policy ("W/MBE Preference Policy") will apply to the award of this ITB.

The County reserves the right to accept or reject any or all Bids or any parts thereof, and the determination of the Award, if an Award is made, will be based on the ranking of each Bid. The County reserves the right to waive irregularities in the Bid.

A Bidder must submit a Bid on all Work to receive consideration. A Bid Bond or Cashier's Check in an amount of five percent (5%) of the Bid must be included on Bids over one hundred thousand dollars ($100,000.00). If the successful Bid is greater than two hundred thousand dollars ($200,000.00), a Public Construction Bond will be required. An Irrevocable Letter of Credit may be considered in lieu of the Public Construction Bond depending on its verbiage. The Bidder must be a Licensed General Contractor in the State of Florida. The Bid must be accompanied by evidence of the Bidder's qualifications to do business in the State of Florida, in accordance with Chapter 489, Florida Statutes.

The principal features of the Project are: Acquisition and installation of ten (10) surficial aquifer system monitoring wells at seven (7) locations, the installation of three (3) automated lake stage and streamflow recorders, and one (1) automated weather station pursuant to Southwest Florida Water Management District specifications.

The Board does not discriminate upon the basis of any individual's disability status. This non-discrimination policy involves every aspect of the Board's functions, including one's access to, participation, employment or treatment in its programs or activities. Anyone requiring reasonable accommodation as provided for in the Americans with Disabilities Act or Section 286.26, Florida Statutes, should contact Ms. Pamela Rogers, ADA Coordinator at: 863-402-6842 (Voice), or via Florida Relay Service 711, or by e-mail: progers@hcbcc.org. Requests for CART or interpreter services should be made at least 24 hours in advance to permit coordination of the service.

Board of County Commissioners, Highlands County, FL **www.hcbcc.net**

DIVISION 0 - SECTION 00100
INSTRUCTIONS TO BIDDERS
ITB 18-010

Article 1 - Defined terms

1.01 Terms used in these Instructions to Bidders have the meanings indicated below and in Section 00700 of this ITB which are applicable to both the singular and plural thereof:

A. Alternative – Amount proposed by Bidder and stated on the Bid Form that will be added to or deducted from the base Bid amount if Engineer decides to accept a corresponding change in either Scope of Work or in products, materials, equipment, systems or installation methods described in Construction Documents.

B. Award – The selection by the County of the lowest responsible and responsive Bidder to perform the Work.

C. Bid – The Bid Form and other documents submitted by a Bidder in response to this ITB.

D. Bidder - The individual or entity who submits a Bid directly to the County.

E. Bid Form – Section 00300 of this ITB, which shall be used to submit a Bid.

F. Bidding Documents – This ITB, all Addenda to this ITB, and the Construction Documents.

G. Board – County's Board of County Commissioners.

H. County Attorney – The County's County Attorney.

I. County Engineer – The County's County Engineer.

J. County or Owner –Highlands County, a political subdivision of the State of Florida.

K. Engineer – The Engineer of Record.

L. Project Manager – The County Project Manager

M. Purchasing Division - The County's Purchasing Division, which issues Bidding Documents and administers the bidding procedures.

N. Sites – The Sites described and depicted in the Construction Documents.

O. Work – The Work described and depicted in the Construction Documents.

Article 2 - Copies of Bidding Documents

2.01 Complete sets of the Bidding Documents in the number and for the deposit sum, if any, stated in the Advertisement or this ITB may be obtained from the Purchasing Division.

2.02 Complete sets of Bidding Documents must be used in preparing Bids; neither Owner nor Project Manager assume any responsibility for errors or misinterpretations resulting from the use of incomplete sets of Bidding Documents.

2.03 Owner and Project Manager in making copies of Bidding Documents available on the above terms do so only for the purpose of obtaining Bids for the Work and do not confer a license or grant for any other use.

Article 3 - Qualifications of Bidders

3.01 To demonstrate Bidder's qualifications to perform the Work, Bidder shall submit detailed written evidence with the Bid Form as follows:

A. A list of a minimum of five (5) jobs that the Bidder has performed within the past three (3) years which are of equal magnitude and complexity as the type of work to be done for the Owner. The list should include the name of the entity, complete address, name, phone number, fax, and email of a responsible individual qualified to respond to questions concerning the Bidder's abilities, costs, schedules, etc. Prior successful, on-time accomplishment of such equal work will be a consideration in determining whether the Bidder is qualified to perform the Work.

B. A list of the supervisory personnel and other staff planned for the Work, with resumes describing their supervisory and staff capabilities and the number and classification of personnel required per shift.

C. List of equipment available for use on this Project. Identify if equipment is owned or leased.

D. A minimum of five (5) references of clients for whom similar work has been performed.

E. A list of the Bidder's employees and subcontract firms that will provide the following qualifications:

(1) Instrumentation technician or manufacturer's representative trained in installation of each specific requested monitoring equipment for the installation of the monitoring/recording devices to be installed pursuant to this ITB.

(2) Well Instrumentation Installation Technician

(3) Automated lake stage / flow recorder installation technician

F. Identify individuals with the following types of licenses who are employed by or will be contracted by the Bidder for this Project.

(1) Florida Licensed Well Installer (same as Florida Water Well Contractor from SFWMD)

(2) Florida Licensed Marine Contractor

(3) Florida Registered Professional Surveyor and Mapper

G. Each Bid must contain evidence of Bidder's qualification to do business in the State of Florida, in accordance with Chapter 489, Florida Statutes. (Copies of Licenses and Certificates)

H. A listing of all Subcontractors is required when the subcontract value exceeds ten percent (10%) of the total contract amount. Provide experience statements for these Subcontractors.

I. List of present commitments (workload), including name of project, location, and value of contract.

Article 4 - Examination of Bidding Documents, Other Related Data, and Sites

4.01 Subsurface and Physical Conditions known to Owner are shown in the Construction Documents. No Site specific subsurface studies have been done.

4.02 Underground Facilities known to Owner are shown on the Construction Documents. No Site specific utility locates have been done.

4.03 No Hazardous Environmental Condition has been identified at the Sites.

4.04 Provisions concerning responsibilities for the adequacy of data furnished to prospective Bidders with respect to subsurface conditions, other physical conditions and Underground Facilities, and possible changes in the Contract Documents due to differing or unanticipated conditions appear in Paragraphs 5.03, 5.04 and 5.05 of Section 00700 Standard General Conditions of the Construction Contract as modified in Section 00800 Supplementary Conditions of the Contract Documents. Provisions concerning responsibilities for the adequacy of data furnished to prospective Bidders with respect to Hazardous Environmental Conditions at the Sites, if any, and possible changes in the Contract Documents due to Hazardous Environmental Conditions uncovered or revealed at the Sites which were not shown or indicated in the Drawings or Specifications or identified in the Contract Documents to be within the scope of the Work appear in Paragraph 5.06 of Section 00700 Standard General Conditions of the Construction Contract as modified in Section 00800 Supplementary Conditions of the Contract Documents.

4.05 On request, the Purchasing Division will provide Bidder access to Sites to conduct such examinations, investigations, explorations, tests, and studies, as Bidder deems necessary for submission of a Bid. Bidder shall fill all holes and clean up and restore the Sites to their former conditions upon completion of such explorations, investigations, tests, and studies.

4.06 On request, the Purchasing Division will provide to each Bidder for examination access to or copies of Contract Documents (other than portions thereof related to price) for such other work.

4.07 It is the responsibility of each Bidder before submitting a Bid to:

A. Examine and carefully study the Bidding Documents, including any Addenda and the other related data identified in the Bidding Documents;

B. Visit the Sites and become familiar with and satisfy Bidder as to the general, local, and Site conditions that may affect cost, progress, and performance of the Work;

C. Become familiar with and satisfy Bidder as to all federal, state, and local Laws and Regulations that may affect cost, progress, or performance of the Work;

D. Carefully study all drawings of physical conditions in or relating to existing surface or subsurface structures at or contiguous to the Sites;

E. Obtain and carefully study (or assume responsibility for doing so) all additional or supplementary examinations, investigations, explorations, test, studies, and data concerning conditions (surface, subsurface, and Underground Facilities) at or contiguous to the Sites which may affect cost, progress, or performance of the Work or which relate to any aspect of the means, methods, techniques, sequences, and procedures of construction to be employed by Bidder, including any specific means, methods, techniques, sequences, and procedures of construction expressly required by the Bidding Documents, and safety precautions and programs incident thereto;

F. Agree at the time of submitting its Bid that no further examinations, investigations, explorations, tests, studies, or data are necessary for the determination of its Bid for performance of the Work at the price bid and within the times and in accordance with the other terms and conditions of the Bidding Document;

G. Become aware of the general nature of the Work to be performed by Owner and others at the Sites that relates to the Work as indicated in the Bidding Document;

H. Correlate the information known to Bidder, information and observations obtained from visits to the Sites, reports and drawings identified in the Bidding Documents, and all additional examinations, investigations, explorations, tests, studies, and data with the Bidding Documents;

I. Promptly give Engineer and the Purchasing Division written notice of all conflicts, errors, ambiguities, or discrepancies that Bidder discovers in the Bidding Documents and confirm that the written resolution thereof by Engineer and the Purchasing Division is acceptable to Bidder; and

J. Determine that the Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for the performance of the Work.

4.08 The submission of a Bid will constitute an incontrovertible representation by Bidder that Bidder has complied with every requirement of this Article 4, that without exception the Bid is premised upon performing and furnishing the Work required by the Bidding Documents and applying any specific means, methods, techniques, sequences, and procedures of construction that may be shown or indicated or expressly required by the Bidding Documents, that Bidder has given Engineer and the Purchasing Division written notice of all conflicts, errors, ambiguities, and discrepancies that Bidder has discovered in the Bidding Documents and the written resolutions thereof by Engineer and the Purchasing Division are acceptable to Bidder, and that the Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performing and furnishing the Work.

Article 5 - Pre-Bid Meeting

5.01 There will be a MANDATORY Pre-Bid Meeting as specified in ITB Section 00010 in the Engineering Training Room located at 505 S. Commerce Ave., Sebring FL 33870 at 2 P.M. on Thursday, October 12, 2017.

Article 6 - Sites and Other Areas

6.01 The Sites are identified in the Summary of Work (Section 01010). All additional lands and access thereto required for temporary construction facilities, construction equipment, or storage of materials and equipment to be incorporated in the Work is to be obtained and paid for by the Contractor. Easements for permanent structures or permanent changes in existing facilities are to be obtained and paid for by Owner unless otherwise provided in the Bidding Documents.

Article 7 - Interpretation and Addenda

7.01 All questions about the meaning or intent of the Bidding Documents are to be directed to the Purchasing Division. Interpretations or clarifications considered necessary by the Purchasing Division and Project Manager in response to such questions will be issued by Addenda and will be mailed, emailed, or delivered to all parties recorded by the Purchasing Division as having received the Bidding Documents and attended the Mandatory Pre-Bid Meeting. A Request for Information (RFI) Request for Information received after a set date may not be answered. Only RFI answered by formal written Addenda will be binding. Oral and other interpretations or clarifications will be without legal effect.

7.02 Addenda may be issued to clarify, correct, or change the Bidding Documents as deemed advisable by Owner, Engineer or the Purchasing Division.

7.03 Addenda will be posted to the County's website; www.hcbcc.net. <u>It is the sole responsibility of the Bidder to frequently check the County's website for Addenda.</u>

Article 8 - Bid Security

8.01 8.01 A "Bid Bond" or Cashier's Check, in the amount of five percent (5%) of the Bid, must be included on each Bid over one hundred thousand dollars ($100,000.00). If the successful Bid is greater than two hundred thousand dollars ($200,000.00), a "Public Construction Bond" of not less than one hundred percent (100%) of the Awarded Bid amount will be required. All Bonds must be in a form acceptable to Owner and County Attorney.

8.02 8.02 Within thirty (30) days after the Award, Owner will return the bid securities to all Bidders whose Bids are not to be further considered in awarding the Contract. Retained bid securities will be held until the Agreement has been finally executed, after which all bid securities, other than Bidder's bond and any guarantees which have been forfeited, will be returned to the respective Bidders whose Bids they accompanied.

Article 9 - Contract Times

9.01 The number of days within which, or the dates by which, the Work is to be (a) Substantially Completed and, (b) also completed and ready for final payment are set forth in the Bid Form. (Section 00300)

Article 10 - Liquidated Damages

10.01 Provisions for liquidated damages, if any, are set forth in the Agreement. (Section 00500)

Article 11 - Substitute or 'Or-Equal" Items

11.01 The Contract, if awarded, will be on the basis of materials and equipment described in the Bidding Documents with consideration of possible substitute or "or-equal" items if allowed within the Bidding Documents. Whenever it is specified or described in the Bidding Documents that a substitute or "or-equal" item of material or equipment may be furnished or used by Contractor if acceptable to Engineer, application for such acceptance will be considered by Engineer during the allotted time frame for Request for Information (RFI).

Article 12 - Subcontractors, Suppliers and Others

12.01 The apparent successful Bidder, and any other Bidder so requested, shall within five (5) days after Bid opening, submit to the County a list of proposed Subcontractors, Suppliers, individuals, or entities proposed for those portions of the Work for which such identifications are required. Such list shall be accompanied by an experience statement with pertinent information regarding similar projects and other evidence of qualification for each Subcontractor, Supplier, individual, or entity if requested by Owner. If Owner, Project Manager or the Purchasing Division after due investigation, has reasonable objection to any proposed Subcontractor, Supplier, individual, or entity, Owner may, before the Notice of Award is given, request apparent successful Bidder to submit a substitute, without an increase in the Bid.

12.02 If the apparent successful Bidder declines to make any such substitution, Owner may Award the Contract to the next lowest Bidder that proposes to use acceptable Subcontractors, Suppliers, individuals, or entities. Declining to make requested substitutions will not constitute grounds for forfeiture of the bid security of any Bidder. Any Subcontractor, Supplier, individual, or entity so listed and against which Owner, Project Manager or the Purchasing Division makes no written objection prior to giving of the Notice of Award will be deemed acceptable to all indicated parties subject to revocation of such acceptance after the Effective Date of the Contract as provided in Paragraph 7.06 of Section 00700 Standard General Conditions of the Construction Contract as modified in Section 00800 Supplementary Conditions of the Contract Documents.

12.03 Contractor shall not be required to employ any Subcontractor, Supplier, individual, or entity against whom Contractor has reasonable objection.

12.04 It is the responsibility of the Contractor to insure that all Subcontractors comply with all insurance requirements.

Article 13 - Bid Form

13.01 Bidder shall use and/or make necessary copies of Section 00300 “Bid Form” of this ITB for their Submittal Document(s).

13.02 All blanks on the Bid Form shall be completed by printing in black ink or by typewriter and the Bid Form shall be signed. A Bid Price shall be indicated for each unit price item listed therein, if applicable, or the words “No Bid”, “No Change”, or “Not Applicable” entered. All names shall be typed or printed below the signature line with all signatures in blue ink.

13.03 A Bid by a corporation shall be executed in the corporate name by the president or a vice president or other corporate officer accompanied by evidence of authority to sign. The corporate seal shall be affixed and attested by the secretary or an assistant secretary. The corporate address and state of incorporation shall be shown below the signature.

13.04 A Bid by a partnership shall be executed in the partnership name and signed by a partner (whose title must appear under the signature), accompanied by evidence of authority to sign. The official address of the partnership and state of organization and type of partnership shall be shown below the signature.

13.05 A Bid by a limited liability company shall be executed in the name of the firm by a member and accompanied by evidence of authority to sign. The state of formation of the firm and the official address of the firm must be shown below the signature.

13.06 A Bid by an individual shall show the Bidder’s name and official address, telephone number, fax number, and email address.

13.07 A Bid by a joint venture shall be executed by each joint venture in the manner indicated on the Bid Form. The official address of the joint venture must be shown below the signature.

13.08 The Bid shall contain an acknowledgment of receipt of all Addenda, the numbers of which shall be filled in on the Bid Form.

13.09 All Bid Forms shall have the name, official address, telephone number, fax number, and email address for communications regarding the Bid.

13.10 Attachments to the Bid Form shall include the following:

A. Documentation as required in Article 3 of this Section including a copy of Contractors License.

B. All insurance from both Contractor and Subcontractor (if applicable) required to fulfill the obligations of this Project.

C. Certifications from Section 00160, signed and notarized.

Article 14 - Basis of Bid; Evaluation of Bids

14.01 Bidders shall submit a Bid on a Lump Sum and Unit Price basis as noted on the Bid Form for the Work listed in these Bid Documents.

14.02 The Bid price shall include such amounts as the Bidder deems proper for overhead and profit on account of cash allowances.

Article 15 - Submittal of Bids

15.01 Each prospective Bidder is furnished one copy of the Bidding Documents and if required, the Bid Bond Section 00410 of this ITB. An unbound copy of the Bid Form is to be completed and submitted with the bid security and the following data:

A. A current copy of Bidder's Certificate of Insurance and a statement of Bidder's ability to acquire the insurance limits and requirements stated in Paragraphs 6.2 and 6.3 of Section 00700 Standard General Conditions of the Construction Contract as modified in Section 00800 Supplementary Conditions of the Contract Documents.

B. All documentation from Subcontractors (if applicable) including their ability to acquire the insurance limits and requirements stated in Paragraphs 6.2 and 6.3 of Section 00700 Standard General Conditions of the Construction Contract as modified in Section 00800 Supplementary Conditions of the Contract Documents.

15.02 A Bid shall be submitted no later than the date and time prescribed and at the place indicated in the advertisement or Invitation to Bid (Section 00010) and shall be enclosed in a sealed opaque envelope or package, plainly marked with the Bid #, Bid / Project Title, the name and address of Bidder, and shall be accompanied by the bid security and other required documents. A mailed Bid shall be addressed to the Highlands County BCC; Attn: Purchasing Division, 600 S Commerce Ave., Sebring, FL 33870.

Article 16 - Modification and Withdrawal of Bids

16.01 Prior to the date and time for the opening of Bids, a Bid may be modified or withdrawn by an appropriate document duly executed in the manner that a Bid must be executed and delivered to the place where Bids are to be submitted.

Article 17 - Opening of Bids

17.01 Bids will be opened at the time and place indicated in the advertisement or ITB Section 00010 and, unless obviously non-responsive, read aloud publicly. An abstract of the amounts of the base Bids and major alternates, if any, will be made available to Bidders after the opening of Bids by means of a copy of the "Bid Opening Sheet."

Article 18 - Bids to Remain Subject to Acceptance

18.01 All Bids will remain subject to acceptance for the period of time stated in the Bid Form and as allowed by Section 119.071, Florida Statutes, but Owner may, in its sole discretion, release any Bid and return the Bid security prior to the end of this period.

Article 19 - Award of Contract

19.01 All work for this ITB will be awarded to one (1) Bidder.

19.02 Owner reserves the right to reject any or all Bids, including without limitation, non-conforming, non-responsive, unbalanced, or conditional Bids. Owner further reserves the right to reject the Bid of any Bidder that it finds, after reasonable inquiry and evaluation, to be non-responsible. Owner may also reject the Bid of any Bidder if Owner believes that it would not be in the best interest of the Project to make an Award to that Bidder. Owner also reserves the right to waive all informalities not involving price, time, or changes in the Work and to negotiate contract terms with the successful Bidder.

19.03 More than one Bid for the same Work from an individual or entity under the same or different names will not be considered. Reasonable grounds for believing that any Bidder has an interest in more than one Bid for the Work may be cause of disqualification of that Bidder and the rejection of all Bids in which that Bidder has an interest.

19.04 Evaluation of Bids

A. In evaluating Bids, Owner will consider whether or not the Bids comply with the prescribed requirements, and such alternatives, unit prices, and other data, as may be requested in the Bid Form or prior to the Notice of Award.

B. In the comparison of Bids, alternatives will be applied in the same order of priority as listed in the Bid Form. To determine the Bid prices for purposes of comparison, Owner shall announce to all Bidders a “Base Bid plus alternatives” budget after receiving all Bids, but prior to opening them. For comparison purposes alternatives will be accepted, following the order of priority established in the Bid Form, until doing so would cause the budget to be exceeded. After determination of the successful Bidder based on this comparative process and on the responsiveness, responsibility, and other factors set forth in these Instructions, the award may be made to the successful Bidder on its base Bid and any combination of its additive alternate Bids for which Owner determines funds will be available at the time of award.

C. In evaluating Bids, Owner will consider whether or not the Bids comply with the prescribed requirements, and such alternates, unit prices and other data, as may be requested in the Bid Form or prior to the Notice of Award.

D. In evaluating Bidders, Owner will consider the qualifications of Bidders and may consider the qualifications and experience of Subcontractors, Suppliers, and other individuals or the entities proposed for those portions of the Work for which the identity of Subcontractors, Suppliers, and other individuals or entities must be submitted as required by Article 12 of this Section 00100.

19.05 Owner may conduct such investigations as Owner deems necessary to establish the responsibility, qualifications, and financial ability of Bidders, proposed Subcontractors, Suppliers, individuals, or entities to perform the Work in accordance with the Contract Documents.

19.06 If the Contract is to be awarded, Owner will Award the Contract to the Bidder whose Bid is determined to be the most advantageous to Owner, taking into consideration those Bids in compliance with the requirements as set forth in this ITB.

19.07 Within thirty-five (35) days after the opening of Bids, unless otherwise stated in this ITB, Owner will accept one of the Bids or will act in accordance with these Instructions to Bidders or the Section 00250 General Terms and Conditions for Construction Projects. The acceptance of the Bid will be by written Notice of Intent of Award with an attached copy of the signed Bid tabulation, emailed, mailed or delivered to the office designated in the Bid, with a copy to all other Bidders. In the event of failure of the lowest responsible qualified Bidder to sign and return the Agreement, as prescribed herein, Owner may Award to the next lowest responsible and responsive qualified Bidder. Such Award, if made will be made within ninety (90) days after opening Bids.

Article 20 - Insurance

20.01 When the successful Bidder delivers the executed Agreement to Owner, it must be accompanied by the required Certificate of Insurance.

Article 21 - Signing of Agreement

21.01 When Owner gives a Notice of Award to the successful Bidder, it shall be accompanied by the required number of unsigned counterparts of the Agreement with the other Contract Documents, which are identified in the Agreement attached thereto. Within fifteen (15) days thereafter, successful Bidder shall sign and deliver the required number of counterparts of the Agreement and attached Contract Documents to Owner. Within thirty (30) days thereafter, Owner shall deliver one fully signed counterpart to successful Bidder.

Article 22 - Retainage

22.01 Provisions concerning retainage are set forth in the Contract Documents.

Article 23 - Designated Contacts and Request for Information (RFI) Deadline

23.01 All questions regarding this ITB must be submitted in writing to:

Ms. Jamee Soto
HCBCC Buyer I
600 S Commerce Ave, Sebring, Florida 33870
Phone: (863) 402-6526; Fax: (863) 402-6735
Email: jasoto@hcbcc.org

23.02 The deadline to submit questions is 5 P.M. on Tuesday; October 17, 2017. The County will release responses in the form of an Addendum to all Mandatory Pre-Bid attendees via email. This Addendum will be posted to the County's website: www.hcbcc.net.

Article 24 - Direct Purchase Procedure

24.01 The Owner and the Contractor will utilize the Direct Material Purchase Procedure of Paragraph 7.09 of Section 00700 Standard General Conditions of the Construction Contract as modified in Section 00800 Supplementary Conditions of the Contract Documents.

24.02 Depth of well installation will be overseen by a Florida Professional Geologist retained by the County.

DIVISION 0 - SECTION 00160
CERTIFICATION PURSUANT TO SECTION 287.135, FLORIDA STATUTES
ITB 18-010

THIS FORM MUST BE SIGNED AND SWORN TO IN THE PRESENCE OF A NOTARY PUBLIC OR OTHER OFFICIAL AUTHORIZED TO ADMINISTER OATHS.

1. This sworn statement is submitted to the HIGHLANDS COUNTY BOARD OF COUNTY COMMISSIONERS

by _____
[Print individual's name and title]

for _____
[Print name and state of incorporation or other formation of the entity submitting this sworn statement]

whose business address is _____ and

whose Federal Employer Identification Number (FEIN) is _____ (hereinafter referred to as "Bidder")

2. CERTIFICATION

Bidder hereby certifies that at the time of its Bid the Bidder is not on the Scrutinized Companies that Boycott Israel list created pursuant to Section 215.4725, Florida Statutes, is not participating in a boycott of Israel, is not on the Scrutinized Companies with Activities in Sudan List or the Scrutinized Companies with Activities in the Iran Petroleum Energy Sector List and that it does not have business operations in Cuba or Syria.

THIS CERTIFICATION IS MADE PURSUANT TO SECTION 287.135(5), FLORIDA STATUTES, AND IS, UPON DELIVERY, A PUBLIC RECORD.

_____

Print Name:_____

STATE OF _____
COUNTY OF _____

The foregoing Certification was sworn to before me this ___ day of _____, 2017, by _____, as _____, the duly authorized officer of _____, on its behalf, who is either personally known to me [ ] or has produced _____ as identification [ ].

(AFFIX NOTARY SEAL)

_____
Print Name: _____
Notary Public, State of Florida
Commission No. _____
My Commission Expires: _____

CERTIFICATION PURSUANT TO SECTION 287.087, FLORIDA STATUTES
PREFERENCE TO DO BUSINESS WITH DRUG FREE WORKPLACE PROGRAMS
ITB 18-010
THIS FORM MUST BE SIGNED AND SWORN TO IN THE PRESENCE OF A NOTARY PUBLIC OR OTHER OFFICIAL AUTHORIZED TO ADMINISTER OATHS.

1. This sworn statement is submitted to the HIGHLANDS COUNTY BOARD OF COUNTY COMMISSIONERS

by _____
[Print individual's name and title]

for _____
[Print name and state of incorporation or other formation of the entity submitting this sworn statement]

whose business address is _____ and

whose Federal Employer Identification Number (FEIN) is _____ (hereinafter referred to as "Bidder")

2. CERTIFICATION
Bidder hereby certifies that at the time of its Bid the Bidder has a drug free workplace program in place. The program meets the requirements of Section 287.087, Florida Statutes.

THIS CERTIFICATION IS MADE PURSUANT TO SECTION 287.087, FLORIDA STATUTES, AND IS, UPON DELIVERY, A PUBLIC RECORD.

_____
Print Name: _____ Date: ____/____/___

STATE OF FLORIDA
COUNTY OF _____

The foregoing Certification was sworn to before me this ___ day of _____, 20___, by _____, as _____, the duly authorized officer of _____, on its behalf, who is either personally known to me [ ] or has produced _____ as identification [ ].

Signature: _____
Print Name: _____
(AFFIX NOTARY SEAL) Notary Public, State of_____
Commission No. _____
My Commission Expires: _____

SWORN STATEMENT UNDER SECTION 287.133(3)(A), FLORIDA STATUTES,
ON PUBLIC ENTITY CRIMES
ITB 18-010
THIS FORM MUST BE SIGNED AND SWORN TO IN THE PRESENCE OF A NOTARY PUBLIC OR OTHER OFFICIAL AUTHORIZED TO ADMINISTER OATHS.

DESCRIPTION OF CONTRACT: _____

STATE OF FLORIDA }ss
COUNTY OF _____ }

Before me, the undersigned authority, personally appeared _____ who, being by me first duly sworn, made the following statement:

1. The business address of _____(name of bidder or contractor), is _____

2. I understand that a public entity crime as defined in Section 287.133 of the Florida Statutes includes a violation of any state or federal law by a person with respect to and directly related to the transaction of business with any public entity in Florida or with an agency or political subdivision of any other state or with the United States, including, but not limited to, any bid or contract for goods or services to be provided to any public entity or such an agency or political subdivision and involving antitrust, fraud, theft, bribery, collusion, racketeering, conspiracy or material misrepresentation.

3. I understand that "convicted" or "conviction" is defined by the statute to mean a finding of guilt or a conviction of a public entity crime, with or without an adjudication of guilt, in any federal or state trial court of record relating to charges brought by indictment or information after July 1, 1989, as a result of a jury verdict, non-jury trial, or entry of a plea of guilt or nolo contendere.

4. I understand that "affiliate" is defined by the statute to mean (1) a predecessor or successor of a person or a corporation convicted of a public entity crime, or (2) an entity under the control of any natural person who is active in the management of the entity and who has been convicted of a public entity crime, or (3) those officers, directors, executives, partners, shareholders, employees, members, and agents who are active in the management of an affiliate, or (4) a person or corporation who knowingly entered into a joint venture with a person who has been convicted of a public entity crime in Florida during the preceding 36 months.

5. Neither the bidder or contractor nor any officer, director, executive, partner, shareholder, employee, member or agent who is active in the management of the bidder or contractor nor any affiliate of the bidder or contractor has been convicted of a public entity crime subsequent to July 1, 1989.
(Draw a line through paragraph 5 if paragraph 6 below applies.)

6. There has been a conviction of a public entity crime by the bidder or contractor, or an officer, director, executive, partner, shareholder, employee, member or agent of the bidder or contractor who is active in the management of the bidder or contractor or an affiliate of the bidder or contractor. A determination has been made pursuant to 287.133(3) by order of the Division of Administrative Hearings that it is not in the public interest for the name of the convicted person or affiliate to appear on the convicted vendor list. The name of the convicted person or affiliate is _____.

A copy of the order of the Division of Administrative Hearings is attached to this statement.

(Draw a line through paragraph 6 if paragraph 5 above applies.)

THIS SWORN STATEMENT IS MADE PURSUANT TO SECTION 287.133(3)A, FLORIDA STATUTES, AND IS, UPON DELIVERY, A PUBLIC RECORD

Signature: _____

Print Name: _____

Print Title: _____

On _____ day of _____, 20_____.

Sworn and subscribed before me in the State and County first mentioned above on the _____ day of _____, 20_____.

Signature: _____

Print Name: _____

(AFFIX NOTARY SEAL)

Notary Public, State of_____

Commission No. _____

My Commission Expires: _____

CERTIFICATION PURSUANT TO SECTION 287.134, FLORIDA STATUTES DISCRIMINATION; DENIAL OR REVOCATION OF THE RIGHT TO TRANSACT BUSINESS WITH PUBLIC ENTITIES

ITB 18-010

THIS FORM MUST BE SIGNED AND SWORN TO IN THE PRESENCE OF A NOTARY PUBLIC OR OTHER OFFICIAL AUTHORIZED TO ADMINISTER OATHS.

1. This sworn statement is submitted to the HIGHLANDS COUNTY BOARD OF COUNTY COMMISSIONERS

by _____

[Print individual's name and title]

for _____

[Print name and state of incorporation or other formation of the entity submitting this sworn statement]

whose business address is _____ and

whose Federal Employer Identification Number (FEIN) is _____ (hereinafter referred to as "Bidder")

2. CERTIFICATION

Bidder hereby certifies that at the time of its Bid the Bidder has not been placed on the discriminatory vendor list by the Department of Management Services.

THIS CERTIFICATION IS MADE PURSUANT TO SECTION 287.134, FLORIDA STATUTES, AND IS, UPON DELIVERY, A PUBLIC RECORD.

_____

Print Name: _____ Date: ____/____/___

STATE OF FLORIDA
COUNTY OF _____

The foregoing Certification was sworn to before me this ___ day of _____, 20___, by _____, as _____, the duly authorized officer of _____, on its behalf, who is either personally known to me [ ] or has produced _____ as identification [ ].

Signature: _____

Print Name: _____

(AFFIX NOTARY SEAL) Notary Public, State of_____

Commission No. _____

My Commission Expires: _____

CERTIFICATION OF PARTICIPATION IN THE UNITED STATES CITIZENSHIP AND IMMIGRATION SERVICE BUREAU'S E-VERIFY PROGRAM

ITB 18-010

THIS FORM MUST BE SIGNED AND SWORN TO IN THE PRESENCE OF A NOTARY PUBLIC OR OTHER OFFICIAL AUTHORIZED TO ADMINISTER OATHS.

1. This sworn statement is submitted to the HIGHLANDS COUNTY BOARD OF COUNTY COMMISSIONERS

by _____
[Print individual's name and title]

for _____
[Print name and state of incorporation or other formation of the entity submitting this sworn statement]

whose business address is _____ and

whose Federal Employer Identification Number (FEIN) is _____ (hereinafter referred to as "Bidder")

2. CERTIFICATION

Bidder hereby certifies that at the time of its Bid the Bidder participates in the United States Citizenship and Immigration Services Bureau's E-Verify Program, and does not knowingly employ, hire for employment, or continue to employ an unauthorized alien.

Bidder's E-verify Company ID #: _____

THIS CERTIFICATION IS, UPON DELIVERY, A PUBLIC RECORD.

_____
Print Name: _____ Date: ____/____/___

STATE OF FLORIDA
COUNTY OF _____

The foregoing Certification was sworn to before me this ___ day of _____, 20___, by _____, as _____, the duly authorized officer of _____, on its behalf, who is either personally known to me [ ] or has produced _____ as identification [ ].

Signature: _____
Print Name: _____
(AFFIX NOTARY SEAL) Notary Public, State of_____
Commission No. _____
My Commission Expires: _____

LOCAL PREFERENCE AFFIDAVIT OF ELIGIBILITY
ITB 18-010

THIS FORM MUST BE SIGNED AND SWORN TO IN THE PRESENCE OF A NOTARY PUBLIC OR OTHER OFFICIAL AUTHORIZED TO ADMINISTER OATHS.

1. This sworn statement is submitted to
HIGHLANDS COUNTY BOARD OF COUNTY COMMISSIONERS

by _____
[Print individual's name and title]

for _____
[Print name of Company/Individual submitting sworn statement]

Whose business address is_____

(If applicable) its Federal Employer Identification Number (FEIN) is_____

(If the entity has no FEIN, include the Social Security Number of the individual signing this

Sworn statement):_____.

2. LOCAL PREFERENCE ELIGIBILITY

A. Vendor/Individual has had a fixed office or distribution point located in and having a street address within Highlands County for at least twelve (12) months immediately prior to the issuance of the request for quotation, competitive bids or request for proposals by the County.

YES _____ NO _____

B. Vendor/Individual holds business license required by the County, and/or if applicable, the Municipalities:
YES _____ NO _____

C. Vendor/Individual employs at least one full-time employee, or two part-time employees whose primary residence is in Highlands County, or, if the business has no employees, the business shall be at least fifty (50) percent owned by one or more persons whose primary residence is in Highlands County.
YES _____ NO _____

I UNDERSTAND THAT THE SUBMISSION OF THIS FORM TO THE PUBLIC ENTITY IDENTIFIED IN PARAGRAPH 1 (ONE) ABOVE IS FOR THAT PUBLIC ENTITY ONLY AND, THAT THIS FORM SHALL BE CONSIDERED PUBLIC RECORD.

_____
[Signature and Date]

STATE OF _____, COUNTY OF _____

Subscribed and sworn before me, the undersigned notary public on this ____ day of _____, 20___.

_____ **NOTARY PUBLIC** **SEAL** _____ **Commission Expiration Date**

DIVISION 0 - SECTION 00250
GENERAL TERMS AND CONDITIONS FOR CONSTRUCTION PROJECTS
ITB 18-010

A. All Bidding Documents shall become the property of the County.

B. Compliance with Florida Statutes

- Section 287.087, on Drug Free Workplace,
- Section 287.133(2)(a), on Public Entity Crimes,
- Section 287.134, on Discrimination, and
- Section 287.135, Prohibiting contracting with scrutinized companies is required.

1. Section 287.087, Florida Statutes. Preference to businesses with drug free workplace programs. In order to have a drug free workplace program, a business shall:

   a. Publish a statement notifying employees that the unlawful manufacture, distribution, dispensing, possession, or use of a controlled substance is prohibited in the workplace and specifying the actions that will be taken against employees for violations of such prohibition.

   b. Inform employees about the dangers of drug abuse in the workplace, the business's policy of maintaining a drug free workplace, any available drug counseling, rehabilitation, and employee assistance programs, and the penalties that may be imposed upon employees for drug abuse violations.

   c. Give each employee engaged in providing the commodities or contractual services that are under bid a copy of the statement specified in subsection (1).

   d. In the statement specified in subsection (1), notify the employees that, as a condition of working on the commodities or contractual services that are under bid, the employee will abide by the terms of the statement and will notify the employer of any conviction of, or plea of guilty or nolo contendere to, any violation of Chapter 893, Florida Statutes, or of any controlled substance law of the United States or any state, for a violation occurring in the workplace no later than five (5) days after such conviction.

   e. Impose a sanction on, or require the satisfactory participation in a drug abuse assistance or rehabilitation program if such is available in the employee's community by, any employee who is so convicted.

   f. Make a good faith effort to continue to maintain a drug free workplace through implementation of this section.

2. Section 287.133, Florida Statutes. Public entity crime; denial or revocation of the right to transact business with public entities:

   (2)(a) A person or affiliate who has been placed on the convicted vendor list following a conviction for a public entity crime may not submit a bid, proposal, or reply on a contract to provide any goods or services to a public entity; may not submit a bid, proposal, or reply on a contract with a public entity for the construction or repair of a public building or public work;

may not submit bids, proposals, or replies on leases of real property to a public entity; may not be awarded or perform work as a contractor, supplier, subcontractor, or consultant under a contract with any public entity; and may not transact business with any public entity in excess of the threshold amount provided in Section 287.017, Florida Statutes for CATEGORY TWO for a period of 36 months following the date of being placed on the convicted vendor list.

3. Section 287.134, Florida Statutes. Discrimination; denial or revocation of the right to transact business with public entities:

   (2)(a) An entity or affiliate who has been placed on the discriminatory vendor list may not submit a bid, proposal, or reply on a contract to provide any goods or services to a public entity; may not submit a bid, proposal, or reply on a contract with a public entity for the construction or repair of a public building or public work; may not submit bids, proposals, or replies on leases of real property to a public entity; may not be awarded or perform work as a contractor, supplier, subcontractor, or consultant under a contract with any public entity; and may not transact business with any public entity.

4. Section 287.135, Florida Statutes. Prohibition against contracting with scrutinized companies:

   (2) A company is ineligible to, and may not, bid on, submit a proposal for, or enter into or renew a contract with an agency or local governmental entity for goods or services of $1 million or more if at the time of bidding or submitting a proposal for a new contract or renewal of an existing contract, the company:

   (a) Is on the Scrutinized Companies that Boycott Israel List, created pursuant to Section 215.4725, Florida Statutes, or is engaged in a boycott of Israel;

   (b) Is on the Scrutinized Companies with Activities in Sudan List or the Scrutinized Companies with Activities in the Iran Petroleum Energy Sector List, created pursuant to Section 215.473, Florida Statutes.

   (c) Is engaged in business operations in Cuba or Syria.

   (5) At the time a company submits a bid or proposal for a contract or before the company enters into or renews a contract with an agency or governmental entity for goods or services of $1 million or more, the company must certify that the company is not participating in a boycott of Israel, on the Scrutinized Companies with Activities in Sudan List or the Scrutinized Companies with Activities in the Iran Petroleum Energy Sector List, or that it does not have business operations in Cuba or Syria.

5. CERTIFICATIONS OF COMPLIANCE WITH THE ABOVE-REFERENCED STATUTES ARE LOCATED ON SECTION 00160, AND MUST BE INCLUDED WITH THE BID, SIGNED AND NOTARIZED.

C. Bids are due and must be received in accordance with the instructions given in Section 00100 of this ITB.

D. Owner will not reimburse Bidder(s) for any costs associated with the preparation and submittal of any Bid.

E. Bidders, their agents and associates shall NOT solicit any County official. Bidders, their agents and associates shall NOT contact any County official other than the individual(s) listed in Article 23 of Section 00100 of this ITB for additional information and clarification.

F. Due care and diligence have been exercised in the preparation of this ITB and all information contained herein is believed to be substantially correct; however, the responsibility for determining the full extent of the service required rests solely with those making response. Neither Owner nor its representatives shall be responsible for any error or omission in the Bids submitted, nor for the failure on the part of the Bidders to determine the full extent of the exposures.

G. All timely responses meeting the specifications set forth in this ITB will be considered. However, Bidders are cautioned to clearly indicate any deviations from these specifications. The terms and conditions contained herein are those desired by Owner and preference will be given to those Bids in full or substantially full compliance with them.

H. Each Bidder is responsible for full and complete compliance with all laws, rules and regulations including those of the Federal Government, the State of Florida and the County of Highlands. Failure or inability on the part of the Bidder to have complete knowledge and intent to comply with such laws, rules and regulations shall not relieve the Bidder from its obligation to honor its Bid and to perform completely in accordance with its Bid.

I. County, at its discretion, reserves the right to waive minor informalities or irregularities in any Bids, to reject any and all Bids in whole or in part, with or without cause, and to accept that Bid, if any, which in its judgment will be in its best interest.

J. Award will be made to the Bidder whose Bid is determined to be the most advantageous to Owner, taking into consideration those Bids in compliance with the requirements as set forth in this ITB. The Board reserves the right to reject any and all Bids for any reason or make no Award whatsoever or request clarification of information from the Bidders.

K. Any interpretation, clarification, correction or change to this ITB will be made by written addendum issued by the Purchasing Division. Any oral or other type of communication concerning this ITB shall not be binding.

L. Bids must be signed by an individual of the Bidder's organization legally authorized to commit the Bidder to the performance of the product(s) and/or service(s) contemplated by this ITB.

M. The insurance requirements of Paragraphs 6.02, 6.03, and 6.06 of the Standard General Conditions, as amended by the Supplementary Conditions, found in Sections 00700 and 00800 of this ITB must be satisfied before delivery of goods and performance of services.

N. If submitting a Bid for more than one ITB, each Bid must be in a separate envelope and correctly marked. Only one (1) Bid per project shall be accepted from any person, corporation or firm. Modifications will not be accepted or acknowledged.

O. If the successful Bid is greater than two hundred thousand dollars ($200,000.00), a Public Construction Bond will be required. Awarded Bidder must record Public Construction Bond at the Clerk's Recording Department and comply with Section 255.05, Florida Statutes. All Bonds must be in a form acceptable to Owner and County Attorney.

P. Each Bid must contain proof of enrollment in E-Verify. See certification in Section 00160.

Q. Board policy prohibits any County employee or members of their family from receiving any gift, benefit, and/or profit resulting from any contract or purchase. Except for advertising novelties valued less than ten dollars ($10.00), Board policy also prohibits acceptance of gifts of any kind.

R. Construction Projects that are awarded for less than two hundred thousand dollars ($200,000.00) and without a Public Construction Bond are subject to the following provisions:

1. At any time prior to final completion of the Contract, Owner will not authorize or make payment to the Contractor in excess of ninety percent (90%) of the amount due on the Contract on the basis of the Work suitably completed.

2. In case of the default by the Contractor, the laborers, materialmen, and Subcontractors, as defined in Section 713.01, Florida Statutes, making claims for unpaid bills, may be paid from the ten percent (10%) retainage.

3. The final payment of retainage shall not be made until: (1) the Project has been inspected by the Project Manager or other person designated by the County for the purpose; (2) Project Manager or other designated person has issued a written certificate that the Project has been constructed in accordance with the approved Construction Documents and approved Change Orders; (3) the County has accepted the Project; and (4) the Contractor has supplied the County with signed and dated statements from all laborers, materialmen, and subcontractors as defined in Section 713.01, Florida Statutes, and identified under paragraph 5 of this section R, that they have no claims against the Contractor for the Work under the Contract. Said statements shall identify the Project by name and Project number.

4. The Contractor, before beginning Work or within two (2) workdays thereafter, shall post in a conspicuous place on the Site the following notice.

"Notice is hereby made to all those concerned and affected that
_____(Contractor's Name) is performing the
"Lake Jackson Watershed Hydrology Groundwater,
Meteorology and Surface Water/Stream Flow Sensor
Station Acquisition and Installation."

All parties furnishing labor and/or materials to said project must,
within twenty (20) days of first providing such labor and/or materials,
deliver notice of such in writing, by certified mail, returned receipt requested, to:

HIGHLANDS COUNTY BOARD OF COUNTY COMMISSIONERS
NATURAL RESOURCES DEPARTMENT
ATTN: CLELL FORD
4344 GEORGE BLVD., SEBRING, FLORIDA 33875-5803

5. The Contractor shall provide a certified list of all Subcontractors, laborers, and material suppliers to the Owner or Designee within thirty (30) days of receiving the Notice to Proceed with the Work. This list shall be updated thereafter each month with a certified statement that the list and its updates include the names and address of all of those Subcontractors, laborers, and material suppliers furnishing labor and/or material for the Project.

6. The Contractor shall provide a written statement with each pay request to the Project Manager which indicates how each payment will be distributed. This pay request breakdown shall define

the disbursement intended for all the funds requested. When the Contractor receives any payment it shall pay such moneys received to each Subcontractor and material supplier as set forth in that written statement.

7. The Contractor shall provide a written statement with all but the first payment request from each of the Subcontractors, laborers, and material suppliers indicated in paragraph 5 of this Section R that they have in fact received payment as indicated in paragraph 6 of this Section R. In the event a payment is not made as indicated on a prior written statement provided pursuant to paragraph 5 of this Section R, the Contractor shall furnish an explanation as to the reasons for such deviation and shall request approval from the Project Manager.

S. Late Bids will not be accepted under any circumstances. If Bids are received after the scheduled time of the Bid Opening Meeting, the Bidder will be contacted for disposition. The Purchasing Division, at the Bidder's expense, can return the unopened envelope, or, at the Bidder's request, in writing, can destroy it.

T. Electronically submitted Bids and faxed Bids will not be accepted. Any blank spaces on the required Bid Form or the absence of required submittals or signatures may cause the Bid to be declared non-responsive.

U. The County is not responsible for correcting any errors or typos made on the Bid response. Incorrect calculations may cause the Bid to be declared non-responsive.

V. Minority Owned and Women owned businesses must submit a copy of the certificate to receive credit.

W. The Bidder shall comply with the Florida Sales and Use Tax Law as it may apply to this Contract. The quoted amount(s) shall include any and all Florida Sales and Use Tax payment obligations required by Florida Law of the successful Bidder and/or its Subcontractors or material suppliers.

X. Public Records: Any material submitted in response to this ITB will become Public Record pursuant to Section 119(1)(b) and (c), Florida Statutes.

Y. All pages included in or attached by reference to this ITB shall be called and constitute the Invitation to Bid.

DIVISION 0 - SECTION 00300

BID FORM

ITB 18-010

PROJECT IDENTIFICATION: LAKE JACKSON WATERSHED HYDROLOGY GROUNDWATER, METEOROLOGY AND SURFACE WATER/STREAM FLOW SENSOR ACQUISITION AND INSTALLATION (Re-bid of ITB 17-031)

THIS BID IS SUBMITTED TO: Highlands County Board of County Commissioners
Attn: Purchasing Division
600 S Commerce Ave., Sebring, FL 33870

BID SUBMITTED BY:

_____
[Bidding Company's Name, 'Bidder']

_____
[Bidder's Authorized Representative's Name]

_____
[Bidder's Address, Building #, Street]

_____
[Bidder's Address, City, State, Zip]

_____
[Print Contact Person's Name for this bid]

_____
[Contact Person's Email Address]

_____
[Contact Person's Phone Number]

A. The Bidder proposes and agrees, if this Bid is accepted, to furnish all labor, materials, and equipment to construct and complete the Work according to and as specified or indicated in ITB 18-010 and the Bidding Documents for the Bid Price and within the time periods stated in this Bid and in accordance with the other terms and conditions of the Contract Documents.

B. Bidder accepts all of the terms and conditions of the Advertisement or Invitation to Bid and Instructions to Bidders, including without limitation those dealing with the disposition of Bid security. This Bid will remain subject to acceptance for thirty (30) days after the day of Bid opening. Bidder will sign and deliver the required number of the other documents required by this ITB within fifteen (15) days after the date of County's Notice of Award.

C. In submitting this Bid, Bidder represents that:

1. Bidder has examined and carefully studied the Bidding Documents, including the following Addenda, receipt of all of which is hereby acknowledged:

Date	Number	Date	Number
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

2. Bidder has visited the Site and become familiar with and is satisfied as to the general, local, and Site conditions that may affect cost, progress, performance, and furnishing of the Work;

3. Bidder is familiar with and is satisfied as to all Laws and Regulations that may affect cost, progress, performance, and furnishing of the Work.

4. Bidder acknowledges that County and Project Manager do not assume responsibility for the accuracy or completeness of information and data shown or indicated in the Bidding Documents with respect to Underground Facilities at or contiguous to the Site. Bidder has obtained and carefully studied (or assumes responsibility for having done so) all such additional or supplementary examinations, investigations, explorations, tests, studies, and data concerning conditions (surface, subsurface, and Underground Facilities) at or contiguous to the Site or otherwise which may affect cost progress, performance or furnishing of the Work or which relate to any aspect of the means, methods, techniques, sequences, and procedures of construction to be employed by Bidder and safety precautions and programs incident thereto. Bidder does not consider that any additional examinations, investigations, explorations, tests, studies or data are necessary for the determination of this Bid for performance and furnishing of the Work in accordance with the times, price, and other terms and conditions of the Contract Documents.

5. Bidder is aware of the general nature of the Work to be performed by County and others at the Site that relates to the Work.

6. Bidder has correlated information known to Bidder, information and observations obtained from visits to the Site and all additional examinations, investigations, explorations, tests, studies, and data with the Contract Documents.

7. Bidder has given Project Manager written notice of all conflicts, errors, ambiguities or discrepancies that Bidder has discovered in the Bidding Documents and the written resolution

thereof by Project Manager is acceptable to Bidder, and the Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performing and furnishing the Work.

8. This Bid is genuine and not made in the interest of or on behalf of any undisclosed person, firm or corporation and is not submitted in conformity with any agreement or rules of any group, association, organization or corporation. Bidder has not directly or indirectly induced or solicited any other Bidder to submit a false or sham Bid. Bidder has not solicited or induced any person, firm or corporation to refrain from Bidding, and Bidder has not sought by collusion to obtain for itself any advantage over any other Bidder or over County.

D. Documentation included with Bid packet

		Required?	Included (check if yes)
1.	One (1) original (signed in blue ink), one (1) exact paper copy, and one (1) exact electronic copy (CD or thumb drive) of the submitted Bid.	Yes	
2.	Certificates from Section 00160 • F.S. 287.135 • F.S. 287.087 • F.S. 287.133(3)(A) • F.S. 287.134 • Participation in E-Verify • Local Preference Affidavit	Yes	
3.	Waiver of right to claim against payment/construction bond (Section 00836)	Yes	
4.	Woman or Minority Owned Business Certificate	If applicable	
5.	Qualifications (See Section 00100, Article 3) • List of 5 jobs of similar magnitude • Resumes • List of available equipment • Five (5) reference letters • Copies of required licenses • List of sub-contractors, if applicable • List of present commitments	Yes	
6.	Bid security in the form of _____	Yes, over $100,000.00	

E. Pricing

1. This is a Lump Sum and Unit Price Bid. Bidder will complete the Work in accordance with the Contract Documents for the following Lump Sum and Unit Price Bid items. Award will be based on the total Lump Sum Bid Price, sum of Unit Price items, and requirements of Bidder. If the County chooses to accept the alternate, the amount specified for the alternate will be deducted from the lump-sum. All bidders must provide pricing for deductive alternate bid option.

2. Deductive Alternate option: Florida Registered Professional Surveyor and Mapper to be selected and retained by the County.

TABULATION OF QUANTITIES AND PRICING

Bid Item	Labor cost per site	Material cost per site	# sites	Total monitoring install
Paired - instrumented 2" shallow (≤ 50') and 4" deep (≥ 50') SAS wells			3	
Single 2" shallow SAS well (≤ 50')			2	
Single 4" deep SAS well (≥ 50')			2	
Automated Water level / stream flow platform			3	
Global weather station			1	
Permitting	-	-	-	

The total of the items listed above must total the lump sum amount below.

LUMP SUM BID

Lump Sum Bid [in figures]: $

Lump Sum Bid [in words]:

Deductive Alternate [in figures]: $

Deductive Alternate [in words]:

F. Bidder agrees that the Work will be substantially complete within sixty (60) days and completed and ready for final payment within ninety (90) days after the date when the Contract Times commence to run. The Contract Times will commence to run on the thirteenth (13th) day after the Effective Date of the Agreement or, if a Notice to Proceed is given, on the day indicated in the Notice to Proceed. A

Notice to Proceed may be given at any time within thirty (30) days after the Effective Date of the Agreement.

G. Communications concerning this Bid have been addressed only to the contacts listed in Article 23 of Section 00100 of ITB 18-010.

Submitted on: _____, 20_____.

If Bidder is an Individual

(SEAL)

Individual's name: _____

Signature: _____

Doing business as: _____

Business address: _____

Phone No.: _____

If Bidder is a Partnership

(SEAL)

Partnership's name: _____

State in which organized: _____

Type of partnership: _____

Name of general partner: _____

Signature: _____

Business address: _____

Phone No.: _____

If Bidder is a Corporation:

(SEAL)

Corporation's name: _____

State of incorporation: _____

Name of authorized person to sign: _____

Title: _____

Signature: _____

Date of qualification to do business: _____

Attest: _____

Business address: _____

Phone No.: _____

If Bidder is a Joint Venture

(SEAL)

Name 1: _____

Signature 1: _____

Address 1: _____

Name 2: _____

Signature 2: _____

Address 2: _____

Address for receipt of official communications: _____

Phone number for official communications: _____

(Each joint venturer must sign. The manner of signing for each individual, partnership and corporation that is a party to the joint venture should be in the manner indicated above for an individual or the appropriate form of entity.)

DIVISION 0 – SECTION 00410
BID BOND
ITB 18-010

STATE OF FLORIDA COUNTY OF
HIGHLANDS

KNOW ALL MEN BY THESE PRESENTS, that we _____

(hereinafter called "Principal"), and _____as Surety, (hereinafter called "Surety"), are held and firmly bound unto the Highlands County, a political subdivision of the State of Florida (hereinafter called "Owner"), in the sum of _____Dollars ($_____), lawful money of the United States of America, for the payment of which sum well and truly to be made, we bind ourselves, our heirs, executors, administrators and successors, jointly and severally, firmly by these presents:

WHEREAS, the "Principal" contemplates submitting or has submitted to bid to the said "Owner" for Bid No. ITB 18-010.

LAKE JACKSON WATERSHED HYDROLOGY GROUNDWATER, METEOROLOGY AND SURFACE WATER/STREAM FLOW SENSOR STATION ACQUISITION AND INSTALLATION (RE-BID OF ITB 17-031)

WHEREAS, it was a condition precedent to the submission of said bid that a certified check or bid bond in the amount of not less than five percent (5%) of the amount of bid be submitted with said bid as a guarantee that the Bidder would, if awarded the contract, enter into a written contract with the "Owner" within fifteen (15) consecutive calendar days after having been given notice of award of the contract.

NOW, THEREFORE, THE CONDITIONS OF THIS OBLIGATION ARE SUCH, that if the bid of the "Principal" herein be accepted and said "Principal", within fifteen (15) consecutive calendar days after notice being given of such acceptance, enter into a written contract with the "Owner", then this obligation shall be void; otherwise, the sum herein stated shall be due and payable to the "Owner", and the "Surety" herein agrees to pay said sum immediately upon demand of said "Owner", in good and lawful money of the United States of America; as liquidated damages for failure thereof said "Principal".

IN WITNESS WHEREOF, the said _____, as "Principal" herein, has caused these

presents to be signed in its name by its _____and attested by its _____

under its corporate seal, and the said _____ as “Surety” herein, has caused these presents to

be signed in its_____and attested by its _____

under its corporate seal, this_____day of_____, A.D. 2017.

ATTEST:

_____

Title:_____

CONTRACTOR, AS PRINCIPAL:

_____

By:_____(Seal)

Title: _____

ATTEST:

_____

Title:_____

AS SURETY:

_____

By:_____(Seal)

Title: _____

DIVISION 0 - SECTION 00500

AGREEMENT

ITB 18-010

THIS AGREEMENT made this ____ day of _____, 20___, by and between Highlands County, a political subdivision of the State of Florida, 600 South Commerce Avenue, Sebring, Florida 33870 (hereinafter called "Owner" and _____(hereinafter called "Contractor"). Owner and Contractor, in consideration of the mutual covenants hereinafter set forth, agree as follows:

Article 1 - Work

Contractor shall provide all labor, materials, and equipment to construct the Lake Jackson Watershed Hydrology Groundwater, Meteorology and Surface Water/Stream Flow Sensor Station Acquisition and Installation Project. Contractor shall complete the Work as specified or indicated in the Contract Documents. The Work is generally described as follows:

Acquisition and installation of ten (10) surficial aquifer system monitoring wells at seven (7) locations and the installation of three (3) automated lake stage and streamflow recorders and one (1) automated weather station, all pursuant to Southwest Florida Water Management District specifications.

The principal features, as defined above, are not intended to cover every aspect of the Project details. Contractor shall be responsible for reviewing the Contract Documents to determine the full scope of the Work and specific requirements of the Project, which include familiarity and compliance with all Laws and Regulations.

Article 2 - Engineer and County Project Manager

2.01 The hydrologic model and design engineering firm for this project is AIM Engineering and Surveying, a Florida corporation registered to transact business in the State of Florida. B. Lee Flynn, P. E. of AIM Engineering and Surveying, Inc., a Florida corporation, is the point of contact for the monitoring plan design to support the Lake Jackson Watershed hydrologic model.

2.02 The County Project Manager is Clell Ford, Lakes Manager for the Highlands County Board of County Commissioners.

Article 3 - Contract Times

3.01 Contractor agrees that the Work will be substantially complete within sixty (60) days and completed and ready for final payment within ninety (90) days after the date when the Contract Times commence to run. The Contract Times will commence to run on the thirteenth (13th) day after the Effective Date of this Agreement or, if a Notice to Proceed is given, on the day indicated in the Notice to Proceed. A Notice to Proceed may be given at any time within thirty (30) days after the Effective Date of this Agreement.

3.02 Liquidated Damages

A. Owner and Contractor recognize that time is of the essence of this Agreement and that Owner will suffer financial loss if the Work is not completed within the times specified in

paragraph 3.01 of this Article. In agreeing upon the daily liquidated damages amount stated in this paragraph, Owner and Contractor have considered the original Contract Price stated in Article 4 of this Agreement, the average construction, engineering, and inspection costs experienced by Owner, and anticipated costs of project-related delays and inconveniences to Owner and the public. Owner and Contractor also recognize the delays, expense, and difficulties involved in proving the actual loss suffered by Owner if the Work is not completed on time. Accordingly, instead of requiring any such proof, Owner and Contractor agree that as liquidated damages for delay (and not as a penalty) Contractor shall pay Owner Five Hundred Dollars ($500.00) for each day that expires after the time specified in paragraph 3.01 of this Article until the Work is completed and ready for final payment. Liquidated damages shall be deducted by Owner from any balance due Contractor or, if the balance due Contractor is less than the amount of liquidated damages, Contractor shall pay to Owner the remaining unpaid liquidated damages within thirty (30) days after Owner's invoice is sent to Contractor.

B. Owner does not waive its right to liquidated damages due under this Agreement by allowing Contractor to continue and to finish the Work, or any part of it, after the expiration of the Contract Time including granted time extensions.

C. In the case of a default of this Agreement and the completion of the Work by Owner, Contractor and Contractor's surety are liable for the liquidated damages under this Agreement, but Owner will not charge liquidated damages for any delay in the final completion of Owner's performance of the Work due to any unreasonable action or delay on the part of Owner.

Article 4 - Contract Price

Owner shall pay Contractor for completion of the Work in accordance with the Contract Documents an amount in current funds equal to the amount determined pursuant to paragraph 4.01 below:

4.01 For all Work as listed on the Bid Form and described in the Drawings and Specifications, including/excluding Alternate 1 as Exhibit "A", attached hereto and included herein by this reference, a Lump Sum of:

_____

[USE WORDS]

_____

[USE FIGURES]

Contractor has included all costs in the Contract Price and shall cause the Work to be completed for the Contract Price. The Contract Price shall be reduced in the manner described in SC-7.09 of Section 00800 of the Supplementary Conditions of this Agreement.

Article 5 - Payment Procedures

5.01 Deliverables must be received and accepted in writing by the Project Manager prior to reimbursements. Supporting documentation with the invoices must establish that the deliverables were received and accepted in writing by the Project Manager. Contractor may receive progress payments for deliverables based on the Contractor's Schedule of Values and on a percentage of services that have been completed, approved, and accepted to the satisfaction of Owner when properly supported by detailed invoices and acceptable evidence of payment. All costs charged to the Project by Contractor shall be supported by detailed invoices, proof of payments, contracts or vouchers evidencing in proper detail the nature and propriety of the charges.

5.02 Progress Payments; Retainage: Contractor shall deliver Contractor's Applications for Payment to Project Manager on or before the third (3rd) day of each month. Owner shall make progress payments on account of the Contract Price on the basis of Contractor's Applications for Payment as recommended by Project Manager, on or about the twenty-sixth (26th) day of each month during construction as provided in paragraphs 5.02.A and 5.02.B below.

A. Prior to fifty percent (50%) of the Work being completed, progress payments will be made in an amount equal to the percentage indicated below, but in each case, less the aggregate of payments previously made and less such amounts as Project Manager shall determine, or Owner may withhold. Owner will withhold ten percent (10%) of each application for progress payment until:

50 % of the Work is completed, and

0 % of materials and equipment not incorporated in the Work (but delivered, suitably stored, and accompanied by documentation satisfactory to the Owner).

B. After fifty percent (50%) of the Work is completed, progress payments will be made in an amount equal to the percentage indicated below, but in each case, , less the aggregate of payments previously made and less such amounts as Project Manager shall determine, or Owner may withhold. Owner will withhold five percent (5%) of each application for progress payment until:

100 % of the Work is completed, and

100 % of materials and equipment not incorporated in the Work (but delivered, suitably stored, and accompanied by documentation satisfactory to the Owner).

5.03 Final Payment: Upon completion of the Work, Contractor shall notify Owner in writing of the completion. The certification shall state that the Work has been completed in compliance with the Drawings and Specifications. If any deviations are noted from the approved Drawings and Specifications, the certification shall include a list of all deviations along with an explanation that justifies the reason to accept each deviation. After Contractor has, in the opinion of Project Manager, satisfactorily completed all corrections identified during the final inspection and deviations not accepted by Owner and has delivered to Owner, in accordance with the Contract Documents, schedules, guarantees, Bonds, certificates or other evidence of insurance, certificates of inspection, permits, marked-up record documents, paper final as-built Drawings and Specifications, signed, sealed, and certified by a Professional Surveyor, registered in the State of Florida, and all applicable

permits, final releases from Contractor and all Subcontractors and Suppliers at every level, all warranties, and all other documents reasonably required by Owner pertaining to the Work, and provided verification of compliance with the requirements of Article 12 of this Agreement, Contractor may make application for final payment.

Article 6 - Contractor's Representations

In order to induce Owner to enter into this Agreement, Contractor makes the following representations:

6.01 Contractor has examined and carefully studied the Contract Documents (including any Addenda) and the other related data identified in the ITB 18-010 Documents.

6.02 Contractor has visited the Sites and become familiar with and is satisfied as to the general, local and Site conditions that may affect cost, progress, performance or furnishing of the Work.

6.03 Contractor is familiar with and will comply with all Laws and Regulations, whether or not the Laws or Regulations may affect cost, progress, performance and furnishing of the Work.

6.04 Contractor has carefully studied all reports of explorations and tests of subsurface conditions at or contiguous to the Sites and all drawings of physical conditions in or relating to existing surface or subsurface structures at or contiguous to the Sites (except Underground Facilities). Contractor acknowledges that such reports and drawings are not Contract Documents and may not be complete for Contractor's purposes. Contractor acknowledges that Owner and Project Manager do not assume responsibility for the accuracy or completeness of information and data shown or indicated in the Contract Documents with respect to Underground Facilities at or contiguous to the Sites. Contractor has obtained and carefully studied (or assumes responsibility for having done so) all such additional supplementary examinations, investigations, explorations, tests, studies and data concerning conditions (surface, subsurface and Underground Facilities) at or contiguous to the Sites or otherwise which may affect cost, progress, performance or furnishing of the Work or which relate to any aspect of the means, methods, techniques, sequences and procedures of construction to be employed by Contractor and safety precautions and programs incident thereto. Contractor does not consider that any additional examinations, investigations, explorations, tests, studies or data are necessary for the performance and furnishing of the Work at the Contract Price, within the Contract Times and in accordance with the other terms and conditions of the Contract Documents.

6.05 Contractor is aware of the general nature of work to be performed by Owner and others at the Sites that relates to the Work as indicated in the Contract Documents.

6.06 Contractor has correlated the information known to Contractor, information and observations obtained from visits to the Sites, reports, Drawings and Specifications identified in the Contract Documents and all additional examinations, investigations, explorations, tests, studies and data with the Contract Documents.

6.07 Contractor has not given Project Manager written notice of any conflicts, errors, ambiguities or discrepancies that Contractor has discovered in the Contract Documents, and Contractor agrees that the Contract Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performance and furnishing of the Work.

6.08 Contractor certifies by signing this Agreement that no Commissioner or employee of the Highlands County Board of County Commissioners has solicited or accepted gratuities, favors, or anything of monetary value from Contractor or parties to subcontracts. Contractor and Subcontractors shall not pay any gratuities, favors, or anything of monetary value to any Commissioner or employee of the Highlands County Board of County Commissioners.

Article 7 - Contract Documents

The Contract Documents which comprise the entire Contract between Owner and Contractor concerning the Work consist of the following:

7.01 This Agreement (pages 00500-1 to 00500-___, inclusive).

7.02 The Standard General Conditions of the Construction Contract, EJCDC C-700 (2013 Edition).

7.03 ITB 18-010 Section 00800 Supplementary Conditions to EJCDC C-700 (2013 Edition).

7.04 EXHIBIT "A"- Section 01010 – SUMMARY OF WORK, including drawings, figures and references, as augmented by "Lake Jackson Watershed Hydrologic Investigation Task 1b Hydrologic Data Inventory and Recommendations for Additional Data Collection. FINAL Recommendations Report."

7.05 Except as expressly otherwise noted in this paragraph and paragraph 7.06 of this Article, there are no Contract Documents other than those listed in paragraphs 7.01 through 7.04 of this Article. In the event of a conflict among the provisions of the Contract Documents, the order of precedence shall be this Agreement, followed by the Supplementary Conditions, followed by EJCDC C-700 (2013 Edition). The Contract Documents may only be amended to provide for additions, deletions, and revisions in the Work or to modify the terms and conditions thereof in one or more of the following ways:

(a) Written Amendment signed by both parties

(b) Change Order signed by both parties

(c) Work Change Directive signed by both parties

7.06 The requirements of the Contract Documents may be supplemented and minor variations and deviations in the Work may be authorized, by one or more of the following ways:

(a) A Field Order issued by the Project Manager

(b) Project Manager's approval of a Shop Drawing

(c) Project Manager's written interpretation or clarification

Article 8 - Miscellaneous

8.01 No assignment by a party hereto of any rights under or interests in the Contract Documents will be binding on another party hereto without the written consent of the party sought to be bound; and specifically but without limitation, moneys that may become due and moneys that are due may not be assigned without such consent (except to the extent that the effect of this restriction may be limited by Laws and Regulations), and unless specifically stated to the contrary in any written consent of an assignment, no assignment will release or discharge the assignor from any duty or responsibility under the Contract Documents.

8.02 Owner and Contractor each binds itself, its partners, successors, assigns and legal representatives to the other party hereto, its partners, successors, assigns and legal representatives in respect to all covenants, agreements and obligations contained in the Contract Documents.

8.03 Any provision or part of the Contract Documents held to be void or unenforceable under any Law or Regulation shall be deemed stricken, and all remaining provisions shall continue to be valid and binding upon Owner and Contractor, who agree that the Contract Documents shall be reformed to replace such stricken provision or part thereof with a valid and enforceable provision that comes as close as possible to expressing the intention of the stricken provision.

8.04 Upon the occurrence of any event of default, all obligations on the part of Owner to make any further payments of funds pursuant to this Agreement shall, if Owner so elects, terminate but Owner may make any payments or parts of payments after the happening of any event of default without thereby waiving the right to exercise any remedy which it may have and without becoming liable to make any further payment.

8.05 No funds received pursuant to this Agreement may be expended for lobbying the Legislature, the judicial branch, any state agency, Owner or Owner's elected officials, employees or agents.

8.06 By entering into this Agreement, Contractor agrees and promises that, during and after a public emergency, disaster, hurricane, flood, or acts of God, Owner shall be given "first priority" for all goods and services under this Agreement. Contractor agrees to provide all goods and services to Owner during and after the emergency at the terms, conditions, and prices as provided in this Agreement on a "first priority" basis. Contractor shall furnish a twenty-four (24) hour phone number to Owner in the event of such an emergency. Failure to provide the stated priority during and after an emergency shall constitute a breach of Contract and make Contractor subject to sanctions from doing further business with Owner. For purposes of this paragraph, the term "first priority" means priority over all other contracts and agreements between Contractor and any person or entity other than Owner and requires Contractor to deliver the goods and services described in this Agreement to Owner prior to providing those goods and services to any other person or entity during and after the emergency.

8.07 Owner shall not be obligated or liable hereunder to any person, organization or entity other than Contractor. No provision in this Agreement is intended to, or shall be construed to, create any third party beneficiary or to provide any rights to any person, organization or entity not a party to this Agreement, including, but not limited to, any citizen or employees of the Owner and/or Contractor.

8.08 In no event shall the making by Owner of any payment to Contractor constitute or be construed as a waiver by Owner of any breach of covenant or any default which may then exist, on the part of Contractor, and the making of such payment by Owner while any such breach or default exists shall in no way impair or prejudice any right or remedy available to Owner with respect to such breach or default.

8.09 No waiver by either Contractor or Owner with respect to any breach or default of or with respect to any provisions or conditions of this Agreement shall be deemed to constitute a continuing waiver of any other breach or default of or with respect to the same or any other provision or condition of this Agreement. No claim or right arising out of a breach of this Agreement can be discharged in whole

or in part by a waiver or renunciation of the claim or right unless the waiver or renunciation is supported by consideration and is in writing signed by the aggrieved party.

8.10 This Agreement, including exhibits and amendments, and all matters relating to the validity, interpretation, and performance of this Agreement (whether in contract, statute, tort, or otherwise) shall be governed and construed in accordance with the laws of the State of Florida, without giving effect to principles of conflict of laws. Venue for any legal action shall lie in Highlands County, Florida, and any proceedings to enforce or interpret any provision of the Contract Documents shall be brought exclusively in a court of competent jurisdiction in Highlands County, Florida.

8.11 Owner is an Equal Employment Opportunity ("EEO") employer and as such encourages Contractor to voluntarily comply with EEO regulations with regards to gender, age, race, veteran status, country of origin, and creed. In addition, Contractor or anyone under its employ shall comply with all applicable Laws and Regulations thereby pertaining to the avoidance or appearance of sexual harassment or on the job discrimination. Contractor shall maintain a work environment free of discrimination or unwelcome action of a personal nature. Any subcontracts entered into shall make deference to this clause with the same degree of application being encouraged. When applicable, Contractor shall comply with all new Laws and Regulations.

8.12 Contractor may only subcontract a portion of the Work to a Subcontractor or Subcontractors approved in advance, in writing by Project Manager, but Contractor shall perform with its own employees and equipment work amounting to not less than forty percent (40%) of the total Contract amount.

8.13 This Agreement shall be effective upon execution by both parties and shall continue in effect and be binding on the parties until the Project is completed and accepted and payment made by Owner or this Agreement is terminated in accordance with Article 16 of Section 00700 Standard General Conditions of the Construction Contract as modified in Section 00800 Supplementary Conditions of the Contract Documents.

8.14 Contractor shall be responsible for all quality control testing requirements.

8.15 In the event there is a discrepancy between this Agreement and the Contract Documents, the provisions of this Agreement shall govern.

Article 9 - Employment Eligibility Verification

9.01 Definitions. As used in this Article:

A. Employee assigned to this Agreement means an employee who was hired after November 6, 1986, who is directly performing work, in the United States, under this Agreement. An employee is not considered to be directly performing work under this Agreement if the employee

(a) Normally performs support work, such as indirect or overhead functions; and

(b) Does not perform any substantial duties applicable to the Agreement

B. Subcontract means any contract entered into by a Subcontractor to furnish supplies or services for performance of this Agreement or a subcontract under this Agreement. It includes but is not limited to purchase orders, and changes and modifications to purchase orders.

C. Subcontractor means any supplier, distributor, vendor, or firm that furnishes supplies or services to or for Contractor or another subcontractor.

D. United States, as defined in 8 U.S.C. 1101(a)(38), means the 50 States, the District of Columbia, Puerto Rico, Guam, and the U.S. Virgin Islands.

9.02 Enrollment and verification requirements.

A. Contractor must be enrolled in E-Verify at time of Contract award, and Contractor shall use E-Verify to initiate verification of employment eligibility of

i. All new employees

- Enrolled thirty (30) calendar days or more. Contractor shall initiate verification of employment eligibility of all new hires of Contractor, who are working in the State of Florida, whether or not assigned to this Agreement, within three (3) workdays after the date of hire; or
- Enrolled less than thirty (30) calendar days. Within thirty (30) calendar days after enrollment in E-Verify, Contractor shall initiate verification of employment eligibility of all new hires of Contractor who are working in the State of Florida, whether or not assigned to this Agreement, within three (3) workdays after the date of hire; or

ii. Employees assigned to this Agreement. For each employee assigned to this Agreement, Contractor shall initiate verification of employment eligibility, to the extent allowed by the E-Verify program, within thirty (30) calendar days after date of Contract award or within thirty (30) calendar days after assignment to this Agreement, whichever date is later.

B. Contractor shall comply, for the period of performance of this Agreement, with the requirements of the E-Verify program Memorandum of Understanding (MOU). Termination of Contractor's MOU and denial access to the E-Verify system by the Department of Homeland Security or the Social Security Administration or the U.S. Citizenship and Immigration Service is an event of default under this Agreement.

9.03 Website. Information on registration for and use of the E-Verify program can be obtained via the Internet at the U.S. Citizenship and Immigration Service's Web site: http://www.uscis.gov.

9.04 Individuals previously verified. Contractor is not required by this Article to perform additional employment verification using E-Verify for any employee whose employment eligibility was previously verified by Contractor through the E- Verify program.

9.05 Subcontracts. Contractor shall include, and shall require the inclusion of, the requirements of this Article, including this paragraph (9.05) (appropriately modified for identification of the parties), in each subcontract that includes work performed in the United States under this Agreement.

Article 10 - Compliance with Section 287.135(3)(c), Florida Statutes

Pursuant to Section 287.135(3)(c), Florida Statutes, Owner may terminate this Contract, at the option of its Board of County Commissioners, if the Contractor is found to have submitted a certification required by Section 287.135(5), Florida Statutes, that is false or if Contractor is or has been placed on the Scrutinized Companies that Boycott Israel List, or is engaged in a boycott of Israel or if Contractor is or has been placed on the Scrutinized Companies with Activities in Sudan List or the Scrutinized Companies with Activities in the Iran Petroleum Energy Sector List or if Contractor is or has been engaged in business operations in Cuba or Syria.

Article 11 - Notices and designated contact person

Any notice required or permitted by this Contract to be given shall be deemed to have been duly given if in writing and delivered personally or five (5) days after mailing by first class registered or certified mail, return receipt requested, postage prepaid or by Federal Express, UPS or other nationally recognized delivery service, with confirmation of delivery requested, and addressed as follows:

To County:

Highlands County Board of County Commissioners
Parks and Natural Resources Dept.
4344 George Blvd
Sebring, FL 33875
Attn: Clell Ford, Project Manager

To Contractor:

_____
_____
_____
Attn: _____

The Parties shall designate a contact person who shall be the primary contact person for each Party:

The County: Clell Ford, Project Manager

The Contractor: _____

Article 12 - Public Records Compliance

If by providing services to Owner pursuant to this Contract, Contractor is a contractor, as defined by Section 119.0701, Florida Statutes, Contractor shall:

12.01 Keep and maintain public records required by the County to perform the services.

12.02 Upon request of the County's custodian of public records, provide the County with a copy of the requested records or allow the records to be inspected or copied within a reasonable time at the cost that does not exceed the cost provided in Chapter 119, Florida Statutes, or as otherwise provided by law.

12.03 Ensure that public records that are exempt or confidential and exempt from public records disclosure requirements are not disclosed except as authorized by law for the duration of the term of this Contract and following completion of this Contract if Contractor does not transfer the records to the County.

12.04 Upon completion of this Contract, transfer to the County, at no cost, all public records in possession of Contractor or keep and maintain public records required by the County to perform the services. If Contractor transfers all public records to the County upon completion of this Contract, Contractor shall destroy any duplicate public records that are exempt or confidential and exempt from public records disclosure requirements. If Contractor keeps and maintains public records upon completion of this Contract, Contractor shall meet all applicable requirements for retaining public records. All records stored electronically must be provided to the County upon request from the County's custodian of public records, in a format that is compatible with the information technology systems of the County.

IF THE CONTRACTOR HAS QUESTIONS REGARDING THE APPLICATION OF CHAPTER 119, FLORIDA STATUTES, TO THE CONTRACTOR'S DUTY TO PROVIDE PUBLIC RECORDS RELATING TO THIS CONTRACT, CONTACT THE CUSTODIAN OF PUBLIC RECORDS AT:

Gloria Rybinski
County Public Information Officer
Telephone Number: 863-402-6836
E-mail Address: grybinski@hcbcc.org
Mailing Address: 600 South Commerce Avenue
Sebring, FL 33870

THE REMAINDER OF THIS PAGE WAS LEFT BLANK INTENTIONALLY

IN WITNESS WHEREOF, the parties of these presents have executed this Agreement in three (3) counterparts, each of which shall be deemed an original, but all of which constitute the same Agreement, in the year and day first shown and mentioned.

OWNER: HIGHLANDS COUNTY, A POLITICAL SUBDIVISION OF THE STATE OF FLORIDA, BY ITS BOARD OF COUNTY COMMISSIONERS

_____

Don Elwell, Chairman

ATTEST: [SEAL]

_____

Robert W. Germaine, Clerk

CONTRACTOR: _____

Signature: _____ [SEAL]

Print Name: _____

Print Title: _____

ATTEST:

Signature: _____

Print Name: _____

Print Title: _____

DIVISION 0 - SECTION 00600
PUBLIC CONSTRUCTION BOND
ITB 18-010
(Section 255.05(3), Florida Statutes)

Bond No. _____

BY THIS BOND, we, _____, whose principal business address and phone number are _____ (_____), as Principal and _____, whose principal business address and phone number are _____ (_____), as Surety, are bound to Highlands County, a political subdivision of the State of Florida, herein called Owner, whose principal business address and telephone number are 600 South Commerce Avenue, Sebring, Florida 33870 (863-402-6500), in the sum of _____ ($_____), for payment of which we bind ourselves, our heirs, personal representatives, successors, and assigns, jointly and severally.

THE CONDITION OF THIS BOND is that if Principal:

1. Performs the Contract dated _____, between Principal and Owner for construction of the LAKE JACKSON WATERSHED HYDROLOGY GROUNDWATER, METEOROLOGY AND SURFACE WATER/STREAM FLOW SENSOR ACQUISITION AND INSTALLATION, that Contract being made a part of this bond by reference, at the times and in the manner prescribed in the contract; and

2. Promptly makes payments to all claimants, as defined in Section 255.05(1), Florida Statutes, supplying Principal with labor, services, materials, or supplies, used directly or indirectly by Principal in the prosecution of the work provided for in that Contract; and

3. Pays Owner all losses, damages, expenses, costs, and attorney's fees, including appellate proceedings, that Owner sustains because of a default by Principal under that Contract; and

4. Performs the Principal's guarantee of all work and materials furnished under that Contract for the time specified in that Contract, then this bond is void; otherwise it remains in full force.

Any action instituted by a claimant under this bond for payment must be in accordance with the notice and time limitation provisions in Section 255.05(2) and (10), Florida Statutes.

Any changes in or under the Contract Documents and compliance or noncompliance with any formalities connected with that Contract or the changes does not affect Surety's obligation under this bond.

Dated _____ _____, 2017.

AS SURETY:

_____

By: _____
(As Attorney in Fact)

CONTRACTOR, AS PRINCIPAL:

_____

By:_____

Title: _____

INSTRUCTIONS FOR PUBLIC CONSTRUCTION BOND

1. A good and sufficient Public Construction Bond, in the penal sum of not less than one hundred (100%) percent of the contract amount, with a surety company satisfactory to Owner, will be required of Contractor guaranteeing that the contract, including the various guarantee periods thereunder will be faithfully performed; and that Contractor will promptly make payment to all persons supplying Contractor labor, materials, supplies and services used directly or indirectly by Contractor in the prosecution of the work provided for in the Contract.

2. The Surety Company furnishing this bond shall be authorized to do business in the State of Florida, shall be in compliance with the provisions of the Florida insurance code, shall have twice the minimum surplus and capital required by the Florida Insurance code, and shall hold a currently valid certificate of authority issued by the United States Department of Treasury pursuant to Title 31, Sections 9304-9308, of the United States Code. The Surety company must have a rating of not less than “A-X” by the latest edition of the KEY RATING GUIDE as published by A.M. Best Company, Inc., Ambest Road, Oldwick, NJ 08858.

3. The Attorney-in-Fact (Resident Agent) who executes the Public Construction Bond on behalf of the Surety Company must attach a notarized copy of his or her power-of-attorney as evidence of his or her authority to bind the surety on the date of execution of the bonds. All signatures must be original. No copied or facsimile signatures will be accepted. All Contracts, Public Construction Bond, and respective powers-of-attorney will have the same date.

4. In the event the Surety Company becomes unsatisfactory to Owner, Owner may at its discretion, require from Contractor an additional or new bond in the same or lessor penal sum, satisfactory to OWNER, and to be conditioned as above required. Upon Contractor’s failure to furnish such additional or new bond within ten (10) days from the date of written notice to do so, all payments under the Contract will be withheld until such additional bond is furnished.

This document has important legal consequences; consultation with an attorney is encouraged with respect to its use or modification. This document should be adapted to the particular circumstances of the contemplated Project and the controlling Laws and Regulations.

STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

Prepared by

Issued and Published Jointly by

These General Conditions have been prepared for use with the Agreement Between Owner and Contractor for Construction Contract (EJCDC® C-520, Stipulated Sum, or C-525, Cost-Plus, 2013 Editions). Their provisions are interrelated and a change in one may necessitate a change in the other.

To prepare supplementary conditions that are coordinated with the General Conditions, use EJCDC's Guide to the Preparation of Supplementary Conditions (EJCDC® C-800, 2013 Edition). The full EJCDC Construction series of documents is discussed in the Commentary on the 2013 EJCDC Construction Documents (EJCDC® C-001, 2013 Edition).

National Society of Professional Engineers

1420 King Street, Alexandria, VA 22314-2794

(703) 684-2882

www.nspe.org

American Council of Engineering Companies

1015 15th Street N.W., Washington, DC 20005

(202) 347-7474

www.acec.org

American Society of Civil Engineers

1801 Alexander Bell Drive, Reston, VA 20191-4400

(800) 548-2723

www.asce.org

NOTE: EJCDC publications may be purchased at www.ejcdc.org, or from any of the sponsoring organizations above.

STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

TABLE OF CONTENTS

ARTICLE 1 – DEFINITIONS AND TERMINOLOGY

1.01 *Defined Terms*

A. Wherever used in the Bidding Requirements or Contract Documents, a term printed with initial capital letters, including the term's singular and plural forms, will have the meaning indicated in the definitions below. In addition to terms specifically defined, terms with initial capital letters in the Contract Documents include references to identified articles and paragraphs, and the titles of other documents or forms.

1. *Addenda*—Written or graphic instruments issued prior to the opening of Bids which clarify, correct, or change the Bidding Requirements or the proposed Contract Documents.

2. *Agreement*—The written instrument, executed by Owner and Contractor, that sets forth the Contract Price and Contract Times, identifies the parties and the Engineer, and designates the specific items that are Contract Documents.

3. *Application for Payment*—The form acceptable to Engineer which is to be used by Contractor during the course of the Work in requesting progress or final payments and which is to be accompanied by such supporting documentation as is required by the Contract Documents.

4. *Bid*—The offer of a Bidder submitted on the prescribed form setting forth the prices for the Work to be performed.

5. *Bidder*—An individual or entity that submits a Bid to Owner.

6. *Bidding Documents*—The Bidding Requirements, the proposed Contract Documents, and all Addenda.

7. *Bidding Requirements*—The advertisement or invitation to bid, Instructions to Bidders, Bid Bond or other Bid security, if any, the Bid Form, and the Bid with any attachments.

8. *Change Order*—A document which is signed by Contractor and Owner and authorizes an addition, deletion, or revision in the Work or an adjustment in the Contract Price or the Contract Times, or other revision to the Contract, issued on or after the Effective Date of the Contract.

9. *Change Proposal*—A written request by Contractor, duly submitted in compliance with the procedural requirements set forth herein, seeking an adjustment in Contract Price or Contract Times, or both; contesting an initial decision by Engineer concerning the requirements of the Contract Documents or the acceptability of Work under the Contract Documents; challenging a set-off against payments due; or seeking other relief with respect to the terms of the Contract.

10. *Claim*—(a) A demand or assertion by Owner directly to Contractor, duly submitted in compliance with the procedural requirements set forth herein: seeking an adjustment of Contract Price or Contract Times, or both; contesting an initial decision by Engineer concerning the requirements of the Contract Documents or the acceptability of Work under the Contract Documents; contesting Engineer's decision regarding a Change Proposal; seeking resolution of a contractual issue that Engineer has declined to address; or seeking other relief with respect to the terms of the Contract; or (b) a demand or assertion by Contractor directly to Owner, duly submitted in compliance with the procedural requirements set forth herein, contesting Engineer's decision regarding a Change Proposal; or seeking resolution of a contractual issue that Engineer

has declined to address. A demand for money or services by a third party is not a Claim.

11. *Constituent of Concern*—Asbestos, petroleum, radioactive materials, polychlorinated biphenyls (PCBs), hazardous waste, and any substance, product, waste, or other material of any nature whatsoever that is or becomes listed, regulated, or addressed pursuant to (a) the Comprehensive Environmental Response, Compensation and Liability Act, 42 U.S.C. §§9601 et seq. ("CERCLA"); (b) the Hazardous Materials Transportation Act, 49 U.S.C. §§5501 et seq.; (c) the Resource Conservation and Recovery Act, 42 U.S.C. §§6901 et seq. ("RCRA"); (d) the Toxic Substances Control Act, 15 U.S.C. §§2601 et seq.; (e) the Clean Water Act, 33 U.S.C. §§1251 et seq.; (f) the Clean Air Act, 42 U.S.C. §§7401 et seq.; or (g) any other federal, state, or local statute, law, rule, regulation, ordinance, resolution, code, order, or decree regulating, relating to, or imposing liability or standards of conduct concerning, any hazardous, toxic, or dangerous waste, substance, or material.

12. *Contract*—The entire and integrated written contract between the Owner and Contractor concerning the Work.

13. *Contract Documents*—Those items so designated in the Agreement, and which together comprise the Contract.

14. *Contract Price*—The money that Owner has agreed to pay Contractor for completion of the Work in accordance with the Contract Documents. .

15. *Contract Times*—The number of days or the dates by which Contractor shall: (a) achieve Milestones, if any; (b) achieve Substantial Completion; and (c) complete the Work.

16. *Contractor*—The individual or entity with which Owner has contracted for performance of the Work.

17. *Cost of the Work*—See Paragraph 13.01 for definition.

18. *Drawings*—The part of the Contract that graphically shows the scope, extent, and character of the Work to be performed by Contractor.

19. *Effective Date of the Contract*—The date, indicated in the Agreement, on which the Contract becomes effective.

20. *Engineer*—The individual or entity named as such in the Agreement.

21. *Field Order*—A written order issued by Engineer which requires minor changes in the Work but does not change the Contract Price or the Contract Times.

22. *Hazardous Environmental Condition*—The presence at the Site of Constituents of Concern in such quantities or circumstances that may present a danger to persons or property exposed thereto. The presence at the Site of materials that are necessary for the execution of the Work, or that are to be incorporated in the Work, and that are controlled and contained pursuant to industry practices, Laws and Regulations, and the requirements of the Contract, does not establish a Hazardous Environmental Condition.

23. *Laws and Regulations; Laws or Regulations*—Any and all applicable laws, statutes, rules, regulations, ordinances, codes, and orders of any and all governmental bodies, agencies, authorities, and courts having jurisdiction.

24. *Liens*—Charges, security interests, or encumbrances upon Contract-related funds, real property, or personal property.

25. *Milestone*—A principal event in the performance of the Work that the Contract requires Contractor to achieve by an intermediate completion date or by a time prior to Substantial Completion of all the Work.

26. *Notice of Award*—The written notice by Owner to a Bidder of Owner's acceptance of the Bid.

27. *Notice to Proceed*—A written notice by Owner to Contractor fixing the date on which the Contract Times will commence to run and on which Contractor shall start to perform the Work.

28. *Owner*—The individual or entity with which Contractor has contracted regarding the Work, and which has agreed to pay Contractor for the performance of the Work, pursuant to the terms of the Contract.

29. *Progress Schedule*—A schedule, prepared and maintained by Contractor, describing the sequence and duration of the activities comprising the Contractor's plan to accomplish the Work within the Contract Times.

30. *Project*—The total undertaking to be accomplished for Owner by engineers, contractors, and others, including planning, study, design, construction, testing, commissioning, and start-up, and of which the Work to be performed under the Contract Documents is a part.

31. *Project Manual*—The written documents prepared for, or made available for, procuring and constructing the Work, including but not limited to the Bidding Documents or other construction procurement documents, geotechnical and existing conditions information, the Agreement, bond forms, General Conditions, Supplementary Conditions, and Specifications. The contents of the Project Manual may be bound in one or more volumes.

32. *Resident Project Representative*—The authorized representative of Engineer assigned to assist Engineer at the Site. As used herein, the term Resident Project Representative or "RPR" includes any assistants or field staff of Resident Project Representative.

33. *Samples*—Physical examples of materials, equipment, or workmanship that are representative of some portion of the Work and that establish the standards by which such portion of the Work will be judged.

34. *Schedule of Submittals*—A schedule, prepared and maintained by Contractor, of required submittals and the time requirements for Engineer's review of the submittals and the performance of related construction activities.

35. *Schedule of Values*—A schedule, prepared and maintained by Contractor, allocating portions of the Contract Price to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

36. *Shop Drawings*—All drawings, diagrams, illustrations, schedules, and other data or information that are specifically prepared or assembled by or for Contractor and submitted by Contractor to illustrate some portion of the Work. Shop Drawings, whether approved or not, are not Drawings and are not Contract Documents.

37. *Site*—Lands or areas indicated in the Contract Documents as being furnished by Owner upon which the Work is to be performed, including rights-of-way and easements, and such other lands furnished by Owner which are designated for the use of Contractor.

38. *Specifications*—The part of the Contract that consists of written requirements for materials, equipment, systems, standards, and workmanship as applied to the Work, and certain administrative requirements and procedural matters applicable to the Work.

39. *Subcontractor*—An individual or entity having a direct contract with Contractor or with any other Subcontractor for the performance of a part of the Work.

40. *Substantial Completion*—The time at which the Work (or a specified part thereof) has progressed to the point where, in the opinion of Engineer, the Work (or a specified part thereof) is sufficiently complete, in accordance with the Contract Documents, so that the Work (or a specified part thereof) can be utilized for the purposes for which it is intended. The terms "substantially complete" and "substantially completed" as applied to all or part of the Work refer to Substantial Completion thereof.

41. *Successful Bidder*—The Bidder whose Bid the Owner accepts, and to which the Owner makes an award of contract, subject to stated conditions.

42. *Supplementary Conditions*—The part of the Contract that amends or supplements these General Conditions.

43. *Supplier*—A manufacturer, fabricator, supplier, distributor, materialman, or vendor having a direct contract with Contractor or with any Subcontractor to furnish materials or equipment to be incorporated in the Work by Contractor or a Subcontractor.

44. *Technical Data*—Those items expressly identified as Technical Data in the Supplementary Conditions, with respect to either (a) subsurface conditions at the Site, or physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities) or (b) Hazardous Environmental Conditions at the Site. If no such express identifications of Technical Data have been made with respect to conditions at the Site, then the data contained in boring logs, recorded measurements of subsurface water levels, laboratory test results, and other factual, objective information regarding conditions at the Site that are set forth in any geotechnical or environmental report prepared for the Project and made available to Contractor are hereby defined as Technical Data with respect to conditions at the Site under Paragraphs 5.03, 5.04, and 5.06.

45. *Underground Facilities*—All underground pipelines, conduits, ducts, cables, wires, manholes, vaults, tanks, tunnels, or other such facilities or attachments, and any encasements containing such facilities, including but not limited to those that convey electricity, gases, steam, liquid petroleum products, telephone or other communications, fiber optic transmissions, cable television, water, wastewater, storm water, other liquids or chemicals, or traffic or other control systems.

46. *Unit Price Work*—Work to be paid for on the basis of unit prices.

47. *Work*—The entire construction or the various separately identifiable parts thereof required to be provided under the Contract Documents. Work includes and is the result of performing or providing all labor, services, and documentation necessary to produce such construction; furnishing, installing, and incorporating all materials and equipment into such construction; and may include related services such as testing, start-up, and commissioning, all as required by the Contract Documents.

48. *Work Change Directive*—A written directive to Contractor issued on or after the Effective Date of the Contract, signed by Owner and recommended by Engineer, ordering an addition, deletion, or revision in the Work.

1.02 *Terminology*

A. The words and terms discussed in the following paragraphs are not defined but, when used in the Bidding Requirements or Contract Documents, have the indicated meaning.

B. *Intent of Certain Terms or Adjectives*:

1. The Contract Documents include the terms "as allowed," "as approved," "as ordered," "as directed" or terms of like effect or import to authorize an exercise of professional judgment by Engineer. In addition, the adjectives "reasonable," "suitable," "acceptable," "proper," "satisfactory," or adjectives of like effect or import are used to describe an action or determination of Engineer as to the Work. It is intended that such exercise of professional judgment, action, or determination will be solely to evaluate, in general, the Work for compliance with the information in the Contract Documents and with the design concept of the Project as a functioning whole as shown or indicated in the Contract Documents (unless there is a specific statement indicating otherwise). The use of any such term or adjective is not intended to and shall not be effective to assign to Engineer any duty or authority to supervise or direct the performance of the Work, or any duty or authority to undertake responsibility contrary to the provisions of Article 10 or any other provision of the Contract Documents.

C. *Day*:

1. The word "day" means a calendar day of 24 hours measured from midnight to the next midnight.

D. *Defective*:

1. The word "defective," when modifying the word "Work," refers to Work that is unsatisfactory, faulty, or deficient in that it:

a. does not conform to the Contract Documents; or

b. does not meet the requirements of any applicable inspection, reference standard, test, or approval referred to in the Contract Documents; or

c. has been damaged prior to Engineer's recommendation of final payment (unless responsibility for the protection thereof has been assumed by Owner at Substantial Completion in accordance with Paragraph 15.03 or 15.04).

E. *Furnish, Install, Perform, Provide*:

1. The word "furnish," when used in connection with services, materials, or equipment, shall mean to supply and deliver said services, materials, or equipment to the Site (or some other specified location) ready for use or installation and in usable or operable condition.

2. The word "install," when used in connection with services, materials, or equipment, shall mean to put into use or place in final position said services, materials, or equipment complete and ready for intended use.

3. The words “perform” or “provide,” when used in connection with services, materials, or equipment, shall mean to furnish and install said services, materials, or equipment complete and ready for intended use.

4. If the Contract Documents establish an obligation of Contractor with respect to specific services, materials, or equipment, but do not expressly use any of the four words “furnish,” “install,” “perform,” or “provide,” then Contractor shall furnish and install said services, materials, or equipment complete and ready for intended use.

F. Unless stated otherwise in the Contract Documents, words or phrases that have a well-known technical or construction industry or trade meaning are used in the Contract Documents in accordance with such recognized meaning.

ARTICLE 2 – PRELIMINARY MATTERS

2.01 *Delivery of Bonds and Evidence of Insurance*

A. *Bonds*: When Contractor delivers the executed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner such bonds as Contractor may be required to furnish.

B. *Evidence of Contractor’s Insurance*: When Contractor delivers the executed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner, with copies to each named insured and additional insured (as identified in the Supplementary Conditions or elsewhere in the Contract), the certificates and other evidence of insurance required to be provided by Contractor in accordance with Article 6.

C. *Evidence of Owner’s Insurance*: After receipt of the executed counterparts of the Agreement and all required bonds and insurance documentation, Owner shall promptly deliver to Contractor, with copies to each named insured and additional insured (as identified in the Supplementary Conditions or otherwise), the certificates and other evidence of insurance required to be provided by Owner under Article 6.

2.02 *Copies of Documents*

A. Owner shall furnish to Contractor four printed copies of the Contract (including one fully executed counterpart of the Agreement), and one copy in electronic portable document format (PDF). Additional printed copies will be furnished upon request at the cost of reproduction.

B. Owner shall maintain and safeguard at least one original printed record version of the Contract, including Drawings and Specifications signed and sealed by Engineer and other design professionals. Owner shall make such original printed record version of the Contract available to Contractor for review. Owner may delegate the responsibilities under this provision to Engineer.

2.03 *Before Starting Construction*

A. *Preliminary Schedules*: Within 10 days after the Effective Date of the Contract (or as otherwise specifically required by the Contract Documents), Contractor shall submit to Engineer for timely review:

1. a preliminary Progress Schedule indicating the times (numbers of days or dates) for starting and completing the various stages of the Work, including any Milestones specified in the Contract;

2. a preliminary Schedule of Submittals; and

3. a preliminary Schedule of Values for all of the Work which includes quantities and prices of items which when added together equal the Contract Price and subdivides the Work into component parts in sufficient detail to serve as the basis for progress payments during performance of the Work. Such prices will include an appropriate amount of overhead and profit applicable to each item of Work.

2.04 *Preconstruction Conference; Designation of Authorized Representatives*

A. Before any Work at the Site is started, a conference attended by Owner, Contractor, Engineer, and others as appropriate will be held to establish a working understanding among the parties as to the Work and to discuss the schedules referred to in Paragraph 2.03.A, procedures for handling Shop Drawings, Samples, and other submittals, processing Applications for Payment, electronic or digital transmittals, and maintaining required records.

B. At this conference Owner and Contractor each shall designate, in writing, a specific individual to act as its authorized representative with respect to the services and responsibilities under the Contract. Such individuals shall have the authority to transmit and receive information, render decisions relative to the Contract, and otherwise act on behalf of each respective party.

2.05 *Initial Acceptance of Schedules*

A. At least 10 days before submission of the first Application for Payment a conference, attended by Contractor, Engineer, and others as appropriate, will be held to review for acceptability to Engineer as provided below the schedules submitted in accordance with Paragraph 2.03.A. Contractor shall have an additional 10 days to make corrections and adjustments and to complete and resubmit the schedules. No progress payment shall be made to Contractor until acceptable schedules are submitted to Engineer.

1. The Progress Schedule will be acceptable to Engineer if it provides an orderly progression of the Work to completion within the Contract Times. Such acceptance will not impose on Engineer responsibility for the Progress Schedule, for sequencing, scheduling, or progress of the Work, nor interfere with or relieve Contractor from Contractor's full responsibility therefor.

2. Contractor's Schedule of Submittals will be acceptable to Engineer if it provides a workable arrangement for reviewing and processing the required submittals.

3. Contractor's Schedule of Values will be acceptable to Engineer as to form and substance if it provides a reasonable allocation of the Contract Price to the component parts of the Work.

2.06 *Electronic Transmittals*

A. Except as otherwise stated elsewhere in the Contract, the Owner, Engineer, and Contractor may transmit, and shall accept, Project-related correspondence, text, data, documents, drawings, information, and graphics, including but not limited to Shop Drawings and other submittals, in electronic media or digital format, either directly, or through access to a secure Project website.

B. If the Contract does not establish protocols for electronic or digital transmittals, then Owner, Engineer, and Contractor shall jointly develop such protocols.

C. When transmitting items in electronic media or digital format, the transmitting party makes no representations as to long term compatibility, usability, or readability of the items resulting from the recipient's use of software application packages, operating systems, or

computer hardware differing from those used in the drafting or transmittal of the items, or from those established in applicable transmittal protocols.

ARTICLE 3 – DOCUMENTS: INTENT, REQUIREMENTS, REUSE

3.01 *Intent*

A. The Contract Documents are complementary; what is required by one is as binding as if required by all.

B. It is the intent of the Contract Documents to describe a functionally complete project (or part thereof) to be constructed in accordance with the Contract Documents.

C. Unless otherwise stated in the Contract Documents, if there is a discrepancy between the electronic or digital versions of the Contract Documents (including any printed copies derived from such electronic or digital versions) and the printed record version, the printed record version shall govern.

