SPECIFICATIONS OF WORK
PUMPHOUSE AND DISCHARGE OUTLET
INSTALLATIONS EW-1

Marathon Electric Manufacturing Company
Wasau, Wisconsin

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MARCH 1990
REF. NO. 2115(12)

CONESTOGA-ROVERS & ASSOCIATES

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APPENDIX A HEALTH AND SAFETY PLAN

SPECIFICATIONS OF WORK

SW-1 SITE LOCATION

The Site is located at the Marathon Electric Manufacturing Company, Wausau, Wisconsin.

SW-2 OVERVIEW

The Pumphouse and Discharge Outlet Installation to be implemented by Marathon is a system comprised of treatment and discharge of extracted groundwater the vicinity of the Marathon Manufacturing facility . The groundwater will be pumped from an existing well via a vertical turbine pump to a manhole and discharged from a manhole on to a section of riprap and exposed to the atmosphere prior to draining into the Wisconsin River now discharged to River.

SW-3 WORK INCLUDED

The Work to be performed under this Contract shall includes, but is not limited to the following:

1. Construction of cast-in-place concrete pump support for the vertical turbine pump.
2. Construction of cast-in-place concrete floor slab for the pump building complete with reinforcing sleeves, compacted sub-grade and integral grade beams.
3. Supply and installation of a fiberglass pump building, 7'9" x 14'0" x 7'8" minimum dimensions.
4. Supply and installation of a 48"ø precast concrete manhole with frame and cover to the existing 15" ø storm sewage system.
5. A 4' x 5' concrete discharge pad and surrounding rip rap.
6. Supply and installation of a 75 Hp vertical turbine pump on the existing 16" well casing.
7. Supply and installation of an 8"ø piping system from the turbine pump to the manhole complete with all pipe, valves, fittings, flanges, instruments, pipe supports, thrust blocks, anchors, seals, insulation and tie-bars.
8. Supply and installation of a 6"ø piping system from the 8" x 8" x 6" tee, complete with all fittings, flanges and insulation.
9. Supply and installation of a 480 volt electrical system consisting of a 3-phase, 480 volt feeder from the existing Marathon Electric building, a pump building disconnect, a meter socket, a 480 volt, 3"ø splitter, a 200A, 3 phase breaker, a 480 volt wye-delta motor starter, a 30A, 2 phase fused disconnect, a 480 volt 120/240 volt lightning transformer, a NBLP lightning panel and all associated wiring, wiring devices and mounting accessories.

10. Supply and installation of pump control panel wiring, building lights, exhaust fan and louver wiring, thermostat wiring, chromatox electric heater and wiring, and electrical trenching and duct bank.

Except for those materials, services and facilities which are specifically stated in the Specifications of Work as being supplied by Marathon, the Contractor shall provide and include in the rates entered in the Schedule of Prices for the execution of the whole of the Work completed in every respect in accordance with the Contract.

SW-4 WORK NOT INCLUDED

The following item of Work associated with this project do not form part of this Contract:

1. supply and installation of 16" ø extraction well casing.

SW-5 PRE-BID MEETING AND SITE VISIT

The Contractor shall be required to attend a pre-bid meeting and Site visit before submitting his bid and shall satisfy himself by personal examination as to the local conditions to be met with during the construction and conduct of the Work. Representatives of Marathon will be in attendance to discuss the Specifications of Work . The Contractor is not to claim at any time after submission of his bid that there was any misunderstanding of the terms and conditions related to the Site conditions or of the scope of work .

SW-6 STANDARD SPECIFICATIONS

Whenever a standard specification, code or recommended practice is referred to in the Project Specifications, it shall be the latest edition of that specification, code or recommended practice and it shall be considered to be a part of these documents insofar as it applies.

SW-7 SAFETY RULES

The Contractor and his Subcontractors shall abide by all Federal, State, municipal and local safety codes and by-laws and ensure that all personnel employed on the Site abide by those same codes and by-laws. In addition, all personnel working on site shall satisfy applicable OSHA health and safety training requirements. Personnel who have not successfully completed the required training will not be permitted to perform work at the Site. All work shall be conducted in accordance with the Health and Safety Plan presented in Appendix A.

SW-8 CONSTRUCTION SCHEDULE

The Contractor shall commence work on the Site within seven (7) calendar days of Contract award. The Contractor shall within seven (7) days submit a detailed construction schedule to the Marathon for approval showing the commencement and completion dates for all phases of the project.

BID SUMMARY SHEET

PUMPHOUSE AND DISCHARGE OUTLET INSTALLATION
MARATHON ELECTRIC MANUFACTURING COMPANY
WAUSAU, WISCONSIN

SECTION A:	PROJECT START-UP AND CLOSEOUT	$ _____
SECTION B:	PUMPHOUSE EW-1	$ _____
	TOTAL CONTRACT PRICE	$

The undersigned bidder proposes to perform the Work, furnish all materials, and complete the Work in its entirety in the manner and under the conditions required at the prices listed above.

Name of Bidder: _____

Signature of Authorized Officer: _____

Name and Title: _____

Witness: _____

Date: _____

SCHEDULE OF PRICES

Item	Description	Estimated Quantity	Unit	Unit Price	Total Price
A.	PROJECT START-UP AND CLOSEOUT				
A-1	Mobilization/Demobilization	--	L.S.	--	$
A-2	Implementation of Health and Safety Plan and provision of health and safety personnel protective equipment	--	L.S.	--	$
	TOTAL SECTION A				$

SCHEDULE OF PRICES

Item	Description	Estimated Quantity	Unit	Unit Price	Total Price
B.	PUMPHOUSE				
B-1	Pumphouse	--	L.S.	--	$
B-2	Mechanical Components For Pumphouse	--	L.S.	--	$
B-3	Electrical Components For Pumphouse	--	L.S.	--	$
B-4	Discharge Structure For Pumphouse	--	L.S.	--	$
B-5	Concrete Discharge Pad	--	L.S.	--	$
B-6	Riprap Discharge Structure	--	L.S.	--	$
	TOTAL SECTION B				$

FORM OF BID

SCHEDULE OF ADDITIONAL UNIT PRICES

The Contractor agrees to accept payment at the following Additional Unit Prices for work done and materials supplied if and when directed by the Engineer. The Unit Prices shall include material, plant, labor, repairs, fuel, maintenance, overheads, supervision and profit in accordance with the specifications.

Item	Description	Unit	Unit Price
1.	Superintendent	Hour	$_____
		Day	_____
		Week	_____
		Month	_____
2.	Foreman, including pick-up truck	Hour	$_____
		Day	_____
		Week	_____
		Month	_____
3.	Operator	Hour	$_____
		Day	_____
		Week	_____
		Month	_____
4.	Laborer	Hour	$_____
		Day	_____
		Week	_____
		Month	_____
5.	Tradesman		
	a) Electrician	Hour	$_____
		Day	_____
		Week	_____
		Month	_____
	b) Plumber	Hour	$_____
		Day	_____
		Week	_____
		Month	_____
	c) Carpenter	Hour	$_____
		Day	_____
		Week	_____
		Month	_____

d) Welder

Hour $_____
Day _____
Week _____
Month _____

6. Truck Driver

Hour $_____
Day _____
Week _____
Month _____

7. Office Engineer/Clerk

Hour $_____
Day _____
Week _____
Month _____

8. Surveyor

Hour $_____
Day _____
Week _____
Month _____

9. Low boy with tractor

a) 16 - 40 tons

Hour $_____
Day _____
Week _____
Month _____

b) 41 - 60 tons

Hour $_____
Day _____
Week _____
Month _____

10. Backhoe-Crawler mounted, hydraulically operated

a) Less than 2 c.y.

Hour $_____
Day _____
Week _____
Month _____

b) 2 to 2.5 c.y.

Hour $_____
Day _____
Week _____
Month _____

c) Greater than 2.5 c.y.

Hour $_____
Day _____
Week _____
Month _____

11. Front End Loader-Crawler mounted

a) less than 2 c.y.

Hour $_____
Day _____
Week _____
Month _____

b) 2 to 2.5 c.y.

Hour $_____
Day _____
Week _____
Month _____

c) Greater than 2.5 c.y.

Hour $_____
Day _____
Week _____
Month _____

12. Front End Loader-Wheel mounted

a) less than 2 c.y.

Hour $_____
Day _____
Week _____
Month _____

b) 2 to 2.5 c.y.

Hour $_____
Day _____
Week _____
Month _____

c) Greater than 2.5 c.y.

Hour $_____
Day _____
Week _____
Month _____

13. Tractor bulldozer crawler

a) less than 80 H.P.

Hour $_____
Day _____
Week _____
Month _____

b) 81 - 160 H.P.

Hour $_____
Day _____
Week _____
Month _____

c) 161 - 180 H.P.

Hour $_____
Day _____
Week _____
Month _____

d) Greater than 180 H.P.

Hour $_____
Day _____
Week _____
Month _____

14. Dump trucks

a) Single rear axle

Hour $_____
Day _____
Week _____
Month _____

b) Tandem rear axle

Hour $_____
Day _____
Week _____
Month _____

c) Tri rear axle

Hour $_____
Day _____
Week _____
Month _____

d) Tractor-Trailer

Hour $_____
Day _____
Week _____
Month _____

15. Crane-Crawler or Rubber Tired

a) Less than 15 Ton

Hour $_____
Day _____
Week _____
Month _____

b) 15 to 25 Ton

Hour $_____
Day _____
Week _____
Month _____

c) 26 to 50 Ton

Hour $_____
Day _____
Week _____
Month _____

d) 51 Ton to 100 Ton

Hour $_____
Day _____
Week _____
Month _____

16. Rubber tired tractor backhoe

a) 1/2 c.y. or less

Hour $_____
Day _____
Week _____
Month _____

b) 5/8 to 3/4 c.y.

Hour $_____
Day _____
Week _____
Month _____

c) Greater than 3/4 c.y.

Hour $_____
Day _____
Week _____
Month _____

17. Attachments to backhoes

a) HoePac compactor or equal

Hour $_____
Day _____
Week _____
Month _____

b) HoeRam breaker or equal

Hour $_____
Day _____
Week _____
Month _____

18. Compressor (Including Hoses)

a) less than 125 CFM

Hour $_____
Day _____
Week _____
Month _____

b) 125 to 175 CFM

Hour $_____
Day _____
Week _____
Month _____

c) 176 to 375 CFM

Hour $_____
Day _____
Week _____
Month _____

d) Greater than 375 CFM

Hour $_____
Day _____
Week _____
Month _____

19.	Farm tractor (all sizes)	Hour Day Week Month	$_____ _____ _____ _____
20.	Generator		
	a) less than 5 KVA	Hour Day Week Month	$_____ _____ _____ _____
	b) 5 to 15 KVA	Hour Day Week Month	$_____ _____ _____ _____
	c) Greater than 15 KVA	Hour Day Week Month	$_____ _____ _____ _____
21.	Personnel Protection Equipmment		
	a) Level D personnel protection equipment	Day	$_____
	b) Level C personnel protection equipment	Day	$_____

The prices submitted in this Schedule of Additional Unit Prices do not affect the Contractor's bid price for the Works. The Owner reserves the right to delete any price from the Schedule of Additional Unit Prices that in the opinion of the Owner is unbalanced or excessive; in such case work done under the item deleted will be negotiated with the Owner.

LIST OF SUBCONTRACTORS

The following is a list of Subcontractors or Subtrades together with a description of the items showing the portion of the Works to be undertaken by each.

	NAME	ADDRESS	ITEM DESCRIPTION
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			

The employment of Subcontractors or Subtrades other than those listed above will not be permitted without written approval from the Engineer. Information indicating how the Subcontractors or Subtrades listed above qualify in experience and background may be requested by the Engineer before award of the Contract.

DATED THIS _____ DAY OF _____, 19___

_____ _____

Signature of Witness

Signature of Authorized Person signing for Contractor

PROJECT SPECIFICATIONS

Ps.1 SUMMARY OF WORK

Ps.1.01 DESCRIPTION OF PROJECT

The work consists of the installation of a Groundwater Extraction Pump and Pumphouse complete with controls at the location of an existing extraction well; the installation of a discharge manhole, installation of a forcemain and associated piping; and construction of an outfall structure at the existing storm sewer discharge to the Wisconsin River. It is to be noted that the work shall be conducted in accordance with the Health and Safety Plan presented in Appendix A.

Ps.1.02 LOCATION

The Site is located along the west side of the Wisconsin River within the City of Wausau, Wisconsin, on the Marathon Electric property at 100 East Randolph Street.

Ps.1.03 ACCESS TO SITE

Access to the Site is via Cherry Street.

Ps.1.04 DESCRIPTION OF THE WORKS

The Works to be performed under this Contract include but are not limited to the following:

1. mobilization of all material, equipment, plant, and personnel necessary to perform the Works;
2. supply and installation of the specified pumphouse and concrete foundation base at the extraction well location;
3. supply and installation of a vertical turbine pump, controls, valves, pipe, and appurtenances for the extraction well;
4. supply and installation of effluent discharge manhole for the existing 15-inch diameter storm sewer discharge sewer adjacent to the extraction well;
5. trenching backfilling and restoration for installation from the pumphouse to the manhole of a forcemain;
6. supply and installation of all wiring and instrumentation for the system; and
7. all other related and associated work as shown on the Drawings and specified herein.

Ps.2 GENERAL REQUIREMENTS

Ps.2.01 EXISTING UTILITIES

It shall be the contractor's responsibility to field verify all existing utilities.

Existing aboveground utilities including but not limited to power transmission and distribution, telegraph, telephone, if shown on the Drawings or if easily identified, shall, at the Contractor's expense, be maintained, relocated, rerouted, removed and restored as may be necessary by the Contractor.

Existing major underground utilities and appurtenant structures whether shown on the Drawings or not shall, at the Contractor's expense, be maintained and restored by the Contractor.

Minor underground utility service lines adjacent to the Site, including but not limited to sanitary sewer services, gas services, water services, house or yard drains, and electric, cable television, or telephone services, shall be maintained, relocated, rerouted, removed and restored by the Contractor with the least possible interference with such services and in no case shall the interference of such service lines be considered for extra compensation under any of the special cases listed above. It is not anticipated that any of these utilities exist in the proposed work zone, but shall be Contractor field verified.

The right is reserved by owners of public utilities and franchises to enter upon any street, road, right-of-way, or easement for the purpose of maintaining their property during performance of the Works and for making necessary repairs caused by the work. The costs thus incurred shall be paid by the Contractor.

Ps.2.02 RESTORATION OF STRUCTURES AND SURFACES

A. STRUCTURES

The Contractor shall remove such existing structures as may be necessary for the performance of the Works, and shall rebuild the structures thus removed in as good a condition as found with minimum requirements as herein specified. The Contractor shall also repair all existing structures which may be damaged as a result of the Works.

B. CURBS, GUTTERS, DRIVEWAYS AND SIDEWALKS

All curbs, gutters, driveways, sidewalks and similar structures that are broken or damaged by the installation of the work, unless shown otherwise, shall be reconstructed by the Contractor. Reconstruction shall be of the same kind of material with the same finish, and in not less than the same dimensions as the original work. All concrete shall be as specified by Marathon if required. Repairs shall be made by removing and replacing the entire portions between joints or scores and not merely refinishing any damaged part. All work shall match the appearance of the existing improvements as nearly as possible.

