UUCF Pervious Parking Lot Demonstration Project

A-15c Statement of Work

Section 1, Relevance and Importance:

The Unitarian Universalist Church of Fresno (UUCF) is undertaking a program to build a new church campus with an estimated total budget of $6 million. In undertaking this program the membership voted early on to commit to designing the church facilities for environmentally responsible construction and operation. To this end, the UUCF has joined the US Green Building Council (USGBC) and registered the construction project for LEED™ (Leadership in Energy and Environmental Design) certification at the "Gold" level. The LEED™ certification system is a widely accepted means for certifying adherence to sustainable, "green" and environmentally responsible building standards. The UUCF building program is the first, and so far the only, LEED™ registered project in the central Valley between Merced and Bakersfield. The church is committed to using the new facility as an example to the Central Valley for "green" sustainable building practices and is being recognized as such by the City of Fresno. In keeping with this commitment the UUCF is proposing to construct the parking lot in a manner that will not only adhere to a number of LEED™ criteria but will also demonstrate a unique approach to water use reduction.

The membership of the UUCF represents the diversity of the population of Fresno, culturally, ethnically and socio-economically. The church is committed to allowing the use of the new facilities for demonstrating the water use reduction and other sustainable aspects to all interested groups and organizations in California.

The specific goal of this proposed project is to demonstrate a system for constructing and landscaping a parking area that will allow all the rainfall on a parking surface to be captured for irrigation use, thus reducing the demand on a municipal water supply for landscape irrigation. The importance of this system is that, as more and more urban and suburban areas are being developed with large shopping, dining and entertainment complexes, more and more land is needed for parking. In the interests of developing attractive facilities, many developers desire and many municipalities require landscaping and tree shading of these parking facilities. Since conventional parking surfaces of concrete or asphalt cause all rainfall to be diverted into stormwater drainage systems, the entire irrigation needs of the plants must come from municipal water supplies. In some instances, recycled water can be used, but the actual use of recycled water is rare. Another alternative has been to install underground cisterns that capture the runoff from the parking area gutters; this is expensive and requires a system for pumping and distributing the captured water when needed for irrigation.

If a way could be found to allow all the rain that falls on a parking surface to permeate into the soil under the parking surface and provide a top surface that limits the evaporation from the soil, then the rainfall becomes an irrigation source. The proposed project will demonstrate a simple, economical solution using a concrete product called pervious (sometimes referred to as porous, or permeable) concrete. This concrete has numerous voids between the aggregate (small rocks that give concrete body and strength). These voids allow water to freely flow through the concrete surface into the substrate and soil beneath. While having this permeable feature, the concrete also has the structural and low maintenance attributes of a conventional concrete parking surface. In essence, as far as the landscaping plants are concerned, the concrete surface has no effect since all rainfall flows into the soil. The porous pervious concrete also serves in another water saving role, acting as a mulch over the soil, which both reduces evaporation from the soil and prevents weeds from growing (weeds, if not controlled, can account for up to 40% of the irrigation requirements of a landscaped area). The project will be located in NE Fresno, an area of rapid growth and development. In such a location, the project will be highly visible and accessible as a Fresno and Central Valley demonstration site.

The proposed parking area, as shown on the site plan, has an overall area of 67,813 ft^2 (1.56 acres). Of this, 66,413 ft^2 (1.52 acres) will be paved; the remaining 1400 ft^2 will be landscaped. Average rainfall in Fresno is approximately 10" per year. This amount of rain on a 66,413 ft^2 area is approximately 414,000 gallons/year. With an impervious pavement (conventional concrete or asphalt), all of this rainfall either evaporates or flows into a stormwater drainage system. A pervious paving system will use this rainfall for irrigation, thus reducing the demand on a municipal water supply. Thus, the proposed project will save 414,000 gallons/year under average conditions. This is equivalent to 6.23 gallons/ ft^2 per year. In an area with greater rainfall, such as the Bay Area, the water savings would be greater. Extrapolating this savings to a shopping mall sized parking area of, for example, 5 acres, 6.23 gallons/ ft^2 per year will yield an annual water savings of 1.36 million gallons. This savings assumes that the parking area is landscaped with sufficient plants to have a water demand equal to or exceeding the amount provided by rainfall alone. In the case of the proposed project, the landscaping shown on the site plan is projected to have an annual water demand of 2.3 million gallons/year.

