



# City of Woodland

## REPORT TO MAYOR AND CITY COUNCIL

AGENDA ITEM

TO: THE HONORABLE MAYOR  
AND CITY COUNCIL

DATE: July 21, 2009

SUBJECT: Final Acceptance and Notice of Completion for Community/Senior Center – Phase 2, Project No. 08-01 and Final Report on Geothermal System

### **Report in Brief**

In November 2007, the City executed a construction contract with Kenridge Builders to construct the second phase of the Community/Senior Center. The work was performed in accordance with the plans and specifications and is now ready for acceptance by the City Council.

Certain financial issues remain associated with this project. There is a Stop Notice, which was filed by the communications sub-contractor. The City is withholding \$94,015.44 in the Escrow Account until this Stop Notice is released. In addition, the City is withholding \$20,000 of the contract amount for final testing of the audio-visual system. Once the system is tested, they will receive the withheld amount. Otherwise, the City will deduct the cost of the testing and any corrective work from the withheld amount and pay the remaining amount to the contractor.

While these issues need to be resolved, the City is not precluded from accepting the project and filing the Notice of Completion. The contractor has completed the work and the phase 2 improvements have been available for use for three months.

In addition, there have been concerns regarding the efficiency and overall operation of the Geothermal System. Staff has collaborated with Stantec Engineering to complete additional analysis that shows the system is performing within industry standards and is saving energy costs for the Community & Senior Center. Information regarding this issue, while not directly associated with the recommended action under consideration by the City Council, has been included for information purposes within this report.

Staff recommends that the City Council accept as complete, the contract with Kenridge Builders, Inc. for their work on the Community/Senior Center - Phase 2, Project No. 08-01, and authorize the City Clerk to file a Notice of Completion. The final construction contract value (including amounts withheld) is \$3,926,088. The total value of the withheld amount, including the Stop Notice, is \$114,015.44.

### **Background**

The voters approved Measure E in June 2006 and the top vote-getter was Parks Projects at almost a 70% approval rating. The Community & Senior Center, Phase 2, and Sports Park, Phase 1 projects were deemed a top priority in the Parks Capital Program, and design contracts were executed in April 2007.

The Community & Senior Center Phase 2 project includes an 8,000 s.f. building and restroom for dance, aerobics and fitness, parking, a 2-acre dog park what was constructed under separate contract. The project also includes several elements that were left-over from the Phase 1 project, including the front fountain, gym bleachers, A/V equipment, security cameras, and other amenities.

Stantec Consulting completed the construction documents and the project was advertised in September 2007. On November 6, 2007, Council awarded the construction contract to Kenridge Builder., Inc. in the amount of \$3,496,000. Work commenced on November 26, 2007 and was completed in November 2008.

The City completed the Community and Senior Center in 2007 (Phase 1), which included a geothermal exchange system comprised of reverse-cycle heat pump packages interconnected with a closed-circuit water loop and underground horizontal pipe “farm”. Over the past two summers (2007, 2008), City staff has perceived inefficiencies in the system in relation to high water temperatures. Stantec Consulting designed the system and they have been working with City staff over the last several months to identify and resolve issues and educate staff on the operation and maintenance of the energy-efficient system. Staff concurs that the system is functioning as it was intended and will continue to monitor the operation and maintenance. A final report is attached.

### **Discussion**

The Community & Senior Center project was supported with Measure H sales tax funding approved by the voters in March 2000. The first phase of the project was completed in March 2007 and has provided opportunities to seniors, youth, sports enthusiasts, City staff, community members, and regional and state conferences.

One of the issues associated with the Phase I project is the geothermal exchange system. This system is comprised of reverse-cycle heat pump packages interconnected with a closed-circuit water loop and underground horizontal pipe “farm”. Over the past two summers (2007, 2008), City staff has perceived inefficiencies in the system in relation to high water temperatures. Stantec Consulting designed the system and they have been working with City staff over the last several months to identify and resolve issues and educate staff on the operation and maintenance of the energy-efficient system. Staff concurs that the system is functioning as it was intended and will continue to monitor the operation and maintenance. A final report is attached.