C. ROADS AND STREETS

All on-Site roads and streets in which the surface is removed, broken or damaged, or in which the ground has caved or settled due to work under this Contract, unless shown otherwise, shall be completely resurfaced and brought to the original grade unless otherwise indicated. Before resurfacing material is placed, edges of pavements shall be trimmed back far enough to provide clean, solid, vertical faces, and shall be free of any loose material. Roadways other than the special haul routes shown on the Drawings used by the Contractor for hauling materials, equipment, supplies, etc., shall be cleaned and repaired if the condition of the roadway is damaged or otherwise affected due to the Contractor's operations. These requirements are considered the Contractor's responsibility.

D. CULTIVATED AREAS AND OTHER SURFACE IMPROVEMENTS

All cultivated areas, either agricultural or lawns, and other surface improvements which are damaged by actions of the Contractor, unless otherwise shown, shall be restored as nearly as possible to their original condition. Altering of original conditions during restoration may be done only on written approval of Marathon.

E. EXISTING STAKES AND MARKS

All section, section subdivision, plot, U.S.E.D, U.S.C. & G.S., U.S.G.S. and other official monuments or bench marks shall be carefully preserved or replaced. In the event any such monument or marker is disturbed as a result of the Contractor's operations, the Contractor shall replace or reset such monument or marker in a manner satisfactory to Marathon. Replaced or reset monuments shall be of acceptable type and quality and shall be located so as to clear existing utilities or any other interferences. They shall be placed in a manner consistent with good and recognized engineering and surveying practice by a licensed surveyor.

Ps.2.03 COORDINATION WITH OTHER CONTRACTORS

The Contractor is advised that Other Contractors may be working on the Site. The Contractor shall cooperate with and coordinate his activities with all other on-Site contractors. No additional payment will be made for delays, changes in schedule, or any other work due to the fact that Other Contractors are working on Site.

Ps.3 CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

Ps.3.01 WORKING AREAS

Designated areas will be available at the Site for the Contractor's storage as required during performance of the Works. No other areas on the Site shall be used by the Contractor.

Additional areas required on the Site by the Contractor for any purpose shall be developed by the Contractor at his own expense subject to Marathon's approval.

Ps.3.02 DEWATERING

The Contractor shall employ construction methods, plant, procedures and precautions that ensure the Works including excavations are stable, free from disturbance and dry.

Construction methods may include but are not limited to: sheeting and shoring; groundwater control systems; surface or free water control systems employing ditches, diversions, drains, pipes and/or pumps; and any other measures necessary to enable the whole of the Works to be carried out in the dry.

The Contractor shall control surface drainage including ensuring that gutters are kept open at all times, water is not directed across or over pavements or sidewalks except through approved pipes or properly constructed troughs and runoff from unstabilized areas is intercepted and diverted to a suitable outlet approved by Marathon.

Ps.3.03 DUST CONTROL

The Contractor shall implement dust control measures as required and as determined by Marathon to prevent generation of dust from construction activities. Dust control measures shall be available at all times during construction. Water used for dust control measures must be from an approved potable water source.

Ps.3.04 CONSTRUCTION UTILITIES AND MISCELLANEOUS FACILITIES

A. POWER

The Contractor shall provide at his own expense all necessary power.

B. WATER

The Contractor shall provide at his own expense a potable water supply.

C. SANITARY FACILITIES

Marathon shall make available sufficient sanitary facilities for the Contractor.

D. PARKING

The Contractor shall maintain Contractor parking areas as approved by Marathon.

E. TEMPORARY HEATING

The Contractor shall provide at his own expense, temporary heating, covering and enclosures as necessary, to protect all work and material against damage by dampness and cold and to facilitate completion of the Works. The Contractor shall supply all labor, fuel, equipment and material required for temporary heating.

F. GUARDRAILS AND BARRICADES

Guardrails shall be maintained and barricades shall be erected around all excavations, open trenches and active work areas as approved by Marathon. The Contractor shall provide, erect and remove all barricades and maintain guardrails as required for the performance of the Works.

Ps.4 PROJECT START-UP AND CLOSEOUT

Ps.4.01 EXECUTION

A. MOBILIZATION/DEMOBILIZATION

The Contractor shall mobilize all workers, equipment, plant, and material to the Site, provide all Contractor required temporary facilities and services necessary for the performance of the Works furnish bonds, insurance, and necessary permits following mobilization and prior to commencing any activities at the Site, and removing all equipment, temporary facilities and services and materials from the Site upon completion of the Works.

B. IMPLEMENTATION OF HEALTH AND SAFETY PLAN AND PROVISION OF HEALTH AND SAFETY PERSONNEL PROTECTIVE EQUIPMENT

The Contractor shall implement and conduct all Works in accordance with the site specific Health and Safety Plan (see Appendix A) and provide all Contractor required health and safety personnel protection equipment necessary to complete the Works.

The following levels of heath and safety equipment shall be utilized, at a minimum, for completion of the Works:

1. Pumphouse Installation - Level E
2. Discharge and Manhole Installation - Level E
3. Discharge Pipe Installation - Level E
4. Placement of Concrete Pad and Rip Rap - Level E

It is to be noted that the levels of health and safety personnel protection equipment may be required to be upgraded to Level D or Level C, as specified for the individual task, in the Health and Safety Plan (see Appendix A).

Ps.4.02 MEASUREMENT AND PAYMENT

A. MOBILIZATION/DEMOBILIZATION

Payment for mobilization/demobilization will be made at the lump sum price bid in the Form of Bid for Item A-1 which price and payment shall be full compensation for furnishing bonds and insurance and permits; movement of all equipment and materials to the Site, including all Contractor required facilities; supply and installation of all Contractor required services; and all other miscellaneous items for which separate payment is not provided under other Items.

B. IMPLEMENTATION OF HEALTH AND SAFETY PLAN AND PROVISION OF HEALTH AND SAFETY PERSONNEL PROTECTIVE EQUIPMENT

Payment for the implementation of the Health and Safety Plan and provision of health and safety personnel protection equipment will be made at the lump sum price stipulated in the Form of Bid for Item A-2 which price and payment shall be full compensation for implementation of the Health and Safety Plan; providing and

maintaining personnel health and safety equipment; and all other miscellaneous items for which separate payment is not provided under other Items.

Payment for increase in personnel health and safety equipment will be made at the unit price per day stipulated in the Schedule of Additional Unit Prices for Item 21 which price and payment shall be full compensation per day to be added to Item A-2 for increase in the level of personnel protection equipment required.

Ps.5 EXCAVATION, TRENCHING AND BACKFILLING

Ps.5.01 GENERAL

A. DESCRIPTION

1. Work Included

Work of this Section consists of the following items of work:

1. Trenching within the Works to the lines, grades and dimensions as specified and as shown on the Drawings and disposing of excess or unsuitable materials, as directed by Marathon;

2. Supply and placement of imported bedding material to the lines, grades and dimensions as specified and as shown on the Drawings; and

3. Backfilling with imported and/or native material, to the lines, grades and dimensions as shown on the Drawings and as specified herein.

2. Terminology

Common excavation shall mean excavation of materials of whatever nature encountered, including dense tills, hardpan, frozen materials and partially cemented materials which can be ripped and excavated with heavy construction equipment.

Limit of excavation shall refer to the maximum amount of excavation necessary to construct the final work to the lines, grades and dimensions shown or implied on the Drawings and as specified herein.

Ps.5.02 PRODUCTS

A. GENERAL

1. Sources

All material provided under this Section shall be from a source or sources approved by Marathon.

2. Unsuitable Material

All material provided under this Section shall be free of unsuitable materials as determined by Marathon. Unsuitable materials include the following:

1. material containing loam, roots or organic matter;

2. frozen material or material containing snow or ice;

3. clays which are classified as inorganic clays of high plasticity in accordance with ASTM D2487;

4. soft and/or organic clays and silts of low strength;

5. frost susceptible silts or clays;

6. swelling clays;

7. rock and lumps of material with dimensions greater than 1/3 of the specified layer thickness before compaction;

8. trees, stumps, branches, or any other wood or lumber; and

9. wire, steel, cast iron, cans, drums or any other foreign materials.

B. BACKFILL

Approved native material free of unsuitable material shall be used as backfill unless specified otherwise.

C. COMMON FILL

Common fill if required, shall be a clean, well graded imported sand or gravel fill free of unsuitable material. The maximum aggregate size shall be 1 1/2 inches measured through any axis.

D. BEDDING

Bedding for forcemain shall be clean imported sand material with 100 percent passing a 3/8-inch sieve and 0 to 15 percent passing a Number 200 sieve, as approved by Marathon.

E. TYPE 1 FILL

Type 1 fill if required, shall be clean, hard, durable crushed gravel or stone, free from shale, clay, friable materials, organic matter and other deleterious substances and graded within the following limits when tested to ASTM C136 and ASTM C117 and giving a smooth curve without sharp breaks when plotted on a semi-log grading chart in accordance with ASTM E11:

ASTM Sieve Designation	*% Passing*
1"	100
3/4	75-100
3/8	50-100
No. 4	30-70
No. 10	20-45
No. 40	10-25
No. 200	3-8

Ps.5.03 EXECUTION

A. GENERAL

1. Existing Buried Utilities and Structures

The size, depth and location of existing utilities and structures as shown on the Drawings are approximate and are for guidance only. Completeness and accuracy of this information are not guaranteed.

Prior to commencing any excavation work, the Contractor shall notify applicable owners or authorities, and establish location and state use of buried utilities and structures. The Contractor shall clearly mark such locations to prevent disturbance during work.

The Contractor shall confirm locations of buried utilities and structures by careful test excavations and/or other suitable means.

The Contractor shall maintain and protect from damage, water, sewer, gas, electric, telephone and other utilities and structures encountered. The Contractor shall obtain direction from Marathon before moving or otherwise disturbing utilities or structures.

2. Existing Buildings and Surface Features

The Contractor shall conduct, with Marathon, a condition survey of existing trees and other plants, grassed areas, fencing, service poles, wires, rail tracks and paving, survey bench marks and monuments which may be affected by the Work.

The Contractor shall protect existing buildings and surface features which may be affected by the work from damage while work is in progress and repair damage resulting from work to Marathons approval.

Where excavation necessitates root or branch cutting, the Contractor shall do so only as approved by Marathon.

3. Environmental Requirements

The Contractor shall dewater excavations in accordance with Section Ps.3.02. Water shall be disposed of as directed by Marathon. Water shall not be disposed of in a manner which may be detrimental to public and/or private property, or to any portion of the work completed or under construction.

Open excavations shall be protected against damage due to surface run-on and runoff. The Contractor shall take all necessary precautions to prevent erosion of excavated or disturbed surfaces.

B. PREPARATION

Six inches of surficial soil or gravel, if present, shall be removed from the trenching area and stockpiled adjacent to the effected area for subsequent placement following backfilling.

The Contractor shall remove obstructions, ice and snow, from surfaces to be excavated, within the limits shown on the Drawings or as required to construct the finished Works as shown on the Drawings. The Contractor shall cut and remove pavement or sidewalk neatly along the limits of proposed excavation and dispose.

The Contractor shall obtain Marathon's approval of completed excavations prior to commencement of installations, bedding, or backfilling.

C. PERFORMANCE

1. Excavation and Trenching

The Contractor shall excavate to lines, grades, elevations and dimensions as shown on the Drawings and as required to complete the work. Concrete, masonry, paving, walks and other obstructions encountered during excavation shall be removed and disposed of as directed by Marathon.

The Contractor shall not leave any sections of the trench open at the end of each day's operation; open trenches shall be backfilled at the end of each day.

The limits of excavation shall be left undisturbed, evenly graded, and free of loose, soft or organic matter. The Contractor shall advise Marathon when soil at the bottom of the trench appears unsuitable for the proposed installation.

Where unauthorized, over-excavation has occurred, the Contractor shall correct such over-excavation to the satisfaction of Marathon, at no additional cost to Marathon. Correction of over-excavation may include placement of concrete or compacted granular backfill as directed by Marathon.

During all excavation and trenching activities air monitoring shall be conducted using a photoionization detector (PID) for organic vapors. All excavated materials shall be screened using a PID for organic vapors to determine its suitability as backfill material. Excavated materials that yield vapor readings greater than background levels shall be collected and placed in containers for ultimate off-site disposal. Appropriate containers shall be supplied by Marathon and all off-site disposal of contaminated materials shall be conducted by Marathon, in compliance with local, state and federal regulations. Excavated materials that do not exhibit vapor readings greater than background readings (clean materials) shall be used as backfill material, if suitable. The Contractor shall dispose of clean surplus excavated material off site.

2. Bedding

The forcemain trench shall be backfilled for the specified depth below the invert of the pipe with imported bedding as specified in Section Ps.5.02.D prior to placement of pipe in the trench. Bedding material shall be placed in maximum 6-inch lifts and compacted to 95% Standard Proctor Density. Bedding material shall be placed to the specified depth above the top of the pipe as specified above and in accordance with Section Ps.5.02.D.

3. Backfilling

The Contractor shall not proceed with backfilling operations until Marathon has inspected and approved the work.

All excavations shall be free from debris, snow, ice, water or frozen ground prior to commencement of backfilling.

The Contractor shall backfill around subsurface installations as follows:

1. bedding material shall be placed as specified for the installation.

2. backfill shall not be placed around, over or adjacent to cast-in-place concrete within 72 hours of placing concrete.

3. layers shall be placed simultaneously, on all sides of the installed work, to equalize loading.

4. material shall be placed by hand, under, around and over installations until a minimum of two feet of cover is provided; backfill shall not be dumped directly on installations.

5. backfill material originating from the excavation will be screened using a PID to determine its suitability as backfill material. Only clean backfill material (i.e. excavated material that does not exhibit vapor readings greater than background readings) or clean imported material may be used for backfilling.

The Contractor shall place backfill in uniform layers not exceeding six inches compacted thickness. Each layer shall be compacted to a minimum of 95% Standard Proctor Density before successive layers are placed.

Ps.6 CAST-IN-PLACE CONCRETE

Ps.6.01 GENERAL

A. DESCRIPTION

1. Work Included

Work of this Section consists of all labor and material required for mixing, proportioning, testing, placing and reinforced cast-in-place concrete including forming, reinforcing, curing and related work, for the pumphouse foundation slabs.

Ps.6.02 PRODUCTS

A. CEMENT

Standard Portland Cement, conforming to ASTM C150, Type II.

B. AGGREGATE

i) Coarse:

Normal weight, conforming to ASTM C33. Aggregate to be hard, durable, uncoated, uncracked gravel free from loam, silt, clay and foreign matter, with specific gravity approximately 2.62.

ii) Fine:

Clean, hard, durable uncoated grains, free from loam, silt and clay, and conforming to ASTM C33.

C. ADMIXTURES

i) Air Entraining Agent:

Conforming to ASTM C260. "Darex AEA" (W.R. Grace Co.) or MB-AE10 (Master Builders) or approved equal.

ii) No other admixtures will be permitted. In particular calcium chloride based compounds are specifically barred.

D. REINFORCING STEEL

Grade 60, new billet steel conforming to ASTM A615.

E. ANCHOR BOLTS

Carbon steel conforming to ASTM A36 with heavy hex heads.

F. STEEL FABRIC

Steel fabric for concrete reinforcement shall conform to the requirements of AASHTO M 55 or M 221 for plain or deformed wire as specified, with the exception that oversize wire may be permitted, in which case the limitation on the difference between the maximum and minimum diameters shall not apply. Unless otherwise specified the fabric may be furnished in either flat sheets or rolls.

Ps.6.03 EXECUTION

A. PROPORTIONING OF CONCRETE

All concrete for all parts of the work shall be of the specified quality capable of being placed without excessive segregation, and when hardened, of developing all characteristics required by these specifications.

