FRESNO ELITE SPORTS CENTER

The new sports center to be built in Fresno, California will be one of the largest public sports facilities in the United States. It features indoor and outdoor soccer fields, volleyball courts, outdoor baseball and softball fields. It also features a childcare facility and family picnic area. The project site is 73 acres and is located off CA-180 and Marks Avenue in southwest Fresno. This massive project will provide facilities for league and community teams throughout the Central Valley to compete and practice.

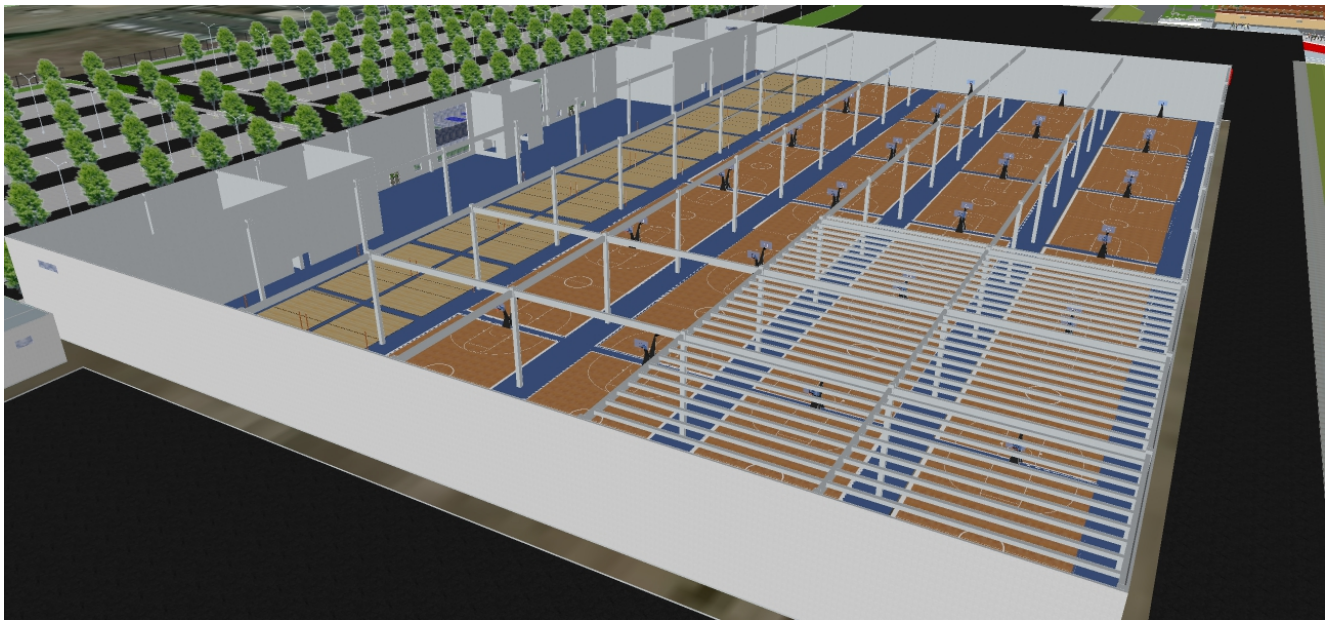
The existing site is mostly an unimpressive and undeveloped plot of land off the freeway. The new site will be a refreshing addition to the City. Turning the existing lot into a top-notch sports facility, however, requires an investment in time, resources, and money. The design engineers, Urban Innovators Inc. (UII) were given the task of making this dream of an elite sports facility a reality. Other than the necessary structures and fields, additional key components of the design were the design of utilities and infrastructure.

Before the Elite Sports Center could host its first game, the engineers discussed how the facility would be designed with all its necessary infrastructure.

STRUCTURES

The design of the gymnasium and the childcare facility are the highlight of the structural portion of the development of the new Fresno Elite Sports Center. Demand for large open areas in the gymnasium is key to the functionality of the courts for the various sports. The gymnasium incorporates a large-span member design that mitigates the intrusion of columns and other structural members on courts. Large-span roofing members resulted in the price consequence of large-sized roofing members but successfully reduced the total amount of columns in the floor area.