The second phase of the project includes an 8,000 s.f. building for dance, aerobics and fitness. The facility is currently used by independent contractors for fitness and dance classes.

The construction elements and contractual requirements for the Community/Senior Center – Phase 2, Project No. 08-01 have been completed by the contractor and are ready for acceptance.

There are two outstanding issues associated with the Phase 2 project: the Stop Notice and the audio-visual system testing. The Stop Notice involves a filing by the communications system subcontractor to Kenridge Builders, claiming they are owed money for work completed. The City has paid Kenridge for the majority of the communications work and the matter is between Kenridge and their sub. The City will require the Stop Notice be released before final payment is made to Kenridge. The only outstanding work is the testing of the audio/visual system, which is waiting for installation of projection screens in the banquet room. The City has procured the screens separately and they should be installed in this month with the required testing performed shortly thereafter. These actions have been reviewed with the City Attorney who is in concurrence with the recommended action.

### **Fiscal Impact**

A revised Project Programming Summary Sheet (PPSS) was approved on November 6, 2007, in the amount of \$6,135,400. This project was completed within the approved budget.

### **Public Contact**

Posting of the City Council agenda.

### **Recommendation for Action**

Staff recommends that the City Council accept as complete, the contract with Kenridge Builders, Inc. for their work on the Community/Senior Center - Phase 2, Project No. 08-01, and authorize the City Clerk to file a Notice of Completion. The final construction contract value (including amounts withheld) is \$3,926,088. The total value of the withheld amount, including the Stop Notice, is \$114,015.44.

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Attachments: Geothermal exchange system report

July 1, 2009

FINAL REPORT TO CITY COUNCIL

**SUBJECT: WOODLAND COMMUNITY AND SENIOR CENTER  
GEOTHERMAL EXCHANGE SYSTEM**

The City completed a new Community and Senior Center in 2007 (Phase 1), which includes a geothermal exchange system comprised of reverse-cycle heat pump packages interconnected with a closed-circuit water loop and underground horizontal pipe “farm”. A Schematic Design Report was prepared by the Design Firm – Stantec Consulting – which included an economic analysis (May 2003) reflecting a payback of 6-1/2 years, including inflation and maintenance. The system was installed under the construction contract with Broward Bros. Inc.

Over the 2007 summer, the City perceived inefficiencies in the system in relation to high water temperatures. For example, system water came out of the facility over 100 deg. F and returned from the geothermal grid system back into the facility at around 97 deg. F. The City’s concern was that the overall mechanical systems were working harder than originally anticipated, resulting in wear and tear on the equipment and reduced rate of return on the investment not commensurate with the original calculations and analyses which supported the decision to install a geothermal system.

The City communicated the concerns to the design firm on several occasions and they concluded that additional “commissioning” was necessary. A specification for the commissioning was prepared and the work performed in June 2008, under the Community Senior Center Phase 2 project. The commissioning included installation of air-relief valves in the mechanical room, testing, flushing and cleaning of the ground loop, finish-testing of all components, cleaning of the coil, and repairing damaged loop-feeder lines hit by the Sports Park contractor.

The City continued to experience the same water temperature related concerns over the summer and fall of 2008 even after completion of the additional commissioning.

Stantec was asked to provide a comparative analysis based on the finished system performance, using actual system and power costs. That comparative analysis (September 2008) calculated a payback of 7 years. However, staff was concerned with some of the assumptions used in the analysis.

In January 2009, City staff held a conference call with a geothermal expert who had a good knowledge of the Woodland Community Center system, having visited the site in

summer 2007 and subsequently worked with Stantec on establishing the Phase 2 specification for Commissioning.

Three main concerns were expressed:

1. Was the functional performance testing and benchmarking completed?  
- although this was not completed, the work was deemed to be not necessary at this point and it would not necessarily address the functional problems.
2. Is the soaker system functioning properly?  
- all indications from staff are that the entire loopfield is not getting wetted, and subsequently the water supply was connected so that more investigation could occur.
3. Has the water in the vault been pumped out and is the water gone for good?  
- staff confirmed that the vault was pumped out last summer and the vault has stayed dry.