All concrete used shall be 3,500 psi.

Entrained air content to be 6% $\pm$ 1% by volume.

At least 90% of the design water must be added at the concrete batch plant.

Slump shall be 4"$\pm$ 1/2 inch.

All concrete must be delivered to the site between 60° and 80° F.

B. FORMWORK

Forms shall be designed, constructed, installed and maintained so as to ensure that after removal of forms, the finished concrete will have true surfaces free of waviness or bulges, conforming accurately to the indicated shapes, dimensions, lines, and elevations. Form surfaces that will be in contact with concrete shall be thoroughly cleaned before each use.

C. CONCRETE PLACEMENT

Concrete shall be placed in accordance with AC1 304 and as specified herein.

i) Preparation for Placing

All hardened concrete, debris and foreign materials shall be removed from the interior of forms and from inner surfaces of mixing and conveying equipment. Reinforcement shall be secure in position, and shall be inspected and approved by Marathon before placing concrete. Runways shall be provided for wheeled concrete-handling equipment; such equipment shall not be wheeled over reinforcement nor shall runways be supported on reinforcement.

ii) Placing Concrete

Concrete shall be handled from mixer to transport vehicle to place of final deposit in a continuous manner, as rapidly as practicable, without segregation or loss of ingredient until the approved unit of operation is completed. Placing will not be permitted when the sun, heat, wind, or limitations of facilities furnished by the Contractor prevent proper finishing and curing of the concrete unless the Contractor conforms to ACI 306 for cold weather placement or to ACI 305 for hot weather placement. Concrete shall be placed in the forms, as close as possible in final position in uniform approximately horizontal layers not over 12 inches deep. Forms splashed with concrete which subsequently hardens and reinforcement splashed with concrete which subsequently hardens or form coating, shall be cleaned in advance of placing subsequent lifts. Concrete shall not be allowed to drop freely more than 5 feet in unexposed work nor more than 3 feet in exposed work. Conduits and pipes shall not be embedded in concrete unless specifically indicated.

D. COMPACTION

Immediately after placing, each layer of concrete shall be compacted by internal concrete vibrators supplemented by hand-spading, rodding and tamping.

E. FINISHES FOR EXPOSED EDGES

Provide 1 inch chamfer where specifically designated on Drawings.

Except where chamfer is called for, edge-tool top horizontal edges of all exposed structures.

Remove fins, burrs, honeycombs and patch voids or irregularities in all other exposed vertical edges.

Provide smooth form finish for formed concrete surfaces that are exposed to view.

F. CURING - SEALING

Concrete shall be maintained in a moist condition at temperatures above 40°F for a minimum of 7 days. Concrete shall be protected from rapid temperature change and rapid drying for the first 72 hours following the removal of temperature protection. Curing activities shall be started as soon as free water has disappeared from the surface of the concrete after placing and finishing.

i) Moist Curing

Unformed surfaces shall be covered with burlap or mats, wetted before placing and overlapped at least 6 inches. Burlap or mats shall be kept continually wet and in intimate contact with the surface. Where formed surfaces are cured in the forms, the forms shall be kept continually wet. If the forms are removed before the end of the curing period, curing shall be continued as on unformed surfaces, using suitable materials. Burlap shall be used only on surfaces that will be unexposed in the finished work and shall be in two layers.

ii) Membrane-Forming Compound Curing

The compound shall be applied on damp surfaces as soon as the moisture film has disappeared. The curing compound shall be applied by power spraying equipment using a spray nozzle equipped with a wind guard. The compound shall be applied in a two-coat, continuous operation at a coverage of not more than 400 square feet per gallon for each coat. When application is made by hand sprayers, the second coat shall be applied in a direction approximately at right angles to the direction of the first coat. The compound shall form a uniform, continuous, adherent film that shall not check, crack or peel, and shall be free from pinholes or other imperfections. Surfaces subjected to rainfall within 3 hours after compound has been applied, or surfaces damaged by subsequent construction operations within the curing period shall be immediately resprayed at the rate specified above. Where membrane forming curing compounds are permitted, permanently exposed surfaces shall be cured by use of a nonpigmented membrane-forming curing compound containing a fugitive dye. Where nonpigmented-type curing compounds are used, the concrete surface shall be shaded from the direct rays of the sun for the curing period. Surfaces coated with curing compound shall be kept free of foot and vehicular traffic and from other sources of abrasion and contamination during the curing period.

G. TESTING AND INSPECTION

Materials and operations shall be tested and inspected as work progresses. Failure to detect defective work shall not present rejection when defect is discovered, nor shall it obligate Marathon for final acceptance.

Testing agencies shall meet the requirements of "Recommended Practice for Inspection and Testing Agencies for Concrete and Steel in Construction" ASTM E329.

The following tests shall be performed by a qualified testing firm retained by the Contractor and subject to the approval of Marathon and all tests shall be paid for by the Contractor:

i) Secure composite samples in accordance with "Method of Sampling Fresh Concrete" ASTM C172;

ii) Mold and secure specimens from each sample in accordance with "Method of Making and Curing Concrete Test Specimens in the Field" ASTM C31;

iii) Test specimens in accordance with "Method of Test for Compressive Strength of Molded Concrete Cylinders" ASTM C39. Two specimens shall be tested at 7 and 28 day strengths;

iv) Make one strength test for each 50 cubic yards or fraction thereof, (or as directed by Marathon) of each mix design of concrete placed in any one day;

v) Determine slump for each strength test. The slump tests shall be determined at the beginning of each, the middle of, and the end of a particular mixer/agitator truck which is selected for testing. In addition, slump tests shall be taken whenever the consistency of the concrete seems to vary at the discretion of

Marathon. The slump shall be determined using the "Method of Test for Slump of Portland Cement Concrete" (ASTM C143);

vi) Determine total air content of normal weight concrete sample for each strength test, in accordance with "Method of Test for Air Content of Freshly Mixed Concrete by the Pressure Method" ASTM C231 or "Method of Test for Air Content of Freshly Mixed Concrete by the Volumetric Method" ASTM C173.

vii) Determine temperature of concrete sample and mixing water for each strength test, daily and as required by Marathon. Determine the temperature of aggregates, cement water and the mixture thereof at the batch plant and as required by Marathon.

H. DEFECTIVE WORK

Concrete work which does not conform to the specifications including strength, tolerances and finishes shall be corrected at the Contractor's expense. The shall be responsible for the cost of rectification of any items of work affected by or resulting from the corrections to the concrete work.

Ps.7 DISCHARGE STRUCTURE

Ps.7.01 GENERAL

A. DESCRIPTION

1. Work Included

This work shall consist of the supply and installation of the discharge structure (manhole), forcemain from the pumphouse to the manhole, concrete discharge pad, installation of rip rap and all trenching and backfilling.

Ps.7.02 PRODUCTS

A. DISCHARGE MANHOLE

1. Precast Concrete

Chambers shall consist of precast reinforced concrete sections complying with ASTM C478. Where specified, manholes shall have precast concrete bases placed on 6 inches of dry mix concrete extending 12 inches beyond the outside diameter of the base. Cement shall be Type III in accordance with ASTM C150. Concrete strength shall be 3000 psi.

2. Joints

Joints between precast sections shall be watertight and shall consist of manufacturer's rubber ring gaskets.

3. Ladder Rungs

Ladder rungs shall be 3/4 inch diameter deformed rail steel bars complying with ASTM A615, hot dipped galvanized after fabrication in accordance with ASTM A123, with safety pattern, drop step type and shall be cast integral with the precast concrete units.

4. Adjusting Rings

Adjusting rings shall be Moduloc adjustment units. Adjustment units shall be placed no more than three rows high and no less than two rows high.

5. Frame and Cover

Frame and cover shall be fabricated as shown on the Drawings. Cover shall bear evenly on frame.

6. Concrete "Splash" Pad

A concrete "splash" pad shall be installed within the manhole also as specified in Section Ps.6 and on the Drawings.

B. CONCRETE DISCHARGE PAD

All materials to be used for the supply and installation of the concrete discharge pad shall be as shown on the Drawings and as specified in Section Ps.6.

C. RIP RAP

Rip Rap shall be 8-inch nominal diameter, placed 1 foot thick and shall be of a material approved by Marathon. The Rip Rap shall be underlain with geotextile fabric as shown on the Drawings.

Ps.7.03 EXECUTION

A. MANHOLE EXCAVATION AND BACKFILLING

Unless otherwise specified or indicated, all excavating and backfilling shall be executed as specified in Section Ps.5 and on the Drawings.

B. MANHOLE

The manhole shall be installed in accordance with details shown on the Drawings. The concrete base shall be installed in accordance with Section Ps.9 and the details shown on the Drawings.

C. INSTALLING CONCRETE DISCHARGE PAD

The 6-inch thick concrete discharge pad shall be installed as shown on the Drawings and as specified in Section Ps.6.

D. INSTALLING RIP RAP

Excavate a trench in accordance with the dimensions shown on the Drawings. Place rip rap on filter fabric as shown on the Drawings and in a careful manner to avoid damaging the fabric. Do not operate equipment directly on the fabric.

Place rip rap in accordance with thickness and details shown on the Drawings using suitable methods so that rip rap does not mix with or damage foundation material and to ensure minimum breakage of individual pieces.

Place rip rap in an approved manner to secure surface and to provide a stable mass. The finished surface shall be stable, reasonably firm, free from bumps or depressions with no excessively large cavities below or individual rock pieces projecting above the general surface.

Ps.7.04 MEASUREMENT AND PAYMENT

A. DISCHARGE STRUCTURE FOR PUMPHOUSE

Payment for Discharge Structure will be made at the lump sum price stipulated in the form of bid for Item B-4, which price and payment shall be full compensation for supplying all labor, plant, materials and equipment required to excavate; supply and placement of backfill; supply and installation of the discharge manhole; and all other miscellaneous items for which separate payment is not provided under other Items.

B. CONCRETE DISCHARGE PAD

Payment for concrete discharge pad will be made at the lump sum price stipulated in the Form of Bid for Item B-5, which price and payment shall be full compensation for supplying all labor, plant, equipment and materials required to excavate; supply and compact bedding material, construction of concrete pad; and all other miscellaneous items for which separate payment is not provided under other Items.

C. RIP RAP

Payment for rip rap will be made at the lump sum price stipulated in the Form of Bid for Item B-6, which price and payment shall be full compensation for supplying all labor, plant, equipment and materials required to excavate; supply and place filter fabric; supply and place rip rap; restoration; and all other miscellaneous items for which separate payment is not provided under other Items.

Ps.8 PUMPHOUSE

Ps.8.01 GENERAL

A. DESCRIPTION

1. Work Included

Work of this Section consists of the supply and installation of a pumphouse as specified and as shown on the Drawings.

Ps.8.02 PRODUCTS

A. GRAVEL BASE

The base for the pumphouse foundation slab shall meet the following gradation requirements.

Sieve Size	% Passing by Weight
2 inch	100
1/4 inch	30-65
No. 40	5-40
No. 200	0-10

All material furnished shall be well graded from coarse to fine and free from organic or other deleterious materials.

B. CONCRETE FOUNDATION SLAB

All materials to be used for the supply and installation of the concrete foundation slab shall be as shown on the Drawings and as specified in Section Ps.6.

C. PUMPHOUSE SHELTER

The pumphouse shelter shall be a prefabricated fiberglass shelter as produced by Warminster Fiberglass Co., Southampton, Pa. The shelter shall be Model No. WFS1008 7'-9"x14'-0" wide and green in color. A fiberglass reinforced plastic single door 2'-6" x 6'-4" shall be on the 6'-0" side and mounted with stainless steel piano hinges. The door shall have a 2 point latch with lock, neoprene sponge gaskets, and a plated stop chain. The shelter shall also contain a neoprene sponge floor gasket, and two cadmium plated lifting eyes. The shelter shall be fully insulated with one inch thick rigid polyurethane closed cell foam insulation.

The standard shelter shall be modified as follows:

i) One shop fabricated, 3-foot x 3-foot square access opening shall be installed directly above the well casing. The access hatch shall be sealed with neoprene gaskets all around and bolted to the shelter roof with stainless steel hardware. The hatch shall be made of the same material as the shelter.

Ps.8.03 EXECUTION

A. PLACING GRAVEL BASE

The 12-inch thick gravel base shall be placed in maximum 6-inch lifts to the lines and grades as shown on the Drawings. The gravel base shall be fully and evenly compacted to 95% Standard Proctor Density.

B. INSTALLING CONCRETE FOUNDATION SLAB

The 6-inch thick concrete foundation slab shall be installed as specified in Section Ps.6 and as shown on the Drawings.

C. PUMPHOUSE INSTALLATION

The pumphouse shall be secured to the concrete slab by bolting the floor flange to the concrete anchor bolts as shown on the Drawings and specified herein. The floor gasket shall be placed continuously around the perimeter of the slab to match the shelter floor flange. The shelter shall be carefully placed and aligned on the slab without imposing unnecessary loads or stress on the structure.

Ps.8.04 MEASUREMENT AND PAYMENT

Payment for the Pumphouse will be made at the lump sum price stipulated in the Form of Bid for Item B-1 which price and payment shall be full compensation for supplying all labor, plant, materials and equipment required to perform excavation if needed; supply and placement of bedding and backfill; construction of a concrete slab; design, supply and installation of the prefabricated pumphouse building; and all other miscellaneous items for which separate payment is not provided under other Items.

Ps.9 MECHANICAL COMPONENTS FOR PUMPHOUSE

Ps.9.01 GENERAL

A. DESCRIPTION

1. Work Included

Work of this Section consists of the supply and installation of mechanical components for the pumphouse as specified and as shown on the Drawings.

Ps.9.02 PRODUCTS

A. DEEP WELL PUMP

1. SCOPE

The Deepwell Turbine Pump covered by these specifications shall be Byron Jackson or equal and have its driving motor mounted at the surface. The pump shall operate in accordance with the following conditions and specifications: Efficiency of the pumping unit shall be as high as practicable consistent with good over-all design and shall not depend on design features which will not stand up under normal service.

(Similar pumps made by other approved manufacturers will be considered on substitution basis. Base bid must be on Byron Jackson equipment.)

2. PERFORMANCE OF PUMP

The pump shall have the capacity in accordance with the following schedule when running at a nominal 1750 RPM with a column length of 110 feet, not including the bowl assembly. Duty point to be minimum 1600 GPM @ 140' TDH.

3. WELL DATA

1) Well (inside diameter) 16 inches
2) Total well depth 150 feet.
3) Depth of 16 inch steel casing - 110 feet below ground.
4) Static water level - 30 feet below ground level.

4. TURBINE PUMP BOWL ASSEMBLY

Design requirements at minimum 1600 GPM, 116 foot setting:
140 feet TDH

The pump bowls shall be Class 35 iron, free of blow holes, sand holes and other detrimental defects, and shall be accurately machined. The top case will have a cutless rubber bearing. Series case bearings will be at least 1-1/2 times the shaft diameter in length.

The impellers shall be Class 35 iron porcelain coated or bronze enclosed, open, statically and dynamically balanced. They shall be securely fastened to the

shaft with taper bushings, lock nuts, or keys. They shall be adjustable vertically by an external means.

Closed impellers will have at least a 3/4" axial sealing (throttle) length where they seat in the series case to reduce internal circulation and provide longer operating life.

Impeller skirt and series case throat area shall be thick enough to allow for machining and wear ring at time of repair.

The pump shaft shall be a A1S1 Type 416 stainless steel, turned and ground. It shall be supported by bronze bearings above and below each impeller.