In addition to reducing the water demand on a municipal water supply, a pervious concrete surface offers collateral benefits that affect water quality and environmental quality. First, by absorbing rainfall and eliminating stormwater runoff, contaminants on the parking surface such as oil and grease from vehicles, particulate rubber from tires, and metallic contaminants from brakes are not carried into stormwater drainage

systems, which in some instances flow into water supplies. These contaminants are either reduced by bacterial action or sequestered in the paving material. Second, absorbing stormwater reduces or eliminates the demand on drainage systems. A third collateral benefit is that, since concrete is more reflective than darker surfaces such as asphalt, the parking surface remains cooler and retains less heat, thus reducing the "heat island" effect which raises air temperatures in densely developed areas. Reducing the heat island effect results in lower energy use by air conditioning systems, both in automobiles and buildings.

The project is located in the San Joaquin Region of the California Bay-Delta Authority. Any water conservation measure in this region has an indirect benefit to the Bay-Delta System by reducing demand. Further, when successfully demonstrated by this project, the design concept of pervious concrete can be implemented anywhere in the state. In regions where water use reduction has a direct benefit to the Bay-Delta System, implementation of this paving system will yield a direct benefit.

Section 2: Technical/Scientific Merit, Feasibility

Pervious concrete has long been used in European countries, on the East Coast and in the Midwest, primarily as a stormwater management measure. The technology for its production and application has recently been implemented in California, but its use has not yet gained wide acceptance. By demonstrating the water savings and other environmental benefits of pervious concrete in addition to the more widely stated benefit of stormwater management, this project would be an example to increase the acceptance of pervious concrete in the Central Valley, and California as a whole.

The Concrete Promotion Council letter (attached) attests to the feasibility of this project and the environmental benefits described in this application. The Concrete Promotion Council also believes this project with pervious concrete would be a valuable demonstration resource for this water conservation technique throughout California.

Although the project could be implemented using a wide variety of shade trees and understory shrubs, there are a variety of plants that have the attributes of low water requirements, hardiness and drought resistance, as well as the aesthetic properties for use in a parking area. To further reduce demand on supplemental irrigation, the plants chosen for this project will be chosen to have these attributes. The actual plant species used will depend on availability and approval by City of Fresno Building Department approval. Candidate species that meet the above requirements are listed on the following page.

Candidate tree and shrub species:

Pistacia chinensis Chinese Pistache
Robinia ambigua 'Idahoensis' Idaho Locust
Vitex agnus castus Chaste Tree
Quercus suber Cork Oak
Nerum Oleander Oleander
Baccharis piluaris Coyote Brush
Lavandula stoechas Spanish Lavender

The water requirements of these types of plants, when grown in the San Joaquin Valley, average about 30,000 gallons/year for a mature shade tree and 8000 gallons/year for understory shrubs. These water requirements vary with species and with a factor called evapotranspiration (ET). Evapotranspiration is the rate at which water is removed from soil by evaporation at the soil surface, and transpiration, the transfer of water in the soil to water vapor in the atmosphere through the process of plant photosynthesis. Evapotranspiration can be thought of as how fast irrigation water is used in a landscaped area. Water demand can be reduced in two ways: 1) by choosing plants with a low transpiration rate, and 2) by reducing the soil evaporation rate with mulch. In the case of this project, the pervious concrete acts as the mulch. By comparing the actual water demand with a projected water demand that is based on a reference evapotranspiration rate, ET_0, the mulching benefit of the pervious concrete can be estimated. ET_0 can be determined by measuring air temperature, wind speed, humidity and solar radiation. An instrument manufactured by Davis Instruments, the Vantage Pro2 Plus, measures these parameters and computes ET_0. In addition to monitoring ET_0, measurements of rainfall and soil moisture will be maintained. All these data will be used to determine the irrigation demand of the plants in order to only supply the water that the plants actually need, to determine the mulching effect of the pervious concrete, and to determine what percentage of total rainfall becomes useful irrigation water.