D. The Contract supersedes prior negotiations, representations, and agreements, whether written or oral.

E. Engineer will issue clarifications and interpretations of the Contract Documents as provided herein.

3.02 *Reference Standards*

A. Standards Specifications, Codes, Laws and Regulations

1. Reference in the Contract Documents to standard specifications, manuals, reference standards, or codes of any technical society, organization, or association, or to Laws or Regulations, whether such reference be specific or by implication, shall mean the standard specification, manual, reference standard, code, or Laws or Regulations in effect at the time of opening of Bids (or on the Effective Date of the Contract if there were no Bids), except as may be otherwise specifically stated in the Contract Documents.

2. No provision of any such standard specification, manual, reference standard, or code, or any instruction of a Supplier, shall be effective to change the duties or responsibilities of Owner, Contractor, or Engineer, or any of their subcontractors, consultants, agents, or employees, from those set forth in the part of the Contract Documents prepared by or for Engineer. No such provision or instruction shall be effective to assign to Owner, Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, any duty or authority to supervise or direct the performance of the Work or any duty or authority to undertake responsibility inconsistent with the provisions of the part of the Contract Documents prepared by or for Engineer.

3.03 *Reporting and Resolving Discrepancies*

A. *Reporting Discrepancies*:

1. *Contractor's Verification of Figures and Field Measurements*: Before undertaking each part of the Work, Contractor shall carefully study the Contract Documents, and check and verify pertinent figures and dimensions therein, particularly with respect to applicable field measurements. Contractor shall promptly report in writing to Engineer any conflict, error, ambiguity, or discrepancy that Contractor discovers, or has actual knowledge of, and shall not proceed with any Work affected thereby until the conflict,

error, ambiguity, or discrepancy is resolved, by a clarification or interpretation by Engineer, or by an amendment or supplement to the Contract Documents issued pursuant to Paragraph 11.01.

2. *Contractor's Review of Contract Documents*: If, before or during the performance of the Work, Contractor discovers any conflict, error, ambiguity, or discrepancy within the Contract Documents, or between the Contract Documents and (a) any applicable Law or Regulation, (b) actual field conditions, (c) any standard specification, manual, reference standard, or code, or (d) any instruction of any Supplier, then Contractor shall promptly report it to Engineer in writing. Contractor shall not proceed with the Work affected thereby (except in an emergency as required by Paragraph 7.15) until the conflict, error, ambiguity, or discrepancy is resolved, by a clarification or interpretation by Engineer, or by an amendment or supplement to the Contract Documents issued pursuant to Paragraph 11.01.

3. Contractor shall not be liable to Owner or Engineer for failure to report any conflict, error, ambiguity, or discrepancy in the Contract Documents unless Contractor had actual knowledge thereof.

B. *Resolving Discrepancies*:

1. Except as may be otherwise specifically stated in the Contract Documents, the provisions of the part of the Contract Documents prepared by or for Engineer shall take precedence in resolving any conflict, error, ambiguity, or discrepancy between such provisions of the Contract Documents and:

a. the provisions of any standard specification, manual, reference standard, or code, or the instruction of any Supplier (whether or not specifically incorporated by reference as a Contract Document); or

b. the provisions of any Laws or Regulations applicable to the performance of the Work (unless such an interpretation of the provisions of the Contract Documents would result in violation of such Law or Regulation).

3.04 *Requirements of the Contract Documents*

A. During the performance of the Work and until final payment, Contractor and Owner shall submit to the Engineer all matters in question concerning the requirements of the Contract Documents (sometimes referred to as requests for information or interpretation—RFIs), or relating to the acceptability of the Work under the Contract Documents, as soon as possible after such matters arise. Engineer will be the initial interpreter of the requirements of the Contract Documents, and judge of the acceptability of the Work thereunder.

B. Engineer will, with reasonable promptness, render a written clarification, interpretation, or decision on the issue submitted, or initiate an amendment or supplement to the Contract Documents. Engineer's written clarification, interpretation, or decision will be final and binding on Contractor, unless it appeals by submitting a Change Proposal, and on Owner, unless it appeals by filing a Claim.

C. If a submitted matter in question concerns terms and conditions of the Contract Documents that do not involve (1) the performance or acceptability of the Work under the Contract Documents, (2) the design (as set forth in the Drawings, Specifications, or otherwise), or (3) other engineering or technical matters, then Engineer will promptly give written notice to Owner and Contractor that Engineer is unable to provide a decision or interpretation. If Owner and Contractor are unable to agree on resolution of such a matter in question, either party may pursue resolution as provided in Article 12.

3.05 *Reuse of Documents*

A. Contractor and its Subcontractors and Suppliers shall not:

1. have or acquire any title to or ownership rights in any of the Drawings, Specifications, or other documents (or copies of any thereof) prepared by or bearing the seal of Engineer or its consultants, including electronic media editions, or reuse any such Drawings, Specifications, other documents, or copies thereof on extensions of the Project or any other project without written consent of Owner and Engineer and specific written verification or adaptation by Engineer; or

2. have or acquire any title or ownership rights in any other Contract Documents, reuse any such Contract Documents for any purpose without Owner's express written consent, or violate any copyrights pertaining to such Contract Documents.

B. The prohibitions of this Paragraph 3.05 will survive final payment, or termination of the Contract. Nothing herein shall preclude Contractor from retaining copies of the Contract Documents for record purposes.

ARTICLE 4 – COMMENCEMENT AND PROGRESS OF THE WORK

4.01 *Commencement of Contract Times; Notice to Proceed*

A. The Contract Times will commence to run on the thirtieth day after the Effective Date of the Contract or, if a Notice to Proceed is given, on the day indicated in the Notice to Proceed. A Notice to Proceed may be given at any time within 30 days after the Effective Date of the Contract. In no event will the Contract Times commence to run later than the sixtieth day after the day of Bid opening or the thirtieth day after the Effective Date of the Contract, whichever date is earlier.

4.02 *Starting the Work*

A. Contractor shall start to perform the Work on the date when the Contract Times commence to run. No Work shall be done at the Site prior to such date.

4.03 *Reference Points*

A. Owner shall provide engineering surveys to establish reference points for construction which in Engineer's judgment are necessary to enable Contractor to proceed with the Work. Contractor shall be responsible for laying out the Work, shall protect and preserve the established reference points and property monuments, and shall make no changes or relocations without the prior written approval of Owner. Contractor shall report to Engineer whenever any reference point or property monument is lost or destroyed or requires relocation because of necessary changes in grades or locations, and shall be responsible for the accurate replacement or relocation of such reference points or property monuments by professionally qualified personnel.

4.04 *Progress Schedule*

A. Contractor shall adhere to the Progress Schedule established in accordance with Paragraph 2.05 as it may be adjusted from time to time as provided below.

1. Contractor shall submit to Engineer for acceptance (to the extent indicated in Paragraph 2.05) proposed adjustments in the Progress Schedule that will not result in changing the Contract Times.

2. Proposed adjustments in the Progress Schedule that will change the Contract Times shall be submitted in accordance with the requirements of Article 11.

B. Contractor shall carry on the Work and adhere to the Progress Schedule during all disputes or disagreements with Owner. No Work shall be delayed or postponed pending resolution of any disputes or disagreements, or during any appeal process, except as permitted by Paragraph 16.04, or as Owner and Contractor may otherwise agree in writing.

4.05 *Delays in Contractor's Progress*

A. If Owner, Engineer, or anyone for whom Owner is responsible, delays, disrupts, or interferes with the performance or progress of the Work, then Contractor shall be entitled to an equitable adjustment in the Contract Times and Contract Price. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times.

B. Contractor shall not be entitled to an adjustment in Contract Price or Contract Times for delay, disruption, or interference caused by or within the control of Contractor. Delay, disruption, and interference attributable to and within the control of a Subcontractor or Supplier shall be deemed to be within the control of Contractor.

C. If Contractor's performance or progress is delayed, disrupted, or interfered with by unanticipated causes not the fault of and beyond the control of Owner, Contractor, and those for which they are responsible, then Contractor shall be entitled to an equitable adjustment in Contract Times. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times. Such an adjustment shall be Contractor's sole and exclusive remedy for the delays, disruption, and interference described in this paragraph. Causes of delay, disruption, or interference that may give rise to an adjustment in Contract Times under this paragraph include but are not limited to the following:

1. severe and unavoidable natural catastrophes such as fires, floods, epidemics, and earthquakes;

2. abnormal weather conditions;

3. acts or failures to act of utility owners (other than those performing other work at or adjacent to the Site by arrangement with the Owner, as contemplated in Article 8); and

4. acts of war or terrorism.

D. Delays, disruption, and interference to the performance or progress of the Work resulting from the existence of a differing subsurface or physical condition, an Underground Facility that was not shown or indicated by the Contract Documents, or not shown or indicated with reasonable accuracy, and those resulting from Hazardous Environmental Conditions, are governed by Article 5.

E. Paragraph 8.03 governs delays, disruption, and interference to the performance or progress of the Work resulting from the performance of certain other work at or adjacent to the Site.

F. Contractor shall not be entitled to an adjustment in Contract Price or Contract Times for any delay, disruption, or interference if such delay is concurrent with a delay, disruption, or interference caused by or within the control of Contractor.

G. Contractor must submit any Change Proposal seeking an adjustment in Contract Price or Contract Times under this paragraph within 30 days of the commencement of the delaying, disrupting, or interfering event.

ARTICLE 5 – AVAILABILITY OF LANDS; SUBSURFACE AND PHYSICAL CONDITIONS; HAZARDOUS ENVIRONMENTAL CONDITIONS

5.01 *Availability of Lands*

A. Owner shall furnish the Site. Owner shall notify Contractor of any encumbrances or restrictions not of general application but specifically related to use of the Site with which Contractor must comply in performing the Work.

B. Upon reasonable written request, Owner shall furnish Contractor with a current statement of record legal title and legal description of the lands upon which permanent improvements are to be made and Owner's interest therein as necessary for giving notice of or filing a mechanic's or construction lien against such lands in accordance with applicable Laws and Regulations.

C. Contractor shall provide for all additional lands and access thereto that may be required for temporary construction facilities or storage of materials and equipment.

5.02 *Use of Site and Other Areas*

A. *Limitation on Use of Site and Other Areas*:

1. Contractor shall confine construction equipment, temporary construction facilities, the storage of materials and equipment, and the operations of workers to the Site, adjacent areas that Contractor has arranged to use through construction easements or otherwise, and other adjacent areas permitted by Laws and Regulations, and shall not unreasonably encumber the Site and such other adjacent areas with construction equipment or other materials or equipment. Contractor shall assume full responsibility for (a) damage to the Site; (b) damage to any such other adjacent areas used for Contractor's operations; (c) damage to any other adjacent land or areas; and (d) for injuries and losses sustained by the owners or occupants of any such land or areas; provided that such damage or injuries result from the performance of the Work or from other actions or conduct of the Contractor or those for which Contractor is responsible.

2. If a damage or injury claim is made by the owner or occupant of any such land or area because of the performance of the Work, or because of other actions or conduct of the Contractor or those for which Contractor is responsible, Contractor shall (a) take immediate corrective or remedial action as required by Paragraph 7.12, or otherwise; (b) promptly attempt to settle the claim as to all parties through negotiations with such owner or occupant, or otherwise resolve the claim by arbitration or other dispute resolution proceeding, or at law; and (c) to the fullest extent permitted by Laws and Regulations, indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against any such claim, and against all costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any claim or action, legal or equitable, brought by any such owner or occupant against Owner, Engineer, or any other party indemnified hereunder to the extent caused directly or indirectly, in whole or in part

by, or based upon, Contractor's performance of the Work, or because of other actions or conduct of the Contractor or those for which Contractor is responsible.

B. *Removal of Debris During Performance of the Work*: During the progress of the Work the Contractor shall keep the Site and other adjacent areas free from accumulations of waste materials, rubbish, and other debris. Removal and disposal of such waste materials, rubbish, and other debris shall conform to applicable Laws and Regulations.

C. *Cleaning*: Prior to Substantial Completion of the Work Contractor shall clean the Site and the Work and make it ready for utilization by Owner. At the completion of the Work Contractor shall remove from the Site and adjacent areas all tools, appliances, construction equipment and machinery, and surplus materials and shall restore to original condition all property not designated for alteration by the Contract Documents.

D. *Loading of Structures*: Contractor shall not load nor permit any part of any structure to be loaded in any manner that will endanger the structure, nor shall Contractor subject any part of the Work or adjacent structures or land to stresses or pressures that will endanger them.

5.03 *Subsurface and Physical Conditions*

A. *Reports and Drawings*: The Supplementary Conditions identify:

1. those reports known to Owner of explorations and tests of subsurface conditions at or adjacent to the Site;

2. those drawings known to Owner of physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities); and

3. Technical Data contained in such reports and drawings.

B. *Reliance by Contractor on Technical Data Authorized*: Contractor may rely upon the accuracy of the Technical Data expressly identified in the Supplementary Conditions with respect to such reports and drawings, but such reports and drawings are not Contract Documents. If no such express identification has been made, then Contractor may rely upon the accuracy of the Technical Data (as defined in Article 1) contained in any geotechnical or environmental report prepared for the Project and made available to Contractor. Except for such reliance on Technical Data, Contractor may not rely upon or make any claim against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, with respect to:

1. the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor, and safety precautions and programs incident thereto; or

2. other data, interpretations, opinions, and information contained in such reports or shown or indicated in such drawings; or

3. any Contractor interpretation of or conclusion drawn from any Technical Data or any such other data, interpretations, opinions, or information.

5.04 *Differing Subsurface or Physical Conditions*

A. *Notice by Contractor*: If Contractor believes that any subsurface or physical condition that is uncovered or revealed at the Site either:

1. is of such a nature as to establish that any Technical Data on which Contractor is entitled to rely as provided in Paragraph 5.03 is materially inaccurate; or

2. is of such a nature as to require a change in the Drawings or Specifications; or

3. differs materially from that shown or indicated in the Contract Documents; or

4. is of an unusual nature, and differs materially from conditions ordinarily encountered and generally recognized as inherent in work of the character provided for in the Contract Documents;

then Contractor shall, promptly after becoming aware thereof and before further disturbing the subsurface or physical conditions or performing any Work in connection therewith (except in an emergency as required by Paragraph 7.15), notify Owner and Engineer in writing about such condition. Contractor shall not further disturb such condition or perform any Work in connection therewith (except with respect to an emergency) until receipt of a written statement permitting Contractor to do so.

B. *Engineer's Review*: After receipt of written notice as required by the preceding paragraph, Engineer will promptly review the subsurface or physical condition in question; determine the necessity of Owner's obtaining additional exploration or tests with respect to the condition; conclude whether the condition falls within any one or more of the differing site condition categories in Paragraph 5.04.A above; obtain any pertinent cost or schedule information from Contractor; prepare recommendations to Owner regarding the Contractor's resumption of Work in connection with the subsurface or physical condition in question and the need for any change in the Drawings or Specifications; and advise Owner in writing of Engineer's findings, conclusions, and recommendations.

C. *Owner's Statement to Contractor Regarding Site Condition*: After receipt of Engineer's written findings, conclusions, and recommendations, Owner shall issue a written statement to Contractor (with a copy to Engineer) regarding the subsurface or physical condition in question, addressing the resumption of Work in connection with such condition, indicating whether any change in the Drawings or Specifications will be made, and adopting or rejecting Engineer's written findings, conclusions, and recommendations, in whole or in part.

D. *Possible Price and Times Adjustments*:

1. Contractor shall be entitled to an equitable adjustment in Contract Price or Contract Times, or both, to the extent that the existence of a differing subsurface or physical condition, or any related delay, disruption, or interference, causes an increase or decrease in Contractor's cost of, or time required for, performance of the Work; subject, however, to the following:

a. such condition must fall within any one or more of the categories described in Paragraph 5.04.A;

b. with respect to Work that is paid for on a unit price basis, any adjustment in Contract Price will be subject to the provisions of Paragraph 13.03; and,

c. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times.

2. Contractor shall not be entitled to any adjustment in the Contract Price or Contract Times with respect to a subsurface or physical condition if:

a. Contractor knew of the existence of such condition at the time Contractor made a commitment to Owner with respect to Contract Price and Contract Times by the submission of a Bid or becoming bound under a negotiated contract, or otherwise; or

b. the existence of such condition reasonably could have been discovered or revealed as a result of any examination, investigation, exploration, test, or study of the Site and contiguous areas expressly required by the Bidding Requirements or Contract Documents to be conducted by or for Contractor prior to Contractor's making such commitment; or

c. Contractor failed to give the written notice as required by Paragraph 5.04.A.

3. If Owner and Contractor agree regarding Contractor's entitlement to and the amount or extent of any adjustment in the Contract Price or Contract Times, or both, then any such adjustment shall be set forth in a Change Order.

4. Contractor may submit a Change Proposal regarding its entitlement to or the amount or extent of any adjustment in the Contract Price or Contract Times, or both, no later than 30 days after Owner's issuance of the Owner's written statement to Contractor regarding the subsurface or physical condition in question.

5.05 *Underground Facilities*

A. *Contractor's Responsibilities*: The information and data shown or indicated in the Contract Documents with respect to existing Underground Facilities at or adjacent to the Site is based on information and data furnished to Owner or Engineer by the owners of such Underground Facilities, including Owner, or by others. Unless it is otherwise expressly provided in the Supplementary Conditions:

1. Owner and Engineer do not warrant or guarantee the accuracy or completeness of any such information or data provided by others; and

2. the cost of all of the following will be included in the Contract Price, and Contractor shall have full responsibility for:

a. reviewing and checking all information and data regarding existing Underground Facilities at the Site;

b. locating all Underground Facilities shown or indicated in the Contract Documents as being at the Site;

c. coordination of the Work with the owners (including Owner) of such Underground Facilities, during construction; and

d. the safety and protection of all existing Underground Facilities at the Site, and repairing any damage thereto resulting from the Work.

B. *Notice by Contractor*: If Contractor believes that an Underground Facility that is uncovered or revealed at the Site was not shown or indicated in the Contract Documents, or was not shown or indicated with reasonable accuracy, then Contractor shall, promptly after

becoming aware thereof and before further disturbing conditions affected thereby or performing any Work in connection therewith (except in an emergency as required by Paragraph 7.15), identify the owner of such Underground Facility and give written notice to that owner and to Owner and Engineer.

C. *Engineer's Review*: Engineer will promptly review the Underground Facility and conclude whether such Underground Facility was not shown or indicated in the Contract Documents, or was not shown or indicated with reasonable accuracy; obtain any pertinent cost or schedule information from Contractor; prepare recommendations to Owner regarding the Contractor's resumption of Work in connection with the Underground Facility in question; determine the extent, if any, to which a change is required in the Drawings or Specifications to reflect and document the consequences of the existence or location of the Underground Facility; and advise Owner in writing of Engineer's findings, conclusions, and recommendations. During such time, Contractor shall be responsible for the safety and protection of such Underground Facility.

D. *Owner's Statement to Contractor Regarding Underground Facility*: After receipt of Engineer's written findings, conclusions, and recommendations, Owner shall issue a written statement to Contractor (with a copy to Engineer) regarding the Underground Facility in question, addressing the resumption of Work in connection with such Underground Facility, indicating whether any change in the Drawings or Specifications will be made, and adopting or rejecting Engineer's written findings, conclusions, and recommendations in whole or in part.

E. *Possible Price and Times Adjustments*:

1. Contractor shall be entitled to an equitable adjustment in the Contract Price or Contract Times, or both, to the extent that any existing Underground Facility at the Site that was not shown or indicated in the Contract Documents, or was not shown or indicated with reasonable accuracy, or any related delay, disruption, or interference, causes an increase or decrease in Contractor's cost of, or time required for, performance of the Work; subject, however, to the following:

    a. Contractor did not know of and could not reasonably have been expected to be aware of or to have anticipated the existence or actual location of the Underground Facility in question;

    b. With respect to Work that is paid for on a unit price basis, any adjustment in Contract Price will be subject to the provisions of Paragraph 13.03;

    c. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times; and

    d. Contractor gave the notice required in Paragraph 5.05.B.

2. If Owner and Contractor agree regarding Contractor's entitlement to and the amount or extent of any adjustment in the Contract Price or Contract Times, or both, then any such adjustment shall be set forth in a Change Order.

3. Contractor may submit a Change Proposal regarding its entitlement to or the amount or extent of any adjustment in the Contract Price or Contract Times, or both, no later than 30 days after Owner's issuance of the Owner's written statement to Contractor regarding the Underground Facility in question.

5.06 *Hazardous Environmental Conditions at Site*

A. *Reports and Drawings*: The Supplementary Conditions identify:

1. those reports and drawings known to Owner relating to Hazardous Environmental Conditions that have been identified at or adjacent to the Site; and

2. Technical Data contained in such reports and drawings.

B. *Reliance by Contractor on Technical Data Authorized*: Contractor may rely upon the accuracy of the Technical Data expressly identified in the Supplementary Conditions with respect to such reports and drawings, but such reports and drawings are not Contract Documents. If no such express identification has been made, then Contractor may rely on the accuracy of the Technical Data (as defined in Article 1) contained in any geotechnical or environmental report prepared for the Project and made available to Contractor. Except for such reliance on Technical Data, Contractor may not rely upon or make any claim against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors with respect to:

1. the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences and procedures of construction to be employed by Contractor and safety precautions and programs incident thereto; or

2. other data, interpretations, opinions and information contained in such reports or shown or indicated in such drawings; or

3. any Contractor interpretation of or conclusion drawn from any Technical Data or any such other data, interpretations, opinions or information.

C. Contractor shall not be responsible for removing or remediating any Hazardous Environmental Condition encountered, uncovered, or revealed at the Site unless such removal or remediation is expressly identified in the Contract Documents to be within the scope of the Work.

D. Contractor shall be responsible for controlling, containing, and duly removing all Constituents of Concern brought to the Site by Contractor, Subcontractors, Suppliers, or anyone else for whom Contractor is responsible, and for any associated costs; and for the costs of removing and remediating any Hazardous Environmental Condition created by the presence of any such Constituents of Concern.

E. If Contractor encounters, uncovers, or reveals a Hazardous Environmental Condition whose removal or remediation is not expressly identified in the Contract Documents as being within the scope of the Work, or if Contractor or anyone for whom Contractor is responsible creates a Hazardous Environmental Condition, then Contractor shall immediately: (1) secure or otherwise isolate such condition; (2) stop all Work in connection with such condition and in any area affected thereby (except in an emergency as required by Paragraph 7.15); and (3) notify Owner and Engineer (and promptly thereafter confirm such notice in writing). Owner shall promptly consult with Engineer concerning the necessity for Owner to retain a qualified expert to evaluate such condition or take corrective action, if any. Promptly after consulting with Engineer, Owner shall take such actions as are necessary to permit Owner to timely obtain required permits and provide Contractor the written notice required by Paragraph 5.06.F. If Contractor or anyone for whom Contractor is responsible created the Hazardous Environmental Condition in question, then Owner may remove and remediate the Hazardous Environmental Condition, and impose a set-off against payments to account for the associated costs.

F. Contractor shall not resume Work in connection with such Hazardous Environmental Condition or in any affected area until after Owner has obtained any required permits related thereto, and delivered written notice to Contractor either (1) specifying that such condition and any affected area is or has been rendered safe for the resumption of Work, or (2) specifying any special conditions under which such Work may be resumed safely.

G. If Owner and Contractor cannot agree as to entitlement to or on the amount or extent, if any, of any adjustment in Contract Price or Contract Times, or both, as a result of such Work stoppage or such special conditions under which Work is agreed to be resumed by Contractor, then within 30 days of Owner's written notice regarding the resumption of Work, Contractor may submit a Change Proposal, or Owner may impose a set-off.

H. If after receipt of such written notice Contractor does not agree to resume such Work based on a reasonable belief it is unsafe, or does not agree to resume such Work under such special conditions, then Owner may order the portion of the Work that is in the area affected by such condition to be deleted from the Work, following the contractual change procedures in Article 11. Owner may have such deleted portion of the Work performed by Owner's own forces or others in accordance with Article 8.

I. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, Subcontractors, and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to a Hazardous Environmental Condition, provided that such Hazardous Environmental Condition (1) was not shown or indicated in the Drawings, Specifications, or other Contract Documents, identified as Technical Data entitled to limited reliance pursuant to Paragraph 5.06.B, or identified in the Contract Documents to be included within the scope of the Work, and (2) was not created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 5.06.H shall obligate Owner to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.

J. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to the failure to control, contain, or remove a Constituent of Concern brought to the Site by Contractor or by anyone for whom Contractor is responsible, or to a Hazardous Environmental Condition created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 5.06.J shall obligate Contractor to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.

K. The provisions of Paragraphs 5.03, 5.04, and 5.05 do not apply to the presence of Constituents of Concern or to a Hazardous Environmental Condition uncovered or revealed at the Site.

ARTICLE 6 – BONDS AND INSURANCE

6.01 *Performance, Payment, and Other Bonds*

A. Contractor shall furnish a performance bond and a payment bond, each in an amount at least equal to the Contract Price, as security for the faithful performance and payment of all of Contractor's obligations under the Contract. These bonds shall remain in effect until one year after the date when final payment becomes due or until completion of the correction period specified in Paragraph 15.08, whichever is later, except as provided otherwise by Laws or Regulations, the Supplementary Conditions, or other specific provisions of the Contract. Contractor shall also furnish such other bonds as are required by the Supplementary Conditions or other specific provisions of the Contract.

B. All bonds shall be in the form prescribed by the Contract except as provided otherwise by Laws or Regulations, and shall be executed by such sureties as are named in "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies" as published in Circular 570 (as amended and supplemented) by the Financial Management Service, Surety Bond Branch, U.S. Department of the Treasury. A bond signed by an agent or attorney-in-fact must be accompanied by a certified copy of that individual's authority to bind the surety. The evidence of authority shall show that it is effective on the date the agent or attorney-in-fact signed the accompanying bond.

C. Contractor shall obtain the required bonds from surety companies that are duly licensed or authorized in the jurisdiction in which the Project is located to issue bonds in the required amounts.

D. If the surety on a bond furnished by Contractor is declared bankrupt or becomes insolvent, or its right to do business is terminated in any state or jurisdiction where any part of the Project is located, or the surety ceases to meet the requirements above, then Contractor shall promptly notify Owner and Engineer and shall, within 20 days after the event giving rise to such notification, provide another bond and surety, both of which shall comply with the bond and surety requirements above.

E. If Contractor has failed to obtain a required bond, Owner may exclude the Contractor from the Site and exercise Owner's termination rights under Article 16.

F. Upon request, Owner shall provide a copy of the payment bond to any Subcontractor, Supplier, or other person or entity claiming to have furnished labor or materials used in the performance of the Work.

6.02 *Insurance—General Provisions*

A. Owner and Contractor shall obtain and maintain insurance as required in this Article and in the Supplementary Conditions.

B. All insurance required by the Contract to be purchased and maintained by Owner or Contractor shall be obtained from insurance companies that are duly licensed or authorized, in the state or jurisdiction in which the Project is located, to issue insurance policies for the required limits and coverages. Unless a different standard is indicated in the Supplementary Conditions, all companies that provide insurance policies required under this Contract shall have an A.M. Best rating of A-VII or better.

C. Contractor shall deliver to Owner, with copies to each named insured and additional insured (as identified in this Article, in the Supplementary Conditions, or elsewhere in the Contract), certificates of insurance establishing that Contractor has obtained and is

maintaining the policies, coverages, and endorsements required by the Contract. Upon request by Owner or any other insured, Contractor shall also furnish other evidence of such required insurance, including but not limited to copies of policies and endorsements, and documentation of applicable self-insured retentions and deductibles. Contractor may block out (redact) any confidential premium or pricing information contained in any policy or endorsement furnished under this provision.

D. Owner shall deliver to Contractor, with copies to each named insured and additional insured (as identified in this Article, the Supplementary Conditions, or elsewhere in the Contract), certificates of insurance establishing that Owner has obtained and is maintaining the policies, coverages, and endorsements required of Owner by the Contract (if any). Upon request by Contractor or any other insured, Owner shall also provide other evidence of such required insurance (if any), including but not limited to copies of policies and endorsements, and documentation of applicable self-insured retentions and deductibles. Owner may block out (redact) any confidential premium or pricing information contained in any policy or endorsement furnished under this provision.

E. Failure of Owner or Contractor to demand such certificates or other evidence of the other party's full compliance with these insurance requirements, or failure of Owner or Contractor to identify a deficiency in compliance from the evidence provided, shall not be construed as a waiver of the other party's obligation to obtain and maintain such insurance.

F. If either party does not purchase or maintain all of the insurance required of such party by the Contract, such party shall notify the other party in writing of such failure to purchase prior to the start of the Work, or of such failure to maintain prior to any change in the required coverage.

G. If Contractor has failed to obtain and maintain required insurance, Owner may exclude the Contractor from the Site, impose an appropriate set-off against payment, and exercise Owner's termination rights under Article 16.

H. Without prejudice to any other right or remedy, if a party has failed to obtain required insurance, the other party may elect to obtain equivalent insurance to protect such other party's interests at the expense of the party who was required to provide such coverage, and the Contract Price shall be adjusted accordingly.

I. Owner does not represent that insurance coverage and limits established in this Contract necessarily will be adequate to protect Contractor or Contractor's interests.

J. The insurance and insurance limits required herein shall not be deemed as a limitation on Contractor's liability under the indemnities granted to Owner and other individuals and entities in the Contract.

6.03 *Contractor's Insurance*

A. *Workers' Compensation*: Contractor shall purchase and maintain workers' compensation and employer's liability insurance for:

1. claims under workers' compensation, disability benefits, and other similar employee benefit acts.

2. United States Longshoreman and Harbor Workers' Compensation Act and Jones Act coverage (if applicable).

3. claims for damages because of bodily injury, occupational sickness or disease, or death of Contractor's employees (by stop-gap endorsement in monopolist worker's compensation states).

4. Foreign voluntary worker compensation (if applicable).

B. *Commercial General Liability—Claims Covered*: Contractor shall purchase and maintain commercial general liability insurance, covering all operations by or on behalf of Contractor, on an occurrence basis, against:

1. claims for damages because of bodily injury, sickness or disease, or death of any person other than Contractor's employees.

2. claims for damages insured by reasonably available personal injury liability coverage.

3. claims for damages, other than to the Work itself, because of injury to or destruction of tangible property wherever located, including loss of use resulting therefrom.

C. *Commercial General Liability—Form and Content*: Contractor's commercial liability policy shall be written on a 1996 (or later) ISO commercial general liability form (occurrence form) and include the following coverages and endorsements:

1. Products and completed operations coverage:

a. Such insurance shall be maintained for three years after final payment.

b. Contractor shall furnish Owner and each other additional insured (as identified in the Supplementary Conditions or elsewhere in the Contract) evidence of continuation of such insurance at final payment and three years thereafter.

2. Blanket contractual liability coverage, to the extent permitted by law, including but not limited to coverage of Contractor's contractual indemnity obligations in Paragraph 7.18.

3. Broad form property damage coverage.

4. Severability of interest.

5. Underground, explosion, and collapse coverage.

6. Personal injury coverage.

7. Additional insured endorsements that include both ongoing operations and products and completed operations coverage through ISO Endorsements CG 20 10 10 01 and CG 20 37 10 01 (together); or CG 20 10 07 04 and CG 20 37 07 04 (together); or their equivalent.

8. For design professional additional insureds, ISO Endorsement CG 20 32 07 04, "Additional Insured—Engineers, Architects or Surveyors Not Engaged by the Named Insured" or its equivalent.

D. *Automobile liability*: Contractor shall purchase and maintain automobile liability insurance against claims for damages because of bodily injury or death of any person or property damage arising out of the ownership, maintenance, or use of any motor vehicle. The automobile liability policy shall be written on an occurrence basis.

E. *Umbrella or excess liability*: Contractor shall purchase and maintain umbrella or excess liability insurance written over the underlying employer's liability, commercial general liability, and automobile liability insurance described in the paragraphs above. Subject to industry-standard exclusions, the coverage afforded shall follow form as to each and every one of the underlying policies.

F. *Contractor's pollution liability insurance*: Contractor shall purchase and maintain a policy covering third-party injury and property damage claims, including clean-up costs, as a result

of pollution conditions arising from Contractor's operations and completed operations. This insurance shall be maintained for no less than three years after final completion.

G. *Additional insureds*: The Contractor's commercial general liability, automobile liability, umbrella or excess, and pollution liability policies shall include and list as additional insureds Owner and Engineer, and any individuals or entities identified in the Supplementary Conditions; include coverage for the respective officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of all such additional insureds; and the insurance afforded to these additional insureds shall provide primary coverage for all claims covered thereby (including as applicable those arising from both ongoing and completed operations) on a non-contributory basis. Contractor shall obtain all necessary endorsements to support these requirements.

H. *Contractor's professional liability insurance*: If Contractor will provide or furnish professional services under this Contract, through a delegation of professional design services or otherwise, then Contractor shall be responsible for purchasing and maintaining applicable professional liability insurance. This insurance shall provide protection against claims arising out of performance of professional design or related services, and caused by a negligent error, omission, or act for which the insured party is legally liable. It shall be maintained throughout the duration of the Contract and for a minimum of two years after Substantial Completion. If such professional design services are performed by a Subcontractor, and not by Contractor itself, then the requirements of this paragraph may be satisfied through the purchasing and maintenance of such insurance by such Subcontractor.

I. *General provisions*: The policies of insurance required by this Paragraph 6.03 shall:

1. include at least the specific coverages provided in this Article.

2. be written for not less than the limits of liability provided in this Article and in the Supplementary Conditions, or required by Laws or Regulations, whichever is greater.

3. contain a provision or endorsement that the coverage afforded will not be canceled, materially changed, or renewal refused until at least 10 days prior written notice has been given to Contractor. Within three days of receipt of any such written notice, Contractor shall provide a copy of the notice to Owner, Engineer, and each other insured under the policy.

4. remain in effect at least until final payment (and longer if expressly required in this Article) and at all times thereafter when Contractor may be correcting, removing, or replacing defective Work as a warranty or correction obligation, or otherwise, or returning to the Site to conduct other tasks arising from the Contract Documents.

5. be appropriate for the Work being performed and provide protection from claims that may arise out of or result from Contractor's performance of the Work and Contractor's other obligations under the Contract Documents, whether it is to be performed by Contractor, any Subcontractor or Supplier, or by anyone directly or indirectly employed by any of them to perform any of the Work, or by anyone for whose acts any of them may be liable.

J. The coverage requirements for specific policies of insurance must be met by such policies, and not by reference to excess or umbrella insurance provided in other policies.

6.04 *Owner's Liability Insurance*

A. In addition to the insurance required to be provided by Contractor under Paragraph 6.03, Owner, at Owner's option, may purchase and maintain at Owner's expense Owner's own liability insurance as will protect Owner against claims which may arise from operations under the Contract Documents.

B. Owner's liability policies, if any, operate separately and independently from policies required to be provided by Contractor, and Contractor cannot rely upon Owner's liability policies for any of Contractor's obligations to the Owner, Engineer, or third parties.

6.05 *Property Insurance*

A. *Builder's Risk*: Unless otherwise provided in the Supplementary Conditions, Contractor shall purchase and maintain builder's risk insurance upon the Work on a completed value basis, in the amount of the full insurable replacement cost thereof (subject to such deductible amounts as may be provided in the Supplementary Conditions or required by Laws and Regulations). This insurance shall:

1. include the Owner and Contractor as named insureds, and all Subcontractors, and any individuals or entities required by the Supplementary Conditions to be insured under such builder's risk policy, as insureds or named insureds. For purposes of the remainder of this Paragraph 6.05, Paragraphs 6.06 and 6.07, and any corresponding Supplementary Conditions, the parties required to be insured shall collectively be referred to as "insureds."

2. be written on a builder's risk "all risk" policy form that shall at least include insurance for physical loss or damage to the Work, temporary buildings, falsework, and materials and equipment in transit, and shall insure against at least the following perils or causes of loss: fire; lightning; windstorm; riot; civil commotion; terrorism; vehicle impact; aircraft; smoke; theft; vandalism and malicious mischief; mechanical breakdown, boiler explosion, and artificially generated electric current; earthquake; volcanic activity, and other earth movement; flood; collapse; explosion; debris removal; demolition occasioned by enforcement of Laws and Regulations; water damage (other than that caused by flood); and such other perils or causes of loss as may be specifically required by the Supplementary Conditions. If insurance against mechanical breakdown, boiler explosion, and artificially generated electric current; earthquake; volcanic activity, and other earth movement; or flood, are not commercially available under builder's risk policies, by endorsement or otherwise, such insurance may be provided through other insurance policies acceptable to Owner and Contractor.

3. cover, as insured property, at least the following: (a) the Work and all materials, supplies, machinery, apparatus, equipment, fixtures, and other property of a similar nature that are to be incorporated into or used in the preparation, fabrication, construction, erection, or completion of the Work, including Owner-furnished or assigned property; (b) spare parts inventory required within the scope of the Contract; and (c) temporary works which are not intended to form part of the permanent constructed Work but which are intended to provide working access to the Site, or to the Work under construction, or which are intended to provide temporary support for the Work under construction, including scaffolding, form work, fences, shoring, falsework, and temporary structures.

4. cover expenses incurred in the repair or replacement of any insured property (including but not limited to fees and charges of engineers and architects).

5. extend to cover damage or loss to insured property while in temporary storage at the Site or in a storage location outside the Site (but not including property stored at the premises of a manufacturer or Supplier).

6. extend to cover damage or loss to insured property while in transit.

7. allow for partial occupation or use of the Work by Owner, such that those portions of the Work that are not yet occupied or used by Owner shall remain covered by the builder's risk insurance.

8. allow for the waiver of the insurer's subrogation rights, as set forth below.

9. provide primary coverage for all losses and damages caused by the perils or causes of loss covered.

10. not include a co-insurance clause.

11. include an exception for ensuing losses from physical damage or loss with respect to any defective workmanship, design, or materials exclusions.

12. include performance/hot testing and start-up.

13. be maintained in effect, subject to the provisions herein regarding Substantial Completion and partial occupancy or use of the Work by Owner, until the Work is complete.

B. *Notice of Cancellation or Change*: All the policies of insurance (and the certificates or other evidence thereof) required to be purchased and maintained in accordance with this Paragraph 6.05 will contain a provision or endorsement that the coverage afforded will not be canceled or materially changed or renewal refused until at least 10 days prior written notice has been given to the purchasing policyholder. Within three days of receipt of any such written notice, the purchasing policyholder shall provide a copy of the notice to each other insured.

C. *Deductibles*: The purchaser of any required builder's risk or property insurance shall pay for costs not covered because of the application of a policy deductible.

D. *Partial Occupancy or Use by Owner*: If Owner will occupy or use a portion or portions of the Work prior to Substantial Completion of all the Work as provided in Paragraph 15.04, then Owner (directly, if it is the purchaser of the builder's risk policy, or through Contractor) will provide notice of such occupancy or use to the builder's risk insurer. The builder's risk insurance shall not be canceled or permitted to lapse on account of any such partial use or occupancy; rather, those portions of the Work that are occupied or used by Owner may come off the builder's risk policy, while those portions of the Work not yet occupied or used by Owner shall remain covered by the builder's risk insurance.

E. *Additional Insurance*: If Contractor elects to obtain other special insurance to be included in or supplement the builder's risk or property insurance policies provided under this Paragraph 6.05, it may do so at Contractor's expense.

F. *Insurance of Other Property*: If the express insurance provisions of the Contract do not require or address the insurance of a property item or interest, such as tools, construction equipment, or other personal property owned by Contractor, a Subcontractor, or an employee of Contractor or a Subcontractor, then the entity or individual owning such property item will be responsible for deciding whether to insure it, and if so in what amount.

6.06 *Waiver of Rights*

A. All policies purchased in accordance with Paragraph 6.05, expressly including the builder's risk policy, shall contain provisions to the effect that in the event of payment of any loss or damage the insurers will have no rights of recovery against any insureds thereunder, or against Engineer or its consultants, or their officers, directors, members, partners, employees, agents, consultants, or subcontractors. Owner and Contractor waive all rights against each other and the respective officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, for all losses and damages caused by, arising out of, or resulting from any of the perils or causes of loss covered by such policies and any other property insurance applicable to the Work; and, in addition, waive all such rights against Engineer, its consultants, all Subcontractors, all individuals or entities identified in the Supplementary Conditions as insureds, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, under such policies for losses and damages so caused. None of the above waivers shall extend to the rights that any party making such waiver may have to the proceeds of insurance held by Owner or Contractor as trustee or fiduciary, or otherwise payable under any policy so issued.

B. Owner waives all rights against Contractor, Subcontractors, and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them, for:

1. loss due to business interruption, loss of use, or other consequential loss extending beyond direct physical loss or damage to Owner's property or the Work caused by, arising out of, or resulting from fire or other perils whether or not insured by Owner; and

2. loss or damage to the completed Project or part thereof caused by, arising out of, or resulting from fire or other insured peril or cause of loss covered by any property insurance maintained on the completed Project or part thereof by Owner during partial occupancy or use pursuant to Paragraph 15.04, after Substantial Completion pursuant to Paragraph 15.03, or after final payment pursuant to Paragraph 15.06.

C. Any insurance policy maintained by Owner covering any loss, damage or consequential loss referred to in Paragraph 6.06.B shall contain provisions to the effect that in the event of payment of any such loss, damage, or consequential loss, the insurers will have no rights of recovery against Contractor, Subcontractors, or Engineer, or the officers, directors, members, partners, employees, agents, consultants, or subcontractors of each and any of them.

D. Contractor shall be responsible for assuring that the agreement under which a Subcontractor performs a portion of the Work contains provisions whereby the Subcontractor waives all rights against Owner, Contractor, all individuals or entities identified in the Supplementary Conditions as insureds, the Engineer and its consultants, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, for all losses and damages caused by, arising out of, relating to, or resulting from any of the perils or causes of loss covered by builder's risk insurance and any other property insurance applicable to the Work.

6.07 *Receipt and Application of Property Insurance Proceeds*

A. Any insured loss under the builder's risk and other policies of insurance required by Paragraph 6.05 will be adjusted and settled with the named insured that purchased the

policy. Such named insured shall act as fiduciary for the other insureds, and give notice to such other insureds that adjustment and settlement of a claim is in progress. Any other insured may state its position regarding a claim for insured loss in writing within 15 days after notice of such claim.

B. Proceeds for such insured losses may be made payable by the insurer either jointly to multiple insureds, or to the named insured that purchased the policy in its own right and as fiduciary for other insureds, subject to the requirements of any applicable mortgage clause. A named insured receiving insurance proceeds under the builder's risk and other policies of insurance required by Paragraph 6.05 shall distribute such proceeds in accordance with such agreement as the parties in interest may reach, or as otherwise required under the dispute resolution provisions of this Contract or applicable Laws and Regulations.

C. If no other special agreement is reached, the damaged Work shall be repaired or replaced, the money so received applied on account thereof, and the Work and the cost thereof covered by Change Order, if needed.

ARTICLE 7 – CONTRACTOR'S RESPONSIBILITIES

7.01 *Supervision and Superintendence*

A. Contractor shall supervise, inspect, and direct the Work competently and efficiently, devoting such attention thereto and applying such skills and expertise as may be necessary to perform the Work in accordance with the Contract Documents. Contractor shall be solely responsible for the means, methods, techniques, sequences, and procedures of construction.

B. At all times during the progress of the Work, Contractor shall assign a competent resident superintendent who shall not be replaced without written notice to Owner and Engineer except under extraordinary circumstances.

7.02 *Labor; Working Hours*

A. Contractor shall provide competent, suitably qualified personnel to survey and lay out the Work and perform construction as required by the Contract Documents. Contractor shall at all times maintain good discipline and order at the Site.

B. Except as otherwise required for the safety or protection of persons or the Work or property at the Site or adjacent thereto, and except as otherwise stated in the Contract Documents, all Work at the Site shall be performed during regular working hours, Monday through Friday. Contractor will not perform Work on a Saturday, Sunday, or any legal holiday. Contractor may perform Work outside regular working hours or on Saturdays, Sundays, or legal holidays only with Owner's written consent, which will not be unreasonably withheld.

7.03 *Services, Materials, and Equipment*

A. Unless otherwise specified in the Contract Documents, Contractor shall provide and assume full responsibility for all services, materials, equipment, labor, transportation, construction equipment and machinery, tools, appliances, fuel, power, light, heat, telephone, water, sanitary facilities, temporary facilities, and all other facilities and incidentals necessary for the performance, testing, start up, and completion of the Work, whether or not such items are specifically called for in the Contract Documents.

B. All materials and equipment incorporated into the Work shall be of good quality and new, except as otherwise provided in the Contract Documents. All special warranties and

guarantees required by the Specifications shall expressly run to the benefit of Owner. If required by Engineer, Contractor shall furnish satisfactory evidence (including reports of required tests) as to the source, kind, and quality of materials and equipment.

C. All materials and equipment shall be stored, applied, installed, connected, erected, protected, used, cleaned, and conditioned in accordance with instructions of the applicable Supplier, except as otherwise may be provided in the Contract Documents.

7.04 *"Or Equals"*

A. Whenever an item of material or equipment is specified or described in the Contract Documents by using the name of a proprietary item or the name of a particular Supplier, the Contract Price has been based upon Contractor furnishing such item as specified. The specification or description of such an item is intended to establish the type, function, appearance, and quality required. Unless the specification or description contains or is followed by words reading that no like, equivalent, or "or equal" item is permitted, Contractor may request that Engineer authorize the use of other items of material or equipment, or items from other proposed suppliers under the circumstances described below.

1. If Engineer in its sole discretion determines that an item of material or equipment proposed by Contractor is functionally equal to that named and sufficiently similar so that no change in related Work will be required, Engineer shall deem it an "or equal" item. For the purposes of this paragraph, a proposed item of material or equipment will be considered functionally equal to an item so named if:

a. in the exercise of reasonable judgment Engineer determines that:

1) it is at least equal in materials of construction, quality, durability, appearance, strength, and design characteristics;

2) it will reliably perform at least equally well the function and achieve the results imposed by the design concept of the completed Project as a functioning whole;

3) it has a proven record of performance and availability of responsive service; and

4) it is not objectionable to Owner.

b. Contractor certifies that, if approved and incorporated into the Work:

1) there will be no increase in cost to the Owner or increase in Contract Times; and

2) it will conform substantially to the detailed requirements of the item named in the Contract Documents.

B. *Contractor's Expense*: Contractor shall provide all data in support of any proposed "or equal" item at Contractor's expense.

C. *Engineer's Evaluation and Determination*: Engineer will be allowed a reasonable time to evaluate each "or-equal" request. Engineer may require Contractor to furnish additional data about the proposed "or-equal" item. Engineer will be the sole judge of acceptability. No "or-equal" item will be ordered, furnished, installed, or utilized until Engineer's review is complete and Engineer determines that the proposed item is an "or-equal", which will be evidenced by an approved Shop Drawing or other written communication. Engineer will advise Contractor in writing of any negative determination.

D. *Effect of Engineer's Determination*: Neither approval nor denial of an "or-equal" request shall result in any change in Contract Price. The Engineer's denial of an "or-equal" request shall be final and binding, and may not be reversed through an appeal under any provision of the Contract Documents.

E. *Treatment as a Substitution Request*: If Engineer determines that an item of material or equipment proposed by Contractor does not qualify as an "or-equal" item, Contractor may request that Engineer considered the proposed item as a substitute pursuant to Paragraph 7.05.

7.05 *Substitutes*

A. Unless the specification or description of an item of material or equipment required to be furnished under the Contract Documents contains or is followed by words reading that no substitution is permitted, Contractor may request that Engineer authorize the use of other items of material or equipment under the circumstances described below. To the extent possible such requests shall be made before commencement of related construction at the Site.

1. Contractor shall submit sufficient information as provided below to allow Engineer to determine if the item of material or equipment proposed is functionally equivalent to that named and an acceptable substitute therefor. Engineer will not accept requests for review of proposed substitute items of material or equipment from anyone other than Contractor.

2. The requirements for review by Engineer will be as set forth in Paragraph 7.05.B, as supplemented by the Specifications, and as Engineer may decide is appropriate under the circumstances.

3. Contractor shall make written application to Engineer for review of a proposed substitute item of material or equipment that Contractor seeks to furnish or use. The application:

a. shall certify that the proposed substitute item will:

1) perform adequately the functions and achieve the results called for by the general design,

2) be similar in substance to that specified, and

3) be suited to the same use as that specified.

b. will state:

1) the extent, if any, to which the use of the proposed substitute item will necessitate a change in Contract Times,

2) whether use of the proposed substitute item in the Work will require a change in any of the Contract Documents (or in the provisions of any other direct contract with Owner for other work on the Project) to adapt the design to the proposed substitute item, and

3) whether incorporation or use of the proposed substitute item in connection with the Work is subject to payment of any license fee or royalty.

c. will identify:

1) all variations of the proposed substitute item from that specified, and

2) available engineering, sales, maintenance, repair, and replacement services.

d. shall contain an itemized estimate of all costs or credits that will result directly or indirectly from use of such substitute item, including but not limited to changes in Contract Price, shared savings, costs of redesign, and claims of other contractors affected by any resulting change.

B. *Engineer's Evaluation and Determination*: Engineer will be allowed a reasonable time to evaluate each substitute request, and to obtain comments and direction from Owner. Engineer may require Contractor to furnish additional data about the proposed substitute item. Engineer will be the sole judge of acceptability. No substitute will be ordered, furnished, installed, or utilized until Engineer's review is complete and Engineer determines that the proposed item is an acceptable substitute. Engineer's determination will be evidenced by a Field Order or a proposed Change Order accounting for the substitution itself and all related impacts, including changes in Contract Price or Contract Times. Engineer will advise Contractor in writing of any negative determination.

C. *Special Guarantee*: Owner may require Contractor to furnish at Contractor's expense a special performance guarantee or other surety with respect to any substitute.

D. *Reimbursement of Engineer's Cost*: Engineer will record Engineer's costs in evaluating a substitute proposed or submitted by Contractor. Whether or not Engineer approves a substitute so proposed or submitted by Contractor, Contractor shall reimburse Owner for the reasonable charges of Engineer for evaluating each such proposed substitute. Contractor shall also reimburse Owner for the reasonable charges of Engineer for making changes in the Contract Documents (or in the provisions of any other direct contract with Owner) resulting from the acceptance of each proposed substitute.

E. *Contractor's Expense*: Contractor shall provide all data in support of any proposed substitute at Contractor's expense.

F. *Effect of Engineer's Determination*: If Engineer approves the substitution request, Contractor shall execute the proposed Change Order and proceed with the substitution. The Engineer's denial of a substitution request shall be final and binding, and may not be reversed through an appeal under any provision of the Contract Documents. Contractor may challenge the scope of reimbursement costs imposed under Paragraph 7.05.D, by timely submittal of a Change Proposal.

7.06 *Concerning Subcontractors, Suppliers, and Others*

A. Contractor may retain Subcontractors and Suppliers for the performance of parts of the Work. Such Subcontractors and Suppliers must be acceptable to Owner.

B. Contractor shall retain specific Subcontractors, Suppliers, or other individuals or entities for the performance of designated parts of the Work if required by the Contract to do so.

C. Subsequent to the submittal of Contractor's Bid or final negotiation of the terms of the Contract, Owner may not require Contractor to retain any Subcontractor, Supplier, or other individual or entity to furnish or perform any of the Work against which Contractor has reasonable objection.

D. Prior to entry into any binding subcontract or purchase order, Contractor shall submit to Owner the identity of the proposed Subcontractor or Supplier (unless Owner has already deemed such proposed Subcontractor or Supplier acceptable, during the bidding process or otherwise). Such proposed Subcontractor or Supplier shall be deemed acceptable to Owner unless Owner raises a substantive, reasonable objection within five days.

E. Owner may require the replacement of any Subcontractor, Supplier, or other individual or entity retained by Contractor to perform any part of the Work. Owner also may require Contractor to retain specific replacements; provided, however, that Owner may not require a replacement to which Contractor has a reasonable objection. If Contractor has submitted the identity of certain Subcontractors, Suppliers, or other individuals or entities for acceptance by Owner, and Owner has accepted it (either in writing or by failing to make written objection thereto), then Owner may subsequently revoke the acceptance of any such Subcontractor, Supplier, or other individual or entity so identified solely on the basis of substantive, reasonable objection after due investigation. Contractor shall submit an acceptable replacement for the rejected Subcontractor, Supplier, or other individual or entity.

F. If Owner requires the replacement of any Subcontractor, Supplier, or other individual or entity retained by Contractor to perform any part of the Work, then Contractor shall be entitled to an adjustment in Contract Price or Contract Times, or both, with respect to the replacement; and Contractor shall initiate a Change Proposal for such adjustment within 30 days of Owner's requirement of replacement.

G. No acceptance by Owner of any such Subcontractor, Supplier, or other individual or entity, whether initially or as a replacement, shall constitute a waiver of the right of Owner to the completion of the Work in accordance with the Contract Documents.

H. On a monthly basis Contractor shall submit to Engineer a complete list of all Subcontractors and Suppliers having a direct contract with Contractor, and of all other Subcontractors and Suppliers known to Contractor at the time of submittal.

I. Contractor shall be fully responsible to Owner and Engineer for all acts and omissions of the Subcontractors, Suppliers, and other individuals or entities performing or furnishing any of the Work just as Contractor is responsible for Contractor's own acts and omissions.

J. Contractor shall be solely responsible for scheduling and coordinating the work of Subcontractors, Suppliers, and all other individuals or entities performing or furnishing any of the Work.

K. Contractor shall restrict all Subcontractors, Suppliers, and such other individuals or entities performing or furnishing any of the Work from communicating with Engineer or Owner, except through Contractor or in case of an emergency, or as otherwise expressly allowed herein.

L. The divisions and sections of the Specifications and the identifications of any Drawings shall not control Contractor in dividing the Work among Subcontractors or Suppliers or delineating the Work to be performed by any specific trade.

M. All Work performed for Contractor by a Subcontractor or Supplier shall be pursuant to an appropriate contractual agreement that specifically binds the Subcontractor or Supplier to the applicable terms and conditions of the Contract Documents for the benefit of Owner and Engineer.

N. Owner may furnish to any Subcontractor or Supplier, to the extent practicable, information about amounts paid to Contractor on account of Work performed for Contractor by the particular Subcontractor or Supplier.

O. Nothing in the Contract Documents:

1. shall create for the benefit of any such Subcontractor, Supplier, or other individual or entity any contractual relationship between Owner or Engineer and any such Subcontractor, Supplier, or other individual or entity; nor

2. shall create any obligation on the part of Owner or Engineer to pay or to see to the payment of any money due any such Subcontractor, Supplier, or other individual or entity except as may otherwise be required by Laws and Regulations.

7.07 *Patent Fees and Royalties*

A. Contractor shall pay all license fees and royalties and assume all costs incident to the use in the performance of the Work or the incorporation in the Work of any invention, design, process, product, or device which is the subject of patent rights or copyrights held by others. If a particular invention, design, process, product, or device is specified in the Contract Documents for use in the performance of the Work and if, to the actual knowledge of Owner or Engineer, its use is subject to patent rights or copyrights calling for the payment of any license fee or royalty to others, the existence of such rights shall be disclosed by Owner in the Contract Documents.

B. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, and its officers, directors, members, partners, employees, agents, consultants, and subcontractors from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals, and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device specified in the Contract Documents, but not identified as being subject to payment of any license fee or royalty to others required by patent rights or copyrights.

C. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device not specified in the Contract Documents.

7.08 *Permits*

A. Unless otherwise provided in the Contract Documents, Contractor shall obtain and pay for all construction permits and licenses. Owner shall assist Contractor, when necessary, in obtaining such permits and licenses. Contractor shall pay all governmental charges and inspection fees necessary for the prosecution of the Work which are applicable at the time of the submission of Contractor's Bid (or when Contractor became bound under a negotiated contract). Owner shall pay all charges of utility owners for connections for providing permanent service to the Work

7.09 *Taxes*

A. Contractor shall pay all sales, consumer, use, and other similar taxes required to be paid by Contractor in accordance with the Laws and Regulations of the place of the Project which are applicable during the performance of the Work.

7.10 *Laws and Regulations*

A. Contractor shall give all notices required by and shall comply with all Laws and Regulations applicable to the performance of the Work. Except where otherwise expressly required by applicable Laws and Regulations, neither Owner nor Engineer shall be responsible for monitoring Contractor's compliance with any Laws or Regulations.

B. If Contractor performs any Work or takes any other action knowing or having reason to know that it is contrary to Laws or Regulations, Contractor shall bear all resulting costs and losses, and shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such Work or other action. It shall not be Contractor's responsibility to make certain that the Work described in the Contract Documents is in accordance with Laws and Regulations, but this shall not relieve Contractor of Contractor's obligations under Paragraph 3.03.

C. Owner or Contractor may give notice to the other party of any changes after the submission of Contractor's Bid (or after the date when Contractor became bound under a negotiated contract) in Laws or Regulations having an effect on the cost or time of performance of the Work, including but not limited to changes in Laws or Regulations having an effect on procuring permits and on sales, use, value-added, consumption, and other similar taxes. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in Contract Price or Contract Times resulting from such changes, then within 30 days of such notice Contractor may submit a Change Proposal, or Owner may initiate a Claim.

7.11 *Record Documents*

A. Contractor shall maintain in a safe place at the Site one printed record copy of all Drawings, Specifications, Addenda, Change Orders, Work Change Directives, Field Orders, written interpretations and clarifications, and approved Shop Drawings. Contractor shall keep such record documents in good order and annotate them to show changes made during construction. These record documents, together with all approved Samples, will be available to Engineer for reference. Upon completion of the Work, Contractor shall deliver these record documents to Engineer.

7.12 *Safety and Protection*

A. Contractor shall be solely responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the Work. Such responsibility does not relieve Subcontractors of their responsibility for the safety of persons or property in the performance of their work, nor for compliance with applicable safety Laws and Regulations. Contractor shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury, or loss to:

1. all persons on the Site or who may be affected by the Work;

2. all the Work and materials and equipment to be incorporated therein, whether in storage on or off the Site; and

3. other property at the Site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures, other work in progress, utilities, and Underground Facilities not designated for removal, relocation, or replacement in the course of construction.

B. Contractor shall comply with all applicable Laws and Regulations relating to the safety of persons or property, or to the protection of persons or property from damage, injury, or loss; and shall erect and maintain all necessary safeguards for such safety and protection. Contractor shall notify Owner; the owners of adjacent property, Underground Facilities, and other utilities; and other contractors and utility owners performing work at or adjacent to the Site, when prosecution of the Work may affect them, and shall cooperate with them in the protection, removal, relocation, and replacement of their property or work in progress.

C. Contractor shall comply with the applicable requirements of Owner's safety programs, if any. The Supplementary Conditions identify any Owner's safety programs that are applicable to the Work.

D. Contractor shall inform Owner and Engineer of the specific requirements of Contractor's safety program with which Owner's and Engineer's employees and representatives must comply while at the Site.

E. All damage, injury, or loss to any property referred to in Paragraph 7.12.A.2 or 7.12.A.3 caused, directly or indirectly, in whole or in part, by Contractor, any Subcontractor, Supplier, or any other individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, shall be remedied by Contractor at its expense (except damage or loss attributable to the fault of Drawings or Specifications or to the acts or omissions of Owner or Engineer or anyone employed by any of them, or anyone for whose acts any of them may be liable, and not attributable, directly or indirectly, in whole or in part, to the fault or negligence of Contractor or any Subcontractor, Supplier, or other individual or entity directly or indirectly employed by any of them).

F. Contractor's duties and responsibilities for safety and protection shall continue until such time as all the Work is completed and Engineer has issued a notice to Owner and Contractor in accordance with Paragraph 15.06.B that the Work is acceptable (except as otherwise expressly provided in connection with Substantial Completion).

G. Contractor's duties and responsibilities for safety and protection shall resume whenever Contractor or any Subcontractor or Supplier returns to the Site to fulfill warranty or correction obligations, or to conduct other tasks arising from the Contract Documents.

7.13 *Safety Representative*

A. Contractor shall designate a qualified and experienced safety representative at the Site whose duties and responsibilities shall be the prevention of accidents and the maintaining and supervising of safety precautions and programs.

7.14 *Hazard Communication Programs*

A. Contractor shall be responsible for coordinating any exchange of material safety data sheets or other hazard communication information required to be made available to or

exchanged between or among employers at the Site in accordance with Laws or Regulations.

7.15 *Emergencies*

A. In emergencies affecting the safety or protection of persons or the Work or property at the Site or adjacent thereto, Contractor is obligated to act to prevent threatened damage, injury, or loss. Contractor shall give Engineer prompt written notice if Contractor believes that any significant changes in the Work or variations from the Contract Documents have been caused thereby or are required as a result thereof. If Engineer determines that a change in the Contract Documents is required because of the action taken by Contractor in response to such an emergency, a Work Change Directive or Change Order will be issued.

7.16 *Shop Drawings, Samples, and Other Submittals*

A. *Shop Drawing and Sample Submittal Requirements*:

1. Before submitting a Shop Drawing or Sample, Contractor shall have:

a. reviewed and coordinated the Shop Drawing or Sample with other Shop Drawings and Samples and with the requirements of the Work and the Contract Documents;

b. determined and verified all field measurements, quantities, dimensions, specified performance and design criteria, installation requirements, materials, catalog numbers, and similar information with respect thereto;

c. determined and verified the suitability of all materials and equipment offered with respect to the indicated application, fabrication, shipping, handling, storage, assembly, and installation pertaining to the performance of the Work; and

d. determined and verified all information relative to Contractor's responsibilities for means, methods, techniques, sequences, and procedures of construction, and safety precautions and programs incident thereto.

2. Each submittal shall bear a stamp or specific written certification that Contractor has satisfied Contractor's obligations under the Contract Documents with respect to Contractor's review of that submittal, and that Contractor approves the submittal.

3. With each submittal, Contractor shall give Engineer specific written notice of any variations that the Shop Drawing or Sample may have from the requirements of the Contract Documents. This notice shall be set forth in a written communication separate from the Shop Drawings or Sample submittal; and, in addition, in the case of Shop Drawings by a specific notation made on each Shop Drawing submitted to Engineer for review and approval of each such variation.

B. *Submittal Procedures for Shop Drawings and Samples*: Contractor shall submit Shop Drawings and Samples to Engineer for review and approval in accordance with the accepted Schedule of Submittals. Each submittal will be identified as Engineer may require.

1. *Shop Drawings*:

a. Contractor shall submit the number of copies required in the Specifications.

b. Data shown on the Shop Drawings will be complete with respect to quantities, dimensions, specified performance and design criteria, materials, and similar data to show Engineer the services, materials, and equipment Contractor proposes to

provide and to enable Engineer to review the information for the limited purposes required by Paragraph 7.16.D.

2. *Samples*:

   a. Contractor shall submit the number of Samples required in the Specifications.

   b. Contractor shall clearly identify each Sample as to material, Supplier, pertinent data such as catalog numbers, the use for which intended and other data as Engineer may require to enable Engineer to review the submittal for the limited purposes required by Paragraph 7.16.D.

3. Where a Shop Drawing or Sample is required by the Contract Documents or the Schedule of Submittals, any related Work performed prior to Engineer's review and approval of the pertinent submittal will be at the sole expense and responsibility of Contractor.

C. *Other Submittals*: Contractor shall submit other submittals to Engineer in accordance with the accepted Schedule of Submittals, and pursuant to the applicable terms of the Specifications.

D. *Engineer's Review*:

1. Engineer will provide timely review of Shop Drawings and Samples in accordance with the Schedule of Submittals acceptable to Engineer. Engineer's review and approval will be only to determine if the items covered by the submittals will, after installation or incorporation in the Work, conform to the information given in the Contract Documents and be compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents.

2. Engineer's review and approval will not extend to means, methods, techniques, sequences, or procedures of construction or to safety precautions or programs incident thereto.

3. Engineer's review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.

4. Engineer's review and approval of a Shop Drawing or Sample shall not relieve Contractor from responsibility for any variation from the requirements of the Contract Documents unless Contractor has complied with the requirements of Paragraph 7.16.A.3 and Engineer has given written approval of each such variation by specific written notation thereof incorporated in or accompanying the Shop Drawing or Sample. Engineer will document any such approved variation from the requirements of the Contract Documents in a Field Order.

5. Engineer's review and approval of a Shop Drawing or Sample shall not relieve Contractor from responsibility for complying with the requirements of Paragraph 7.16.A and B.

6. Engineer's review and approval of a Shop Drawing or Sample, or of a variation from the requirements of the Contract Documents, shall not, under any circumstances, change the Contract Times or Contract Price, unless such changes are included in a Change Order.

7. Neither Engineer's receipt, review, acceptance or approval of a Shop Drawing, Sample, or other submittal shall result in such item becoming a Contract Document.

8. Contractor shall perform the Work in compliance with the requirements and commitments set forth in approved Shop Drawings and Samples, subject to the provisions of Paragraph 7.16.D.4.

E. *Resubmittal Procedures*:

1. Contractor shall make corrections required by Engineer and shall return the required number of corrected copies of Shop Drawings and submit, as required, new Samples for review and approval. Contractor shall direct specific attention in writing to revisions other than the corrections called for by Engineer on previous submittals.

2. Contractor shall furnish required submittals with sufficient information and accuracy to obtain required approval of an item with no more than three submittals. Engineer will record Engineer's time for reviewing a fourth or subsequent submittal of a Shop Drawings, sample, or other item requiring approval, and Contractor shall be responsible for Engineer's charges to Owner for such time. Owner may impose a set-off against payments due to Contractor to secure reimbursement for such charges.

3. If Contractor requests a change of a previously approved submittal item, Contractor shall be responsible for Engineer's charges to Owner for its review time, and Owner may impose a set-off against payments due to Contractor to secure reimbursement for such charges, unless the need for such change is beyond the control of Contractor.

7.17 *Contractor's General Warranty and Guarantee*

A. Contractor warrants and guarantees to Owner that all Work will be in accordance with the Contract Documents and will not be defective. Engineer and its officers, directors, members, partners, employees, agents, consultants, and subcontractors shall be entitled to rely on Contractor's warranty and guarantee.

B. Contractor's warranty and guarantee hereunder excludes defects or damage caused by:

1. abuse, modification, or improper maintenance or operation by persons other than Contractor, Subcontractors, Suppliers, or any other individual or entity for whom Contractor is responsible; or

2. normal wear and tear under normal usage.

C. Contractor's obligation to perform and complete the Work in accordance with the Contract Documents shall be absolute. None of the following will constitute an acceptance of Work that is not in accordance with the Contract Documents or a release of Contractor's obligation to perform the Work in accordance with the Contract Documents:

1. observations by Engineer;

2. recommendation by Engineer or payment by Owner of any progress or final payment;

3. the issuance of a certificate of Substantial Completion by Engineer or any payment related thereto by Owner;

4. use or occupancy of the Work or any part thereof by Owner;

5. any review and approval of a Shop Drawing or Sample submittal;

6. the issuance of a notice of acceptability by Engineer;

7. any inspection, test, or approval by others; or

8. any correction of defective Work by Owner.

D. If the Contract requires the Contractor to accept the assignment of a contract entered into by Owner, then the specific warranties, guarantees, and correction obligations contained in the assigned contract shall govern with respect to Contractor's performance obligations to Owner for the Work described in the assigned contract.

7.18 *Indemnification*

A. To the fullest extent permitted by Laws and Regulations, and in addition to any other obligations of Contractor under the Contract or otherwise, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to the performance of the Work, provided that any such claim, cost, loss, or damage is attributable to bodily injury, sickness, disease, or death, or to injury to or destruction of tangible property (other than the Work itself), including the loss of use resulting therefrom but only to the extent caused by any negligent act or omission of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work or anyone for whose acts any of them may be liable.

B. In any and all claims against Owner or Engineer or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors by any employee (or the survivor or personal representative of such employee) of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, the indemnification obligation under Paragraph 7.18.A shall not be limited in any way by any limitation on the amount or type of damages, compensation, or benefits payable by or for Contractor or any such Subcontractor, Supplier, or other individual or entity under workers' compensation acts, disability benefit acts, or other employee benefit acts.

C. The indemnification obligations of Contractor under Paragraph 7.18.A shall not extend to the liability of Engineer and Engineer's officers, directors, members, partners, employees, agents, consultants and subcontractors arising out of:

1. the preparation or approval of, or the failure to prepare or approve maps, Drawings, opinions, reports, surveys, Change Orders, designs, or Specifications; or

2. giving directions or instructions, or failing to give them, if that is the primary cause of the injury or damage.

7.19 *Delegation of Professional Design Services*

A. Contractor will not be required to provide professional design services unless such services are specifically required by the Contract Documents for a portion of the Work or unless such services are required to carry out Contractor's responsibilities for construction means, methods, techniques, sequences and procedures. Contractor shall not be required to provide professional services in violation of applicable Laws and Regulations.

B. If professional design services or certifications by a design professional related to systems, materials, or equipment are specifically required of Contractor by the Contract Documents, Owner and Engineer will specify all performance and design criteria that such services must satisfy. Contractor shall cause such services or certifications to be provided by a properly licensed professional, whose signature and seal shall appear on all drawings, calculations, specifications, certifications, and other submittals prepared by such professional. Shop

Drawings and other submittals related to the Work designed or certified by such professional, if prepared by others, shall bear such professional's written approval when submitted to Engineer.

C. Owner and Engineer shall be entitled to rely upon the adequacy, accuracy, and completeness of the services, certifications, or approvals performed by such design professionals, provided Owner and Engineer have specified to Contractor all performance and design criteria that such services must satisfy.

D. Pursuant to this paragraph, Engineer's review and approval of design calculations and design drawings will be only for the limited purpose of checking for conformance with performance and design criteria given and the design concept expressed in the Contract Documents. Engineer's review and approval of Shop Drawings and other submittals (except design calculations and design drawings) will be only for the purpose stated in Paragraph 7.16.D.1.

E. Contractor shall not be responsible for the adequacy of the performance or design criteria specified by Owner or Engineer.

ARTICLE 8 – OTHER WORK AT THE SITE

8.01 *Other Work*

A. In addition to and apart from the Work under the Contract Documents, the Owner may perform other work at or adjacent to the Site. Such other work may be performed by Owner's employees, or through contracts between the Owner and third parties. Owner may also arrange to have third-party utility owners perform work on their utilities and facilities at or adjacent to the Site.

B. If Owner performs other work at or adjacent to the Site with Owner's employees, or through contracts for such other work, then Owner shall give Contractor written notice thereof prior to starting any such other work. If Owner has advance information regarding the start of any utility work at or adjacent to the Site, Owner shall provide such information to Contractor.

C. Contractor shall afford each other contractor that performs such other work, each utility owner performing other work, and Owner, if Owner is performing other work with Owner's employees, proper and safe access to the Site, and provide a reasonable opportunity for the introduction and storage of materials and equipment and the execution of such other work. Contractor shall do all cutting, fitting, and patching of the Work that may be required to properly connect or otherwise make its several parts come together and properly integrate with such other work. Contractor shall not endanger any work of others by cutting, excavating, or otherwise altering such work; provided, however, that Contractor may cut or alter others' work with the written consent of Engineer and the others whose work will be affected.

D. If the proper execution or results of any part of Contractor's Work depends upon work performed by others under this Article 8, Contractor shall inspect such other work and promptly report to Engineer in writing any delays, defects, or deficiencies in such other work that render it unavailable or unsuitable for the proper execution and results of Contractor's Work. Contractor's failure to so report will constitute an acceptance of such other work as fit and proper for integration with Contractor's Work except for latent defects and deficiencies in such other work.

8.02 *Coordination*

A. If Owner intends to contract with others for the performance of other work at or adjacent to the Site, to perform other work at or adjacent to the Site with Owner's employees, or to arrange to have utility owners perform work at or adjacent to the Site, the following will be set forth in the Supplementary Conditions or provided to Contractor prior to the start of any such other work:

1. the identity of the individual or entity that will have authority and responsibility for coordination of the activities among the various contractors;

2. an itemization of the specific matters to be covered by such authority and responsibility; and

3. the extent of such authority and responsibilities.

B. Unless otherwise provided in the Supplementary Conditions, Owner shall have sole authority and responsibility for such coordination.

8.03 *Legal Relationships*

A. If, in the course of performing other work at or adjacent to the Site for Owner, the Owner's employees, any other contractor working for Owner, or any utility owner causes damage to the Work or to the property of Contractor or its Subcontractors, or delays, disrupts, interferes with, or increases the scope or cost of the performance of the Work, through actions or inaction, then Contractor shall be entitled to an equitable adjustment in the Contract Price or the Contract Times, or both. Contractor must submit any Change Proposal seeking an equitable adjustment in the Contract Price or the Contract Times under this paragraph within 30 days of the damaging, delaying, disrupting, or interfering event. The entitlement to, and extent of, any such equitable adjustment shall take into account information (if any) regarding such other work that was provided to Contractor in the Contract Documents prior to the submittal of the Bid or the final negotiation of the terms of the Contract. When applicable, any such equitable adjustment in Contract Price shall be conditioned on Contractor assigning to Owner all Contractor's rights against such other contractor or utility owner with respect to the damage, delay, disruption, or interference that is the subject of the adjustment. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times.

B. Contractor shall take reasonable and customary measures to avoid damaging, delaying, disrupting, or interfering with the work of Owner, any other contractor, or any utility owner performing other work at or adjacent to the Site. If Contractor fails to take such measures and as a result damages, delays, disrupts, or interferes with the work of any such other contractor or utility owner, then Owner may impose a set-off against payments due to Contractor, and assign to such other contractor or utility owner the Owner's contractual rights against Contractor with respect to the breach of the obligations set forth in this paragraph.

C. When Owner is performing other work at or adjacent to the Site with Owner's employees, Contractor shall be liable to Owner for damage to such other work, and for the reasonable direct delay, disruption, and interference costs incurred by Owner as a result of Contractor's failure to take reasonable and customary measures with respect to Owner's other work. In response to such damage, delay, disruption, or interference, Owner may impose a set-off against payments due to Contractor.

D. If Contractor damages, delays, disrupts, or interferes with the work of any other contractor, or any utility owner performing other work at or adjacent to the Site, through Contractor's failure to take reasonable and customary measures to avoid such impacts, or if any claim arising out of Contractor's actions, inactions, or negligence in performance of the Work at or adjacent to the Site is made by any such other contractor or utility owner against Contractor, Owner, or Engineer, then Contractor shall (1) promptly attempt to settle the claim as to all parties through negotiations with such other contractor or utility owner, or otherwise resolve the claim by arbitration or other dispute resolution proceeding or at law, and (2) indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against any such claims, and against all costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such damage, delay, disruption, or interference.

ARTICLE 9 – OWNER'S RESPONSIBILITIES

9.01 *Communications to Contractor*

A. Except as otherwise provided in these General Conditions, Owner shall issue all communications to Contractor through Engineer.

9.02 *Replacement of Engineer*

A. Owner may at its discretion appoint an engineer to replace Engineer, provided Contractor makes no reasonable objection to the replacement engineer. The replacement engineer's status under the Contract Documents shall be that of the former Engineer.

9.03 *Furnish Data*

A. Owner shall promptly furnish the data required of Owner under the Contract Documents.

9.04 *Pay When Due*

A. Owner shall make payments to Contractor when they are due as provided in the Agreement.

9.05 *Lands and Easements; Reports, Tests, and Drawings*

A. Owner's duties with respect to providing lands and easements are set forth in Paragraph 5.01.

B. Owner's duties with respect to providing engineering surveys to establish reference points are set forth in Paragraph 4.03.

C. Article 5 refers to Owner's identifying and making available to Contractor copies of reports of explorations and tests of conditions at the Site, and drawings of physical conditions relating to existing surface or subsurface structures at the Site.

9.06 *Insurance*

A. Owner's responsibilities, if any, with respect to purchasing and maintaining liability and property insurance are set forth in Article 6.

9.07 *Change Orders*

A. Owner's responsibilities with respect to Change Orders are set forth in Article 11.

9.08 *Inspections, Tests, and Approvals*

A. Owner's responsibility with respect to certain inspections, tests, and approvals is set forth in Paragraph 14.02.B.

9.09 *Limitations on Owner's Responsibilities*

A. The Owner shall not supervise, direct, or have control or authority over, nor be responsible for, Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. Owner will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.

9.10 *Undisclosed Hazardous Environmental Condition*

A. Owner's responsibility in respect to an undisclosed Hazardous Environmental Condition is set forth in Paragraph 5.06.

9.11 *Evidence of Financial Arrangements*

A. Upon request of Contractor, Owner shall furnish Contractor reasonable evidence that financial arrangements have been made to satisfy Owner's obligations under the Contract Documents (including obligations under proposed changes in the Work).

9.12 *Safety Programs*

A. While at the Site, Owner's employees and representatives shall comply with the specific applicable requirements of Contractor's safety programs of which Owner has been informed.

B. Owner shall furnish copies of any applicable Owner safety programs to Contractor.

ARTICLE 10 – ENGINEER'S STATUS DURING CONSTRUCTION

10.01 *Owner's Representative*

A. Engineer will be Owner's representative during the construction period. The duties and responsibilities and the limitations of authority of Engineer as Owner's representative during construction are set forth in the Contract.

10.02 *Visits to Site*

A. Engineer will make visits to the Site at intervals appropriate to the various stages of construction as Engineer deems necessary in order to observe as an experienced and qualified design professional the progress that has been made and the quality of the various aspects of Contractor's executed Work. Based on information obtained during such visits and observations, Engineer, for the benefit of Owner, will determine, in general, if the Work is proceeding in accordance with the Contract Documents. Engineer will not be required to make exhaustive or continuous inspections on the Site to check the quality or quantity of the Work. Engineer's efforts will be directed toward providing for Owner a greater degree of confidence that the completed Work will conform generally to the Contract Documents. On the basis of such visits and observations, Engineer will keep Owner informed of the progress of the Work and will endeavor to guard Owner against defective Work.

B. Engineer's visits and observations are subject to all the limitations on Engineer's authority and responsibility set forth in Paragraph 10.08. Particularly, but without limitation, during

or as a result of Engineer's visits or observations of Contractor's Work, Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work.

10.03 *Project Representative*

A. If Owner and Engineer have agreed that Engineer will furnish a Resident Project Representative to represent Engineer at the Site and assist Engineer in observing the progress and quality of the Work, then the authority and responsibilities of any such Resident Project Representative will be as provided in the Supplementary Conditions, and limitations on the responsibilities thereof will be as provided in Paragraph 10.08. If Owner designates another representative or agent to represent Owner at the Site who is not Engineer's consultant, agent, or employee, the responsibilities and authority and limitations thereon of such other individual or entity will be as provided in the Supplementary Conditions.

10.04 *Rejecting Defective Work*

A. Engineer has the authority to reject Work in accordance with Article 14.

10.05 *Shop Drawings, Change Orders and Payments*

A. Engineer's authority, and limitations thereof, as to Shop Drawings and Samples, are set forth in Paragraph 7.16.

B. Engineer's authority, and limitations thereof, as to design calculations and design drawings submitted in response to a delegation of professional design services, if any, are set forth in Paragraph 7.19.

C. Engineer's authority as to Change Orders is set forth in Article 11.

D. Engineer's authority as to Applications for Payment is set forth in Article 15.

10.06 *Determinations for Unit Price Work*

A. Engineer will determine the actual quantities and classifications of Unit Price Work performed by Contractor as set forth in Paragraph 13.03.

10.07 *Decisions on Requirements of Contract Documents and Acceptability of Work*

A. Engineer will render decisions regarding the requirements of the Contract Documents, and judge the acceptability of the Work, pursuant to the specific procedures set forth herein for initial interpretations, Change Proposals, and acceptance of the Work. In rendering such decisions and judgments, Engineer will not show partiality to Owner or Contractor, and will not be liable to Owner, Contractor, or others in connection with any proceedings, interpretations, decisions, or judgments conducted or rendered in good faith.

10.08 *Limitations on Engineer's Authority and Responsibilities*

A. Neither Engineer's authority or responsibility under this Article 10 or under any other provision of the Contract, nor any decision made by Engineer in good faith either to exercise or not exercise such authority or responsibility or the undertaking, exercise, or performance of any authority or responsibility by Engineer, shall create, impose, or give rise to any duty in contract, tort, or otherwise owed by Engineer to Contractor, any Subcontractor, any Supplier, any other individual or entity, or to any surety for or employee or agent of any of them.

B. Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. Engineer will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.

C. Engineer will not be responsible for the acts or omissions of Contractor or of any Subcontractor, any Supplier, or of any other individual or entity performing any of the Work.

D. Engineer's review of the final Application for Payment and accompanying documentation and all maintenance and operating instructions, schedules, guarantees, bonds, certificates of inspection, tests and approvals, and other documentation required to be delivered by Paragraph 15.06.A will only be to determine generally that their content complies with the requirements of, and in the case of certificates of inspections, tests, and approvals, that the results certified indicate compliance with the Contract Documents.

E. The limitations upon authority and responsibility set forth in this Paragraph 10.08 shall also apply to the Resident Project Representative, if any.

10.09 *Compliance with Safety Program*

A. While at the Site, Engineer's employees and representatives will comply with the specific applicable requirements of Owner's and Contractor's safety programs (if any) of which Engineer has been informed.

ARTICLE 11 – AMENDING THE CONTRACT DOCUMENTS; CHANGES IN THE WORK

11.01 *Amending and Supplementing Contract Documents*

A. The Contract Documents may be amended or supplemented by a Change Order, a Work Change Directive, or a Field Order.

1. *Change Orders*:

a. If an amendment or supplement to the Contract Documents includes a change in the Contract Price or the Contract Times, such amendment or supplement must be set forth in a Change Order. A Change Order also may be used to establish amendments and supplements of the Contract Documents that do not affect the Contract Price or Contract Times.

b. Owner and Contractor may amend those terms and conditions of the Contract Documents that do not involve (1) the performance or acceptability of the Work, (2) the design (as set forth in the Drawings, Specifications, or otherwise), or (3) other engineering or technical matters, without the recommendation of the Engineer. Such an amendment shall be set forth in a Change Order.

2. *Work Change Directives*: A Work Change Directive will not change the Contract Price or the Contract Times but is evidence that the parties expect that the modification ordered or documented by a Work Change Directive will be incorporated in a subsequently issued Change Order, following negotiations by the parties as to the Work Change Directive's effect, if any, on the Contract Price and Contract Times; or, if negotiations are unsuccessful, by a determination under the terms of the Contract Documents governing adjustments, expressly including Paragraph 11.04 regarding change of Contract Price. Contractor must submit any Change Proposal seeking an

adjustment of the Contract Price or the Contract Times, or both, no later than 30 days after the completion of the Work set out in the Work Change Directive. Owner must submit any Claim seeking an adjustment of the Contract Price or the Contract Times, or both, no later than 60 days after issuance of the Work Change Directive.

3. *Field Orders*: Engineer may authorize minor changes in the Work if the changes do not involve an adjustment in the Contract Price or the Contract Times and are compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. Such changes will be accomplished by a Field Order and will be binding on Owner and also on Contractor, which shall perform the Work involved promptly. If Contractor believes that a Field Order justifies an adjustment in the Contract Price or Contract Times, or both, then before proceeding with the Work at issue, Contractor shall submit a Change Proposal as provided herein.

11.02 *Owner-Authorized Changes in the Work*

A. Without invalidating the Contract and without notice to any surety, Owner may, at any time or from time to time, order additions, deletions, or revisions in the Work. Such changes shall be supported by Engineer's recommendation, to the extent the change involves the design (as set forth in the Drawings, Specifications, or otherwise), or other engineering or technical matters. Such changes may be accomplished by a Change Order, if Owner and Contractor have agreed as to the effect, if any, of the changes on Contract Times or Contract Price; or by a Work Change Directive. Upon receipt of any such document, Contractor shall promptly proceed with the Work involved; or, in the case of a deletion in the Work, promptly cease construction activities with respect to such deleted Work. Added or revised Work shall be performed under the applicable conditions of the Contract Documents. Nothing in this paragraph shall obligate Contractor to undertake work that Contractor reasonably concludes cannot be performed in a manner consistent with Contractor's safety obligations under the Contract Documents or Laws and Regulations.

11.03 *Unauthorized Changes in the Work*

A. Contractor shall not be entitled to an increase in the Contract Price or an extension of the Contract Times with respect to any work performed that is not required by the Contract Documents, as amended, modified, or supplemented, except in the case of an emergency as provided in Paragraph 7.15 or in the case of uncovering Work as provided in Paragraph 14.05.

11.04 *Change of Contract Price*

A. The Contract Price may only be changed by a Change Order. Any Change Proposal for an adjustment in the Contract Price shall comply with the provisions of Paragraph 11.06. Any Claim for an adjustment of Contract Price shall comply with the provisions of Article 12.

B. An adjustment in the Contract Price will be determined as follows:

1. where the Work involved is covered by unit prices contained in the Contract Documents, then by application of such unit prices to the quantities of the items involved (subject to the provisions of Paragraph 13.03); or

2. where the Work involved is not covered by unit prices contained in the Contract Documents, then by a mutually agreed lump sum (which may include an allowance for overhead and profit not necessarily in accordance with Paragraph 11.04.C.2); or

3. where the Work involved is not covered by unit prices contained in the Contract Documents and the parties do not reach mutual agreement to a lump sum, then on

the basis of the Cost of the Work (determined as provided in Paragraph 13.01) plus a Contractor's fee for overhead and profit (determined as provided in Paragraph 11.04.C).

C. *Contractor's Fee*: When applicable, the Contractor's fee for overhead and profit shall be determined as follows:

1. a mutually acceptable fixed fee; or

2. if a fixed fee is not agreed upon, then a fee based on the following percentages of the various portions of the Cost of the Work:

a. for costs incurred under Paragraphs 13.01.B.1 and 13.01.B.2, the Contractor's fee shall be 15 percent;

b. for costs incurred under Paragraph 13.01.B.3, the Contractor's fee shall be five percent;

c. where one or more tiers of subcontracts are on the basis of Cost of the Work plus a fee and no fixed fee is agreed upon, the intent of Paragraphs 11.01.C.2.a and 11.01.C.2.b is that the Contractor's fee shall be based on: (1) a fee of 15 percent of the costs incurred under Paragraphs 13.01.A.1 and 13.01.A.2 by the Subcontractor that actually performs the Work, at whatever tier, and (2) with respect to Contractor itself and to any Subcontractors of a tier higher than that of the Subcontractor that actually performs the Work, a fee of five percent of the amount (fee plus underlying costs incurred) attributable to the next lower tier Subcontractor; provided, however, that for any such subcontracted work the maximum total fee to be paid by Owner shall be no greater than 27 percent of the costs incurred by the Subcontractor that actually performs the work;

d. no fee shall be payable on the basis of costs itemized under Paragraphs 13.01.B.4, 13.01.B.5, and 13.01.C;

e. the amount of credit to be allowed by Contractor to Owner for any change which results in a net decrease in cost will be the amount of the actual net decrease in cost plus a deduction in Contractor's fee by an amount equal to five percent of such net decrease; and

f. when both additions and credits are involved in any one change, the adjustment in Contractor's fee shall be computed on the basis of the net change in accordance with Paragraphs 11.04.C.2.a through 11.04.C.2.e, inclusive.

11.05 *Change of Contract Times*

A. The Contract Times may only be changed by a Change Order. Any Change Proposal for an adjustment in the Contract Times shall comply with the provisions of Paragraph 11.06. Any Claim for an adjustment in the Contract Times shall comply with the provisions of Article 12.

B. An adjustment of the Contract Times shall be subject to the limitations set forth in Paragraph 4.05, concerning delays in Contractor's progress.

11.06 *Change Proposals*

A. Contractor shall submit a Change Proposal to Engineer to request an adjustment in the Contract Times or Contract Price; appeal an initial decision by Engineer concerning the requirements of the Contract Documents or relating to the acceptability of the Work under the Contract Documents; contest a set-off against payment due; or seek other relief under

the Contract. The Change Proposal shall specify any proposed change in Contract Times or Contract Price, or both, or other proposed relief, and explain the reason for the proposed change, with citations to any governing or applicable provisions of the Contract Documents.

1. *Procedures*: Contractor shall submit each Change Proposal to Engineer promptly (but in no event later than 30 days) after the start of the event giving rise thereto, or after such initial decision. The Contractor shall submit supporting data, including the proposed change in Contract Price or Contract Time (if any), to the Engineer and Owner within 15 days after the submittal of the Change Proposal. The supporting data shall be accompanied by a written statement that the supporting data are accurate and complete, and that any requested time or price adjustment is the entire adjustment to which Contractor believes it is entitled as a result of said event. Engineer will advise Owner regarding the Change Proposal, and consider any comments or response from Owner regarding the Change Proposal.

2. *Engineer's Action*: Engineer will review each Change Proposal and, within 30 days after receipt of the Contractor's supporting data, either deny the Change Proposal in whole, approve it in whole, or deny it in part and approve it in part. Such actions shall be in writing, with a copy provided to Owner and Contractor. If Engineer does not take action on the Change Proposal within 30 days, then either Owner or Contractor may at any time thereafter submit a letter to the other party indicating that as a result of Engineer's inaction the Change Proposal is deemed denied, thereby commencing the time for appeal of the denial under Article 12.

3. *Binding Decision*: Engineer's decision will be final and binding upon Owner and Contractor, unless Owner or Contractor appeals the decision by filing a Claim under Article 12.

B. *Resolution of Certain Change Proposals*: If the Change Proposal does not involve the design (as set forth in the Drawings, Specifications, or otherwise), the acceptability of the Work, or other engineering or technical matters, then Engineer will notify the parties that the Engineer is unable to resolve the Change Proposal. For purposes of further resolution of such a Change Proposal, such notice shall be deemed a denial, and Contractor may choose to seek resolution under the terms of Article 12.

11.07 *Execution of Change Orders*

A. Owner and Contractor shall execute appropriate Change Orders covering:

1. changes in the Contract Price or Contract Times which are agreed to by the parties, including any undisputed sum or amount of time for Work actually performed in accordance with a Work Change Directive;

2. changes in Contract Price resulting from an Owner set-off, unless Contractor has duly contested such set-off;

3. changes in the Work which are: (a) ordered by Owner pursuant to Paragraph 11.02, (b) required because of Owner's acceptance of defective Work under Paragraph 14.04 or Owner's correction of defective Work under Paragraph 14.07, or (c) agreed to by the parties, subject to the need for Engineer's recommendation if the change in the Work involves the design (as set forth in the Drawings, Specifications, or otherwise), or other engineering or technical matters; and

4. changes in the Contract Price or Contract Times, or other changes, which embody the substance of any final and binding results under Paragraph 11.06, or Article 12.

B. If Owner or Contractor refuses to execute a Change Order that is required to be executed under the terms of this Paragraph 11.07, it shall be deemed to be of full force and effect, as if fully executed.

11.08 *Notification to Surety*

A. If the provisions of any bond require notice to be given to a surety of any change affecting the general scope of the Work or the provisions of the Contract Documents (including, but not limited to, Contract Price or Contract Times), the giving of any such notice will be Contractor's responsibility. The amount of each applicable bond will be adjusted to reflect the effect of any such change.

ARTICLE 12 – CLAIMS

12.01 *Claims*

A. *Claims Process*: The following disputes between Owner and Contractor shall be submitted to the Claims process set forth in this Article:

1. Appeals by Owner or Contractor of Engineer's decisions regarding Change Proposals;

2. Owner demands for adjustments in the Contract Price or Contract Times, or other relief under the Contract Documents; and

3. Disputes that Engineer has been unable to address because they do not involve the design (as set forth in the Drawings, Specifications, or otherwise), the acceptability of the Work, or other engineering or technical matters.

B. *Submittal of Claim*: The party submitting a Claim shall deliver it directly to the other party to the Contract promptly (but in no event later than 30 days) after the start of the event giving rise thereto; in the case of appeals regarding Change Proposals within 30 days of the decision under appeal. The party submitting the Claim shall also furnish a copy to the Engineer, for its information only. The responsibility to substantiate a Claim shall rest with the party making the Claim. In the case of a Claim by Contractor seeking an increase in the Contract Times or Contract Price, or both, Contractor shall certify that the Claim is made in good faith, that the supporting data are accurate and complete, and that to the best of Contractor's knowledge and belief the amount of time or money requested accurately reflects the full amount to which Contractor is entitled.

C. *Review and Resolution*: The party receiving a Claim shall review it thoroughly, giving full consideration to its merits. The two parties shall seek to resolve the Claim through the exchange of information and direct negotiations. The parties may extend the time for resolving the Claim by mutual agreement. All actions taken on a Claim shall be stated in writing and submitted to the other party, with a copy to Engineer.

D. *Mediation*:

1. At any time after initiation of a Claim, Owner and Contractor may mutually agree to mediation of the underlying dispute. The agreement to mediate shall stay the Claim submittal and response process.

2. If Owner and Contractor agree to mediation, then after 60 days from such agreement, either Owner or Contractor may unilaterally terminate the mediation process, and the Claim submittal and decision process shall resume as of the date of the termination. If the mediation proceeds but is unsuccessful in resolving the dispute, the Claim

submittal and decision process shall resume as of the date of the conclusion of the mediation, as determined by the mediator.

3. Owner and Contractor shall each pay one-half of the mediator's fees and costs.

E. *Partial Approval*: If the party receiving a Claim approves the Claim in part and denies it in part, such action shall be final and binding unless within 30 days of such action the other party invokes the procedure set forth in Article 17 for final resolution of disputes.

F. *Denial of Claim*: If efforts to resolve a Claim are not successful, the party receiving the Claim may deny it by giving written notice of denial to the other party. If the receiving party does not take action on the Claim within 90 days, then either Owner or Contractor may at any time thereafter submit a letter to the other party indicating that as a result of the inaction, the Claim is deemed denied, thereby commencing the time for appeal of the denial. A denial of the Claim shall be final and binding unless within 30 days of the denial the other party invokes the procedure set forth in Article 17 for the final resolution of disputes.

G. *Final and Binding Results*: If the parties reach a mutual agreement regarding a Claim, whether through approval of the Claim, direct negotiations, mediation, or otherwise; or if a Claim is approved in part and denied in part, or denied in full, and such actions become final and binding; then the results of the agreement or action on the Claim shall be incorporated in a Change Order to the extent they affect the Contract, including the Work, the Contract Times, or the Contract Price.

ARTICLE 13 – COST OF THE WORK; ALLOWANCES; UNIT PRICE WORK

13.01 *Cost of the Work*

A. *Purposes for Determination of Cost of the Work*: The term Cost of the Work means the sum of all costs necessary for the proper performance of the Work at issue, as further defined below. The provisions of this Paragraph 13.01 are used for two distinct purposes:

1. To determine Cost of the Work when Cost of the Work is a component of the Contract Price, under cost-plus-fee, time-and-materials, or other cost-based terms; or

2. To determine the value of a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price. When the value of any such adjustment is determined on the basis of Cost of the Work, Contractor is entitled only to those additional or incremental costs required because of the change in the Work or because of the event giving rise to the adjustment.

B. *Costs Included*: Except as otherwise may be agreed to in writing by Owner, costs included in the Cost of the Work shall be in amounts no higher than those prevailing in the locality of the Project, shall not include any of the costs itemized in Paragraph 13.01.C, and shall include only the following items:

1. Payroll costs for employees in the direct employ of Contractor in the performance of the Work under schedules of job classifications agreed upon by Owner and Contractor. Such employees shall include, without limitation, superintendents, foremen, and other personnel employed full time on the Work. Payroll costs for employees not employed full time on the Work shall be apportioned on the basis of their time spent on the Work. Payroll costs shall include, but not be limited to, salaries and wages plus the cost of fringe benefits, which shall include social security contributions, unemployment, excise, and payroll taxes, workers' compensation, health and retirement benefits, bonuses, sick leave, and vacation and holiday pay applicable

thereto. The expenses of performing Work outside of regular working hours, on Saturday, Sunday, or legal holidays, shall be included in the above to the extent authorized by Owner.

2. Cost of all materials and equipment furnished and incorporated in the Work, including costs of transportation and storage thereof, and Suppliers' field services required in connection therewith. All cash discounts shall accrue to Contractor unless Owner deposits funds with Contractor with which to make payments, in which case the cash discounts shall accrue to Owner. All trade discounts, rebates, and refunds and returns from sale of surplus materials and equipment shall accrue to Owner, and Contractor shall make provisions so that they may be obtained.

3. Payments made by Contractor to Subcontractors for Work performed by Subcontractors. If required by Owner, Contractor shall obtain competitive bids from subcontractors acceptable to Owner and Contractor and shall deliver such bids to Owner, who will then determine, with the advice of Engineer, which bids, if any, will be acceptable. If any subcontract provides that the Subcontractor is to be paid on the basis of Cost of the Work plus a fee, the Subcontractor's Cost of the Work and fee shall be determined in the same manner as Contractor's Cost of the Work and fee as provided in this Paragraph 13.01.

4. Costs of special consultants (including but not limited to engineers, architects, testing laboratories, surveyors, attorneys, and accountants) employed for services specifically related to the Work.

5. Supplemental costs including the following:

    a. The proportion of necessary transportation, travel, and subsistence expenses of Contractor's employees incurred in discharge of duties connected with the Work.

    b. Cost, including transportation and maintenance, of all materials, supplies, equipment, machinery, appliances, office, and temporary facilities at the Site, and hand tools not owned by the workers, which are consumed in the performance of the Work, and cost, less market value, of such items used but not consumed which remain the property of Contractor.

    c. Rentals of all construction equipment and machinery, and the parts thereof, whether rented from Contractor or others in accordance with rental agreements approved by Owner with the advice of Engineer, and the costs of transportation, loading, unloading, assembly, dismantling, and removal thereof. All such costs shall be in accordance with the terms of said rental agreements. The rental of any such equipment, machinery, or parts shall cease when the use thereof is no longer necessary for the Work.

    d. Sales, consumer, use, and other similar taxes related to the Work, and for which Contractor is liable, as imposed by Laws and Regulations.

    e. Deposits lost for causes other than negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, and royalty payments and fees for permits and licenses.

    f. Losses and damages (and related expenses) caused by damage to the Work, not compensated by insurance or otherwise, sustained by Contractor in connection with the performance of the Work (except losses and damages within the deductible amounts of property insurance established in accordance with Paragraph 6.05), provided such losses and damages have resulted from causes

other than the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable. Such losses shall include settlements made with the written consent and approval of Owner. No such losses, damages, and expenses shall be included in the Cost of the Work for the purpose of determining Contractor's fee.

g. The cost of utilities, fuel, and sanitary facilities at the Site.

h. Minor expenses such as communication service at the Site, express and courier services, and similar petty cash items in connection with the Work.

i. The costs of premiums for all bonds and insurance that Contractor is required by the Contract Documents to purchase and maintain.

C. *Costs Excluded*: The term Cost of the Work shall not include any of the following items:

1. Payroll costs and other compensation of Contractor's officers, executives, principals (of partnerships and sole proprietorships), general managers, safety managers, engineers, architects, estimators, attorneys, auditors, accountants, purchasing and contracting agents, expediters, timekeepers, clerks, and other personnel employed by Contractor, whether at the Site or in Contractor's principal or branch office for general administration of the Work and not specifically included in the agreed upon schedule of job classifications referred to in Paragraph 13.01.B.1 or specifically covered by Paragraph 13.01.B.4. The payroll costs and other compensation excluded here are to be considered administrative costs covered by the Contractor's fee.

2. Expenses of Contractor's principal and branch offices other than Contractor's office at the Site.

3. Any part of Contractor's capital expenses, including interest on Contractor's capital employed for the Work and charges against Contractor for delinquent payments.

4. Costs due to the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, including but not limited to, the correction of defective Work, disposal of materials or equipment wrongly supplied, and making good any damage to property.

5. Other overhead or general expense costs of any kind and the costs of any item not specifically and expressly included in Paragraph 13.01.B.

D. *Contractor's Fee*: When the Work as a whole is performed on the basis of cost-plus, Contractor's fee shall be determined as set forth in the Agreement. When the value of any Work covered by a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price is determined on the basis of Cost of the Work, Contractor's fee shall be determined as set forth in Paragraph 11.04.C.

E. *Documentation*: Whenever the Cost of the Work for any purpose is to be determined pursuant to this Article 13, Contractor will establish and maintain records thereof in accordance with generally accepted accounting practices and submit in a form acceptable to Engineer an itemized cost breakdown together with supporting data.

13.02 *Allowances*

A. It is understood that Contractor has included in the Contract Price all allowances so named in the Contract Documents and shall cause the Work so covered to be performed for such sums and by such persons or entities as may be acceptable to Owner and Engineer.

B. *Cash Allowances*: Contractor agrees that:

1. the cash allowances include the cost to Contractor (less any applicable trade discounts) of materials and equipment required by the allowances to be delivered at the Site, and all applicable taxes; and

2. Contractor's costs for unloading and handling on the Site, labor, installation, overhead, profit, and other expenses contemplated for the cash allowances have been included in the Contract Price and not in the allowances, and no demand for additional payment on account of any of the foregoing will be valid.

C. *Contingency Allowance*: Contractor agrees that a contingency allowance, if any, is for the sole use of Owner to cover unanticipated costs.

D. Prior to final payment, an appropriate Change Order will be issued as recommended by Engineer to reflect actual amounts due Contractor on account of Work covered by allowances, and the Contract Price shall be correspondingly adjusted.