As a result of this design, columns are conveniently placed along the perimeter of the courts and in walls; out of sight and out of mind for those in the gymnasium. Because the columns supporting the relatively large-spanned roofing members may carry a relatively large load compared to a situation with more columns in the floor area, concentric brace frames were designed to



Gymansium interior

support wind and earthquake loading rather than the columns. While individuals in the gymnasium are attending to the affairs in the gymnasium, the presence of the childcare facility is also key to the overall success of the Fresno Elite Sports Center in order for those in the gymnasium to continue attending to the affairs in the gymnasium. The childcare facility includes only two interior columns in a floor area of 3000 ft^2, another feat possible with steel implementation.

SOIL EXPLORATION

Soil exploration and laboratory testing and analysis are very important tasks that are completed in order to identify what soil conditions are currently on the site for the new Fresno Elite Sports Center. It is important to properly identify the types of soil that are currently at the existing site of the facility. The team conducted laboratory testing which will help classify the soil and determine the soil parameters. With the soil parameters, the foundation of the sports center and childcare facility can be designed properly.

First boreholelogs were obtained through drilling into the current soil to determine the standard peneatration resistence of the soil and to determine the different layers of soil. Amercian Society of Testing Materials (ASTM) laboratory testing on the soil collected from the boreholes provides a standard practice for testing the soil. This type of testing can be correlated with typical testing methods that are used by most professionals. After the soil properties are determined, they can be input in the proper equtions to design the foundation and calculate the potential settlement of the foundation. Calculating the settlement will help prove that the design of the foundation is adequate. With the results from labatory testing and borehole explorations,

recommendations will be made for the construction of the foundations.

FOUNDATIONS

The gymnasium and childcare facility need to have foundations and footings to take the load of the structure and carry it into the soil. By doing this, the structure can remain upright and safe for the occupants. The foundation was designed to transfer the load from the columns and walls of the structure to the footings. It will be designed for the worst-case scenario by using the most critical load.

The site of the Fresno Elite Sports Center is located in southwest Fresno at the intersection of Marks Avenue and Nielsen Avenue. Using a soil sample attained from the site, the geotechnical team was able to determine the soil at the site to be silty sand. And through more thorough testing and analysis, the properties of the soil were reported and used in the design of the foundation.

The soil properties were used to generate a geotechnical report and calculate parameters that needed to be met in order to have a safe and durable foundation.

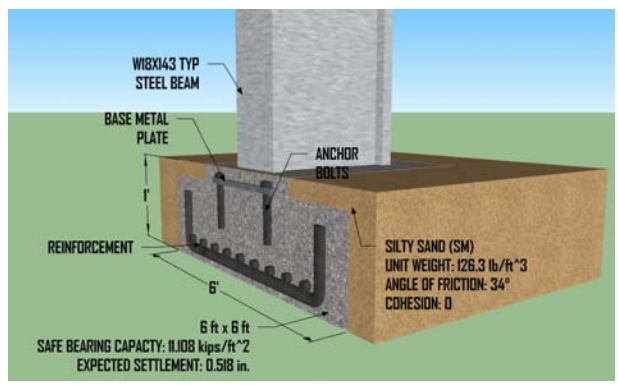
> *The foundations were designed to transfer the building loads from the columns and walls of the structure down to the footings.*

Bearing Capacity

One of these parameters is *bearing capacity*. Bearing capacity lets the engineers know whether the soil will be able to support the load applied to the soil. It is one of the most important parameters because if the soil cannot withstand the load then the structure will not be safe. By calculating the bearing capacity, the engineer can determine the size of the footings.

Settlement

Another important parameter is *settlement*. Settlement is the vertical displacement of soil. It can be caused by many factors, for example" when an increased amount of load is applied to the soil, when the soil shrinks or expands, etc.



Once the bearing capacity and settlement are checked, and the footings are sized, the geotechnical engineer will share their design of the foundation with the structural engineer. The structural engineer will design the steel reinforcement and can take any suggestions from the geotechnical engineer.

