# PROJECT PLAN

**IPRO 312**

## Porous Pavement/Hydro-gel System for Storm Water Management


**Faculty Advisors:**
Fouad Teymour Ph.D. Chem. E.
Said Al-Hallaj Ph.D. Chem. E.

**Teaching Assistant:**
Gregory Weipert

**Team Leader:**
Shawn Shoulders

**Sub Team Leaders:**
Sarah Johnson
William Lewis
Helen Yeung

**Members:**
Misha Chavazha
Chance Lebron
James Myers
Karl Rybaltowski
Nan Wang



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## OBJECTIVES

The objectives of IPRO 312, are to design and demonstrate a hydrogel based, water retention and release system for implementation in various storm water reclamation scenarios while forecasting the impact of such a system, both economically and ecologically on a Chicago-land neighborhood.

## BACKGROUND

Super absorbent polymers or hydrogels are a family of water-soluble polymers that have the property of absorbing fluids from 100 up to 10,000 times their weight. They form a semi-rigid gel structure that tightly binds the water and other ionic species present in the fluid. However, due to the nature of the hydrated polymer, it is difficult to remove the water from the gel structure. IPRO 312 is currently building upon previous IIT research into the water absorption and release abilities of a special class of aqueous polymers: electrically reversible hydrogels. Experimental results of absorption rates for a lightly cross-linked polyacrylic acid polymer have demonstrated the potential for controlling the release process using applied voltage potential. Electrically-induced water release dynamics are also an important aspect in our overall understanding of these hydrogels. New tests are being devised to supplement earlier experiments, where the voltage was varied between a cathode and anode in a water-saturated hydrogel. Preliminary results demonstrated that the release rate of the hydrogel increased with magnitude of voltage applied. Previous tests have also shown that a steady state rate of release can be achieved at lower voltages. The new experiments test the effects of temperature, water purity (pre and post absorption), as well as variants effecting the conductivity of the hydrogel.

Beginning with the reversal of the flow of the Chicago River, the city of Chicago has been the home of waste water treatment. Chicago has continually remained a leader in water reclamation technology, but storm water flooding remains a large issue in Chicago. Stormwater and sewage are collected and moved in a combined sewer tunnel, so after a large storm the amount of water traveling into water reclamation plants increases too often beyond capacity. Excess waste water must be pumped into holding tanks or holding ponds to be pumped once again back into the plant to be treated later, a great expense to the plant and tax payers. When the volume of waste water goes above the holding tanks/ponds and plants capacity then water maybe dumped into lakes or rivers untreated causing beach closures and illness or disease. In the village of Skokie, on the northern outskirts of Chicago, the waste water volume after storms continually increases beyond the capacity of the North Side Water Reclamation Plant. The North Side Plant is currently looking into building another larger holding pond costing millions of dollars. Rather than spending large amounts of money on another pond that will still be below the volume necessary during large storms the Metropolitan Water Reclamation District of Greater Chicago is interested in passive systems that can be implemented throughout the city.

## METHODOLOGY

To efficiently accomplish the stated objectives, a sub-team structure within the group is created. A sub-team overview is available in Table 1, below. Sub-teams are assigned members based on degree field as well as interest. Each team is responsible for reaching the goals and deadlines as set by the faculty/leaders of IPRO 312. The sub- team structure is not strictly rigid, allowing for persons to be a member of more than one team, and promoting cross-group participation. Each team is also expected to develop and adjust to their own goals/deadlines as required, to satisfy the general goals of the sub-team, as well as the overall objectives of IPRO 312. Individual members of the group may also be assigned separate tasks outside of the team structure as required by the needs of the group.

| IPRO 312 | | |
|---|---|---|
| **Team** | **Goals/Responsibilities** | **Members** |
| **Design:** | 1. Investigate and design porous pavement structure capable of supporting hydrogel system.<br>2. Construct working protype for display<br>3. Create map of case study area including hydrogel application points. | Sarah Johnson<br>Chance Lebron<br>James Myers<br>Karl Rybaltowski<br>Helen Yeung |
| **Electrical:** | 1. Research renewable energy sources to use as system power<br>2. Test and verify the electrical properties of the hydrogel.<br>3. Design cell structure, control apparatus and power supply for system. | Misha Chavazha<br>James Myers<br>Shawn Shoulders<br>William Lewis<br>Nan Wang |
| **Logistics:** | 1. Complete and provide all *deliverables* to IPRO office.<br>2. Complete all administrative tasks, such as *minutes* , etc.<br>3. Organize and maintain *IGROUPS web* page.<br>4. Organize and maintain budget. | Shawn Shoulders<br>Helen Yeung<br>Sarah Johnson<br>Greg Weipert |