13.03 *Unit Price Work*

A. Where the Contract Documents provide that all or part of the Work is to be Unit Price Work, initially the Contract Price will be deemed to include for all Unit Price Work an amount equal to the sum of the unit price for each separately identified item of Unit Price Work times the estimated quantity of each item as indicated in the Agreement.

B. The estimated quantities of items of Unit Price Work are not guaranteed and are solely for the purpose of comparison of Bids and determining an initial Contract Price. Payments to Contractor for Unit Price Work will be based on actual quantities.

C. Each unit price will be deemed to include an amount considered by Contractor to be adequate to cover Contractor's overhead and profit for each separately identified item.

D. Engineer will determine the actual quantities and classifications of Unit Price Work performed by Contractor. Engineer will review with Contractor the Engineer's preliminary determinations on such matters before rendering a written decision thereon (by recommendation of an Application for Payment or otherwise). Engineer's written decision thereon will be final and binding (except as modified by Engineer to reflect changed factual conditions or more accurate data) upon Owner and Contractor, subject to the provisions of the following paragraph.

E. Within 30 days of Engineer's written decision under the preceding paragraph, Contractor may submit a Change Proposal, or Owner may file a Claim, seeking an adjustment in the Contract Price if:

1. the quantity of any item of Unit Price Work performed by Contractor differs materially and significantly from the estimated quantity of such item indicated in the Agreement;

2. there is no corresponding adjustment with respect to any other item of Work; and

3. Contractor believes that it is entitled to an increase in Contract Price as a result of having incurred additional expense or Owner believes that Owner is entitled to a decrease in Contract Price, and the parties are unable to agree as to the amount of any such increase or decrease.

ARTICLE 14 – TESTS AND INSPECTIONS; CORRECTION, REMOVAL OR ACCEPTANCE OF DEFECTIVE WORK

14.01 *Access to Work*

A. Owner, Engineer, their consultants and other representatives and personnel of Owner, independent testing laboratories, and authorities having jurisdiction will have access to the Site and the Work at reasonable times for their observation, inspection, and testing. Contractor shall provide them proper and safe conditions for such access and advise them of Contractor's safety procedures and programs so that they may comply therewith as applicable.

14.02 *Tests, Inspections, and Approvals*

A. Contractor shall give Engineer timely notice of readiness of the Work (or specific parts thereof) for all required inspections and tests, and shall cooperate with inspection and testing personnel to facilitate required inspections and tests.

B. Owner shall retain and pay for the services of an independent inspector, testing laboratory, or other qualified individual or entity to perform all inspections and tests expressly required by the Contract Documents to be furnished and paid for by Owner, except that costs incurred in connection with tests or inspections of covered Work shall be governed by the provisions of Paragraph 14.05.

C. If Laws or Regulations of any public body having jurisdiction require any Work (or part thereof) specifically to be inspected, tested, or approved by an employee or other representative of such public body, Contractor shall assume full responsibility for arranging and obtaining such inspections, tests, or approvals, pay all costs in connection therewith, and furnish Engineer the required certificates of inspection or approval.

D. Contractor shall be responsible for arranging, obtaining, and paying for all inspections and tests required:

1. by the Contract Documents, unless the Contract Documents expressly allocate responsibility for a specific inspection or test to Owner;

2. to attain Owner's and Engineer's acceptance of materials or equipment to be incorporated in the Work;

3. by manufacturers of equipment furnished under the Contract Documents;

4. for testing, adjusting, and balancing of mechanical, electrical, and other equipment to be incorporated into the Work; and

5. for acceptance of materials, mix designs, or equipment submitted for approval prior to Contractor's purchase thereof for incorporation in the Work.

Such inspections and tests shall be performed by independent inspectors, testing laboratories, or other qualified individuals or entities acceptable to Owner and Engineer.

E. If the Contract Documents require the Work (or part thereof) to be approved by Owner, Engineer, or another designated individual or entity, then Contractor shall assume full responsibility for arranging and obtaining such approvals.

F. If any Work (or the work of others) that is to be inspected, tested, or approved is covered by Contractor without written concurrence of Engineer, Contractor shall, if requested by Engineer, uncover such Work for observation. Such uncovering shall be at Contractor's expense unless Contractor had given Engineer timely notice of Contractor's intention to

cover the same and Engineer had not acted with reasonable promptness in response to such notice.

14.03 *Defective Work*

A. *Contractor's Obligation*: It is Contractor's obligation to assure that the Work is not defective.

B. *Engineer's Authority*: Engineer has the authority to determine whether Work is defective, and to reject defective Work.

C. *Notice of Defects*: Prompt notice of all defective Work of which Owner or Engineer has actual knowledge will be given to Contractor.

D. *Correction, or Removal and Replacement*: Promptly after receipt of written notice of defective Work, Contractor shall correct all such defective Work, whether or not fabricated, installed, or completed, or, if Engineer has rejected the defective Work, remove it from the Project and replace it with Work that is not defective.

E. *Preservation of Warranties*: When correcting defective Work, Contractor shall take no action that would void or otherwise impair Owner's special warranty and guarantee, if any, on said Work.

F. *Costs and Damages*: In addition to its correction, removal, and replacement obligations with respect to defective Work, Contractor shall pay all claims, costs, losses, and damages arising out of or relating to defective Work, including but not limited to the cost of the inspection, testing, correction, removal, replacement, or reconstruction of such defective Work, fines levied against Owner by governmental authorities because the Work is defective, and the costs of repair or replacement of work of others resulting from defective Work. Prior to final payment, if Owner and Contractor are unable to agree as to the measure of such claims, costs, losses, and damages resulting from defective Work, then Owner may impose a reasonable set-off against payments due under Article 15.

14.04 *Acceptance of Defective Work*

A. If, instead of requiring correction or removal and replacement of defective Work, Owner prefers to accept it, Owner may do so (subject, if such acceptance occurs prior to final payment, to Engineer's confirmation that such acceptance is in general accord with the design intent and applicable engineering principles, and will not endanger public safety). Contractor shall pay all claims, costs, losses, and damages attributable to Owner's evaluation of and determination to accept such defective Work (such costs to be approved by Engineer as to reasonableness), and for the diminished value of the Work to the extent not otherwise paid by Contractor. If any such acceptance occurs prior to final payment, the necessary revisions in the Contract Documents with respect to the Work shall be incorporated in a Change Order. If the parties are unable to agree as to the decrease in the Contract Price, reflecting the diminished value of Work so accepted, then Owner may impose a reasonable set-off against payments due under Article 15. If the acceptance of defective Work occurs after final payment, Contractor shall pay an appropriate amount to Owner.

14.05 *Uncovering Work*

A. Engineer has the authority to require special inspection or testing of the Work, whether or not the Work is fabricated, installed, or completed.

B. If any Work is covered contrary to the written request of Engineer, then Contractor shall, if requested by Engineer, uncover such Work for Engineer's observation, and then replace the covering, all at Contractor's expense.

C. If Engineer considers it necessary or advisable that covered Work be observed by Engineer or inspected or tested by others, then Contractor, at Engineer's request, shall uncover, expose, or otherwise make available for observation, inspection, or testing as Engineer may require, that portion of the Work in question, and provide all necessary labor, material, and equipment.

1. If it is found that the uncovered Work is defective, Contractor shall be responsible for all claims, costs, losses, and damages arising out of or relating to such uncovering, exposure, observation, inspection, and testing, and of satisfactory replacement or reconstruction (including but not limited to all costs of repair or replacement of work of others); and pending Contractor's full discharge of this responsibility the Owner shall be entitled to impose a reasonable set-off against payments due under Article 15.

2. If the uncovered Work is not found to be defective, Contractor shall be allowed an increase in the Contract Price or an extension of the Contract Times, or both, directly attributable to such uncovering, exposure, observation, inspection, testing, replacement, and reconstruction. If the parties are unable to agree as to the amount or extent thereof, then Contractor may submit a Change Proposal within 30 days of the determination that the Work is not defective.

14.06 *Owner May Stop the Work*

A. If the Work is defective, or Contractor fails to supply sufficient skilled workers or suitable materials or equipment, or fails to perform the Work in such a way that the completed Work will conform to the Contract Documents, then Owner may order Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, this right of Owner to stop the Work shall not give rise to any duty on the part of Owner to exercise this right for the benefit of Contractor, any Subcontractor, any Supplier, any other individual or entity, or any surety for, or employee or agent of any of them.

14.07 *Owner May Correct Defective Work*

A. If Contractor fails within a reasonable time after written notice from Engineer to correct defective Work, or to remove and replace rejected Work as required by Engineer, or if Contractor fails to perform the Work in accordance with the Contract Documents, or if Contractor fails to comply with any other provision of the Contract Documents, then Owner may, after seven days written notice to Contractor, correct or remedy any such deficiency.

B. In exercising the rights and remedies under this Paragraph 14.07, Owner shall proceed expeditiously. In connection with such corrective or remedial action, Owner may exclude Contractor from all or part of the Site, take possession of all or part of the Work and suspend Contractor's services related thereto, and incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere. Contractor shall allow Owner, Owner's representatives, agents and employees, Owner's other contractors, and Engineer and Engineer's consultants access to the Site to enable Owner to exercise the rights and remedies under this paragraph.

C. All claims, costs, losses, and damages incurred or sustained by Owner in exercising the rights and remedies under this Paragraph 14.07 will be charged against Contractor as set-offs against payments due under Article 15. Such claims, costs, losses and damages will

include but not be limited to all costs of repair, or replacement of work of others destroyed or damaged by correction, removal, or replacement of Contractor's defective Work.

D. Contractor shall not be allowed an extension of the Contract Times because of any delay in the performance of the Work attributable to the exercise by Owner of Owner's rights and remedies under this Paragraph 14.07.

ARTICLE 15 – PAYMENTS TO CONTRACTOR; SET-OFFS; COMPLETION; CORRECTION PERIOD

15.01 *Progress Payments*

A. *Basis for Progress Payments*: The Schedule of Values established as provided in Article 2 will serve as the basis for progress payments and will be incorporated into a form of Application for Payment acceptable to Engineer. Progress payments on account of Unit Price Work will be based on the number of units completed during the pay period, as determined under the provisions of Paragraph 13.03. Progress payments for cost-based Work will be based on Cost of the Work completed by Contractor during the pay period.

B. *Applications for Payments*:

1. At least 20 days before the date established in the Agreement for each progress payment (but not more often than once a month), Contractor shall submit to Engineer for review an Application for Payment filled out and signed by Contractor covering the Work completed as of the date of the Application and accompanied by such supporting documentation as is required by the Contract Documents. If payment is requested on the basis of materials and equipment not incorporated in the Work but delivered and suitably stored at the Site or at another location agreed to in writing, the Application for Payment shall also be accompanied by a bill of sale, invoice, or other documentation warranting that Owner has received the materials and equipment free and clear of all Liens, and evidence that the materials and equipment are covered by appropriate property insurance, a warehouse bond, or other arrangements to protect Owner's interest therein, all of which must be satisfactory to Owner.

2. Beginning with the second Application for Payment, each Application shall include an affidavit of Contractor stating that all previous progress payments received on account of the Work have been applied on account to discharge Contractor's legitimate obligations associated with prior Applications for Payment.

3. The amount of retainage with respect to progress payments will be as stipulated in the Agreement.

C. *Review of Applications*:

1. Engineer will, within 10 days after receipt of each Application for Payment, including each resubmittal, either indicate in writing a recommendation of payment and present the Application to Owner, or return the Application to Contractor indicating in writing Engineer's reasons for refusing to recommend payment. In the latter case, Contractor may make the necessary corrections and resubmit the Application.

2. Engineer's recommendation of any payment requested in an Application for Payment will constitute a representation by Engineer to Owner, based on Engineer's observations of the executed Work as an experienced and qualified design professional, and on Engineer's review of the Application for Payment and the accompanying data and schedules, that to the best of Engineer's knowledge, information and belief:

a. the Work has progressed to the point indicated;

b. the quality of the Work is generally in accordance with the Contract Documents (subject to an evaluation of the Work as a functioning whole prior to or upon Substantial Completion, the results of any subsequent tests called for in the Contract Documents, a final determination of quantities and classifications for Unit Price Work under Paragraph 13.03, and any other qualifications stated in the recommendation); and

c. the conditions precedent to Contractor's being entitled to such payment appear to have been fulfilled in so far as it is Engineer's responsibility to observe the Work.

3. By recommending any such payment Engineer will not thereby be deemed to have represented that:

a. inspections made to check the quality or the quantity of the Work as it has been performed have been exhaustive, extended to every aspect of the Work in progress, or involved detailed inspections of the Work beyond the responsibilities specifically assigned to Engineer in the Contract; or

b. there may not be other matters or issues between the parties that might entitle Contractor to be paid additionally by Owner or entitle Owner to withhold payment to Contractor.

4. Neither Engineer's review of Contractor's Work for the purposes of recommending payments nor Engineer's recommendation of any payment, including final payment, will impose responsibility on Engineer:

a. to supervise, direct, or control the Work, or

b. for the means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or

c. for Contractor's failure to comply with Laws and Regulations applicable to Contractor's performance of the Work, or

d. to make any examination to ascertain how or for what purposes Contractor has used the money paid on account of the Contract Price, or

e. to determine that title to any of the Work, materials, or equipment has passed to Owner free and clear of any Liens.

5. Engineer may refuse to recommend the whole or any part of any payment if, in Engineer's opinion, it would be incorrect to make the representations to Owner stated in Paragraph 15.01.C.2.

6. Engineer will recommend reductions in payment (set-offs) necessary in Engineer's opinion to protect Owner from loss because:

a. the Work is defective, requiring correction or replacement;

b. the Contract Price has been reduced by Change Orders;

c. Owner has been required to correct defective Work in accordance with Paragraph 14.07, or has accepted defective Work pursuant to Paragraph 14.04;

d. Owner has been required to remove or remediate a Hazardous Environmental Condition for which Contractor is responsible; or

e. Engineer has actual knowledge of the occurrence of any of the events that would constitute a default by Contractor and therefore justify termination for cause under the Contract Documents.

D. *Payment Becomes Due*:

1. Ten days after presentation of the Application for Payment to Owner with Engineer's recommendation, the amount recommended (subject to any Owner set-offs) will become due, and when due will be paid by Owner to Contractor.

E. *Reductions in Payment by Owner*:

1. In addition to any reductions in payment (set-offs) recommended by Engineer, Owner is entitled to impose a set-off against payment based on any of the following:

a. claims have been made against Owner on account of Contractor's conduct in the performance or furnishing of the Work, or Owner has incurred costs, losses, or damages on account of Contractor's conduct in the performance or furnishing of the Work, including but not limited to claims, costs, losses, or damages from workplace injuries, adjacent property damage, non-compliance with Laws and Regulations, and patent infringement;

b. Contractor has failed to take reasonable and customary measures to avoid damage, delay, disruption, and interference with other work at or adjacent to the Site;

c. Contractor has failed to provide and maintain required bonds or insurance;

d. Owner has been required to remove or remediate a Hazardous Environmental Condition for which Contractor is responsible;

e. Owner has incurred extra charges or engineering costs related to submittal reviews, evaluations of proposed substitutes, tests and inspections, or return visits to manufacturing or assembly facilities;

f. the Work is defective, requiring correction or replacement;

g. Owner has been required to correct defective Work in accordance with Paragraph 14.07, or has accepted defective Work pursuant to Paragraph 14.04;

h. the Contract Price has been reduced by Change Orders;

i. an event that would constitute a default by Contractor and therefore justify a termination for cause has occurred;

j. liquidated damages have accrued as a result of Contractor's failure to achieve Milestones, Substantial Completion, or final completion of the Work;

k. Liens have been filed in connection with the Work, except where Contractor has delivered a specific bond satisfactory to Owner to secure the satisfaction and discharge of such Liens;

l. there are other items entitling Owner to a set off against the amount recommended.

2. If Owner imposes any set-off against payment, whether based on its own knowledge or on the written recommendations of Engineer, Owner will give Contractor immediate written notice (with a copy to Engineer) stating the reasons for such action and the specific amount of the reduction, and promptly pay Contractor any amount

remaining after deduction of the amount so withheld. Owner shall promptly pay Contractor the amount so withheld, or any adjustment thereto agreed to by Owner and Contractor, if Contractor remedies the reasons for such action. The reduction imposed shall be binding on Contractor unless it duly submits a Change Proposal contesting the reduction.

3. Upon a subsequent determination that Owner's refusal of payment was not justified, the amount wrongfully withheld shall be treated as an amount due as determined by Paragraph 15.01.C.1 and subject to interest as provided in the Agreement.

15.02 *Contractor's Warranty of Title*

A. Contractor warrants and guarantees that title to all Work, materials, and equipment furnished under the Contract will pass to Owner free and clear of (1) all Liens and other title defects, and (2) all patent, licensing, copyright, or royalty obligations, no later than seven days after the time of payment by Owner.

15.03 *Substantial Completion*

A. When Contractor considers the entire Work ready for its intended use Contractor shall notify Owner and Engineer in writing that the entire Work is substantially complete and request that Engineer issue a certificate of Substantial Completion. Contractor shall at the same time submit to Owner and Engineer an initial draft of punch list items to be completed or corrected before final payment.

B. Promptly after Contractor's notification, Owner, Contractor, and Engineer shall make an inspection of the Work to determine the status of completion. If Engineer does not consider the Work substantially complete, Engineer will notify Contractor in writing giving the reasons therefor.

C. If Engineer considers the Work substantially complete, Engineer will deliver to Owner a preliminary certificate of Substantial Completion which shall fix the date of Substantial Completion. Engineer shall attach to the certificate a punch list of items to be completed or corrected before final payment. Owner shall have seven days after receipt of the preliminary certificate during which to make written objection to Engineer as to any provisions of the certificate or attached punch list. If, after considering the objections to the provisions of the preliminary certificate, Engineer concludes that the Work is not substantially complete, Engineer will, within 14 days after submission of the preliminary certificate to Owner, notify Contractor in writing that the Work is not substantially complete, stating the reasons therefor. If Owner does not object to the provisions of the certificate, or if despite consideration of Owner's objections Engineer concludes that the Work is substantially complete, then Engineer will, within said 14 days, execute and deliver to Owner and Contractor a final certificate of Substantial Completion (with a revised punch list of items to be completed or corrected) reflecting such changes from the preliminary certificate as Engineer believes justified after consideration of any objections from Owner.

D. At the time of receipt of the preliminary certificate of Substantial Completion, Owner and Contractor will confer regarding Owner's use or occupancy of the Work following Substantial Completion, review the builder's risk insurance policy with respect to the end of the builder's risk coverage, and confirm the transition to coverage of the Work under a permanent property insurance policy held by Owner. Unless Owner and Contractor agree otherwise in writing, Owner shall bear responsibility for security, operation, protection of the Work, property insurance, maintenance, heat, and utilities upon Owner's use or occupancy of the Work.

E. After Substantial Completion the Contractor shall promptly begin work on the punch list of items to be completed or corrected prior to final payment. In appropriate cases Contractor may submit monthly Applications for Payment for completed punch list items, following the progress payment procedures set forth above.

F. Owner shall have the right to exclude Contractor from the Site after the date of Substantial Completion subject to allowing Contractor reasonable access to remove its property and complete or correct items on the punch list.

15.04 *Partial Use or Occupancy*

A. Prior to Substantial Completion of all the Work, Owner may use or occupy any substantially completed part of the Work which has specifically been identified in the Contract Documents, or which Owner, Engineer, and Contractor agree constitutes a separately functioning and usable part of the Work that can be used by Owner for its intended purpose without significant interference with Contractor's performance of the remainder of the Work, subject to the following conditions:

1. At any time Owner may request in writing that Contractor permit Owner to use or occupy any such part of the Work that Owner believes to be substantially complete. If and when Contractor agrees that such part of the Work is substantially complete, Contractor, Owner, and Engineer will follow the procedures of Paragraph 15.03.A through E for that part of the Work.

2. At any time Contractor may notify Owner and Engineer in writing that Contractor considers any such part of the Work substantially complete and request Engineer to issue a certificate of Substantial Completion for that part of the Work.

3. Within a reasonable time after either such request, Owner, Contractor, and Engineer shall make an inspection of that part of the Work to determine its status of completion. If Engineer does not consider that part of the Work to be substantially complete, Engineer will notify Owner and Contractor in writing giving the reasons therefor. If Engineer considers that part of the Work to be substantially complete, the provisions of Paragraph 15.03 will apply with respect to certification of Substantial Completion of that part of the Work and the division of responsibility in respect thereof and access thereto.

4. No use or occupancy or separate operation of part of the Work may occur prior to compliance with the requirements of Paragraph 6.05 regarding builder's risk or other property insurance.

15.05 *Final Inspection*

A. Upon written notice from Contractor that the entire Work or an agreed portion thereof is complete, Engineer will promptly make a final inspection with Owner and Contractor and will notify Contractor in writing of all particulars in which this inspection reveals that the Work, or agreed portion thereof, is incomplete or defective. Contractor shall immediately take such measures as are necessary to complete such Work or remedy such deficiencies.

15.06 *Final Payment*

A. *Application for Payment*:

1. After Contractor has, in the opinion of Engineer, satisfactorily completed all corrections identified during the final inspection and has delivered, in accordance with the Contract Documents, all maintenance and operating instructions, schedules, guarantees, bonds, certificates or other evidence of insurance, certificates of

inspection, annotated record documents (as provided in Paragraph 7.11), and other documents, Contractor may make application for final payment.

2. The final Application for Payment shall be accompanied (except as previously delivered) by:

   a. all documentation called for in the Contract Documents;

   b. consent of the surety, if any, to final payment;

   c. satisfactory evidence that all title issues have been resolved such that title to all Work, materials, and equipment has passed to Owner free and clear of any Liens or other title defects, or will so pass upon final payment.

   d. a list of all disputes that Contractor believes are unsettled; and

   e. complete and legally effective releases or waivers (satisfactory to Owner) of all Lien rights arising out of the Work, and of Liens filed in connection with the Work.

3. In lieu of the releases or waivers of Liens specified in Paragraph 15.06.A.2 and as approved by Owner, Contractor may furnish receipts or releases in full and an affidavit of Contractor that: (a) the releases and receipts include all labor, services, material, and equipment for which a Lien could be filed; and (b) all payrolls, material and equipment bills, and other indebtedness connected with the Work for which Owner might in any way be responsible, or which might in any way result in liens or other burdens on Owner's property, have been paid or otherwise satisfied. If any Subcontractor or Supplier fails to furnish such a release or receipt in full, Contractor may furnish a bond or other collateral satisfactory to Owner to indemnify Owner against any Lien, or Owner at its option may issue joint checks payable to Contractor and specified Subcontractors and Suppliers.

B. *Engineer's Review of Application and Acceptance*:

1. If, on the basis of Engineer's observation of the Work during construction and final inspection, and Engineer's review of the final Application for Payment and accompanying documentation as required by the Contract Documents, Engineer is satisfied that the Work has been completed and Contractor's other obligations under the Contract have been fulfilled, Engineer will, within ten days after receipt of the final Application for Payment, indicate in writing Engineer's recommendation of final payment and present the Application for Payment to Owner for payment. Such recommendation shall account for any set-offs against payment that are necessary in Engineer's opinion to protect Owner from loss for the reasons stated above with respect to progress payments. At the same time Engineer will also give written notice to Owner and Contractor that the Work is acceptable, subject to the provisions of Paragraph 15.07. Otherwise, Engineer will return the Application for Payment to Contractor, indicating in writing the reasons for refusing to recommend final payment, in which case Contractor shall make the necessary corrections and resubmit the Application for Payment.

C. *Completion of Work*: The Work is complete (subject to surviving obligations) when it is ready for final payment as established by the Engineer's written recommendation of final payment.

D. *Payment Becomes Due*: Thirty days after the presentation to Owner of the final Application for Payment and accompanying documentation, the amount recommended by Engineer (less any further sum Owner is entitled to set off against Engineer's recommendation,

including but not limited to set-offs for liquidated damages and set-offs allowed under the provisions above with respect to progress payments) will become due and shall be paid by Owner to Contractor.

15.07 *Waiver of Claims*

A. The making of final payment will not constitute a waiver by Owner of claims or rights against Contractor. Owner expressly reserves claims and rights arising from unsettled Liens, from defective Work appearing after final inspection pursuant to Paragraph 15.05, from Contractor's failure to comply with the Contract Documents or the terms of any special guarantees specified therein, from outstanding Claims by Owner, or from Contractor's continuing obligations under the Contract Documents.

B. The acceptance of final payment by Contractor will constitute a waiver by Contractor of all claims and rights against Owner other than those pending matters that have been duly submitted or appealed under the provisions of Article 17.

15.08 *Correction Period*

A. If within one year after the date of Substantial Completion (or such longer period of time as may be prescribed by the terms of any applicable special guarantee required by the Contract Documents, or by any specific provision of the Contract Documents), any Work is found to be defective, or if the repair of any damages to the Site, adjacent areas that Contractor has arranged to use through construction easements or otherwise, and other adjacent areas used by Contractor as permitted by Laws and Regulations, is found to be defective, then Contractor shall promptly, without cost to Owner and in accordance with Owner's written instructions:

1. correct the defective repairs to the Site or such other adjacent areas;

2. correct such defective Work;

3. if the defective Work has been rejected by Owner, remove it from the Project and replace it with Work that is not defective, and

4. satisfactorily correct or repair or remove and replace any damage to other Work, to the work of others, or to other land or areas resulting therefrom.

B. If Contractor does not promptly comply with the terms of Owner's written instructions, or in an emergency where delay would cause serious risk of loss or damage, Owner may have the defective Work corrected or repaired or may have the rejected Work removed and replaced. Contractor shall pay all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such correction or repair or such removal and replacement (including but not limited to all costs of repair or replacement of work of others).

C. In special circumstances where a particular item of equipment is placed in continuous service before Substantial Completion of all the Work, the correction period for that item may start to run from an earlier date if so provided in the Specifications.

D. Where defective Work (and damage to other Work resulting therefrom) has been corrected or removed and replaced under this paragraph, the correction period hereunder with respect to such Work will be extended for an additional period of one year after such correction or removal and replacement has been satisfactorily completed.

E. Contractor's obligations under this paragraph are in addition to all other obligations and warranties. The provisions of this paragraph shall not be construed as a substitute for, or a waiver of, the provisions of any applicable statute of limitation or repose.

ARTICLE 16 – SUSPENSION OF WORK AND TERMINATION

16.01 *Owner May Suspend Work*

A. At any time and without cause, Owner may suspend the Work or any portion thereof for a period of not more than 90 consecutive days by written notice to Contractor and Engineer. Such notice will fix the date on which Work will be resumed. Contractor shall resume the Work on the date so fixed. Contractor shall be entitled to an adjustment in the Contract Price or an extension of the Contract Times, or both, directly attributable to any such suspension. Any Change Proposal seeking such adjustments shall be submitted no later than 30 days after the date fixed for resumption of Work.

16.02 *Owner May Terminate for Cause*

A. The occurrence of any one or more of the following events will constitute a default by Contractor and justify termination for cause:

1. Contractor's persistent failure to perform the Work in accordance with the Contract Documents (including, but not limited to, failure to supply sufficient skilled workers or suitable materials or equipment or failure to adhere to the Progress Schedule);

2. Failure of Contractor to perform or otherwise to comply with a material term of the Contract Documents;

3. Contractor's disregard of Laws or Regulations of any public body having jurisdiction; or

4. Contractor's repeated disregard of the authority of Owner or Engineer.

B. If one or more of the events identified in Paragraph 16.02.A occurs, then after giving Contractor (and any surety) ten days written notice that Owner is considering a declaration that Contractor is in default and termination of the contract, Owner may proceed to:

1. declare Contractor to be in default, and give Contractor (and any surety) notice that the Contract is terminated; and

2. enforce the rights available to Owner under any applicable performance bond.

C. Subject to the terms and operation of any applicable performance bond, if Owner has terminated the Contract for cause, Owner may exclude Contractor from the Site, take possession of the Work, incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere, and complete the Work as Owner may deem expedient.

D. Owner may not proceed with termination of the Contract under Paragraph 16.02.B if Contractor within seven days of receipt of notice of intent to terminate begins to correct its failure to perform and proceeds diligently to cure such failure.

E. If Owner proceeds as provided in Paragraph 16.02.B, Contractor shall not be entitled to receive any further payment until the Work is completed. If the unpaid balance of the Contract Price exceeds the cost to complete the Work, including all related claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals) sustained by Owner, such excess will be paid to Contractor. If the cost to complete the Work including such related claims, costs, losses,

and damages exceeds such unpaid balance, Contractor shall pay the difference to Owner. Such claims, costs, losses, and damages incurred by Owner will be reviewed by Engineer as to their reasonableness and, when so approved by Engineer, incorporated in a Change Order. When exercising any rights or remedies under this paragraph, Owner shall not be required to obtain the lowest price for the Work performed.

F. Where Contractor's services have been so terminated by Owner, the termination will not affect any rights or remedies of Owner against Contractor then existing or which may thereafter accrue, or any rights or remedies of Owner against Contractor or any surety under any payment bond or performance bond. Any retention or payment of money due Contractor by Owner will not release Contractor from liability.

G. If and to the extent that Contractor has provided a performance bond under the provisions of Paragraph 6.01.A, the provisions of that bond shall govern over any inconsistent provisions of Paragraphs 16.02.B and 16.02.D.

16.03 *Owner May Terminate For Convenience*

A. Upon seven days written notice to Contractor and Engineer, Owner may, without cause and without prejudice to any other right or remedy of Owner, terminate the Contract. In such case, Contractor shall be paid for (without duplication of any items):

1. completed and acceptable Work executed in accordance with the Contract Documents prior to the effective date of termination, including fair and reasonable sums for overhead and profit on such Work;

2. expenses sustained prior to the effective date of termination in performing services and furnishing labor, materials, or equipment as required by the Contract Documents in connection with uncompleted Work, plus fair and reasonable sums for overhead and profit on such expenses; and

3. other reasonable expenses directly attributable to termination, including costs incurred to prepare a termination for convenience cost proposal.

B. Contractor shall not be paid on account of loss of anticipated overhead, profits, or revenue, or other economic loss arising out of or resulting from such termination.

16.04 *Contractor May Stop Work or Terminate*

A. If, through no act or fault of Contractor, (1) the Work is suspended for more than 90 consecutive days by Owner or under an order of court or other public authority, or (2) Engineer fails to act on any Application for Payment within 30 days after it is submitted, or (3) Owner fails for 30 days to pay Contractor any sum finally determined to be due, then Contractor may, upon seven days written notice to Owner and Engineer, and provided Owner or Engineer do not remedy such suspension or failure within that time, terminate the contract and recover from Owner payment on the same terms as provided in Paragraph 16.03.

B. In lieu of terminating the Contract and without prejudice to any other right or remedy, if Engineer has failed to act on an Application for Payment within 30 days after it is submitted, or Owner has failed for 30 days to pay Contractor any sum finally determined to be due, Contractor may, seven days after written notice to Owner and Engineer, stop the Work until payment is made of all such amounts due Contractor, including interest thereon. The provisions of this paragraph are not intended to preclude Contractor from submitting a Change Proposal for an adjustment in Contract Price or Contract Times or otherwise for

expenses or damage directly attributable to Contractor's stopping the Work as permitted by this paragraph.

ARTICLE 17 – FINAL RESOLUTION OF DISPUTES

17.01 *Methods and Procedures*

A. *Disputes Subject to Final Resolution*: The following disputed matters are subject to final resolution under the provisions of this Article:

1. A timely appeal of an approval in part and denial in part of a Claim, or of a denial in full; and

2. Disputes between Owner and Contractor concerning the Work or obligations under the Contract Documents, and arising after final payment has been made.

B. *Final Resolution of Disputes*: For any dispute subject to resolution under this Article, Owner or Contractor may:

1. elect in writing to invoke the dispute resolution process provided for in the Supplementary Conditions; or

2. agree with the other party to submit the dispute to another dispute resolution process; or

3. if no dispute resolution process is provided for in the Supplementary Conditions or mutually agreed to, give written notice to the other party of the intent to submit the dispute to a court of competent jurisdiction.

ARTICLE 18 – MISCELLANEOUS

18.01 *Giving Notice*

A. Whenever any provision of the Contract Documents requires the giving of written notice, it will be deemed to have been validly given if:

1. delivered in person, by a commercial courier service or otherwise, to the individual or to a member of the firm or to an officer of the corporation for which it is intended; or

2. delivered at or sent by registered or certified mail, postage prepaid, to the last business address known to the sender of the notice.

18.02 *Computation of Times*

A. When any period of time is referred to in the Contract by days, it will be computed to exclude the first and include the last day of such period. If the last day of any such period falls on a Saturday or Sunday or on a day made a legal holiday by the law of the applicable jurisdiction, such day will be omitted from the computation.

18.03 *Cumulative Remedies*

A. The duties and obligations imposed by these General Conditions and the rights and remedies available hereunder to the parties hereto are in addition to, and are not to be construed in any way as a limitation of, any rights and remedies available to any or all of them which are otherwise imposed or available by Laws or Regulations, by special warranty or guarantee, or by other provisions of the Contract. The provisions of this paragraph will be as effective as if repeated specifically in the Contract Documents in connection with each particular duty, obligation, right, and remedy to which they apply.

18.04 *Limitation of Damages*

A. With respect to any and all Change Proposals, Claims, disputes subject to final resolution, and other matters at issue, neither Owner nor Engineer, nor any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, shall be liable to Contractor for any claims, costs, losses, or damages sustained by Contractor on or in connection with any other project or anticipated project.

18.05 *No Waiver*

A. A party's non-enforcement of any provision shall not constitute a waiver of that provision, nor shall it affect the enforceability of that provision or of the remainder of this Contract.

18.06 *Survival of Obligations*

A. All representations, indemnifications, warranties, and guarantees made in, required by, or given in accordance with the Contract, as well as all continuing obligations indicated in the Contract, will survive final payment, completion, and acceptance of the Work or termination or completion of the Contract or termination of the services of Contractor.

18.07 *Controlling Law*

A. This Contract is to be governed by the law of the state in which the Project is located.

18.08 *Headings*

A. Article and paragraph headings are inserted for convenience only and do not constitute parts of these General Conditions.

DIVISION 0 - SECTION 00800
SUPPLEMENTARY CONDITIONS
ITB 18-010

These Supplementary Conditions amend or supplement the Standard General Conditions of the Construction Contract, EJCDC C-700 (2013 Edition) and other provisions of the Contract Documents as indicated below. All references in these Supplementary Conditions to the Standard General Conditions are to the Standard General Conditions of the Construction Contract, EJCDC C-700 (2013 Edition). All provisions which are not so amended or supplemented remain in full force and effect.

The terms used in these Supplementary Conditions will have the meanings stated in those Standard General Conditions. Additional terms used in these Supplementary Conditions have the meanings indicated below, which are applicable to both the singular and plural thereof.

The address system used in these Supplementary Conditions is the same as the address system used in the Standard General Conditions of the Construction Contract EJCDC C-700 (2013 Edition), with the prefix "SC" added thereto.

SC-1.01 *Defined Terms*

Delete the definition of the term Liens in Paragraph 1.01.A.24. and insert in its place the following:

24. *Liens* – Charges, security, interests, or encumbrances upon Contract – related funds, real property, or personal property and claims delivered to Owner by laborers, Subcontractors, and Suppliers who have not been paid by Contractor.

SC-2.01 *Delivery of Bonds and Evidence of Insurance*

Delete Paragraph 2.01.A. in its entirety and insert the following in its place:

A. When Contractor delivers the executed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner unexecuted copies of the bonds and related powers of attorney that Contractor will be required to furnish. Within 10 days after execution of the Agreement by Owner, Contractor shall deliver to Owner fully executed bonds, accompanied by a certified copy of the signing individual's authority to bind the surety establishing that it is effective on the date the agent or attorney-in-fact signed the accompanying bond, as provided in Paragraph 5.06.B. of the Standard General Conditions.

SC-2.02 *Copies of Documents*

Delete Paragraph 2.02.A. in its entirety and insert the following in its place:

A. Owner shall furnish Contractor with 1 printed copy of the fully executed Contract Documents. Additional copies will be furnished upon request at the cost of reproduction.

SC-2.04 *Preconstruction Conference; Designation of Authorized Representatives*

Add the following to the end of Paragraph 2.04.A.:

Contractor shall be ready, willing, and able to attend this conference within 10 calendar days after the date of the notice to proceed. The date, time, and place of this conference will be set by Engineer.

SC-4.01 *Commencement of Contract Times; Notice to Proceed*

Delete Paragraph 4.01.A. in its entirety and insert the following in its place:

A. The Contract Times will commence to run on the day indicated in a Notice to Proceed.

SC-4.02 *Starting the Work*

Add the following new Paragraph to Paragraph 4.02:

B. Contractor, before beginning the Work or within 2 workdays thereafter, shall post in a conspicuous place on the Site the following notice.

Notice is hereby made to all those concerned and affected that _____ _____ is performing the "LAKE JACKSON WATERSHED HYDROLOGY GROUNDWATER, METEOROLOGY AND SURFACE WATER/STREAM FLOW SENSOR ACQUISITION AND INSTALLATION". All parties furnishing labor and/or materials to that project must, within twenty (20) days of first providing such labor and/or materials, deliver notice of such in writing, by certified mail, return receipt requested, to:

HIGHLANDS COUNTY BOARD OF COUNTY COMMISSIONERS
PARKS AND NATURAL RESOURCES DEPARTMENT
ATTN: CLELL FORD
4344 GEORGE BLVD. SEBRING, FLORIDA 33875-5803

SC-5.01 *Availability of Lands*

Delete the following from Paragraph 5.01.B.:

as necessary for giving notice of or filing a mechanic's or construction Lien against such lands in accordance with applicable Laws and Regulations

SC-5.02 *Use of SiteS and Other Areas*

Add the following new paragraph to Paragraph 5.02:

E. Contractor shall at all times control dust and keep the Sites free from accumulation of waste materials or rubbish caused by Contractor's employees or subcontractors, and at the completion of the Work, Contractor shall remove all Contractor's rubbish from and about the Sites and all Contractor's tools and surplus materials and shall leave Contractor's Sites and any other Work area clean. Owner may remove the rubbish and charge the cost to Contractor as the Engineer may determine to be just. In the event that Contractor does not keep the Sites and any other Work area free of rubbish or accumulations of waste materials and control dust, Owner will withhold an additional 5% from any pay request, above and beyond the standard 10% retainage.

SC-5.03 *Subsurface and Physical Conditions*

Add the following new paragraphs immediately after Paragraph 5.03.B:

C. *Subsurface Conditions Known to Owner*: The subsurface conditions at or contiguous to the Site known to Owner are shown on the Drawings and Specifications that are Exhibit "A" of the Contract Documents. Contractor is not entitled to rely upon any other information and data known to or identified by Owner or Project Manager.

D. *Unforeseen Physical Conditions:* Contractor shall notify Engineer in writing of any subsurface or latent physical condition at the Site differing materially from those indicated in the Contract Documents. Engineer shall promptly investigate those conditions and advise Owner in writing if additional information shall be required. Owner shall then obtain such information, and if deemed necessary, shall issue written orders to perform necessary revisions.

SC 5.05 *Underground Facilities*

Add the following new Paragraph to Paragraph 5.05:

F. *Protection of Underground Facilities*.

1. Existing utilities and other facilities such as drainage structures have been indicated on the Drawings and Specifications only to the extent that such information was made available to Owner. There is no guarantee as to the accuracy or completeness of this information, and Owner will not be responsible for such accuracy or completeness.

2. Contractor shall be responsible for protecting all such utilities indicated in the manner determined necessary by the owner of such utilities. Any utilities not indicated on the Drawings and Specifications, which do not require relocation, shall be protected by Contractor. The Work shall be performed at the original Contract Price. All visible surface facilities or underground utilities shown on the Drawings and Specifications, whether or not shown to be relocated, shall be protected or relocated by Contractor at its expense.

3. Utility relocations are not anticipated for this Project. However, existing utilities which are found during construction and determined necessary to be relocated will be considered an unknown condition. Contractor will cooperate with the appropriate authority in identifying and protecting the utility during relocation.

4. Abandoned utilities, when encountered, shall be severed and plugged at Contractor's expense.

5. Contractor shall be responsible for discovery of existing underground installations, in advance of excavating or trenching, by contacting all local utilities and by prospecting and pot holing. Any damage to facilities not shown shall be solely the responsibility of Contractor.

SC-5.06 *Hazardous Environmental Conditions at Site*

Delete Paragraphs 5.06.A. and 5.06B. in their entirety and insert the following:

A. No reports or drawings related to Hazardous Environmental Conditions at the Site are known to Owner.

B. Not Used.

Delete Paragraph 5.06.I. in its entirety.

SC-6.01 *Performance, Payment, and Other Bonds*

Delete Paragraph 6.01.A. in its entirety and insert the following in its place:

A. Contractor shall furnish a payment and performance bond in an amount at least equal to the Contract Price, in complete satisfaction of the provisions of Section 255.05, Florida Statutes, as security for the faithful performance and payment of all of Contractor's obligations under the Contract. The form of the payment and performance bond shall be in the form of the Pubic Construction Bond provided by Owner in Section 00600 of the ITB issued by Owner for construction of the Work. These bonds shall remain in effect until one year after the date when final payment becomes due or until completion of the correction period specified in Paragraph 15.08, whichever is later, except as provided otherwise by Laws and Regulations,

the Supplementary Conditions, or other specific provisions of the Contract. Contractor shall also furnish such other bonds as are required by the Supplementary Conditions or other specific provisions of the Contract. Contractor shall record that bond in the Public Records of Highlands County, Florida, as required by Section 255.05(1), Florida Statutes.

SC-6.03 *Contractor's Insurance*

Delete Paragraph 6.03.I.3. in its entirety and insert the following in its place:

3. contain a provision or endorsement that the coverage afforded will not be canceled, materially changed or renewal refused until at least 10 days, or such longer time period as is required by Laws and Regulations, prior written notice has been given to Contractor.

Add the following new Paragraphs to Paragraph 6.03:

K. Contractor shall have and maintain in full force and effect the following insurance during the Term of this Contract and shall furnish to County Certificates of Insurance documenting that insurance coverage has been obtained which meets the following requirements:

1. Workers' Compensation. Contractor shall have and maintain workers' compensation insurance for all employees for statutory limits in compliance with Laws and Regulations. This insurance policy must include Employer's Liability with a limit of $100,000 each accident, $500,000 disease (policy Limit), and $100,000 disease (each employee).

2. Commercial General Liability. Occurrence Form Required: Contractor shall have and maintain commercial general liability (CGL) insurance with a limit of not less than $3,000,000 each occurrence. If such CGL insurance contains a general aggregate limit, it shall apply separately to this project in the amount of $3,000,000. Products and completed operations aggregate shall be $3,000,000. CGL insurance shall be written on an occurrence form and shall include bodily injury and property damage liability for premises, operations, independent contractors, products and completed operations, contractual liability, broad form property damage and property damage resulting from explosion, collapse or underground (x, c, u) exposures, personal injury, and advertising injury. Fire damage liability shall be included at $100,000.

3. Commercial Auto Liability Insurance. Contractor shall have and maintain commercial automobile liability insurance with a limit of not less than $3,000,000 combined single limit per occurrence for bodily injury and property damage liability. That insurance shall cover liability arising out of

any auto (including owned, hired, and non-owned autos). The policy shall be endorsed to provide contractual liability coverage.

4. Umbrella Excess Liability - Contractor may satisfy the required minimum liability limits with an Umbrella or Excess Liability policy. Contractor agrees to endorse Owner and its elected officials, agents, employees, and volunteers, in the manner required by Paragraph 6.03.K.7, as Additional Insureds unless the Umbrella provides "follow form" provisions of the underlying policies. This must be confirmed in writing on the Certificate of Insurance.

5. Deductibles/Retentions - Contractor is responsible for any expenses or costs below deductibles applicable to any policies.

6. Formal Certificates of Insurance shall be delivered by Contractor to Owner upon execution of the Agreement. Certificates of Insurance shall be signed by a person authorized by that insurer to bind coverage on its behalf. All Certificates of Insurance must be on file with and approved by Owner before commencement of any Work activities.

7. The formal insurance certificates shall name "Highlands County, a political subdivision of the State of Florida and its elected officials, agents, employees and volunteers" as "Additional Insureds" on all policies except Workers' Compensation. Additional Insureds status for Completed Operations must be provided without time limitation or for a minimum of 5 years following completion of the Project.

8. These are minimum requirements which are subject to modification in response to high hazard operations. Owner reserves the right to require Contractor to provide and pay for any other insurance coverage Owner deems necessary, depending upon the possible exposure to liability.

9. The policies of insurance shall be written on forms acceptable to Owner and placed with insurance carriers authorized by the Insurance Department in the State of Florida and meet a minimum financial AM Best company rating of no less than "A- Excellent: FSC VII.

10. All policies must include Waiver of Subrogation and any liability aggregate limits shall apply "Per Jobsite"/Per Job Aggregate. All liability insurance shall be Primary and Non-Contributory. Each Certificate of Insurance shall confirm in writing that these provisions apply.

L. Contractor shall require each Subcontractor to have and maintain the insurance required by Paragraph 6.03.K. This requirement may be modified by Owner by written instrument on a case by case basis, in its sole discretion. It is the

responsibility of the Contractor to ensure that all Subcontractors comply with all insurance requirements.

M. Contractor shall provide notification to Owner and Engineer by overnight delivery return receipt requested, hand delivery or confirmed facsimile 30 days prior to giving and within 3 days after receiving notice of cancellation, modification, non-renewal, or any other lapse in coverage of any required insurance policies.

SC-6.05 *Property Insurance*

Delete Paragraph 6.05.B. in its entirety and insert the following Paragraph in its place:

B *Notice of Cancellation or Change*: All the policies of insurance (and the certificates or other evidence thereof) required to be purchased and maintained in accordance with this Paragraph 6.05 will contain a provision or endorsement that the coverage afforded will not be canceled or materially changed or renewal refused until at least 10 days, or such longer time period as is required by Laws and Regulations, prior written notice has been given to the purchasing policyholder. Contractor shall provide notification to Owner and Engineer by overnight delivery return receipt requested, hand delivery or confirmed facsimile 30 days prior to giving and within 3 days after receiving notice of cancellation, modification, non-renewal, or any other lapse in coverage of any required insurance policies.

SC-6.06 *Waiver of Rights*

Delete Paragraphs 6.06.B. and C. in their entirety.

SC-7.01 *Supervision and Superintendence*

Add the following to the end of Paragraph 7.01.B.:

The superintendent will be Contractor's representative at the Site and shall have authority to act on behalf of Contractor. All communications given to or received from the superintendent shall be binding on Contractor.

SC-7.02 *Labor; Working Hours*

Add the following new Paragraphs immediately after Paragraph 7.02.B.:

C. In all cases, local labor shall be given preference when available.

D. Whenever Owner shall notify Contractor that any man on the Work is, in his opinion, incompetent, unfaithful, or disorderly, or who uses threatening or abusive language to any person representing Owner when on the Work, such man shall be immediately discharged from the Work and shall not be re-employed thereon except with the consent of Owner.

SC-7.03 *Services, Materials, and Equipment*

Add the following new Paragraph immediately after Paragraph 7.03.C.:

D. The responsibility for the protection and safekeeping of equipment and materials on or near the Site will be entirely that of Contractor and that no Claim shall be made against Owner by reason of any act of an employee or trespasser. Should an occasion arise necessitating access to the sites occupied by the stored materials and equipment, Contractor shall immediately move same. No materials or equipment may be placed upon the property of Owner until Owner has approved the location contemplated by Contractor to be used for storage.

SC-7.04 *"Or Equals"*

Delete the word "considered" from Paragraph 7.04.E. and insert the word "consider" in its place.

SC-7.06 *Concerning Subcontractors, Suppliers, and Others*

Delete Paragraph 7.06.H. in its entirety and insert the following in its place:

H. Prior to submitting the first Application for Payment and within 3 workdays after any change, Contractor shall submit to Engineer a complete list of all Subcontractors and Suppliers having a direct contract with Contractor, and of all other Subcontractors and Suppliers known to Contractor at the time of submittal.

SC-7.07 *Patent Fees and Royalties*

Delete Paragraph 7.07.B. in its entirety.

SC-7.08 *Permits*

Delete Paragraph 7.08.A. in its entirety and insert the following in its place:

A. Unless otherwise provided in the Contract Documents or Section 218.80, Florida Statutes, Contractor shall obtain and pay for all construction permits and licenses. Owner shall assist Contractor, when necessary, in obtaining such permits and licenses. Contractor shall pay all governmental charges and inspection fees necessary for the prosecution of the Work which are applicable at the time of the submission of Contractor's Bid (or when Contractor became bound under a negotiated contract). Owner shall pay all charges of utility owners for connections for providing permanent service to the Work.

SC-7.09 *Taxes and Direct Material Purchase Procedure*

Add the following new Paragraphs immediately after Paragraph 7.09.A.:

B. Owner is exempt from payment of sales and compensating use taxes of the State of Florida and of cities and counties thereof on all materials to be incorporated into the Work.

C. Contractor shall provide assistance to Owner for Direct Purchases to enable Owner to purchase tangible personal property needed for this Project which Owner intends to purchase in order to realize savings of sales tax on all tangible personal property needed for this Project. Contractor will recommend direct purchases for items where those direct purchases will result in significant tax savings to Owner. Owner will either accept or reject Contractor's recommendations, and purchases will be made according to Owner's decision. Owner retains the absolute right, with or without Contractor's recommendation, to purchase any or all tangible personal property needed for this Project.

D. Contractor will provide detailed scoping and pricing for purchase orders with a minimum value of $5,000, in harmony with the Subcontractors to Owner for the incorporation in Owner's purchase orders.

E. Owner will issue purchase orders within 3 workdays from the date of receipt of requisition, directly to the vendors and provide a copy of each purchase order to Contractor.

F. Contractor will be responsible for the materials until they are incorporated into the Project and will purchase and/or have ample Builder's Risk insurance for the direct purchased materials.

G. Contractor will issue a deductive subcontract adjustment to the Subcontractor which will account for the value of the material and the sales tax as it pertains to that Subcontractor's contract. All subcontracts shall include a clause incorporating, by reference, the provisions of this Paragraph 7.09.

H. As the material is delivered to the Site, the Subcontractor will sign off on the delivery receipt/invoice for the material delivered, store and secure the material adequately at the Site, and forward the invoice to Contractor who will review, approve and forward the invoice to Owner's Representative for approval and processing.

I. Owner will draft a check for the approved invoice amount and mail that check directly to the vendor. A list of the check numbers with related dates of issue, names of vendors, amounts paid, and paid invoice numbers will be forwarded to Contractor in order that Contractor can accurately track payment.

J. Contractor and Owner are encouraged to take advantage of all discounts available.

K. Owner will issue to Contractor a deductive Change Order in the amount of the direct purchased materials. The amount equal to the sales tax which would have been paid if those materials had been purchased by Contractor will be credited to Owner through a Contingency line item on the pay application's schedule of values, and the Contract Price specified in Article 4 of the Agreement shall be reduced by an amount equal to the amounts paid directly by Owner for direct purchases made pursuant to this Article, plus an amount equal to the sales tax that would have been paid if those materials had been purchased by Contractor.

SC-7.10 *Laws and Regulations*

Delete Paragraph 7.10.B. in its entirety and insert the following in its place:

B. It shall be Contractor's responsibility to make certain that the Work described in the Contract Documents is in accordance with Laws and Regulations. Contractor shall bear all costs and losses, and shall indemnify and hold harmless Owner and Owner's officers and employees from and against all liabilities, damages, losses, and costs, including, but not limited to, reasonable attorney's fees arising out of or relating to Work or other action that is contrary to Laws or Regulations.

SC-7.11 *Record Documents*

Delete the word "Engineer" at the end of Paragraph 7.11.A. and insert the word "Owner" in its place.

SC-7.12 *Safety and Protection*

Add the following new Paragraph to Paragraph 7.12:

H. Contractor shall pay for all damages to private property, public property, and any public utilities.

SC-7.17 *Contractor's General Warranty and Guarantee*

Add the following new Paragraph to paragraph 7.17:

E. All materials incorporated in the Work shall comply with the requirements of the Construction Documents. Any Defective Work which develop within 1 year after the date of final acceptance shall be promptly repaired by or replaced to "as new" condition by Contractor without any additional expense to Owner.

SC-7.18 *Indemnification*

Delete Paragraph 7.18 in its entirety and insert the following in its place.

A. To the fullest extent permitted by Laws and Regulations, and in addition to any other obligations of Contractor under the Contract or otherwise, Contractor shall indemnify and hold harmless Owner and Owner's officers and employees from and against all liabilities, damages, losses, and costs, including, but not limited to, reasonable attorney's fees to the extent caused by the negligence, recklessness, or intentional wrongful misconduct of Contractor and persons employed or utilized by Contractor in the performance of any of the Work.

B. In any and all claims against Owner or any of its officers or employees by any employee (or the survivor or personal representative of such employee) of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly utilized by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, the indemnification obligation under Paragraph 7.18.A shall not be limited in any way by any limitation on the amount or type of damages, compensation, or benefits payable by or for Contractor or any such Subcontractor, Supplier, or other individual or entity under workers' compensation acts, disability benefit acts, or other employee benefit acts.

C. The indemnification obligations of Contractor under Paragraph 7.18.A shall be limited to $1,000,000 per occurrence.

SC-7.19 *Delegation of Professional Design Services*

Add the following new Paragraph immediately after Paragraph 7.19.E.:

F. If Contractor provides professional design services as a design professional, as that term is defined in Section 725.08(4), Florida Statutes, Contractor shall indemnify and hold harmless Owner and Owner's officers and employees, from liabilities, damages, losses, and costs, including, but not limited to reasonable attorneys' fees, to the extent caused by the negligence, recklessness, or intentionally wrongful conduct of Contractor providing professional design services as a design professional and other persons employed or utilized by Contractor in the performance of the professional design services.

SC-7.20-7.29

Add the following new Paragraphs immediately after new Paragraph 7.19.F.:

SC-7.20 *Storage of Materials*

A. The responsibility for the protection and safekeeping of equipment and materials on or near the Site will be entirely that of Contractor, and no claim shall be made against Owner by reason of any act of an employee or trespasser. Should an occasion arise necessitating access to the sites occupied by these stored materials and equipment, Contractor shall immediately move same. No materials or equipment

may be placed upon the property of Owner until Owner has approved the location contemplated by Contractor to be used for storage.

SC-7.21 *Erosion and Drainage Control*

A. Contractor shall implement Best Management Practices (BMP's) to provide for drainage of storm water and such water as may be applied or discharged on the Site in performance of the Work. Drainage facilities shall be adequate to prevent damage to the Work, the Site and adjacent property.

B. Contractor shall prevent the pollution of drains and watercourses by sanitary wastes, sediment, debris or other substances resulting from this work. Contractor shall clean up and isolate such materials on a continuing basis to prevent risk of washing into such drainage ways.

C. Contractor shall determine if a Stormwater Discharge Permit or a Construction Dewatering Discharge Permit applies to the Work. Contractor shall obtain required permit(s) if necessary for completion of the Work.

SC-7.22 *Protection of Trees and Natural Conditions*

A. No trees or shrubs shall be damaged or removed beyond delineated limits of disturbance except those flagged by Owner. No areas shall be disturbed beyond the designated limits indicated by Owner. Contractor shall install orange safety fence to delineate limits of disturbance, and Contractor shall be responsible for damage mitigation beyond these limits.

SC-7.23 *Dewatering*

A. If dewatering is required at the Site, Contractor shall comply with all dewatering requirements of governmental agencies.

SC-7.24 *Protection of Public and Private Property*

A. Contractor shall protect, shore, brace, support and maintain all underground pipes, conduits, drains, and other underground or above ground structures uncovered or otherwise affected by the construction of the Work performed by Contractor. All pavement, surfacing, driveways, curbs, walks, buildings, utility poles, guy wires, fences, guard posts, and other surface structures affected by construction operations, together with all trees, sod and shrubs in yards and parking lots removed or damaged, shall be restored to their original condition or replaced as determined and approved by Owner, whether within or outside Owner's right-of-way. All replacements shall be made with new materials.

B. Contractor shall be responsible for all damages to streets, roads, highways, shoulders, ditches, embankments, culverts, facilities and utilities, bridges, property corners and monuments and other public or private property, regardless of location or character, which may be caused by construction of the Work or by transporting equipment, materials or men to or from the Work or any part or site thereof, whether by Contractor or Contractor's Subcontractors. Contractor shall make satisfactory and acceptable arrangements with the owner of, or the agency or authority having jurisdiction over, the damaged property concerning its repair or replacement or payment of costs incurred in connection with the damage.

C. All fire hydrants and water control valves shall be kept free from obstruction and for use at all times.

D. Contractor shall be responsible for any damage to existing structures during the course of the Work.

SC-7.25 *Maintenance of Traffic*

A. Contractor shall provide traffic control plans as required by the controlling highway, street or road authority. Contractor shall perform the Work so as to interfere as little as possible with public travel, whether vehicular or pedestrian. Whenever necessary to cross, use, obstruct or close roads, driveways and walks, whether public or private, Contractor shall, at its own expense, provide and maintain suitable and safe bridges, detours or other temporary expedients, for the accommodation of public and private travel, and shall give reasonable notice to owners of private drives before interfering with them. Such maintenance of traffic will not be required when Contractor has obtained permission from the owner and tenant of private property, or from the authority having jurisdiction over the public property involved, to obstruct traffic at the designated point. Obstructions, such as material piles and equipment, shall be provided with appropriate warning signs and lights.

B. After completion, the roadway shall be restored to original condition, and disturbed areas shall be restored to original condition.

SC-7.26 *Testing*

A. Contractor shall be responsible for all testing required for sampling and testing of materials to prove compliance with the Contract Documents. This shall include, but not be limited to mix design approvals for concrete and asphalt, pipe bedding gradations and Proctor tests and gradations for imported granular fill materials. Specific requirements shall be included in the applicable specification sections.

B. Tests required to monitor control performance of the Work in accordance with the Contract Documents such as concrete cylinder tests and compaction tests shall be ordered and paid for by Contractor. Any retesting required as a result of the first test failure will be at Contractor's expense. Contractor will assist in providing locations and allowing the tests to be conducted without obstructions and in accordance with all Laws and Regulations. Contractor shall correct or modify its operations where indicated necessary by the test results.

SC-7.27 *Unfavorable Construction Conditions*

A. During unfavorable weather, wet ground or other unsuitable construction conditions, Contractor shall confine its operations to work which will not be affected adversely by such conditions. No portion of the Work shall be constructed under conditions which affect adversely the quality or efficiency thereof, unless special means or precautions are taken by Contractor to perform the Work in a proper and satisfactory manner.

SC-7.28 *Notices to Owners and Authorities*

A. Contractor shall notify owners of adjacent property and utilities when prosecution of Work may affect them.

B. Utilities and other concerned agencies shall be contracted at least 48 hours prior to cutting or closing streets or other traffic areas or excavating near Underground Facilities or pole lines.

SC-7.29 *Storage of Fuel or Hazardous Materials*

A. No fuel or other hazardous materials shall be stored on the Site. Extreme care and compliance with all regulations shall be required when handling all such materials.

SC-11.01 *Amending and Supplementing Contract Documents*

Delete the first sentence of Paragraph 11.01.A. and insert the following in its place:

The Contract Documents may be amended or supplemented by a Change Order, a Work Change Directive, or a Field Order if approved, in writing, by Owner.

SC-14.02 *Tests, Inspections, and Approvals*

Delete Paragraph 14.02.B. in its entirety and insert the following in its place:

B. Owner shall retain and Contractor shall pay for the services of an independent inspector, testing laboratory, or other qualified individual or entity to perform all inspections and tests expressly required by the Contract Documents to be furnished by Owner, except that costs incurred in connection with tests or inspections of covered Work shall be governed by the provisions of Paragraph 14.05.

SC-15 **ARTICLE 15 – PAYMENTS TO CONTRACTOR; SET-OFFS; COMPLETION; CORRECTION PERIOD.**

Add the following to the end of 15.01.B.1.:

If the payment and performance of the Work is not secured by a payment and performance bond, all applications for payment shall include a written statement that indicates how the payment will be distributed. Contractor shall disburse the payment as provided in that written statement.

Add the following new Paragraph to Paragraph 15.01.B.:

4. *If Requested by Owner:*

   a. Contractor shall deliver a certified list of all Subcontractors, laborers, and material suppliers to Owner within 30 days of receiving the request. This list shall be updated by Contractor thereafter each month with a certified statement by Contractor that the list and its updates include the names and address of all of Subcontractors, laborers, and Suppliers furnishing labor and/or material for the Project.

   b. Contractor shall provide a written statement with each pay request to the Owner which indicates how each payment will be distributed. This pay request breakdown shall define the disbursement of all the funds requested.

   c. When Contractor receives any payment pursuant to this Contract, Contractor shall pay laborers and each Subcontractor and Supplier the amounts stated in Contractor's written statement delivered to Owner for that pay request.

   d. Contractor shall provide a written statement with all but the first payment request from each of the Subcontractors, laborers, and Suppliers identified in Paragraph 15.01.B.4.b., that they have in fact received payment as provided in Paragraph 15.01.B.4.c. In the event a payment will not made as stated on a prior written statement delivered pursuant to Paragraph 15.01B.4.b., Contractor shall furnish an explanation as to the reasons for such deviation and shall request approval from the Engineer.

Add the following new Paragraphs immediately after Paragraph 15.08.E.:

SC-15.09 *Local Government Prompt Payment Act*

A. If the total cost of the construction services purchased by Owner pursuant to this Contract exceeds $200,000, the provisions of this Article are subject to the provisions of the Local Government Prompt Payment Act, Sections 218.70 through 218.79, inclusive, Florida Statutes, except to the extent provided therein and in that event provisions of this Article are modified and amended to the extent required to be consistent with the Local Government Prompt Payment Act.

SC-15.10 *Interest*

A. All moneys not paid when due as provided in Paragraph 15 shall bear interest at the maximum rate of 6 percent per annum, simple.

SC-16.02 *Owner May Terminate for Cause*
Delete Paragraph 16.02 in its entirety and insert the following in its place:

16.02 *Owner May Terminate for Cause*

A. The occurrence of any one or more of the following events will constitute a default by Contractor and justify termination for cause:

1. Contractor's persistent failure to perform the Work in accordance with the Contract Documents (including, but not limited to, failure to supply sufficient skilled workers or suitable materials or equipment or failure to adhere to the Progress Schedule);

2. Failure of Contractor to perform or otherwise to comply with a material term of the Contract Documents;

3. Contractor's disregard of Laws or Regulations of any public body having jurisdiction;

4. Contractor's repeated disregard of the authority of Owner or Engineer; or

5. Contractor becomes involved as a debtor in a bankruptcy proceeding, or becomes involved in a reorganization, dissolution, or liquidation proceeding, or if a trustee or receiver is appointed over all or a substantial portion of the property of Contractor under federal bankruptcy law or any state insolvency law.

B. If one or more of the events identified in Paragraph 16.02.A occurs, then after giving Contractor (and any surety) 10 days written notice that Owner is considering a declaration that Contractor is in default and termination of the Contract, Owner may proceed to:

1. declare Contractor to be in default, give Contractor (and any surety) notice that the Contract is terminated, and enforce the rights available to Owner under any applicable payment and performance bond; or

2. notify Contractor of the deficiency with a requirement that the deficiency be corrected within a specified time, otherwise the Contract will be terminated at the end of such time; or
3. take whatever action is deemed appropriate by Owner.

C. Subject to the terms and operation of any applicable performance bond, if Owner has terminated the Contract for cause, Owner may exclude Contractor from the Site, take possession of the Work, incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere, and complete the Work as Owner may deem expedient.

D. If Owner proceeds as provided in Paragraph 16.02.B, Contractor shall not be entitled to receive any further payment until the Work is completed. If the unpaid balance of the Contract Price exceeds the cost to complete the Work, including all related claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals) sustained by Owner, such excess will be paid to Contractor. If the cost to complete the Work including such related claims, costs, losses, and damages exceeds such unpaid balance, Contractor shall pay the difference to Owner. Such claims, costs, losses, and damages incurred by Owner will be reviewed by Engineer as to their reasonableness and, when so approved by Engineer, incorporated in a Change Order. When exercising any rights or remedies under this paragraph, Owner shall not be required to obtain the lowest price for the Work performed.

E. Where Contractor's services have been so terminated by Owner, the termination will not affect any rights or remedies of Owner against Contractor then existing or which may thereafter accrue, or any rights or remedies of Owner against Contractor or any surety under any payment bond or performance bond. Any retention or payment of money due Contractor by Owner will not release Contractor from liability.

F. If and to the extent that Contractor has provided a performance bond under the provisions of Paragraph 6.01.A, the provisions of that bond shall govern over any inconsistent provisions of Paragraph 16.02.B.

DIVISION 0 - SECTION 00836
WAIVER OF RIGHT TO CLAIM
AGAINST THE PUBLIC CONSTRUCTION BOND
(FINAL PAYMENT)

The undersigned, in consideration of the final payment in the amount of $ _____, hereby waives its right to claim against the Public Construction Bond for labor, services, or materials furnished to _____ _____ on the job of Highlands County, a political subdivision of the State of Florida, for improvements to the following described project: LAKE JACKSON WATERSHED HYDROLOGY GROUNDWATER, METEOROLOGY AND SURFACE WATER/STREAM FLOW SENSOR ACQUISITION AND INSTALLATION.

DATED ON _____, 2017.

By:_____

IN WITNESS WHEREOF _____ have (has) hereunto set hand and seal this _____day of _____, 2017.

WITNESS:

_____ (Seal)

Print Name:_____

SWORN AND SUBSCRIBED TO BEFORE ME THIS _____day of _____, 2017.

_____
Notary Public
State of Florida-at-Large

My Commission Expires: _____

WAIVER OF RIGHT TO CLAIM
AGAINST THE PAYMENT BOND
(PROGRESS PAYMENT)

The undersigned, in consideration of the sum of $_____, hereby waives its right to claim against the Public Construction Bond for labor, services, or materials furnished through (insert date) to (insert the name of your customer) on the job of (Highlands County, a political subdivision of the State of Florida), for improvements to the following described project: LAKE JACKSON WATERSHED HYDROLOGY GROUNDWATER, METEOROLOGY AND SURFACE WATER/STREAM FLOW SENSOR ACQUISITION AND INSTALLATION

This waiver does not cover any retention or any labor, services, or materials furnished after the date specified.

DATED ON _____, 2017.

By:_____

IN WITNESS WHEREOF _____ have (has) hereunto set hand and seal this _____day of _____, 2017.

WITNESS:

_____ (Seal)

Print Name:_____

SWORN AND SUBSCRIBED TO BEFORE ME THIS _____day of _____, 2017.

_____
Notary Public
State of Florida-at-Large

My Commission Expires: _____

DIVISION 1 - SECTION 01010
SUMMARY OF WORK
ITB 18-010

Article 1 - General

1.01 Description

A. This Section summarizes the Work of the Project as covered in detail in the complete Contract Documents.

B. This is a general summary and is not intended to be complete and all-inclusive of the required Work items. Furnish all labor, materials, tools, equipment and services as indicated in accord with provisions of Contract Documents.

C. Related specifications include but are not limited to

(1) Division 02 – Section 02010 Groundwater Monitoring Well Installation, Section 02020 Meteorological Station Installation, Section 02030 Staff Gauge Installation, Section 02031 Stilling Well Installation.

1.02 Work covered by the contract

A. Introduction:

(1) The Highlands County Natural Resources Department is inviting bids from qualified vendors for the acquisition and installation of ten (10) surficial aquifer system monitoring wells at seven (7) locations, the installation of three (3) automated lake stage and streamflow recorders, and one (1) automated weather station pursuant to Southwest Florida Water Management District specifications.

B. Groundwater Wells:

(1) Install single two inch (2”) internal diameter shallow surficial aquifer system (SAS) wells [50’ or less below land surface(BLS)] at site #1 and site #4 as shown on Figure 1, to the depth specified in Table 1, as verified by a Florida Professional Geologist retained by the owner. Install two single four inch (4”) internal diameter deep SAS wells (50’ to 150’ BLS) at site #2 and site #5 as shown on Figure 1, to the depth specified in Table 1, as verified by a Florida Professional Geologist retained by the owner. Each of these wells shall be installed flush to the ground as specified in Figure 2, taken from the “Monitoring Well Design and Construction Guidance Manual” (FDEP 2008). Installation shall be per the “Minimum Requirements for the Collection and Management of Hydrologic and Meteorologic Data” (SWFWMD 2014, p 8, FDEP 2008, p 6-10).

(2) Install paired shallow and deep SAS wells with instrumentation at sites #3, #6 and #7 as shown on Figure 1, to the depth specified in Table 1, as verified by a Florida Professional Geologist retained by the owner; the shallow wells for the paired sites will be two inch (2") internal diameter and the deep wells will four inch (4") diameter. The instrumentation for each pair of wells will consist of a pressure transducer for each well, cable, data recorder and weather-proof cover. The automated recording devices must meet the SWFWMD minimum criteria for groundwater level measurement (SWFWMD 2014, p. 21). Because of the data recording requirement, these wells will be installed with the well casing extending above the land surface as feasible, and incorporate lockable metal wellhead protectors (Figure 3 and Figure 4, SWFWMD 2014). Each of these paired wells shall be installed per "Minimum Requirements for the Collection and Management of Hydrologic and Meteorologic Data" (SWFWMD 2014, p 8).

(3) Well installation must be by a groundwater well installer holding a valid license in the State of Florida. The location and elevation of each well must be established per the DATUM section of the Minimum Requirements for the Collection and Management of Hydrologic and Meteorologic Data" (SWFWMD 2014, p 2-5). All location and elevation surveys shall be based on two National Geodetic Survey (NGS) second order or better published benchmarks. All elevations shall be established to NGS third order standards and certified to those standards by a Professional Surveyor and Mapper registered in the State of Florida. All data shall be recorded in feet relative to the North American Vertical Datum of 1988 (NAVD88).

Table 1. Well site information subject to modification based on site specific conditions

Well #	Digital Elevation Model Elevation (ft. NAVD88)	Shallow SAS Depth (ft. BLS)	Deep SAS Depth (ft. BLS)	Well size
1	123	50	-----N/A-----	2"
2	102	-----NA-----	150	4"
*3**	*101*	*30*	*150*	*2" and 4"*
4	108	50	-----N/A-----	2"
5	102	-----N/A-----	100	4"
*6**	*123*	*50*	*150*	*2" and 4"*
*7**	*105*	*30*	*150*	*2" and 4"*

*Locations with both shallow and deep SAS wells

Table 2. Well Locations (Electronic location file available upon request.)

Well #	Parcel number	Neighborhood	Parcel Owner
1	S-29-34-29-070-0940-00D0	Town of Sebring	City of Sebring*
2	S-23-34-28-020-00M0-006A	Lake Jackson Northwest	Board of County Commissioners
3	C-06-35-29-110-0000-0080	Sparta Road North End	Board of County Commissioners
4	S-33-34-29-080-0000-0160	Sebring SE Lakeview Dr. Area	Board of County Commissioners
5	S-23-34-28-020-00B0-0051	US 27 Fairmont Dr. to Sparta Rd	City of Sebring
6	C-23-34-28-A00-0450-0000	Rural Tracts in 34/28	Board of County Commissioners
7	S-19-34-29-060-2520-0000	Lake Jackson Hidden Beach Area	City of Sebring

C. Installation of Meteorological monitoring system

(1) Install a Global Water WE-800 Weather station or approved equivalent with the following additional sensors: 1) WE100 Barometric Pressure Sensor, 2) WE300 Solar Radiation Sensor, 3) BC100 Smart Battery Charger, 4) EP180 Evaporating Pan, 4) RG600 Rain Gauge with 8" tipping bucket and 5) SP102 Solar Panel. The location for this station is shown in Figure 5. Installation shall be per SWFWMD Minimum Requirements for the Collection and Management of Hydrologic and Meteorologic Data, Structure and Installation – Precipitation Monitoring (p 9). Automated meteorological recording devices must meet the SWFWMD minimum criteria for recording meteorological data (SWFWMD 2014, p 22).

(2) The meteorological station location and elevation must be established from two National Geodetic Survey second order or better published benchmarks. All elevations shall be established to NGS third order standards and certified to those standards by a Professional Surveyor and Mapper registered in the State of Florida.

(3) The location and elevation of the meteorological station must be established per the DATUM section of the Minimum Requirements for the Collection and Management of Hydrologic and Meteorologic Data" (SWFWMD 2014, p 2-5). All location and elevation surveys shall be based on two National Geodetic Survey (NGS) second order or better published benchmarks. All elevations shall be established to NGS third order standards and certified to those standards by a Professional Surveyor and Mapper registered in the State of Florida. All data shall be recorded in NAVD88.

D. Installation of Surface water monitoring system

(1) Install one (1) automated lake stage / flow recorder at each of the three (3) locations specified in Table 3 and shown on Figure 6. Suggested platform design is per Figure 7. Installation shall be per SWFWMD Minimum Requirements for the Collection and Management of Hydrologic and Meteorologic Data, Structure and Installation –

Surface Water Level Monitoring (p 5). Automated level recording devices must meet the SWFWMD minimum criteria for water level measurements (SWFWMD 2014, p21) and surface water flow monitoring measurements (SWFWMD 2014, p. 23).

(2) The surface water monitoring station installation must be by a marine contractor holding a valid license in the State of Florida. The location and elevation of each surface water monitoring station must be established per the DATUM section of the Minimum Requirements for the Collection and Management of Hydrologic and Meteorologic Data" (SWFWMD 2014, p 2-5). All location and elevation surveys shall be based on two National Geodetic Survey (NGS) second order or better published benchmarks. All elevations shall be established to NGS third order standards and certified to those standards by a Professional Surveyor and Mapper registered in the State of Florida. All data shall be recorded in NAVD88.

Table 3. Surface Water Monitoring Locations. (Electronic location file available upon request.)

Automated Water Level / Streamflow Monitoring Site	Parcel Number	Latitude	Longitude	Parcel Owner*
1	N/A	27º 30' 48.26" N	81º 28' 44.63" W	N/A
2	C-06-35-29-A00-0022-0000	27º 28' 06.81" N	81º 27' 30.74" W	Jack Morton and Alexander Debay
3	C-05-35-29-060-0000-0610	27º 27' 59.48" N	81º 26' 45.22" W	Francis I Cooperative Association Inc.

*Highlands County has a drainage easement on each of these locations.

E. References

(1) Google Earth Pro version 7.1.8.3036 (32-bit), http://earth.google.com, 2017.

(2) Interactive GIS Map, Highlands County Property Appraiser, http://hcpao.org/gis, 2017.

(3) "Lake Jackson Watershed Hydrologic Investigation Task 1b Hydrologic Data Inventory and Recommendations for Additional Data Collection. FINAL Recommendations Report." AIM Engineering Inc, 2016. See Appendix 03.

(4) "Minimum Requirements for the Collection and Management of Hydrologic and Meteorologic Data," Hydrologic Data Section, Southwest Florida Water Management District, 2014, 55p. See Appendix 04.

(5) “Monitoring Well Design and Construction Guidance Manual,” Florida Department of Environmental Protection Bureau of Water Facilities Regulation, 2008. See Appendix 02.

Figure 1. Locations of ground water monitoring wells

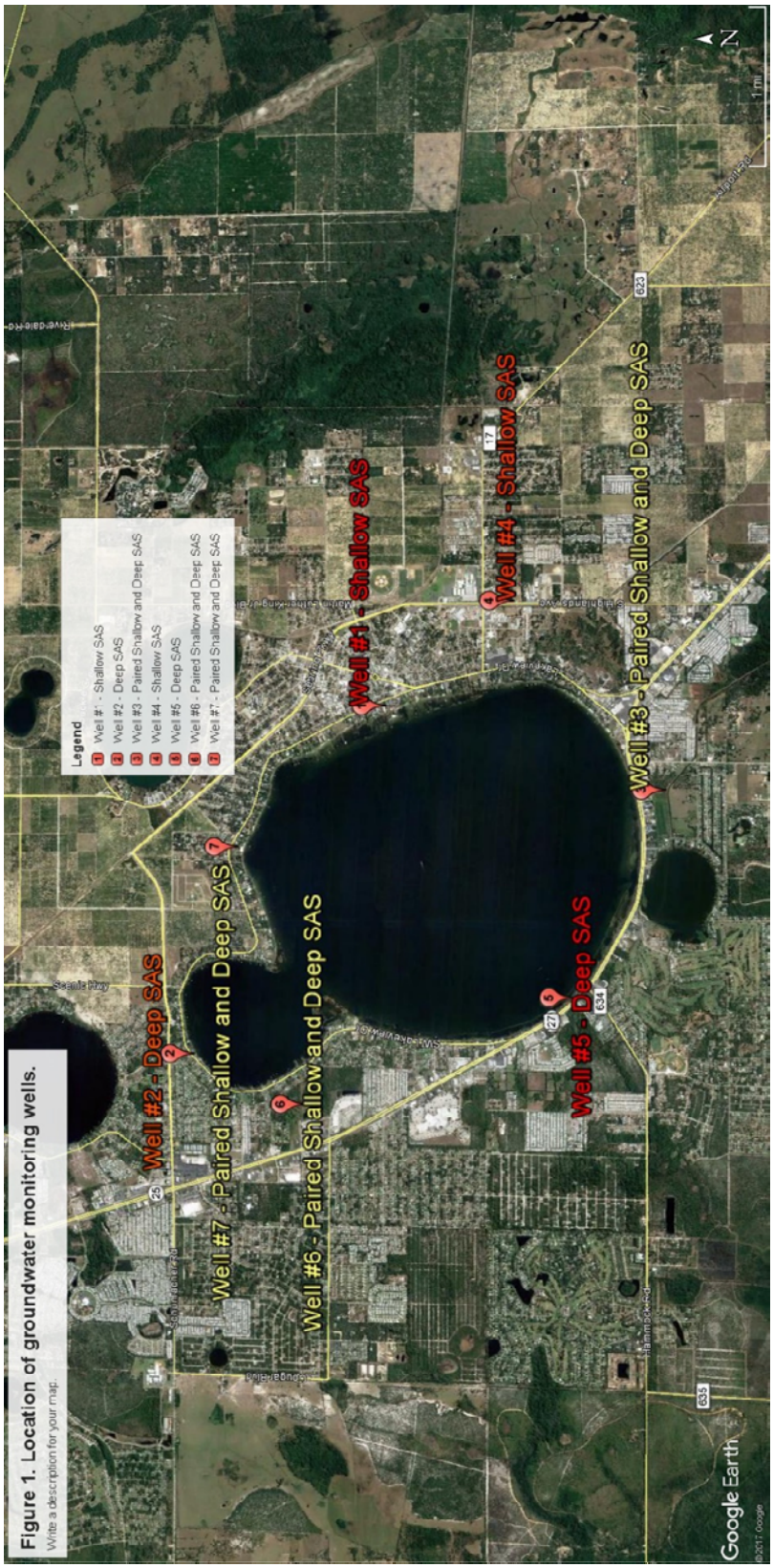


Figure 2. Flush mount well (Figure 3 in DEP 2008).

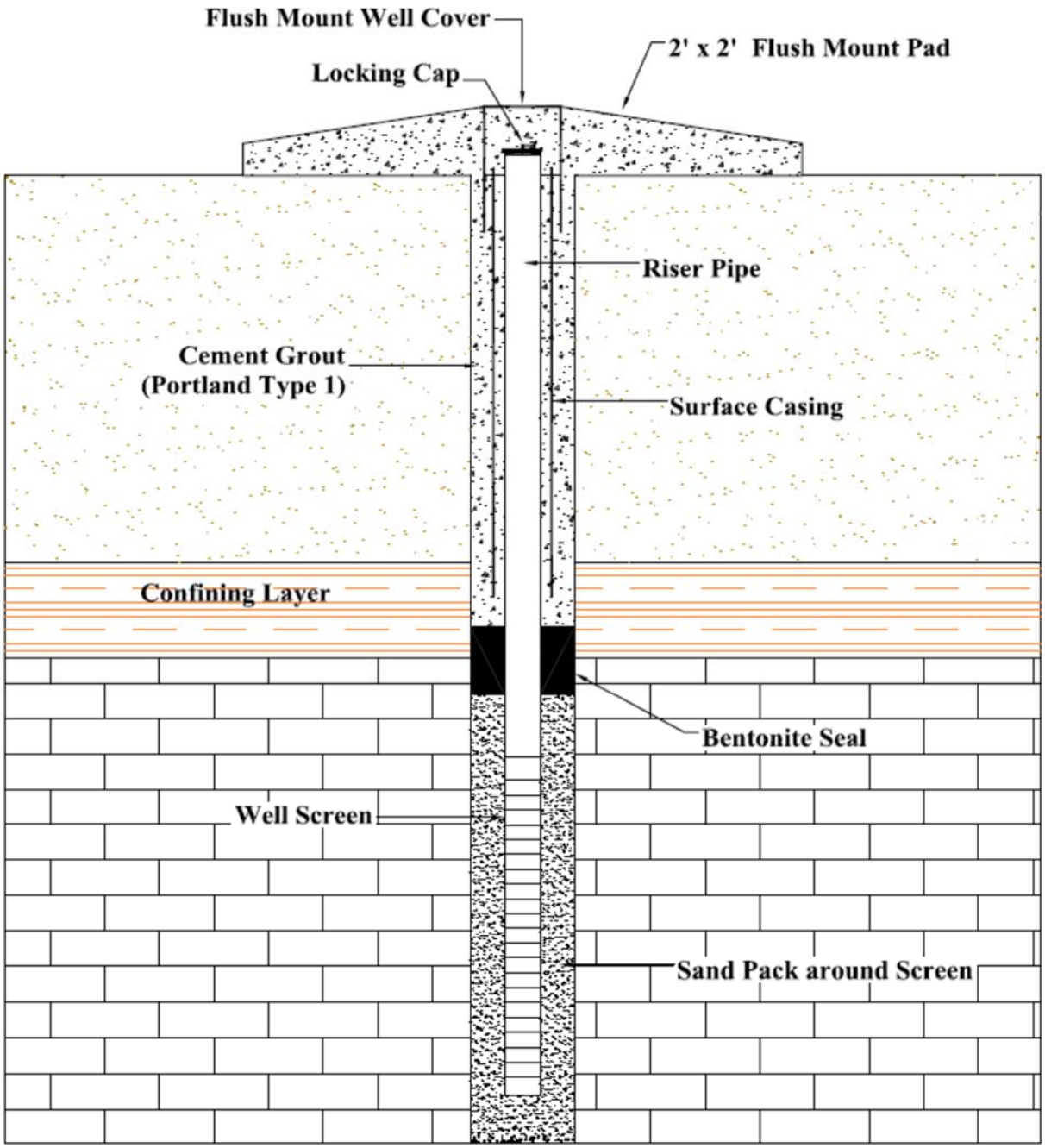


Figure 3. Above ground mount well and protective casing. (Figure 4 in FDEP 2008).

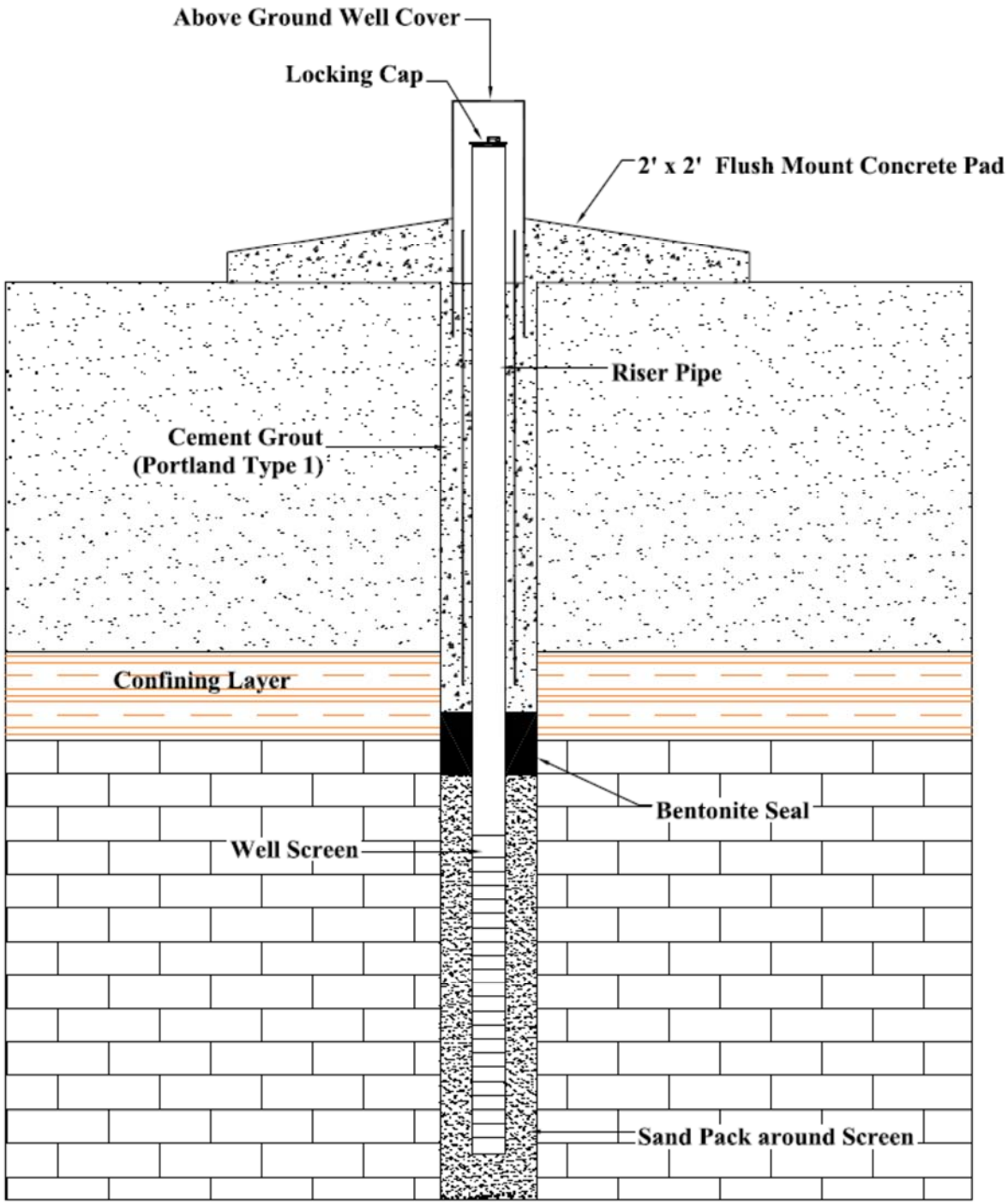


Figure 4. Lock cap detail (Detail 7 in SWFWMD 2014)

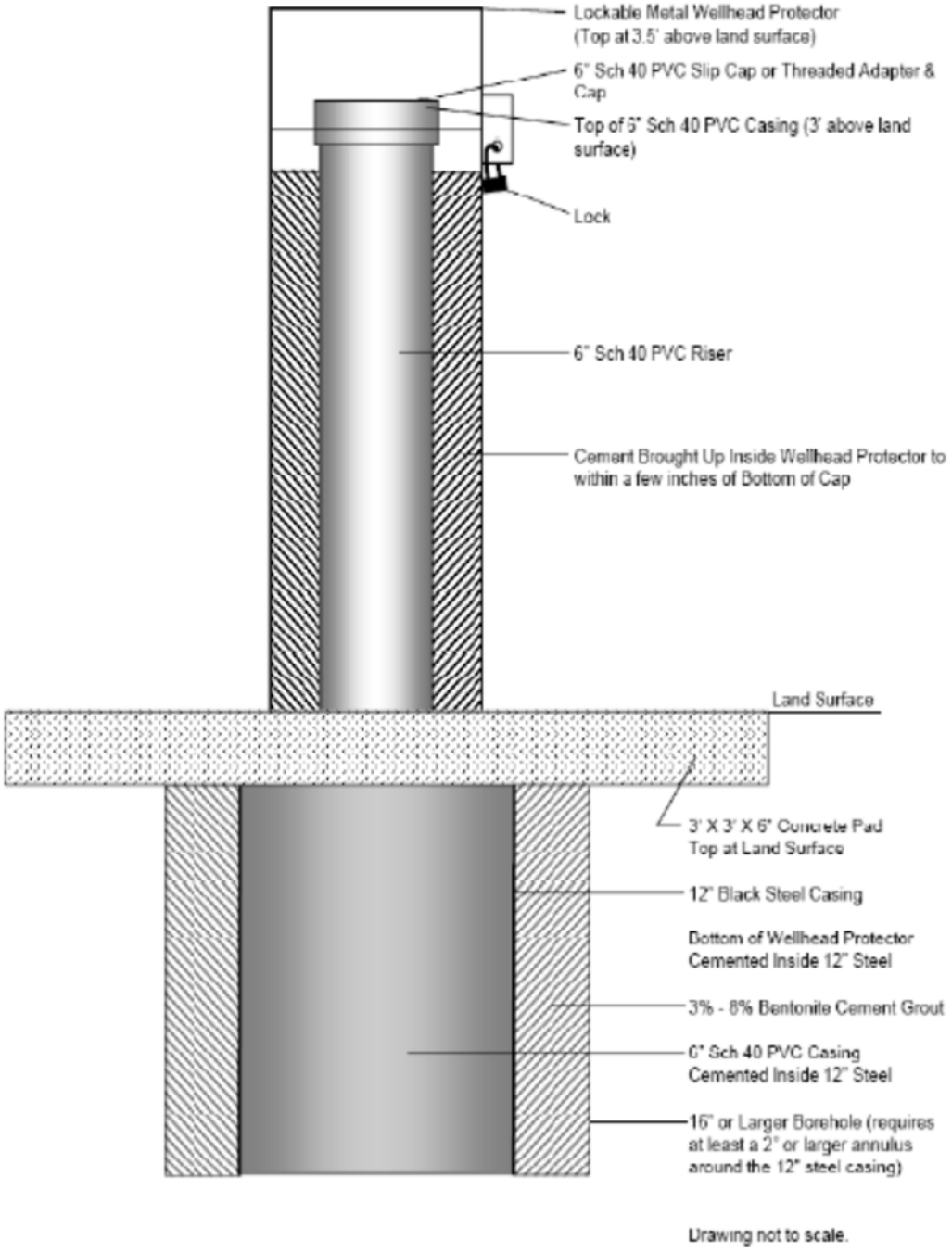
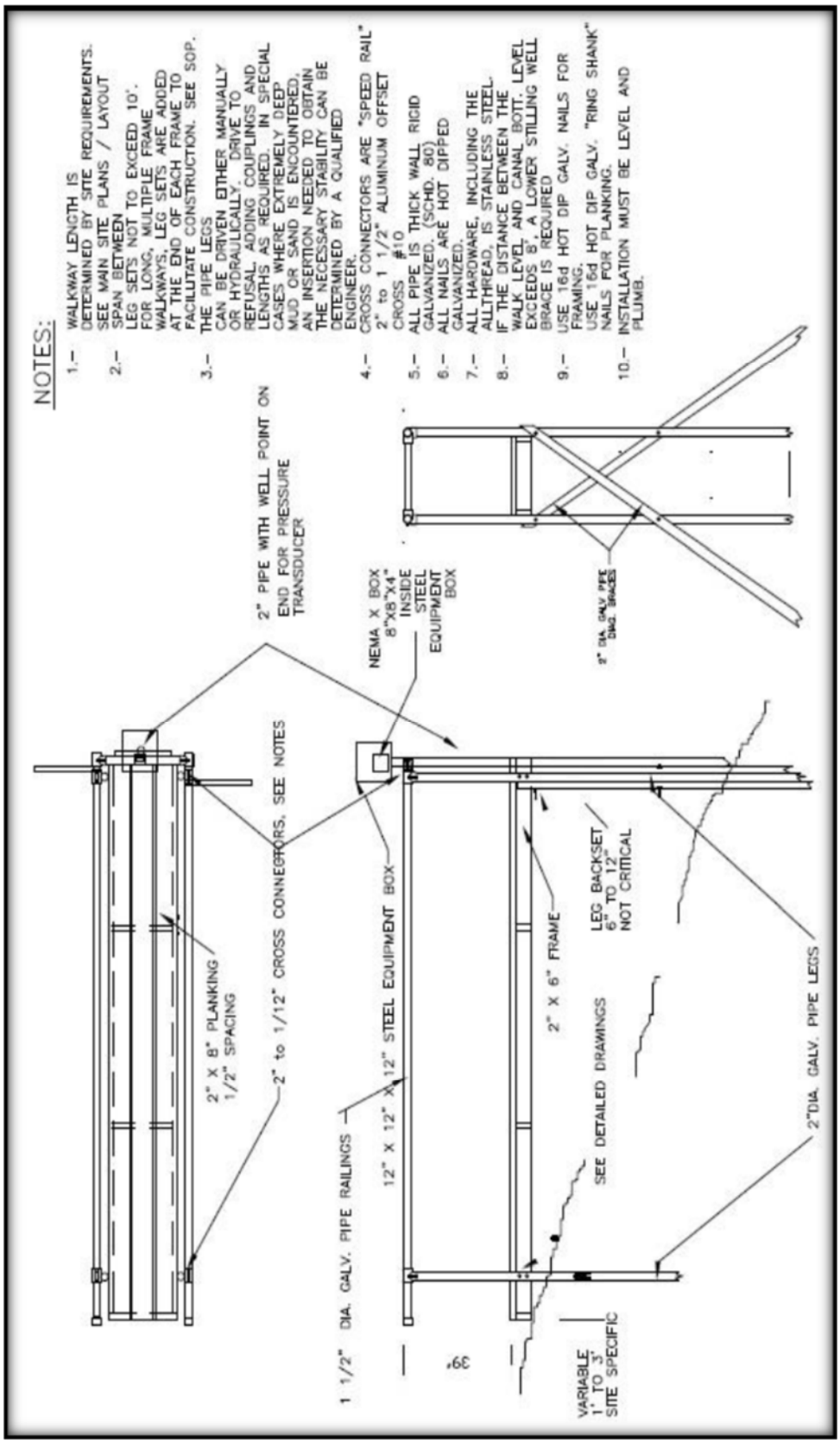


Figure 5. Location of meteorological station (Highlands County Property Appraiser, 2017)

Figure 6. Location of surface water well / streamflow monitoring sites

Figure 7. Example of automated water level/streamflow monitoring platform station (Figure 23 in AIM 2016).



DIVISION 1 - SECTION 01050
FIELD ENGINEERING AND SURVEYING
ITB 18-010

Article 1 - General

1.01 SUMMARY

A. The intent of this specification is to briefly describe the responsibilities of the contractor with regards to field engineering for construction of groundwater & surface water monitoring wells and a meteorological station.

Article 2 - PRODUCTS

2.01 CONSTRUCTION LAYOUT

A. It shall be the Contractor's responsibility to:

(1) Perform all required field surveying in order to construct all of the said activities stated above.

(2) Establish all required horizontal and vertical control required for the project work areas by utilizing permanent and temporary benchmarks.

(3) Procure a registered in the State of Florida surveyor to perform the required work.

(4) Record the drilled well depths, provide vertical elevations at each wellhead and surface water monitoring location.

2.02 SURVEYING STANDARDS

A. Standards apply to all monitoring stations.

(1) All vertical elevations shall commence from a minimum of two (2) National Geodetic Survey (NGS) second order or better published benchmarks.

(2) All elevations shall be established to NGS third order standards and certified to those standards by a Professional Surveyor and Mapper registered in the State of Florida.

(3) All elevations shall be established in NAVD 88.

(4) State Plane Coordinates (NAD 83/2011) shall be established at benchmark locations with a positional accuracy of +/- three (3) feet.

B. As Built:

(1) Datum:

a. Horizontal: NAD 83/2011 (Florida East Zone)

b. Vertical: NAVD 88

Article 3 - DOCUMENTATION

3.01 As-Built Drawings

A. It shall be the Contractor's responsibility to:

(1) Maintain a marked up set of the construction survey or drawings that accurately reflects all changes made to the work as approved by County staff.

(2) Provide the record drawings to the County at the end of the project so that accurate as-built drawings can be produced by the County.

DIVISION 1 - SECTION 01340
SUBMITTALS
ITB 18-010

Article 1 - General

1.01 SUBMITTALS

A. Bid-Opening Meeting – CONTRACTOR shall furnish all items required in Section 00300 Item D with their sealed bid submittal.

B. Pre-Construction Meeting – CONTRACTOR shall furnish the following at the time of the pre-construction meeting:

(1) Maintenance of Traffic Plan (if necessary), which follows the requirements set forth in the FDOT Design Standards, latest edition.

(2) Construction Schedule (Gantt Chart or equivalent) which outlines the construction events from Mobilization to 'Final Completion' of the project.

(3) Lines of Authority which details the names, position, and contact information of the individuals involved with the work for the project.

(4) Hurricane Preparedness Plan which specifies in detail the necessary steps that the Contractor will follow in the event of a natural disaster.

C. During Construction – CONTRACTOR shall furnish the following throughout the construction of the project.

(1) Testing Reports which will include any material or water testing for the project. These said tests will be at the request of the COUNTY. Reports shall be conducted by a firm or individual that is certified to provide such services.

(2) Geotechnical Analysis Report – Subsurface exploration shall be conducted by a licensed Geotechnical Engineer. Information to be included in the report shall be, but not limited to: soil column, gradation, & water table analysis. The report shall provide, at a minimum, recommendations for depths of monitoring wells and soil capabilities for concrete base pads at the wellhead.

(3) Concrete Mix Designs for well casing and pad at wellhead. Mix design(s) shall meet the requirements set forth in the enclosed document figure.

(4) All equipment installed for the project shall come furnished with said equipment manufacturer's warranty and operation manual. Contractor shall provide these documents once the equipment is installed.

(5) Develop on-site well construction diagram sketch during drilling. Diagram will be finalized by Licensed Geologist representing the County

D. Final Completion – CONTRACTOR shall furnish the following during the final completion process:

(1) As-Built Drawings shall include, but not limited to: location of all monitoring sites, wellhead, well depth, flow meter, etc. elevations. Additional information may be necessary, at the request of the COUNTY or Licensed Geologist representing the County.

DIVISION 2 - SECTION 02010
GROUNDWATER MONITORING WELL INSTALLATION
ITB 18-010

Article 1 - General

1.01 SUMMARY

A. Section includes instructions for installation of groundwater monitoring wells.

B. Installation depths will be site specific, per the guidance of the project professional geologist.

C. Seven groundwater well locations in the Lake Jackson watershed are specified in Section 01010 Summary of Work.

D. SWFWMD well construction permit may be obtained by a contractor licensed per Part III of Chapter 373, Florida Statutes through SWFWMD ePermitting:

www.swfwmd.state.fl.us/permits/wellconstruction/.

E. Related specifications include but are not limited to

(1) Division 00 – Section 00100 Instructions to Bidders, Section 00160 Certifications, Section 00300 Bid Form, Section 00500 Agreement, Section 00700 Standard General Conditions and 00800 Supplementary Conditions.

(2) Division 01 Section 01010 Summary of Work, 01050 Field Engineering and Surveying, 01340 Submittals.

F. References:

(1) Monitoring Well Design and Construction Guidance Manual, Florida Department of Environmental Protection Bureau of Water Facilities Regulation, Tallahassee, FL, 2008. See Appendix 02.

(2) Design and Installation of Monitoring Wells, SESDGUID-101-R1, U.S. Environmental Protection Agency, Science and Ecosystem Support Division, Athens, Ga, 2013.

1.02 SUBMITTALS

A. Information required by the well construction permit. Additional information including but not limited to as built diagrams of well, and as appropriate pressure transducer and data recorder shelter with top of ground survey elevations, distance to critical bench marks and other survey related information.

Article 2 - PRODUCTS

2.01 MATERIALS

A. Shallow surficial aquifer system monitoring wells – single site

(1) 2-inch Schedule 40 PVC riser pipe. Length of riser pipe used will be site specific.

(2) 2-inch schedule 40 PVC slotted (0.1 or 0.2 slot) well screen. Length of well screen used will be site specific.

(3) Surface casing (3.1.9, FDEP 2008).

(4) Cement Grout (Portland Type 1). Amount of grout will be site specific.

(5) Sand pack for screen (3.1.10, FDEP 2008). Amount of sand pack will be site specific.

(6) 2' x 2' flush mount pad.

(7) Flush mount well cover.

(8) Locking cap and padlock.

B. Deep Surficial Aquifer system monitoring Wells

(1) 4-inch schedule 40 PVC riser pipe. Length of riser pipe used will be site specific.

(2) 4-inch schedule 40 PVC slotted (0.1 or 0.2 slot) well screen. Length of well screen used will be site specific.

(3) Surface casing (3.1.9, FDEP 2008).

(4) Cement Grout (Portland Type 1). Amount of grout will be site specific.

(5) Bentonite for seal at confining layer. Amount of bentonite will be site specific.

(6) Sand pack for screen (3.1.10, FDEP 2008). Amount of sand pack will be site specific.

(7) 2' x 2' flush mount pad.

(8) Flush mount well cover.

(9) Locking cap and padlock.

C. Paired Shallow and deep surficial aquifer system monitoring wells.

(1) 2-inch Schedule 40 PVC riser pipe. Length of pipe used will be site specific.