The length of the top and bottom bearings shall be a minimum of 3 times the shaft diameter. The size of the shaft shall be no less than that determined by ADA Specification B17c, "Code for Design of Transmission Shafting."

5. MOTOR

The motor shall be suitable for Star-Delta, reduced voltage starting vertical hollow shaft squirrel-cage induction type; and shall be designed for 40°C ambient to nema WP-1 specification with 1.15 service factor. The motor shall be of the proper size to drive the pump continuously over the complete head-capacity range without the load exceeding the service factor 480 volt.

The connection between the motor and the pump shaft shall be through a coupling or clutch in the motor head complete with non-release protection to prevent the line shaft from unscrewing in the event of phase reversal.

A thrust bearing of ample capacity to carry the weight of all rotating parts, plus the hydraulic thrust, shall be incorporated into the motor as an integral part. The bearing shall be of such a size that the average life rating is no less than 5 years continuous operation.

6. DISCHARGE HEAD

The discharge head shall be of Class 35 iron, free of blow holes, sand holes and other detrimental defects, and shall be
accurately machined. A fabricated steel head may be provided if this construction is manufacturer's standard. The base shall be round and machined flat for a gasketed and bolted fit to a separate cast Class 30 iron soleplate that can be grouted and bolted to the concrete foundation.

The head shall be provided with the manufacturer's standard stuffingbox arrangement. The stuffingbox will be provided with throttle bushing, cage ring, packing and provisions for discharge bleedoff.

A bronze bearing shall be placed directly below seal, in the head to eliminate any shaft "whip" which could damage seal. Provision shall be made so that seal faces can be adjusted without disturbing motor or impeller setting.

The discharge head shall include a prelubrication arrangement that will allow wetting down of the lineshaft bearings before starting the pump.

The top shaft (headshaft) shall be of A1S1 416 SS. It shall be of the two piece design with a coupling located between the pump and motor for ease of installation. An adjusting method shall be provided on the top of the headshaft to allow impeller adjustment. This method shall provide a positive locking device.

7. COLUMN ASSEMBLY

The lineshaft shall be of carbon steel, turned and polished. They shall be furnished in interchangeable sections not over 10' in length.

The butting faces shall be machined square to the axis of the shaft, with the maximum permissible axial misalignment of the thread axis with the shaft axis being 0.002" in 6 inches. The size of the shaft shall be no less than that determined by ASA specification B58, Section 4.3 per Table 5.6, A1S1 C-1045 Lineshaft Selection, and shall be such that elongation due to hydraulic thrust will not exceed the axial clearance to the impellers in the pump bowls.

The lineshafts shall be provided with A1S1 Type 416 stainless steel surfaces or sleeves at the location of each lineshaft bearing.

The lineshaft bearings shall be of cutlass rubber, spaced not more than 10 feet apart and mounted in bronze bearing drop in retainers in the column couplings.

The outer column shall be of butt welded steel pipe in interchangeable sections not more than 10 feet in length with
the ends of each section faced parallel and machined with eight straight threads per inch permitting ends to butt and insuring alignment when connected by standard mill steel couplings. The weight of the column shall be no less than that stated in ASA Specification B58.1, Section 5.1 "Standard Specifications for Discharge Column Pipe". The column size shall be such that the friction loss will not exceed 5 feet per 100 feet, based on the rated capacity of the pump. If possible, the column size shall also be such as to provide a velocity of not less than 4 feet per second at the rated capacity.

8. SUCTION PIPE AND STRAINER

The suction pipe shall be 1-1/2 feet in length and of a size at least equal to the outer column. The weight shall be as specified for outer column of equivalent size.

A galvanized type strainer shall be provided having a net inlet area equal to at least four times the suction pipe area. The maximum opening shall be not more than 75% of the minimum opening of the water passage through the bowls and impellers.

B. AIR RELIEF VALVE

The air valve shall vent air out of the orifice when pump starts - close liquid tight when water enters and permit large quantities of air to re-enter through the orifice when pump stops to prevent vacuum forming in the pump column suction. The main valve parts shall be a body, cover, baffle float and seat. The baffle shall shield float from direct impact of air and water to prevent premature float closure. The

float and baffle assembly shall be shrouded with a diffuser assembly. The discharge orifice shall be fitted with a double acting throttling device to regulate and restrict air venting and air re-entry. The valve shall be an APCO Series 142 WDT-50 valve as manufactured by Valve & Primer Corp., Schaumburg, Illinois.

The inlet shall be piped with an isolation butterfly valve with hand lever and variable position locking device. This shall be an APCO, Wafer Style.

The discharge of the air and vacuum valve shall be piped to the well casing.

C. PIPE AND FITTINGS

1. Ductile Iron

Ductile iron pipe shall comply with ANSI A21.51, Class 52.

Ductile iron fittings shall comply with ANSI A21.10 and be suitable for 150 psi pressure rating.

Ductile iron pipe and fittings shall be cement mortar lined in accordance with ANSI A21.4.

Joints for ductile iron pipe shall comply with the following:

a) Flangeo Joint Pipe shall conform to ANSI A21.15.

b) Mechanical Joints Shall be of the stuffing box type and shall conform to ANSI A21.11 as modified by ANSI A21.51.

c) Push-On Joints Shall conform to ANSI A21.51.

d) Rubber Gaskets and Lubricant Shall conform to the applicable Requirements of ANSI A21.11.

e) Bonded Joints A metallic bond shall be provided at each joint, including joints made with flexible couplings, caulking, or rubber gaskets, of ferrous metallic piping to effect continuous conductivity. The bond wire shall be type RHW-USE, size 1/0 neoprene-jacketed copper conductor conforming to UL Standard UL 854 and shall be shaped to stand clear of the joint.

f) Insulating Joints Shall be installed between non-threaded ferrous and nonferrous metallic pipe, fittings and valves. Insulating joints shall consist of a sandwich-type flange insulating gasket of the dielectric type, insulating washers and insulating outside diameter equal to the flange outside diameter. Bolt insulating sleeves shall be full length. Units shall be of a shape to prevent metal-to-metal contact of dissimilar metallic piping elements.

2. Cement Mortar Lining

Linings shall be cement mortar standard thickness in accordance with ANSI Standard A21.4.

D. PIPE BEDDING

Forcemain pipe bedding shall comply with Section Ps.5.02.D - Bedding.

E. CONCRETE

Cast-in-place concrete for anchor blocks and chamber benching shall comply with Section Ps.6, except that strength shall not be less than 3500 psi in 24 hours when using high-early strength concrete and in seven days when using normal Portland cement.

F. FLOW CONTROL VALVE

The flow control valve shall be hydraulically-operated, pilot-controlled diaphragm type glove valve, 8 inches diameter with flanged ends. Pilot lines shall be equipped with shutoff cock, "Y" strainer, restriction assembly and differential control. The valve shall be class 150, cast iron body equipped with orifice plate assembly capacity 1,500 USGPM model 60-44 KX-8" as manufactured by Cla-Val Co. or approved equal.

G. FLOW METER

Flow meter shall be cast bronze, magnetic drive 8-inch Turbine meter, operating range 35 - 3,500 USGPM with maximum operating pressure 150 psi. The meter shall be equipped with hermetically sealed direct reading register with units of measure in gallons (1000), as manufactured by Neptune, or equal.

H. BUTTERFLY VALVE

Butterfly valve shall be a wafer type suitable for installation between raised-face weld-neck flanges and shall be 8 inches in diameter.

Valve body shall be resilient with rubber, no flange gasket shall be required.

No part of a body or shaft shall be exposed to flowing media.

Butterfly valve shall be Keystone Model F-1000 or equal rated at 200 psi complete with manual actuator.

I. FITTING AND VALVE COATING

All fittings and valves shall be coated with the following multi-coat vinyl system as manufactured by Carboline of St. Louis, Missouri.

- Primer Coat — 2.5 mils, Rustbond 8HB
- Intermediate Coat — 4 mils, Amercoat 936
- Finish Coat — 4 mils, Amercoat 936

J. JOINT COMPOUND

Teflon tape shall be used as joint compound.

K. WATER LEVEL INDICATOR

Supply and install water level indicating pressure gauge, 1/4-inch tee, schraeder air valve and 1/4-inch polyethylene air line as shown on the drawings. The pressure gauge shall be a 4-1/2-inch diameter meter figure A566 or equal with a 0-300 foot range and 1/4-inch connection.

Ps.9.03 EXECUTION

A. MATERIALS HANDLING AND STORAGE

The safe delivery to the Site of all materials in this section shall be the Contractor's responsibility. All materials shall be delivered to and stored on the Site in a manner satisfactory to Marathon. All materials shall be jointly inspected by Marathon and the Contractor for damage in transit.

No defective material shall be delivered to the Site and materials found defective at any time shall be removed immediately and replaced at the Contractor's expense.

The Contractor shall be responsible for the proper on-Site storage of equipment and shall ensure that the equipment is protected against damage to the satisfaction of Marathon. All materials damaged while being stored on the Site shall be replaced by the Contractor at the Contractor's expense.

B. INSTALLATION

All pipes, valves, fittings and the pumping unit shall be installed according to the lines and elevations and dimensions as shown on the Drawings. All dimensioned pipes and fittings shall be installed before fitting make-up pieces and the whole shall be joined so that no stress or strain is created in the lines and associated fittings due to forcing parts into position. All pipes shall be carefully aligned and supported before joints are securely connected. Unless otherwise shown or specified, the pipe shall be supported at the center of the pumphouse.

Screwed joints in piping shall be made with full standard tapered threads with Teflon tape applied to male threads only. Ream or file for full bore, clean and free from scale.

Temporary bracing and supports shall be provided to adequately support the pipe during installation. All permanent supports shall be in place before temporary bracing and supports are removed.

Care shall be taken that no foreign matter be left in the piping. After the piping has been assembled and properly aligned with equipment and connections, all joints shall be made tight to ensure no leakage.

The well casing shall be cut to the appropriate height prior to installation of the pitless adaptor. The pitless adaptor shall be installed in accordance with manufacturer's instructions.

C. OPERATION AND MAINTENANCE MANUALS AND INSTRUCTIONS

Upon completion of all work the Contractor shall fully instruct Marathon in the operation and maintenance of all materials, equipment and systems installed under this section. The Contractor shall furnish to Marathon four complete sets of manufacturer's operating and maintenance instructions and literature including warranties, guarantees, wiring diagrams, spare parts lists of all materials, equipment and systems installed.

D. TRIAL OPERATION AND TESTING

Following completion of the system installation, the Contractor shall operate the system for a sufficient length of time to demonstrate, to the satisfaction of Marathon, that all system components including pump, meter, flow recorder and control valve are operating in accordance with manufacturers specifications and this Specification.

The Contractor shall notify Marathon in advance of operation and testing of the system such that Marathon may notify the U.S. EPA and WDNR at least two weeks prior to such activities, unless otherwise approved by Marathon, in conjunction with the U.S. EPA and the WDNR.

Ps.9.04 MEASUREMENT AND PAYMENT

A. MECHANICAL COMPONENTS FOR PUMPHOUSE

Payment for mechanical components for Pumphouse will be made at the lump sum price stipulated in the Form of Bid for Item B-2 which price and payment shall be full compensation for supplying all labor, plant, materials and equipment required to supply and install as specified pump, valves, flow meter system, piping, fittings, gauges, cable and wiring as shown on the Drawings and as required to complete all connections to the pumphouse piping system; provide shop drawings for equipment supplied; complete equipment testing and reporting; and all other miscellaneous items for which separate payment is not provided under other Items.

Ps.10 ELECTRICAL COMPONENTS FOR PUMPHOUSE

Ps.10.01 GENERAL

A. DESCRIPTION

1. Work Included

Work of this Section consists of all of the labor, materials, tools, equipment and supervision and other services to execute the Work as specified and as shown on the Drawings.

The Work shall include, but not necessarily be limited to:

a) Extension of 480 V feeder from existing plant service to pumphouse.

b) Supply and installation of electrical components in new pumphouse.

c) Supply and installation of communication conduit from the pumphouse to the assembly plant.

B. REFERENCE

The publications listed below form part of this Specification to the extent specified in this Section.

All work shall meet all requirements of the latest edition of the National Electrical Code (NFPA 70) and all national, state and local regulations that may apply. Standards of the following associations or organizations shall be followed and applied where applicable as minimum requirements:

UL	Underwriters Laboratories
IEEE	Institute of Electrical and Electronic Engineers
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
NBFU	National Board of Fire Underwriters
ASTM	American Society of Testing Materials
NEC	National Electric Code

C. QUALITY ASSURANCE

1. Marathon will be responsible for verifying that materials and services provided by the Contractor meet specification criteria.

2. The Contractor shall be licensed to perform this work or he shall obtain the services of a licensed subcontractor capable of doing so.

D. SUBMITTALS

1. Certificate of Acceptance

Furnish a Certificate of Acceptance from approving authority Inspection Department to Marathon on completion of work.

2. Acceptance Tests

Submit test results to Marathon upon successful completion of the work.

E. PRODUCT DELIVERY AND HANDLING

1. Delivery

Delivery of equipment to the Site shall be arranged for by the Contractor with Marathon.

2. Storage and Handling

Store all electrical equipment and materials in dry locations in a manner satisfactory to Marathon. The Contractor shall be responsible for the proper on-Site storage of equipment and shall ensure that the equipment is protected against damage to the satisfaction of Marathon.

F. JOB CONDITIONS

1. Existing Conditions

Visit the Site of the work and thoroughly ascertain that the work can be carried out satisfactorily without any changes to the drawings or specifications. No extras will be allowed for anything which would have been revealed in the course of such an examination.

2. Drawings and Coordination

The Contractor shall refer to the Drawings for dimensions, location of equipment, etc. Field measurements, however, take precedence over dimensioned Drawings. Report any discrepancies discovered between electrical drawings and the drawings of the other sections to Marathon.

3. Sequencing and Scheduling

The priority and sequence of the Work will be established by Marathon. All work will be coordinated through Marathon.

4. Environmental Protection

The Contractor shall comply with all applicable federal, state and local environmental protection requirements, including those applying to transformer oils containing PCBs.

Ps.10.02 PRODUCTS

A. GENERAL

Use new materials and equipment unless otherwise specified.

Provide material and equipment of specified design and quality, performing to published ratings and for which replacement parts are readily available.

Use products of one manufacturer for equipment or material of same type or classification unless otherwise specified.

Materials and equipment of manufacturer specified have been incorporated on the Drawings with space and areas required for the respective manufacturers equipment.

Equipment manufacturer specified first is the manufacturer whose equipment is preferred. Second preference is listed second and so on.

Alternate manufacturer's may be submitted with the bid form provided that the alternate product is adequately described and any adjustment in price is also noted.

For work of this section, whenever an alternate is proposed, this Contractor shall guarantee that such proposed alternate will not result in any additional expense to be incurred by the Honeywell due to the use of the alternate product, particularly in connection with any required changes in the work which may affect other trade contractors that are a part of the project.

Each major component of equipment shall have the manufacturer's name, address, model number and rating on a plate securely affixed in a conspicuous place. The nameplate of a distributing agent is not acceptable.