In the experts opinion, the system was designed within industry standards, although he would have placed the Loopfield coils deeper than the 5-foot, which he says is the minimum allowed. He stated that water in the system should be cooled to around 70 deg F in spring and slowly heat up into the 90's by the end of summer, with an in/out temperature differential of between 5 – 8 deg F. The City has recorded water temperatures in the 90's all summer long, although the temperature differential may be within normal ranges.

In response to the soaker system concerns, staff potholed the loopfield coils and soaker hose in March 2009 and, along with a Stantec representative, observed that the loopfield coils were on average 5-feet deep and the soaker hose was about 1-foot above that. The soaker hose was turned on and it was observed that it took several minutes to charge the line and that only the hose exposed near the beginning of the system showed water coming out of the perforations. Staff voiced concerns with the adequacy of the water pressure to the hose as well as the soil interaction with the hose and its ability to function as designed.

On March 27, 2009, staff met with Stantec to discuss the following items:

1. Over-view of what's transpired to-date.
  - a. Original Construction
  - b. Soaker Line Substitution
  - c. Additional Commissioning Work
  - d. Meetings between City and Stantec
  - e. Two summers of higher than expected system-water temperatures and compressor unit failure.
  - f. September 2008 analysis

2. Current findings with potholing of loopfield and soaker system
3. City's concern of system efficiency in accordance with original analysis.
4. City's concern with soaker system adequacy and function, and depth of Loopfield.
5. City's concern with over-use of mechanical system and operation and maintenance \$.
6. City wants Stantec to take the lead on certifying that the system is working efficiently and, if it's not, provide recommendations to make it efficient as originally represented to the City.

In response, Stantec developed an action plan, which included the following:

1. Conduct a site visit to review existing conditions.

The site visit was completed on March 30<sup>th</sup>. With Stantec's recommendation, the City backfilled the inspection pits and activated the soaker system for approximately four hours each day during the week of April 7<sup>th</sup>.

2. Hire a geotechnical engineer to test soil placed over geothermal field.

Stantec retained Wallace-Kuhl & Associates (WKA) to conduct an investigation of soil conditions and moisture content. The field work was completed on April 16<sup>th</sup> and WKA performed its laboratory testing and issued the attached report (No. 5684.03, April 24, 2009) summarizing its findings.

The moisture readings taken at 10 boring locations within the limits of the geofield (at depths ranging from 5' to 8') showed moisture content ranging from 11.7% to 23.8%, with an average soil moisture content at 15.9%.

The area immediately to the east of the loop field showed a moisture content range of 9.8% to 13.0%. On average, these readings are about 25% lower than at the loop field.

Four readings taken to the west of the loop field (across the parking aisle) showed moisture content ranging from 12.2% to 25.4%. On average, these readings are about 21% higher than at the loop field. WKA observed in a follow up conversation that the lower grade elevation of this area relative to the surrounding grades and parking lot may be a contributing factor to the higher moisture readings.

The moisture readings at the loop field are generally lower than the 20%+ range that WKA would have expected in soil charged by the soaker system, but

all readings are within the operational design parameters of 10%-20% moisture content for the loop field. So while the soil moisture testing data may not be conclusive as to the performance of the soaker system, the loop field installation is not currently contributing to the HVAC performance issues.

The design of the geothermal system assumed (per the original master plan) that an irrigated natural turf field would be installed over the array. The actual installed conditions are expected to yield lower soil moisture content and higher ground temperatures, not only from lack of regular watering during warmer months, but also due to the drying effect of a higher ground surface temperature and added surface solar heat gain.

3. Hire a qualified service technician to troubleshoot the wire overheating and compressor failure on Heat Pump #5.

Stantec retained Airco Mechanical who conducted an investigation of the heat pump equipment, and concluded the cause of the problems was loose connections, which were tightened by maintenance staff.

4. Contact PG&E for records on the voltages at the service to the building, to determine if voltage-drops are contributing to the heat pump malfunctions.