POTABLE WATER

Before the Elite Sports Center could host its first game, the engineers at UII sat around a table and discussed how the facility would be supplied with water for showers, restrooms, field irrigation, and emergency fire-fighting water.

The conservation of natural resources was high on the priority list. With so many outdoor fields, the water required for irrigation alone would be significant. To reduce the daily water consumption, artificial turf was chosen for some of the outdoor fields. While incurring a higher up-front cost, the money saved in monthly water bills made up the difference.

The final goal of water demand calculations is to find the volumetric flow in gallons per minute (gpm) that the site will use under different conditions.

But exactly how much water will the new site require? This information is critical in estimating the operational costs of the facility and in determing what type and size of water pipes to install on the site. Since this site will be tapping into the City of Fresno water network for its drinking water and fire water, the City needs to know what to expect the site to use. There are several practices that engineers use to determine what the possible water demand will be.

The final goal of water demand calculations is to find the volumetric flow in gallons per minute (gpm) that the site will use. The flowrate is dependent on how that water is used. For example, taking a shower will require more water than washing your hands, so the shower has a higher predicted flow than the sink. Each water-using feature has what is called a "fixture" that allows water from the system to be utilized for the given function. A shower fixture, sink fixture, and toilet fixture each have predictable flowrate values. These predicatble flow values can be used to estimate the *total flowrate* for the building – it just requires adding up all the different types of fixtures. Table 1 shows the number of fixtures from the main gymanisum and their corresponding flowrates.

The 267 gpm value from the table represents how much water the gymanisum would require if ALL the fixtures were run simultaneously. This is an unlikely occurrence for the sports complex and for most sites. Therefore, this is considered the worst-case scenario or *peak hour demand flowrate.* The peak hour demand is what the water demand is expected to be during the busiest hour on the busiest day. The *maximum day demand* is assumed to 1.5 times less than that and the *average day demand* is assumed to be 1.5 times less than the maximum day demand. Those three

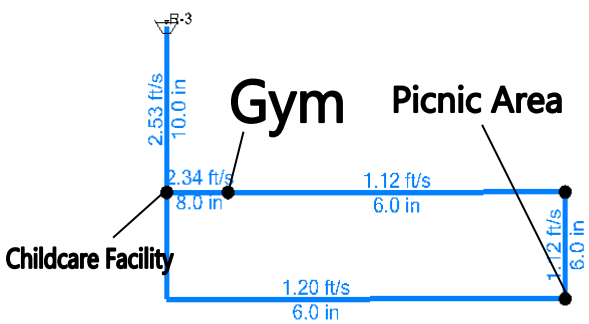
Gymnasium		
Fixture Type	Number	Instantaneous Design Flowrate (gpm)
Drinking Fountain	7	5
Showerhead (public)	20	62
Lavatory	10	35
Water Closet (public flush valve)	19	89
Urinal (public flush valve)	6	41
Hose Bib (1/2")	10	35
Total	**72**	**267**

conditions (peak hour, maximum day, and average day) are used to determine what size pipes the facility should use.

System Design

The City of Fresno Department of Public Works requires that pipes abide by certain criteria. This is to ensure safety, quality, and durability of the water system. The requirements include limitations on water velocity, pressure, and energy loss throughout the pipe. Water flowing through a pipe can lose energy due to the friction between the pipe wall and the water.

Computer software programs are used to model how the system will perform



Drinking water distribution system.

under the three conditions. The water system is drawn in the program and elevation and flowrate information is inputted. The pipe sizes are adjusted until all the City of Fresno requirements can be met.

Fire Water System

In case of fire, the site must have access to emergency fire water. The engineers at UII chose to design a storage tank to have an on-site fire water supply. A fire pump was designed to supply large quantites of water (up to 1500 gpm) to quickly and safely fight fires. Fire sprinkler systems were used in the childcare facility and gymnasium and fire hydrants were used throughout the site.

