

**BID DOCUMENTS  
FOR**

**IFB 21-BM-009  
GEOTHERMAL AND HVAC MAINTENANCE AND  
REPAIR SERVICES FOR CITY HALL**

**CITY OF RIO RANCHO, NEW MEXICO**



September 2020

PREPARED BY:  
City of Rio Rancho  
Department of Finance/Purchasing Division  
3200 Civic Center Circle, NE  
Rio Rancho, New Mexico 87144  
Telephone (505) 891-5064

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### ***Bid Submission Packet***

Bid submission packet must include the following items:

- Bid Submission Cover Page 25
- Bid Form 26
- Local/Area/Resident/Resident Veteran/Recycled Content Goods  
Preference Certification Form 29
- Resident Veterans Preference Certification 32

Attachment 1: Heating, Ventilation and Air Conditioning Assessment  
Prepared By Huitt-Zollars (As Attached)

Attachment 2: Rio Rancho City Hall As-Builts (As Attached)



**BID SPECIFIC REQUIREMENTS**  
**IFB 21-BM-009**  
**GEOHERMAL AND HVAC MAINTENANCE AND REPAIR SERVICES FOR CITY HALL**

THE REQUIREMENTS MARKED WITH A ☒ BELOW APPLY TO THIS BID. FAILURE TO COMPLY WITH THE STATED REQUIREMENTS MAY RESULT IN IMMEDIATE DISQUALIFICATION.

- ☒ Due to the current health concerns and the changing environment in respect to COVID-19 the City is requesting all bid submissions be submitted via email to mschimmel@rrnm.gov on October 12, 2020 no later than 11:00 AM MST. The City will conduct the public bid opening and reading of bids received via the GoToMeeting service. A link will be provided on the City's website. Bidders must submit their original bid in a sealed envelope or container via USPS or other mailing service no later than October 6, 2020 to the address specified in the bid document. Bidders will be deemed Non-Responsive if original physical bid submissions are received after the aforementioned date.
- ☒ A Pre-Bid meeting will be held out front of City Hall on the eastside at 3200 Civic Center Circle NE, Rio Rancho, NM 87124 will take place on September 17 at 9:00 AM MST. Interested Bidders will only be allowed one (1) representative from their company to attend. All attendees will be required to wear a face covering or mask and maintain at least a 6ft distance between other attendees. Whenever attendance is not specified as mandatory, prospective Bidder are encouraged to attend and should be prepared to ask questions or request clarifications regarding the project and bidding documents. Nothing stated at the pre-bid conference shall change the bidding documents unless a change is made by Addendum. When attendance is not mandatory, failure of a Bidder to attend the pre-bid conference shall mean that the bidding documents are clear, unambiguous, and acceptable to all non-participants, with respect to all who submit bids.
- ☒ The bid must be signed by an authorized representative.
- ☒ Please acknowledge receipt of Addenda (if any) by initialing next to the number of each Addendum received.
- ☒ Previous Experience and Knowledge of Geothermal HVAC Systems: Bidder(s) shall have the proper licensure and working knowledge of geothermal heating and cooling systems. Bidder shall have successfully performed services similar to those described herein for a minimum of one (1) year. Bidder(s) shall provide the name(s), location(s), and contact information of at least one (1) geothermal reference facility for which preventive maintenance, inspection, and repair services have been performed in the last two (2) years with bid submission. The City may contact Bidders referenced facilities to verify experience and quality of the work. Any experience or knowledge of facts the City may obtain regarding the credibility and/or experience of the Bidder(s) may also be used in evaluating the Bidder(s) qualifications under this requirement, whether the Bidder(s) lists

the project or not. If this requested information is not submitted with the bid submission, the bid will be deemed non-responsive.

- Liability Insurance:** The successful Bidder shall obtain and maintain during the life of any Contract resulting from this IFB a comprehensive general liability insurance policy and automobile liability coverage with liability limits in amounts not less than One Million dollars (\$1,000,000.00) per claim of liability for bodily injury, including death, and property damage in any one occurrence. If required coverages are provided by separate policies, each policy shall have the liability limits required above. Such policy(ies) shall include coverage for all of Contractor's operations performed for the City, coverage for the use of all owned, non-owned and hired automobiles, vehicles and other equipment, both on- and off-site, and contractual liability coverage that specifically insures the Contractor for any liability arising from its indemnification obligations under the Contract resulting from this IFB. Prior to commencing any work under the Contract, the Contractor shall provide the City's Purchasing Office one or more certificates of insurance demonstrating the Contractor's fulfillment of the foregoing insurance requirements. The Contractor shall require the same insurance coverages and endorsements from each subcontractor engaged by the Contractor to fulfill any of its obligations under the Contract resulting from this IFB. The City shall be named an additional insured in each such policy maintained in satisfaction of the foregoing requirements.
- Pricing for All Bid Items Required:** Bidder shall provide pricing for all items included on the bid proposal form. Failure of the Bidder to provide pricing for any and all items on the bid proposal form may cause a bid to be considered non-responsive. It is the City's intent to award to the Responsive and Responsible Bidder offering the lowest extended total price for all items / services. If a contract resulting from this IFB shall be a "List Price plus Discount" contract, as defined by the City's Procurement Code. Cost plus Percentage Cost contracts are prohibited by the City's Procurement Code, and no bid shall be accepted where such Cost plus Percentage Cost offers are proposed. Bidder(s) shall provide a less percentage discount off the published catalog/price list maintained at the time of receipt of bids for each section identified in the Bid Form or as requested by the City.
- Price List or Catalog:** Before a Purchase Order is issued, the successful Bidder shall be required to submit a copy of the price list or catalog referred to in the successful offer. The price list shall become effective when it is received and accepted by the Purchasing Office. Failure to submit a price list by the required date specified in this request may cause a bid to be considered non-responsive.
- Additional Work Rates:** The Bidder shall provide an hourly rate and a material cost in addition to the lump sum offer to be used solely for computing the costs of any additional work required and approved by the City.
- Manufacturer's Information:** Any offer made in response to this IFB must include the manufacturer's make and model number (as applicable) of each item and literature clearly describing the item. Failure to provide this information may result in rejection of the offer.
- Bid Bond:** Each offer must be accompanied by a bid bond, issued by a surety duly authorized to conduct business in the State of New Mexico and acceptable to the City in the amount of five percent (5%) of the total bid price, as a guaranty that the Bidder, if awarded the Contract, will promptly execute such Contract in accordance with this IFB and, if required by this IFB, will furnish good and sufficient bond for the faithful performance of the Contract and for the payment

of all labor and materials. The Bidder must be named as principal on the bond. No third party bid bonds will be accepted. Certified checks, personal checks, cash or other substitutes will not be accepted in lieu of a bid bond.

- Local Area Maintenance: No offer will be considered unless adequate maintenance is available in the Albuquerque Metro Area.
- Prequalification Requirement: Bidders must be prequalified through the City's Purchasing Division in order to qualify to submit for this IFB.

**Bid Schedule:**

- Legal Advertisement: September 13, 2020
- Pre-Bid Scheduled: September 17, 2020 at 9:00 AM MST on-site at City Hall
- Question Submission Deadline: September 21, 2020 by 5:00 PM MST
- Addendum Deadline: September 24, 2020
- Bid Submission Deadline: October 1, 2020 by 11:00 AM MST
- Mailed Original Signed Bid Submission After Opening: October 6, 2020

**ACKNOWLEDGEMENT FORM**

Please complete this form and return it to the City of Rio Rancho Financial Services Department. Form may be faxed, emailed or mailed to the City contact listed below. Failure to return this form will not exclude a firm from submitting a bid; however, only those prospective Bidders who elect to return this form completed with the indicated intention of submitting a bid will receive addenda, if issued, or other additional information pertaining to this bid.

COMPANY: \_\_\_\_\_

REPRESENTED BY: \_\_\_\_\_

TITLE: \_\_\_\_\_

TELEPHONE: \_\_\_\_\_ FAX: \_\_\_\_\_

EMAIL ADDRESS: \_\_\_\_\_

ADDRESS: \_\_\_\_\_

CITY: \_\_\_\_\_ STATE: \_\_\_\_\_ ZIP CODE: \_\_\_\_\_

If you require additional information regarding this bid, or the Procurement process, please contact:

City of Rio Rancho  
Department of Finance Services, Purchasing Division  
Attention: Matthew Schimmel, Purchasing Specialist  
3200 Civic Center Circle NE, STE 300  
Rio Rancho, NM 87144  
Telephone: (505) 891-5064  
Fax: (505) 891-5762  
mschimmel@rrnm.gov

**INSTRUCTIONS TO BIDDERS**

**DEFINITIONS:** As used in this IFB and in the City of Rio Rancho Procurement Code, the following definitions apply:

- A. AGREEMENT means any contract between the City and Contractor pertaining to price, terms, and conditions for the Procurement of items of tangible personal property, services or construction services as described in and awarded as a result of this Invitation for Bids.
- B. AREA BUSINESS means a Resident Business or Resident Contractor which:
  - (1) Is authorized to do and is doing business under the laws of the State of New Mexico;
  - (2) Possesses a current City business registration;
  - (3) Maintains a bona fide place of business within the corporate limits of the City, and agrees to conduct its activities pursuant to the Contract for which it is bidding or proposing, to the extent practicable, from that place of business; and
  - (4) Agrees to furnish evidence, in a form suitable to the City, of its payment of New Mexico Gross Receipts Tax.
- C. Bidder means a business that submits a bid in response to this Invitation for Bids.
- D. Central Purchasing Office or Purchasing Office means the Purchasing Division of the City's Department of Financial Services.
- E. City means the City of Rio Rancho, a political subdivision of the State of New Mexico.
- F. Contract means any agreement between the City and Contractor as to price, terms, and conditions for the Procurement of items of tangible personal property, services or construction services as described in and awarded as a result of this Invitation for Bids.
- G. Contractor means a Bidder who has been awarded a Contract.
- H. Invitation for Bids or IFB means this Invitation for Bids, which includes all exhibits, schedules and other attachments referred to herein.
- I. Local Business LOCAL BUSINESS means a Resident Business or Resident Contractor which:
  - (1) Is authorized to do and is doing business under the laws of the State of New Mexico;
  - (2) Possesses a current City business registration;
  - (3) Maintains its principal place of business within the corporate limits of the City; and
  - (4) Agrees to furnish evidence, in a form suitable to the City, of its payment of New Mexico Gross Receipts Tax.
- J. Notice of Invitation for Bids means the notice regarding this Invitation for Bids, containing a brief description of the items of tangible personal property, services or construction to be procured, the location where this Invitation for Bids can be obtained, where bids are to be received, the cost, if any, for copies of plans and specifications, the date and place of the bid opening, and other information the Procurement Officer deems necessary.
- K. Procurement means the purchasing, renting, leasing, lease purchasing or otherwise acquiring items of tangible personal property, services or construction, and all aspects of such Procurement, including

but not limited to preparation of specifications, solicitation of sources, qualification or disqualification of Bidders, preparation and award of Contract, and Contract administration.

- L. Procurement Officer means the City Manager or other person authorized by the City Manager to oversee the administration of the Procurement process.
- M. Purchase Order means the document issued by the Central Purchasing Office, which directs a Contractor to deliver items of tangible personal property, services or construction pursuant to an existing Contract, and creates an encumbrance of funds necessary for payment.
- N. RECYCLED CONTENT GOODS has the meaning set forth in NMSA 1978 § 13-1-21(A)(6), as amended from time to time.
- O. Resident Business: has the meaning set forth in NMSA 1978 § 13-1-21(A)(5), as amended from time to time.
- P. Resident Contractor: has the meaning set forth in NMSA 1978 § 13-4-2(A)(5), as amended from time to time.
- Q. Resident Veteran Business: has the meaning set forth in NMSA 1978 § 13-1-22(A)(7), as amended from time to time.
- R. Resident Veteran Contractor: has the meaning set forth in NMSA 1978 § 13-4-2(A)(6), as amended from time to time.
- S. Responsible Bidder means a business that submits a Responsive bid and which has furnished, when required, information sufficient to prove that the Bidder's financial resources, production or service facilities, integrity, personnel, service reputation and experience are adequate to satisfactorily deliver the items of tangible personal property described in this Invitation for Bids.
- T. Responsive bid means a bid which conforms in all material respects to the requirements set forth in this Invitation for Bids and the drawings, specifications and other documents designated herein. Material respects of a bid include, but are not limited to, price, quality, quantity or delivery requirements.
- U. STATUTORY PREFERENCE means the five percent (5%) preference for Resident Businesses, Resident Contractors, and Recycled Content Goods provided in NMSA 1978 §§ 13-1-21 or 13-4-5, as amended from time to time.
- V. QUALIFYING COMPANY means a company that qualifies for a Statutory Preference under NMSA 1978 §§ 13-1-21 or 13-4-5, as amended from time to time.

#### **PREPARATION OF BIDS:**

- A. Submission: All bids must be submitted on the Bid Proposal Form attached. Failure to do so may disqualify your bid. It is the responsibility of the Bidder to submit sufficient additional information to allow for a thorough evaluation of the bid submitted.
- B. Preparation method: All information required in this IFB must be typewritten or handwritten in ink and must be legible. Erasures or other changes must be initialed by the person signing the bid. Each bid must be signed on the appropriate pages by an individual authorized to bind the Bidder submitting

the bid. In the event that a bid or Contract is signed by an agent, the City reserves the right to require evidence of the agent's authority.

- C. Unit Prices: The unit price for each item offered shall be shown unless otherwise specified. In the case of a discrepancy between the unit price and the extended price, the unit price shall govern in determining the price used for evaluation.
- D. Estimated Quantities: The quantities shown on the bid are estimated quantities only. The City of Rio Rancho reserves the right to purchase more than or less than the quantities shown. In any event, the unit bid prices shall govern for the duration of the Contract. Any and all price increases for items specified under the bid shall be mutually agree upon via a Contract modification and shall become effective upon written approval of the City's Procurement Officer, or his designee.
- E. Delivery Time: Delivery time stated in the specifications shall apply. Deviations by the Bidder shall be stated as an exception taken to this IFB as part of their response to this IFB. Time, if stated in number of days, will be consecutive calendar days.
- F. Delivery, Unpacking, Assembly and Placement: Any offer in response to this IFB must include delivery, unpacking, assembly and placement of items as specified in this IFB. All costs associated with delivery, unpacking, assembly and placement must be included as a part of the unit price bid for each item.
- G. Freight Policy: Freight will be F.O.B. Destination (as indicated on the Request Form), Freight Prepaid, unless otherwise specified in this IFB.
- H. Taxes: The City of Rio Rancho is exempt from payment of New Mexico Gross Receipt Taxes (NMGRT) on materials purchased, but is subject to such tax on services, including construction services as defined in NMSA 1978 § 7-9-3.M. A Bidder shall include any applicable NMGRT in its bid price, unless specified otherwise in this IFB, and bids will be construed in that manner. Determination of whether NMGRT is due and payment of the tax is the responsibility of the Bidder. Applicable taxes are to be listed separately and included in each invoice due and may not be billed more than sixty (60) days after providing the services to which the taxes apply.
- I. New Material, Etc.: All materials, supplies, equipment, and vehicles specified in this IFB shall be new, the latest in production and manufactured within the last twelve (12) months (computed from the date and time of bid opening), unless otherwise indicated. This does not apply to materials, supplies, equipment or vehicles used by the Contractor to provide the required item(s) of tangible personal property.
- J. Warranty: Materials furnished by the successful Bidder shall be accompanied by the manufacturer's written warranty against defects in quality, craftsmanship, and materials. The Bidder agrees that item(s) of tangible personal property furnished under any Contract resulting from this IFB shall be covered by the most favorable commercial warranties the Bidder gives to any customer for such item(s). Further, the Bidder agrees that the rights and remedies provided in such warranties will extend to the City and are in addition to and do not limit any rights afforded to the City by any other clause of this IFB. The Bidder agrees not to disclaim any warranties of fitness for a particular purpose or of merchantability. Warranties shall become effective at the time of acceptance of the goods furnished.
- K. Equivalent Bids: Where a product is characteristic of a sole manufacturer, or where a brand name is indicated in the specifications, it shall be defined to mean "minimum acceptable level" or "minimum quality required" unless the specifications state that no substitutions or equivalents will be allowed. If

the Bidder bids an item other than the one specified, which the Bidder considers comparable, the manufacturer's name and model number of that item must be specified in the bid and sufficient performance and descriptive data provided to permit a thorough evaluation. Failure to provide the appropriate information may result in disqualification of the bid.

- L. Exceptions to Specifications: Specifications of items or components included in a bid shall be equal to or better than the standards set by the technical specifications made a part of this IFB, and all exceptions to these specifications shall be so listed on a separate sheet titled, "EXCEPTIONS TO THE SPECIFICATIONS." Any bid submitted without exceptions will be required to meet every detail of the City's technical specifications regardless of cost to the Bidder.
- M. Site Inspection: All Bidders are required to conduct an on-site inspection. Failure by the Bidder to become acquainted with the conditions affecting the work specified in this IFB shall not constitute relief from responsibility for estimating properly the difficulty or cost of successfully performing the work. The Bidder shall be responsible for any excess costs resulting from failure to estimate accurately. Failure to conduct an on-site inspection may result in the rejection of a bid.
- N. Service Facilities: The Bidder, upon submitting a bid in response to this IFB, must have service facilities, which are, in the opinion of the City, adequate to perform the services specified in this IFB. The City reserves the right to inspect and determine if the facilities meet this requirement. The final determination of satisfaction of this requirement rests with the City.
- O. Licenses and Certifications: The Bidder must provide proof, in a manner acceptable and within the time period specified by the Purchasing Office, but prior to award, unless otherwise specified in this IFB, that they are licensed and certified by the appropriate agencies as required by law to provide the goods specified in this IFB.

#### **ETHICAL CONDUCT:**

By submitting a bid in response to this IFB, each Bidder certifies that:

- A. It has not offered, given or agreed to give to any City employee or former employee, a gratuity or offer of employment to influence the preparation of or recommendation of award of this IFB;
- B. It has not retained a person to solicit or secure a City Contract for a contingent fee;
- C. It has not taken any action in restraint of free competitive bidding in connection with this IFB;
- D. It has not in any way violated the ethical conduct or other provisions of the City's Procurement Code;
- E. It currently has no interest and will not acquire any interest, direct or indirect, which would conflict in any manner or degree with its performance of any Contract resulting from this IFB; and
- F. The accompanying bid is not the result of, or affected by, any unlawful act of collusion with any other person or company engaged in the same line of business or commerce, or any other fraudulent act punishable under state or federal law.
- G. The City of Rio Rancho Procurement Code, Section 36.37, paragraph B, notes that New Mexico criminal statutes impose felony penalties for illegal bribes, gratuities and kickbacks.

**REQUESTS FOR EXPLANATIONS BY BIDDERS:**

- A. Requests for Explanation: Any explanation desired by the Bidder regarding the meaning or interpretation of specifications or any part of this IFB must be requested in writing and received in the Purchasing Office not less than ten (10) calendar days prior to the scheduled bid opening. This IFB is issued on behalf of the City of Rio Rancho by the Purchasing Office, which is **THE SOLE POINT OF CONTACT DURING THE PROCUREMENT PROCESS**. Communications initiated by Bidders with members of the Governing Body or City Personnel other than as coordinated by Purchasing Office Staff, shall be grounds for Bidder Disqualification. Any inquiries or requests during the Procurement process shall be submitted in writing to the following point of contact:

City of Rio Rancho  
 Department of Finance Services, Purchasing Division  
 Attention: Matthew Schimmel, Purchasing Specialist  
 3200 Civic Center Circle NE, STE 300  
 Rio Rancho, NM 87144  
 Telephone: (505) 891-5064  
 Fax: (505) 891-5762  
 mschimmel@rrnm.gov

- B. Responses to Requests: Oral explanations or instructions given prior to the opening of the offer shall not be binding. All official explanations must be issued in writing by the Purchasing Office.

**CLARIFICATION OF BIDS:**

The City may, in the evaluation of bids, request clarification from Bidders regarding their bids, or additional material or literature, and pursue other avenues of research, as the City deems necessary to insure that a thorough evaluation is conducted.

**SUBMISSION OF BIDS:**

- A. Time: Bids not received by the time and date indicated in this IFB will not be accepted.
- B. Emailed Bid Submission: Due to the current health concerns and the changing environment in respect to COVID-19 the City is requesting all bid submissions be submitted as follows:
- Bids must be submitted via email to Matthew Schimmel, mschimmel@rrnm.gov on October 1, 2020 no later than 11:00 AM MST.
  - The City will conduct the public bid opening and streamed via GoToMeeting. Please visit the City's website for the link to join the virtual meeting.
- C. Hand Delivered or Mailed Submissions: Bidders must submit their original bid in a sealed envelope or container to the City by hand delivering, USPS or other mailing service no later than October 6, 2020 to Office of the City Clerk, Attn: Matthew Schimmel, 3200 Civic Center Circle NE, Room #150, Rio Rancho, NM 87144, and will be considered submitted when actually received and time stamped. The City shall not be responsible for bids that are mailed and not received by the date and time specified in this IFB.
- D. Envelope Preparation: The envelope or package containing a bid must be sealed and the following identifying information legibly written or typed on the outside:
- a. Name of Bidder;

- b. Bid Number assigned by the City to this IFB; and
  - c. Opening date identified in this IFB or in one or more subsequent addenda.
- E. No Other Methods of Delivery: No means of delivery of bids other than those specified above, including telephone, or facsimile, will be accepted.
- F. Public Inspection: Each bid shall be open to public inspection, except to the extent the Bidder designates trade secrets or other proprietary data to be confidential. Material so designated shall accompany the bid and each page shall be clearly marked and readily separable from the bid in order to facilitate public inspection of the non-confidential portions of the bid. Prices and makes and models or catalog numbers of items offered, deliveries and term of payment shall be publicly available at the time of the opening of the bids, regardless of any designation to the contrary. The City shall endeavor to restrict distribution of material designated as confidential to only those individuals involved in the review and analysis of bids. Bidders are cautioned, however, that materials designated confidential may nevertheless be subject to disclosure to any New Mexico citizen under the Inspection of Public Records Act (NMSA 1978 §§ 14-2-1 through 14-2-12).
- G. Delays or Closings of City Offices: In the event that City Hall is officially on a delayed opening for any reason (for example, inclement weather) and City Hall is not open at least two (2) hours prior to bid opening, the deadline for bid and proposal submissions will be delayed for exactly the amount of time indicated in the official City announcement. For example, if City Hall is on a two (2) hour delay, deadline for receipt of bids and proposals due prior to 12:00 p.m. will be delayed by two (2) hours and bids due after 12:00 p.m. will be due at their regularly scheduled time. Also, if City Hall is officially closed for any reason (such as inclement weather) for all or part of the day that submission of bids is due (other than an official, announced delayed opening), bids will be due at the same time on the following business day. Any delayed opening or closing of City Hall will be announced on the City's website <http://www.rnm.gov>.

#### **WITHDRAWAL OF BIDS:**

A bid may be withdrawn in person at any time BEFORE the scheduled opening of bids, provided a receipt for the withdrawn offer is signed by the Bidder or the Bidder's authorized representative. The City reserves the right to request proof of authorization to withdraw a bid.

#### **OPENING OF BIDS:**

Bids will be opened by the Purchasing Division at the time and place specified in this IFB. Openings are held via a GoToMeeting link provided on the City's website [www.rnm.gov/bids](http://www.rnm.gov/bids)

#### **DISQUALIFICATION OF BIDS:**

The City reserves the right to reject a bid for any one or more of the following reasons:

- A. The City determines a bid to be non-responsive in any manner to the requirements of this IFB.
- B. In the past the Bidder has failed to comply with previous contractual commitments, bids, proposals, or offers to the City.
- C. In the opinion of the City, the Bidder is not capable of providing the offered items of tangible personal property, services or construction as offered or required by this IFB or is otherwise not a Responsible Bidder.

- D. The Bidder has not provided sufficient or detailed information to allow for the evaluation of the bid.
- E. In the opinion of the City, the bid prices are higher than the prices for which the specified items or services can be purchased on the open market.
- F. The Bidder failed to properly fill in any space on the Request Form or any attached document in which information or a signature is required.
- G. The Bidder did not, at the time the bid is submitted, have any license or certification required by law.
- H. The Bidder failed to submit with its bid any bond or other material requirements of this IFB or has otherwise submitted a non-responsive offer.
- I. There are unauthorized additions, conditions, alternate proposals or other irregularities of any kind, which might make the bid incomplete, indefinite or ambiguous in meaning.
- J. The bid was not submitted in ink or typewritten, or there is any erasure or alteration of words or figures relating to pricing which is not initialed in ink by the Bidder.
- K. The City determines that a bid contains any misrepresentations whatsoever.
- L. Notwithstanding the foregoing, the City reserves the right to waive any irregularity in a bid if the Procurement Officer deems, in his or her sole discretion, such irregularity to be immaterial to the purpose of this solicitation and that waiving the same is in the best interest of the City.

**REJECTION/CANCELLATION OF BIDS:**

Any solicitation, prior to opening or after opening, may be canceled or any or all bids may be rejected in whole or in part when it is in the best interest of the City to do so.

**MINOR OR TECHNICAL IRREGULARITIES:**

Minor or technical irregularities in a bid, when there is no effect on price, quality or quantity may be waived and clerical errors in a bid may be corrected, if it is in the best interest of the City.

**NONCONFORMING/CONDITIONAL, OR COUNTER BIDS:**

The City will reject any bid that is nonconforming or conditional, in whole or in part.

**BID ANALYSIS:**

The City reserves the right to analyze, examine and interpret any bid for a period of ninety (90) calendar days after the scheduled time for the opening of bids. Bids may not be rescinded during this period except for good cause and with the written approval of the Procurement Officer. In those situations where the analysis/evaluation exceeds ninety (90) calendar days, Bidders may withdraw their bids from consideration.

**AWARD OF CONTRACT:**

- A. When Award Occurs: The award of a Contract occurs when a Purchase Order is issued or other evidence of acceptance by the City is provided to the Bidder. A recommendation of award does not constitute award of Contract.
- B. Award: The City of Rio Rancho reserves the right to reject any or all bids or accept any presented which meet these specifications, and which would be in the best interest of the City and will not necessarily be bound to accept the low bid. The City reserves the right to make multiple awards as a result of this IFB if doing so would be advantageous to the City. The City may issue multiple awards on an item-by-item basis to the Responsive and Responsible Bidder(s) offering the lowest price for each item or to the Responsive and Responsible Bidder(s) offering the lowest total price for each category of items. Multiple source awards shall not be made when a single award will meet the need of the City without sacrifice of economy or service. Awards shall be limited to the least number of suppliers necessary to meet the requirements of the City. In addition, The City reserves the right to award to Primary and Secondary Vendors, in which case, the lowest Responsive bid overall, in each category, or for each item shall be the Primary Vendor who shall be the primary source for all designated bid items. The next lowest Responsive bid shall be the Secondary Vendor who shall be the secondary or back-up source of for all designated bid items. The Secondary Vendor shall be utilized only if extenuating circumstances or non-compliance precludes the Primary Vendor from fulfilling orders for goods or services. This IFB gives no guarantee of minimum quantities or work.

If a contract resulting from this IFB shall be a “List Price plus Discount” contract, as defined by the City’s Procurement Code. Cost plus Percentage Cost contracts are prohibited by the City’s Procurement Code, and no bid shall be accepted where such Cost plus Percentage Cost offers are proposed. Bidder(s) shall provide a less percentage discount off the published catalog/price list maintained at the time of receipt of bids for each section identified in the Bid Form or as requested by the City.

- C. Determination of Bidder Responsibility: The City may make such investigations it deems necessary to determine the ability of the Bidder to perform the services and/or supply the items of tangible personal property specified herein. The Bidder shall, within seven (7) calendar days, furnish to the City all such information and data for this purpose as the City may request. The City reserves the right to reject any bid if evidence submitted by, or investigation of such Bidder fails to satisfy the City that such Bidder is properly qualified to carry out the obligations of this Invitation For Bids.
- D. Application of Resident, Local, Area, and Recycled Content Goods Preference: In all Invitations for Bid and requests for proposals, the Statutory Preferences shall be applied in the manner set forth in NMSA 1978 §§ 13-1-21 or 13-4-5, as amended from time to time. A copy of a valid Resident Business Certificate or Resident Contractor Certificate issued by the New Mexico Taxation & Revenue Department. Information regarding resident preference can be obtained by contacting the Point of Contact as listed herein.

In addition to the Statutory Preferences, a preference for Local Businesses and Area Businesses shall be administered in the same manner as the Statutory Preferences, as follows:

- (1) in the event a Local Business submits a qualifying bid or proposal and one or more Qualifying Companies also submits a bid or proposal, the Local Business shall receive a two percent (2%) preference in addition to (and not in lieu of) the Statutory Preference; and

- (2) in the event an Area Business submits a qualifying bid or proposal and one or more Qualifying Companies also submits a bid or proposal, the Area Business shall receive a one percent (1%) preference in addition to (and not in lieu of) the Statutory Preference.

In addition to the definitions and criteria set forth in this section, the Central Purchasing Office may impose additional requirements regarding the nature, size and/or location of offerors or Bidders in any request for proposals or Invitation for Bids. As a result, companies responding to such solicitations should review the solicitation documents thoroughly.

Information regarding the City's Procurement Code and the application of the local and resident preference can be obtained by contacting the Point of Contact as listed herein.

For consideration for the Area, Local, and Recycled Content Goods preference, the Offeror must complete the Preference Certification Form, attached hereto, in accordance with the instructions and return the form with its Technical Proposal.

In addition to the definitions and criteria set forth in the section, when a joint bid or joint proposal is submitted by both Resident and non-Resident Businesses, the Resident Business preference provided pursuant to Subsection B or C of the NMSA 978 §§ 13-1-21 or 13-4-5, as amended from time to time, shall be reduced in proportion to the percentage of the Contract, based on the dollar amount of the goods or services provided under the Contract, that will be performed by a non-Resident Business as specified in the joint bid or proposal.

#### **PROTEST PROCESS:**

- A. Right to Protest: Any Bidder or Bidder who is aggrieved in connection with a solicitation or award of a Contract may protest to the Central Purchasing Office.
- B. Timely Protest: The protest must be submitted in writing within ten (10) calendar days after knowledge of the facts or occurrences given rise thereto.
- C. Required Information: All protests must be submitted in legible, written form and delivered either personally or by mail to the Purchasing Division of the City's Department of Financial Services (the same address to which bids are to be mailed). Protests delivered by any other method, including facsimile, telephone, or e-mail will not be accepted. Protest shall contain at a minimum the following:
- (1) Name and address of the protesting party;
  - (2) The solicitation/IFB number;
  - (3) A clear statement of the reason(s) for the protest;
  - (4) A clear statement of the facts that support the protest;
  - (5) Attachments of any written evidence available to substantiate the protest; and
  - (6) A statement specifying the relief or ruling requested.
- D. The envelope enclosing a protest should clearly indicate "PROTEST" and the IFB number.
- E. Authority to resolve. The Procurement Officer has the authority to take any action reasonably necessary to resolve a protest in accordance with the City's Procurement Code, but does not have any authority to award money damages or attorney fees.

## **GENERAL REQUIREMENTS AND SPECIFICATIONS**

These General Requirements and Specifications are a description of the physical or functional characteristics, or nature of the item(s) of tangible personal property, service or construction to be procured under this Invitation for Bids, and also contain the applicable terms and conditions for the Procurement of the same. The General Requirements and Specifications set forth herein are intended to establish the type, function, appearance, and/or quality required by the City of Rio Rancho and shall be satisfied without exception. Any exceptions taken by Bidder(s) may, at the City's sole discretion, be accepted if they are minor, equal, or superior to that which is specified, or are otherwise acceptable to the City, and provided that they are listed and fully explained in the bid form section entitled, "Exceptions to Specifications". The exceptions taken by Bidder(s) shall refer to the specification name and/or number and shall detail in a clear and concise way, the nature and extent of the exception taken.

The City reserves the right to make such investigations it deems necessary to determine the ability of the bidder to perform the work. The bidder shall within seven (7) calendar days furnish to the City all such information and data for this purpose as the City may request. Upon receipt of bids but prior to award, the City reserves the right to inspect all facilities for which the bidder proposes to perform services. The City reserves the right to reject any bid if the evidence submitted by, or investigation of, such bidder fails to satisfy the City that such bidder is properly qualified to carry out the obligations of the agreement and to complete the work contemplated herein.

### **I. SYSTEM INFORMATION:**

The City of Rio Rancho, New Mexico ("Owner" or "City") is soliciting formal bids for an all-inclusive preventive maintenance, inspection, and repair services for the Geothermal System and Heating, Ventilation, and Air Conditioning (HVAC) systems located at City Hall in accordance with the terms, conditions, general requirements, and specifications as set forth in this Invitation for Bids (IFB). The Contractor shall provide all labor, materials, tools, equipment, and parts for total HVAC services, as specified in this IFB.

Rio Rancho's City Hall is located at 3200 Civic Center Circle in Rio Rancho, NM, and is a four story municipal building constructed in 2007 which has 67,670 heated and cooled square feet. This facility utilizes a ground source heat pump system for heating and cooling plus outside air units located on the roof to meet the Uniform Mechanical Code's (UMC) required ventilation rate.

During the design, modifications to the original mechanical system's ground source heat exchange well field design was made which reduced it from 192 boreholes x 200-ft to 171 boreholes x 200-ft. The mechanical system also includes one hundred twenty-seven (127) individual heat pumps to supply heating and cooling to all areas of the facility. The City is seeking a vendor to preform regularly scheduled maintenance and have experienced personnel with these types of systems.

The City had an independent review of the system. The review found that the system was not being properly maintained and thus the system was not operating optimally. Areas of concern

identified by the review found that 12 ground wells, out of 171 were taken off-line around 2016 as a result of failure within the underground piping. Most of the areas are outside of the targeted set point of 72° F by a larger than 2° F variance

Below are some of the issues needing to be addressed:

- Concerns with Seasonal deficiencies including too hot in many areas of the building during the summer and too cold during the winter months.
- Lack of consistent air flow throughout the building or offices.
- Dust blowing into the offices periodically which effects employees and the public whose allergies worsen.
- Noise disturbances (banging pipes or rattling on different floors)

A complete and thorough maintenance cleaning and controls recommission followed by a preventative maintenance care program was recommended in the City's evaluation of the current HVAC system. The list below is not all inclusive, please reference the record set of plans for all equipment. This maintenance phase shall be concurrent with the recommissioning process conducted by others. The City will work with the awarded vendor to determine how often (monthly, quarterly, semi-annually etc.) the following tasks will need to be performed.

**STATEMENT OF SCOPE OF WORK:**

- Replace air filters on all units requiring filtration
- Check that all zones are in correct working order and are functioning as designed.
- Clean all strainers at each location (heat pumps, bag filters, etc.) and re-install
- Check to verify the system contains antifreeze which protects the pumps from freezing and what type of antifreeze is used.
- Determine the control of the high solid content in the cooling water, check the pH level and flush the system to lower the solids and control this in the future through monthly testing of contaminated well fields.
- Clean evaporative coils
- Clean wye strainers
- Adjust motor alignments
- Adjust or replace contactors
- Flush entire system by running the system.
- Examine and clean all strainers and restart system. Flush entire system
- Establish duct work repairs/upgrades to optimize unit performance.
- Calibrate thermostats. If calibration cannot be performed, thermostat will need to be replaced.
- Estimate cost of filter dryer to be installed (Recommended by Huitt-Zollars Report)
- Ensure all Energy Recovery Units (8 total) are running properly. Be sure that all are marked correctly, running in their assigned and perspective areas, the BMS (Building Management System) is communicating with each unit and provide any testing to the units as necessary.

- Water testing of the active well fields shall be the responsibility of the contractor. Testing will need to include processes that add corrosion inhibitors, dispersants, and chemical mixtures to the well fields to help mitigate the fouling within the system. Testing will also need to prove that filtration is improving due to the previously mentioned processes.

## **SYSTEMS:**

**HVAC Systems:** The scope of work required under this IFB shall not be limited to the major HVAC equipment, but shall also include any associated devices and systems that relate to the HVAC system for City Hall as shown and listed in the record set plans. Associated devices and systems shall be taken to include, but is not limited to, the following:

**Heating System:** Pumps, heating coils, steam traps, water strainers, unit heaters, heat exchanger, humidifiers, and general parts for these systems.

**Cooling System:** Air conditioning compressor(s), condensers, chiller tubes, fans, pumps, water chillers, cooling coils, motors, and general parts for these systems.

**Air Handling Systems:** Fans, motors, air grills, plenums, registers, dampers, induction units, mixing boxes, fan coil units, outside air dampers, damper motors, and general parts for these systems.

**Temperature Control:** Thermostats, valves, damper motors, controllers, sensors, pneumatic compressors, time clocks and general parts for these systems.

**Miscellaneous Equipment:** Integrate Control System: Web control software and Automated Logics hardware.

**System Alterations and Equipment Additions:** The scope of work shall include major equipment, associated devices and those system components added after the effective date of the agreement to the existing HVAC systems established hereunder.

**HVAC System Exclusions:** Items that shall be considered excluded include: foundation structural supports, domestic water lines, and outside of air handling equipment room.

### **Preventive Maintenance Service Requirements**

Services shall be performed on the City Hall HVAC systems and equipment as provided below and as generally described under the following definition of Preventive Maintenance Services. Preventive Maintenance consists of pre-scheduled recurring preventive maintenance actions performed on a minimum quarterly basis after award. The awarded contractor shall be required to conduct inspections at the time of performing preventative maintenance on all systems and submit reports to the City's Buildings Maintenance Supervisor. These services are designed to keep maintenance equipment in prime operating

conditions at optimal effectiveness, reliability, and efficiency during peak demand months. The City will work with the awarded vendor to determine how often (monthly, quarterly, semi-annually etc.) the following tasks will need to be performed. The following is the action list representing specific requirements under the contract resulting from this IFB:

- The Contractor shall schedule, perform, and complete an immediate review of the system within 30 days of the executed price agreement. The Preventive Maintenance Service on all the heating and cooling systems shall be completed on a quarterly basis beginning the first month of each quarter (i.e. January, April, July, and October) and after the initial system review/maintenance is completed. The City and Contractor shall agree on the scheduled maintenance days at least 5 working days prior to the work being performed. . A report of the findings and work performed shall be submitted to the City of Rio Rancho within 7 calendar days after completion.
- Motor repair and replacement.
- Examine each piece of equipment and devices to see that it is functioning properly and is in good operating condition.
- Clean all components of dust, old lubricants, etc. to allow the equipment to function as designed.
- Paint all equipment as needed to prevent against corrosion and deterioration.
- Lubricate all equipment where needed, to permit bearings, gears, and all contact wearing points to operate freely and without undue wear.
- Adjust linkages, motors, drivers, etc. that have drifted from initial design settings.
- Calibrate all sensing, monitoring, output, safety, and read-out devices for proper ranges settings, and optimum efficiencies.
- Test and cycle all equipment as a system, after it has been cleaned, lubricated, adjusted, and calibrated, to see that it is in good condition and at peak efficiency.
- All cooling/heating air filters shall be replaced.

#### **Repair Service Requirements:**

**Minor Repairs:** Minor repairs may be but are not limited to tasks performed during preventative maintenance inspection(s) on an as needed basis such as minor disassembly, and removal and replacement, and/or repair of HVAC system components and accessories. All minor repairs shall be performed at the expense of the Contractor. Delivery times for minor repair services shall be within 2 hours upon notification, and shall be documented in writing on the quarterly maintenance report.

If after the routine preventative maintenance inspection a unit fails or is inoperable, the City will contact the awarded contractor to evaluate and provide a printed diagnostic report of the non-functioning unit to determine if the repair is a minor repair or major repair as defined in the General Information and Specifications.

*Parts Replacement:* Unless otherwise agreed upon in writing by the City, all parts, components, associated devices and accessories for HVAC systems that are worn or are not in proper operational condition, shall be repaired, and/or replaced with new

parts, components, associated devices and accessories. When equipment or parts are replaced in their entirety, and if a new design of this device is available and is functional equivalent and compatible the device of the newer design shall be used as the replacement. All repair and replacement parts, components, and the devices shall be at the expense of the Contractor. Unless otherwise agreed upon in writing by the City, replacement of worn or damaged equipment and parts must be completed within one (1) to two (2) weeks of time when damage is discovered by either City or Contractor.

**Major Repairs:** Major repairs that require new equipment, due to being obsolete or no longer serviceable, shall be purchased either by the City or Contractor based on best value to the City. The Contractor shall submit an itemized quote and schedule for the major repairs for approval by the City within 5 calendar days of being notified that a quote is required.

**Emergency Service and Repairs:** Emergency service and repairs consist of unscheduled service and/or repair, including diagnostic service, performed in response to a request by the City's Buildings & Fleet Division Manager or Building Maintenance Supervisor. Emergency service and repair shall be available seven (7) days a week, twenty four (24) hours a day. Contractor shall respond promptly to requests for emergency service; emergency response time shall not exceed two (2) hours. The Contractor shall provide the City with a quote for services and repairs within 24 hours of the problem being identified and notice to the Contractor is made. Repair quote shall be approved by the City before providing services. The City will approve work and provide a purchase order to enable the Contractor to proceed with services. Delivery times for emergency service and repair shall be established for each emergency service and repair via mutual agreement between the Contractor(s) and the City, and shall be documented in writing.

### **Maintenance Procedures and Records:**

The Contractor is responsible for the means and methods to achieve the goals and required outcomes of the resulting contract.

The required preventative maintenance report will be provided by the awarded Contractor within a month of Notice to Proceed and quarterly thereafter. These reports shall be provided to the City within 7 calendar days of the completion of the preventative maintenance inspection. If reports are not submitted to the City, payment will be withheld until reports are submitted.

During the course of the service program, the Contractor shall advise and assist the City of Rio Rancho to conserve energy and minimize utility expenditures

The Contractor shall provide the Building Maintenance Supervisor with all Safety Data Sheets (SDS) for materials used at all City locations.

**Environmental Health and Safety:**

Contractor shall conduct its operations in compliance with all environmental health and safety regulations.

**II. MISCELLANEOUS GENERAL REQUIREMENTS****Miscellaneous General Requirements:**

The City reserves the right to request quotations from the Contractor for materials, products, and/or items similar in nature to those specified in this IFB for which requirements were not known when this IFB was issued. Additions, deletions and/or contract modifications of any kind shall not be effective until accepted in writing by the City's Procurement Officer, or his designee. Any contract resulting from this IFB shall not be considered a requirements contract. The City does not surrender its right to purchase the products specified herein from other sources. Regardless of the award of Contract hereunder, the City retains the right to purchase the same of similar materials or items from other sources should it be determined that doing so would be in the City's best interest, based on cost, quality, and other considerations; however, in such event, Contractor may be given the first option of meeting or rejecting the proposed alternate source's lower price of higher quality.

The City's Building Maintenance Section shall be notified of any units that are taken out of service prior to them being turned off. Units that are placed out of service shall be explained by the awarded contractor, and solutions for repair including repair times provided.

**Invoicing and Payments:**

Invoices shall include copies of all purchases for parts and materials, including vendor and date purchased. Invoices for maintenance and repairs outside of the general maintenance required shall include copies of all purchases for parts and materials, discounts shall be clearly identified, include vendor information and date purchased. Services shall be authorized through issue of a Purchase Order by the City, and shall be executed by work and payment procedures prescribed by the general conditions and technical specifications. In cases of emergency the City will issue written authorization for the work without cost estimates.

Invoicing for the awarded contract for general maintenance will be billed monthly in lump sum amounts. This is the total bid amount divided into 12 payments. Monthly invoices will be paid by the city within 30 days of receipt. Monthly invoicing will need to accompany a report of all completed repairs to City Hall for the billed month. This shall include any and all work performed.

## TERMS AND CONDITIONS

**Agency:** In the event that a bid or contract is signed by an agent, the City reserves the right to require evidence of the agent's authority.

**Cited Model:** Any model(s) cited herein is (are) intended only as a reference; any model offered must meet all of the technical specifications accompanying this IFB.

**City Business Registration Requirement:** The successful bidder, if not already registered to engage in business in the City of Rio Rancho, shall be required to apply to the City and pay the business registration fee, as stipulated in City Code §§ 14-2-1 through 14-2-9, prior to receiving a contract under this Bid.

**Compensation:** The Bidder *will not* receive any compensation until goods have been delivered or services have been completed, final inspection has been made, the work has been accepted by an authorized representative of the City and complete and correct invoices have been received by the City following the invoicing process detailed on the issued purchase order. Progress payments *will not* be made to any contractor unless otherwise specified in this IFB.

**Contract Period:** Unless sooner terminated a contract resulting from this IFB shall be for a term of one (1) year from the date of issue of the City's award letter with option to renew for three (3) additional one (1) year terms. In no case shall the term of this agreement exceed a term of four (4) years from the date of issue of the award letter.

**Responsibility for Damage:** The successful Bidder shall be responsible for any damage caused by its delivery, removal or installation. Damage shall be reported immediately to the designated City representative.

**Delivery, Unpacking, Assembly and Placement:** Any offer in response to this IFB must include delivery, unpacking, assembly and placement of items as specified in this IFB. All costs associated with Delivery, Unpacking, Assembly and Placement must be included as a part of the unit price bid for each item.

**Design Conformance - OSHA:** The design of all equipment purchased as a result of a bid made in response to this IFB shall be in conformance with all applicable regulations of the federal Occupational Safety and Health Act in effect at the time of delivery.

**Estimated Quantities; Not an Order:** The estimated quantities listed do not constitute an order and are not necessarily comprehensive; they are a representative sample of what is likely to be purchased during the course of a contract resulting from this IFB and will be used only to evaluate offers and award such a contract. These quantities as stated may increase or decrease depending on the actual needs of the City. The user will place actual orders. The terms of this Agreement and all amounts payable hereunder are contingent upon sufficient appropriations therefor by the City's Governing Body. If sufficient appropriations are not made, the City shall notify the Contractor of the same, and this Agreement shall terminate forthwith.

**Freight and Shipping:** Freight will be F.O.B. Destination. F.O.B. point other than indicated by the City will not be acceptable.

**Guaranteed Performance:** The successful bidder guarantees that the materials and/or items supplied are capable of the performance required in the specifications accompanying this IFB, and agrees to make such changes, adjustments or replacements as may be necessary in order for the materials to meet the specification requirements at no cost to the City. If defects or specification failures are discovered, the Procurement Officer may, notwithstanding acceptance and payment, require the unit(s) or item(s) to be properly furnished in accordance with the specifications and drawings at the sole cost and expense of the bidder or the bidder's surety.

**Independent Contractor:** The Contractor (and each agent, employee and contractor employed or engaged by the Contractor to fulfill the Contractor's obligations hereunder) shall be an independent contractor performing services for the City and not an employee of the City or an agent of the City for any purpose beyond the specific engagement for services set forth herein. As independent contractors, the Contractor and its agents and employees shall not qualify for or receive any employee benefits from the City, including but not limited to leave, retirement, insurance, bonding, use of City vehicles, or any other benefits afforded to City employees.

**Inspection of Materials:** The City reserves the right to inspect materials and/or items provided by the Bidder through a contract resulting from this IFB to determine their quality, fitness and suitability. Inspection of these materials may be conducted whenever the City considers necessary.

**Liability Insurance:** The successful bidder shall obtain and maintain during the life of any contract resulting from this IFB a comprehensive general liability insurance policy and automobile liability coverage with liability limits in amounts not less than Five Hundred Thousand Dollars (\$500,000) combined single limit of liability for bodily injury, including death, and property damage in any one occurrence. If required coverages are provided by separate policies, each policy shall have the liability limits required above. Such policy(ies) shall include coverage for all of contractor's operations performed for the City, coverage for the use of all owned, non-owned and hired automobiles, vehicles and other equipment, both on- and off-site, and contractual liability coverage that specifically insures the contractor for any liability arising from its indemnification obligations under the contract resulting from this IFB. Prior to commencing any work under the contract, the contractor shall provide the City's purchasing office one or more certificates of insurance demonstrating the contractor's fulfillment of the foregoing insurance requirements. The contractor shall require the same insurance coverages and endorsements from each subcontractor engaged by the contractor to fulfill any of its obligations under the contract resulting from this IFB. The City shall be named an additional insured in each such policy maintained in satisfaction of the foregoing requirements.

