OAKLAND COUNTY WATER RESOURCES COMMISSIONER

MUNICIPAL WELL AND WELL HOUSE

DESIGN STANDARDS

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TABLE OF CONTENTS

I. SCOPE

These standards are intended to serve as a guide in the design and preparation of well house plans and specifications. Adherence to the requirements listed will allow Oakland County Water Resources Commissioner Staff to provide a high quality level of service to the community.

II. WELL REFERENCE STANDARDS AND REGULATIONS

American National Standards Institute (ANSI)

American Water Works Association (AWWA)

American Society for Testing and Materials (ASTM)

Michigan Safe Drinking Water Act, Act 399, P.A. 1976, as amended and administrative rules

Well Head Protection Standards.

Recommended Standards for Water Works, Great Lakes-Upper Mississippi River Board of State Sanitary Engineers.

Water Well Drilling Act, Act No. 294, P.A. of 1965

Applicable Federal, State, local laws, ordinances and regulations

Oakland County Water Resources Commissioner (WRC) Requirements and Standards

Ground Water Quality Control Act, Part 127 of Act 368, P.A. 1978 as amended and administrative rules

Michigan Department of Environmental Quality (M.D.E.Q.), Division of Drinking Water and Radiological Protection requirements, standards and guidelines

III. WELL GENERAL REQUIREMENTS

1. Since an adequate water supply is of major importance to the development of a project, expansion of an existing system, and/or well siting and well development should be one of the first tasks undertaken. The yield of the well and the required well isolation radius could affect the size and/or layout of the development.

2. The WRC may elect to permit or require the Proprietor to connect to another water supply system in lieu of developing a separate well supply. In this event a connection fee will be charged.

3. In areas where the well house will be inter-connected with an existing community well system, the operating pressure shall be compatible with the existing water system pressures.

4. If a new development is required to connect to an existing water supply system and the additional demand exceeds the existing capacity, a new well, 12-inch diameter minimum, and well house complete with tank or variable speed drive pump shall be installed to supply the additional water as required. The WRC may consider alternatives to the new well including participation in upgrading the existing facilities.

5. Where an existing water supply is not available, the minimum requirement shall be one production well, 12-inch diameter minimum capable of providing the required firm capacity and one standby well, 12-inch diameter minimum. Each well shall provide a minimum of 500 gpm. These wells shall be a minimum of 30 feet apart and screened to yield the full capacity allowed by the aquifer.

6. WRC Water Operations shall be notified 48 hours before drilling is to proceed and shall have full authority to inspect the drilling operation. All drilling shall be done in accordance with the requirements of The State of Michigan and WRC.

7. Fees (revised 9/24/99) are required to cover the cost of plan review and inspection by county personnel. Well house and booster station fees required are $5,000.00 each. The storage tank fee is $4,000.00 each. A SCADA equipment and installation fee of $9,000.00 is required. Water main fees are based on the linear footage involved. The amount of fees is subject to change without notice. Check with Oakland County Water Resources Commissioner's office for the current requirements.

8. Water system plans shall be prepared and submitted for review on 24" by 36" size drawings only. The plan cover sheet shall include the Project Name, the Township Name, the Township and Range, the section number, the quarter section designation, the property description of the isolation radius and parcel to be deeded to the County, a 6" by 6" site map with the well in the center at a scale of 1" = 200", a location map, the property address, the name and address of the proprietor, the name and address of the design engineer.

9. The second sheet, or sheets of the water system plans shall contain a service district map drawn at a scale of 1" = 200' showing each lot or parcel to be served by this well. This sheet shall also show the calculation of the design peak water usage requirement for the entire service area. These calculations shall clearly identify the demand associated with each parcel in the district. The fire flow requirements or provisions of the well system shall be stated and approved by the local engineer and fire department. The service district shall have the written approval of the local municipal engineer stating the plan complies with the municipal master water plan.

10. The water system plan drawings shall include the pump discharge curves; all well logs and sieve analyses; the diameter, size of screen opening, and length of the screens; the settings for the screens and pumps; motor name plate data; hydro-pneumatic tank sizing calculations and drawings; and reference to the hydro geologic study.

11. All construction documents and work, materials and equipment shall comply with applicable Federal, State and local: laws, ordinances, regulations and utility company rules.

12. All submittals intended for the M.D.E.Q. should be directed first to The Oakland County Water Resources Commissioner's office for their review and approval.

13. Construction plans for the community well and well house must be completed and approved prior to the construction plans for the water distribution system.

14. The Design Engineer shall schedule a pre-construction coordination meeting. Attendees shall include WRC; the Construction Contractor; the Well Driller; the proprietor and others as appropriate. Prior to final acceptance, a final coordination meeting with the above named shall be scheduled by the Design Engineer to address the punch list items.

IV. INSTALLING AND DEVELOPING THE WELL

1. Under no circumstances is the construction of wells, well houses, or water mains permissible without approval and permits from the M.D.E.Q.

2. No alterations, changes, or modifications shall be made to the approved plans unless requested in writing by the design engineer and approved by the appropriate reviewing agencies.

3. Observation wells shall be installed to determine the performance of the aquifer being tested. Observation wells shall terminate at the same depth as the well being pumped.

4. Test Well - The Design Engineer shall obtain approval of the proposed well site(s) from The State of Michigan Department of Environmental Quality. Accompanying this request the Design Engineer must include a site plan showing the precise location of the proposed well(s) on the overall site plan, and identify any and all natural or man-made features that could adversely affect the acceptability of the site(s). It is recommended that at least two sites be selected in the event one site is unacceptable or two wells must be constructed at separate locations to provide sufficient supply. The M.D.E.Q. along with WRC Water Operations, the Developer's Representative and the Municipality, if required, will meet at the site. If it is determined that the site is acceptable, the State may issue permission, in writing, to construct the test well. After receipt of permission to construct the test well, the Driller shall notify WRC Water Operations at least 48 hours in advance of beginning construction of the test well to schedule inspection of the work.

5. The test well shall be drilled to bedrock and the best available aquifer shall be selected.

6. Upon completion of the test well five (5) copies of a hydro-geological report shall be submitted. The report shall contain the following information: data and results of the step test; results of the aquifer test; an aquifer analysis; and well logs showing the surface elevation, casing length, screen length, elevation of the bottom of the screen and soils encountered. The hydro-geological report shall be forwarded to the Water Operations Engineer along with a request for a permit to construct a second production well and convert the test well to a production well. The Water Operations Engineer will review the data for completeness and if he concurs with the findings of the aquifer analysis he will forward the information to the M.D.E.Q. for their review and request that permits be issued.

7. If a test well is to be used as a production well, the screen size must be selected by the well screen manufacturer based upon a sieve analysis and approved by the Water Operations Engineer. All materials shall be new.

8. Second Production Well - with receipt of the M.D.E.Q. Permit by the WRC office, the construction of the production well may be started. The Well Driller shall notify Water Operations a minimum of 48 hours prior to the commencement of well construction to schedule inspection of the work.

V. STANDARDS AND PROCEDURES FOR INSTALLATION OF TEST AND PRODUCTION WELLS

INTRODUCTION

Proposed Type 1 water systems to be developed in Oakland County and then operated by the Oakland County Water Resources Commissioner (WRC) shall be developed in accordance with all local and state requirements, in accordance with the procedures, and to the standards, outlined below.

Stand alone systems which will be served by water wells must meet the firm capacity requirements determined by the maximum water demand of the development and all local requirements. Firm capacity means the capacity of the well system with the largest unit out of service. This means that for the typical stand-alone system two wells are required.

TEST/EXPLORATORY well is a unit drilled to determine the potential water bearing formations underlying the site and typically, upon completion, will be abandoned and plugged.

TEST/OBSERVATION well is a unit installed for the purpose of monitoring water levels during the required pumping tests on a Test/Production well. If they are left in place the well casing must be grouted with neat cement in conformity with Michigan Department of Environmental Quality (M.D.E.Q.) requirements.

TEST/PRODUCTION well is a unit installed with the intent, once necessary testing and evaluation is completed, of being converted to a Production well. The casing of a test/production well must be grouted with neat cement.

PRODUCTION well is a unit that, upon approval from both M.D.E.Q. and WRC, is to be equipped and utilized as a supply well. The casing of production wells shall be grouted with neat cement.

INITIATING PROCEDURES

1. Submit site plan and request site inspection and approval from M.D.E.Q. through WRC Standard isolation requirements for a Type 1 well is 200 feet in all directions. The water system owner, without encumbrances of any kind, must own the land within this radius. Transfer of title to WRC shall be by Warranty Deed only at the time of final acceptance as stated in Section XVII.

2. Receive letter of approval for test drilling from M.D.E.Q. through WRC.

3. Approval is for test drilling. At the Owner's option, the test well may be used for exploratory purposes only or if properly sized and constructed may later be converted to a Test/Production well if approved by M.D.E.Q. and WRC.

4. Test wells shall be drilled in conformance with Standards outlined below. Results including well log, geophysical logs, grain size analysis, yield estimate, and proposed design of a Test Production well shall be submitted to WRC.

5. Receive approval from M.D.E.Q. and WRC for construction of Test/Production Well. Construction and testing procedures shall conform to the standards detailed below.

6. Notify WRC 48 hours in advance of the date construction is to start, when the casing is to be grouted, when the well screen is to be set, and when the aquifer test will be conducted. WRC personnel shall inspect and be on site for each of these procedures.

7. Upon completion and testing, all data, and analysis, shall be submitted in a formal report to WRC. The report shall include a study of the hydro geological conditions as required by the State of Michigan Safe Drinking Water Act, paragraph 325.10813 along with the safe yield of the aquifer and the projected drawdown at the expected rated capacity of the well. Five copies shall be submitted to WRC for approval.

8. WRC, in conjunction with M.D.E.Q., will issue the Permit for a Production well. This permit will include well capacity and equipment ratings.

TEST/EXPLORATORY WELL SPECIFICATIONS

The minimum drilled diameter of a Test/Exploratory well shall be 6 inch. The test shall penetrate to bedrock and samples of the drill cutting collected every 5 feet or at each change in formation, which ever is less. Samples shall be bagged and labeled with date and depth for submission to the WRC, if requested.

The well bore shall be geophysically logged, including an electrical log and gamma-ray log, prepared in graphical form, for submission to the WRC

A well screen manufacturer, or other approved laboratory shall perform grain size analyses of the granular material of the targeted formation and recommend a well screen opening size. The analysis shall include grain size distribution curves, 90% retained size, 60% retained size, 50% retained size, 40% retained size, and the uniformity coefficient.

If the well is intended only as an exploratory hole it shall be plugged and abandoned. Documentation of all well abandonment shall be provided in the form of an abandonment log acceptable to M.D.E.Q., Drinking Water & Radiological Protection Division.

Original documentation to be submitted to the WRC shall included the driller's log, geophysical logs, grain size analyses, screen opening recommendations, original screen setting, a proposed design for the Test/Production Well, and a map showing the geographical location of the Test/ Exploratory well.

TEST/OBSERVATION WELL SPECIFICATIONS

The minimum cased diameter of a Test/Observation shall be 2 inch. A minimum of 4 feet of well screen shall be installed in the same depth interval proposed for the Test/Production well screen. The Contractors hydro-geologist shall determine the exact depth and screen length. The well shall be developed and pumped until clear water is produced to ensure that water levels will properly reflect the aquifer's response to pumpage.

It is anticipated, in most cases, the Test/Observation wells shall remain in place and as a result the casing shall be grouted with a minimum of 2 inches of neat cement to a depth of at least 25 feet.

Casing for Test/Observation wells may be galvanized steel pipe or schedule 40 PVC. Well screens shall be stainless steel wire wound.

TEST/PRODUCTION WELL

1. MATERIALS

   a. Well Casing

      Well casing shall be new and conform to ASTM specification A53, A589. A106, or API 5L for seamless steel pipe. All casing shall be clearly marked with the ASTM designation and wall thickness. Minimum wall thickness for all sizes shall be 0.375 inches. The supplier prior to installation shall provide certification on the casing. Casing may be beveled for field welding or threaded for couplings. If threaded and coupled pipe is used the coupling shall be secured to the pipe by back welding with at least two passes of weld. Provide actual heat number for each type pipe used.

   b. Well Screen

      The screen shall be of 304 stainless steel and wire wound with a 304 stainless steel bottom plate. The screen to casing seal shall be with a "K" packer or directly attached to the well casing. Johnson or Cook or other pre-approved manufacturer shall manufacture the screen.

   c. Cement Grout

      The grouting agent for the well casing shall be a neat cement material weighing 15 lbs/gallon consisting of Portland Cement, ASTM C150 Type 1 mixed with a maximum of 6 gallons of water.

   d. Gravel Pack Material

      Gravel, if used for stabilizing the annular space between the screen and well bore, shall be at least 94% silica having a uniformity coefficient of no greater than 1.35.

2. WELL DRILLING

   a. Drilling Method

      The Contractor, in his submission for construction approval, shall include the proposed method of drilling the well.

   b. Formation Samples

      Drill cuttings shall be collected every five feet, or at every change in formation, which ever is less, placed in bags labeled with the date, depth, and well number. The samples grain size analyses, along with the well log and proposed well construction shall be submitted to WRC.

   c. Screen

      The Contractor shall be responsible for providing the proper size screen opening, and, if used, gravel pack material to stabilize the native formation. The Contractor shall also be responsible for providing sand free water. The screen entrance velocity, for the proposed equipping rate of the well, shall not exceed 0.1 foot per second.

d. Geophysical Logging

The complete well bore shall be geophysical logged, including an electrical log and gamma-ray log for rotary holes and a gamma-ray log for cable tool holes. Original logs, prepared in graphical form shall be submitted to WRC.

e. Grouting of Well Casing

The well casing shall be pressure grouted with neat cement from the surface to the top of the formation, and in no case shall extend to a depth of less then 25 feet. The well casing shall be pressure grouted using tremie pipe, cement shoe, or braiden head. The grout wall shall have a minimum thickness of 2 inches. The Contractor shall provide written verification on the volume of cement grout used.

f. Placement of Stabilizing Gravel

Gravel used for stabilization shall be placed through a tremie pipe. Dumping of gravel into the bore hole shall not be accepted.

g. Well Alignment

The well shall be constructed, and casing set round, plumb, and true to a line defined herein. To demonstrate compliance the Contractor shall furnish all labor, tools, and equipment and shall make the alignment tests described to the satisfaction, and in the presence of the WRC.