B. MATERIALS

1. Wire

a) All conductors shall be copper.

b) All service and feeders to panels shall be 600 V, THHN insulated conductors.

c) All branch circuit wiring from panels shall be 600 V R90 insulated continuously.

d) All motor wiring conductors shall be stranded.

e) No wires smaller than #14 gauge shall be used for control circuits and #12 gauge for branch circuits type R90 or RW90 (X-Link). Power cables installed in ducts shall be type RWU-90.

f) Wire and cable shall be color coded as follows:

i) Power - Black
ii) Lighting - White - Neutral grounding conductor - Red, Black, Blue - ungrounded conductor
iii) Equipment Grounding - Green
iv) AC Control Wiring - Red
v) DC Wiring - Blue
vi) Interlock Control Circuit - Yellow

2. Lighting Fixtures

a) See drawings for description of fixtures, lamps, ballast voltages and other requirements.

3. Outlet and Junction Boxes

a) All outlet and junction boxes shall be PVC material type for use with rigid PVC conduit systems.

b) 4" Octagon boxes shall be used for light outlets.

4. Receptacles

15 ampere or 20 ampere as required, 125 volt, A.C. rated, single or duplex as indicated; with wrap-around steel strap attached to receptacle back; automatic grounding feature.

5. Ground Fault Receptacle GFC1

Feed through type with test and reset.

6. Cover Plates

a) For receptacles use Hubbell weatherproof covers for duplex receptacles on FS/FD boxes, gray polycarbonate #5221, or approved equal.

b) For light switches, use Hubbell weatherproof cover, gray polycarbonate, #7243 or approved equal.

7. Wire Connections

a) Wire connections at motors shall be with Burndy, or approved equal, pressure type lugs using a ratchet type crimping tool and "Everdur" hardware.

b) Control wire and cable terminations, taps, and splices shall be secured with solderless pressure type connectors using a ratchet-type crimping tool. Connectors shall be Thomas & Betts, Burndy, or approved equal at all screw-type connection points.

8. Fuses

Fuses shall be Bussman "Fusetron" time-delay type or approved equal, non-renewable and sized as shown on the Drawings.

9. Panelboards

a) Lighting panel "A" to be 60A, 120/240 volt, 1 phase, 3 wire, 12 circuit panelboard.

b) Acceptable manufacturers: Square "D", FPE, ITE.

10. Disconnect Switches

a) Fusible and non-fusible disconnect switches shall be heavy duty visible blades, external handle for manual operation, and provision for locking in the "OFF" position. The sizes and number of poles are indicated on the drawings.

b) Disconnects used for motors shall be horsepower rated.

c) Acceptable manufacturers Square "D", FPE, Westinghouse.

11. Switches

15 amp, single pole, toggle type as Hubbell #1201-I or approved equal.

12. Electrical Control Components

Electrical control components shall be as manufactured by Allen Bradley and as indicated on the Drawings.

13. Conduit

1. Conduits generally shall be rigid, hot dip galvanized, heavy walled and threaded type. All conduit runs shall be at right angles to the building structural members.

2. Conduits shall be supported at least every 5'-0". The Contractor shall furnish and install hangers and supports throughout the project so as to provide a first class workmanlike installation. No conduits shall be supported from piping.

   Where conduits are to be supported singly on ceilings or walls, one-hole malleable straps shall be used.

3. All conduits shall be installed to ensure a 3" minimum clearance from heating and steam pipes.

4. Double locknuts shall be used throughout on all conduit work entering sheet metal boxes or enclosures.

5. Insulating bushings shall be used throughout. Where grounding or bonding of conduits is required, grounding bushings shall be provided.

6. Couplings and threaded hubs shall have no less than five (5) threads of the conduit engaged and shall be screwed up tight and butted.

7. All conduits installed shall be new.

Ps.10.03 EXECUTION

A. PREPARATION

1. Read Specifications and drawings of other trades and conform with their requirements before proceeding with any work specified in this Division related to other trades.

2. Cooperate with all other trades on the job, so that all equipment can be satisfactorily installed, and so that no delay is caused to any other trade.

3. Arrange for openings in the walls and floors for transportation and installation of large and heavy equipment. Extra charges for cutting and making good of walls or floors will not be accepted.

4. Misinterpretation of any requirements of either the drawings or specifications will not relieve the Contractor of responsibility to complete the work, if in doubt contact Marathons for written clarification prior to submitting a bid.

B. INSPECTION

1. The Contractor shall notify the Inspection Department with the approval authority upon completion of work.

2. Marathon will carry out inspections and prepare deficiency list for action by Contractor, during and on completion of project.

C. INSTALLATION

1. Lighting and Outlets

a) Supply and install all light fixture, receptacle, switch and accessories as specified and shown on the Drawings.

2. Installation of Fixtures

a) Support fixtures independently of conduit and outlet box.

b) Fixture shall be installed accurately as to line and level.

c) Locations of fixture is generally indicated. Final locations as per job conditions.

3. Conduit Installation

a) Where exposed install parallel with building lines and neatly grouped.

b) Size to suit the number and type of conductors the conduits are carrying and of sufficient size to permit easy removal of conductors at any time. Where sizes are shown on Drawings, these sizes are minimum and in no case shall they be reduced.

c) Raceways must be plugged and kept clean and dry during installation, be free from kinks or foreign matter, and all cut or threaded ends reamed.

d) Every conduit shall have at least one support. Use only approved conduit hangers. Perforated pipe stays, tie wires, etc. will not be permitted.

e) Install conduits to all devices shown on Drawings.

4. Outlet and Junction Boxes

a) Support outlet and junction boxes independently of conduit.

b) Fill boxes with paper, sponges, or foam or similar approved material to prevent entry of construction materials.

5. Wire Installation

a) All branch wiring shall be sized and so installed that the voltage drop shall not exceed 3 percent from the panels to the farthest outlet at full load. Circuits sharing a common neutral shall not be connected to the same main phase.

b) Install wiring in conduit systems to outlet boxes.

c) As far as practicable, all feeder cables shall be continuous from origin to panel termination, without running splices in intermediate pull boxes or splicing chambers except as noted in this specification. Sufficient slack shall be left at the termination to make proper connection.

d) No splices shall be pulled into a conduit or be so placed as to be inaccessible.

e) All wiring for systems, controls, etc. shall be identified on each end by a circuit or wire number using Brady wire wrap markers.

f) PULLING

Before wires are pulled, conduits shall be cleaned out by drawing a swab through the tubing and all the wires shall then be pulled in such a manner as to avoid kinking or injury to the insulation. The use of lubricants, other than talc, powered soapstone or non-hardening compounds approved by the Underwriter's Laboratories and the cable manufacturer for pulling, is not permissible.

SPLICES

Lighting circuits and Services: No splices shall be made in conduits. Splices in condulets and junction boxes must be made with enough spare wire to enable two or more splices to be remade with the wire in event of fault.

In all boxes, where splices and taps are not made, enough slack shall be provided to allow for future taps.

Connections shall be made expertly in an approved manner with solderless compress-type connectors. Connectors shall be formed, high conductivity copper, securely fastened with tools recommended by connector manufacturer.

Power and Control Circuits: No splices shall be made in conduits, condulets and junction boxes. Splices shall be made at control stations.

g) MOTORS AND POWER CONNECTIONS

Conduit connections to all motors, power transformers, etc., shall be by means of flexible coupling with approved fittings.

6. Location of Electrical Equipment

a) The location of any panel, equipment, outlet, raceway and wiring may be changed by Marathon if the new location is within a limit of 10'-0" radius of the original location. Provide changes without extra cost if required before installation in the original locations.

b) Do not install wall mounted equipment at locations where other equipment is to be installed.

7. Mounting Heights

a) Generally mount equipment at heights as follows unless otherwise shown on the drawings.

b) Dimensions refer to the centre line of equipment above the finished floor unless otherwise shown or specified.

c) Refer to Architectural elevations when provided or referred to on Electrical drawings.

d) If mounting height is not indicated, verify before proceeding with installation.

e) Equipment:

panelboards:	6'-0" to top
individual safety switches:	5'-0"
individual motor controls:	5'-0"
light switches:	4'-0"
convenience receptacles:	1'-6"
thermostat:	4'-0"

8. Labels and Signs

a) Manufacturers nameplates and labels to be visible and legible after equipment is installed.

b) Provide warning signs, as specified or to meet requirements of Inspection Department and Marathon.

9. Sleeves, Inserts

a) This contractor is responsible for supplying and setting of all sleeves and inserts for conduit.

b) Floor sleeves shall extend 4" above floor. All sleeves to be made from schedule 40 steel pipe.

10. Excavation, Trenching and Backfilling

a) This contractor shall provide all excavation, trenching, backfilling, and compaction required in connection with his work as specified in Ps.10.

b) Trenches shall be dug true to line as possible and slope away from the building entrances.

c) Provide protective material around and over services existing or newly installed and be present at all times during excavation and backfilling to supervise work.

d) Non-concrete encased electrical conduits installed in trenches shall be supported on a minimum of three inches of sand and covered with an additional three inches of sand before backfilling unless otherwise indicated.

e) Trenches may be backfilled using the native backfill material providing stones or other debris is not larger than two inches in diameter.

f) All trenches containing high voltage ducts or conduits shall have buried utility marker tape six inches wide buried 12 inches below finished grade installed continuously for the length of the trench.

g) Where trenches are left open until the installation has been inspected, proper covers, barricades and warning signs must be provided.

11. Concrete Bases

All concrete bases required for electrical equipment shall be provided by this contractor at his expense, unless otherwise noted in this specification.

12. Cutting and Patching

a) All cutting of openings to walls, floors, foundations, footings, ceilings, plaster and drywall ceilings, roof manhole casings or any other surfaces or finishes shall be the responsibility of this Contractor when related to any of his work.

b) All patching, painting and making good of walls, floors, ceiling, partitions, roof and manhole casings will be at the expense of this contractor and shall be done by a qualified tradesman specializing in that particular field.

13. Wiring Terminations

a) Lugs, terminals, screws used for termination of wiring to be suitable for copper conductors.

b) Identify wiring with permanent indelible identifying markings, either numbered or colored plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.

c) Maintain phase sequence and color coding throughout.

14. Grounding

a) Provide all equipment grounding as required regardless of whether it has been shown on the drawings or called for in this specification.

b) Arrange grounds to that under normal operating conditions no injurious amount of current will flow in any grounding conductor.

15. Control of Debris

a) At all times keep the premises free from all accumulation of debris resulting from the electrical work.

16. Feeders

Supply and install the 480 V feeder from the existing building to the pumphouse as shown on the drawings. 480 V power source in the existing building will be indicated by Marathon.

17. Pumphouse

Supply and install the pumphouse components as shown on the Drawings.

18. Equipment Identification

All starters disconnect switches lighting panels etc., shall be identified with engraved white-black-white lamicoid nameplates, complete with bevelled edges. The nameplates shall be neatly secured with contact cement to the device. The nameplate shall state the unit number(s), motor number(s), and name(s) of the device. Lettering shall be 3/16" high, nameplate details to be issued by Marathon.

19. Temporary and Trial Usage

It is understood and agreed that Marathon has the privilege of temporary and trial usage as soon as the Contractor claims that said work is completed in accordance with the drawings and specifications for such reasonable length of time as Marathon shall deem to be sufficient for making a complete and thorough test of same, and that no claim for damage will be made by the Contractor for the injury to or breaking of any parts of such work which may be so used, whether caused by weakness or inaccuracy of structural parts, or by defective material or workmanship of any kind. It is further understood and agreed that the trial or temporary usage of any device, machinery, apparatus, equipment, or any work or materials supplied under this contract before final completion and written acceptance is not to be construed as evidence of acceptance of the same.

20. Panels and Feeders

The Contractor shall supply and install all panels, complete with breakers, mains and total number of poles, as detailed on the plans; panels shall be complete with code gauge locking doors and neatly typed directories. Panel doors shall have locks operated with a common key.

Circuits sharing a common neutral shall not be connected to the same main. Two and three pole breakers shall have a common trip. Lighting circuits switched at panels shall be in consecutive order beginning with breaker number 1.

Until final nameplates and circuit directories are installed, the Contractor shall apply temporary tags, indicating the circuits controlled, at the time connections are made. This is to avoid confusion, by others, as to what circuits are or are not in operation.

21. Dry Type Transformers

Provide and install dry type ANS Class B (ANN Class H) CEMA 1 transformers as shown and sized on the drawings. The transformers shall be provided with 2, 2-1/2% full capacity taps, one above and one below rated voltage. Neutrals of 3 phase, 4 wire transformers and single phase transformers shall be grounded to the building service grounding and/or as shown.

D. FIELD QUALITY CONTROL

1. Workmanship

a) Only first class workmanship will be accepted, not only in regards to durability, efficiency and safety, but also in regards to neatness of detail. Present a neat and clean appearance on completion to the satisfaction of Marathon. Any unsatisfactory workmanship will be replaced at no extra cost.

b) Conform to the best practices applicable of this type of work. Install all equipment and systems in accordance with the manufacturer's recommendations, but consistent with the General Requirements of this Specification.

c) Unless otherwise noted, all equipment shall be factory finished with a prime coat and two coats of good quality finish paint.

d) Protect work so that finishes will not be damaged or marred during construction. Maintain the necessary protection until completion of the work.

e) Minor damages to finish on factory finished equipment shall be touched up to Marathon's satisfaction. Items suffering major damage to finish shall be replaced at the direction of Marathon.

2. Insulation and Resistance Testing

a) Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.

b) Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument.

E. ADJUSTMENT AND CLEANING

1. Adjusting and Startup

a) This Contractor is to conduct acceptance tests to demonstrate that the equipment and systems actually meet the specified requirements. Tests may be conducted as soon as conditions permit, and consequently the Contractor shall make all changes, adjustments, or replacements required as the preliminary tests may indicate prior to the final tests.

b) Tests shall be as specified in various sections of this Division.

c) Carry out tests in the presence of Marathon.

d) Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of the project.

e) Submit test results.

F. SCHEDULES

1. Coordination

Coordinate work of this Section with other work and where necessary, with FCC.

2. Continuity and Responsibility

a) Schedule the electrical work so that disruption to the rest of the circuitry will be kept to a minimum.

b) Obtain prior authorization when a circuit will be de-energized.

c) Ensure service continuity to existing circuits not affected by the construction work. Make temporary connections, if necessary.

d) Contractor is responsible for any damage resulting from operations to existing facilities such as underground cables, hard surface areas, watermains, and other utilities. Contractor to restore, replace or repair any such damage to the satisfaction of Marathon. Wherever possible, obtain locates prior to commencing work.

Ps.10.04 MEASUREMENT AND PAYMENT

A. Electrical Components for Pumphouse

Payment for the electrical components for pumphouse will be made at the lump sum price stipulated in the Form of Bid for Item B-3 which price and payment shall be full compensation for all labor, materials and equipment required to complete the electrical installation for the interior and exterior of the new pumphouse building; and all other miscellaneous items for which separate payment is not provided under other Items.

APPENDIX A

HEALTH AND SAFETY PLAN

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1.0 SITE CHARACTERISTICS AND HAZARDS

1.1 GENERAL PROJECT DESCRIPTION

The field work for this project involves the installation of a groundwater extraction well and associated outlet structure to collect and discharge extracted groundwater to the Wisconsin River. Field tasks include:

- Mobilization
- Extraction well installation
- Extraction well development and pump testing
- Pumphouse installation
- Discharge manhole installation
- Discharge pipe installation
- Placement of concrete pad and rip rap at discharge outlet

1.2 SITE DESCRIPTION

The extraction well and associated discharge outlet structure will be installed at the Marathon Electric Manufacturing Company facility in Wausau, Wisconsin. The Site is located along the west side of the Wisconsin River within the City of Wausau. Access to the Site is available via Cherry Street slightly south of Randolph Street. A regional and site location map are shown in Figures 1.1 and 1.2, respectively. The location of the extraction well is shown on Figure 1.3.