All insurance policies maintained in satisfaction of the foregoing requirements shall provide that the City's purchasing office be given thirty (30) calendar days prior written notice before the policy is canceled, materially changed, or not renewed. Neither the City's approval, nor failure to disapprove, any policies or evidence of insurance shall relieve the Contractor or any subcontractor(s) of full responsibility for maintaining the required insurance in full force and effect for as long as required by the contract.

**Worker's Compensation Insurance:** The Bidder, if awarded a contract as a result of this IFB, shall comply with the provisions of the Worker's Compensation Act, Subsequent Injury Act, and the New Mexico Occupational Disease Disablement Law. The Bidder shall obtain and maintain complete Workers and Employee's Liability Insurance in accordance with New Mexico law and regulations during the life of any contract resulting from this IFB. In the event that the Bidder is not required by law to obtain Worker's Compensation Insurance, the bidder shall provide a certified statement attesting that the Bidder will obtain such coverage should the Bidder, in the course of any contract resulting from this IFB, be required by law to do so. If any portion of the work is to be sublet, the Bidder as primary contractor, shall require the subcontractor(s) to provide the same coverage for all employees working under this contract. The City, its officers or employees, will not be responsible for any claims or actions resulting from the failure of the Bidder or any subcontractor to comply with the provisions of this paragraph.

**Laws and Regulations:** The Bidder shall give all notices and comply with all laws, ordinances, rules and regulations that apply to this work. The Bidder shall obtain and pay for all permits and licenses necessary to execute and complete the work. All required licenses must be in force at the time of submission of a bid and remain in force during the entire period of any contract resulting from this IFB. Failure to provide proof of required licenses in force will result in the offer being judged non-responsive.

**Non-exclusivity:** The City reserves the right to engage other contractors to perform services described herein, and the Contractor likewise may provide the same services to other clients; provided, however, the Contractor shall devote reasonable time and effort to any task undertaken hereunder.

**Materials and Workmanship:** All materials and/or workmanship furnished by the Bidder shall be free from defects and imperfections. Workmanship shall be in accord with the best industry standards and practices. Both materials and workmanship shall be subject to the approval of the City.

**Price Escalation:** If the Bidder does not offer a firm price, or if a bid contains an escalation clause, the offer may be considered only under the following conditions:

- a. Offered prices must be firm for at least one (1) year after written notification of award of a contract.
- b. All price increases shall be accompanied by a certified letter from the Bidder's supplier showing the price increase to the Bidder.
- c. All invoices of the offered items, from suppliers to the Bidder, shall be subject to auditing by the City and furnished without delay upon request.
- d. The City reserves the right to cancel a contract resulting from this IFB and solicit a new contract if the escalated price is above the current open market price for the same commodity. Cancellation of the contract shall not affect any outstanding orders.
- e. All revisions of the price list shall become effective when they are received, in writing, and accepted, by the Purchasing Office of the City, provided that they do not conflict with item (f.) of this paragraph.

- f. All approved price changes resulting from this escalation clause shall be firm for a period of one (1) year after acceptance in writing by the City.
- g. The Bidder shall be limited to a maximum of one (1) price escalations per contract period unless otherwise specified in this IFB.
- h. The Bidder shall provide to the City written notice of any requested price changes at least sixty (60) calendar days prior to those changes taking effect.
- i. If the Bidder receives any price de-escalations from the supplier of goods sold to the City through a contract resulting from this IFB, the Bidder is responsible for notifying the City within twenty-four (24) hours of such de-escalations, and passing those price changes on to the City immediately.
- j. No price increases shall exceed 10% of the existing contract price.

**Release/Indemnity:** By its receipt of final payment of all amounts due under this Agreement, the Contractor shall release the City, and its officers and employees, from all liabilities, claims, and obligations whatsoever, arising from or under this Agreement. The Contractor shall indemnify and defend the City and hold the City harmless for and from any and every claim, action, liability, loss, damage or suit, arising from the fault of the Contractor in performing (or omitting to perform) services hereunder.

**Removing Debris and Cleaning the Area:** The Bidder shall, during the progress of the work, remove and dispose of all debris and keep the premises clean and safe. When the work is complete, the Bidder shall remove all construction equipment and surplus material (except materials that are to remain the property of the City as provided in the specifications) and leave the premises in a clean condition satisfactory to the City.

**Risks:** All risk of deterioration, destruction, and loss of materials and equipment stored at the site of the work shall be borne by the Bidder.

**Service Facilities:** The Bidder, upon submitting a bid in response to this IFB, must have service facilities, which are, in the opinion of the City, adequate to perform the services specified in this IFB. The City reserves the right to inspect and determine if the facilities meet this requirement. The final determination of satisfaction of this requirement rests with the City.

**Shelf Life of Merchandise:** the City shall compute Shelf life from the time of delivery to and acceptance.

**Site Inspection:** all Bidders are required to conduct an on-site inspection. Failure by the Bidder to become acquainted with the conditions affecting the work specified in this IFB shall not constitute relief from responsibility for estimating properly the difficulty or cost of successfully performing the work. The Bidder shall be responsible for any excess costs resulting from failure to estimate accurately. Failure to conduct an on-site inspection may result in the rejection of a bid.

**Sub-Contracting Services, Disallowed and Approval:** All services provided as a result of this IFB must be performed by the Bidder to whom the contract is awarded. No subcontracting shall be allowed unless approved in writing from the City.

**Termination:** Either party may terminate this contract upon written notice to the other at least thirty (30) calendar days in advance of the date of termination.

**Title:** Title to all items of tangible personal property, services and construction provided pursuant to a contract resulting from this IFB shall pass to the City at the time of payment free and clear of all liens, claims, security interests and encumbrances.

**Use of Agreement:** This Price Agreement may be utilized by any State of New Mexico Agencies, Commissions, Institutions, Political, Sub-divisions and Local Bodies allowed by law.

**Working Conditions:** The City is not responsible for obstacles, unfavorable conditions, or hazards, which may be encountered by the Bidder, either above or below ground. These conditions are part of the risk and responsibility of the Bidder.

**Work Site Damages:** Any damages to existing utilities, equipment or finished surfaces resulting from the performance of this contract shall be repaired to the Owner's satisfaction at the Contractor's expense.

CITY OF RIO RANCHO  
STATE OF NEW MEXICO



PURCHASING DIVISION  
3200 Civic Center Circle NE - Suite 300  
Rio Rancho, NM 87144

INVITES YOUR FIRM TO OFFER A BID ON:

**IFB 21-BM-009**  
**GEOHERMAL AND HVAC MAINTENANCE AND REPAIR**  
**SERVICES FOR CITY HALL**

AS SPECIFIED IN THE ATTACHED BID DOCUMENTS.

**Sealed bids will be received until 11:00 AM Local Mountain Time**  
**on Thursday, October 1 2020**

By the  
Email: [mschimmel@rrnm.gov](mailto:mschimmel@rrnm.gov)  
Mailed Originals: City of Rio Rancho  
Office of the City Clerk  
1st Floor, Room # 150  
3200 Civic Center Circle NE  
Rio Rancho, NM

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NAME OF BIDDER/CONTRACTOR

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ADDRESS

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CITY, STATE ZIP CODE

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TELEPHONE

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FAX

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EMAIL

Complete this form as well as the following forms in their entirety as specified in the Instruction to Bidders to ensure that your bid submission is complete.

**BID PROPOSAL**

Prices shall include all costs associated with the performance of the services specified, including materials, supervision, labor, insurance, transportation, delivery, fuel or other surcharges, and related costs. **No other charges shall be allowed unless approved by the City in advance.**

In compliance with all Specifications and Terms and Conditions, as stated and incorporated herein, the undersigned offers and agrees, if this bid is accepted by the City of Rio Rancho within ninety (90) calendar days or as otherwise provided for in this IFB, to furnish the following items of tangible personal property and/or perform the services specified for the stated unit prices, as determined below:

Provide pricing **excluding** applicable taxes.

Total Annual Price for Maintenance	\$
Lump Sum Monthly Preventative Maintenance Price	\$

Additional Pricing

Journeyman – Hourly Rate - Regular Hours	\$
Journeyman – Hourly Rate – 5 pm to 8 am	\$
Journeyman – Hourly Rate – Weekend rate	\$
Journeyman – Hourly Rate – Holiday rate	\$

Apprentice – Hourly Rate - Regular Hours	\$
Apprentice – Hourly Rate – 5 pm to 8 am	\$
Apprentice – Hourly Rate – Weekend rate	\$
Apprentice – Hourly Rate – Holiday rate	\$

Discount given off all retail parts and materials:	%
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**Warranty**

Parts		Labor	
Time	Months	Time	Months

Provide applicable tax rate: \_\_\_\_\_

Bidder shall acknowledge receipt of Addenda (if any) by initialing next to the number of each Addendum received.

Addendum No. \_\_\_\_\_ Date \_\_\_\_\_ Addendum No. \_\_\_\_\_ Date \_\_\_\_\_  
 Addendum No. \_\_\_\_\_ Date \_\_\_\_\_ Addendum No. \_\_\_\_\_ Date \_\_\_\_\_  
 Addendum No. \_\_\_\_\_ Date \_\_\_\_\_ Addendum No. \_\_\_\_\_ Date \_\_\_\_\_

Exceptions to the Specifications:

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This Bid is hereby respectfully submitted by:

\_\_\_\_\_  
Name of BIDDER

\_\_\_\_\_  
Federal Tax ID Number

\_\_\_\_\_  
Printed Name

\_\_\_\_\_  
Authorized Signature

\_\_\_\_\_  
Title

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Date

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Bidder's Mailing Address

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Bidder's NM Contractor's License  
Number(s) and Classifications(s)

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Additional Address Information

---

City, State, Zip Code

---

Contractor's Department of Labor  
Registration Number

---

Bidder's Telephone Number

---

Bidder's Fax Number

---

New Mexico State Corporation  
Commission Number

---

Bidder's E-Mail Address

---

Bidder's Gross Receipts Tax No.

---

Bidder's Data Universal Numbering System (DUNS) No.

**LOCAL/AREA/RESIDENT/RESIDENT VETERAN/RECYCLED CONTENT GOODS PREFERENCE  
CERTIFICATION FORM**

Business Name: \_\_\_\_\_

Principle Place of Business: \_\_\_\_\_

Address: \_\_\_\_\_

State: \_\_\_\_\_

Zip Code: \_\_\_\_\_

**DEFINITIONS:**

Recycled content goods has the meaning set forth in NMSA 1978 § 13-1-21(A)(6) , as amended from time to time.

RESIDENT BUSINESS has the meaning set forth in NMSA 1978 § 13-1-21(A)(5) , as amended from time to time.

RESIDENT CONTRACTOR has the meaning set forth in NMSA 1978 § 13-4-2(A)(5) , as amended from time to time.

RESIDENT VETERAN BUSINESS has the meaning set forth in NMSA 1978 § 13-1-21(A)(7), as amended from time to time.

RESIDENT VETERAN CONTRACTOR has the meaning set forth in NMSA 1978 § 13-4-2(A)(6), as amended from time to time.

STATUTORY PREFERENCE means the preference for Resident Businesses, Resident Contractors, Resident Veteran Businesses, Resident Veteran Contractors, and Recycled Content Goods provided in NMSA 1978 §§ 13-1-21 or 13-4-5, as amended from time to time.

Qualifying company means a company that qualifies for a Statutory Preference under NMSA 1978 §§ 13-1-21 or 13-4-5, as amended from time to time.

LOCAL BUSINESS means a Resident Business or Resident Contractor which:

- (a) Is authorized to do and is doing business under the laws of the State of New Mexico;
- (b) Possesses a current city business registration;
- (c) Maintains its principal place of business within the corporate limits of the city; and
- (d) Agrees to furnish evidence, in a form suitable to the city, of its payment of New Mexico Gross Receipts Tax.

AREA BUSINESS means a Resident Business or Resident Contractor which:

- (a) Is authorized to do and is doing business under the laws of the State of New Mexico;
- (b) Possesses a current city business registration;
- (c) Maintains a bona fide place of business within the corporate limits of the city, and agrees to conduct its activities pursuant to the contract for which it is bidding or proposing, to the extent practicable, from that place of business; and
- (d) Agrees to furnish evidence, in a form suitable to the city, of its payment of New Mexico Gross Receipts Tax.

No bid or proposal shall receive both the Local Business and Area Business preferences.

**INSTRUCTIONS:**

In all invitations for bid and requests for proposals, the Statutory Preferences shall be applied in the manner set forth in NMSA 1978 §§ 13-1-21 or 13-4-5, as amended from time to time.

In addition to the Statutory Preferences, a preference for Local Businesses and Area Businesses shall be administered in the same manner as the Statutory Preferences, as follows:

- (1) in the event a Local Business submits a qualifying bid or proposal and one or more Qualifying Companies also submits a bid or proposal, the Local Business shall receive a two percent (2%) preference in addition to (and not in lieu of) the Statutory Preference; and
- (2) in the event an Area Business submits a qualifying bid or proposal and one or more Qualifying Companies also submits a bid or proposal, the Area Business shall receive a one percent (1%) preference in addition to (and not in lieu of) the Statutory Preference.

No bid or proposal shall receive both the Local Business and Area Business preferences.

In addition to the definitions and criteria set forth in this section, the central purchasing office may impose additional requirements regarding the nature, size and/or location of offerors or bidders in any request for proposals or invitation for bids. As a result, companies responding to such solicitations should review the solicitation documents thoroughly.

**A COPY OF A RESIDENT BUSINESS OR CONTRACTOR / VETERAN BUSINESS OR CONTRACTOR CERTIFICATE ISSUED BY THE NEW MEXICO TAXATION AND REVENUE DEPARTMENT IS REQUIRED TO BE SUBMITTED ALONG WITH YOUR BID / OFFER IN ORDER TO QUALIFY FOR THE STATUTORY RESIDENT / VETERAN PREFERENCE. In addition, the attached Resident Veterans Preference Certification form must accompany any bid/offer and any business wishing to receive a resident veteran's preference must complete and sign the form.**

**REQUESTS FOR RECYCLED CONTENT GOODS PREFERENCE MUST BE ACCOMPANIED BY OFFICIAL / VERIFIABLE EVIDENCE THAT THE MATERIAL BEING BID / OFFERED CONTAINS THE MINIMUM RECYCLED CONTENT REQUIRED BY STATE STATUE.**

**THIS FORM MUST BE SUBMITTED AT THE TIME BIDS / OFFERS IN ORDER TO CLAIM LOCAL, AREA, RESIDENT, VETERAN OR RECYCLED CONTENT GOODS PREFERENCE.**

PLEASE INDICATE THE TYPE OF PREFERENCE CLAIMED:

If your firm is a Qualifying Company please circle the type of preference for which your firm qualifies and indicate your appropriate annual revenue threshold:

RECYCLED CONTENT GOODS

RESIDENT BUSINESS

RESIDENT CONTRACTOR

RECYCLED CONTENT GOODS RESIDENT VETERAN BUSINESS

- Annual revenue up to \$3,000,000.00
- Annual revenue more than \$3,000,000.00 or more

RESIDENT VETERAN BUSINESS

- Annual revenue up to \$3,000,000.00
- Annual revenue more than \$3,000,000.00 or more

**RESIDENT VETERAN CONTRACTOR**

- Annual revenue up to \$3,000,000.00
- Annual revenue more than \$3,000,000.00 or more

If your firm is applying for either a Local or Area Preference, please circle the type of preference for which your firm qualifies. (Select only one):

LOCAL BUSINESS

AREA BUSINESS

CITY OF RIO RANCHO BUSINESS LICENSE REGISTRATION NUMBER: \_\_\_\_\_  
(Must be provided if claiming Local Business or Area Business Preference)

If submitting a joint bid/proposal please indicated proportion of work to be completed by qualifying company:

\_\_\_\_\_ %

**CERTIFICATION:** I hereby certify that the information which I have provided on this form is true and correct, that I am authorized to sign on behalf of the business set out above and if requested by the City will provide, within 10 days of notice, the necessary documents to substantiate the information provided on this form.

By: \_\_\_\_\_ Title: \_\_\_\_\_ Date: \_\_\_\_\_

**RESIDENT VETERANS PREFERENCE CERTIFICATION**

\_\_\_\_\_ (NAME OF CONTRACTOR)  
hereby certifies the following in regard to application of the resident veterans' preference to this procurement:

**Please check one box only:**

- I declare under penalty of perjury that my business prior year revenue starting January 1 ending December 31 is less than \$3M allowing me the 10% preference discount on this solicitation. I understand that knowingly giving false or misleading information about this fact constitutes a crime.
- I declare under penalty of perjury that my business prior year revenue starting January 1 ending December 31 is more than \$3M.

"I agree to submit a report, or reports, to the State Purchasing Division of the General Services Department declaring under penalty of perjury that during the last calendar year starting January 1 and ending on December 31, the following to be true and accurate:

"In conjunction with this procurement and the requirements of this business' application for a Resident Veteran Business Preference/Resident Veteran Contractor Preference under Sections 13-1-21 or 13-1-22 NMSA 1978, when awarded a contract which was on the basis of having such veterans preference, I agree to report to the State Purchasing Division of the General Services Department the awarded amount involved. I will indicate in the report the award amount as a purchase from a public body or as a public works contract from a public body as the case may be.

"I understand that knowingly giving false or misleading information on this report constitutes a crime."

I declare under penalty of perjury that this statement is true to the best of my knowledge. I understand that giving false or misleading statements about material fact regarding this matter constitutes a crime.

_____ Signature of Business Representative	_____ Date
---	---------------

\*Must be an authorized signatory for the Business.

The representations made in checking the boxes constitutes a material representation by the business that is subject to protest and may result in denial of an award or unaward of the procurement involved if the statements are proven to be incorrect.

# HEATING, VENTILATION AND AIR CONDITIONING ASSESSMENT

City of Rio Rancho  
IEB 21-PW-009  
Attachment 1

Prepared For



**Project Location:**

3200 Civic Center Circle NE  
Rio Rancho, NM 87144

August 05, 2019



Prepared By

## HUITT-ZOLIARS

ENGINEERING ARCHITECTURE CONSTRUCTION MANAGEMENT SURVEY

333 Rio Rancho Blvd. NE, Suite 101  
Rio Rancho, NM 87124  
(505) 892-5141, Fax (505) 892-3259  
[www.huitt-zollars.com](http://www.huitt-zollars.com)

in conjunction with:



# HEATING, VENTILATION AND AIR CONDITIONING ASSESSMENT STUDY FOR CITY HALL

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## Executive Summary

### Background and Project Team

This Condition Assessment Report was to determine the condition of the heating, ventilation and air conditioning (HVAC) systems for Rio Rancho's City Hall located at 3200 Civic Center Circle in Rio Rancho, NM. This four story municipal building, constructed in 2007, is approximately 67,670 heated and cooled square feet. The facility utilizes a ground source heat pump system for heating and cooling plus outside air units located on the roof to meet the Uniform Mechanical Code's (UMC) required ventilation rate.

Value engineering reduced the original mechanical system's ground source heat exchange well field design from 192 boreholes x 200-feet to 171 boreholes x 200-feet. The mechanical system also included one-hundred twenty-seven (127) individual heat pumps to supply heating and cooling to all areas of the facility. This type of mechanical system requires regularly scheduled maintenance by personnel with significant experience on similar systems. This does not appear to have occurred.

The Project Team includes City of Rio Rancho Public Works Department, Huitt-Zollars for Project Management, Yearout Mechanical for evaluation of interior mechanical units, and Major Geothermal for evaluation of the ground source heat exchange well field. Project team engineers and technicians reviewed as-built documents and maintenance records, interviewed building occupants, and maintenance personnel as part of the study.

### Findings

Twelve (12) ground source wells, out of 171, were taken off-line in approximately 2016 as a result of failure within the underground piping.

The functioning mechanical equipment appears to be in very poor maintenance condition. Most of the areas are outside of the targeted set point of 72°F by an amount larger than the set 2°F variance. This is caused by a variety of reasons such as un-calibrated thermostats, inoperable communications between thermostats and controls system, lack of preventative maintenance care, and misaligned ductwork. Some ductwork realignment has occurred causing some of the ground source heat pumps to be distributing to areas much too large or too small for its capacity. Lack of proper maintenance and further reduction in operating ground source wells has resulted in the system operating at less than optimum and has yielded some areas of the building that is either too hot or too cold.

### Recommendations

**First**, it is recommended that a full maintenance cleaning and controls recommission be performed by a mechanical contractor with adequate depth and knowledge of similar systems. This should be followed by a semi-annual maintenance care program targeted at cleaning evaporative coils, cleaning wye strainers, changing filters, adjusting motors, and calibrating thermostats and controls. **Second**, establish the well field to the as-built condition. **Third**, add additional wells to the field to restore original design intent.

Implementing these recommendations will improve City Hall's HVAC system performance and provide long term operational cost savings.

## I. INTRODUCTION

### Purpose

The purpose of this study is to provide a review of the current City Hall Heating, Ventilation, and Air Condition (HVAC) system and make recommendations for improving and restoring system performance, including an estimated probable cost of construction.



The facility is an approximately 67,670 square foot, 4-story building with an atrium consisting of administrative offices for the City of Rio Rancho. The building was designed in 2006. The Architect of Record is The Design Group and the Mechanical/Electrical Engineer of Record is Bridgers and Paxton. Gerald Martin, Ltd was the facility's general contractor who broke ground in June 2006 and was substantially complete in March 2007. National Heating and Ventilating Company was the Mechanical Contractor. The facilities heating and cooling systems have performed less than optimal over the last several years. Above average temperatures were experienced the last week of June 2018 and the third week of July 2018 when it was observed by building occupants on each floor that the facility's ambient temperatures were too hot for productive work.

### Authorization

Authorization for this Condition Assessment is provided in a contract between the City of Rio Rancho (City of Rio Rancho) and Huitt-Zollars, Inc. (HZ) entitled "City Hall HVAC System Improvements," City of Rio Rancho Purchase Order Number 190716.

### Scope

This work assignment was for assistance in developing an evaluation of the existing HVAC system and scope recommendations to include estimated costs for purposes of programming phased system improvements. The project was divided into five separate tasks including:

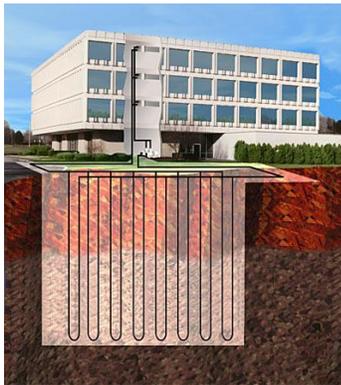
- **Task 1:** Review Existing Documents and Reports

- **Task 2:** Conduct a Site Visit and Inventory Existing Conditions (system layout, zoning, controls, and balancing)
- **Task 3:** Interview Building Occupants
- **Task 4:** Evaluate existing HVAC system and develop a program document for phased construction.
- **Task 5:** Assist with development of RFP documents.

Preparation of construction drawings is not included with this scope of work.

## City Hall

The building uses a ground source heat pump system to heat and cool the facility with outside air units located on the roof to meet the



Uniform Mechanical Code's (UMC) required ventilation rate. The ventilation units are not connected directly to the ground source heat pump units but use a plenum type system. The system as designed required 192 wells located in the parking lot. The construction base bid consisted of 171 wells at 200-foot deep.



Responsive bidders were required to submit unit pricing to deepen each well and install additional wells to the well field. Record Information indicates that 171 wells were installed to a depth of 200-feet. The design intent for the ground source heat pump was to provide a total of 170 tons of cooling for the building. It appears that all but two wells within loop A and nineteen wells within Loop B were installed, as shown in Appendix C – Record Drawings. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) principles generally recommend that each well provide approximately 1-ton of cooling, which corresponds with the number of wells installed. The well manifold is located in the building's mechanical room along with the main pumps and the system control panel.

The HVAC building controls system is an AutomatedLogic platform developed by United Technologies. The controls system manages the 127 heat pumps located on the building's four floors. The units are spread through the four (4) floors as follows:

- Ground Floor: 43 units
- Second Floor: 36 units
- Third Floor: 25 units
- Fourth Floor: 23 units

## II. INVESTIGATION

### Site Visits

**A.** An initial site visit occurred on February 24, 2019 and the following is a list of key component observations and overall system status / alerts:

- The well manifold is located within the building's mechanical room along with the main pumps.
- A chemical feed in the water side of the ground source heat pump has been installed (after facility construction and not part of the construction design plans) within the well manifold. The chemical feed equipment was installed in attempt to reduce the high solids content within the heating/cooling water. As part of this study water samples supplied by the City of Rio Rancho were submitted to Industrial Water Engineering (IWE) for analysis. High solids content remains a problem as indicated in the IWE analysis included as Appendix D.
- The system was in alarm at the time of site visit due unit heat pump failures.
- One section of the well field manifold that was shutdown due to a leak discovered by previous maintenance personnel. This section of well field is designated as #15 and contains 12 ground source heat pump wells. The leak was originally identified in 2010.
- As a sanity check, a block load calculation of the building using the Trane 'Trace' computer program indicates the building requires 177 tons of cooling. The design intent provided 170 tons of cooling which seems reasonable. Currently the system is not operating at the original design level and is providing less than the 170 tons of cooling.

**B.** A second site visit occurred on March 12, 2019 with personnel from AutomatedLogic and Rio Rancho. The following conditions and observations were made:

- The team noted the system does not have any trending data for the operation of the heat pumps. This is an action item to be corrected by the City of Rio Rancho for future system monitoring operations.
- The team visually evaluated several units on each floor and witnessed that some were in alarm. The alarms were attributable to inadequate air temperatures or in several cases the units were not operational.
- The team requested information but never received the following additional information from AutomatedLogic:
  - Trend data for the heat pump water loop temperatures;

- Trend data for five (5) heat pumps throughout the facility
  - Trend data for the outside air units.
- 
- It was noted that AutomatedLogic maintenance staff does not have adequate access to the AutomatedLogic system.
  - The team also inspected several ground source heat pumps on the second floor which were in alarm during the first inspection. The units were still in alarm and the team requested trend data for the heat pump water loop temperatures, 4 or 5 heat pumps throughout the facility and the outside air units.
  - AutomatedLogic Control maintenance staff did not provide access to the AutomatedLogic system at the time of this report.
- C. A third site visit occurred on May 7, 2019 by Yearout Mechanical personnel who inventoried all 127 units. Yearout's report is included in Appendix A and includes inspection of each unit.

## Employee Interviews

As part of this analysis, our Project Team conducted several random interviews with City of Rio Rancho employees to better understand the complaints / deficiencies of the existing system. These interviews were conducted to assist with determining if the system is experiencing seasonal overloads or if the system in general does not meet the HVAC requirements for proper heating and cooling. These interviews included meeting with building occupants on all floors and at various locations / sides of the building. The most common complaints received regardless of floor or office location included:

- Seasonal operation issues. Hot during the summer and cold during the winter
- Lack of consistent airflow
- Dust blows into the offices periodically
- Allergies seem to worsen once in the building
- Noise disturbances
- Having to work around temporary HVAC units for heating and cooling.

### III. RECORDS REVIEW

#### Documents

- A. Our Project Team reviewed and analyzed existing drawings, documents, and reports including the following:
- Rio Rancho City Hall “As-Built” Construction Plans not dated prepared by The Design Group and Record Drawings.
  - HVAC Operations & Maintenance Manual for Rio Rancho City Hall City Centre dated July 31, 2007 by Gerald Martin.
  - Trending Data Report for Rio Rancho City Hall dated January 25, 2008 prepared by Integrated Control Systems, Inc.
  - Point to Point Report for Rio Rancho City Hall dated January 25, 2008 prepared by Integrated Control Systems, Inc.
  - Review of construction shop drawings.
  - Review of the equipment submittals.

#### Findings

- A. Our Project Team draws the reviews attention to notable document findings:
- A review of the record drawings notes one line of wells (12 in all) crossed out as if not installed.
  - We have reviewed the original design including the schematic adding a future cooling tower.

### IV. WELL FIELD ANALYSIS

Major Geothermal, a Denver based geothermal firm, has assessed the integrity of the closed loop ground heat exchange system and their report is included as Appendix B. The ground source heat pump equipment appears to have experienced several service issues related to strainer contamination and possibly entering water temperate ranges not compatible with unit operation. Re-flushing and purging of both the interior hydronic system and the ground heat exchange may be required, with the addition of an intermediate filtration plant. Routine pH testing and resulting biocide and/or corrosion inhibitor adjustments could further improve system performance and reduce maintenance from nuisance lockouts due to fouled hydronic water.

The controls sequence of operation for the bypass portion of the hydronic piping could be reset for making better use of the extended range ground source heat pump units, potentially reducing some operating cost related to pump power reduction.

For extended range use of the heat pumps it should be verified if antifreeze is used in the system. This should be considered if currently not used to protect the heat pumps and the controls are reset to extended range to take advantage of using a wider entering water temperature range.

Functional testing by random sampling of heat pumps from the hydronic side could verify representative system health and aid in more definitive troubleshooting efforts.

Correlating past maintenance and service issues with frequency and type of problems with specific areas of the building might suggest some areas are more problematic than others, where more detailed diagnostics might be warranted.

## V. WATER ANALYSIS

In November 2018, as part of our analysis and to better understand the overall system conditions, we contracted with an independent firm specializing in industrial water applications. Industrial Water Engineering collected water samples from the closed loop system and performed a chemical and physical analysis. The full water analysis is illustrated in Appendix D and summarized below:

### WATER ANALYSIS

	Reported As	Ground Source Loop Mg/L
<b>Total Hardness</b>	CaCO	64
<b>Copper</b>	Cu	0.03
<b>Iron</b>	Fe	1.10
<b>Phosphate</b>	PO	50
<b>Organophosphonate</b>	OP	21
<b>Digested Phosponate</b>	PO	32.8
<b>Nitrite</b>	NaN <sub>o</sub>	80
<b>Molybdate</b>	Mo	0.76
<b>RTC</b>	Ppb	269.8
<b>pH</b>	pH	7.64
<b>Temperature</b>	F	70
<b>Conductivity</b>	Micromhos	1,509

## VI. RIO RANCHO CITY HALL MAINTENANCE RECORDS

As part of our analysis, we reviewed the maintenance work orders to date provided by the City of Rio Rancho. We then collated this information based on the maintenance problems noted from the work orders but could not find a corresponding problem specifically isolating the existing system's deficiencies. This information is illustrated in Appendix E. The data analyzed ranges from January 2011 to October 2018; however, we did not total the overall work orders for maintenance costs incurred by the City of Rio Rancho

## VII. OPINION OF PROBABLE COSTS

Based on our review of the system, we evaluated two options for the City of Rio Rancho to proceed in repairing the existing HVAC system. The following four steps include the estimated probable construction costs:

**Step 1.** Establish a proper maintenance program with regularly scheduled maintenance throughout the calendar year to include initial maintenance cleaning and controls recommissioning. This task would be completed as follows:

- Replace air filters.
- Clean all strainers at each location (heat pump, bag filters, etc.) and reinstall.
- Clean evaporative coil
- Adjust motor alignment
- Adjust or replace contactor
- Flush entire system by running the system.
- Examine and clean all strainers and restart system. Flush entire system.
- Establish duct work to optimize unit performance.
- Calibrate thermostats
- Recommission controls

- *Opinion of probable construction cost for initial maintenance: \$250,000.*
- *Opinion of annual maintenance program: \$50,000 to \$200,000*

**Step 2.** Reintroduce the existing 12 wells back into to the system and well field.

- *Opinion of probable construction cost: \$120,000.*

**Step 3.** Add 12 wells to the system and well field which were removed as part of the VE process.

- *Opinion of probable construction cost: \$205,000.*

Step 1 does not require professional design services. Steps 2 and 3 will require professional design services.

## VIII. RECOMMENDATIONS

After reviewing the existing documents, performing additional water quality testing, observation of the existing system, and discussions with facility maintenance personnel the City of Rio Rancho should first establish a proper maintenance program, second reestablish the 12 wells isolated in 2016, and third develop 12 additional wells.

It is **not** recommended to abandon the existing system and install a cooling tower or boilers. The City of Rio Rancho paid a premium for the state of the art heating and cooling system at City Hall and through proper maintenance coupled with a mild expansion of the existing geothermal well field the facility then the air temperature within the facility should be within industry standards. The City of Rio Rancho will spend considerable more money converting the heating and cooling system into a conventional system.

# APPENDIX A

## Yearout Mechanical Report



Prepared For: Huitt-Zollars

ATTN: Scott Eddings

RE: City of Rio Rancho Admin Building





## **Assessment of Condition of HVAC/Plumbing Systems**

### **OVERVIEW**

The objective of this assessment is to determine the condition of the HVAC Systems for (1) Commercial Building Located at 3200 Civic Center Cir in Rio Rancho, NM. This four story commercial office building is approximately 67,670 Heated and Cooled square feet.

### **PURPOSE:**

The intent of this report is to Provide general information and make recommendations of the condition of the and existing Mechanical Systems of the above mentioned properties, as part of our clients process to determine a long term solution, for the proper operation and reliability.

**INVESTIGATION:** Under Attachment “A” the findings are recorded as noted via an onsite investigation. We were able to obtain the information via the building management system as well as a unit to unit check of the operational function of each heat Pump, ERV, and Pump. The Geo Thermal field study is being performed by another contractor with input and data supplied by their own investigation, data obtained in this investigation and a cooperative effort of all of the investigative parties.



## **Findings:**

The functioning mechanical equipment appears to be in very poor maintenance condition. Most of the areas are outside of the targeted set point by an amount larger than the set 2°F variance. This is caused by a variety of reasons including all of the following but not limited to such:

- 1- The Thermostats at each HP location and the Controls system designations are not calibrated properly and therefore are given two different temperature ranges not in sync with each other.
- 2- The HP are not communication with the controls system for a variety of reasons
  - A- Broken Communication lines
  - B- Systems physically shut off
  - C- Bad or malfunctioning Thermostats
- 3- The units are dirty and in need of complete Preventive Maintenance care. This is to include a thorough cleaning of each evaporator coil, remove and clean (or replace) Wye strainers at each Heat Pump, filter change, motor realignment, contactor tightening (and in some instances replacement)
- 4- Associated Duct work has been manipulated (Changed), from the original design distribution schematic. This is causing some of the units to be distributing to an area much too large for its capacity and in other areas much too small.

There did not appear to be any external evidence of leaks, however as the units are cleaned and recommissioned properly, refrigerant leaks may be discovered at that time..

There are Eight Energy Recovery HVAC units on the roof, two for each floor. The plans supplied indicated the area in which each was to serve however, one is clearly mismarked and it is undetermined at this time if the BMS system has picked this up correctly or if this is contributing to the issue being experienced. Since the building was occupied at the time of inspection no override was performed.



There are no recommendations for upgrade, replacement at this time on the functioning equipment. The maintenance of these units seemed behind schedule, as the last visit appeared to be inadequate if performed at all. According to the markings on the filters, some of them haven't been changed in years. Yearout recommends air filter be changed no less frequently than quarterly. Operationally the units appear to be in fair condition, and will service the needs of the existing layout and programming at the facility, if fully functional and maintained. However, when floor plan changes are made, a professional HVAC and Controls contractor should be involved to resize and re-program accordingly.

### **CONCLUSIONS & NEXT STEPS:**

We recommended, a full maintenance cleaning and controls recommission be performed. This will be in tandem with any findings from the Forensic Study of the Geo Fields. Assuming the Geo Field is brought to capacity and is functional, we believe the installed system after thorough maintenance, recommissioning and any mechanical deficiencies repaired, will operate adequately, comfortably and reliably, so long as a qualified maintenance program is put in place. It is our belief and with evidence to support, the maintenance performed on this system for the foreseeable past, was not performed by a contractor who is familiar with GEO thermal heat pump operations. Improper maintenance performance and lack of routine functional testing has led to the internal breakdown of the system operation.

### **Limitations and Assertions:**

Yearout asserts that there may be subsequently discovered items or issues that could not have been reasonably foreseen or detected, using industry standards, during the performance of this visual assessment. Furthermore items undetectable because of barriers, lack of access or other matters affecting accessibility or matters that were not disclosed to Yearout prior to, during, or after the performance of the assessment. Furthermore, any new deficiency that arose after the completion of the assessment. To the extent that additional information becomes available to Yearout, Yearout reserves the right (without any obligation to do so) to modify its evaluation and/or this Report at any time, based upon further review and analysis of any such additional information or data. Certain items mentioned in the Report may have been performed by others not involving the supervision of, or management by, Yearout, but were relied upon in making its evaluation and assessment.



Total Heat Pumps All Floors		Total Count			Total Tons			Design GPM			GPM Ton			BMS Information										At Location Verification									
		127			216.00			642.60			648.00																						
Floor	Count	Code/Tag	Make	Model	Nom. Tons	Design GPM	GPM/Ton	Tstat Location	Service Area	Discharge	Heat Set Point	Cool Set Point	Room Temp	Discharge	Heat Set Point	Cool Set Point	Room Temp	Effective Set Point	<-/-> Operation	Notes													
Ground	1	HP-H21	Carrier	50RHR042	3.50	10.50	10.50	A105	120,114,113,112	72	68	71	73.7	63	68	72	73	70	3.00														
Ground	2	HP-H4	Carrier	50RHR012	1.00	3.00	3.00	A138	103	73.8	70	74	73.7	72	70	74	73	72	1.00														
Ground	3	HP-H16	Carrier	50RHR030	2.50	7.50	7.50	A122	Hall,123,125,127	75.2	70	72	72.1	65	67	69	72	68	4.00														
Ground	4	HP-H14	Carrier	50RHR024	2.00	6.00	6.00	A119	115,109,117,107,119, 105, 106	74.9	70	74	71.8	72	68	72	72	70	2.00														
Ground	5	HP-H10	Carrier	50RHR019	1.50	4.50	4.50	A106	111	52.7	67	70	69.3	60	68	71	70	69.5	0.50														
Ground	6	HP-H8	Carrier	50RHR015	1.25	3.50	3.75	A113	110,108	74.3	70	74	72.9	60	68	72	73	70	3.00														
Ground	7	HP-H9	Carrier	50RHR015	1.25	3.50	3.75	A116	121,124,116,126,118	75	68	72	71.9	63	68	72	72	70	2.00														
Ground	8	HP-H18	Carrier	50RHR036	3.00	9.00	9.00	A131	128	74.9	70	74	73.4	64	70	74	74	72	2.00														
Ground	9	HP-H4	Carrier	50RHR012	1.00	3.00	3.00	A101	122	60.3	68	74	74.7	75	68	72	75	70	5.00														
Ground	10	HP-H15	Carrier	50RHR030	2.50	7.50	7.50	A128	104	75	68	72	72.2	60	66	70	72	68	4.00														
Ground	11	HP-H4	Carrier	50RHR012	1.00	3.00	3.00	A155	145	75.5	68	73	75.1	66	69	74	73	71.5	1.50														
Ground	12	HP-H2	Carrier	50RHR009	0.75	2.20	2.25	A139	102	74.1	68	72	72.7	56	66	70	72	68	4.00														
Ground	13	HP-H7	Carrier	50RHR015	1.25	3.50	3.75	A140	101	55.5	69	73	73.2	64	68	72	73	70	3.00														
Ground	14	HP-H16	Carrier	50RHR030	2.50	7.50	7.50	A154	139140141	75.9	70	73	74.9	63	69	72	75	70.5	4.50														
Ground	15	HP-H14	Carrier	50RHR024	2.00	6.00	6.00	A142	Zoning Staff	No Com	No Com	No Com	No Com	OFF	OFF	OFF	OFF	#DIV/0!	#VALUE!	Unit Manually Disengaged													
Ground	16	HP-H10	Carrier	50RHR019	1.50	4.50	4.50	A158	142	75.7	68	73	74.7	66	67	72	72	69.5	2.50														
Ground	17	HP-H4	Carrier	50RHR012	1.00	3.00	3.00	A132	136	74.4	68	73	70.6	60	66	71	73	68.5	4.50														
Ground	18	HP-H11	Carrier	50RHR019	1.50	4.50	4.50	A153	100 & Vestibule	75.2	70	71	73.5	No Stat	No Stat	No Stat	73		Locked On														
Ground	19	HP-H4	Carrier	50RHR012	1.00	3.00	3.00	A171	Stair #1	70	68	72	70.9	68	NC	NC	67	#DIV/0!	#DIV/0!	Locked On													
Ground	20	HP-H16	Carrier	50RHR030	2.50	7.50	7.50	A177	143,143c	74.3	67	71	73.9	57	64	68	72	66	6.00	Unit Not responding to BMS													
Ground	21	HP-H17	Carrier	50RHR030	2.50	7.50	7.50	A145	137,138, Hall, 135,134,133,132,131	75.5	67	72	71.5	61	67	72	72	69.5	2.50														
Ground	22	HP-H19	Carrier	50RHR036	3.00	9.00	9.00	A166	Hall, 130, Copy Area, Bathrooms, 144	49.9	68	72	71.8	63	68	71	71	69.5	1.50														
Ground	23	HP-H1	Carrier	50RHR006	0.50	1.50	1.50											#DIV/0!	#DIV/0!														
Ground	24	HP-H13	Carrier	50RHR024	2.00	6.00	6.00	A181	Lobby W	76	68	72	72.6	72	67	71	73	69	4.00														
Ground	25	HP-H11	Carrier	50RHR019	1.50	4.50	4.50	A161	Admin Sec, 143a	53.7	70	72	72.1	64	68	70	72	69	3.00														
Ground	26	HP-H22	Carrier	50RHR048	4.00	12.00	12.00	A179	149	73.7	67	71	69.1	52	65	69	71	67	4.00														
Ground	27	HP-H23	Carrier	50RHR060	5.00	15.00	15.00	A182	Vestibule	51.1	68	72	69	No Stat	No Stat	No Stat	71																
Ground	28	HP-H4	Carrier	50RHR012	1.00	3.00	3.00	B119	150,153	56.5	67	72	72.5	60	68	72	72	70	2.00														
Ground	29	HP-H11	Carrier	50RHR019	1.50	4.50	4.50	B101	158	45.1	68	72	71.4	52	66	70	73	68	5.00														
Ground	30	HP-H13	Carrier	50RHR024	2.00	6.00	6.00	B103	159,160	50	70	73	73.2	64	70	74	72	72	0.00														
Ground	31	HP-H7	Carrier	50RHR015	1.25	3.50	3.75	B109	157,156	48.4	69	72	71.3	60	69	73	72	71	1.00														
Ground	32	HP-H1	Carrier	50RHR006	0.50	1.50	1.50	B104	Mech Room/161	54.7	70	74	79.3	64	70	74	77	72	5.00	Unit having hard time keeping up													
Ground	33	HP-H8	Carrier	50RHR015	1.25	3.50	3.75	B107	152,151	50	70	73	73.2	65	69	73	71	71	0.00														
Ground	34	HP-H3	Carrier	50RHR009	0.75	2.10	2.25	B113	162	75.4	70	73	70.9	65	70	74	71	72	-1.00														
Ground	35	HP-H12	Carrier	50RHR019	1.50	4.50	4.50	B116	154	60.2	68	72	72	66	68	72	72	70	2.00														
Ground	36	HP-H13	Carrier	50RHR024	2.00	6.00	6.00	A181	Lobby E	71	68	72	72	71	66	70	72	68	4.00														
Ground	37	HP-H14	Carrier	50RHR024	2.00	6.00	6.00	B124	Bathrooms, halls, 167	77	68	72	71.6	66	68	72	72	70	2.00														
Ground	38	HP-H11	Carrier	50RHR019	1.50	4.50	4.50	B118	Council Table	76.3	68	71	69.6	55	68	72	68	70	-2.00														
Ground	39	HP-H20	Carrier	50RHR042	3.50	10.50	10.50	B125	166	46.3	68	71	70.5	55	68	72	68	70	-2.00														
Ground	40	HP-H23	Carrier	50RHR060	5.00	15.00	15.00	B130	170	74.9	68	72	71.4	57	68	71	71	69.5	1.50														
Ground	41	HP-H22	Carrier	50RHR048	4.00	12.00	12.00	B133	168	74.1	68	72	71.6	74.1	66	70	70	68	2.00														
Ground	42	HP-H7	Carrier	50RHR015	1.25	3.50	3.75	B132	169	73.6	70	74	72.7	73.6	70	74	70	72	-2.00														
Ground	43	HP-H4	Carrier	50RHR012	1.00	3.00	3.00	B135	Stair #3	71.4	68	72	71	No Stat	No Stat	No Stat	74																
Ground	43				83.00	247.30	249.00																										

2nd Floor																					
Floor	Count	Code/Tag	Make	Model	Nom. Tons	Design GPM	GPM/Ton	Tstat Location	Service Area	Discharge	Heat Set Point	Cool Set Point	Room Temp	Discharge	Heat Set Point	Cool Set Point	Room Temp	Effective Set Point	<-/-> Operation	Notes	
Second	1	HP-H4	Carrier	50RHR012	1.00	3.00	3.00	A201	214	48.7	68	72	71.7	59	68	72	72	69.5	-3.50		
Second	2	HP-H4	Carrier	50RHR012	1.00	3.00	3.00	A203	212,213	48.8	66	72	71.9	56.7	66	72	71	69	2.00		
Second	3	HP-H5	Carrier	50RHR012	1.00	3.00	3.00	A207	205	51.2	65	69	68.5	58	65	69	69	67	2.00		
Second	4	HP-H11	Carrier	50RHR019	1.50	4.50	4.50	A205	269,208,206	52	68	71	72.4	56	68	71	71	69.5	1.50	Heating Not engaging	
Second	5	HP-H14	Carrier	50RHR024	2.00	6.00	6.00	A215	211,210,207, Hall (a208)	74.7	68	72	72.2	59	68	72	72	70	2.00		
Second	6	HP-H16	Carrier	50RHR030	2.50	7.50	7.50	A212	215,216,217,218	74.8	68	72	72.5	55	68	72	72	70	2.00		
Second	7	HP-H1	Carrier	50RHR006	0.50	1.50	1.50	A217	203	75.2	68	72	71.9	61	68	72	72	70	2.00		
Second	8	HP-H8	Carrier	50RHR015	1.25	3.50	3.75	A219	204,202	73.7	69	72	73.3	58	68	71	71	69.5	1.50		
Second	9	HP-H1	Carrier	50RHR006	0.50	1.50	1.50	A244	Line Locaters Area	75.1	70	74	73.6	73	68	72	73	70	3.00		
Second	10	HP-H1	Carrier	50RHR006	0.50	1.50	1.50	A228	200	66.7	68	72	72.2	63	70	74	73	72	1.00		
Second	11	HP-H4	Carrier	50RHR012	1.00	3.00	3.00	A236	Stair #1	71.9	68	74	NC	68	No Stat	No Stat	68				
Second	12	HP-H13	Carrier	50RHR024	2.00	6.00	6.00	A225	220,221,222,223,201	66.7	68	72	72.2	58	68	72	72	70	2.00		
Second	13	HP-H5	Carrier	50RHR012	1.00	3.00	3.00											#DIV/0!	#DIV/0!		
Second	14	HP-H4	Carrier	50RHR012	1.00	3.00	3.00	A249	230	75	66	70	75.8	73	64	68	73	66	7.00	In Alarm	
Second	15	HP-H7	Carrier	50RHR015	1.25	3.50	3.75	A248	231	50.3	69	71	72.4	55	67	69	72	68	4.00	BMS not responding	
Second	16	HP-H7	Carrier	50RHR015	1.25	3.50	3.75	A253	229	54.3	68	72	72.1	61	68	72	72	70	2.00		
Second	17	HP-H13	Carrier	50RHR024	2.00	6.00	6.00	A254NE	Lobby	74.9	70	74	74.3	72	70	74	73	72	1.00	No T Stat Control	
Second	18	HP-H14	Carrier	50RHR024	2.00	6.00	6.00	A238	219,Hall (a219), 224,Bathrooms	60.3	67	71	71.8	70	66	70	71	68	3.00	No T Stat Control	
Second	19	HP-H21	Carrier	50RHR042	3.50	10.50	10.50	A251	Const Inspectors Area	75.3	68	74	73.9	72	66	72	72	69	3.00	No T Stat Control	
Second	20	HP-H4	Carrier	50RHR012	1.00	3.00	3.00	B201	255	76.6	65	70	71.8	62	67	72	66	69.5	-3.50		
Second	21	HP-H4	Carrier	50RHR012	1.00	3.00	3.00	B202	256	54.4	68	72	72	64	70	74	68	72	-4.00	Heating Not engaging	
Second	22	HP-H4	Carrier	50RHR012	1.00	3.00	3.00	B209	254	74.9	68	72	73.6	66	70	74	69	72	-3.00		
Second	23	HP-H13	Carrier	50RHR024	2.00	6.00	6.00	A254SE	Lobby	75.3	70	74	74.7	73	70	74	72	72	0.00	No T Stat Control	
Second	24	HP-H13	Carrier	50RHR024	2.00	6.00	6.00	A254SW	Lobby	74.7	70	74	74.1	73	70	74	73	72	1.00	No T Stat Control	
Second	25	HP-H14	Carrier	50RHR024	2.00	6.00	6.00	B218	250,Admin area, Bathrooms,266	39.9	69										