**Table 1. Sub-team goals and members.**

## EXPECTED RESULTS

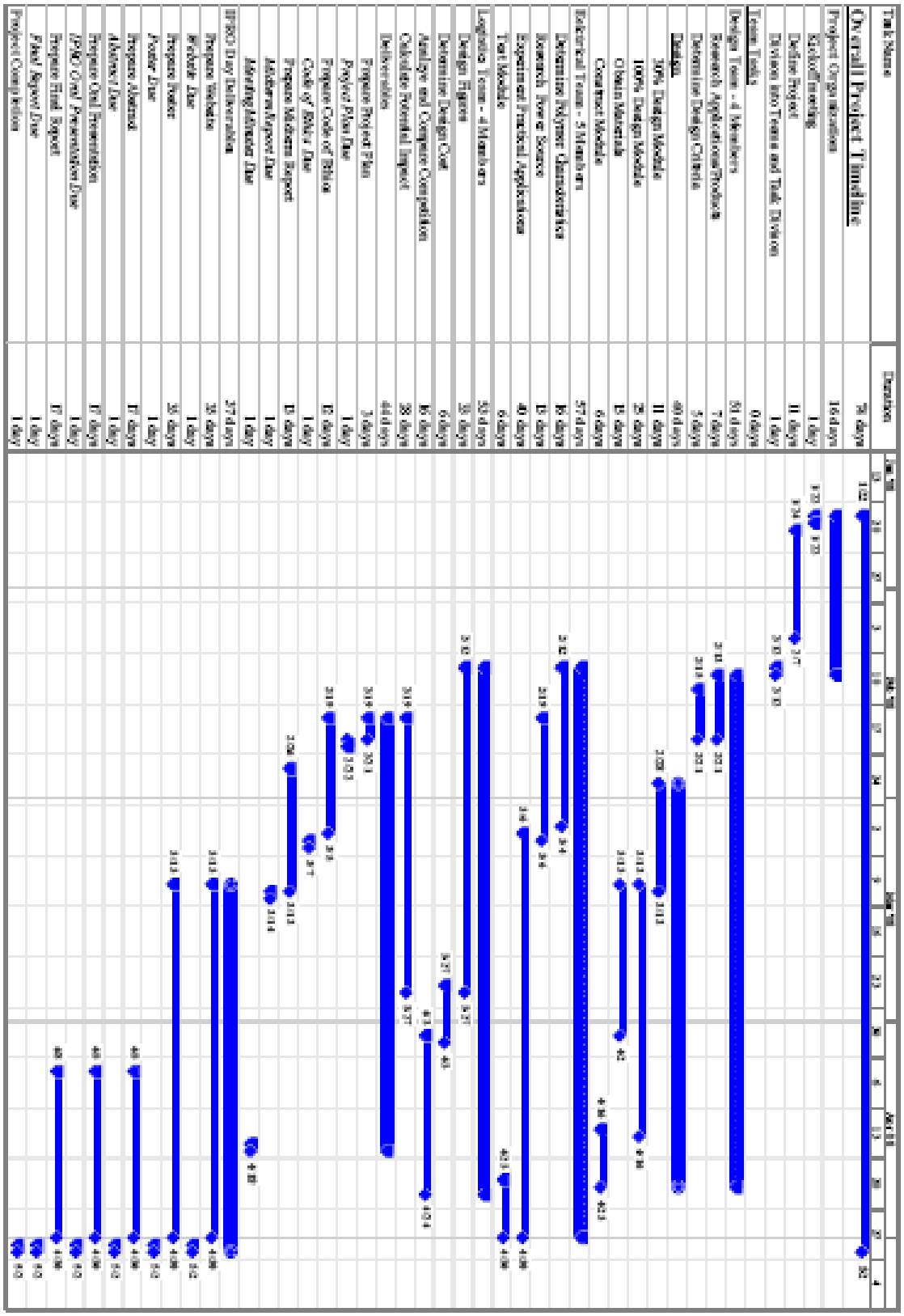
Our expected results include:

- Design for and working prototype of a hydrogel filled cell capable of adsorbing and releasing water at a specified rate.
- Design and working prototype of a porous pavement/hydrogel storm water collection system.
- Map of case study area with projected hydrogel application points.
- Projected impact of hydrogel system on an actual waste water management scenario including cost analysis.

## PROJECT BUDGET

| **Item** | **Cost** |
|---|---|
| Modeling supplies | $ 50.00 |
| Raw materials for prototypes | 100.00 |
| Document Printing ($.07 per black and white) | 30.00 |
| Poster Printing ($5 per linear foot) | 60.00 |
| Final Printing (good paper, bound) | 60.00 |
| ***TOTAL*** | ***$ 300.00*** |

## SCHEDULE OF TASKS AND MILESTONE EVENTS



## INDIVIDUAL TEAM MEMBER ASSIGNMENTS

All sub-team assignments and goals have been defined in Table 1. Teams were assigned based on the interests and degree fields of its members.

| IPRO 312 | | | |
|---|---|---|---|
| **Name** | **Major** | **Assignment** | **Role** |
| Misha Chavazha | Physics | Electrical | |
| Sarah Johnson | Architecture | Design/Logistics | Leader of Design |
| Chance Lebron | Architecture | Design | |
| William Lewis | Mechanical Engineering | Electrical | Leader of Electrical |
| James Myers | Mechanical Engineering | Electrical/Design | |
| Karl Rybaltowski | Civil Engineering | Design | |
| Shawn Shoulders | Materials Engineering | Logistics/Electrical | IPRO Team leader |
| Nan Wang | Electrical Engineering | Electrical | |
| Gregory Weipert | Chemical Engineering | Logistics | IPRO TA |
| Helen Yeung | Civil Engineering | Logistics/Design | Leader of Logistics |

## DESIGNATION OF ROLES

The following roles have been assigned: (Administrative duties not listed to be handled by *Logistics* team)

- IPRO Faculty Advisor: Said Al-Hallaj
- IPRO Faculty Advisor: Fouad Teymour
- IPRO Teaching Assistant: Greg Weipert
- Team Leader: Shawn Shoulders
- Minutes: Helen Yeung
- Agenda: Shawn Shoulders
- Status report: Shawn Shoulders
- Scheduling and hours Greg Weipert