(2) 2-inch schedule 40 PVC slotted (0.1 or 0.2 slot) well screen. Length of well screen used will be site specific.

(3) Surface casing for 2-inch diameter pipe (3.1.9, FDEP 2008).

(4) 4-inch schedule 40 PVC riser pipe. Length of riser pipe used will be site specific.

(5) 4-inch schedule 40 PVC slotted (0.1 or 0.2 slot) well screen. Length of well screen used will be site specific.

(6) Surface casing for 4-inch diameter pipe (3.1.9, FDEP 2008).

(7) Above ground well cover.

(8) Cement Grout (Portland Type 1). Amount of grout will be site specific.

(9) Sand pack for screen (3.1.10, FDEP 2008). Amount of sand pack will be site specific.

(10) Flush mount pad, sufficient size to accommodate two monitoring wells.

(11) Pressure transducers (compensated for barometric pressure), including cable, one per well. Length of cable will be specific to each well

D. Electronic Components and aluminum equipment shelter for paired wells

(1) Data recorder.

(2) Grounding and surge protection including grounding rod for electronic components to protect from lightning strikes and other voltage surges.

(3) Solar panel and battery to provide power to data recorder and other electronic components.

(4) Aluminum equipment shelter, including lid, hasp and lock.

(5) Construction hardware, fasteners, all non-corrosive (aluminum, stainless steel or galvanized).

(6) Padlock to secure equipment in shelter.

Article 3 - INSTALLATION

A. Groundwater wells will be installed following the Monitoring Well Design and Construction Guidance Manual (FDEP 2008). Depth of installation will be determined at each site by the project professional geologist, depending on the type of well and the depth to the shallow surficial aquifer system confining layer.

B. Electronic components shall be installed per manufacturer's specifications for the three sites with continuous recording devices.

Article 4 - DOCUMENTATION

A. Draw a map of the site with distance and directions to the Benchmark

B. Make photographic records of the completed monitoring station

C. Complete a miscellaneous field note with a description of the well, water level readings at the time of note taking, etc.

D. Record GPS location (latitude and longitude) position

E. Update field folder

DIVISION 2 - SECTION 02020
METEOROLOGICAL STATION INSTALLATION
ITB 18-010

Article 1 - General

1.01 SUMMARY

A. Section includes instructions for installation of a meteorological station.

B. Installation site is per locations identified in Section 01010 Summary of Work.

C. Related specifications include but are not limited to

(1) Division 00 – Section 00100 Instructions to Bidders, Section 00160 Certifications, Section 00300 Bid Form, Section 00500 Agreement, Section 00700 Standard General Conditions and 00800 Supplementary Conditions.

(2) Division 01 Section 01010 Summary of Work, 01050 Field Engineering and Surveying, 01340 Submittals.

D. References:

(1) Global Water Publication Number 38600512, Weather Station WE800/WE900, Global Water Instrumentation Inc., College Station, TX, 2012. See Appendix 01.

1.02 SUBMITTALS

A. Information including but not limited to as built diagrams of meteorological station installation, top of ground survey elevations, distance to critical bench marks and other survey related information.

Article 2 - PRODUCTS

2.01 MATERIALS

A. Global Water WE800 Weather Station Data logger, includes Data logger, wind speed sensor, temperature sensor, humidity sensor, solar shield.

B. WE100, Barometric pressure sensor.

C. WE300, Solar Radiation Sensor.

D. BC100, Smart Battery Charger.

E. EP108, Evaporation Pan.

F. RG600, Rain Gauge, 8” Tipping Bucket.

G. SP102, Solar Panel.

H. Electronic Components.

Grounding and surge protection including grounding rod for electronic components to protect from lightning strikes and other voltage surges.

Article 3 - INSTALLATION

A. Meteorological station be installed following the Global Water Publication Number 38600512, Weather Station WE800/WE900 (Global Water 2012).

B. Electronic components shall be installed per manufacturer's specifications.

Article 4 - DOCUMENTATION

(1) Draw a map of the site with distance and directions to the Benchmark

(2) Make photographic records of the completed monitoring station

(3) Complete miscellaneous field notes with a description of the station, elevations, etc.

(4) Record GPS location (latitude and longitude) position

(5) Update field folder.

DIVISION 2 - SECTION 02030
STAFF GAUGE INSTALLATION
ITB 18-010

Article 1 - General

1.01 SUMMARY

A. Section includes instructions for installation of staff gauges, stilling wells.

B. Three locations in Lake Jackson and downstream within waters of the state of Florida have been identified for the placement of these stations, as specified in Section 01010 Summary of Work.

C. FDEP requires that a “Request for Verification of Exemption from Permitting” be completed for each stilling and support structure that is installed.

D. Related specifications include but are not limited to:

(1) Division 00 – Bidding requirements, Contract Forms and Conditions of the Contract

(2) Division 01 Section 01010 Summary of Work, 01050 Field Engineering and Surveying, 01340 Submittals

1.02 SUBMITTALS

A. As built diagrams of structure including staff gauge, stilling well, flow meter and data recorder shelter with survey elevations, distance from shore and access gantry as pertinent to the location.

Article 2 - PRODUCTS

2.01 MATERIALS

A. Staff gauge

(1) Staff gauge must conform to USGS Style A, and be constructed of 16-gage porcelain-enameled iron or steel

(2) 1” x8” pressure-treated wood backing board for mounting staff sections. The backing board shall be painted black with an epoxy paint

(3) 3” x 0.125” aluminum or galvanized pipe/tubing. Length of pipe/tubing will be site specific

(4) Mounting brackets/bolts for attaching backing board to staff gauge

(5) Stainless screws; aluminum/stainless bolts, nuts, flat/lock washers, brackets, etc. to affix staff sections to backing-board

(6) District ID plate.

B. Equipment Needs

(1) Jet pump or post driver

(2) Boat (as applicable); hip/chest waders or dry suit as applicable

(3) Cordless drill, drill bits, hacksaw and other assorted tools necessary to complete staff gauge installation

(4) Carpenter's level

(5) Graduated steel measuring tape

(6) Laser leveling equipment

Article 3 - INSTALLATION

A. The staff gauge must be positioned vertically and secured sufficiently to a stationary object or driven into the bottom sediments to eliminate vertical and horizontal movement.

(1) Assemble all necessary materials and equipment as above.

(2) Attach 3-inch pipe brackets to backing-board with necessary stainless hardware.

(3) Attach gauge sections to the backing-board with necessary hardware making sure gauge sections used will cover the anticipated range of water level fluctuation. Gauge sections are prone to variations in scale so these sections must be calibrated by using a graduated steel measuring tape across the sections and adjusting the gap between them to the measuring tape. Note: gauge sections must be affixed in a manner that allow adjustment for calibration to elevation requirements (per section 01050).

(4) Install the District ID plate on top of the staff gauge or backing-board.

(5) Place the 3 inch aluminum/galvanized pipe (staff) at the location of the gauge placement. The staff must be positioned upright and vertical. [Note: The staff gauge is to be installed separate from the recorder station and within reach to facilitate cleaning and reading.]

(6) Using jet pump or post driver, advance staff vertically downward into the substrate, checking vertical alignment and correctness with a carpenter's level during the advancement process. The staff must be driven into the substrate to a sufficient depth (approximately 4 feet, or to sediment refusal, whichever occurs first) to prevent vertical or horizontal movement under all prevailing environmental conditions at the site. The height of the staff must be planned to remain above extreme high water levels and from becoming inundated or submerged.

(7) Attach the backing board (with gauge sections) to the staff, adjusting it up or down in the water so that the gauge sections will be able to measure increasing or decreasing levels.

(8) Set a reference point on the backing-board at a specific gauge reading point.

(9) Use laser level equipment and establish Benchmark to determine the true elevation of the reference point from step #8.

(10) Adjust gauge sections on the backing-board to correct elevation relative to the reference point.

Article 4 - DOCUMENTATION

A. Draw a map of the site with distance and directions to the Benchmark

B. Make photographic records of the completed staff gauge and monitoring station

C. Complete a miscellaneous field note with a description of the staff, water level readings at the time of note taking, etc.

D. Record GPS location (latitude and longitude) position

E. Update field folder

DIVISION 2 - SECTION 02031
STILLING WELL INSTALLATION
ITB 18-010

Article 1 - General

1.01 SUMMARY

A. Section includes instructions for installation stilling wells, equipment shelters, access walk-ways/docks and equipment to collect and record elevation and flow data.

B. Three locations in Lake Jackson and downstream within waters of the state of Florida have been identified for the placement of these stations, as specified in Section 01010 Summary of Work.

C. FDEP requires that a “Request for Verification of Exemption from Permitting” be completed for each stilling and support structure that is installed.

D. Related specifications include but are not limited to

(1) Division 00 - Section 00100 Instructions to Bidders, Section 00160 Certifications, Section 00300 Bid Form, Section 00500 Agreement, Section 00700 Standard General Conditions and 00800 Supplementary Conditions.

(2) Division 01 - Section 01010 Summary of Work, 01050 Field Engineering and Surveying, 01340 Submittals.

(3) Division 02 - Section 02030 Installation of staff gauges, 02032 Installation of automated, continuous flow readings for measurement of surface water elevation and water flow.

1.02 SUBMITTALS

A. As built diagrams of structure including staff gauge, stilling well, flow meter and data recorder shelter with survey elevations, distance from shore and access gantry as pertinent to the location for each surface water monitoring station.

Article 2 - PRODUCTS

2.01 MATERIALS

A. Stilling Well

(1) 6-inch to 10-inch Schedule 40 PVC slotted (0.1 or 0.2 slot) well screen. Length of well screen used will be site specific.

(2) 6-inch to 10-inch Schedule 40 PVC end cap.

(3) 3-inch diameter aluminum tubing. Length of tubing will be site specific for supporting aluminum equipment shelter.

(4) 2x8 pressure treated wood to attach stilling well to aluminum tubing. Amount will depend on height of equipment shelter above ordinary high water level.

(5) 5-inch aluminum strapping to connect stilling well to tubing supporting aluminum equipment shelter. Length of strapping is determined in the field.

(6) Brackets for mounting to platform.

(7) 6-inch to 10-inch flange to connect PVC well screen to aluminum equipment shelter box.

(8) PVC glue and PVC cleaner.

B. ELECTRONIC COMPONENTS

(1) Pressure transducer (compensated for barometric pressure), including cable.

(2) Acoustic flow meter, including cable.

(3) Data recorder.

(4) Grounding and surge protection including grounding rod for electronic components to protect from lightning strikes and other voltage surges.

(5) Solar panel and battery to provide power to data recorder and other electronic components.

C. ALUMINUM EQUIPMENT SHELTER, SUPPORT PLATFORM AND WALKWAY

(1) Aluminum equipment shelter, including lid, hasp and lock.

(2) 4x4 pressure treated lumber sufficient to support walkway from shore to stilling well and aluminum equipment shelter.

(3) 2x4 pressure treated decking sufficient to construct a walkway and rails from shore to stilling well.

(4) Construction hardware, fasteners, all non-corrosive (aluminum, stainless steel or galvanized).

(5) Padlock to secure equipment in shelter.

D. Equipment Needs

(1) Jet pump or post driver

(2) Boat (as applicable); hip/chest waders or dry suit as applicable

(3) Cordless drill, drill bits, hacksaw and other assorted tools necessary to complete equipment installation.

(4) Carpenter’s level

(5) Graduated steel measuring tape.

(6) Construction hardware, fasteners, all non-corrosive (aluminum, stainless steel or galvanized).

Article 3 - INSTALLATION

3.01 The stilling well must be positioned vertically and secured sufficiently to eliminate vertical and horizontal movement. Structure height must be sufficient to keep monitoring equipment above extreme high water levels and must be located in an area deep enough to provide a full range of water level conditions without creating a hazard to navigation.

A. Construct support platform and walkway, jetting or driving support posts sufficiently must be driven into the substrate to a sufficient depth (approximately 4 feet, or to sediment refusal, whichever occurs first) to prevent vertical or horizontal movement under all prevailing environmental conditions at the site.

B. Level and jet or drive aluminum tubing into the substrate to refusal, creating a four-post structure to support the aluminum equipment shelter above and the stilling well below. Attache to supporting pressure treated wood.

C. Cut PVC slotted well screen to appropriate length and glue end-cap to bottom of PVC screen.

D. Drill several ¼ inch holes in bottom of end cap;

E. Use brackets to mount stilling well to 2x8 pressure treated wood.

F. Use appropriate PVC flange to mount on top of stilling well.

G. Use appropriate shelter to mount to flange;

H. Mount to platform

I. Use appropriate brackets to mount stilling well to platform.

Article 4 - DOCUMENTATION

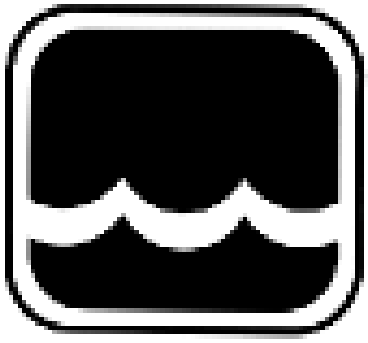
A. Draw a map of the site with distance and directions to the Benchmark;

B. Make photographic records of the completed monitoring station;

C. Complete a miscellaneous field note with a description of the staff, water level readings at the time of note taking, etc.

D. Record GPS location (latitude and longitude) position;

E. Update field folder.



Global Water

Instrumentation, Inc.

151 Graham Road
P. O. Box 9010
College Station, TX 77842-9010
T: 800-876-1172
Int'l: (979) 690-5560, F: (979) 690-0440

Weather Station: WE800 / WE900

Publication Number 38600512

Congratulations on your purchase of the Global Water WE800/WE900 Weather Station. This instrument has been quality tested and approved for providing accurate and reliable measurements. We are confident that you will find the WE800/WE900 to be a valuable asset for your application. Should you require assistance, our technical staff will be happy to help.

Table of Contents

I. Checklist

WE800

a. Weather Sensors

b. Weather Sensor Manual

c. Datalogger

d. Datalogger Communication package (Datalogger Manual, Software, Cable)

e. Mounting Hardware

f. Weather Station Manual

g. 12V Battery (inside Datalogger)

h. Battery charger

WE900

a. Weather Sensors

b. Weather Sensor Manual

c. Mounting Hardware

d. Weather Station Manual

II. Inspection

a. The WE800 / WE900 unit was carefully inspected and certified by Global Water's Quality Assurance Team before shipping. If any damage has occurred during shipping, please notify Global Water Instrumentation, Inc. and file a claim with the carrier involved.

   Use the checklist to ensure that everything needed to operate the Weather Station was shipped.

III. Description

a. The Global Weather Station is a rugged and reliable system for monitoring and/or recording several weather related sensors. The standard logging model can monitor and record up to seven 4-20 mA sensors and one pulse output sensor, such as a rain gauge.

IV. Installing the Weather Station

a. Please refer to Appendix A and B prior to installing the Weather Station to review any optional sensor's mounting instructions that may modify the standard setup.
b. Each sensor comes equipped with mounting hardware for a 1" diameter pipe.
c. The Weather Station stand consists of a 1" diameter stainless steel cross bar with a T fitting and the mast (two 1" diameter tubes connected together with a pvc insert). The top piece of the mast has a T fitting with a 1" stub attached also.
d. Insert the bottom of the mast into a solid base and secure it. Global Water sells a Tripod for this purpose, WE830.
e. Slide the top of the mast onto the pvc insert to complete the mast.
f. Mount the cross bar to the top of the mast using the attached T fitting. Tighten the set screw with the enclosed hex wrench. Ensure that the

cross bar is level. NOTE: For best results the cross bar should be at least 8' above the ground or roof.

g. The Wind Speed and Wind Direction sensors should be mounted on the opposite ends of the cross bar. Loosen the set screw holding the Wind Direction sensor in the elbow. Line up the notches on the Wind Direction Sensor, turn the sensor until the notches face north, and secure the sensor.

h. The Temperature Sensor and Humidity Sensor are pressure fitted inside the Solar Shield. The Solar Shield has a 1" elbow that mounts on the stub attached to the top portion of the mast. Place the elbow on the stub and secure with the set screw.

i. If the mast is in an area of extreme wind it may be necessary to secure the Weather Station with guy wires (not included).

V. Weather Station Calibration Information

WE800

a. The Weather Station comes factory calibrated and the sensors are pre-attached to the Datalogger and if removed should be reattached to the same channel. Refer to the Weather Sensor manual to determine how often each sensor should have its calibration checked. Refer to the Datalogger manual for instructions on recalibration.

WE900

a. Each Weather Sensor will have to be calibrated to your PLC, RTU, or SCADA system. Calibration numbers have been attached to each sensor. Refer to the Weather Sensor manual to determine how often each sensor should have its calibration checked.

VI. Specifications

a. Refer to the Weather Sensor manual for individual sensor specifications.
b. Refer to the Datalogger manual for datalogger specifications.
c. Weather Station Stand
   Material: 1" Stainless Steel Tube

VII. Maintenance

a. Refer to the Weather Sensor manual for individual sensor maintenance instructions.
b. Refer to the Datalogger for the datalogger's maintenance instructions.
c. Periodic cleaning of the stand may be necessary. Use soap and water.

VIII. Trouble Shooting

a. Refer to Weather Sensor and Datalogger manuals for more information.

Other issues

b. Call us for tech support: 800-876-1172 or (979) 690-5560 (many problems can be solved over the phone). Fax: (979) 690-0440 or Email: globalw@globalw.com.

   Be prepared to describe the problem being experienced, including specific details of the application and installation and any additional pertinent information.

c. In the event that the equipment needs to be returned to the factory for any reason, please call to obtain a RMA # (Return Material Authorization). Do not return items without a RMA # Weather Stationed on the outside of the package.

Include a written statement describing the problems.

Send the package with shipping prepaid to Global Water's factory address. Insure the shipment, as the warranty does not cover damage incurred during transit.

d. When calling for tech support, please have the following information ready;

    1. Model #.
    2. Unit serial number.
    3. P.O.# the equipment was purchased on.
    4. Global Water's sales number or the invoice number.
    5. Repair instructions and/or specific problems relating to the product.

IX. Warranty

a. Global Water Instrumentation, Inc. warrants that its products are free from defects in material and workmanship under normal use and service for a period of one year from date of shipment from factory. Global Water's obligations under this warranty are limited to, at Global Water's option: (I) replacing or (II) repairing; any products determined to be defective. In no case shall Global Water's liability exceed the products original purchase price. This warranty does not apply to any equipment that has been repaired or altered, except by Global Water Instrumentation, Inc., or which has been subject to misuse, negligence or accident. It is expressly agreed that this warranty will be in lieu of all warranties of fitness and in lieu of the warranty of merchantability.

b. The warranty begins on the date of the product's invoice.

X. Appendix A: Optional Equipment Mounting Instructions

Datalogger Mounting Instructions

a. The optional mounting hardware is located on the rear of the Datalogger enclosure.
b. Loosen the nut so the retaining bolt can be removed and the fitting can placed around the mast. Global Water recommends that the Datalogger be attached to the lower portion of the mast.
c. Place the Datalogger on the mast with the cables coming out the bottom of the unit.
d. Secure the bolt in the fitting and tighten the nut to secure the Datalogger to the mast.

Barometric Pressure Sensor Mounting Instructions

a. If the Barometric Pressure Sensor was installed at Global Water, it was installed inside the Datalogger enclosure.
b. If the sensor is being installed in the field Global Water recommends that it be attached to the lid of the Datalogger with tape in such a way that the enclosure can open and close freely. The cable can either be cut, stripped, and connected to the Datalogger on a free channel or the cable can be run out of the enclosure through a free strain relief, run back into the enclosure through a different strain relief, and connected to a free channel on the Datalogger.
c. Ensure that a strain relief hole is open, or the pressure valve is open to allow airflow or the Pressure Sensor will read incorrectly.

Solar Radiation Sensor Mounting Instructions

a. The Solar Radiation Sensor comes with mounting hardware similar to the Wind Direction and Wind Speed Sensors.
b. The T fitting and stub should be mounted on the upper portion of the mast and secured at a height and in a direction where the sensor will not be shaded by any other sensor of object. Tighten the T fitting's set screws with the enclosed hex wrench to secure the stub in place.
c. The Solar Radiation Sensor has a 1" elbow that mounts on the stub. Place the elbow on the stub and secure with the set screw.
d. Use the bubble level and three mounting screws to level the sensor

Tipping Bucket Mounting Instructions

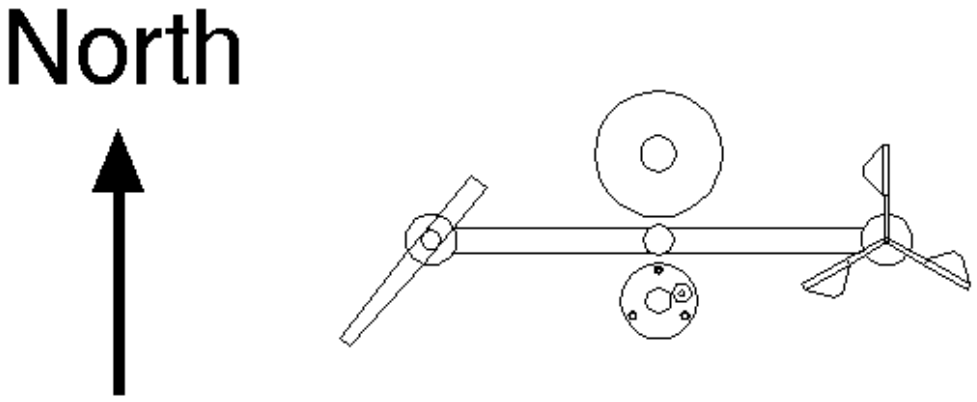
a. See Tipping Bucket manual for installation instructions.

Solar Panel Mounting Instructions

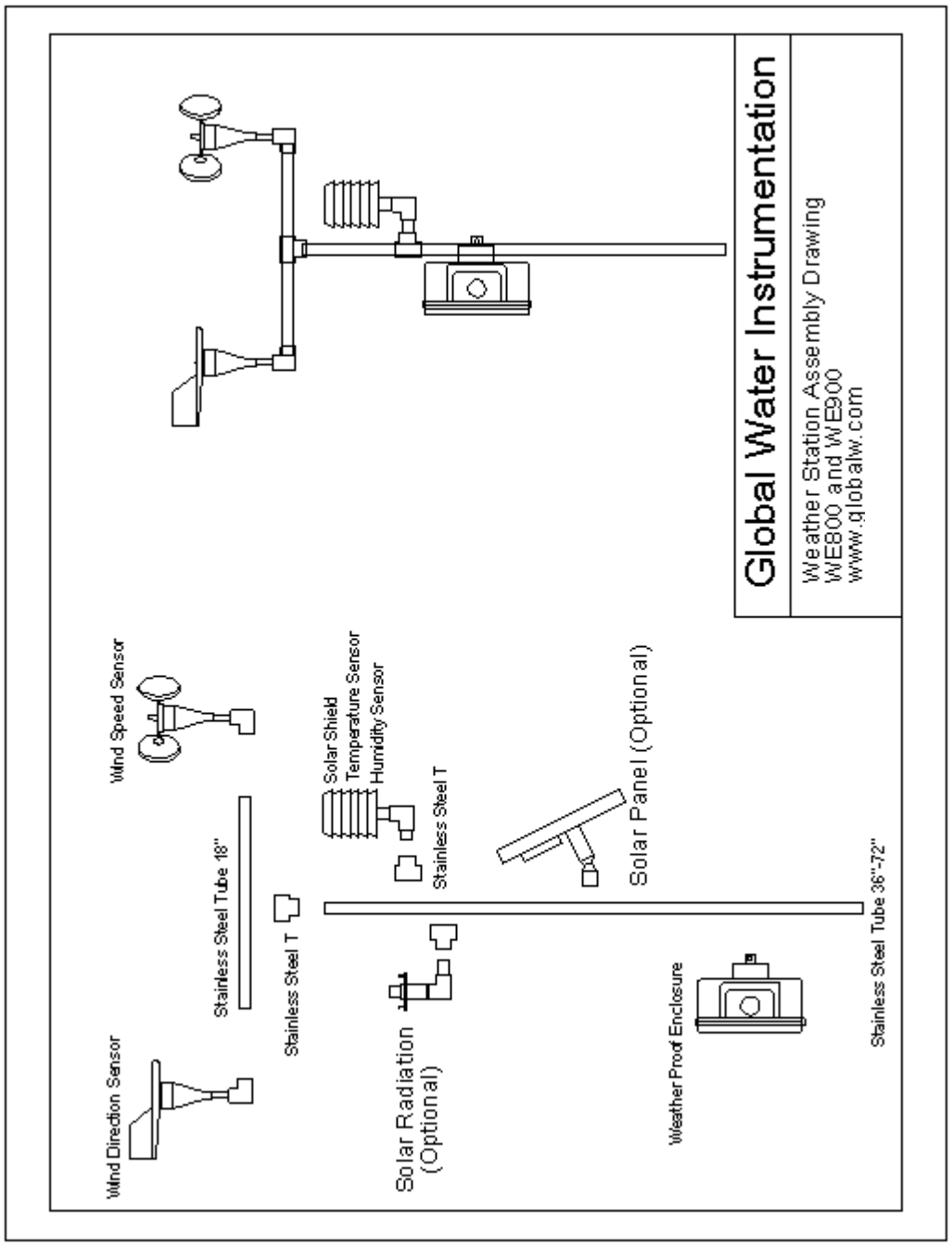
a. The Solar Panel comes with mounting hardware similar to the Wind Direction and Wind Speed Sensors.
b. The T fitting and stub may be mounted any where on the mast as long as the solar panel faces the sun's general path across the sky, refer to the solar panel manual for further instructions, available online at, www.globalw.com, in the downloads section. Tighten the T fitting's set screws with the enclosed hex wrench to secure the stub in place.

Weather Station Orientation

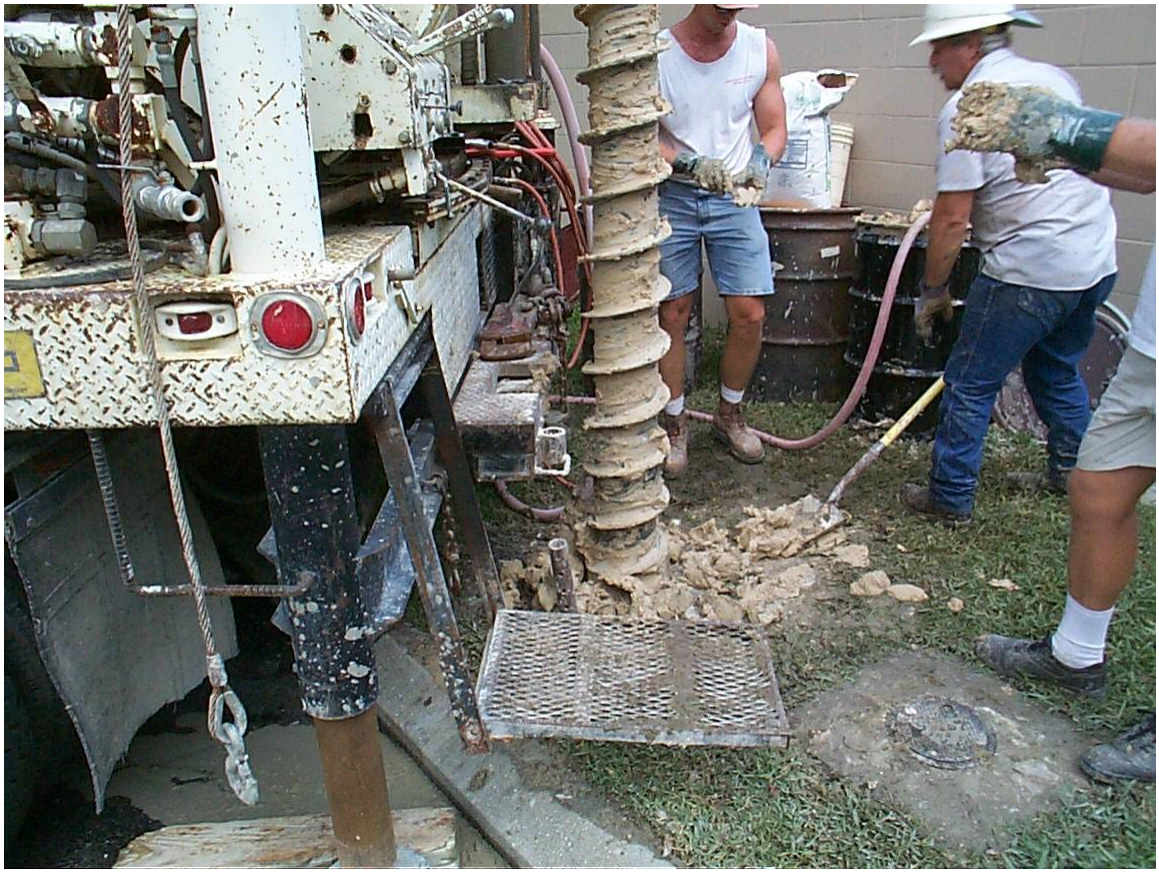
a. For optimal results set your weather station up so that the Wind Speed and Wind Directions Sensors are to the East and West.
b. Place the Solar Shield with all of it's sensors in the same hemisphere you are in (IE if you are in the North hemisphere place it on the North side)
c. Place the Solar Radiation sensor on the side closest to the sun, be sure to level the sensor to get accurate results.
d. Place the Solar Panel under the Radiation Sensor and angle it panel so you get maximum coverage.



Appendix B: Weather Station Assembly Drawing



Monitoring Well Design and Construction Guidance Manual



Florida Department of Environmental Protection
Bureau of Water Facilities Regulation
2008

Table of Contents

Tables, Figures and Forms

FIGURES

TABLES

FORMS

Monitoring Well Design and Construction Guidance Manual

1.0 Introduction

1.1 Purpose

This guidance manual provides the protocols and recommended procedures for the proper design and construction of monitoring wells such that quality ground water samples representative of actual conditions can be collected. A properly designed, installed and developed ground water monitoring well provides ground water samples that exhibit the physical and chemical properties of that portion of the aquifer screened by the well.

1.2 Planning

Each monitoring well within a network requires a design that considers project objective, site geology, hydrology, site history, waste site operational history (if applicable), ground water quality, and anticipated contaminants of concern. Prior to monitoring well design and installation, development of a conceptual hydrogeologic framework that identifies potential flow path and the target monitoring zone(s) is necessary. The following site characterization data elements should be utilized to form a conceptual model of the site:

1) Site geology and hydrology;

2) Potential contaminant sources, properties, and distribution;

3) Release mechanism and rates;

4) Fate and transport processes;

5) Current and potential receptors;

6) Potential remedial options; and

7) Other available site characterization data.

1.3 Design Considerations

The design and installation of monitoring wells should consider 1) permanence, 2) installation methodology, and 3) well construction requirements. Many factors

must be considered when evaluating each of these three components, utilizing only the most reliable data and information. Monitoring requirements and project timeline and objectives will, in part, determine the need for temporary and/or permanent wells. Site conditions, geological and hydrological settings will influence the types of required drilling method, installation procedures and well construction characteristics. When designing monitoring wells, the U.S. Environmental Protection Agency (USEPA) document, *Environmental Investigations Standard Operating Procedure and Quality Assurance Manual*, Section 6, (2001), recommends the following considerations:

1) Short- and long-term objectives,

2) Purpose(s) of the well(s),

3) Probable duration of the monitoring program,

4) Contaminants likely to be monitored,

5) Types of well construction materials to be used,

6) Surface and subsurface geologic conditions,

7) Properties of the aquifer(s) to be monitored,

8) Well screen placement,

9) General site conditions, and

10) Potential site health and safety hazards.

A ground water monitoring and well installation plan can be developed from these data and information. The plan should address all phases of the installation and monitoring program, including site access, health and safety, drilling techniques, decontamination protocol, well installation, well development, well abandonment, sample collection, waste management, and site surveys.

2.0 Drilling Operations

A driller, water well contractor or water well consultant should ensure that all materials and equipment for drilling and installing any given well are available and onsite prior to commencing drilling activities. For long schedules, it should be ensured that the above-mentioned materials needed for at least 2 days of operation are onsite prior to drilling. Site-specific factors that preclude the availability of needed secure storage areas should be identified and resolved in a ground water monitoring plan.

2.1 Logistics

2.1.1 Permitting, Licenses and Registration

The driller, water well contractor, and/or water well consultant is responsible for identifying all applicable permits, licenses, professional registration, rights-of-entry, and applicable State and local regulatory procedures for drilling, well installation, and well abandonment (to include any requirements for the submission of well logs, samples, etc). Acquisition and submittal of these items to State or local authorities should be coordinated between the driller, contactor, and/or consultant, with the responsibilities of each specified in a ground water monitoring plan and subcontract agreements.

2.1.2 Access and Security

The need for any rights-of-entry should be specified in a ground water monitoring plan along with the organization(s) responsible for their acquisition. The driller or water well contractor shall comply with all security policies at a project site. The driller is responsible for securing his own equipment, and should prepare for any special situations identified in a ground water monitoring plan.

2.1.3 Site Safety

Safety precautions should be implemented for any drilling operation and in particular for activities related to the investigation and monitoring of hazardous and potentially hazardous materials sites. When appropriate, a site health and safety plan should be developed and followed during all drilling activities. The driller or designated safety person should be responsible for the safety of the drilling team during all drilling activities. All personnel involved with drilling activities should be qualified in proper drilling and safety procedures. Guidance related to drilling activities is available in Occupational Safety and Health Administration (OSHA) documents, particularly 29 CFR 1910.120 and 29, CFR 1926.

2.1.4 Site Preparation, Well Installation and Restoration

2.1.4.1 Site Reconnaissance

Site visits should be made prior to drilling activities to evaluate physical conditions and equipment and logistical requirements. Particular interests include site access, proximal utilities, barriers and hindrances to movement of equipment, potential hazards, and geographical locations of support facilities (i.e., drilling supplies, drilling water, sample shipment facilities, and emergency facilities). Site modifications and adaptations to drilling plans should be made accordingly and as is practical.

2.1.4.2 Utility Clearances

Prior to drilling or excavation activities, the driller, water well contractor, water well consultant, or appropriate person must coordinate with the appropriate utility locator services to identify and locate all underground utilities and other subsurface features that could obstruct or be damaged by such activities. Digging permits may be required and a locator service given notice to allow adequate time to locate and mark utilities prior to any onsite operations. Overhead utilities and structures should also be considered with respect to clearance space required by the drilling equipment.

As appropriate, boreholes should be advanced to a minimum of two to three feet below land surface (or more as required or needed) with a hand auger or post hole digger. The diameter of the manually advanced borehole should be at least as wide as the largest auger or other equipment to be placed within the borehole.

2.1.4.3 Equipment

The driller should arrive at the site with all the necessary personnel, supplies, and equipment to complete the specified tasks described in Chapter 3.0, Well Design and Material Specifications. All equipment must have been properly inspected, serviced, maintained, and tested prior to relocation to the site to ensure that it is in proper working condition, and to minimize the potential for delays. Sufficient replacement or repair equipment and supplies shall be kept on hand or readily available in the event of mechanical failures or malfunctions.

2.1.4.4 Borehole Requirements

The borehole shall be drilled and constructed so as to 1) allow for the proper construction of the monitoring well, 2) properly monitor the parameters of interest and 3) meet the objectives of the ground water monitoring program. Generally, monitored parameters occur in ground water as aqueous (those dissolved in the ground water) non-aqueous phase liquids (NAPLS) and particulate matter (colloid-sized particles that may be inert or biologically active. The borehole must

allow for the proper placement of the well screen so as to allow for monitoring of parameters based upon chemical and physical characteristics.

The borehole shall be drilled as close to vertical as possible. Slanted boreholes are not acceptable unless specified in the design. The depth and volume of the borehole, including any overdrilling if applicable, should be calculated such that appropriate quantities of materials are procured and installed during well construction. Table A-1 Appendix A, provides several typical volume calculations for use during boring and well installation. If the well boring is drilled too deeply, it should be backfilled to the desired installation depth with pure bentonite pellets (for fine-grained aquifers) or filter sand (for coarse-grained aquifers). If bentonite pellets are used, a minimum of 1 foot of filter sand should be placed above the bentonite prior to screen installation. This will protect the bottom of the well screen from bentonite intrusion.

The selected hollow-stem augers, temporary casing, or permanent surface casing should have an inside diameter (I.D.) sufficient to allow the installation of the prescribed diameter screen and well riser plus annular space for a tremie pipe through which to place the filter pack and annular sealants. It is advantageous that the I.D. of the drill casing or hollow-stem auger be at least 4 inches greater than the outside diameter (O.D.) of the centered well riser and screen. This increased borehole size will allow placement of a wider filter pack, annular seal, and annular grout. This will also allow the use of a 1.5-inch O.D. tremie pipe for emplacing well construction materials. However, larger diameter augers will also result in additional drilling time, increased cost of well installation, and increased production of investigations-derived waste (IDW), including drill cuttings and fluids removed from the borehole and monitoring well. Depending upon the project objectives and regulatory requirements, the advantages must be weighed against the disadvantages such that the project objectives are met with the minimum cost incurred.

When telescoping outer casings (one casing within another), the specified annulus may not be practical or functional. In this case, a lesser spacing allowing for proper grout placement may be acceptable, depending on site specifics and project objectives.

A separate pilot boring should be advanced if significant drilling beyond the desired screen interval(s) is required (as for defining stratigraphy or locating a zone of interest). Upon completion of the exploration, the pilot boring should be properly abandoned and a new boring advanced for the placement of a monitoring well. ASTM Standard D5299 provides guidance for abandonment of boreholes and ground water wells.

2.1.4.5 Well Installation Schedule

Ideally, well installation should begin immediately after boring completion. Once installation has begun, no breaks in the installation process should be made until the well has been grouted and temporary drill casing removed. This includes interruptions due to the end of the driller's work shift, weekend, or holiday. This does not include the time required for proper hydration of the bentonite seal.

Unscheduled delays may occur, including personal injury, equipment breakdowns, or sudden inclement weather. Scheduled delays may also occur such as the time required for downhole geophysical surveys. In such cases, the type of delay, beginning and ending times of the delay, and the delay interval should be noted on a well construction diagram (Section 3.2). In instances where a cased hole into bedrock is to be partially developed prior to well insertion, well installation should begin within 12 hours after this initial development.

Temporary casing and hollow-stem augers may be withdrawn from the boring prior to well installation if the potential for cross-contamination is not likely and if the borehole wall will not slough during the time required for well installation. This procedure is usually successful in firm clays and in bedrock that is not intensely fractured or highly weathered.

Any materials, especially soils, blocking the bottom of the drill casing or hollow-stem auger should be dislodged and removed from the casing prior to well insertion. The use of a bottom plug, dove-tail bit, or internal drill rods during drilling may be beneficial for reducing and/or eliminating soil blocking and heaving sands. If used, the composition of any disposable bottom plug (such as stainless steel or wooden plug) must be appropriate considering the analytical parameters of interest.

2.1.4.6 Restoration

All work areas around the wells and/or borings should be restored to a condition equivalent to that prior to installation. This includes the disposal of borehole cuttings and rut repair. IDW, i.e., borehole cuttings, discarded samples, drilling fluids, equipment cleaning residue, water removed from a well during installation, development, or aquifer testing, and personal protection equipment (PPE) must be disposed of in a manner consistent with a waste management plan and all applicable Federal, State, and local regulations and ordinances. Restoration, disposal procedures, and responsibilities should be discussed in detail in a ground water monitoring plan.

2.2 Oversight

A site geologist, engineer or geotechnical engineer, suitably qualified to conduct hydrogeologic investigations should be present at each operating drill rig. The site geologist, engineer or geotechnical engineer must be familiar with all State,

Federal, and local laws, regulations, and requirements pertaining to the geologist's, engineer's or geotechnical engineer's duties and responsibilities. The geologist, engineer or geotechnical engineer shall be responsible for logging, acquisition, and shipment of samples, boring logs and well construction diagrams, and recording the well installation and abandonment procedures. Ideally, each site geologist, engineer or geotechnical engineer should be responsible for only one operating rig. The geologist, engineer or geotechnical engineer should have onsite sufficient tools, forms, and professional equipment in operable condition to efficiently perform the duties as outlined in this manual or other relevant project documents.

2.3 Drilling Methodology

2.3.1 Objectives

The objectives of selecting a drilling method for monitoring well installation are to use that technique which:

1) Provides representative data and samples consistent with project objectives;

2) Eliminates or minimizes the potential for subsurface contamination and/or cross-contamination; and

3) Minimizes drilling costs.

2.3.2 Methods

There are several drilling methods that can be used for site characterization and to install acceptable monitoring wells. Additional information and details on the various drilling methods can be found in Driscoll (1986), U.S. Army Corp of Engineers (USCOE) (1998), National Ground Water Association (1998) and Section 6.3 of the EPA manual, as well as numerous other sources. In addition, ASTM International maintains standards, ASTM D6286 and ASTM D5092, for selection of drilling methods for site characterization and the design and installation of ground water monitoring wells, respectively, as well as method-specific standards for many drilling techniques. The following drilling methods are most typically used in the installation of monitoring wells:

1) Hollow-stem augers;

2) Solid-stem augers;

3) Water/mud rotary;

4) Air/pneumatic rotary;

5) Sonic;

6) Direct Push; and

7) Casing or cable

The drilling method must be specified and described in a ground water monitoring plan. The plan should also contain detailed rationale for the selection of the specified method including, but not limited to, how the anticipated drilling conditions are accounted for by the selected method and how cross-contamination would be minimized.

2.3.3 Concerns Related to Drilling Methodology

Dry methods: Dry methods advance a boring using purely mechanical means without the aid of an aqueous or pneumatic drilling "fluid" for cuttings removal, bit cooling, or borehole stabilization. In this way, the chemical interaction with the subsurface is minimized, though not eliminated. Local aeration and heating of the borehole wall, for example, may occur simply by the removal of compacted or confining soil or rock (USCOE, 1998).

Aqueous methods: Aqueous drilling methods use fluid, usually either approved water or water and bentonite slurry, for cuttings removal, bit cooling, and borehole stabilization (USCOE, 1998). For environmental work, the use of these materials increases the potential to add a new contaminant or suite of contaminants to the subsurface environment adjacent to the boring. Even the removal of one or more volumes of water equal to the volume lost during drilling will not remove all of the lost fluid. The level of effort to be expended upon well development is directly related to the amount of fluid lost during drilling: a minimum of five times the volume lost should be removed during development. Therefore, the less fluid loss, the less the development effort, time, and cost.

Air/Pneumatic Rotary methods: Air/pneumatic rotary methods involve the use of compressed air to evacuate cuttings. Potential problems with this method include the introduction of pollutants such as hydrocarbons into the subsurface from the compressed air source, volatilization/stripping of contaminants from the subsurface, and mobilization of dust and/or vapor phase components to create a potential breathing hazard. However, this method may be advantageous in materials where circulation of other fluids cannot be maintained. Appropriate dust collection/suppression equipment must be provided. Wells installed using this method must be developed until the water becomes clear and free of sediment.

Sonic methods: The fundamental difference between the sonic drilling method and other rotary-type methods is that it employs a combination of rotation and high-frequency vibration for drill bit penetration. This method is suitable for use

in either consolidated or unconsolidated materials. The advantages of this technology are rapid drilling rates and relatively minimal amounts of waste generated. Disadvantages include potential disturbance to samples collected for geotechnical analyses and volatilization of chemical samples.

Direct push Technologies: Direct push technologies (DPT) utilize equipment that push or drive steel rods into the ground. They allow cost-effective, rapid sampling and data collection from unconsolidated soils and sediments. A tremendous variety of equipment is available, particularly in the type of attachments used at the end of rods to collect samples and data. These attachments may collect soil, soil gas, or ground water samples; they may conduct *in situ* analysis of contaminants; or they may collect geophysical data that are continuously logged as the DPT rods are advanced. Continuous logs of subsurface conditions are particularly valuable because they help to develop a three-dimensional conceptual site model.

Tables 1 and 2 provide a brief description and comparison of some common drilling methods.

Table 1: Drilling Methods for Monitoring Wells

Method and ASTM Standard	Drilling Principle	Depth Limitation Feet (meters)	Advantages	Disadvantages
Auger, Hollow-Stem and Solid-Stem ASTM D5784, ASTM D1452	Successive 5-foot (1.5m) flights of spiral-shaped drill stem are rotated into the ground to create a borehole. Cuttings are brought to the surface by the rotation of the auger flights	150 (45)	• May be inexpensive • Fairly simple, quick setup time and moderately fast operation • Rigs are highly mobile and can reach most drilling sites • No drilling fluid or lubricants used, eliminating contamination from additives • Can be used to avoid hole caving • Hollow-stem allows formation water to be sampled during drilling via screened auger or advancing a well point ahead of the augers • Small-diameter wells can be built inside hollow-stem flights • Hollow-stem allows the collection of split-spoon samples, continuous sampling possible • Natural gamma-ray logging can be done inside hollow-stem flights	• Limited to unconsolidated or semiconsolidated (weathered rock) materials Compact, gravelly materials may be hard to penetrate • Possible problems controlling heaving sands • Rips and smears borehole wall, creating problems with connecting to the aquifer during well development • Well points yields low rates of water • Small diameter well screen may be hard to develop. Screen may become clogged if thick clays are penetrated • May not be able to run a complete suite of geophysical logs

Method and ASTM Standard	Drilling Principle	Depth Limitation Feet (meters)	Advantages	Disadvantages
Water/Mud Rotary (Hydraulic Rotary) ASTM D5783	Rotating bit breaks formation; cuttings are brought to the surface by a circulation fluid (mud). Mud (which should be contaminant-free water and bentonite without additives) is forced down the interior of the drill stem, out the bit, and up the annulus between the drill stem and borehole wall. Cuttings are removed by settling in a mud pit at the ground surface and the mud is circulated back down the drill stem.	5,000+ (1,500+)	• Drilling is fairly rapid in all types of geologic materials, unconsolidated and consolidated • Borehole may stay open from formation of a mud wall on the sides of borehole by the circulating mud • Geologic cores can be collected • A complete suite of geophysical logs can be obtained in the open borehole • Many options for well construction. Can use casing-advancement drilling method, or casing may not be required • Smaller rigs can reach most drilling sites • Borehole can be gravel packed and easily grouted	• May be expensive, requires experienced driller and a fair amount of peripheral equipment; overburden casing required • Drilling fluids mix with formation water, may contaminate and can be difficult to remove. • Completed well may be difficult to develop, especially small diameter wells, due to mud cake invading the formation and is difficult to remove • Geological logging by visual inspection is only fair, can miss strata and composition • Location of water-bearing zones during drilling may be difficult to detect • Drilling fluid circulation is often lost and difficult to maintain in fractured rock, and gravel or cavernous zones • Difficult drilling in boulder and cobble zones • Circulation of drilling mud through a contaminated zone can create a hazard a ground surface and cross-contaminate clean zones • Organic drilling fluids can interfere with bacterial and/or organic-related analyses and are not allowed; bentonitic fluids with metal analyses, but may be necessary.

Method and ASTM Standard	Drilling Principle	Depth Limitation Feet (meters)	Advantages	Disadvantages
Reverse Rotary ASTM D5781	Similar to hydraulic rotary, except the drilling fluid is circulated down the borehole outside the drill stem and is pumped up the inside; the reverse of the usual rotary method. Water is used as the drilling fluid and the borehole is kept open by the hydrostatic pressure of the water standing in the borehole.	5,000+ (1,500+)	• Drilling is readily accomplished in most geologic materials, unconsolidated and consolidated • Drilling is relatively fast and can be used for drilling large diameter boreholes • Large borehole diameter facilitates ease of well installation • Geophysical logs can be run prior to installation of well • Creates a "clean" borehole, not contaminated by introduced fluids • Split-spoon sampling possible	• May be expensive, requires experienced driller and a fair amount of peripheral equipment; overburden casing required • May be difficult to drill in boulder, cobble or cavernous zones • The addition of drilling lubricants may be required: lubricants interfere with borehole wall composition and water chemistry • Cross-contamination from circulating water is likely • A large water supply is needed to maintain hydrostatic pressure in deep holes and when highly conductive formations are encountered • Geologic samples brought to surface are generally of poor quality; fine-grained materials are washed out
Air Rotary ASTM D5782	Similar to hydraulic rotary. Air is used as the primary drilling "fluid" as opposed to mud or water	5,000+ (1,500+)	• Can be used in all geologic formations; most successfully in highly fractured environments • Useful at almost any depth • Drilling rates are usually fast • Can use the casing-advancement method • Drilling mud or water is not required • Borehole is accessible to geophysical logging prior to well installation • Geologic sampling is excellent in hard, dry formations • First water zone easily detected • Well development is relatively easy	• Relatively expensive, requires experienced drill crew • Overburden casing usually required • Air mixes with borehole water and blown from the hole, creating potential for cross-contamination, surface contamination, health and environmental risks • Water flow between zones with different hydrostatic pressures will occur between the time that drilling is completed and the hole is properly cases and grouted • Compressor discharge to air may contain hydrocarbons • Organic foam additives to aid cuttings removals may cause cross contamination

Method and ASTM Standard	Drilling Principle	Depth Limitation Feet (meters)	Advantages	Disadvantages
Air-Percussion Rotary or Down-the-Hole Hammer (DTH) ASTM D5781	Air rotary with a reciprocating hammer connecting to the bit used to fracture rock.	600 (2,00)	• Very fast drill rates • Useful in all geologic formations • Only small amounts of water need for dust and bit temperature control • Cross-contamination potential can be reduced by driving casing • Can use casing-advancement method • Well development relatively easy	• Relatively expensive • As with most hydraulic rotary methods, the rig is large, heavy and has limited accessibility • Overburden casing usually required • Vertical mixing of water and air craters cross contamination potential • Hazard posed to surface environment if toxic compounds are encountered • DTH hammer drilling can cause hydraulic fracturing of borehole wall • The DTH hammer required lubrication during drilling • Organic foam additives for cuttings removal may contaminate samples
Sonic (Vibratory) ASTM D6914	Uses high-frequency mechanical vibration to take continuous core samples of overburden soils and most hard rocks.	500 (150)	• Can obtain large diameter, continuous and relatively undisturbed cores of almost any soil material without the use of drilling fluids • Can drill through boulders, wood, concrete and other construction debris • Can drill and sample most softer rock with a high percentage of core recovery • Drill rates are faster than most other methods • Large reduction of investigation-derived wastes	• Relatively expensive • Equipment is not readily available • Rock drilling requires the addition of water or air or both to remove drill cuttings • Extraction of casing can smear borehole wall with clays and silts • Extraction of casing can damage well screen

Method and ASTM Standard	Drilling Principle	Depth Limitation Feet (meters)	Advantages	Disadvantages
Direct Push ASTM D6724, ASTM D6725	Advances a sampling device into the subsurface by applying static pressure, impacts, or vibrations or any combination thereof to the above ground portion of the sampler extensions until the samples has been advanced its full length into the soil strata.	100 (30)	• Avoids use of drilling fluids and lubricants during drilling • Equipment is highly mobile • Disturbance of geochemical conditions during installation is minimized • Drilling and well screen installation is fast, considerably less labor intensive • Does not produce drill cuttings, reduction of investigation-derived wastes	• Limited to fairly soft materials such as clay, silt, sand and gravel • Compact, gravelly materials may be hard to penetrate • Small diameter well screen may be hard to develop. Screen may become clogged if thick clays are penetrated • The small diameter drive pipe generally precluded conventional borehole geophysical logging • The drive points yield relatively low rates of water
Cable-Tool (Percussion) ASTM D5875, ASTM D5872	Borehole is created by dropping a heavy "string" of drill tools into well bore, crushing materials at the bottom. Cuttings are removed occasionally by bailer. Generally, casing is driven just ahead of the bottom of the hole; a hole greater than 6 inches in diameter is usually made	1,000+ (300+)	• Can be used in consolidated and unconsolidated formations • Can drill boulder, cobble, fractured and cavernous zones • Fairly accurate logs can be made from cuttings if collected often enough • Core samples easily obtained • Driving casing ahead of hole minimizes cross-contamination via vertical leakage of formation waters, maintains borehole stability • Excellent method for drilling in soils and rock where loss of circulation fluids is problematic • Recovery of borehole fluid samples excellent • Excellent method for detecting thin water-bearing zones • Excellent for well development	• The potential for cross-contamination of samples is very high • Steel casing must be used • Heavy steel drive pipe and drilling "tools" can limit accessibility • Heavier wall, larger diameter casing than that used for other drilling methods normally used • Cannot run a complete suite of geophysical logs due to the presence of the drive pipe • Temporary casing can cause problems with placement of effective filter pack and grout seal • Usually a screen must be set before a water sample can be collected • Heaving of unconsolidated sediment into bottom of casing can be problematic

Adapted from U.S. Army Corps of Engineers, November 1998

Table 2: Comparison of Drilling Methods

Drilling Method	Shallow and Intermediate Boreholes	Deep Boreholes	Water Sampling	Soil Sampling	Well Installation	Boulders and other obstructions	Control of Hydrostatic Pressure	Downhole Geophysics
Hollow-Stem Auger	E	P	E	E	E	P	F	L
Solid-Stem Auger	E	P	NA	NA	F	P	P	NA
Water/ Mud Rotary	E	E	P	P	F	G	E	E
Reverse Rotary	E	E	P	P	F	P	E	E
Air Rotary	E	E	P	P	F	G	P	P
Sonic	E	G	E	E	E	E	E	E
Direct Push	E	F	E	E	G	L	E	L
Cable-Tool (Cased Boring)	E	F	E	E	E	G	E	L

Notes:
E = Excellent
G = Good
F = Fair
P = Poor
L = Limited application
NA = Not applicable

2.3.4 Special Concerns

2.3.4.1 Recirculation Tanks and Sumps

Portable recirculation tanks should be used for mud or water rotary operations and similar functions. The use of dug sumps or pits (lined or unlined) are expressly prohibited to minimize cross-contamination and to optimize both personal safety and work area restoration (USCOE, 1998).

2.3.4.2 Surface Runoff

Surface runoff, e.g., precipitation, wasted or spilled drilling fluid, and miscellaneous spills and leaks, should not enter any boring or well either during or after construction. To help avoid such entry, the use of temporary casing, recirculation tanks, berms around the borehole, or temporary surficial bentonite packs is recommended (USCOE, 1998).

2.3.4.2 Drilling Fluids

To the extent practical, the use of water during drilling, and any other water used during well installation and completion, should be held to a minimum. When use of water is deemed necessary, the source of any water used must be specified in the ground water monitoring plan and approved by the appropriate authority. The driller should have the responsibility to procure, transport, and store the approved water required for project needs in a manner that avoids the chemical contamination or degradation of the approved water once obtained.

If there is a suitable source of approved water onsite, the source should be used. If no onsite approved water is available, a potential source must be located and water quality evaluated and approved prior to the arrival of any drilling equipment onsite. It is important that the approved water be free of site-related analytes. It is advantageous that the drilling water be pretested (sampled and analyzed) for the contaminants of interest. Knowledge of the water chemistry is the most important factor for water quality approval. Surface water bodies must not be used as a water source.

Pure bentonite (no additives) is the only drilling fluid additive that is typically allowed under normal circumstances. This includes any form of bentonite (powders, granules, or pellets) intended for drilling mud or sealants. The use of any bentonite shall be adequately discussed in the ground water monitoring plan, including documentation of the manufacturer’s recommendations and product constituents. Bentonite shall only be used if absolutely necessary to ensure that the borehole will not collapse or to improve cuttings removal (USCOE, 1998).

2.4 Decontamination

ASTM Standard D5088 provides guidance for decontamination of field equipment. All drilling equipment that is utilized in drilling or sampling activities must be cleaned or washed with high pressure hot water and decontaminated prior to arriving at the site or at the designated decontamination area before entering the site. This includes drilling rigs, support vehicles, water tanks (inside and out), augers, drill casings, rods, samples, tools, and recirculation tanks. The initial cleaning must be adequate to remove all rust, soil, or other material that may have been transported from another site. Any downhole auguring, drilling, and sampling equipment with paint, rust, or scale that cannot be removed by pressure washing or steam cleaning must be sandblasted prior to arrival on site. All equipment shall be inspected prior to site entry to confirm that all seals and gaskets are intact; no fluids are leaking; and all oil, grease, and other fluids have been removed. No oils or grease may be used to lubricate drill rods or any other equipment being used above or in the borehole without specific approval from the site geologist, engineer or geotechnical engineer. Such approval must be recorded on the well construction form.

All drilling, sampling, and associated downhole equipment that contacts the sample medium shall be cleaned and decontaminated by the following procedures:

1) Clean with approved water, laboratory-grade, phosphate-free detergent, and brush to remove particulate matter and surface films. Steam cleaning or high pressure hot water washing may be used in lieu of, or in addition to, brushing. Equipment that is hollow or perforated to transmit water or drilling fluids must be cleaned inside and outside. The steam cleaner or high pressure hot water washer must be capable of generating a pressure of at least 2500 PSI and producing hot water or steam of at least 200 ° F;

2) Rinse thoroughly with approved water. Approved water may be applied with a pump sprayer. All other decontamination liquids must be applied with non-interfering containers made of glass, Teflon ®, or stainless steel. Rinsing operations will be inspected by the site geologist, engineer or geotechnical engineer prior to initiation of work;

3) Rinse thoroughly with approved decontamination water;

4) Unless otherwise specified, rinse twice with pesticide-grade isopropanol;

5) Rinse thoroughly with approved decontamination water and allow to air dry;

6) Any equipment that will be stored or transported must be wrapped in aluminum foil (or clean plastic if equipment has been air dried);

7) Any printing or writing on well casing, tremie pipe, etc., arriving on site must be removed with sandpaper or emery cloth prior to initial cleaning; and

8) Well casing, tremie pipe, or other materials constructed of plastic or polyvinyl chloride (PVC) must be solvent rinsed during the cleaning and decontamination process.

After the onsite cleaning, only the equipment used or soiled at a particular boring or well should need to be cleaned between each boring or well at a given project. Paint applied by the equipment manufacturer may not have to be removed from drilling equipment, depending upon the paint composition and its contact with the environment and contaminants of concern. All equipment must be decontaminated before it is removed from the project site. If drilling requires telescoping casing because of differing levels of contamination in subsurface strata, then decontamination may be necessary before setting each string of smaller casing and before drilling beyond any casing. To the extent practical, all cleaning should be performed in a single remote area that is surficially cross gradient or downgradient and downwind from the clean equipment drying area and from any sited to be sampled. Waste solids and water from the cleaning and decontamination process shall be properly collected and disposed, as discussed in Chapter 5.0, Management of Investigation-Derived Waste. This may require that cleaning be conducted on a concrete pad or other surface from which the waste materials may be collected.

2.5 Sampling and Coring

A sufficient number of soil or rock samples should be collected and evaluated by the site and/or project geologist. The purpose of this collection is to provide a sound basis for the design of the ground water monitoring system. A “sufficient number of samples” is dependent on project-specific objectives, and should be described in the ground water monitoring plan. Soil samples should be collected according to ASTM Standards D1452, D1586, D3550, or D1587, whichever is appropriate given the anticipated characteristics of the soil samples. Rock samples should be collected using ASTM Standard D2113. Additional guidance on both soil and rock sampling can be found in ASTM Standard D6169.

2.5.1 Soil Sampling

The primary purpose of collecting soil samples, other than for chemical analysis, is the characterization of the subsurface lithology and stratigraphy. Typically, intact soil samples for physical descriptions are collected every 5 feet (1.5

meters) or at each change of material, whichever occurs first. Alternate sampling plans, with supporting information, should be detailed in the ground water monitoring plan. Additionally, a sufficient number of representative samples of the intervals significant to well design and hydrogeologic characterization should be collected for physical analyses; these results should then be used to support well design. These samples should be representative of the geographic and geologic range of materials within the project area and should specifically include the screened interval of a representative number of wells. Samples should be obtained with driven (e.g., split spoon), pushed (e.g., thin-wall Shelby tube), or rotary (e.g., Dennison) type samplers. Borehole cuttings do not usually provide the desired information and, therefore, are not usually satisfactory. Sampling procedures should be detailed in the ground water monitoring plan. Lithological logging of samples should be recorded according to the procedures listed in Section 2.9. Disposition of samples should be in accordance with Chapter 5.0

2.5.2 Rock Coring

Bedrock should be cored unless the ground water monitoring plan specifies otherwise. Coring, using a diamond- or carbide-studded bit, produces a generally intact sample of the bedrock lithology, structure, and physical condition. The use of a gear-bit, tri-cone, etc., to penetrate bedrock should only be considered for the confirmation of the “top of rock” (where penetration is limited to a few feet), enlargement of a previously cored hole, or drilling of highly fractured intervals. Lithologic logging of the core should be conducted in accordance with Section 2.9, Documentation.

Rock cores should be retrieved and stored in such a way as to reflect natural conditions and relative stratigraphic position. Gaps in the core and intervals of lost core should be noted in the core sequence. Cores should be stored in covered core boxes to preserve their relative position by depth. Boxes should be marked on the cover (both inside and outside) and on the ends to provide project name, boring number, cored interval, and box number in cases of multiple boxes. Each box shall clearly denote the top and bottom of the rock core present in that box. Any core box known or suspected to contain contaminated core should be appropriately marked on the log and on the box cover, (inside and out), and on both ends. Storage of rock cores must be in accordance with the approved ground water monitoring plan, and disposition must be in accordance with Chapter 5.0.

If photographs of the core are taken, the core surface must be cleaned or peeled, as appropriate, and wetted. Photographs should be taken in color.

2.6 Drilling through Contaminated Zones

When drilling through contaminated strata to reach lower, possibly uncontaminated, strata, the potential for "drag down" of contamination should be minimized by drilling technique. In this procedure, an outer drill casing is set and sealed within an "impermeable" layer or at a level below which the underlying environment is thought to be "cleaner" than the overlying environment. The drill fluids used to reach this point are disposed of according to Chapter 5.0 and replaced by a fresh supply. This system can be repeated, resulting in telescopic drill casing through which the final well casing is placed. These situations should be specifically addressed in the ground water monitoring plan.

2.7 Drilling Fluid Loss and Removal

When a borehole, made with or without the use of drilling fluid, contains an excessively thick, particulate-laden fluid that would preclude or hinder the specified well installation, the borehole fluid should be removed. This removal should facilitate the proper placement of casing, screen, granular filter, and seal.

Note: Unless the borehole wall has been supported by casing, the wall is likely to partially or completely collapse during fluid removal. Therefore, when no casing is present the fluid must be removed with great caution and the condition of the borehole monitored. Fluid losses in this operation must be recorded on the well diagram or boring log and later on the well development record. Any fluid removal prior to well replacement should be contingent upon the site geologist, engineer or geotechnical engineer's evaluation of hole stability (i.e. sufficient for the desired well and seal placement).

If large drilling fluid losses occur in bedrock, the drilling operator should remove some of this fluid loss prior to well insertion. The intent here is to allow the placement of a larger pump in the borehole than otherwise possible in the well casing, thereby reducing subsequent development time and removing the lost water closer to the time of the loss. Development of the completed well can then be reduced by a volume equal to that which was removed through the above procedure.

2.8 Abandonment

All soil borings not completed as wells must be abandoned in accordance with Chapter 7.0, Well and Boring Abandonment. In addition, wells that are deemed

to be unnecessary for continued site monitoring or remediation system performance or to be structurally unsound should be abandoned.

2.9 Documentation

2.9.1 General

Each boring log should fully describe the subsurface environment and the procedures used to gain that description. Unless otherwise specified in the ground water monitoring plan, a log shall be produced for every boring completed. The information in subsection 2.9.3, Routine Entries, is required on boring logs although not necessarily in the format illustrated. Example soil and rock parameters for logging are included in Tables B-1 and B-2, respectively.

2.9.2 Time of Recording

Boring logs should be recorded directly in the field without transcription from a field book or other document. This technique minimizes the chance of errors of manual copying and allows the completed document to be field-reviewed closer to the time of drilling.

2.9.3 Routine Entries

In addition to specific data required by the ground water monitoring plan, the following information should be routinely entered on the boring log:

1) Each boring and well (active and abandoned) should be uniquely numbered in accordance with an established well designation plan (discussed in Subsection 3.1.1);

2) Depths and heights (and reference to the appropriated datum) should be recorded in feet and decimal fractions (tenths of feet);

3) Field soil classification must be in accordance with the Unified Soil Classification System (USCS) or Standard D2487 and D2488, and shall be recorded in the field at the time of the sampling by the geologist. Such terms as “trace,” “some", “several,” must be consistent with the USCS or ASTM Standard D2488;

4) Each soil sample collected should be fully described on the log. Sample colors should be described using a Munsell soil and/or rock color chart. Samples should be described when wetted;

5) When used to supplement other sampling techniques, disturbed samples (e.g., wash samples, cuttings, and auger flight samples) should be described in terms of the appropriated soil/rock parameters

6) Rock cores should be fully described on the boring log. Sample colors should be described using a Munsell rock color chart. Samples should be described when wetted;

7) For rock core the log will include, denoting by depth, the location, orientation, and nature (natural or mechanical) of all core breaks. Also mark the breaks purposely made to fit the core into the core boxes. If fractures are too numerous to be individually shown, their location may be drawn as a zone and described on the log. Also note, by depth, the intervals of all lost core and hydrologically significant details. This sketch should be prepared at the time of core logging, concurrent with drilling;

8) All special problems and their resolution should be recorded in the field logbook, with appropriated entries on the log form. Examples of problems include, hole squeezing, recurring problems at a particular depth, sudden tool drops, excessive grout takes, drilling fluid losses, unrecovered tools in hole, and lost casings;

9) The dates and times for the start and completion of borings should be recorded on the log;

10) Each sequential boundary between the various soils and individual lithologies should be noted on the log by depth and elevation;

11) The depth of the first encountered free water should be indicated. Before proceeding, the first encountered water should be allowed to partially stabilize for a minimum of 5 to 10 minutes and recorded along with the time between measurements. It is important to note if the measured water level increases or decreases over time;

12) The purpose and interval by depth for each sample collected, classified, and/or retained should be noted on the log;

13) A record of the blow counts, hammer type and weight, and length of hammer fall for driven samplers should be made when standard penetration samplers are used. For thin-wall samplers, indicate whether the sampler was pushed or driven and the pressure/blow count per drive. Blow counts should be recorded in half-foot increments when standard penetrations samplers (1-⅜ inch I.D. X 2

inch O.D.) are used. For penetration less than a half-foot, annotate the count with the distance over which the count was taken. Blow counts, in addition to their engineering significance and classification purpose, may be useful for stratigraphic correlation;

14) When drilling fluid is used, a quantitative record in the field logbook should be maintained of fluid losses and/or gains and the interval over which they occur. Adjustment should be made for fluid losses due to spillage and intentional wasting (e.g., recirculation tank cleaning) to more closely estimate the amount of fluid lost to the subsurface environment. Losses should be noted by time and depth interval;

15) Record the total depth of drilling and sampling on the log;

16) Record significant color and viscosity changes in the drilling fluid return, even when intact soil samples or rock core are being obtained. Include the color/viscosity change, depth at which change occurred, and a lithologic description of the cuttings before and after the change;

17) Soil gas and breathing zone readings, if taken, should be recorded on the log. Each notation should include interval sampled and reading. When possible, a general note on the log should indicate meter manufacturer, model, serial number, and calibration material. If several meters are used, key the individual readings to the specific meter; and

18) Special abbreviations used on the log and/or well diagram should be defined where used.

2.9.4 Soil Boring Abandonment

For each soil boring, its final status (abandoned; converted to a monitoring well, etc.) should be recorded on the boring log form. If the boring is abandoned, the date(s) of abandonment and the abandonment method should be included. The boring abandonment procedures should comply with Chapter 7.0 of the manual.

2.9.5 Well Abandonment

For each abandoned monitoring well or piezometers, a record of the abandonment must be provided on the Well Abandonment Form. An example of this form is included in Appendix B. Well abandonment procedures should comply with Chapter 7.0 of the manual.

3.0 Well Design and Material Specifications

3.1 Well Design Specifications

This section describes the design specifications for the various monitoring well components. Figure 1, Single-Cased Monitoring Well Schematic Diagram, illustrates typical single-cased well components described in the following subsections. Well construction specifications for monitoring wells installed with conventional drill rigs are outlined in Sections 6.4 through 6.6 of the USEPA guidance document (USEPA, 2001) and for direct-push micro wells in the ASTM Standard 6725. Variations from standard practices should be based upon site, geologic, and hydraulic conditions and must be approved prior to installation by the appropriate regulatory authorities and must follow appropriate regulatory procedures. Persons with authority to address and grant variances should be identified in the ground water monitoring plan. Circumstances and factors leading to variances must be properly documented.

3.1.1 Well Designation

Each well at a site should have a unique label that distinguishes it from all other wells located at the installation. Prior to assigning a well label, all wells at the site should be checked to ensure no duplication. An example of a naming convention is given below:

Site:	Johnson Bulk Tank Farm No. 2
Well Number (Name):	JBTF-N2-MW01;
Where:	JBTF = Johnson Bulk Tank Farm N2 = Farm No. 2 MW01 = monitoring well 01

It is preferred that wells be labeled with an identification tag. A metal tag containing the well designation should be attached to the protective casing of each monitoring well. Figure 2 presents a diagram of a well identification tag. The following specification can be applied to the use and installation of well tags:

Specifications:

4”X4”X0.032” stainless steel or aluminum
3/16” lettering
1/8” diameter mounting holes
black printed or stamped lettering

Printing:

A printing press can be used to complete as much information as possible before mobilizing to the site. Required information to be included in on a tag is shown in Figure 2. Information that is not available at the time of printing must be hand stamped in the field.

Figure 1: Typical Monitor Well Construction, Single-Cased Monitor Well

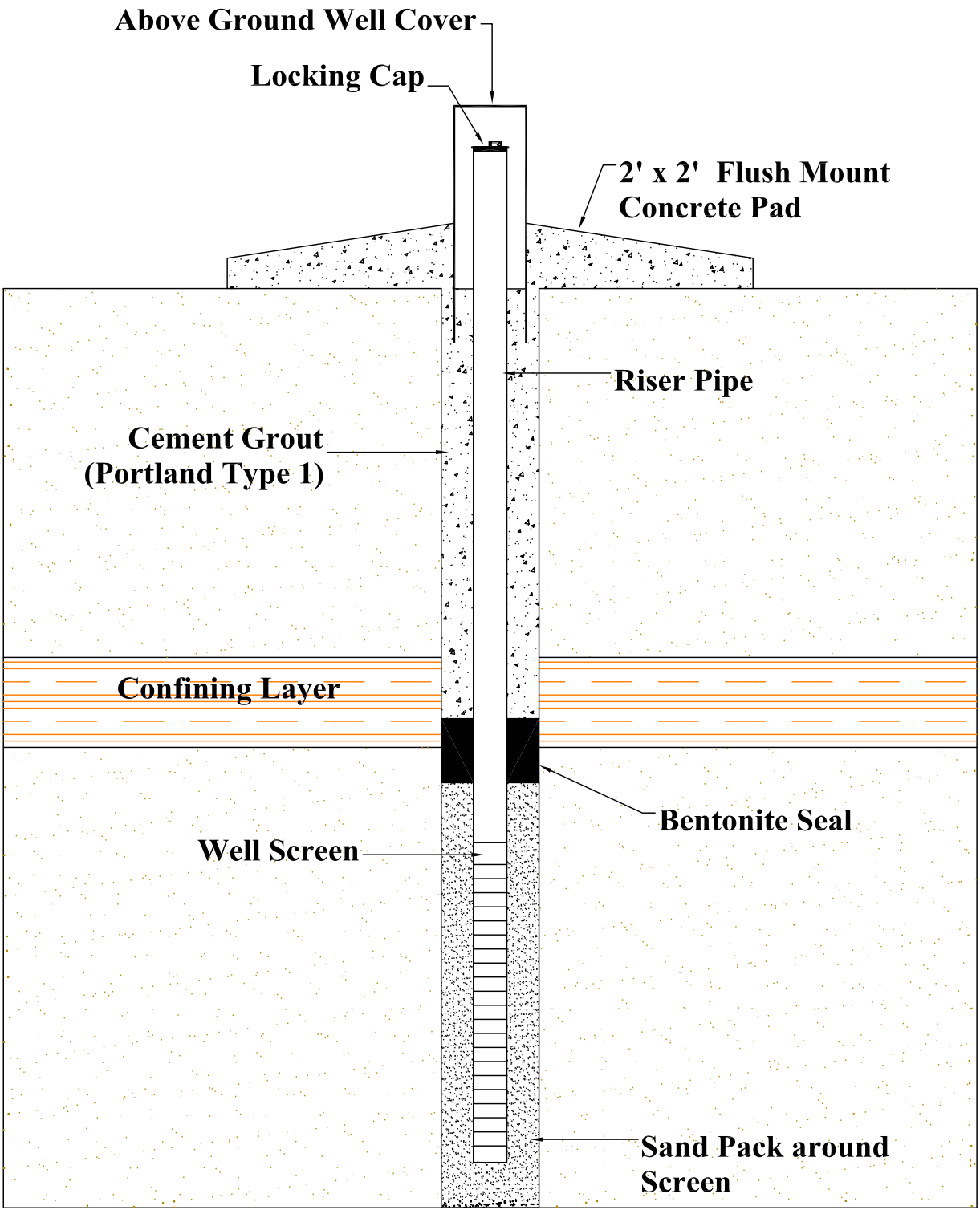


Figure 2: Monitoring Well Identification Tag

3.1.1.1 The Florida Unique Well Identification Program

The Florida Unique Well Identification (FLUWID) program provides a means to simplify the identification and exchange of water well information between state agencies and other interested parties. Under the program, water wells are assigned a unique alphanumeric code called the FLUWID identification number (example: AAA0000). The alphanumeric code is printed on a weather resistant adhesive tag/label and attached to a wellhead or pump house for identification. The FLUWID identification number serves as the primary water well identification number which enables different state agency water well databases to be cross referenced and queried. The FLUWID identification number is meant to be used in conjunction with any other numbering identification scheme such as the permit numbering system for water well construction and identification water well samples.

The naming convention in subsection 3.1.1 can still be used; however the FLUWID number can either replace the well number or be used in conjunction with the well number. For example a FLUWID number, AAB2123, queried from the database would show that this FLUWID number is associated to the original site name JBT-N2-MW01, and the FLUWID number would associate any sample identifications related to JBT-N2-MW01, as well as any other related data and information associated with that well.

The FLUWID Coordinator maintains the FLUWID Program Database (database). The database records the agency that is issued FLUWID tags, the date of issuance, differential global positioning system (DGPS) coordinates and other well information. The primary function of the database is to simplify water well

data inquires by directing all request to the party issued the FLUWID tags. The database is not a repository for water well historical data.

The FLUWID Program is not mandated by law, but implemented voluntarily to facilitate water well data collection The FLUWID Program only works if all parties participate and report data associated to the FLUWID ID numbers that are issued to said parties. It is most important that all data be returned to the FLUWID coordinator in a timely fashion in order to maintain an up-to-date and accurate database.

3.1.2 Well Material Specifications

The selected well construction materials should be chosen based on site and hydrogeological conditions and the physical and chemical monitoring objectives. The prime concern when selecting well materials is that these materials will not contribute foreign constituents to the ground water quality sample or alter the surrounding environment, either by leaching or sorption. The introduction of foreign matter or alteration of ground water quality may compromise the integrity of the well and of any analytical data. Also, well materials must not absorb any of the contaminants of interest that may be present in the ground water. An additional concern is that all well materials must be durable enough to withstand installation and well development and endure for the entire designed monitoring period. ASTM Standard D5092 presents an excellent discussion of material terminology and definitions. Deviations from acceptable well material specifications should be specified the ground water monitoring plan and approved prior to installation.

PVC and stainless steel are the most commonly used monitoring well screen and riser materials. However, in some situations, other materials, such as Teflon®, or carbon steel (for riser pipe) may meet project objectives. Typically, the riser is constructed of the same material as the well screen. However, depending upon the project objectives, PVC or carbon steel riser pipe material may be used to reduce the material cost when stainless steel well screens are specified. Where a different riser material is used to produce a “hybrid” well, the materials anticipated to be in contact with the ground water must be consistent with the material of the well screen. Table A-2, Appendix A, provides a comparison of stainless steel and PVC material characteristics. Table A-3, Appendix A, provides a comparison of the relative compatibility of miscellaneous well materials to potentially reactive substances.

All PVC screens, casings, and fittings are typically Schedule 40 or 80 and shall conform to National Sanitation Foundation (NSF) Standard 14 for approved water usage or ASTM Standards F480 or D1785. If the driller uses a screen and/or casing manufacturer or supplier who removes or does not apply this logo, a written statement from the manufacturer/supplier that the screens and/or casing

have been appropriately rated by NSF or ASTM should be included in the ground water monitoring plan.

Stainless steel well screen is typically Type 316 or 304. The stainless steel well screen must have flush threaded joints, sealing “O” rings of compatible material with the project objectives, and conform to ASTM Standard A312/A312M.

A Teflon® well screen must have flush threaded joins, sealing Teflon® “O” rings, and conform to ASTM Standard D4894 or D4895. Specific materials must be specified in the ground water monitoring plan. All materials should be as chemically inert as technically practical with respect to the site environment. Marking, writing, or paint strips are not allowed.

All monitoring well joints must be water tight. Couplings with the casing and between the casing and screen must be compatibly threaded. Thermal- or solvent-welded couplings on PVC pipe shall not be used. This restriction also applies to threaded or to slip-joint couplings thermally welded to the casing by the manufacturer or in the field. Gaskets, pop rivets, or screws are not normally used on monitoring wells. Exceptions are: 1) manufactured flush-joint casing requiring an o-ring to seal the joint and 2) stainless steel screws required to attach a bottom cap to a nonstandard length of screen material where the normal joint structure is missing. Exceptions should be approved prior to installation and must be recorded in the well completion report. All screen bottoms must be securely fitted with a cap or plug of the same composition as the screen. Solvents or glues are not permitted in the construction of a monitoring well.

All well screens and well casings must be free of foreign matter (e.g., adhesive tape, labels, soil, grease, etc.). Typically, well casing and screen materials are prepared, wrapped, and boxed by the manufacturer with a certificate of being “clean”. If the cleanliness of the well materials is in doubt, the casing and screen must be decontaminated using an approved protocol. Cleaned materials must be stored in appropriate containers until just prior to installation. Pipe nomenclature stamped or stenciled directly on the well screen and/or blank casing within and below the bentonite seal must be removed by means of sanding, unless removable with approved water. Solvents, except approved water, must not be used for removal of markings.

3.1.3 Well Screen Usage

Each well should be constructed with new, machine-slotted or continuously-wound screen section. The end plug should be composed of the same material as the well screen. The screen assembly must be able to withstand installation and development pressures without collapsing or rupturing.

Although many wells set into bedrock could be installed as open-hole installations, the extra cost and effort for screen installation can be more than

offset by the assurance of an unobstructed opening to the required depth during repeated usage. Well integrity and consistent access to the original sample interval during prolonged monitoring is thereby maintained.

3.1.4 Well Screen Length

Well screen lengths should be selected based on the purpose of the well. Some wells are designed to determine the presence or absence of contaminants. Others are designed to monitor a discrete zone for a particular contaminant type. Design of screen length must take into account hydrostratigraphy, temporal considerations, environmental setting, analytes of concern, fate and transport of contaminants, and/or regulatory requirements.

In most situations, monitoring wells are designed to double as ground-water quality sampling points and as piezometers to monitor water levels or hydraulic head at that particular location and depth. In order to satisfy these dual roles, monitoring well screen lengths may range from as short as 2 feet to greater than 20 feet. Typically, though, well screen lengths are 5 or 10 feet, and rarely exceeding 20 feet. It is important that well screen lengths be specified in the ground water monitoring plan.

3.1.5 Well Screen Diameter

The inside diameter (I.D.) of the well screen should be chosen based on anticipated use of the well. Generally, a 2-inch I.D. well is sufficient to allow sampling with most types of sampling devices such as bailers or low-flow samplers. If the well may be used as part of a remedial system, a greater I.D. may be considered (e.g., 4-inch or 6 inch), however, the advantages of this increased diameter should be evaluated with respect to cost increases in drilling, material, and disposal of waste material.

The actual inside diameter of a nominally sized well is a function of screen construction and the wall thickness/schedule of the screen, casing, and joints. In the case of continuously-wound steel screens, their interior supporting rods may reduce the full inside diameter. Additionally, the welded couplings on 2-inch I.D. stainless steel well pipe frequently reduces the inside diameter to slightly less than 2 inches. This consideration is critical when sizing pumps, bailers, surge devices, etc.

All well screens must be commercially fabricated, slotted or continuously wound, and have an I.D. equal to or greater than the I.D. of the well casing. An exception may be warranted in the case of continuously-wound screens. No fitting should restrict the I.D. of the joined casing and/or screen.

3.1.6 Well Screen Slot Size

The grain size distribution of the screened formation and the filter pack gradation are the primary parameters that should be used when selecting a slot size for the well screen. Therefore, the grain size of the aquifer material should be the determining factor in selecting well screen slot size.

The largest practical slot size that is compatible with the aquifer and available filter material should be used. This will allow maximum intake volume per unit screen length. The slot size should retain at least 90 percent (preferably 99 percent) of the filter pack material. The method for determining the appropriate gradation of filter pack material is described in paragraph 3.1.11.2, Primary Filter Pack.

3.1.7 Well Screen Placement

The screen shall be place such that the parameters of concern can be properly monitored. Chemical constituents with a specific gravity greater than water tend to sink and may accumulate as a dense non-aqueous phase liquid (DNAPL). If the well screen is to be installed in a location known or suspected to be impacted by DNAPLs, then the borehole must not be overdrilled and the screen must be placed at the bottom of the borehole. The screen must be placed with no filter pack beneath the base of the screen as this construction may provide a sediment trap and the DNAPLs may sink and not be detected. DNAPLs may exhibit an overall vertical migration, even with a predominant horizontal ground water flow. Therefore, screens need to be place at the bottom of a saturated zone or just above a confining layer. Screen lengths should be as short as possible, at the most 10 feet and preferably 5 feet (or less), to decrease the likelihood of cross contamination of deeper portions of an aquifer.

Overdrilling of a borehole is sometimes performed for such activities as definition of stratigraphy, location of a confining unit or to creation of a sediment trap. It is preferred that exploratory activities (i.e., stratigraphic definition and strata location) are conducted in a pilot hole and then the borehole be properly abandoned. A separate borehole should be advanced for the monitoring well.

Overdrilling to create sediment traps is not encouraged. If, however, overdrilling is performed to create a sediment trap, the bottom of a well screen may be placed at a minimum of 6 inches, but no more than 3 feet above the bottom of the borehole. If bentonite pellets are used to seal the bottom of the borehole, a minimum of one foot of filter sand must be placed above the bentonite prior to screen placement. Overdrilling must be appropriate for site conditions and the monitoring parameters of concern. The use and style of sediment traps must be discussed in the ground water monitoring plan.

3.1.8 Well Riser

The I.D. of the riser should be chosen based on the anticipated use of the well. Usually a minimum of 2-inch I.D. riser is required to allow use of most sampling devices and water level indicators. In most cases, the well riser will be fabricated of the same material and be the same I.D. as the selected well screen. Couplings within casing segments and between the casing and screen must be compatibly threaded.

Each riser section should be installed as straight and level as possible. For deep installations (greater than 40 feet) centralizers should be used to ensure a constant annular spacing between the borehole and well materials. The top of the uppermost riser pipe, i.e., the top of the well, must be level. A point on the top of the well should be marked such that survey and water level measurements are collected from the same location. Traditionally, this mark is placed on the north side of the riser.

3.1.9 Surface Casing

Outer well casing used as a permanent part of the installation when multi-cased wells are installed must be composed of new material. The casing must be free of interior and exterior protective coatings and must be steam cleaned or washed with a high-pressure water device (if appropriate for the selected material) using approved water immediately before installation. The type of material and wall thickness of the casing must be adequate to withstand the installation process. Surface casing must consist of steel meeting ASTM Standard A53/A53M-06 or Schedule 40 or 80 PVC, and shall have a minimum wall thickness of 0.25 inch, unless otherwise specified. The ends of each casing section should be either flush-threaded or beveled for welding.

At sites where multiple aquifers may be penetrated or where a confined or semi-confined aquifer must remain isolated from potential surface water infiltration, surface casing is required to prevent cross-contamination between the separate zones. When used to seal a confining layer or bedrock surface, well casing is typically installed 3 feet to 5 feet into the top of the unit. This should provide a sufficient isolation of the aquifer to be protected. For thin confining layers or thin saprolite horizons, a shallower penetration depth may be appropriate.

Different casing sizes may be required depending on the types of geologic materials encountered at the drilling site and the anticipated purpose of the well. The site geologist, engineer or geotechnical engineer should anticipate these conditions and design the monitoring wells accordingly. Casing diameters for filter-packed wells should be selected so that a minimum annular space of 2 inches is maintained radially between the inside diameter of the surface casing and outside diameter of the monitoring well riser. Also, the diameter of all casings in multi-cased wells should be sized so that a minimum of 2 inches of

annular space is maintained between the surface casing and the borehole. For example, a 2-inch diameter well screen will require a 6-inch diameter casing inside a 10-inch diameter boring.

3.1.10 Granular Filter Packs

3.1.10.1 Filter Pack Materials

All granular filters should be discussed in a ground water monitoring plan, including composition, source, placement, and gradation. If the actual gradation is to be determined during drilling, then more than one filter pack gradation should be available so that well installation will not be unnecessarily delayed. A 1-pint representative sample should be collected for possible future analysis.

Granular filter packs must be at least 98 percent pure silica sand, visually clean (as seen through a 10-power hand lens), free of materials that would pass through a No. 200 U.S. Standard sieve, inert, composed of rounded grains, and of appropriated size for the well screen and host environment. The filter material should be packaged in bags by the suppliers and therein delivered to the site.

Filter packs are placed in the borehole and around the well screen to prevent natural formation material from entering the well screen. The use of a tremie pipe for filter pack placement is recommended; especially when the boring contains thick drilling fluid or mud or is sufficiently deep such that bridging is likely. Exceptions to the use of a tremie pipe for filter pack placement may include vadose zone wells or surficial well with less than approximately 10 feet of standing water.

The final depth to the top of the granular filter should be directly measured (by fiberglass or stainless steel tape measure or rod) and recorded on a well construction form. Final depths must not be estimated based on volumetric measurements of placed filter sand.

When installing a monitoring well in karst or highly fractured bedrock, the borehole configuration of void spaces within the formation surrounding the borehole is often unknown. Therefore, the installation of a filter pack becomes difficult and may not be feasible.

3.1.10.2 Primary Filter Pack

The primary filter pack consists of granular, siliceous material or glass beads. These materials should be clean and free of materials that would compromise the integrity of the representative ground water quality.

The filter pack shall extend from the bottom of the boring to a minimum of 3 feet above the top of the screen unless otherwise specified in the work plan. As mentioned in Subsection 2.1.4.4, Borehole Requirements, the filter pack is not

placed beneath the screen when potential contaminants with a specific gravity greater than that of water (i.e. DNAPLs) are suspected. Once the filter pack material is in place the well should be surged to break bridged filter pack materials in the borehole and to consolidate those materials around the screened interval.

As appropriate, up to 5 feet of filter pack can be placed above the top of the screen. This additional filter pack thickness will allow for settling from infiltration and compaction of the filter pack during development and repeated sampling events. The additional filter also helps to maintain a separation between the bentonite seal and well screen. The selected filter pack material should be uniformly graded and composed of siliceous particles that have been appropriately washed and screened. The filter pack grain-size is based on the smallest natural formation material. The following table presents a comparison of typical filter pack mesh sizes and appropriate screen size openings:

Table 3: Comparison of Screen Slot Size and Filter Pack

Screen Size Opening (Inches)	Screen Size Slot Number	Typical Sand Pack Mesh Size (U.S. Standard Sieve Number)
0.005	5	100
0.010	10	20 to 40
0.020	20	10 to 20
0.030	30	10 to 20

3.1.10.3 Secondary Filter Pack

As appropriate and as borehole depth and hydrogeologic conditions allow, a minimum 1- to 2-foot thick secondary filter pack should be used during well installation. A fine-grained sand (i.e. 30/65) may be used as a secondary filter pack.

The objective of a secondary filter pack is to prevent intrusion of the bentonite seal into the primary filter pack. Additionally, a secondary filter pack can also be used between the bentonite seal and the grout backfill to prevent intrusion of the grout into the bentonite seal. Finally, for wells completed with the seal located above the static ground water level, a secondary filter pack should be installed to replace the bentonite seal.

3.1.11 Annular Seal

The objective of an annular seal is to prevent intrusion of the annular grout into the primary and/or secondary filter pack. An annular seal of fine-grained,

washed silica sand is recommended in situations where monitor well screen sections are designed to intercept the water table. In situations where the annular seal is assured to remain below the water table and saturated, a bentonite seal is appropriate. Bentonite has the ability to expand when completely hydrated to form a dense clay mass with very low in-place permeability, thereby providing an effective barrier to water migration. However, bentonite is not effective when 1) improperly hydrated, 2) allowed to desiccate in place or 3) placed in high or low pH environments. To allow for adequate hydration and avoid desiccation bentonite seals must be placed at a depth below the lowest anticipated static ground water level in the well.

Because bentonite has a high cation exchange capacity and high pH, it may adversely affect water-quality samples that come in contact with, or have migrated through or past the bentonite seal. Additional concerns include the use of bentonite in ground water that exhibits high total dissolved solids or high chloride content, or may contain chemicals reactive to the bentonite's cation exchange capacity and pH. For these reasons, the rationale and design specifications for bentonite seals should be detailed in a work plan. If selected for use during the design process, the bentonite seal should have a minimum 2-foot thickness.

Bentonite used in drilling slurries and as annular sealant shall be powdered, granular, chipped or pelletized. Pelletized or chipped bentonite should be used for bentonite seals, whereas powdered or granular bentonite should be used when required in preparing slurries and grout. The materials must be a 100 percent pure sodium bentonite (montmorillonite) supplied in sacks or plastic buckets. The bentonite must be free of any additives or other material that may negatively affect water quality in the resulting monitoring well. The diameter of the bentonite pellets used should be less than one fifth the width of the annular space into which they are placed. This will help reduce the possibility of the material bridging in the annular space.

The preferred method of placing bentonite pellets or chips is by positive displacement or by use of a tremie pipe. Use of the tremie method minimizes the risk of pellets or chips bridging in the borehole, but time and care must be taken to prevent plugging of the tremie pipe. Pouring of the pellets is acceptable in shallow boreholes (less than 40 feet). In order to provide accurate measurement of bentonite pellet thickness in the well boring, the pellet seal should be tamped during measurement. Bentonite pellet/chips seals should be measured during and immediately after placement, without allowance for swelling. Granular or chip bentonite may be used if the seal is set in a dry condition.

If the proposed seal location is above the anticipated static ground water level, a bentonite seal should not be used. In this case, a 1- to 2-foot layer of fine-grained sand (secondary filter pack) placed atop the primary filter pack will enhance resistance to downward grout migration.

Slurry seals should be used only as a last resort, as when the seal location is too far below water to allow for pellet or chips or containerized-bentonite placement or within a narrow well-borehole annulus. Typically, the specific gravity of cement grout placed atop the slurry seal will be greater than that of the slurry. Therefore, the intent to use a slurry seal should be detailed in the ground water monitoring plan, and details should include a discussion of how the grout will be precluded from migrating through the slurry. An option includes a secondary filter pack of fine-grained sand and the use of a side discharging tremie pipe. Slurry seals should have a thick, batter-like (high viscosity) consistency with a placement thickness of 3 feet to 5 feet.

The final depth of the top of the bentonite seal should be directly measured (by tape or rod) and recorded. Final depths should not be estimated based on volumetric measurements of placed bentonite.

In a well designed to monitor competent bedrock, the bottom of the bentonite seal should be located at 3 feet below the top of firm bedrock, as determined by drilling. “Competent bedrock” refers to that portion of solid or relative solid, moderately weathered to unweathered bedrock where the frequency of loose and fractured rock is markedly less than in the overlying, highly weathered bedrock. Special designs will be needed to monitor fractured bedrock.

3.1.12 Annular Grout

Grout used in monitoring well construction and borehole/well abandonment should be one of the five Portland cement types specified in ASTM Standard C150. Type I Portland cement is most commonly used for monitoring well construction. Bentonite-based grouts (30 percent solids) can be used when the grout needs to remain somewhat flexible. The cement-based grout should be composed of Type I Portland cement , 100 percent pure sodium bentonite (10 percent dry bentonite per 94-lb. sack of dry cement), and shall not exceed 6 gallons of water per 94 pounds of Portland cement. The amount of approved water used should be kept at a minimum. Use of 10 percent bentonite, by weight, added to a cement–based grout is advantageous when lower shrinkage, better workability, and reduced weight are important. The considerations of using bentonite include reduced set strength, increased set time, and potential incompatibility with some ground water chemistry conditions

When a sulfate-resistant grout is needed, Types II or V cement should be used instead of Type I. Quick-setting cements containing additives must not be used for monitoring well installation. These additives may leach from the cement and adversely affect the chemistry of the water samples collected from the resulting monitoring well. Generally, the use of air-entrained cements should be avoided to negate potential analytical interference in ground water samples by the

entraining additives. Neither additives nor borehole cuttings shall be mixed with the grout.

3.1.13 Surface Completion

Protective casing should be installed around each monitoring well the same day as the initial grout placement. Any annulus formed between the outside of the protective casing and the borehole or between the monitoring well and protective casing should be filled to the ground surface with grout as part of the overall grouting procedure. Specific details of well protection should be detailed in the ground water monitoring plan. Details and specific elements of well protection should be included in well completion diagrams. Figures 3 and 4 present schematic diagrams for flush-mounted and stick-up protective casing, respectively. ASTM Standard D5787 provides guidance for monitoring well protection.

All protective casing should be steamed or hot-water-pressure cleaned prior to placement; free of extraneous openings; and devoid of any asphaltic, bituminous, encrusted, and/or coating materials, except the paint or primer applied by the manufacturer.

As specified in Subsection 3.1.1, Well Designation, a metal identification tag containing the well designation should be attached to the protective casing of each monitoring well or placed square on the protective concrete pad, centered on the northern or northwestern side of the pad, with the top of the tag toward the well head. For new pads, the tag shall be placed and pinned during pad construction. For existing pads, the tag should be epoxy grouted and cement screwed.

The material type of the surface completion casing should be adequate to protect the completed monitoring well. The surface completion materials need to be selected such that they provide adequate protection against physical destruction, tampering, natural degradation, and the environment.

Unless otherwise specified, surface completion materials should conform to the following specifications:

1) Locking 16-gauge steel or aluminum protective well cover, round or square and 5-feet in length, or flush-mounted 22-gauge steel, water resistant, welded box with 3/8-inch steel lid;

2) Cement consisting of one of the five Portland cement types that are specified in Standard C 150 as discussed in Paragraph 3.1.12, Annular Grout;

3) Brass, corrosion resistant, keyed-alike padlock;

4) Protective bumper posts constructed of 4-inch diameter and minimum 5-foot long steel or aluminum pipe (four per well). Each post must be set into concrete outside the corners of the concrete pad and filled with concrete;

5) Paint that matches existing monitoring wells at the installation. Where no wells exist, it is recommended to use high visibility yellow epoxy paint;

6) A well identification tag as detailed in Subsection 3.1.1, Well Designation; and

7) Cement consisting of one of the five Portland cement types that are specified in Standard C 150 as discussed in Paragraph 3.1.12, Annular Grout.

The primary purpose of a properly designed surface completion is to maintain the integrity of the well for the designed monitoring period. After the well is installed, it shall be completed at the ground surface in one of two ways:

1) Construct around the protective casing a 2-foot by 2-foot, 4-inch thick concrete pad, sloping from the casing to the perimeter such that water will drain away from the well. The bottom of the concrete pad should be installed partially or completely below grade to protect against undermining. Bentonite grout should then be placed in the annular space below ground level within the protective casing. Pea gravel should then be placed in the annular space above the bentonite to about 6 inches from the top of the well riser.

2) Where monitoring well protection must be flush-mounted with the ground, a locking security internal cap must be on top of the riser within the steel manhole or vault. This cap must be leak proof so that if the vault or manhole should fill with water, the water will not enter the well casing. A bolt-down manhole cover should be required for security. The manhole cover should be installed into a 6-inch thick, 2-foot square, concrete pad, sloped (1 inch per foot) to provide water drainage away from the well, and finished flush to existing grade. Ideally the manhole cover should also be leak-proof.

If the well is completed above ground the protective casing should extend from slightly above the well casing to below ground with a minimum of 2.5 feet below grade. The protective casing should be waterproof and held firmly in lean concrete placed around the outside of the protective casing. The casing should be placed in alignment with the well riser pipe.

Figure 3: Flush-Mounted Protective Casing

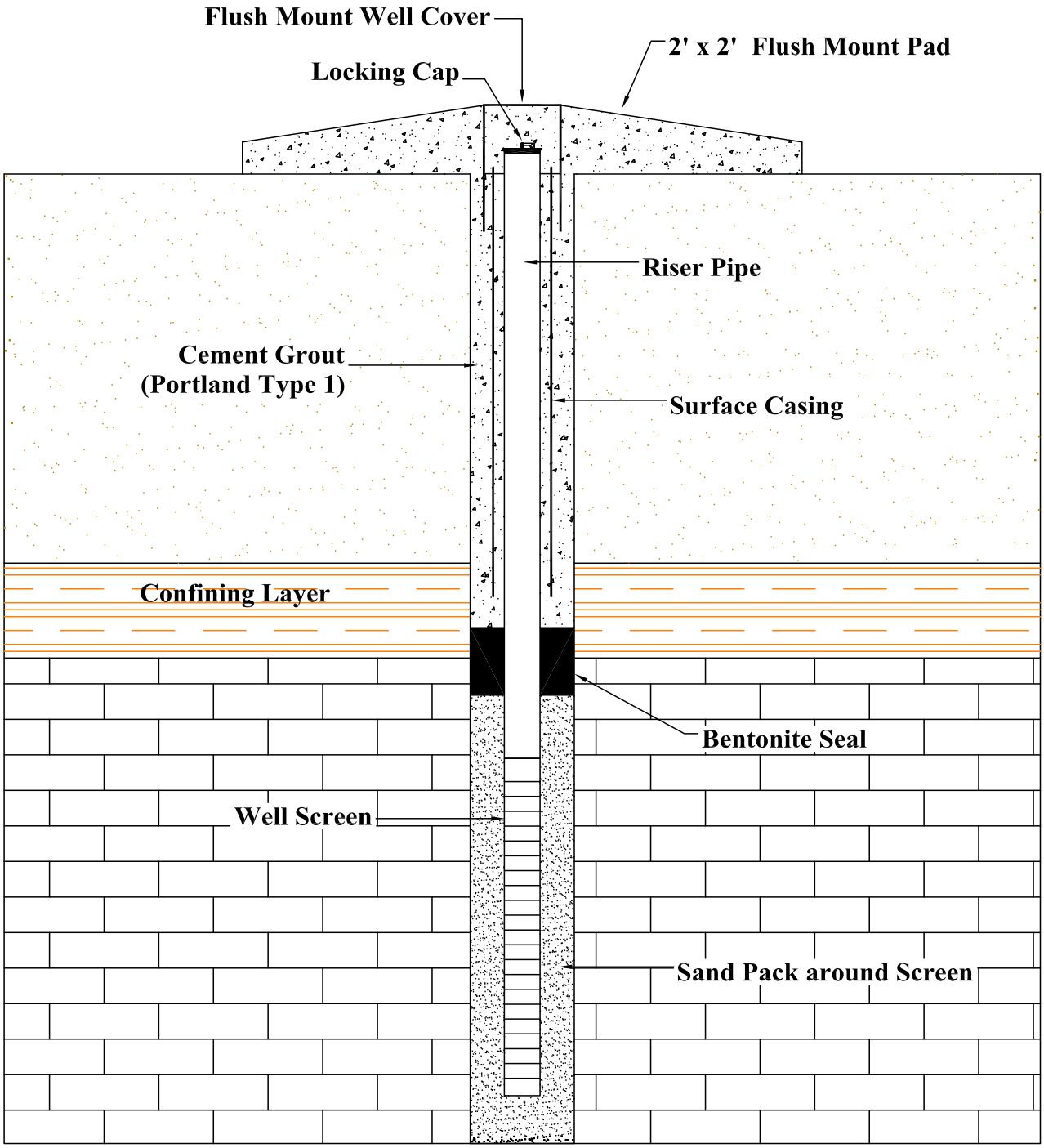
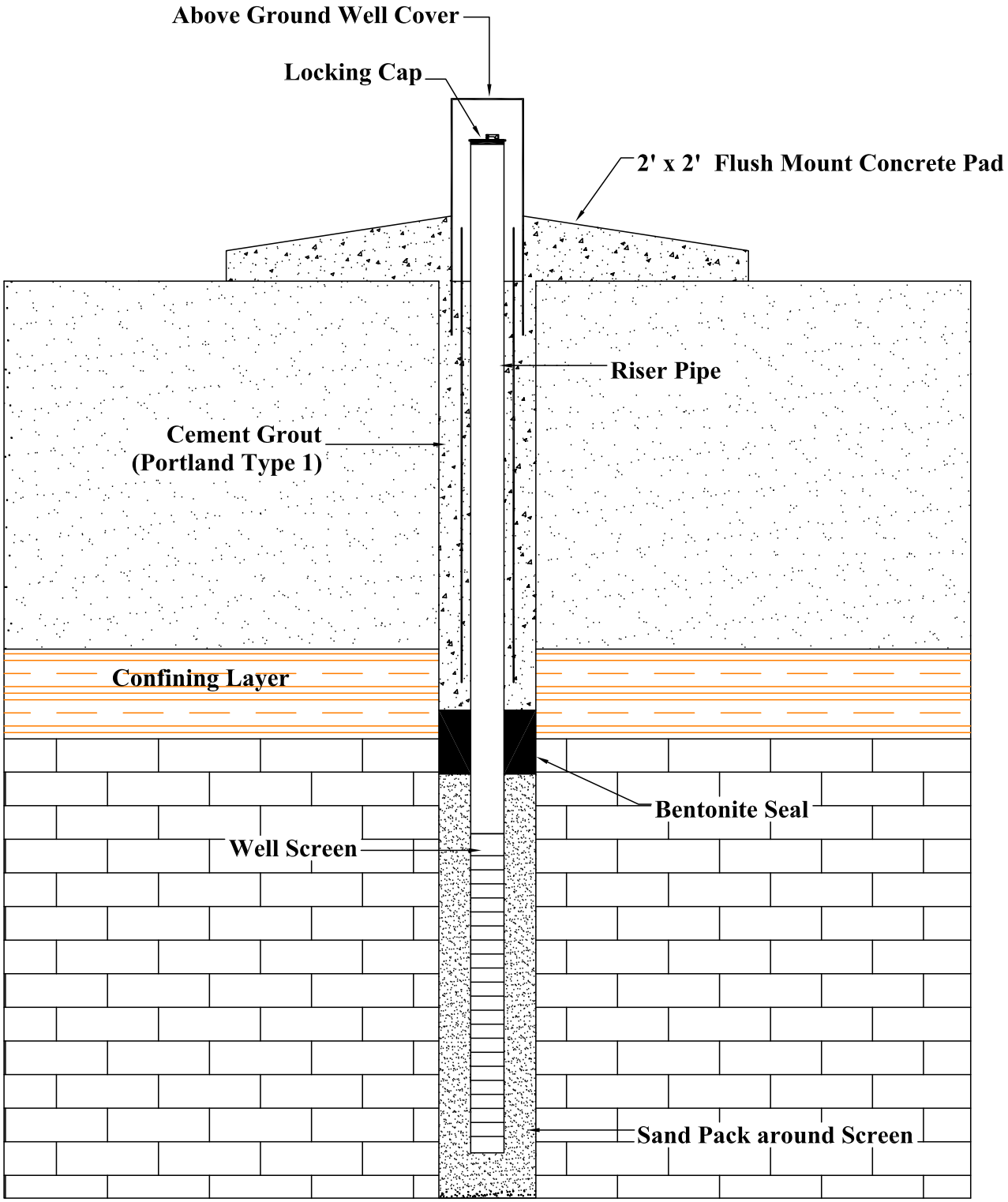


Figure 4: Above-Ground Protective Casing



Prior to protective casing installation, a ⅛-inch diameter vent hole should be drilled or slotted in the well riser approximately 6 inches below the cap to allow the well to vent. A second ¼-inch diameter hole (or weep hole), should be drilled in the surface casing immediately above the concrete pad to allow water to drain from the inside of the protective casing. Vent holes should not be used for flush-mounted well completions. Enough clearance, usually 6 inches, should be left between the lid of the protective casing and the tip of the riser to allow the introduction of sampling equipment and/or pumps. All materials chosen shall be documented.