Irrigation water will be distributed throughout the parking area's landscaping through a low-flow point source (drip) system. The irrigation system's timing and volume will be adjusted, as needed, to provide only the required water based on the measurements of soil moisture and calculated ET_0. The attached letter from Robert Boro, Landscape Architect, supports the feasibility of the landscaping scheme proposed for this project.

The actual parking surface is constructed and installed like a conventional concrete parking surface; the only difference being that the thickness of the concrete is 6" with a

pervious mix, compared to 4" with a conventional mix. Grading, soil compaction, and leveling are done just as with a conventional system. Curbs, parking lines and markings, and parking area lighting are conventional and will be selected and installed to meet municipal ordinances. The site plan shows the parking area and a cross-section of the parking surface. The attached letter from Blair, Church & Flynn, Consulting Engineers, attests to the feasibility of the pervious concrete construction. It should be noted that the valley gutter in the center of each parking lane is not expected to drain any rainfall from the parking area under normal conditions. In the event of an extraordinarily heavy rainfall, where the pervious concrete cannot absorb all the rain, the valley gutter provides flow to a stormwater drain. A rainfall of this magnitude is extremely rare in the Fresno area. Additionally, since the soil at the demonstration project site is a very dense, silty-sand type soil that has low water absorption properties, a relatively thick (30") sand base is called for to insure rainfall will be retained in the parking area. Otherwise, the parking area could become saturated during a heavy rainfall. When implemented at other sites with more absorptive soils, this sand base thickness can be reduced.

This project will be built in conjunction with the construction of a church and educational facility adjacent to the parking area. It should be noted at this point that the project site is owned by the applicant, and that construction of the church/educational facility will be funded by member pledges already in place and by the sale of the existing church property which is owned by the applicant. This construction project, including the parking area, was approved by the City of Fresno Planning Commission with Conditional Use Permit C-02-105 on November 10, 2004. The Fresno City Council approved an accompanying Rezoning Application R-04-38. Together with these two actions, the Fresno City Council approved Environmental Assessment No. R-04-38/C-04-105, finding that this project has no substantial impact on the environment as identified in the Fresno General Master Plan (MEIR No. 10130) dated September 3, 2004.

Project tasks, schedule and costs:

Task	Start	Complete	Cost ($K)
Soil analysis	3/05	3/05	0.5
Plant selection	3/05	3/05	0.8
Preparation of grading plan	3/05	4/05	1.2
Construction drawings	4/05	5/05	2.5
Landscaping/irrigation plan	4/05	5/05	0.8
Lighting/electrical plan	4/05	5/05	1.5
Plan check/Permits	5/05	7/05	0.5
Planning/Design/Engineering total			$7.8K

(continued on following page)

Fresno Municipal Flood Control District fees	7/05	7/05		$10.0K
Grading/base installation	8/05	9/05	166.0	
Install irrigation	9/05	9/05	3.8	
Install electrical/light fixtures	10/05	10/05	42.4	
Pour concrete	11/05	11/05	365.0	
Install curbs and gutters	11/05	12/05	68.0	
Soil prep for understory	1/06	1/06	1.1	
Plant understory/shade plants	2/06	2/06	11.5	
Line markings/painting/signage	3/06	3/06	3.5	
Construction management (6%)	8/05	3/06	39.7	
Construction total				$701.0K
Install water use meters	3/06	3/06	0.5	
Install temperature, humidity, Wind, solar radiation, soil moisture and rainfall measurement system	3/06	3/06	1.5	
Monitor water use/rainfall	3/06	indef	2.7	
Establish Excel© report base	3/06	indef	1.8	
Website modifications	3/06	3/06	0.5	
Prepare reports	continuing as required		1.0	
Monitoring, evaluation and reporting total				$8.0K
Project total				$726.8K