Plumbness and alignment shall be measured by lowering a "bird cage" plumb bob down the casing and measuring the deflection and direction of deflection every 5 feet for the entire length of the casing. The plumb bob shall be not more then 1/2 inch smaller than the inside diameter of the casing being tested.

Vertical variance of the casing pipe, in excess of 2/3 the inside diameter per 100 feet, shall be corrected by the Contractor at his own expense. Should the Contractor fail to correct the faulty alignment or plumbness the WRC may refuse to accept the well.

h. Well Development

The initial well development shall be by flushing and/or pumping to clear all drill cuttings from the borehole, and shall continue until clear water is obtained. A turbine pump capable of producing two times the proposed equipping rate of the well shall then be installed. The well shall be further developed by surging and over pumping until the water remains clear. The Contractor shall maintain a log describing the development efforts, including hours worked.

i. Sand Content of Water

It shall be the responsibility of the Contractor to complete a well that produces sand free water. The sand content of the water shall average not more then 5 mg/l for a complete pumping cycle of 2 hours duration when pumping at the proposed equipping rate.

Not less then 10 measurements shall be taken at equal intervals to permit plotting of sand content as a function of time for determination of the average content for each cycle.

It shall be the responsibility of the Contractor to do such work, as may be necessary to meet this sand content requirement. Should the Contractor fail to meet the sand content requirement the WRC may refuse to accept the well.

j. Well Testing for Efficiency

Upon completion of the initial development work a Step-Drawdown Test shall be conducted on the well. The test shall consist of a two-hour rest period and three steps, each of three hours duration. The first step to be one-third the maximum rate, the second at two-thirds maximum rate and the third step at maximum rate. No recovery readings are required. The maximum rate shall be at the proposed rated capacity of the well.

A calibrated free fall orifice pipe shall measure the pumping rate with a gate valve installed at the pump head to regulate flow. Water level measurements shall be taken in the pumped well and in available nearby Test/Observation wells. Water level measurements shall be taken by an electric measuring device or wetted tape to the nearest 0.01 foot. Contractor shall be responsible for disposal of water so that it does not pond or recirculate.

Readings shall be made in accordance with the following schedule.

Rest period - - every 15 minutes
Each step - - - every 1 minute for 1st 10 minutes
every 5 minutes for next 30 minutes
every 10 minutes for next 20 minutes
every 15 minutes for remainder of test

The actual pumping rate shall be recorded when each water level reading is taken.

Upon completion of the Step-Drawdown Test the data shall be analyzed for well efficiency and the results submitted to the WRC for review. It will be the responsibility of the Contractor to provide a well having an efficiency of no less then 80%. The efficiency shall be that as determined from the Step-Drawdown Test. The well efficiency is herein defined as the product of the first power losses, as determined from the step test, divided by the total drawdown. It is the Contractors responsibility to do such additional work, to achieve an efficiency of 80%.

k. Aquifer Testing

The aquifer shall be tested by conducting a constant rate pumping test. The standard test shall consist of 18-hour rest period, 72 hour pumping period, and a 24-hour recovery period. The pumping rate shall be at the proposed rated capacity of the well.

Water levels shall be taken, to the nearest 0.01 feet in the pumped well and in two monitor wells within a reasonable distance from the pumped well. The testing procedures and locations of the Monitor Wells shall meet the Aquifer Test requirements of M.D.E.Q. Drinking Water and Radiological Protection Division dated January 1, 1996.

Water level readings shall be taken in accordance with the following schedule.

Rest period - -	every 30 minutes
Pumpage period - -	every 20 seconds for 1st 2 minutes
	every 1 minute for next 8 minutes
	every 2 minutes for next 10 minutes
	every 5 minutes for next 40 minutes
	every 15 minutes for next 120 minutes
	every 30 minutes for next 180 minutes
	every 60 minutes for remainder of test
Recovery period - -	same as pumpage period

The actual pumping rate shall be recorded each time a water level reading is taken. Water pumped during the test shall be piped away from the site so it does not pond, erode the soil, or have the opportunity to recirculate into the aquifer.

Upon the completion of the pumping test the data shall be analyzed for safe yield of the aquifer and three copies of a complete hydro geologic report submitted to the WRC for review. The report shall meet all the requirements of the Michigan Safe Drinking Water Act, paragraph 325.10813 and paragraph 325.10830.

l. Water Samples

The Contractor shall make arrangements, obtain samples bottles, and collect water samples at the end of the test for analyses. The Contractor shall be responsible for delivering the samples to a State Certified Laboratory in a timely fashion.

The chemical monitoring parameters to be analyzed shall include all the current requirements of the M.D.E.Q. for new public water supply wells. Should any parameter not meet the current M.D.E.Q. maximum contaminant level (MCL), then either treatment or a new well will be required.

m. Well Disinfection

Upon completion of all testing procedures the Contractor shall disinfect the well. Disinfection shall be accomplished by the addition of chlorine solution to provide a concentration of not less then 50 mg/l in the volume of water contained within the well bore. Upon completion of the chlorination the well shall be capped.

n. Reports Required

Reports to be submitted to the WRC include individual reports on each Test/Exploratory well and a complete hydro geologic/aquifer test report on the Test/Production well.

The Test/Exploratory well report shall include all documentation on the well, including complete grain size analyses, driller's log, and geophysical logs. The analyses of the aquifer or aquifers penetrated shall include a yield projection for the submitted test/production well design.

The hydro geologic/aquifer test report shall meet all requirements of the Michigan Department of Environmental Quality necessary for permitting of the production well. The report shall include, but not be limited to identification of geological formations, including thickness and hydraulic characteristics of the aquifer, the thickness and number of protective clay layers and their areal extend, location of the well relative to sources of contamination, susceptibility of the area to flooding, depth and elevation (reference to sea level) of the water table, analysis of the aquifer test, and complete water quality analysis.

By reference the State of Michigan Safe Drinking Water Act 399, PA 1976, Section R325.10813 and the Michigan Department of Environmental Quality (M.D.E.Q.) Drinking Water and Radiological Protection Division Policy/ Procedure Number DWRP-03-003, effective date December 1, 1997, "Aquifer Test Requirements for Public Water Supply Wells" are made part of these specifications.

VI. WELL LOGS AND TESTS

The Developer/Owner shall provide complete well logs and other information, including the following information:

- Accurate well location in State Plane Coordinates
- Ground surface and casing elevation in geodetic datum.
- Lithology/geologic descriptions at five-foot intervals or at strata changes.
- Total drilled depth of the well.
- Static water level.
- Geophysical logs of wells including electric and or gamma ray type.
- Length, location and description/specifications of the screen.
- Screen design criteria (e.g. slot size) and supporting sieve analysis from screen manufacturer.
- Warranty deed for the isolation area property required by Oakland County Water Resources Commissioner (WRC).

WELL TEST / AQUIFER ANALYSIS

At least 24 hours prior to the aquifer test, a step drawdown test shall be performed. This usually consists of 3 equally spaced pumping rates with the highest rate equal to the maximum pumping rate for the screen design.

The aquifer tests for Type I well systems shall be conducted in accordance with the latest revision of the Michigan Department of Environmental Quality (M.D.E.Q.), Division of Water Supply Aquifer Testing requirements. A brief summary of the current aquifer testing requirements is included below for information purposes only:

- Groundwater direction and gradient must be determined prior to the initiation of the aquifer test. A combination of on-site and off-site monitoring locations may be used with the approval of the M.D.E.Q. and private property owners (if necessary).
- All wells over 5" diameter located within one half mile of the proposed well field boundaries shall be identified and illustrated including location (x,y only), capacity and the screening interval (in geodetic datum).
- The aquifer test must have a minimum duration of 72 hours (as determined by the complex subsurface geology found in Oakland County) to ensure that governing boundary conditions and recharge areas are determined.
- The aquifer test must be conducted such that the pumping rate is held constant at the proposed firm capacity of the well field.
- A minimum of two monitoring wells are required and are to be located by a qualified hydro geologist in accordance with the M.D.E.Q. Division of Water Supply requirements. At a minimum, the qualified hydro geologist must have supervised and performed analysis of pump/aquifer tests, groundwater flow delineation (computer modeling) and hydro geologic studies for potable water systems.

- Groundwater level measurements are to be recorded to the nearest hundredth of a foot at the following increments:

  1 per minute for the 0 to 10 minute period
  Every 2 minutes for the 10 to 20 minute period
  Every 5 minutes for the 20 to 60 minute period
  Every 15 minutes for the 60 to 180 minute period
  Every 30 minutes for the 180 to 360 minute period
  Every 60 minutes for the 360 minute to completion of the aquifer test.

- Readings on the rate of recovery shall follow the same schedule and shall continue for one third of the length of the pump test. The first reading shall be taken two minutes after the pump has been stopped. The minimum aquifer characteristic properties such as transmissivity and storativity shall be determined by the analysis of the testing results by a qualified hydro geologist in accordance with the latest requirements by the Water Supply Division of the M.D.E.Q.

A hydro geologic report shall be prepared by a qualified hydro geologist for the test and production wells. The report shall contain a compilation and evaluation of collected and published data necessary to determine the aquifer characteristics, isolation area, acceptability of the well location and construction, and the availability of groundwater supplies. The hydro geologic report shall include as a minimum the following items:

- Well logs including the depth and the identification of geologic formations to bedrock.

- Aquifer testing methodology including the rational for placing monitoring wells and establishing screening intervals.

- Static groundwater elevations per aquifer testing requirements.

- Well efficiency.

- Recommendations of well rating based on a one hundred day drawdown (without recharge) per aquifer testing requirements.

- Water quality analysis from samples drawn at the completion of the aquifer test.

- Determine the necessity for additional hydro geologic investigations to address issues such as boundary interference related to adjacent wells and subsurface geologic conditions.

Five copies of the hydro geologic report shall be submitted to WRC upon the completion of construction and testing for approval by the Water Operations and the Water Supply Division of the Michigan Department of Environmental Quality.

WELLHEAD PROTECTION AREA DELINEATION

GENERAL

The wellhead protection area shall be delineated prior to acceptance by the Oakland County Water Resources Commissioner' Division of in accordance with M.D.E.Q. - Division of Water Supply and M.D.E.Q. Land and Water Management, Office of Water Resources requirements. The delineation shall include the determination of the ten-year time of travel (TOT) as determined by a computer model (analytic or numeric based). The computer model shall be calibrated using the results of the aquifer testing results, and shall be approved by the M.D.E.Q.

The wellhead protection area delineation must be completed under the direct supervision of a qualified hydro geologist or as required by the M.D.E.Q. The analysis must include the effects of interference from other Type I or irrigation wells (on or offsite) if these wells are located in the same aquifer.

The developer/owner shall submit to Oakland County prior to acceptance an electronic file (AutoCAD; version per WRC standards) showing the location of the proposed well field, location of the production, testing and observation wells within the well field and the ten year TOT wellhead protection area. All known wells (public, private, oil/gas, etc) located within the wellhead protection area shall be included in the electronic file. This electronic file shall be referenced to Michigan State Plan Coordinate system.

The develop/owner shall be required to provide contaminant source information on sites showing justifiable concern and/or sites noted as possible contaminant sources during WRC and M.D.E.Q. site reviews.

WELLHEAD DELINEATION GUIDELINES

The purpose of this section is to provide an overview of the steps necessary to complete the delineation of a wellhead protection area (WHPA) to the satisfaction and approval of the M.D.E.Q. This section does not contain every technical delineation requirement and M.D.E.Q. can provide specific technical requirements as necessary.

The following phases are recommended in order to obtain the approval of the M.D.E.Q. without expending unnecessary costs or efforts:

- **WORKPLAN PHASE**

- It is strongly recommended that the owner/developer meet with the M.D.E.Q. to develop consensus regarding the aquifer testing, computer model type, delineation, the effects of offsite wells and other site specific issues.

- The owner/developer should submit the proposed workplan (reflecting the input received at the initial meeting with the M.D.E.Q.) for approval prior to initiation of any field activities by the owner.

- **CONCEPT PHASE**

- Perform the required aquifer test in accordance with the specifications of the M.D.E.Q. Division of Water Supply (latest version).

- Combine the results of the aquifer test, static water level determination, geologic characterization efforts and technical expertise (e.g. qualified hydro geologist) to construct a groundwater flow model.

- Apply the groundwater flow model to analyze the aquifer under the proposed conditions (e.g. location and rated capacity of each well) and determine the ten-year time of travel for the specific aquifer and well field location.

- **DELINEATION**

- All information summarizing the delineation of the wellhead protection area shall be shown in an AutoCAD electronic file (WRC current version).

- Clearly show the location of existing wells, proposed production wells and the wellhead protection area on a site drawing (to scale). Also include the location of any offsite wells (within one half mile of the subject site) and of the monitoring/ observation wells used during the aquifer test.

- Show the location of the ten-year time of travel for the rated well field capacity. Highlight any boundary conditions (e.g. impacts of subsurface drainage divides) and interference of adjacent irrigation or potable water wells.

VII. WELL PUMPS AND APPURTENANCES:

1. Pumps shall be sized to provide the required flow at a normal system operation pressure of 50 -70 psi at street level. In areas where significant elevation differences occur, the minimum operating pressure shall provide no less than 40 psi at the highest street elevation at the pump on setting, and no more than 80 psi at the lower street elevation on the pump off setting.

2. Pumps shall be deep well vertical turbines, hollow shaft, high thrust with water lubricated bearings and bronze semi-enclosed impellers. The pumps shall be equipped with a close coupled shaft and anti-reversing ratchet. Provide mechanical seal, Dura Metallic Mechanical RA Seal with a steady bushing on the motor. Seal all joints with FDA approved multi-part silicone sealant. Manufacturer's certified test curves and physical dimension sheets shall be furnished to the WRC for approval. Pumps shall be subject to field testing to assure performance in accordance with specifications. Impellers shall be semi-enclosed or semi-open as designated by the manufacturer. Pumps shall conform to AWWA Standard - AWWA E101-77 (certified documentation to be provided WRC).

3. Motors shall be 1800 RPM, base speed, 3 phase, totally enclosed fan cooled, with Class F insulation. Final H.P. requirements will be determined after analysis of the manufacture's curves. Motors must have at least a 1.15 S.F.

4. Developer/owner may be required to provide variable frequency drive (VFD) or distribution system storage tank(s) based on projected system demand. If determined as necessary by WRC, this requirement shall be met prior to system acceptance.

5. Plastic altitude lines and direct reading gauges shall be installed at the elevation of the discharge pipe centerline for each well. Gauges shall be 4" diameter with feet graduations. Flexible airline tubing will be installed and plumbed into the upper portion of the tank.