Second	26	HP-H7	Carrier	50RHR015	1.25	3.50	3.75	B207	263	56.3	68	72	72.2	80	70	74	68	72	-4.00
Second	27	HP-H8	Carrier	50RHR015	1.25	3.50	3.75	B222	252,251,265	75.6	68	73	73.4	68	68	73	71	70.5	0.50 No T Stat Control
Second	28	HP-H9	Carrier	50RHR015	1.25	3.50	3.75	B214	253,257,259,264	56	68	72	74.3	61	68	72	72	70	2.00
Second	29	HP-H19	Carrier	50RHR036	3.00	9.00	9.00	B223	Engineer Tech Area	46.5	68	72	72.3	67	66	70	70	68	2.00
Second	30	HP-H4	Carrier	50RHR012	1.00	3.00	3.00	B232	Stair # 3	72.9	70	74	NC	NC	No Stat	No Stat	66		
Second	31	HP-H4	Carrier	50RHR012	1.00	3.00	3.00	B237	270	49.1	70	74	74.8	72	70	74	71	72	-1.00 Cooling Mode not engaging
Second	32	HP-H4	Carrier	50RHR012	1.00	3.00	3.00	B238	271	49.5	70	74	71.9	63	68	71	71	69.5	1.50 Cooling Mode not engaging
Second	33	HP-H4	Carrier	50RHR012	1.00	3.00	3.00	B242	275	74	68	72	75.9	68	68	72	69	70	-1.00 No T Stat Control
Second	34	HP-H13	Carrier	50RHR024	2.00	6.00	6.00	A254NW	Lobby	76.1	70	74	74.1	73	70	74	72	72	0.00 No T Stat Control
Second	35	HP-H17	Carrier	50RHR030	2.50	7.50	7.50	B234	Large Open Area	76.6	72	75	74	73	70	73	72	71.5	0.50 No T Stat Control
Second	36	HP-H18	Carrier	50RHR036	3.00	9.00	9.00	B239	272,273,274	75.7	70	75	75.3	70	71	76	72	73.5	-1.50 No T Stat Control
	36				54.00	160.50	162.00												

Second	13??	H-13	Carrier	50RHR024	2.00	6.00	6.00	B206	258,260,261,262	49	68	72	71.4	57	68	72	69	70	-1.00
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3rd Floor

Floor	Count	Code/Tag	Make	Model	Nom. Tons	Design GPM	GPM/Ton													
Third	1	HP-H5	Carrier	50RHR012	1.00	3.00	3.00	A303	311,309	48.9	68	72	73.6	59	70	74	74	70	2.00	
Third	2	HP-H8	Carrier	50RHR015	1.25	3.50	3.75	A305	307,305	74.4	69	73	72.6	62	69	73	73	71	2.00	
Third	3	HP-H2	Carrier	50RHR009	0.75	2.20	2.25	A301	312	56.5	69	72	75.9	61	69	72	72	70.5	1.50	
Third	4	HP-H4	Carrier	50RHR012	1.00	3.00	3.00	A306	304	50.4	68	72	72.5	58	68	72	71	70	1.00	
Third	5	HP-H4	Carrier	50RHR012	1.00	3.00	3.00	A313	308	74.5	68	72	72	58	68	72	72	70	2.00	
Third	6	HP-H8	Carrier	50RHR015	1.25	3.50	3.75	A317	303,302	74.4	71	74	74.3	60	71	74	73	72.5	0.50	
Third	7	HP-H14	Carrier	50RHR024	2.00	6.00	6.00	A316	Hall (a308),306,301,300	74.4	68	72	72.2	55	68	72	71	71	0.00	
Third	8	HP-H11	Carrier	50RHR019	1.50	4.50	4.50	A318	314,315,317	74.7	68	72	72.7	60	66	70	70	68	2.00	
Third	9	HP-H1	Carrier	50RHR006	0.50	1.50	1.50	A320	316	73.6	68	72	71.6	60	68	72	71	70	1.00	
Third	10	HP-H16	Carrier	50RHR030	2.50	7.50	7.50	A349SW	Lobby	75	68	72	72.4	72	68	72	71	70	1.00 No T Stat Control	
Third	11	HP-H14	Carrier	50RHR024	2.00	6.00	6.00	A331	321,335, Haa(a344), Bathrooms, Hall(a344)	44.5	67	72	72.9	58	65	70	73	67.5	5.50	
Third	12	HP-H9	Carrier	50RHR015	1.25	3.50	3.75	A324	318,322,323,324,325, Hall(a329)	74.8	69	73	73	61	69	73	73	71	2.00	
Third	13	HP-H8	Carrier	50RHR015	1.25	3.50	3.75	A330	319,320	73.9	68	72	71.3	61	68	72	72	70	2.00	
Third	14	HP-H4	Carrier	50RHR012	1.00	3.00	3.00	A334	Stair #1	73.2	68	74	NC	68	No Stat	No Stat	68			
Third	15	HP-H18	Carrier	50RHR036	3.00	9.00	9.00	A345	333	73.4	68	72	70.6	58	68	72	70	70	0.00	
Third	16	HP-H13	Carrier	50RHR024	2.00	6.00	6.00	A347	332,331,330	74.9	70	74	73.6	NC	NC	NC	NC	#DIV/0!	#VALUE!	No Communication
Third	17	HP-H16	Carrier	50RHR030	2.50	7.50	7.50	A349SE	Lobby	74.8	68	72	70.6	72	68	72	71	70	1.00 No T Stat Control	
Third	18	HP-H1	Carrier	50RHR006	0.50	1.50	1.50	B301	Stair #2	73.2	68	72	71.7	68	No Stat	No Stat	68			
Third	19	HP-H22	Carrier	50RHR048	4.00	12.00	12.00	A349N	Lobby	74.6	68	72	71.3	72	68	72	71	70	1.00 No T Stat Control	
Third	20	HP-H11	Carrier	50RHR019	1.50	4.50	4.50	B303	352,353,355	54.5	67	71	70.3	61	67	71	71	69	2.00	
Third	21	HP-H11	Carrier	50RHR019	1.50	4.50	4.50	B311	350,351	75.2	68	72	75	72	66	70	73	68	5.00	
Third	22	HP-H8	Carrier	50RHR015	1.25	3.50	3.75	B306	356,358	75.2	70	73	73.1	60	70	73	73	71.5	1.50	
Third	23	HP-H5	Carrier	50RHR012	1.00	3.00	3.00	B316	357,359	75.8	68	72	73.7	62	69	73	72	71	1.00 Alarm	
Third	24	HP-H6	Carrier	50RHR012	1.00	3.00	3.00	B313	Hall (b313)	76.6	69	73	73	72	64	68	73	66	7.00	
Third	25	HP-H4	Carrier	50RHR012	1.00	3.00	3.00	B308	Stair # 3	73.8	68	72	73.2	100	No Stat	No Stat	66			
	25				37.50	111.20	112.50													

4th Floor

Floor	Count	Code/Tag	Make	Model	Nom. Tons	Design GPM	GPM/Ton													
Fourth	1	HP-H10	Carrier	50RHR019	1.50	4.50	4.50	A401	410	56	69	72	72.8	95	69	72	70	70.5	-0.50	
Fourth	2	HP-H11	Carrier	50RHR019	1.50	4.50	4.50	A403	409,407,404	55	68	70	68.1	58	66	68	69	67	2.00	
Fourth	3	HP-H11	Carrier	50RHR019	1.50	4.50	4.50	A407	411,412,413	51.8	67	71	71.3	58	71	75	72	73	-1.00 Malfunctioning T stat	
Fourth	4	HP-H17	Carrier	50RHR030	2.50	7.50	7.50	A421	405,400,401,406,415	47.1	68	72	70.5	52	66	70	70	68	2.00	
Fourth	5	HP-H15	Carrier	50RHR030	2.50	7.50	7.50	A405	403	76.1	66	70	69.7	56	64	68	66	68	0.00	
Fourth	6	HP-H2	Carrier	50RHR009	0.75	2.20	2.25	A413	402	75	68	72	71	72	66	70	68	68	0.00 Malfunctioning T stat	
Fourth	7	HP-H9	Carrier	50RHR015	1.25	3.50	3.75	A416	Recept,408	75.1	68	72	71.1	55	66	70	70	68	2.00 No T Tstat Control	
Fourth	8	HP-H4	Carrier	50RHR012	1.00	3.00	3.00	A441	426	78.9	68	72	74.7	66	68	73	68	70.5	-2.50	
Fourth	9	HP-H12	Carrier	50RHR019	1.50	4.50	4.50	B432	414,416,417,418,424, Bathrooms	75.9	68	72	71.5	NC	64	68	71	66	5.00 Fan not responding	
Fourth	10	HP-H23	Carrier	50RHR060	5.00	15.00	15.00	A447SE	Lobby	48	68	72	73.8	60	68	72	69	70	-1.00	
Fourth	11	HP-H4	Carrier	50RHR012	1.00	3.00	3.00	B428	Stair #1	73.5	70	74	72.1	66	No Stat	No Stat	66			
Fourth	12	HP-H11	Carrier	50RHR019	1.50	4.50	4.50	A443	425,423,422	77.5	70	72	70.9	56	70	72	70	71	-1.00	
Fourth	13	HP-H11	Carrier	50RHR019	1.50	4.50	4.50	A445	Recep,420	76.8	70	74	73.8	88	70	74	70	72	-2.00	
Fourth	14	HP-H23	Carrier	50RHR060	5.00	15.00	15.00	A447NE	Lobby	48	67	71	71.4	58	67	71	68	69	-1.00	
Fourth	15	HP-H1	Carrier	50RHR006	0.50	1.50	1.50	B401	Stair #2	74.2	69	72	72.5	69	No Stat	No Stat	67			
Fourth	16	HP-H23	Carrier	50RHR060	5.00	15.00	15.00	A447W	Lobby	52	67	71	73.1	68	68	71	68	69.5	-1.50	
Fourth	17	HP-H13	Carrier	50RHR024	2.00	6.00	6.00	B409	450,recep,452	77.6	69	74	73.9	68	71	76	70	73.5	-3.50 No T Tstat Control	
Fourth	18	HP-H3	Carrier	50RHR009	0.75	2.10	2.25											#DIV/0!	#DIV/0!	
Fourth	19	HP-H11	Carrier	50RHR019	1.50	4.50	4.50	B414	454,456,458	78	68	72	72	88	68	72	68	70	-2.00	
Fourth	20	HP-H3	Carrier	50RHR009	0.75	2.10	2.25	B412	Youth Worker Area	79.8	66	72	74.6	67	66	72	69	69	0.00	
Fourth	21	HP-H8	Carrier	50RHR015	1.25	3.50	3.75	B405	455,457	60.3	68	72	71.5	81	68	70	68	69	-1.00	
Fourth	22	HP-H2	Carrier	50RHR009	0.75	2.20	2.25	B416	459	80.4	68	72	77.1					#DIV/0!	#DIV/0!	No Access
Fourth	23	HP-H4	Carrier	50RHR012	1.00	3.00	3.00	B417	Stair #3	74.4	68	74	73.3	66	No Stat	No Stat	66			
	23				41.50	123.60	124.50													

Fourth
--------

ERV 1E	Dirty OA Filters	Missing Return Air Filters		Unit Serves 1st Floor
ERV 2E	Good			Unit Serves 2nd Floor
ERV 3E	Dirty OA Filters	Missing Return Air Filters		Unit Serves 3rd Floor
ERV 4E	Dirty OA Filters	Missing Return Air Filters		Unit Serves 4th Floor
	Phase 1	Phase 2	Phase 3	
Pump 1	13.1a	12.8a	13.5a	
Pump 2	11.2a	13.2a	12.3a	

# APPENDIX B

## Major Geothermal Report



# Closed Loop Ground Heat Exchanger & GSHP Mechanical System Preliminary Report

May 18, 2019



Rio Rancho City Hall  
3200 Civic Center Circle NE  
Rio Rancho, NM 87144

Mr. Scott Eddings, Project Manager  
Huitt-Zollars  
333 Rio Rancho Blvd.  
Rio Rancho, NM 87124



## **Rio Rancho City Hall, Rio Rancho, New Mexico Preliminary Report – Closed Loop Ground Heat Exchanger & GSHP Mechanical System**

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Typical Mechanical Abbreviations & Symbols

2'/Second	Minimum fluid velocity, pure water, required for air removal in GHX systems
ACHR	Air Changes Per Hour
AHU	Air Handling Unit
AHRI/ISO	American Heating Refrigeration Institute/Int'l Organization for Standardization
AHRI/ISO 13256-1	Rating standard for water-air heat pumps – water well <sup>1</sup> , boiler/tower <sup>2</sup> , extended range <sup>3</sup>
AHRI/ISO 13256-2	Rating standard for water-water heat pumps – water well <sup>1</sup> , boiler/tower <sup>2</sup> , extended range <sup>3</sup>
ASHRAE	American Society of Heating, Refrigeration, Air Conditioning Engineers
BAS	Building Automation System
Btuh	British thermal units per hour
Btuh/Ft <sup>2</sup> °F	Value of thermal conductivity – symbol <i>k</i>
°C	degrees Celsius
CFM	Cubic Feet per Minute
CGD	Certified GeoExchange Designer
COP	Coefficient of Performance – efficiency value for heating with water-source heat pumps
Cx	Commissioning
Δ	Delta, meaning differential as in Δ for pressure, flow rate, temperature, etc.
DR/SDR	Dimension ratio/schedule dimension ratio, describes piping diameter ratio from nominal size
EAT	Entering Air Temperature
ECM	Electronically Commutated Motor, used for variable speed blowers; greater comfort, efficiency
EER	Energy Efficiency Ratio – efficiency value for cooling with water-source heat pumps
ERU	Energy Recovery Unit
ESC	Environmental Stress Cracking
EWP	Entering Water Pressure
EWT	Entering Water Temperature
Extended range	EWT range of 20°F to 120°F, typical rated operation range of GSHP equipment
°F	degrees Fahrenheit
FC	Fan Coil
FIM	Facility Improvement Measure
FPT	Functional Performance Test
Ft/hd	Feet of Head
Ft <sup>2</sup>	Square Feet
Ft <sup>2</sup> /day	Value of diffusivity – symbol <i>α</i>
Ft <sup>3</sup>	Cubic Feet
GHX	Ground Heat Exchanger – also loop field, closed loop ground heat exchanger, etc.
GSHP	Ground Source Heat Pump, capable of extended range EWT operation
GPM	Gallons per Minute
HC	Heating Coil
HDPE	High density polyethylene, plastic component used in GHX piping systems
HPR/HPS	Heat pump return/heat pump supply
HVAC	Heating, Ventilating and Air-Conditioning
HW	Hot Water
HX	Heat Exchanger
IAQ	Indoor Air Quality
IECC	International Energy Conservation Code
IGSHPA	International Ground Source Heat Pump Association

<sup>1</sup> AHRI/ISO 13256-1, 2: Validation tested for EWT ranges for water well operation: 86°F Cooling, 68°F Heating  
<sup>2</sup> AHRI/ISO 13256-1, 2: Validation tested for EWT ranges for boiler/tower operation: 59°F Cooling, 50°F Heating  
<sup>3</sup> AHRI/ISO 13256-1, 2: Validation tested for EWT ranges for closed ground loop operation: 77°F Cooling, 32°F Heating



### Typical Mechanical Abbreviations & Symbols (*cont'd*)

IMC	International Mechanical Code
IOM	Installation Operation Manual
Kbtuh	British thermal unit per hour, thousand – also mbh
kW	Kilowatt
kWh	Kilowatt Hour
LAT	Leaving Air Temperature
LWP	Leaving Water Pressure
LWT	Leaving Water Temperature
Mbh	Thousand Btu per hour – also Kbtuh
O&M	Operation & Maintenance
OA	Outside Air
PG	Propylene Glycol
PD	Pressure Drop, either Ft/hd or PSI
PSC	Permanent Split Capacitor motor, used for set speed blower, as opposed to ECM motors
PSI	Pounds per Square Inch
P/T port	Pressure/Temperature Diagnostic Port – used to sample true fluid temperature and pressure
RAT	Return Air Temperature
RCx	Retro-Commissioning
RWT	Return Water Temperature
SAT	Supply Air Temperature
SCM	Standing Column Well
SOO	Sequence of Operation (controls)
TAB	Testing, Adjusting and Balancing
TC	Thermal Conductivity – typically Btuh/Ft/°F ( $k$ ), with related Ft <sup>2</sup> /day ( $\alpha$ ) and UT (°F)
TDS	Total Dissolved Solids
Therm	100,000 Btu Units, typical unit of energy for natural gas
Ton	12,000 Btuh
UT	Undisturbed Temperature
VAV	Variable Air Volume
VFD	Variable Frequency Drive – may be controlled by either pressure $\Delta$ or temperature $\Delta$
W	Watt
WA GSHP	Water-to-air GSHP
WW GSHP	Water-to-water GSHP
WSHP	Water source heat pump, typically limited to EWT ranges managed by boiler/chiller systems

Abbreviations\_updated April 2019\_MG letterhead



May 18, 2019

**Rio Rancho City Hall, Rio Rancho, New Mexico  
Preliminary Report – Closed Loop Ground Heat Exchanger & GSHP Mechanical System**

**Executive Summary**

**Objectives:** As a sub-consultant to Huitt-Zollars (HZ), Major Geothermal’s primary task is to determine if the closed loop ground heat exchanger (GHX) has sufficient capacity to service the ground source heat pump (GSHP) mechanical system for the Rio Rancho City Hall (RRCH). Our secondary responsibility is to review the above-ground portion of the mechanical system, working with both HZ and Yearout Mechanical (YM), to identify potential issues and provide recommended corrections as necessary.

At this time, a site visit to inspect the system has not yet been completed. This narrative is based primarily upon review of provided mechanical drawings, with supplemental information gathered from HZ, YM and the drilling contractor by telephone. The mechanical engineer of record has been contacted for feedback but to date no response has been provided. Access to the building automation system has not yet been provided. Detailed information related to hydronic trending of both the GHX and hydronic building loop are either not provided or non-existent. As-built drawings and specifications have not yet been provided. All calculations, comments, opinions, and findings in this report are therefore subject to change as more information is acquired.

**Preliminary Findings/Opinions - GHX:** The GHX is suspected of being contaminated with both soil and residue from the above-ground hydronic piping in the building. This has been determined from the HZ<sup>1</sup> report, including photos and water test reports found in Appendix B and maintenance descriptions in Appendix C.

Without detailed water temperature trends for both the building hydronic loop and closed loop ground heat exchanger, we cannot definitively determine if the GHX has sufficient capacity to meet the entering water temperature (EWT) requirements of the GSHP units to function reliably. From the comments and maintenance notes found in the HZ report it is suspected that the GHX may be insufficient to provide a minimum and maximum EWT that can sustain the operation of the heat pumps at any time of the year. It should be noted however that this may also be suggested by excessive contamination resulting in low water flow to the heat pumps, which can be misinterpreted as excessively low or high water temperatures as reasons for heat pump failure or lockouts.

If hourly load calculation data can be provided, we intend to run a GHX performance simulation to determine if the ground loop field has sufficient capacity, requires the addition of either more

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<sup>1</sup> Huitt-Zollars, March 2019



boreholes, or supplemental cooling/heating capacity using conventional components such as a cooling tower and/or boiler. From the provided drawings the engineer has allowed for the addition of future supplemental capacity.

***Preliminary Findings/Opinions – GSHP Mechanical System:*** The GSHP equipment seems to have experienced several service issues related to strainer contamination and possibly EWT ranges not compatible with unit operation. Re-flushing and purging of both the interior hydronic system and the GHX may be required, with the addition of an intermediate filtration plant. Routine pH testing and resulting biocide and/or corrosion inhibitor adjustments could further improve system performance and reduce maintenance from nuisance lockouts due to fouled hydronic water.

The controls sequence of operation for the bypass portion of the hydronic piping could be reset for making better use of the extended range GSHP units, potentially reducing some operating cost related to pump power reduction.

For extended range use of the heat pumps it should be verified if antifreeze is used in the system. This should be considered if currently not used to protect the heat pumps and the controls are re-set to extended range to take advantage of using a wider EWT range.

Functional testing by random sampling of heat pumps from the hydronic side could verify representative system health and aid in more definitive trouble shooting efforts.

Correlating past maintenance and service issues with frequency and type of problems with specific areas of the building might suggest some areas are more problematic than others, where more detailed diagnostics might be warranted.

### **GHX – Final Configuration**

The provided plans describe 192 boreholes x 200' (MS01- dated 4/27/2006). Referencing the HZ report, 171 boreholes x 200' were installed; this same report claims one header pair, servicing 12 boreholes, was abandoned in 2016 due to a leak but there is no breakout of which header pair was isolated. The provided MS01 site plan (4/27/2006) does not assign a numbering nomenclature to ground heat exchanger components; i.e., if a borehole were designated A1, this would mean it is part of header pair A, borehole 1. Determination of specific components of the GHX could aid in evaluation and diagnostic efforts.

The undersigned contacted the drilling contractor, Geothermal Drilling Inc. (GDI), who stated that they drilled 180 boreholes x 250' depth with 1" u-bend circuit pipes. GDI claimed they ran two TC tests, one on 9/19-21/2006, and another on 9/22-24/2006<sup>2</sup>, but there are no notes on what boreholes were used for testing or if they were later integrated into the operating field. Since the tests are dated in September 2006, but the plans provided were from April 2006, the assumption

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<sup>2</sup> See attachments



would be that GDI is correct in that 180 boreholes x 250' were installed, but to date no as-builts showing the final field installation layout have been provided.

Presuming 180 boreholes x 250' were installed, and one header pair has been abandoned, this would result in a current field capacity of 168 boreholes x 250' assuming 12 bores per header pair.

**GHX – Fluid Calculations**

Based upon the line distances as per sheet MS01, subsurface reducing manifold schedule as per sheet M201, u-bend circuit size as per M501, and a borehole depth of 250' (all sheets dated 4/27/2006), the following values are determined:

Peak Flow, Pressure Drop

Peak flow:	642.60	GPM
Total PD, Water:	74.08	Ft/Hd
Total PD, Water:	32.12	PSI

Peak Flow, Pressure Drop – assuming 25% propylene glycol, 30°F LWT from building

Peak flow:	642.60	GPM
Total PD, Water:	74.08	Ft/Hd
Total PD, Water:	32.12	PSI
Total PD, 25% p-glycol @ 30° F	105.19	Ft/Hd
Total PD, 25% p-glycol @ 30° F	45.60	PSI

Header Pair Purge Rate, Minimum (longest header pair)

Peak flow:	68.40	GPM
Total PD, Water:	166.28	Ft/Hd
Total PD, Water:	72.09	PSI

Total GHX Fluid Capacity

Total Ground Heat Exchanger Capacity:	7,096.6	Gallons
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Total GHX Fluid Capacity – Antifreeze Option

Total Ground Heat Exchanger Capacity:	7,096.6	Gallons
Propylene glycol - volume percentage	25.0%	
Propylene glycol - volume capacity	1,774.2	Gallons



**Building Automation System (BAS) Access**

BAS access could be useful to determine specific operating metrics of the mechanical system, particularly for GSHP systems where GHX supply and return water temperatures are critical. This of course assumes the necessary control points were initiated. As in the Huitt-Zollars report, trending would be extremely important, specifically of ground heat exchanger supply and return water temperatures, and building loop supply and return water temperatures.

To date, BAS access has yet to be provided.

**Packaged Heat Pumps**

From the plans provided, 127 packaged Carrier water-to-air packaged heat pumps were counted from sheets M111 through M114, dated 4/27/2006, ranging in size from 0.5 to 5.0 nominal tons.

Ground Floor

Total Packaged GSHP Units	43
Total Nominal Tons	83
Peak Design Flow, GPM	247.3

Second Floor

Total Packaged GSHP Units	36
Total Nominal Tons	54
Peak Design Flow, GPM	160.5

Third Floor

Total Packaged GSHP Units	25
Total Nominal Tons	37.5
Peak Design Flow, GPM	111.2

Fourth Floor

Total Packaged GSHP Units	23
Total Nominal Tons	41.5
Peak Design Flow, GPM	123.6

Whole Building

Total Packaged GSHP Units	127
Total Nominal Tons	216
Peak Design Flow, GPM	642.6



**Reverse-Engineering of GHX**

The objective of a GHX is to provide an entering water temperature (EWT) range that is compatible for use with extended range water source heat pumps (WSHP), otherwise referred to as ground source heat pumps. To design a closed loop ground heat exchanger, or reverse engineer such a system, it is important to note what the design objectives require. This is dictated by the type of heat pumps specified; therefore an explanation of WSHP types are required for perspective.

Conventional WSHP units can only operate on limited EWT ranges provided by boilers and cooling towers, with a typical EWT ranges of 60°F+ to 80°F+.

WSHP units rated for use with open loop, or water well systems, may have a relatively consistent EWT with little fluctuation ranging between 50°F+/- to 70°F+ depending on geographic location and regional aquifer water temperatures.

GSHP equipment can tolerate much wider EWT ranges. This allows for the design of closed loop GHX systems that are smaller in scope and cost, as opposed to the design of a ground loop required for a conventional WSHP which would require a GHX substantially larger to provide a much narrower EWT range.

WSHP equipment is typically rated by independent validation testing, where the manufacturer’s claims of cooling and heating capacity, efficiencies and power consumption for specific models are independently confirmed at a standardized EWT for cooling and heating:

ASHRAE/AHRI/ISO 13256-1<sup>3</sup> Test EWT Standards for WSHP Products

Type	Cooling EWT °F	Heating EWT °F
Water Loop (Boiler/Cooling Tower)	86	68
Ground Water (Water Well)	59	50
Ground Loop (Closed Loop GHX)	77	32

Note: The same EWT ratings are used for water-to-water heat pumps (ASHRAE/AHRI/ISO 13256-2)

According to the provided plans, the packaged GSHP units are from Carrier. The Carrier water-to-air GSHP units are extended range rated for the vintage of installation, capable of operating at EWT ranges as low as 20°F for heating and as high as 110°F for cooling. Based on the date of the plans these units should be using R22 refrigerant (sheet M002, 4/27/2006). The use of R22 refrigerant is confirmed in some of the HZ report maintenance notes.

<sup>3</sup> American Society of Heating, Refrigerating and Air-Conditioning Engineers / Air Conditioning, Heating, and Refrigeration Institute / International Organization for Standardization



The schedule on sheet M002 notes that the GSHP units are specified for a heating EWT of 70°F and 85°F for cooling. The design cooling EWT is reasonable but the heating EWT is not. We do not at this time have hourly load calculations to run a GHX simulation but typically for a building of this type, occupancy, usage, geographic climate location and geology, the heating design EWT should be in the 35°F to 45°F range.

Assigning a nominal peak cooling or heating capacity such as 1 ton (12,000 btuh) per borehole will not verify what the actual supply water temperature will be to the heat pumps. For example, assume an identical 100 ton heat pump system is used in a church and an office building that are side by side. The climate and geology are the same, but the office building might need 3x, 6x or more ground loop than the office building, the reason being the loads on the office building are of substantially greater duration than that of the church which might see peak occupancy for only a few hours every week.

To design or run a GHX simulation, the total annual amount of heat rejected and extracted must be known; efficiency of the heat pumps is required at differing EWT ranges as this impacts compressor gain (heat) in addition to the internal cooling loads; compressor heat must be known in heating mode; water flow rate also influences GHX performance and predicted temperature; and finally, thermal conductivity must be known, specifically thermal conductance, thermal diffusivity and undisturbed ground temperature. Spacing and geometry details can also come into play to impact GHX temperature performance.

Since we have thermal conductivity test data for the subject ground heat exchanger, and details of the heat pump schedule, the only remaining item needed to generate a simulation to predict performance of the GHX is an hourly load profile of the building.

Our intended reverse-engineering simulations will account for both the installed 180 bores x 250' depth, and the assumed field reduction of 168 bores x 250' depth resulting from the loss of one header pair. This will determine if the current field of 168 bores x 250' can provide sufficient capacity to the heat pumps to provide an EWT range consistent with operating needs, or if the field is insufficient to service the needs of the system. If the latter, we will provide 1) the minimum number of additional boreholes required, or 2) the minimum auxiliary hybrid capacity required for supplemental cooling and/or heating.

### **Internal Mechanical**

***Bypass:*** The controls sequence of operation (SOO) for operating the 'Hydronic Loop Temperature Control' (sheet M402, 4/27/2006) is set to bypass using the GHX to temper the interior hydronic building loop when the building loop temperature is between 65°F and 85°F. The intent of this strategy is to force the building to load share whenever possible, which can be advantageous for reducing circulation pump power with a VFD controlled pump by removing the use of the GHX when unnecessary.



Until we run GHX simulations we cannot say for certain if the 85°F upper limit is a reasonable temperature range to set the bypass at.

The lower limit of 65°F is not recommended; this is not taking advantage of the extended range capacity of the GSHP units. A more reasonable range to set the bypass would be 35°F to 40°F on the low end, and possibly maintain an 85°F setting on the high end. Should the building loop begin to drop below or above these settings, the bypass would then close and put the GHX into full communication with the building loop to moderate the interior hydronic water temperature.

***Antifreeze, Extended Range Control Board Settings:*** If the GHX and building loop temperature are operating at 40°F or below, antifreeze should be present to protect the heat pump internal water-refrigerant heat exchanger from freeze bursting. At this time it is unknown if antifreeze is in the system, and if so, what type of antifreeze is used and in what amount of volume percentage. Excessive antifreeze can inhibit heat transfer in both the unit's internal water-refrigerant heat exchanger and the closed loop GHX, severely reducing system capacity.

The heat pumps are equipped with control board settings to allow for extended range operation. GSHP equipment is typically shipped with freeze protection set for boiler/cooling tower operation, or pure water, for liability protection. Some of the comments in the maintenance records in the HZ report noted lock outs on freeze protection in the heating mode. The freeze stat sensor is typically on the suction side of the compressor so a freeze stat lockout is triggered by excessively low refrigerant temperature which can result from either low EWT and/or low water flow; the latter means that refrigerant cannot extract enough heat from the water, which means that either a strainer is clogged or is otherwise starving for sufficient water flow rate.

If the GSHP control boards are set for extended range operation, it should be confirmed antifreeze is present otherwise the units are at risk of freeze-bursting a water-refrigerant heat exchanger should the supply water temperature be excessively low, typically under 40°F, which can result in a LWT below freezing.

***Trending of Maintenance / Service Issues:*** From the maintenance records included in the HZ report ranging from 1/7/2011 through 10/22/2018, specific references are made to some rooms or zones being too cold or too hot, descriptions of service work required for individual heat pumps, compressor replacements, etc. This information may be used to determine if there might be any trending for specific areas of the building that are more problematic than others. Such information might provide focus for more detailed service work; for example, if one area of the building is experiencing greater strainer congestion, this part of the building's hydronic piping could be targeted for more aggressive flushing or water treatment.

For any units where a compressor or other key refrigeration circuit component is replaced, we recommend the addition of a filter drier in the heat pump if not already installed. This could prevent future 'poisoning' of surviving key components. It is not uncommon for example to



replace a compressor that has been stressed or failed, where a new compressor, TXV or reversing valve will fail later due to earlier poisoning of the refrigerant resulting from ester or other refrigerant component degradation from the original failure. This would also involve a complete refrigerant evacuation and replacement with new refrigerant.

**Functional Performance Testing:** Primary testing of any water source heat pump regardless for routine preventive maintenance or for more detailed service diagnostics, aside from obvious issues such as leaks, clogged air filters, etc., is typically commenced by obtaining temperature and water pressure differentials directly through the unit's internal water-to-refrigerant heat exchanger. This is facilitated through the use of pressure/temperature (P/T) diagnostic ports; these are specified on the sheet M501, detail 1; a snapshot of this detail is noted on Figure 1. P/T ports should always be installed at the water port cabinet connections for measurement of pressure and temperature, in particular for pressure differentials. If installed on the opposite side of flex connections this can adversely impact the accurate measurement of actual pressure values occurring within the heat pump's internal heat exchanger.

Knowledge of pressure and temperature differentials allows for accurate assessment from the manufacturer's performance tables. This is used at start-up to verify performance is within factory standards, and as a benchmark for future service diagnostic comparisons. This can also determine if a service issue is a result of hydronic flow and temperature issues, or eliminate the hydronic side as a problem and focus on the refrigeration circuit for diagnostics.

The importance of this is described on the start-up and diagnostic section from the manufacturer's IOM manual under Start-Up Checklist, pages CL-1 and CL-2. These sheets are also included in the attachments section of this narrative.

**Hydronic Water Quality, Testing:** The water quality as described in the HZ report notes solids contamination in the hydronic fluid and breakdown of the fluid with regards to pH. We concur with HZ that the hydronic fluid should be flushed and air purged; for the GHX we have calculated a minimum air purging<sup>4</sup> flow rate assuming line sizes and distances as described on MS01, but used 250' borehole depths instead of 200 feet as per GDI. Purging a GHX of air is different than for flushing solids. The type and amounts of contaminants, along with density of debris mass would have to be known for calculating minimum flow rate for debris removal; therefore, the air purging flow rate and pressure drop are considered a minimum for GHX system flushing.

Purging of the GHX would be accommodated by the purge ports as described on sheet M201 (Figure 2). Hydronic building purging/flushing could also be managed from this portion of the system as the drawings describe correct placement of isolation valves to facilitate this work.

For the above reasons we agree again with HZ that an intermediate filtration plant using a sock filter configuration be considered for long term elimination of solids contamination. An example

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<sup>4</sup> 2'/second minimum water flow velocity (pure water) in smooth pipe for air removal, IGSHPA Design Guide, 2010



of this is shown in Figures 3. and 4. from a similar installation for a school in Colorado whose GHX and building hydronic piping were grossly contaminated.

It is also recommended that a coupon rack be retrofitted within the mechanical room to facilitate water treatment testing more efficiently if one is not already installed.

**Follow-Up**

Any as-built drawings and specifications are requested for additional evaluation.

If a detailed hourly load calculation can be provided possibly by YM or others, this would allow for reverse-engineering of the GHX to determine if capacity can sustain the operation of the GSHP system.

The undersigned intends to make a site visit to field check various portions of the mechanical system. This would preferably be done in association with YM. Pending additional documents and hourly loads, coordination with HZ and YM, this site visit may be scheduled for the middle or latter part of June.

\* \* \* \* \*

Respectfully,

A handwritten signature in blue ink that reads "Terry Proffer".

Terry Proffer, CGD, Geothermal Manager  
**Major Geothermal**

RioRanchoCityHall\_PrelimReport-GSHP Mechanical\_2019-05-18.docx

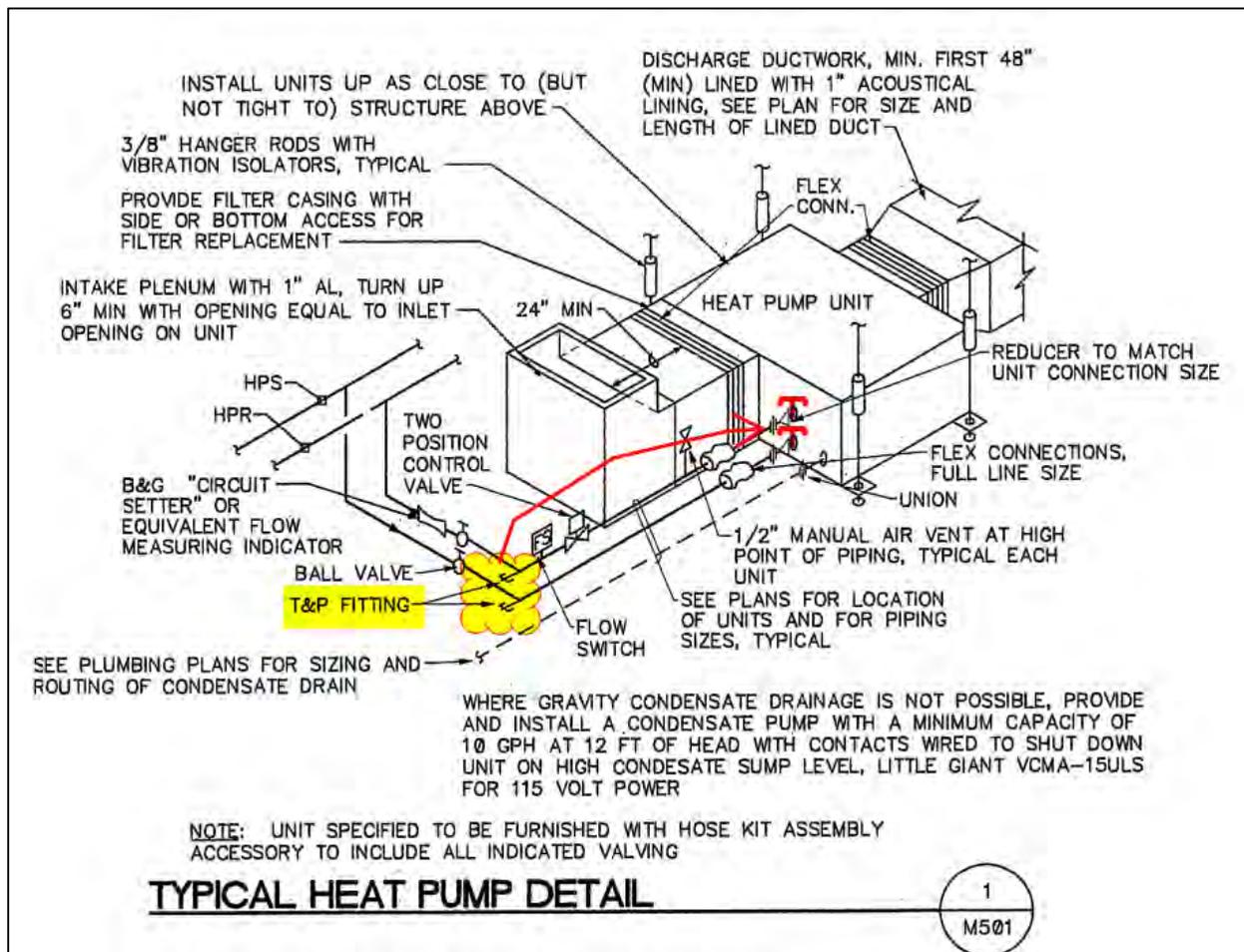


Figure 1. Incorrect placement of "T & P" diagnostic ports, more commonly referred to as "P/T ports" or "Pete's Plugs".

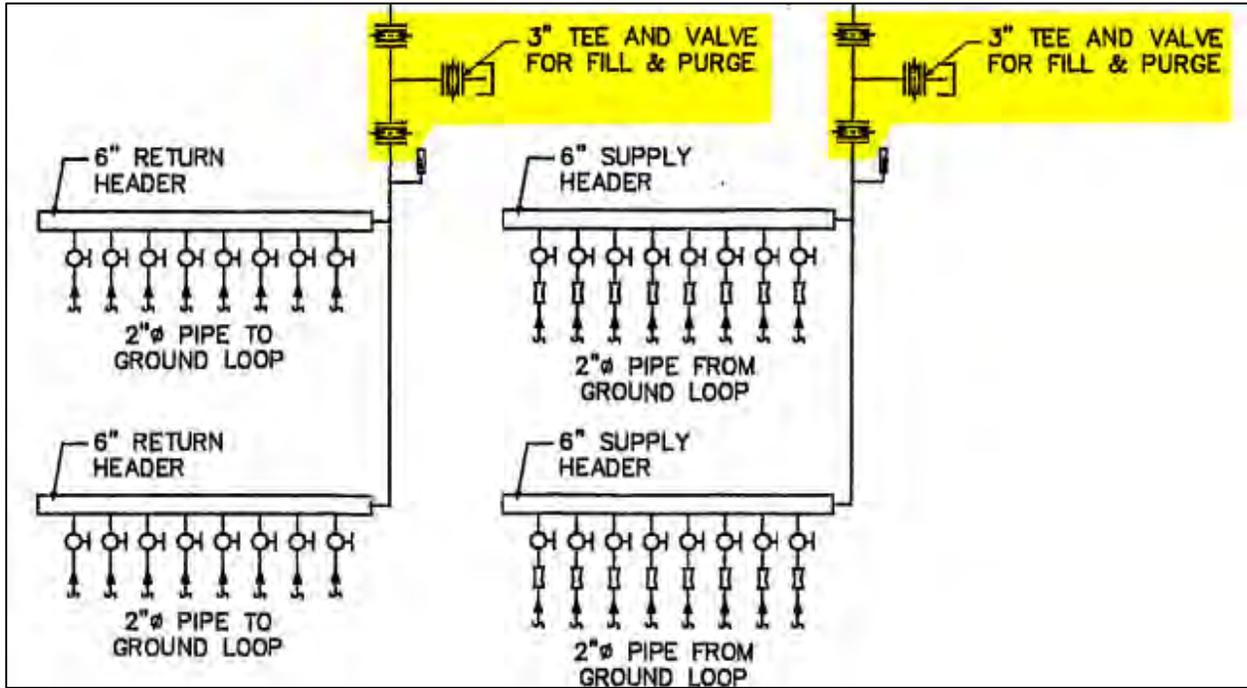


Figure 2. Purge ports for flushing hydronic system, GHX and above ground hydronic piping, M201.



Figure 3. Sock filter assembly for hydronic fluid contamination, front view.



Figure 4. Sock filter assembly for hydronic fluid contamination, side view.