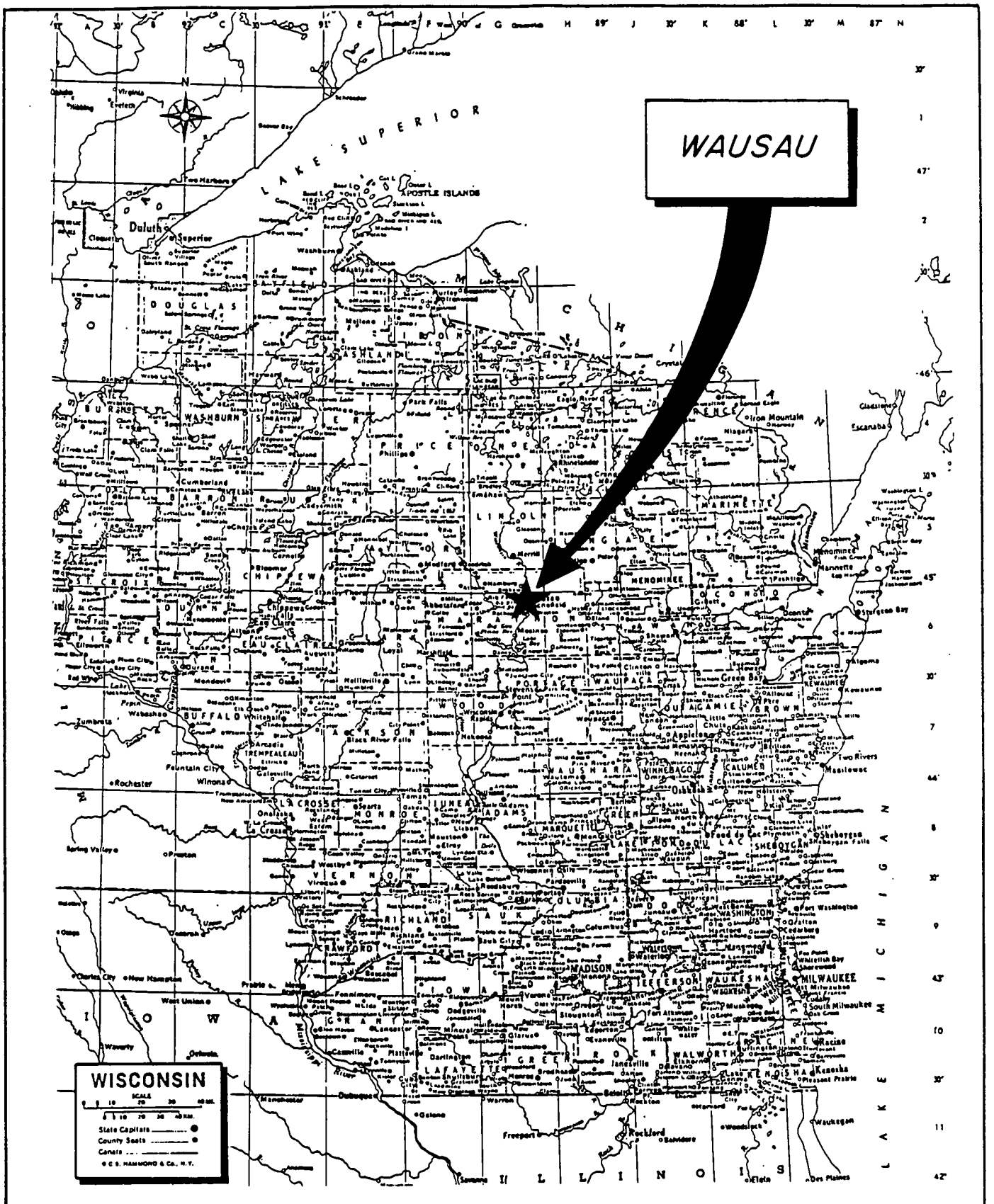


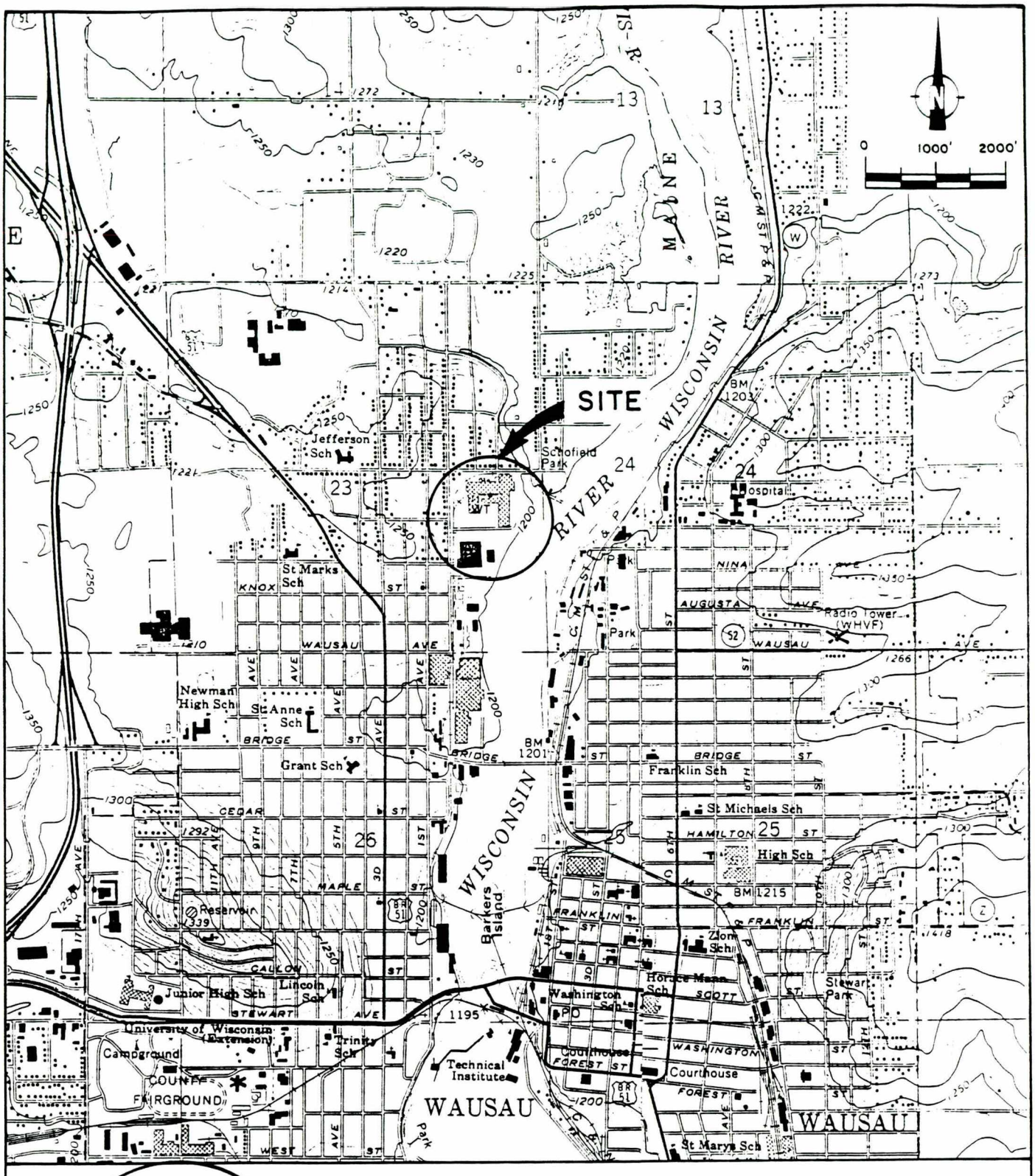
figure 1.1

REGIONAL LOCATION MAP

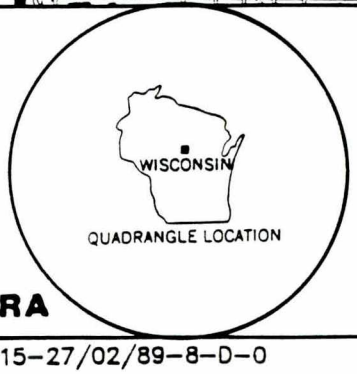
Marathon Electric Manufacturing Co.

CRA

2115-27/02/89-8-D-0



SOURCE : U.S.G.S. WAUSAU WEST QUADRANGLE MAP.



CRA

figure 1.2

SITE LOCATION

Marathon Electric Manufacturing Co.

2115-27/02/89-8-D-0

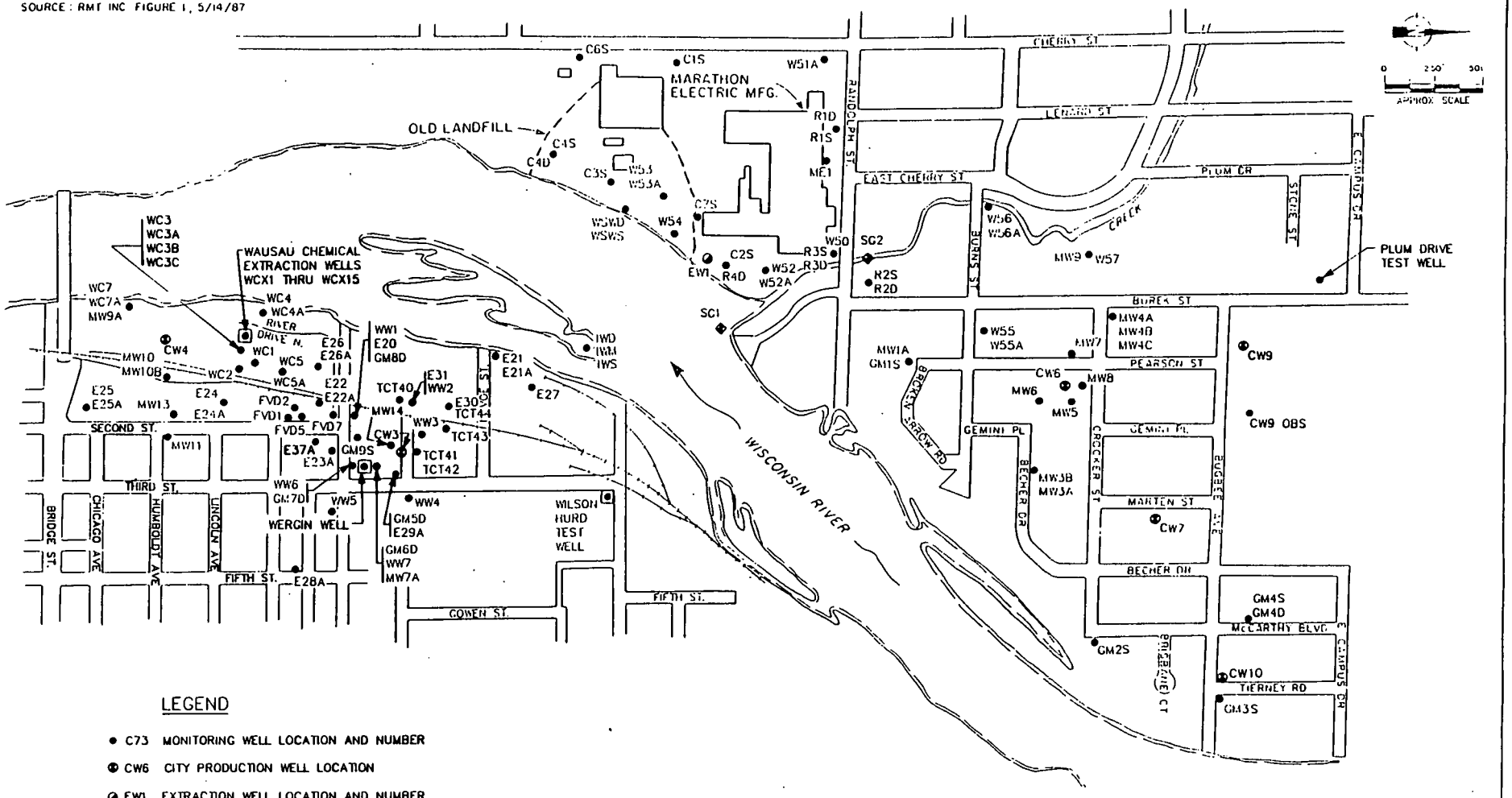


figure 1.3

EXTRACTION WELL AND MONITORING WELL LOCATIONS

Marathon Electric Manufacturing Co.

CRA

2115-27/02/89-8-D-0

1.3 SITE HISTORY

The City discovered in early 1982 that its production wells CW3, CW4, and CW6 were contaminated by volatile organic compounds (VOCs). Toluene, ethylbenzene, and xylene were also detected at CW4. Trichloroethene (TCE) is the predominant volatile organic compound detected at CW6, although below method detection limit (BMDL) concentrations for tetrachloroethene (PCE) and 1,2-Dichloroethene have also been previously reported (Weston, 1984). Since the contamination was first detected in early 1982, TCE concentrations from CW6 have ranged from 70 micrograms per liter (µg/L) to 260 µg/L. Sampling conducted in March 1988 indicated TCE concentrations of approximately 160 µg/L. Sample results from the East Well Field (CW3 and CW4) have indicated PCE, TCE, and DCE impact at both wells. CW4 has generally indicated steadily decreasing concentrations of the three constituents since February 1984. CW3 has indicated decreasing PCE and DCE concentration since the VOCs were discovered in early 1982. However, TCE concentrations at CW3 have remained relatively constant at concentrations ranging between 80 µg/L and 210 µg/L.

To reduce VOC concentrations, the City originally instituted a program where uncontaminated water from CW9 and CW7 was blended with water from CW3, CW4, and CW6 to dilute the VOC concentrations. However, increasing VOC concentrations in groundwater caused this method to be ineffective, and resulted in then current regulatory limits being exceeded.

In 1983, the United States Environmental Protection Agency (U.S. EPA) awarded the City of Wausau a federal grant to help fund the design and installation of a packed tower VOC stripper in order to provide sufficient water of acceptable quality to City residents. However, because VOC levels in the distribution system continued to increase, U.S. EPA's emergency response team was asked for assistance. As an interim measure in June 1984, the U.S. EPA installed a granular activated carbon (GAC) treatment system on CW6. VOC stripping towers were installed in the Summer and Fall of 1984 at the City water treatment plant to treat water from CW3 and CW4. Subsequently, the GAC system was removed from service in October 1984. In December 1985 the Wausau Groundwater Contamination site was added to the National Priorities List (NPL) for remedial activities under Superfund.

The City blends water treated for VOC removal with water from uncontaminated supply sources (CW7, CW9 and CW10) to reduce VOC concentrations in the water supply distribution system. Following installation of the packed tower VOC strippers, the water supply distribution system has had relatively low levels of VOCs (generally below detection limits of 0.5 to 1.0 µg/L). These levels are dependent on continued effective operation of the treatment system for CW3 and CW4, the influent VOC concentration for each well, and continued use of the three uncontaminated wells (CW7, CW9 and CW10).

In accordance with a Consent Decree, entered with the court on September 9, 1989, Marathon Electric is proceeding with an extraction well and associated discharge outlet installation. The purpose of

the extraction well is to create a cone of depression capable of containing an identified contaminant plume source to prevent further migration toward City production wells.

1.4 SITE FEATURES

Topography: The extraction well is to be installed in a relatively flat area behind the Marathon Electric Facility adjacent to the bank of the Wisconsin River. The bank has a relatively steep slope.