6. A minimum 3" pipe with threaded cap shall be welded at an angle of 45 degrees to the casing of each well with the vertical to provide access for an electrical depth gauge. This pipe shall protrude from the base a sufficient length to permit easy removal of the cap and not project into the aisles. A 2" pipe with a gooseneck pointing down and screened, shall be threaded into the cap of the pipe to vent the well casing.

7. The pump column pipe shall be of sufficient length to permit the bottom bowl intake to be set 5' above the top of screen. No tailpiece will be permitted.

8. A 1/2" copper tubing pre-lube line with gate valves shall be installed to each well from the pressure side of the check valves for each well. Pump pre-lube shall be activated through a solenoid valve with pump on delayed from 15 seconds to 2 minutes after pre-lube begins.

9. A minimum 2" air and vacuum valve with throttle as manufactured by APCO #144DAT or VAL-MATIC #102WS for deep wells shall be provided on discharge lines between check valve and pump. Minimum 2" air relief piping shall be sloped to a southerly building elevation, at 7'-6" minimum elevation with a brass screen fitting pointing downward one foot from the pump house wall.

10. A piston type air compressor of adequate size shall be securely wall mounted 3 to 4 feet above the floor, and be equipped with self unloader. The compressor shall be equipped with a minimum 3/4 HP, 3i motor with a minimum required rating of 3 CFM at 90 psig. Air compressor to be equipped with an oil separator that allows a maximum of 2 parts of oil per one million parts of output.

VIII. WELL TANK AND PIPING

1. The pressure tank shall have minimum 1/4" steel plate sides and 5/16" plate ends. All tanks shall be tested and certified by the manufacturer to 150 psi or 1.5 times the maximum system design pressure, which ever is greater, and shall have a metal certification tag attached. The tank shall be lined with a NSF approved epoxy suitable for potable water contact per NSF 60/61. The tank manufacturer shall provide documentation of NSF approval of the lining material used prior to acceptance by WRC. Interior tank coating shall be applied in accordance with the coating manufacturer's recommendation. See Division 9 Finishes of Section XIV.

2. A minimum of two 24" diameter round blind flanged manholes, face mounted vertical, one on each end of the tank, and sufficient taps for sight glasses, controls, relief valves, compressor, etc. shall be located in the front end of tank. No openings will be allowed in the top of the tank.

3. All openings in the tank, including sight glasses and controls, except the manhole, shall have a ball valve immediately adjacent to the tank.

4. All valves on 3" diameter and larger piping shall be flanged and conform to applicable ASTM specifications. Valves shall have hand wheels with arrows indicating direction of opening and all valves shall open counterclockwise and have rising stems.

5. A minimum 6" bottom drain and gate valve shall be located near the rear end of the tank in the bottom and piped to outside the well house. No standpipes inside tank will be allowed. Tanks over 10,000 gallons must have 8" drains.

6. An adequate electrically operated air pressure relief valve shall be provided at the pressure tank. This shall be vented to the outside at ceiling height and a suitable muffler installed to reduce the noise level below 40 db (A). This relief valve shall be gate valved for removal from a pressurized tank. A typical setting shall be 10 psi above the high operating pressure. Void air pressure switch shall control a solenoid valve that will open at high air level to void all excess air.

7. Gauges shall be provided on discharge lines between the check valve and pump, and on the front of the hydro-pneumatic tank. The pressure gauges shall be liquid filled, stainless steel case with brass movements, not less than 4 inches in diameter, 0 to 150 psi range, with a shut-off valve and pulsation dampener.

8. Check valves with outside weight and lever shall be installed in the discharge line from each pump.

9. Propeller type meters as manufactured by Sparling (certified " 2% accuracy) shall be installed on the discharge line of each pump to accurately record the pump flow. The meters shall be located between the pump and the blow-off line after the check valve. No meter shall be directly connected to any fitting. A straight pipe of length recommended by the manufacturer shall be installed on each side of the meter. One blank plate cover (to factory specifications) shall be supplied for each water meter in the building to allow for continuous operation while meters are out for repair. Meters must provide a pulse output for the SCADA system.

10. Pumping equipment, piping and all appurtenances shall be located to provide a minimum of 48" clearance between interior of walls and said equipment. The clearance between the interior wall and the side of the tank opposite the pumps may be reduced to 36 inches. Clearance from the floor to the bottom of tank shall be a minimum of 24" and clearance from ceiling to top of tank shall be a minimum of 18". The bottom of flanges of all piping shall be at least 6 inches above the floor.

11. Vertical discharge piping through the floor of the pump house shall be tied with stainless steel rods, and thrusted. Interior joints other than flanged joints shall be tied with steel rods. Adequate pipe supports shall be provided on maximum ten foot spacing, under bends, heavy fittings, valves, or as required by the Water Operations Engineer. Pipe supports shall be Standon Adjustable Pipe Supports, Model S89 Flange Supports and Model S92 Saddle Supports, as supplied by Material Resources, Hillsboro, Oregon or approved equal. No contractor fabricated supports will be accepted.

12. Three 1/2" test cocks shall be provided, one at each pump head and one at the tank discharge. Discharge from test cocks shall be downward. A 1" tap shall be made in the feeder main 10' outside the building and 1" K copper line run underground to a sample point inside the building. Sample point shall have a 1" ball valve, nipples, tee, elbows, and sample cock. The minimum cover for this line shall be 5'. See Standard Detail.

13. Underground water main shall be Class 54 Ductile Iron cement lined conforming to ASTM A377, ASA A21.51, and AWWA C151. Mechanical joints are to meet ANSI A21.11, AWWA C111 in combination with ANSI A21.6 or ANSI A21.4 AWWA C106.

14. All above ground pump house water mains shall be steel pipe, ASTM Specification A-53, Schedule 40 with flanged joints. Flanges for welded piping shall be 150# welded neck per ASTM A181 and ANSI B16.5, drilled to American Standard Template and ANSI B16.1. Use square head bolts of open hearth steel, ASTM A575 and A576 and hex nuts, semi-finished, ASTM A307 grade B or better.

15. Steel "Dresser" couplings with 5/8" minimum tie rods shall be used on discharge lines from both pumps and from the tank. Where uni-flange style pipes and fittings are used, a minimum of 2 1/2" diameter tie rods are required across all joints. Vitaulic type grooved end mechanical coupling systems are allowed with County approval.

16. All pump to waste lines and hydropneumatic tank drain shall have exterior pipe flanges with caps. Flange caps shall have two minimum 1/4" diameter weep holes for freeze protection. The water pressure relief line shall have a flap valve.

17. Each pump discharge pipe shall be provided with two 3/4" corporation stops using stainless steel saddles for chemical injection.

18. Exterior coating system for hydropneumatic tanks to be provided by Valspar Corporation or equal. Work to be performed in accordance with manufacturers written recommendations. Provide written certification that preparation, coverage and ANSI/NSF requirements have been met.

Surface Preparation: SSPC SP-6 Commercial Blast.

Primer: Moisture Cured Urethane Primer, Product No. 513-F-108.
Factory installed 2.0 to 3.0 Mils d.f.t.

Intermediate: Moisture Cured Urethane, Buff Product No. 541-D-102.
Factory Installed 3.0 to 5.0 Mils d.f.t.

Finish: Moisture Cured Urethane (Gloss) or Moisture Cured Urethane (Semi-Gloss) W/MIOX
Product No. 540 Series or 543 Series, 1.5 to 2.0 Mils d.f.t.

19. Interior coating system for hydropneumatic tanks to be provided by Valspar Corporation or equal. Work to be performed in accordance with manufacturers written recommendations. Product to have ANSI/NSF Standard 61 approval.

Surface Preparation: SSPC SP-10 Near White Blast.

Primer: Hi-Build Tank Epoxy, Light Buff Product No. 32-D-7PWR.
4.0 to 6.0 Mils d.f.t.

Finish: Hi-Build Tank Epoxy, White
Product No. 32-W-3PWR
4.0 to 6.0 Mils d.f.t.

IX. CHLORINE AND PHOSPHATE TREATMENT

1. SAMPLE AND TEST

   Determine phosphate and/or chlorine chemical feed requirements.

2. EQUIPMENT LIST

   a. Chemical Feed Pump:
   Two for each well and one spare for each well.
   LMI B-111-915 38.5 gallons per day

   b. Injector Assembly:
   Two for each well and one spare for each well.
   LMI part #25335

   c. Chemical feed tank:
   Two for each well and one spare for each well house.
   U.S. Plastics part #08616 65 gallon-polyethylene

   d. Chlorine test kit: Hach Model # 46700-00
   One for each well house

   e. The supplier of the above equipment shall furnish supervision of installation and testing of all equipment.

   f. Phosphate and chlorine solution pumps shall have a H-O-A switch located near each pump and shall be wired to the well pump starters.

   g. Pump manufacturer and model shall be approved by WRC Water Operations.

   h. Provide one spill containment system for each well: Poly-Spill 2000 by Empac, U.S. Plastics part number 03180.

3. INJECTION LOCATIONS

   Phosphate: Immediately downstream from the check valve.

   Chlorine: A minimum distance of one foot for each inch in diameter of pipe size, downstream of the phosphate injection point or ahead of the bypass for the storage tank, whichever is greater.

X. WELL HOUSE DRAWING REQUIREMENTS

1. After receipt of approval of the hydro-geological report from the Michigan Department of Environmental Quality and a permit to equip the wells has been issued, the design engineer may proceed with the preparation of final well house drawings and specifications.

2. The design engineer through the proprietor and with the approval of the WRC shall select, employ and pay an independent testing laboratory to provide soil borings for the building area and paving area before proceeding with construction drawings. Minimum soil bearing for project development shall be 2500 pounds per square foot for all building and paving work.

3. The drawings and specifications shall be prepared under the supervision of an engineer and/or architect registered in the State of Michigan and each sheet shall be sealed and signed by the Engineer or Architect.

4. Only that data pertinent to the municipal well and pump house installation shall be shown on the construction drawings.

5. Construction drawings shall consist of a title sheet, detailed construction sheets and detail sheets. Sheet size shall be 24" x 36" only.

6. The title sheet shall show:

   a. Project title.

   b. Location map with north indicator and graphic scale, drawn with appropriate scale not smaller than 1" - 2000', showing the general location of the project.

   c. Project map with north indicator and graphic scale, drawn with appropriate scale not smaller than 1" - 200', delineating the wells, the isolation radius, the well head protection area, and well house site and its specific location with respect to government survey line(s) and corner(s) including Sidwell Numbers. This map shall include lot numbers or other building site designations and the general layout of the distribution system.

   d. Metes and bounds description of the well site, including Sidwell Number and the certified location of each well by a Registered Land Surveyor.

   e. Sheet index.

   f. Symbol legend.

   g. Name, address and phone number of the Proprietor.

   h. Name, address and phone number of the Developer.

   i. Name, address and phone number of the firm or person responsible for preparation of the construction drawings.

   j. Plan completion date and revision block, to be updated as revisions are made.

k. Confirmation that the site is above the 100-year flood plain and is not subject to flooding.

l. Statements that all construction must be in compliance with local Building, Plumbing, Mechanical, and Electrical Code requirements and zoning and other applicable ordinances.

7. Detailed construction information shall be given through the use of plan views, elevations, sectional views, diagrams and tables to clearly depict the construction requirements. All information shall be at a scale of 3/8" - 1 foot or larger and shall be complete so that scaling of dimensions will not be required. Scales used shall be clearly identified.

8. Final well construction data shall be tabulated on a separate construction sheet including:

   a. A final well log drawn to scale.

   b. Casing materials in accordance with Section V.

   c. Screen manufacturer's name, construction and capacity in accordance with Section V.

   d. Detailed Specifications for the final production well:

      1) Name of manufacturer

      2) Type and model

      3) Number of stages

      4) Impeller size (diameter)

      5) Rated capacity (flow gpm) at rated tdh.

      6) Manufacture's head dischard curve

      7) Depth of well to bottom

      8) Pump setting

      9) Length of pump column pipe

      10) Motor manufacturer's name

      11) Motor type and model

      12) Motor size (H.P.)

      13) Pump and motor R.P.M.

9. Detail sheets shall include specific and complete details for all appurtenances and structures to be included with the construction, and special or unusual construction requirements.

10. Provide a complete ladder diagram showing all switches, relays, etc., in accordance with well house electrical specifications.

XI. WELL HOUSE DESIGN REQUIREMENTS

1. All well houses shall be compatible with surrounding facilities, design and construction. They shall comply with local Building, Plumbing, Mechanical, and Electrical Code requirements and zoning and other applicable ordinances.

2. The well house lot shall be properly landscaped, top-soiled, graded, fertilized and seeded. A 16' wide bituminous drive shall be brought from the existing road. Parking for at least three vehicles to be provided located near the building entrance and also located to serve for truck boom accesses to the wells through roof hatches. Pavement at truck boom accesses to be concrete at least a 10' by 10' area.

3. A sprinkler irrigation system shall be installed for the entire site. Installation to be in accordance with all local plumbing and electrical codes. System shall include an automatic timer.

4. Site fencing shall be installed as specified by the local community.

5. A fire hydrant shall be installed on the pump house discharge piping within the isolation radius of the wells, not less than 50 feet nor more than 100 feet from the well. The hydrant will be located approximately 7 feet from the edge of the drive and shall be readily accessible for operation. Threads and type to be in accordance with local community standard water main standard detail sheet per WRC standards for each community.

6. Concrete splash pads shall be installed outside of the well house under each blow off and under the tank drain. The pads shall be adequately sized to prevent soil erosion from water that may be discharged during maintenance, testing or blow off.

7. All well house walls shall be a minimum 8" masonry block with ties for exterior facing. Exterior wall facings shall be brick or stone. All exposed interior wall surfaces shall receive two coats of masonry paint in accordance with Division 9 of Section XIV. Concrete footings shall be designed from soil borings with a minimum width to allow for 8" block, 2" insulation, 2" air space and concrete foundation wall ledge for brick or stone exterior facing.

8. Roofs may be of pitched frame construction, gable end style or flat roof of pre-cast concrete construction compatible with surrounding facilities design. Ceiling/attic structure may be reinforced pre-cast concrete plank in accordance with Division 3 of Section XIII or plywood and gypsum drywall to achieve a two-hour fire resistive rating.

9. All other areas, such as soffit, fascia, frieze, etc., shall be aluminum with baked-on enamel finish. No exposed exterior wood will be allowed. Ridge vents will be required unless other venting is approved by WRC.