Monitoring wells located in high traffic areas should be flush mounted whenever possible. If a well can not be flush-mounted in high traffic areas or areas where heavy equipment is operated, the well should be protected with four steel bumper posts. This type of protection may not be necessary at all monitoring well locations**.**

Additional design details for a typical aboveground protective casing include the following:

1) A 5-foot minimum length of steel or aluminum protective casing shall extend approximately 2.5 feet above ground surface and set into the protective apron (aluminum should be used in coastal environments due to its corrosion resistant characteristics);

2) The protective casing inside diameter shall be at least 4 inches greater than the nominal diameter of the well riser;

3) An aluminum-hinged cover or loose-fitting telescopic slip-joint-type cap should be used to keep precipitation and cap runoff out of the casing;

4) All protective casing covers/caps shall be secured to the protective casing by means of a padlock at the time the protective casing is installed;

5) If practical, all padlocks at a given site should be keyed alike;

6) No more than a 2-inch clearance should be left between the top of the protective casing and the top of the well riser. This spacing may be required for installation of monitoring and/or pumping devices. If, however, acoustical equipment will be used for water-level determinations, a smaller spacing (2 inches or less) may be necessary;

7) Only the outside of the protective casing, hinges (if present), and covers/caps must be prepainted or painted with a paintbrush (no aerosol can). Paint shall dry prior to initially sampling that well;

8) A metal identification tag should be placed on the outside of the protective casing; and

9) In high traffic areas, install four steel or aluminum bumper posts. Each post should be radially located 4 feet from the well (immediately outside each corner of the concrete pad) and placed a minimum 2 feet below ground surface, having a minimum of 3 feet above ground surface. The posts should be set into and filled with concrete. Flagging or signposts in areas of high vegetation may be helpful. The bumper posts should be prepainted or painted using a brush.

3.1.14 Quality Assurance Sampling

Certain well construction materials used during installation should be collected for quality assurance (QA) purposes. It is not always necessary to perform chemical analyses on collected materials. However, with the exception of the approved water, the materials should be archived until the chemical results are received from the environmental samples at that location in case that the results appear to be anomalous. In this case, it may be desirable to analyze some or all of the well construction materials. Such materials include drilling fluids (approved water and any additives, if used), annular filter pack, bentonite, and cement.

3.2 Documentation

Unless otherwise specified in the ground water monitoring plan, a well construction diagram and a certificate of conformance must be produced for every monitoring well constructed.

3.2.1 Well Construction Diagram

Each diagram must be attached to, or placed on the original boring log and maintained by the site geologist, engineer or geotechnical engineer until completion of the field effort. Figure 3-1 presents an example of a completed well construction diagram included on a soil boring log. The original diagram and boring log should be retained for later reference, as needed. Special abbreviations used on the well completion diagram must be defined on the diagram.

The following information should be attached to the original boring log and graphically denote, by the depth from ground surface:

1) The bottom of the boring (that part of the boring most deeply penetrated by drilling and/or sampling) and boring diameter(s);

2) Screen type and interval;

3) Joint type and depths;

4) Granular filter pack type and depth interval;

5) Seal type and depth interval;

6) Grout type and depth interval;

7) Cave-in, if any;

8) Centralizer locations;

9) Height of riser (stickup) without cap/plug above ground surface;

10) The following protective casing details; and
    a. Height of protective casing, without cap/cover, above ground surface;
    b. Base of protective casing below ground;
    c. Weep hole location and size;
    d. Concrete pad thickness, height, and extent, and;
    e. Protective post configuration.

11) Water level immediately after completion and 24 hours after completion with date and time of measurement.

In addition to the graphical presentation discussed above, the following items should be described on each diagram:

1) The actual quantity and composition of the grout, bentonite seal, and granular filter pack used for each well;

2) The screen slot-size in inches, slot configuration type, total open area per foot of screen, outside diameter, nominal inside diameter, schedule/thickness, composition, and manufacturer;

3) The material between the bottom of the boring and the bottom of the screen;

4) The outside diameter, nominal inside diameter, schedule/thickness, composition, and manufacturer of the well casing;

5) The joint design and composition;

6) Centralizer design and composition;

7) Depth and description of any permanent pump or sampling device. For pumps, include the voltage, phase requirements, and electrical plug configuration;

8) Protective casing composition, length, and nominal inside diameter;

9) Special problems and their solutions; e.g., grout in well, lost casing and/or screens, bridging, casing repairs and adjustments, etc.; and

10) Dates and times for the start and completion of well installation.

3.3 Special Concerns

3.3.1 Shallow Wells

During shallow well construction (i.e., less than approximately 15 feet) sufficient depth may not be available to install the desired thickness of typical well components (filter pack, bentonite seal, grout, etc.). Tailored well designs and deviations from standard well construction requirements should be detailed in a ground water monitoring plan. The design, if modified, should minimize the potential infiltrations of surface water.

3.3.2 Well Clusters

Unless otherwise specified in an approved work plan, each well in a cluster shall be installed in a separate boring rather than co-located within one large-diameter boring. Each monitoring well is a mechanism through which to obtain a ground water sample representative of the aquifer zone monitored and, if so designed, to measure the potentiometric surface in that well. To ensure this representation, each well in a cluster must be constructed and installed in a separate boring. Multiple well placements in a singe boring are too difficult for effective execution and evaluation to warrant single hole usage. One exception includes the intentional design and installation of well clusters such as bundled piezometers for DNAPL characterization. Such exemptions must be detailed in a ground water monitoring plan.

4.0 Well Development

4.1 General

Borehole drilling activities may retard the ability of an aquifer to transmit water to a monitoring well. Obstructions can be caused by physical alteration of the aquifer material, or by formation damage as a result of the introduction of drilling fluids or solids in the aquifer, causing reduced permeability adjacent to the borehole. Well development is necessary to correct this damage and improve hydraulic conductivity in the immediate vicinity of the monitoring well. The objective of well development is to remove all or as much as possible of the introduced drilling fluids, mud, cuttings, mobile particulates, and entrapped gases from within and adjacent to a newly installed well, thus providing an improved connection between the well screened interval and the aquifer. The resulting inflow to the well should be physically and chemically representative of that portion of the aquifer adjacent to the screened interval. The appropriate development method or procedure to use will vary according to the hydrologic characteristics of the aquifer, the drilling method used, and the type of well completion.

4.2 Development Methods

The method most appropriate for monitoring well development is dependent upon the construction material and size of the well screen and casing, design of the filter pack, characteristics of the formation material, disposal considerations of development fluids, borehole drilling method used, impact of development method on aquifer chemistry, well depth, and cost. ASTM Standard D5521 provides guidance for the development of monitoring wells in granular aquifers.

The following are some of the most commonly used methods:

Mechanical Surging This method involves use of a swedge (surge) block that is moved up and down the well screen and casing. Water is alternately forced in and out of the screen to loosen sediment bridges and draw fine-grained material into the well, which is then pumped out. This is the preferred method of well development. Fine-grained materials can become trapped between the swedge and the inner wall of the screen and well casing causing the swedge to freeze in the well as well as scouring the well materials.

Overpumping The well is pumped at a higher rate than when it will be purged and sampled. Theoretically, the high flow rates dislodge fine-grained materials, opening the flow paths between the well and the aquifer. This method is subject to sediment bridging, requires large pumps that may be difficult to fit into small

diameter wells, generates large volumes of water that must be disposed, and results in poor development of wells with long screen intervals.

Rawhiding In this method, the well is alternately pumped and stopped at intervals that draw water into the well and back out, developing the filter pack by fluid surging. The technique can cause a high rate of wear on the pump and in certain situations may not produce a sufficient surge action for development.

Jetting This method uses high velocity streams of water to loosen fine-grained material and drilling fluids from the formation. The material that enters the wells is then pumped out. This method requires an external water supply and high velocity streams can damage the well screen. Jetting may be appropriate for redevelopment of wells that have become fouled with silt and clay or other fine matter.

Air Lift Air Lift involves forcing air out through the screen and into the monitoring well to clean debris from the well. This method alters the chemistry of the aquifer, may introduce contaminants to the aquifer via the air supply, may release contaminants to the air via mists from the well, and may damage the screen and filter pack.

4.3 Timing and Record Submittal

The development of monitoring wells should not be initiated sooner than 12 hours after or longer than 7 days beyond placement of grout. Well development should be appropriately documented on a monitoring well development record and included with the boring log.

4.4 Oversight

The development of a monitoring well should be overseen and recorded by a site geologist, engineer or geotechnical engineer.

4.5 Development Criteria

Well development should continue until representative water; free of drilling fluids, cuttings, or other materials introduced during well construction is obtained. In other words, the well should be developed until the water is non-turbid. Well discharge water should be metered in the field until it can be established that development has attenuated and stabilized turbidity to the maximum degree possible. All turbidity sampling times and measurements should be recorded on a well completion form.

Suggested minimum volumes to be withdrawn from a well are:

1) For those wells where the boring was made without the use of drilling fluid, but approved water was added to the well installation, remove five times the amount of any water unrecovered from the well during installation (in addition to five times the standing volume).

2) For those wells where the boring was made or enlarged (totally or partially) with the use of drilling fluid, remove five times the measured, or estimated, amount of total fluids lost while drilling, plus five times that used for well installation (in addition to the five times the standing volume). Exceptions may be warranted during the drilling of deep well borings where significant water was lost in a previous hydrologic zone.

Note: Developing a well for too short a period is a common and major cause for poor well performance. Also, water should not be added to a well as part of the development once the initial bentonite seal atop the filter pack is placed.

If any of the following circumstances occur, the site geologist, engineer or geotechnical engineer should document the event in writing and use an alternate plan of action:

1) After extensive development, a non-turbid sample cannot be collected due to a significant fraction of fine-grained material in the surrounding aquifer;

2) Persistent water discolorations remain after the required volumetric development; and

3) Excessive sediment remains after the required volumetric removal.

4.6 Development – Sampling Break

Well development must be completed at least 24 hours before well sampling. The intent of this hiatus is to provide time for the newly installed well and backfill materials to sufficiently equilibrate to their new environment and for that environment to re-stabilize after disturbance of drilling. Applicable Federal, State, and local regulations may require up to 14 days before well sampling can begin.

4.7 Pump/Bailer Movement

During development, water should be removed throughout the entire water column in the well by periodically lowering and raising the pump intake (or bailer stopping point).

4.8 Well Washing

Well development should include the washing of the entire well cap and the interior of the well riser above the water table using only water from that well. The result of this operation will be a well casing free of extraneous materials (grout, bentonite, sand, etc.) inside the well cap and casing, between the top of the well and the water table. The washing should be conducted before and/or during development, and not after development.

4.9 Well Development Record

The following data shall be recorded on a monitoring well development record during development:

1) Name of the responsible site geologist, engineer or geotechnical engineer;

2) Well designation and location;

3) Site name and location;

4) Date(s) of well installation;

5) Date(s) and time of well development;

6) Description of surge/development technique;

7) Type, size, capacity, and pumping rate of pump and/or bailer used;

8) Depth from top of well casing to bottom of well;

9) Well and casing inside diameter;

10) Static water level (equilibrium) from top of well casing before and after development;

11) Field measurements of pH, specific conductance, temperature, and turbidity before, at least twice during, and after development;

12) Screen length and interval;

13) Physical character of removed water, to include changes during development in clarity, color, particulates, and any noted incidental odor;

14) Cumulative water volume or pumping rate;

15) Quantity of fluids/water removed and time interval for removal (present both incremental and total values); and

16) Drilling company.

4.10 Determination of Hydraulic Conductivity from Specific Capacity

Immediately following well development, estimates of hydraulic conductivity can be obtained by conducting specific capacity tests. Specific capacity of a well is the well yield per unit drop of water level in the well. Immediately after monitoring well development, the specific capacity can be measured and used to provide an estimate of the hydraulic conductivity. If the well does not sustain pumping rates of at least 0.5 gallons per minute without excessive drawdown, other aquifer tests, such as slug tests, should be conducted.

Inherent in the calculation of hydraulic conductivity from specific capacity data are certain assumptions, therefore the responsible site geologist, engineer or geotechnical engineer should account for the following potential sources of error when calculating the hydraulic conductivity from specific capacity data:

1) Effects of variable discharge;

2) Effects of partial penetration of the well;

3) Calculation of well losses;

4) Appearance of delayed yield in the aquifer; and

5) Estimates of aquifer storativity.

Appendix C presents details on the performance of specific capacity tests.

5.0 Management of Investigation-Derived Waste

Investigation-Derived Waste (IDW) is defined as waste materials generated during environmental field activities. IDW may include drilling muds, cuttings, and purge water from test pit and well installation; purge water, soil, and other materials from sample collection; residues such as ash, spent carbon, well development purge water for testing of treatment technologies; contaminated PPE; and solution used to decontaminate equipment and non-disposable PPE. An IDW management plan should be developed as part of a ground water monitoring plan.

5.1 IDW Management Requirements

The fundamental purpose of IDW management is to choose options that are:

1) Protective of human health and the environment; and

2) In compliance with regulations and applicable or relevant and appropriate requirements (ARARs).

5.2 General Objectives for IDW Management

General objectives that site managers should consider include:

1) Protectiveness;

2) Minimization of IDW generation; and

3) Management of IDW consistent with the final remedy for the site.

To the extent that the objectives can be achieved is highly dependent on site-specific conditions.

5.2.1 Protectiveness

Factors that should be considered in determining if a specific management or disposal option is protective include the following:

1) The contaminants, their concentrations, and total volume of IDW;

2) Potentially affected media under management options;

3) Location of the nearest population(s) and likelihood or degree of site access;

4) Potential exposure to workers; and

5) Potential for environmental impacts.

Generally, best professional judgment will be required to make this determination.

5.2.2 IDW Management

Site managers should attempt to minimize the generation of IDW to reduce the need for special storage or disposal requirements that may result in substantial additional costs yet provide little or no reduction in site risks relative to the final remedial action. Generation of IDW can be minimized through proper planning of all remedial activities that may generate IDW, as well as through use of screening information during the site inspection. The potential problems of managing IDW should be a factor in choosing an investigation method.

5.2.3 Consistency with Final Remedy

Most IDW generated during the course of an investigation are intrinsic elements of the site. If possible, IDW should be considered part of the site and should be managed with other wastes from the site, consistent with the final remedy. This will avoid the need for separate treatment and/or disposal arrangements. Because early planning for IDW can prevent unnecessary costs and the use of treatment and disposal capacity, IDW management should be considered as early as possible during the remedial process. A key decision to be made is whether the waste will best be treated or disposed of immediately or addressed with the final remedy. In addition, when IDW is stored on site, it should be managed as part of the first remedial action that addresses the affected media.

5.3 Selection of IDW Disposal Options

The manner of waste disposal must be consistent with applicable Federal, State, and local regulations. Actual disposal and/or treatment techniques for contaminated materials are the same as those for any hazardous substance, that is, incineration, deposition in a landfill, treatment, etc. Protocols and the parties responsible for the handling and disposal of IDW should be included in the ground water work plan.

Disposal option selection should be based on the previously discussed factors:

1) The type and quantity of IDW generated;

2) Risk posed by managing the IDW on site;

3) Compliance to regulations, standards, and ARARs;

4) IDW minimization; and

5) Whether the final remedy is anticipated to be an off site or and onsite remedy.

6.0 Topographic Survey

6.1 Licensing

When practical or if site circumstances require, topographic survey efforts should be conducted by a Florida-licensed surveyor. Exceptions may include low resolution surveys, temporary point locations, and relative location surveys performed by personnel familiar with land surveying but not state certified.

6.2 Horizontal Control

Each boring and/or well installation should be topographically surveyed to determine its location referenced to either a Universal Transverse Mercator (UTM) grid or the State Plane Coordinate System (SPCS). These surveys should be connected to the UTM or SPCS by third order, Class II control surveys in accordance with the Standards and Specifications for Geodetic Control Networks (Federal Geodetic Control Committee, 1984). If the project is an area remote from UTM or SPCS benchmarks and such horizontal control is not warranted, then locations measured from an alternate system depicted on project plans may be acceptable. An accuracy of +/- 0.10 foot is expected for monitoring well locations. Under typical conditions, all borings, temporary wells, temporary and/or permanent markers should also have an accuracy of +/- 1.0.

6.3 Vertical Control

Elevations for a designated point (marked measuring point) on the rim of the uncapped well casing (not the protective casing) for each bore/well site should be surveyed to within +/- 0.010 foot and referenced to the National Geodetic Vertical Datum (NGVD) of 1988. If elevations for the natural ground surface at the bore/well site (not the top of the concrete pad) are required, the survey should be within +/- 0.10 foot and referenced to the NGVD 1988. These surveys should be connected by third order leveling to the NGVD in accordance with the Standards and Specification for Geodetic Control Networks. If the project is in an area remote to NGVD benchmarks and such vertical control is not warranted, then elevations measured from a project datum may suffice, at least on a temporary basis.

6.4 Benchmark Placement

Temporary benchmarks may be installed to perform survey work. Temporary benchmarks typically consist of one or more of the following:

1) Iron pin (#4 rebar minimum, 24 inches in length);

2) Railroad spike in utility pole or tree;

3) Masonry nail driven in pavement;

4) Chiseled square on a concrete structure; and

5) Painted portion of a fixed object, such as a specific part of a fire hydrant.

Permanent benchmarks may be required to provide future control at a site. Permanent benchmarks will consist of a concrete monument a minimum of 5 inches square and two feet in depth with an iron pin imbedded full depth of the concrete and set flush with the top of the concrete, or a brass marker set in a five inches square, two-foot deep concrete monument.

6.5 Field Data

The topographic survey should be completed as near to the time of the last well completion as possible. Survey field data (as corrected), should include loop closures and other statistical data in accordance with the Standards and Specifications. Closure should be within the horizontal and vertical limits referenced above. These data shall be clearly listed in tabular form; the coordinates (and system) and elevation (ground surface and top of riser) for all borings, wells, and reference marks. All permanent and semi permanent reference marks used for horizontal and vertical control (benchmarks, caps, plates, chiseled cuts, rail spikes, etc.) should be described in terms of their name, character, physical location, and reference value. These field data should become part of the project records maintained by the site geologist, engineer, geotechnical engineer, project manager, or other appropriate person.

6.6 Survey Reports

The survey report should include the following:

1) A map showing the locations of the monitoring wells, reference points, and benchmarks. Elevations must be included for all wells (ground surface and top of well riser) and benchmarks;

2) A copy of all checked field notes taken during the field work; and

3) A copy of all coordinates and elevations for the monitoring wells, soil borings, surface water/sediment locations, etc., and temporary control points (baseline and traverse points).

6.7 Geographic Positioning System

As an alternative to conventional land surveying, a Geographic Positioning System (GPS) may be used to determine the horizontal and vertical location of points in the field. GPS may provide greater convenience, reduce equipment and personnel demands, and reduce the time required to conduct a survey as opposed to more traditional methods. GPS is particularly suited for point positioning in remote locations away from established benchmarks. Adequate GPS units must be employed, though, as typical well location and elevation determinations require high resolution surveying.

7.0 Well and Boring Abandonment

7.1 General

Abandonment procedures are designed to permanently close a boring or monitoring well. As such they are designed to preclude current or subsequent fluid media from entering or migrating within the subsurface environment along the borehole vertical axis. It is therefore important that a borehole be sealed in such a manner that it cannot act as a conduit for migration of contaminants from the ground surface to the water table or between aquifers.

All soil borings not completed as monitoring wells must be abandoned in accordance with the following procedures and must be documented on the boring log as such. The date(s) of abandonment and the abandonment method must be included on the boring log.

7.2 Methodology

Each boring to be abandoned should be sealed by grouting from the bottom of the boring/well to ground surface. This should be done by placing a tremie pipe to the bottom for the boring (i.e., to the maximum depth drilled) and pumping grout through the pipe until undiluted grout flows from the boring at ground surface. The ground sealant must consist of high-solids, 100 percent-pure sodium bentonite grout. The amount of approved water used should be kept to a minimum. Neither additives nor borehole cuttings should be mixed with the grout. No borehole shall be backfilled with cuttings.

After 24 hours, the driller, site geologist, engineer, geotechnical engineer, or other field representative, should check the abandoned site for grout settlement. Any settlement depression should be immediately filled even with the ground surface and rechecked 24 hours later. Additional grout should be added using a tremie pipe inserted to the top of the firm grout, unless the depth of the unfilled portion of the hole is less than 5 feet and that portion is dry. The process should be repeated until firm grout remains at the ground surface. It may be necessary to grout the boring to a depth of 2 feet below grade and complete the backfill with lean concrete or asphalt, depending upon the composition of the original surface.

References Cited

29 CFR 1910,120, Code of Federal Regulations, 29 CFR 1910,120, Hazardous Waste Operations and Emergency Response

29 CFR 1926, Code of Federal Regulations, 29 CFR 1926, Safety and Health Regulations for Construction

ASTM A53/A53M, “Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless,” ASTM International

ASTM A312/A312M, “Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipe,” ASTM International

ASTM C150, “Standard Specification for Portland Cement”, ASTM International

ASTM, D1452, “Standard Practice for Soil Investigation and Sampling by Auger Borings,” ASTM International

ASTM D1586, “Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils,” ASTM International

ASTM D1587, “Standard Practice for Thin-Walled Tube Sampling of Soils for Geotechnical Purposes,” ASTM International

ASTM D1785, “Standard Specification for Poly Vinyl Chloride (PVC) Plastic Pipe, Schedules 40, 80, and 120,” ASTM International

ASTM D2113 Historical Standard, “Standard Practice for Rock Core Drilling and Sampling of Rock for Site Investigation,” ASTM International

ASTM D2487, “Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System),” ASTM International

ASTM D2488, “Standard Practice for Description and Identification of Soils,” ASTM International

ASTM D3550, “Standard Practice for Thick Wall, Ring-lined, Split Barrel, Drive Sampling of Soils,” ASTM International

ASTM D4894, “Standard Specification of Polytetraflurorethylene (PTFE) Granular Molding and Ram Extrusion Materials,” ASTM International

ASTM D4895, “Standard Specification for Polytetraflurorethylene (PTFE) Resin Produced From Dispersion,” ASTM International

ASTM D5088, “Standard Practice for Decontamination of Field Equipment Used at Nonradioactive Waste Sites,” ASTM International

ASTM D5092, “Standard Practice for Design and Installation of Ground Water Monitoring Wells in Aquifers,” ASTM International

ASTM D5299, “Standard Guide for Decommissioning of Ground Water Wells, Vadose Zone Monitoring Devices, Boreholes, and Other Devices for Environmental Activities,” ASTM International

ASTM D5521, “Standard Guide for Development of Ground-Water Monitoring Wells in Granular Aquifers,” ASTM International

ASTM D5781, “Standard Guide for Use of Dual-Wall Reverse-Circulation Drilling for Geoenvironmental Exploration and the Installation of Subsurface Water-Quality Monitoring Devices,” ASTM International

ASTM D5782, “Standard Guide for Use of Casing Advancement Drilling Methods for Geoenvironmental Exploration and Installation of Subsurface Water-Quality Monitoring Devices,” ASTM International

ASTM D5783, “Standard Guide for Use of Direct Rotary Drilling with Water-Based Drilling Fluid for Geoenvironmental Exploration and the Installation of Subsurface Water-Quality Monitoring Devices,” ASTM International

ASTM D5784, “Standard Guide for Use of Hollow-Stem Augers for Geoenvironmental Exploration and the Installation of Subsurface Water-Quality Monitoring Devices,” ASTM International

ASTM D5787, “Standard Practice for Monitoring Well Protection,” ASTM International

ASTM D5872, “Standard Guide for Use of Casing Advancement Drilling Methods for Geoenvironmental Exploration and Installation of Subsurface Water-Quality Monitoring Devices,” ASTM International

ASTM D5875, “Standard Guide for Use of Cable-Tool Drilling and Sampling Methods for Geoenvironmental Exploration and Installation of Subsurface Water-Quality Monitoring Devices,” ASTM International

ASTM D6169, “Standard Guide for Selection of Soil and Rock Sampling Devices Used With Drill Rigs for Environmental Investigations,” ASTM International

ASTM D6286, “Standard Guide for Selection of Drilling Methods for Environmental Site Characterization,” ASTM International

ASTM D6724, “Standard Guide for Installation of Direct Push Ground Water Monitoring Wells”, ASTM International

ASTM D6725, “Standard Guide for Direct Push Installation of Prepacked Screen Monitoring Wells in Unconsolidated Aquifers,” ASTM International

ASTM D6914, “Standard Practice for Sonic Drilling for Site Characterization and the Installation of Subsurface Monitoring Devices,” ASTM International

ASTM F480, “Standard Specification for Thermoplastic Well Casing Pipe and Couplings Made in Standard Dimension Ratios (SDR), SCH 40 and SCH 80, ASTM International

Driscoll, Fletcher, Ph.D., Ground water and Wells, Johnson Division, St. Paul, MN, 1996.

National Ground Water Association, Stuart Smith, ed., Manual of Water Well Construction Practices, NGWA, Westerville, OH (1998)

U.S. Army Corps of Engineers (USCOE), Engineering and Design, Monitoring Well Design, Installation, and Documentation at Hazardous, Toxic, and Radioactive Waste Sites, EM 1110-1-4000, 1 November 1998

USCOE, EM 385-1-1, Safety and Health Requirements Manual

USCOE, ER 385-1-92, Safety and Occupational Health Document Requirements for Hazardous, Toxic, and Radioactive (HTRW) and Ordnance and Explosive Waste (OEW) Activities

U. S. Environmental Protection Agency, Environmental Investigations Standard Operating Procedure and Quality Assurance Manual, Section 6: Design and Installation of Monitoring Wells, November 2001

Other Suggested References

ASTM D 5876, “Standard Guide for Use of Direct Rotary Wireline Casing Advancement Drilling Methods for Geoenvironmental Exploration and Installation of Subsurface Water-Quality Monitoring Devices,” ASTM International

ASTM D 5978, “Standard Guide for Maintenance and Rehabilitation of Ground-Water Monitoring Wells,” ASTM International

ASTM D 5979, “Standard Guide for Conceptualization and Characterization of Ground-Water Systems,” ASTM International

U.S. Environmental Protection Agency, Nonaqueous Phase Liquids Compatibility with Materials Used in Well Construction, Sampling, and Remediation, (EPA/540/S-95/503, July, 1995) http://www.epa.gov/ada/download/issue/napl.pdf

Appendix A – Tables

- Table 4: Typical Borehole and Annulus Volume Calculations
- Table 5: Comparison of Stainless Steel, PVC, and Teflon® for Monitoring Well Construction
- Table 6: Relative Compatibility of Rigid Well Casing Material (Percent)

Table 4: Typical Borehole and Annulus Volume Calculations

Inside Diameter of Borehole (inches)	Outside Diameter of Casing Within Borehole (inches)	Cubic Feet per Foot of Depth	U.S. Gallons per Foot of Depth
1.0	NA	0.005	0.04
1.5	NA	0.012	0.09
2.0	NA	0.022	0.16
2.5	NA	0.034	0.25
3.0	NA	0.049	0.37
3.5	NA	0.067	0.50
4.0	NA	0.087	0.65
4.0	2.5	0.053	0.40
4.5	NA	0.110	0.83
5.0	NA	0.136	1.02
5.5	NA	0.165	1.23
6.0	NA	0.196	1.47
6.0	2.5	0.162	1.21
6.0	4.5	0.086	0.64
6.5	NA	0.230	1.72
7.0	NA	0.267	2.00
8.0	NA	0.349	2.61
8.0	2.5	0.315	2.36
8.0	4.5	0.239	1.78
8.0	6.5	0.119	0.89
9.0	NA	0.442	3.30
10.0	NA	0.545	4.08
10.0	2.5	0.511	3.82
10.0	4.5	0.435	3.25
10.0	6.5	0.315	2.36
11.0	NA	0.660	4.94
12.0	NA	0.785	5.87
12.0	2.5	0.751	5.62
12.0	4.5	0.675	5.05
12.0	6.5	0.555	4.15
14.0	NA	1.069	8.00
14.0	4.5	0.959	7.17
14.0	6.5	0.839	6.27
16.0	NA	1.396	10.44
16.0	4.5	1.286	9.62
16.0	6.5	1.186	8.72

Table 5: Comparison of Stainless Steel, PVC, and Teflon® for Monitoring Well Construction

Characteristic	Stainless Steel	Schedule 40 PVC	Teflon
Strength	Use in deep wells to prevent compression and closing of screen and/or riser	Use when shear and compression strength are not critical	Low-strength capabilities limit deep-well construction
Weight	Relatively heavier	Light-weight	Relatively light
Cost	Relatively expensive	Relatively inexpensive	Expensive
Corrosivity	Deteriorates more rapidly in corrosive water, particularly when exposed to $H_2SO_4$4	Non-corrosive – may deteriorate in presence of high concentrations of ketones, aromatics, alkyl sulfides, or some chlorinated hydrocarbons	Nearly totally resistant to chemical and biological attack, oxidation, weathering and ultraviolet radiation
Ease of Use	Difficult to adjust size or length in the field	Easy to handle and work with in the field	Fairly easy to handle and work with in the field
Preparation for Use	Should be steam cleaned if organics will be subsequently sampled	Never use glue fillings – pipes should be threaded or pressure fitted. Should be steam cleaned when used for monitoring wells is not certified clean	Should be steam cleaned if not wrapped by manufacturer and if organics will be subsequently sampled
Interaction with contaminants	May sorb organic or inorganic substances when oxidized	May sorb or release organic substances	Almost completely chemically inert; may react to halogenated compounds, and sorption of some organic compounds, (Reynolds and Gillham, 1985). Except in the case of very low yield wells which preclude purging prior to sampling, these reactions are unlikely to cause significant sample bias.

Table 6: Relative Compatibility of Rigid Well Casing Material (Percent)

Potentially-Reactive Substance	Type of Casing Material						
	PVC 1	Galvanized Steel	Carbon Steel	Lo-Carbon Steel	Stainless Steel 304	Stainless Steel 316	Teflon®*
Buffered Weak Acid	100	56	51	59	97	100	100
Weak Acid	98	59	43	47	96	100	100
Mineral Acid/High Solids Content	100	48	57	60	80	82	100
Aqueous/ Organic Mixtures	64	69	73	73	98	100	100
Percent Overall Rating	91	58	56	59	93	96	100

Preliminary Ranking of Rigid Materials:

1. Teflon®*
2. Stainless Steel 316
3. Stainless Steel 304
4. PVC
5. Lo-Carbon Steel
6. Galvanized Steel
7. Carbon Steel

*Teflon is a registered product of DuPont

Appendix B – Forms

- Form 1: Soil Parameters for Logging
- Form 2: Rock Parameters for Logging
- Form 3: Monitoring Well Completion Report
- Form 4: Application to Construct, Repair, Modify or Abandon a Well

Form 1: Soil Parameters for Logging

Parameter	**Example**
Classification	
Depositional Environment and formation, if known	
ASTM D 2488 Group Symbol	
Secondary Components and estimated percentages	
Color: *Give both narrative and numerical description and what chart was used – Munsell Soil and/or GSA Rock Color*	
Plasticity	
Consistency (cohesive soil)	
Density (non-cohesive soil)	
Moisture content (use relative terms)	
Structure and orientation	
Grain angularity	

Source: U.S. COE, 1988

Form 2: Rock Parameters for Logging

Parameter	Example
Rock Type	
Formation	
Modifier denoting variety	
Bedding/banding characteristics	
Color: *Give both narrative and numerical description and what chart was used – Munsell Soil and/or GSA Rock Color*	
Hardness	
Degree of cementation	
Texture	
Structure and orientation	
Degree of Weathering	
Solution or Void Conditions	
Primary and secondary permeability, including estimates and rationale	
Rock quality designation	

Source: U.S. COE, 1988

Form 3: Monitoring Well Completion Report

DEP Form # 62-520.900(3)
Form Title MONITORING WELL COMPLETION REPORT
Effective Date
DEP Application No.
(Filled in by DEP)

Florida Department of Environmental Protection

Bob Martinez Center, 2600 Blair Stone Road Tallahassee, Florida 32399-2400

MONITORING WELL COMPLETION REPORT

PART I: GENERAL INFORMATION

Well ID:	Site Name:		Well Install Date
Facility ID	Alternate ID	FLUWID #	WMD Permit #
Well Purpose ☐ Background ☐ Intermediate ☐ Compliance ☐ Other (explain)			
Latitude (to nearest 0.1 seconds)		Longitude (to nearest 0.1 seconds)	
Latitude and Longitude collection method: ☐ DGPS ☐ AGPS ☐ MAP ☐ ZIPCODE ☐ DPHO ☐ UNKNOWN ☐ OTHER			

PART II: WELL CONSTRUCTION DETAILS

Water Well Contractor Name				Contractor License #
Company Name				
Construction Method: ☐ Hollow Stem Auger ☐ Solid Stem Auger ☐ Water/Mud Rotary ☐ Air Rotary ☐ Cable Tool ☐ Direct Push ☐ Sonic ☐ Other (describe)				Aquifer Monitored
Top of Casing Elevation (NVGD or NAVD)			Ground Surface Elevation (NVGD or NAVD)	

Casing

Material	Inside Diameter	Outside Diameter	Depth (ft.) From	Depth (ft.) To

Screen

Material	Inside Diameter	Outside Diameter	Depth (ft.) From	Depth (ft.) To	Slot Size

Annulus

Material including additives for sealant	Size of Material	Amount (# of bags)	Depth (ft.) From	Depth (ft.) To	Installation Method

PART III: WELL DEVELOPMENT DETAILS

Well Development Date	Well Development Method: ☐ Surge/Pump ☐ Pump ☐ Compressed Air ☐ Other (explain)		
Development Duration			
Pumping Rate	Maximum Drawdown	Well Purged Dry ☐ yes ☐ no	Pumping Condition ☐ continuous ☐ intermittent
Turbidity (if Measured): Start:	End:		Stabilized Water Level (BLS)
Water appearance (color and odor) at start of development:			
Water appearance (color and odor) at end of development:			

Report Prepared By:	Date
Title/Company	License #

PLEASE ATTACH BORING LOG

Remarks

Form 4: Application to Construct, Repair, Modify or Abandon a Well

STATE OF FLORIDA PERMIT APPLICATION TO CONSTRUCT, REPAIR, MODIFY, OR ABANDON A WELL

☐ Southwest
☐ Northwest
☐ St. Johns River
☐ South Florida
☐ Suwannee River

CHECK BOX FOR APPROPRIATE DISTRICT. ADDRESS ON BACK OF PERMIT FORM.

THIS FORM MUST BE FILLED OUT COMPLETELY.

The water well contractor is responsible for completing this form and forwarding the permit to the appropriate delegated county where applicable.

Permit No. _____
Florida Unique I.D. _____
Permit Stipulations Required (See attached)
62-524 well ☐
CUP/WUP Application No. _____

ABOVE THIS LINE FOR OFFICIAL USE ONLY

Fold at this line in order that address is visible through envelope window

1. _____
Owner, Legal Name of Entity if Corporation — Address — City — Zip — Telephone Number

2. _____
Well Location — Address, Road Name or Number, City

3. _____
Well Drilling Contractor — License No. — Telephone No.

_____
Address

_____
City — State — Zip

4. _____ (smallest) 1/4 of _____ (biggest) 1/4 of Section _____
(Indicate Well on Chart)

5. Township _____ Range _____

NW NE SW SE

6. _____ County | _____ Subdivision Name | _____ Lot | _____ Block | _____ Unit

7. **Number of proposed wells** _____ **Check the use of well:** (See back of permit for additional choices) _____ Domestic Monitor (type) _____

_____ Irrigation (type) (See Back) Public Water Supply (type) _____ (See Back) List Other _____

Distance from septic system _____ ft. **Description of facility** _____ **Estimated start of construction date** _____

8. **Application for:** _____ New Construction _____ Repair/Modify _____ Abandonment _____ (Reason for Abandonment)

Date Stamp

9. **Estimated:** Well Depth _____ Casing Depth _____ Screen Interval from _____ to _____
Casing Material: Blk-Steel / Gal / PVC Casing Diameter _____ Seal Material _____

10. **If applicable: Proposed Grouting Interval** From _____ to _____ Seal Material _____
From _____ to _____ Seal Material _____
From _____ to _____ Seal Material _____

Draw a map of well location and indicate well site with an "X". Identify known roads and landmarks; provide distances between well and landmarks.

North
West
East
South

11. **Telescope Casing** _____ **or Liner** _____ (check one) Diameter _____
Blk-Steel / Galvanized / PVC Other (specify: _____

12. **Method of Construction:** _____ Rotary _____ Cable Tool _____ Combination
_____ Auger _____ Other (specify:) _____)

13. **Indicate total No. of wells on site** _____. **List number of unused wells on site** _____.

14. **Is this well or any other well or water withdrawal on the owner's contiguous property covered under a Consumptive/Water Use Permit (CUP/WUP) or CUP/WUP Application?** ___No ___Yes
(If yes, complete the following) CUP/WUP No. _____
District well I.D. No. _____
Latitude _____ Longitude _____
Data obtained from GPS ____ or map ____ or survey ____ (*map datum NAD 27*____ *NAD 83*____)

15. I hereby certify that I will comply with the applicable rules of Title 40, Florida Administrative Code, and that a water use permit or artificial recharge permit, if needed, has been or will be obtained prior to commencement of well construction. I further certify that all information provided on this application is accurate and that I will obtain necessary approval from other federal, state, or local governments, if applicable. I agree to provide a well completion report to the District within 30 days after drilling or the permit expiration, whichever occurs first.

_____ Signature of Contractor — License No.

I certify that I am the owner of the property, that the information provided is accurate, and that I am aware of my responsibilities under Chapter 373, Florida Statutes, to maintain or properly abandon this well; or, I certify that I am the agent for the owner, that the information provided is accurate, and that I have informed the owner of his responsibilities as stated above. Owner consents to personnel of the WMD or a representative access to the well site.

_____ Owner's or Agent's Signature — Date

DO NOT WRITE BELOW THIS LINE — FOR OFFICIAL USE ONLY

Approval Granted By: _____ Issue Date: _____ Hydrologist Approval _____ Initials

Owner Number: _____ Fee Received: $ _____ Receipt No.: _____ Check No.: _____

THIS PERMIT NOT VALID UNTIL PROPERLY SIGNED BY AN AUTHORIZED OFFICER OR REPRESENTATIVE OF THE WMD. IT SHALL BE AVAILABLE AT THE WELL SITE DURING ALL DRILLING OPERATIONS. ***This permit is valid for 90 days from date of issue.***

WHITE: ORIGINAL FILE
YELLOW: DRILLING CONTRACTOR
PINK: OWNER

SRWMD FORM 40B-3-1 REV. 12/95

Appendix C- Specific Capacity Testing

The purpose of specific capacity testing can be multi-fold, and depends on project demands. Specifically, some of the objectives of specific capacity testing include:

1) Determine the maximum pumping rate for a given well;

2) Obtain data to calculate first estimate of hydraulic conductivity and storativity; and

3) Obtain data to determine well efficiency.

Specific capacity tests can be conducted during or following development, or during purging for sampling. Specific capacity testing should be considered if the well is capable of sustaining a measurable yield, and if the test well pump is capable of sustaining a constant rate discharge. Specific capacity is defined as yield divided by drawdown, and is normally expressed as gallons per minute/feet of drawdown. Both pumping rate and drawdown are measured simultaneously in the tested well after a given amount of time has elapsed. Dividing the yield rate by the stabilized drawdown, gives the specific capacity. Specific capacity can vary with pumping duration, with specific capacity decreasing as pumping time increases. Additionally, specific capacity also generally decreases as discharge rate increases. Both of these responses are due to the dewatering of the aquifer within the domain of the cone of depression; for a given amount of drawdown, the yield progressively becomes less as the saturated thickness of the aquifer is reduced. Specific capacity may also vary with yield as function of the system efficiency, including the pump, well, discharge piping, well efficiency, etc., which all add an element of friction to the process.

The analysis of specific capacity test data is relatively straightforward, and based on equations presented in Jacob (1946) and Lohman (1972). Bradbury and Rothschild (1985) compiled a computer program to accept specific capacity data and output aquifer transmissivity. This program accounts for well loss and partial penetration, and is easily compiled from the reference. The treatment of partial penetration in the program is straightforward, and is treated mathematically in the reference. Well loss is less apparent, and is discussed further.

Well loss in an important factor in the analysis of specific capacity data when yield rate is substantially high. Well loss, or head loss due to well inefficiency, is due to turbulent flow of water through the well bore, into the well, and into the pump. Well loss is expressed as a percentage, or as a coefficient.

The equation representing general well loss (Walton, 1987) is expressed as:

Equation 1 $S_\omega = CQ^2$

Where:

S_ω = drawdown component due to well loss, in feet
C = well coefficient, in sec^2/ft^5
Q = production well discharge rate, in cubic feet per second (cfs) (1 cfs = 449 gallons per minute [gpm])

Values of the well loss coefficient as used in the Bradbury and Rothschild program for production wells are generally less than 10 and are more often than not less than 2 (Walton, 1987). Typically, well loss is calculated using step drawdown test data. During a step drawdown test, yield rate and drawdown are measured synoptically while the pump is operated at successive stages at some fraction of full capacity. Using a step test data, the well loss coefficient may be estimated by the following equation (Walton, 1987):

Equation 2 $$C = \frac{(\Delta S_n/\Delta Q_n) - (\Delta S_{n-1}/\Delta Q_{n-1})}{(\Delta Q_{n-1} + \Delta Q_n)}$$

The following example illustrates a typical well loss coefficient calculation: A step drawdown test was performed. The pumping rates and times are shown below:

Start Time	End Time	Pumping Rate (gpm)
10:30	12:40	13.3
12:40	14:00	25.0
14.00	14.20	42.0

During the pumping periods, the water levels in the pumping well were recorded using an electronic water/level indicator. Data required to calculate the well loss coefficient are shown below:

Step # (n)	Q (gpm)	Q (cfs)	ΔQ (cfs)	s (ft)	Δ s (ft)
1	13.3	0.0296	0.0296	5.6	5/.6
2	25.0	0.0557	0.0261	11.6	6.0
3	42.0	0.0935	0.0378	21.2	9.6

Where:

Q = Actual discharge for the time step
ΔQ = Increase in discharge for the time step
S = Drawdown at the time step pumping rate
ΔQ = Increase in drawdown from the previous time step

Using Equation 2, the well loss coefficients are:

C 1.2 = 730.7 sec^2 / ft^5
C 2.3 = 377.1 sec^2 / ft^5

Therefore, the average well loss coefficient is 553.9 sec^2 / ft^5. Using Equation 1, the well loss at 42 gpm is theoretically calculated to be 4.8 feet.

The importance of determining the well loss coefficient will depend on the yield rate of the test. Because of the association with turbulent flow, calculation of the well loss coefficient may be impractical and unnecessary for a yield rate of a few gallons per minute or less.

The procedure for conducting a specific capacity test is quite simple, and consists of the following general steps:

1) Open the well to vent;

2) Measure the static water level;

3) Insert pump into well and allow to equilibrate;

4) Remeasure water level to ensure equilibration following pump insertion;

5) Initiate pumping;

6) Measure yield rate and drawdown synoptically at regular and frequent intervals, and record on the specific capacity test form;

7) Pump until drawdown stabilized (subjective determination; generally measurements within 0.03 feet over a ten minute interval can be considered stable);

8) Terminate pumping; and

9) Measure water levels at frequent intervals during recovery to ensure original static water level is reached; the water level measured when residual drawdown stabilized should be used as the static water level.

Lake Jackson Watershed Hydrologic Investigation

Task 1b – Hydrologic Data Inventory and Recommendations For Additional Data Collection. FINAL Recommendations Report

Prepared For:

Highlands County, FL.

Prepared By:

AIM Engineering & Surveying, Inc.

Interflow Engineering, L.L.C.
IE Project No. 2015-AI01

March 15, 2016

Table of Contents

Executive Summary

This report serves as a data inventory and review of the pertinent available hydrologic data near Lake Jackson/Little Lake Jackson and the surrounding water bodies within the proposed study area. The inventory and review focused on data that may be relevant and useful in future lake-level modeling efforts. The report provides an overview of the available data, including sources, period of record (POR) and some data analysis to enhance the understanding of the area before model development. Subsequent sections discuss the various types of data (Atmospheric, Surface water, and Ground water) and shows the location of each gage presented within the appropriate section of the report.

The data analysis presents Lake Jackson Stage, Avon Park Rainfall and selected public supply groundwater withdrawals near Lake Jackson. The intent is not to be an exhausting cause and effect analysis, rather a cursory or screening evaluation of the data sources to better the understanding of the interactions of rainfall, and pumpage with respect to Lake Jackson stage, and to guide the recommendations for data collection efforts to occur in the next phase of this project.

The final section of the report identifies potential data collection sites that might be implementable within the funding constraints. The majority of proposed monitoring sites are located on Highlands County or City of Sebring owned parcels to ensure the highest probability of site availability (land area for well installation). Additional groundwater monitoring locations are presented within the proposed study area and are locations of existing wells with the potential for future data collection.

The data collected and presented in this report as well as the proposed monitoring locations, will serve to inform a future modeling effort and provide additional calibration locations to build the most defensible and scientifically robust model of the area.

1.0 Introduction

The study area includes Lake Jackson in Highlands County and relevant portions of the surrounding Upper Josephine / Jackson Creek Watershed. This area was the focus of previous long-term hydrologic modeling which supported an evaluation of possible management scenarios designed to increase lake levels in Lake Jackson. The results of the previous work suggest that data available at the time was a limitation to the modeling approach that was utilized. The work effort described herein comprises the second of three tasks of a multi-year investigation to identify the causes of low water levels in Lake Jackson and Little Lake Jackson over the last decade, and to develop cost-effective recovery strategies.

2.0 Data Inventory/ Data Analysis

The following sections will detail data collected as part of Task 1b. This data will be incorporated into a future modeling effort, as well as provide the foundation with which to compare several results from the model. Each section will include a list of available data, details including: site/station name, period of record and a presentation of the data (i.e. graphs). A map will be provided showing all gage locations, from precipitation to groundwater.

2.1 Rainfall Data

Available rainfall data were gathered from SWFWMD, and NOAA. While not presented within this report, SWFWD maintains a repository of spatially and temporally variable radar rainfall, known as NEXRAD. For the purposes of this task, it was not necessary to obtain hourly data, but rather note the availability and usefulness in future modeling efforts.

Data found to date including POR:

- Daily data from NOAA – AVON PARK 2 W FL US - 07/01/1948 to 10/8/2015
- Daily data from SWFWMD – ROMP 28 KUHLMAN - 8/15/2000 to 10/15/2015
- Yearly totals for Highlands County: from SWFWMD – 1915 to 2015

Figures 2 to 4 present the annual total rainfall in inches for each of the aforementioned gages (data sources). Of note is the data presented in **Figure 4**, where the SWFWMD has gathered and processed rainfall data for the entire county and provided yearly totals from 1915 to present.

In the following figures, the annual rainfall for each gage, including Highlands County totals, is presented in each figure as the horizontal black line for the duration of each rainfall graph. As shown, the average for the rainfall data presented below is about 51-inches. Additionally, each graph shows some variability in the minimum and maximum rainfall totals observed, with the highest variability shown in the minimum yearly rainfall totals. Minimum yearly rainfall from the sources shown ranges from 20 to 30 inches in a given year. Maximum rainfall totals can range from 70 to 80 inches in a given year. This variability is quite normal for Florida, and is indicative of the extreme weather patterns the state experiences as a whole. Data trends will be further discussed in **Section 3.0 Data Analysis**.

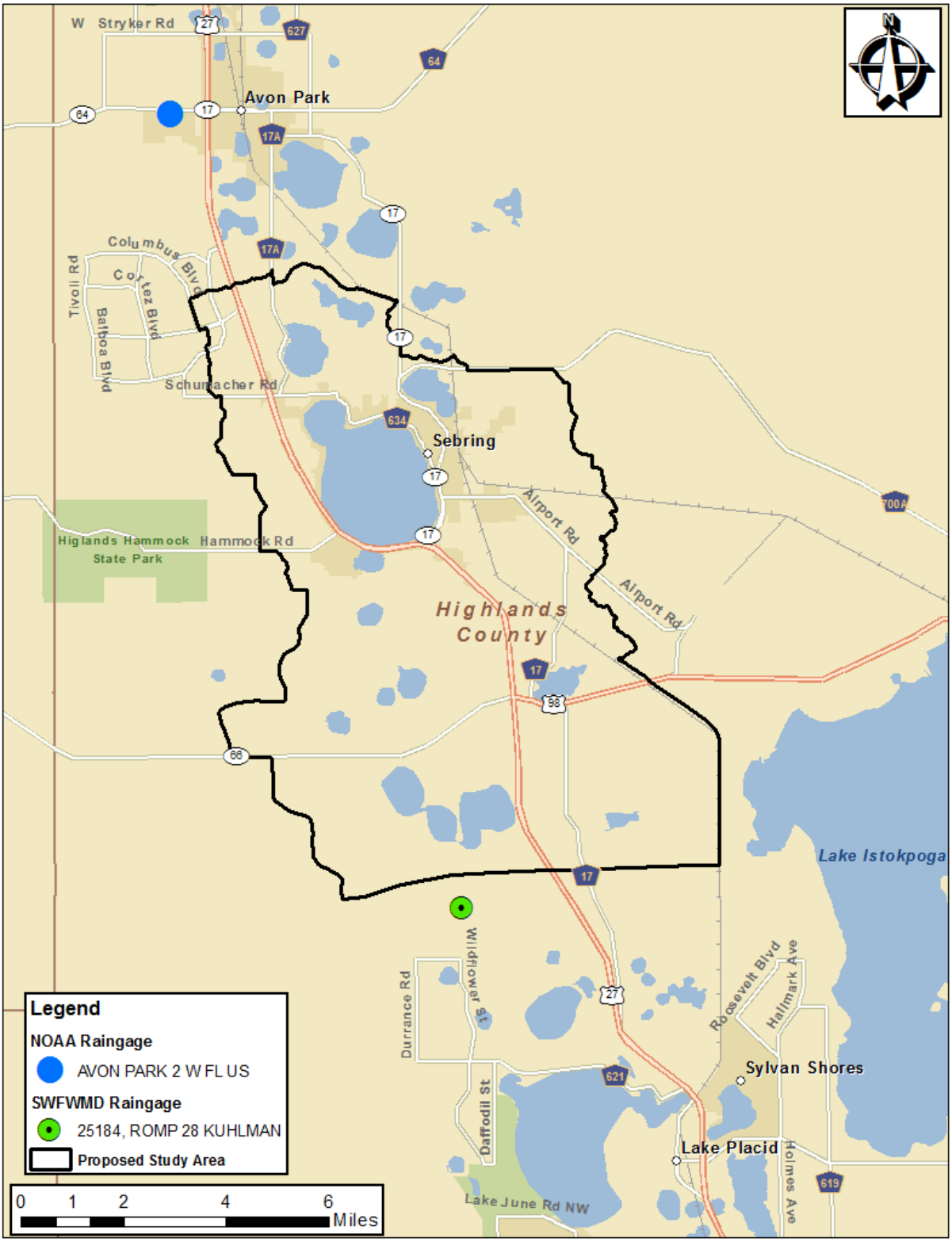


Figure 1. Precipitation Gages near Proposed Study Area.

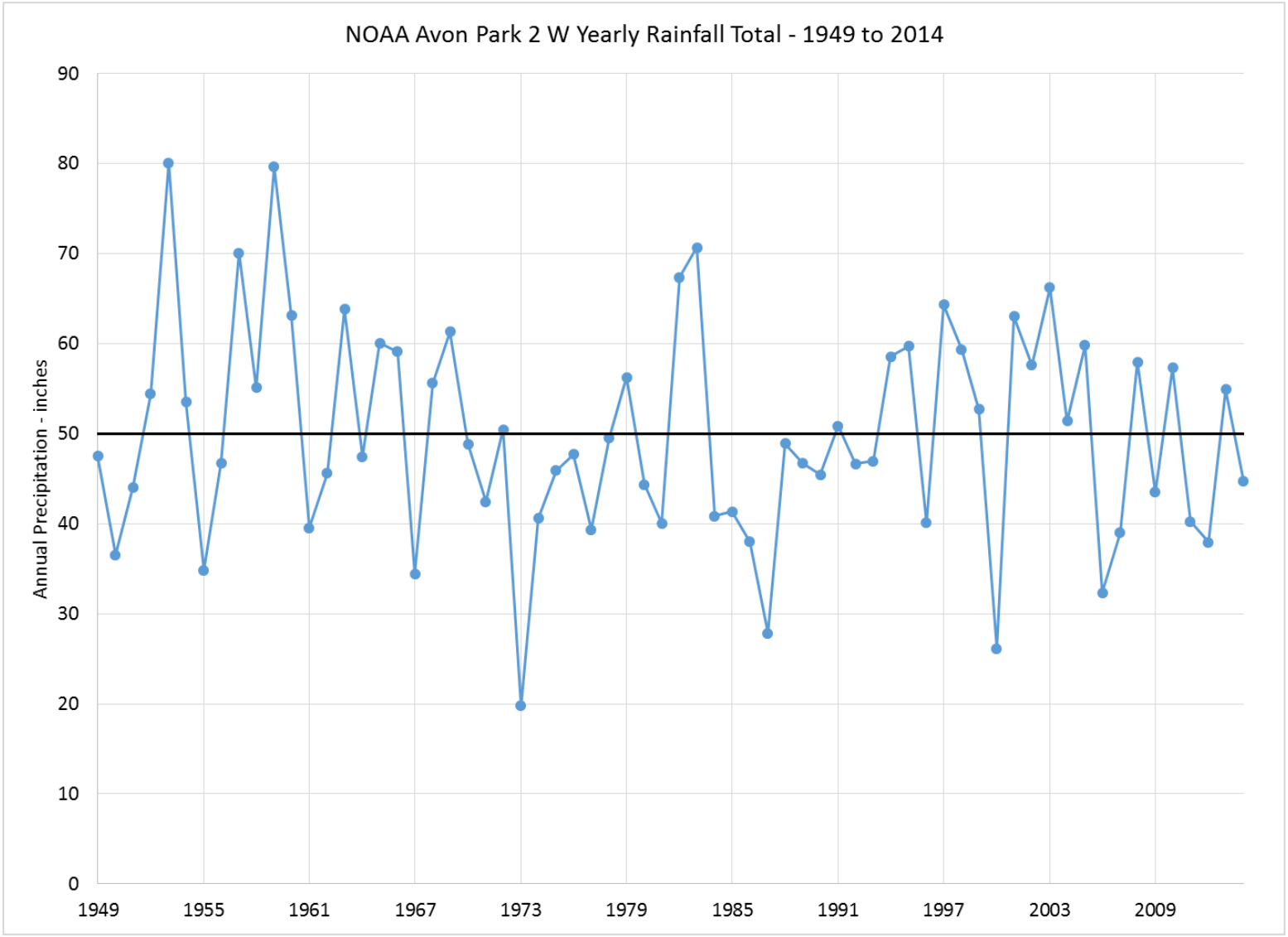


Figure 2. Yearly Rainfall Totals – NOAA Avon Park 2 W Gage.

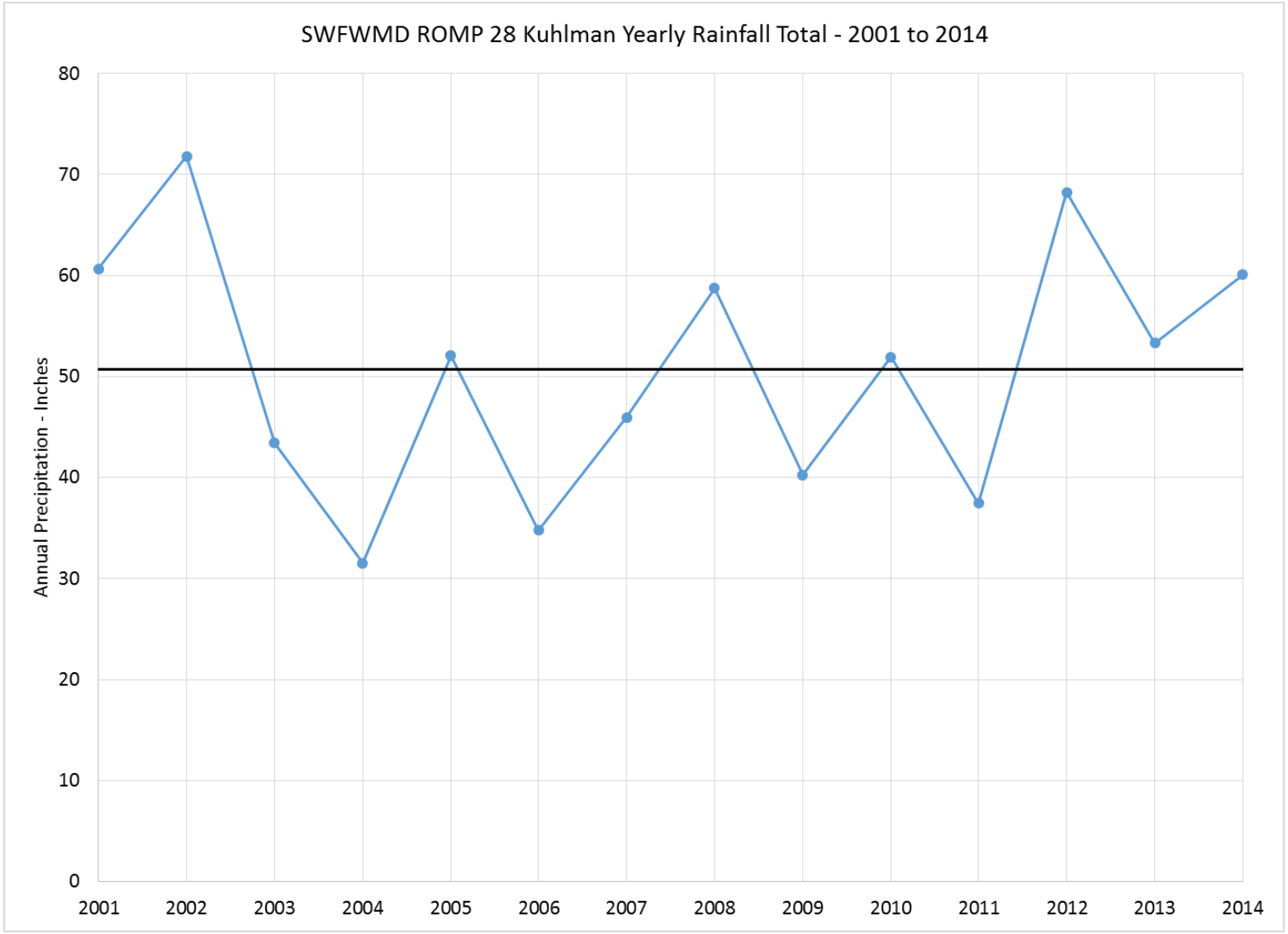


Figure 3. Yearly Rainfall Totals –SWFWMD ROMP 28 Kuhlman.

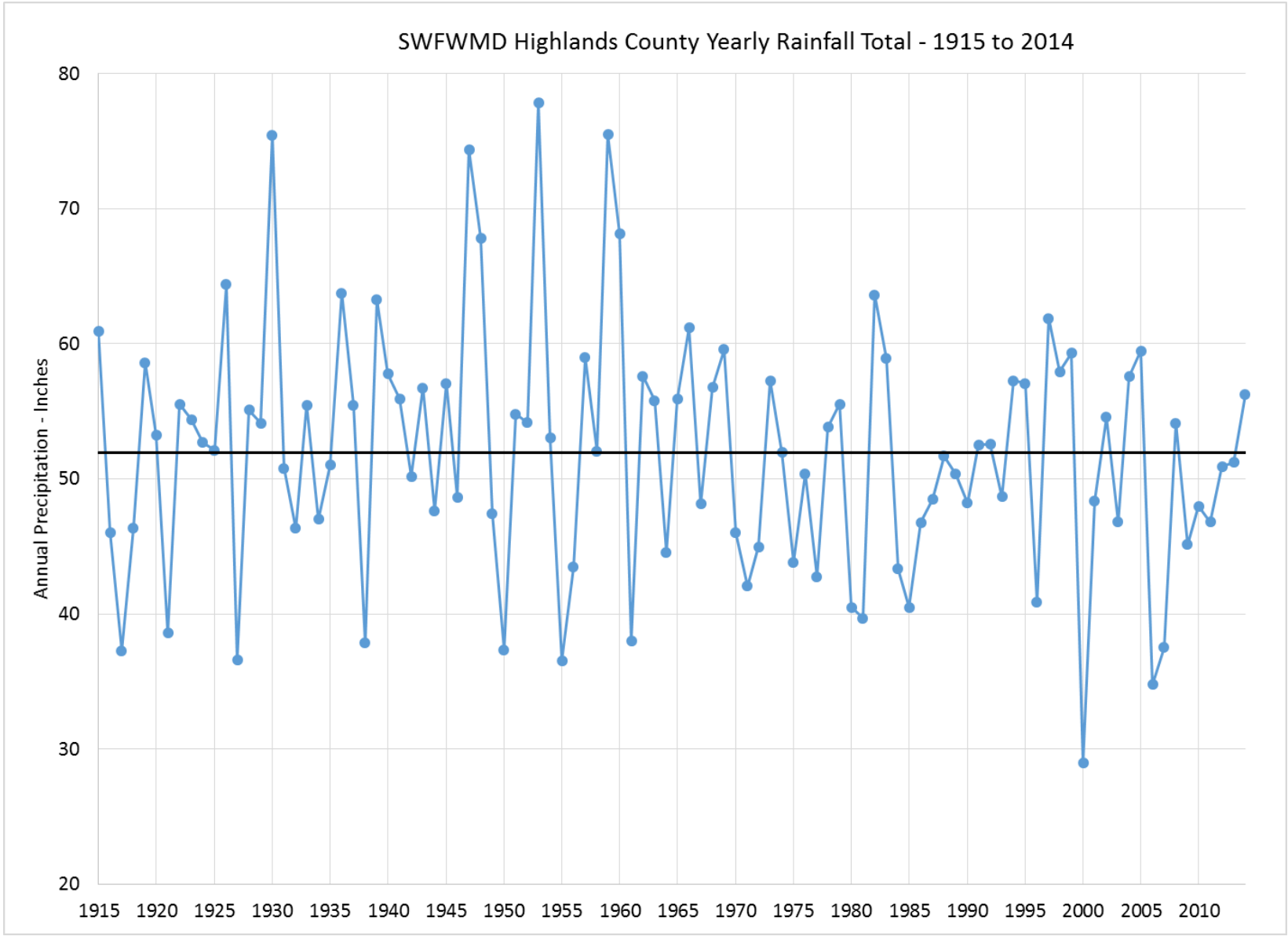


Figure 4. Yearly Rainfall Totals - SWFWMD Highlands County.

Figure 5 presents SWFWMD NEXRAD climate pixels which represent a 2km x 2km grid over the proposed study area. Each pixel within the grid shows the location of the available data coverage of SWFWMD NEXRAD rainfall data and USGS GOES RET data. NEXRAD rainfall data is available from 1995 to present in 15min, hourly, and daily time increments. Rainfall data with hourly resolution will be sufficient for model simulations to calculate the water budget of Lake Jackson.

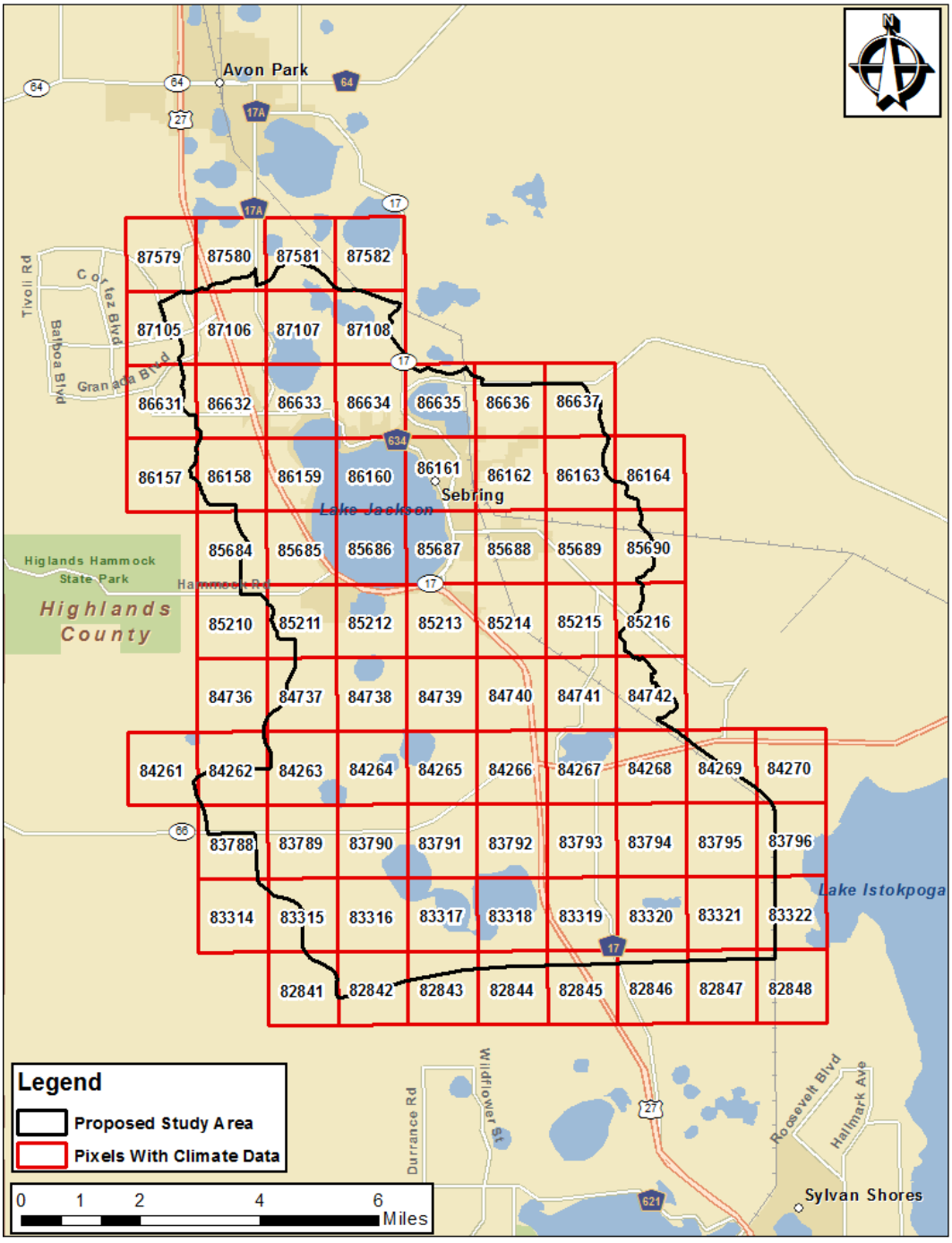


Figure 5. SWFWMD Climate PIXELS.

2.2 Evaporation and Evapotranspiration Data

Reference Evapotranspiration (RET) is one of the most important components of a water budget effort and subsequently building a watershed model, as evapotranspiration (ET) is typically the second-largest component of a watershed's overall water budget. Daily Geostationary Operational Environmental Satellite (GOES) Satellite Based RET data was obtained from the USGS, which is considered the best available data for a distributed watershed model such as that proposed in Task 1a. The USGS RET data is available on a daily time step and is applied on the same grid as the NEXRAD rainfall data. USGS GOES RET data was obtained and analyzed for the proposed Lake Jackson Study area. The available data provided coverage from 1996 through 2014. **Table 1** presents the yearly statistics of RET over the study area.

Table 1. USGS GOES RET Statistics for Proposed Study Area.

USGS GOES RET Yearly Statistic	RET inches/year
Max	58.2
Min	50.9
Average	53.9

As mentioned, ET is the second largest component of the water budget and one of the most difficult to estimate. ET varies with changes in weather, land use, soil moisture conditions, and land cover.

Douglas, et al (2009) analyzed observed daily ET (DET) for 18 sites based on different Florida land cover types. **Table 2** presents a summary of these stations that are located within areas of land cover, soils, and weather patterns that are similar to those found in the Northwest and Central Florida area near the study area. These stations all have multiple years of continuous ET measurements.

Table 2. Measured Evapotranspiration Rates at Selected ET Stations (from Douglas, et al, 2009).

ET Station Name	County	Land Cover	Available Period of Record	Average Annual ET (in)
Alachua (Donaldson)	Alachua	Forest (immature pine)	January 1999-June 2003	29.03
Alachua (Austin Cary)	Alachua	Forest (mature pine)	July 2000-June 2002	44.26
Kennedy Space Center	Brevard	Forest (scrub oak)	March 2000-March 2003	32.62
Kennedy Space Center	Brevard	Forest (slash pine)	March 2002-February 2003	33.91
Blue Springs Tract	Hamilton	Forest (pine)	January 2003-December 2004	45.98

ET Station Name	County	Land Cover	Available Period of Record	Average Annual ET (in)
Disney Wilderness Preserve	Polk	Grass	July 2000-January 2006	36.36
Duda Farms	Brevard	Grass	June 2000-May 2005	43.97
Ferris Farm	Citrus	Grass	January 2003-February 2005	22.7
Starkey Wellfield	Orange	Grass	April 2003-December 2004	36.93
Reedy Lake	Pasco	Open water	December 2001-October 2005	60.07

Additional investigation into ET data was performed, whereby, the SWFWMD database was examined and found to contain an inactive weather station (Avon Park ET I). The period of record for Avon Park ET I was 1983 to 1988 and will not prove useful for calibration or other checks against USGS GOES RET data. As such the inactive weather station which contained air temperature data and other climate information including pan evaporation was not analyzed as a function of this task as the available data would not add value to the study.

2.3 Surface water Data

Available surface water data from active sites were collected from the SWFWMD database (WMIS) and includes nine (9) active surface water monitoring locations within the study area. **Figure 6** presents the existing surface water monitoring locations from the SWFWMD database. **Table 3** presents relevant surface water information obtained and analyzed during this task.

Six (6) of the nine (9) monitoring stations collect water level data manually (minimal streamflow data) through the utilization of a calibrated staff gauge. The remaining three (3) monitoring stations collect data through the use of data recorders, provided by USGS and SWFWMD. Most of the monitoring stations (with the exception of the Lake Josephine Outflow) provide water level data from the 1980's to present time , with minor data gaps, as shown in **Figure 7**.

Available surface water data was collected and analyzed to get a clear picture of historical lake level observations for Lake Jackson. Utilization of the existing monitoring sites will be highly dependent on the staff gauge condition, as well as available funding to update the current monitoring site to an automated condition. The existing monitoring stations are recommended to be assessed in the field to determine the condition, as well as accessibility to the sites. More information about the proposed automated lake level monitoring sites are presented in **Section 4.0 Monitoring Recommendations.**

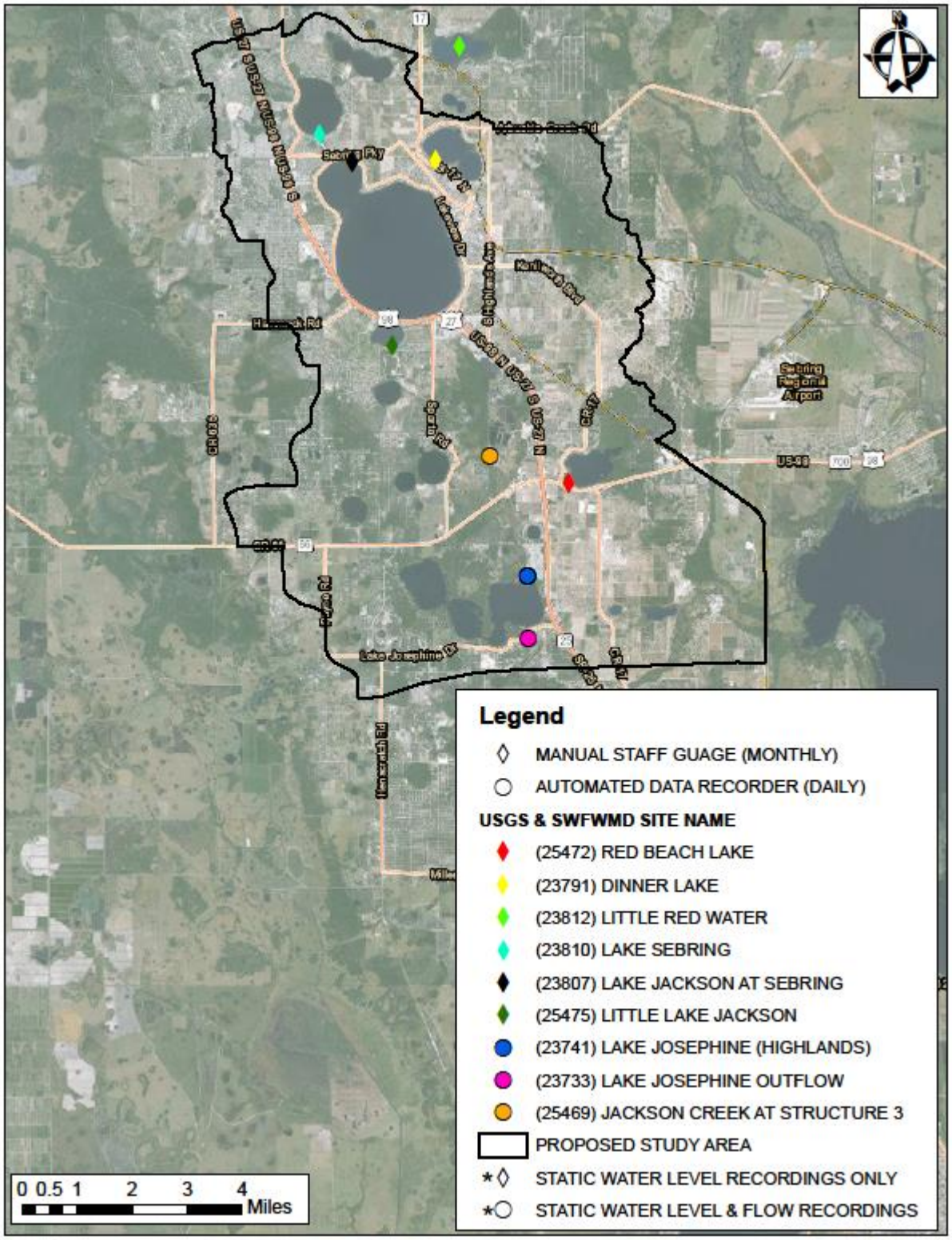


Figure 6. Surface Water Monitoring Sites within Proposed Study Area
(See Table 3 Below for Additional Details)

Table 3. Available Surface Water Level Data (SWFWMD Database).

SWFWMD ID	Site Name	Start Date	End Data	Data Source	Location	Collection Method	Data Frequency (% of Daily Data Coverage)
23807	Lake Jackson at Sebring	10/23/1984	10/26/2015	SWFWMD	Lake Jackson	Manual Staff Gauge	Monthly
23810	Lake Sebring	6/28/1984	12/7/2015	SWFWMD	Lake Sebring	Manual Staff Gauge	(1984-1996), Bi-Monthly & (1997-2015), Monthly
25472	Red Beach Lake	10/1/1985	12/9/2015	SWFWMD	Red Beach Lake	Manual Staff Gauge	Monthly
25475	Little Lake Jackson	7/1/1981	10/13/2015	SWFWMD	Little Lake Jackson	Manual Staff Gauge	Monthly
25469	Jackson Creek at Structure 3	10/2/1991	4/5/2012	SWFWMD	Jackson Creek	District Recorder	Daily (70)
23741	Lake Josephine (Highlands)	12/6/1984	10/12/2015	SWFWMD	Jackson Creek	USGS Recorder/Manual	(1984-1996) Daily (94), (1996-2015) Monthly
23733	Lake Josephine Outflow	12/2/2001	11/3/2015	SWFWMD	Lake Jackson	District Recorder	Daily (93)
23791	Dinner Lake	6/28/1984	11/12/2013	SWFWMD	Dinner Lake	Manual Staff Gauge	Monthly
23812	Little Red Water	6/25/1981	12/10/2015	SWFWMD	Little Red Water	Manual Staff Gauge	Monthly

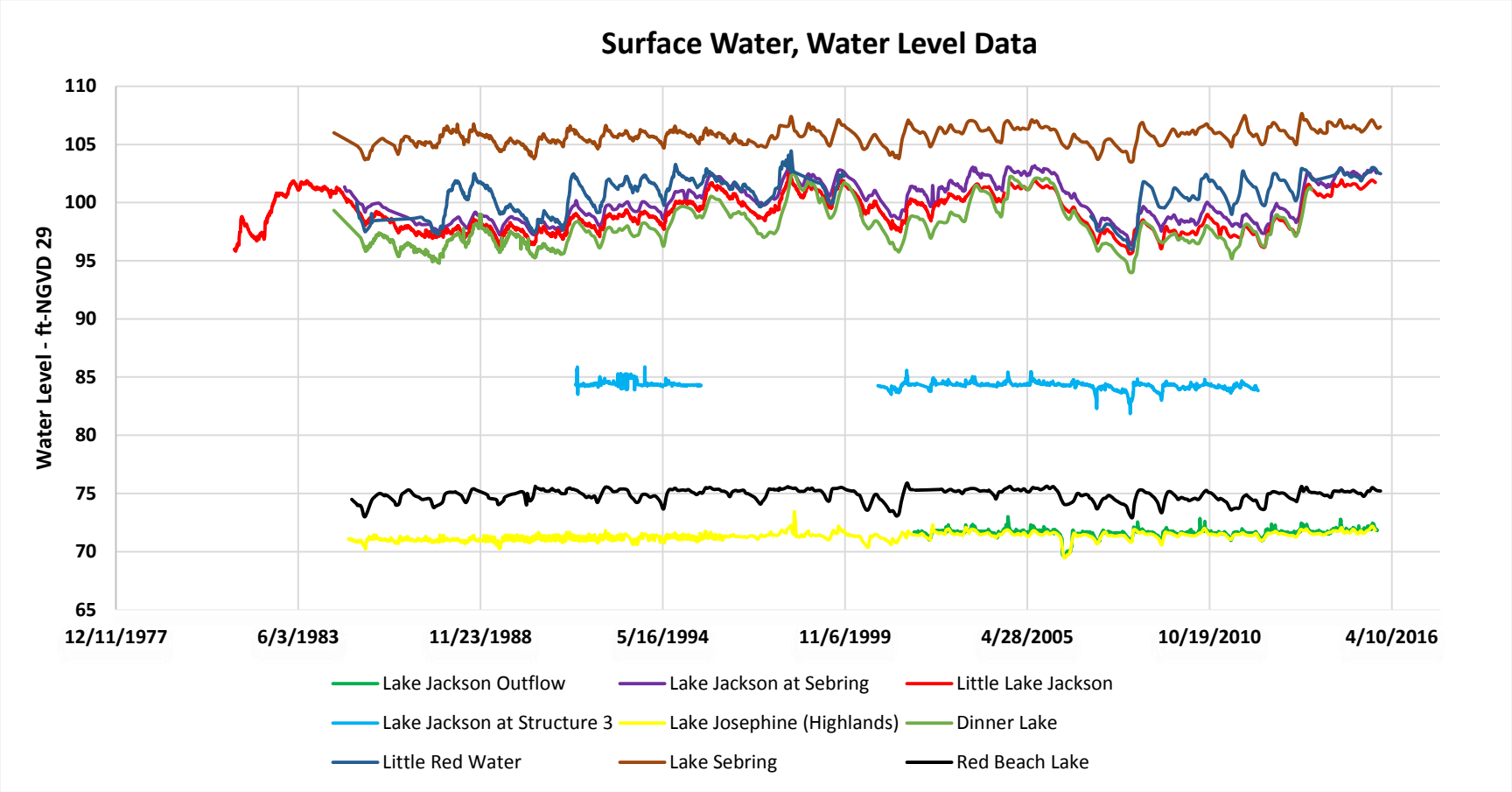


Figure 7. SWFWMD Surface Water Monitoring Sites, Water Level Data.

2.4 Infrastructure Data

To complement the overall hydrologic analysis and recommendations of that within, an inventory of existing water control structures within the proposed study area (As-Builts) were collected to verify hydraulic conveyance characteristics, as well as any potential water level impacts these structures may contribute to Lake Jackson, if any. **Figures 8 and 9** present the locations of these existing structures within the study area. These figures were provided by Highlands County, and were created by Kisinger Campo & Associates Corp.

Currently there is an existing conveyance ditch connecting Lake Sebring to Lake Jackson, which crosses under the Sebring Parkway, Lake Sebring Drive, Sunset Drive, and Lakeview Drive in a southerly direction, before discharging into Lake Jackson. The water levels within this said stormwater ditch is currently controlled by two sheet pile weirs. The upstream weir is designated as Structure HC-8 and the downstream weir at Structure HC-7 by Highlands County.

Additionally, six (6) structures were found within Jackson Creek and Lake Josephine to the south. Structures HC-9, HC-10, and HC-15 are the main structures within Jackson Creek. Structures HC-11 and HC-12 provide drainage control from areas east of Sparta Road, into Jackson Creek. Structure HC-17 is the existing outfall structure from Lake Josephine to Josephine Creek. A more detailed description of the aforementioned structures is presented in **Table 4.**

Table 4. Study Area Structure Inventory (Highlands County Structure Inventory).

Highlands County Site ID	Reference	Basin	Waterbody	Location Description	Structure Type	Weir Width, (ft.)	Control Elevation, (ft. NGVD)
7		Other	Lake Sebring to Lake Jackson	Lakeview Drive	Sheet Pile Weir	6	106.09
8		Other	Lake Sebring to Lake Jackson	Lake Sebring Drive	Sheet Pile Weir	6	106.16
9	STR 1	Jackson-Josephine Creek	Jackson-Josephine Canal	Tubbs Road	Concrete Sharp Crested Weir	30	102.7
10	STR 2	Jackson-Josephine Creek	Jackson-Josephine Canal	East of Sparta Road	Concrete Sharp Crested Weir w/ Radial Gates	24	97.13
11		Jackson-Josephine Creek	Jackson-Josephine Canal	East of Sparta Road	Improved Earthen Berm	25	94
12	S-6	Jackson-Josephine Creek	Jackson-Josephine Canal	North of Tubbs Pits	CMP Riser	7	90
15	STR 3	Jackson-Josephine Creek	Jackson-Josephine Canal	South of Tubbs Pits	Concrete Sharp Crested Weir w/ Radial Gates	48	85
17	STR 4	Jackson-Josephine Creek	Josephine Creek	North of Lake Josephine Drive	Concrete Wall Weir	100	71

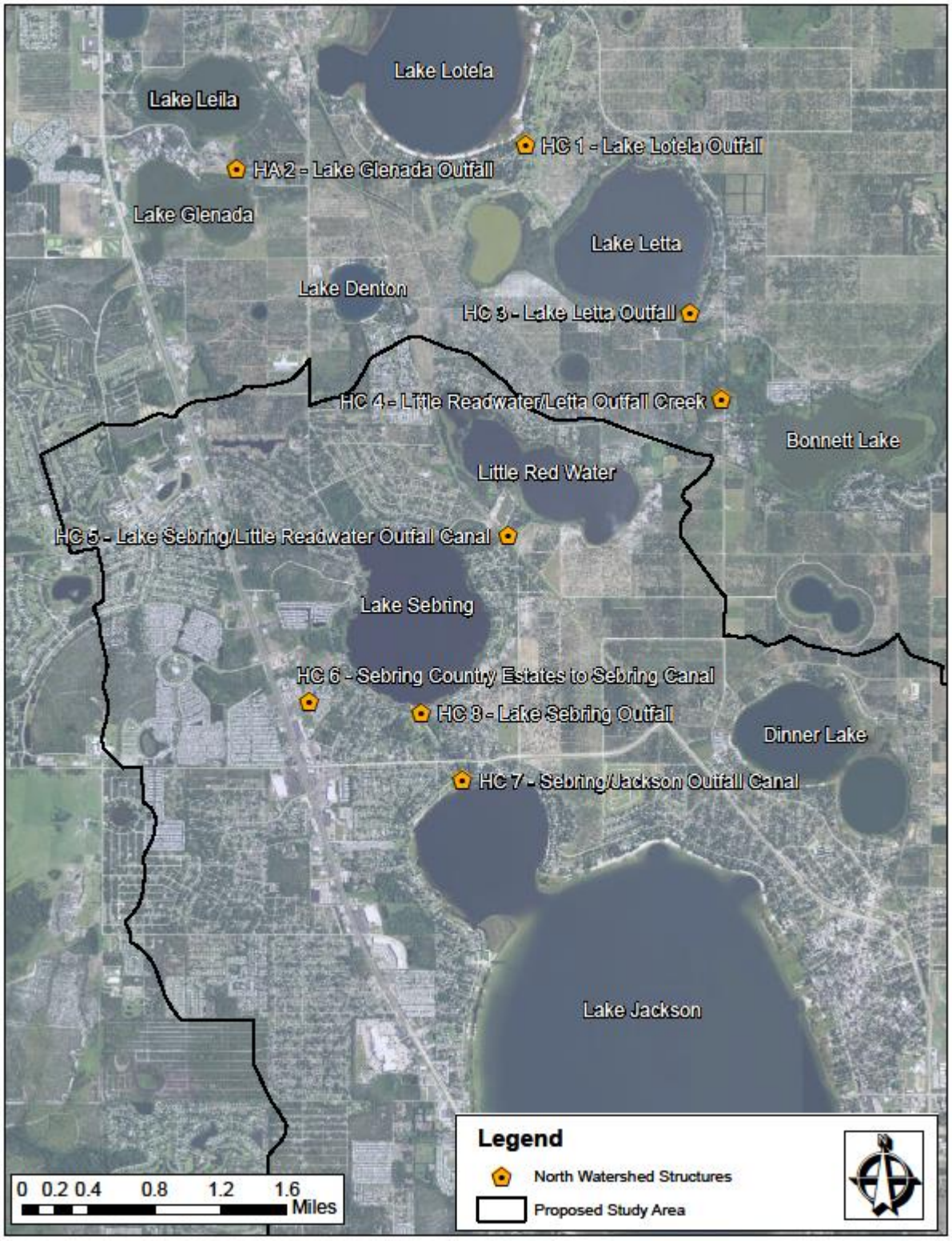


Figure 8. North Watershed Chain of Lakes Structure Inventory (After: KCA Corp.).

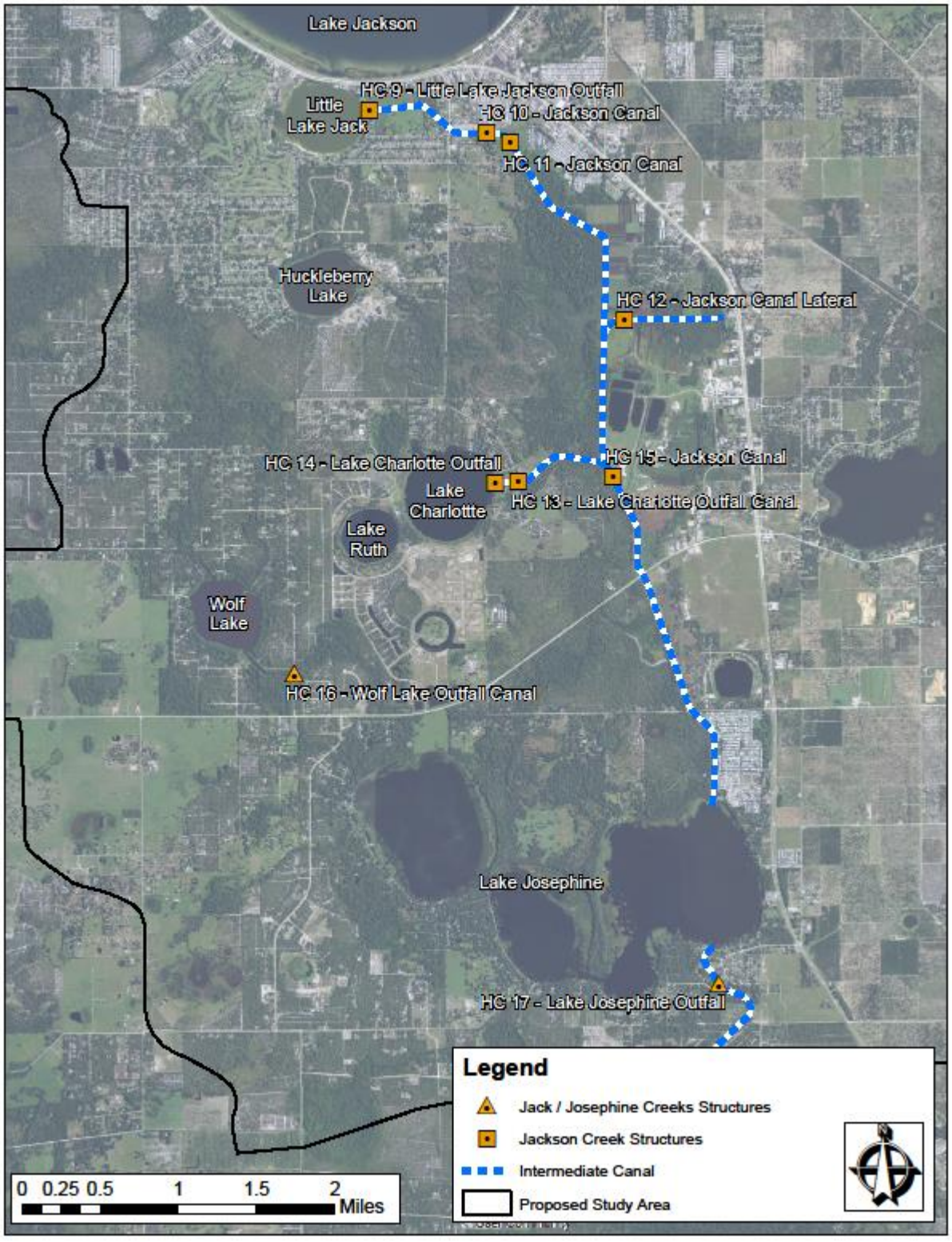


Figure 9. Jackson Creek Watershed Chain of Lakes Structure Inventory *(After: KCA Corp.)*

2.5 Groundwater Well Data

Readily available groundwater data from active and inactive monitoring wells were gathered and assessed. **Figure 10** presents well locations from the SWFWMD, and USGS data repositories, with relevant information from each source presented in **Tables 5 and 6**.

Table 5 presents well information obtained from the SWFWMD database (WMIS), and includes four USGS wells. While these wells are also available from the USGS, they are presented here as readily available data from the SWFWMD. Graphs of data will be presented in **Appendix A**

Table 6 presents additional USGS wells only available from the USGS database. These wells are in general considered "historical" as most do not contain data to present time. Additionally, most of the water level observations from wells presented in **Table 6** are sparse/sporadic in nature. Graphs of data will be presented in **Appendix A**.

This data was gathered and assessed to provide information with regards to past groundwater observations, as well as the potential location for a monitoring site(s) to be maintained by Highlands County. The monitoring sites from existing wells (either SWFWMD or USGS) is highly dependent on well condition (capped, plugged, removed, etc.) and available funding. Well condition would need to be assessed in the field, and funding is dependent on the availability of money and personnel to collect data from the proposed monitoring sites More information will be provided and a discussion presented in **Section 4.0 Monitoring Recommendations**.

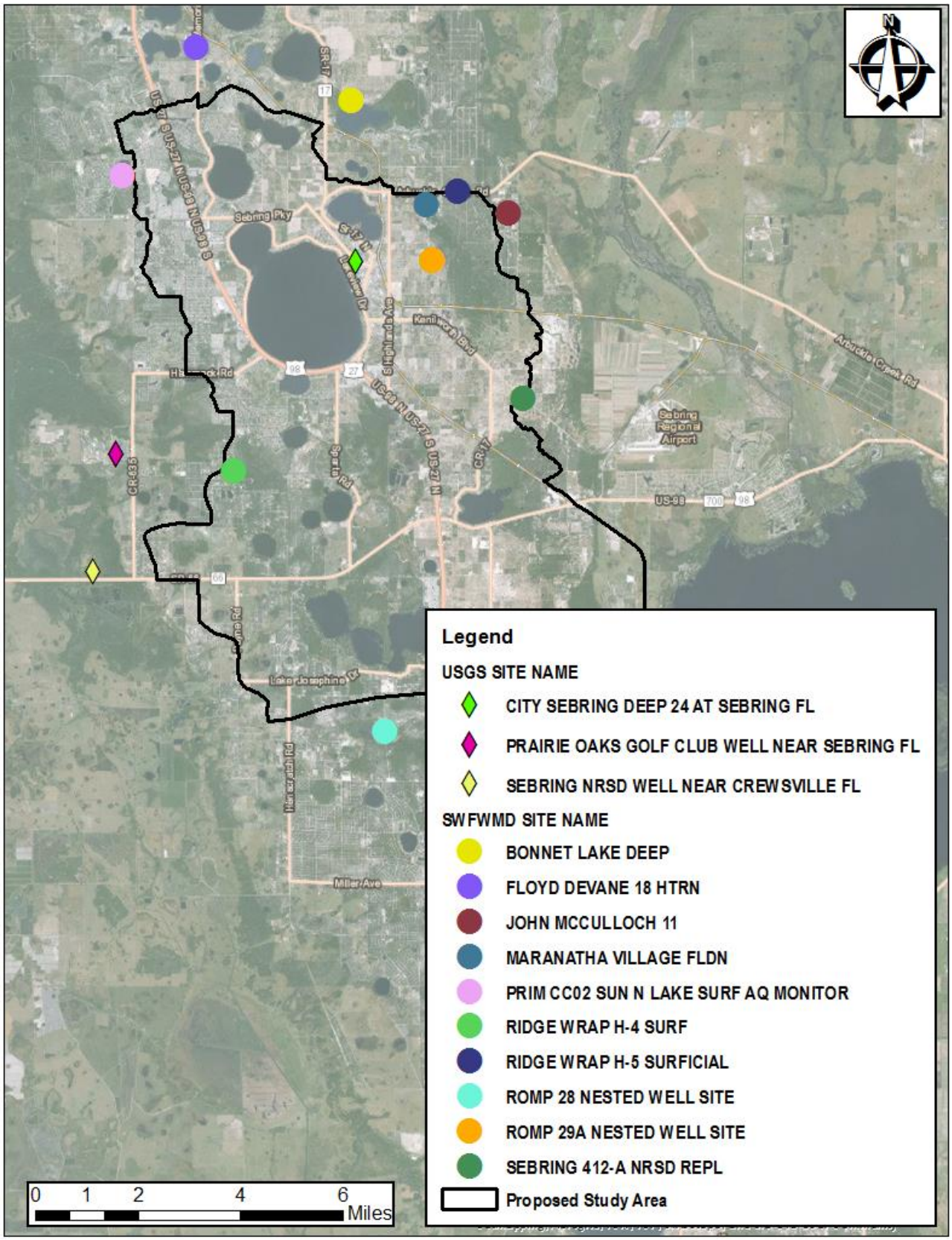


Figure 10. SWFWMD and USGS Well Locations within Proposed Study Area.

Table 5. Available Well Data (SWFWMD Database).

SWFWMD ID	Site Name	Start Date	End Date	Data Source	Aquifer	Well Depth (ft.)	Data Frequency (% of Daily Data Coverage)
711069	BONNET LAKE DEEP	5/18/1988	9/14/2011	USGS	Floridan	600	2x/yr. May and Sept.
711071	FLOYD DEVANE 18 HTRN	9/18/1986	9/14/2011	USGS	Intermediate (ICU/IAS)	340	2x/yr. May and Sept.
711067	JOHN MCCULLOCH 11	9/18/1986	9/20/2006	USGS	‡ Unknown (Likely ICU/IAS)	1029	2x/yr. May and Sept.
711037	MARANATHA VILLAGE FLDN	5/15/1986	9/14/2011	USGS	Floridan	50	2x/yr. May and Sept.
758386	PRIM CC02 SUN N LAKE SURF AQ MONITOR	7/22/2010	9/10/2015	SWFWMD	Surficial	841	Daily (98)
25487	RIDGE WRAP H-4 SURF	4/3/1991	10/6/2015	SWFWMD	Surficial	370	Monthly
23795	RIDGE WRAP H-5 SURF	4/3/1991	7/13/1995	SWFWMD	Surficial	55	Monthly
Nested Wells	ROMP 28	2/5/1996	10/19/2015	SWFWMD	Surficial to Floridan	Varies	Daily (84)
Nested Wells	ROMP 29A	9/15/2008	10/14/2015	SWFWMD	Surficial to Floridan	Varies	Monthly
25481	SEBRING 412/412-A NRSD	3/05/1955	11/4/2015	USGS/ SWFWMD*	Surficial	63	Variable: Daily 1977 to Present (57)

*- SWFWMD currently monitors and maintains data for this well, previously USGS maintained site.

‡ - Aquifer labeled as “unknown” in database, assumed ICU/IAS based on well depth and published formation data.

Percent of Daily Data Coverage denotes the overall percentage within the period of record with available data.

Table 6. Available Well Data (USGS Database).

USGS ID	Site Name	Start Date	End Date	Aquifer	Well Depth (ft.)	Data Frequency (% of Daily Data Coverage)
272452081314101	SEBRING NRSD WELL NEAR CREWSVILLE FL	6/17/2004	2/01/2006	Surficial	21.7	Daily (96)
272652081311501	PRAIRIE OAKS GOLF CLUB WELL NEAR SEBRING FL	9/18/1986	9/15/1993	Intermediate (ICU/IAS)	239	2x/yr. May and Sept.
23007081263901	CITY SEBRING DEEP 24 AT SEBRING FL	9/18/1980	9/12/1995	Floridan	1400	2x/yr. May and Sept.