## **ATTACHMENT**

### **THERMAL CONDUCTIVITY TEST REPORTS COURTESY GEOTHERMAL DRILLING INC.**

## Formation Thermal Conductivity Analysis

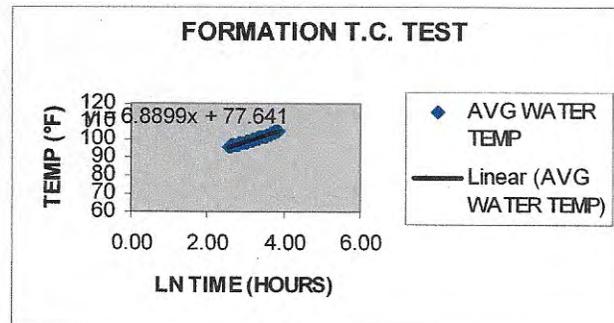
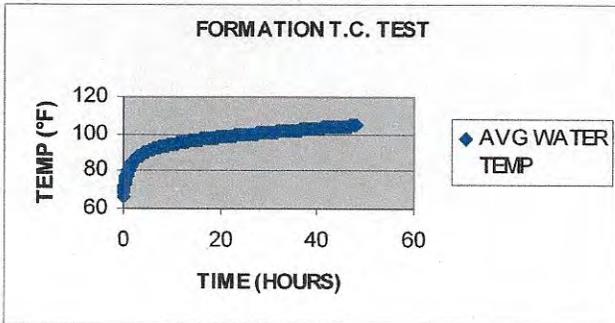
**Project:** Rio Rancho CH 100 CITY HALL - TEST CH100

**Date:** 09/19/06 - 09/21/06

**Test Conducted By:** Geothermal Drilling

<b>Vertical Heat Exchanger</b>		<b>Drilling Log</b>
VHE Type	2 pipe	NA
Bore Depth (ft)	250.0	
U-bend pipe size (in)	1.00	
Borehole dia. (in)	4.75	
Grout (bentonite)	20%	

### In-situ Testing



Circulating Fluid	Water	
Avg Volts	218.13	
Avg Amps	25.46	
Avg Power (Watts)	5552.50	
Test Duration (hr)	47.93	
Test Period Analyzed	12.00 -	47.93
Slope	6.89	

**Calculated Thermal Conductivity**

**0.88 Btu/hr-ft-°F**

## Formation Thermal Conductivity Analysis

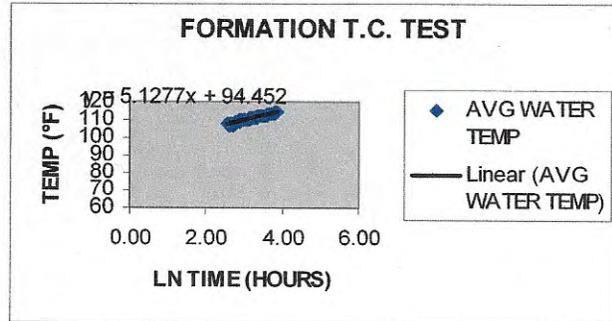
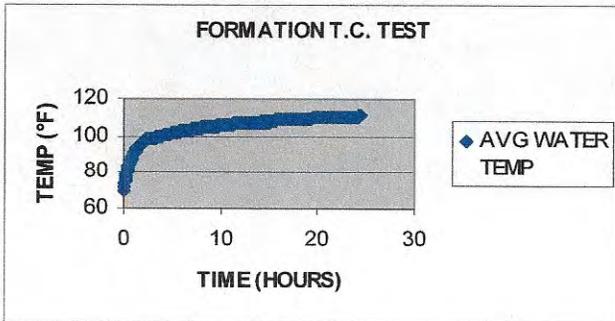
**Project:** Rio Rancho CH 200 **CITY HALL - TEST CH200**

**Date:** 09/22/06 - 09/24/06

**Test Conducted By:** Geothermal Drilling

<b>Vertical Heat Exchanger</b>		<b>Drilling Log</b>
VHE Type	2 pipe	NA
Bore Depth (ft)	250.0	
U-bend pipe size (in)	1.00	
Borehole dia. (in)	5.00	
Grout (bentonite)	20%	

### In-situ Testing



Circulating Fluid	Water	
Avg Volts	213.86	
Avg Amps	20.93	
Avg Power (Watts)	4475.94	
Test Duration (hr)	47.97	
Test Period Analyzed	12.00 -	47.97
Slope	5.13	

**Calculated Thermal Conductivity**

**0.95 Btu/hr-ft-°F**





**ATTACHMENT**

**GROUND HEAT EXCHANGER  
FLUID CALCULATIONS**

Project: Rio Rancho City Hall  
Product: Carrier  
Date: 5/17/2019

Configuration:	15x12 vertical	
Header pairs:	15	
Circuits/hdr. pair:	12	
Total circuits:	180	
Spacing:	25.00	Feet
Peak Flow Rate:	642.600	GPM
Header Flow Rate:	42.840	GPM
Circuit Flow Rate:	3.570	GPM

**Pressure Drop:**

<b>Peak flow:</b>	<b>642.60</b>	GPM
Total PD, Water:	74.08	Ft/Hd
Total PD, Water:	32.12	PSI
<b>Total PD, 25% p-glycol @ 30° F</b>	<b>105.19</b>	Ft/Hd
<b>Total PD, 25% p-glycol @ 30° F</b>	<b>45.60</b>	PSI

Constant:	3960	
Pump efficiency:	85%	
BHP:	20.08	Brake horsepower calculated
Estimated Kw:	14.97	1 HP equals ~0.7456 Kw
Cost per Kwh:	\$0.10	
Est'd hourly operating cost:	\$1.4974	
State	NM	
GHG (CO <sub>2</sub> ) per kwh*:	2.02	lbs/kWh
GHG (CO <sub>2</sub> ) est'd per hour peak pumping:	30.25	lbs/kWh

\* From federal Energy Information Agency  
<http://www.eia.doe.gov/pub/oiaf/1605/cdrom/pdf/e-supdoc.pdf>

**Header Pair Purge, Minimum:**

Peak flow:	<b>68.40</b>	GPM
Total PD, Water:	<b>166.28</b>	Ft/Hd
Total PD, Water:	<b>72.09</b>	PSI

**GHX Total Fluid Capacity, Antifreeze:**

Total Ground Heat Exchanger Capacity:	<b>7,096.6</b>	Gallons
Propylene glycol - volume percentage	<b>25.0%</b>	
Propylene glycol - volume capacity	<b>1,774.2</b>	Gallons

**Project:** Rio Rancho City Hall  
**Product:** Carrier  
**Date:** 5/17/2019

Total Units	Unit #	Manuf.	Model	Equipment	Flow
				Nom. Tons	GPM
1	HP-H21	Carrier	50RHR042	3.50	10.50
2	HP-H4	Carrier	50RHR012	1.00	3.00
3	HP-H16	Carrier	50RHR030	2.50	7.50
4	HP-H14	Carrier	50RHR024	2.00	6.00
5	HP-H10	Carrier	50RHR019	1.50	4.50
6	HP-H8	Carrier	50RHR015	1.25	3.50
7	HP-H9	Carrier	50RHR015	1.25	3.50
8	HP-H18	Carrier	50RHR036	3.00	9.00
9	HP-H4	Carrier	50RHR012	1.00	3.00
10	HP-H15	Carrier	50RHR030	2.50	7.50
11	HP-H4	Carrier	50RHR012	1.00	3.00
12	HP-H2	Carrier	50RHR009	0.75	2.20
13	HP-H7	Carrier	50RHR015	1.25	3.50
14	HP-H16	Carrier	50RHR030	2.50	7.50
15	HP-H14	Carrier	50RHR024	2.00	6.00
16	HP-H10	Carrier	50RHR019	1.50	4.50
17	HP-H4	Carrier	50RHR012	1.00	3.00
18	HP-H11	Carrier	50RHR019	1.50	4.50
19	HP-H4	Carrier	50RHR012	1.00	3.00
20	HP-H16	Carrier	50RHR030	2.50	7.50
21	HP-H17	Carrier	50RHR030	2.50	7.50
22	HP-H19	Carrier	50RHR036	3.00	9.00
23	HP-H1	Carrier	50RHR006	0.50	1.50
24	HP-H13	Carrier	50RHR024	2.00	6.00
25	HP-H11	Carrier	50RHR019	1.50	4.50
26	HP-H22	Carrier	50RHR048	4.00	12.00
27	HP-H23	Carrier	50RHR060	5.00	15.00
28	HP-H4	Carrier	50RHR012	1.00	3.00
29	HP-H11	Carrier	50RHR019	1.50	4.50
30	HP-H13	Carrier	50RHR024	2.00	6.00
31	HP-H7	Carrier	50RHR015	1.25	3.50
32	HP-H1	Carrier	50RHR006	0.50	1.50
33	HP-H8	Carrier	50RHR015	1.25	3.50
34	HP-H3	Carrier	50RHR009	0.75	2.10
35	HP-H12	Carrier	50RHR019	1.50	4.50
36	HP-H13	Carrier	50RHR024	2.00	6.00
37	HP-H14	Carrier	50RHR024	2.00	6.00
38	HP-H11	Carrier	50RHR019	1.50	4.50
39	HP-H20	Carrier	50RHR042	3.50	10.50
40	HP-H23	Carrier	50RHR060	5.00	15.00
41	HP-H22	Carrier	50RHR048	4.00	12.00
42	HP-H7	Carrier	50RHR015	1.25	3.50
43	HP-H4	Carrier	50RHR012	1.00	3.00
44	HP-H4	Carrier	50RHR012	1.00	3.00
45	HP-H4	Carrier	50RHR012	1.00	3.00
46	HP-H5	Carrier	50RHR012	1.00	3.00
47	HP-H11	Carrier	50RHR019	1.50	4.50
48	HP-H14	Carrier	50RHR024	2.00	6.00
Total Packaged Unit Tons, Flow:				89.50	266.80

**Project:** Rio Rancho City Hall  
**Product:** Carrier  
**Date:** 5/17/2019

Total Units	Unit #	Manuf.	Model	Equipment	Flow
				Nom. Tons	GPM
49	HP-H16	Carrier	50RHR030	2.50	7.50
50	HP-H1	Carrier	50RHR006	0.50	1.50
51	HP-H8	Carrier	50RHR015	1.25	3.50
52	HP-H1	Carrier	50RHR006	0.50	1.50
53	HP-H1	Carrier	50RHR006	0.50	1.50
54	HP-H4	Carrier	50RHR012	1.00	3.00
55	HP-H13	Carrier	50RHR024	2.00	6.00
56	HP-H5	Carrier	50RHR012	1.00	3.00
57	HP-H4	Carrier	50RHR012	1.00	3.00
58	HP-H7	Carrier	50RHR015	1.25	3.50
59	HP-H7	Carrier	50RHR015	1.25	3.50
60	HP-H13	Carrier	50RHR024	2.00	6.00
61	HP-H14	Carrier	50RHR024	2.00	6.00
62	HP-H21	Carrier	50RHR042	3.50	10.50
63	HP-H4	Carrier	50RHR012	1.00	3.00
64	HP-H4	Carrier	50RHR012	1.00	3.00
65	HP-H4	Carrier	50RHR012	1.00	3.00
66	HP-H13	Carrier	50RHR024	2.00	6.00
67	HP-H13	Carrier	50RHR024	2.00	6.00
68	HP-H14	Carrier	50RHR024	2.00	6.00
69	HP-H7	Carrier	50RHR015	1.25	3.50
70	HP-H8	Carrier	50RHR015	1.25	3.50
71	HP-H9	Carrier	50RHR015	1.25	3.50
72	HP-H19	Carrier	50RHR036	3.00	9.00
73	HP-H4	Carrier	50RHR012	1.00	3.00
74	HP-H4	Carrier	50RHR012	1.00	3.00
75	HP-H4	Carrier	50RHR012	1.00	3.00
76	HP-H4	Carrier	50RHR012	1.00	3.00
77	HP-H13	Carrier	50RHR024	2.00	6.00
78	HP-H17	Carrier	50RHR030	2.50	7.50
79	HP-H18	Carrier	50RHR036	3.00	9.00
80	HP-H5	Carrier	50RHR012	1.00	3.00
81	HP-H8	Carrier	50RHR015	1.25	3.50
82	HP-H2	Carrier	50RHR009	0.75	2.20
83	HP-H4	Carrier	50RHR012	1.00	3.00
84	HP-H4	Carrier	50RHR012	1.00	3.00
85	HP-H8	Carrier	50RHR015	1.25	3.50
86	HP-H14	Carrier	50RHR024	2.00	6.00
87	HP-H11	Carrier	50RHR019	1.50	4.50
88	HP-H1	Carrier	50RHR006	0.50	1.50
89	HP-H16	Carrier	50RHR030	2.50	7.50
90	HP-H14	Carrier	50RHR024	2.00	6.00
91	HP-H9	Carrier	50RHR015	1.25	3.50
92	HP-H8	Carrier	50RHR015	1.25	3.50
93	HP-H4	Carrier	50RHR012	1.00	3.00
94	HP-H18	Carrier	50RHR036	3.00	9.00
95	HP-H13	Carrier	50RHR024	2.00	6.00
96	HP-H16	Carrier	50RHR030	2.50	7.50
Total Packaged Unit Tons, Flow:				162.75	484.00

**Project: Rio Rancho City Hall**  
**Product: Carrier**  
**Date: 5/17/2019**

Total Units	Unit #	Manuf.	Model	Equipment	Flow
				Nom. Tons	GPM
97	HP-H1	Carrier	50RHR006	0.50	1.50
98	HP-H22	Carrier	50RHR048	4.00	12.00
99	HP-H11	Carrier	50RHR019	1.50	4.50
100	HP-H11	Carrier	50RHR019	1.50	4.50
101	HP-H8	Carrier	50RHR015	1.25	3.50
102	HP-H5	Carrier	50RHR012	1.00	3.00
103	HP-H6	Carrier	50RHR012	1.00	3.00
104	HP-H4	Carrier	50RHR012	1.00	3.00
105	HP-H10	Carrier	50RHR019	1.50	4.50
106	HP-H11	Carrier	50RHR019	1.50	4.50
107	HP-H11	Carrier	50RHR019	1.50	4.50
108	HP-H17	Carrier	50RHR030	2.50	7.50
109	HP-H15	Carrier	50RHR030	2.50	7.50
110	HP-H2	Carrier	50RHR009	0.75	2.20
111	HP-H9	Carrier	50RHR015	1.25	3.50
112	HP-H4	Carrier	50RHR012	1.00	3.00
113	HP-H12	Carrier	50RHR019	1.50	4.50
114	HP-H23	Carrier	50RHR060	5.00	15.00
115	HP-H4	Carrier	50RHR012	1.00	3.00
116	HP-H11	Carrier	50RHR019	1.50	4.50
117	HP-H11	Carrier	50RHR019	1.50	4.50
118	HP-H23	Carrier	50RHR060	5.00	15.00
119	HP-H1	Carrier	50RHR006	0.50	1.50
120	HP-H23	Carrier	50RHR060	5.00	15.00
121	HP-H13	Carrier	50RHR024	2.00	6.00
122	HP-H3	Carrier	50RHR009	0.75	2.10
123	HP-H11	Carrier	50RHR019	1.50	4.50
124	HP-H3	Carrier	50RHR009	0.75	2.10
125	HP-H8	Carrier	50RHR015	1.25	3.50
126	HP-H2	Carrier	50RHR009	0.75	2.20
127	HP-H4	Carrier	50RHR012	1.00	3.00
128					
129					
130					
131					
132					
133					
134					
135					
136					
137					
138					
139					
140					
141					
142					
143					
144					
Total Packaged Unit Tons, Flow:				216.00	642.60

**Project: Rio Rancho City Hall****Product: Carrier****Date: 5/17/2019****Roof-Top Packaged Units**

Unit #	Manuf.	Model	Nom. Tons	GPM
Total RTHP Units:			0.00	0.00

**ERV units with integrated heat pumps**

Unit #	Manuf.	Model	Nom. Tons	GPM
Total ERV/GSHP Units:			0.00	0.00

**Water/Water heat pump - domestic, snowmelt, other**

Unit #	Manuf.	Model	Nom. Tons	GPM
Total W/W GSHP Units:			0.00	0.00

			Nom. Tons	GPM
<b>Total All Units:</b>			<b>216.00</b>	<b>642.60</b>

**Loopfield & Long Header PD Calculation Spread Sheet**  
Assumes Reverse-Return Parallel Manifold & Headers  
Terry Proffer, CGD - Major Geothermal October 27, 2006



**Project Name:** Rio Rancho City Hall  
**Date:** 5/17/2019  
**By:** Terry  
**Configuration:** 15x12 vertical  
**Header pairs:** 15  
**Circuits/hdr. pair:** 12  
**Total circuits:** 180  
**Spacing:** 25.' for long header calculation  
**Peak Flow Rate:** 642.600 GPM  
**Header Flow Rate:** 42.840 GPM  
**Circuit Flow Rate:** 3.570 GPM

<b>Peak flow:</b>	<b>642.60</b>	<b>GPM</b>
<b>Total PD, Water:</b>	<b>74.08</b>	<b>Ft/Hd</b>
<b>Total PD, Water:</b>	<b>32.12</b>	<b>PSI</b>
<b>Total PD, 25% p-glycol @ 30° F</b>	<b>105.19</b>	<b>Ft/Hd</b>
<b>Total PD, 25% p-glycol @ 30° F</b>	<b>45.60</b>	<b>PSI</b>
<b>Total PD, 10% methanol @ 30° F</b>	<b>88.16</b>	<b>Ft/Hd</b>
<b>Total PD, 10% methanol @ 30° F</b>	<b>38.22</b>	<b>PSI</b>

Antifreeze by volume. PD correction factors as per p. 4-26, table 4.21 (IGSHPA, Remund)

**Loopfield Pressure Drop, DR11 schedule assumed**

Pipe Size	Fittings	Equiv. Ft.		Length		Total Length	
10"		'	+	'	=	'	
8"		'	+	'	=	'	
6"		'	+	'	=	'	
4"		'	+	'	=	'	
3"		'	+	'	=	'	DR 15.5
2"	10	30'	+	990'	=	1020'	DR 11
1.25"		'	+	'	=	'	DR 11
1"	3	9'	+	500'	=	509'	DR 11
0.75"		'	+	'	=	'	DR 11

Pipe Size (in)	GPM	Total Length (ft)		PD per 100' *		Actual PD
10		'	/ 100 =	0.00	X	0.00 = 0.00
8		'	/ 100 =	0.00	X	0.00 = 0.00
6		'	/ 100 =	0.00	X	0.00 = 0.00
4		'	/ 100 =	0.00	X	0.00 = 0.00
3		'	/ 100 =	0.00	X	0.00 = 0.00
2	42.840	1020'	/ 100 =	10.20	X	4.25 = 43.39
1.25		'	/ 100 =	0.00	X	0.00 = 0.00
1	3.570	509'	/ 100 =	5.09	X	0.96 = 4.90
0.75		'	/ 100 =	0.00	X	0.00 = 0.00

Insert header & circuit flow from inputs above

Peak Flow **642.600** Total PD **48.29**  
GPM Ft/Hd

**Header manifold must be designed for most efficient purge effort @ 2' of fluid flow/second**  
Assumes schedule DR11 HDPE pipe 2" and under

Stub size	GPM	Total Length (ft)		PD per 100' *		Actual PD	RR LEG
2	42.84	275'	/ 100 =	2.75	X	4.25 = 11.70	
2	39.27	50'	/ 100 =	0.5	X	3.64 = 1.82	1
2	35.70	50'	/ 100 =	0.5	X	3.06 = 1.53	2
2	32.13	50'	/ 100 =	0.5	X	2.54 = 1.27	3
2	28.56	50'	/ 100 =	0.5	X	2.05 = 1.03	4
2	24.99	50'	/ 100 =	0.5	X	1.61 = 0.81	5
1.5	21.42	50'	/ 100 =	0.5	X	3.57 = 1.79	6
1.5	17.85	50'	/ 100 =	0.5	X	2.58 = 1.29	7
1.25	14.28	50'	/ 100 =	0.5	X	3.29 = 1.65	8
1.25	10.71	50'	/ 100 =	0.5	X	1.97 = 0.98	9
1	7.14	50'	/ 100 =	0.5	X	2.91 = 1.46	10
1	3.57	50'	/ 100 =	0.5	X	0.96 = 0.48	11
	0.00	50'	/ 100 =	0.5	X	0.00 = 0.00	12
	-3.57	50'	/ 100 =	0.5	X	0.00 = 0.00	13
	-7.14	50'	/ 100 =	0.5	X	0.00 = 0.00	14
	-10.71	50'	/ 100 =	0.5	X	0.00 = 0.00	15
	-14.28	50'	/ 100 =	0.5	X	0.00 = 0.00	16
	-17.85	50'	/ 100 =	0.5	X	0.00 = 0.00	17
	-21.42	50'	/ 100 =	0.5	X	0.00 = 0.00	18
	-24.99	50'	/ 100 =	0.5	X	0.00 = 0.00	19

Insert correct manifold sizes for appropriate self-purging manifold configuration

Peak Flow **642.6** Total PD **25.79**  
GPM Ft/Hd

**Loopfield & Long Header Purging PD Calculation Spread Sheet**  
Assumes Reverse-Return Parallel Manifold & Headers  
Terry Proffer, CGD - Major Geothermal October 27, 2006



Fields in yellow require data input

**Project Name:** Rio Rancho City Hall  
**Date:** 5/17/2019  
**By:** Terry  
**Configuration:** 15x12 vertical  
**Header pairs:** 15  
**Circuits/hdr. pair:** 12

**Circuit size:** 1" 5.70 Flow rate

**Spacing (vertical):** 25.' for long header calculation  
**Peak Flow Rate:** 68.40 GPM - pure water  
**Circuit Flow Rate:** 5.70 GPM - pure water

**Purge rate for 2' / second:**

DR15.5 4" = 76.00 gpm  
DR15.5 3" = 46.00 gpm  
DR11 2" = 18.60 gpm  
DR11 1.25" = 9.10 gpm  
DR11 1" = 5.70 gpm  
DR11 0.75" = 3.70 gpm  
DR11 (DR11, HDPE)

<b>Peak flow:</b>	<b>68.40</b>	<b>GPM</b>
<b>Total PD, Water:</b>	<b>166.3</b>	<b>Ft/Hd</b>
<b>Total PD, Water:</b>	<b>72.1</b>	<b>PSI</b>

**Loopfield Pressure Drop, DR11 schedule assumed**

Pipe Size	Fittings	Equiv. Ft.		Length		Total Length
10"	0	'	+	'	=	'
8"	0	'	+	'	=	'
6"	0	'	+	'	=	'
4"	0	'	+	'	=	'
3"	0	'	+	'	=	'
2"	10	30'	+	990'	=	1020'
1.25"	0	'	+	'	=	'
1"	3	9'	+	500'	=	509'
0.75"	0	'	+	'	=	'

Pipe Size	GPM	Total Length (ft)		PD per 100' *		Actual PD
10		'	/ 100 =	0	X	0.00 = 0.00
8		'	/ 100 =	0	X	0.00 = 0.00
6		'	/ 100 =	0	X	0.00 = 0.00
4		'	/ 100 =	0	X	0.00 = 0.00
3		'	/ 100 =	0	X	0.00 = 0.00
2	68.40	1020'	/ 100 =	10.2	X	9.88 = 100.80
1.25		'	/ 100 =	0	X	0.00 = 0.00
1	5.70	509'	/ 100 =	5.09	X	1.95 = 9.90
0.75		'	/ 100 =	0	X	0.00 = 0.00

Insert header & circuit flow from inputs above

**Peak Flow** 68.40 **Total PD** 110.70  
GPM Ft/Hd

**Header manifold must be designed for most efficient purge effort @ 2' of fluid flow/second**  
Assumes schedule DR11 HDPE pipe

tub size (ir)	GPM	Total Length (ft)				PD per 100' *		Actual PD	RR LEG
2	68.40	275'	/ 100 =	2.75	X	9.88	=	27.18	1
2	62.70	50'	/ 100 =	0.5	X	8.45	=	4.22	2
2	57.00	50'	/ 100 =	0.5	X	7.11	=	3.56	3
2	51.30	50'	/ 100 =	0.5	X	5.88	=	2.94	4
2	45.60	50'	/ 100 =	0.5	X	4.76	=	2.38	5
2	39.90	50'	/ 100 =	0.5	X	3.74	=	1.87	6
1.5	34.20	50'	/ 100 =	0.5	X	8.29	=	0.00	7
1.5	28.50	50'	/ 100 =	0.5	X	5.97	=	2.98	8
1.25	22.80	50'	/ 100 =	0.5	X	7.63	=	3.82	9
1.25	17.10	50'	/ 100 =	0.5	X	4.55	=	2.28	10
1	11.40	50'	/ 100 =	0.5	X	6.74	=	3.37	11
1	5.70	50'	/ 100 =	0.5	X	1.95	=	0.97	12
0	0.00	50'	/ 100 =	0.5	X	0.00	=	0.00	13
0	-5.70	50'	/ 100 =	0.5	X	0.00	=	0.00	14
0	-11.40	50'	/ 100 =	0.5	X	0.00	=	0.00	15
0	-17.10	50'	/ 100 =	0.5	X	0.00	=	0.00	16
0	-22.80	50'	/ 100 =	0.5	X	0.00	=	0.00	17
0	-28.50	50'	/ 100 =	0.5	X	0.00	=	0.00	18
0	-34.20	50'	/ 100 =	0.5	X	0.00	=	0.00	19
0	-39.90	50'	/ 100 =	0.5	X	0.00	=	0.00	

Peak Flow **68.40** Total PD **55.57**



**Loopfield & Long Header Fluid Capacity Spread Sheet**  
Assumes Reverse-Return Parallel Manifold & Headers  
Terry Proffer, CGD - Major Geothermal October 27, 2006

**Project Name:** Rio Rancho City Hall  
**Date:** 5/17/2019  
**By:** Terry  
**Configuration:** 15x12 vertical

<b>Header pairs:</b>	15		
<b>Circuits/hdr. pair:</b>	12		
<b>Total circuits:</b>	180		
<b>Spacing (vertical):</b>	25'	for long header calculation	
<b>Header Line A</b>	245'	490'	2-way
<b>Header Line B</b>	225'	450'	2-way
<b>Header Line C</b>	190'	380'	2-way
<b>Header Line D</b>	170'	340'	2-way
<b>Header Line E</b>	150'	300'	2-way
<b>Header Line F</b>	130'	260'	2-way
<b>Header Line G</b>	105'	210'	2-way
<b>Header Line H</b>	85'	170'	2-way
<b>Header Line I</b>	495'	990'	2-way
<b>Header Line J</b>	475'	950'	2-way
<b>Header Line K</b>	440'	880'	2-way
<b>Header Line L</b>	420'	840'	2-way
<b>Header Line M</b>	400'	800'	2-way
<b>Header Line N</b>	380'	760'	2-way
<b>Header Line O</b>	355'	710'	2-way
<b>Header Line P</b>	'	'	2-way
<b>Header Line Q</b>	'	'	2-way
<b>Header Line R</b>	'	'	2-way
<b>Header Line S</b>	'	'	2-way
<b>Header Line T</b>	'	'	2-way
<b>Total header dist:</b>	4265'	8530'	2-way
<b>Circuit length:</b>	500'		

<b>490</b>	ft. total header line length
<b>450</b>	ft. total header line length
<b>380</b>	ft. total header line length
<b>340</b>	ft. total header line length
<b>300</b>	ft. total header line length
<b>260</b>	ft. total header line length
<b>210</b>	ft. total header line length
<b>170</b>	ft. total header line length
<b>990</b>	ft. total header line length
<b>950</b>	ft. total header line length
<b>880</b>	ft. total header line length
<b>840</b>	ft. total header line length
<b>800</b>	ft. total header line length
<b>760</b>	ft. total header line length
<b>710</b>	ft. total header line length
<b>0</b>	ft. total header line length
<b>0</b>	ft. total header line length
<b>0</b>	ft. total header line length
<b>0</b>	ft. total header line length
<b>0</b>	ft. total header line length
<b>0</b>	ft. total header line length
<b>8,530</b>	ft. total header line length, all headers
<b>90,000</b>	ft. total circuit length

DR11 schedule assumed unless otherwise noted

Pipe Size	Length		Gals/100'	Total Gals.
10"	'	x		0.0
8"	'	x	203.19	0.0
6"	'	x	119.90	0.0
4"	'	x	62.69	0.0
3"	'	x	37.90	0.0
2"	8530'	x	15.4	1,313.6
1.25"	'	x	7.52	0.0
1"	90000'	x	4.71	4,239.0
0.75"	'	x	3.02	0.0

DR15.5  
DR15.5  
DR11  
DR11  
DR11  
DR11

**Total Gallons:** **5,552.6**

<b>Total Loop Fluid Capacity:</b>	<b>7,097</b>	<b>gallons</b>
Propylene glycol:	25.0%	1,774 gallons
Methanol	10.0%	710 gallons

Antifreeze options, by volume

Stub size	Total Length (ft)	(Manifolding)	Gallons/100'		Gallons			RR LEG
2	275'	/ 100 =	2.75	X	15.40	=	42.35	
2	50'	/ 100 =	0.5	X	15.40	=	7.70	1
2	50'	/ 100 =	0.5	X	15.40	=	7.70	2
2	50'	/ 100 =	0.5	X	15.40	=	7.70	3
2	50'	/ 100 =	0.5	X	15.40	=	7.70	4
2	50'	/ 100 =	0.5	X	15.40	=	7.70	5
1.5	50'	/ 100 =	0.5	X	9.85	=	4.93	6
1.5	50'	/ 100 =	0.5	X	9.85	=	4.93	7
1.25	50'	/ 100 =	0.5	X	7.52	=	3.76	8
1.25	50'	/ 100 =	0.5	X	7.52	=	3.76	9
1	50'	/ 100 =	0.5	X	4.71	=	2.36	10
1	50'	/ 100 =	0.5	X	4.71	=	2.36	11
0	50'	/ 100 =	0.5	X	0.00	=	0.00	12
0	50'	/ 100 =	0.5	X	0.00	=	0.00	13
0	50'	/ 100 =	0.5	X	0.00	=	0.00	14
0	50'	/ 100 =	0.5	X	0.00	=	0.00	15
0	50'	/ 100 =	0.5	X	0.00	=	0.00	16
0	50'	/ 100 =	0.5	X	0.00	=	0.00	17
0	50'	/ 100 =	0.5	X	0.00	=	0.00	18
0	50'	/ 100 =	0.5	X	0.00	=	0.00	19
							102.93	
<b>Total Gallons:</b>							<b>1,544</b>	

**Total Fluid Capacity, exclusive of internal piping and heat pumps:** **7,097** Gallons

Header line distances

	Header Line #	1-way		2-way	
1	Header Line A	245	Feet	490	Feet
2	Header Line B	225	Feet	450	Feet
3	Header Line C	190	Feet	380	Feet
4	Header Line D	170	Feet	340	Feet
5	Header Line E	150	Feet	300	Feet
6	Header Line F	130	Feet	260	Feet
7	Header Line G	105	Feet	210	Feet
8	Header Line H	85	Feet	170	Feet
9	Header Line I	495	Feet	990	Feet
10	Header Line J	475	Feet	950	Feet
11	Header Line K	440	Feet	880	Feet
12	Header Line L	420	Feet	840	Feet
13	Header Line M	400	Feet	800	Feet
14	Header Line N	380	Feet	760	Feet
15	Header Line O	355	Feet	710	Feet
16	Header Line P	0	Feet	0	Feet
17	Header Line Q	0	Feet	0	Feet
18	Header Line R	0	Feet	0	Feet
19	Header Line S	0	Feet	0	Feet
20	Header Line T	0	Feet	0	Feet
	Maximum	495	Feet	990	Feet

DR11 1.00" Pipe volume per 100':

Pipe ID:	1.554	inches
Radius:	0.777	inches
Pi:	3.141593	
Length:	100	feet
Length:	1200	inches
Volume:	2276.005	cubic inches
Volume:	9.852834	gallons

DR15.5 4.00" Pipe volume per 100':

Pipe ID:	3.92	inches
Radius:	1.96	inches
Pi:	3.141593	
Length:	100	feet
Length:	1200	inches
Volume:	14482.49	cubic inches
Volume:	62.69477	gallons

9.852834



# **ATTACHMENT**

## **GROUND SOURCE HEAT PUMP SCHEDULE**

Rio Rancho City Hall  
Heat Pump Schedule  
Drawing M002, dated 4/7/2006

Inputs from M002 for COP and EER values (note - EER values not given, calculated from power and total cooling capacities given)

Count	Area	Code/Tag	Make	Model	Nom. Tons	Design GPM	GPM/Ton	SPEC'D EWT	
								EWT 70°F	EWT 85°F
1		HP-H1	Carrier	50RHR006	0.50	1.50	1.50	3.90	6.8
2		HP-H2	Carrier	50RHR009	0.75	2.20	2.25	4.20	6.1
3		HP-H3	Carrier	50RHR009	0.75	2.10	2.25	4.10	6.0
4		HP-H4	Carrier	50RHR012	1.00	3.00	3.00	4.10	7.5
5		HP-H5	Carrier	50RHR012	1.00	3.00	3.00	4.00	7.5
6		HP-H6	Carrier	50RHR012	1.00	3.00	3.00	4.10	7.5
7		HP-H7	Carrier	50RHR015	1.25	3.50	3.75	5.30	7.9
8		HP-H8	Carrier	50RHR015	1.25	3.50	3.75	5.10	7.9
9		HP-H9	Carrier	50RHR015	1.25	3.50	3.75	5.10	7.9
10		HP-H10	Carrier	50RHR019	1.50	4.50	4.50	4.50	7.0
11		HP-H11	Carrier	50RHR019	1.50	4.50	4.50	4.40	6.9
12		HP-H12	Carrier	50RHR019	1.50	4.50	4.50	4.20	6.8
13		HP-H13	Carrier	50RHR024	2.00	6.00	6.00	4.00	7.0
14		HP-H14	Carrier	50RHR024	2.00	6.00	6.00	3.80	6.9
15		HP-H15	Carrier	50RHR030	2.50	7.50	7.50	4.30	8.0
16		HP-H16	Carrier	50RHR030	2.50	7.50	7.50	4.30	8.0
17		HP-H17	Carrier	50RHR030	2.50	7.50	7.50	4.20	8.0
18		HP-H18	Carrier	50RHR036	3.00	9.00	9.00	4.20	7.4
19		HP-H19	Carrier	50RHR036	3.00	9.00	9.00	4.10	7.3
20		HP-H20	Carrier	50RHR042	3.50	10.50	10.50	4.40	12.5
21		HP-H21	Carrier	50RHR042	3.50	10.50	10.50	4.40	12.4
22		HP-H22	Carrier	50RHR048	4.00	12.00	12.00	4.30	11.8
23		HP-H23	Carrier	50RHR060	5.00	15.00	15.00	4.50	11.2

Count	Code/Tag	Make	Model	Nom. Tons	FLA	Voltage	Kwh	TC (kbtuh)	EER
1	HP-H1	Carrier	50RHR006	0.50	2.9	265	0.77	5.2	6.8
2	HP-H2	Carrier	50RHR009	0.75	4.2	265	1.11	6.8	6.1
3	HP-H3	Carrier	50RHR009	0.75	4.2	265	1.11	6.7	6.0
4	HP-H4	Carrier	50RHR012	1.00	5.1	265	1.35	10.1	7.5
5	HP-H5	Carrier	50RHR012	1.00	5.1	265	1.35	10.1	7.5
6	HP-H6	Carrier	50RHR012	1.00	5.1	265	1.35	10.1	7.5
7	HP-H7	Carrier	50RHR015	1.25	5.7	265	1.51	12.0	7.9
8	HP-H8	Carrier	50RHR015	1.25	5.7	265	1.51	11.9	7.9
9	HP-H9	Carrier	50RHR015	1.25	5.7	265	1.51	11.9	7.9
10	HP-H10	Carrier	50RHR019	1.50	9.0	265	2.39	16.7	7.0
11	HP-H11	Carrier	50RHR019	1.50	9.0	265	2.39	16.5	6.9
12	HP-H12	Carrier	50RHR019	1.50	9.0	265	2.39	16.3	6.8
13	HP-H13	Carrier	50RHR024	2.00	10.4	265	2.76	19.3	7.0
14	HP-H14	Carrier	50RHR024	2.00	10.4	265	2.76	19.0	6.9
15	HP-H15	Carrier	50RHR030	2.50	11.5	265	3.05	24.5	8.0
16	HP-H16	Carrier	50RHR030	2.50	11.5	265	3.05	24.5	8.0
17	HP-H17	Carrier	50RHR030	2.50	11.5	265	3.05	24.3	8.0
18	HP-H18	Carrier	50RHR036	3.00	14.9	265	3.95	29.2	7.4
19	HP-H19	Carrier	50RHR036	3.00	14.9	265	3.95	29.0	7.3
20	HP-H20	Carrier	50RHR042	3.50	6.0	460	2.76	34.5	12.5
21	HP-H21	Carrier	50RHR042	3.50	6.0	460	2.76	34.3	12.4
22	HP-H22	Carrier	50RHR048	4.00	7.5	460	3.45	40.7	11.8
23	HP-H23	Carrier	50RHR060	5.00	9.9	460	4.55	50.9	11.2

Total Heat Pumps	Total Count
All Floors	127

Total Tons	Design GPM	GPM Ton
216.00	642.60	648.00

Floor	Count	Code/Tag	Make	Model	Nom. Tons	Design GPM	GPM/Ton
Ground	1	HP-H21	Carrier	50RHR042	3.50	10.50	10.50
Ground	2	HP-H4	Carrier	50RHR012	1.00	3.00	3.00
Ground	3	HP-H16	Carrier	50RHR030	2.50	7.50	7.50
Ground	4	HP-H14	Carrier	50RHR024	2.00	6.00	6.00
Ground	5	HP-H10	Carrier	50RHR019	1.50	4.50	4.50
Ground	6	HP-H8	Carrier	50RHR015	1.25	3.50	3.75
Ground	7	HP-H9	Carrier	50RHR015	1.25	3.50	3.75
Ground	8	HP-H18	Carrier	50RHR036	3.00	9.00	9.00
Ground	9	HP-H4	Carrier	50RHR012	1.00	3.00	3.00
Ground	10	HP-H15	Carrier	50RHR030	2.50	7.50	7.50
Ground	11	HP-H4	Carrier	50RHR012	1.00	3.00	3.00
Ground	12	HP-H2	Carrier	50RHR009	0.75	2.20	2.25
Ground	13	HP-H7	Carrier	50RHR015	1.25	3.50	3.75
Ground	14	HP-H16	Carrier	50RHR030	2.50	7.50	7.50
Ground	15	HP-H14	Carrier	50RHR024	2.00	6.00	6.00
Ground	16	HP-H10	Carrier	50RHR019	1.50	4.50	4.50
Ground	17	HP-H4	Carrier	50RHR012	1.00	3.00	3.00
Ground	18	HP-H11	Carrier	50RHR019	1.50	4.50	4.50
Ground	19	HP-H4	Carrier	50RHR012	1.00	3.00	3.00
Ground	20	HP-H16	Carrier	50RHR030	2.50	7.50	7.50
Ground	21	HP-H17	Carrier	50RHR030	2.50	7.50	7.50
Ground	22	HP-H19	Carrier	50RHR036	3.00	9.00	9.00
Ground	23	HP-H1	Carrier	50RHR006	0.50	1.50	1.50
Ground	24	HP-H13	Carrier	50RHR024	2.00	6.00	6.00
Ground	25	HP-H11	Carrier	50RHR019	1.50	4.50	4.50
Ground	26	HP-H22	Carrier	50RHR048	4.00	12.00	12.00
Ground	27	HP-H23	Carrier	50RHR060	5.00	15.00	15.00
Ground	28	HP-H4	Carrier	50RHR012	1.00	3.00	3.00
Ground	29	HP-H11	Carrier	50RHR019	1.50	4.50	4.50
Ground	30	HP-H13	Carrier	50RHR024	2.00	6.00	6.00
Ground	31	HP-H7	Carrier	50RHR015	1.25	3.50	3.75
Ground	32	HP-H1	Carrier	50RHR006	0.50	1.50	1.50
Ground	33	HP-H8	Carrier	50RHR015	1.25	3.50	3.75
Ground	34	HP-H3	Carrier	50RHR009	0.75	2.10	2.25
Ground	35	HP-H12	Carrier	50RHR019	1.50	4.50	4.50
Ground	36	HP-H13	Carrier	50RHR024	2.00	6.00	6.00
Ground	37	HP-H14	Carrier	50RHR024	2.00	6.00	6.00
Ground	38	HP-H11	Carrier	50RHR019	1.50	4.50	4.50
Ground	39	HP-H20	Carrier	50RHR042	3.50	10.50	10.50
Ground	40	HP-H23	Carrier	50RHR060	5.00	15.00	15.00
Ground	41	HP-H22	Carrier	50RHR048	4.00	12.00	12.00
Ground	42	HP-H7	Carrier	50RHR015	1.25	3.50	3.75
Ground	43	HP-H4	Carrier	50RHR012	1.00	3.00	3.00
	43				83.00	247.30	249.00

Floor	Count	Code/Tag	Make	Model	Nom. Tons	Design GPM	GPM/Ton
Second	1	HP-H4	Carrier	50RHR012	1.00	3.00	3.00
Second	2	HP-H4	Carrier	50RHR012	1.00	3.00	3.00
Second	3	HP-H5	Carrier	50RHR012	1.00	3.00	3.00
Second	4	HP-H11	Carrier	50RHR019	1.50	4.50	4.50
Second	5	HP-H14	Carrier	50RHR024	2.00	6.00	6.00
Second	6	HP-H16	Carrier	50RHR030	2.50	7.50	7.50
Second	7	HP-H1	Carrier	50RHR006	0.50	1.50	1.50
Second	8	HP-H8	Carrier	50RHR015	1.25	3.50	3.75
Second	9	HP-H1	Carrier	50RHR006	0.50	1.50	1.50
Second	10	HP-H1	Carrier	50RHR006	0.50	1.50	1.50
Second	11	HP-H4	Carrier	50RHR012	1.00	3.00	3.00
Second	12	HP-H13	Carrier	50RHR024	2.00	6.00	6.00
Second	13	HP-H5	Carrier	50RHR012	1.00	3.00	3.00
Second	14	HP-H4	Carrier	50RHR012	1.00	3.00	3.00
Second	15	HP-H7	Carrier	50RHR015	1.25	3.50	3.75
Second	16	HP-H7	Carrier	50RHR015	1.25	3.50	3.75
Second	17	HP-H13	Carrier	50RHR024	2.00	6.00	6.00
Second	18	HP-H14	Carrier	50RHR024	2.00	6.00	6.00
Second	19	HP-H21	Carrier	50RHR042	3.50	10.50	10.50
Second	20	HP-H4	Carrier	50RHR012	1.00	3.00	3.00
Second	21	HP-H4	Carrier	50RHR012	1.00	3.00	3.00
Second	22	HP-H4	Carrier	50RHR012	1.00	3.00	3.00
Second	23	HP-H13	Carrier	50RHR024	2.00	6.00	6.00
Second	24	HP-H13	Carrier	50RHR024	2.00	6.00	6.00
Second	25	HP-H14	Carrier	50RHR024	2.00	6.00	6.00
Second	26	HP-H7	Carrier	50RHR015	1.25	3.50	3.75
Second	27	HP-H8	Carrier	50RHR015	1.25	3.50	3.75
Second	28	HP-H9	Carrier	50RHR015	1.25	3.50	3.75
Second	29	HP-H19	Carrier	50RHR036	3.00	9.00	9.00
Second	30	HP-H4	Carrier	50RHR012	1.00	3.00	3.00
Second	31	HP-H4	Carrier	50RHR012	1.00	3.00	3.00
Second	32	HP-H4	Carrier	50RHR012	1.00	3.00	3.00
Second	33	HP-H4	Carrier	50RHR012	1.00	3.00	3.00
Second	34	HP-H13	Carrier	50RHR024	2.00	6.00	6.00
Second	35	HP-H17	Carrier	50RHR030	2.50	7.50	7.50
Second	36	HP-H18	Carrier	50RHR036	3.00	9.00	9.00
	36				54.00	160.50	162.00

Floor	Count	Code/Tag	Make	Model	Nom. Tons	Design GPM	GPM/Ton
Third	1	HP-H5	Carrier	50RHR012	1.00	3.00	3.00
Third	2	HP-H8	Carrier	50RHR015	1.25	3.50	3.75
Third	3	HP-H2	Carrier	50RHR009	0.75	2.20	2.25
Third	4	HP-H4	Carrier	50RHR012	1.00	3.00	3.00
Third	5	HP-H4	Carrier	50RHR012	1.00	3.00	3.00
Third	6	HP-H8	Carrier	50RHR015	1.25	3.50	3.75
Third	7	HP-H14	Carrier	50RHR024	2.00	6.00	6.00
Third	8	HP-H11	Carrier	50RHR019	1.50	4.50	4.50
Third	9	HP-H1	Carrier	50RHR006	0.50	1.50	1.50
Third	10	HP-H16	Carrier	50RHR030	2.50	7.50	7.50
Third	11	HP-H14	Carrier	50RHR024	2.00	6.00	6.00
Third	12	HP-H9	Carrier	50RHR015	1.25	3.50	3.75
Third	13	HP-H8	Carrier	50RHR015	1.25	3.50	3.75
Third	14	HP-H4	Carrier	50RHR012	1.00	3.00	3.00
Third	15	HP-H18	Carrier	50RHR036	3.00	9.00	9.00
Third	16	HP-H13	Carrier	50RHR024	2.00	6.00	6.00
Third	17	HP-H16	Carrier	50RHR030	2.50	7.50	7.50
Third	18	HP-H1	Carrier	50RHR006	0.50	1.50	1.50
Third	19	HP-H22	Carrier	50RHR048	4.00	12.00	12.00
Third	20	HP-H11	Carrier	50RHR019	1.50	4.50	4.50
Third	21	HP-H11	Carrier	50RHR019	1.50	4.50	4.50
Third	22	HP-H8	Carrier	50RHR015	1.25	3.50	3.75
Third	23	HP-H5	Carrier	50RHR012	1.00	3.00	3.00
Third	24	HP-H6	Carrier	50RHR012	1.00	3.00	3.00
Third	25	HP-H4	Carrier	50RHR012	1.00	3.00	3.00
	25				37.50	111.20	112.50

Floor	Count	Code/Tag	Make	Model	Nom. Tons	Design GPM	GPM/Ton
Fourth	1	HP-H10	Carrier	50RHR019	1.50	4.50	4.50
Fourth	2	HP-H11	Carrier	50RHR019	1.50	4.50	4.50
Fourth	3	HP-H11	Carrier	50RHR019	1.50	4.50	4.50
Fourth	4	HP-H17	Carrier	50RHR030	2.50	7.50	7.50
Fourth	5	HP-H15	Carrier	50RHR030	2.50	7.50	7.50
Fourth	6	HP-H2	Carrier	50RHR009	0.75	2.20	2.25
Fourth	7	HP-H9	Carrier	50RHR015	1.25	3.50	3.75
Fourth	8	HP-H4	Carrier	50RHR012	1.00	3.00	3.00
Fourth	9	HP-H12	Carrier	50RHR019	1.50	4.50	4.50
Fourth	10	HP-H23	Carrier	50RHR060	5.00	15.00	15.00
Fourth	11	HP-H4	Carrier	50RHR012	1.00	3.00	3.00
Fourth	12	HP-H11	Carrier	50RHR019	1.50	4.50	4.50
Fourth	13	HP-H11	Carrier	50RHR019	1.50	4.50	4.50
Fourth	14	HP-H23	Carrier	50RHR060	5.00	15.00	15.00
Fourth	15	HP-H1	Carrier	50RHR006	0.50	1.50	1.50
Fourth	16	HP-H23	Carrier	50RHR060	5.00	15.00	15.00
Fourth	17	HP-H13	Carrier	50RHR024	2.00	6.00	6.00
Fourth	18	HP-H3	Carrier	50RHR009	0.75	2.10	2.25
Fourth	19	HP-H11	Carrier	50RHR019	1.50	4.50	4.50
Fourth	20	HP-H3	Carrier	50RHR009	0.75	2.10	2.25
Fourth	21	HP-H8	Carrier	50RHR015	1.25	3.50	3.75
Fourth	22	HP-H2	Carrier	50RHR009	0.75	2.20	2.25
Fourth	23	HP-H4	Carrier	50RHR012	1.00	3.00	3.00
	23				41.50	123.60	124.50



## **ATTACHMENT**

**CARRIER GSHP PERFORMANCE TABLES  
50R SERIES - 0.5 to 5.0 TON PACKAGED HEAT PUMPS  
EWT RANGES, COOLING & HEATING  
CAPACITIES & EFFICIENCIES  
from: MANUAL NUMBER 50R-4PD  
print date: 6-1-2002**



# Performance data

## 50RHR006 200 CFM NOMINAL AIRFLOW

EWT (F)	GPM	PRESSURE DROP		COOLING CAPACITY				HEATING CAPACITY		
		PSI	ft wg	TC	TSC	kW	THR	TC	kW	THA
20	0.8	0.9	2.0	Operation Not Recommended				Operation Not Recommended		
	1.1	1.2	2.9							
	1.5	2.1	4.9							
30	0.8	0.8	2.0	7.4	4.8	0.23	8.2	5.1	0.52	3.3
	1.1	1.2	2.8	7.6	4.9	0.22	8.3	5.2	0.50	3.5
	1.5	2.0	4.7	7.8	5.0	0.21	8.5	5.4	0.49	3.7
40	0.8	0.8	1.9	7.1	4.7	0.29	8.1	5.6	0.53	3.8
	1.1	1.2	2.7	7.3	4.8	0.28	8.3	5.8	0.52	4.0
	1.5	2.0	4.5	7.5	4.8	0.27	8.4	6.0	0.51	4.2
50	0.8	0.8	1.8	6.9	4.5	0.36	8.1	6.2	0.55	4.3
	1.1	1.1	2.6	7.0	4.6	0.34	8.2	6.3	0.54	4.5
	1.5	1.9	4.4	7.2	4.7	0.33	8.3	6.5	0.52	4.8
60	0.8	0.8	1.8	6.6	4.4	0.42	8.0	6.7	0.57	4.8
	1.1	1.1	2.5	6.8	4.5	0.40	8.1	6.9	0.55	5.0
	1.5	1.8	4.2	6.9	4.5	0.39	8.2	7.1	0.54	5.3
70	0.8	0.7	1.7	6.3	4.2	0.48	8.0	7.2	0.58	5.2
	1.1	1.0	2.4	6.5	4.3	0.46	8.1	7.5	0.57	5.5
	<b>1.5</b>	<b>1.8</b>	<b>4.0</b>	6.6	4.4	0.44	8.2	<b>7.7</b>	<b>0.56</b>	<b>5.8</b>
80	0.8	0.7	1.6	6.1	4.1	0.55	7.9	7.8	0.60	5.7
	1.1	1.0	2.3	6.2	4.2	0.53	8.0	8.0	0.59	6.0
	1.5	1.7	3.9	6.4	4.2	0.50	8.1	8.2	0.57	6.3
85	<b>1.5</b>	<b>1.7</b>	<b>3.9</b>	<b>6.2</b>	<b>4.2</b>	<b>0.53</b>	<b>8.0</b>	Operation Not Recommended		
90	0.8	0.7	1.6	5.8	3.9	0.61	7.9	8.3	0.62	6.2
	1.1	1.0	2.3	5.9	4.0	0.59	7.9	8.6	0.60	6.5
	1.5	1.7	3.8	6.1	4.1	0.56	8.0	8.8	0.59	6.8
100	0.8	0.7	1.6	5.5	3.8	0.67	7.8	Operation Not Recommended		
	1.1	1.0	2.2	5.7	3.9	0.65	7.9			
	1.5	1.6	3.7	5.8	3.9	0.62	7.9			
110	0.8	0.7	1.5	5.3	3.6	0.74	7.8	Operation Not Recommended		
	1.1	0.9	2.1	5.4	3.7	0.71	7.8			
	1.5	1.6	3.6	5.5	3.8	0.68	7.8			

LEGEND

- EWT** — Entering Water Temperature (F)
- GPM** — Gallons Per Minute
- TC** — Total Capacity (MBtuh)
- THA** — Total Heat of Absorption (MBtuh)
- THR** — Total Heat of Rejection (MBtuh)
- TSC** — Total Sensible Capacity (MBtuh)

NOTES:

1. Interpolation is permissible, extrapolation is not.
2. All entering air conditions are 80 F db (dry bulb) and 67 F wb (wet bulb) in cooling and 70 F db in heating.
3. ARI 320 points (bold printing) are shown for comparison purposes only. These are not certified data points.
4. All performance data is based upon the lower voltage of dual voltage rated units.
5. Operation below 60 F EWT requires optional insulated water circuit.
6. Operation below 40 F EWT is based upon 15% antifreeze solution.
7. See Correction Factor tables for operating conditions other than those listed above.
8. Performance capacities shown in thousands of Btuh.