Stantec received voltage monitoring information from PG&E. The phase to neutral voltage levels were recorded by PG&E from December 11, 2008 to December 31, 2008. The maximum voltage recorded during that time period was 291 volts and the minimum was 274 volts with an average of 282 volts. The design voltage for phase to neutral was 277 volts. In addition, the phase to neutral voltages for the three phases were nearly equal indicating a balanced system. These findings indicate that there was not an under-voltage condition at the Community Center main switchboard during the time of the readings. Calculated voltage drops to the HVAC units indicate voltage drops of one percent or less. The National Electrical Code recommends voltage drops on branch circuits to not exceed three percent. Based on the information from PG&E and the voltage drop calculations, there does not appear to be an under-voltage problem.

Upon completion of the action plan, Stantec met with staff to present a response to the City's concerns and an updated comparative analysis.

The City concerns with regard to the system were:

1. Was the geothermal system a valid selection for the City?

The Pros and Cons were discussed as follows:

Pros:

Based on ASHRAE design standards the estimated equipment efficiency of geofield systems is 37% higher than conventional rooftop equipment.

Geofields experience a longer service life than conventional condensing systems, buried polyethylene pipe 100 yrs, versus cooling towers - 20 yrs, boilers - 25 yrs, rooftop unit air cooled systems – 15 years.

Typically less maintenance than rooftop equipment, cleaning condensers, replacing condenser fans, weatherproofing and corrosion issues.

Eliminates the requirement for cooling towers and boilers and the associated maintenance, chemical water treatment, and additional components to maintain.

ASHRAE lists service life of commercial water to air heat pumps at 19 years vs. 15 years for rooftop HVAC units.

Cons:

Higher first cost

Commercial system installations are limited in our area resulting in a lack of qualified installation contractors and service/commissioning contractors familiar with geofield systems.

2. Is the City receiving a return on investment in line with expectations?

Stantec reviewed the City's return on investment

They compared electric and gas consumption between March 07 and March 08, and March 08 to March 09\*, and concluded the overall building energy consumption is considerably less than the standard baseline building used for comparative analysis by Title 24 Energy Calculations. The performance based Title 24 Energy Calculations are a computer modeled simulation of the standard building predicted energy performance and calculated building performance. This is the basis for building department energy compliance and utility company incentive rebates. This is based on comparing the attached Title 24 utility incentive worksheet and actual utility costs:

Electric

Standard building electrical consumption (kWh)	1,304,131
Calculated building electrical consumption (kWh)	1,162,819
*Actual building electrical consumption (kWh)	799,800
Unit Cost	\$0.15/(kWh)

Estimated annual electrical savings over a standard building: \$75,650.00 (40%)

Gas

Standard building gas consumption (therms)	10,797
Calculated building gas consumption (therms)	18,161
*Actual building gas consumption (therms)	5,168
Unit Cost	\$1.04/(therms)

Estimated annual gas savings over a standard building: \$5,854 (52%)

Based on the standard design building the space heating, cooling and fans associated with the geothermal system consume approximately 65% of the energy and the systems are saving approximately \$54,000/year as a result of the geothermal system.

3. Is the system operation in line with expectations?

The system is operating within manufacturers recommended operating ranges. The components are manufactured to accommodate water temperatures entering the system between 20 degF and 110 degF. The City's system falls within these temperature ranges.

4. Are the recent compressor failure and concerns about overheated wiring in some units related to geofield performance?

Compressor failure and overheating was attributed to loose wire connections, and not under-voltage from the main service or geothermal system performance. The problem has not reoccurred.

5. What issues have been resolved to maintain lower geofield water temperatures late in the season?

System was purged of air last season to improve heat transfer and flow. Units are now receiving recommended regularly scheduled maintenance. Soaker system is operational in lieu of irrigated soccer field, although additional tests will confirm whether soaker is affecting the entire geofield.

Based on the analysis and information presented to-date, staff concurs with Stantec that the geothermal system is functioning as it was intended and the City is receiving benefit through energy cost-savings. Stantec has committed to the City that they will continue to support the City with operational questions and concerns related to the geothermal system and all other systems constructed with the two Community and Senior Center projects.