Figures 11 and 12 present data from the SWFWMD nested well sites ROMP 29A and ROMP 28 respectively. A nested well site is one in which multiple wells exist in close geographic proximity, with multiple wells monitoring several aquifers. This type of site is invaluable for hydrologic data collection and other groundwater research and modeling efforts, as it provides a complete picture of the groundwater at a single site. Nested wells are often preferred if the funding is available to construct and monitor such a site.

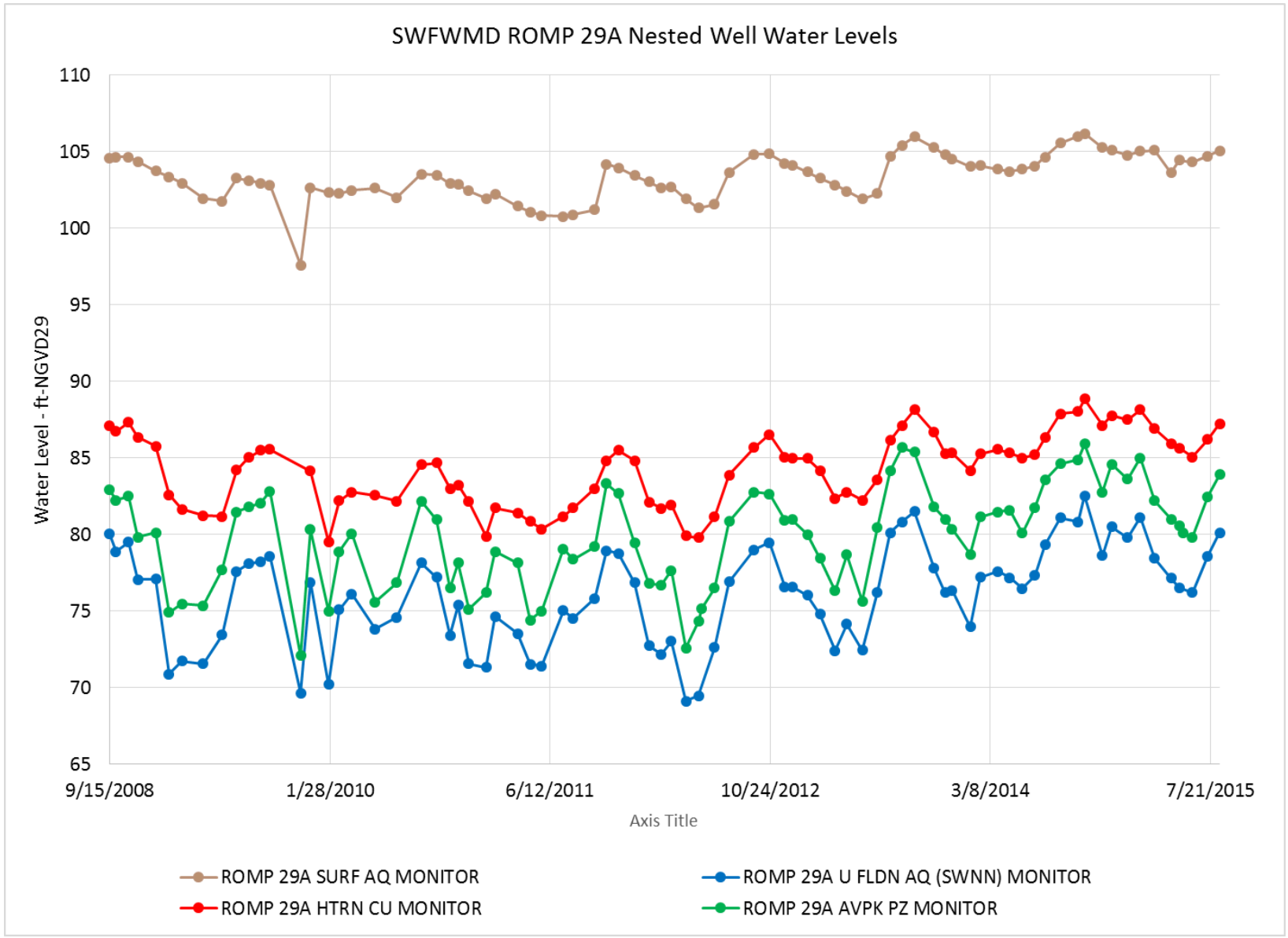


Figure 11. SWFWMD ROMP 29A Nested Well Graph

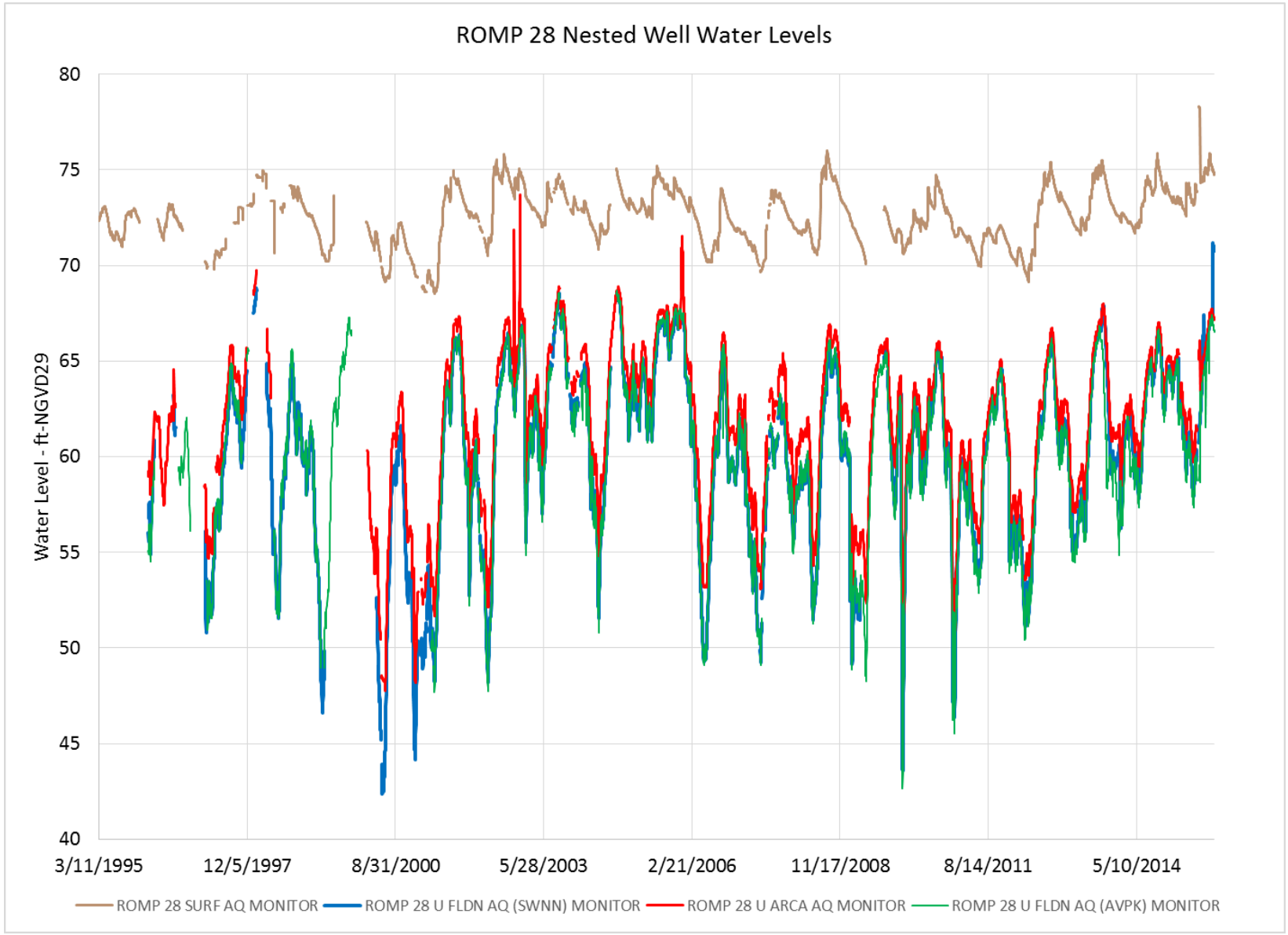


Figure 12. SWFWMD ROMP 28Nested Well Graph

2.6 Groundwater Use Data

Groundwater use data was obtained from the appropriate water use permit (WUP) located in the SWFMWD WMIS database. The selected WUP were shown as the largest users for Public Supply (P/S) withdrawals in the vicinity of Lake Jackson. **Figure 13** presents the location of these WUP boundaries (and associated pumping well locations), where withdrawals for the City of Sebring are in closest proximity to Lake Jackson, with sites along the East, and west borders of the lake. Additionally, the City of Avon Park has WUP boundaries along the majority of the border with Lake Sebring. Finally, the WUP of the Sun'N Lake of Sebring Imp. Dist. was included due to the relatively large withdrawals and the proximity of the district to Lake Jackson. Data presented in this section is not intended to be an all-inclusive dataset needed for modeling purposes, rather to illustrate a trend in public supply withdrawals in the vicinity of Lake Jackson. In future phases of this project, during model development, all available WUP data will be gathered from the SWFWMD database for metered withdrawals (P/S, agriculture, etc.) of 0.1 MGD or greater, as required by SWUCA rules.

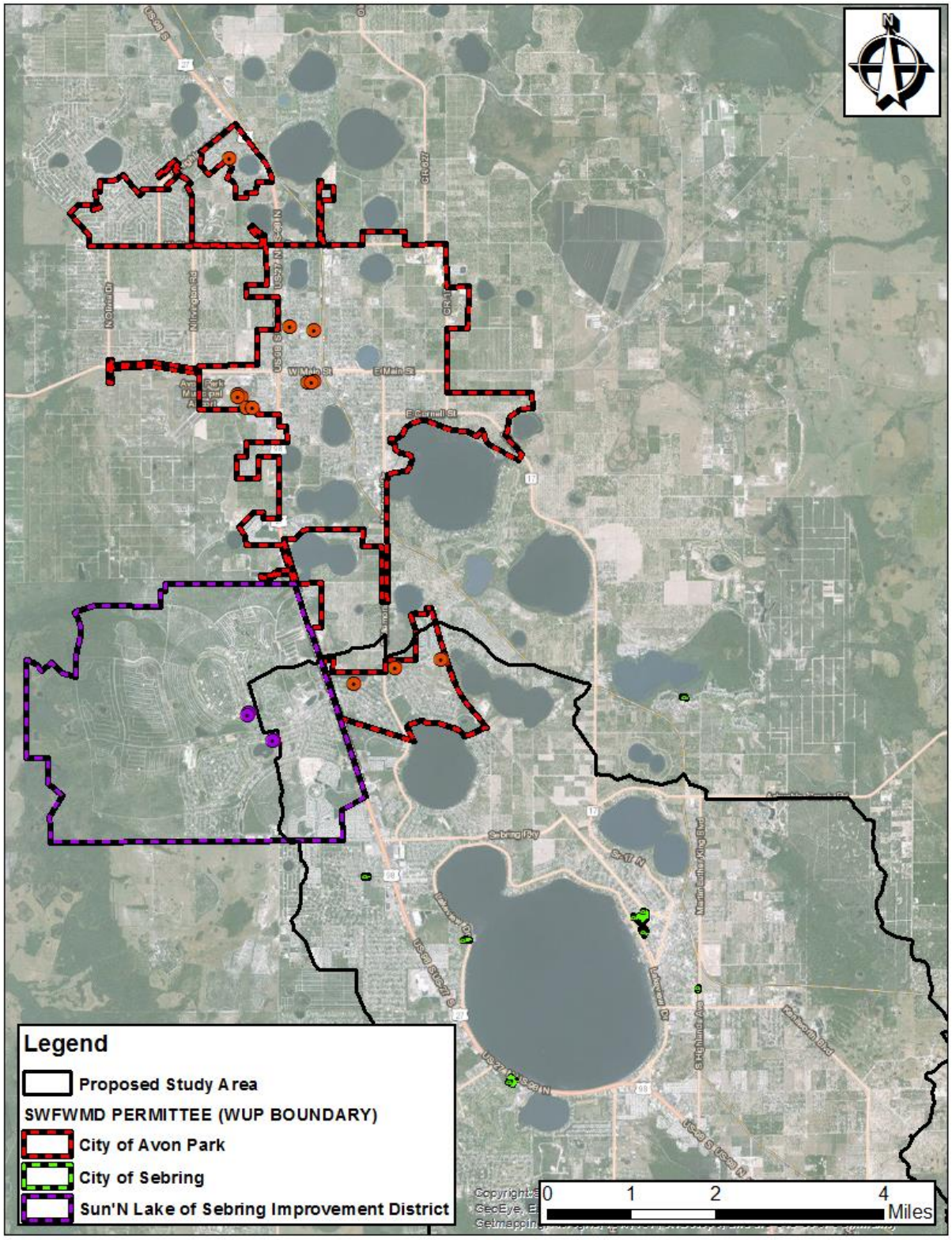


Figure 13. SWFWMD WUP Boundaries Near Lake Jackson.

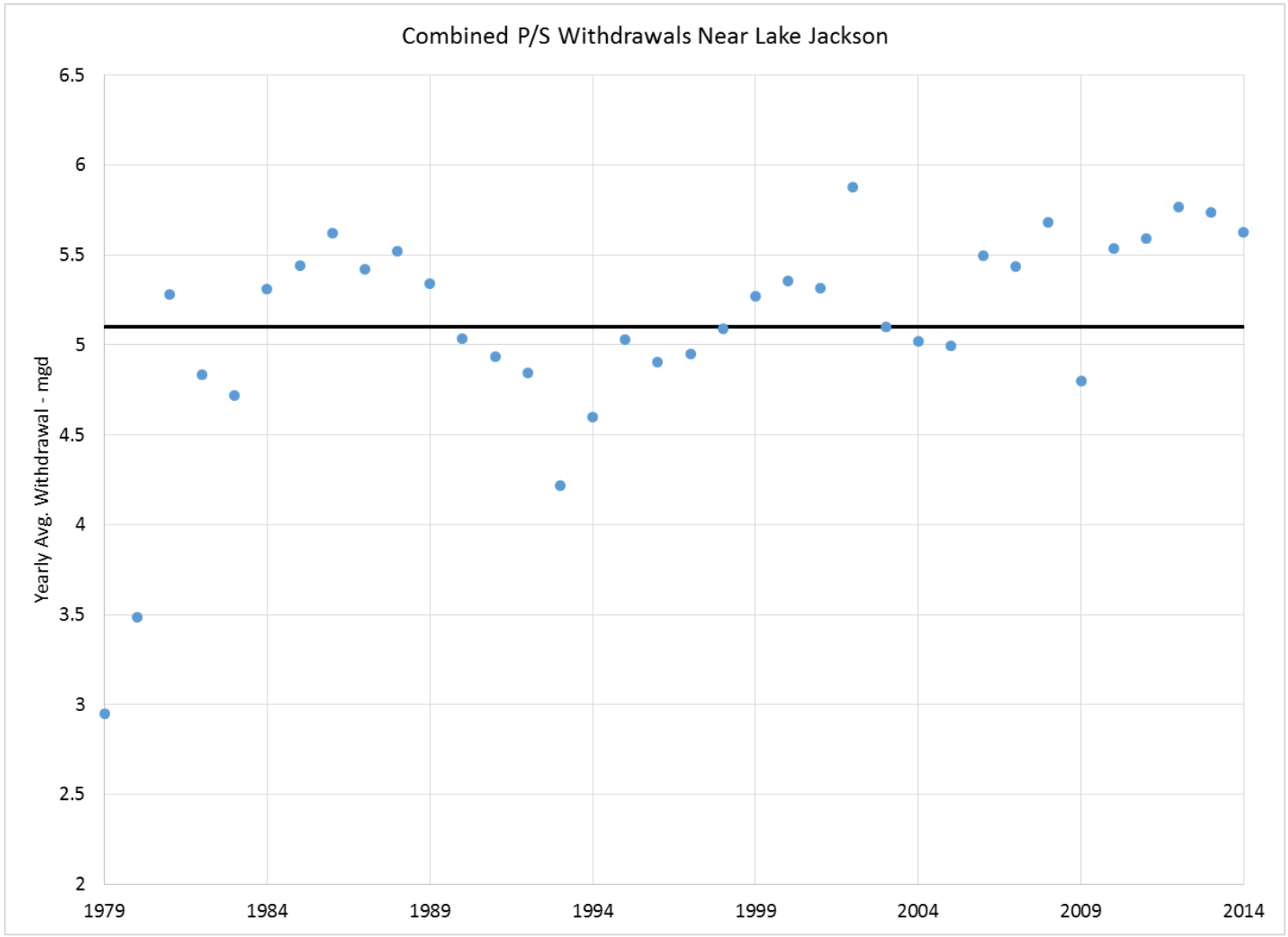


Figure 14. Combined Average Annual Withdrawals of Public Supply Water Near Lake Jackson.

As evidenced in **Figure 13** there are multiple public supply withdrawals of water around and in close proximity to Lake Jackson. **Figure 14** presents the average annual withdrawal of water from 1979 to present with an average withdrawal over the period of record of about 5.1 mgd (black horizontal line). In general, groundwater withdrawals for public supply near and around Lake Jackson appear to be increasing over the period analyzed. The WUP data presented in **Figure 14** will be further discussed in **Section 3.0 Data Analysis**.

2.7 Aquifer Tests (APT and Slug)

The SWFWMD provides data from Aquifer Performance Tests (APT) and/or slug tests for most aquifers in the district boundary. For the purposes of this report, APT test data was obtained and evaluated for sites within Highlands County, close to the proposed study area. **Figure 15**, presents the location of APT data for tests completed in the ICU/IAS

APT data provides insight for the hydraulic parameters of an aquifer, specifically the Transmissivity (T) which defines the amount of water that can be transmitted horizontally through a unit width by the full saturated thickness of the aquifer under a hydraulic gradient of 1 (Fetter, 2001). Another important aquifer parameter that can be calculated from slug tests and the APT data is saturated hydraulic conductivity (K), which defines the rate water moves through the aquifer material (ft./day). The availability of APT and slug test performed on the ICU/IAS will inform future modeling efforts as well as allow for the calculation of the potential leakage/flux from the overlying surficial aquifer through the ICU/IAS into the Upper Floridan Aquifer. For the purposes of this report, K was calculated for the wells with APT data using the published formation thickness of the entire aquifer (ICU/IAS) for wells shown in **Figure 15**. Additionally, the APT data was inconclusive for ROMP 29A, as such slug tests were performed to provide a K value, from the K value Transmissivity was calculated from published aquifer thickness. **Table 7** presents the SWFWMD APT and slug test results, as well as the calculated K and T values as previously described.

Table 7. ICU/IAS Aquifer Test Results.

SWFWMD APT SITE	Transmissivity (T) ft^2/day	Saturated Hydraulic Conductivity (K) ft./day	Aquifer Thickness (b) feet °
Hicoria ROMP 14 Well #3	31.2	0.10 ‡	300
ROMP 28 Kuhlman	162	0.62 ‡	260
ROMP 43 Bee Branch (Zone 2)	800	3.81 ‡	210
ROMP 43 Bee Branch (Zone 3)	400	1.90 ‡	210
ROMP 29A *	7.8	0.03	260

Notes for Table 7:

1. * - APT data inconclusive. K value comes from slug test, calculated T from, K and published formation thickness.
2. ‡ - K values calculated from published formation thickness and T values for each site.
3. **°** - Data obtained from *USGS Scientific Investigations Report 2010-5097.*

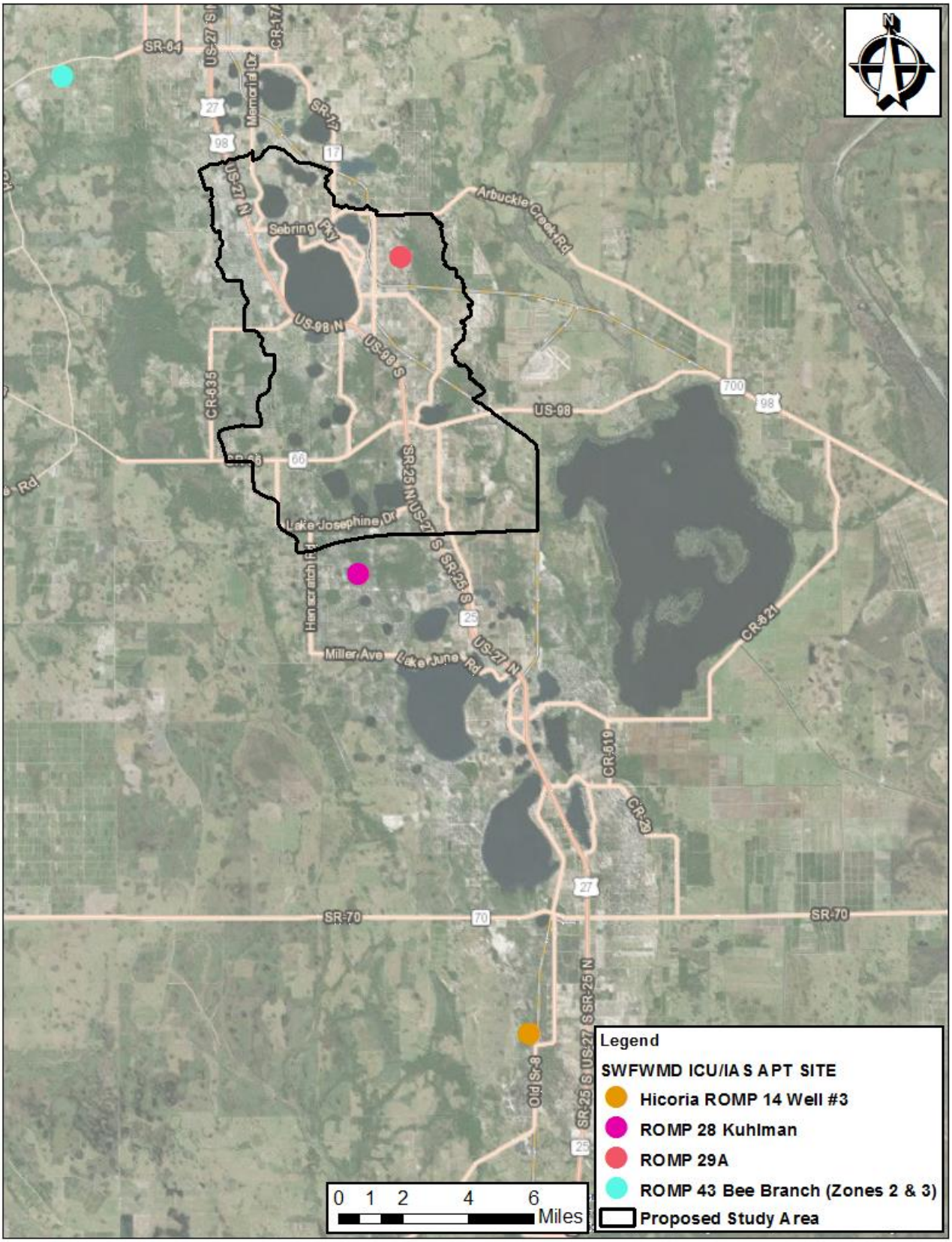


Figure 15. SWFWMD APT Sites – ICU/IAS.

3.0 Data Analysis

Rainfall, public supply (p/s) groundwater withdrawal (pumpage), and stages in Lake Jackson have been compared from 1985 to 2014. **Figure 16** presents comparisons of annual average P/S pumpage, Lake Jackson water levels and rainfall totals from the NOAA Avon Park rain gage. In addition to annual averages (and rainfall totals), are trend lines of the 7-year moving average for each data source. While lake levels in general respond to changes in rainfall and pumpage on a shorter timescale. The 7-year moving average presented in **Figure 16** was chosen due to the statistical significance shown in long term trends in Lake Jackson water level response (i.e. Lake Jackson levels vs rainfall and P/S pumpage). Statistical significance determined through multiple regression analyses are discussed later in this section.

A moving average is the average computed over a given period (i.e. number of years prior) over the selected data period. In the case below, a seven year moving average was chosen to show trends and smooth out the data from 1985 to present. As shown in the figure below there is a slight decreasing trend in the lake stage data from about 2005 to present. This same decreasing trend in lake stage is accompanied by an increasing trend in P/S pumpage and a decreasing trend in rainfall for the 7-year moving average.

With respect to the public supply withdrawal of water, it is the intention of this document, to analyze the selected sub-set of available pumpage data to determine if any trends between lake stage, pumpage and surficial aquifer water levels can be shown. This document does not serve as a robust statistical comparison of cause and effect, rather attempts to identify trends in readily available data, using standard statistical methods.

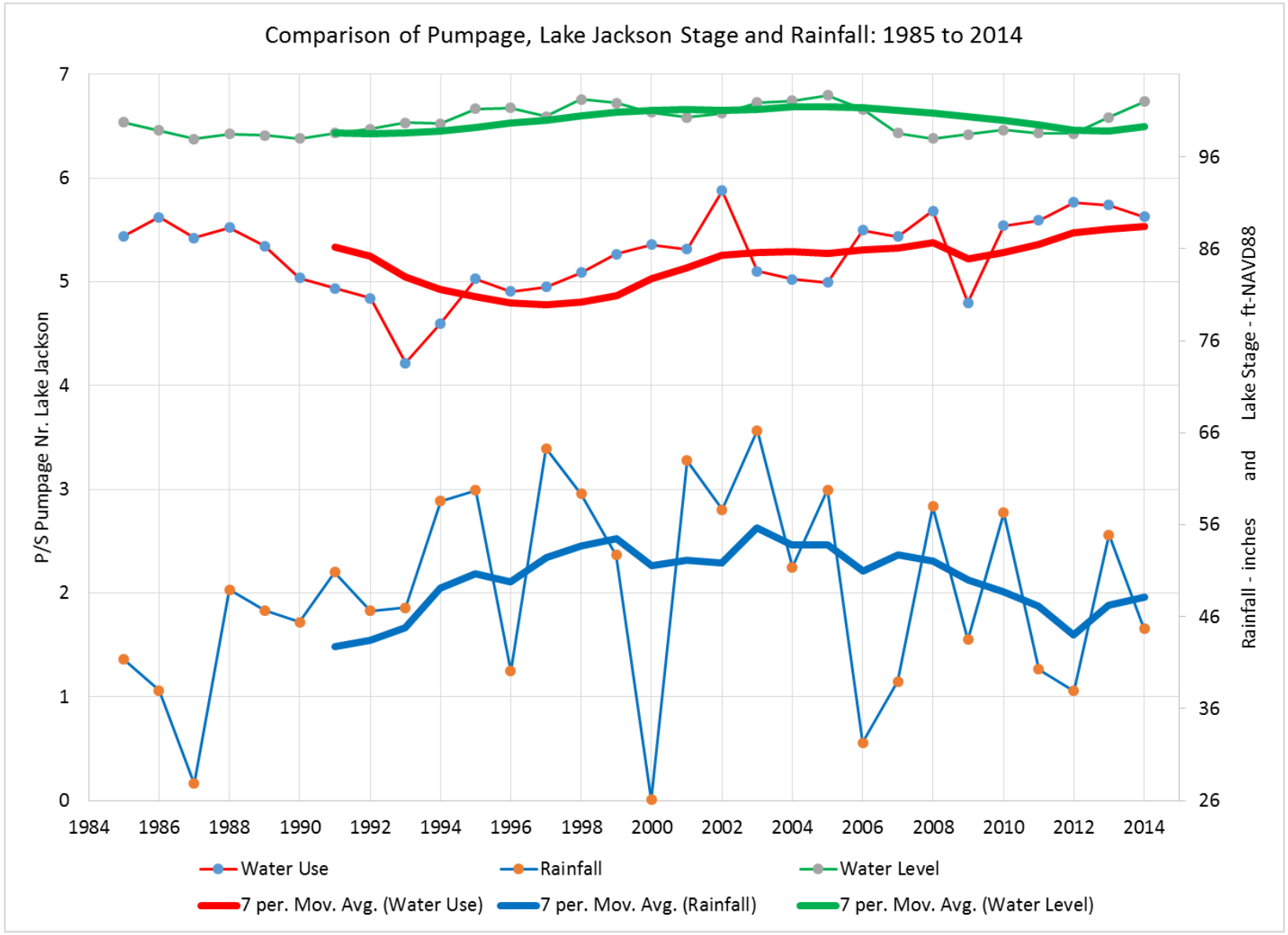


Figure 16. Comparison of Avg. Annual P/S Pumpage, Lake Jackson Water Levels and Annual Rainfall including 7-yr Moving Avg. 1985-2014.

Additionally, multiple regression statistical analyses were performed on annual data as well as, 3-yr 5-yr, and 7-yr moving averages over the same time period presented in **Figures 17 & 18.**

Multiple regression is a technique where a single dependent variable is compared against multiple independent variables. In the case of the analyses presented here, the dependent variable was Lake Jackson Water Level, and independent variables were rainfall and p/s pumpage. Statistics for all the multiple regressions are shown in **Appendix B**.

A brief discussion of each multiple regression analysis and plot for the corresponding moving average are presented below. Annual and 7-yr moving average data are not presented in separate plots as this has been previously shown in **Figure 16**.

Annual Data

With the two independent variables, the Significance F (p-value) was 0.18 meaning the regression was not significant at the 10% level (Assume significance of F of 0.10 or lesser). However, in examining the two independent variables, rainfall was significant at p-value of 0.09, but pumpage was not significant at 0.68.

3-year Moving Average

The 3-year moving average was much more significant (0.005) than the annual series but the significance was being governed primarily by rainfall with a p-value of 0.001. Pumpage remained not significant at a p-value of 0.65.

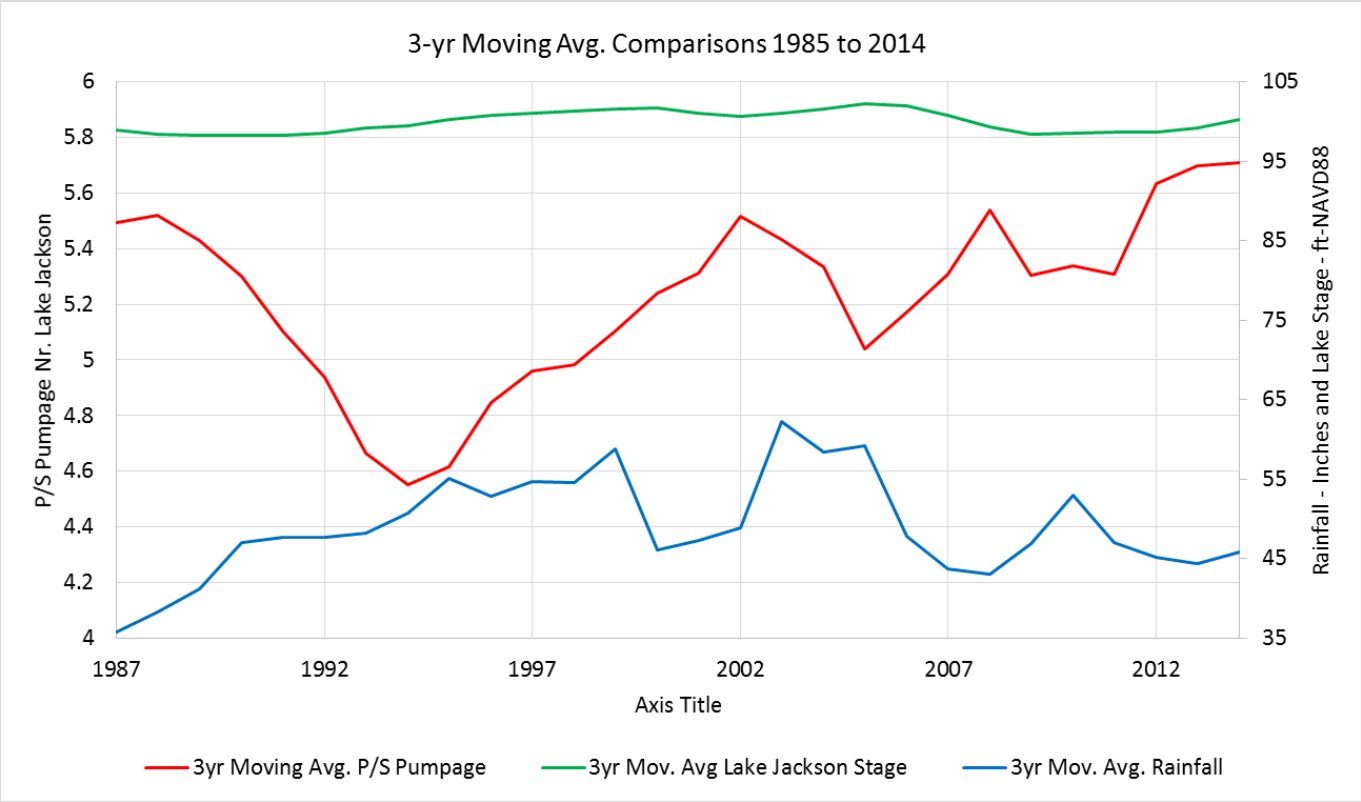


Figure 17. 3-yr Moving Avg. Comparison of Pumpage, Rainfall and Lake Stage 1985-2014.

5-Year Moving Average

The significance F continued to improve with the increasing years for the moving average. Significance F was 7.53E-06. P-value for rainfall was 1.78E-06 and pumpage only slightly outside the 10% level at 0.12

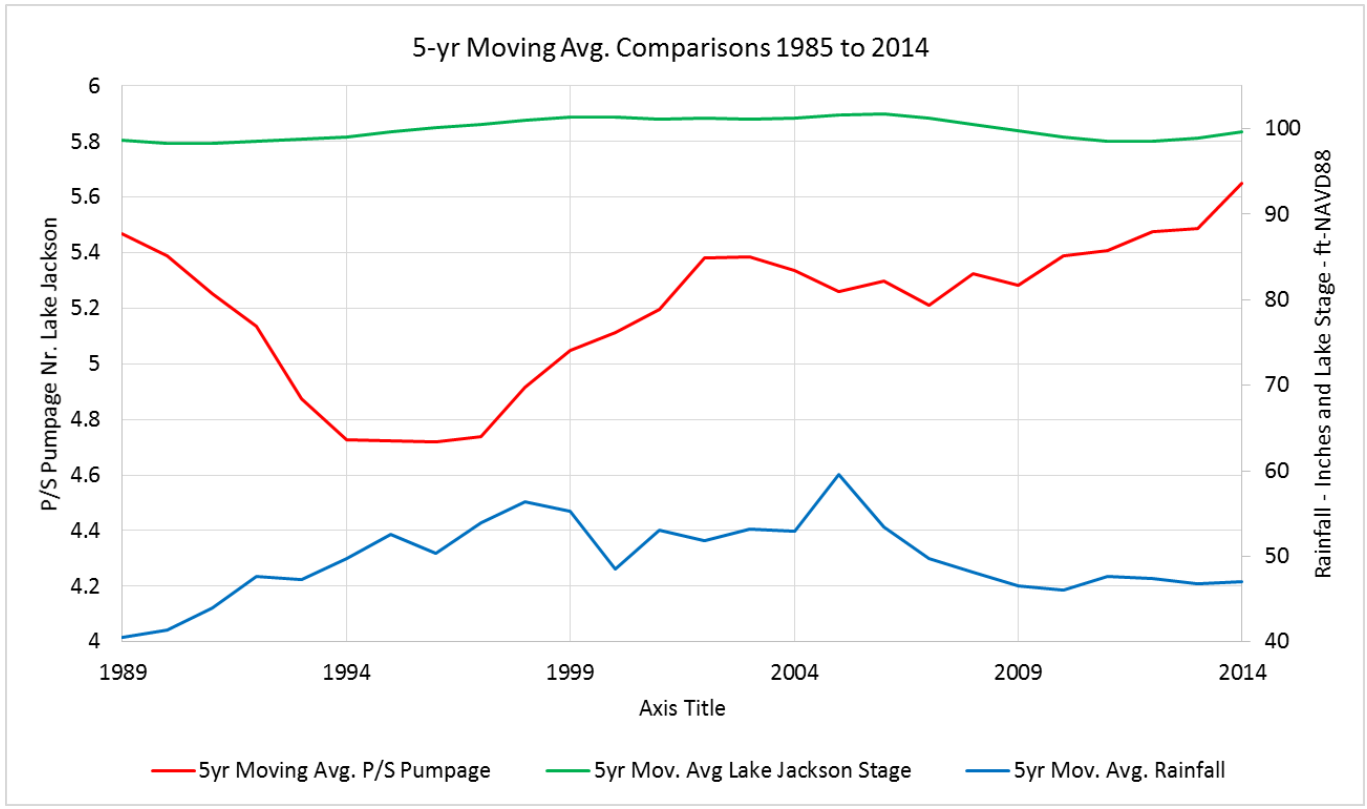


Figure 18. 5-yr Moving Avg. Comparison of Pumpage, Rainfall and Lake Stage 1985 to 2014.

7-Year Moving Average

The 7-year average was by far the best of the relationship with a Significance F of 2.86E-08. Both rainfall and pumpage were significant with 5.5E-09, and 0.013 p-values, respectively.

4.0 Monitoring Recommendations

Based on the previous Sections, extensive research was conducted by the consultant to verify the necessary recommendations for additional data collection to fill gaps in the POR of existing wells (i.e., Re-instrument a USGS, SWFWMD well, & staff gage or recorder in a water body). Additionally the data research conducted in the previous sections painted a picture of what additional data should be needed to adequately and efficiently create the basis for a hydraulic model to be conducted on the requested study area. Based on the availability of the existing data, the consultant has proposed additional monitoring sites (Surface water/Groundwater) as presented in the following sub-sections.

4.1 Meteorological/Weather Station

Per Exhibit "A" of the County's Project Plan, under Agreement No. 14C00000039, within Project Tasks "Field Assessment" section, "the County will design and construct (1) automated weather station pursuant to DISTRICT specifications". After extensive research, two manufacturers were selected as viable options given the weather variable parameters that they could potentially collect data for.
Global Water's WE-800 Weather Station is a fully integrated, easy-to-use, computer-based weather station for monitoring and reporting weather conditions. In addition to the data logger, the included sensors are:

- Wind Speed Sensor
- Wind Direction Sensor
- Temperature Sensor
- Humidity Sensor
- Solar Shield

The base price for the Global Water's WE-800 Weather Station Data logger is **$3,742.00**

Through coordination with Highlands County staff and reviewing the design needs of the project a list of additional sensor costs was generated and presented in **Table 8**.

Table 8. Additional WE-800 Weather Station Sensors Description/Costs.

Item No.	Item Description	2015 List Price
EA0000	WE100, Barometric Pressure Sensor	$ 493.00
EB0000	WE300, Solar Radiation Sensor	$ 935.00
FN0000	BC100 Smart Battery Charger	$ 134.00
EN0000	EP180, Evaporation Pan	$ 1,492.00
EK0000	RG600, Rain Gauge, 8" Tipping Bucket	$ 549.00
FH0000	SP102, Solar Panel	$ 415.00
	Total Additional Sensor Costs	**$ 4,018.00**
	Total Weather Station Costs including Add. Sensors	**$ 7,760.00**

(Weather Station Costs Referenced from www.globalw.com/products/we800.html)

Based on conversations with County staff, the consultant has provided a conceptual location for the proposed weather station. It is assumed that the County would prefer to place the proposed weather station within County or the City of Sebring's lands, which is located adjacent to or near Lake Jackson and is free of vegetation so that the station can operate as efficiently as possible. The proposed location is shown in **Figure 19**. As previously stated, all proposed locations are suggestions, and may be modified upon further coordination with County and SWFWMD staff.

Figure 19. Proposed Weather Station Location (Highlands County Property Appraiser, additional graphics by AIM Engineering & Surveying, Inc.).

4.2 Lake Seepage

While there are not existing lake seepage data for Lake Jackson, or any other lake in the proposed study area it is the intent of this subsection to identify a potential method to monitor lake seepage from the bottom of Lake Jackson.

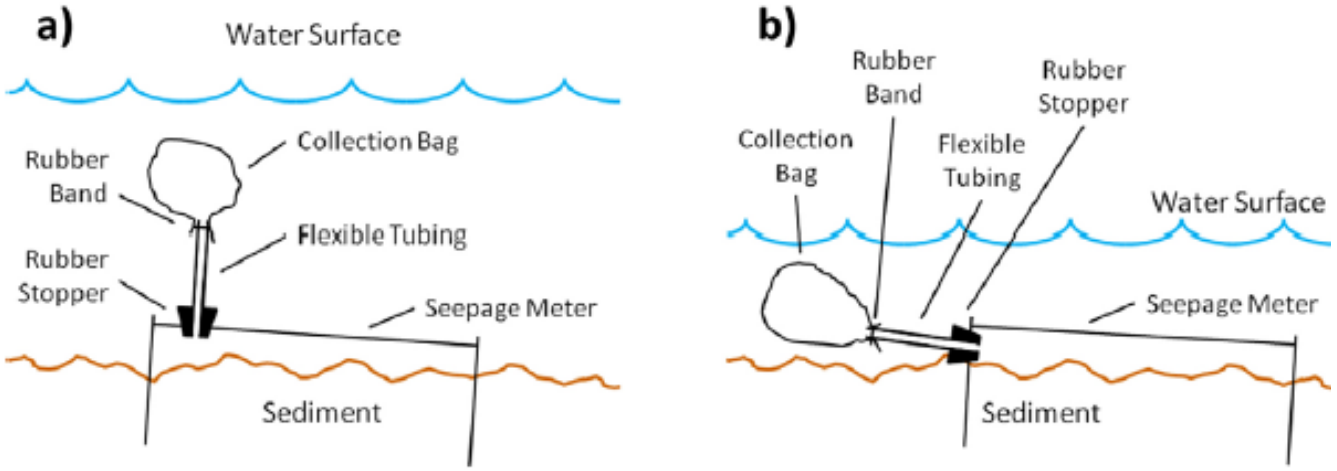


Figure 1. Cross-section view showing a typical installation of a seepage meter at left (a) and for an installation in shallow water (b).

Figure 20. Seepage Meter Diagram (After: Martinez, 2013).

As shown in **Figure 20**, a basic seepage meter can be a simple, effective and inexpensive piece of equipment, consisting of a 55-gallon drum, flexible tubing, a rubber stopper, rubber band and collection bag. The collection bag has a known volume of water at the time of installation, where the 55-gallon drum (or other large opened bottom container) with the bottom cut off is driven into the lake sediments. Over a set time interval, the volume of water in the bag is recorded. The difference in volume from the collection bag is the amount gained or lost over the time period. Accounting for the change in the volume of water, a vertical groundwater flux (seepage rate) in units of length per time can be calculated based on the exposed area of the 55-gallon drum, over the time interval (USGS, 2007). In other words, a flow rate is determined by the volume of water gained or lost over a time interval, where water gained indicates an upward flux of water (water into the lake from the surficial aquifer), and water lost indicates a downward flux of water (water from the lake into the surficial aquifer). Once this data is collected, Darcy's Law can be solved for K (hydraulic conductivity) by incorporating lake stage data and surficial aquifer elevations to calculate the hydraulic gradient. It should be noted here that a piezometer installed alongside or in close proximity to the seepage meter is best in determining hydraulic gradient. However, surficial aquifer wells near Lake Jackson should suffice for this purpose.

Figure 21 presents a conceptual seepage meter grid design based on a 1,000-ft x 1,000 ft. grid resolution. Each proposed seepage meter would be installed in the centroid of each grid cell, pending the grid cell lies within Lake Jackson. Grid cells lying outside of the Lake Boundary are included for graphical purposes but not included in the final count of proposed seepage meters to be installed.

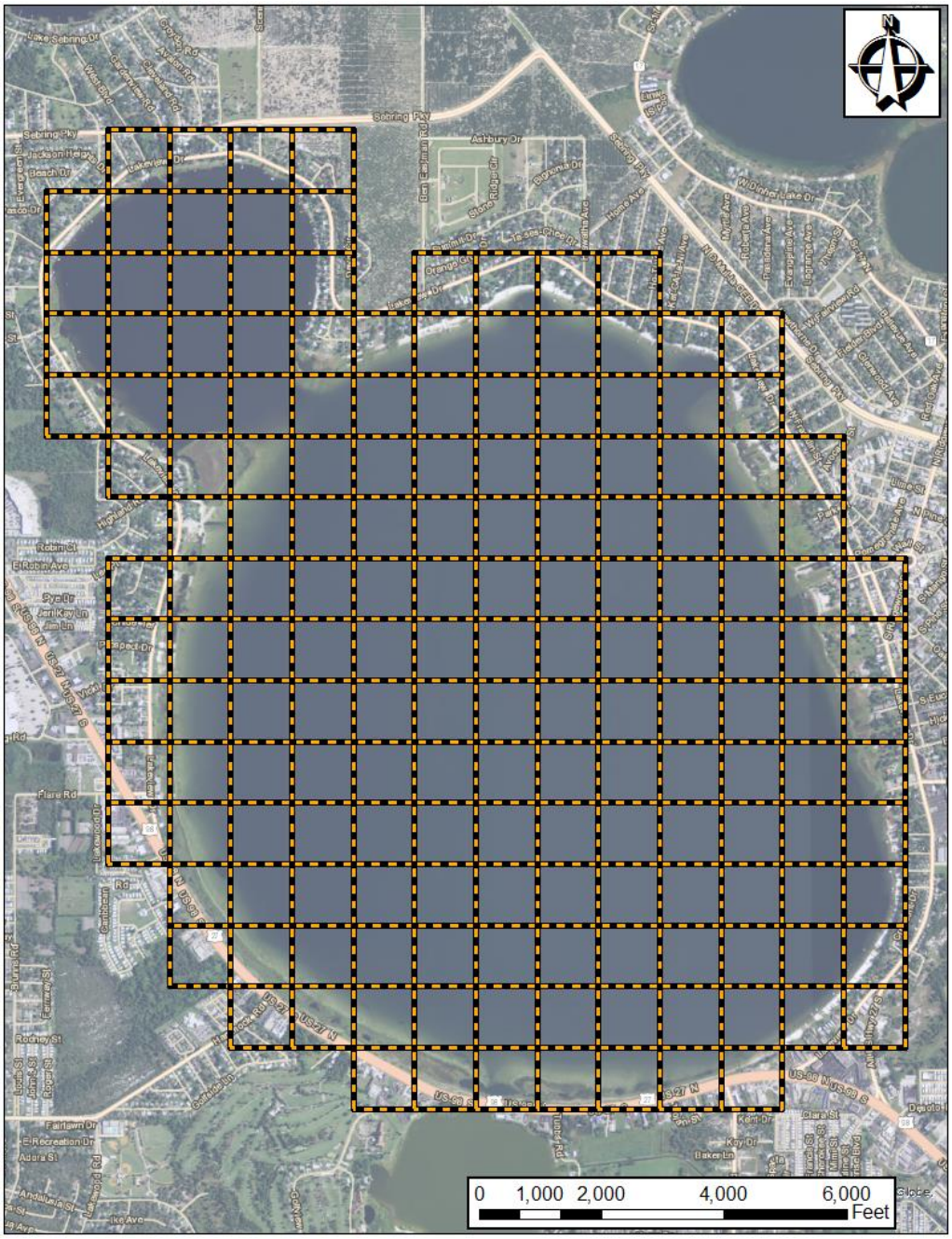


Figure 21. Conceptual Seepage Meter Grid Spacing for Lake Jackson (1,000ft. x 1,000ft).

The main limitation is the resolution (number of seepage meters) necessary to obtain a reasonable dataset. From GIS measurements, Lake Jackson is about 17,000 feet at the longest axis and about 11,500-feet at the widest axis. Assuming a resolution (spacing of seepage meters in a gridded pattern within the boundary of Lake Jackson) of 1,000-feet, this would equate about 162 seepage meters in a gridded pattern along the bottom of Lake Jackson. A coarser resolution (say, 2,000') may yield useful results, but with about 40 seepage meters. However, even at the coarser resolution, the resources required to install and monitor the instruments would likely be cost-prohibitive; as it would require periodic visits to each meter by certified divers, with the associated equipment, boats, insurance, etc. While seepage meters in Lake

Jackson would yield valuable information, it is understood that at this time, funding is not available for this type of monitoring effort regardless of the resolution (grid size) for the proposed seepage meters.

4.3 Groundwater Sites

As presented in **Section 2.5** groundwater data from the SWFWMD and USGS in the vicinity of Lake Jackson is sparse in both temporal resolution and areal extent. This is likely due to loss of funding, or past projects aimed at data collection periods of short duration.

Figure 22 presents the potential location of seven (7) proposed Surficial Aquifer (SAS) well sites to be installed around Lake Jackson. Each newly proposed well will consist of: a casing diameter of 2-inches, PVC material and depths will vary from 20 to 150-feet below land surface (BLS) and are proposed to be screened for the bottom 5 to 10-ft of each well. At this time it is not feasible to recommend specific screening intervals or depth (BLS), as final installation of an individual well will depend on site specific conditions. However, the FDEP guidance manual for monitoring wells was consulted, and suggest well screen lengths between 5 and 10-ft with well screens rarely exceeding 20-ft (FDEP, 2008). Installation of each 2-inch diameter well has been assumed to cost $2,500/well (up to 150-feet deep). In the event that larger diameter (6-inch) wells are necessary or preferred, the associated cost increases are substantial for deeper wells (up to 150-ft.). Conversations with contractors in Highlands County indicate that a 6-inch well to 150-feet deep will cost $8,250 per well, while a 6-in. well to 50-ft. will cost $2,750. This will add an additional $18,000 in well construction costs should this option be chosen (additional costs determined by increased well cost for three wells to 50-ft. {$250/well} and three wells to 150-ft {$5,750/well}).

It is assumed that all proposed well construction will follow the SWFWMD Hydro Data SOP standards and that data will be collected on a monthly interval by employing the measure down method. These proposed wells are all located in close proximity to Lake Jackson, on parcels owned by Highlands County or the City of Sebring. Proposed well sites were selected with the intention that the parcel owner (County or City) was assumed to be a cooperative party for the well installation on lands considered to be public.

Proposed wells would provide the most valuable data if they are installed in pairs, where one well was at a depth of 20-50-ft below land surface (BLS) and another between 100-150-feet BLS depending on the topography and site specific hydrogeology. For the purposes of this study, Lake Jackson has been assumed to have an average depth of 24-feet and the surficial aquifer is 200-ft thick in the vicinity of Lake Jackson.

A paired well installation would greatly improve the understanding of shallow groundwater dynamics in the study area, specifically interactions between Lake Jackson and the surficial aquifer. In future modeling efforts, the surficial aquifer system will likely be modeled as two layers. The ability to collect data representing two depths at a single location within the surficial aquifer will be invaluable for modeling efforts. Due to the limited budget for these sites, considerations have been made to provide a best case scenario (three (3) paired well sites in combination with single wells at four (4) of the remaining locations) and two other scenarios where only paired wells or a single well will be installed at each of the proposed site locations (site ID).

Table 9 and **Table 10** present well placement information with respect to well depth at each proposed site ID (**Figure 22**) under different funding possibilities. Under a best case scenario, wells (site ID) presented in **Table 9** would be installed in pairs as previously described, with the remaining well sites installed as a single well from a combination of the remaining sites found in **Table 10**, for a total of ten (10) wells.

In the event that paired wells with infilling of single well sites is found infeasible due to budgetary limitations, paired wells (**Table 9**) are preferential to single well sites. In other words, if budgetary constraints prohibit the option of the paired well plus single well site configuration, then paired wells at three sites, for a total of six (6) wells is preferred.

Alternatively, in the event that single well sites are the only form of available proposed well sites, **Table 10** may be used to guide the installation of all wells as a single point for each proposed site ID, for a total of seven (7) wells.

These proposed wells will allow for the collection of data around Lake Jackson to inform the team of shallow groundwater interactions near and across the lake. It should be noted here that the proposed wells around Lake Jackson are of primary importance to this study. **Appendix C** provides higher resolution location maps of each of the proposed wells. In addition to well location maps, **Appendix C** also provides a table of well locations, well depth, casing depth and casing diameter for the proposed wells shown in **Figure 22**.

Table 9. Proposed Paired Well Site Information.

Proposed Site Location	DEM Elevation (ft.-NAVD)	Shallow SAS Well Depth (ft. BLS)	Deep SAS Well Depth (ft. BLS)
3	101	30	100
6	123	50	150
7	105	30	150

Table 10. Proposed Well Site Information.

Proposed Site Location	DEM Elevation (ft.-NAVD)	SAS Well Depth (ft. BLS)
1	123	50
2	102	150
3	101	150
4	108	50
5	102	100
6	123	50
7	105	30

Additional wells shown on **Figure 22** are existing well sites owned and previously maintained by SWFWMD. From **Figure 22** there are multiple wells within the surficial aquifer, and a potential site in the Floridan aquifer, and one in an "unknown formation." According to the SWFWMD database these wells are still active in terms of "Well Status". What this means is that the well is not plugged, capped, abandoned or otherwise destroyed. These wells, subject to site verification to ensure functionality, are excellent sources of data, and are considered the most cost effective option for monitoring locations in future data collection efforts. Cost effective in that the well is already in place, negating any capital investment for well construction. All that is needed is a monthly measurement taken as a measure down from a known datum on each well, assuming access and well availability. Additional information on these existing SWFWMD wells is presented in **Table 11**. All information presented in **Table 11** was found directly

from the GWIS well database and the consultant does not provide any assurances as to location accuracy, or other well characteristics. As previously stated, all well characteristics (location, depth, casing diameter, etc.), will need to be field verified before any data collection efforts are initiated.

Table 11. Existing SWFWMD Well Sites Recommended For Future Monitoring.

SWFWMD Site ID	SWFWMD Site Name	Well Depth (feet - BLS)	Casing Diameter (inches)	Aquifer Monitored	LATITUDE (Deg. Min. Sec.)	LONGITUDE (Deg. Min. Sec.)
23751	JOSEPHINE 7 SURF	9	2	SURFICIAL	27 24 45.46	81 26 32.37
25471	JOSEPHINE 9 SURF	6	2	SURFICIAL	27 26 08.67	81 25 19.21
23744	17th STREET SOUTH SURF	80	2	SURFICIAL	27 24 59.08	81 24 04.42
23743	DESOTO TOWER FLDN	UNKNOWN	4	FLORIDAN	27 25 14.01	81 24 00.19
25489	LLJ W1 SURF	50	2	SURFICIAL	27 28 09.27	81 28 10.35
25495	LLJ W2 SURF	50	2	SURFICIAL	27 27 52.39	81 28 02.89
25490	LLJ W3 SURF	50	2	SURFICIAL	27 27 35.00	81 28 26.00
25492	LLJ W4 SURF	50	2	SURFICIAL	27 27 55.00	81 28 37.00
23737	JOSEPHINE 2 SURF	7	2	SURFICIAL	27 23 20.86	81 27 09.89
23739	JOSEPHINE 3 SURF	7	2	SURFICIAL	27 24 21.40	81 27 52.83
23740	JOSEPHINE 4 SURF	11	2	SURFICIAL	27 23 57.25	81 25 04.93
23747	JOSEPHINE 6 SURF	9	2	SURFICIAL	27 24 45.44	81 25 41.42
23792	ARBUCKLE CREEK ROAD SURF	50	2	SURFICIAL	27 31 21.94	81 27 12.61
23669	PARADISE ROAD SURF	32	2	SURFICIAL	27 28 01.04	81 24 14.40
23735	JOSEPHINE 1 SURF	11	2	SURFICIAL	27 23 07.07	81 26 07.68
23748	JOSEPHINE 5 SURF	13	2	SURFICIAL	27 24 46.54	81 25 06.11
23754	JOSEPHINE 8 SURF	5	2	SURFICIAL	27 25 20.20	81 26 46.41
23742	JW YONCE & SONS 3	130	12	UNKNOWN	27 24 21.09	81 23 21.06

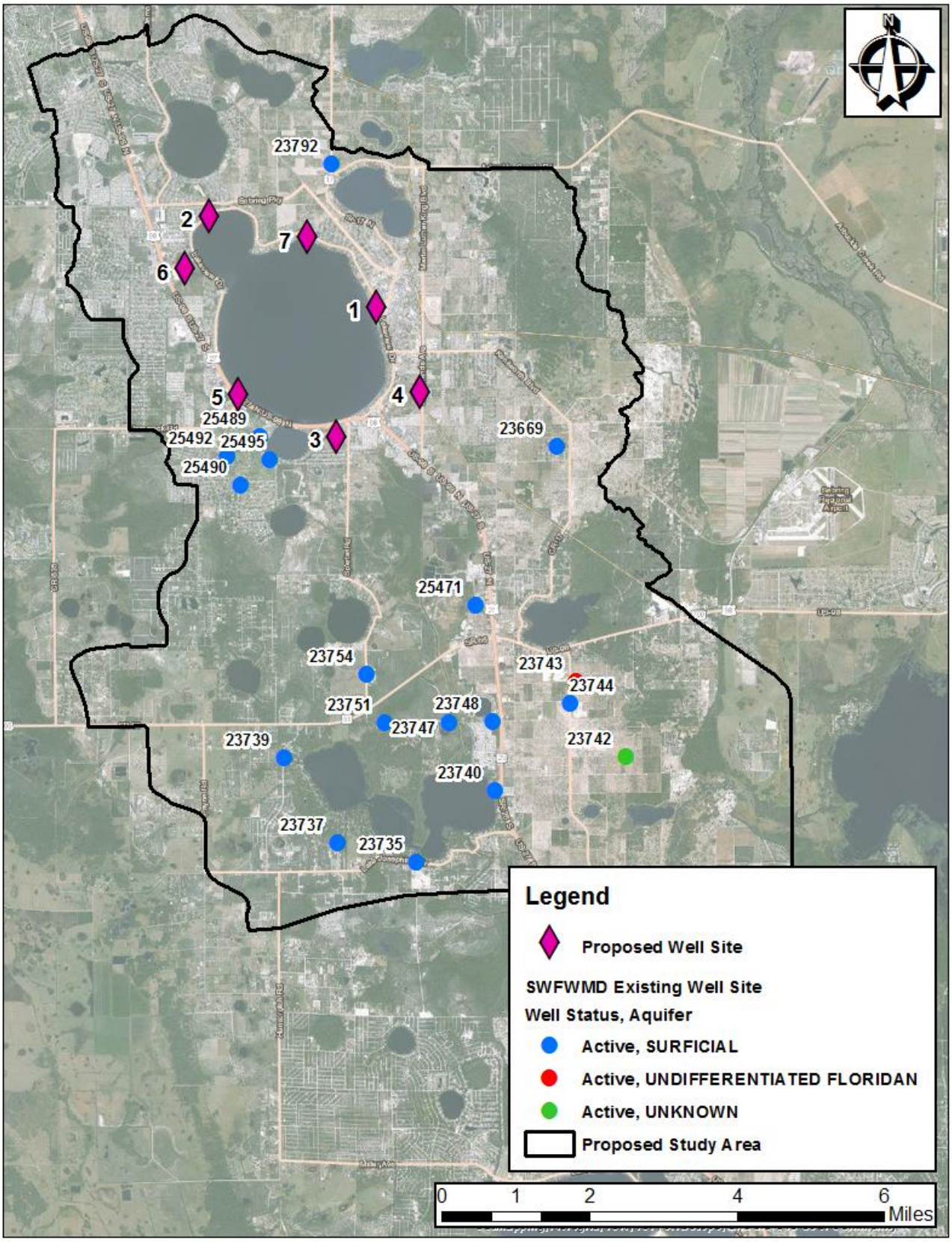


Figure 22. Proposed Monitoring Locations and Locations of Other SWFWMD Wells.

4.4 Surface water Sites

As presented in **Section 2.3**, there are currently nine (9) active collection sites within the study area. However, the data from these locations are mainly water level data that, is collected both automated and manually, as described in **Section 2.3**. The County's Project Plan under Agreement No. 14C00000039 calls for the design and construction of two (2) automated lake stage/flow recorders pursuant to **DISTRICT data specifications**. Following correspondence with the stakeholders, they believed that the addition of a water level/flow recorder on the downstream end of Structure HC-10 (within Jackson/Josephine Creek) would be beneficial and meet the project's plan description. The consultant recommends that the automated lake stage/flow recorders not only record lake levels, but streamflow data as well. Currently there is one inflow and one outflow between the Lake Jackson and Little Lake Jackson Chain. It is recommended that one automated lake stage/flow recorder be placed at the downstream end of the inflow area, and one at the upstream end of the structure (Structure 1) where the outflow location is to Jackson Creek. Also, one recorder is proposed to be installed at the Structure HC-10 location, as stated above. Approximate locations are shown in **Figure 24**. **Appendix D** provides higher resolution location maps of each of the proposed surface water/flow monitoring stations.

Based on previous project experience, water level monitoring and data collection is most efficient with the use of a small platform that extends out into the water body to collect accurate streamflow and water level data. In **Figure 23** (**informational purposes only),** is an example design specification for a platform with monitoring transducer. The proposed infrastructure should also be fitted with a calibrated staff gauge for data calibration comparison. The average estimated cost for each platform water level monitoring station is approximately **$3,500 each.**

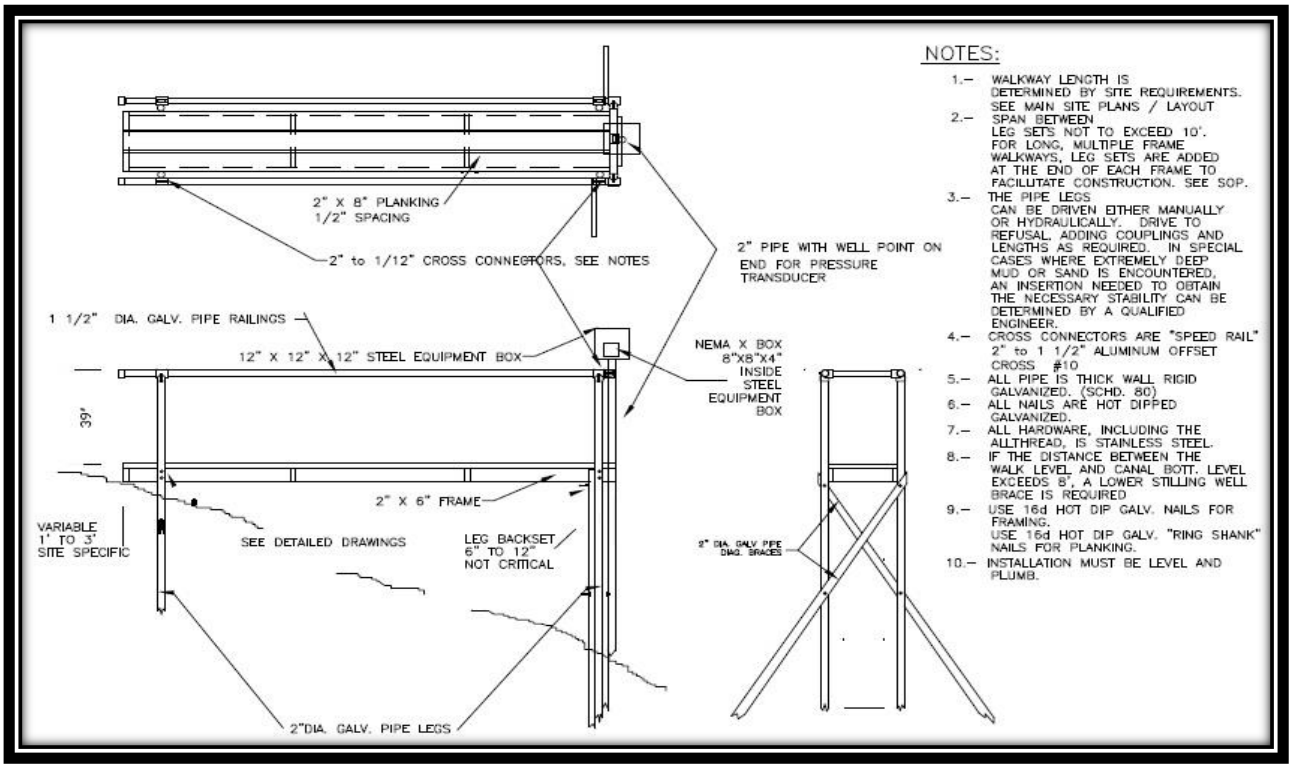


Figure 23. Proposed Automated Water Level/Streamflow Monitoring Platform Station (Designed by AIM Engineering & Surveying, Inc.).

Figure 24. Proposed Automated Water Level/Streamflow Monitoring Locations.

4.5 Summary and Cost Analysis of Proposed Monitoring Recommendations

Table 12 presents the cumulative proposed costs associated with the various monitoring plan options discussed within **Section 4.** The differences in proposed costs depend on the available budget and level of detail decided on when funding becomes available. For example, a total of 4 options are presented, relating proposed costs to monitoring well, monitoring surface water/streamflow, and weather station configurations. That is, depending on monitoring well configuration, and weather station needs, equipment and installation costs can vary considerably ($33k to $51k).

Table 12. Summary and Associated Costs for Monitoring Plan Options.

Description of Proposed Monitoring Costs	**Option ID**
Projected Cumulative Costs for (7) Proposed 2" Single Well Monitoring Sites Global Water With Additional Sensors, (3) automated water level/streamflow monitoring platforms	A
Projected Cumulative Costs for (10) Proposed 2" Single and Paired Well Monitoring Sites Global Water With Additional Sensors, (3) automated water level/streamflow monitoring platforms	B
Projected Cumulative Costs for (6) Proposed 2" Paired Well Monitoring Sites Global Water With Additional Sensors, (3) automated water level/streamflow monitoring platforms	C
Projected Cumulative Costs for (6) Proposed 6" Paired Well Monitoring Sites Global Water With Additional Sensors, (3) automated water level/streamflow monitoring platforms	D

Option ID	**Option Total Cost (USD)**
A	**$35,760**
B	**$43,260**
C	**$33,260**
D	**$51,260**

Note: 2" Single Well - $2,500.00 each
2" Paired Wells - $5,000.00 combined costs
6" Well - $8,250.00 each, 6" paired well - $11,000.00 each
Global Weather Station (including add. Sensors) - $7,760.00 each
Automated Water Level/Streamflow Monitoring Platform - $3,500.00 each

5.0 References

Douglas, E.M., J. Jacobs, D. Sumner, R. Ray, 2009. A comparison of models for estimating potential evapotranspiration for Florida land cover types. Journal of Hydrology 373, p. 366-376.

FDEP, 2008. Monitoring Well Design and Construction Guidance Manual. Florida Department of Environmental Protection Bureau of Water Facilities Regulation.

Fetter, C.W., 2001. Applied Hydrogeology – Fourth Edition. Prentice Hall Inc. Upper Saddle River, New Jersey 07458.

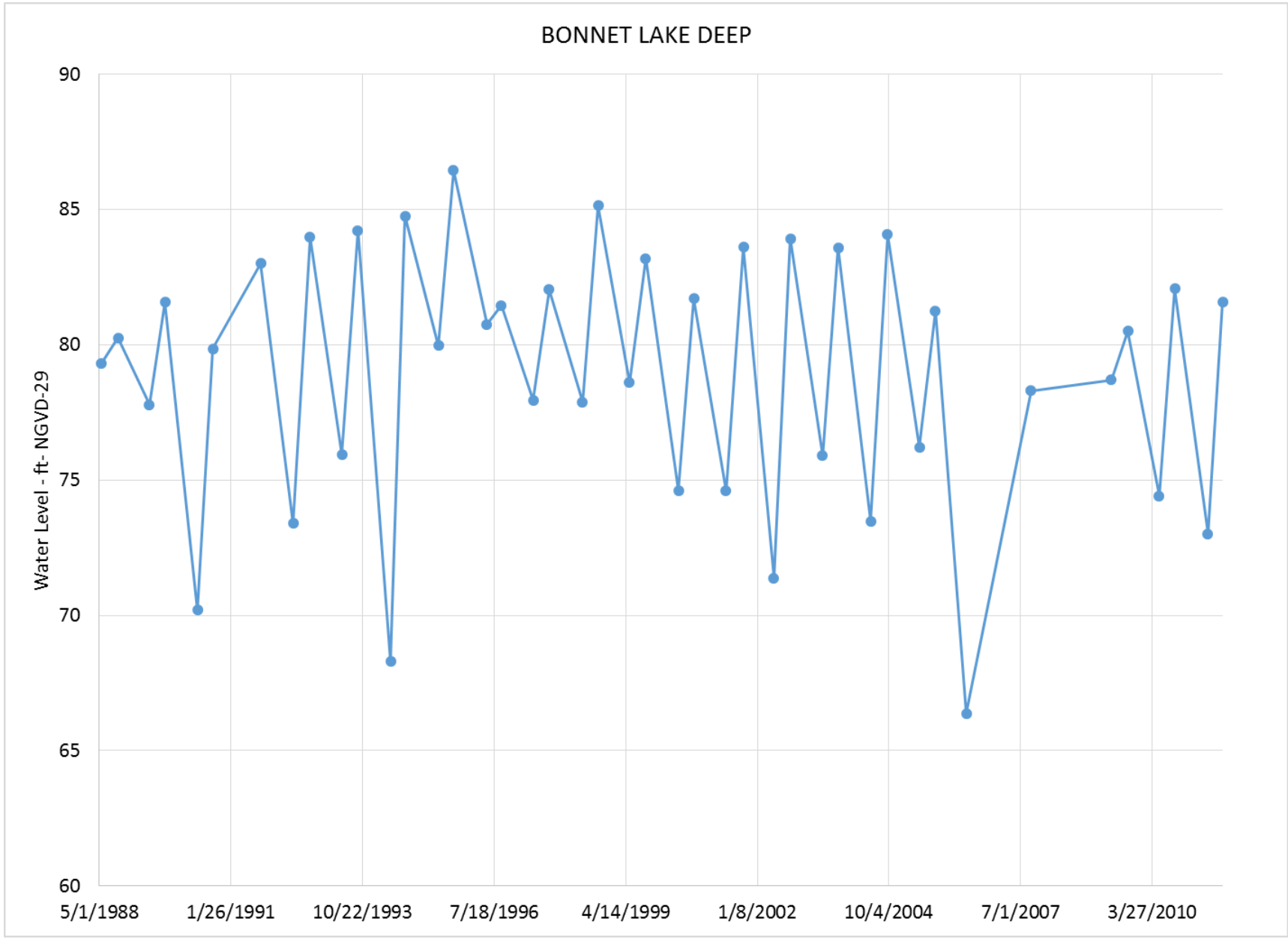
Martinez, C.J., 2013. Seepage Meters for Measuring Groundwater – Surface Water Exchange. UF/IFAS Document: AE435. University of Florida, Gainesville, Florida.

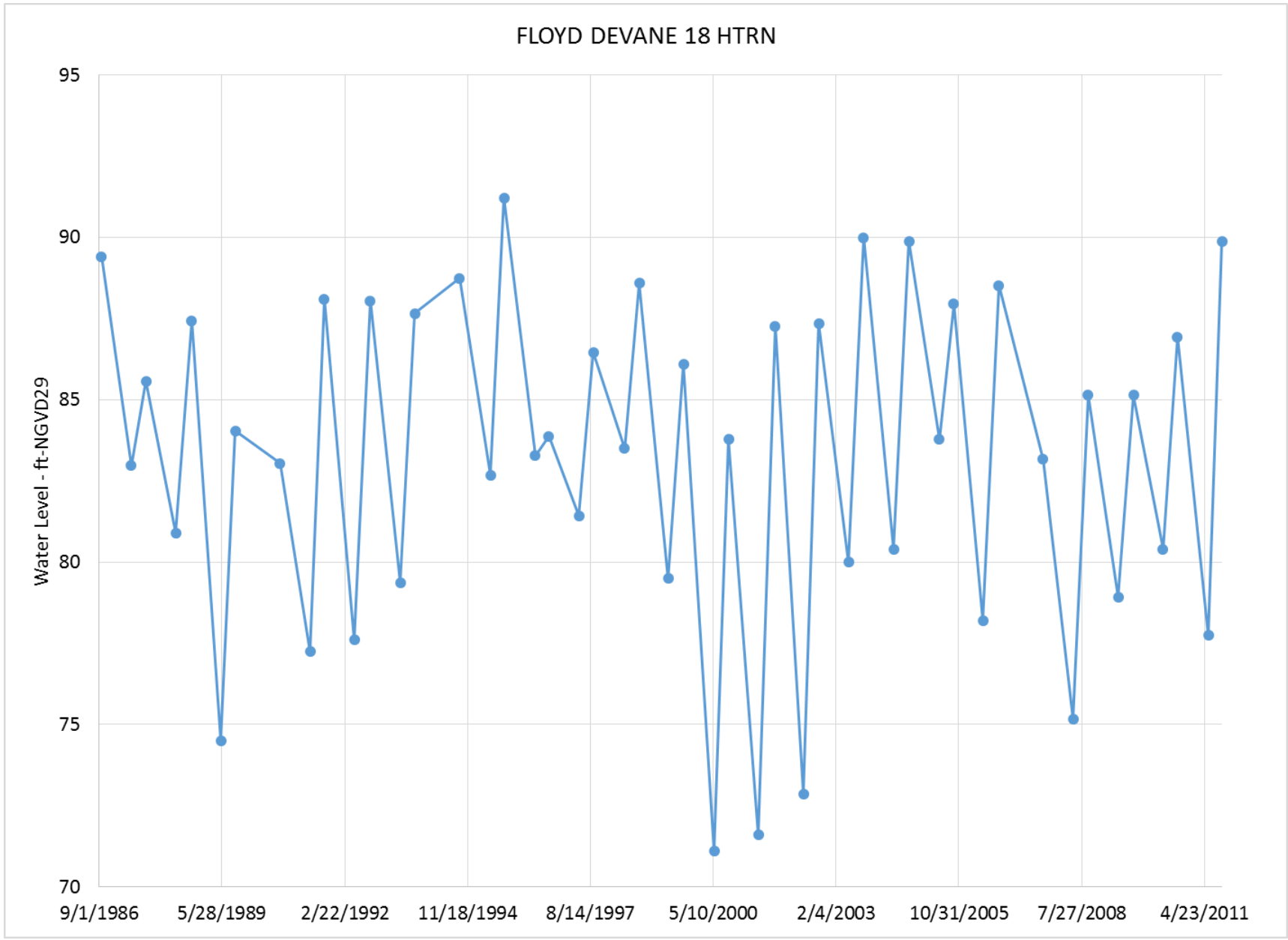
Spechler R.M., 2010. Hydrogeology and Groundwater Quality of Highlands County, Florida. USGS Scientific Investigations Report 2010-5097.

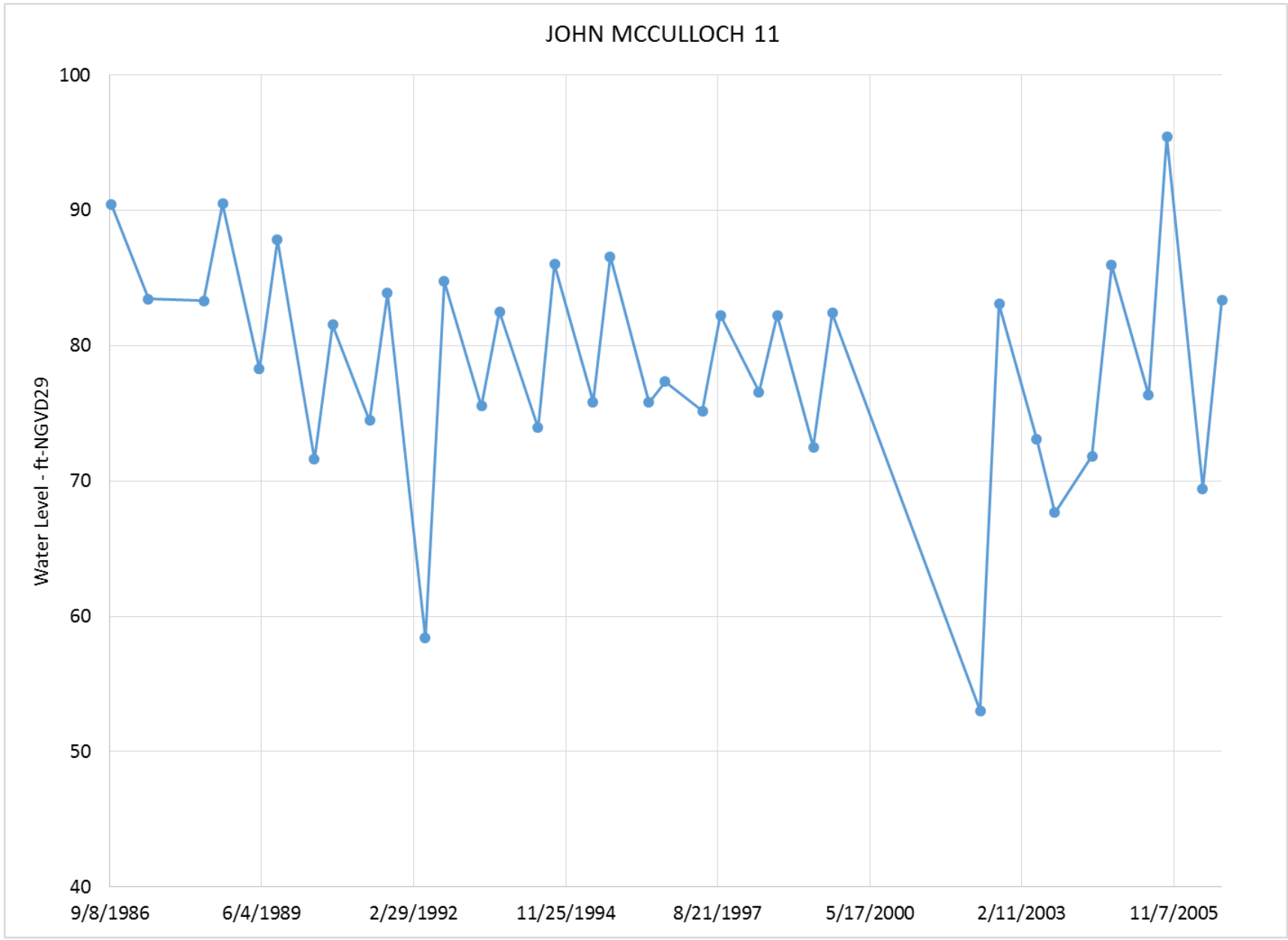
Zamoria, C., 2007. Estimating Water Fluxes Across the Sediment – Water Interface in the Lower Merced River, California. USGS Scientific Investigations Report 2007-5216.

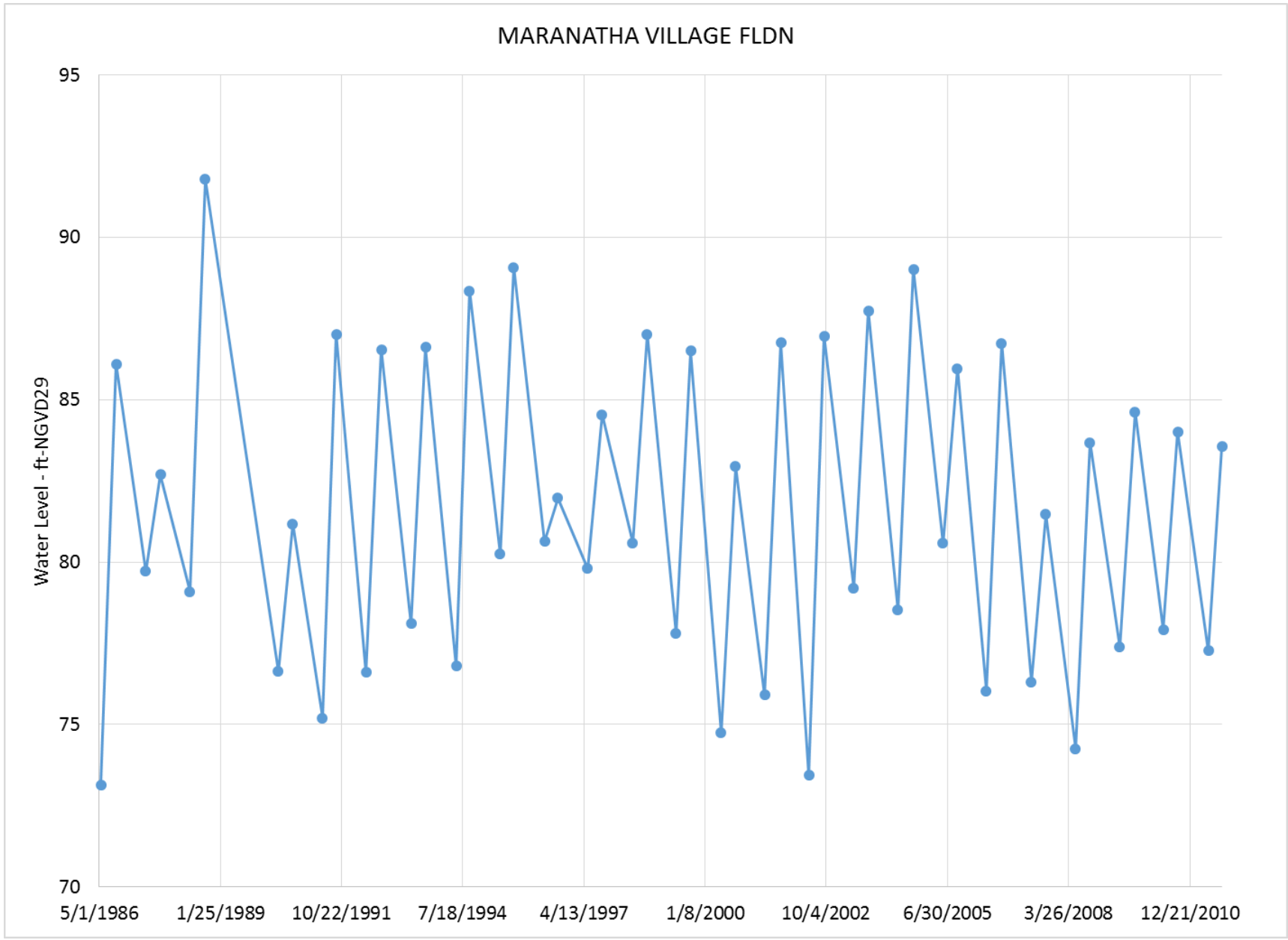
Appendix A

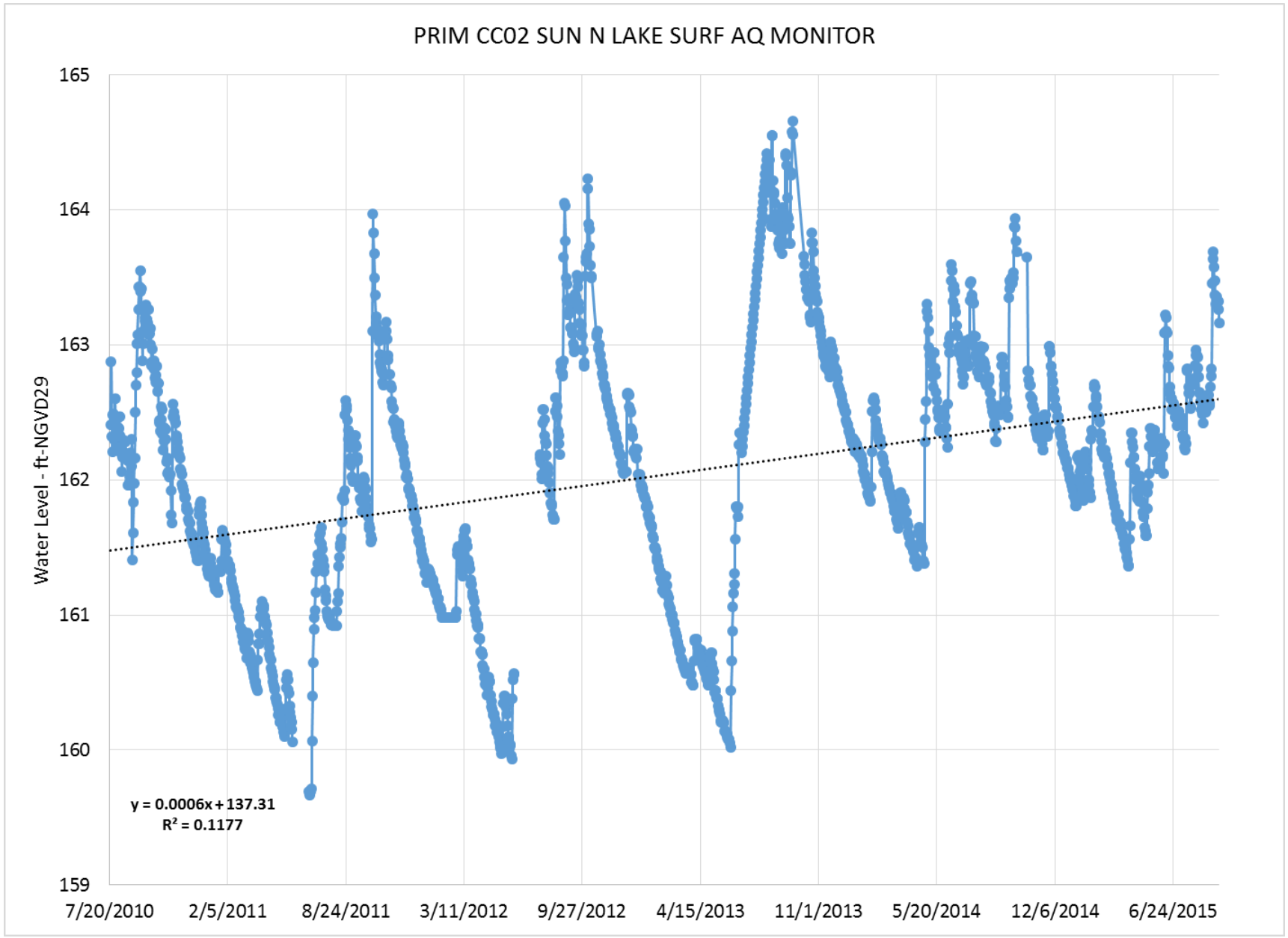
The following figures present the available groundwater data for each well described in **Section 2.5**. A trendline of the data is presented for a graph if the trend (up or down) in waterlevel was found significant using the Significance F test of less than 0.10. Statistical output for a significant trendline is presented on the following page after each appropriate figure.