10. The finished floor shall be concrete, with welded wire fabric matt reinforcement in accordance with Division 3 of Section XIII. The floor shall be saw cut into approximate 100 square foot squares to provide controlled cracking. The floor shall pitch 2" per 10' to the building wall opposite the doors, shall be finished smooth and receive a waterproof traffic coating in accordance with Division 7 of Section XIV. A floor drain trough for the full length of pump house floor 4" wide and 4" deep shall be installed 6" from the building wall opposite the doors. This trough shall drain to a 4" diameter pipe at the center of the trough length with a screened free fall gravity outlet to the outside. Finish floor shall be a minimum of 12" above finish grade.

11. Insulation thickness and type of material shall be detailed on the construction plans in accordance with the standards specifications. Foundation walls, building walls, and ceilings shall be insulated to provide the following minimum values:

Foundation walls	R-10
Building Walls	R-14
Ceiling	R-38

12. A concrete pedestal shall be constructed to support and anchor each pump and shall extend at least 12 inches above the pump house floor and the well casing shall extend at least one inch above the pedestal. When setting the pump to ensure a watertight joint, the pump discharge box shall be set on a gasket as specified in Section VII. Four (1/2" minimum) stainless steel bolts must be set into each pedestal to anchor the pump base assembly.

13. The tank shall be provided with four steel saddles, painted the same as the tank, to support the tank on concrete foundations.

14. A one-half (1/2) inch minimum expansion pad shall be installed completely around all concrete tank cradles.

15. Where the water systems supply main exits through the pump house floor, there shall be a 24" x 24" floor opening filled with pea gravel.

16. Doors shall be as a minimum 36" x 84" x 1-3/4" metal, flush type, swing out doors without louvers or windows. Doors shall be insulated - no cardboard fillers - complete with frame, hardware, and threshold. Doorframes shall be metal with mortar-filled jambs. Doors shall be completely weather-stripped and weather-sealed with adjustable metal doorsills. Frames to be caulked with sealant. All doors shall open to the outside. Locks shall be keyed for master keying per WRC key system. Doors must have moisture drain holes in bottom. Hydraulic closers shall be installed on all doors.

17. Aisles in the building, and door and/or louver clear opening sizes shall be adequate for service, replacement of manufactured pieces of equipment and the requirements of these specifications. Clearance around pieces of equipment and related piping shall be adequate for maintenance and meet all relevant codes and meet OSHA/MIOSHA requirements.

18. Access hatches for well service shall be prefabricated "Bilco" type, hinged on the outside, hinge side to be perpendicular to the roof ridge. Hatches shall be operable from the inside of the well house only. Hatches shall be sized to easily and safely remove the pumping equipment. These hatches shall be designed to facilitate all well, pump and motor maintenance.

19. All chemical and air piping shall be installed below the ceilings.

20. Internal pump house ventilation shall be provided by a through wall exhaust fan with operable damper, exterior louver and bird screen, placed high on the wall opposite the wall with the through wall brick vents.

21. Automatic heating shall be provided to maintain a temperature inside of not less than 40^{o}F at the floor, when the outside temperature is -20^{o}F. Heating in the pump room shall be by natural gas, where available; otherwise, L.P. gas may be considered. Heating in the chemical equipment room and stand-by generator room shall be electric heat. All thermostats shall be degree reading type.

22. The Design Engineer shall be responsible for the coordination of the plans and specifications for the well house, including all plumbing, mechanical, electrical, structural and architectural components.

23. A separate room, 10' by 7' minimum, is required for the chemical equipment with personnel and supply access directly to the outside with no interior access. Additional treatment equipment may be required as determined by WRC review of future/proposed state and federal regulations.

24. A separate room is required for the stand-by generator and the automatic transfer switch with personnel and supply access directly to the outside with no interior access. Fuel tank fill and vent lines should extend to the outside of the building.

25. A SCADA compatible intrusion alarm at the well house is required.

26. Well house design shall be in accordance with the following standard specifications. For convenience, division in accordance with the general arrangement of the Construction Specification Institute arranges the specifications.

XII. WELL HOUSE GENERAL SPECIFICATIONS

1. SHOP DRAWINGS

GENERAL REQUIREMENTS

The construction drawings and specifications shall be supplemented by other drawings, brochures, and portfolios of all equipment, apparatus, materials, etc. furnished by the Contractor and reviewed by the Design Engineer. All such supplementary drawings or instructions are intended to be consistent with the construction drawings and specifications, true developments thereof and reasonable inferable therefrom.

These original and supplementary drawings constitute the drawings according to which the work is to be completed. The Contractor shall keep at the site of the work, an approved or confirmed copy of all drawings and specifications and shall at all times give the WRC access thereto.

The Design Engineer shall furnish to the WRC approved copies of all Contractor's, Subcontractors, and Manufacturer's Drawings, which shall be deemed to include Shop Drawings, Catalog Cuts, Brochures, Illustrations, Material Lists, and Performance Data, which may be required by the specifications, requested by the Design Engineer, or otherwise necessary for the proper execution of the work.

Each and every piece of material, equipment, apparatus, and accessory, shall be checked by the Contractor to ensure that it will comply with the requirements of the contract drawings and specifications. All working drawings, brochures or other items of information shall be clearly marked for identification with respect to their applications and installation locations, job name and number, and corresponding specification section number.

No work shall be undertaken until WRC has reviewed the Design Engineer approved shop drawings.

FIELD ENGINEERING

The Contractor shall immediately upon entering the site locate and make provisions to preserve property line stakes, benchmarks or datum points. Verify accuracy of the established lines, levels and bench mark, and report any deviation to WRC. Layout new work and establish a permanent bench mark on the floor of the pump room at the exterior entrance in accordance with U.S.G.S. and provide a permanent marker.

REGULATORY REQUIREMENTS

The Contractor shall secure all permits for any demolition and for all the new work under Contract required by Federal, State, County, local authority or any other authority having jurisdiction over any part of this work and arrange for all inspections.

The Electrical shall secure all necessary permits and arrange for all inspections for all new electrical work under Contract required by Federal, State, County, local or any other authority having jurisdiction over any part of this electrical work and arrange for all inspections.

Each Mechanical Contractor shall secure all necessary permits and arrange for all inspections for all new mechanical work under Contract required by Federal, State, County, local or any other authority having jurisdiction over any part of this mechanical work and arrange for all inspections.

SUBMISSION OF SHOP DRAWINGS

Transmittal letters and all material submitted for review shall be identified with title and location of the project, name of the Proprietor and Contractor and submission date. The relevant specification section number or detail number shall also be included on all items.

The Contractor's shop drawings shall include the Engineer's detail number with the Contractor's detail number when the location of isolated details warrants such additional referencing.

Samples shall be submitted as early as possible and shall be of sufficient size to be representative of the color range, texture and finish of the completed work.

REQUIRED SHOP DRAWINGS

Shop drawings shall be submitted where called for in the specifications specified hereinafter or otherwise deemed necessary by the WRC to provide sufficient and proper coordination of the work in order to comply with the approved construction drawings and specifications.

Shop drawings are required for well pump and appurtenances as specified and as follows:

- All pump data
- Valves, gauges, fire hydrants and meters
- Chemical feed equipment
- Pressure tank
- Pipe supports

Shop drawings are required for general building work as specified and as follows:

- Pre-cast concrete
- Steel systems
- Wood trusses
- Insulation
- Roofing system and flashing
- Roof hatches
- Doors and hardware
- Painting systems
- Louvers

Shop drawings are required for all mechanical equipment and piping.

Shop drawings are required for all electrical work. Shop drawings shall show conduit layout, conduit sizes and location and equipment foundations, details and locations, all accurately dimensioned. Exposed conduits need not be dimensioned.

Certified shop drawings and diagrams for all electrical equipment shall be furnished by the Contractor and delivered to the Design Engineer for review as follows:

a. General dimension and outline drawings showing the principal dimensions of the equipment and the location and size of electrical connections.

b. Wiring diagrams including one-line, and schematics.

c. Control schematics shall use ladder diagram type format incorporating operation function statement. Format and symbols shall be as approved by the Design Engineer. Wire and terminal numbers shall be clearly shown.

d. Detailed drawings, descriptive data and other data sheets showing design information that verifies that the equipment meets the technical requirements of the specifications.

2. QUALITY CONTROL

The proprietor, through the Design Engineer, will select, employ and pay an independent testing laboratory to perform testing and inspection services the WRC deems appropriate. These services to include, but not limited to, testing and/or inspection for the following:

a. Soil compaction control per ASTM C117, and C136.

b. Asphalt concrete paving per ASTM D1557, D1559, D2172 and Michigan Modified Marshal Mix Design.

c. Concrete per ASTM C39, C31, C138, C231, and C172 or C231.

d. Face brick per ASTM C67, concrete block masonry per ASTM C140 and mortar and grout per ASTM C144, C405, C780 and C1019.

e. Steel welding per ASNT SNT-TC-1A, AWS QC1 and AWS D1.1 and bolts per ASTM A325.

The testing laboratory shall promptly notify the Contractor of irregularities or deficiencies of work, which are observed during performance of service. Promptly submit two copies of tests and/or inspections to the Contractor, two copies to the Design Engineer, and two copies to the WRC Reports to include:

- Date inspection or test, date of test and date issued.
- Project name
- Testing laboratory name and inspector name and signature.
- Record of temperature and weather
- Identification of product and specification section
- Type of inspection or test and test procedure authority and number
- Observations regarding compliance with Contract Documents

3. INSPECTION SERVICES

Quality control inspection services provided must be acceptable to WRC as part of the construction process. The party or parties that will provide these services will be established prior to the pre-construction meeting and approved by WRC.

The Design Engineer shall notify WRC office to schedule inspection of the work at least 48 hours in advance of beginning of construction that requires inspection.

a. WELL DRILLING:

- Check placement of observation wells and test well. Ensure location conforms to the hydrologist's requirements, test well is drilled to bedrock and all aquifers are properly recorded (aquifer samples taken and screened for determination of aquifer to be used).
- Check materials used for well construction. Ensure screen slot opening, length, and material conforms to WRC requirements and screen is at proper depth.
- Check well grouting.
- Check during well development to ensure standard procedures are being followed and maximum efficiency is obtained.
- Observe step test of test well to ensure pumping rates are correct, recorded for each step and pumped for the proper length of time. Ensure drawdowns are recorded using required recorders.
- Observe steady rate pump test to ensure pumping rate is correct and required recorders are used on all observation wells, and the pumped well and recorders are working correctly.
- Make sure water samples are taken properly and sent to a certified laboratory.
- Perform same checks on the production well or wells.

b. SITE WORK:

- Grading and site drainage
- Road and parking requirements
- Seed germination and landscaping

c. WELL HOUSE CONSTRUCTION:

- Footings and foundations
- Wall construction
- Pre-cast concrete or truss and ceiling construction
- Roofing system
- Paint systems
- Floor drains
- Mechanical requirements

- Electrical requirements, including generator testing

d. WATER SYSTEM CONSTRUCTION:

- Pump design, installation, and performance
  1). Well casing protrusion above pedestal.
  2). Gpm produced at various total dynamic heads (tdh) so engineer can compare to manufacturer's curve.
  3). Wire to water efficiency at these tdh's.
- Chemical equipment, where applicable
- Pipe supports

4. CLOSEOUT DOCUMENTATION

FINAL "AS BUILT" SUBMISSION:

Upon completion of the work, furnish to WRC one complete set of prints, neatly bound together and in good condition, of all major Contractor's, subcontractors' and manufacturers' drawings as finally reviewed by the Design Engineer with all modifications approved by WRC subsequent thereto, showing the work as actually completed. Also furnish one copy of all other shop drawing submittals such as catalog cuts, brochures, and other data as finally approved by the Design Engineer bound together in a loose leaf binder.

MANUALS – REQUIREMENTS:

a. Furnish to WRC six (6) complete sets of loose leaf bound manuals covering each item of equipment, apparatus and device furnished or erected by the Contractor, to include but not limited to:

1) Catalog data or literature
2) Installation instructions
3) Manufacturer's operating instructions
4) Manufacturer's maintenance instructions
5) Wiring diagrams
6) Pump and other equipment operating characteristics.

b. In each of these, the correct model number and data for the model supplied shall be marked in ink where the literature covers more than one model. The maintenance instructions shall be accompanied by detailed parts drawings with a corresponding detailed parts list. Parts list must be specific as to materials used and complete as to all parts, including purchased parts in order to provide identification of parts by nomenclature, number and use. All bearing numbers shall be listed.

c. In addition, Manuals for individual components shall contain:

1) Storage requirements

2) Installation instructions that will include alignment instructions & tolerances

3) Recommended spare parts list

d. The maintenance instructions in these manuals shall fully describe the method of assembly and disassembly of all components; the method of making all adjustments; the trouble shooting tips and the remedial measures; the lubrication schedules and recommended lubricants; and the routine recommended preventative maintenance and upkeep procedure of all the individual pieces of equipment furnished in the contract.

e. The Contractor shall also be responsible for the following information when supplying packaged equipment or equipment systems:

1) Provide a description of the system including diagrams, charts, capacities, etc.

2) Explain start-up, shutdown, normal operation and malfunction of the system. Explanation of system operation shall include a detailed sequence of operation for all modes of operation.

3) Tabulate a lubrication schedule for the system.

4) Describe preventative maintenance procedures for the system.

5) Include a cross-reference to all individual component manuals.

XIII. WELL HOUSE CIVIL SPECIFICATIONS

DIVISION 2 - SITE WORK

DEMOLITION

Remove all items of existing construction as shown on the drawings, including all items built into or attached to items being removed. Exterior walls that are to be removed are to be removed in their entirety, including foundations and footings.

All items to be re-used shall be stored in a safe and convenient location. If any items are damaged during removal or storage, the contractor shall replace it at no cost to the owner.

All items that are not to be re-used shall be removed from the site immediately.

All demolition work shall be carried out in a neat and orderly manner. All noise, dust, etc., shall be kept to a minimum.

All precautions shall be taken to avoid damage to existing materials to remain.

All products from demolition are to be removed from the site.

STRUCTURE EXCAVATION AND BACKFILL

An independent testing laboratory shall sample and test all site work activities.

Excavate for structure and remove subsoil from site.

Cap off and seal discontinued utility services and remove portions of lines within excavated areas as noted.

Shore and brace excavations, as required.

Over excavate, if required.

Granular Material: Michigan Department of Transportation Class II Fill.

EXCAVATION

Excavate subsoil in accordance with lines and levels, to be shown on the drawings, for construction of the work, including space for forms, bracing, and shoring.