**50RHR,RVR009**  
**300 CFM NOMINAL AIRFLOW**

EWT (F)	GPM	PRESSURE DROP		COOLING CAPACITY				HEATING CAPACITY		
		PSI	ft wg	TC	TSC	kW	THR	TC	kW	THA
20	1.1	1.2	2.8	Operation Not Recommended				Operation Not Recommended		
	1.7	1.8	4.2							
	2.2	3.6	8.3					5.5	0.63	3.4
30	1.1	1.2	2.7	10.6	7.0	0.40	12.0	5.9	0.62	3.8
	1.7	1.7	4.0	10.9	7.1	0.38	12.2	6.2	0.64	4.0
	2.2	3.5	8.0	11.1	7.2	0.36	12.4	6.5	0.66	4.3
40	1.1	1.1	2.6	10.1	6.8	0.47	11.7	6.8	0.65	4.6
	1.7	1.7	3.9	10.3	6.9	0.45	11.8	7.2	0.67	4.9
	2.2	3.4	7.8	10.6	7.0	0.43	12.0	7.5	0.69	5.2
50	1.1	1.1	2.5	9.5	6.5	0.53	11.3	7.7	0.68	5.4
	1.7	1.6	3.7	9.7	6.7	0.51	11.5	8.1	0.70	5.7
	2.2	3.2	7.5	10.0	6.8	0.49	11.6	8.5	0.71	6.1
60	1.1	1.0	2.4	9.0	6.3	0.60	11.0	8.6	0.71	6.2
	1.7	1.6	3.6	9.2	6.5	0.58	11.1	9.1	0.72	6.6
	2.2	3.1	7.2	9.4	6.6	0.55	11.3	9.5	0.74	7.0
70	1.1	1.0	2.3	8.4	6.1	0.67	10.7	9.5	0.73	7.0
	1.7	1.5	3.5	8.6	6.2	0.64	10.8	10.0	0.75	7.5
	<b>2.2</b>	<b>3.0</b>	<b>6.9</b>	8.8	6.4	0.61	10.9	<b>10.5</b>	<b>0.77</b>	<b>7.9</b>
80	1.1	1.0	2.2	7.9	5.9	0.74	10.4	10.4	0.76	7.8
	1.7	1.5	3.4	8.0	6.0	0.71	10.5	11.0	0.78	8.3
	2.2	2.9	6.7	8.2	6.1	0.68	10.5	11.5	0.80	8.8
85	<b>2.2</b>	<b>2.9</b>	<b>6.7</b>	<b>7.9</b>	<b>6.0</b>	<b>0.71</b>	<b>10.4</b>	Operation Not Recommended		
90	1.1	0.9	2.2	7.3	5.7	0.80	10.1	11.3	0.79	8.7
	1.7	1.4	3.3	7.5	5.8	0.77	10.1	11.9	0.81	9.2
	2.2	2.8	6.6	7.7	5.9	0.74	10.2	12.5	0.83	9.7
100	1.1	0.9	2.1	6.8	5.5	0.87	9.7	Operation Not Recommended		
	1.7	1.4	3.2	6.9	5.6	0.84	9.8			
	2.2	2.8	6.4	7.1	5.7	0.80	9.8			
110	1.1	0.9	2.1	6.2	5.3	0.94	9.4			
	1.7	1.4	3.1	6.4	5.4	0.90	9.4			
	2.2	2.7	6.2	6.5	5.5	0.86	9.4			

LEGEND

- EWT** — Entering Water Temperature (F)
- GPM** — Gallons Per Minute
- TC** — Total Capacity (MBtuh)
- THA** — Total Heat of Absorption (MBtuh)
- THR** — Total Heat of Rejection (MBtuh)
- TSC** — Total Sensible Capacity (MBtuh)

NOTES:

1. Interpolation is permissible, extrapolation is not.
2. All entering air conditions are 80 F db (dry bulb) and 67 F wb (wet bulb) in cooling and 70 F db in heating.
3. ARI 320 points (bold printing) are shown for comparison purposes only. These are not certified data points.
4. All performance data is based upon the lower voltage of dual voltage rated units.
5. Operation below 60 F EWT requires optional insulated water circuit.
6. Operation below 40 F EWT is based upon 15% antifreeze solution.
7. See Correction Factor tables for operating conditions other than those listed above.
8. Performance capacities shown in thousands of Btuh.



# Performance data (cont)

## 50RHR,RVR012 375 CFM NOMINAL AIRFLOW

EWT (F)	GPM	PRESSURE DROP		COOLING CAPACITY				HEATING CAPACITY		
		PSI	ft wg	TC	TSC	kW	THR	TC	kW	THA
20	1.5	2.9	6.7	Operation Not Recommended				Operation Not Recommended		
	2.3	6.2	14.4							
	3.0	10.0	23.0					7.6	0.84	4.7
30	1.5	2.8	6.4	14.3	10.1	0.57	16.2	8.2	0.85	5.3
	2.3	6.0	13.9	14.6	10.3	0.54	16.5	8.7	0.87	5.7
	3.0	9.6	22.3	15.0	10.5	0.52	16.8	9.1	0.89	6.1
40	1.5	2.7	6.2	13.8	9.8	0.65	16.0	9.6	0.89	6.6
	2.3	5.8	13.5	14.1	10.0	0.63	16.3	10.1	0.92	7.0
	3.0	9.3	21.5	14.4	10.2	0.60	16.5	10.6	0.94	7.4
50	1.5	2.6	6.0	13.3	9.6	0.74	15.8	11.0	0.94	7.8
	2.3	5.6	13.0	13.6	9.8	0.71	16.0	11.6	0.96	8.3
	3.0	9.0	20.7	13.9	10.0	0.68	16.2	12.2	0.99	8.8
60	1.5	2.5	5.8	12.8	9.3	0.82	15.6	12.4	0.98	9.1
	2.3	5.4	12.5	13.1	9.5	0.79	15.8	13.1	1.01	9.7
	3.0	8.6	19.9	13.4	9.7	0.75	15.9	13.7	1.03	10.2
70	1.5	2.4	5.5	12.3	9.1	0.90	15.3	13.8	1.03	10.3
	2.3	5.2	12.0	12.5	9.2	0.87	15.5	14.6	1.05	11.0
	<b>3.0</b>	<b>8.3</b>	<b>19.2</b>	12.8	9.4	0.83	15.7	<b>15.3</b>	<b>1.08</b>	<b>11.6</b>
80	1.5	2.3	5.4	11.7	8.8	0.99	15.1	15.2	1.07	11.6
	2.3	5.1	11.7	12.0	9.0	0.95	15.3	16.0	1.10	12.3
	3.0	8.1	18.7	12.3	9.2	0.91	15.4	16.8	1.13	13.0
85	<b>3.0</b>	<b>8.0</b>	<b>18.4</b>	<b>12.0</b>	<b>9.0</b>	<b>0.95</b>	<b>15.3</b>	Operation Not Recommended		
90	1.5	2.3	5.3	11.2	8.6	1.07	14.9	16.6	1.12	12.8
	2.3	4.9	11.4	11.5	8.7	1.03	15.0	17.5	1.15	13.6
	3.0	7.9	18.2	11.8	8.9	0.98	15.1	18.4	1.18	14.4
100	1.5	2.2	5.1	10.7	8.3	1.16	14.7	Operation Not Recommended		
	2.3	4.8	11.1	11.0	8.5	1.11	14.8			
	3.0	7.7	17.7	11.2	8.6	1.06	14.9			
110	1.5	2.2	5.0	10.2	8.1	1.24	14.4			
	2.3	4.7	10.8	10.5	8.2	1.19	14.5			
	3.0	7.5	17.3	10.7	8.4	1.14	14.6			

LEGEND

- EWT** — Entering Water Temperature (F)
- GPM** — Gallons Per Minute
- TC** — Total Capacity (MBtuh)
- THA** — Total Heat of Absorption (MBtuh)
- THR** — Total Heat of Rejection (MBtuh)
- TSC** — Total Sensible Capacity (MBtuh)

NOTES:

1. Interpolation is permissible, extrapolation is not.
2. All entering air conditions are 80 F db (dry bulb) and 67 F wb (wet bulb) in cooling and 70 F db in heating.
3. ARI 320 points (bold printing) are shown for comparison purposes only. These are not certified data points.
4. All performance data is based upon the lower voltage of dual voltage rated units.
5. Operation below 60 F EWT requires optional insulated water circuit.
6. Operation below 40 F EWT is based upon 15% antifreeze solution.
7. See Correction Factor tables for operating conditions other than those listed above.
8. Performance capacities shown in thousands of Btuh.



**50RHR,RVR015**  
**500 CFM NOMINAL AIRFLOW**

EWT (F)	GPM	PRESSURE DROP		COOLING CAPACITY				HEATING CAPACITY		
		PSI	ft wg	TC	TSC	kW	THR	TC	kW	THA
20	1.8	2.5	5.8	Operation Not Recommended				Operation Not Recommended		
	2.6	4.9	11.4							
	3.5	8.4	19.4					9.9	0.94	6.7
30	1.8	2.4	5.6	17.8	12.8	0.67	20.1	10.4	0.94	7.2
	2.6	4.8	11.0	18.0	13.0	0.64	20.2	11.0	0.96	7.7
	3.5	8.1	18.8	18.3	13.3	0.61	20.3	11.5	0.98	8.2
40	1.8	2.4	5.4	17.1	12.3	0.76	19.8	11.9	0.98	8.6
	2.6	4.6	10.6	17.4	12.6	0.73	19.8	12.5	1.00	9.1
	3.5	7.8	18.1	17.6	12.8	0.69	19.9	13.2	1.02	9.7
50	1.8	2.3	5.2	16.5	11.8	0.86	19.4	13.4	1.02	9.9
	2.6	4.4	10.2	16.7	12.1	0.82	19.5	14.1	1.04	10.5
	3.5	7.6	17.5	16.9	12.3	0.78	19.5	14.8	1.06	11.2
60	1.8	2.2	5.0	15.8	11.3	0.97	19.1	14.9	1.06	11.2
	2.6	4.3	9.8	16.0	11.6	0.92	19.1	15.6	1.08	12.0
	3.5	7.3	16.8	16.2	11.8	0.88	19.2	16.4	1.11	12.7
70	1.8	2.1	4.9	15.1	10.8	1.07	18.8	16.3	1.10	12.6
	2.6	4.1	9.5	15.3	11.1	1.02	18.8	17.2	1.13	13.4
	<b>3.5</b>	<b>7.0</b>	<b>16.2</b>	15.5	11.3	0.97	18.8	<b>18.1</b>	<b>1.15</b>	<b>14.1</b>
80	1.8	2.0	4.7	14.4	10.3	1.18	18.5	17.8	1.15	13.9
	2.6	4.0	9.2	14.6	10.6	1.13	18.5	18.8	1.17	14.8
	3.5	6.8	15.7	14.8	10.8	1.07	18.5	19.7	1.20	15.6
85	<b>3.5</b>	<b>6.7</b>	<b>15.5</b>	<b>14.5</b>	<b>10.5</b>	<b>1.13</b>	<b>18.3</b>	Operation Not Recommended		
90	1.8	2.0	4.6	13.8	9.8	1.30	18.2	19.3	1.19	15.2
	2.6	3.9	9.0	13.9	10.1	1.24	18.2	20.3	1.22	16.1
	3.5	6.6	15.3	14.1	10.3	1.18	18.1	21.3	1.25	17.1
100	1.8	1.9	4.5	13.1	9.3	1.42	18.0	Operation Not Recommended		
	2.6	3.8	8.8	13.3	9.5	1.35	17.9			
	3.5	6.5	14.9	13.4	9.7	1.29	17.8			
110	1.8	1.9	4.4	12.5	8.8	1.54	17.7			
	2.6	3.7	8.5	12.6	9.0	1.47	17.6			
	3.5	6.3	14.6	12.8	9.2	1.40	17.5			

LEGEND

- EWT** — Entering Water Temperature (F)
- GPM** — Gallons Per Minute
- TC** — Total Capacity (MBtuh)
- THA** — Total Heat of Absorption (MBtuh)
- THR** — Total Heat of Rejection (MBtuh)
- TSC** — Total Sensible Capacity (MBtuh)

NOTES:

1. Interpolation is permissible, extrapolation is not.
2. All entering air conditions are 80 F db (dry bulb) and 67 F wb (wet bulb) in cooling and 70 F db in heating.
3. ARI 320 points (bold printing) are shown for comparison purposes only. These are not certified data points.
4. All performance data is based upon the lower voltage of dual voltage rated units.
5. Operation below 60 F EWT requires optional insulated water circuit.
6. Operation below 40 F EWT is based upon 15% antifreeze solution.
7. See Correction Factor tables for operating conditions other than those listed above.
8. Performance capacities shown in thousands of Btuh.



# Performance data (cont)

## 50RHR,RVR019 600 CFM NOMINAL AIRFLOW

EWT (F)	GPM	PRESSURE DROP		COOLING CAPACITY				HEATING CAPACITY		
		PSI	ft wg	TC	TSC	kW	THR	TC	kW	THA
20	2.3	1.9	4.4	Operation Not Recommended				Operation Not Recommended		
	3.4	3.5	8.0							
	4.5	6.8	15.8							
30	2.3	1.9	4.3	24.3	15.7	1.01	27.7	13.1	1.18	9.1
	3.4	3.4	7.8	25.1	15.9	0.98	28.5	13.8	1.22	9.6
	4.5	6.6	15.3	26.0	16.2	0.94	29.2	14.5	1.25	10.2
40	2.3	1.8	4.1	24.1	15.4	1.14	27.9	15.6	1.29	11.2
	3.4	3.3	7.5	24.9	15.6	1.10	28.6	16.4	1.33	11.8
	4.5	6.4	14.8	25.8	15.9	1.05	29.4	17.2	1.37	12.5
50	2.3	1.7	4.0	23.3	15.0	1.26	27.5	18.1	1.40	13.3
	3.4	3.1	7.2	24.1	15.3	1.21	28.2	19.0	1.44	14.1
	4.5	6.2	14.2	24.9	15.5	1.17	28.9	19.9	1.48	14.8
60	2.3	1.7	3.8	22.0	14.6	1.38	26.7	20.5	1.51	15.4
	3.4	3.0	7.0	22.8	14.8	1.33	27.3	21.6	1.55	16.3
	4.5	5.9	13.7	23.6	15.1	1.28	28.0	22.6	1.60	17.2
70	2.3	1.6	3.7	20.5	14.1	1.50	25.7	23.0	1.61	17.5
	3.4	2.9	6.7	21.3	14.4	1.45	26.2	24.2	1.66	18.5
	<b>4.5</b>	<b>5.7</b>	<b>13.2</b>	22.0	14.6	1.40	26.8	<b>25.3</b>	<b>1.71</b>	<b>19.5</b>
80	2.3	1.6	3.6	19.0	13.6	1.63	24.5	25.5	1.72	19.6
	3.4	2.8	6.5	19.6	13.8	1.57	25.0	26.8	1.77	20.7
	4.5	5.6	12.8	20.3	14.1	1.51	25.5	28.1	1.83	21.8
85	<b>4.5</b>	<b>5.5</b>	<b>12.6</b>	<b>19.5</b>	<b>13.7</b>	<b>1.57</b>	<b>24.9</b>	Operation Not Recommended		
90	2.3	1.5	3.5	17.5	13.0	1.75	23.4	27.9	1.83	21.7
	3.4	2.7	6.3	18.1	13.2	1.69	23.9	29.4	1.88	22.9
	4.5	5.4	12.5	18.7	13.4	1.62	24.3	30.8	1.94	24.2
100	2.3	1.5	3.4	16.2	12.4	1.87	22.6	Operation Not Recommended		
	3.4	2.7	6.2	16.8	12.6	1.80	23.0			
	4.5	5.3	12.2	17.4	12.8	1.74	23.3			
110	2.3	1.4	3.3	15.4	11.7	1.99	22.2			
	3.4	2.6	6.0	15.9	11.8	1.92	22.5			
	4.5	5.1	11.9	16.5	12.0	1.85	22.8			

LEGEND

- EWT** — Entering Water Temperature (F)
- GPM** — Gallons Per Minute
- TC** — Total Capacity (MBtuh)
- THA** — Total Heat of Absorption (MBtuh)
- THR** — Total Heat of Rejection (MBtuh)
- TSC** — Total Sensible Capacity (MBtuh)

NOTES:

1. Interpolation is permissible, extrapolation is not.
2. All entering air conditions are 80 F db (dry bulb) and 67 F wb (wet bulb) in cooling and 70 F db in heating.
3. ARI 320 points (bold printing) are shown for comparison purposes only. These are not certified data points.
4. All performance data is based upon the lower voltage of dual voltage rated units.
5. Operation below 60 F EWT requires optional insulated water circuit.
6. Operation below 40 F EWT is based upon 15% antifreeze solution.
7. See Correction Factor tables for operating conditions other than those listed above.
8. Performance capacities shown in thousands of Btuh.



**50RHR,RVR024**  
**800 CFM NOMINAL AIRFLOW**

EWT (F)	GPM	PRESSURE DROP		COOLING CAPACITY				HEATING CAPACITY		
		PSI	ft wg	TC	TSC	kW	THR	TC	kW	THA
20	3.0	2.0	4.7	Operation Not Recommended				Operation Not Recommended		
	4.5	4.3	10.0							
	6.0	7.2	16.6					13.4	1.34	8.9
30	3.0	2.0	4.6	29.8	19.3	1.12	33.6	13.6	1.37	8.9
	4.5	4.2	9.7	30.2	19.4	1.08	33.9	14.0	1.39	9.2
	6.0	7.0	16.1	30.7	19.6	1.03	34.2	14.4	1.42	9.5
40	3.0	1.9	4.4	28.3	19.5	1.34	32.9	16.2	1.50	11.1
	4.5	4.0	9.3	28.8	19.6	1.28	33.2	16.7	1.53	11.5
	6.0	6.7	15.5	29.2	19.8	1.23	33.4	17.2	1.56	11.8
50	3.0	1.8	4.2	27.0	18.9	1.49	32.1	19.7	1.66	14.1
	4.5	3.9	9.0	27.5	19.0	1.42	32.3	20.3	1.70	14.5
	6.0	6.5	15.0	27.9	19.2	1.36	32.5	20.9	1.73	15.0
60	3.0	1.8	4.1	25.7	18.0	1.62	31.3	23.4	1.83	17.2
	4.5	3.7	8.6	26.1	18.2	1.55	31.4	24.1	1.86	17.8
	6.0	6.2	14.4	26.5	18.3	1.48	31.6	24.9	1.90	18.4
70	3.0	1.7	3.9	24.4	17.3	1.77	30.4	26.5	1.96	19.8
	4.5	3.6	8.3	24.8	17.4	1.69	30.5	27.3	2.00	20.5
	<b>6.0</b>	<b>6.0</b>	<b>13.9</b>	25.1	17.5	1.62	30.7	<b>28.1</b>	<b>2.03</b>	<b>21.2</b>
80	3.0	1.7	3.8	23.0	16.8	1.95	29.6	28.2	2.04	21.3
	4.5	3.5	8.1	23.3	16.9	1.87	29.7	29.1	2.08	22.0
	6.0	5.8	13.5	23.7	17.1	1.78	29.8	29.9	2.12	22.7
<b>85</b>	<b>6.0</b>	<b>5.8</b>	<b>13.3</b>	<b>23.0</b>	<b>16.9</b>	<b>1.87</b>	<b>29.4</b>	Operation Not Recommended		
90	3.0	1.6	3.7	21.6	16.6	2.15	28.9	27.7	2.03	20.8
	4.5	3.4	7.9	21.9	16.7	2.06	29.0	28.6	2.07	21.5
	6.0	5.7	13.1	22.3	16.8	1.97	29.0	29.4	2.11	22.2
100	3.0	1.6	3.6	20.4	16.4	2.33	28.4	Operation Not Recommended		
	4.5	3.3	7.7	20.7	16.5	2.24	28.3			
	6.0	5.5	12.8	21.0	16.6	2.14	28.3			
110	3.0	1.5	3.5	19.6	15.7	2.45	27.9			
	4.5	3.2	7.5	19.9	15.9	2.35	27.9			
	6.0	5.4	12.5	20.2	16.0	2.24	27.8			

LEGEND

- EWT** — Entering Water Temperature (F)
- GPM** — Gallons Per Minute
- TC** — Total Capacity (MBtuh)
- THA** — Total Heat of Absorption (MBtuh)
- THR** — Total Heat of Rejection (MBtuh)
- TSC** — Total Sensible Capacity (MBtuh)

NOTES:

1. Interpolation is permissible, extrapolation is not.
2. All entering air conditions are 80 F db (dry bulb) and 67 F wb (wet bulb) in cooling and 70 F db in heating.
3. ARI 320 points (bold printing) are shown for comparison purposes only. These are not certified data points.
4. All performance data is based upon the lower voltage of dual voltage rated units.
5. Operation below 60 F EWT requires optional insulated water circuit.
6. Operation below 40 F EWT is based upon 15% antifreeze solution.
7. See Correction Factor tables for operating conditions other than those listed above.
8. Performance capacities shown in thousands of Btuh.



# Performance data (cont)

## 50RHR,RVR030 1000 CFM NOMINAL AIRFLOW

EWT (F)	GPM	PRESSURE DROP		COOLING CAPACITY				HEATING CAPACITY		
		PSI	ft wg	TC	TSC	kW	THR	TC	kW	THA
20	3.8	1.5	3.4	Operation Not Recommended				Operation Not Recommended		
	5.5	2.5	5.9							
	7.5	4.1	9.4							
30	3.8	1.4	3.3	39.6	28.7	1.46	44.6	18.9	1.77	12.8
	5.5	2.4	5.7	40.9	29.2	1.41	45.7	19.5	1.80	13.4
	7.5	3.9	9.1	42.2	29.8	1.36	46.9	20.2	1.83	14.0
40	3.8	1.4	3.2	34.6	25.5	1.59	40.1	21.9	1.90	15.5
	5.5	2.4	5.5	35.8	26.0	1.53	41.0	22.7	1.93	16.1
	7.5	3.8	8.8	37.0	26.5	1.48	42.0	23.5	1.96	16.8
50	3.8	1.3	3.0	31.5	23.6	1.75	37.4	25.2	2.03	18.3
	5.5	2.3	5.3	32.5	24.1	1.68	38.3	26.1	2.07	19.1
	7.5	3.7	8.5	33.6	24.5	1.62	39.1	27.0	2.10	19.8
60	3.8	1.3	2.9	29.6	22.5	1.92	36.1	28.6	2.16	21.2
	5.5	2.2	5.1	30.5	23.0	1.86	36.9	29.6	2.20	22.1
	7.5	3.5	8.1	31.5	23.4	1.79	37.6	30.6	2.23	23.0
70	3.8	1.2	2.8	28.4	22.0	2.11	35.6	31.9	2.28	24.1
	5.5	2.1	4.9	29.4	22.4	2.04	36.3	33.0	2.32	25.1
	7.5	<b>3.4</b>	<b>7.8</b>	30.3	22.9	1.97	37.0	<b>34.1</b>	<b>2.36</b>	<b>26.1</b>
80	3.8	1.2	2.7	27.6	21.7	2.31	35.5	35.0	2.39	26.9
	5.5	2.1	4.7	28.5	22.1	2.23	36.1	36.2	2.43	27.9
	7.5	3.3	7.6	29.5	22.5	2.15	36.8	37.5	2.47	29.0
85	<b>7.5</b>	<b>3.3</b>	<b>7.5</b>	<b>28.9</b>	<b>22.3</b>	<b>2.23</b>	<b>36.5</b>	Operation Not Recommended		
90	3.8	1.2	2.7	26.6	21.2	2.50	35.1	37.9	2.48	29.4
	5.5	2.0	4.6	27.5	21.6	2.41	35.7	39.2	2.52	30.6
	7.5	3.2	7.4	28.4	22.0	2.32	36.3	40.5	2.56	31.8
100	3.8	1.1	2.6	24.8	20.4	2.69	34.0	Operation Not Recommended		
	5.5	1.9	4.5	25.7	20.8	2.60	34.5			
	7.5	3.1	7.2	26.5	21.2	2.50	35.0			
110	3.8	1.1	2.5	21.9	18.9	2.88	31.7	Operation Not Recommended		
	5.5	1.9	4.4	22.6	19.3	2.77	32.1			
	7.5	3.1	7.0	23.3	19.7	2.67	32.4			

LEGEND

- EWT** — Entering Water Temperature (F)
- GPM** — Gallons Per Minute
- TC** — Total Capacity (MBtuh)
- THA** — Total Heat of Absorption (MBtuh)
- THR** — Total Heat of Rejection (MBtuh)
- TSC** — Total Sensible Capacity (MBtuh)

NOTES:

1. Interpolation is permissible, extrapolation is not.
2. All entering air conditions are 80 F db (dry bulb) and 67 F wb (wet bulb) in cooling and 70 F db in heating.
3. ARI 320 points (bold printing) are shown for comparison purposes only. These are not certified data points.
4. All performance data is based upon the lower voltage of dual voltage rated units.
5. Operation below 60 F EWT requires optional insulated water circuit.
6. Operation below 40 F EWT is based upon 15% antifreeze solution.
7. See Correction Factor tables for operating conditions other than those listed above.
8. Performance capacities shown in thousands of Btuh.



**50RHR,RVR036**  
**1200 CFM NOMINAL AIRFLOW**

EWT (F)	GPM	PRESSURE DROP		COOLING CAPACITY				HEATING CAPACITY		
		PSI	ft wg	TC	TSC	kW	THR	TC	kW	THA
20	4.5	1.2	2.7	Operation Not Recommended				Operation Not Recommended		
	6.8	2.2	5.2							
	9.0	3.6	8.4							
30	4.5	1.1	2.6	41.1	28.2	1.94	47.7	22.9	2.20	15.4
	6.8	2.2	5.0	41.8	28.4	1.89	48.3	23.6	2.24	16.0
	9.0	3.5	8.1	42.6	28.6	1.83	48.8	24.3	2.28	16.5
40	4.5	1.1	2.5	39.2	28.5	2.05	46.2	27.0	2.39	18.9
	6.8	2.1	4.8	39.9	28.7	1.99	46.6	27.9	2.44	19.6
	9.0	3.4	7.8	40.5	28.9	1.93	47.1	28.7	2.48	20.3
50	4.5	1.1	2.4	38.0	28.1	2.23	45.6	31.4	2.58	22.5
	6.8	2.0	4.6	38.7	28.3	2.16	46.1	32.4	2.64	23.4
	9.0	3.3	7.5	39.4	28.5	2.10	46.5	33.3	2.69	24.2
60	4.5	1.0	2.4	37.0	27.3	2.43	45.3	35.7	2.78	26.3
	6.8	1.9	4.5	37.7	27.5	2.36	45.7	36.9	2.84	27.2
	9.0	3.1	7.2	38.3	27.7	2.29	46.1	38.0	2.89	28.1
70	4.5	1.0	2.3	35.8	26.4	2.62	44.7	40.1	2.98	29.9
	6.8	1.9	4.3	36.4	26.6	2.54	45.1	41.4	3.04	31.0
	<b>9.0</b>	<b>3.0</b>	<b>7.0</b>	37.0	26.8	2.46	45.4	<b>42.6</b>	<b>3.10</b>	<b>32.1</b>
80	4.5	1.0	2.2	34.1	25.5	2.78	43.6	44.4	3.17	33.5
	6.8	1.8	4.2	34.7	25.7	2.70	43.9	45.8	3.23	34.7
	9.0	2.9	6.8	35.3	25.9	2.62	44.2	47.2	3.30	35.9
85	<b>9.0</b>	<b>2.9</b>	<b>6.7</b>	<b>34.2</b>	<b>25.5</b>	<b>2.70</b>	<b>43.4</b>	Operation Not Recommended		
90	4.5	0.9	2.1	32.0	24.7	2.96	42.1	48.6	3.36	37.1
	6.8	1.8	4.1	32.6	24.9	2.87	42.4	50.1	3.43	38.4
	9.0	2.9	6.6	33.1	25.1	2.78	42.6	51.6	3.49	39.7
100	4.5	0.9	2.1	29.9	23.9	3.17	40.7	Operation Not Recommended		
	6.8	1.7	4.0	30.4	24.1	3.08	41.0			
	9.0	2.8	6.4	31.0	24.3	2.99	41.2			
110	4.5	0.9	2.0	28.3	23.1	3.51	40.3			
	6.8	1.7	3.9	28.8	23.3	3.40	40.5			
	9.0	2.7	6.3	29.3	23.4	3.30	40.6			

LEGEND

- EWT** — Entering Water Temperature (F)
- GPM** — Gallons Per Minute
- TC** — Total Capacity (MBtuh)
- THA** — Total Heat of Absorption (MBtuh)
- THR** — Total Heat of Rejection (MBtuh)
- TSC** — Total Sensible Capacity (MBtuh)

NOTES:

1. Interpolation is permissible, extrapolation is not.
2. All entering air conditions are 80 F db (dry bulb) and 67 F wb (wet bulb) in cooling and 70 F db in heating.
3. ARI 320 points (bold printing) are shown for comparison purposes only. These are not certified data points.
4. All performance data is based upon the lower voltage of dual voltage rated units.
5. Operation below 60 F EWT requires optional insulated water circuit.
6. Operation below 40 F EWT is based upon 15% antifreeze solution.
7. See Correction Factor tables for operating conditions other than those listed above.
8. Performance capacities shown in thousands of Btuh.



# Performance data (cont)

## 50RHR,RVR042 1400 CFM NOMINAL AIRFLOW

EWT (F)	GPM	PRESSURE DROP		COOLING CAPACITY				HEATING CAPACITY		
		PSI	ft wg	TC	TSC	kW	THR	TC	kW	THA
20	5.3	1.5	3.4	Operation Not Recommended				Operation Not Recommended		
	7.9	3.0	6.9							
	10.5	4.7	10.9							
30	5.3	1.4	3.3	47.6	33.2	2.10	54.8	28.5	2.54	19.8
	7.9	2.9	6.6	48.1	33.4	2.03	55.0	29.2	2.57	20.5
	10.5	4.6	10.5	48.6	33.6	1.97	55.3	30.0	2.61	21.1
40	5.3	1.4	3.2	48.0	33.6	2.35	56.0	33.5	2.75	24.1
	7.9	2.8	6.4	48.5	33.8	2.27	56.2	34.4	2.79	24.8
	10.5	4.4	10.2	49.0	34.1	2.20	56.5	35.3	2.83	25.6
50	5.3	1.3	3.1	47.3	33.4	2.56	56.0	38.1	2.95	28.1
	7.9	2.7	6.2	47.8	33.7	2.48	56.3	39.1	2.99	28.9
	10.5	4.2	9.8	48.3	33.9	2.40	56.5	40.2	3.03	29.8
60	5.3	1.3	3.0	45.8	32.7	2.77	55.2	42.4	3.12	31.8
	7.9	2.6	5.9	46.2	33.0	2.69	55.4	43.6	3.16	32.8
	10.5	4.1	9.4	46.7	33.2	2.60	55.6	44.7	3.21	33.8
70	5.3	1.2	2.9	43.6	31.7	3.00	53.8	46.4	3.27	35.2
	7.9	2.5	5.7	44.0	31.9	2.91	54.0	47.6	3.32	36.3
	<b>10.5</b>	<b>3.9</b>	<b>9.1</b>	44.5	32.1	2.82	54.1	<b>48.9</b>	<b>3.36</b>	<b>37.4</b>
80	5.3	1.2	2.8	41.0	30.4	3.26	52.1	50.0	3.40	38.4
	7.9	2.4	5.6	41.4	30.6	3.16	52.2	51.4	3.45	39.6
	10.5	3.8	8.8	41.8	30.8	3.06	52.2	52.7	3.50	40.8
85	<b>10.5</b>	<b>3.8</b>	<b>8.7</b>	<b>40.4</b>	<b>30.1</b>	<b>3.18</b>	<b>51.2</b>	Operation Not Recommended		
90	5.3	1.2	2.7	38.2	29.0	3.52	50.2	53.3	3.52	41.3
	7.9	2.3	5.4	38.5	29.2	3.42	50.2	54.8	3.57	42.6
	10.5	3.7	8.6	38.9	29.4	3.31	50.2	56.2	3.61	43.9
100	5.3	1.1	2.6	35.4	27.7	3.78	48.2	Operation Not Recommended		
	7.9	2.3	5.3	35.7	27.9	3.66	48.2			
	10.5	3.6	8.4	36.1	28.1	3.55	48.2			
110	5.3	1.1	2.6	32.8	26.8	3.98	46.4	Operation Not Recommended		
	7.9	2.2	5.1	33.2	27.0	3.86	46.3			
	10.5	3.5	8.1	33.5	27.2	3.73	46.2			

LEGEND

- EWT** — Entering Water Temperature (F)
- GPM** — Gallons Per Minute
- TC** — Total Capacity (MBtuh)
- THA** — Total Heat of Absorption (MBtuh)
- THR** — Total Heat of Rejection (MBtuh)
- TSC** — Total Sensible Capacity (MBtuh)

NOTES:

1. Interpolation is permissible, extrapolation is not.
2. All entering air conditions are 80 F db (dry bulb) and 67 F wb (wet bulb) in cooling and 70 F db in heating.
3. ARI 320 points (bold printing) are shown for comparison purposes only. These are not certified data points.
4. All performance data is based upon the lower voltage of dual voltage rated units.
5. Operation below 60 F EWT requires optional insulated water circuit.
6. Operation below 40 F EWT is based upon 15% antifreeze solution.
7. See Correction Factor tables for operating conditions other than those listed above.
8. Performance capacities shown in thousands of Btuh.



**50RHR,RVR048**  
**1600 CFM NOMINAL AIRFLOW**

EWT (F)	GPM	PRESSURE DROP		COOLING CAPACITY				HEATING CAPACITY		
		PSI	ft wg	TC	TSC	kW	THR	TC	kW	THA
20	6.0	2.1	4.9	Operation Not Recommended				Operation Not Recommended		
	9.0	4.1	9.4							
	12.0	6.6	15.3							
30	6.0	2.1	4.7	51.6	35.5	2.49	60.1	33.5	3.01	23.2
	9.0	3.9	9.1	52.5	35.0	2.42	60.8	34.4	3.07	23.9
	12.0	6.4	14.8	53.4	34.6	2.35	61.4	35.2	3.14	24.5
40	6.0	2.0	4.6	55.4	38.6	2.76	64.8	38.7	3.23	27.7
	9.0	3.8	8.8	56.3	38.1	2.68	65.5	39.7	3.30	28.5
	12.0	6.2	14.2	57.3	37.6	2.60	66.1	40.7	3.37	29.2
50	6.0	1.9	4.4	55.0	39.3	3.01	65.2	44.4	3.48	32.6
	9.0	3.7	8.5	55.9	38.8	2.92	65.9	45.6	3.56	33.5
	12.0	5.9	13.7	56.8	38.2	2.83	66.5	46.8	3.63	34.4
60	6.0	1.8	4.3	52.6	38.5	3.27	63.8	50.9	3.75	38.1
	9.0	3.5	8.1	53.5	38.0	3.17	64.3	52.2	3.83	39.1
	12.0	5.7	13.2	54.4	37.5	3.08	64.9	53.6	3.91	40.2
70	6.0	1.8	4.1	49.8	37.2	3.53	61.9	57.6	4.03	43.9
	9.0	3.4	7.8	50.7	36.7	3.43	62.4	59.2	4.12	45.1
	<b>12.0</b>	<b>5.5</b>	<b>12.7</b>	51.5	36.2	3.32	62.9	<b>60.7</b>	<b>4.20</b>	<b>46.3</b>
80	6.0	1.7	4.0	47.4	35.8	3.81	60.4	63.8	4.31	49.1
	9.0	3.3	7.6	48.2	35.3	3.70	60.8	65.5	4.41	50.5
	12.0	5.4	12.4	49.0	34.8	3.59	61.3	67.2	4.50	51.8
<b>85</b>	<b>12.0</b>	<b>5.3</b>	<b>12.2</b>	<b>48.0</b>	<b>34.2</b>	<b>3.72</b>	<b>60.7</b>	Operation Not Recommended		
90	6.0	1.7	3.9	45.5	34.5	4.10	59.4	68.0	4.60	52.3
	9.0	3.2	7.4	46.2	34.0	3.98	59.8	69.8	4.70	53.8
	12.0	5.2	12.0	47.0	33.5	3.86	60.2	71.6	4.80	55.2
100	6.0	1.6	3.8	43.3	33.1	4.39	58.3	Operation Not Recommended		
	9.0	3.1	7.2	44.1	32.6	4.26	58.6			
	12.0	5.1	11.7	44.8	32.2	4.13	58.9			
110	6.0	1.6	3.7	39.6	31.3	4.68	55.6			
	9.0	3.1	7.0	40.3	30.9	4.54	55.8			
	12.0	5.0	11.4	41.0	30.4	4.40	56.0			

LEGEND

- EWT** — Entering Water Temperature (F)
- GPM** — Gallons Per Minute
- TC** — Total Capacity (MBtuh)
- THA** — Total Heat of Absorption (MBtuh)
- THR** — Total Heat of Rejection (MBtuh)
- TSC** — Total Sensible Capacity (MBtuh)

NOTES:

1. Interpolation is permissible, extrapolation is not.
2. All entering air conditions are 80 F db (dry bulb) and 67 F wb (wet bulb) in cooling and 70 F db in heating.
3. ARI 320 points (bold printing) are shown for comparison purposes only. These are not certified data points.
4. All performance data is based upon the lower voltage of dual voltage rated units.
5. Operation below 60 F EWT requires optional insulated water circuit.
6. Operation below 40 F EWT is based upon 15% antifreeze solution.
7. See Correction Factor tables for operating conditions other than those listed above.
8. Performance capacities shown in thousands of Btuh.



# Performance data (cont)

## 50RHR,RVR060 2000 CFM NOMINAL AIRFLOW

EWT (F)	GPM	PRESSURE DROP		COOLING CAPACITY				HEATING CAPACITY		
		PSI	ft wg	TC	TSC	kW	THR	TC	kW	THA
20	7.5	3.0	7.0	Operation Not Recommended				Operation Not Recommended		
	11.3	5.9	13.6							
	15.0	9.7	22.4							
30	7.5	2.9	6.8	54.2	37.6	3.29	65.4	43.1	3.97	29.6
	11.3	5.7	13.2	54.3	37.7	3.18	65.2	43.8	4.01	30.1
	15.0	9.4	21.7	54.5	37.8	3.08	65.0	44.5	4.04	30.7
40	7.5	2.8	6.5	62.6	44.3	3.64	75.0	49.3	4.12	35.2
	11.3	5.5	12.7	62.7	44.5	3.52	74.7	50.1	4.15	35.9
	15.0	9.1	20.9	62.9	44.6	3.40	74.5	50.8	4.19	36.5
50	7.5	2.7	6.3	65.3	47.0	3.93	78.7	55.8	4.28	41.2
	11.3	5.3	12.3	65.5	47.2	3.80	78.4	56.7	4.32	41.9
	15.0	8.7	20.2	65.6	47.3	3.68	78.2	57.6	4.36	42.7
60	7.5	2.6	6.1	64.8	47.3	4.21	79.2	62.4	4.46	47.2
	11.3	5.1	11.8	65.0	47.5	4.07	78.9	63.4	4.50	48.1
	15.0	8.4	19.4	65.2	47.6	3.94	78.6	64.4	4.54	48.9
70	7.5	2.5	5.8	63.0	46.5	4.50	78.3	68.6	4.63	52.8
	11.3	4.9	11.4	63.1	46.7	4.36	78.0	69.6	4.67	53.7
	<b>15.0</b>	<b>8.1</b>	<b>18.7</b>	63.3	46.8	4.21	77.6	<b>70.7</b>	<b>4.72</b>	<b>54.6</b>
80	7.5	2.5	5.7	60.7	45.4	4.83	77.2	73.3	4.77	57.1
	11.3	4.8	11.1	60.9	45.5	4.67	76.8	74.5	4.81	58.1
	15.0	7.9	18.2	61.0	45.6	4.52	76.5	75.7	4.85	59.1
85	<b>15.0</b>	<b>7.8</b>	<b>17.9</b>	<b>60.0</b>	<b>45.1</b>	<b>4.70</b>	<b>76.0</b>	Operation Not Recommended		
90	7.5	2.4	5.5	58.6	44.3	5.22	76.4	75.6	4.82	59.1
	11.3	4.7	10.8	58.7	44.4	5.05	76.0	76.8	4.87	60.2
	15.0	7.7	17.7	58.9	44.5	4.88	75.5	78.0	4.91	61.2
100	7.5	2.3	5.4	56.3	43.1	5.67	75.6	Operation Not Recommended		
	11.3	4.5	10.5	56.4	43.3	5.49	75.2			
	15.0	7.5	17.3	56.6	43.4	5.30	74.7			
110	7.5	2.3	5.2	52.9	41.4	6.21	74.1			
	11.3	4.4	10.2	53.0	41.5	6.00	73.5			
	15.0	7.3	16.8	53.2	41.7	5.80	73.0			

LEGEND

- EWT** — Entering Water Temperature (F)
- GPM** — Gallons Per Minute
- TC** — Total Capacity (MBtuh)
- THA** — Total Heat of Absorption (MBtuh)
- THR** — Total Heat of Rejection (MBtuh)
- TSC** — Total Sensible Capacity (MBtuh)

NOTES:

1. Interpolation is permissible, extrapolation is not.
2. All entering air conditions are 80 F db (dry bulb) and 67 F wb (wet bulb) in cooling and 70 F db in heating.
3. ARI 320 points (bold printing) are shown for comparison purposes only. These are not certified data points.
4. All performance data is based upon the lower voltage of dual voltage rated units.
5. Operation below 60 F EWT requires optional insulated water circuit.
6. Operation below 40 F EWT is based upon 15% antifreeze solution.
7. See Correction Factor tables for operating conditions other than those listed above.
8. Performance capacities shown in thousands of Btuh.



## **ATTACHMENT**

### **FACTORY START-UP & DIAGNOSTIC TEST FORMS**

**CL-1, CL-2**

**from: MANUAL NUMBER 50R-4SI**

**print date: 9-1-2004**

**50RHC,RVC,RHR,RHS,RVR,RVS,RDS  
 START-UP CHECKLIST**

CUSTOMER: \_\_\_\_\_ JOB NAME: \_\_\_\_\_  
 MODEL NO.: \_\_\_\_\_ SERIAL NO.: \_\_\_\_\_ DATE: \_\_\_\_\_

**I. PRE-START-UP**

DOES THE UNIT VOLTAGE CORRESPOND WITH THE SUPPLY VOLTAGE AVAILABLE? (Y/N) \_\_\_\_\_  
 HAVE THE POWER AND CONTROL WIRING CONNECTIONS BEEN MADE AND TERMINALS TIGHT? (Y/N) \_\_\_\_\_  
 HAVE WATER CONNECTIONS BEEN MADE AND IS FLUID AVAILABLE AT HEAT EXCHANGER? (Y/N) \_\_\_\_\_  
 HAS PUMP BEEN TURNED ON AND ARE ISOLATION VALVES OPEN? (Y/N) \_\_\_\_\_  
 HAS CONDENSATE CONNECTION BEEN MADE AND IS A TRAP INSTALLED? (Y/N) \_\_\_\_\_  
 IS AN AIR FILTER INSTALLED? (Y/N) \_\_\_\_\_

**II. START-UP**

IS FAN OPERATING WHEN COMPRESSOR OPERATES? (Y/N) \_\_\_\_\_  
 IF 3-PHASE SCROLL COMPRESSOR IS PRESENT, VERIFY PROPER ROTATION PER INSTRUCTIONS. (Y/N) \_\_\_\_\_

**UNIT VOLTAGE — COOLING OPERATION**

PHASE AB VOLTS _____	PHASE BC VOLTS _____ (if 3 phase)	PHASE CA VOLTS _____ (if 3 phase)
PHASE AB AMPS _____	PHASE BC AMPS _____ (if 3 phase)	PHASE CA AMPS _____ (if 3 phase)

**CONTROL VOLTAGE**

IS CONTROL VOLTAGE ABOVE 21.6 VOLTS? (Y/N) \_\_\_\_\_.  
 IF NOT, CHECK FOR PROPER TRANSFORMER CONNECTION.

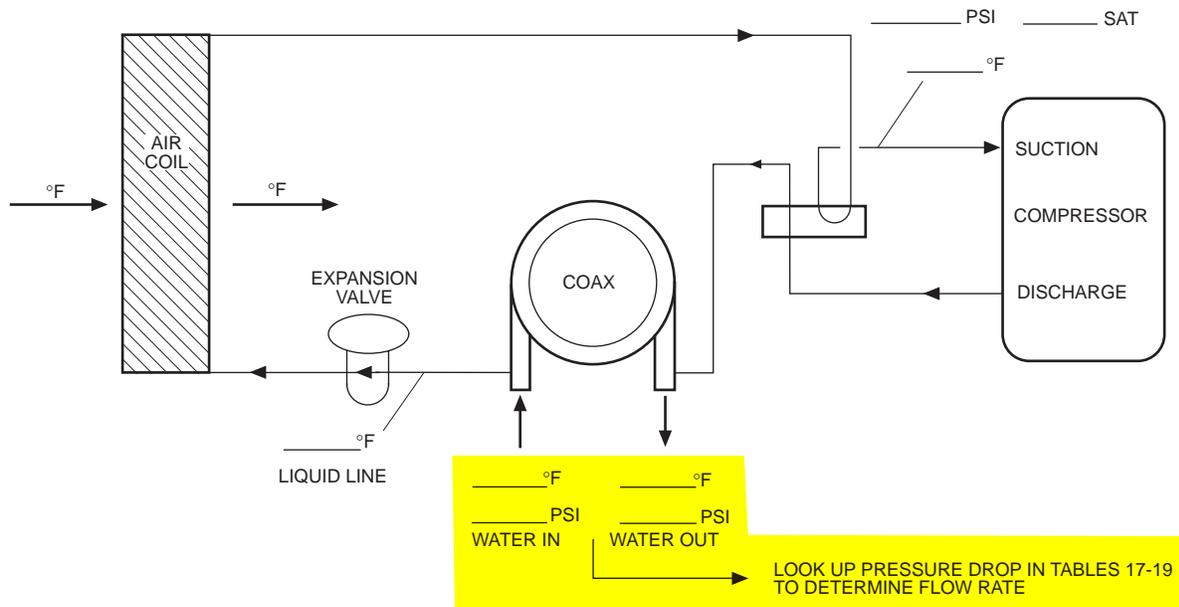
**TEMPERATURES**

FILL IN THE ANALYSIS CHART ATTACHED.