Section 3: Monitoring and Assessment:

Prior to the start of project construction, the existing soil will be analyzed and plant species will be selected. Based on the soil analysis and historical water use requirements for the San Joaquin Valley environment, irrigation requirements for the landscaping (assuming no rainfall, which would be consistent with an conventional, impermeable parking surface) will be determined. These irrigation requirements will be used as a baseline for comparison with the pervious parking surface. This estimation is considered to be accurate within 10%. Soil moisture meters will be installed in three locations under the pervious parking surface and in one control location (an area of uncovered soil with plantings similar to those of the parking area). These meters will

have an accuracy of better than 5%. A rainfall meter will be installed in an exposed area adjacent to the parking area. A water use meter will be connected to the irrigation system.

After the project construction is complete and the landscaping plants are planted, soil moisture, rainfall, and irrigation water use will be monitored and data collected on a weekly basis. These data will allow a comparison of soil moisture content under the parking surface with soil in an uncovered area as one measure of the efficacy of the mulching effect of the pervious concrete. As described in Section 2, air temperature, humidity, wind speed and solar radiation will be monitored to determine the evapotranspiration index, ET_0, which will also be used to estimate the mulching effect as well as to determine the actual irrigation demand of the plants.

Rainfall data will be maintained as well, so that total rainfall during the measurement periods described above can be compared with historical average rainfall data for the Fresno area. If the measurement period occurs in a season with total rainfall significantly greater than or less than historical average rainfall, the conclusions drawn from the measurements can be adjusted for an "average" rainfall year.

The measurement data, calculations and results will be entered and calculated in a spreadsheet format, using Microsoft Excel©. The completed spreadsheets will be imported to the Unitarian Universalist Church of Fresno's website www.uufresno.org, where they will be accessible to the Department of Water Resources (DWR) and others.

The costs associated with implementation of the monitoring and evaluation plan are detailed in the Project Tasks and Schedule in Section 2, above. The total cost is $8.3k.

Qualifications of the Applicants and Cooperators A-15f

The Project manager will be George A. Burman, whose resume is attached. Mr. Burman is also the Project Manager for the entire church construction project, of which the parking area is a part.

External Cooperators will be:

1. McCamant and Durrett, Architects. Responsible for the overall design of the church facility. Primary contact: Kathryn McCamant.

2. Robert Boro, Landscape Architects. Responsible for the design of the parking area, the landscaping of the parking area and the church facility. Primary contact: Richard Vaillancour
3. Blair, Church & Flynn, Consulting Engineers. Responsible for the civil engineering aspects of the project, including preparation and approval of construction drawings and specification for the parking area. Primary contact: Alan Mok.
4. A general contractor and appropriate sub-contractors will be selected to prepare the parking area, install the parking base, pervious concrete, irrigation system, lighting fixtures and electrical wiring, and plantings. Selection of the general/sub contractors will be by competitive or negotiated bids. There are at least two local paving contractors in the Fresno area qualified to apply the pervious concrete paving.
5. The Concrete Promotion Council of Northern California. An industry advocacy group who will assist in actively promoting the use of pervious concrete as a water saving measure.
6. The City of Fresno, which actively promotes sustainable building practices including water use reduction measures.

The Unitarian Universalist Church of Fresno has not participated in any previous water use efficiency programs.

The cumulative effect is saving a great deal of water, and being an open demonstration site to builders and planners in the Central Valley. The transformation of water use is imperative, with the continuing increase in diverse population the Fresno area is experiencing.

The City of Fresno is interested in this demonstration project. Attached is a draft resolution to be considered by the Fresno City Council on January 11, 2005 and is expected to be adopted without opposition. In addition, the specifics of this demonstration project have been discussed with the Fresno Planning and Development Department; a staff architect and civil engineer agree to the feasibility of the pervious concrete construction and encourage its use as a water use reduction measure. See attached letter from the City architect.