When complete, verify soil bearing capacities, depths and dimensions. Minimum soil bearing pressure shall be 2500 pounds per square foot for all building and paving work.

Correct unauthorized excavation as directed, at no cost to the Owner.

Fill over-excavated areas under structure bearing surfaces with concrete as specified for foundations.

Excavations shall not interfere with normal 45 degree bearing splay of any foundation, unless said foundations have been underpinned.

Excavate for all walls, footings, piers, floors and other below grade excavation, indicated on drawings. Grading in the vicinity of structure shall be controlled to prevent surface water from running into excavated areas.

BACKFILLING

Backfill systematically and as early as possible to allow maximum time for natural settlement and compaction.

Place and compact fill materials in 12-inch lifts maximum.

Wherever possible, backfilling shall be done simultaneously on both sides of walls to equalize lateral pressures. Do not backfill on only one side of vertically spanning walls unless walls are adequately shored or permanent construction is in place to furnish lateral support at both top and bottom of wall.

No broken concrete, brickbats, or similar unsuitable material will be permitted as backfill.

All fill material shall be obtained from cut areas on the site as designated on the drawings, or from borrow areas outside the site according to the Contractor's sources of supply, but with the approval of the Architect/Engineer or Testing Laboratory. Borrow material shall be equal to M.D.O.T. Class II material.

Compacting around concrete pedestals and next to foundation walls shall be with hand operated vibrating compactors for granular soils and Barco rammer type compactors for clay soils. All compaction should be to 95% modified proctor.

FINISH GRADING AND SEEDING

Finish grade shall slope 2% minimum away from the building in all directions for a minimum distance of 10 feet before any swaling. All surface water shall be able to drain on the surface (including hard surfaced areas) to the natural watershed; ponding or water entrapment is not permitted. Hard surfaced areas to slope between 1% and 4%. Existing conditions to be field verified and grading to be done according to this procedure and field verified conditions.

Provide 6" depth topsoil of friable loam free from subsoil. Do not bury foreign debris. Disc in a slow release commercial fertilizer, composition to be 17% nitrogen, 32% phosphoric acid, 6% potassium to a depth of 4" at a rate of 20 lbs. per 1000 square feet.

After the first cutting apply a slow release commercial fertilizer, composition to be 24% nitrogen, 6% phosphoric acid, 18% potassium, at a rate of 20 lbs. per 1000 square feet.

Contractor shall maintain the lawn for a minimum of two mowings and a good stand of grass. At that time the Contractor may request an inspection for approval.

Schedule of Seed Mixture

Proportion	Seed Type	Purity	Germination
20%	Certified Baron Bluegrass	98%	80%
20%	Certified Adelphi Bluegrass	98%	80%
20%	Certified Glade Bluegrass	98%	80%
30%	Certified Pennlawn Creeping Red Fescue	95%	85%
10%	Annual Rye	95%	85%

Weed seed content shall not exceed 0.25%. Spread at rate of 4 lbs. per 1000 square feet.

ASPHALTIC CONCRETE PAVING

Meet State of “Michigan, Department of Transportation, Standard Specifications for Construction" latest edition. Paving shall be designed as heavy duty for truck traffic.

Sub-base course, 12" minimum thickness, aggregate shall conform to MDOT Class II Granular Material.

Base course, 8" minimum thickness, aggregate shall conform to MDOT Dense Graded Aggregate 22-A.

Bituminous base, if required by soil conditions as indicated in the soils report, 6" minimum thickness, specification No. 5 bituminous mixtures using asphalt cement 85-100 penetration, Marshall stability 1000# minimum.

Level course, 1 1/2" minimum thickness, Bituminous Mixture Designation No. 1300T using Asphalt Cement AC-10. Marshall stability shall be at least 1300 pounds.

Wearing course, 1 1/2" minimum thickness, Bituminous Mixture Designation No. 1300L using Asphalt Cement AC-10. Marshall stability shall be at least 1300 pounds.

Greater thickness to be used if recommended in the soils report.

Tack coat shall be SS-1h.

Furnish a Marshall mix design from accredited laboratory, or data from recent projects, certifying that the job mix meets or exceeds the specified requirements.

Proof roll sub-grade compacted to 95% modified proctor. Remove and replace unsuitable material or material that cannot be consolidated.

Sub-base material shall be placed in layers not exceeding 8". Float and level in combination with rolling with a vibrating or pneumatic type roller until each layer is consolidated to 95% modified proctor.

Gravel base shall be placed in layers not exceeding 6". Float and level in combination with rolling with a vibrating or pneumatic type roller until each layer is consolidated to 95% modified proctor.

Bituminous base, if required, shall not be placed in lifts exceeding 3". Compact to at least 95% of the control density established by the Marshall Mix Design.

Leveling course shall be compacted to 95% of the control density established by the Marshall Mix Design.

Wearing course shall be compacted to 95% of the control density established by the Marshall Mix Design. Place wearing surface on properly cured tack coat.

The completed courses shall conform to the required line, grade, and cross-section.

Place asphalt concrete mixture on prepared surface. Spread mixture at a minimum temperature of 225EF (107EC). Place in strips not less than 10' wide. If more than 72 hours have elapsed after placement of the leveling course, or if the leveling course has been contaminated with dirt or dust, a tack coat shall be placed prior to the wearing coarse. Place tack coat at a rate of 0.05 to 0.15 gallons per square yard of surface.

Make joints between old and new pavement, or between successive days work for continuous bond. Construct joints to have same texture, density, and smoothness as other sections of asphalt concrete course. Clean contact surfaces and apply tack coat prior to paving.

Accomplish breakdown or initial rolling immediately following the rolling of joints and outside edges. Repair displaced areas with hot material. While mixture is hot, continue second rolling until mixture is completely compacted. Finish rolling while mixture is warm enough for removal of roller marks. Continue rolling until roller marks are eliminated and the coarse has obtained maximum density.

Remove and replace areas mixed with foreign materials and defective areas. Cut out such areas and fill with fresh, hot asphalt concrete. Place in layers of depth to match existing. Compact by rolling to maximum surface density and smoothness. Patch areas damaged by premature use.

The independent testing laboratory will make all density tests on installed materials. Rework, correct, or replace work that does not meet specifications.

DIVISION 3 - CONCRETE

Work to meet all applicable sections of ACI 301 for these project types of work. All concrete work to be formed, earth forming is unacceptable.

All concrete shall be 4,000 PSI at 28 days, 5.5 sack minimum mix. All concrete to be ready-mix in accordance with ASTM C-94. Portland cement shall conform to ASTM C-150, Type 1.

Submit concrete mix designs for approval by the design engineer. Concrete proportions to be based on ACI 318-89, Chapter 5. Maximum slump to be 4".

All exterior concrete, including foundation walls, shall be air entrained with air content conforming to ACI 318-89, Table 4.1.1, for severe exposure.

Reinforcement - welded wire fabric matts 6 x 6 - W1.4 x W1.4 minimum, and shall conform to ASTM A-185. Concrete reinforcement bars - ASTM A-615, A616 or A617 Grade 60.

Aggregates to conform to ASTM C33. Fine aggregate shall not exceed 30% to 50% of the weight of the total (fine + coarse) aggregates.

Construction and control joints, shall be placed no farther apart than 12'. Form control joints by inserting pre-molded plastic hardboard or fiberboard strip into fresh concrete. After concrete has cured, remove strip, and clean groove of loose debris. Then apply joint sealer, "No-Track" by A.C. Horn.

Curing and sealing compound shall be a clear styrene acrylate type, 30% solids content minimum, and have test data from an independent testing laboratory indicating a maximum moisture loss of 0.030 grams per square centimeter when applied at a coverage rate of 300 square feet per gallon.

Provide a vapor barrier under all interior slabs on grade. Vapor barrier to be six mil polyethylene plastic sheets with all sheet joints sealed.

Interior slabs shall be 6" minimum thickness, with welded wire fabric, trowel finished. Place on 4" thick 95% proctor compacted bank sand fill.

Exterior slabs for boom trucks shall be 6" minimum thickness, with welded wire fabric matts 6 x 6 - W2.9 x W2.9, trowel finished and anti-spaling curing compound. Place on 8" thick 95% proctor compacted bank sand fill.

Set all items required to be set in concrete, including miscellaneous metals.

Locate all sleeves, openings and embedded items, etc., to be indicated on the drawings. Check with other trades to make sure the sleeves, openings, and embedded items that are to be provided and set in place prior to placing of concrete in the area involved.

Foundation wall insulation to be extruded polystyrene board by Dow Chemical Co. "Styrofoam" or equal. Board shall be 2" thick x 24" wide and extend from underside of slab to top of footing at perimeter foundation.

PRECAST CONCRETE

Design and provide pre-cast concrete attic or roof slab members in accordance with ACI 512. Design to be in accordance with the latest recommendations of the PCI Design Handbook and ACI 318 building code requirements under the direct supervision of a Professional Engineer registered in the state of Michigan. Drawings to show superimposed dead and live loads for all members.

Provide pre-cast splash blocks and car bumpers of standard design with smooth finish. Fabricators to be certified by P.C.I., and meet PCI MNL - 116.

Pre-cast hollow slabs to meet the following standards:

American Concrete Institute: ACI 318, ACI 525, ACI 301, and ACI 315.

Pre-stressed Concrete Institute: MNL - 116.

American Welding Society: AWS D1.1, AWS D12.1.

Industrial Fastener Institute: Fastener Standards.

as well as all standards referenced in within these standards.

Materials to be as specified in ACI 301, the AISC Manual of Steel Construction, and concrete section of these specifications. Concrete shall have 5000 psi compressive strength at 28 days, minimum.

Stranded steel cables, seven wire type, shall be produced by a recognized manufacturer of wire products conforming to ASTM Specification A 416. Cables shall be made from stress-relieved, uncoated (bright) wire with a minimum ultimate strength of 250,000 psi, with a 2% strain set equal to 85% of ultimate strength and an elongation in 24" equal to 4%.

Grout all longitudinal joints with non-shrink, non-metallic, grout with compressive strength of 10,000 psi, 28 day strength or greater.

Bearing pads to be tempered hardboard, 1/8" thick, smooth both sides.

End plugs of core hole to be glass fiber insulation.

Manufacturing procedures for pre-cast pre-stressed members shall be in general compliance with Division 1 and 2, Section 1 of Division 4, and Sections 1-4 of Division 5 of PCI MNL - 116.

Manufacturing procedures for pre-cast members shall be in general compliance with Division 2 Section 1 of Division 4, and applicable standards for pre-cast design in Sections 1-4 of Division 5 of PCI MNL - 116.

Ensure reinforcing steel, anchors, inserts, plates, angles and other cast in items are embedded and located as designed.

Exposed to view finish surfaces are to be uniform in color and appearance. Finish to be as outlined in Division 2, Section 5 of PCI MNL - 116 but with no major or unsightly imperfections, honeycomb, or structural defects will be permitted.

Only competent and qualified workers trained to handle and erect structural concrete members shall do erection. Handle members in a manner consistent with their design and shape. Protect edges and faces to prevent staining, chipping, or spalling. Provide for erection procedures, temporary bracing and loads.

Holes for openings larger than 6" in diameter shall be cast by the manufacturer in accordance with approved shop drawings.

TOLERANCES

Length	" 1/8" per 10', " 1/2"max.
Cross section	" 1/8" less than 7" width or depth " #/16" &" to 16" width or depth
Squareness	1/8" for up to 12" 1/8" + 1/16" per ft., 1/4" max.
Camber	" 1/8" per 10", " 1/2" max.
Differential Camber	" 1/8" per 10', 1/2" max.

XIV. WELL HOUSE ARCHITECTURAL SPECIFICATIONS

DIVISION 4 - MASONRY

Masonry work will conform to specification for Masonry Structures - ACI 530.1-92/ASCE 6-92/TMS 602-92.

CONCRETE MASONRY UNITS (CMU)

Concrete masonry units to be 8" x 16" nominal face dimension (16" maximum length), Grade N-1, normal weight units for below grade work and medium weight units for all other masonry units.

Concrete masonry containing vertical reinforcing to be two (2) cell units.

All exposed corners to be bullnose.

Concrete masonry units to be laid in running bond.

Fire rated units to be installed where required by Code.

All joints to be tooled to form a concave joint.

FACE BRICK

Face brick to be type FBS, grade SW, except no waivers for water absorption, initial rate of 5, and no more than 25 g/min./30 in^2, and compressive strength average 7000 psi, individual unit minimum 6500 psi. Size, type and color range to meet WRC requirements.

Face brick to be laid in running bond.

MORTAR

Mortar to be type N. Mortar for reinforced masonry to be type S. Mortar shall be mortar cement mortar or Portland Cement/Lime Mortar.

Provide color admixture for mortar with color.

MASONRY ACCESSORIES

Masonry accessories to be type, product, and manufacturer, or approved equal, as follows:

Control Joints:	Weatherite "R" or Keyseal by Williams Products for single wythe and composite walls.
Vertical Wall Expansion Joint Bellows:	WS10-6 by Expand-O-Flash.
Dampcoursing:	2 oz. copper or copper/fabric by Revere Dryseal.
Brick Vents (weeps):	2-1/4" high, with custom color to match mortar joints, by Williams Products.
Stone Sills:	Oolitic limestone, ILI standard grade buff, smooth finish.

Cavity Wall Insulation:	2" thick extruded polystyrene board by Dow Chemical Co. "Styrofoam" or equal.
Block Fill Insulation:	Zonolite or Peralite water-repellent masonry insulation.
Low Masonry Cavity Wall Vent:	Heavy duty cast aluminum load-bearing concrete block and brick vent as manufactured by McKinley, LVR6S with screens and adjustable shut-off dampers. Full wall duct sleeves to be CD6. Interior vent to be BRV6S with sliding register control and for use with full wall duct sleeve.

MASONRY REINFORCING

Masonry reinforcing to be type and product indicated as manufactured by AA Wire Products Co. or approved equal:

Wire Reinforcing

Block:	AA600, Blok-Trus
Brick and Block:	AA640, Econo-Block-Trus

Anchors

Concrete:	AA100, Dovetail Slot AA200, Dovetail Anchor

Ties

A311, Corrugated Wall Ties

AA222, Wall Plug

Rebar Positioners

Vertical, AA225

Horizontal, AA238

Perimeter block walls with face brick facing to have all cores filled with Zonolite or Peralite water-repellent masonry insulation. Install in accordance with manufacturers written instructions.