**YELLOW HIGHLIGHT: REQUIRES P/T PORTS AS INSTALLED ON WATER PORT CABINET CONNECTIONS. P/T PORTS INSTALLED ON OPPOSITE SIDE OF FLEX HOSE CONNECTIONS OR OTHER WILL ADVERSELY IMPACT TRUE PRESSURE READINGS.**

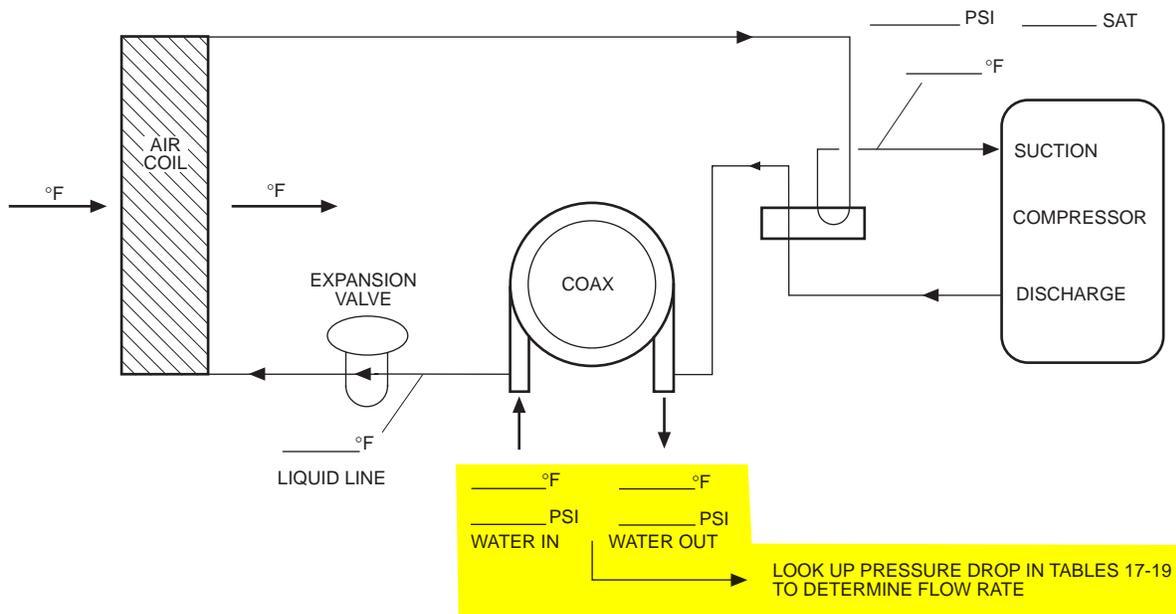
<b>COAXIAL HEAT EXCHANGER</b>	<b>COOLING CYCLE:</b> FLUID IN _____	<b>F</b> FLUID OUT _____	<b>F</b> _____	<b>PSI</b> _____	<b>FLOW</b> _____
	<b>HEATING CYCLE:</b> FLUID IN _____	<b>F</b> FLUID OUT _____	<b>F</b> _____	<b>PSI</b> _____	<b>FLOW</b> _____
AIR COIL	<b>COOLING CYCLE:</b> AIR IN _____	<b>F</b> AIR OUT _____	<b>F</b> _____		
	<b>HEATING CYCLE:</b> AIR IN _____	<b>F</b> AIR OUT _____	<b>F</b> _____		

**HEATING CYCLE ANALYSIS**



**YELLOW HIGHLIGHT: REQUIRES P/T PORTS AS INSTALLED ON WATER PORT CABINET CONNECTIONS.**

**COOLING CYCLE ANALYSIS**



**HEAT OF EXTRACTION (ABSORPTION) OR HEAT OF REJECTION =**

\_\_\_\_\_ FLOW RATE (GPM) x \_\_\_\_\_ TEMP. DIFF. (DEG F) x \_\_\_\_\_ FLUID FACTOR\* = \_\_\_\_\_  
 (Btu/hr)

**SUPERHEAT** = SUCTION TEMPERATURE – SUCTION SATURATION TEMPERATURE  
 = \_\_\_\_\_ (DEG F)

**SUBCOOLING** = DISCHARGE SATURATION TEMPERATURE – LIQUID LINE TEMPERATURE  
 = \_\_\_\_\_ (DEG F)

\*Use 500 for water, 485 for antifreeze.

**P/T PORTS INSTALLED ON OPPOSITE SIDE OF FLEX HOSE CONNECTIONS OR OTHER WILL ADVERSELY IMPACT TRUE PRESSURE READINGS.**

CUT ALONG DOTTED LINE



May 20, 2019

**Rio Rancho City Hall, Rio Rancho, New Mexico  
Addendum - Freeze Protection, Antifreeze  
Preliminary Report of May 18, 2019  
Closed Loop Ground Heat Exchanger & GSHP Mechanical System**

**GSHP Freeze Protection, Antifreeze**

The drilling contractor, Geothermal Drilling Inc., confirmed this morning that they did not install any antifreeze in the hydronic system.

If no antifreeze was installed by others, or later after the building was completed, then the control boards should be confirmed to have jumper wire J3 intact<sup>1</sup>. Otherwise, if J3 were disabled, this would allow the units to operate below 40°F EWT and put them at risk of damage due to freezing of the internal water-refrigerant heat exchanger should the ground loop supply water temperature, without antifreeze protection, ever drop low enough for this to be a concern.

If the freeze protection jumper wires are intact and any units are locking out due to low temperature safety, this could indicate the closed loop ground heat exchanger is not capable of sustaining an EWT above 40°F. Once an hourly load profile is provided where a reverse simulation of the GHX can be generated, it can be determined at that time if the addition of antifreeze might be necessary to permit the heat pumps to operate at cooler supply water temperature ranges.

**Maximum Recommended Antifreeze Capacity**

Should it later be determined to operate the heat pumps with J3 cut, antifreeze will be required.

As excessive antifreeze can inhibit heat transfer in a GHX by preventing sufficient hydronic turbulence in smooth-bore pipe, the maximum amount of propylene glycol recommended is no more than 20% by volume (~21°F hard freeze protection). Industry typically determines turbulence by a calculation to determine a ratio of turbulence, known as the Reynolds Number (Re), calculated using the flow rate, a pipe surface factor, density of fluid, and temperature. The minimum RE value for sufficient heat extraction in a ground loop pipe is 2500<sup>2</sup>.

The values calculated for 180 boreholes, with a peak heat pump flow rate of 642.6 GPM, equates to an individual borehole circuit flow rate of 3.57 GPM. The RE number was calculated using both 20% and 25% propylene glycol (PG) by volume.

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<sup>1</sup> P. 28, factory Installation, Operation & Maintenance manual, print date 9-1-2004

<sup>2</sup> IGSHPA Design Guide, 2010



3.57 GPM, 180 Boreholes, Peak GSHP Flow Rate of 642.6 GPM

Propylene Glycol %	Temperature °F	RE Number
25	30.0	1852
20	30.0	2546

As it is assumed one header pair has been abandoned, the remaining number of bores is 168. The RE numbers for 20% and 25% PG would therefore be as follows:

3.83 GPM, 168 Boreholes, Peak GSHP Flow Rate of 642.6 GPM

Propylene Glycol %	Temperature °F	RE Number
25	30.0	1984
20	30.0	2728

For this reason, should the system be determined to require antifreeze pending a review and reverse simulation of the GHX to more accurately predict minimum and maximum EWT ranges to the heat pump system, the maximum amount of PG should not exceed 20% by volume.

Respectfully,

A handwritten signature in blue ink that reads "Terry Proffer".

Terry Proffer, CGD, Geothermal Manager  
**Major Geothermal**

## Step 9 — Low Voltage Wiring

**THERMOSTAT CONNECTIONS** — The thermostat should be wired directly to the Aquazone™ control board. See Fig. 19, 20, and 23.

**WATER FREEZE PROTECTION** — The Aquazone control allows the field selection of source fluid freeze protection points through jumpers. The factory setting of jumper JW3 (FP1) is set for water at 30 F. In earth loop applications, jumper JW3 should be clipped to change the setting to 13 F when using antifreeze in colder earth loop applications. See Fig. 24.

**AIR COIL FREEZE PROTECTION** — The air coil freeze protection jumper JW2 (FP2) is factory set for 30 F and should not need adjusting.

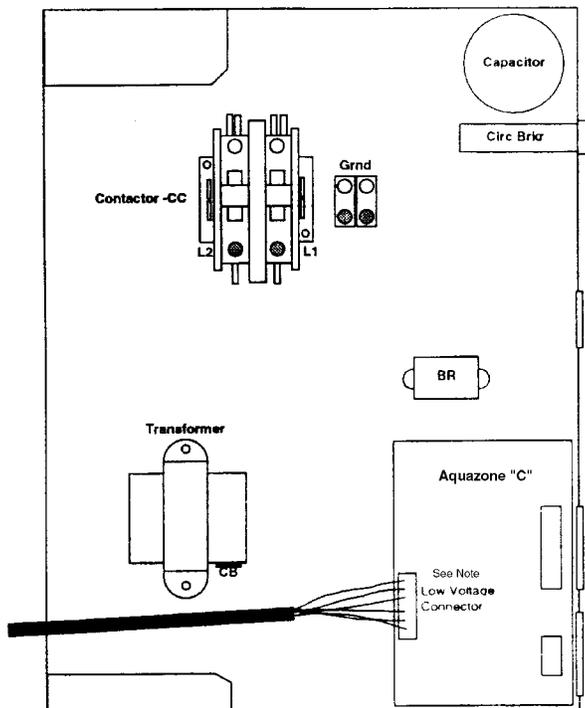
**ACCESSORY CONNECTIONS** — Terminal A on the control is provided to control accessory devices such as water valves, electronic air cleaners, humidifiers, etc. This signal operates with the compressor terminal. See Fig. 25. Refer to the specific unit wiring schematic for details.

**NOTE:** The A terminal should *only* be used with 24 volt signals — not line voltage signals.

**WATER SOLENOID VALVES** — Water solenoid valves may be used on primary secondary pump and ground water installations. A typical well water control valve wiring, which can limit waste water in a lockout condition is shown in Fig. 25. A slow closing valve may be required to prevent water hammer. When using a slow closing valve, consider special wiring conditions. The valve takes approximately 60 seconds to open (very little water will flow before 45 seconds) and it activates the compressor only after the valve is completely opened by closing its end switch. When wired as shown, the valve will have the following operating characteristics:

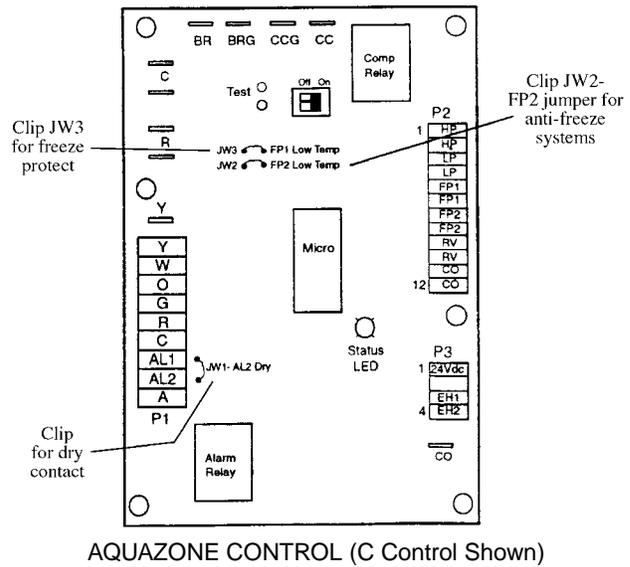
1. Remain open during a lockout
2. Draw approximately 25 to 35 VA through the “Y” signal of the thermostat.

**IMPORTANT:** Connecting a water solenoid valve can overheat the anticipators of electromechanical thermostats. Only use relay based electronic thermostats.

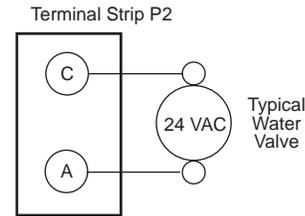


NOTE: Low voltage connector may be removed for easy installation.

**Fig. 23 — Low Voltage Field Wiring**



**Fig. 24 — Typical Aquazone Control Board Jumper Locations**



**Fig. 25 — Typical D Control Accessory Wiring**

## PRE-START-UP

**System Checkout** — When the installation is complete, follow the System Checkout procedure outlined below before starting up the system. Be sure:

1. Voltage is within the utilization range specifications of the unit compressor and fan motor and voltage is balanced for 3 phase units.
2. Fuses, breakers and wire are correct size.
3. Low voltage wiring is complete.
4. Piping and system flushing is complete.
5. Air is purged from closed loop system.
6. System is balanced as required. Monitor if necessary.
7. Isolation valves are open.
8. Water control valves or loop pumps are wired.
9. Condensate line is open and correctly pitched.
10. Transformer switched to lower voltage tap if necessary.
11. Blower rotates freely — shipping support is removed.
12. Blower speed is on correct setting.
13. Air filter is clean and in position.
14. Service/access panels are in place.
15. Return air temperature is between 40 to 80 F heating and 50 to 110 F cooling.
16. Air coil is clean.
17. Control field selected settings are correct.

**AIR COIL** — To obtain maximum performance, clean the air coil before starting the unit. A ten percent solution of dishwasher detergent and water is recommended for both sides of the coil. Rinse thoroughly with water.

Reynolds Number and Velocity Calculation Sheet

From: GSHP Residential & Light Commercial Design & Installation Guide, Remund, 2010, page 4-9

- Inputs: Flow rate in GPM **3.57 GPM, 180 Boreholes, Peak GSHP Flow Rate of 642.6 GPM**  
 Pipe ID, actual - inches  
 Percentage by volume PG to be used  
 Lowest operating temperature expected, °F  
 Fluid viscosity for % volume of PG and temperature, in centipoise (from tables)\*  
 Fluid density for % volume of PG and temperature, in lbs/ft<sup>3</sup> (from tables)\*

\* = May require interpolation

Pipe ID, DR11	
Nom.	ID
0.75	0.860
1.00	1.077
1.25	1.358
1.50	1.554
2.00	1.943

Fluid velocity in feet per second:

$$V = 0.4085 \times \frac{Q}{D^2}$$

- V = Fluid velocity in feet per second  
 0.4085 = Constant  
 Q = Fluid flow rate in GPM  
 D = Inside pipe diameter in inches

Q, Flow rate GPM	<b>3.57</b>	GPM
D, Pipe ID	<b>1.077</b>	inches
V, Velocity	<b>1.26</b>	Ft per second

Reynolds number:

$$Re = 124 \times \frac{V \times D}{(\mu/\rho)}$$

- Re = Reynolds #  
 124 = Constant  
 V = Fluid velocity in feet per second  
 D = Inside pipe diameter in inches  
 μ = Fluid viscosity in centipoise (cp)  
 ρ = Fluid density in pounds per cubic foot (lbs/ft<sup>3</sup>)

PG %	<b>25%</b>	by volume
Temperature	<b>30</b>	°F
μ =	5.845	from tables
ρ =	64.465	from tables
V, Velocity	1.26	Ft per second
D, Pipe ID	1.077	inches
μ, Fluid viscosity	5.845	centipoise (cp)
ρ, Fluid density	64.465	pounds cu. ft. (lbs/ft <sup>3</sup> )
Re	<b>1852</b>	Reynolds #

Note:

- μ = Viscosity of specific fluid mixture (ie, % by volume PG at specified temperature)  
 ρ = Fluid density of specific fluid mixture (ie, % by volume PG at specified temperature)

Reynolds Number and Velocity Calculation Sheet

From: GSHP Residential & Light Commercial Design & Installation Guide, Remund, 2010, page 4-9

- Inputs: Flow rate in GPM **3.57 GPM, 180 Boreholes, Peak GSHP Flow Rate of 642.6 GPM**  
 Pipe ID, actual - inches  
 Percentage by volume PG to be used  
 Lowest operating temperature expected, °F  
 Fluid viscosity for % volume of PG and temperature, in centipoise (from tables)\*  
 Fluid density for % volume of PG and temperature, in lbs/ft<sup>3</sup> (from tables)\*

\* = May require interpolation

Pipe ID, DR11	
Nom.	ID
0.75	0.860
1.00	1.077
1.25	1.358
1.50	1.554
2.00	1.943

**Fluid velocity in feet per second:**

$$V = 0.4085 \times \frac{Q}{D^2}$$

- V = Fluid velocity in feet per second  
 0.4085 = Constant  
 Q = Fluid flow rate in GPM  
 D = Inside pipe diameter in inches

Q, Flow rate GPM	<b>3.57</b>	GPM
D, Pipe ID	<b>1.077</b>	inches
V, Velocity	<b>1.26</b>	Ft per second

**Reynolds number:**

$$Re = 124 \times \frac{V \times D}{(\mu/\rho)}$$

- Re = Reynolds #  
 124 = Constant  
 V = Fluid velocity in feet per second  
 D = Inside pipe diameter in inches  
 μ = Fluid viscosity in centipoise (cp)  
 ρ = Fluid density in pounds per cubic foot (lbs/ft<sup>3</sup>)

PG %	<b>20%</b>	by volume
Temperature	<b>30</b>	°F
μ =	4.23	from tables
ρ =	64.14	from tables
V, Velocity	1.26	Ft per second
D, Pipe ID	1.077	inches
μ, Fluid viscosity	4.23	centipoise (cp)
ρ, Fluid density	64.14	pounds cu. ft. (lbs/ft <sup>3</sup> )
Re	<b>2546</b>	Reynolds #

Note:

- μ = Viscosity of specific fluid mixture (ie, % by volume PG at specified temperature)  
 ρ = Fluid density of specific fluid mixture (ie, % by volume PG at specified temperature)

Reynolds Number and Velocity Calculation Sheet

From: GSHP Residential & Light Commercial Design & Installation Guide, Remund, 2010, page 4-9

- Inputs: Flow rate in GPM **3.83 GPM, 168 Boreholes, Peak GSHP Flow Rate of 642.6 GPM**  
 Pipe ID, actual - inches  
 Percentage by volume PG to be used  
 Lowest operating temperature expected, °F  
 Fluid viscosity for % volume of PG and temperature, in centipoise (from tables)\*  
 Fluid density for % volume of PG and temperature, in lbs/ft<sup>3</sup> (from tables)\*

\* = May require interpolation

Pipe ID, DR11	
Nom.	ID
0.75	0.860
1.00	1.077
1.25	1.358
1.50	1.554
2.00	1.943

Fluid velocity in feet per second:

$$V = 0.4085 \times \frac{Q}{D^2}$$

- V = Fluid velocity in feet per second  
 0.4085 = Constant  
 Q = Fluid flow rate in GPM  
 D = Inside pipe diameter in inches

Q, Flow rate GPM	<b>3.83</b>	GPM
D, Pipe ID	<b>1.077</b>	inches
V, Velocity	<b>1.35</b>	Ft per second

Reynolds number:

$$Re = 124 \times \frac{V \times D}{(\mu/\rho)}$$

- Re = Reynolds #  
 124 = Constant  
 V = Fluid velocity in feet per second  
 D = Inside pipe diameter in inches  
 μ = Fluid viscosity in centipoise (cp)  
 ρ = Fluid density in pounds per cubic foot (lbs/ft<sup>3</sup>)

PG %	<b>25%</b>	by volume
Temperature	<b>30</b>	°F
μ =	5.845	from tables
ρ =	64.465	from tables
V, Velocity	1.35	Ft per second
D, Pipe ID	1.077	inches
μ, Fluid viscosity	5.845	centipoise (cp)
ρ, Fluid density	64.465	pounds cu. ft. (lbs/ft <sup>3</sup> )
Re	<b>1984</b>	Reynolds #

Note:

- μ = Viscosity of specific fluid mixture (ie, % by volume PG at specified temperature)  
 ρ = Fluid density of specific fluid mixture (ie, % by volume PG at specified temperature)

Reynolds Number and Velocity Calculation Sheet

From: GSHP Residential & Light Commercial Design & Installation Guide, Remund, 2010, page 4-9

- Inputs: Flow rate in GPM **3.83 GPM, 168 Boreholes, Peak GSHP Flow Rate of 642.6 GPM**  
 Pipe ID, actual - inches  
 Percentage by volume PG to be used  
 Lowest operating temperature expected, °F  
 Fluid viscosity for % volume of PG and temperature, in centipoise (from tables)\*  
 Fluid density for % volume of PG and temperature, in lbs/ft<sup>3</sup> (from tables)\*

\* = May require interpolation

Pipe ID, DR11	
Nom.	ID
0.75	0.860
1.00	1.077
1.25	1.358
1.50	1.554
2.00	1.943

**Fluid velocity in feet per second:**

$$V = 0.4085 \times \frac{Q}{D^2}$$

- V = Fluid velocity in feet per second  
 0.4085 = Constant  
 Q = Fluid flow rate in GPM  
 D = Inside pipe diameter in inches

Q, Flow rate GPM	<b>3.83</b>	GPM
D, Pipe ID	<b>1.077</b>	inches
V, Velocity	<b>1.35</b>	Ft per second

**Reynolds number:**

$$Re = 124 \times \frac{V \times D}{(\mu/\rho)}$$

- Re = Reynolds #  
 124 = Constant  
 V = Fluid velocity in feet per second  
 D = Inside pipe diameter in inches  
 μ = Fluid viscosity in centipoise (cp)  
 ρ = Fluid density in pounds per cubic foot (lbs/ft<sup>3</sup>)

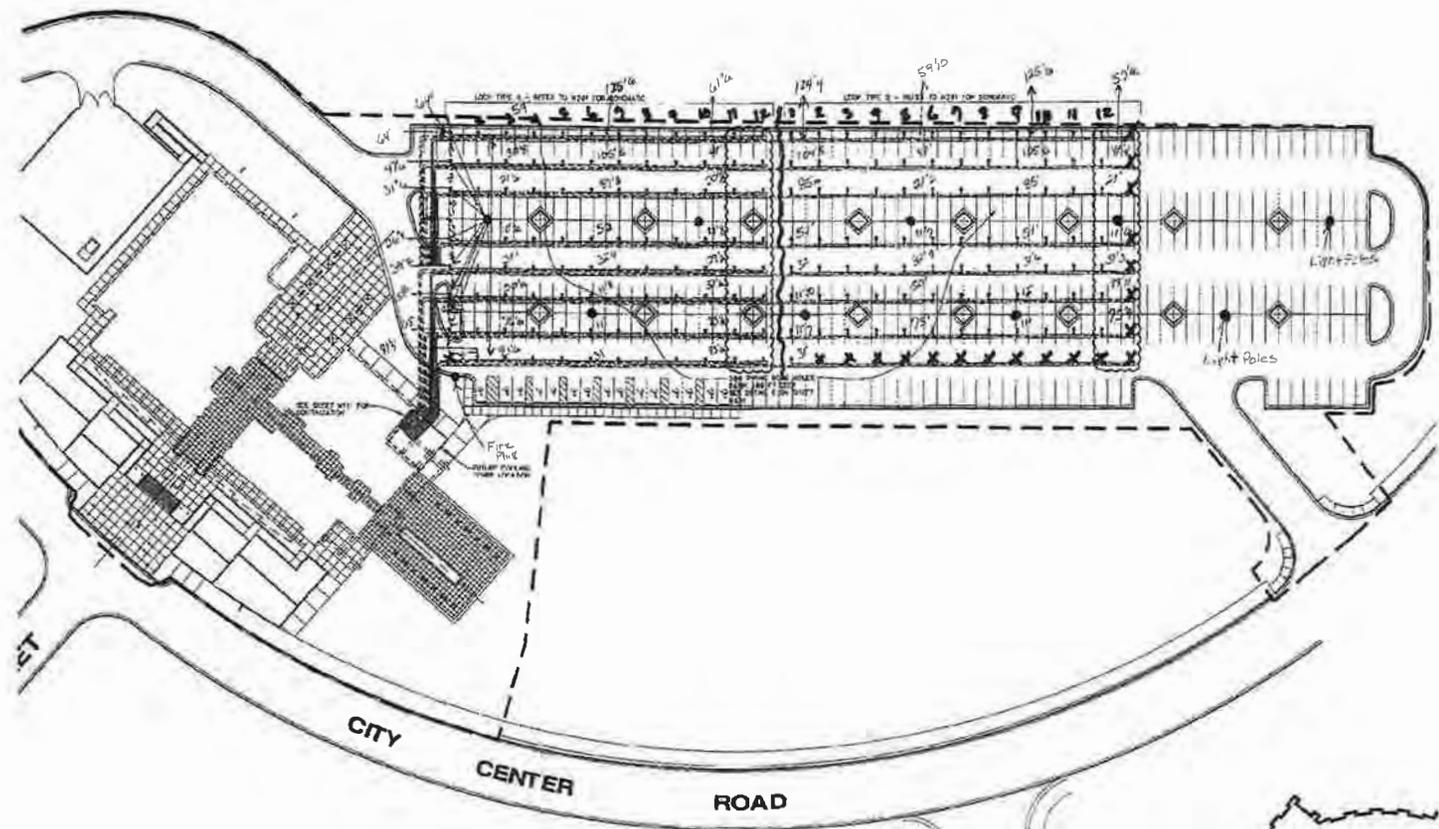
PG %	<b>20%</b>	by volume
Temperature	<b>30</b>	°F
μ =	4.23	from tables
ρ =	64.14	from tables
V, Velocity	1.35	Ft per second
D, Pipe ID	1.077	inches
μ, Fluid viscosity	4.23	centipoise (cp)
ρ, Fluid density	64.14	pounds cu. ft. (lbs/ft <sup>3</sup> )
Re	<b>2728</b>	Reynolds #

Note:

- μ = Viscosity of specific fluid mixture (ie, % by volume PG at specified temperature)  
 ρ = Fluid density of specific fluid mixture (ie, % by volume PG at specified temperature)

# APPENDIX C

## Record Drawings



**GENERAL NOTES**

The design intent for the ground mounted heat dump system is to provide a total of 178 tons of cooling for the building.

1. Provide a unit price per foot to install a well spaced 200 ft. This shall cover the cost to determine the optimal cost to extend or split in a section that exceeds 1 foot in cooling if needed based on the results of the conductivity test.

2. Provide a unit price for additional split in the additional 200 ft. This shall cover the cost to extend or split in a section that exceeds 1 foot in cooling if needed at the end of the well and split in a section that exceeds 1 foot in cooling if needed.

3. Provide a unit price per well for ground after the location of the well is determined. This shall include the cost to install the well and the cost to extend or split in a section that exceeds 1 foot in cooling if needed at the end of the well and split in a section that exceeds 1 foot in cooling if needed.

Holes on 20' spacing  
 Red dots on plan  
 3-7-07 William Hopkins

Geothermal Wells  
 about 20' of Light  
 Poles E.O.O.P. Plans  
 3-7-07 William Hopkins

200908 V&A CONSULTING  
 1/6/06

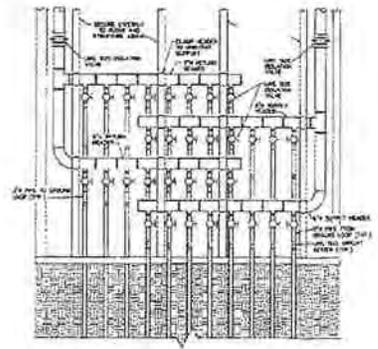
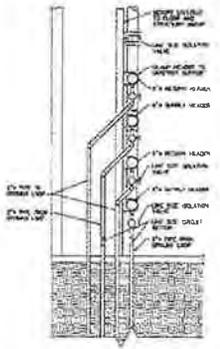
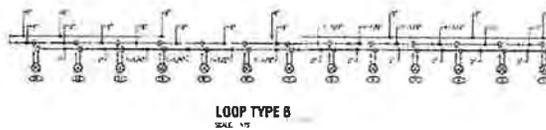
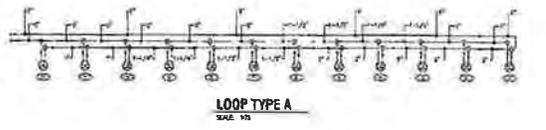
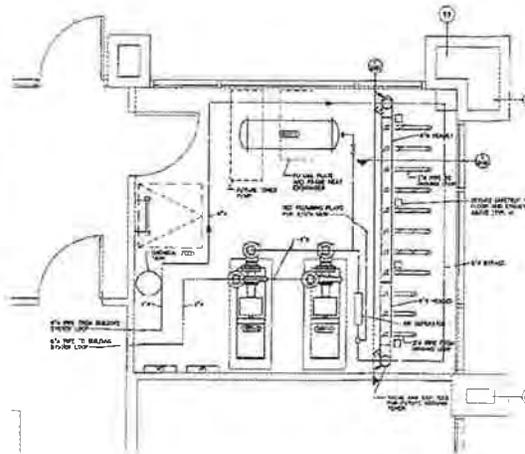
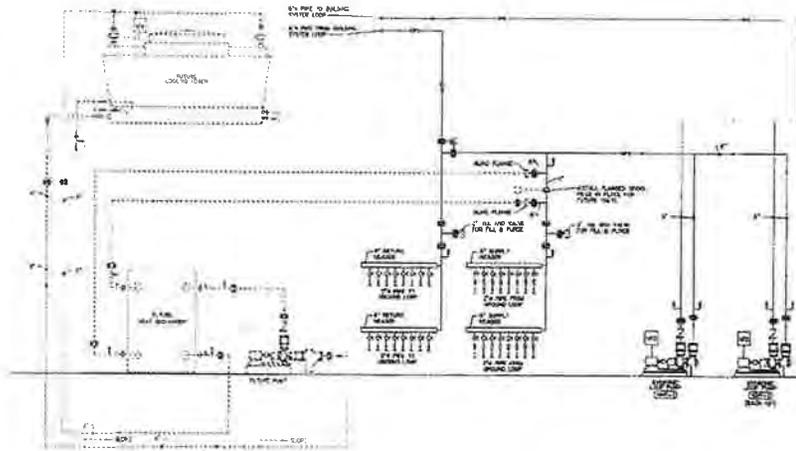


PROJECT NUMBER	200908 V&A CONSULTING
PROJECT NAME	200908 V&A CONSULTING
DATE OF ISSUE	1/6/06
ISSUED BY	BRIDGERS & PAXTON
DATE OF REVIEW	
REVIEWED BY	
DATE OF APPROVAL	
APPROVED BY	

**MECHANICAL SITE PLAN**

**BRIDGERS & PAXTON**  
 CONSULTING ENGINEERS, INC.

MS01



21000 P&ID CORRECTED  
 6/1/06

**The Design Group**  
 INCORPORATED  
 10000 N. ALBUQUERQUE BLVD. SUITE 100  
 ALBUQUERQUE, NM 87112  
 (505) 263-1000  
 www.thedesigngroup.com

PROJECT NAME:  
 RIO RANCHO CITY HALL  
 NOTES:  
 NO MECHANICAL ROOM VIEWS  
 APPROVED:  
 DATE: 6/1/06  
 DRAWN BY: [Name]  
 CHECKED BY: [Name]  
 NO MECHANICAL SECTION

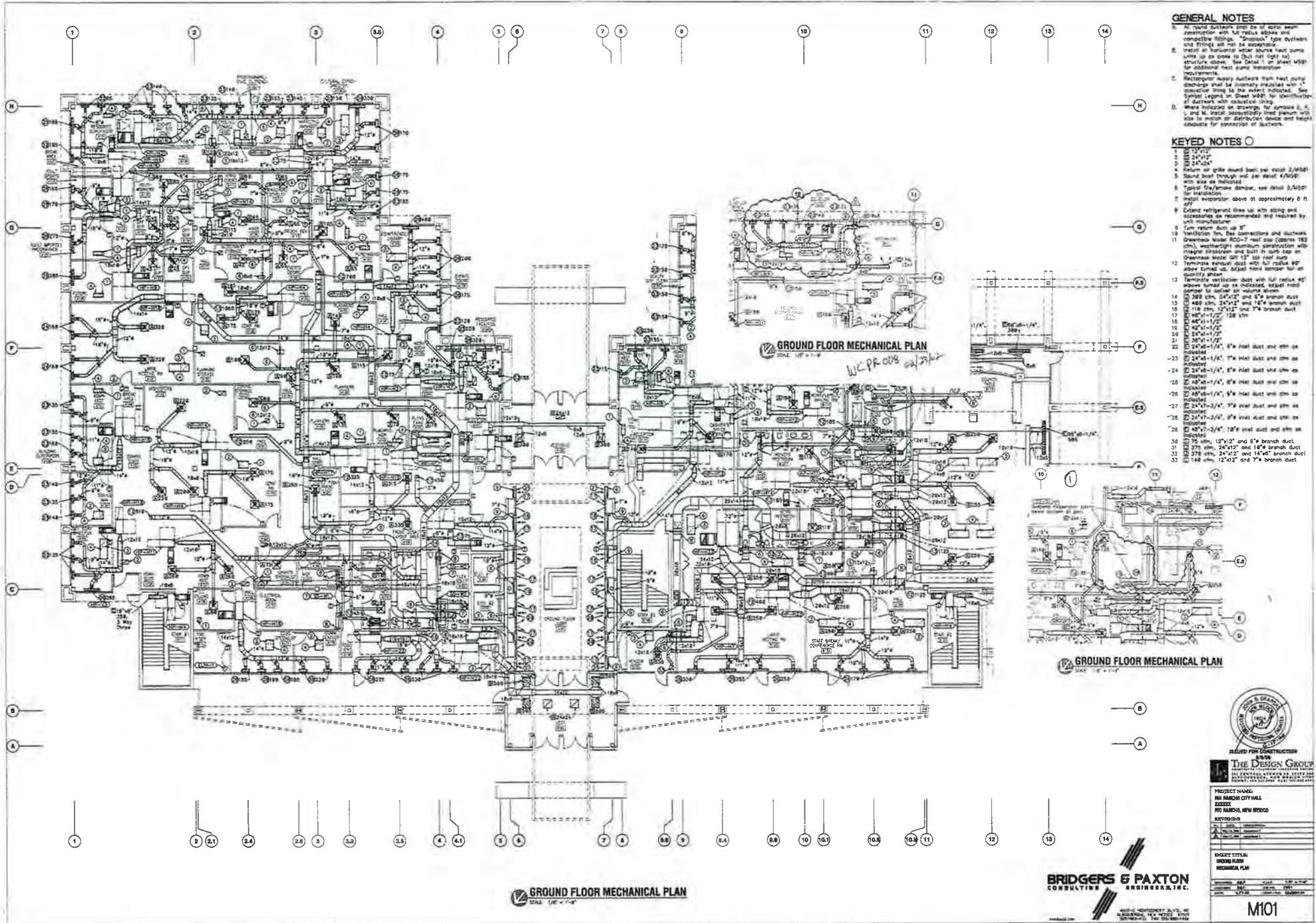
**BRIDGERS & PAXTON**  
 CONSULTING ENGINEERS, INC.

M201









- GENERAL NOTES**
- A. All ductwork shall be installed in accordance with ASHRAE 90.1 and applicable building codes. "Smooth" type ductwork shall be installed in all areas where it is exposed. All ductwork shall be installed in accordance with the applicable building codes. See Detail 1 of sheet M001 for additional notes and connection requirements.
  - B. Where indicated in drawings, for systems A, B, C, and M, install appropriate fire protection. See the notes on distribution ductwork and height schedule for connection of ductwork.

- KEYED NOTES**
- 1. 12" x 12"
  - 2. 24" x 12"
  - 3. 24" x 24"
  - 4. Return of grille shall be set per detail 2 of M001
  - 5. Sound dead through wall per detail 4 of M001 with size as indicated
  - 6. Typical fire/smoke damper, see detail 1 of M001 for installation
  - 7. Metal evaporator above at approximately 8 ft off
  - 8. Extend refrigerant lines up with piping and accessories as recommended and required by unit manufacturer
  - 9. 2m return duct up 8"
  - 10. Ventilation fan, fan connections and ductwork. Drawings under 3000-7 roof cap (copies 183 only), mechanical aluminum construction with integral strapping and built in cup-top on Greenman blade cut 1/2" up roof duct
  - 11. Temporary exhaust duct with full radius 90° elbow turned up. 18" dia. 12" x 12" 7" branch duct
  - 12. Temporary exhaust duct with full radius 45° elbow turned up as indicated. 18" dia. 12" x 12" 7" branch duct
  - 13. 18" dia. 12" x 12" 7" branch duct
  - 14. 18" dia. 12" x 12" 7" branch duct
  - 15. 18" dia. 12" x 12" 7" branch duct
  - 16. 18" dia. 12" x 12" 7" branch duct
  - 17. 18" dia. 12" x 12" 7" branch duct
  - 18. 18" dia. 12" x 12" 7" branch duct
  - 19. 18" dia. 12" x 12" 7" branch duct
  - 20. 18" dia. 12" x 12" 7" branch duct
  - 21. 18" dia. 12" x 12" 7" branch duct
  - 22. 18" dia. 12" x 12" 7" branch duct
  - 23. 18" dia. 12" x 12" 7" branch duct
  - 24. 18" dia. 12" x 12" 7" branch duct
  - 25. 18" dia. 12" x 12" 7" branch duct
  - 26. 18" dia. 12" x 12" 7" branch duct
  - 27. 18" dia. 12" x 12" 7" branch duct
  - 28. 18" dia. 12" x 12" 7" branch duct
  - 29. 18" dia. 12" x 12" 7" branch duct
  - 30. 18" dia. 12" x 12" 7" branch duct
  - 31. 18" dia. 12" x 12" 7" branch duct
  - 32. 18" dia. 12" x 12" 7" branch duct
  - 33. 18" dia. 12" x 12" 7" branch duct

GROUND FLOOR MECHANICAL PLAN  
 SCALE: 1/8" = 1'-0"

GROUND FLOOR MECHANICAL PLAN  
 SCALE: 1/8" = 1'-0"

GROUND FLOOR MECHANICAL PLAN  
 SCALE: 1/8" = 1'-0"



THE DESIGN GROUP, INC.  
 8000  
 10000  
 STATE OF NEW MEXICO

PROJECT NAME:  
 RIO RANCHO CITY HALL  
 10000  
 10000  
 10000

DESIGNER:  
 BRIDGERS & PAXTON  
 CONSULTING ENGINEERS, INC.  
 10000  
 10000  
 10000

DATE:  
 10000  
 10000  
 10000

PROJECT TITLE:  
 GROUND FLOOR  
 MECHANICAL PLAN

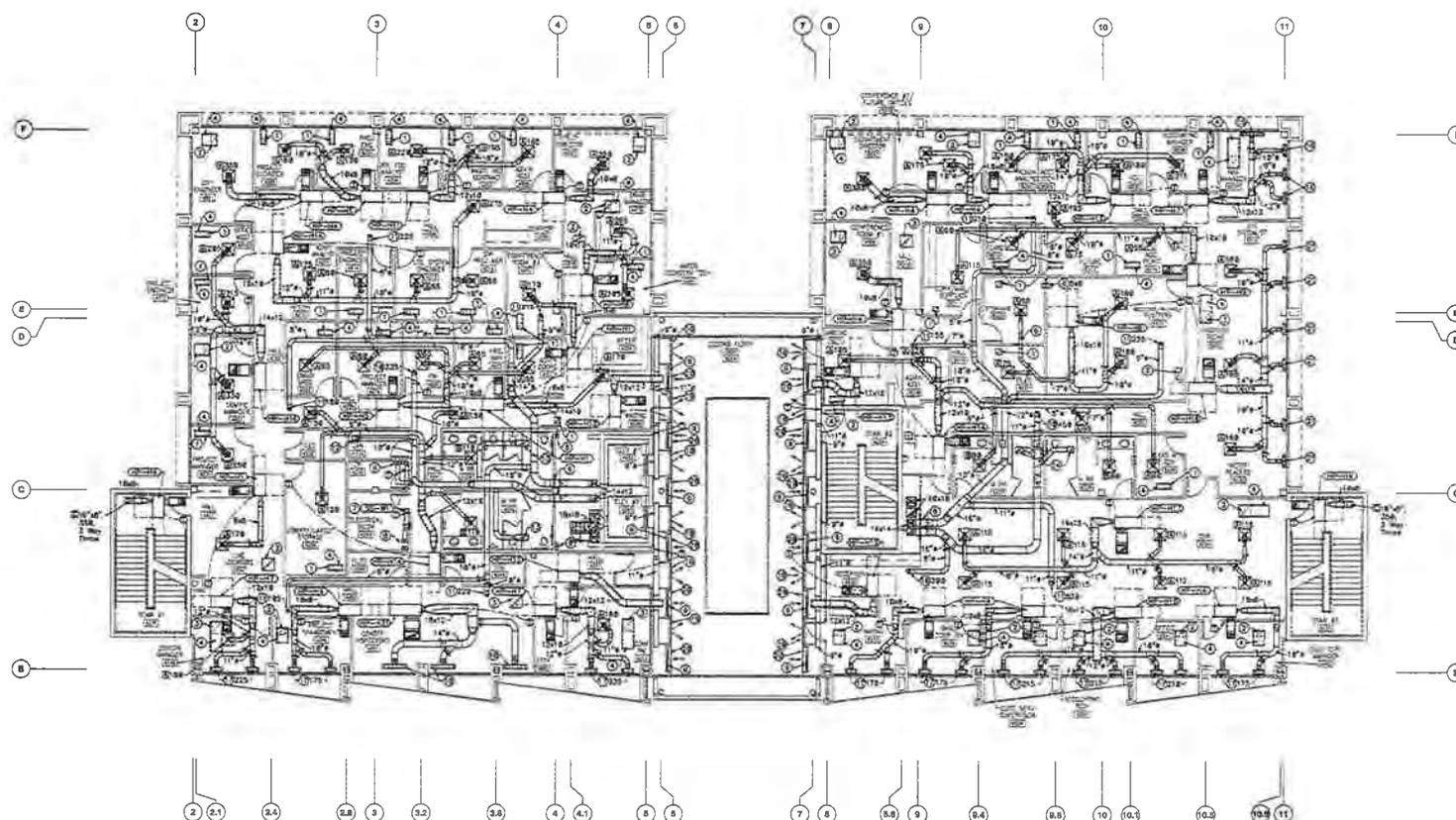
M101

**GENERAL NOTES**

- A. All HVAC ductwork shall be of equal length construction with full ducts above and compatible fittings. "Snap-on" row ductwork and fittings will not be acceptable.
- B. Install of horizontal water service from pump units to the floor to duct riser height to structure above. See Detail 1 on sheet MS01 for additional water pump installation requirements.
- C. Refrigerant supply ductwork shall meet same standards as the water indicated. See Detail Legend on sheet IFB02 for identification of ductwork and associated piping.
- D. Where indicated an arrangement for particles L, F, L and M, install appropriately sized vacuum air-sets to include air distribution device and height schedule for installation of ductwork.

**KEYED NOTES**

1. 12" x 12"
2. 24" x 14"
3. 24" x 24"
4. Return air grille round spot per detail 3/MS01
5. Round lock through wall per detail 4/MS01 with wire as indicated.
6. Typical dry/dampener, see detail 5/MS01 for installation.
7. Install condenser coils at approximately 5 ft AFT.
8. Extend refrigerant lines up into ceiling and disconnect as recommended and required by unit manufacturer.
9. 1/2" return duct to 8"
10. Terminate exhaust duct with full radius 90° elbow turned on 90° hand damper for air quality when.
11. Terminate ventilation duct with full radius 45° elbow turned on air induction return area damper in return air plenum shown.
12. 60 cfm, 12" x 12" and 2" branch duct
13. 225 cfm, 24" x 24" and 2" branch duct
14. 345 cfm, 12" x 12" and 2" branch duct
15. 225 cfm, 18" x 18" and 2" branch duct
16. 125 cfm, 24" x 24" and 1" branch duct
17. 24" x 24", 8" x 8" main duct and 2" x 2" branch duct
18. 420 cfm, 48" x 24" and 12" main duct
19. 60" x 24" 248 cfm
20. 60" x 24"
21. 120 cfm, 24" x 24" and 7" x 7" inlet duct



**SECOND FLOOR MECHANICAL PLAN**  
 SCALE: 1/8" = 1'-0"



ISSUED FOR CONSTRUCTION

**THE DESIGN GROUP, INC.**  
 4508  
 400 CENTRAL AVENUE, SUITE 100  
 ALBUQUERQUE, NEW MEXICO 87102-2424

PROJECT NAME:  
 RIO RANCHO CITY HALL  
 XXXXXX  
 RIO RANCHO, NEW MEXICO

DESCRIPTION:  
 \_\_\_\_\_  
 \_\_\_\_\_

DESIGNER:  
 \_\_\_\_\_  
 \_\_\_\_\_

REVISIONS:  
 \_\_\_\_\_  
 \_\_\_\_\_

PROJECT NO.:  
 \_\_\_\_\_  
 \_\_\_\_\_

DATE:  
 \_\_\_\_\_  
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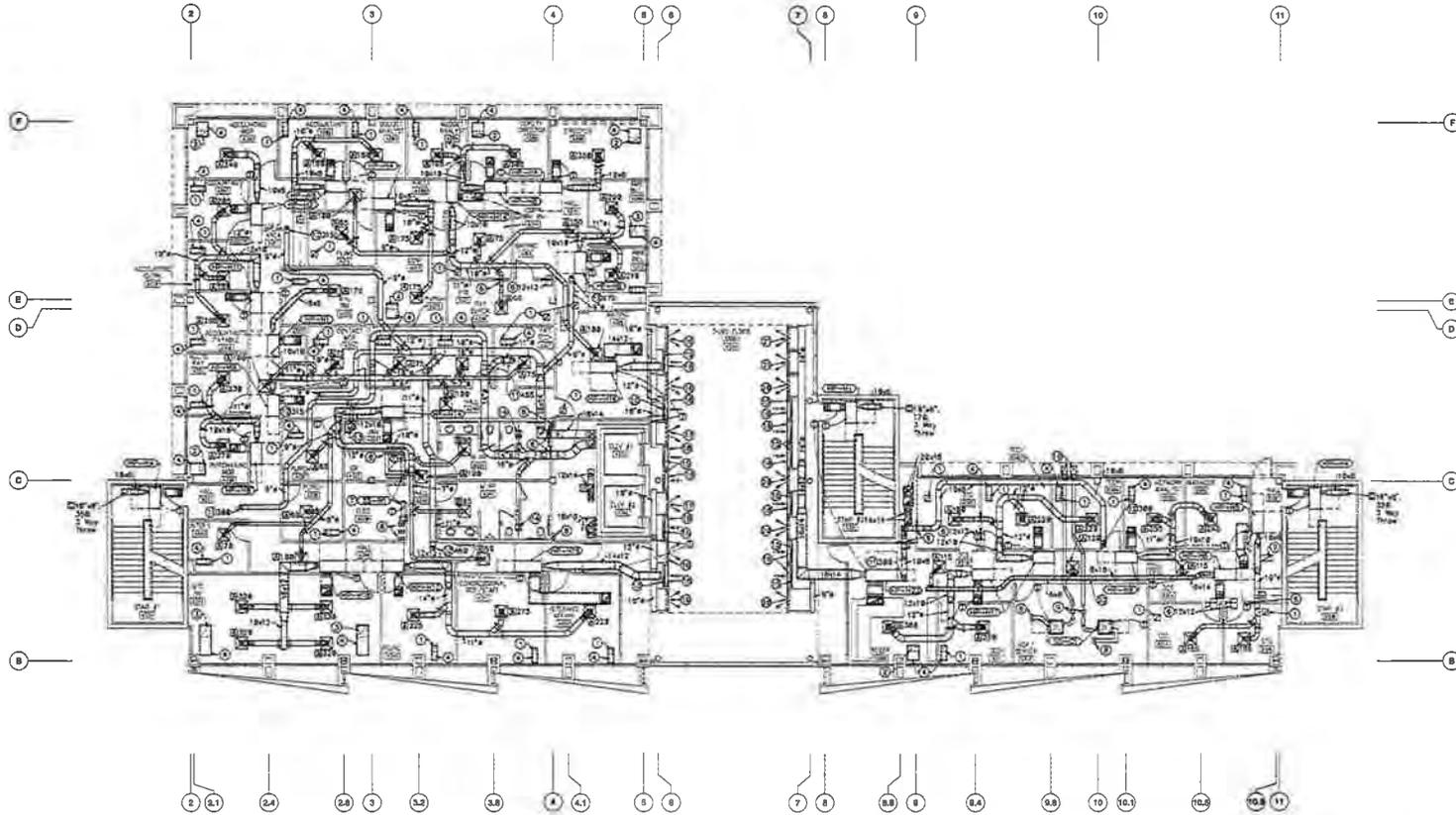
M102

**GENERAL NOTES**

1. All round ductwork shall be of spiral seam construction with full radius elbows and cambrida fittings. "Nonseal" type ductwork and fittings will not be acceptable.
2. Install an horizontal water source heat pump unit as shown in Detail 1 (per Unit) and schedule shown. See Detail 1 for sheet #841 for ductboard heat curve installation requirements.
3. Rectangular supply ductwork from heat pump discharge shall be internally insulated with 1" convoluted lining to the extent indicated. See Symbol Legend on Sheet M501 for identification of ductwork and installation items.
4. Where indicated on drawings, for systems C, F, I, and M, install approximately 1000 square feet of insulation on ductwork and heat exchangers for protection of ductwork.