Buildings: Marathon Electric Facility (see Figure 3)

Waterways: Wisconsin River

Utilities: To be notified prior to drilling activities; consult local utilities

Area Population: 45,000

1.5 PRINCIPAL CHEMICAL EXPOSURE HAZARDS

The principal hazardous materials of concern are the following volatile organic compounds:

Chemical	*Maximum Concentration in Monitoring Well (µg/L)*
Perchloroethylene (PCE)	55
Trichloroethylene (TCE)	3200
1,2-Dichloroethylene (DCE)	641

The concentrations listed above reflect the maximum concentrations of the principal hazardous materials detected in the west side plume monitoring wells.

1.6 SAFETY HAZARDS

Safety hazards unique to site operations include the operation of drilling rigs, construction equipment, and use of manually operated equipment. These hazards vary with the specific tasks and are addressed under the tasks in Section 3.0: Task Evaluation. The Health and Safety Plan, contained herein, is specifically for the installation and construction phase of the groundwater extraction, treatment and discharge system.

1.7 HEAT STRESS

The possibility of heat stress will be addressed by the Site Safety Officer in the daily safety briefings if it becomes applicable. The content of heat stress review is contained in Appendix A.

1.8 COLD EXPOSURE

The possibility of cold exposure will be addressed by the Site Safety Officer in the daily briefings if it becomes applicable. The content of cold exposure review is included in Appendix B.

1.9 ELECTRICAL HAZARDS

Electrical hazards may occur from overhead lines or buried lines during drilling operations or excavating operations. The work site will be cleared by the local utilities prior to the start of activities. The Contractor's discretion will be used for the avoidance of overhead lines.

1.10 SITE CONTROL PROCEDURES

A site such as the Wausau NPL Site possesses characteristics that make conditions different from a more typical abandoned hazardous waste site. Because the sources and spread of chemical contamination are below ground, the concepts of restricted access, exclusion zones, and support areas do not readily apply from the U.S. Army model for chemical, biological, radiological warfare.

A temporary exclusion zone will, however, be set up around the extraction well location during drilling and during the

installation of the discharge outlet manhole and discharge pipe. The exclusion zone will extend approximately 20 feet beyond the drill rig or excavation, as appropriate, and will be delineated in the field by caution tape or other appropriate means. All unauthorized personnel shall not be allowed to enter this exclusion zone.

All other operations shall not require the establishment of an exclusion zone. As conditions warrant, unauthorized personnel will be requested to stay at safe distances from the work area by field personnel.

1.11 ORGANIZATIONAL STRUCTURES

Overall field management will be provided by Marathon Electric's designated Field Supervisor. Health and Safety issues will also be the purvey of Marathon Electric's designated Field Supervisor/Site Safety Officer. Safety monitors will be provided as a part of each Contractor field team. Safety monitors will report safety concerns, including air monitoring results and personnel protection equipment and practices employed, to the Site Safety Officer. All personnel will be required to employ safe operating practices at all times.

1.12 MEDICAL MONITORING REQUIREMENTS

As required by 29 CFR 1910.120[f] (OSHA) on-site personnel that have a potential for exposure to hazardous material, or will be

required to wear a respirator, must receive a physical examination that will determine their fitness for these tasks. This determination will be made by a qualified physician and its documentation will be received before field work will begin.

1.13 PERSONNEL TRAINING

Pursuant to 29 CFR 1910.120 [e] (OSHA) on-site personnel involved in the extraction well, discharge manhole outlet structure and discharge pipe installation shall receive a minimum of 40 hours of off-site classroom training. This training shall include, but not be limited to, those topics addressed in that section.

All other on-site personnel that may perform other related work such as the installation of the pumphouse or discharge outlet (rip-rap) shall not be required to have completed the OSHA 40-hour training program. These personnel will not come in contact with potentially contaminated material.

2.0 CHEMICAL HAZARD INFORMATION

2.1 CHEMICAL HAZARD INFORMATION

The following summarizes chemical hazard information.

Chemical Properties

Name	*Specific Gravity*	*Flash Point*	*Flam. Limits*	*Vapor Pressure*	*Vapor Density*	*Ionization Potential*	*Solubility*
Perchloroethylene	1.63	Not Combustible		14 mmHg	5.83	9.32 eV	0.015%
Trichloroethylene	1.46	89.6°F	11-41%	58 mmHg	4.53	9.47 eV	0.1%
1,2-Dichloroethylene	1.27	37.0°F	9.7-12.8%	180-265 mmHg	3.34	9.65 eV	0.35 - 0.63%

Health Properties

Name	*Odor Characteristic*	*Threshold*	*TLV*	*IDLH*	*Dermal Toxicity*	*Approved Cartridge*
Perchloroethylene	chloroform-like	4.7 ppm	50 ppm	500 ppm	moderate	organic vapor
Trichloroethylene	chloroform-like	21.4 ppm	40 ppm	1000 ppm	skin irritant	organic vapor
1,2-Dichloroethylene	chloroform-like	0.085 ppm	200 ppm	4000 ppm	moderate	organic vapor

3.0 TASK EVALUATION

3.1 SUBTASK ANALYSIS

The field investigation includes the following subtasks. Specific hazards and levels of protection are described for each subtask.

Subtask 1 Extraction Well Installation

Level D, C, and/or B Protection

The drilling rig will be supervised by Marathon Electric's designated Field Supervisor/Site Safety Officer.

Well drilling will be performed utilizing a normal or reverse circulation method. The pilot hole to be drilled prior to the extraction well drilling may be conducted using hollow stem augers. Soil samples will be collected from the pilot hole.

In addition to the chemical hazards involved with contact of contaminated soils and groundwater, personnel must address the physical hazards of operating machinery. Professional caution, especially with regard to the limitations presented by protective equipment, must be stressed for all personnel engaged in drilling operations.

Personal protection will be guided by air monitoring of the drilling crew's breathing zones with a PID. Operations may begin in level

D protection. Upgrade to level C (breathing zone PID readings greater 2 ppm over background level, but less than 200 ppm over background) and to level B (breathing zone PID readings greater than 200 ppm over background level) may be necessary as the borehole is advanced. The rationale for selection of these actions levels is presented in Section 3.2. Upgrade of personal protection may be necessary as an interim measure in some situations; if PID readings show a persistent return to below action levels, work may proceed with upgraded protection at the ready.

Subtask 2 Well Development and Testing

Level D and/or C Protection

The extraction well will be developed subsequent to installation and a pumping test conducted. Purge water from the well will be discharged to the treatment/discharge outlet and rip-rap system.

The potential for dermal contact with the dissolved chlorinated solvents exists, and should be kept to a minimum by the use of dermal protection and eye and face protection (level D). If air monitoring indicates significant vapor concentrations of the solvents (PID readings greater than 2 ppm over background level), air purifying respirators should be utilized (level C). The rational for selection of the action levels is presented in Section 3.2.

Air monitoring will be performed during well development and testing with a photoionization detector (PID). The action

level for upgrade to level C is any persistent reading in the sampler's breathing zone greater than background (as ppm benzene).

Subtask 3 Pumphouse Installation

Level E Protection

A prefabricated fiberglass pumphouse will be erected over the extraction well and all mechanical and electrical components of the pumping system installed.

Hazards other than those provided by normal field operations are not anticipated.

Air monitoring will not be included for this subtask.

Subtask 4 Discharge Manhole Installation

Level E, D or C Protection

Activities conducted under this subtask will include excavation, installation of a prefabricated manhole, connection of the manhole to the existing storm sewer discharge line and backfilling. It is not anticipated that workers will contact any potentially contaminated groundwater. Should groundwater be encountered during excavation, personnel protection shall be upgraded to level D.

Air monitoring of the excavated soils will be performed during excavation with a PID. The action level for upgrade to level C will be a persistent reading in the breathing zone greater than background (as ppm benzene).

Subtask 5 Discharge Pipe Installation

Level E, D, or C Protection

A discharge pipe will be installed to a depth of approximately five feet extending between the pumphouse and the discharge manhole. It is not anticipated that workers will contact any potentially contaminated groundwater. Should groundwater be encountered during excavation, personnel protection shall be upgraded to level D.

Air monitoring of the excavated soils will be performed during excavation with a PID. The action level for upgrade to level C will be a persistent reading in the breathing zone greater than background (as ppm benzene).

Subtask 6 Placement of Concrete Pad and Rip Rap

Level E Protection

At the existing storm sewer discharge point, a concrete pad and rip rap will be installed. The rip rap will be placed from the base of the existing discharge outlet to the Wisconsin River (approximately 20 feet).

Hazards other than those provided by normal field operations are not anticipated.

Air monitoring will not be included for this subtask.

Subtask 7 Location and Elevation Survey

Level E Protection

A location and elevation survey of the extraction well and discharge outlet structure will be performed by Marathon Electric following installation.

Air monitoring is not anticipated for this subtask.

3.2 LEVELS OF PROTECTION

The following section describes the levels of protection which may be implemented during the site activities. If upgraded from one level to another is required, authorized site visitors will be advised at that time.

Level E

Level E is to be implemented when work activities (e.g. site setup, pumphouse installation) take place where there are no anticipated or known environmental health hazards. Level E may include the following:

- steel toe boots
- hard hat
- disposable latex gloves (when needed)
- coveralls
- participation in medial monitoring program and Health and Safety trained, according to OSHA 20 CFR 1910.120.

Level D

Level D is to be worn during activities which do not suggest any initial respiratory protection, but where dermal protection is warranted. The following list outlines the personal protective equipment to be utilized for Level D:

- Polyethylene (PE) coated Tyvek coveralls
- steel toe/steel shank leather work boots with latex overboots or steel toe/steel shank neoprene boot
- disposable latex gloves
- Nitrile or neoprene gloves
- eye protection (safety glasses or face shield)
- hard hat

Level C

Level C is to be worn when work area organic vapor air contamination is between 2 ppm over background concentration and 200 ppm greater than background (according to the PID readings). The following outlines this level of protection.

- PE coated tyvek coveralls
- steel toe/steel shank leather work boots with latex overboots or steel toe/steel shank neoprene boots
- disposable latex gloves
- nitrile or neoprene gloves
- full face, air purifying respirator with combination organic vapor/dust and mist cartridge
- hard hat

Level B

Level B protection is worn when work area organic vapor air contamination is between 200 and 500 ppm (according to PID readings). The following outlines this level of protection:

- PE coated tyvek coveralls
- Steel toe/steel shank leather work boots with latex overboots or steel toe/steel shank neoprene boots
- disposable latex gloves

- nitrile or neoprene gloves
- positive pressure self-contained breathing apparatus (SCBA) or airline supplied respirator with 5-minute escape pack
- hard hat

The action level criteria presented in this plan are based on the historical data base developed for the Wausau site areas. Contaminants identified are included in Section 2 of this Plan, which include chlorinated ethylene compounds. The ACGIH had defined the TLV as the time-weighted average concentration for a normal 8-hour workday and a 40-hour work week, to which nearly all workers may be repeatedly exposed, day after day, without adverse effect. Because the lower TLV for the contaminants of concern is 50 ppm, the basis of upgrade from level D to level C may be placed at 50 ppm. Because field photoionization detectors (PID) typically measure chlorinated ethylene at about 50 percent efficiency compared to their calibration standard (HNU Systems, Inc. literature), a reading of 25 ppm greater than background level on a field PID would represent the TLV. CRA has selected a level of about one tenth this meter reading, 2 ppm, as its action level for upgrade of respiratory protection to full face air purifying respirators with organic vapor cartridge.

The action level for upgrade to a supplied air system is developed on the same basis. Because the maximum use concentration (MUC) is based on the TLV of the known contaminant and the protection factor (PF) of the selected respirator by the relationship:

$$MUC = TLV \times PF$$

an action level based on site conditions can be developed. With a PF of 100 for a full face purifying respirator (ANSI 288.2-1980), the MUC would be 5000 ppm. However, NIOSH approval of the purifying respirators used, limits their use to 1000 ppm organic vapors. With a 50 percent efficiency of PID air monitor, the MUC would read 500 ppm. CRA's action level of 200 ppm is well below this value. The action level is also less than the IDLH values for the chlorinated ethylenes of concern.

The action levels for respiratory protection were developed for known chemical contaminants unique to the Wausau project area. Their determination was made on a conservative basis, not only from the hazard of chemical exposure, but also to avoid unnecessary exposure to the physical hazards of restricted vision and mobility inherent in the use of respiratory protection equipment.

3.3 DECONTAMINATION PROCEDURES

Personnel Decontamination

A decontamination line will be established by the Site Safety Officer. The decontamination line will be set up such that no cross contamination will take place when disposing of contaminated personal protection equipment. Decontamination procedures should be followed including washing hands and face, upon finishing a field activity.

Drill Rig and Related Equipment Decontamination

Steam cleaning the drilling rig after the completion of the extraction well installation will be conducted at a decontamination (decon) area. The decon area will be located in the Marathon Electric parking area adjacent to the work site. Decon water will be collected and either discharged to the sanitary sewer or the storm sewer. Decon water will not be discharged to the storm sewer if PID screening indicates elevated levels of contaminants in the rinse water (i.e. PID readings greater than background). In such cases the decon water will be discharged to the sanitary sewer.

Securing provisions for drums containing contaminated soil cuttings will also be provided. Level C personal protection may possibly be required for decontamination of grossly contaminated equipment, based on PID measurements of the equipment.

Equipment Decontamination

All sampling and monitoring equipment will be cleaned with Alconox or equivalent, triple rinsed with deionized water and allowed to air dry prior to use. All rinsings will be collected and either discharged to the sanitary sewer or the storm sewer. Rinse water will not be discharged to the storm sewer if PID screening indicates elevated levels of contaminants in the rinse water (i.e. PID readings greater than background). In such cases the rinse water will be discharged to the sanitary sewer.

3.4 INVESTIGATION-DERIVED WASTES

Extraction well development and pump test water will be discharged to the treatment/discharge outlet and rip-rap system. Decon water will be collected and either discharged to the sanitary sewer or the storm sewer. Decon water will not be discharged to the storm sewer if PID screening indicates elevated levels of contaminants in the rinse water (i.e. PID readings greater than background). In such cases the decon water will be discharged to the sanitary sewer.

Bagged disposable protective equipment will be disposed at locations determined by Marathon Electric in compliance with local, state and federal regulations.

Boring cuttings will be field screened with a PID for organic vapors. Cuttings that yield vapor readings greater than background levels will be contained in drums and disposed of using a method determined to be in compliance with local, state and federal regulations.

It is unlikely that contaminated soils will be encountered during excavation for the installation of the discharge outlet manhole/structure or the discharge pipe. In the event that contaminated soils are encountered, based on elevated PID measurements (with or without the assistance of visual or olfactory evidence), the contaminated material will be excavated and will be contained in drums or other suitable containers. This material will be disposed at a location determined by Marathon Electric in compliance with local, state and federal regulations.

4.0 SITE EMERGENCY CONTINGENCY PLAN

4.1 CHEMICAL EXPOSURE SYMPTOMS

Vapors of chlorinated organic solvents are irritating to the eyes, nose, and throat. If inhaled in high concentration they can cause difficult breathing, nausea or dizziness.

Liquids containing these solvents can be irritating to the eyes and skin. If swallowed, they may produce nausea.

4.2 FIRST AID TREATMENT

For vapor exposure, remove victim to fresh air. If breathing has stopped, begin artificial respiration.

For liquid exposure, remove contaminated clothing and flush affected skin with plenty of water. If in eyes, hold eye lids open and flush with plenty of water. If swallowed and the victim is conscious, have him drink water or milk and induce vomiting. If swallowed and the victim is unconscious, do nothing except keep him warm and contact emergency medial help.