Install full head joint brick vents in lowest course atop flashings at 24 inches horizontal. Also provide full head joint brick vents at 48 inches horizontal at top of exterior cavity walls in the first full course below the top of wall, fascia, window sills, or other horizontal interruptions of the cavity.

DIVISION 5 - METALS AND STRUCTURAL STEEL

The work shall be done in accordance with AISC "Specifications for the Design, Fabrication, and Erection of Structural Steel for Buildings" and the "Code of Standard Practice for Steel Buildings and Bridges", latest edition. Welding shall conform to AWS D1.1 "Structural Welding Code" and be preformed by qualified and certified welders.

All structural steel shall be fabricated and erected according to the latest AISC "Specifications for the Design Fabrication, and Erection of Structural Steel for Buildings".

Structural shapes and plates shall conform to ASTM A-36 (Fy = 36 ksi). Steel tubes shall conform to ASTM A-500, Grade B (Fy = 46 ksi).

All steel shall be primed with TNEMEC "10-99 Tnemec Primer", unless noted otherwise. Preparation to be equal to Steel Structures Painting Council, SSPC-SP-2, except exterior to be equal to SSPCF-SP-3.

Bolts shall conform to ASTM A-325N.

All connections shall be adequate to carry a reaction equal to Wc/2L for specified size and shape in the tables of "Uniform Load Constants for Beams Laterally Supported" in the AISC "Manual of Steel Construction", eighth edition.

All connections shall be welded in accordance with the latest AWS Specifications for E70XX electrodes and field bolted with ASTM A-325N bolts. All A-325N bolts are to be installed in accordance with the latest "Specification for Structural Joints using ASTM A-325 or A-490 Bolts".

All steel to receive one shop coat of paint. Omit paint at holes for friction type connections, encased or in contact with concrete.

All exterior steel to be galvanized steel and painted. Touch-up to comply to Military Specification MIL-P-21035 (ships), "ZRC" Chemical Products.

The structural steel and miscellaneous metal contractor will be held to have completely checked the drawings and to have included all items of miscellaneous iron and steel, including all lintels, which are not distinctly indicated to be furnished under other sections of the specifications.

DIVISION 6 - CARPENTRY

Provide and install all items of rough and finish carpentry. Provide all suitable connectors and fasteners not supplied by others.

Materials shall be as follows:

Rough Lumber - #2 or standard grade Douglas fir surfaced 4 sides. Nailers, blocking, furring, trim, etc. - #2 ponderosa pine per rules of WWPA & ASWLS, PS 20.

Plywood base shall be APA rated sheathing exterior glue, wolmanized. Roof sheathing shall be 1/2" minimum thickness.

Wood trusses to be designed and certified by a licensed engineer employed by the manufacturer, design and manufacture to meet the BOCA Building Code.

All wood used to meet structural grade required by the BOCA Building Code for size of members indicated on the drawings.

All wood used, such as nailers, furring, bucks, grounds, blocking, or other framing materials embedded in or in contact with windows, masonry, concrete or metal, nailers and blocking at roof for metal flashing, copings, gravelstops, curbs, and cant strips, and any wood exposed to extreme weather conditions shall be pressure treated in accordance with the current AWPB LP-2. All fasteners shall be in accordance with BOCA Building Code.

DIVISION 7 - THERMAL & MOISTURE PROTECTION

BUILDING INSULATION

Rigid attic insulation board may be foil faced polyisocyanurate foam with a flame spread of 25. Seal all joints and penetrations and install in accordance with manufacturers written instructions, or batt insulation to meet Federal Specification HH-I-521 E, type I & III, fiberglass unfaced and foil faced ("Fiberglas FS 25") blankets.

TRIM, FASCIA SYSTEM

Materials/Components: Provide manufacturer's standard system formed to size, profile, finish, and accessories, for panning of all exposed exterior wood trim at eaves. Provide pre-finished aluminum system, .032" minimum thickness. Pitched roofs to have continuous vented eave.

Provide a factory finish applied in accordance with manufacturers' specifications and shall have a 20-year guarantee against crazing, cracking, or color fading.

Aluminum substrate shall receive a multi-stage chemical pretreatment, approved by the paint manufacturer, to ensure proper adhesion of paint to metal. Prime coat shall be applied to a 0.2-0.4 mil thickness. Finish color coat shall be "Kynar" fluorocarbon coating, applied to a minimum of 1.0 mil thickness and baked on at 450E F metal temperature.

ROOFING SYSTEMS

Roofing system to be compatible in appearance with the surrounding community. System may be either pitched with hip or gable end or flat.

Pitched roof buildings to have cold ventilated attics with the attic floor insulated with an aged R value of at least 38, and shingles. The minimum slope of pitched roof system to be 4 in 12.

Flat roof buildings to have tapered rigid insulation with an average aged R value of at least 38. Flat roofs to be sloped 1/4" per foot, to roof drains.

Flat or pitched roof systems to be selected, as appropriate for the system, and to meet the following requirements.

ASPHALT SHINGLES (PITCHED ROOFS)

Asphalt shingles to meet ASTM D225 shingle to be square tab, self-sealing, 2 or 3 tab, 235 pound weight, minimum, and Class "C" fire resistant.

Felts, to meet ASTM D226, 15 pound underlayment unperforated asphalt saturated.

Edge underlayment to be 3 foot wide self-adhering sheet composite polyethylene sheeting and rubberized asphalt, Ice and Water Shield as manufactured by W. R. Grace & Co. or approved equal. Install in accordance with the manufacturer's written instructions.

Nails, standard round wire shingle type of hot dipped zinc coated steel, 13/64" head, .08"shank diameter of sufficient length.

Metal Edge Strip, 26 gauge preformed steel with 1.25 oz. galvanized coating, ASTM A361, and color coating to match fascia.

Roof vents to be manufacturers standard for the intended use. Eave, ridge, and gable end vents to be used.

At the completion of the roofing system work, the Roof Contractor shall furnish a letter through the General Contractor to the certifying that the materials used on this project conform in all respects to the specified materials and referenced standards, and that they have been installed in accordance with manufacturer's requirements.

MEMBRANE ROOF & ROOFING INSULATION (FLAT ROOFS)

Workmanship and materials for the Elastomeric Sheet Roofing System shall produce a roof that will be maintained in a weather tight condition for a period of at least ten years from the date of Substantial Completion.

At the completion of the membrane roofing system work, the Roof Contractor shall furnish a letter through the General Contractor certifying that the materials used on this project conform in all respects to the specified materials and referenced standards, and that they have been installed in accordance with manufacturer's requirements.

At the completion of the membrane roofing system, the Roofing contractor shall furnish the WRC a copy of the Roofing Systems Manufacturer's Roof Inspection Report.

The Roof System Manufacturer shall issue a Roof Guarantee stating that the manufacturer guarantees to maintain the elastomeric sheet roof in a weather tight condition for a period of ten (10) years from the date of the completion of the entire project.

Manufacturers of alternative membrane roofing systems will not be approved on this project.

Adhered smooth surface (unballasted) single-ply membrane roofing shall be:

Carlisle Syntec Systems "Sure-Seal Design 'A', Fully Adhered" Goodyear Tire and Rubber Company "Versigard Fully Adhered" or Firestone Building Products Company "Rubberguard Adhered System," consisting of, but not necessarily limited to, the following components:

EPDM Membrane, .060" thick, formed into flexible sheets complying with ANSI/RMA IRP-1, non reinforced white. Flashings, adhesives, sealants, etc.

Roof Insulation shall be 1.5" thick and 1/4" slope tapered with manufacturer's standard facing rigid polyisocyanurate board, "Celo-Foam" by Celotex or "AcFoam I or II" by Atlas Energy Products, average aged R = 38 at 75^{o} F.

Taper Insulation and cant strips as shown and where required per manufacturer's recommendations.

Observe all precautions listed in the Roofing System Manufacturer's Literature and Shop Drawings. Unusual conditions not addressed by the Literature shall be brought to the attention of the Roofing System Manufacturer for his written recommendations.

Inspection of the completed installation, shall be made by a representative of the Roofing System has been installed in accordance with the Roofing System Manufacturer's Specifications and Shop Drawings. The Roofing Contractor and Roofing Membrane System Manufacturer shall notify the Architect of the date and time of the inspection so that he may be present.

The Roofing System Manufacture shall furnish copies of his inspection report, to the Roofing Contractor for submittal to the Architect and Owner.

FLOOR TRAFFIC COATING

All concrete floors in the building shall receive the installation of a liquid applied, waterproof membrane.

Traffic coating shall be a fluid applied one component polyurethane system designed by the manufacturer to produce a waterproof membrane with an integral aggregate surface. Color to be selected by WRC

Traffic coating shall be Scotch-Clad Brand Deck Coating “System P” by 3M Company, “Peda-Gard 11" by The Neogard Corporation, “Dex-o-Tex” by Crossfield Products Corporation, “Iso-Flex 750/System U-40" by Harry S. Peterson Company, or “PBS-850" by Tremco Construction Products.

Manufacturers shall rigidly adhere to their standard specifications for the products that are used.

Related materials to be used with the coating such as primers, sealants, backerrod, sheet flashing and flashing reinforcement all as described in the manufacturer’s literature shall be furnished by the systems manufacturer.

Aggregate to be mesh silicon carbide.

Before coating work is started, surface shall be inspected and treated as necessary for bonding of the coating. Concrete surfaces shall be visibly dry and contain no condensation prior to application of coating system. Verify that curing methods used for concrete are compatible with the coating system.

Thoroughly clean all surfaces to receive coating materials in strict accordance with manufacturer’s instructions and recommendations. Rout or saw cut cracks exceeding 1/16" in width, fill with sealant. Fill expansion, control, and construction joints with sealant.

Apply flashings, primer and detail work, base coat, and top coat, per manufacturer’s written directions. While top coat is still fluid, uniformly broadcast silicon carbide over the surface at the rate of 5 lbs. Per 100 square feet. Immediately roll to evenly distribute and completely coat the aggregate. Allow the topcoat to cure for 24 hours minimum.

FLASHINGS AND SHEET METAL

Galvanized metal to meet ASTM Standard A525. Two piece and other shapes to be formed to sizes and shapes as required by project conditions of 26 gauge galvanized steel. Methods of construction and installation shall be as recommended by the National Association of Sheet Metal and Air Conditioning Contractors manual.

Flux to be muriatic acid killed with zinc soldering type, acid shall be washed off.

Nails, screws and other fasteners to be hot dipped galvanized steel.

Treat dissimilar metals with Koppers No. 50.

GRAVEL STOP, FASCIA SYSTEM (for flat roofs)

Materials/Components: Provide manufacturer's standard aluminum system formed to size, profile, finish, and accessories, such as but not limited to splice plates with prefabricated inside and outside mitered corners, with miters welded before finishing. To be extruded aluminum, .047" minimum thickness.

Provide a factory finish applied in accordance with manufacturers' specifications and shall have a 20-year guarantee against crazing, cracking, or color fading.

Aluminum substrate shall receive a multi-stage chemical pretreatment, approved by the paint manufacturer, to ensure proper adhesion of paint to metal. Prime coat shall be applied to a 0.2-0.4 mil thickness. Finish color coat shall be "Kynar" fluorocarbon coating, applied to a minimum of 1.0 mil thickness and baked on at 450E F metal temperature.

ROOF SPECIALTIES

Roof hatches to be Model SS-20 as manufactured by the Bilco Company, with a clear horizontal opening of 4' x 4'. Comparable products of Milcor Incorporated and Babcock-Davis Hatchways Inc. are also acceptable.

Fabricate roof hatches from zinc-coated steel, ASTM A526 with ASTM A525, G90 hot-dip zinc coating, mill phosphatized and primed per manufacturer's standards.

Design and fabricate roof hatches to support external loading of 40lbs. per square foot and internal loading pressure of 20 lbs. per square foot.

Fabricate single leaf cover with 3" beaded flange and with 1" glass fiber insulation covered and protected with metal liner.

Fabricate curbs 12" high integral double walled with 1" fiberboard insulation.

Equip roof hatches with heavy pintle hinges, compression spring operators enclosed in telescoping tubes, snap-latch with turn handles and padlock hasps inside, and rubber gasket draft seal. Provide padlock with cylinder and keyed to build keying system. Equip cover with automatic hold-open arm complete with vinyl grip handle.

The clear hatchway opening to be centered above each well. If a pitched roof is used, the attic space between the openings in the pre-cast concrete attic slab and the underside of the pitched roof to be enclosed with exterior plywood attached to support framing and insulated with an R value equal to that of the attic/roof.

Roof hatches on pitch roofs are to be larger to obtain the same clear opening as that through the attic pre-cast. Hinge side of hatch to be parallel with the roof slope, perpendicular to the roof ridge.

SEALANT

All interior and exterior caulking and sealant shall be equal to Tremco's "Dymeric" with appropriate back-up material. Color shall match adjacent material.

Apply at:

- Entire perimeter of all openings, sides, interior and exterior surfaces.
- Exterior control joints in concrete and masonry.
- Intersection of interior masonry walls.
- Perimeter of all hollow metal frames, doors and louvers.
- Interior control joints in masonry walls.
- Underside joints between pre-cast plank members.
- All intersections of dissimilar interior surfaces.
- Splice joints in roof flashings and gravel stops.
- Metal flashings in concrete or masonry.

DIVISION 8 - DOORS, & FRAMES

Hollow metal doors, and frames to meet NAAMM CHM-1-74 and "Fire Rated Custom Doors and Frames". Doors to be 1-3/4" thick, 18 gauge with top and bottom flush caps, 22 gauge steel internal stiffeners 6" apart. Frames for interior to be 16 gauge, and 14 gauge for exterior. Frames to be welded construction. Doors and frames as manufactured by Ceco, Curries, or Fenestra are acceptable. Apply shop coat of prime paint of even consistency to provide a uniformly finish surface ready to receive finish paint.

All doors and frames to be galvanized steel and painted ASTM A-591 Class A.

Fire rated doors and frames to meet UL. or FM. requirements for fire labels.

FINISH HARDWARE

Hardware to be dull chrome & dull satin stainless steel finish. From the following manufactures:

Butts	Stanley
Locks	Sargent
Cylinders	Best
Closers	LCN
Lockguards	Precision
Thresholds & W.S.	National Guard

Provide all approved finish hardware for the project in accordance with the following schedule.