**KEYED NOTES**

1. 13"x13"
2. 24"x12"
3. 24"x24"
4. Return air grille sound boot per detail 3/M501
5. Sound boot through wall per detail 4/M501 with size as indicated
6. Typical fire/smoke damper, see detail 5/M501 for installation
7. Install exhauster above or approximately 8 ft AFT
8. Extend refrigerant lines up with string and accommodate as recommended and required by unit manufacturer
9. Ventilation fan, see connections and ductwork
10. Gramercy Model DU-401 (approx 165 cfm), 12"x12" black louver in soffits, extruded aluminum construction primed for field painting, 2 style blades, 1-1/2" full perimeter flange, interior aluminum brackets, 6.25 sq. ft. free area, 0.668" PD at 185 cfm and 828 fpm
11. Terminate exhaust duct with full radius 90° elbow turned up, offset hand damper for air quantity shown
12. Terminate ventilation duct with full radius 45° elbow turned up as indicated, offset hand damper to deliver or volume shown
13. 88 cfm, 12"x12" and 6"x6" branch duct
14. 285 cfm, 12"x12" and 6"x6" branch duct
15. Turn return duct up 4"
16. 48"x3", 335 cfm
17. 48"x3", 336 cfm
18. 48"x3"
19. 44"x3"
20. 48"x3", 283 cfm
21. 48"x3", 278 cfm
22. Install ductwork to be clear of unit maintenance area



**THIRD FLOOR MECHANICAL PLAN**  
 SCALE: 1/8" = 1'-0"

**BRIDGERS & PAXTON**  
 CONSULTING ENGINEERS, INC.

1000 UNIVERSITY BLVD. N.E.  
 ALBUQUERQUE, N.M. 87102  
 PHONE: 505-263-7400  
 FAX: 505-263-7400

**THE DESIGN GROUP**  
 ARCHITECTS

PROJECT NAME:  
 RIO RANCHO CITY HALL  
 300 RANCHO, NEW MEXICO

REVISIONS

NO.	DATE	DESCRIPTION

DRAWN BY:  
 TMB/PLW  
 RECALCULATED BY:  
 TMB/PLW

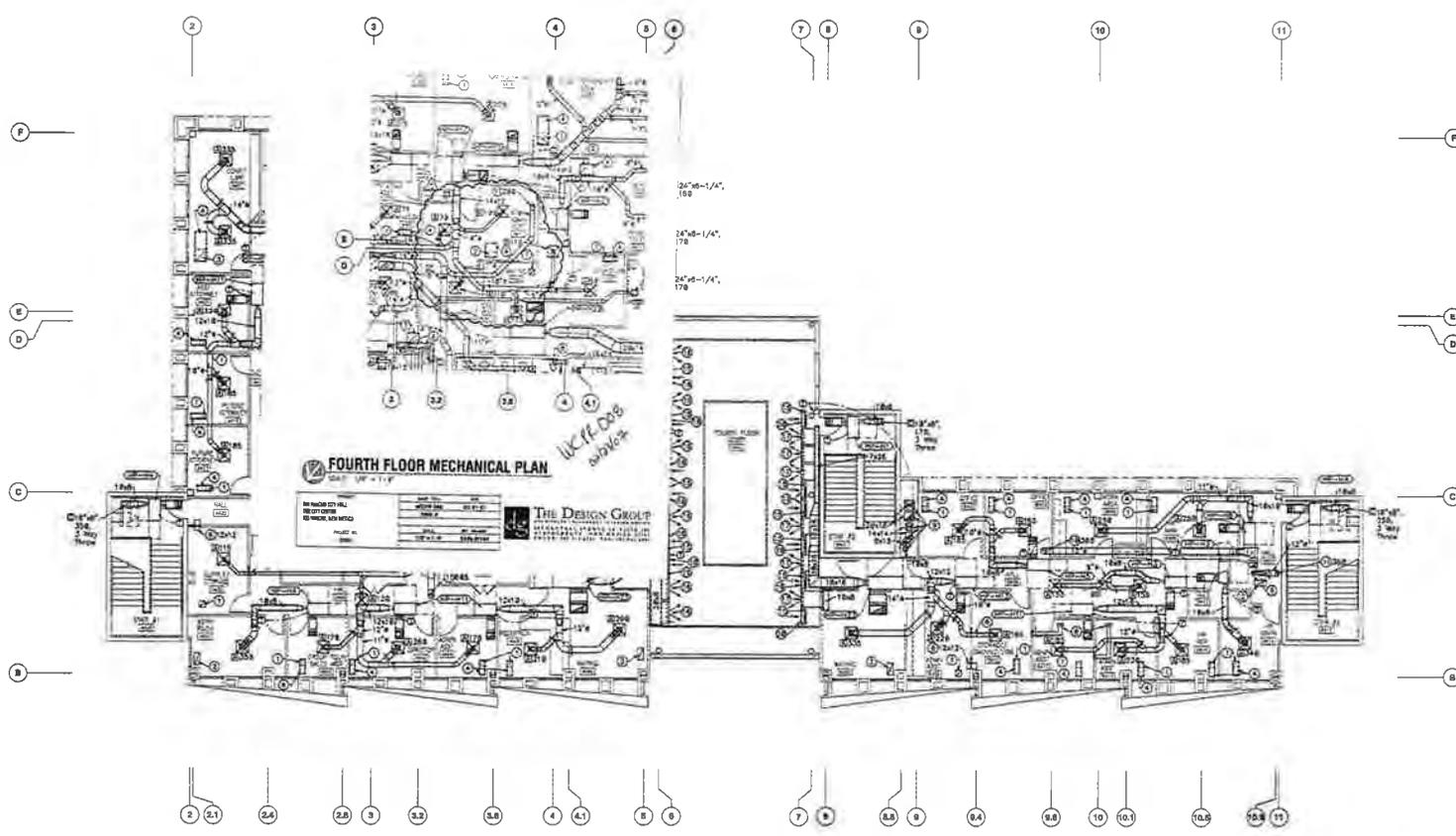
**M103**

**GENERAL NOTES**

1. All round ductwork shall be an equal term construction with 1/4" radius elbows and compression fittings. "Snaplock" type ductwork and fittings will not be acceptable.
2. Install all horizontal water source heat pump units so as close to duct (not tight) as structure allows. See Detail 3 or detail M501 for additional heat pump manufacturer requirements.
3. Refrigerant supply ductwork from heat pump discharge shall be properly insulated with 1" minimum R-11 in the areas indicated. See General Legend on sheet M502 for identification of ductwork with insulation. Where indicated on drawings, for symbols E, F, L and M, install automatically closed slanting unit with its motor or distribution device and height adequate for suspension of ductwork.

**KEYED NOTES**

- 1 12"x12"
- 2 24"x12"
- 3 24"x24"
- 4 Return air grille sound boot per detail 3/M501
- 5 Sound boot through wall per detail 4/M501 with size as indicated.
- 6 Typical fire/smoke damper, see detail 3/M501 for installation.
- 7 Install evaporator above of approximately 8 ft AFT
- 8 Extend refrigerant lines up with sling and accessories as recommended and required by unit manufacturer.
- 9 Ductwork through roof to energy recovery unit
- 10 Terminate exhaust duct with full radius 80" above turned up, adjust hand damper for air quantity shown.
- 11 Terminate ventilation duct with full radius 45" above turned up or indicated, adjust hand damper to deliver air volume shown.
- 12 80 cfm, 12"x12" and 8" branch duct
- 13 285 cfm, 12"x12" and 8" branch duct
- 14 75 cfm, 12"x12" and 8" branch duct
- 15 Turn return duct up 8"
- 16 48"x24" - 870 cfm
- 17 30"x24" - 330 cfm
- 18 45"x24"
- 19 30"x24"
- 20 34"x24"
- 21 Duct sleeve through roof to elevator shaft relief hood.



**FOURTH FLOOR MECHANICAL PLAN**  
 Scale: 1/4" = 1'-0"

NO HATCH ON WALL  
 REVISIONS TO MECHANICAL SYSTEMS

NO.	DATE	BY	CHKD.	DESCRIPTION
1	11/11/11	...	...	...
2	11/11/11	...	...	...

**THE DESIGN GROUP**  
 ARCHITECTS & ENGINEERS  
 10000 RIO RANCHO BLVD. N.W.  
 SUITE 1000  
 RIO RANCHO, NM 87149  
 (505) 891-1100  
 WWW.THEDESIGNGROUP.COM

**FOURTH FLOOR MECHANICAL PLAN**  
 Scale: 1/4" = 1'-0"



DESIGNED FOR CONSTRUCTION  
 DATE: 11/11/11

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 10000 RIO RANCHO BLVD. N.W.  
 SUITE 1000  
 RIO RANCHO, NM 87149  
 (505) 891-1100  
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PROJECT NAME:  
 RIO RANCHO CITY HALL  
 000000  
 RIO RANCHO, NEW MEXICO

REVISED BY:  
 DATE: 11/11/11  
 BY: [Signature]  
 CHECKED BY: [Signature]  
 DATE: 11/11/11

DESIGN BY:  
 DATE: 11/11/11  
 BY: [Signature]  
 CHECKED BY: [Signature]  
 DATE: 11/11/11

SCALE: 1/4" = 1'-0"

DATE: 11/11/11

**BRIDGERS & PAXTON**  
 CONSULTING ENGINEERS, INC.

10000 RIO RANCHO BLVD. N.W.  
 SUITE 1000  
 RIO RANCHO, NM 87149  
 (505) 891-1100  
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M104

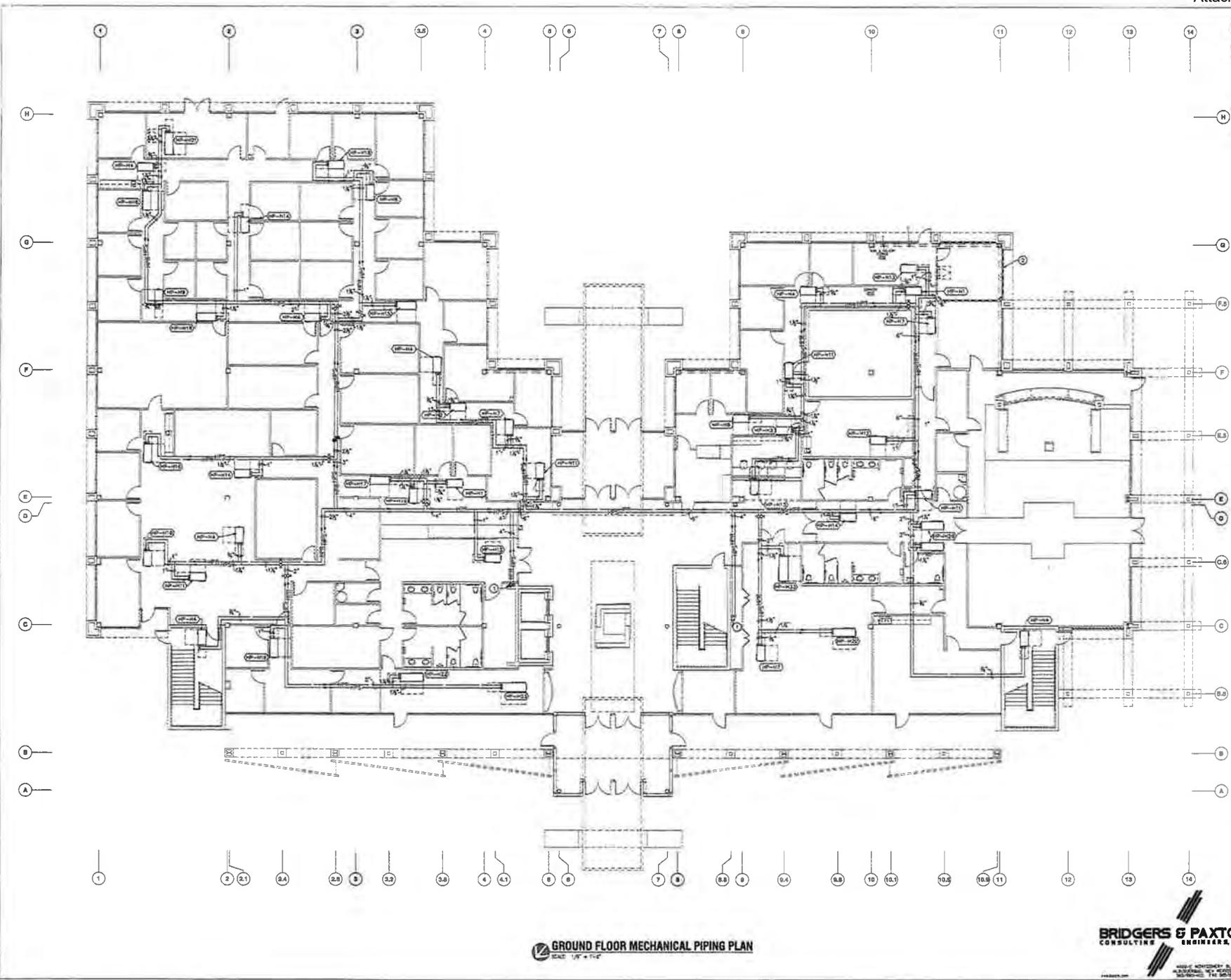


**GENERAL NOTES**

- A. Provide and install manual air vents at all high points in the system.
- B. Provide and install low point drains at all low points in the system.
- C. For heat pump connection detail, refer to detail 1/1021.

**KEYED NOTES**

- 1. Refer to drawing M11C for construction.
- 2. Refer to drawing M201 for mechanical room plan.



**GROUND FLOOR MECHANICAL PIPING PLAN**  
 SCALE: 1/8" = 1'-0"

**BRIDGERS & PAXTON**  
 CONSULTING ENGINEERS, INC.

BRIDGERS & PAXTON CONSULTING ENGINEERS, INC.  
 10000 UNIVERSITY BLVD., SUITE 100  
 ALBUQUERQUE, NEW MEXICO 87123  
 (505) 263-1000 FAX (505) 263-1001

**THE DESIGN GROUP**  
 ARCHITECTS

PROJECT NAME:  
 RIO RANCHO CITY HALL  
 22000  
 RIO RANCHO, NEW MEXICO

DATE: 08/11/11

PROJECT TITLE:  
 SECOND FLOOR  
 MECHANICAL PIPING PLAN

DATE: 08/11/11

**M11**

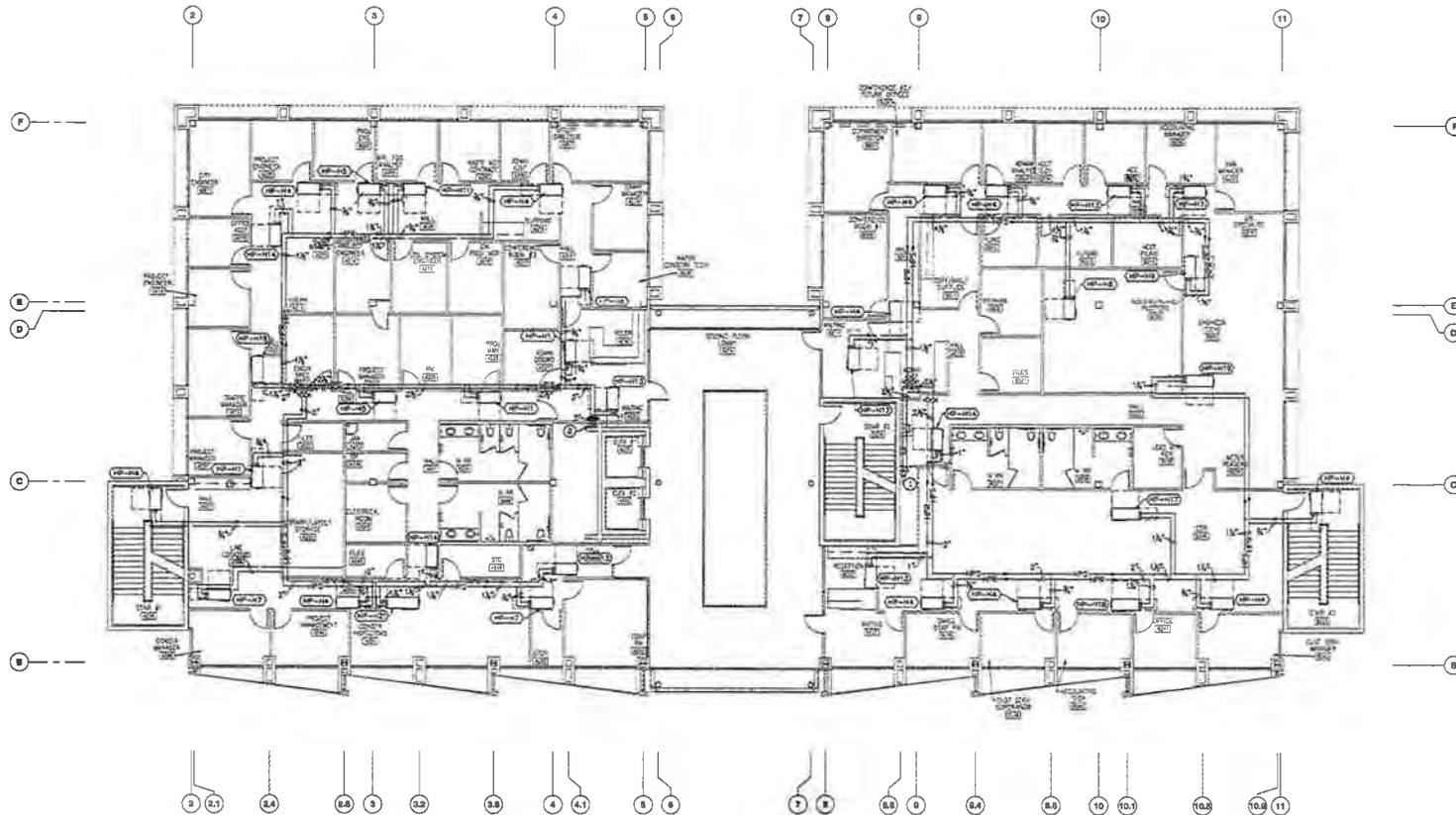


**GENERAL NOTES**

- A. Provide and install manual air vents at all high points in the system.
- B. Provide and install the girth drains at all low points in the system.
- C. For heat pump connection detail refer to detail 1/AS01

**KEYED NOTES** ○

1. 4" NPS/R size on first floor. 3" NPS/R lines up to third floor. Transition above 2"-1/2" NPS/R tops for second floor. Refer to drawings M111 and M112 for explanation.
2. 4" NPS/R size up from first floor. 4" NPS/R size up to third floor. Refer to drawings M111 and M112 for explanation.



**SECOND FLOOR MECHANICAL PIPING PLAN**  
 SCALE: 1/8" = 1'-0"



DESIGN FOR CONSTRUCTION

**THE DESIGN GROUP, INC.**  
 10000 N. ALBUQUERQUE BLVD. SUITE 100  
 ALBUQUERQUE, NEW MEXICO 87124  
 PHONE: 505.261.1000 FAX: 505.261.1001

PROJECT NAME:  
 RIO RANCHO CITY HALL  
 XXXXX  
 RIO RANCHO, NEW MEXICO

DATE: 05/11/2021  
 TIME: 10:00 AM

SHEET TITLE:  
 SECOND FLOOR  
 MECHANICAL PIPING PLAN

PROJECT NO.:  
 21-009  
 SHEET NO.:  
 M112

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 CONSULTING ENGINEERS, INC.

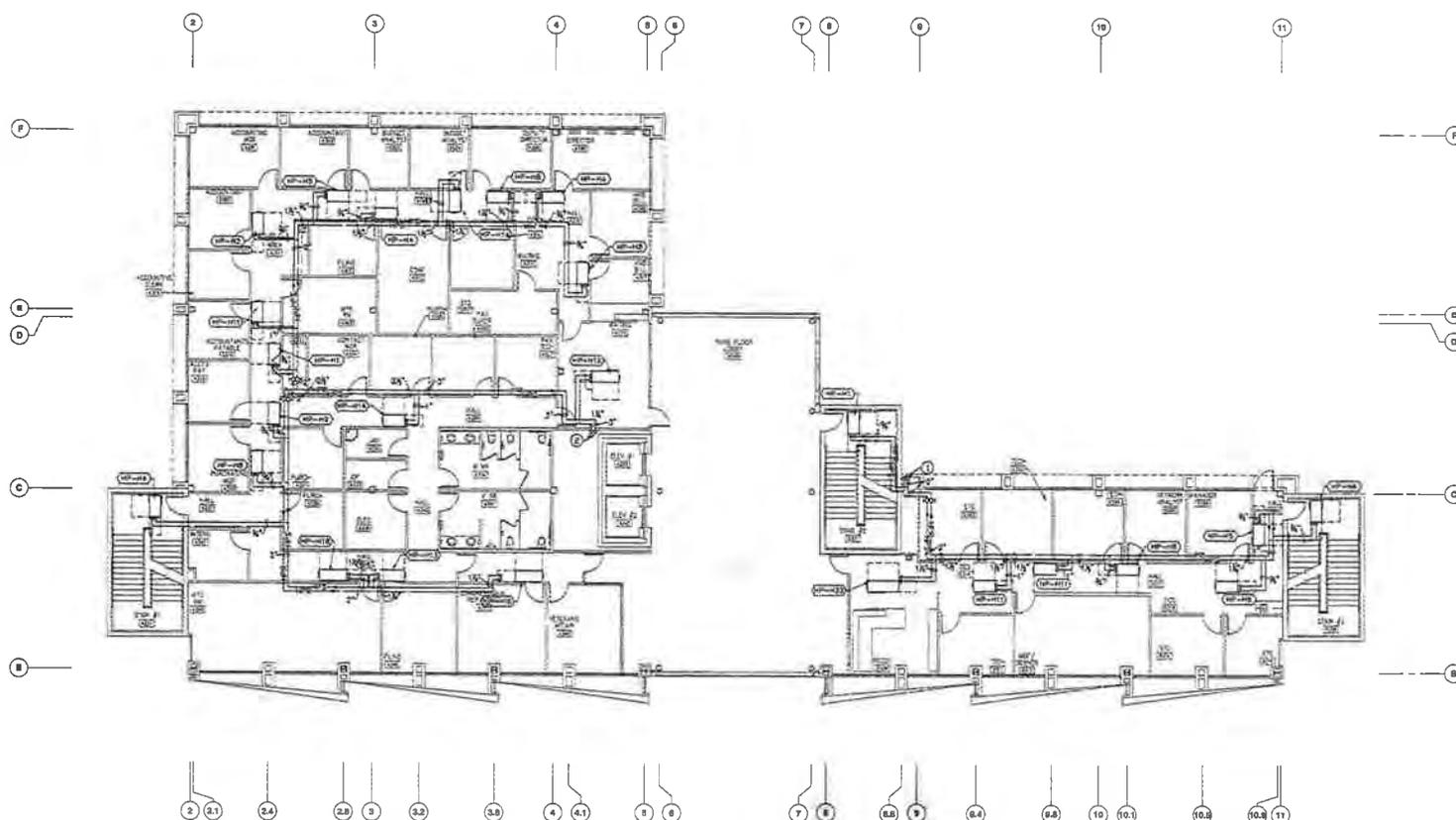
4400 G. HORTON BLVD., NE  
 ALBUQUERQUE, NEW MEXICO 87111  
 TEL: 505.261.1000 FAX: 505.261.1001

**GENERAL NOTES**

1. Provide pipe and hangers as noted at all high points in the system.
2. Provide and install low point drains at all low points in the system.
3. For steel pipe connections specify refer to section 1.0207.

**KEYED NOTES**

1. 2" IPS/2# lines up from second floor. 2" IPS/2# lines up to fourth floor. Transition above 2" IPS/2# lines for third floor. Refer to drawings M112 and M114 for construction.
2. 2" IPS/2# lines up from second floor. 2" IPS/2# lines up to fourth floor. Refer to drawings M112 and M114 for construction.



**THIRD FLOOR MECHANICAL PIPING PLAN**  
 SCALE: 1/8" = 1'-0"



DESIGNED FOR CONSTRUCTION  
 12/18/21  
**THE DESIGN GROUP, INC.**  
 111 EASTWICK AVENUE SUITE 100  
 ALBUQUERQUE, NEW MEXICO 87102  
 PHONE: (505) 261-0700 FAX: (505) 261-0701

**PROJECT NAME:**  
 RIO RANCHO CITY HALL  
**OWNER:**  
 RIO RANCHO, NEW MEXICO  
**DESCRIPTION:**

No.	DESCRIPTION

**DESIGN STYLE:**  
 THIRD FLOOR  
 MECHANICAL PIPING PLAN

DATE	BY	CHKD BY	APP'D BY



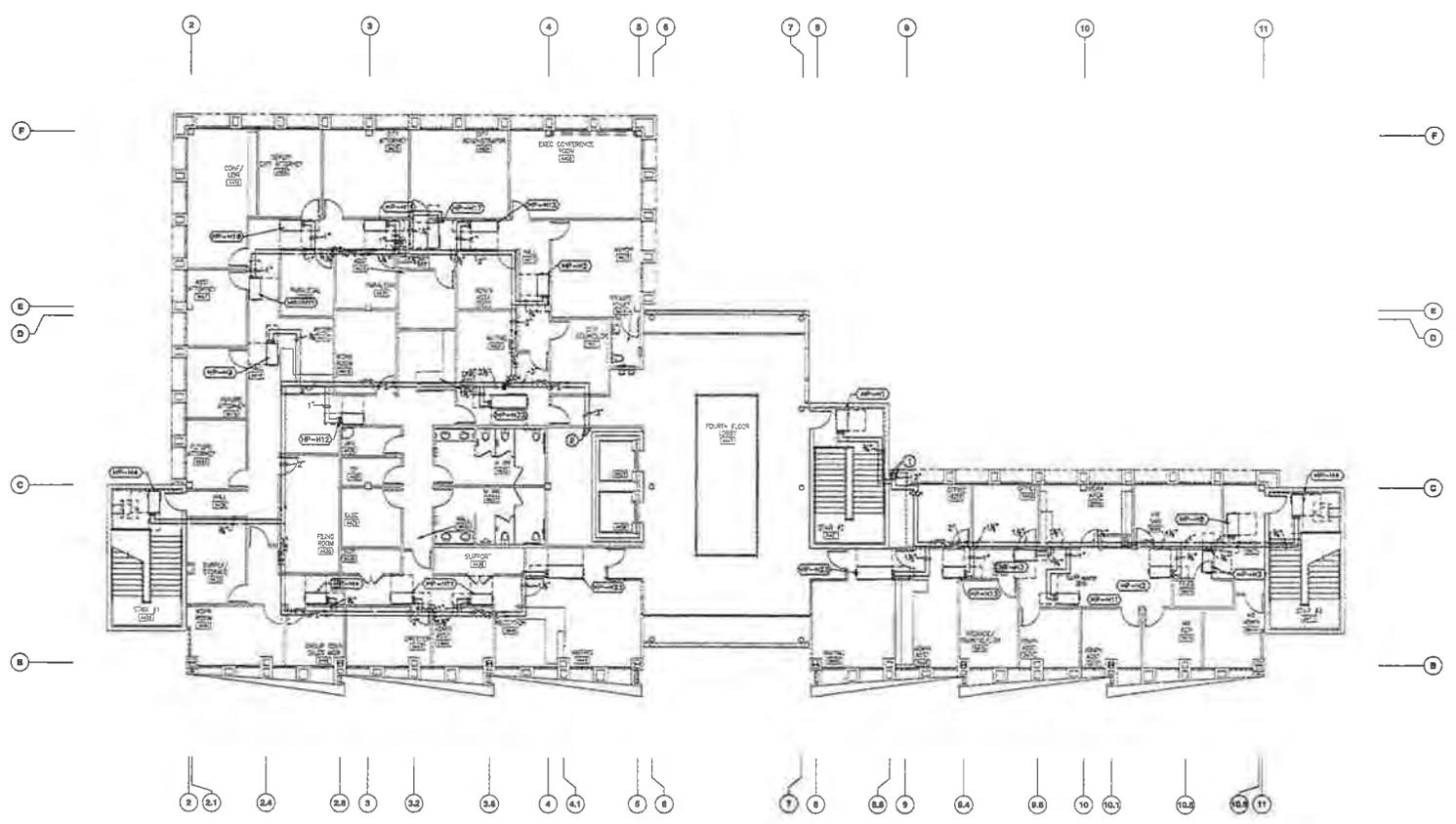
**M113**

**GENERAL NOTES**

- A. Provide and install minimum six (6) points at all high points in the system.
- B. Provide and install four (4) point drains at all low points in the system.
- C. For most pipe connection details, refer to section 1.4.3.1.

**KEYED NOTES**

- 1. 2" HDPE pipe over to third floor. Refer to drawings M113 for installation.
- 2. 2" HDPE pipe over to third floor. Refer to drawings M113 for installation.



**FOURTH FLOOR MECHANICAL PIPING PLAN**  
 SCALE: 1/8" = 1'-0"



SEAL FOR CONSTRUCTION

**THE DESIGN GROUP**  
 CONSULTING ENGINEERS ARCHITECTS  
 ALL LICENSES ARE IN GOOD AND  
 FULL COMPLIANCE WITH THE STATE OF  
 NEW MEXICO

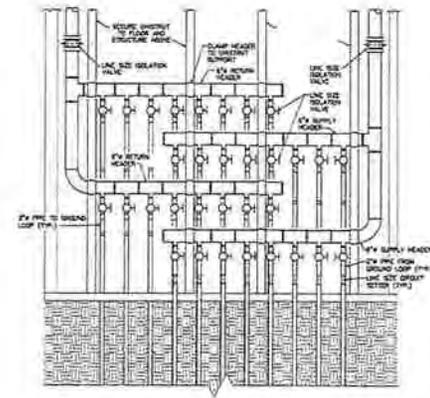
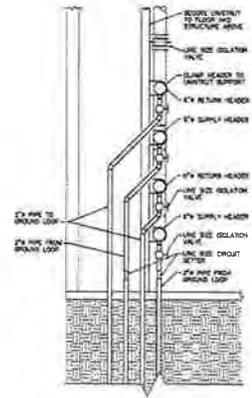
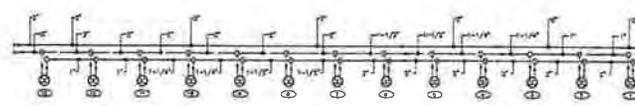
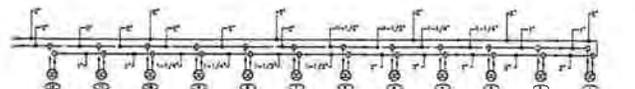
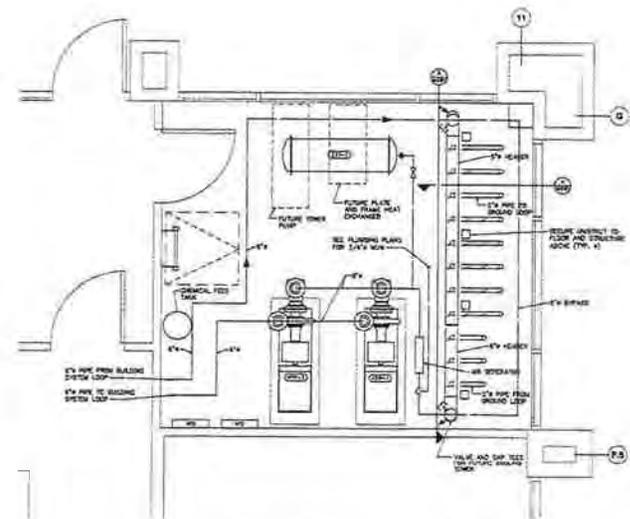
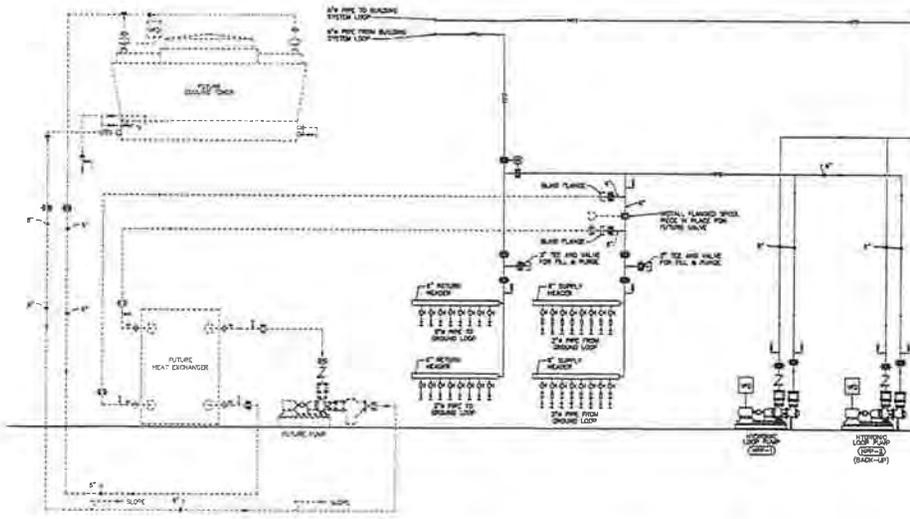
PROJECT NAME:  
 RIO RANCHO CITY HALL  
 XXXXX  
 RIO RANCHO, NEW MEXICO

NO. 1, SHEET 1 OF 1

SHEET TITLE:  
 FOURTH FLOOR  
 MECHANICAL PIPING PLAN



M114



ISSUED FOR CONSTRUCTION  
 6/2/06

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PROJECT NAME:  
 RIO RANCHO CITY HALL  
 230000  
 RIO RANCHO, NEW MEXICO

DATE: 6/2/06

SCALE: 1/2" = 1'-0"

DATE: 6/2/06

BY: [Signature]

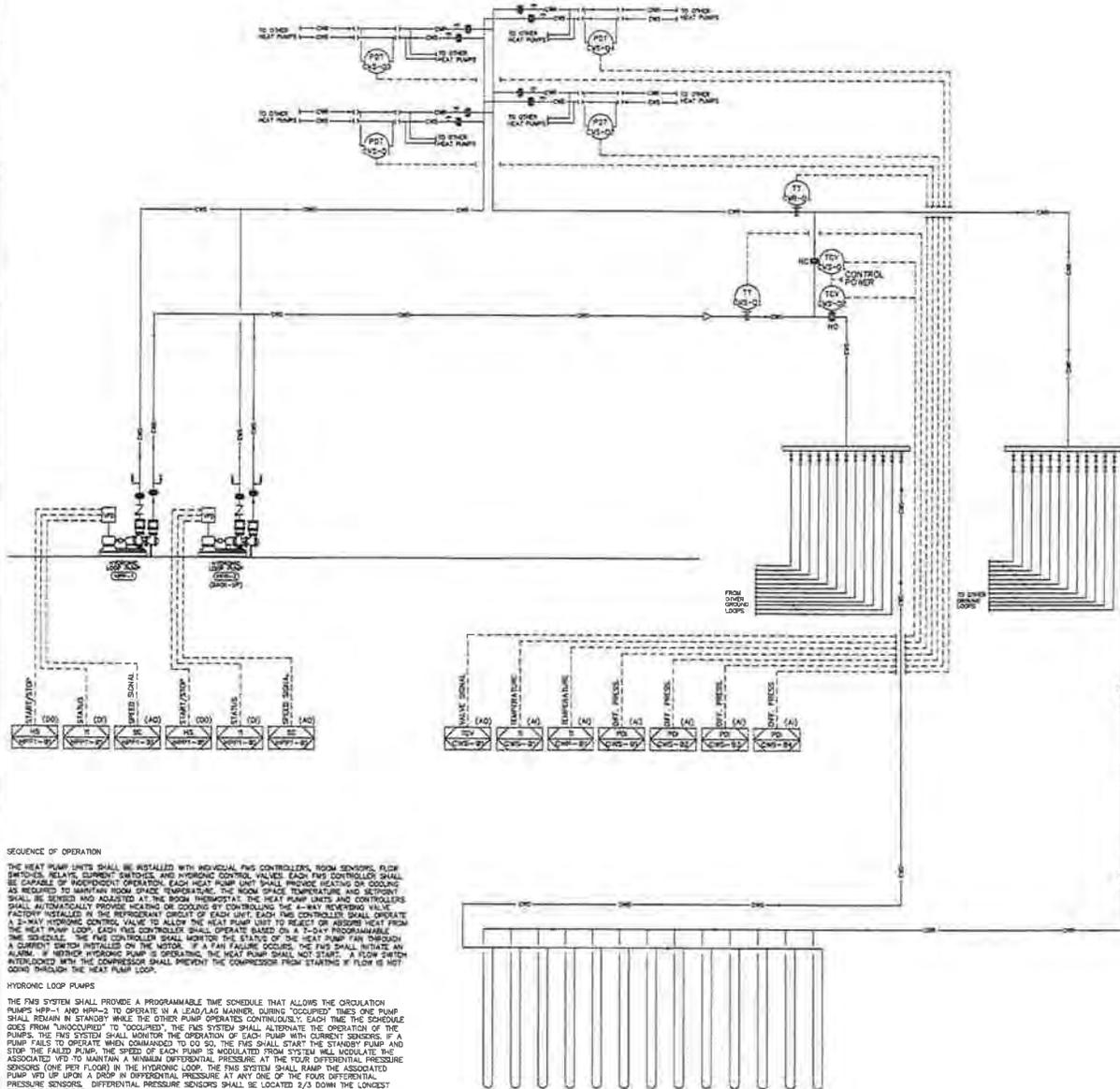
FOR: [Signature]

PROJECT NO.: M201

**BRIDGERS & PAXTON**  
 CONSULTING ENGINEERS, INC.

10000 MONTEVISTA BLVD., N.E.  
 ALBUQUERQUE, NEW MEXICO 87110  
 PH: (505) 261-1100 FAX: (505) 261-1101  
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**HEAT PUMP LOOP CONTROL DIAGRAM**

**SEQUENCE OF OPERATION**

THE HEAT PUMP UNITS SHALL BE INSTALLED WITH INDIVIDUAL FMS CONTROLLERS, ROOM SENSORS, FLOW SWITCHES, RELAYS, CURRENT SWITCHES, AND HYDRONIC CONTROL VALVES. EACH FMS CONTROLLER SHALL BE CAPABLE OF INDEPENDENT OPERATION. EACH HEAT PUMP UNIT SHALL PROVIDE HEATING OR COOLING AS REQUIRED TO MAINTAIN ROOM SPACE TEMPERATURE. THE ROOM SPACE TEMPERATURE AND SETPOINT SHALL BE SENSITIVELY ADJUSTED AT THE ROOM THERMOSTAT. THE HEAT PUMP UNITS AND CONTROLLERS SHALL AUTOMATICALLY PROVIDE HEATING OR COOLING BY CONTROLLING THE 4-WAY REVERSING VALVE FACTORY INSTALLED IN THE REFRIGERANT CIRCUIT OF EACH UNIT. EACH CONTROLLER SHALL OPERATE A 2-WAY HYDRONIC CONTROL VALVE TO ALLOW THE HEAT PUMP UNIT TO SELECT OR ABSORB HEAT FROM THE HEAT PUMP LOOP. EACH CONTROLLER SHALL OPERATE BASED ON A 2-DAY PROGRAMMABLE A CURRENT SWITCH INSTALLED ON THE MOTOR. IF A FAN FAILURE OCCURS, THE FMS SHALL INITIATE AN ALARM. IF NETWORK HYDRONIC PUMP IS OPERATING, THE HEAT PUMP SHALL NOT START. A FLOW SWITCH INTERLOCKED WITH THE COMPRESSOR SHALL PREVENT THE COMPRESSOR FROM STARTING IF FLOW IS NOT GOING THROUGH THE HEAT PUMP LOOP.

**HYDRONIC LOOP PUMPS**

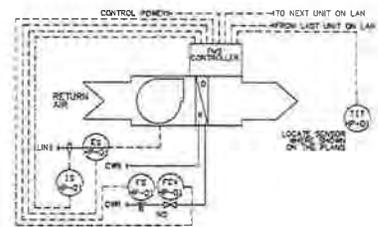
THE FMS SYSTEM SHALL PROVIDE A PROGRAMMABLE TIME SCHEDULE THAT ALLOWS THE CIRCULATION PUMPS HPP-1 AND HPP-2 TO OPERATE IN A LEAD/LAG MANNER. DURING "OCCUPIED" TIMES ONE PUMP SHALL REMAIN IN STANDBY WHILE THE OTHER PUMP OPERATES CONTINUOUSLY. EACH TIME THE SCHEDULE GOES FROM "UNOCCUPIED" TO "OCCUPIED", THE FMS SYSTEM SHALL ALTERNATE THE OPERATION OF THE PUMPS. THE FMS SYSTEM SHALL MONITOR THE OPERATION OF EACH PUMP WITH CURRENT SENSORS. IF A PUMP FAILS TO OPERATE WHEN COMMANDED TO DO SO, THE FMS SHALL START THE STANDBY PUMP AND STOP THE FAILED PUMP. THE SPEED OF EACH PUMP IS MODULATED FROM SYSTEM WILL MODULATE THE ASSOCIATED VFD TO MAINTAIN A MINIMUM DIFFERENTIAL PRESSURE AT THE TYPICAL DIFFERENTIAL PRESSURE SENSORS (ONE PER FLOOR) IN THE HYDRONIC LOOP. THE FMS SYSTEM SHALL RAMP THE ASSOCIATED PUMP VFD UP UPON A DROP IN DIFFERENTIAL PRESSURE AT ANY ONE OF THE FOUR DIFFERENTIAL PRESSURE SENSORS. DIFFERENTIAL PRESSURE SENSORS SHALL BE LOCATED 2/3 DOWN THE LONGEST RUN OF EACH FLOOR.

**HYDRONIC LOOP TEMPERATURE CONTROL**

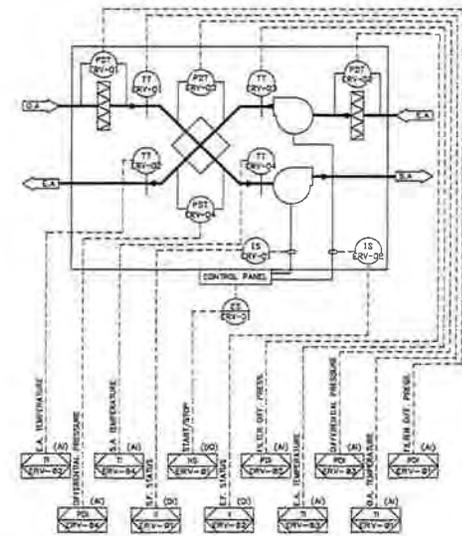
THE FMS SHALL MODULATE THE BYPASS CONTROL VALVES TO MAINTAIN THE HEAT PUMP LOOP TEMPERATURE BETWEEN 45°F AND 55°F. THE BYPASS VALVE SHALL BE CLOSED AND THE GROUND LOOP VALVE OPEN IF THE HEAT PUMP LOOP SUPPLY TEMPERATURE IS NOT WITHIN THESE TEMPERATURE RANGES.

**HEAT RECOVERY UNITS**

THE HEAT RECOVERY UNITS SHALL OPERATE CONTINUOUSLY DURING "OCCUPIED" TIMES. THE FMS SYSTEM SHALL START AND STOP THE OPERATION OF THE HEAT RECOVERY UNITS BASED ON A PROGRAMMABLE TIME SCHEDULE. SMOKE DETECTORS IN THE SUPPLY AND EXHAUST DUCTWORK SHALL STOP THE OPERATION OF THE SUPPLY FAN WHEN SMOKE IS SENSED. THE FMS SHALL MONITOR THE STATUS OF THE UNIT THROUGH A CURRENT SWITCH. IF A FAN FAILURE OCCURS, THE FMS SHALL INITIATE AN ALARM.



**TYPICAL HEAT PUMP CONTROL DIAGRAM**



**TYPICAL ENERGY RECOVERY VENTILATOR CONTROL DIAGRAM**

ISSUED FOR CONSTRUCTION  
 6/9/06

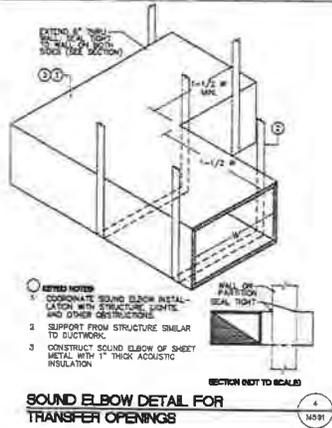


**THE DESIGN GROUP**  
 ARCHITECTS ENGINEERS INTERIORS  
 10000 N. ALBUQUERQUE BLVD. SUITE 100  
 ALBUQUERQUE, NM 87124  
 PHONE: 505.263.8800 FAX: 505.263.8801

PROJECT NAME	00 HANCOCK CITY HALL	
DESIGNER	BRIDGERS & PAXTON, NEW MEXICO	
REVISIONS		
NO.	DATE	DESCRIPTION
SHEET TITLE		MECHANICAL CONTROL
DATE	BY	CHKD



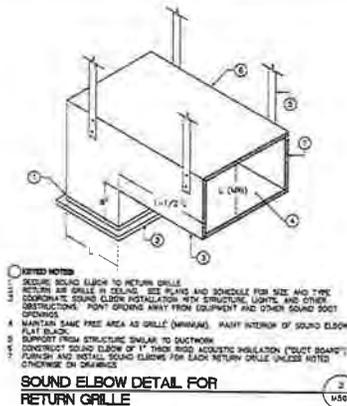
M402



- REVISED NOTES:**
- COORDINATE SOUND CLOAK INSTALLATION WITH STRUCTURE, LIGHTS, AND OTHER OBSTRUCTIONS.
  - SUPPORT FROM STRUCTURE SIMILAR TO DUCTWORK.
  - CONSTRUCT SOUND CLOAK OF SHEET METAL WITH 1" THICK ACOUSTIC INSULATION.

**SOUND ELBOW DETAIL FOR TRANSFER OPENINGS**

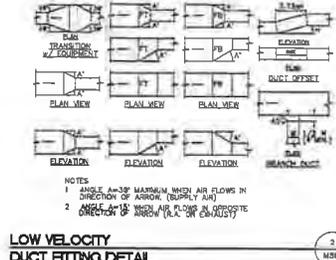
M581



- REVISED NOTES:**
- SECURE SOUND ELBOW TO RETURN GRILLE.
  - COORDINATE SOUND CLOAK INSTALLATION WITH STRUCTURE, LIGHTS, AND OTHER OBSTRUCTIONS. POINT GRINGS AWAY FROM EQUIPMENT AND OTHER SOUND SENSITIVE OPENINGS.
  - MAINTAIN SAME FREE AREA AS GRILLE (MINIMUM). PAINT INTERIOR OF SOUND ELBOW FLAT BLACK.
  - SUPPORT FROM STRUCTURE SIMILAR TO DUCTWORK.
  - CONSTRUCT SOUND CLOAK OF 1" THICK RIGID ACOUSTIC INSULATION (FOLOT BOARD) FURNISH AND INSTALL SOUND ELBOWS FOR EACH RETURN GRILLE (UNLESS NOTED OTHERWISE ON DRAWINGS).

**SOUND ELBOW DETAIL FOR RETURN GRILLE**

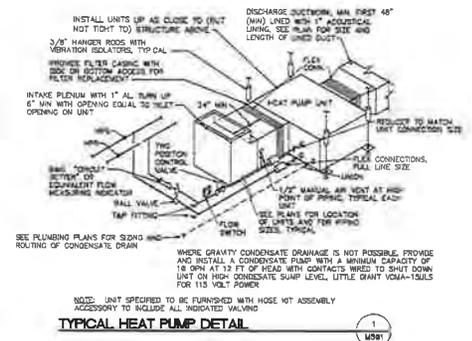
M581



- NOTES:**
- ANGLE 45-30 MAXIMUM, WHEN AIR FLOWS IN DIRECTION OF ARROW. (SUPPLY AIR)
  - ANGLE 45-15 MAXIMUM, WHEN AIR FLOWS IN OPPOSITE DIRECTION OF ARROW. (R.A. OR EXHAUST)

**LOW VELOCITY DUCT FITTING DETAIL**

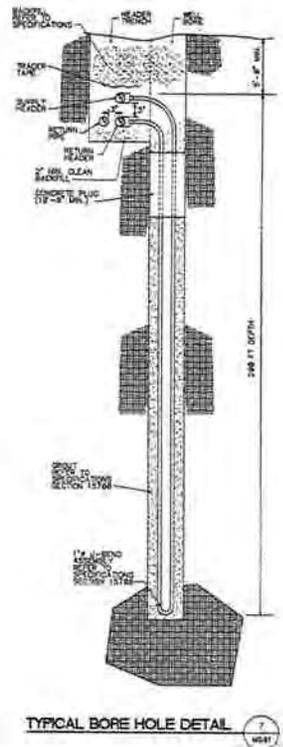
M581



- NOTES:** UNIT REQUIRED TO BE FURNISHED WITH HOSE NOT ASSEMBLY NECESSARY TO INCLUDE ALL INDICATED TAPPING.