4.3 RESOURCES

Service or Organization	*Location*	*Phone Number*
Hospital: Wausau Hospital Center	Wausau, WI 333 Pine Ridge Blvd.	715-847-2121
Fire Department	Wausau, WI	715-845-1111
Poison Control Center	Green Bay, WI	414-433-8100
Police	Wausau, WI	715-842-2055
Rescue/Ambulance	Wausau, WI	715-845-1111

4.4 HOSPITAL ROUTE

Take Cherry Street south (left) to Wausau Avenue. Go west (right) one block to First Avenue. Go south (left) to Bridge Street. Go west (right) on Bridge Street about 500 feet west of U.S. 51, to West Wood Drive. Go south (left) on West Wood about 0.2 mi. to Pine Ridge Blvd. Go west (right) on Pine Ridge Blvd. to the hospital, about 0.2 mi.

Personnel should ascertain that this route is available prior to the start of field activities.

APPENDIX A

HEAT STRESS

STANDARD OPERATING PROCEDURES FOR EMERGENCIES DUE TO HEAT AND HEAT STRESS MONITORING

Field operations during the summer months can create a variety of hazards to the employee. Heat cramps, heat exhaustion, and heat stroke can be experienced and, if not remedied, can threaten life or health. Therefore, it is important that all employees be able to recognize symptoms of these conditions and be capable of arresting the problem as quickly as possible.

THE EFFECTS OF HEAT

As the result of normal oxidation processes within the body, a predictable amount of heat is generated. If the heat is liberated as it is formed, there is no change in body temperature. If the heat is liberated more rapidly, the body cools to a point at which the production of heat is accelerated and the excess is available to bring the body temperature back to normal.

Interference with the elimination of heat leads to its accumulation and thus to the elevation of body temperature. As a result, the person is said to have a fever. When such a condition exists, it produces a vicious cycle in which certain body processes speed up and generate additional heat. Then the body must eliminate not only the normal but also the additional quantities of heat.

Heat produced within the body is brought to the surface largely by the bloodstream and escapes to the cooler surroundings by conduction and radiation. If air movement or a breeze strikes the body, additional heat is lost by convection. However, when the temperature of the surrounding air becomes equal to or rises above that of the body, all of the heat must be lost by vaporization of the moisture or sweat from the skin surface. As the air becomes more humid (contains more moisture), vaporization from the skin slows down. Thus, on a day when the temperature is 95 to 100°F, with high humidity and little or no breeze, conditions are ideal for the retention of heat within the body. It is on such a day or, more commonly, a succession of such days (a heat wave) that medical emergencies due to heat are likely to occur. Such emergencies are classified in three categories: heat cramps, heat exhaustion, and heat stroke.

HEAT CRAMPS

Heat cramps usually affect people who work in hot environments and perspire a great deal. Loss of salt from the body causes very painful cramps of the leg and abdominal muscles. Heat cramps also may result from drinking iced water or other drinks either too quickly or in too large a quantity.

Heat Cramp Symptoms. The symptoms of heat cramp are:

- Muscle cramps in legs and abdomen,
- Pain accompanying the cramps,
- Faintness, and
- Profuse perspiration.

Heat Cramp Emergency Care. Remove the patient to a cool place. Give him sips of liquids such as "Gatorade" or its equivalent. Apply manual pressure to the cramped muscle. Remove the patient to a hospital if there is any indication of a more serious problem.

HEAT EXHAUSTION

Heat exhaustion occurs in individuals working in hot environments, and may be associated with heat cramps. Heat exhaustion is caused by the pooling of blood in the vessels of the skin. The heat is transported from the interior of the body to the surface by the blood. The blood vessels in the skin become dilated and a large amount of blood is pooled in the skin. This condition, plus the blood pooled in the lower extremities when an individual is in an upright position, may lead to an inadequate return of blood to the heart and eventually to physical collapse.

Heat Exhaustion Symptoms. The symptoms of heat exhaustion are:

- Weak pulse;
- Rapid and usually shallow breathing;
- Generalized weakness;
- Pale, clammy skin;
- Profuse perspiration;
- Dizziness;
- Unconsciousness; and
- Appearance of having fainted (the patient responds to the same treatment administered in cases of fainting).

Heat Exhaustion Emergency Care. Remove the patient to a cool place and remove as much clothing as possible. Administer cool water, "Gatorade," or its equivalent. If possible, fan the patient continually to remove heat by convection, but do not allow chilling or overcooling. Treat the patient for shock, and remove him to a medical facility if there is any indication of a more serious problem.

HEAT STROKE

Heat stroke is a profound disturbance of the heat-regulating mechanism, associated with high fever and collapse. Sometimes this condition results in convulsions, unconsciousness, and even death. Direct

exposure to sun, poor air circulation, poor physical condition, and advanced age (over 40) bear directly on the tendency to heat stroke. It is a serious threat to life and carries a 20% mortality rate. Alcoholics are extremely susceptible.

Heat Stroke Symptoms. The symptoms of heat stroke are:

- Sudden onset;
- Dry, hot, and flushed skin;
- Dilated pupils;
- Early loss of consciousness;
- Full and fast pulse;
- Breathing deep at first, later shallow and even almost absent;
- Muscle twitching, growing into convulsions; and
- Body temperature reaching 105 to 106°F or higher.

Heat Stroke Emergency Care. Remember that this is a true emergency. Transportation to a medical facility should not be delayed. Remove the patient to a cool environment if possible, and remove as much clothing as possible. Assure an open airway. Reduce body temperature promptly--preferably by wrapping in a wet sheet or else by dousing the body with water. If cold packs are available, place them under the arms, around the neck, at the ankles, or at any place where blood vessels that lie close to the skin can be cooled. Protect the patient from injury during convulsions, especially from tongue biting.

AVOIDANCE OF HEAT-RELATED EMERGENCIES

Please note that, in the case of heat cramps or heat exhaustion, "Gatorade" or its equivalent is suggested as part of the treatment regime. The reason for this type of liquid refreshment is that such beverages will return much-needed electrolytes to the system. Without these electrolytes, body systems cannot function properly, thereby increasing the represented health hazard. Therefore, when personnel are working in situations where the ambient temperatures and humidity are high--and especially in situations where protection Levels A, B, and C are required--the site safety officer must:

- Assure that all employees drink plenty of fluids ("Gatorade" or its equivalent);
- Assure that frequent breaks are scheduled so overheating does not occur; and
- Revise work schedules, when necessary, to take advantage of the cooler parts of the day (i.e., 5:00 a.m. to 1:00 p.m., and 6:00 p.m. to nightfall).

If protective clothing must be worn, especially Levels A and B, the suggested guidelines for ambient temperature and maximum wearing time per excursion are:

Ambient Temperature (°F)	Maximum Wearing Time per Excursion (Minutes)
Above 90	15
85 to 90	30
80 to 85	60
70 to 80	90
60 to 70	120
50 to 60	180

One method of measuring the effectiveness of employees' rest-recovery regime is by monitoring the heart rate. The "Brouha guideline" is one such method:

- During a three-minute period, count the pulse rate for the last 30 seconds of the first minute, the last 30 seconds of the second minute, and the last 30 seconds of the third minute.
- Double the count.

If the recovery pulse rate during the last 30 seconds of the first minute is at 110 beats/minute or less and the deceleration between the first, second, and third minutes is at least 10 beats/minute, the work-recovery regime is acceptable. If the employee's rate is above that specified, a longer rest period is required, accompanied by an increased intake of fluids.

APPENDIX B

COLD EXPOSURE

FIRST AID FOR HYPOTHERMIA VICTIMS

Incorrect treatment of hypothermia victims may induce a condition known as "after-drop." This is caused by improper rewarming, allowing cold, stagnant blood from the extremities to return to the core of the body. This may cause the core temperature to drop below the level which will sustain life.

(1) Move the victim to shelter and warmth. *Do not allow victim to walk.*

(2) Remove all wet clothing, but handle the victim gently.

(3) Apply heat to the victim's *trunk* by using a warm bath, shower, hot water bottles or *heated* blankets. Do not wrap a hypothermic in a blanket *without* an auxiliary source of heat unless it is to protect him against further heat loss before treatment. An effective field treatment is for one or more of the rescuers to remove their own clothing, using their bodies to warm the victim's naked body. If the victim appears dead, heart massage and mouth-to-mouth resuscitation should be administered.

(4) In cases of mild hypothermia, shelter and dry clothing may be all that is needed. If the victim is conscious and can swallow without difficulty, he may be given a hot sugary drink. Care must be taken to ensure that the victim does not take the liquid into the lungs. Do *not* give the victim alcohol.

NEVER put an unconscious victim in a bathtub.

ALL hypothermia victims should be seen by a doctor.

Some of the information in this brochure has been taken from "Man in Cold Water" with permission of Dr. Martin Collis, University of Victoria, British Columbia, Canada; and from the U.S. Coast Guard publication, "Hypothermia and Cold Water Survival."

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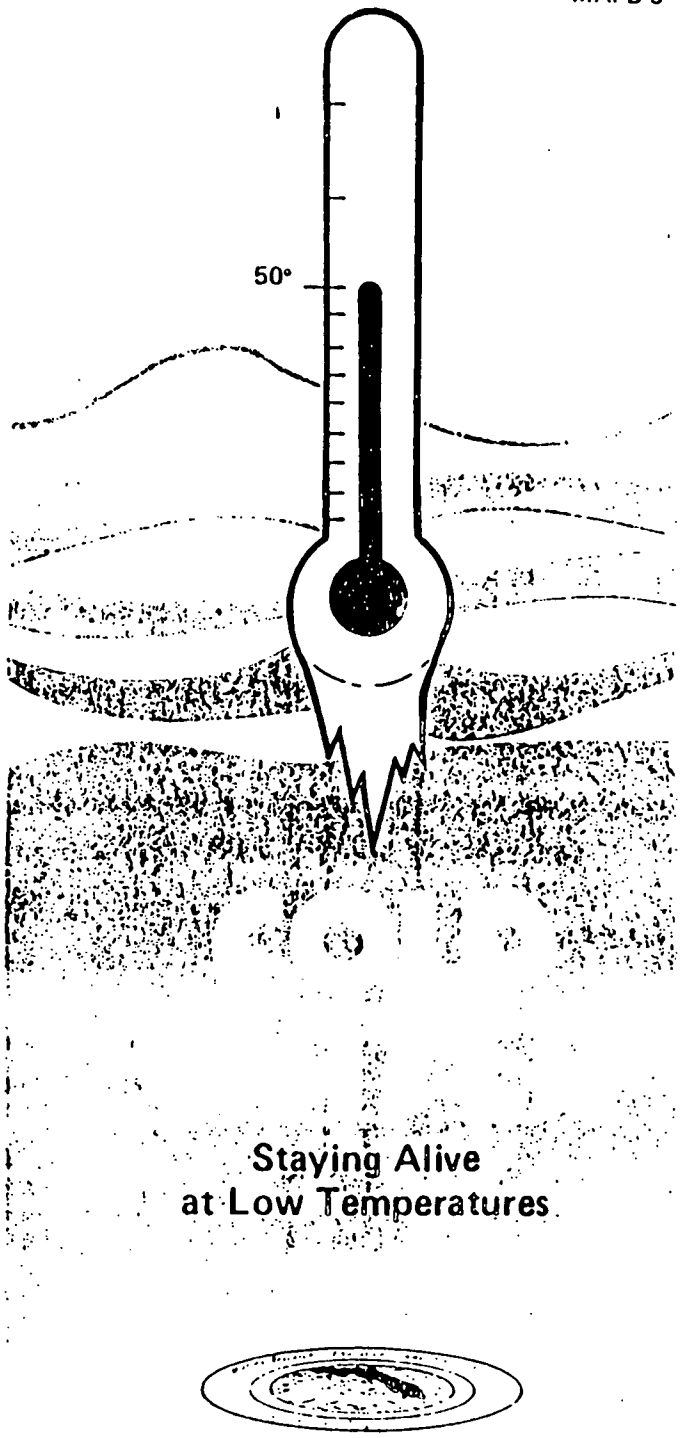
MAPB-5



Staying Alive at Low Temperatures

INTRODUCTION

Even in the Sunshine State, cold water can be a menace.

All boaters and others in danger of accidental immersion in cold water should be aware of the factors that determine body cooling rate and eventual death from hypothermia as well as survival techniques.

The following information focuses on the major problems of cold water immersion and provides recommendations for survival.

HYPOTHERMIA - Lowered Deep Body Temperature

In cold water, the skin and nearby tissues become cooled very rapidly, but it takes 10-15 minutes before the temperature of the heart and brain begin to cool. Intensive shivering occurs in an attempt to counteract large heat loss.

COLD WATER SHOCK

Immersion in cold water causes immediate major changes in body functions, occasionally resulting in heart attacks or ruptured blood vessels. However, this is unlikely to occur in someone with a healthy heart and circulatory system. Also, cold water shock causes immediate hyperventilation (overbreathing) which could lead to uncontrolled inhalation of water and drowning.

IF AN ACCIDENT HAPPENS

Remember that water conducts heat many times faster than air. Most boats will float even when capsized or swamped. Therefore, get in or on the boat to get as far out of the water as possible. Wearing a personal flotation device (PFD) is a must. It will keep you afloat even if you are unconscious.

SURVIVAL FACTORS

Temperature of the water is not the only factor to be considered in cold water survival. Activity in the water, body size and fat have an effect. Small, thin people cool faster than large, fat people. Children cool faster than adults. The following table shows predicted survival times for the "average" person in 50°F water.

SITUATION	Predicted Survival Time (Hours)
NO FLOTATION	
Drownproofing	1.5
Treading Water	2.0
WITH FLOTATION	
Swimming	2.0
Holding-still	2.7
H.E.L.P.	4.0
Huddle	4.0

Treading water and drownproofing are anti-drowning techniques used when the person is without a PFD. Treading water is the continuous movement of arms and legs in certain patterns which keeps the head out of the water. Body cooling rate is 34% faster when treading water than while holding still in a life jacket.

Drownproofing, which involves restful floating with lungs full of air and raising the head out of the water every 10-15 seconds to breathe causes a person to cool 82% faster than while holding still in a life jacket. This is mostly due to putting the head, a high heat loss area, into the water along with the rest of the body. Drownproofing appears to be the *fastest way to die* from hypothermia.

Swimming is not recommended unless the individual is absolutely certain of reaching safety. Some good swimmers have been able to swim 8/10 of a mile in 50°F water before being overcome by hypothermia. Others have not been able to swim 100 yards.

Although the body produces almost three times as much heat when swimming slowly and steadily in cold water compared to holding-still, this extra heat (and more) is lost to the cold water due to more blood circulation to the arms, legs and skin. The average person swimming in a life jacket cools 35% faster than when holding still.

CRITICAL BODY HEAT LOSS AREAS

In addition to the head (which is normally out of the water) certain other body regions have high rates of heat loss while a person is holding-still in cold water. The sides of the chest, where there is little muscle or fat, is a major route for heat loss from the warm chest cavity. Also, the groin region loses much heat due to large blood and lymph vessels near the surface. The following survival techniques focus on these areas.

TECHNIQUES THAT INCREASE SURVIVAL TIME APPROXIMATELY 50%

H.E.L.P. (Heat Escape Lessening Posture) - Hold the inner side of the arms tight against the side of the chest over the warm chest cavity and raise the thighs to close off the groin region - similar to the fetal position.

HUDDLE - If there are several people in the water, form a huddle so that the sides of the chests of different persons are held close together.