Hardware Set #1

1-1/2 pr. butts - FBB 193 - 32D - 4-1/2 x 4-1/2 - NRP
Lockset - 28 - 7705 - KBD - Less Cylinder
Cylinder - 1E74
Threshold - 8424
Sweep Strip - 421 DKB
Closer - Cush -H - Alum. x Spacer Block - TB
Weatherstrip - 131 N - DKB
Lockguard - 1627 - 32D

All finish hardware shall conform to the "Michigan Construction Code" for barrier free design, and American Disability Act (ADA).

All key locks shall be grand master keyed & master keyed to the existing key system. Consult with the owner for specific keying requirements.

DIVISION 9 - FINISHES

PAINTING

Paint all new and remodeled materials that do not have a finished factory paint finish.

After proper surface preparation, the following surfaces shall have the following types and coats of paint applied. This specification is based on materials manufactured by Pittsburgh Plate Glass Company. Colors shall be selected by the WRC.

Exterior Metal (ungalvanized ferrous)

a. First Coat: Zinc chromate primer (Fed. Spec. #TT-57a)
b. Second Coat: Exterior latex enamel (semi-gloss)
c. Both coats in addition to factory primer.

Exterior Metal (galvanized)

a. Treat metal with "Galva-prep" as manufactured by Am-Chem Inc.
b. First Coat: Zinc Dust Primer (Fed. Spec. #TTP641b, Type II)
c. Second Coat: Exterior latex enamel (semi-gloss)

Exterior Metal (aluminum)

a. Treat metal with "Alum-Prep" as manufactured by Am-Chem Inc.
b. First Coat: Zinc chromate Primer (Fed. Spec. #TTP57a)
c. Second Coat: Exterior latex enamel

Interior Concrete Block

a. First Coat: Epoxy block filler, pin hole free
b. Second Coat: Epoxy enamel, semi-gloss
c. Third Coat: Epoxy enamel, semi-gloss (for deep accent colors)
d. Unless otherwise noted, deep accent colors will constitute no more than 25% of wall surface.
e. Spray and roll all coats.

Interior Concrete and Concrete Ceiling

a. First Coat: Epoxy sealer
b. Second Coat: Epoxy enamel, semi-gloss
c. Third Coat: Epoxy enamel, semi-gloss (for deep accent colors)
d. Unless otherwise noted, deep accent colors will constitute no more than 25% of wall surface.
e. Spray and roll all coats.

Interior Metal (ungalvanized ferrous)

a. Both coats in addition to any factory primer.
b. First Coat: Metal primer
c. Second Coat: Alkyd semi-gloss enamel

Interior Metal (galvanized)

a. Treat metal with solvent cleaner
b. First Coat: Galvanized primer
c. Second Coat: Alkyd semi-gloss enamel

Exposed Piping, Hangers and Equipment (ungalvanized)

a. First Coat: Metal primer
b. Second Coat: Alkyd gloss enamel
c. Note: Cast iron pipe shall first be thoroughly cleaned with rags soaked in mineral spirits to remove oily film, then primed and finished as indicated above.
d. If cast iron pipe has a tar coating use latex primer

Exposed Piping, Hangers and Equipment (galvanized)

a. Treat metal with solvent cleaner to remove oil and grease
b. First Coat: Galvanized primer
c. Second Coat: Alkyd semi-gloss enamel
d. Note: Use acrylic paint for PVC pipe.

Covered (Insulated) Piping and Ductwork (unprimed)

a. First Coat: Vinyl primer-sealer
b. Second Coat: Alkyd gloss enamel
c. Note: Aluminum jackets for insulated piping shall not be painted.

The color-coded scheme for water system shall be:

Pressure Tank	-	Green
Water Piping	-	Blue
Water Valves	-	Red
Water Blow-Off Piping	-	Orange
Air Blow-Off Piping	-	Gray

The pump house interior walls and ceiling shall receive prime and finish coats of paint in different colors. Finish coat color shall be semi-gloss white.

DIVISION 10 - SPECIALTIES

LOUVERS

Louvers to be fixed extruded aluminum weather louvers. Emergency generator exhaust louver shall be sized for requirements of the generator. The shape shall allow for the replacement of the generator by removing only the louver.

Free areas shall be calculated in accordance with the latest AMCA Specifications.

Louvers to be weatherproof, drainable blade type. Louver blades and frames to be .081" thick and 6" wide. Frame to be channel type and louver blades must be set on 35E angle.

All louvers shall have 1/2" mesh aluminum bird screen mounted in a "U" type frame and attached to the interior face of louver.

Louvers shall be American Warming LW-P-3131-ES or EA, 6"deep or equal.

Louver pressure drops and water carry through data must be certified by an independent testing laboratory to be weatherproof with intake velocity of 650 f.p.m. Water carry through at 650 f.p.m. velocity shall not exceed .5 grams of water penetration per square foot, per minute, based on a 2 inch per hour rainfall rate and free falling rain across the louver face.

SECURITY SCREEN

Provide security screens for all louvered openings. Screens to be the product of Chamberlin - Barnhart Company Inc. or Kane Manufacturing Corp. and meet these requirements.

Screen units to consist of a sub-frame, hinged main frame, wire cloth and support assembly special lock, lock bolts, concealed hinges, screws, rivets or bolts.

Sub-frame and outer cover plate shall be an integral channel design of not less than 11 gauge steel, corners of the swing frame to be electrically welded and ground smooth. When frame is in a closed position both the inside and outside faces shall be free from all fasteners, providing maximum security from either side.

Woven rod to be 16-3 mild steel rod, 1/4" diameter, double crimped, woven in a square 2" x 2" pattern set square in frame. Each rod to be welded at each point at which it intersects the frame.

Screens to have a concealed bitt key lock, actuating case hardened steel bolts. Bolts to operate from one key station with a special bitt key. Each screen shall be provided with rubber bumpers, two or more concealed plated 11 gauge steel hinges and hard brass loose pins. Provide all necessary installation hardware, fastening screws, adjusting screws, and 16 gauge scribes.

Finish of all surfaces of all parts shall be bonderized and apply two coats of paint, one gray primer, and one coat of electrostatically applied baked on enamel.

FIRE EXTINGUISHERS

Fire extinguishers shall be installed in accordance with NFPA Standard 10-94 and shall be Multi-Purpose Dry Chemical 2A-10BC, complete with hose, 5 or 6 lb. capacity, fully charged, with 12-foot minimum range. Cylinders shall be high-grade steel, with enamel finish, and brass fittings. Provide with brackets and surface mount.

XV. WELL HOUSE MECHANICAL SPECIFICATIONS

DIVISION 15 - MECHANICAL

PLUMBING

WATER SUPPLY SYSTEM

Building service for domestic water is to be installed in accordance with the local building code standards. All interior domestic water piping is to be Type L copper or, for piping larger than 2 1/2", may be Schedule 40 galvanized steel.

Joints for copper water piping up to 2 1/2" are to be 95/5 solder. Sillfoss is to be used on larger copper pipe.

Install isolation valves at all equipment and hose bibs with vacuum breakers inside building and 3/4" non-freeze wall hydraulics with vacuum breakers in outside wall. Make-up galvanized pipe joint using malleable iron screwed, fittings or mechanical grooved joint couplings.

SOIL AND WASTE PIPING – when required.

The sanitary sewer is to be connected to the site sanitary sewer system. Floor drains will be provided. Waste and vent piping is to be Schedule 40 PVC-DWV plastic pipe and drainage fittings.

STORM SEWER SYSTEM

The storm water system is to be connected to the site storm sewer. The material is to be RCP. Provide a complete interior drainage system for all roof drains on flat roof buildings. Material is to be service weight cast iron, or Schedule 40 PVC-DWV plastic pipe.

PLUMBING FIXTURES – Eyewash in chemical feed room.

NATURAL GAS SYSTEM

Interior gas piping is to be Schedule 40 black steel with 150 lb. malleable iron fittings.

MECHANICAL (HEATING AND VENTILATING)

DESIGN CONDITIONS

The system provided shall maintain the following conditions in the pump house space.

Winter:	50EF (inside) @ -20E ambient
Summer:	10EF above ambient
Ventilation:	Limited to 10EF rise above ambient

HEATING

Each building space (with the exception of generator and chlorine rooms) is to be heated by a gas fired unit heater. The heater is to have a minimum efficiency of 80%, AGA certification, blower assisted exhaust with safety interlock, electronic ignition, high limit control, 100% shut off, and meeting NFPA standard 888. Generator and chlorine rooms are to be heated with an electric heater.

A low voltage thermostat is to be mounted five foot above finished floor on an interior wall for control.

VENTILATION

To remove excess building heat, install on the long axis of the building a sidewall exhaust fan with a louver/gravity damper and an air inlet louver/motorized damper, thermostatically controlled system on the opposite wall designed to draw air across the space. A wall-mounted thermostat (close on temperature rise) set at 85EF is to open the inlet air dampers and then start the exhaust fan. The ventilation rate shall be based on the heat release from the pump motors but not less than 3000 CFM.

The exhaust fan is to be a low silhouette, 3 phase, centrifugal, heavy gauge spun aluminum housing, and self-supporting. It should include bird screen, motor operated back draft damper, and disconnect switch with the fan.

The anodized aluminum louver is to be AMCA certified and be storm proof design. Maximum airflow is to be less than 800 feet per minute based on free area.

The intake dampers are to be motor operated, insulated, open inward, spring return and low leakage type with edge and jamb seals.

The discharge dampers are to be balanced gravity operated, insulated, open outward, and low leakage type with edge and jamb seals.

DEHUMIDIFICATION

Install an industrial type dehumidifier similar to SlecTemp. The unit is to be self-contained with controls and have a capacity of 140 pints per 24 hours. The refrigerant is to be R-22. Locate a floor drain adjacent to the unit or discharge through wall onto grade as required on the plans.

ENGINE/GENERATOR

The unit is to be installed in accordance with local codes, UL, and NFPA. The fuel tank capacity is to be 560 gallons (inner tank to be 48" diameter x 6') or 48 hour at 50% load supply, whichever is greater. The tank to be thermally insulated, for two hour fire rating per UL 2085 and secondary containment. Tank shall be “Fireguard ™” per Steel Tank Institute specifications. The tank is to be located above grade on saddles and have a spill retention enclosure equal to the tank capacity with a spill monitoring system. The fuel leak detention system is to be equal to PermAlert ESP TankWatch with PCHA contact adapter; two (2) PFS float switches, and NEMA 4 junction box. Unit is to be UL listed for use around diesel fuel. Locate remote alarm near the remote panel for the generator. Locate one float in the retention enclosure and the other at the generator base.

Install a fuel oil tank gauge equal to Pneumercator direct reading system with 8" diameter indicator.

The fuel oil piping is to be A53 with 150 psi fitting. Install flexible connectors at the engine.

The tank fill piping is to be 2" with OPW1611A-2 dry disconnect and 634.B adapter locking cap.

85EF Insulate the engine exhaust piping system and muffler with 4" calcium silicate.

Locate the engine heat exhaust louver and damper in front of the engine and the intake louver and damper directly across the room from the engine. Connect the louver and engine radiator together with a sheet metal enclosure meeting ASHRAE standards. Size and design the exhaust louver for radiator cooling and to allow removal of engine/generator. Design the intake louver for radiator cooling, combustion air, and engine heat dissipation.

The sheet metal enclosure shall be 18 gauge minimum sheet metal with 2" x 2" x 1/4" steel angle reinforcing on minimum 5'-0" centers to be designed for radiator exhaust and to allow recirculation of warm air back to the space. Enclosure shall have an access door for service. Where ductwork connects to the engine generator fireproofed canvas connections shall be made.

The intake dampers are to be motor operated, insulated, open inward, spring return, and low leakage type with edge and jamb seals. Interlock the louver dampers with the engine generator. Intake dampers are also to provide summer ventilation controlled by a space thermostat. Damper is to open when room temperature rises above 80EF.

The discharge dampers are to be balanced gravity operated, insulated, open outward, and low leakage type with edge and jamb seals.

XVI. WELL HOUSE ELECTRICAL SPECIFICATIONS

DIVISION 16 - ELECTRICAL

All electrical work shall be done in accordance with the current rules and regulations of the National Board of Fire Underwriters, the National Electrical Code, the local and state codes and the rules of the power company serving the Municipality.

All electrical equipment and materials shall be UL listed and labeled. Panels, starters, etc., to be NEMA rated, shall be as manufactured by Allen Bradley, Siemens, BW Controls, Divirsified Electronics, or approved equal that has a local stocking agency.

A stand-by generator shall be provided as required by M.D.E.Q. and as described unless the distribution system is permanently interconnected to another well house which has adequate generator and well capacity to also serve the new development as determined by WRC

When a stand-by generator is not required as a part of the original well house construction, a three-way (utility, off, generator) transfer switch and an Appleton AJA200-34-250-RS generator connector shall be wall mounted inside the pump house.

All electrical panels, starters, and switches shall be identified by 5-ply lamacoid nameplates with 1/2" black letters and white background as to the equipment served and applicable voltage. All wiring shall be numbered and corresponding to an as-built electrical ladder diagram for all electrical work.

All wiring shall be numbered, and a corresponding as-built electrical ladder diagram for all electrical shall be provided. This ladder diagram shall be complete showing all switches, relays, etc. per pump house installation. Attached to the electrical diagram shall be an equipment listing giving brand names and model or part numbers. Manufacturer’s diagrams are not acceptable. Ladder diagram and list shall be provided on one 24" x 36" Mylar sheet suitable for reproduction.

All distribution and control equipment shall be mounted in one location, as practical. All electrical distribution and control equipment shall be mounted to 4' x 8' x 3/4" sheets of exterior grade, pressure treated plywood. Chipboard and particleboard panels are not acceptable alternates. The plywood panels shall be securely attached to the wall three feet above the floor. All electrical equipment must be kept 24" minimum above finished floor level. All heavy electrical equipment, such as transformers, shall be lagged through the plywood into the block wall. Mount near the control end of the hydro-pneumatic tank.

Final inspection and acceptance of the electrical installation will be made by WRC after approval by Municipal Electrical Inspector.

CONDUIT

All wire shall be run in rigid conduit. Use metallic conduit in the generator room and rigid Schedule 40 PVC conduit in pump room, chemical storage room and below grade or in concrete floors, walls, block, etc. with necessary expansion joint provided. Terminate in suitable PVC or ABS boxes with gasketed corrosion resistant cover plates.

All motor terminal boxes shall be connected with a 24" maximum section of liquid tight, PVC coated, flexible conduit.

WIRES AND CABLES

In general, all conductors or cable shall be 600 volt, 98 percent conductivity copper with code types "THHN, THWN" for control and code types "XHWW, THHN, THWN" for power, and type "MTW" for control panel wiring. Type "G" cable shall be used for wiring of the generator connectors to allow freedom of movement of the connector pins. All are to be insulated per National Board of Underwriters. All wiring within control panel shall be non-jacketed machine tool type.