BONNET LAKE DEEP
Water Level - ft- NGVD-29
90
85
80
75
70
65
60
5/1/1988
1/26/1991
10/22/1993
7/18/1996
4/14/1999
1/8/2002
10/4/2004
7/1/2007
3/27/2010

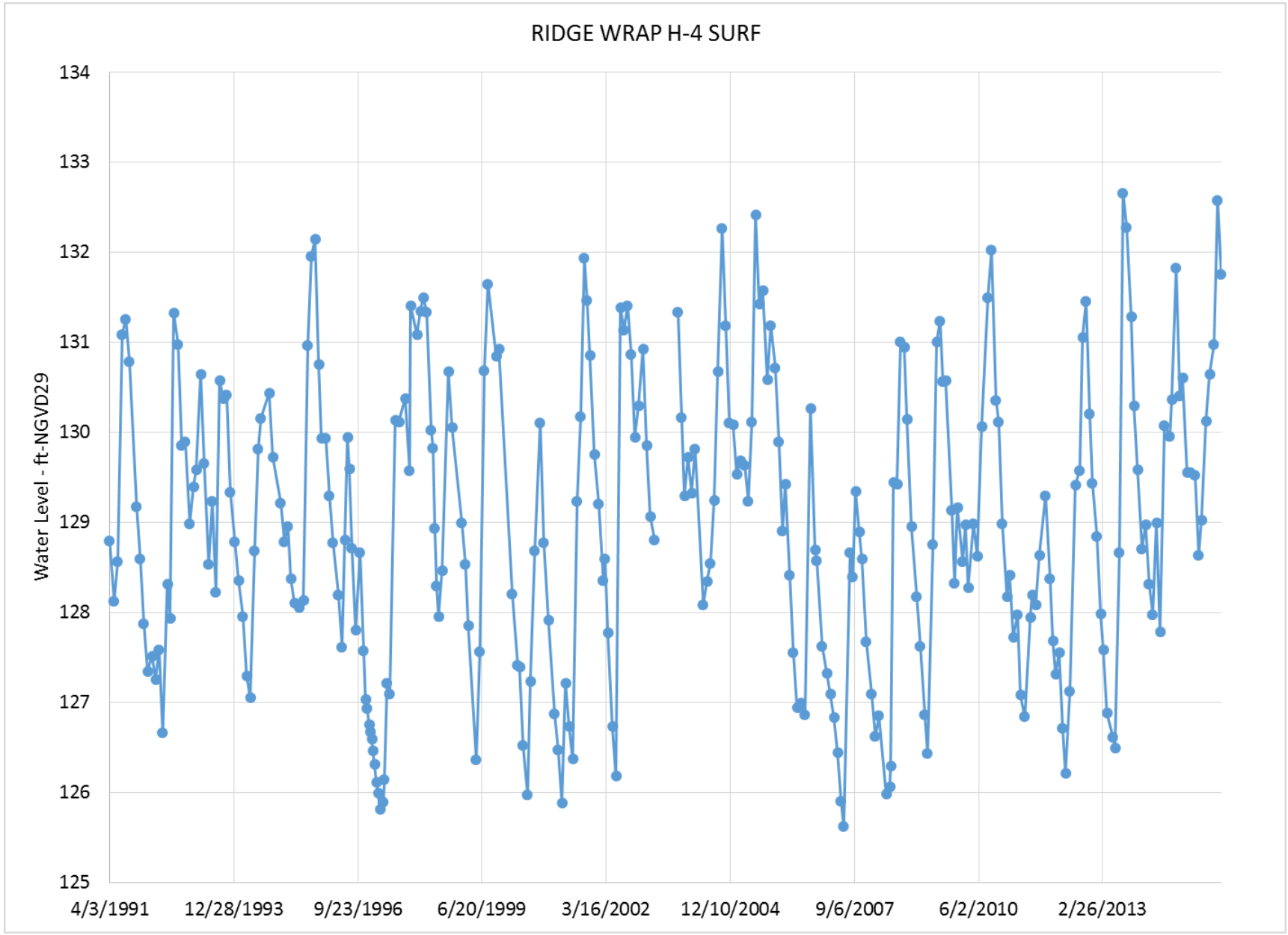

FLOYD DEVANE 18 HTRN
Water Level - ft-NGVD29
95
90
85
80
75
70
9/1/1986
5/28/1989
2/22/1992
11/18/1994
8/14/1997
5/10/2000
2/4/2003
10/31/2005
7/27/2008
4/23/2011

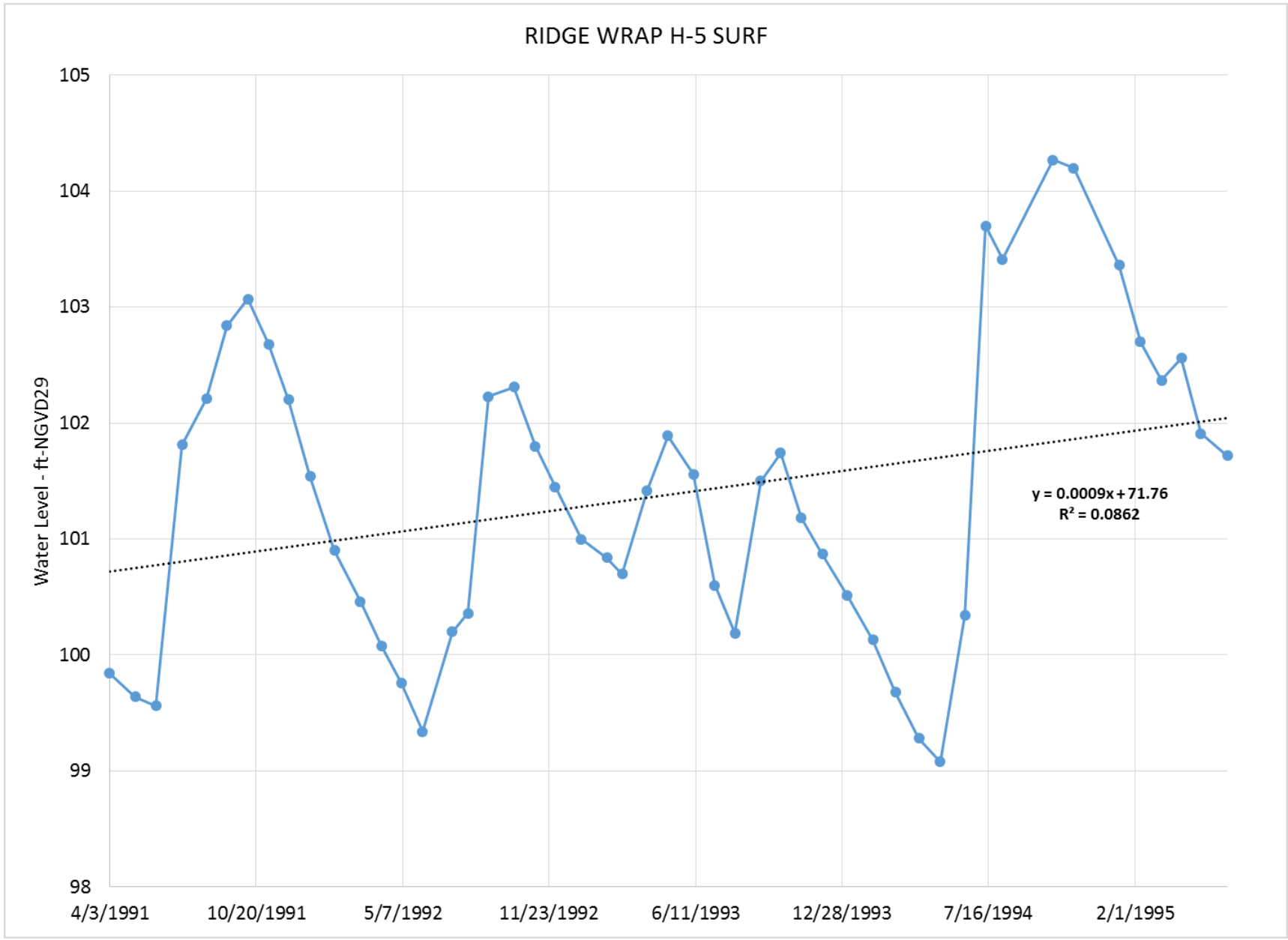

JOHN MCCULLOCH 11
Water Level - ft-NGVD29
100
90
80
70
60
50
40
9/8/1986
6/4/1989
2/29/1992
11/25/1994
8/21/1997
5/17/2000
2/11/2003
11/7/2005


MARANATHA VILLAGE FLDN
Water Level - ft-NGVD29
95
90
85
80
75
70
5/1/1986
1/25/1989
10/22/1991
7/18/1994
4/13/1997
1/8/2000
10/4/2002
6/30/2005
3/26/2008
12/21/2010

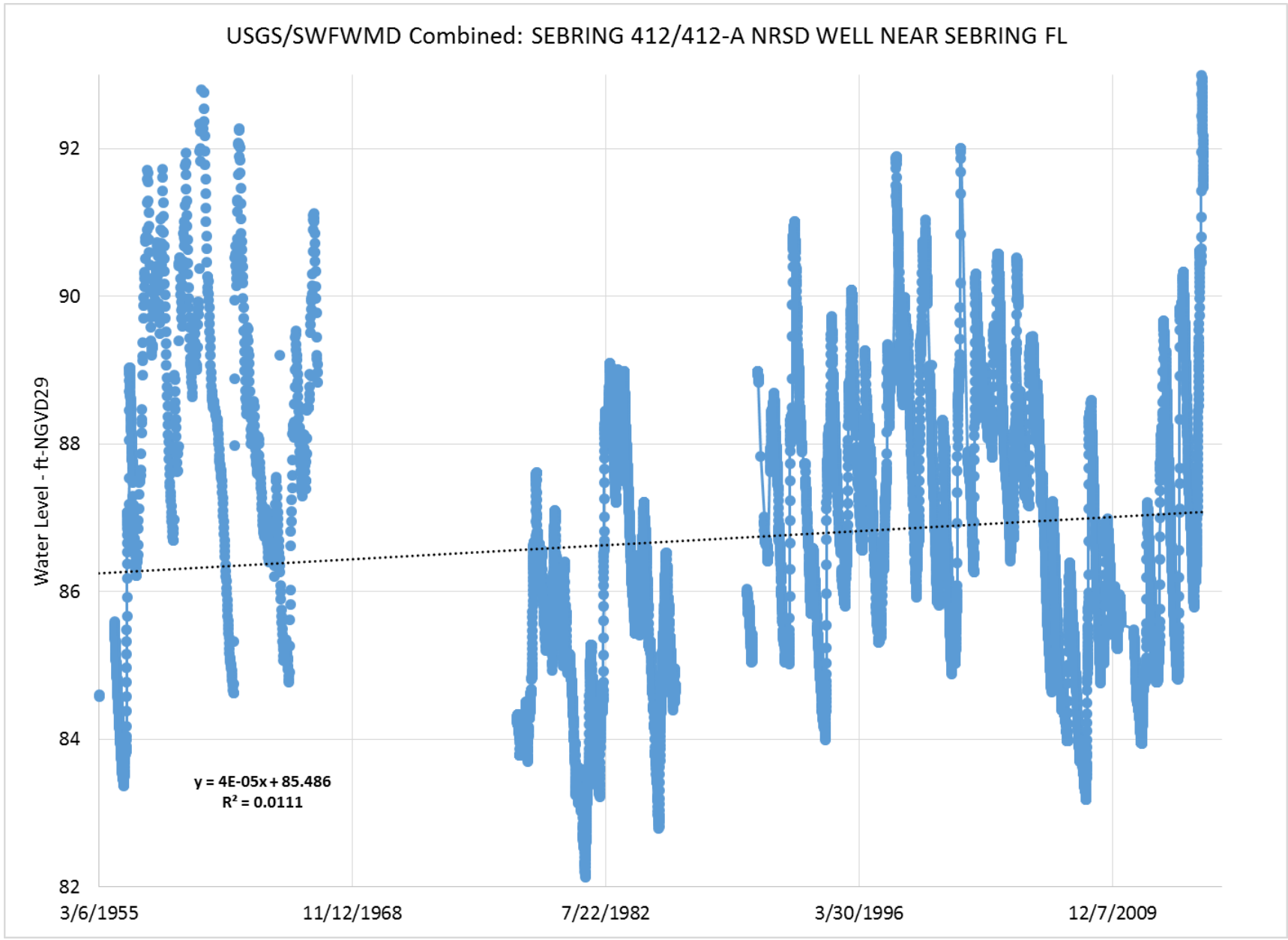

PRIM CC02 SUN N LAKE SURF AQ MONITOR
Water Level - ft-NGVD29
165
164
163
162
161
160
159
7/20/2010
2/5/2011
8/24/2011
3/11/2012
9/27/2012
4/15/2013
11/1/2013
5/20/2014
12/6/2014
6/24/2015
y = 0.0006x + 137.31
R² = 0.1177

PRIM CC02 SUN N LAKE SURF AQ MONITOR STATISTICAL OUTPUT								
Regression Statistics								
Multiple R	0.343							
R Square	0.118							
Adjusted R Square	0.117							
Standard Error	0.900							
Observations	1765							
ANOVA								
	df	*SS*	*MS*	*F*	*Significance F*			
Regression	1	190.370	190.370	235.208	6.28189E-50			
Residual	1763	1426.913	0.809					
Total	1764	1617.282						
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	137.305	1.613	85.114	0.000	134.141	140.469	134.141	140.469
Date	0.001	0.000	15.337	6.28E-50	0.001	0.001	0.001	0.001

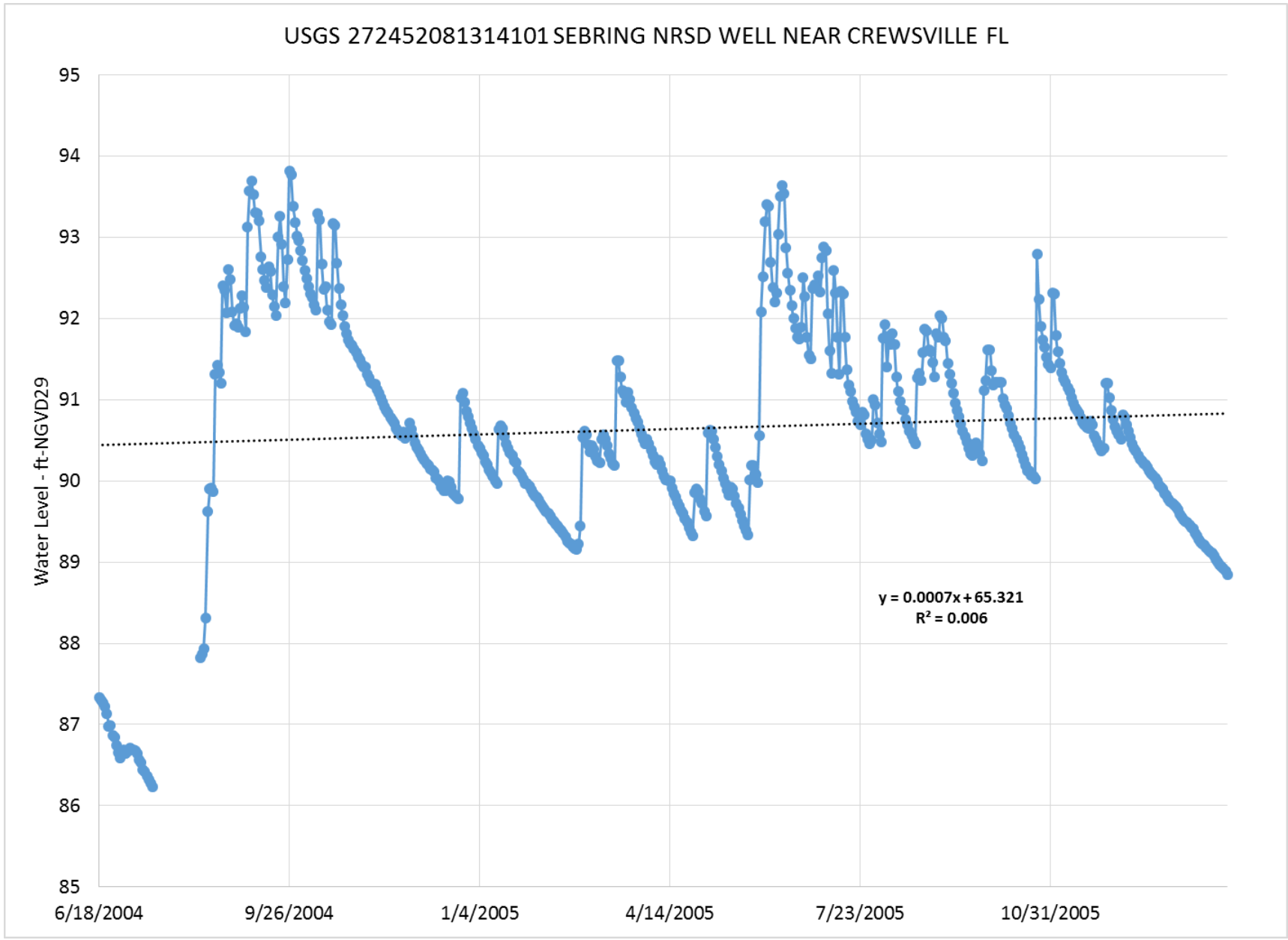

RIDGE WRAP H-4 SURF
Water Level - ft-NGVD29
134
133
132
131
130
129
128
127
126
125
4/3/1991
12/28/1993
9/23/1996
6/20/1999
3/16/2002
12/10/2004
9/6/2007
6/2/2010
2/26/2013


RIDGE WRAP H-5 SURF
Water Level - ft-NGVD29
105
104
103
102
101
100
99
98
4/3/1991
10/20/1991
5/7/1992
11/23/1992
6/11/1993
12/28/1993
7/16/1994
2/1/1995
y = 0.0009x + 71.76
R² = 0.0862

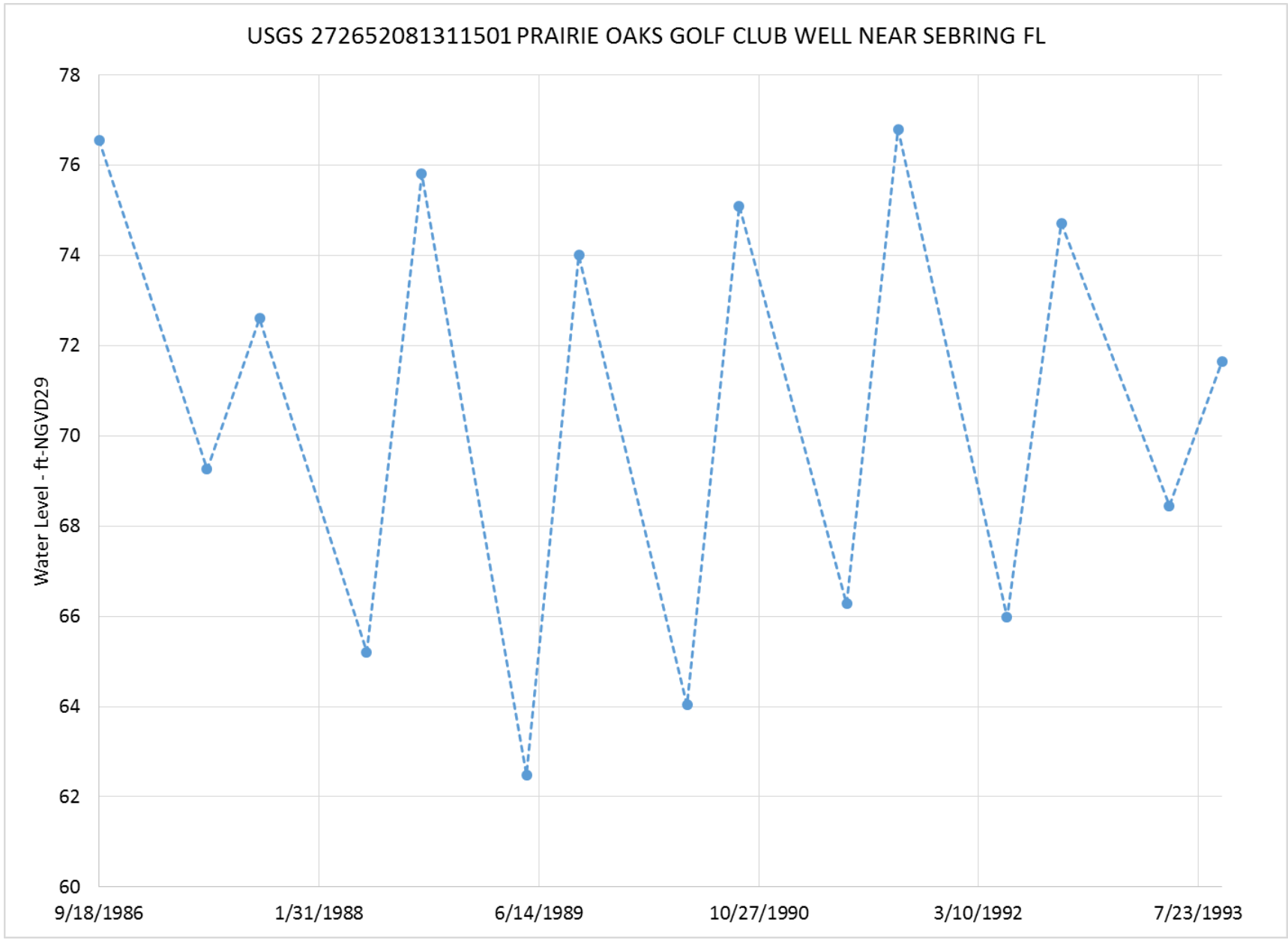
RIDGE WRAP H-5 SURF STATISTICAL OUTPUT								
Regression Statistics								
Multiple R	0.294							
R Square	0.086							
Adjusted R Square	0.067							
Standard Error	1.282							
Observations	49							
ANOVA								
	df	*SS*	*MS*	*F*	*Significance F*			
Regression	1	7.295	7.295	4.435	0.041			
Residual	47	77.304	1.645					
Total	48	84.599						
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	71.760	14.059	5.104	5.91E-06	43.47608	100.044	43.476	100.044
Date	0.001	0.000	2.106	0.041	3.89E-05	0.002	3.89E-05	0.002

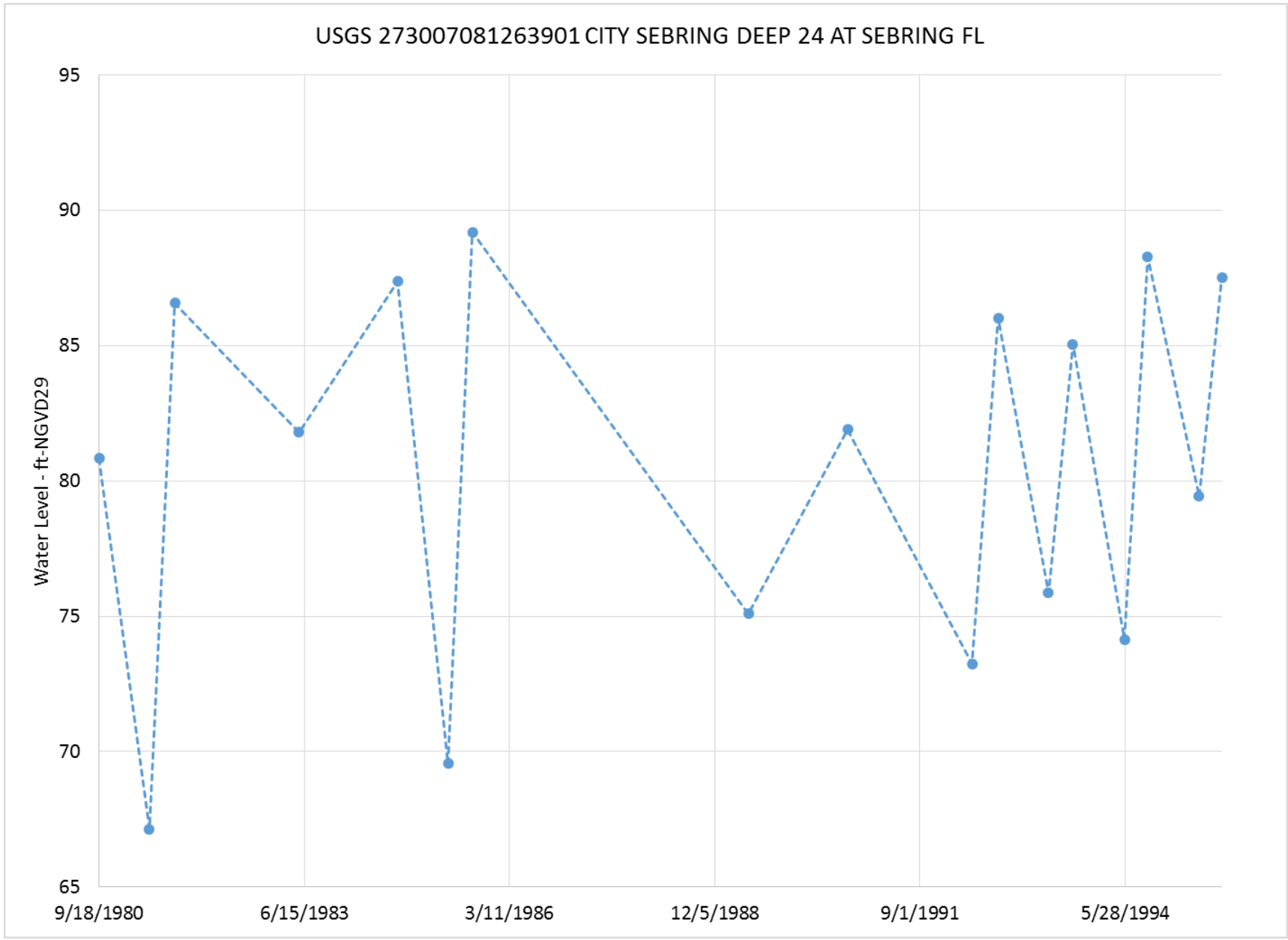

USGS/SWFWMD Combined: SEBRING 412/412-A NRSD WELL NEAR SEBRING FL
Water Level - ft-NGVD29
92
90
88
86
84
82
3/6/1955
11/12/1968
7/22/1982
3/30/1996
12/7/2009
y = 4E-05x + 85.486
R² = 0.0111

USGS/SWFWMD Combined: SEBRING 412/412-A NRSD WELL NEAR SEBRING FL STATISTICAL OUTPUT								
Regression Statistics								
Multiple R	0.153							
R Square	0.024							
Adjusted R Square	0.023							
Standard Error	1.971							
Observations	12719							
ANOVA								
	df	*SS*	*MS*	*F*	*Significance F*			
Regression	1	1190.163	1190.163	306.271	8.81E-68			
Residual	12717	49418.02	3.886					
Total	12718	50608.18						
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	84.954	0.111	766.323	0	84.737	85.172	84.737	85.172
Date	5.56E-05	3.18E-06	17.501	8.81E-68	4.93E-05	6.18E-05	4.93E-05	6.18E-05


USGS 272452081314101 SEBRING NRSD WELL NEAR CREWSVILLE FL
Water Level - ft-NGVD29
95
94
93
92
91
90
89
88
87
86
85
6/18/2004
9/26/2004
1/4/2005
4/14/2005
7/23/2005
10/31/2005
y = 0.0007x + 65.321
R² = 0.006

USGS 272452081314101 SEBRING NRSD WELL NEAR CREWSVILLE FL STATISTICAL OUTPUT								
Regression Statistics								
Multiple R	0.078							
R Square	0.006							
Adjusted R Square	0.004							
Standard Error	1.413							
Observations	571							
ANOVA								
	df	*SS*	*MS*	*F*	*Significance F*			
Regression	1	6.899	6.899	3.457	0.063			
Residual	569	1135.447	1.996					
Total	570	1142.346						
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	65.321	13.618	4.797	2.06E-06	38.574	92.068	38.574	92.068
Date	0.001	0.0004	1.859	0.063496	-3.7E-05	0.001	-3.7E-05	0.001


USGS 272652081311501 PRAIRIE OAKS GOLF CLUB WELL NEAR SEBRING FL
Water Level - ft-NGVD29
78
76
74
72
70
68
66
64
62
60
9/18/1986
1/31/1988
6/14/1989
10/27/1990
3/10/1992
7/23/1993


USGS 273007081263901 CITY SEBRING DEEP 24 AT SEBRING FL
Water Level - ft-NGVD29
95
90
85
80
75
70
65
9/18/1980
6/15/1983
3/11/1986
12/5/1988
9/1/1991
5/28/1994

Appendix B

Multiple Regression on Yearly Average Data	
SUMMARY OUTPUT	
Regression Statistics	
Multiple R	0.349
R Square	0.122
Adjusted R Square	0.054
Standard Error	1.488
Observations	29

ANOVA					
	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	7.991	3.995	1.805	0.184
Residual	26	57.538	2.213		
Total	28	65.528			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	99.301	4.333	22.920	9.046E-19	90.396	108.207	90.396	108.207
Avg. Rainfall	0.046	0.027	1.738	0.094	-0.008	0.101	-0.008	0.101
Avg. P/S Pumpage	-0.304	0.739	-0.411	0.685	-1.822	1.215	-1.822	1.215

Multiple Regression on 7-yr Moving Average Data	
SUMMARY OUTPUT	
Regression Statistics	
Multiple R	0.899
R Square	0.809
Adjusted R Square	0.791
Standard Error	0.488
Observations	24

ANOVA					
	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	21.155	10.577	44.412	2.86E-08
Residual	21	5.001	0.238		
Total	23	26.156			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	79.655	3.198	24.910	4.47E-17	73.005	86.305	73.005	86.305
7yr Mov. Avg. Rainfall	0.279	0.030	9.416	5.5E-09	0.217	0.340	0.217	0.340
7yr Moving Avg. P/S Pumpage	1.253	0.461	2.719	0.013	0.295	2.211	0.295	2.211

Multiple Regression on 5-yr Moving Average Data	
SUMMARY OUTPUT	
Regression Statistics	
Multiple R	0.801
R Square	0.641
Adjusted R Square	0.610
Standard Error	0.757
Observations	26

ANOVA					
	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	23.591	11.795	20.575	7.53E-06
Residual	23	13.185	0.573		
Total	25	36.776			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	83.337	4.246	19.629	7.27E-16	74.554	92.120	74.554	92.120
5yr Mov. Avg. Rainfall	0.233	0.037	6.347	1.78E-06	0.157	0.309	0.157	0.309
5yr Moving Avg. P/S Pumpage	0.981	0.614	1.598	0.124	-0.289	2.250	-0.289	2.250

Multiple Regression on 3-yr Moving Average Data	
SUMMARY OUTPUT	
Regression Statistics	
Multiple R	0.591
R Square	0.349
Adjusted R Square	0.297
Standard Error	1.122
Observations	28

ANOVA					
	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	16.879	8.439	6.703	0.005
Residual	25	31.475	1.259		
Total	27	48.353			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	91.694	5.085	18.031	7.68E-16	81.221	102.168	81.221	102.168
3yr Mov. Avg. Rainfall	0.131	0.038	3.466	0.002	0.053	0.209	0.053	0.209
3yr Moving Avg. P/S Pumpage	0.347	0.763	0.455	0.653	-1.225	1.919	-1.225	1.919

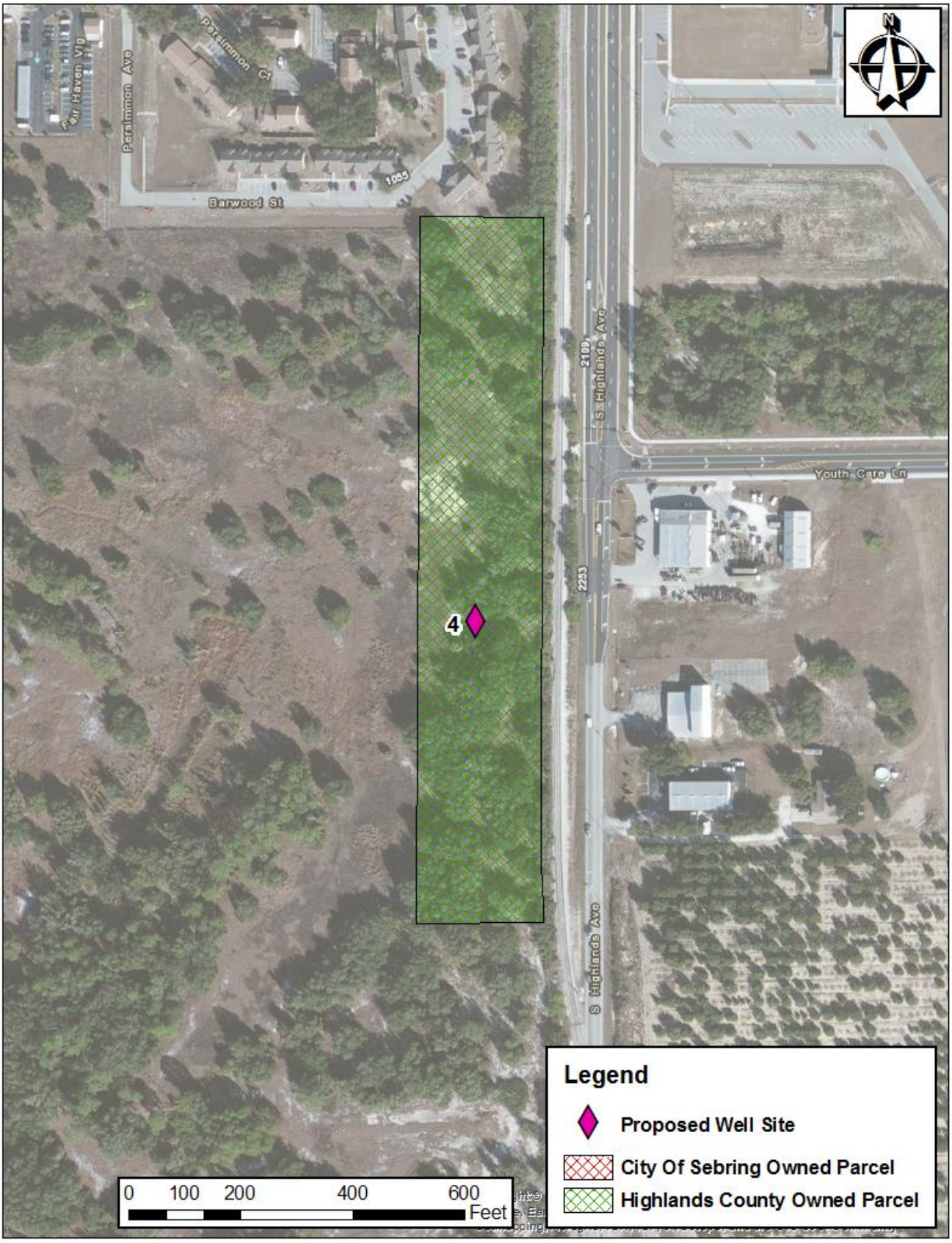
Appendix C

Proposed Well Site	STRAP	Parcel Number	Neighborhood	Parcel Owner
1	29342907009300011S	S29342907009300011	SEBRING SIDE STREET REDEV.	HIGHLANDS COUNTY BOARD OF CNTY COMM
2	28342302000M0006AS	S23342802000M0006A	LAKE JACKSON N.W.	HIGHLANDS COUNTY BOARD OF CNTY COMM
3	29350611000000080C	C06352911000000080	SPARTA RD NORTH END	HIGHLANDS COUNTY BOARD OF CNTY COMM
4	29343209000300070S	S32342909000300070	SEBRING SE LAKEVIEW DR AREA	HIGHLANDS COUNTY BOARD OF CNTY COMM
5	28342302000B00051S	S23342802000B00051	US 27 FAIRMOUNT DR TO SPARTA RD	CITY OF SEBRING
6	283423A0004500000C	C233428A0004500000	RURAL TRACTS IN 34/28	HIGHLANDS COUNTY BOARD OF CNTY COMM
7	29341906025200000S	S19342906025200000	LAKE JACKSON HIDDEN BEACH AREA	CITY OF SEBRING

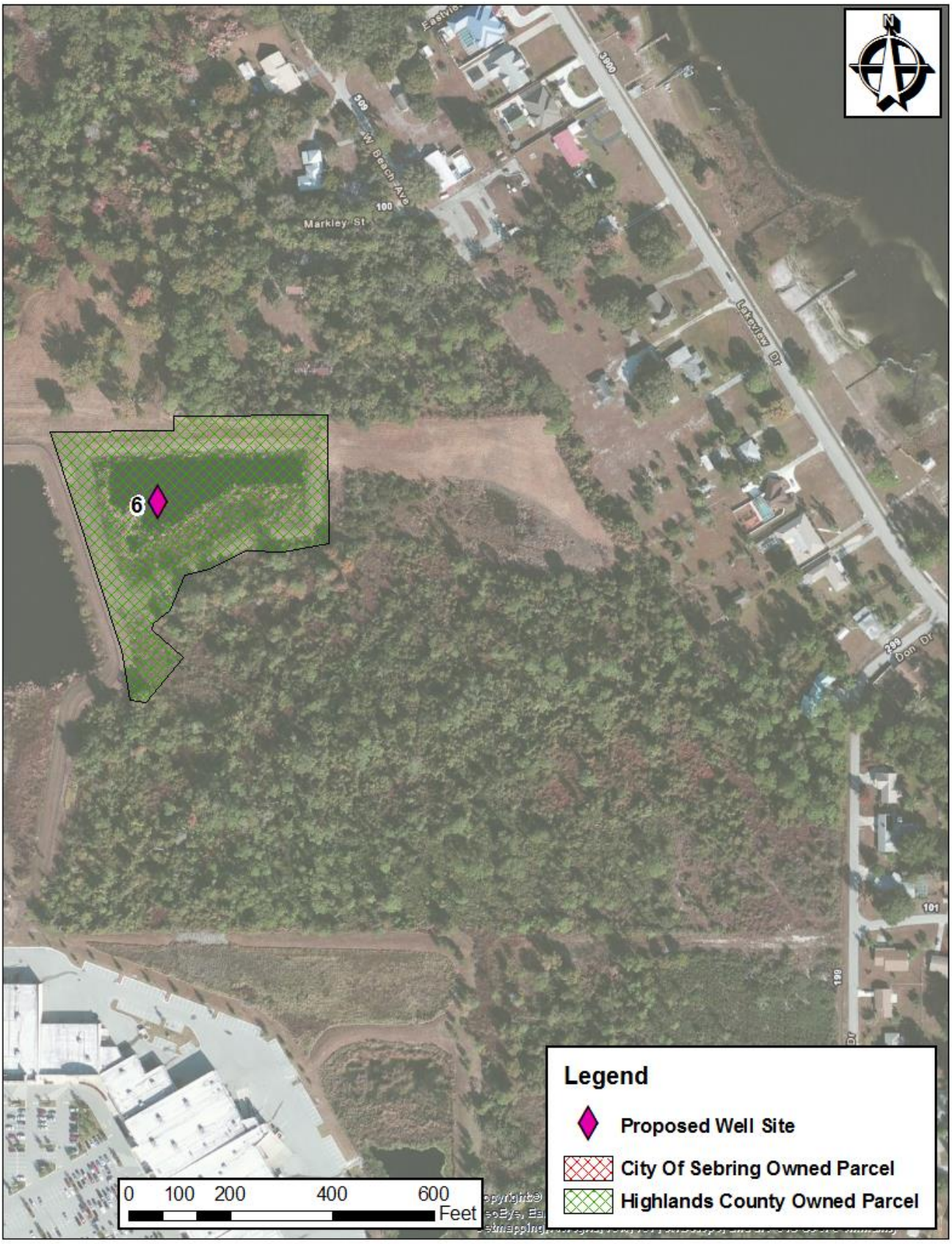

N
Commerce Ave
Pomegranate Ave
N Franklin St
W Center Ave
Lakeview Dr
Lakeview Dr
S Ridgewood Dr
1
Legend
Proposed Well Site
City Of Sebring Owned Parcel
Highlands County Owned Parcel
0 100 200 400 600
Feet


Sunset Dr
Eastview Rd
West Blvd
Sebring Pky
Sandra Blvd
Lakeview Dr
3710
3700
3610
3512
3509
1899
1849
1727
1700
1631
1800
1722
3520
3500
3532
2
Legend
Proposed Well Site
City Of Sebring Owned Parcel
Highlands County Owned Parcel
0 100 200 400 600
Feet


N
US-98 N US-27 N
US-98 S US-27 S
Sparta Rd
Trojan St
Koy Dr
Baker Ln
Berry Ln
3
1293
0 100 200 400 600
Feet
Legend
Proposed Well Site
City Of Sebring Owned Parcel
Highlands County Owned Parcel


Persimmon Ave
Persimmon Ct
Barwood St
1055
2109
S Highlands Ave
Youth Care Ln
2253
4
S Highlands Ave
Legend
Proposed Well Site
City Of Sebring Owned Parcel
Highlands County Owned Parcel
0 100 200 400 600
Feet

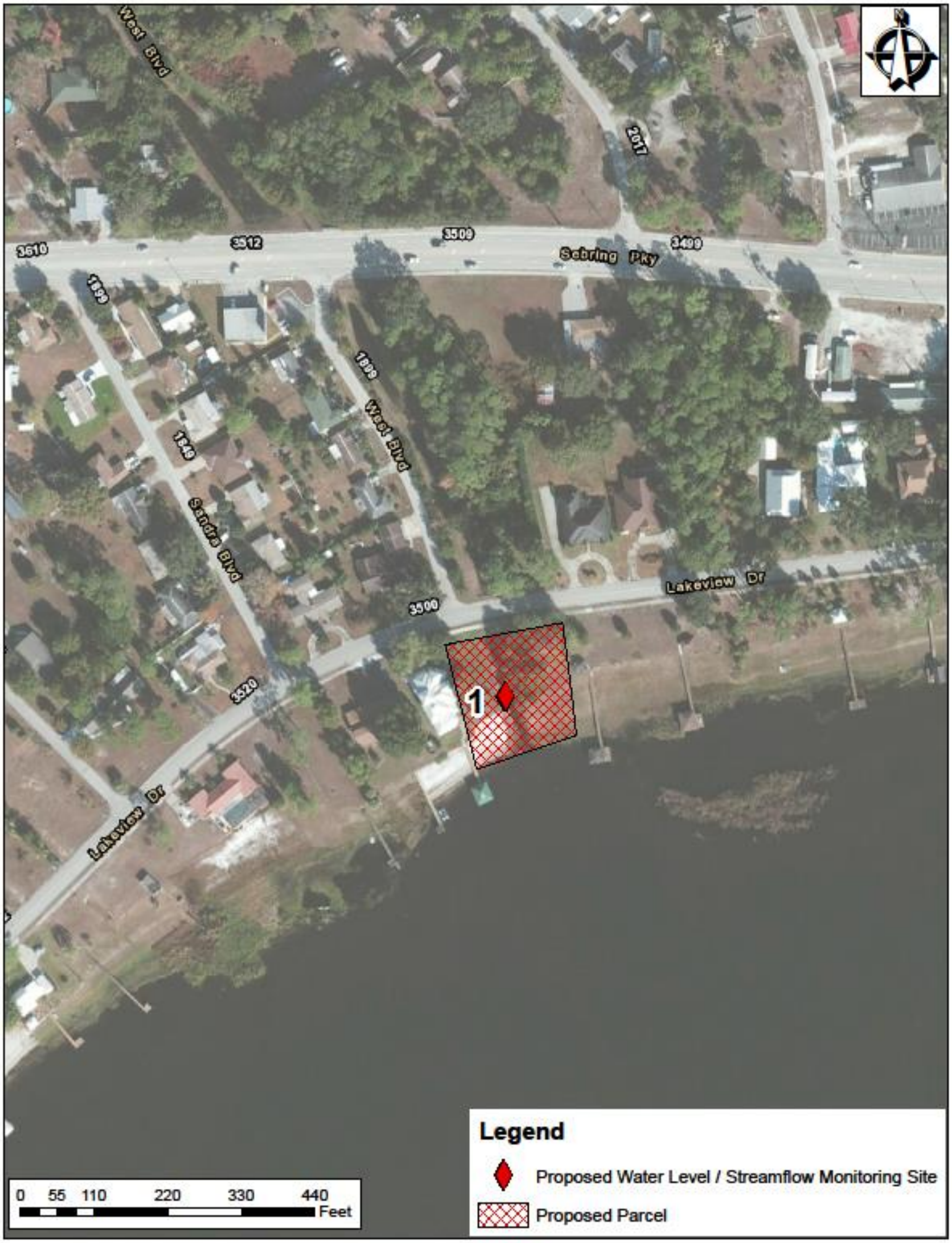

N
US-98 N US-27 N
US-98 S US-27 S
US-27 N US-98 N
US-27 S US-98 S
5
Lloyd Dr
Horizon Vw
Nanette Pl
Garner Ln
Royal Palm Dr
Starlight Ln
Cuttle Pl
Hammock Rd
Ashley Oaks Cir
Ashley Oaks Ln
Legend
Proposed Well Site
City Of Sebring Owned Parcel
Highlands County Owned Parcel
0 100 200 400 600
Feet


N
Markley St
W Beach Ave
Lakeview Dr
Don Dr
6
Legend
Proposed Well Site
City Of Sebring Owned Parcel
Highlands County Owned Parcel
0 100 200 400 600
Feet


Summit Dr
Hiawatha Ave
Valencia Ave
Ta-ses-Chee Dr
Taseschee Dr
Lakeview Dr
Roma Ave
7
0 100 200 400 600
Feet
Legend
Proposed Well Site
City Of Sebring Owned Parcel
Highlands County Owned Parcel

Appendix D

Proposed Automated Water Level/Streamflow Monitoring Site	Parcel Number	Latitude	Longitude	Parcel Owner
1	N/A (Drainage Easement)	27° 30’ 48.26” N	81° 28’ 44.63” W	N/A
2	C063529A0000220000	27° 28’ 06.81” N	81° 27’ 30.74” W	Jack Morton & Alexander Debay
3	C05352906000000610	27° 27’ 59.48” N	81° 26’ 45.22” W	Francis I Cooperative Assn Inc.


West Blvd
2017
3610
3512
3509
Sebring Pky
3499
1899
1899
West Blvd
1849
Sandra Blvd
Lakeview Dr
3500
3520
Lakeview Dr
1
Legend
Proposed Water Level / Streamflow Monitoring Site
Proposed Parcel
0 55 110 220 330 440
Feet


US-98 N US-27 N
US-98 S US-27 S
27
US-98 N US-27 N
US-98 S US-27 S
Tubbs Rd
Trojan Ave
2
Tubbs Rd
Killarn
Killarney Dr
Kerry Dr
Shamrock Dr
Erin Rd
0 95 190 380 570 760
Feet
Legend
Proposed Water Level / Streamflow Monitoring Site
Proposed Parcel


Clara St
Kent Dr
Renaud St
Tanglewood St
Eva St
Key Dr
Sebring Dr
Cherokee St
Mimi St
Sunrise Blvd
Sparta Dr
Tiger Tail Rd
Francis St
Pauline St
Sunshine Ln
Pepper Dr
Bonds Ave
Von Maxcy Rd
3
Addison St
Jason Creek Cir
Loewy Ct
Schlosser Rd
Stiles Ln
0 100 200 400 600 800
Feet
Legend
Proposed Water Level / Streamflow Monitoring Site
Proposed Parcel

Minimum Requirements for the Collection and Management of Hydrologic and Meteorologic Data

Hydrologic Data Section

February 2014
Hydrologic Data
Southwest Florida Water Management District
2379 Broad Street
Brooksville, FL 34604-6899

[THIS PAGE HAS BEEN INTENTIONALLY LEFT BLANK]

TABLE OF CONTENTS

[THIS PAGE HAS BEEN INTENTIONALLY LEFT BLANK]

ITB 18-010 - APPENDIX 4

LIST OF DETAILS

[THIS PAGE HAS BEEN INTENTIONALLY LEFT BLANK]

STATEMENT OF INTENT

It is the intent of the Hydrologic Data Section (HDS) at the Southwest Florida Water Management District (District) to collect, record, analyze, manage and archive hydrologic and meteorologic data in accordance with generally accepted procedures consistent with applicable scientific and technical standards of practice, established bureau procedures and/or with procedures described in this document.

PURPOSE

The Hydrologic Data Section is responsible for the implementation and maintenance of a network of observation and monitoring stations throughout the District's 16-county area that are used to monitor various hydrologic and meteorologic parameters over time. All data collected are processed, analyzed and validated, then uploaded into the Water Management Information System (WMIS) for general access by District scientists, engineers, nature resource managers and the general public. The WMIS is also periodically augmented with hydrologic and meteorologic data from the United States Geological Survey (USGS) and the National Oceanic and Atmospheric Administration (NOAA).

This document applies to HDS personnel and contractor personnel authorized by the HDS to collect hydrologic and meteorologic data for the HDS data collection program.

The source information used in the preparation of this document has relied heavily on the guidelines, procedures, techniques and methods used by other agencies regarding their data collection programs. A list of additional informational resources is provided at the end of this document (see Detail 14). Referral to these informational resources is highly recommended for additional guidance and more detailed information regarding data collection and management requirements, procedures, techniques and methodologies.

SCOPE

The scope of this document specifies certain guidelines and minimum requirements that are necessary for the consistent and accurate collection of hydrologic and meteorologic data by the HDS. Elements presented in the document include the minimum requirements and procedures for the documentation and design of the data collection network, requirements for initial and ongoing survey work, requirements for the installation of instrumentation, requirements for the collection of time series data, and requirements for the processing, editing, analyzing, validating, managing and archiving of hydrologic and meteorologic data

Since the collection of field data can present many challenges, it is critical that all field data be collected using properly installed and acceptable field instrumentation, using consistent and repeatable data collection techniques, and utilizing appropriate quality control methods, in order to provide accurate, cost effective and defensible data for use in the management and protection of the District's water resources and related natural systems.

Sometimes, the greatest value of hydrologic and meteorologic data is only realized long after the data has been collected, when that data is relied upon or referenced in a future study.

TRAINING

All HDS staff, including contractor and cooperator personnel, involved in data collection and management activities shall have the necessary education, experience and skills to perform their assigned job duties. Personnel shall be trained and familiar with the appropriate safety protocols, equipment and procedures, required quality control procedures, and those specific procedures to be conducted for each task.

Training includes, but is not limited to, workshops, seminars, short-courses and by working under the guidance of senior colleagues. Training procedures, training records, and demonstration of capabilities shall be documented.

All HDS staff are required to attend monthly staff meetings.

DATUM

The following is a process to determine the elevations and locations of instrumentation at data monitoring sites. All necessary elevations and locations of instrumentation at data monitoring sites must be determined through the use of permanent and professionally surveyed benchmarks installed with the minimum requirements described in this section. All work performed in the establishment of benchmarks and determination of elevations and locations must be documented and stored in the appropriate District database(s) using established and acceptable database formats.

Permanent Benchmarks

- All benchmarks must be established under the supervision of a Florida licensed Professional Surveyor and Mapper in accordance with applicable minimum technical standards defined in 61G17, FAC.

- A minimum of two NAVD88 vertical control benchmarks must be established within 500 feet of each data collection device assigned a Site Identification Number (SID), including wells, staff gauges, or other measuring devices. One of the benchmarks shall be located within 100 feet of each device

- Existing NAVD88 vertical control benchmarks in the vicinity of the site can be used if the data are published by the National Geodetic Survey (NGS) or established and published by a Florida Professional Survey & Mapper (PSM).

- The vertical accuracy of newly-established or existing vertical control benchmarks shall not exceed +/- 0.10 feet local network accuracy and directly measured to a minimum of two existing NGS or PSM vertical control benchmarks. The surveyor shall publish a datasheet and surveyor's report for all newly-established vertical control benchmarks.

- A corresponding derived NGVD29 elevation (e.g., Vertcon) for each benchmark must be determined and noted in the site documentation records.

- The Surveyor in charge of constructing the monuments shall assure that the materials used will adequately establish a stable monument. If the soil is unstable and cannot be compacted to adequately stabilize the monument, the type of benchmark shall be no less than a metal rod or metal pipe driven to point of refusal with a concrete collar poured around the rod/pipe at ground level and a disk set in top center of concrete. The disk shall display the surveyor's identification number. Refusal shall be defined as several full blows with an eight (8) pound sledge hammer rendering no perceptible movement of the rod/pipe. See Detail 1 for details of the monument construction checklist.

- The permanent benchmark shall be documented in a vertical control datasheet. See Detail 2 for an example of the information to be included on the datasheet.

Determining Horizontal and Vertical Information

1) Acceptable Types of Survey Equipment and Methods

   a) A global positioning system (GPS) receiver with differential correction capability (WASS/SBAS), or equipment with greater precision, must be used for determining the horizontal position of the measuring devices.

   b) Differential leveling equipment and standard land surveying techniques must be used to determine all elevations. See Detail 3 and Detail 4 for guidelines on transferring NAVD88 elevations from the benchmarks to the monitoring sites.

2) Protocol for Determining Horizontal Location

   a) The horizontal location (latitude/longitude) of all measuring devices must be recorded. The observer shall record the horizontal accuracy as displayed by the GPS receiver.

   b) Record the PDOP, number of satellites and the displayed accuracy. Record this information two separate times, with 15 minutes between recordings. A minimum of five satellites and a PDOP of less than six shall be required. If offsets are needed, a minimum of four offset points should be obtained (two sets of two points on a line with the measuring device) and the offset distances measured with a tape to the measuring device, with distances recorded to the nearest foot.

Protocol for "Leveling" Measuring Devices

All elevations related to measuring devices must be determined using a minimum of two permanent benchmarks as described above. The field technician shall transfer the NAVD88 elevation from the benchmarks to the devices using closed loop differential leveling techniques between the benchmarks and the appropriate points on the devices (as described below). The procedures for transferring the NAVD88 elevation from the benchmarks to the measuring points are shown in Detail 3 and 4.

Staff Gauge Sites

- A permanent reference point with elevation shall be established on each staff gauge with appropriate file marks, and recorded in the field book and database. A photograph should be recorded, and the reference point and numerical reading of the staff gauge must be plainly visible in the photograph.

- An elevation reading shall be recorded at an even foot mark of the gauge. Both the elevation and the numerical reading (i.e. 2.00', 3.00', etc.) of the gauge where the elevation reading was taken shall be recorded in the field book and database.

- Water level reading on the staff gauge shall also be noted in the field book and database, along with the time and date of the reading. An elevation reading shall be taken on the ground surface at the base of the gauge and shall be recorded in the field book and database.

- A sketch of the staff gauge location(s) with the latitude and longitude shall be recorded in the field book and database. If applicable, the sketch shall illustrate the location of the gauge in relation to a dock or other semi-permanent structure, either by compass bearing and distance or by distance ties if the gauge is attached to a dock, a description of the location and type of mark identifying the measuring point, and the location of all benchmarks and reference marks.

- Data collection sites may have more than one gauge. All gauges at the site will be surveyed in accordance with the procedures outlined above.

- Survey information to be reported includes 1) gauge locations, 2) information on benchmarks used to determine staff gauge elevations, 3) the elevation of top of supporting structure, 4) ground/dry reading, 5) the water level reading at the time of installation, 6) factor to convert staff gauge readings to NAV88 and/or NGVD 29, if needed, and 7) photographs.

Well Sites

- A permanent measuring point (MP) shall be established at the well from which water levels will be measured. MP elevations for wells shall be measured from the top of the well casing (or other fixed component of the well above the elevation of the well casing), and marked with file marks spaced two inches apart with survey rod readings taken between the file marks. MP's set on removable well caps, spigot handles and other movable and/ or removable components, and/or marked with paint or similar substance, are not acceptable. If a recorder shelter is installed on the well and a survey rod cannot be set on the top of the well casing or PVC riser pipe, the MP shall be set on the floor of the recorder shelter box. A 2" by 2" square marked with black felt pen shall be placed next to the opening of the floor and the elevation established at that point. A brief description and photograph of the MP shall be recorded in the field book and database (the measuring point of the well must be plainly visible in the photograph). An elevation reading shall be taken on the ground surface at the base of the well and shall be recorded in the field book and database.

- A sketch of the well location with the latitude and longitude shall be recorded in the field book and database. At a minimum, the sketch shall illustrate the location of the well in relation to the established bench mark(s) and any semi-permanent structures or other distinguishing feature, by compass bearing and distance.

- Survey information to be documented includes: 1) well locations, 2) information on benchmarks used to determine well elevations, 3) elevation of top of casing (at the measuring point, if applicable), 4) ground elevation at the well, 5) total depth of well (from ground surface) 6) depth of casing (from ground surface), 7) photographs, and 8) if applicable, water quality sampling depth. Although not a surveyed value, the casing material and diameter should also be documented.

Automated Recorder Sites

- The measuring point will be set on the top of the well casing in the recorder box and marked with a black permanent marker. If the rod cannot be set on the top of the well casing, the measuring point shall be set on the floor of the recorder box. A 2" by 2" square marked with black permanent marker shall be placed next to the opening of the floor and the elevation established at that point. The MP elevation shall be written on the recorder box floor next to the MP. A brief description and photograph of the measuring point shall be recorded in the station records and database (the measuring point and numerical elevation shall be plainly visible in the photograph). An elevation reading shall be taken on the ground surface adjacent to the recorder and shall be recorded in the field book and database.

- A sketch of the recorder site location with the latitude and longitude shall be recorded in the field book and database. If applicable, the sketch shall show the location of the recorder in relation to the nearest permanent landmark (e.g., roadway, building, bridge, dock, etc.), either by compass bearing and distance or by distance ties if the recorder is attached to a dock, a description of the location and type of mark identifying the measuring point, and the location of all benchmarks and reference marks.

- Survey information to be reported includes 1) recorder box location, 2) information on benchmarks used to determine recorder elevations, 3) elevation of recorder box floor at the measuring point, 4) ground elevation at the recorder, and 5) photographs. Although not a surveyed value, information on the type of recorder should be reported.

Survey Maintenance

- Due to the possibility of subsidence, the elevation of the wells and gauges should be checked six months after installation, and thence every three years.

- As part of these checks, the two benchmarks are compared to each other (see Detail 3). If any change in the elevations of the benchmarks is determined, the elevations of the benchmarks shall be re-evaluated by a Florida licensed Professional Surveyor and Mapper in accordance with applicable minimum technical standards defined in 61G17, FAC.

Documentation Requirements

- All field data shall be recorded in standard bound field books, and transferred to established databases.

- Digital photographs shall be taken at the measuring device site. Multiple photographs shall be taken as the situation warrants when a site contains more than one well, staff gauge, recorder and benchmarks. The photographs shall be JPEG format and the digital files will be named according to the SID. One or more photographs shall illustrate an overall view of the benchmarks, well/staff gauge and/or recorder site and any adjacent distinguishing features to aid in identifying and locating the site. Additional photographs shall be taken showing the benchmark monument, the measuring point and location of the well, the recorder, the staff gauge with level rod held on measuring point to indicate where the elevation measurement was taken, and the identification number or name of the device written on a surface that will be plainly legible in the photograph. The measuring point of the benchmark, well, recorder or staff gauge must be plainly visible in the photographs.

- All applicable site information, elevation, and location information shall be appropriately documented, including:

    - Identification, location, and elevations of all benchmarks used;
    - Identification, location, and elevations of all data collection devices (specific elevations as described throughout this document);
    - Photographs;
    - Sketches or maps;
    - Personnel performing leveling work;
    - Site address, including county;
    - Site Section Township and Range;
    - Site ownership (including land owner, and group or individual responsible for data collection and site maintenance);
    - SID associated with the device.

MONITORING STATION REQUIREMENTS

The collection of high quality field data is partly a function of the quality of the installation and maintenance of the instruments used to measure the data. This section describes the minimum requirements for the installation of measuring devices for groundwater level, surface water level and flow, and rainfall monitoring.

Surface Water Level Monitoring

Measurements of water level in surface water bodies (e.g., rivers, lakes, wetlands, etc.) are collected by manual observations and by installing automated recording devices (see Automated Recording Devices section, below). The vertical staff gauge is the preferred instrument for manually measuring surface water levels (stage), while a “stilling well” is the preferred instrument used for collecting automated water level measurements in conjunction with a staff gauge.

Continuous measurements of flow in rivers and streams are determined by measuring stage in the flow systems and converting the stage measurements to flow through a pre-determined stage-discharge relationship. The stage-discharge relationship is used to develop a discharge rating curve for the site. Several techniques are available for the determination of the stage-discharge relationship. While these techniques are not included in this document, the specific proposed technique should be documented in the station records and appropriate databases

The following methods are to be used to install and maintain staff gauges and stilling wells.

Location

Staff gauges and stilling wells located in lakes and flowing systems (e.g., river, streams, etc.) are typically installed as to not interfere with navigation, and are often located near or attached to docks or other semi-permanent structures. In flowing systems, a location that minimizes the potential for clogging with floating debris should be chosen. Staff gauges and stilling wells located in wetlands are typically installed in the deepest part of the wetland, but because of easement limitations, safety reasons or other considerations this may not always be possible. In some cases, multiple staff gauges are used to accommodate systems with highly fluctuating water levels. For all sites, the location should be one that allows the instrumentation to record all likely ranges of water levels, and that allows an observer to read the staff gauge with the naked eye.

Structure and Installation – Staff Gauge

Staff gauges must conform to either USGS Style A (preferred) or Style C standards, and be constructed of 16-gage porcelain-enameled iron or steel (see Detail 5 for guidelines for staff gauge installations). Staff gauges must be attached to a backing plate and mounted to a stable structure in the water body. The staff gauge must be mounted vertical and plumb to the water surface. If more than one staff gauge section is used, adjustments for accuracy between sections should be made by measuring the distance from the middle of one section to that of an adjacent section.

Structure and Installation – Stilling Well

Stilling wells are used in surface water bodies to (either) accommodate instrumentation that automatically collect water level measurements, and/or to minimize the effects of wave action on water level measurements (see Detail 6 for guidelines for stilling well installations). It is essential that the water level in the stilling well correspond to the stage level in the surface water body. Stilling wells must be of sturdy construction, provide a stable platform for water level monitoring instrumentation, be mounted vertical and plumb to the water surface, and meet the following minimum requirements:

- The stilling well should be constructed of schedule 40 polyvinyl chloride (PVC) slotted well screen, with a cap glued onto the bottom. Several holes should be drilled into the cap to allow water flow. A 6- to 10-inch diameter is recommended;
- Have sufficient height to accommodate the maximum stage level anticipated, while deep enough for its bottom to be at least a foot below the minimum stage level anticipated;
- Have intake slots at various stages (elevations) to accommodate widely varying stages;
- Have intake holes of sufficient diameter to assure that the water level in the stilling well will not lag the rise or fall of the water level in the water body;
- Have intake holes of such diameter to damp out short period wave effect or oscillation;
- Have some provision to accommodate periodic cleaning.

Surveying

The staff gauge should be calibrated to the nearby benchmarks, and the elevation of the ground adjacent to the staff gauge should be determined. Refer to the Surveying Requirements section for required procedures. If the elevation values on the staff gauge are not displayed as values of NAVD88 or NGVD 29, a correction value to convert the values to NAVD88 and NGVD 29 must be stored in the appropriate database. However, it is highly recommended that gauges with values in NAVD88 or NGVD29 be used. Stilling wells installed in conjunction with a staff gauge shall be calibrated to the water level as indicated by the associated staff gauge.

Site Identification

Every staff gauge shall be assigned a unique SID Number and Site Name. The SID number should be obtained prior to gauge installation. The SID number and Site Name shall be clearly and permanently marked on the staff gauge. Stilling wells installed in conjunction with a staff gauge shall bear the same identification as the staff gauge. Any adjustment factor to convert the values on the staff gauge to NAVD88 or NGVD 29 shall be documented in site records and recorded in the appropriate database(s).

Maintenance

Staff gauges are designed for lengthy service and, as such, general cleanliness is very important to ensure trouble-free operation. Staff gauges must be kept clean so that all graduations can be read accurately and be handled in a manner that the calibration is not altered. Periodic brushing will keep the gauge readable. At each site visit, the instrument should be closely inspected for problems that would affect the readability, such as corrosion, and perform maintenance as needed.

Stilling wells must be inspected and maintained on a regular basis. The physical integrity of the stilling well components, including the support structure and well screen, shall be checked during each site visit. The exterior and interior well screen shall be inspected and kept free of debris, any foreign objects, and the buildup of sand and silt. Any obvious signs of damage or degradation to the support structure, well screen or other components shall be documented, reported, and corrective action(s) taken.

Replacement and Abandonment

Any time the location of a staff gauge is significantly changed, a new SID number shall be required. If a staff gauge is repaired or replaced in the same location as the original, no new SID is required (although resurveying will likely be needed). In the event that a staff gauge is no longer needed for water level monitoring, the staff gauge and any supporting structure shall be removed and the site restored to pre-gauge construction conditions upon completion of staff gauge removal.

Groundwater Level Monitoring

Measurements of water level in groundwater wells are collected by manual observations, or by the installation of automated recorders (see Automated Recording Devices section, below). The HDS monitors groundwater levels in the surficial aquifer, intermediate aquifer and the Upper Floridan Aquifer. Groundwater level measurements are made on static and artesian wells.

Location

The location of groundwater wells monitored by the HDS are typically already established (existing) or have been pre-determined by other District staff prior to inclusion into the HDS monitor well network. However, the existing site and landscape conditions that may affect the water levels to be measured must be properly evaluated for possible affects to groundwater levels. Natural water bodies, manmade ditches or ponds, septic systems, spray fields, adjacent wellfields and other such features may influence the levels measured in monitor wells. Therefore, existing site conditions must be documented and kept with station records.

Structure and Installation – Groundwater Well

The following are general requirements for HDS monitor wells, unless otherwise specified or authorized:

- The well construction characteristics shall be determined or verified prior to initiation of monitoring, and should conform to those standards as set forth in Chapter 40D-3, F.A.C, as feasible. At a minimum, the monitor well casing depth, total depth and open-hole interval(s) shall be known prior to monitoring.
- For operational considerations, the recommended minimum casing diameter for a monitor well shall be two inches.
- The well casing shall extend at least three feet above land surface, as feasible.
- A 3 ft X 3 ft X 6 inch concrete (not cement grout) pad shall be installed around each well. The well should be centered in the pad and the top of the pad should be flush with land surface.
- A metal wellhead protector casing with lockable cap should be placed over and around the well and cemented in place at land surface (See Detail 7 for typical wellhead protector casing diagram). The top of the wellhead protector casing should extend approximately 3.5 feet above land surface or 6 inches taller than the monitor well casing. Cement (or other acceptable material) should be brought up inside the wellhead protector casing to within a few inches below the base of the monitor well casing and well cap. The wellhead protector casing is designed to protect the monitor well from weather, vandalism, fire damage, impacts and/or other detrimental field conditions.

Surveying

The elevation of the top of the monitor well casing and the elevation of the ground adjacent to the monitor well should be determined. Refer to the Surveying Requirements section for required specifications. Note also that wells must be straight and plumb to allow for installation of water level monitoring equipment and for accuracy in tape measurements.

Site Identification

Each well will be assigned a unique SID and Site Name. The SID number should be obtained prior to monitoring. The well shall be labeled using a standardized method that is durable and can be maintained. Information to be included on the label shall include SID Number and Site Name.

Maintenance

All preventive and routine maintenance shall be performed in accordance with established bureau procedures and SOP's (as applicable). Monitor wells used for water level measurement shall be inspected and maintained on a routine basis. During each site visit, the physical integrity of the well shall be checked. Any obvious changes to the well measuring point elevation, significant changes in the measured total depth of the well, or any obvious degradation to the well pad or protective casing shall be reported and corrected.

If any repairs are made to the well, including the protective casing or concrete pad, these repairs shall be documented. If the total depth of the well is found to be significantly less than the original well construction specifications, a survey will be performed to ascertain the cause (sediment infilling, equipment obstruction, etc.). If it is determined that the well has had significant sediment infilling, the well shall be properly cleaned (e.g., re-developed) in accordance with established bureau procedures before the next regularly scheduled monitoring event. All accessible foreign objects will be removed from the well if possible. If such remediation techniques are unsuccessful, the replacement of the well may be necessary.

Replacement, Abandonment, and Site Restoration

If it is determined that a monitor well must be replaced, a well permit to abandon the old well (under Chapter 40D-3) will be needed and a permit for the construction of any new well (also under Chapter 40D-3) will also be needed. As part of the process for the construction of the new well, a new SID number will be assigned.

In the event that the drilling contractor fails to construct a well as specified for any cause, including, but not limited to, the loss of drilling equipment into the well or loss of the hole to caving, or if the well is no longer needed for monitoring purposes, the well shall be plugged in accordance with those standards as set forth in Chapter 40D-3, F.A.C.

It is the drilling contractor's responsibility to restore each site to pre-well construction conditions upon completion of well construction.

Precipitation Monitoring

Precipitation is defined as any form of water particle, liquid or solid, that falls from the atmosphere and reaches the ground. It is not fog, dew, rime, or frost because it must fall. It is not cloud or fog because it must reach the ground. Precipitation includes the following forms: rain, drizzle, freezing rain/drizzle, hail, and very occasionally snow.

Precipitation data are intrinsically both difficult to measure accurately and easy to misinterpret. A great deal of care must, therefore, be taken to collect precipitation data in a consistent and precise way, and to annotate the data with as much background detail as possible. Many factors can affect the recorded data values or their interpretation. For example, tipping bucket rain gauges may underreport rainfall when intensities approach six inches per hour, while poor equipment maintenance or calibration practices can also induce significant errors in data that may be very difficult to identify. Therefore, a well designed and maintained data collection network must ensure that these factors are taken into consideration. Additionally, the measurement frequency by automated instrumentation should be sufficient enough for the data processor to identify extreme rainfall events in order to identify possible underestimation.

The following methods are to be used to install and maintain rainfall monitoring stations.

Location (Sitting and Exposure)

Rainfall gauges should not be located under power lines, close to trees, or near buildings, which may obstruct or alter the amount of rainfall being measured. To avoid problems with excessive wind, instruments should not be located on the top of buildings. Rainfall instruments should be installed as close to ground as possible without being subject to splash. Instruments should be installed at a distance from obstructions of at least two (preferably four) times the height of the object above the top of the gauge.

Structure, Installation and Instrumentation

Rainfall gauges shall be installed on a stable structure with solid support that does not shake or sway in the wind, in accordance with the manufacturer's instruction. Rainfall gauges should be installed such that the receiver is exposed in a level, horizontal plane.

The tipping-bucket type rainfall gauge is the HDS preferred standard for rainfall measurements. The tipping-bucket type rainfall gauges consist of a lightweight container or bucket divided into two equal compartments (buckets) and balanced atop a horizontal axis. Two stops, one under each end of the container, limit the container's movement. The rainfall that is caught by the receiver runs through the outer funnel into one of the two compartments until the bucket becomes unbalanced and tips to its other position. This places the second compartment in position to receive rain from the funnel and at the same time drains the collected water from the first compartment. The tipping of the bucket actuates a contact closure (switch) and produces a recordable event. The time between tips represents the rate of rainfall depending upon the capacity of each compartment.

Surveying

A GPS receiver with differential correction capability (WASS/SBAS), or equipment with greater precision, must be used for determining the horizontal position of all rainfall measuring devices. All necessary surveying requirements must be performed in compliance with the guideline found in the section of this report on surveying.

Site Identification

Every rainfall monitoring station shall be assigned a unique SID and Site Name, which should be obtained prior to station installation. The SID must be clearly and permanently marked on the rain gauge device.

Maintenance

General cleanliness is very important to ensure trouble-free operation of rainfall gauges. Gauges must be kept clean so that measurements can be read accurately. The receiver of the instrument should be checked for horizontal alignment and levelness, as a leaning gauge can compromise measurement accuracy. If the gauge does not appear to be exposed in a level horizontal plane, repairs should be immediately performed and documented. At each site visit, the instrument should be closely inspected for problems that would affect the accuracy of the measurement. If a problem is found, the technician must enter this information into their field notes so maintenance can be scheduled. Manufacturer's specific guidelines for maintenance and calibration should be observed.

Tri-annual (Four-Month) Field Maintenance Requirements

Once every four months, the following maintenance shall be performed in addition to the preventative field maintenance work referenced above:

- Perform a field calibration test with a known volume of water in accordance with established HDS field operating procedures. If the instrument is found to be out of calibration, it should be replaced with a calibrated instrument (no adjustments should be made in the field).
- Perform a field calibration test with a known volume of water in accordance with established HDS field operating procedures. If the instrument is found to be out of calibration, it should be replaced with a calibrated instrument (no adjustments should be made in the field).
- Timing intervals and dates of records must be checked.

Annual Maintenance and Calibration Requirements

Once per year each instrument shall be replaced with a calibrated instrument. The rain gauge shall be taken out-of-service and brought to the HDS laboratory for annual maintenance activities, including cleaning the outer funnel, insect screens, and drains, wiping them free of all debris and obstructions. The tipping bucket and inner funnel should be cleaned and cleared of all insect materials, especially spider webbing on the side of the tipping bucket. The bucket mechanism should be moved from side to side to ensure that the pivot pin has enough play for it not to bind, yet not fall out. Calibration of the tipping bucket shall be performed by passing a known amount of water through the tipping mechanism at various rates and by adjusting the mechanism to the known volume. Manufacturer's specific guidelines for maintenance and calibration should be observed. If the instrument cannot be properly serviced and calibrated by District personnel, it shall be sent to the manufacturer for servicing and calibration.

Replacement and Abandonment

Any time the location of a rainfall monitoring station is significantly changed, a new SID is required. If a measuring device is repaired or replaced in the same location as the original, no new SID is required.

Automated-Recording Devices

Certain data collection monitoring sites contain instruments that automatically collect and store hydrologic and meteorologic data. Equipment and sensors deployed by the HDS at automated-recording sites can continuously record surface water levels, groundwater levels, rainfall and other hydro-meteorological parameters.

Location

Location guidance for automated-recording devices is the same as the gauge or well for which it is installed**.**

Structure, Installation and Instrumentation

Automated-recording devices are installed at groundwater monitoring sites, surface water monitoring sites and rainfall monitoring sites. Equipment and devices installed typically consist of an aluminum equipment shelter with stabilizing structure used for housing and protecting sensitive electronic instrumentation from weather, theft/vandalism, fire damage, ultraviolet radiation degradation, and/or other detrimental field conditions; a data storage device (i.e., data-logger) used for electronic storage of data; one or more sensors (i.e., devices used to measure a specific hydrologic or meteorologic parameter); and other ancillary equipment, such as a power source (rechargeable batteries), solar panel(s) for recharging batteries, lightning protection and grounding device(s), electrical conduit, wiring, et cetera.

The HDS preferred instrumentation (sensor) for monitoring surface water and groundwater levels is (either) a “shaft encoder with float/pulley” or a “submersible pressure transducer.” The preferred instrument for measuring rainfall is the “tipping-bucket” rain gauge (refer to Precipitation Monitoring section above).

Aluminum Equipment Shelter

An aluminum equipment shelter and support structure shall be installed in conjunction with the installation of automated-recording devices. The equipment shelter is mounted on top of the well or stilling well casing. The shelter will be secured with (either) 4x4 pressure-treated lumber support legs and/or 3-inch diameter aluminum tubing. The shelter floor will be level, and clearly marked with the location of the measuring point and corresponding elevation (with relevant datum). All wiring will be buried at least 18 inches below ground level, and secured within conduit, and weather-sealed at all ends. The equipment shelter should be well-grounded, and equipment protected from induction surges through the use of voltage spike suppressors. An ionization rod is recommended to further protect the equipment from lightning. All construction materials should be made of non-corrosive metals (aluminum and/or galvanized or stainless steel) to minimize repairs. Equipment shelters should be kept locked to prevent unauthorized access to equipment. A District Logo or other identifying marking should be prominently displayed on the shelter and clearly visible with the naked-eye.

In some cases, a NEMA-4 equipment box mounted to a galvanized metal pole can be used to house recording instruments, rather than installing an aluminum equipment shelter. All sensor wiring shall be protected within conduit, secured to the mounting pole, and buried at least 18 inches below ground level. The support pole shall be completely vertical, extend at least 4 feet into the ground and be cemented at the base.

All water level recording devices should be installed using the manufacturer’s instructions and in accordance with established HDS procedures.

Data-Logger

A data-logger is a device that coverts and records sensor signals into a digital data format. The data-logger is typically installed within the equipment shelter box and can be mounted onto the shelter floor by removal bolts or screws.

Shaft-Encoder with Float/Pulley

A shaft-encoder with float/pulley is a device that measures the distance from a float on the surface of the water to a fixed point above the water surface. It uses a float and counterweight suspended over a pulley by a flexible line or tape. As the water level rises or falls, the float moves proportionally causing the pulley to rotate. The pulley is attached by a shaft to an electronic encoder that records the water-level measurements digitally and stores the values in the datalogger memory. A shaft/encoder with float/pulley can be installed onto a well or stilling well within the equipment shelter box and can be mounted onto the shelter floor with removable bolts or screws. The shelter floor must be permanently marked to indicate which side of the pulley assembly is dedicated for the float and which side is dedicated to the counterweight.

Submersible Pressure Transducer

A submersible pressure transducer is a device that converts water pressure into an electrical signal that is then converted into a water level measurement. The HDS uses submersible pressure transducers that are “compensated” for atmospheric pressure. One side of the pressure sensor diaphragm is vented to the atmosphere, thus compensating for changes in atmospheric pressure and measuring water pressure only. These transducers use a tube in the cabling to vent the transducer to the atmosphere, eliminating the need for atmospheric pressure considerations. A desiccant capsule is incorporated into the venting tube to prevent atmospheric moisture from entering the transducer.

Ancillary Equipment

The type of ancillary equipment installed, such as a power source (e.g., rechargeable batteries), solar panel(s) for recharging batteries, lightning protection devices, etc., shall be on a site-specific basis.

Maintenance

- All equipment shelters shall be kept locked when not in use. The exterior and interior areas and surfaces of the equipment shelter box and associated platform structure shall be kept clean and free of debris, overgrown vegetation, animal/insect infestation or nesting materials, and any foreign objects.

- The data-logger (and other electronic instrumentation, as appropriate) must be effectively grounded to prevent damage to the unit due to surges caused by nearby lightning strikes. If a malfunctioning datalogger unit or corrupted datalogger memory is encountered, the unit should be replaced with a new unit and the problem unit sent back to the manufacturer for repair or replacement.

- The float/encoder equipment is designed for lengthy service without maintenance. However, general cleanliness is very important to ensure trouble-free operation. The technician shall make the following checks during each site visit:

  - o Inspect the instrument closely and remove all foreign materials, such as corrosion or insect debris. Be especially observant for spider webs and paper- or mud-wasp nests on float lanyards and tapes.
  - o The float tape must be checked regularly to ensure that it is in good condition in terms of spine alignment and does not show any evidence of fatigue or bending (kinks) in the tape. Wave action or kinks in the tape will make the perforated tape slip.
  - o If any problems are noted, the equipment must be adjusted or replaced, and a description of any changes must be documented by the technician in their field notes.

- Submersible pressure transducers generally require minimal maintenance, but problems can arise if they are not checked periodically. The technician shall make the following checks during each site visit:

  - o Verify that the vent line has not been bent or kinked and is not clogged.

- Ensure that the vent line desiccant is dry and in good condition. If not, replacement of the desiccant shall be necessary.
- Under most circumstances, common problems that arise can only be resolved by replacing the transducer. Common problems include: water leaking into the transducer housing; open or short circuits that can result in erratic data values, zero values, or default values; grounding problems; diaphragm failure; voltage surges; faulty shielding that allow electromagnetic impulses to corrupt the signal from the sensor to the data logger; and over-range problems that occur when sensor output increases beyond the anticipated maximum output programmed into the data-logger. Should any of these problems be encountered, the equipment must be adjusted or replaced, and a description of any corrective action(s) must be documented.
- If a pattern of instrument drift is noticed during routine data collection, especially if the drift is significant, the transducer must be replaced with a new unit, and the old transducer sent back to the manufacturer for repair or replacement. Small amounts of linear drift can be corrected in processing of the data if identified in the field and properly noted. Occasionally, data shifts can occur suddenly by mistakes made in the field by technicians. These include setting the wrong elevation value or time on the recorder before leaving the site, accidentally moving the transducer to the wrong depth, or not properly securing the transducer cable to prevent slippage down the well.

  Data shifts resulting from mistakes made by field staff usually can be easily identified by the time of occurrence and comparison of the technician's field notes, and normally can be corrected during processing of the data.

- All preventative and regular maintenance shall follow established HDS procedures and the manufacturer’s instructions for the specific instrumentation installed.

Surveying

Surveying should be consistent with the requirements outlined above for the gauge or well for which it is installed.

Station Identification

Station Identification should be consistent with the requirements outlined above for the gauge or well for which it is installed.

Surface Water Flow Monitoring

The District and USGS operate and maintain active surface water flow (or discharge) monitoring sites that provide instantaneous 15-minute intervals and mean daily flow data. Accurate flow or discharge estimates are essential elements of water resource planning, development and management. Flow values are either directly measured or derived from water level measurement data. The rate of flow will change based on the elevation of the water surface, the velocity of the water, and the size of the water body (e.g., river, stream, canal, etc.). The amount of surface water that moves through a location per unit of time is usually expressed in cubic feet per second (cfs). Flow data are either measured or estimated using mathematical equations. Although manual flow measurements do not typically require installation of structures, installation of staff gauges and stilling wells in conjunction with surface water flow monitoring may be required.

Location

The location of manual flow measurements at a flowing surface water body is dependent on the site-specific conditions at the time of measurement, including: 1) safety; 2) the field technician's knowledgeable decisions regarding the best suitable channel cross-sectional area; 3) site access; 4) adequate streamflow; 5) uniformity of streamflow distribution; 6) flow turbulence; 7) flow direction; 8) obstructions; 9) bottom roughness/softness; and 10) the type of measurement equipment used.

The site location for manual flow measurements should be established, and as practicable, the same location should be used for all subsequent manual flow measurements.

Structure and Installation

For staff gauges and stilling wells, refer to the Surface Water Level Monitoring section for applicable requirements and procedures.

Minimum Specifications for Flow Measurement Techniques/Equipment

Devices used for manual flow measurements include mechanical current meters (e.g., Price AA and Pigmy meter), electromagnetic current meters, and acoustic meters. Currently, most field measurements are made with acoustic Doppler instrumentation, while mechanical current meters are used only when acoustic meters are not applicable or for measurements in emergency situations.

Most flow measurement equipment comes with clear specifications in terms of accuracy and precision. Unfortunately, these specifications do not reflect the actual measurement uncertainty. The actual precision is a function of the measuring environment and needs to be evaluated based on direct observations whenever necessary. In cases when this is not possible, the measurement uncertainty must be established based on a partial data from direct measurements.

Typically, the manufacturer's specifications of instrument accuracy are either given in terms of full-scale percentage or in terms of percentage of reading. An instrument with 10 ft/s range and 0.5% full-scale accuracy has an absolute error tolerance of 0.05 ft/s, applicable throughout the range of velocities. As a result, at low velocities, the same instrument would have accuracy below 0.5%.

The following are acceptable measurement techniques:

- Acoustic Doppler Current Profiler (ADCP) measurements will be performed following the guidelines established in the most recent ADCP Manuals by RD Instruments (1994) or later, and the (USGS) Quality Assurance Plan, Lipscomb (1995). The ADCP is a very recent flow-monitoring device, therefore, the user or Contractor should adopt flow measuring strategies in compliance with the RD Instruments' Manual. Otherwise, the methodology used should be discussed and agreed upon with District staff before implementation.

- Acoustic Current Meter (ACM) measurements will be conducted as defined in the ACM Manual by EG&G Marine Instruments (1993) or later and/or as directed by District staff. Any other measurement technique using the ACM shall be submitted for District approval before implementation.

- Price AA and pygmy current meters used to determine stream velocity will be maintained according to USGS TWRI Calibration and Maintenance of Vertical Axis Type Current Meters by G.F. Smoot and C.E. Novak. Measurements of velocity in streams made using the Price-AA meter will be made as described in the USGS TWRI, Discharge Measurements at Gaging Stations by Buchanan and Somers. All meters will be cared for and maintained using USGS TWRI, Care and Maintenance of Vertical Axis Current Meters for guidance.

- Measurements using the Dye-Dilution Technique will be conducted as described in the most recent version of the Model 10-AU-005 Field Fluorometer User's manual or in the USGS Techniques of

Water Resources Investigations by Kilpatrick and Cobb (1985). Any other flow measurement approach using the Dye-Dilution Technique shall be submitted for District approval before implementation.

The following are acceptable methodologies and standards:

- Daily mean streamflow, measured in cubic feet per second, will be calculated using discharge ratings and shift curves by discharge measurements and PZF's as described in USGS TWRI Computation of Continuous Records of Streamflow by E.J. Kennedy.

- Shift adjustments will be applied and discharge computed according to USGS TWRI Computation of Continuous Streamflow Records by E.J. Kennedy, and USGS Water Supply Paper 2175 Measurement and Computation of Streamflow: Volume 2. Computation of Discharge by S.E. Rantz and others.

- The techniques and policies described in the USGS TWRI Discharge Measurements at Gaging Stations by T. J. Buchanan and W.P. Somers and USGS Water Supply Paper 2175 Measurement and Computation of Streamflow: Volume1. Measurement of Stage and Discharge by S.E. Rantz and others will be rigidly adhered to.

- Standard discharge measurement notes will be completed for each measurement and include SID number, station name, sequential measurement number, date, time inside, outside and recorder readings at the beginning and end of each measurement, spin test, total area, width, mean velocity, discharge, and remarks. All measurements will include notes as to the quality of the measurement, control conditions in the stream that may affect the gauge height/discharge relation, and a PZF (if applicable).

Surveying

For staff gauges and stilling wells, refer to the Surveying Requirements section for requirements and procedures.

Station Identification

Station Identification should be consistent with the requirements outlined above for the associated staff gauge.

Maintenance

- All stage/discharge sites will be assigned a District SID. All correspondence and data records will carry this SID.
- The streambed of the cross-sectional area of the flow measurement site should be kept clear and free of submerged aquatic vegetation, weed growth, debris and foreign objects. The stream banks on each side of the measurement site should be kept cleared of shrubs and high grass over a somewhat larger reach.

Telemetry-Equipped (SCADA) Monitoring

Telemetry equipment is installed at some automated-recorder stations where data availability on a near real-time basis is needed for critical hydrometeorological and/or operational decision making purposes. Telemetry-equipped stations utilize the District's Supervisory Control and Data Acquisition (SCADA) system to transmit and receive information on groundwater levels, surface water levels, rainfall and other hydrometeorological data from field locations. The system operates on a twenty-four hour basis via cellular telemetry and area Telecommunications Service Providers (TSPs). SCADA site data are collected continuously at the site and relayed to update the SCADA database hourly or daily depending on necessity. The telemetry system is a polled system supporting ad-hoc data retrieval in addition to scheduled events.

The SCADA system incorporates versatile poll scheduling capable of simultaneous TCP\IP (Internet) communications and concurrent TELCO (Telephone Company) modem connections maximizing capacity.

Location

Location guidance for telemetry-equipped stations shall be consistent with the gauge or well for which it is installed.

Structure, Installation and Instrumentation

Telemetry equipment is deployed at some automated-recorder stations in accordance with the gauge or well for which it is installed. Telemetry-equipment, such as modems, radio transmitter, antenna, wireless cellular equipment, and other accessory equipment shall be installed in accordance with established HDS procedures and the manufacturer's instructions for the specific instrumentation installed.
A recorder shelter box shall be installed to house and protect the recording and telemetry instrumentation from weather conditions, vandalism, fire damage, ultraviolet radiation degradation, and/or other detrimental field conditions.

Telemetry equipment deployed at monitoring stations can vary depending on ever changing and rapid advances in technology, as well as site-specific conditions. Typical telemetry components of current SCADA telemetry systems are indicated in Detail 8.

Equipment Procedures and Maintenance:

Establishing near real-time access at a new instrumented site is a straightforward process, as follows:

1) Determine the appropriate telemetry technology for the application (wireless cellular or TELCO). TELCO installations will need coordination with the District business unit responsible for TELCO line installations to order the service from the local area provider.
2) Install the modem as specified and provide the necessary electrical connections to the site power system. Wireless modems will also require the installation of an external antenna.
3) Connect the modem to the Campbell datalogger with a serial interface cable.
4) Test local connections at the site, SCADA standard serial parameters for data collection are 1200 Baud Rate, 8 Data Bits, 1 Stop Bit and No Parity.
5) Record the phone number or IP and PakBus addresses and provide to the SCADA System Developer for configuration in the SCADA application.

Additions or modifications to the SCADA tag database can only be performed on a SCADA Development System by an authorized account holder.

Remote telemetry commissioning and troubleshooting procedures are similar, as follows:
1) Determine the communications devices (modems) can establish communications.
2) When the communication link is established, determine if the quality of the link can support operations.
3) Once communications issues are eliminated, determine the communicating system components are operating correctly.

Personnel responsible for the operation and installation of SCADA telemetry components will need familiarity with respective tools and procedures.

If a SCADA site is suspect (SCADA shows communication errors, data readings are stale or a problem has been reported) basic communication should be checked. For TCP/IP sites this is usually a "ping" test, a request using the ICMP protocol designed for testing, not data transport. It should be noted ICMP is frequently disabled on firewalls to prevent its malicious use for denial of service attacks.

TELCO sites can be dialed with handsets, computers and other equipment to determine if communication lines are operational. With networking and firewall issues eliminated, non-responding ping test will require a site visit to determine equipment status (available power, antenna condition, etc.); faulty TELCO lines are reported to the service provider for repair.

Once rudimentary testing is successful, if problems still exist, the quality of the connection should be checked to determine if it is capable of supporting data communications. Quality issues, such as dropped lines or dropouts, noise and weak signal, etc., can cause intermittent communications and high retry rates. The SCADA and support software incorporate tools for communications statistics and diagnostics. Obscure or difficult problems may require loopback testing, port monitoring and packet analysis.

With known good communications, other issues can be isolated, bad datalogger or corrupted datalogger memory, mal-functioning modem terminal server (conversion between Ethernet packet and serial port protocol) and system software driver issues. Software debuggers and diagnostics can uncover many of these problems when used skillfully.

Surveying

Surveying should be consistent with the requirements outlined above for the gauge or well on which the telemetry device is installed.

Station Identification

Station identification should be consistent with the gauge or well for which the telemetry-device is installed.

DATA COLLECTION REQUIREMENTS

Data collection is the process of gathering data by manual measurements, automated-recording devices and telemetry. Data collection involves obtaining field measurements at data collection monitoring stations. The results of the data collection process include measurements, observations, and instrument readings.

Proper field data collection techniques, data handling, and database management are critical to the value of field data. This section describes the procedures to be used to collect field data regarding surface water levels, groundwater levels, and rainfall.

Field Preparation

Field technicians typically have predetermined field schedules to visit data collection monitoring stations on a monthly or semi-monthly (every two weeks) basis. Technicians also perform other special tasks related to monitoring stations (e.g., installations, repairs, upgrades, etc.) based upon a schedule prepared by the HDS field technician supervisor. When a special task or work order is assigned, the field technician will coordinate completion of the assignment based upon:

1) Personnel availability (when assistance or coordination of activities involve other staff or parties);
2) Equipment availability (e.g., canoe, boat, ATV, etc.);
3) Status of call-ahead stations (i.e. property access permission).

When the daily data collection run or special task for the day has been established, the technician will load the necessary equipment into their pre-assigned vehicle and complete their daily work assignments.

Site Arrival

The first step in the data collection process once the technician has arrived at the site is the identification of the site. The sites are identified based upon written descriptions, photographs, and/or maps located in file folders, or by Garmin GPS location.

The technician must verify that the proper site (e.g., well, gauge, etc.) is located prior to the start of the data collection process or special work assignment. **The proper identification of the site is a critical step in the data collection process.**

The technician's vehicle should be parked as close to the site as possible. If the site is located at a bridge or roadside, extra care should be taken to park in a safe location. When possible, park the vehicle behind a guard rail or as far off the road as possible.
When parking on a bridge, turn on the strobes which are located on the front and rear of every field vehicle and place orange caution cones around the vehicle. Caution vests are also available and should be worn at all times.

Note: If the monitoring station is located within or accessed through a citrus grove, staff must follow the District's citrus canker sanitation protocol (see Detail 9).

Field Data Verification Requirements

In order to ensure continued accuracy of recorded data, routine site visits are critical. The minimum acceptable frequency of data verification visits is once per month.

During each site visit, the technician shall verify and perform the following;

- The SID number is clearly and permanently marked on the well or gauge or within the equipment shelter.

- All data recorded MUST indicate which datum (NGVD29, NAVD 88, or unadjusted reading) is the basis for the reading.

- All wells shall have a clearly marked measuring point on the casing of the well or on the floor of the equipment shelter. The elevation of the measuring point shall be clearly labeled on the well or the floor of the equipment shelter. All measurements of water level shall be taken from this point.

- Both graduated stainless steel measuring tapes or graduated electronic measuring tapes are used by HDS personnel for determining depth to water in groundwater wells and surface water stilling wells. All graduated stainless steel tapes and electronic measurements tapes used for water level measurements shall have a graduated scale precision, resolution and accuracy of measurement of 0.01 feet. Steel tapes shall be long enough to measure deep water levels at ground water sites. Etched markings are graduated in hundredths of a foot or millimeters. Some tapes have both scales on opposite sides of the tape. Measuring tapes should be kept clean and free of debris, and wiped off after use. It is important to keep the tapes tightly wound on the reel to prevent kinking. Serious kinking of the tape will adversely affect measurements of depth to water. Field measurement tapes should be checked annually and verified against a standard calibrated reference tape for excessive stretch or wear.

- A hand-held pressure gauge can be used for measuring water levels in artesian (flowing) wells. All hand-held pressure gauges shall be capable of performing within a standard measurement resolution of four digits with floating decimal and a measurement accuracy standard of $\pm$ 0.05 percent of full scale, plus one least significant digit including linearity, repeatability, and hysteresis. Hand-held pressure gauges should be kept clean and free of debris, wiped off after use, and should be kept in the manufacturer's padded "carrying-case" when not in use so as to prevent damage to the device's sensitive internal components.

- For automated-recording devises, sensor data stored on the data-logger shall be manually downloaded to the field computer at non-telemetry sites; whereas, sensor data at telemetry (SCADA) sites is automatically downloaded by SCADA on a daily basis.

- The Time Clock on all field computers and field data-loggers shall be set to record time relative to Eastern Standard Time year round. No changes are to be made for Daylight Savings Time. If the time is off, it must be reset to the correct Eastern Standard Time.

- Electronic data files (ELBIS files) created in the field each day on the technician's field computer shall be downloaded to the appropriate folder onto the centralized computer system (currently the departmental L-drive) at the end of each work day upon returning from the field.

Field Data Collection Procedures

The field technician should have the field computer turned on, with the "ELBIS" program selected. From the ELBIS menu, the SID is looked up in the computer and selected, and the technician begins the data collection and entry procedures regarding the parameter being measured.
A general overview of ELBIS is provided in Detail 10. The SID should be double checked prior to data entry to make sure the correct site has been chosen in the field computer.

Surface Water Level Measurements – Manually Read

Manual surface water level measurements are collected by use of a staff gauge (refer to Detail 5). Surface water data are recorded in elevation relative to a standard reference (datum) and the units are feet.

Frequency

The minimum acceptable frequency of surface water level measurements is semi-monthly (twice per month) or monthly, depending on project needs.

Precision and Accuracy

The precision requirement for a manual surface water level measurement is ± 0.01 feet. The accuracy requirement is ± 0.01 feet.

Process

During each site visit and when collecting manual surface water level measurements, the following minimum requirements shall apply:

- Visually inspect the monitoring site and the condition of the gauge for problems that could affect the accuracy of the measurements. Clean the face plate if necessary (see maintenance instructions in previous section). Look for and note damage or signs of the gauge having been disturbed. If the gauge shows signs of having been disturbed, it will be necessary to reset the gauge and then re-establish the gauge elevation by standard survey methods (see Survey section). If the gauge condition is normal and the water surface is on the gauge, observe and record the gauge reading as described below.

- A surface water level measurement, as read on the gauge, shall be recorded by the technician to the nearest 0.01 feet accuracy onto the field computer into ELBIS using the appropriate data-entry procedure. The ELBIS program will automatically calculate the water level elevation and the date and time.

- If there is no water at the gauge, the technician shall indicate this condition in ELBIS by "checking" the appropriate box, and also by documenting this condition as a "comment" in ELBIS, such as:

    - Comment: Water level is below staff gauge, but water is visible in the lake/wetland system; or
    - Comment: Staff gauge is dry and no visible water remains in the lake/wetland system.

Groundwater Level Measurements – Manually Read

Manual water level measurements at groundwater sites (i.e., wells) are collected by using a calibrated stainless steel tape with chalk, a calibrated electronic measurement tape, or a hand-held pressure gauge (see Detail 11 for example water level measuring devices). Each measurement instrument has its accuracy and limitations. Groundwater data are recorded in feet and/or psi.

Frequency

The minimum acceptable frequency of groundwater level measurements is semi-monthly (twice per month) or monthly, depending on project needs.

Precision and Accuracy

The precision requirement for a manual groundwater level measurement is ± 0.01 feet. The accuracy requirement is ± 0.01 feet.

Process

During each site visit and when collecting manual groundwater level measurements, the following minimum requirements shall apply:

- Visually inspect the monitoring site and well condition for problems that could affect the accuracy of the measurements (see maintenance instructions in previous section). Look for and note damage or signs of the well having been disturbed. If the well shows signs of having been disturbed, it will be necessary to have the well assessed for damage, corrected as needed, and resurveyed (see Survey section). If the well condition appears normal, observe and record the well water level reading as described below.

- A groundwater level measurement shall be recorded by the technician to the nearest 0.01 feet resolution onto the field computer into ELBIS using the appropriate data-entry procedure. The ELBIS program will automatically calculate the water level elevation and the date and time.

- When collecting a manual water level measurement using a graduated stainless steel tape, the technician manually unrolls the tape down the well casing until the bottom section of the tape contacts the water, thereby wetting the tape surface. In order to identify the depth to water, the tape is typically rubbed with chalk as it descends the casing. The length of tape down the well is read at the MP, and the HELD measurement value is entered into ELBIS. As the tape is reeled up from the well casing, the technician looks for the line denoting dry chalk and the wet tape. The tape scale is read at this line and the WET measurement value is entered into ELBIS. The ELBIS program will automatically calculate the depth to water and the corrected water level elevation. To ensure the water level is correctly measured, this procedure should be repeated at least two times, holding the tape at a different scale level each time. The calculated depth to water and corrected water level elevation should not vary by more than 0.05 foot between readings. If variance between two readings is greater than 0.05 foot, the well should be re-measured until the readings fall within this tolerance. The final recorded value shall be the mean of the two closest reading.

- When collecting a manual water level measurement using a graduated electronic measuring tape, the technician manually unrolls the tape down the well casing until the bottom section of the tape contacts the water. When the probe enters the water, an electrical circuit is completed. Contact with the water surface is indicated by a sharp needle deflection on a meter and an audio alert. Depth indication is provided by numbered metal tags securely crimped to the cable at intervals of five feet. When the water level is between two marks, a pocket tape is used to measure from the nearest point of the line to the point that was measured.

The length of tape down the well is read at the MP, and the HELD measurement value is entered into ELBIS. For the WET measurement value, a Zero (0) value is entered into ELBIS when using an E-tape. The ELBIS program will automatically calculate the depth to water and the corrected water level elevation. To ensure the water level is correctly measured, this procedure should be repeated at least two times. The calculated depth to water and corrected water level elevation should not vary by more than 0.05 foot between readings.
If variance between two readings is greater than 0.05 foot, the well should be re-measured until the readings fall within this tolerance. The final recorded value shall be the mean of the two closest reading.

- When collecting a manual water level measurement using a hand-held pressure gauge, the technician manually connects the gauge to the top of the well using a semi-rigid walled tube. The gauge is held so that the dial is vertical and the water inlet is at the bottom. The gauge is positioned such that the center of the gauge is at the same elevation as the MP, and the psi reading is entered into ELBIS. The ELBIS program will automatically calculate the water level elevation. To ensure the water level is correctly measured, this procedure should be repeated at least two times. The calculated water level elevation should not vary by more than 0.05 foot between readings. If variance between two readings is greater than 0.05 foot, the well should be re-measured until the readings fall within this tolerance. The final recorded value shall be the mean of the two closest reading.

- All manually collected water level measurements shall be recorded to the nearest 0.01 feet accuracy onto the field computer into ELBIS using the appropriate data-entry procedure for the specific parameter being measured (e.g., wells, staff gauge). The ELBIS program will automatically calculate the water level elevation and the date and time.

- If there is no water in the well, the technician shall indicate this condition in ELBIS by “checking” the appropriate box, and by documenting this condition as a “comment” in ELBIS, such as:

    - Comment: Well is dry

Groundwater or Surface Water Level Measurements - Automated-Recording Devices

Automated-recording stations collect water level measurements from sensors deployed in wells and stilling wells and record and store those measurements onto a datalogger for download. Surface water level (stage) data are also used to estimate water flows in streams, rivers and at control structures.

Frequency

The minimum acceptable frequency of data verification visits is once per month. The minimum acceptable recording interval for groundwater level measurements is once-per-hour, starting at the top of the hour. The minimum acceptable recording interval for surface water level measurements at non-flowing water bodies is once-per-hour, starting at the top of the hour. At surface water bodies where discharge is calculated, the minimum recording interval is 15-minutes, starting at the top of the hour.

Precision and Accuracy

The precision requirement for a water level sensor measurement is ± 0.01 feet. The accuracy requirement is ± 0.01 feet.

Process

During each site visit and when collecting groundwater or surface water level measurements at automated-recording stations, the following minimum requirements shall apply:

- Visually inspect the monitoring site and condition of the well or staff gauge for problems that could affect the accuracy of the measurements (see maintenance instructions in previous section). Look for and note damage or signs of the well or gauge having been disturbed. If the well/gauge shows signs of having been disturbed, it will be necessary to have the well/gauge assessed for damage, repaired or replaced as necessary, and resurveyed (see Survey section). All problems encountered (or work performed) on instruments must be noted in the technician's notes, along with any site observations that might explain the problem or reason(s) for the work. This information is critical to making corrections to the source data.

- If the well or gauge condition appears normal, observe and record the water level reading as described below.

- The time-clock on the data-logger shall be checked. If the data-logger time is off, it must be reset to the correct Eastern Standard Time. No changes are to be made for Daylight Savings Time.

- Check the condition of the battery, instrumentation setup and wiring connections. Replace the battery if voltage is below 12 volts or other prescribed level(s).

- A manual water level measurement shall be collected at the staff gauge or in the well, as appropriate, in accordance with the procedures for manual water level measurements described above.

- The technician shall record the water-level elevation as manually measured from the adjacent staff gauge or in the well, and check and record the current “as found” value and time as reflected by the data-logger. If the difference in water-level readings between the recorder value and the manually measured value is greater than 0.05 feet, the recorder shall be adjusted to reflect the manually measured elevation. All adjustments made shall be documented in the technician's field notes, along with any site observations that might explain the discrepancy.

- Transfer, or “download,” the data from the data-logger to the field computer.

- If a pattern of instrument drift is noticed, especially if the drift is significant, the instrument (i.e., encoder or pressure transducer) shall be replaced with a new unit, and the old instrument sent back to the manufacturer for repair or replacement. Small amounts of linear drift can be corrected in processing of the data if identified in the field and properly noted. Occasionally, data shifts can occur suddenly by mistakes made in the field by technicians. These include setting the wrong elevation value or time on the recorder before leaving the site; for encoders, putting the float assembly on backwards or not securing the tape to the pulley; and for pressure transducers, accidentally moving the transducer to the wrong depth or not properly securing the transducer cable to prevent slippage down the well. Data shifts resulting from mistakes made by field staff usually can be easily identified by the time of occurrence and comparison of the technician's field notes, and normally can be corrected during processing of the data.

- Secure site before leaving.

<u>Precipitation Measurements</u>

Frequency

The minimum acceptable frequency of data verification visits is once per month, while the minimum acceptable recording interval for tipping bucket gauges is 15-minutes, starting at the top of the hour.

Precision and Accuracy

Tipping-bucket rain gauges shall have a precision of measurement of 0.01 inch or less. Devices shall have an accuracy standard for measurement of total rainfall between two observations to within 0.01 inch or less, and at intensities of ± 1 mm/hour; ± 5% for >20 mm. For rainfall rates of less than one inch an hour, the instrument shall have an accuracy of plus or minus 3 percent, whereas for rain rates greater than one inch an hour, it shall have an accuracy of plus or minus 5 percent.

Process

During each site visit and when performing rainfall measurements, the following minimum requirements shall apply:

- Visually inspect the monitoring site and rain gauge (see maintenance instructions in previous section). Look any problems that could affect the accuracy of the rainfall measurements and perform corrective action (as necessary, including scheduling maintenance. All problems encountered (or work performed) on instruments shall be noted in the technician's notes, along with any site observations that might explain the problem or reason(s) for the work. This information is critical to making corrections to the source data. In addition, the following shall be performed:

    1) Visual check for 45-degree clearance above collector.
    2) Visual check of the collector cup screen(s) and funnel. Clean, as necessary, and note condition (clean or dirty) in field notes.
    3) Re-level the instrument if necessary (collector must be vertical), as a leaning gauge can compromise measurement accuracy. If the gauge does not appear to be exposed in a level horizontal plane, repair should be immediately performed and documented.
    4) Make sure the small drain holes at the bottom of the gauge are not plugged with dirt or other material (drill them larger if plugging becomes a chronic problem).

- The site ID number must be clearly and permanently marked within the equipment shelter.

- The field technician shall connect the field computer to the datalogger and download to the field computer the appropriate rainfall data stored on the datalogger. The technician shall check and record the “as found” value and time as reflected by the data recorder.

- The time-clock, as set on the datalogger, shall be relative to Eastern Standard Time (EST) year-round. No changes are to be made for Daylight Savings Time. If the data-logger time is off, it must be reset to the correct Eastern Standard Time.

Surface Water Flow Monitoring

Frequency

The minimum acceptable frequency of manually collected field surface water flow measurements (and associated manual staff gauge measurements) is monthly. The minimum recording interval for automated-recording devices on stilling wells is 15-minutes, starting at the top of the hour.

Precision and Accuracy

General flow measurement methods, including precision and accuracy standards, are described in standard textbooks, USGS Water-Supply Paper 2175, and the Techniques of Water-Resources Investigations of the United States Geological Survey (TWRIs); in Chapters A1 through A19 of Book 3, and Chapters A2 and B2 of Book 8. These may be accessed from http://water.usgs.gov/pubs/twri/.
The methods are consistent with the American Society for Testing and Materials (ASTM) standards and generally follow the standards of the International Organization for Standards (ISO).

Process

During each site visit and when performing manual field surface water flow measurements, the following minimum requirements shall apply:

- Measure stream discharge, including a point-of-zero-flow (PZF) determination. To the maximum extent possible, streamflow shall be recorded during the same week of the month of measurement.
- Verify measurement plots on current discharge-rating. Make second measurement if not within 5% of rating. Document why measurement does not agree with current rating.
- On an annual basis, collect at least one low base flow (non-zero) manual flow measurement and one high-water manual flow measurement.
- Compare flow measurements to existing rating equations and identify the need for new rating equations. Develop new discharge rating, if needed.
- Define and justify any shifts to current rating.
- Record water stage (relative to NGVD29) and/or flow (CFS) at a minimum frequency of one reading per hour.
- Use approved USGS methods for all discharge measurements and discharge ratings, as described above.
- Measure flow using current meters approved by the District Project Manager, as described above.
- Standard discharge measurement notes will be completed for each measurement and include S ID number, station name, sequential measurement number, date, time inside, outside and recorder readings at the beginning and end of each measurement, spin test, total area, width, mean velocity, discharge, and remarks. All measurements will include notes as to the quality of the measurement, control conditions in the stream that may affect the gauge height/discharge relation, and a PZF (if applicable).
- Annually, provide a report that summarizes all activities pertaining to manual field flow measurements, rating analysis and flow data Quality Assurance/Quality Control (QA/QC).
- TheSID number must be clearly and permanently marked on staff gauges and within the equipment shelter for stilling wells.
- Manual and automated-recording surface water level measurements at staff gauges and stilling wells shall be collected in accordance with the procedures, techniques and precision described above.

Data Reporting and Management Requirements

Procedures have been established to ensure that all hydrologic and meteorologic data are thoroughly reviewed and quality assurance/control checks are completed prior to release of the data files.

Field Data

Field data is hydrologic or meteorlogic data that has been collected from a field monitoring station. The method of collection can vary from manual collection, automated-recording devices, or telemetry based systems reporting data values on a near real-time basis. Field data has had little or no quality checks performed on them and are considered less reliable.

Manual field data are collected by field technicians throughout the workday and readings are entered into ELBIS and stored onto the portable field computer. At the end of each workday the field computer data file is downloaded to a centralized computer system. Field data files are filed by SID numbers.

Automated-recording devices stored data onto a data-logger at such installations. At non-telemetry sites, this data is downloaded monthly by the field technician onto a field computer. At telemetry (SCADA) sites, data stored on the data-logger is downloaded at least daily onto a centralized computer system.

Each night, the field data files that are stored onto the centralized computer system are downloaded into a temporary Hydstra file. Within 90 days, field data is processed and validated.

A visual review of the data in temporary Hydstra files is performed to ensure that the field data is associated with the correct SID number, that typographical errors have not been made, and that data anomalies do not exist or have been explained. If necessary, corrections are made to the data and documented. At this time any pertinent Data Analyst comments or data qualifier codes are also added to the database (see Detail 12).

Validated Data

Validated data is any hydrologic or meteorologic data that has been collected from a field monitoring station and has passed through a set of quality assurance and data validation procedures, and filed in a permanent Hydstra file. Data validation can vary from simple data collection location verification and maximum/minimum range-checking to more robust automated data pre-processing. For small volumes of data, a system consisting of manual review of control information and random data value checking has been established. For larger volumes of data, an automated validation process has been established.
The following is a list and explanation of validation checks performed by the HDS staff.

- Unique SID# - A unique SID# has been established for every monitor site. All field data records include the SID# so the collected data can be attributed to the appropriate monitoring site.

- Data record – The start date of an incoming period of record should be checked against the end date of the last period of record received. This check serves two purposes. First, the continuity of the period of record is maintained. Gaps or overlaps in the period of record can be identified and resolved. Second, unmatched end-to-start dates of consecutive periods of record might be an early indication that the periods of record may not have been collected at the same location.

- Minimum and maximum values – Although a very high or very low data value may not necessarily indicate an anomaly, minimum and maximum values have been established for each monitoring site. Any exceedance of these values is investigated.

- Data units – Consistent data units are used to reduce errors or inconsistencies, which can occur when conversions from one unit of measurement to another is introduced.

- On a daily basis, check the Comments report located on the L-drive at:
  L:\HydroDat\HYDRO\DataReport\output\CommentsRpt

- Correct any problems noted. If the comment is ‘RSV’ (reset value), in Hydstra, make a copy of the archive file and append the TF file to it. Open the recorder data (.05) and open a reference trace of the manual (.51) data. Highlight the data from the last good manual point to the current manual point. Use the ‘move’ tool to adjust the recorder data to the manual point. Hydstra will incrementally adjust the data.

- At least each 90 days, plots of all HD collected sites are made for the previous four months. Correct resets, spikes, missing data, or other obvious mistakes i.e. two different readings on the same day.

- Automated processes produce daily reports regarding data reporting, data checks, problems, and QA/QC (see Detail 13 for a listing of computerized programs).

Audits

Quarterly Audit

- During each 90-day period (quarterly), a data analyst shall review graphical plots of all data collected at HDS sites for the prior four-month period. All questionable data shall be investigated, such as outlier values, correct resets, spikes, missing data, or other obvious mistakes (i.e. two different readings during the same day/time). All necessary corrective action(s) to the data shall be taken.

- The field technician supervisor shall ensure that field data collection activities are performed in accordance with established bureau policies and procedures and/or with the procedures described in this manual. The field technician supervisor shall coordinate field activities to assure completion of tasks within established time frames. The field technician supervisor shall identify quality control problems and initiate and monitor corrective actions.

- As part of each HDS staff's Quarterly Work Plan (QWP) review process, the Hydrologic Data Section Manager or Field Technician Supervisor (as appropriate) shall review HDS personnel's quarterly performance related to the data collection program, and take the appropriate action(s) to improve the data collection program.

Annual Audit

Each year during the month of September, the Hydrologic Data Section Manager shall conduct an annual review of hydrologic performance during the current fiscal year. This review shall include but not be limited to the following:

- Changes to the Hydrologic Data Section's Data Collection SOP Manual;
- Implement review procedures to monitor and verify accurate manual and automated data entry and recordkeeping for those data collection activities indicated in this manual;
- Review of the current fiscal year's quarterly deficiencies/inefficiencies and corrective action(s) during current fiscal year;
- Hydrologic workload changes
- Stakeholder feedback and response.

External Agency Data

External agencies source data (e.g. NOAA, USGS, etc.) loaded into the District's WMIS database is not validated. All questions regarding the collection, accuracy, precision or reliability of data from external agencies shall be referred to those agencies.

Detail 1 - NAVD88 Vertical Control Benchmark Monument Construction Checklist

Benchmark Site Selection:

Set two site benchmarks. One of the site benchmarks should have unobstructed GPS visibility. The first benchmark should be located within 100feet of the hydrologic data measuring device; the second benchmark should be located within 500feet of the hydrologic data measuring device. The purpose of the NAVD88 benchmarks is to provide an elevation reference for site calibration; two benchmarks will provide a check between benchmarks.

- **Must check for underground utilities, especially when setting benchmarks in right-of–ways!**
- Benchmarks should be set in an area with good GPS visibility whenever possible.
- Benchmarks should be set close to the hydrologic data measuring device as possible with a witness post set adjacent to each monument.

Benchmark Monument Construction

The Surveyor in charge of constructing the monuments will assure that the materials used will adequately establish a stable monument. If the soil is unstable and cannot be compacted to adequately stabilize the monument, the type of benchmark shall be no less than a metal rod or metal pipe driven to point of refusal with a concrete collar poured around the rod/pipe at ground level and a disk set in top center of concrete. The disk shall display the surveyor's identification number. Refusal shall be defined as several full blows with an 8 pound sledge hammer rendering no perceptible movement of the rod/pipe.

- **Benchmark material used:**

  _____ Feet of Metal Rod/ Pipe _____ Benchmark Disk stamping

  Field Book & Page: _____

- **Latitude/Longitude of monument (use DGPS receiver):**

  Benchmark Name: _____ Lat: _____N Long: _____W

  Accuracy: +/- _____ PDOP: _____ Number of Satellites: _____

  Describe the GPS receiver (ex: Garmin 76, WASS enabled): _____

  Describe the Location of the benchmark relative to the hydrologic data measuring device:

- **Digital photos:**

  Photo 1 of vicinity; and Photo 2 of Benchmark disk with GPS unit in the view showing the Latitude and Longitude in photograph.

  File name of Photo 1- _____, Photo 2- _____

- **Additional information:**

  Site access, land owner information, any existing bench marks in area, any special considerations that need to be made at the benchmark location site.