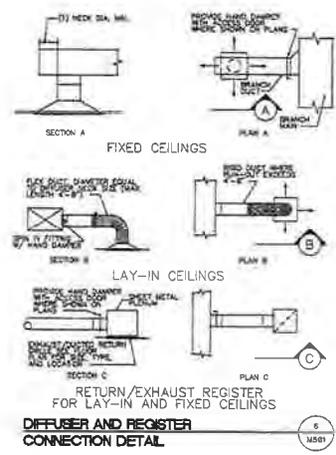
**TYPICAL HEAT PUMP DETAIL**

M581



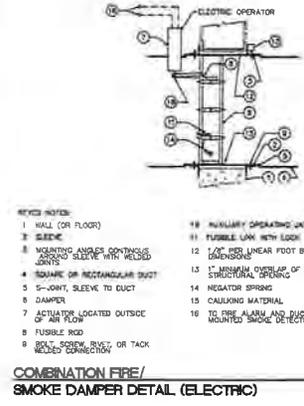
**TYPICAL BORE HOLE DETAIL**

M581



**RETURN/EXHAUST REGISTER FOR LAY-IN AND FIXED CEILINGS DIFFUSER AND REGISTER CONNECTION DETAIL**

M581



- REVISED NOTES:**
- HALL (OR FLOOR)
  - SLUICE
  - INSULATING ANGLE CONTINUOUS AROUND SLEEVE WITH WELDED JOINTS
  - SQUARE OR RECTANGULAR DUCT
  - S-JOINT, SLEEVE TO DUCT
  - DAMPER
  - ACTUATOR LOCATED OUTSIDE
  - FUSIBLE ROD
  - WELDED CONNECTION
  10. FUSIBLE LINK WITH SLOPE
  11. 1/4\"/>
  - 12. 1/4\"/>
  - 13. 1\"/>
  - 14. NEGATOR SPRING
  - 15. CALKING MATERIAL
  - 16. TO ONE ALUMINUM AND DUCT MOUNTED SMOKE DETECTORS.

**COMBINATION FIRE/SMOKE DAMPER DETAIL (ELECTRIC)**

M581

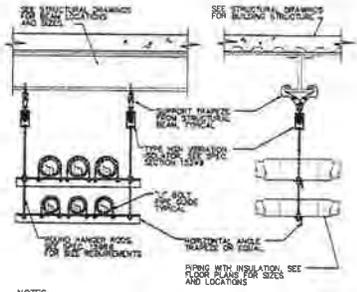
DESIGNED FOR CONSTRUCTION  
 6/4/08

**THE DESIGN GROUP**  
 REGISTERED PROFESSIONAL ENGINEERS  
 1000 UNIVERSITY AVENUE, SUITE 100  
 ALBUQUERQUE, NEW MEXICO 87102-3000  
 PHONE: 505.263.1100 FAX: 505.263.1101

PROJECT NUMBER:  
 100 RANCHO CITY HALL  
 100 RANCHO, NEW MEXICO

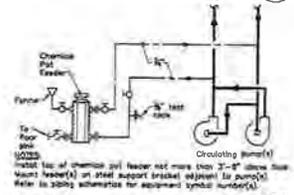
PROJECT TITLE:  
 MECHANICAL DETAILS

**M501**

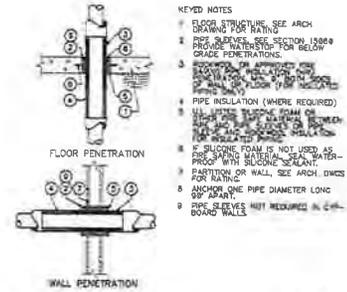


- NOTES:
- 1 "U" BOLTS SHALL BE USED AS GUIDES ONLY, NOT ANCHORS
  - 2 "U" BOLTS SHALL BE ON EVERY THIRD TRAPEZE (MIN)
  - 3 DO NOT TIGHTEN "U" BOLTS ON PIPING OR INSULATION, LEAVE LOOSE AS PIPE GUIDE
  - 4 PROVIDE 14 GA. GALV. STEEL PROTECTION SADDLE, 12" LONG AT ALL TRAPEZE HANGERS
  - 5 REFER TO SPECIFICATION SECTION 12088.
  - 6 CONTRACTOR MAY SUPPORT TRAPEZE FROM IRONST PLATE IN NEW CONCRETE SLAB ABOVE. SEE SPEC. 12060.

**PIPE HANGER DETAIL WITH VIBRATION ISOLATORS** U562

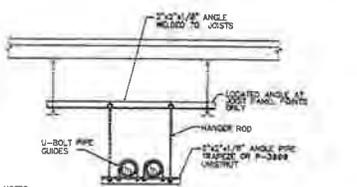


**CHEMICAL POT FEEDER DETAIL** U563



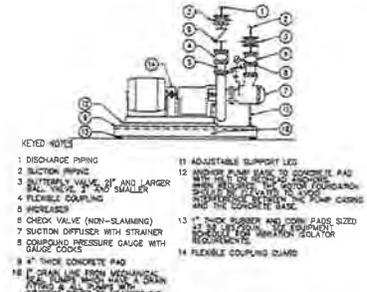
- KEYED NOTES
- 1 FLOOR STRUCTURE SEE ARCH DRAWING FOR RATING
  - 2 PIPE SERVICE SECTION 12060 PROTECT PENETRATION BELOW GRADE PENETRATIONS
  - 3 FLOOR PENETRATION SEE ARCH DRAWING FOR RATING
  - 4 PIPE INSULATION (WHERE REQUIRED)
  - 5 FLOOR PENETRATION SEE ARCH DRAWING FOR RATING
  - 6 FLOOR PENETRATION SEE ARCH DRAWING FOR RATING
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  - 100 FLOOR PENETRATION SEE ARCH DRAWING FOR RATING

**PIPE PENETRATION THRU FIRE RATED BARRIER** U562

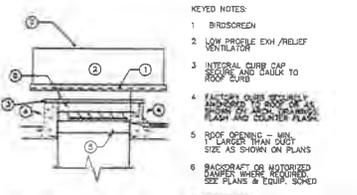


- NOTES:
- 1 PROVIDE SHEET METAL SLEEVES AROUND PIPE INSULATION AT ALL PIPE HANGERS. SEE SPEC. FOR INSULATION
  - 2 "U" BOLTS SHALL BE USED AS GUIDES ONLY, NOT ANCHORS
  - 3 "U" BOLTS SHALL BE ON EVERY THIRD TRAPEZE (MIN)
  - 4 DO NOT TIGHTEN "U" BOLTS ON PIPING OR INSULATION, LEAVE LOOSE AS PIPE GUIDE

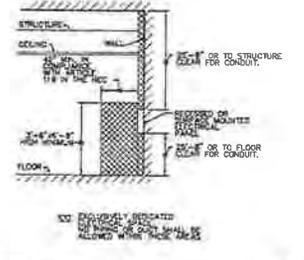
**PIPE HANGER DETAIL** U563



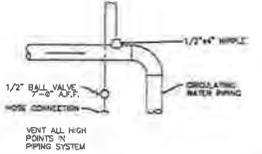
**PUMP AND BASE DETAIL** U562



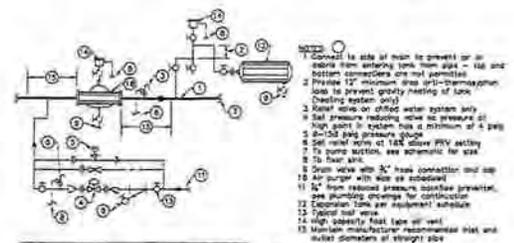
**RELIEF VENTILATOR DETAIL** U562



**CLEARANCE REQUIREMENTS AT ELECTRICAL PANELS** U562



**MANUAL AIR VENT DETAIL** U562



**AIR CONTROL AND MAKE-UP WATER DETAIL** U562

DESIGNED FOR SANITATION



**THE DESIGN GROUP**  
 ARCHITECTURAL, ENGINEERING, INTERIOR DESIGN, AND CONSTRUCTION SERVICES

PROJECT NAME:  
 RIO RANCHO CITY HALL  
 EXCISE  
 RIO RANCHO, NEW MEXICO

DESIGN TITLE:  
 MECHANICAL DETAILS



DATE:	12/11/14
BY:	U562
CHECKED BY:	
DATE:	

**M502**

APPENDIX D  
Water Analysis  
from  
Industrial Water Engineering



### Industrial Water Engineering

7309 Jefferson St NE Albuquerque, NM 87109  
505.345.5055 Fax 505.345.5375 800.543.6519

UNDILUTED SOLUTIONS

Customer ID	System	Laboratory ID
City of Rio Rancho	Ground Source Loop	Analysis by: KP
Testudo Engineering		Laboratory No. 1284
		Sample Date:11/19/2018 Test Date:11/20/2018

## WATER ANALYSIS

	REPORTED AS	Ground Source Loop Mg/L
<b>Total Hardness</b>	<b>CaCO<sub>3</sub></b>	<b>64</b>
<b>Copper</b>	<b>Cu</b>	<b>0.03</b>
<b>Iron</b>	<b>Fe</b>	<b>1.10</b>
<b>Phosphate</b>	<b>PO<sub>4</sub></b>	<b>50</b>
<b>Organophosphonate</b>	<b>OP</b>	<b>21</b>
<b>Digested phosphonate</b>	<b>PO<sub>4</sub></b>	<b>32.8</b>
<b>Nitrite</b>	<b>NaNO<sub>2</sub></b>	<b>80</b>
<b>Molybdate</b>	<b>Mo<sup>6+</sup></b>	<b>0.76</b>
<b>RTC</b>	<b>ppb</b>	<b>269.8</b>
<b>pH</b>	<b>pH</b>	<b>7.64</b>
<b>Temperature</b>	<b>°F</b>	<b>70</b>
<b>Conductivity</b>	<b>Micromhos</b>	<b>1,509</b>

1. The loop was recently treated with CS-8060-RTC Closed Loop Corrosion Inhibitor which contains a dispersant to suspend solids for removal by filtration.
2. The samples arrived in two bottles and were merged into a single bottle before analysis. Because of the solid deposit seen in the samples, before running analysis, the samples were filtered using a 45 micron filter and rough vacuum pump.



**Industrial Water Engineering**

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UNDILUTED SOLUTIONS

After the solid deposit was filtered from the water sample and dried in the furnace, pictures were taken to document the coloration of the deposit and x-ray fluorescence was performed on the dried solid deposit sample.



*Figure 1 from left to right: unfiltered and filtered water sample, dried red-brown solid filtered from water sample, filter paper depicting two distinct colorations of solid, and filter paper with fine, dark brown deposit*

XRF analysis of the solid filtered from the water sample indicate that the solid is mainly iron oxide. Because of the different coloration of the solid deposit, it is reasonable to infer that there are several different iron oxide species present in the geothermal loop this sample was taken from.

This kind of fouling is common in closed loops that have not been properly cleaned and maintained with corrosion inhibitor and is caused by a variety of factors. It is understood that iron corrosion is commonly seen in closed loop systems due to the use of mixed metal systems, poor passivation of the system, and presence of mill scale. In general, this iron oxide fouling is a long-term struggle in operating closed loop systems. To alleviate this struggle, dispersants and chemical mixtures are employed to help suspend the deposits in the liquid phase. In suspending the solids in the liquid phase, there is a reduction in fouling since the solids are less prone to settling within the plumbing and other areas of the water system. The solids can then be removed with filtration.



**Industrial Water Engineering**

8701 Alameda Park Drive NE Albuquerque, NM 87113  
505.345.5055 Fax 505.345.5375 800.543.6519

UNDILUTED SOLUTIONS

November 28, 2018

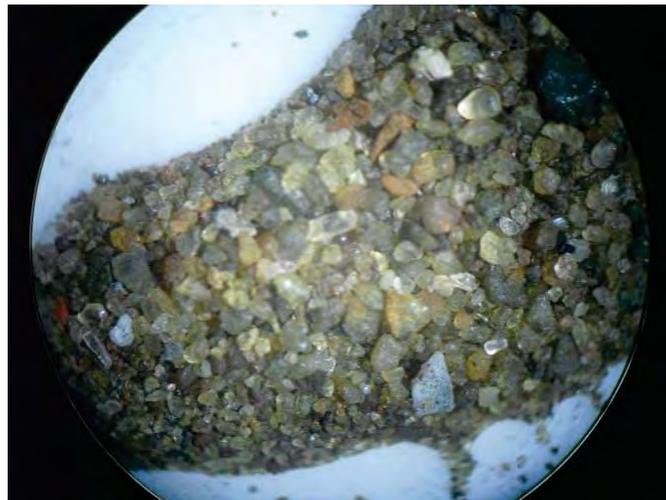
Mr. Wayne Yevoli, PE  
Testudo Engineering, Inc.  
[Wayne@testudoeng.com](mailto:Wayne@testudoeng.com)

Mr. Yevoli,

Attached is the Water Analysis and X-Ray Fluorescent Deposit Analysis of the recent samples Testudo Engineering provided from the Rio Rancho City Hall Geothermal Closed Loop.

Here is a history of IWE's involvement with the system:

1. Mr. Chris Greeno of the City of Rio Rancho contacted IWE for an analysis and quote for treatment of the Geothermal Loop in 2010. A contractor was purging the loop on a frequent basis due to fouling of heat pumps. Our analysis found there wasn't any corrosion inhibitor present and the debris was sediment. Mr. Greeno provided a sample of the debris removed from one of the heat pumps. Here is a 40X magnification of the debris:



2. The City did not issue IWE a PO at that time. It appears the Geothermal Loop went for an extended period of time without corrosion protection both before and after 2010.



**Industrial Water Engineering**

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505.345.5055 Fax 505.345.5375 800.543.6519

UNDILUTED SOLUTIONS

3. In September 2016 Mr. Greeno contacted IWE again for an analysis of the Geothermal Loop water quality. A leak had occurred in the above ground piping in the mechanical room and Mr. Greeno was seeking to prevent any additional failures.
4. Corrosion was evident in the mechanical room piping. IWE recommended the addition of closed loop corrosion inhibitor and the installation of a 2" inlet/outlet filter housing for removal of debris.
5. IWE received a PO in December 2016 to provide service visits and chemical treatment to the loop. The City had one of their contractors install the filter and IWE staff began treatment and service visits. In addition to water testing and addition of chemical IWE staff inspected the filters on a monthly basis and changed them out as needed.
6. IWE has received POs to provide service visits, testing, and corrosion inhibitor for 22 of the last 25 months. A three month gap occurred due to Fiscal Year end.
7. After the initial addition of CS-8060 Closed Loop Corrosion Inhibitor it became clear a large leak was present in the underground piping.
8. Dye packs were added on several occasions to help identify the source of the leak without success.
9. IWE field staff worked closely with Mr. Greeno and provided weekly visits for a period of time to help identify the source of the leak. Mr. Greeno isolated three zones of the loop at a time until the source of the leak was isolated to one leg.
10. In September 2018 the leaking leg was identified and isolated and CS-8060 was added. As far as we are aware the leaking portion is still isolated from the rest of the system. CS-8060 chemical residual was within the control range in November 2018.
11. Since 2016 the leak prevented the maintenance of CS-8060 corrosion inhibitor in the loop. The CS-8060 leaked out in its entirety on several occasions. During the service visits in which CS-8060 was present the chemical residual was below the acceptable limit 11 out of 14 times.
12. The attached lab analysis clearly depicts the level of corrosion that has occurred in the system. The debris is primarily iron oxide corrosion products.
13. Due to the large amount of corrosion that has occurred the loop may need to be flushed with a high pressure purge to remove the corrosion products. Filtration will be a year's long process and may never remove all the fouling.



**Industrial Water Engineering**

8701 Alameda Park Drive NE Albuquerque, NM 87113  
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---

UNDILUTED SOLUTIONS

Sincerely,

A handwritten signature in black ink that reads "Gary Wilkinson". The signature is written in a cursive, flowing style.

Gary Wilkinson, CWT  
Vice President



## Industrial Water Engineering

7309 Jefferson St NE Albuquerque, NM 87109  
 505.345.5055 Fax 505.345.5375 800.543.6519  
 IndustrialWaterEngineering.com

FXL-75948

Time 2018-11-06 12:05  
 Units %  
 SAMPLE City of Rio Rancho  
 LOCATION Testudo Engineering  
 INSPECTOR KP  
 NOTE X-ray Fluorescence



	%	+/-	Error
Bal	35.339	+/-	0.384
Fe	55.261	+/-	0.338
Ca	4.838	+/-	0.073
Cu	1.307	+/-	0.019
S	0.960	+/-	0.018
Si	0.823	+/-	0.020
P	0.463	+/-	0.015
Ti	0.170	+/-	0.010
Mn	0.163	+/-	0.009
Zn	0.119	+/-	0.004
Cl	0.112	+/-	0.005
K	0.103	+/-	0.015
Ba	0.098	+/-	0.011
Co	0.066	+/-	0.022
Cr	0.051	+/-	0.004
Sr	0.045	+/-	0.001
V	0.022	+/-	0.004
Pb	0.015	+/-	0.001
Th	0.005	+/-	0.001

Supervised By: Kathryn Perkins \_\_\_\_\_



## Industrial Water Engineering

7309 Jefferson St NE Albuquerque, NM 87109  
 505.345.5055 Fax 505.345.5375 800.543.6519  
 IndustrialWaterEngineering.com

FXL-75948

Time 2018-11-06 12:09  
 Units %  
 SAMPLE City of Rio Rancho  
 LOCATION Testudo Engineering  
 INSPECTOR KP  
 NOTE X-ray Fluorescence



	%	+/-	Error
Bal	35.421	+/-	0.385
Fe	55.220	+/-	0.338
Ca	4.809	+/-	0.072
Cu	1.301	+/-	0.019
S	0.965	+/-	0.018
Si	0.804	+/-	0.019
P	0.452	+/-	0.015
Ti	0.159	+/-	0.010
Mn	0.163	+/-	0.009
Zn	0.124	+/-	0.005
Cl	0.111	+/-	0.005
K	0.128	+/-	0.015
Ba	0.098	+/-	0.010
Co	0.071	+/-	0.022
Cr	0.050	+/-	0.004
Sr	0.045	+/-	0.001
V	0.020	+/-	0.004
Pb	0.015	+/-	0.001
Th	0.003	+/-	0.001

Supervised By: Kathryn Perkins \_\_\_\_\_



## Industrial Water Engineering

7309 Jefferson St NE Albuquerque, NM 87109  
505.345.5055 Fax 505.345.5375 800.543.6519  
IndustrialWaterEngineering.com

FXL-75948

Time 2018-11-06 12:13  
Units %  
SAMPLE City of Rio Rancho  
LOCATION Testudo Engineering  
INSPECTOR KP  
NOTE X-ray Fluorescence



	%	+/-	Error
Bal	35.419	+/-	0.389
Fe	55.258	+/-	0.342
Ca	4.799	+/-	0.073
Cu	1.289	+/-	0.019
S	0.965	+/-	0.018
Si	0.823	+/-	0.019
P	0.447	+/-	0.014
Ti	0.173	+/-	0.009
Mn	0.167	+/-	0.009
Zn	0.121	+/-	0.005
Cl	0.114	+/-	0.005
K	0.110	+/-	0.015
Ba	0.104	+/-	0.010
Co	0.050	+/-	0.023
Cr	0.049	+/-	0.004
Sr	0.044	+/-	0.001
V	0.024	+/-	0.004
Pb	0.017	+/-	0.001
Th	0.004	+/-	0.001

Supervised By: Kathryn Perkins \_\_\_\_\_

# APPENDIX E

## Rio Rancho City Hall HVAC Maintenance Records

## Rio Rancho City Hall HVAC Maintenance Records

Date	Room/Space	Work Done
1/7/2011	248	Changed T-stat setting
1/27/2011	2nd Fl Stairs	Replaced compressor
2/4/2011	235	No signal to low pressure switch. Board is bad
2/9/2011	235	Changed out Board
3/7/2011	IDF 1st Fl	No work done
3/21/2011	IDF 4th Fl	Reset unit. Loss of refrigerant possible. Check after leak test
4/22/2011	2nd Fl Atrium	Heat pump not responding. No signal to T-stat or control board
5/12/2011	254	No power to unit. Breaker is on though
5/27/2011	331	Comm issues. Problem lies in automated logic system
5/31/2011	331	Redownloaded card. Unit back online. Bad 24V transformer is making unit on 2nd Fl not communicate
6/21/2012	4th Fl Peter Wells (443)	No heat. Power cycled unit. Controlling computer was off. Rebooted it
8/3/2011	A106	Unit is not in working order. 55F air being blown into 71F room
8/3/2011	Unit 254	Breaker was tripped. Reset it. Replaced capacitor. Unit is works
8/3/2011	Unit B222	Replaced reversing valve coil
8/8/2011	A101	Wire to control card disconnected. Reconnecting blew the 24V transformer. Need a new one
8/9/2011	101	Replaced transformer
8/9/2011	106	Adjusted programming for unit
8/11/2011	3rd/4th Fl Stairs, 303, 222, 101, 3rd Fl IUR	Changed all filters. Listed rooms are hot. ERVs on roof need belts and pullies. IUR room condensing fan is bad
8/10/2011	2nd Fl IDF, 4th Fl IDF	Fan was off in 2nd Fl. 4th Fl lost its charge and needs leak test
8/16/2011	4th Fl IDF	Did leak test. Compression Fitting on Line Set was leaking on Low Side at the Cond unit. Repaired. Recharged w/4.1lbs R22
8/18/2011	112, 113	1 unit for both rooms. Checked cooling. Receiving 46.6F supply
8/19/2011	106, 166, 421	Bad control board in 106. Reset units in 166 & 421. Still blowing hot air but compressors are running
8/22/2011	A106, 421	Replaced control board. Unit in 421 locked out. Reset it
8/24/2011	421	No work done
8/29/2011	A106	Unit is running 12AM-12PM. Needs to be changed to 7AM-7PM
8/30/2011	4th Fl Peter Wells (443)	Cleaned out strainer screen
9/1/2011	101, 106	Need new board for 106. Also need ICS
9/22/2011	261	Light rattling from A/C vibrations
10/3/2012	All	Changed all filters. ERV-3E needs sensor wheel and shelf for it. ERV-1W needs new sensor wheel, shaft, and drive belt
10/6/2011	All	Changed filters and washed all washables. Units on roof need pullies and belts
10/19/2011	2nd Fl Stairs	Compressor mounting bolt loose. Flex for low V rattling on top
10/24/2011	2nd Fl Stairs	Flex for low V still rattling. Clipped flex off unit
11/14/2011	418	Compressor shorted to ground. Fuse in disconnect is bad
11/16/2011	1st and 4th	Leak in water line on the unit in 1st. Couldn't find noise on 4th

## Rio Rancho City Hall HVAC Maintenance Records

Date	Room/Space	Work Done
11/21/2011	303	Bad relay in control board. Replaced transformer
1/19/2012	B103, A405	B103: Unit locked out. Reason unknown. Reset unit A405: Unit turned off at disconnect
1/23/2012	B103	Unit locked out on low pressure. Replaced capacitor
5/17/2012	4th Fl Elec Rm	No power at condenser from blown fuses. Compressor shorted to ground. Replaced fuses and drained refrigerant
5/21/2012	4th Fl Elec Rm	Replaced compressor. Did leak test. Recharged with 4.1lbs R22. Ordered new control parts
5/23/2012	4th Fl IDF	Blower motor making noise and needs to be replaced
5/25/2012	4th Fl IDF	Redundant
5/30/2012	4th Fl Elec Rm	Replaced control assembly on split system
6/8/2012	425	Remove and replace blower motor
6/15/2012		Compressor locked up. Removed and replaced it
7/13/2012	1st Fl Elec Rm, A181, 254	Condensate drain plugged. A181, 254 had a wire shorted to ground. A421 unit was locked out. MAY HAVE BAD WATER FLOW
7/22/2012	4th Fl NW	Unit locked out. Reset it
8/2/2012	261, 166	261: Adjusted safety wire to stop vibration. 166: Bad blower
8/3/2012	2nd Fl	No comm. No power to AAR card. Restored power
8/4/2012	4th Fl	Replaced circuit board. Wiring issue between control board and automated control card
8/10/2012	3rd Fl server rm & IDF	Server room blower failed. IDF: Open windings on condensing fan motor
8/17/2012	3rd Fl server room	Installed new blower motor
8/17/2012	3rd Fl IDF	Replaced condensing fan. Compressor is seized
8/20/2012	2nd Fl Development Services	Replaced bad blower motor
8/21/2012	214	Called for no cooling. No work done
8/21/2012	3rd Fl IDF	Replaced compressor
8/27/2012	4th Fl Peter Wells (443)	Unit locked out. Reset it and bled debris from condensing water system. Control board needs to be replaced
9/6/2012	Linda Neushwuger	Called for no cooling. No work done. Problem is intermittent
9/7/2012	4th Fl Stairs	Short between capacitor wire and discharge line. Replaced capacitor. Reset breaker. Cleaned strainer. Compressor was overheated when cap shorted
9/7/2012	HR Dept Linda Neushwuger	Unit locked out from loss of charge switch. Control board not delivering proper voltage to LOC switch. Board to be replaced
9/14/2012	HR Dept Linda Neushwuger	Replaced control board
9/24/2012	4th Fl	Transformer replaced. It shorted by jumper wire not being cut
9/26/2012	105	Blower motor is bad
10/1/2012	414	Unit locked out from POOR WATER FLOW. Cleaned screen
10/10/2012	105, 2nd Fl Stairs	105: Replaced blower motor. Checked squeaking noise in stairs
10/11/2012	2nd Fl Stairs	Sounds like blower bearings are bad. Ordered new blower

## Rio Rancho City Hall HVAC Maintenance Records

Date	Room/Space	Work Done
10/24/2012	315, 2nd Fl Stairs	Serviced blower bearing. Flex duct making noise from being too close to main trunk
11/1/2012	315	Replaced blower
11/16/2012	205	Unit not heating because setpoint is 68F. No work done
11/20/2012	2nd Fl Stairs	Replaced blower
11/27/2012	207	Called for no cooling. Couldn't find anything wrong
11/29/2012	207	Unit locked out on LOC switch. Visible leak found. Tightened schrader. Added 5oz R22. Unit needs to be monitored
12/3/2012	4th Fl IDF & Elec Rm	Both units locked out on low ambient temp. Both units might need low ambient control installed. Monitor both
12/4/2012	206	No cooling. Changed set points back to 68F and 72F
12/7/2012	4th Fl IDF, 414	IDF: Need low ambient control. 414: Unit locked out. Reset it
12/28/2012	122	Bad capacitor made blower not work
1/11/2013	414	Unit locked out on LOC switch. Refrigerant 9.5oz low. Did leak test. Recharged unit to 44oz
1/17/2013	Stairs, 4th Fl Peter Wells (443)	All 8 units locked out on low pressure. Ambient air too cold. Reset unoccupied setting from 55F to 66F. 443: changed xfrm
2/11/2013	414 Stairs	Called for no heat. Space at temp. Stairs: Unit locked out on freeze protection. Reset it
2/13/2013	208	Breaker tripped in hall. Cause unknown. Reset breaker
2/14/2013	3rd Fl	Test port leaking. Capped and stopped the leak
3/26/2013	A128, A236, A334, A428, B453-(403), B202	A128: Needs new board an blower capacitor. A236, 334, 428: Locked out on freeze protection. Cleaned water screens. B453-(403): No work done. B202: No work done
3/28/2013	A128	Installed new board. Redownloaded software to card
5/20/2013	ERV-3E	Replaced exhaust motor on unit
6/5/2013	IT Server Rm	Dirty condensing coils. Unit should be cleaned at least 2/year
6/19/2013	214	Reversing valve not energizing due to board, integration or the reversing valve itself
6/24/2013	3rd Fl Computer Rm	Cleaned coil. Found mouse droppings in ceiling
7/9/2013	All IDF, 4th Fl City Attorney Office	3rd Fl: Need new compressor (short to ground). Unit 4W8 needs new power head for the TXV. Water leak on 1st Fl was condensate overflow. 4th Fl Atrium was locked out on condensate overflow
7/11/2013	3rd Fl IDF, TXV 4th Fl	IDF: R and R bad compressor. New power head in HP 421
7/18/2013	1st Fl TV control rm	Control board in indoor unit needs to be replaced
7/23/2013	1st Fl TV control rm	Installed new defrost board
9/27/2013	3rd Fl Server Rm	Unit had frozen over. Turned off until defrosted
10/1/2013	B202 Rm 256	Unit was locket out on freeze protection. Turned off an back on
10/2/2013	256	Unit locked out on freeze protection. Changed fan from low to high. Did leak test. Replaced schrader valve. Recharged system to 15oz R22 (factory spec)

## Rio Rancho City Hall HVAC Maintenance Records

Date	Room/Space	Work Done
10/3/2013	256	Unit locked out on freeze protection. Cut JWS jumper on board. Might need to replace board
10/7/2013	B202	Unit turning off at 12AM, causing freeze lockout. Locked fan on to prevent freeze protection lock out
11/4/2013	202	Replaced control board in unit B202
11/11/2013	B202	Unit locked out on freeze protection. Reset and changed fan
12/12/2013	A158	Leak found in line
12/16/2013	A158	Lead repaired
12/23/2013	Parks and Rec Hall	Leak found. Replaced ball valve
12/30/2013	Parks and Rec Hall	Same leak found. Replaced 18"x3/4" nipple
2/7/2014	A207	Locked out on freeze protection. Low suction at start of cycle but coming up to acceptable pressure. Cut JWS jumper to allow high tolerance for low suction pressure
5/7/2014	2nd Fl Rm 200's	Setpoints were too high. Lowered set points by 2F
5/28/2014	207, 136	Adjusted setpoint for 136. Checked statuses. Cleaned strainer
6/21/2014	3rd Fl server	Replaced bad fuse. Cleaned condensate coils
6/30/2014	3rd Fl server	Replaced 2 fuses
7/29/2014	2nd Fl All	"Mugginess" is from afternoon rains
8/8/2014	205	Unit locked out on freeze protection. Reset and monitored
8/19/2014	256	Washed water screen for cond water. Need to monitor
8/19/2014	256	Set unit from cooling only to auto. Monitored for an hour
9/1/2014	202, 205, 275	275: Locked out on FPZ. Reset unit. 205: No work done. 202: odd pressures. Difficulty keeping temp at 70F. Checked water flow
9/10/2014	202	Replaced reversing valve
9/12/2014	205, 230	205: Cleaned water screen and check valve. 230: Fan was set to low and charge was a little low
9/16/2014	202	Check valve plugged with rust. Cleaned it
9/17/2014	275	Locked out on FP2. Reset unit. Monitored 30 min
9/23/2014	202, 205, 275	205: Locked out on FP2. Installed new board Reset unit. 202 & 275: Adjusted charge
9/24/2014	205	Locked out on FP2. Removed FP1 & 2 thermistors to test Freon
10/6/2014	202	Replaced TXV. Recharged unit
10/8/2014	275	Locked out on freeze protection. Adjusted thermistor
10/17/2014	275	TXV not working
10/20/2014	3rd Fl Conf 333	Reset setpoint to 72
10/31/2014	275	Replaced TXV
11/5/2014	142, 143	142: No work done. 143: Fan locked out. Installed new fan cap
11/24/2014	1st Fl	Breaker was tripped. Reset it
1/20/2015	205, 256, 275, 159	205&256&275: Replaced thermistors. 159: Replace compressor run cap
1/26/2015	205	Locked out on FP2. Adjusted thermistor and reset unit
1/28/2015	143	Nipple at unit leaking. Replaced nipple
4/6/2015	139, 122	139: tripped breaker. Reset unit. 122: No cooling signal from ICS

## Rio Rancho City Hall HVAC Maintenance Records

Date	Room/Space	Work Done
4/10/2015	122	ICS fixed programming on card. Compressor is bad
4/15/2015	258	Fan set to continuous. Changed to only running during heating and cooling
4/29/2015	111	Replaced 24V transformer
5/18/2015	122	Replaced compressor
5/20/2015	255	No work done
5/20/2015	255	No work done
5/21/2015	255	Locked out on low pressure. Replaced stake for low pressure switch wire
5/26/2015	255	Locked out on FP. Reset unit. Reset override from 66F to 68F
6/1/2015	123, 145	Both units locked out on high head pressure. Cleaned water screen
6/23/2015	255, 216, 217	No work done
6/5/2015	Development	Loose wire vibrating when compressor running. Tied it back
6/23/2015	4th Fl Attorney Office	Compressor locked up
7/1/2015	4th Fl Attorney Office	Replaced compressor
8/19/2015	312	Loose studs in wall buzzing. Adjusted them to get rid of noise
8/24/2015	Geo System, 155, 166	Geo: Make up was turned back on. 155: Compressor locked up, making breaker trip. 166: Locked out on high head pressure. Reset unit
8/26/2015	122	Locked out on high head pressure. Reset unit
8/28/2015	123, 159	123: Locked out on high head pressure. Cleaned plugged water flow
8/31/2015	155	Replaced compressor
9/9/2015	316	Locked out on FP2. Reset unit
9/30/2015	B118E, B182	B118E: Comm loss. Redownloaded card. B182: Comm loss from power loss. Replace due to extreme heating. Replaced shorted compressor
10/23/2015	155	Replaced capacitor. Compressor needs to be replaced
10/28/2015	212	No work done
10/30/2015	205, W entry, N Stairs	205: Need new compressor. Entry: Need new unit. Stairs: On same breaker as 155. 155 has been turned off
11/5/2015	155	Replaced compressor
11/5/2015	205	Replaced compressor
12/3/2015	273, 274	No work done
12/15/2015	2nd & 3rd Fl	Adjusted setpoints. Redownloaded a card on 3rd Fl
12/17/2015	4th Fl Attorney Office	Redownloaded card
1/6/2016	232	Break tripped. No grounding found
1/8/2016	Stair wells	Units on 4th Fl need to be recharged. 1 on 3rd Fl center stair needs to be recharged. Shrater valves were leaking. Changed all stair well filters
1/12/2016	Stair wells	No work done

## Rio Rancho City Hall HVAC Maintenance Records

Date	Room/Space	Work Done
1/14/2016	Water leak	Visibly coming from roof
1/22/2016	426	Cleaned screens
1/27/2016	427	Locked out on FP1. Reset unit
2/18/2016	2nd Fl	Reset unit
2/22/2016	2nd Fl Scott's Office	Locked out on FP1 again. Replaced thermistor. Reset unit
3/1/2016	212	Reset temp. Added a zone temp on the logic
4/13/2016	3rd Fl Server	1 unit was frozen. Turned on only the fan. Set from 62F to 68F
5/10/2016	265, 166	265: Locked out on low pressure. Reset unit. 166: Locked out on high pressure. Reset unit
5/23/2016		Locked out on high pressure. Cleaned inlet screen and flow regulator. Replaced zone sensor/t-stat bad
5/24/2016	265	No work done
5/25/2016	319, 306	319: Retightened compressor mounting colts. 306: 24V transformer bad connection to board. Replaced positive wire
6/2/2016	265	Locked out on low pressure. Reset unit. Balanced pressures. Cleaned water screen and flushed unit
6/9/2016	2nd Fl	Breaker tripped. Comm loss to all 2nd fl
6/20/2016		Washed cond coils
6/21/2016	407	Cleaned clogged CHW line
6/23/2016	Server Rm	Replaced all thermistors in both A/C units
7/18/2016		Replaced blower motor. Replaced fresh air filters on roof
7/22/2016	159	Locked out on high head pressure. Cleaned CHW screen and back flow regulator
8/3/2016	250, 159, 200, 302	159: Locked out on cond overflow. Reset unit. 200: Locked out on FP2. Replaced filter. Reset unit. 250: Powre loss. 302: No work done
8/3/2016	250, 331, Cashier, Copy Rm	250&331: Card redownloaded. Cashier. Locked out on RP. Reset unit. Copy: Locked up compressor. Order new one
8/17/2016	1st Fl Elec Rm	Lead on discharge line at compressor on cond unit. Installed new 24V transformer
8/23/2016	2nd Fl	Replaced pipe that was leaking and new coupling
8/30/2016	212, 213	Replaced the compressor
9/7/2016	1st Fl Copy Rm	Replaced the compressor
10/20/2016	3rd Fl Server	Units frozen. Will check tomorrow
10/21/2016	3rd Fl Server	Replaced fan control in both cond units
11/23/2016	N entrance	Replaced unit
10/24/2016	All	Replaced leaking 2" nipple and 90deg elbow. Shut down all AC units. Repaired leak. Restored power and water to all AC units
11/14/2016	B182	Still shorted to ground. Has signs of extra heat
11/15/2016	Server Rm	Bad connection on service disconnect. Cleaned and adjusted

## Rio Rancho City Hall HVAC Maintenance Records

Date	Room/Space	Work Done
12/6/2016	125	Cleaned plugged CHW screen and pressure regulator. Locked out on FP. Added R22
12/8/2016	CHW System	Installed and plumbed new bag filter
12/29/2016	215	Zone sensor problem. Redownloaded card. No zone sensor in room
1/1/2017	2nd Fl IDF	Blower wheel broken. If wheel can't be replaced by itself, recommend replacing whole unit
1/30/2017	2nd Fl IDF	Replaced fan wheel and mini split unit
2/2/2017	Server Rm	Replaced cond fan control switch
3/8/2017	A248, A236, B218, B401	B401: Reset unit. B218: Bad run cap. Lost download. A236&248: Bad compressor in 236 made breaker trip. Shared break w/248
3/9/2017	A236, B218	A236: Replaced compressor and run cap. B218: Replaced run cap
3/22/2017	212, 213	Out on high head pressure. Cleaned CHW lines, screen, and pressure regulator
3/23/2017	212	Requested setpoint of 68F. Unable to turn down manually or at computer
3/28/2017	212, 213	Added 2oz R22. If problem persists, leak test needed
5/3/2017	RTU14	Replaced blower motor and cap
5/4/2017	4th Fl Elec Rm	Indoor unit has bad boards. Ordered them
5/9/2017	A158, B119, A101, B303	A158: No work done. B303: Alarm adjustment. B119: Replaced run cap for compressor. A101: Need new blower motor and control board. Ordered them
5/16/2017	141, 265	141: Replaced run cap. 265: Locked out on low refrigerant. Reset unit and redownloaded card
5/19/2017	256, 101	256: Reset unit. 101: Replaced blower and control board. Blower on. No cooling
5/22/2017	Elevator Rm	Both cond units off at disconnect. Reset disconnects
6/7/2017	256	Locked out on high head pressure. Reset unit. Locked out again after 20 min. Back washed unit. Reset it
6/20/2017	351	Leak at Eq line for TXV. Repaired leak. Recharged unit
6/22/2017	212, 233	212: Unit locked out on high head pressure. Cleaned strainer screen. 233: Controller board not communicating with unit
6/29/2017	212	Locked out on high head pressure. Reset unit
7/3/2017	265	Locked out on low pressure. Computer showed reversing valve failure. Manually actuated it. Reset unit
7/5/2017	233	Met with ICS
7/6/2017	265	Bad connection with LOC wire. Repaired it
7/12/2017	3rd/4th Fl, 331, 357, 407/408	3rd/4th Fl: Breaker tripped for all 3rd/4th HP units. 331: Redownloaded card. 357: Compressor shorts to ground. 407/408: lowered T-stat setting
7/18/2017	212, 213	Locked out on FP2. Previously locked out on high head pressure

## Rio Rancho City Hall HVAC Maintenance Records

Date	Room/Space	Work Done
7/19/2017	TV Rm	No work done
7/20/2017	357	Replaced compressor
7/21/2017	256, 133, 135, Inspections, Inspector	256: Water valve motor is bad, causing lock out on high head pressure. 133/135/Inspections: Adjusted T-stat. Inspector: Reset unit at computer
7/28/2017	209, A142, A155, 202,	209: Locked out on FP. Will replace charge. A142: Locked out on high
8/1/2017	208, Inspector	Inspector: Reset unit. Cleared cond drain. 208: Balanced charge
8/8/2017	134	Locked out on high cond level. Relevelled unit to improve drain
8/21/2017	147 IDF	Need new blower motor and cond fan motor
8/22/2017	3rd Fl	Locked out on FP2. Adjusted charge
8/22/2017	Half 4th Fl	7 units in alarm. Reset them. 416 locked out on high pressure. Water loop was plugged with rust. Cleaned it
8/24/2017	316, 218	316: Locked out on high head pressure. Return line full of rust. Recharged unit. 218: Wire was tapping pipes
8/30/2017	147	Replaced motor on split system. Balanced charge
9/1/2017	134	Adjusted T-stat
9/7/2017	256, B401	256: No work done. B401: Comm loss. Need ICS
9/12/2017	9/12/1900	Locked out on FP2. Reset unit
9/15/2017	319	CHW line vibrating against metal wall. Added insulation between them
9/22/2017	309, 311	Ceiling grid wires were rubbing together
9/28/2017	214	Low on refrigerant. Balanced charge
10/2/2017	200, 213, 212	200: No work done. 212&213: Locked out on FP2. Reset unit
10/6/2017	357	Compressor needs to be replace. Ordered it
10/10/2017	4th Fl	Main breaker tripped. Reset it
10/10/2017	357	Replace compressor
10/12/2017	214	Bad high pressure switch. Cleaned water lines. Bypassed switch
11/7/2017	Cashier's Cage	Lock out on FP. Reset and bypassed
12/15/2017	Admin	Adjusted setpoints
12/26/2017	275	Adjusted T-stat
1/19/2018	N Stairs	1st/3rd fl units reset. 4th fl unit locked out on high head pres
1/22/2018	4th Fl Stairs A	Noise from actuator. Recommend replacing valve
1/23/2018	4th Fl Stairs A	Replaced actuator valve
1/24/2018	1st & 2nd Fl	Compressor not running due to low pressure. Opened water loop. Reset units. Monitored system
1/26/2018	Geothermal	Not keeping pressure. Recommend installing pressure regulator for make up water system
1/27/2018		Installed PRV, ball valve and spiggot

## Rio Rancho City Hall HVAC Maintenance Records

Date	Room/Space	Work Done
1/30/2018	441	Locked out on FP. Freezing from LOW WATER FLOW. Lines and unit full of rust and grit. Cleaned A407 strainer. Reset B416 & 409
3/8/2018	200, 212, 213, 214	Reset units
3/14/2018	408	T-stat changed from 75F to 72F
3/29/2018	309	No work done
3/30/2018	4th Fl	Cond water line leaking at take off at 451. Waiting for approval
4/9/2018	214	Cleaned CHW lines on unit. Changed T-stat from 78F to 73F
4/10/2018	309	Locked out on FP1. Reset unit
4/12/2018	256, 212	256: reset and monitor. 212: replaced compressor
4/21/2018	4th Fl	Replaced nipple on water loop
4/25/2018	214, 358, 359	214: Fixed FP2 thermistor connection. Reset unit. 358: Tightened lug for contactor. Redownloaded board. 359: Bad thermistor but back online
5/2/2018	411, 413	Locked out on high head pressure. Cleaned water lines and screen. Reset head pressure switch
5/9/2018	306, 312, 324	306: New filter. 312: Reset unit and opened damper. 324: No work done
6/5/2018	416, 417, 428, 432, 441	Reset units
6/11/2018	A432, A441	Reset units. Ceiling temp and cond water temps are high
6/12/2018	357	Unit locked out on high pressure. Cleaned rust from water line in flow setter. Reset unit
6/13/2018	Council Chambers	Reset unit
6/20/2018	1st, 4th Fl, 249, 256	4th: Adjusted T-stat from lowest setting. Changed fan to continuous run. 249: Clogged water line locking unit on high head pressure. 256: Repaired high head pressure switch connection. 1st: Replaced run cap
6/21/2018	1st Fl	Compressor is bad. Unit needs to be pulled
6/21/2018	426	Locked out on high head pressure. Reset unit
6/27/2018	426	No work done
7/16/2018	324	Opened air vent to 324 to allow more air
7/17/2018	413	Locked out on high head pressure. Reset unit
7/19/2018	413	Locked out on high head pressure. Cleaned strainer and check valve
7/23/2018	403, 407	Both locked out on high head pressure. Cleaned strainers and check valves. Bag filter missing. Installed new one
7/25/2018	413	413: Took apart check valved and flushed
7/26/2018	4th Fl Stairs B	Replaced controller on WSHP
7/30/2018	413, 4th Fl Atrium, 407	413: Locked out on high head pressure. Flushed and back flushed condensing coil. Atrium: Changed setpoints. 407: Replaced bag filter again

## Rio Rancho City Hall HVAC Maintenance Records

Date	Room/Space	Work Done
8/1/2018	Council Chambers, 159, Planning Rm, 413, 4th Fl Atrium	Council: Replaced water valve actuator. 159: Cleaned water lines and strainer. Planning Rm: Drained, flushed and back washed water lines. 413: Back washed system and adjusted T-stat. Atrium: Cleaned water lines and strainers. Flushed and back washed units. Rewired actuator
8/7/2018	426, 413	426: Locked out on high head pressure. Removed debris blocking actuator. 413: Locked out on high head. Reset unit. Removed 2.12lbs R22. Compressor is bad
8/9/2018	413, 412, 411	Replaced compressor in WSHP
8/14/2018	413	Reversing valve failing, making high pressure liquid to leak into suction side of compressor
8/20/2018	413, 249	413: Air started running warm at 3:30. Reset and monitored. 249: Cleaned strainers and water lines
8/22/2018	213	Locked actuator valve open and ordered new one
8/24/2018	214, 312, Mayor conf rm, 134	214: Compressor is grounded. Thermal protector is bad. 312: Adjusted damper. Mayor: Locked out on cond level. Reset unit. 134: Adjusted vent and T-stat
8/28/2018	214	Replaced compressor. Found wire and replaced wire that had shorted. Need new reversing valve
8/28/2018	413	Replaced water valve motor. Reset unit
8/30/2018	413, 264	264: Adjusted vents. 413: Locked out on high head pressure. Reset unit. Need to replace high pressure switch
9/6/2018	413	Replaced high pressure switch. Recharged with 2.75lbs R22
9/7/2018	214	Replaced reversing valve. Suction pressure low. Left unit off until further investigation
9/10/2018	413, 159, 214	214: Recommend replacing TXV. 159: Locked out on cond overflow. No sign of water. Reset unit. 413: Replaced reversing valve. Disconnect is tripping mid-cycle. Recommend replacing
9/11/2018	413	Replaced 15A disconnect switch.
9/18/2018	250	Locked out on high head pressure. Cleaned strainer and flushed unit
9/19/2018	214, 213, 250	214: Replaced TXV. Filled with 15oz R22. 213: Locked out on high head. Flushed condensate line. Recovered, vacuumed, and recharged with 15oz R22. 250: Same as 213, but system did not improve
9/20/2018	250	Need new actuator motor. Valve is fully open
9/25/2018	261, 256	261: need 45 vf capacitor. 256: Out on high head pressure. Cleaned water lines
9/26/2018	262, 249	262: Cleaned water hoses and back flushed water in unit. Replaced 45vf capacitor. 249: Installed new actuator motor
10/5/2018	256	Out on FP2. Reset unit

## Rio Rancho City Hall HVAC Maintenance Records

Date	Room/Space	Work Done
10/15/2018	3rd Fl NE Stairs, 4th Fl stairs	3rd: out on FP. Replaced schrader. Added 2.4oz R22. 4th: Compressor locked and needs to be replaced. Unit is off
10/19/2018	4th Fl Stairs	Replaced compressor and capacitor
10/22/2018	Conference Rm	Reseated O-ring



## Office Locations



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