CONNECTIONS AND DEVICES

Receptacle outlets shall be duplex, specification grade, polarized, U-ground, 20 amperes, 125 volts, NEMA 5-20R, ground fault interrupter protected. An electrical outlet shall be provided at each pump, at the front of the storage tank at the control panel, and in the generator room.

Switches: 120/277 volt, quiet type, toggle handle, totally enclosed, 1 HP rated, 20 amperes, specification grade. Disconnect switches shall be load break rated.

An electrical outlet, as specified above, and energized with the pump motor for each well, shall be provided in the chemical feed room for the chemical feed pumps.

A non-resetable running time meter for each pump shall be installed in the door of the electrical control panel. The read out shall be in hours and tenths, and shall be Cramer 63SK or approved equal with readings available from panel face for each pump.

A 120 VAC wall mounted, 8" minimum electric clock shall be provided and mounted with the electrical control equipment on the backboard.

GROUNDING

The pump house electrical system shall be grounded per the National Electrical Code, the requirements of the local utility company and the following:

- Ground grid resistance shall be measured using 3-point method per IEEE 81 with earth ground test meter, and two (2) copies of certified test results provided. Additional ground rods and conductors shall be provided as required and remeasured until resistance to ground is equal to, or less than:

- Services, Substations, and Equipment: 5 Ohms

- Electronic Equipment: 1 Ohm

Underground connections shall be the exothermically welded type properly selected for applications, Cadweld or equal, where underground grounding conductors connect to grounding electrodes or to each other.

Above ground connections shall be the mechanical pressure type and heavy-duty bolted clamps, listed for application.

Grounding electrodes (driven rods) shall be copper-clad steel with high strength steel core and welded copper outer sheath, 3/4" diameter x 10 feet.

Service arrester shall be rated for the service voltage and number of phases available, Square D #SP-3650.

A separate grounding grid shall be provided for each pad-mounted primary switchgear enclosure, pad-mounted transformer and service entrance location, consisting of at least three (3) driven rods separated by at least twenty (20) feet and interconnected with #4/0 bare stranded copper cable.

A ground wire shall be installed in each raceway.

One (1) #8 solid cu conductor in 1/2" (12 mm) conduit shall be provided from main communications equipment to nearest approved grounding electrode.

MOTOR STARTERS AND CONTROLS

Each motor shall be controlled by a NEMA rated magnetic motor starter and fusible disconnect switch. The motor starter shall be as manufactured by Allen-Bradley and shall have nonadjustable overload relays and built in "H-O-A" selector switches. Disconnect switches shall have auxiliary contacts to interrupt the motor control circuit. All motor fuses shall be Buss or equal dual element fuses. All pump motors 50 hp and larger, or the largest motor in the facility, shall have reduced voltage starting of the part winding, auto-transformer, or delta-wye types. Electronic motor controllers such as Allen Bradley Smart Motor Starter may be utilized where a slow start and stop are required.

Automatic, alternating control of pump starting shall be provided by “B/W” controls.

Pilot devices shall be full size NEMA 13 with engraved nameplates. Indicator lights shall be push to test, transformer type with low voltage lamps. Selector switches shall have operators and replaceable contact blocks, Allen Bradley 800T or approved equal.

Level sensing for SCADA shall be provided by RF Capacitance Controls such as Magnetrol Level probe (Transmitter Model #82-8303-400), (Probe Model #41-5001-xxx) as supplied by Commerce Controls Inc. Novi, Michigan. Probe length to be 36" unless otherwise specified by WRC, 15% above and 35% below center, position probe chamber on tank during installation. Provide 10' of slack cable.

Wiring for SCADA signals shall be twisted pairs properly shielded and run in separate conduit.

The electrodes for the controls shall be mounted in a 3-inch minimum diameter chamber mounted on the front of the tank with gate valves and unions so that the electrodes and chamber can be serviced with the tank pressurized. The electrodes shall be 1/4" in diameter solid type 316 stainless steel. Chambers shall be plumb.

An indicator light for each incoming power leg shall be located on the control panel visible from the auxiliary power receptacle. The indicator lights shall be of the transformer type with low voltage lamps. Allen Bradley mod 800T or approved equal.

Provide lightning protection at incoming service.

Each three phase motor shall be equipped with a loss of phase, phase reversal, and low voltage protection as manufactured by Diversified Electronics, model #SLA 440-ALE (for 440 volt systems).

A float switch shall be installed inside the pump house to prohibit pumping with water level 1’-0" above the finished floor level. A level sensor bypass shall be installed in the control panel.

BUILDING LIGHTING

Inside: 48" energy saving fluorescent type lighting fixtures equipped with ballasts and 2-F032 energy saving cool white lamps. Minimum of 50-foot candles shall be provided in the pump room and in the generator room. Generator room lights to be provided with wire guards and shall be switched at all entrances to the room. Switches for the pump room lighting shall be provided at all building entrances. Chemical equipment room lighting shall be incandescent installed in a PVC vapor tight fixture. Provide continuous fluorescent fixtures above control and distribution panels.

Outside: One (1) weatherproof lighting fixture and 150 watt HPS lamp with photo cell at each building entry door, and manual control though a switch at the control panel. Light fixtures must have vandal resistant lens covers, Lexan, or equal.

Emergency: One (1) battery pack, self-contained, automatic, emergency lighting unit in the generator room. The unit must be corrosion resistant, have twin sealed halogen beams, and 15 year life expectancy, maintenance free, pure lead battery, Dual Lite N4X Series, or equal.

ENGINE GENERATOR SET

Each well house, except as noted, shall have a standby generator mounted inside the well house and be adequately sized to run all heating, lighting and motor loads and start all loads with a 25% maximum voltage dip. In general, units shall be diesel driven; however, natural gas driven units may be proposed for installations requiring 100 kw or less of emergency power if they are proven to be more economical. The generator shall be supplied with the following.

- Automatic transfer switch
- Main circuit breaker
- Auto start control/alarm outputs
- Provisions for remote status/alarm signaling
- Block heater
- Battery(s), rack and cable
- Automatic battery charger
- Vibration isolators
- Residential sound level muffler
- Integral radiator with flexible shroud

The on-board control alarm panel shall include the following:

- Oil pressure gauge, water temperature gauge, low oil pressure alarm contacts, high water temperature alarm contacts, low oil pressure shutdown contacts, high water temperature shutdown contacts, overspeed shutdown contacts, cranking limiter, volt meter and volt meter selector switch, ammeter and ammeter selector switch complete with current transformers as required, frequency meter (vibrating reed type), voltage adjustment rheostat (plus or minus 5 percent), and running time meter.

- Contacts to control opening and closing of dampers for cooling air ducts.
- OFF-START-AUTO selector switch, trouble horn, silencing switch and indicating lights and illuminated annunciators with engraved nameplates reading:
- "Auto" switch off (flashing red)
- Low oil pressure shut down (red)
- High water temperature shut down (red)
- Overspeed shut down (red)
- Over cranking shut down (red)
- Low oil pressure pre-alarm (yellow)
- High water temperature pre-alarm (yellow)
- High battery volts (charger malfunction) (red)
- Low battery volts (red)
- Low water temperature (red)
- Low fuel (red)
- System ready (engine running) (green)

The following alarm conditions shall be monitored and grouped to provide a common alarm output for remote signaling.

- Emergency stop
- Switch off
- Low oil pressure shut down
- High water temperature shut down
- Overspeed shut down
- Over cranking shut down
- Low oil pressure pre-alarm
- High water temperature pre-alarm
- High battery volts
- Low battery volts
- Low water temperature
- Low fuel

The engine generator set to be manufactured by Caterpillar, Onan or Kohler.

The emergency generator system including, the automatic transfer switch, shall be warranted by the manufacturer for five years or 1,000 hours, whichever occurs first, from the date of the site start-up. Parts and labor included.

The automatic transfer switch shall be as follows:

- The contactor type motor operated and mechanically linked. Electrically operated, mechanically held and obtaining control and transfer power from the source to which it is being transferred. Transfer switches shall be load breaker rated.
- Close and withstand current ratings exceeding available fault current.
- Provide following features in addition to automatic transfer function:
- Time delay relay to delay retransfer from emergency to normal on restoration of normal power, adjustable from 0 to 30 minutes.
- Time delay relay, to prevent generator startup on momentary failure of normal power, adjustable from 0 to 6 seconds.
- Time delay relay to delay generator shutdown after retransfer to normal, to permit engine cooling off period, adjustable from 0 seconds to 5 minutes.
- Engine starting contacts.
- Four indicating lights to indicate emergency transfer switch position and source available.
- Auxiliary contacts to control motorized dampers in cooling equipment.
- One additional normally open contact on both normal and emergency relays.
- One set of normally open auxiliary contacts for remote indication of normal power failure.
- Test switch to simulate normal power failure.
- Time delay at neutral position to permit decay of regenerative power during transfer, 2 seconds minimum, or in-phase monitor controls to allow transfer and retransfer only when power sources are sufficiently close to zero phase-angle difference.

Wall dampers shall be interlocked with engine operation.

The generator shall be mounted on the 6" minimum thickness reinforced concrete floor slab. Vibration isolators shall be placed between the generator rails and mounting slab.

Diesel powered generators shall have 48-hour fuel supply system with a complete secondary containment systems for fuel tank, or fuel line leaks. A thermally insulated, double walled, above ground, fireguard tank shall be installed.

- A 1/2” drain line with draincock shall be installed from the bottom of the muffler to the nearest floor drain for periodic draining of the muffler.

- Oil and radiator drain lines shall extend to beyond the engine base and terminate in a shut-off valve on each line.

- The engine must be made to provide a sufficient height above its base to permit dropping oil pan without removing unit.

- Provide vibration isolation between the engine and exhaust equipment to prevent transfer of vibration into building components.

- The Contractor shall provide the initial fuel tank fill. The Contractor shall refill tank to replenish fuel used for start-up and testing. Fuel shall be winterized type.

Site tests: The manufacturer's local representative shall perform an installation check, start-up, and building load test. The engineer, regular operators, and the maintenance staff shall be notified at least 48 hours in advance of the time and date of the site test. The tests shall include:

- The fuel tank shall be air tested on site before filling the first time. Use testing procedure recommended by The Steel Tank Institute for this test unless otherwise instructed. WRC Water Systems Operations Personnel must witness this test.

- Fuel, lubricating oil, and antifreeze (liquid cooled models) shall be checked for conformity to the manufacturer's recommendations under the environmental conditions present and expected.

- Check accessories that normally function while the set is in stand by, prior to cranking the engine. This shall include: engine heaters, battery charger, generator strip heaters, remote annunciator, etc.

- Check for exhaust leaks, path of exhaust gases outside the building, cooling air flow, movement during starting and stopping, vibration during running, normal and emergency line-to-line voltage and phase rotation.

- Test automatic start-up four (4) times at 15-minute maximum intervals by means of simulated power outage to test remote-automatic starting, transfer of the load, and automatic shutdown. Prior to this test, all transfer switch timers shall be adjusted for proper systems coordination. Engine temperature, oil pressure and battery charge level along with generator voltage, amperes, and frequency shall be monitored throughout the test.

- Full load/test the unit for 4 hours utilizing a portable load bank. Record kilowatts, amps, voltage, coolant temperature, frequency, oil pressure and room temperature in 20-minute intervals.

The generator shall be located so that it may be removed from the well house without removal of walls.

XVII. FINAL ACCEPTANCE

1. Prior to final acceptance a recordable Warranty Deed for the well site, isolation area, and access road must be presented to and approved by the Water Systems Operations Engineer.

2. Water Systems Operations shall prepare a quality assurance list (punch list) covering all items involved in construction and equipping the well house including grading and landscaping. The Design Engineer shall schedule a final coordination meeting with attendees to include the WRC, Construction Contractor, Well Driller, Proprietor, and others as appropriate to address the punch list items.

3. Three copies of Manuals shall be provided, bound in a three-ring loose-leaf binder. The data shall be arranged into sections so that all information pertaining to a specific item of equipment will be contained in that section.

4. WRC will assume the responsibility when the system has been approved for water service.

5. The Contractor shall provided copies of all applicable manufacturer's warranties and in addition, shall guarantee the well and well house and equipment to be free from defects in materials and workmanship for a period of two (2) years from acceptance.

6. Provide original copies of all Certificates of Inspection.

7. Provide two (2) year maintenance and guarantee bond from date of final acceptance.

8. The proprietor shall provide a final waiver of lien for all material and labor to WRC.

OAKLAND COUNTY DRAIN COMMISSIONER

MUNICIPAL WELL AND WELL HOUSE

DESIGN STANDARDS

Published January 1997
Revised June 2002

JOHN P. MCCULLOCH
Oakland County Drain Commissioner

ADDEMDUM #1

EFFECTIVE: JUNE 29, 2004

OCDC POLICY STATEMENT

In order to improve water quality and protect the health and safety of the citizens of Oakland County, the Oakland County Drain Commissioner requires that all new well sites meet the Safe Drinking Water Act secondary iron limit of 0.3 parts per million (ppm) or less and an arsenic limit of 5 parts per billion (ppb) or less.

If groundwater sampled from a new well site does not meet these standards, a water treatment system must be installed at the site that will ensure the reduction of the above mentioned parameters to below the required levels in the potable drinking water. In addition, the treatment technology must meet all EPA, AWWA, Safe Drinking Water Act and Recommended Standards for Water Works standards. The treatment technology must be approved by OCDC and the Michigan Department of Environmental Quality.

Signed: _____ Date: 6/24/04

John P. McCulloch,
Oakland County Drain Commissioner

XVIII. CHANGE RECORD

Revision	Date	Responsible Person	Description of Change
Release	10/31/01		Updated fee's, language,
		Product Review Committee	additional site requirements
			(sprinkler system, intrusion alarm)
Revision	06/10/02		Updated Committee Name
		Standards Review Committee	Added 25-29 to Distribution List
	09/11/02	Document Control Person	Revised Distribution List
Revision	03/11/05	ISO Coordinator	Added Addendum #1 (June 2004)

XIX. DISTRIBUTION LIST

Book	Location	Division / Unit	Date
1.	Public Works Building	OCDC Document Control Person	03/11/2005
2.	N/A		
3.	N/A		
4.	N/A		
5.	N/A		
6.	N/A		
7.	N/A		
8.	N/A		
9.	N/A		
10.	N/A		