Detail 2 - Sample Site Vertical Calibration Survey Information

PROJECT TITLE: **NAVD88 Migration (B134)**
PURCHASE ORDER: **08POSOW1430**
WORK ORDER NAME: **FY2008, Work Order NO. 3 North District Hydrological Data Collection Sites Vertical Calibration Survey.**
WORK ORDER NUMBER: **3**
CONSULTANT NAME: **MACTEC Engineering & Consulting, Inc.**
PROJECT MANAGERS: **James F. Owens, PLS (SWFWMD)**
Thomas M. Jennings, PLS (MACTEC)

Southwest Florida Water Management District

2379 Broad Street
Brooksville, Florida 34604

HYDROLOGIC DATA SECTION
SITE CALIBRATION SURVEY FORM

SITE INFORMATION		
SITE NAME: **WITHLACOOCHEE RIVER AT TRILBY**	SITE I.D. (SID): **23546 (Recording Well)**	
UID_TYPE / UID_SITE_ID: **FLO / 122**	DATE OF SURVEY: **September 29, 2008**	
LATITUDE: **N 28° 28 48.37"**	LONGITUDE: **W 82° 10' 39.80"**	
COUNTY: **HERNANDO**	SECTION: **14** TOWNSHIP: **23 S**	RANGE: **21 E**
LAND OWNER NAME: **FDOT R/W**	LAND OWNER ADDRESS: **N/A**	

NAVD 88 MEASUREMENT POINT INFORMATION	
DESCRIPTION OF MEASUREMENT POINT	NAVD88 ELEVATION (ORTHOMETRIC HEIGHT)
1.) **Set 2" square box with magic maker on the floor of recorder box on the East rim of opening in floor.**	**79.42** (US FEET)
2.) **Natural ground at recorder**	**47.9** (US FEET)

NAVD 88 SITE BENCHMARK INFORMATION		
BENCHMARK NAME / AGENCY: **"A 662" / SWFWMD**	NAVD 88 ELEVATION: **65.663**	(US FEET)
LATITUDE: **N 28° 28' 38.08918"** Existing NGS mon. (Primary Station)	LONGITUDE: **W 82° 10' 42.64415"**	
BENCHMARK NAME / AGENCY: **(F 0122 A) / SWFWMD**	NAVD 88 ELEVATION: **78.434**	(US FEET)
LATITUDE: **N 28° 28' 46.85"** Existing FDOT disk – SE (RPBM)	LONGITUDE: **W 82° 10' 39.79"**	
BENCHMARK NAME / AGENCY: **(F 0122 B) / SWFWMD**	NAVD 88 ELEVATION: **78.567**	(US FEET)
LATITUDE: **N 28° 28' 50.45"** Existing FDOT disk – NW (RPBM)	LONGITUDE: **W 82° 10' 39.03"**	

SURVEYOR'S NOTES AND CERTIFICATION

1.) The *Measurement Point elevations* established at each calibration site as a part of this Calibration Project (referenced above), and as contained on these report sheets, were established in accordance with Southwest Florida Water Management District (SWFWMD) specifications as outlined in the Scope of Services. These elevations are displayed to the nearest hundredth (1/100th) of a foot (except for ground shots), and may be considered accurate to the level of precision as displayed.

2.) The Vertical Datum of these *Measurement Point elevations* is referenced to the North American Vertical Datum (NAVD) of 1988, and is based on the high precision GPS static network (established as part of the North District Vertical Control Survey by MACTEC in 2007) which included direct occupation 53 NGS 1st and 2nd Order Benchmarks held as fixed vertical control. These control values were supplemented by 19 additional 3rd Order closed loop level runs from NGS-published 1st and 2nd Order Benchmarks to GPS Primary Network stations as a quality control measure to check GPS-derived orthometric heights. Elevations were placed on Secondary "Reference Point Bench Marks" (RPBM's) established in the immediate vicinity of each hydrological monitoring station site through 3rd Order closed loop level runs from the Primary Network Stations. Calibration operations involve 3rd Order leveling procedures based on these previously-established RPBM's, are closed loop, and include checks of the height differences between these on-site control monuments.

3.) The Horizontal Datum of the data is referenced to the North American Datum (NAD) of 1983/2007, and is based on the final GPS Primary Station (212) network (established as part of the North District Vertical Control Survey) of 1261 measured static vectors incorporating 19 National Geodetic Survey (NGS) High-Accuracy Regional Network (HARN) Stations held as fixed horizontal control. Horizontal locations of 36 calibration sites and RPBM's are based on these Primary Control Stations, and were established during calibration operations through a combination of differentially-corrected GPS measurements and conventional total station measurements to retro prisms, with geometric checks and redundancy of measurements. These newly-established locations, while displayed to the nearest foot (to avoid truncation error for users), should be considered accurate to a precision of well within the +/- 10 feet specified by client (SWFWMD).

4.) The list of sites to be calibrated, and their designations (SID #'s, UID #'s, etc.) were provided by client (SWFWMD), as were other support materials, including all aerial orthophotography (dated 2007).

5.) This report is not valid without the signature and original raised seal of the Florida Registered Land Surveyor indicated below.

THIS SPECIFIC PURPOSE SURVEY IS CERTIFIED TO THE SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT AS MEETING OR EXCEEDING, IN QUALITY AND PRECISION, THE STANDARDS APPLICABLE FOR THIS WORK, AS SET FORTH IN CHAPTER 61G17-6, FLORIDA ADMINISTRATIVE CODE.

2/24/09
Signature Date

Thomas M. Jennings, PLS
Florida Professional Land Surveyor
License Number LS 4551

REPORT FORM COMPILATION: Anthony D. Waters
Survey Technician

SHEET INDEX

MACTEC, Inc.
4150 N. JOHN YOUNG PARKWAY ORLANDO, FL.
(407) 522-7570 Fax: (407) 522-7576
LB # 6989

PROJECT TITLE: **NAVD88 Migration (B134)**
PURCHASE ORDER: **08POSOW1430**
WORK ORDER NAME: **FY2008, Work Order NO. 3 North District Hydrological Data Collection Sites Vertical Calibration Survey.**
WORK ORDER NUMBER: **3**
CONSULTANT NAME: **MACTEC Engineering & Consulting, Inc.**
PROJECT MANAGERS: **James F. Owens, PLS (SWFWMD)**
Thomas M. Jennings, PLS (MACTEC)

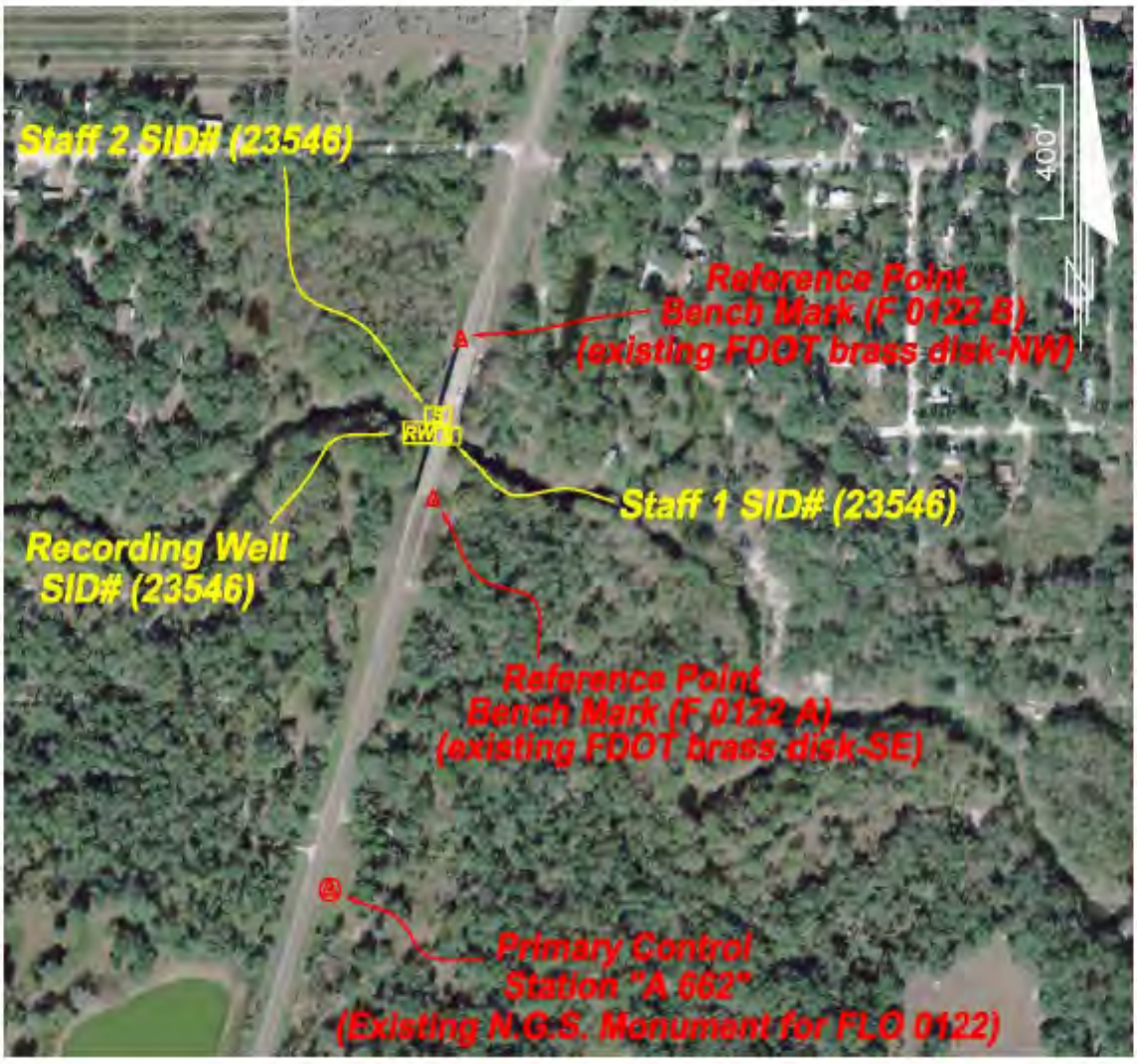
Southwest Florida Water Management District

2379 Broad Street
Brooksville, Florida 34604

HYDROLOGIC DATA SECTION
SITE CALIBRATION SURVEY FORM

SITE INFORMATION	
SITE NAME: **WITHLACOOCHEE RIVER AT TRILBY**	SITE I.D. (SID): **23546 (Recording Well)**
UID_TYPE / UID_SITE_ID: **FLO / 122**	DATE OF SURVEY: **September 29, 2008**
LATITUDE: **N 28° 28 48.37"**	LONGITUDE: **W 82° 10' 39.80"**
COUNTY: **HERNANDO**	SECTION: **14** TOWNSHIP: **23 S** RANGE: **21 E**
LAND OWNER NAME: **FDOT R/W**	LAND OWNER ADDRESS: **N/A**

SITE LOCATION AERIAL OVERLAY



SHEET INDEX

MACTEC, Inc.
4150 N. JOHN YOUNG PARKWAY ORLANDO, FL.
(407) 522-7570 Fax: (407) 522-7576
LB # 6969

PROJECT TITLE: **NAVD88 Migration (B134)**
PURCHASE ORDER: **08POSOW1430**
WORK ORDER NAME: **FY2008, Work Order NO. 3 North District Hydrological Data Collection Sites Vertical Calibration Survey.**
WORK ORDER NUMBER: **3**
CONSULTANT NAME: **MACTEC Engineering & Consulting, Inc.**
PROJECT MANAGERS: **James F. Owens, PLS (SWFWMD)**
Thomas M. Jennings, PLS (MACTEC)

Southwest Florida Water Management District

2379 Broad Street
Brooksville, Florida 34604

HYDROLOGIC DATA SECTION
SITE CALIBRATION SURVEY FORM

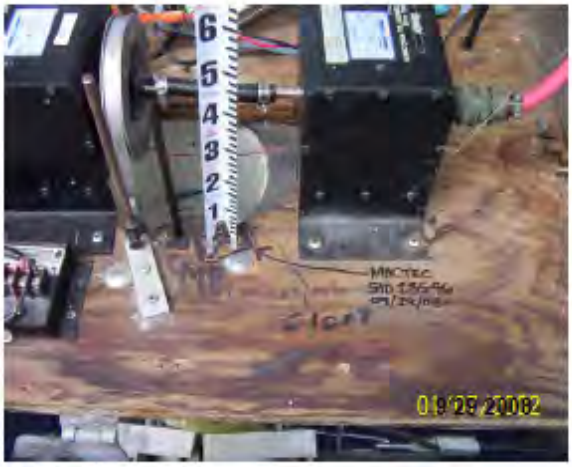
SITE INFORMATION	
SITE NAME: **WITHLACOOCHEE RIVER AT TRILBY**	SITE I.D. (SID): **23546 (Recording Well)**
UID_TYPE / UID_SITE_ID: **FLO / 122**	DATE OF SURVEY: **September 29, 2008**
LATITUDE: **N 28° 28 48.37"**	LONGITUDE: **W 82° 10' 39.80"**
COUNTY: **HERNANDO**	SECTION: **14** TOWNSHIP: **23 S** RANGE: **21 E**
LAND OWNER NAME: **FDOT R/W**	LAND OWNER ADDRESS: **N/A**

SITE PHOTOGRAPHS

PHOTOGRAPH 1 –
LOOKING: SOUTH

PHOTOGRAPH 2-
LOOKING: WEST

PHOTOGRAPH 3 –
LOOKING: WEST



PHOTOGRAPH 4 –
LOOKING: WEST

SHEET INDEX
SHEET 1: SITE CALIBRATION SURVEY INFORMATION
SHEET 2: SITE LOCATION AERIAL OVERLAY
SHEET 3: SITE PHOTOGRAPHS
SHEET 4-5: FIELD NOTES

MACTEC, Inc.
4150 N. JOHN YOUNG PARKWAY ORLANDO, FL.
(407) 522-7570 Fax: (407) 522-7576
LB # 6969

SHEET 3 OF 5

PROJECT TITLE: **NAVD88 Migration (B134)**
PURCHASE ORDER: **08POSOW1430**
WORK ORDER NAME: **FY2008, Work Order NO. 3 North District Hydrological Data Collection Sites Vertical Calibration Survey.**
WORK ORDER NUMBER: **3**
CONSULTANT NAME: **MACTEC Engineering & Consulting, Inc.**
PROJECT MANAGERS: **James F. Owens, PLS (SWFWMD)**
Thomas M. Jennings, PLS (MACTEC)

Southwest Florida Water Management District

2379 Broad Street
Brooksville, Florida 34604

HYDROLOGIC DATA SECTION
SITE CALIBRATION SURVEY FORM

SITE NAME: **WITHLACOOCHEE RIVER AT TRILBY**	SITE I.D. (SID): **23546 (Recording Well)**
UID_TYPE / UID_SITE_ID: **FLO / 122**	DATE OF SURVEY: **September 29, 2008**

FIELD NOTES

SHEET INDEX

MACTEC, Inc.
4150 N. JOHN YOUNG PARKWAY ORLANDO, FL.
(407) 522-7570 Fax: (407) 522-7576
LB # 6969

PROJECT TITLE: **NAVD88 Migration (B134)**
PURCHASE ORDER: **08POSOW1430**
WORK ORDER NAME: **FY2008, Work Order NO. 3 North District Hydrological Data Collection Sites Vertical Calibration Survey.**
WORK ORDER NUMBER: **3**
CONSULTANT NAME: **MACTEC Engineering & Consulting, Inc.**
PROJECT MANAGERS: **James F. Owens, PLS (SWFWMD)**
Thomas M. Jennings, PLS (MACTEC)

Southwest Florida Water Management District

2379 Broad Street
Brooksville, Florida 34604

HYDROLOGIC DATA SECTION
SITE CALIBRATION SURVEY FORM

SITE NAME: **WITHLACOOCHEE RIVER AT TRILBY**	SITE I.D. (SID): **23546 (Recording Well)**
UID_TYPE / UID_SITE_ID: **FLO / 122**	DATE OF SURVEY: **September 29, 2008**

FIELD NOTES (CONT.)

SHEET INDEX

MACTEC, Inc.
4150 N. JOHN YOUNG PARKWAY ORLANDO, FL.
(407) 522-7570 Fax: (407) 522-7576
LB # 6969

Detail 3 - Benchmark Ties Guidelines

Operations Department

Hydrologic Data Section

Benchmark Ties

Guidelines for

THIRD-ORDER LEVELING TIES FROM VERTICAL SURVEY CONTROL STATIONS (NAVD88 BENCHMARKS) TO NEARBY HYDROLOGIC DATA COLLECTION DEVICES

Southwest Florida
Water Management District

WATERMATTERS.ORG · 1-800-423-1476

May 2009
Jim Owens
Tammy Plazak

Introduction

The purpose of these guidelines is to provide the information necessary to transfer an elevation from an existing NAVD88 benchmark to a nearby hydrologic data collection device. The existing benchmarks must be “close by” which is defined as no more than four “set-ups” of the leveling instrument.

Benchmark Level Tie (3rd Order)

Recover the existing benchmarks located near the hydrologic data collection site. For SWFWMD sites, the following web link will provides an interactive map of the SWFWMD Survey Control: http://bsm02.freac.fsu.edu/imf2/FREAC/SWFWMD.jsp ; zoom to the site location and view the datasheets using the identify function. The NAVD88 Benchmark Control Forms and the Hydrologic Data Collection data sheets are indexed by SID number and saved in PDF format.
Using the procedures outlined in this document, verify the elevation difference of the existing benchmarks by leveling between the benchmarks, and transfer the NAVD88 elevation to the measuring point at the hydrologic data collection device.
Record rod readings to hundredths of feet (0.01). The model, type of instrument, and serial number of instrument and rods (e.g., fiberglass, aluminum, single piece, etc.) shall be entered on the “Observations of Bench Mark Ties” form where indicated. The leveling instrument should be checked for collimation error on a regular basis.

Observing Sequence for Leveling

1. Remove equipment from travel cases, attach level instrument to tripod, and let equipment acclimate to local conditions. Perform instrument check per manufacturer’s instructions. Set up the instrument about halfway between the stations, but no more than 200 feet away from either point or from one of the points and a turning pin in the case of multiple setup requirements. Backsight distance to foresight distance imbalance shall be less than 15 feet. Accumulated backsight to foresight distance imbalance shall be less than 30 feet in the case of multiple setups

2. Plumb the level rod on the highest point of the 1st Benchmark. In the following example, the first Benchmark is called “123456A.” Record the designation of the benchmark (stamped on the disk) and its published elevation (from the survey datasheet) noting the reference vertical datum and units of measure.

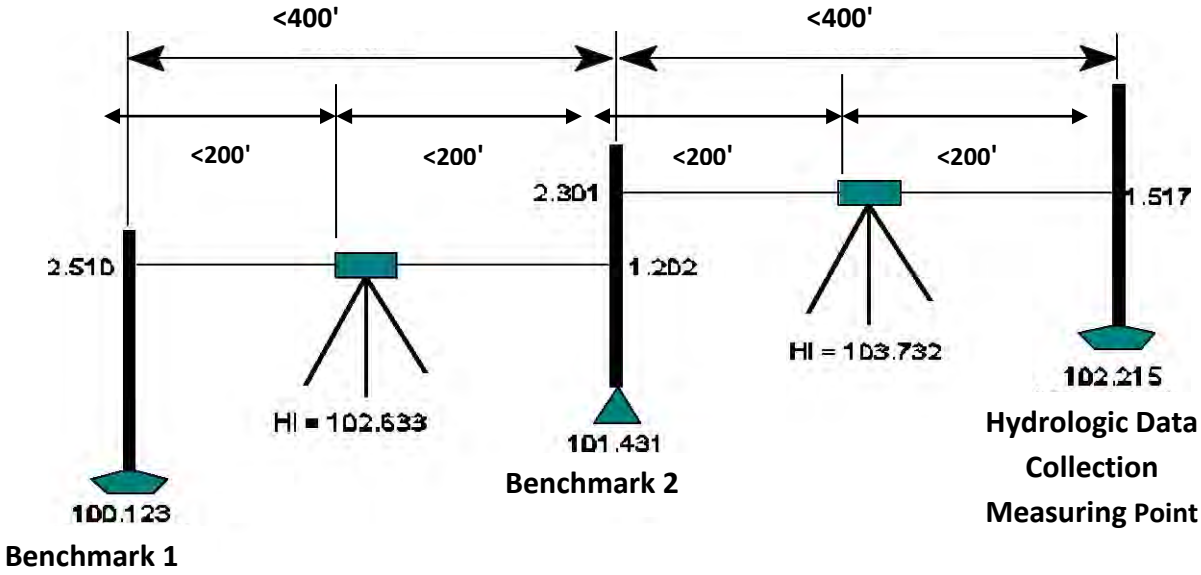


Figure 1 1st Benchmark ("123456A") to 2nd Benchmark ("123456B") level tie for distances over 400 feet. **Note:** Backsight-foresight distance imbalance should be less than 15 feet, and the accumulated backsight-foresight setup imbalance should be less than 30 feet.

3. Backsight Reading: Observe the intersection of the top, middle and bottom wire with the rod scale as the backsight reading. Record the rod reading to the nearest one hundredth of a foot. Compute and record the average of the three readings. The average should be within one hundredth (0.01) of the middle wire rod reading. If the average of the three numbers is not within one hundredth of a foot, the recordings should be re-observed. Compute the stadia distance from the point to the instrument (top wire – bottom wire x 100 = distance in feet).

4. Compute height of instrument, HI, which is the sum of the backsight and the published elevation.

5. Plumb the rod on the highest point of the 2nd Benchmark. Record the designation of the 2nd Benchmark, e.g., "123456B," or "TP1" (for turning point 1 in the case of multiple setups).

6. Foresight Reading: Observe the intersection of the top, middle and bottom wire with the rod scale as the foresight reading. Record the rod reading to the nearest one hundredth of a foot. Compute and record the average of the three readings. The average should be within one hundredth (0.01) of the middle wire rod reading. If the average of the three numbers is not within one hundredth of a foot, the recordings should be re-observed. Compute the stadia distance from the point to the instrument (top wire – bottom wire x 100 = distance in feet).

7. Compute the elevation of the 2nd Benchmark, or turning point, which is the difference o the HI minus the foresight.

8. Reset and re-level the instrument. Level backward from the 2nd Benchmark to the 1st Benchmark, in the same manner as steps 2 through 7.

Note: The elevation computed for the 1st Benchmark as a result of the backward leveling shall differ from the published elevation by no more than +/- 0.05 x sqrt of the distance in miles between the benchmarks, eg,: 0.05 x(sqrt of 1) = 0.05 feet.

9. To determine the elevation of the measuring point at the hydrologic data collection device (well or staff gauge), level forward and backward from one of the benchmarks to the measuring point in the same manner as steps 2 through 8.

Data Submission

The following **must be supplied** by the field technician:

1. The completed "**OBSERVATIONS FOR TIES TO EXISTING NAVD88 BENCHMARKS AT HYDROLOGIC DATA COLLECTION SITE**" form. (See Appendix D)

2. Digital copies of benchmark and measuring point photographs.

DETAIL 4 - Worksheet for Third-Order Leveling Ties from Vertical Survey Control Stations (NAVD88 Benchmarks) To Nearby Hydrologic Data Collection Devices

Appendix D. OBSERVATIONS FOR TIES TO EXISTING NAVD88 BENCHMARKS AT HYDROLOGIC DATA COLLECTION SITE

DATE OF FIELD OBSERVATIONS: SWFWMD SID: FIELD OBSERVATIONS BY:

LEVELING EQUIPMENT (MAKE/MODEL/SERIAL NUMBER):

LEVELING FROM 1ST BENCHMARK TO 2ND BENCHMARK:

POINT DESCRIPTION	BACKSIGHT		HEIGHT OF INSTRUMENT	FORESIGHT		ELEVATION	REMARKS
	TOP=						
1ST BENCHMARK	MIDDLE=	AVERAGE=					DESCRIBE BENCHMARK
	BOTTOM=						PHOTOGRAPH NO.
	TOP=			TOP=			
TURNING POINT 1	MIDDLE=	AVERAGE=		MIDDLE=	AVERAGE=		DESCRIBE TURNING POINT
	BOTTOM=			BOTTOM=			
	TOP=			TOP=			
2ND BENCHMARK	MIDDLE=	AVERAGE=		MIDDLE=	AVERAGE=		DESCRIBE BENCHMARK
	BOTTOM=			BOTTOM=			PHOTOGRAPH NO.
	TOP=			TOP=			
TURNING POINT 1	MIDDLE=	AVERAGE=		MIDDLE=	AVERAGE=		DESCRIBE TURNING POINT
	BOTTOM=			BOTTOM=			
				TOP=			
1ST BENCHMARK				MIDDLE=	AVERAGE=		DESCRIBE BENCHMARK
				BOTTOM=			
		SUM BACKSIGHTS			SUM FORESIGHTS	LOOP CLOSURE	

LEVELING FROM BENCHMARK TO MEASURING POINT:

POINT DESCRIPTION	BACKSIGHT		HEIGHT OF INSTRUMENT	FORESIGHT		ELEVATION	REMARKS
BENCHMARK	TOP=						
"123456"	MIDDLE=	AVERAGE=					DESCRIBE BENCHMARK
	BOTTOM=						
	TOP=			TOP=			
SU NUMBER	MIDDLE=	AVERAGE=		MIDDLE=	AVERAGE=		MEASURING POINT AT SU#
	BOTTOM=			BOTTOM=			DESCRIBE MEASURING POINT
							PHOTOGRAPH NO.
BENCHMARK				TOP=			
"123456A"				MIDDLE=	AVERAGE=		CHECK BACK TO BENCHMARK
				BOTTOM=			
		SUM BACKSIGHTS			SUM FORESIGHTS	LOOP CLOSURE	

DETAIL 5 - Guidelines for Staff Gauge Installation

Specification Purpose

The purpose of this technical procedure is to describe the general procedures for installing a vertical staff gauge (see Figures 1 and 2), to ensure proper hydrologic data collection at a surface water site.

General Requirements

- Staff gauges shall be of a sturdy construction, be easy to operate and maintain, and shall be of such a design that they can be effectively used under the site's prevailing environmental conditions and be readable for all anticipated water levels.
- Staff gauges shall conform to either USGS Style A (preferred) or Style C standards (see figure 3), and shall be constructed of 16-gage porcelain-enameled iron or steel.
- The standard measurement resolution for a staff gauge shall be 0.01 foot.

Background

Staff gauges are installed in surface water bodies associated with District projects or programs for the purpose of measuring water levels. The type of staff gauge commonly used at the District is the "Vertical Staff Gauge," which consists of porcelain enameled iron sections, securely bolted or fixed to a secure backing or staff, and are precisely graduated and accurately located for scalar measurement sections (see Figure 4). Staff gauges are generally installed (either) as a stand-alone gauge or affixed to an existing permanent structure (e.g., dock, pier, bridge piling, etc.). This procedure describes the installation of a "stand-alone" staff gauge.

Staff gauges are used for water level readings in two common applications:

1. As the primary gauge at a surface water site to monitor water levels; or
2. As a primary water level gauge outside of and in conjunction with a stilling well at recorder sites, to verify the measurement inside the stilling well.

The staff gauge is the primary gauge and is the standard from which the water level data is collected. Water level data shall be referenced to either height or elevation.

Site Research Prior To Gauge Installation

To the maximum extent practicable, the following research is recommended prior to staff gauge installation:

1. Examination of existing hydrological data regarding the site (e.g., WMIS database, reports, etc.) to determine historical maximum and minimum water levels.
2. Field investigation of site conditions, including identification of high water marks, determination of bottom characteristics, etc. Look for maximum depth close to shore.
3. Determination of the most suitable location for the staff gauge. The location should be in an area deep enough to provide the full range of water level conditions, without creating a hazard to navigation. If it is an observer site or on private property, consult with the observer and/or landowner regarding a suitable location. Make sure the observer will be able to read the staff gauge at the proposed location. In any case, the staff gauge location must meet any hydraulic requirements for its application and must therefore be chosen with care.
4. Determine the best method for installing the staff gauge and the equipment need for the installation.
5. Locate, or have installed, a Permanent Benchmark which will be needed for determining the elevation of the staff gauge (see Figure x). Benchmark construction and distance from the staff gauge location must comply with District benchmark standards.

Installation Procedures

I. Materials Needed

- Staff section(s)
- 1" x 8" pressure-treated wood backing-board for mounting staff sections. The backing-board shall be painted black with an epoxy paint.
- 3" x 0.125" aluminum tubing (pipe). Length of pipe will be site specific.
- Mounting brackets/bolts for attaching backing-board to staff
- Stainless screws; aluminum/stainless bolts, nuts, flat/lock washers, brackets, etc., to affix staff sections to backing-board.
- District ID plate

II. Equipment Needs

- Jet pump or post driver
- Boat (as applicable); hip/chest waders or dry suit
- Cordless drill, drill bits, hacksaw and other assorted tools (wrenches, screwdriver(s), pliers, etc.) necessary to complete staff gauge installation
- Carpenters level
- Graduated steel measuring tape
- Laser leveling equipment

III. Installation

The staff gauge must be positioned vertically and secured sufficiently to a stationary object or driven into the bottom sediments to eliminate vertical and horizontal movement.

1. Assemble all necessary materials and equipment for the installation of the staff gauge.
2. Attach 3-inch pipe brackets to backing-board with necessary stainless hardware.
3. Attach staff sections to the backing-board with necessary stainless/aluminum screws, nuts/bolts, brackets, etc., making sure staff sections used will cover the anticipated range of water level fluctuation. Staff sections are prone to variations in scale so calibrate the assembly of sections by using a graduated steel measuring tape across the sections and adjust the gap between them to the measuring tape. NOTE: Gauge sections must be affixed in a manner that allows adjustment for calibration to elevation requirements (i.e., tuning it to Datum).
4. Install the District ID plate on top of the staff or backing-board.
5. Place the 3-inch aluminum/galvanized pipe (staff) at the location of gauge placement. The staff must be positioned upright and vertical. [Note: The staff gauge should be installed separate from a dock if it is a recorder site and it should be with-in reach of the dock for easy cleaning and reading.]
6. Using jet pump or post driver, advance staff vertically downward into the substrate, checking vertical alignment and correctness with the carpenter's level during the advancement process. The staff must be driven into the substrate to a sufficient depth (approx. 3 or 4 feet or sediment refusal, whichever occurs first) to prevent vertical or horizontal movement under all prevailing environmental conditions at the site. The height of the staff must be planned to remain above extreme high water levels and from becoming inundated or submerged.
7. Attach the backing-board (with gauge sections) to the staff, adjusting it up or down in the water so that the gauge sections will be able to measure increasing/decreasing water levels.
8. Set a measuring point (MP) on the backing-board at a specific gauge reading.

9. Use laser level equipment and established Benchmark and adjust the MP on the backing-board to the correct elevation.

IV. Documentation:

- Draw a map of site with distance and directions to Benchmark.
- Take pictures
- Fill out a miscellaneous field note with a description of the staff, WL readings, etc.
- Record GPS position

V. Update field folder

Figure 1: Staff gauge located in a surface water body

Figure 2: Staff gauge located adjacent to a stilling well and recorder shelter

Figure 3: USGS Style A and C Gauge Sections

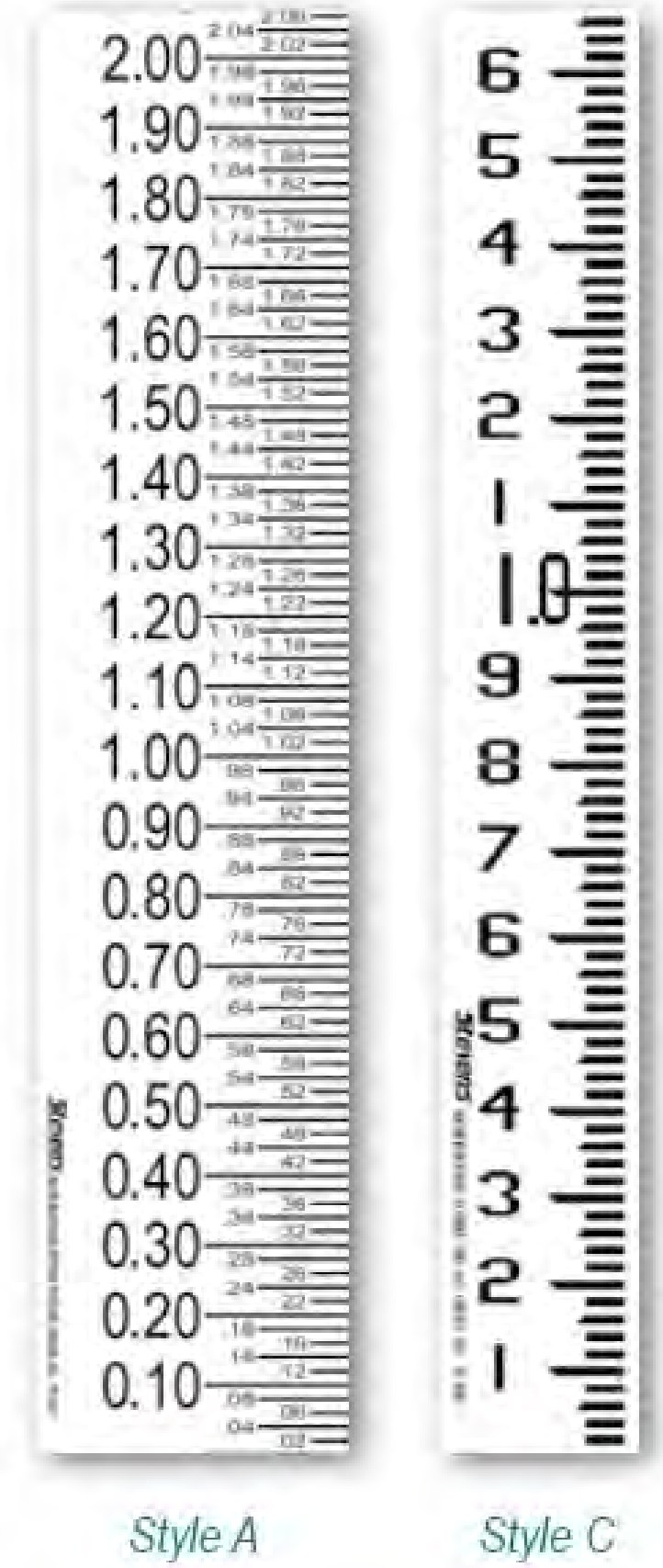


Figure 4: Diagram of staff gauge

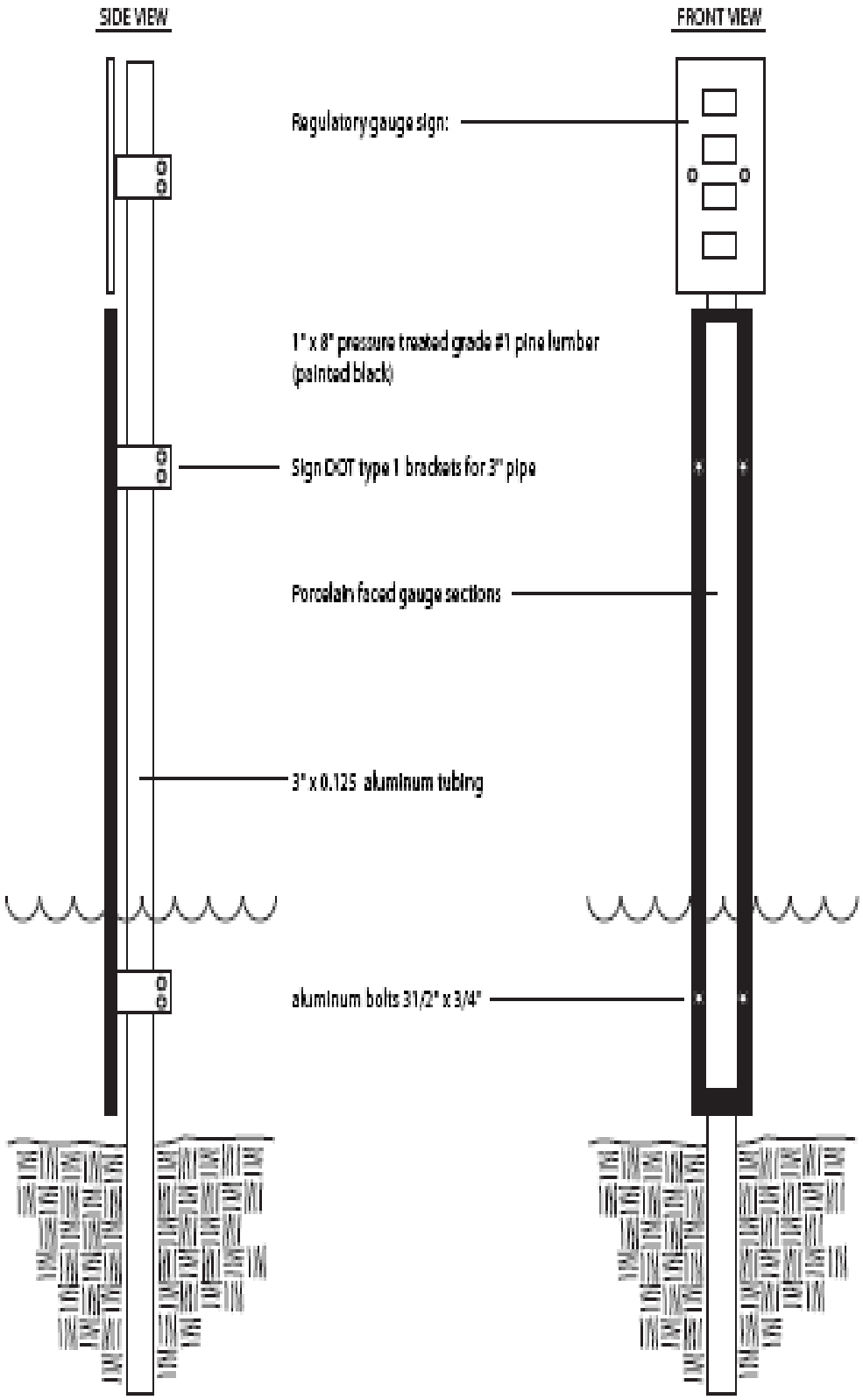


Figure X: Location of Existing Benchmark on Withlacoochee River

DETAIL 6 - Guidelines for Stilling Well Installation

Specification Purpose

The purpose of this procedure is to establish guidelines for the preparation and installation of stilling wells. To ensure proper Hydrologic data collection at surface water and lake sites.

Background:

Stilling wells are used for instruments to recorder water level readings in a surface water body (e.g., lake, pond, stream, etc.) to obtain an accurate stage level and minimize the effects of wave action. If a station is equipped with a water-stage recorder and a stilling well, it is essential that the water level in the well correspond to the stage in the water body
Where the stilling well accommodates the float for a float-operated recorder, it is recommended that the stilling well meet the following conditions: a) have sufficient height to accommodate the entire range in stage at the station and be vertical; b) have intake slots at various stages (elevations) to accommodate widely varying stages; c) have intake holes of sufficient diameter to assure that the water level in the well will not lag the rise or fall of the water level in the stream; d) have intake holes of such diameter to damp out short period wave effect or oscillation; and e) have some provision to accommodate periodic cleaning.

Procedure:

A stilling well must be positioned vertically and secured sufficiently to eliminate vertical and horizontal movement.

Material List:

- 6 or 8 inch Schedule 40 PVC slotted (0.10 or 0.20 slot) well screen. Length of well screen used will be site specific;
- 6 or 8 inch Schedule 40 PVC end cap;
- 3-inch diameter aluminum tubing. Length of tubing used will be site specific;
- 5-inch aluminum strapping. Length of strapping is determined in the field;
- Mounting clamps and bolts to fit the size of the PVC well screen;
- Brackets if mounting to a platform;
- 6 or 8-inch flange to connect PVC well screen to recorder shelter box;
- PVC glue and PVC cleaner.

Equipment List:

- Jet pump or aluminum pipe-driver;
- Boat (if needed);
- Cordless drill, drill bits, hacksaw and other assorted tools (wrenches, screwdriver(s), pliers, etc.) necessary to complete installation;
- Shelter box;
- Bolts to mount shelter;
- Carpenters level.

Surface water sites may require the construction of docks or other supports to install a stilling well. Materials used should be pressure-treated lumber and non-corrosive materials and hardware. Supports for a dock or other structure should be jetted in to ensure they will not yield during abnormally high flows.

The height of the structure must be planned to remain above extreme high water levels, and to keep the top of the stilling well and recorder from becoming inundated or submerged. Likewise, the dock should be constructed into an area deep enough to provide the full range of water level conditions, without creating a hazard to navigation. The stilling well should be constructed of schedule 40 PVC slotted well screen, with a cap glued onto the bottom. Several holes should be drilled into the cap to allow water flow. A 6- to 10-inch diameter is recommended.

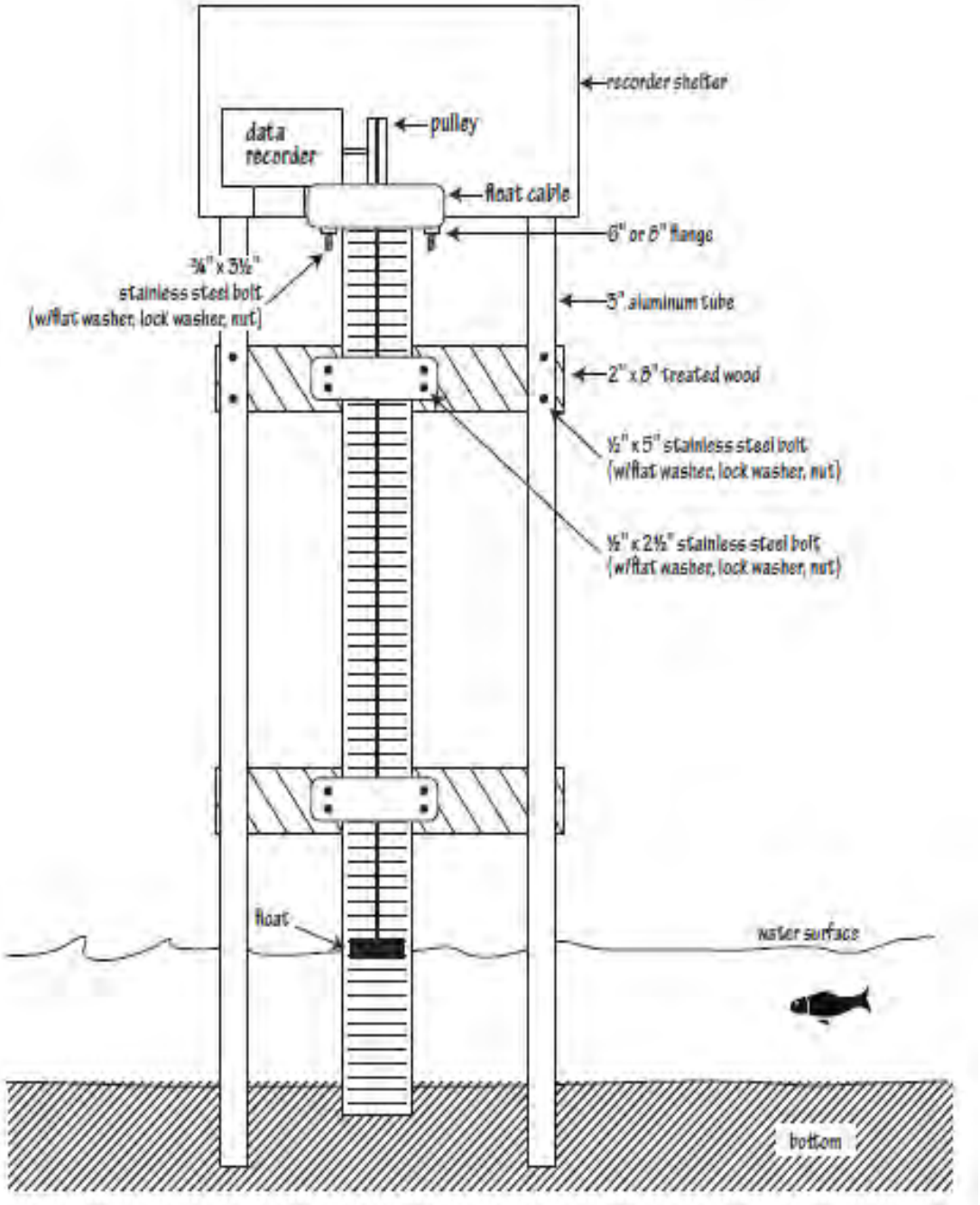
Installation:

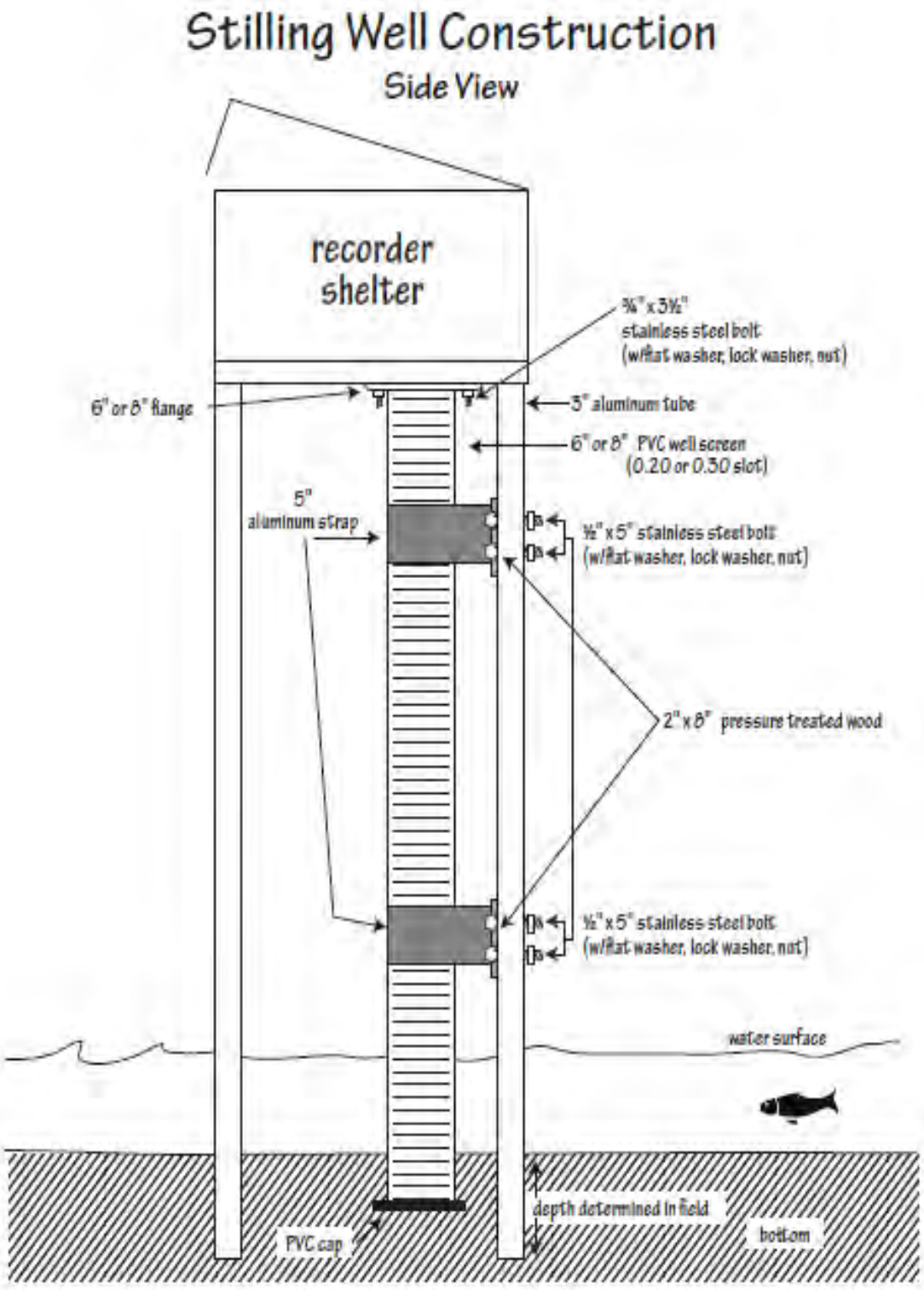
- Cut PVC slotted well screen to appropriate length and glue end-cap to bottom of PVC screen;
- Drill ¼ inch hole in the bottom of end-cap;
- Level and jet or drive in aluminum tubing to refusal, creating a four post structure. Attach support pressure-treated wood;
- Use appropriate brackets to mount stilling well to 4x6 PT;
- Use appropriate PVC flange to mount on top of stilling well;
- Use appropriate shelter to mount to flange;
- Mount to platform;
- Use appropriate brackets to mount stilling well to platform.

Figure 3: Stilling Well and Staff Gauge Facility

Stilling Well Construction

Front View




Stilling Well Construction
Side View
recorder shelter
¾" x 3½" stainless steel bolt (w/flat washer, lock washer, nut)
6" or 8" flange
3" aluminum tube
6" or 8" PVC well screen (0.20 or 0.30 slot)
5" aluminum strap
½" x 5" stainless steel bolt (w/flat washer, lock washer, nut)
2" x 8" pressure treated wood
½" x 5" stainless steel bolt (w/flat washer, lock washer, nut)
water surface
depth determined in field
bottom
PVC cap

DETAIL 7 - Diagram of Typical Wellhead Protector

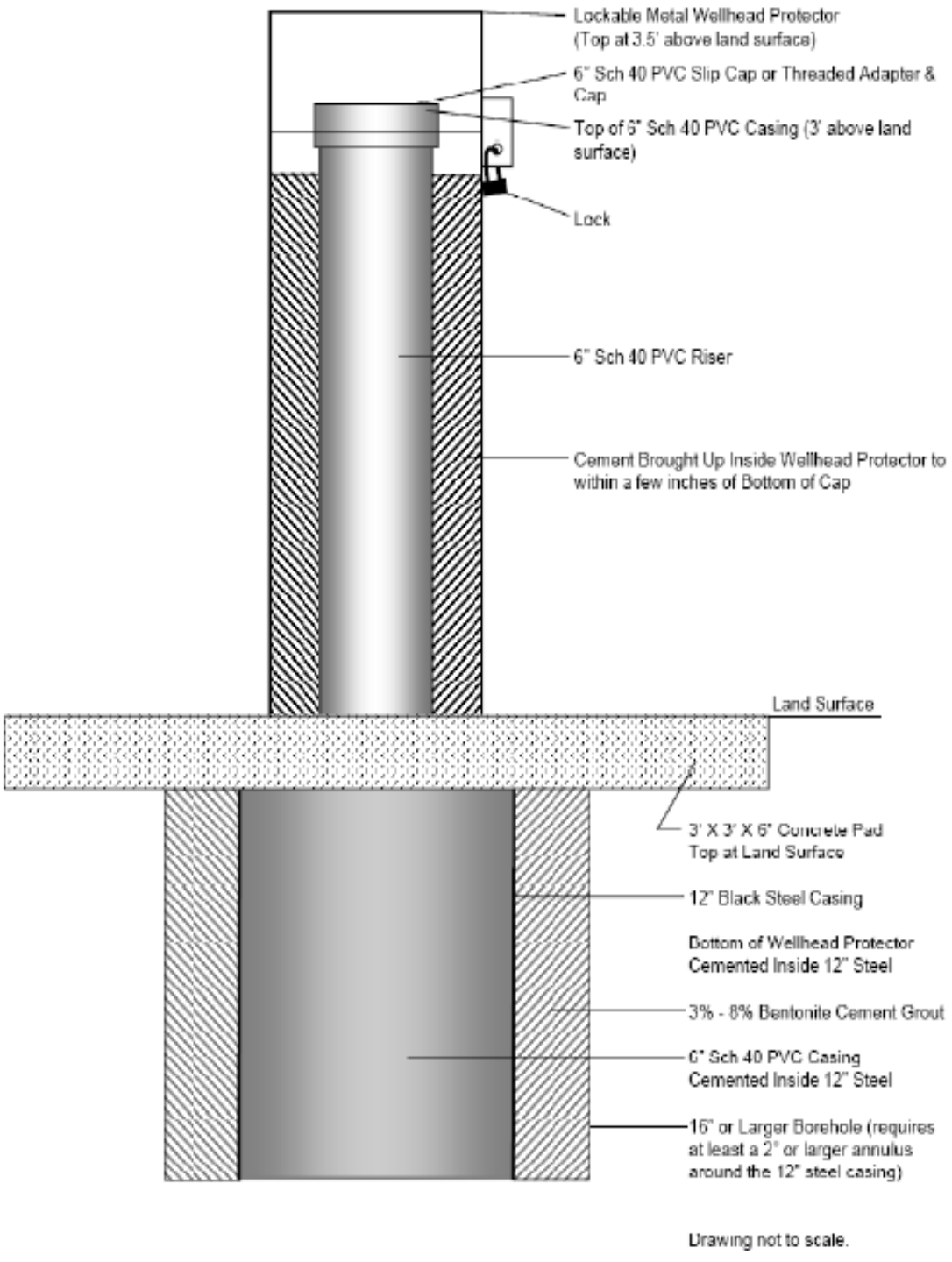


Figure 4. Illustration of installed Wellhead Protector.

DETAIL 8 - Typical Components of SCADA Telemetry Systems

The SCADA system provides a network of real-time water level and rainfall data collection stations. The District has standardized on Campbell Scientific, Inc research-grade dataloggers coupled with telemetry constituting remote-terminal units (RTUs) for data collection operations. Wireless telemetry is provided by AT&T and Verizon, the premier carriers for two leading cellular technologies. Choosing between the two competing networks guarantees the best performance for the localized area available from resource rich companies. Land line (TELCO) communications are provided by local area TSPs. SCADA TELCO lines and USRobotics 5686E 56K faxmodems used to dial remote site locations are located at the Brooksville, Tampa and Bartow District offices. A bank of TELCO modems is connected to each SCADA server in the system for a total of 21 available units. Although the modems are distributed across different TELCO systems and geographically separate, they are logically pooled for SCADA operations. Long distance service is provided by the local TSP or Division of Management Services. TELCO modems used at remote data collection sites are provided by Campbell Scientific, Inc. and have design features such as voice-synthesized data reporting and low power requirements optimized for battery\solar powered remote telemetry.

A data collection site must be instrumented with compatible electronics to qualify as a District SCADA site. Sensor data must be present in the datalogger memory in a format transferable to the master SCADA system. The SCADA system must incorporate software (called driver software) capable of interfacing to and controlling the selection and transfer of RTU data. The District adheres to standardized telemetry equipment selection to minimize support, management and maintenance issues and cost.

Standardized components of the SCADA telemetry system shown are:

SCADA server hardware:

Dell Precision T-3500 , Intel Xeon CPU W3550 3.07 GHz 4GB
Comtrol Rocket Port serial port card (high density serial ports)
Dell Network Interface

Maintaining hardware standards contributes to reliable telemetry operation, differing hardware frequently operates with subtle differences and timing causing problems that are difficult to detect.

SCADA server software:

Windows 7 Professional Operating System
Vipre Enterprise Antivirus
Comtrol (serial multiport card driver and utilities)
Remotely Anywhere (remote control software)
Sunbelt Software (Vipre Antivirus)
Trihedral Engineering Ltd. (VTS core SCADA software and application)
Oracle (Oracle database client)

Maintaining core system software standards also contribute to reliable telemetry operation. Modern software must rely on the operating system services to handle interfacing to I\O (Ethernet and serial port communications) devices for consistency and security. Antivirus and driver software can be complex to configure for trouble free operation. Remote control software must operate within the enterprise security specification.

SCADA support software:

Campbell LoggerNet (datalogger configuration software)

Sierra Wireless Airlink AceManager (Airlink IP modem configuration software)

Campbell LoggerNet software is the only full featured product available for all configuration tasks for Campbell datalogger products. This OEM developed product can also be used for data acquisition and is useful for comparison troubleshooting. The Airlink AceManager software provides a user friendly GUI interface for IP modem management.

SCADA site telemetry equipment:

Sierra Wireless Airlink “Raven” IP modems with serial port (AT&T & Verizon)

Campbell Scientific COMxxx TELCO modems

The District has standardized on Sierra Wireless Airlink IP modems for TCP/IP telemetry. The District has also standardized on the Campbell COMxxx series TELCO modems. Most TELCO installations are older sites using array based dataloggers that are no longer in production (CR10x and CR510). Most new sites are TCP/IP cellular based and use the newer, table based datalogger (CR800 and CR1000) which support the Campbell PakBus(packet based) network

DETAIL 9 - Citrus Canker Sanitation Protocol

CITRUS CANKER SANITATION PROTOCOL

The following recommendations/procedures have been developed as a result of concerns about the potential for District employees/vehicles working within citrus groves to spread citrus canker. Groves in all areas of the District are susceptible to contamination.

Staff must make contact with grove owners or managers prior to any entry. Every District employee/vehicle shall be sanitized prior to entering and when exiting any citrus grove. Sanitation is required by Florida Department of Agriculture and Consumer Services rule upon entering or exiting groves within the quarantine areas. It is highly recommended by DACS and the Institute of Food and Agricultural Sciences outside the quarantine areas, which staff shall follow until further notice.

District employees should enter citrus groves only when necessary and contact with citrus trees and other vegetation should be minimized or avoided. Grove owners should be contacted prior to entering groves to determine what precautions the owner/manager is following and to let them know that we are sanitizing prior to entering his grove. Some groves have vehicles which are only used within the grove and access for other vehicles is restricted. If a grove owner's vehicle is used, employees must still sanitize their hands, arms, clothes, shoes and equipment.

Vehicle/Employee Sanitation

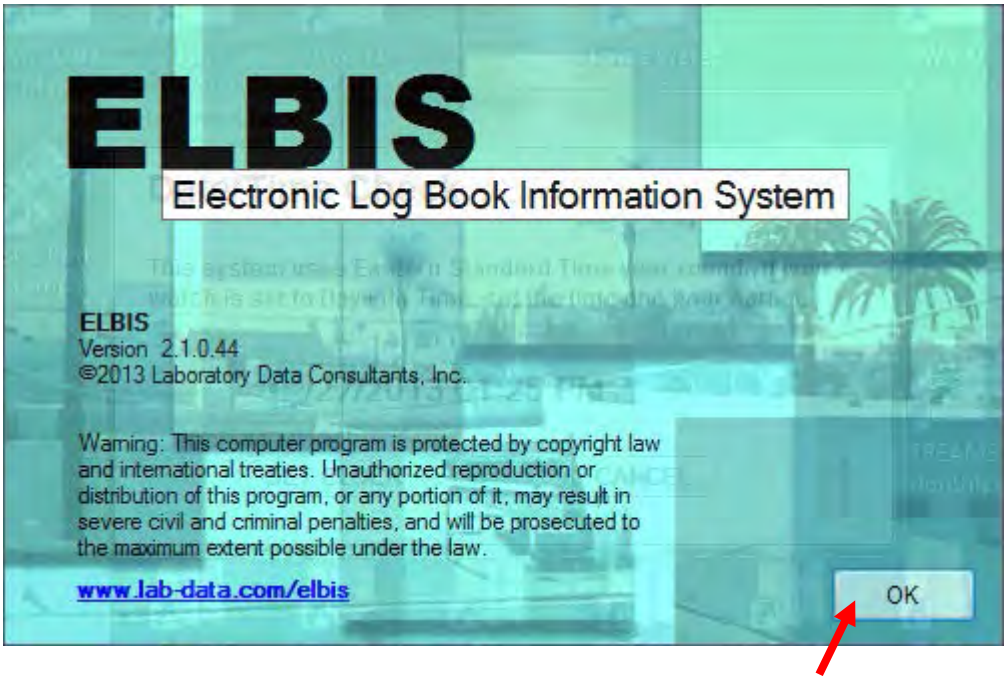
1) **Read and follow label directions on the sanitation product labels.**
2) Wear the required protective equipment (face shield and rubber gloves) when handling or mixing either of the concentrated products and when spraying vehicles with the Gallex 900 solution. Do not get either product in your eyes. If you do get it in your eyes, flush eyes with water for 15 minutes.
3) Mix 2.4 ounces of the GX 1027 antibacterial soap product per gallon of water. Use this mixture to wash your hands and arms for 20-30 seconds then rinse with water. Also, use the diluted mixture in a spray bottle to spray your sleeves if wearing a long sleeve shirt, pants, or legs if wearing shorts, shoes, especially the soles. No rinsing is necessary.
4) Mix one ounce of the Gallex 900 solution per gallon of water in a one or two gallon pump up sprayer. Make sure that you properly rinse the measuring cup by filling it with clean water and emptying it three times into the sprayer. Use this diluted mixture to spray the tires, axles, fenders, bumpers, sides and any other parts of the vehicle which may have contacted the ground or vegetation within the grove.
5) All field equipment must be sprayed with the Gallex 900 solution utilized for sanitizing vehicles

Vehicle Sanitation Kit

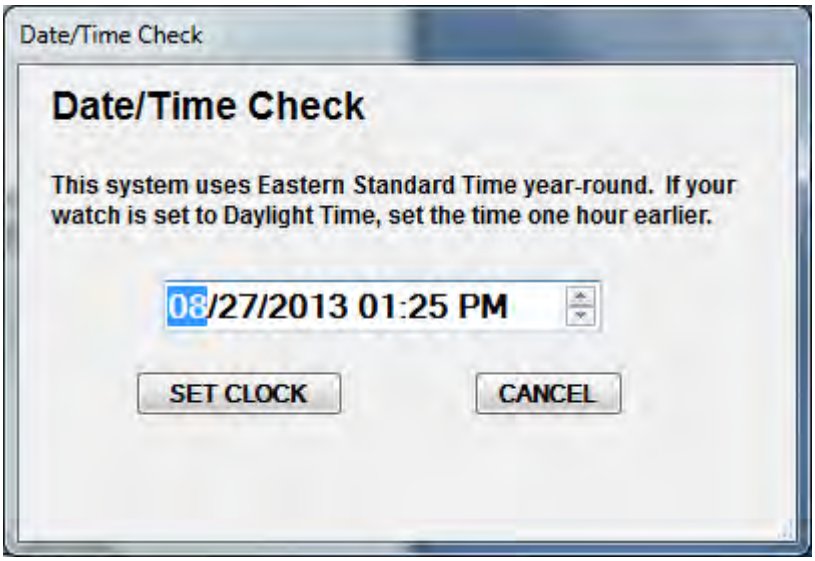
Each vehicle which will be used within a citrus grove should have the following supplies:

- Face shield
- Rubber gloves
- Spray bottle (two)
- Pump-up sprayer, one or two gallon
- Small (one to four ounce) measuring cup
- Plastic gallon jugs of water, three or more (save empty jugs and refill with tap water)
- Paper towels
- Eye wash bottle

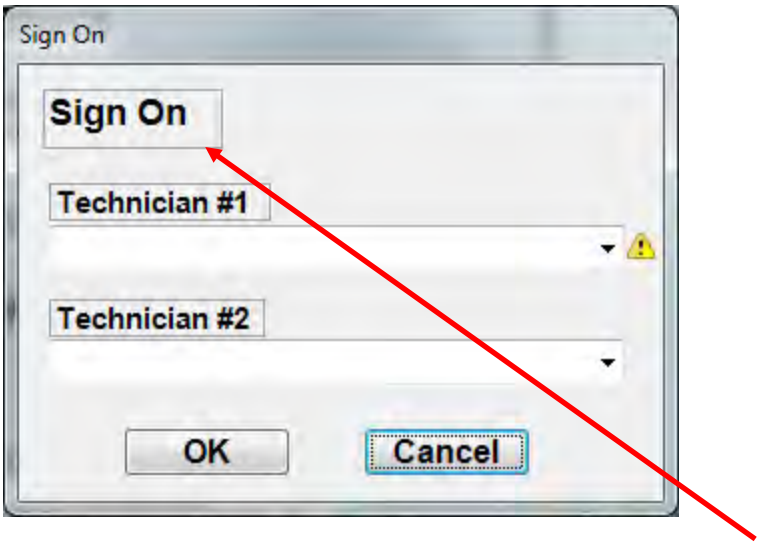
DETAIL 10 - ELBIS Overview



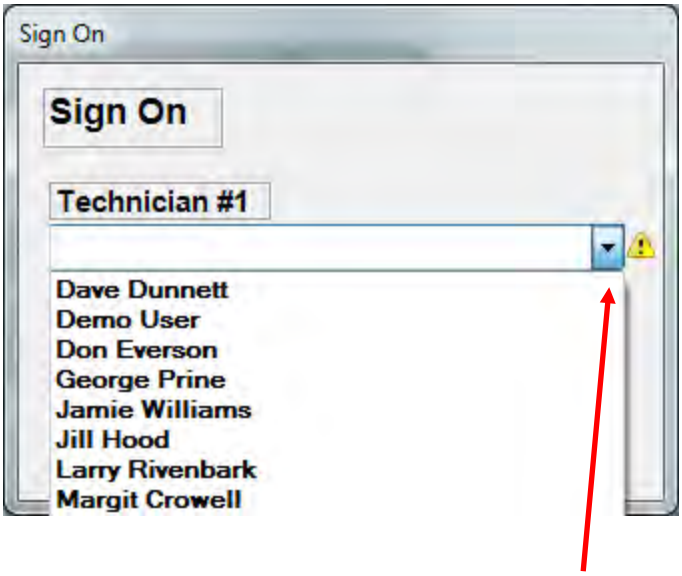
When the program is started, a main ELBIS screen is displayed (above). The technician clicks the "OK" button to access the program.



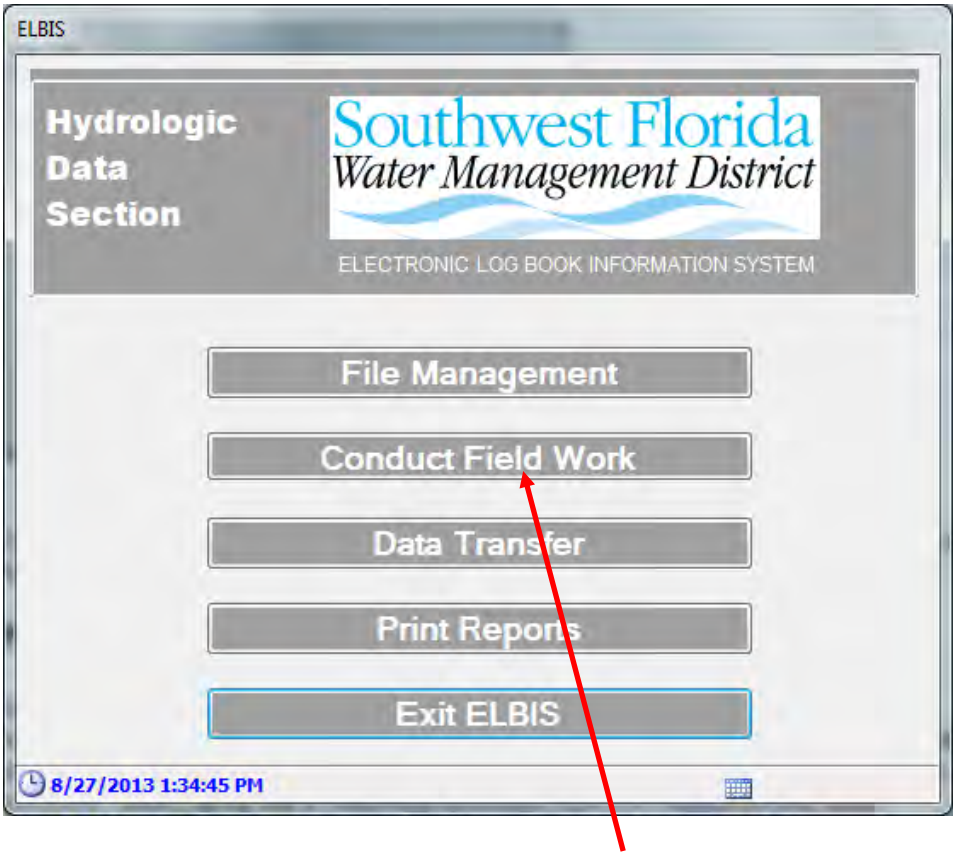
A pop-up screen will prompt the technician to set the time and date, as necessary. If the ELBIS date/time-clock is off, the technician must make the appropriate corrections and then click on "**SET CLOCK**." If the ELBIS date/time is correct, the tech will click "**CANCEL**."



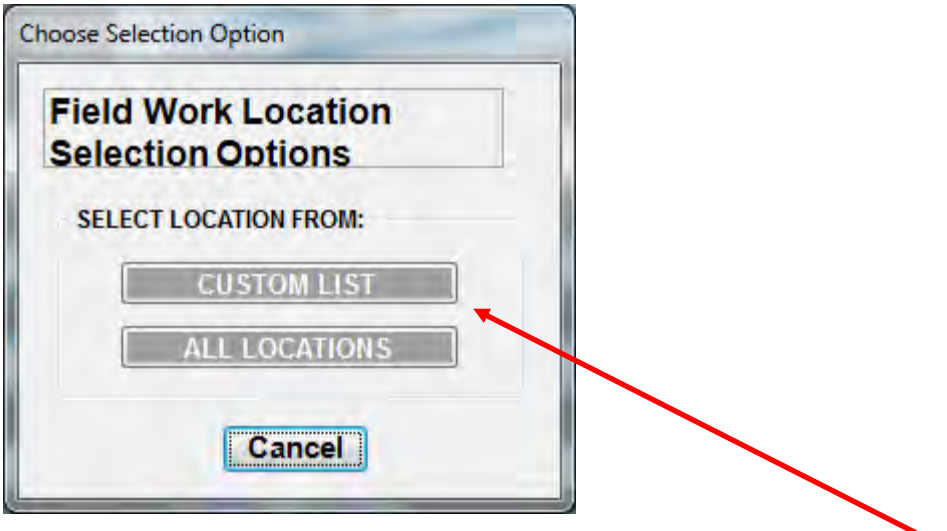
The next screen after the time-clock screen is the"**Sign On**" screen.



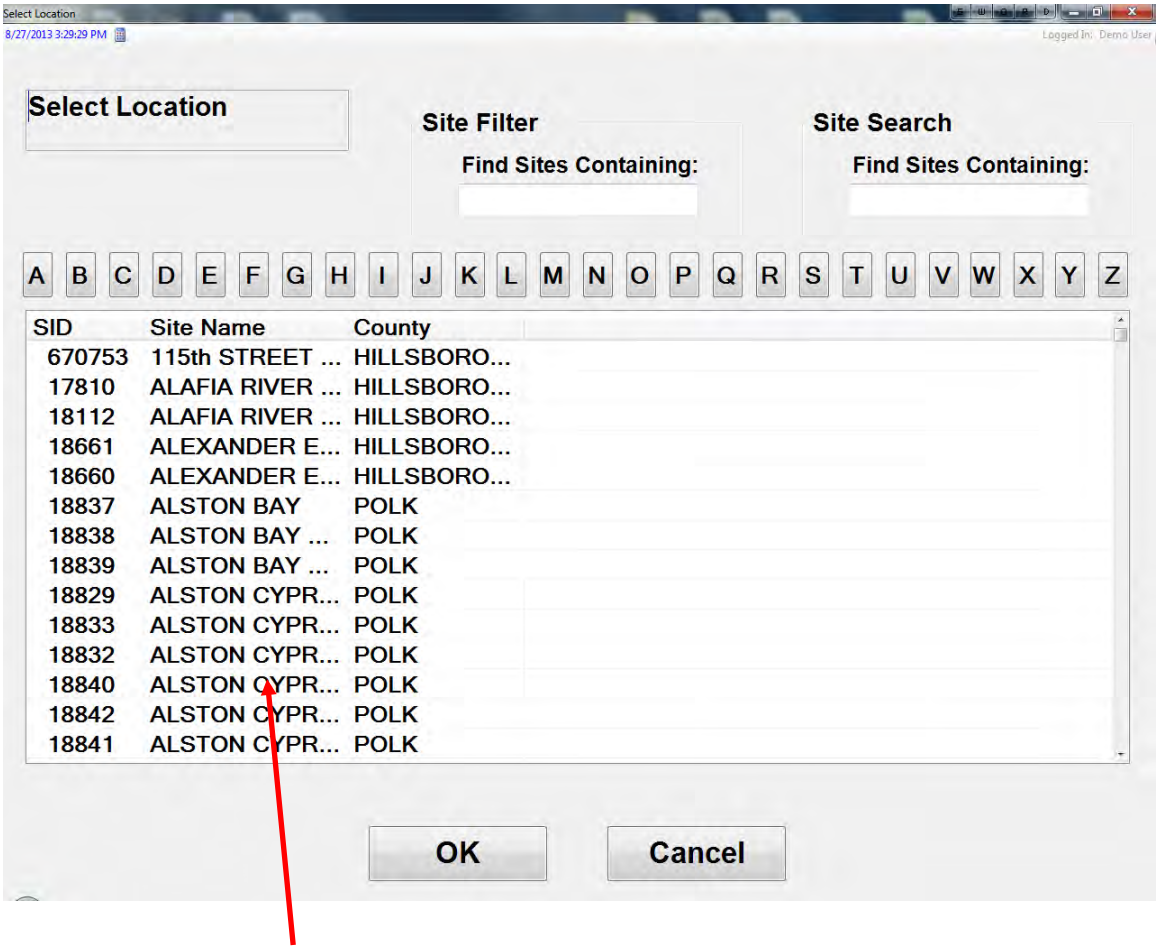
To sign into ELBIS, the technician clicks on the drop-down menu icon and then clicks onto their name.



Once the technician clicks onto their name in the previous screen, a new screen is displayed that allows them to select "**Conduct Field Work**." They can click on this button, which brings up the "**Field Work Location Selection Options**" screen (below).

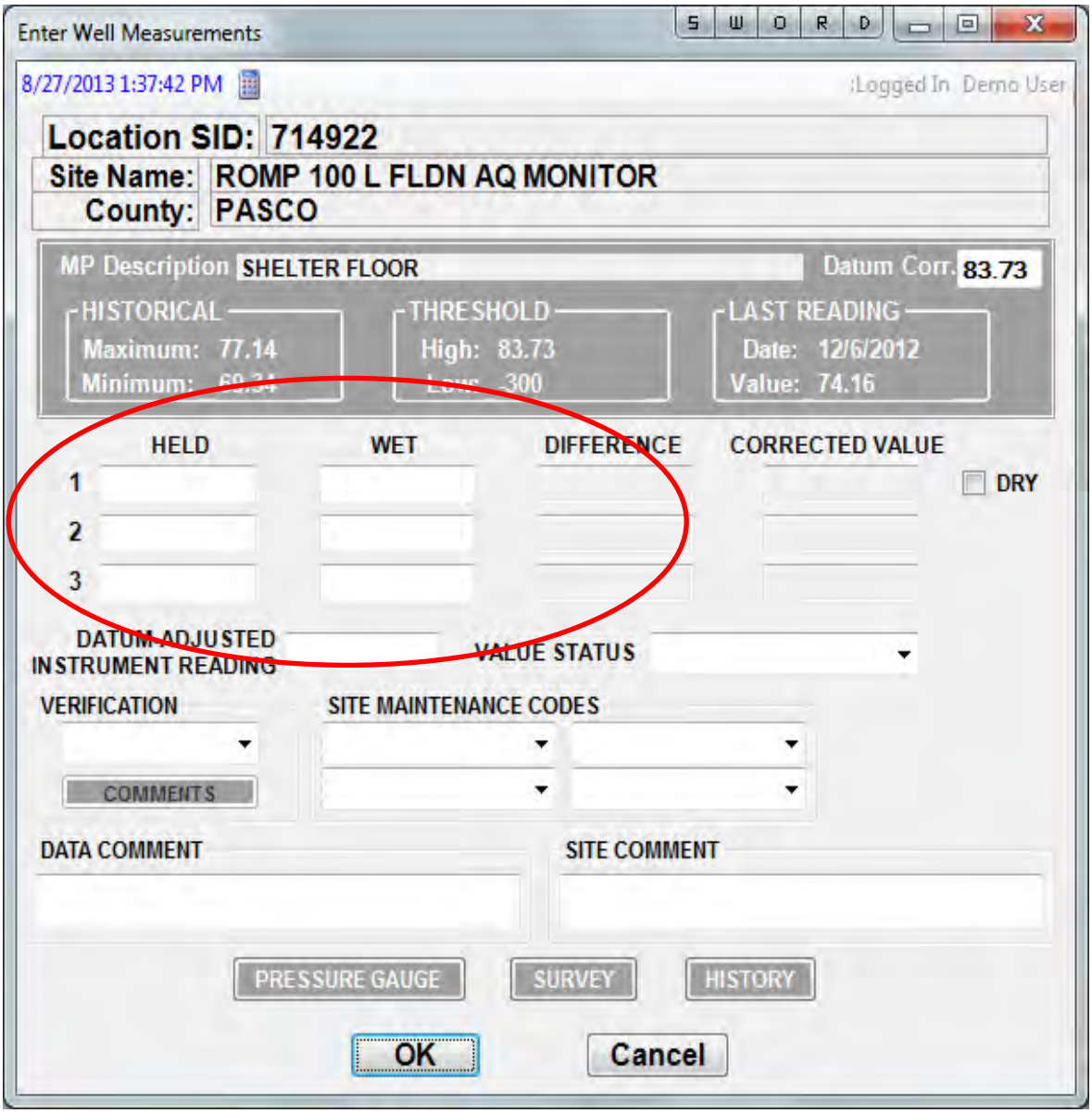


The technician can then select the monitoring site by clicking-on (either) a "**Custom List**" of sites they can create, or from the "**All Locations**" list.



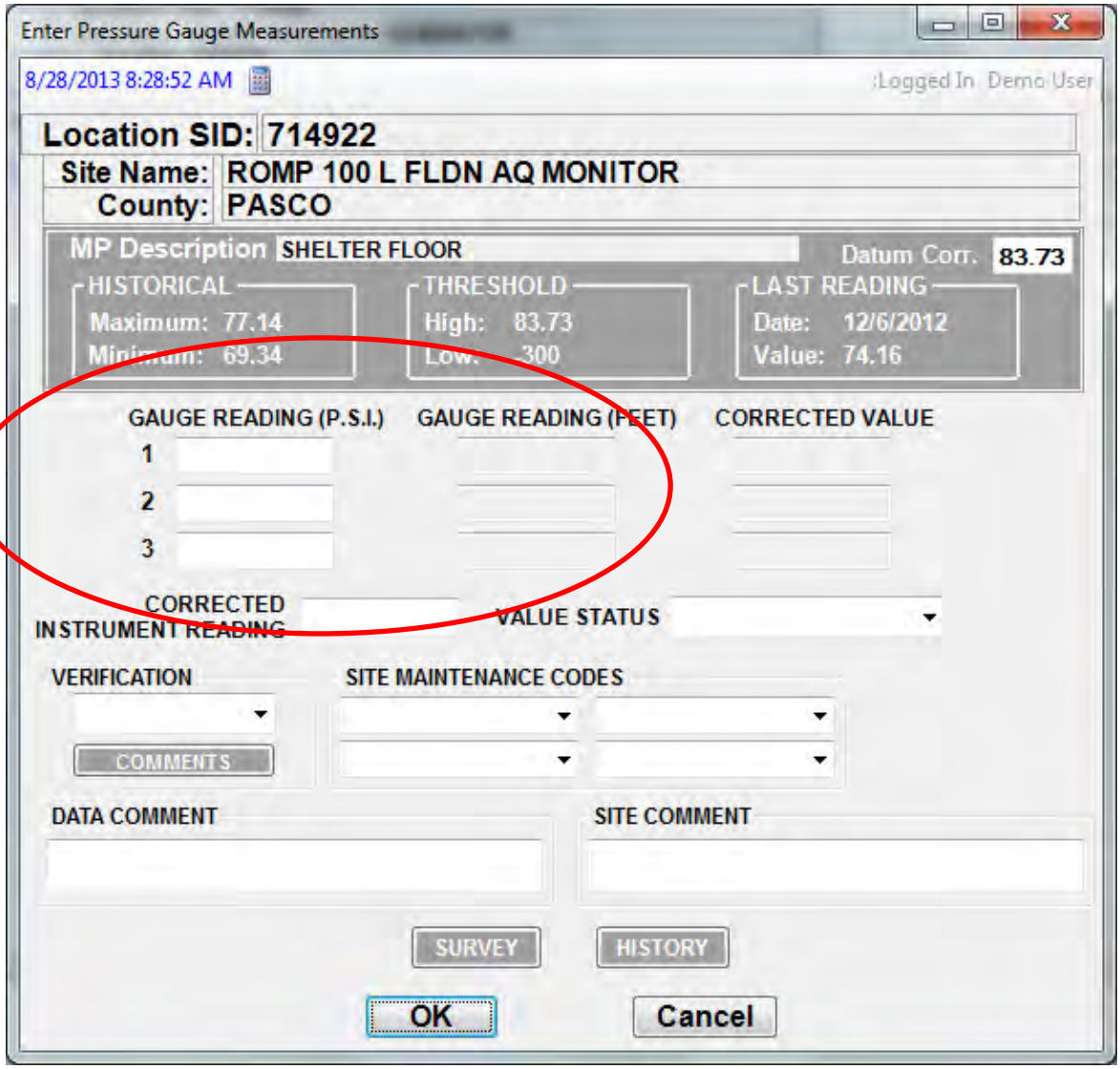
Next, a list of data collection sites is displayed from which the technician can select and click-on the appropriate monitoring site.

Well Sites (Non-flowing)



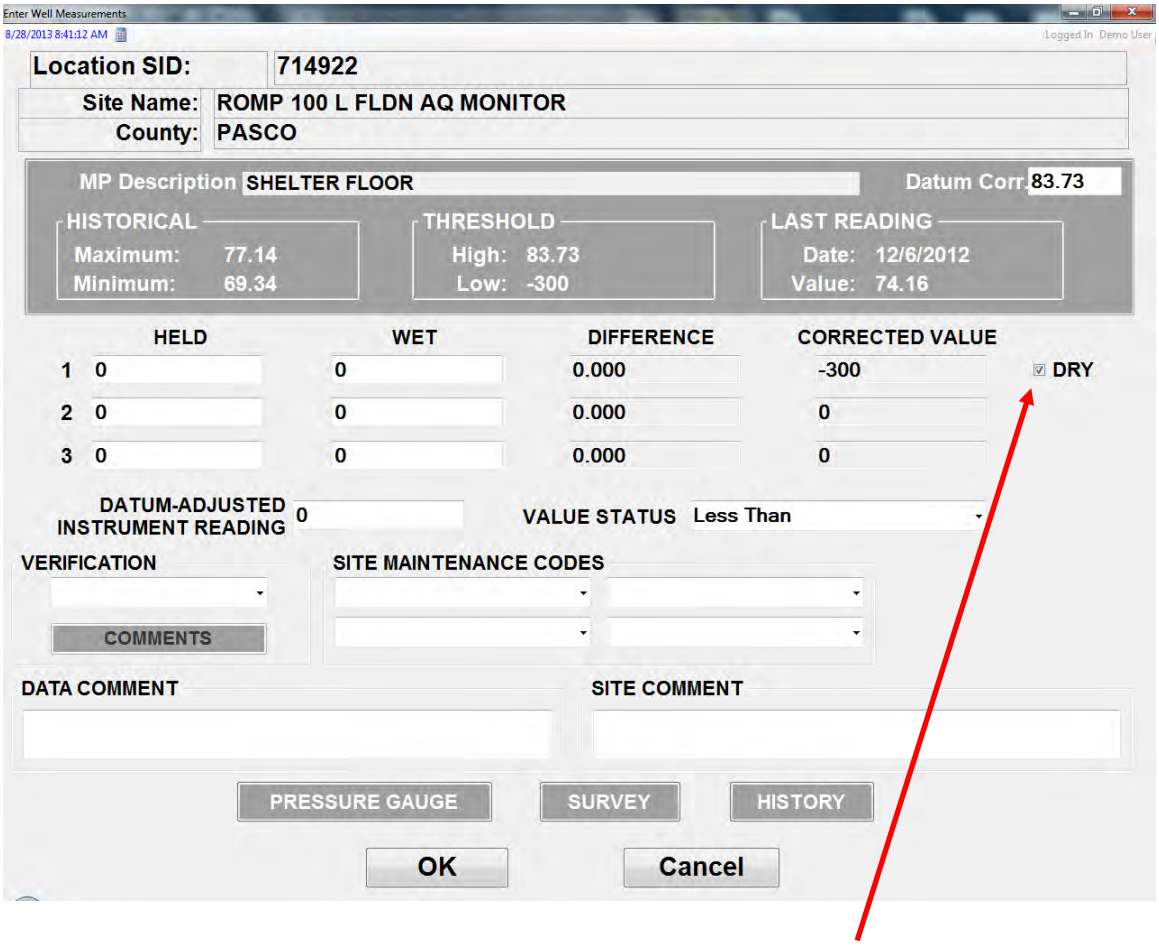
The above screen is used by the technician to enter water level measurements at non-flowing well sites.

Well Sites (Artesian or Flowing)



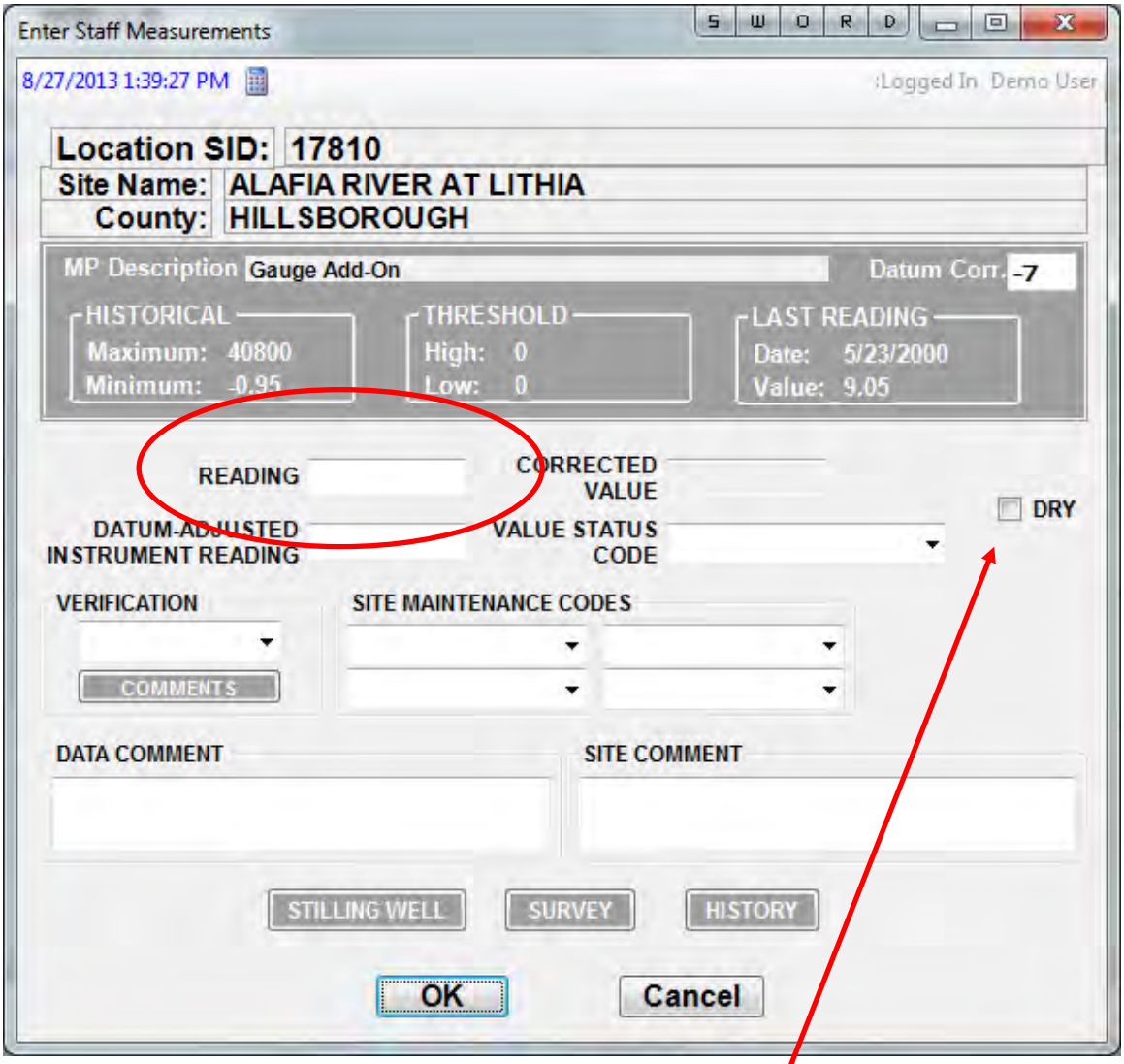
The above screen is used by the technician to enter pressure gauge readings, in psi, at artesian (flowing) well sites.

Well Sites (Dry Well)



At dry wells, the technician checks the **DRY** Box. This will put zeros in the held and wet, but it should go to the database as the correct reading.

Staff Gauge Sites



The above screen is used by the technician to enter staff gauge readings.

If the gauge is dry, the technician will check the **DRY** box.

DETAIL 11 - Manual Water Level Measurement Devices

Example: Calibrated Stainless-Steel Tape

Example: Calibrated Electronic Measuring Tape

Example: Portable (hand-held) Pressure Gauge

DETAIL 12 - Data Quality Codes

QUALITY CODE		QUALITY DESCRIPTION
1		Good continuous records
2		Good-quality edited data
26		Good daily-read records
30		Irregular time-rate data
76		Reliable interpolation
77		Correlation with other station
79		Fewer than 24 values in daily aggregate
80		Accumulated
81		Wet day w/i accumulated rainfall period
82		Linear interpolation across record gap
83		Verification value
84		Could not locate site
85		Canker alert -- no site access
86		Site destroyed
87		Weeds too high to read gage
88		No access to site
89		Gage missing
90		Less than
91		Greater than
93		Unknown date
95		Estimated
96		Override
97		Surveyed
98		Below gauge or sensor
99		Value not verifiable
140		Data unchecked
149		Outside of measurable limits
150		Rating table extrapolated
151		Data missing
153		Above staff gauge
154		Out of service
200		Data to be deleted
201		Data not recorded
254		Rating table exceeded
255		No data exist

DETAIL 13 - List of Computerized Programs for Data Reporting and QA/QC

TYPE	SAS PROGRAM	FUNCTION	OUTPUTS	REQUENCY	AUTOSCHEDULED
EXEC	I:\hydrodat\hydro\Ridge_Hydrographs\programs\monthly_ridge_lakes_hydrographs_v1.sas	Creates hydrograps of monthly mean Lk Wales Ridge lake levels in context of their minimum levels	Pdf file, email	Monthly	no
QAQC	c:\scadasas\program\QAQCPGM.sas	Processes SCADA data for upload to Hydstra, ftps data to ACOE, USF, TBW. Creates email of Tsala Apopka levels to news org. Manages file accumulations in several folders.	Text files, SAS files,	Daily	yes
EXEC	c:\scadasas\program\Rain_event_program_SASV9.2_v1.sas	Creates table and plot of rain totals on occasions when District rain gage totals are needed up to within an hour of report time.	Pdf file, email	as needed	no
EXEC	c:\scadasas\program\DailyHydroReport_SASV9.2_v1.sas	Creates tables of elevations for surface waters with structures, gage rainfall statistics on several time scales, and discharge of District rivers. Plots of daily rainfall, and annual river discharge.	Pdf file, email	Daily	yes
USGS	d:\gs_data\programs\DV_create_a_dataset_of_usgs_dv_data_v1.sas	Creates from scratch the USGS daily value data for all District USGS sites, and loads to Hydstra.	csv file	as needed	no
USGS	d:\gs_data\programs\WK_overlay_new_and_changed_data_to_Hydstra_v1.sas	Replaces USGS daily value data in Hydstra with any edited data flagged by USGS as changed or updated; includes new daily data values.	csv file	weekly	yes
USGS	d:\gs_data\programs\WK_run_usgsxml_v1.sas	Produces xml file for transfer of any changed USGS data to WMIS	SAS dataset, Hydstra updates	weekly	yes
USGS	d:\gs_data\programs\RT_create_a_dataset_of_hourly_usgs_data_v1.sas	loads daily realtime USGS data to Hydstra	SAS dataset, Hydstra updates	daily	yes
USGS	d:\gs_data\programs\MO_overlay_new_and_changed_data_to_Hydstra_v1.sas	loads monthly changes to USGS data (approval and value change) to SAS dataset, and then to Hydstra	SAS dataset, Hydstra updates	monthly	yes
USGS	d:\gs_data\programs\DV_lastmodified_create_a_dataset_of_usgs_dv_data_v1.sas	loads last modified data to Hydstra	SAS dataset, Hydstra updates	daily	yes
USGS	d:\gs_data\programs\RD_create_a_dataset_of_usgs_dv_data_v1.sas	loads recent daily values to Hydstra	SAS dataset, Hydstra updates	daily	yes
USGS	d:\gs_data\programs\GW and QW usgs get and load to hydstra_v1.sas	retrieves GW and QW manual USGS data to Hydstra	SAS dataset, Hydstra updates	monthly	no
HCR	I:\hydrodat\hydro\HCR_lakes\programs\HydroLakeLevels_SASV9.2_v1.sas	Hydrologic Conditions lakes levels report	pdf file, report	monthly	no
HCR	I:\hydrodat\hydro\HCR_lakes\programs\ProvisionalLakeReport_SASV9.2_v2.sas	Hydrologic Conditions lakes levels report (provisional lakes set)	pdf file, report		no
HCR	I:\hydrodat\hydro\HCR_springs\programs\load tampa bay water data.sas	Loads TBW springs data to Hydstra for HCR springs reporting	csv file	monthly	no
HCR	I:\hydrodat\hydro\HCR_springs\programs\HCR_springs_report_SASV9.2_v2.sas	Hydrologic Conditions springs report	pdf file, report	monthly	no
HCR	I:\hydrodat\hydro\HCR_streams\programs\Hydro_Report_Streamflow_SASV9.2_v1.sas	Hydrologic Conditions streamflow report	pdf file, report	monthly	no
HCR	I:\hydrodat\hydro\HCR_streams\programs\Provisional_Streamflow_Report_SASV9.2_v1.sas	Hydrologic Conditions streamflow report (provisional data)	pdf file, report	monthly	no
HCR	I:\hydrodat\hydro\HCR_streams\programs\60day_discharge_SASV9.2_v2.sas	60-day discharge for selected rivers	pdf file, report	monthly	no
HCR	I:\hydrodat\hydro\HCRrain\programs\create rainfall csv files v4.sas	produces .csv files summarizing period of record data for counties and regions	csv file	monthly	no
HCR	I:\hydrodat\hydro\HCRrain\programs\HCR_Rainfall_Report_by County_SAS9.2_v3.sas	Hydrologic Conditions rainfall report	pdf file, report	monthly	no
HCR	I:\hydrodat\hydro\HCRwells\programs\HCR_wells_by_County_SAS9.2_v2.sas	Hydrologic Conditions well levels report	pdf file, report	monthly	no

EXEC	I:\hydrodat\hydro\freeze_map\programs\Dover_Region_Freeze_Report_SASV9.2_v3.sas	produces Dover region well levels report during freeze events	pdf file, report	as needed	no
NEXRAD	I:\hydrodat\hydro\nexrad_recent\programs\batch_daily_data_from_vieux_ftp_site_SASV9.2_v1.sas	retrieves and loads daily rainfall totals for pixels in the District. 60-day period	SAS and MS Access datasets	daily	yes
NEXRAD	I:\hydrodat\hydro\nexrad_recent\programs\batch_15min_data_from_vieux_daily_xml_files.sas	saves individual daily 15-minute rainfall pixel totals to SAS datasets. 60-day period	SAS datasets	daily	yes
NEXRAD	I:\hydrodat\hydro\nexrad_recent\programs\Maintain_database_of_Vieux-reported_gage_errors.sas	Currently not used	text report	daily	yes
REG	I:\hydrodat\hydro\reg_rivers\programs\Regulatory_Rivers_Report_SASV9.2_v1.sas	produces Regulatory Rivers 8-week discharge report (4 production rivers)	pdf file, report	weekly	yes
REG	I:\hydrodat\hydro\reg_rivers\programs\7-day_Reg_Rivers_Report_SASV9.2_v2.sas	produces Regulatory Rivers 7-day discharge report	pdf file, report	weekly	yes
REG	I:\hydrodat\hydro\reg_rivers\programs\Regulatory_Rivers_Report_All_Rivers_SASV9.2_v3.sas	produces Regulatory Rivers 8-week discharge report (total 12 major rivers and streams)	pdf file, report	weekly	yes
REG	I:\hydrodat\hydro\recovery\programs\well_elevation_recovery_25th_pctl_SASV9.2_v2.sas	produces weekly aquifer recovery index report for wells in the District	text report	weekly	no
REG	I:\hydrodat\hydro\recovery\programs\make_recovery_map_SASV9.2_v1.sas	Map and symbols for individaul recovery well percentile rankings	pdf file, report	monthly	no
REG	I:\hydrodat\hydro\cume_rain\programs\6-Month Rainfall Totals Report_SASV9.2_v4.sas	cumulative 6-month rainfall totals report	pdf file, report	monthly	no
REG	I:\hydrodat\hydro\cume_rain\programs\12-Month Rainfall Totals Report_SASV9.2_v4.sas	cumulative 12-month rainfall totals report	pdf file, report	monthly	no
REG	I:\hydrodat\hydro\cume_rain\programs\24-Month Rainfall Totals Report_SASV9.2_v4.sas	cumulative 24-month rainfall totals report	pdf file, report	monthly	no
REG	I:\hydrodat\hydro\cume_rain\programs\36-Month Rainfall Totals Report_SASV9.2_v4.sas	cumulative 36-month rainfall totals report	pdf file, report	monthly	no
REG	I:\hydrodat\hydro\cume_rain\programs\48-Month Rainfall Totals Report_SASV9.2_v4.sas	cumulative 48-month rainfall totals report	pdf file, report	monthly	no
REG	I:\hydrodat\hydro\cume_rain\programs\60-Month Rainfall Totals Report_SASV9.2_v4.sas	cumulative 60-month rainfall totals report	pdf file, report	monthly	no
REG	I:\hydrodat\hydro\cume_rain\programs\1-10 year Rainfall Totals Report_SASV9.2_v4.sas	cumulative multiple year rainfall totals report	pdf file, report	monthly	no
HYDSTRA	I:\hydrodat\hydro\datareport\programs\elbus_upload.sas	uploads daily manual values from field tech Elbis laptops	csv file	daily	yes
QAQC	I:\hydrodat\hydro\datareport\programs\tech_site_completions_report_runs_from_elbusdata.sas	reports sample completion progress for manual sites by technician	pdf or text file report	daily	yes
HYDSTRA	h:\programs\Prepare_and_load_campbell_data_to_svrimp.sas	uploads Campbell data files to Hydstra	csv file	daily	yes
HYDSTRA	h:\programs\xml_filer\run_wknd_archxml_v2.sas	produces the .xml file of Hydstra archive file data for upload to WMIS	xml file	weekly	yes
HYDSTRA	h:\programs\xml_filer\run_weekly_commout_v3.sas	produces file of all comments for updating WMIS hydrologic data	csv file	weekly	yes
HYDSTRA	h:\programs\xml_filer\run_daily_tfilexml.sas	produces the .xml file of Hydstra t-file (provisional) data for upload to WMIS	xml file	daily	yes
REG	d:\event_intensity\programs\event rainfall comparator runs from scada data.sas (SCADA DATA)	compares rain event totals for varying periods to duration-frequency tables	pdf file, report	as needed	no
REG	d:\event_intensity\programs\event rainfall comparator runs from hydstra data.sas (HYDSTRA DATA)	compares rain event totals for varying periods to duration-frequency tables	pdf file, report	as needed	no
REG	d:\event_intensity\programs\event rainfall comparator runs from nexrad data.sas (NEXRAD DATA)	compares rain event totals for varying periods to duration-frequency tables	pdf file, report	as needed	no

DETAIL 14 - Additional Informational Resources

Buchanan, T.J., and Somers, W.P. 1984. Discharge Measurements at Gauging Stations. U.S. Geological Survey, Techniques of Water-Resources Investigations Book 3, Chapter A8

Cunningham, W.L., and Schalk, C.W., comps., 2011, Groundwater technical procedures of the U.S. geological Survey: U.S. Geological Survey Techniques and Methods 1-A1, 151 p.

Freedman, L.A., et al., 2004, Use of Submersible Pressure Transducers in Water-Resource Investigations, U.S. Geological Survey Techniques of Water-Resources Investigations, Book 8, Chapter A, 52 p.

Inter-District Data Collection Focus Group, St. Johns River Water Management District, South Florida Water Management District, Southwest Florida Water Management District, Guidelines for Collection of Hydrologic and Meteorologic Data, Volumes 1 (Field Applications) and Volume 2 (Data Management), 1994 and 2001

Office of Surface Water Technical Memorandum No. 2006.01 – Memorandum for Collection, Quality Assurance, and Presentation of Groundwater Data, 2005, U.S. Geological Survey, Water Resources Division

Sauer, V.B., and Turnipseed, D.P., 2010, Stage Measurement at Gaging Stations: U.S. Geological Survey Techniques and Methods book 3, chap. A7, 45 p.

Technical Procedure No. Q205, QA/QC of Groundwater Data Procedures, South Florida Water Management District, October 2006

Turnipseed, D.P., and Sauer, V.B., 2010, Discharge measurements at gaging stations: U.S. Geological Survey Techniques and Methods book 3, chap. A8, 87 p.

U.S. Bureau of Reclamation. 1997. Water Measurement Manual. U.S. Dept of the Interior, Bureau of Reclamation, Denver, Colorado

World Meteorological Organization, 1994, Guide to Hydrological Practices: Data Acquisition and Processing, Analysis, Forecasting and Other Applications, WMO-No. 168