Press coverage and future workshops on smart water use could transform the Central Valley and its 'thirst' requirements. Engaging the larger public in active dialogue on water consequences and ways to recycle water through this project will be part of the intentional demonstration aspect of this project.

If this grant is funded, it is the intention of the project to be a demonstration for creative, ecological building in the Valley. The UUCF will foster, through press releases and workshops, commitments by public and private agencies for new construction and retrofitted construction which will promote development of landscape and parking lot water conservation and water use that meets the urban water challenges of this geography, weather, and environmental sustainability.

The water use reduction promised by this will be directly beneficial for the UUCF church facility and the City of Fresno water supply and promises a positive outcome that would otherwise not occur. The Unitarian Universalist Church of Fresno is committed to this project and ongoing programmatic dissemination of its results for major impact on construction for good water use in this state.

Innovation A-15h

While pervious concrete has been previously demonstrated to be feasible for parking surfaces, low-demand plants have been selected for landscaping, and environmental conditions monitored to determine optimum irrigation quantities, the innovation here is to combine all three approaches to landscape irrigation water conservation. Further, while the stormwater management attributes of pervious concrete have been adequately demonstrated, its application in an integrated landscape water saving system is new.

Applicant: **Unitarian Universalist Church of Fresno**

THE TABLES ARE FORMATTED WITH FORMULAS: FILL IN THE SHADED AREAS ONLY

Table C-5 Project Annual Physical Benefits (Quantitative and Qualitative Description of Benefits)

	Qualitative Description - Required of all applicants[1]				**Quantitative Benefits - where data are available [2]**
	Description of physical benefits (in-stream flow and timing, water quantity and water quality) for:	Time pattern and Location of Benefit	Project Life: Duration of Benefits	State Why Project Bay Delta benefit is Direct[3] Indirect [4] or Both	Quantified Benefits (in-stream flow and timing, water quantity and water quality)
Bay Delta	The benefit will be water quality in that local rainfall that would ordinarily be diverted to a storm drainage system will be retained for irrigation of a a landscaped parking area. The amount of captured rainfall will directly offset demand on the local municipal water supply	The benefit will accrue throughout the rain season	The benefit will last for the lifetime of the paved parking area, projected at 50 years or more.	The indirect benefit is that any water savings in the San Joaquin Valley region of the Bay-Delta System reduces dependency on the Bay Delta System. When the demonstrated paving system is applied in areas other than the demonstration site, there will be a direct benefit to the Bay Delta System i areas where reduced water use is a direct benefit.	For applications of the demonstrated system throughout the Bay-Delta region; water savings can be calculated as: 27,154 gallons/in (local rainfall) per acre of parking surface. For example, a parking area of five acres, in a region with 18" of annual rainfall will save 27,154 x 18 x 5+ 2,440,000 gallons or, 7.5 acre-feet.
Local	The benefit will be water quantity, in the local rainfall that would ordinarily be diverted to a storm drainage system will be retained for irrigation of a landscaped parking area. The amount of captured rainfall will directly offset demand on the local municipal water supply.	The benefit will accrue throughout the rain season; in Fresno this is typically from November to April.	The benefit will last for the lifetime of the paved parking area, projected at 50 years or more.	**Not applicable.**	The water quantity benefit of the demonstration project will be 414,000 gallons/" annual rainfall/ year, assuming an average 10" annual rainfall.

[1] The qualitative benefits should be provided in a narrative description. Use additional sheet.

[2] Direct benefits are project outcomes that contribute to a CALFED objective within the Bay-Delta system during the life of the project.

[3] Indirect benefits are project outcomes that help to reduce dependency on the Bay-Delta system. Indirect benefits may be realized over time.

[4] The project benefits that can be quantified (i.e. volume of water saved or mass of constituents reduced) should be provided.