Irrigation Water System

The family picnic area features a 2-acre lawn. Since this is used for recreation, the engineers

at UII chose not to use turf like in the sports fields. Water used for irrigation purposes do not have to be treated to the same level as water for human consumption. Reclaimed water from a wastewater treatment plant can be used to water lawns. Since the Elite Sports Center site features a wastewater plant, the engineers at UII decided to reuse the treated wastewater to water the family picnic area. If this water was not reused on the site, it would have been discharged into the City's sewer system. This would have incurred a

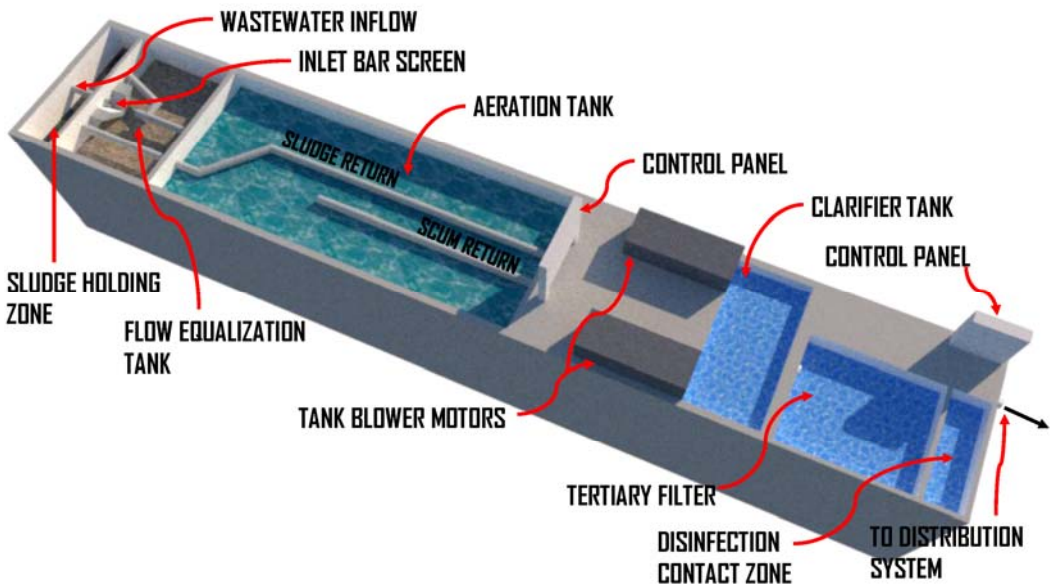
> *Reclaimed water from a wastewater treatment plant may be used for a variety of sources but NOT for human consumption.*

monthly fee. Choosing to reuse the water conserves resources and saves money.

WASTEWATER

So where will all the used water go? All the water draining from the toilets, sinks, and showers must be transported to a treatment facility. The wastewater flows through a sanitary sewer system designed by UII and into a package extended aeration wastewater treatment plant. It is crucial to develop an

adequate sanitary sewer system to carry the wastewater flow into an on-site package wastewater treatment plant. Various methods were used to determine how much sewage would enter the system and the treatment



plant. The sewage generation calculations were based on the calculated water demand (see above for water demand calculations). The sewer system was designed based on the average and peak hour flows generated during the expected operation hours.

Wastewater package treatment plant.

The wastewater flow will be carried to the package extended aeration wastewater treatment plant through a gravity sewer system. A pump station will be incorporated to pump the wastewater flow from the wet-well (holding chamber) into the storage and flow equalizer tank. A flow equalizer tank will be incorporated to deliver a constant flowrate into the package wastewater treatment plant. It is important to deliver a constant flowrate into the treatment plant to obtain high quality treated water. The treated water will be stored until distributed into the irrigation system.

The designed wet well will be used to decrease the dention time of the sewage to avoid septic action. The wet well was also designed large enough to avoid excessive starting and stopping of the lift pumps to optimize the operation of the system.

It is crucial to develop an adequate sanitary sewer system to carry the wastewater to the on-site package treatment plant.

STORM WATER

Water from indoor drains are not the only wastewater the new facility will generate. The stormwater drainage design is an important element for the new Fresno Elite Sports Center. Good design must strive to maintain compatibility and control flooding

of property, structures for design flood events; and minimize the potential environmental impacts on stormwater runoff.

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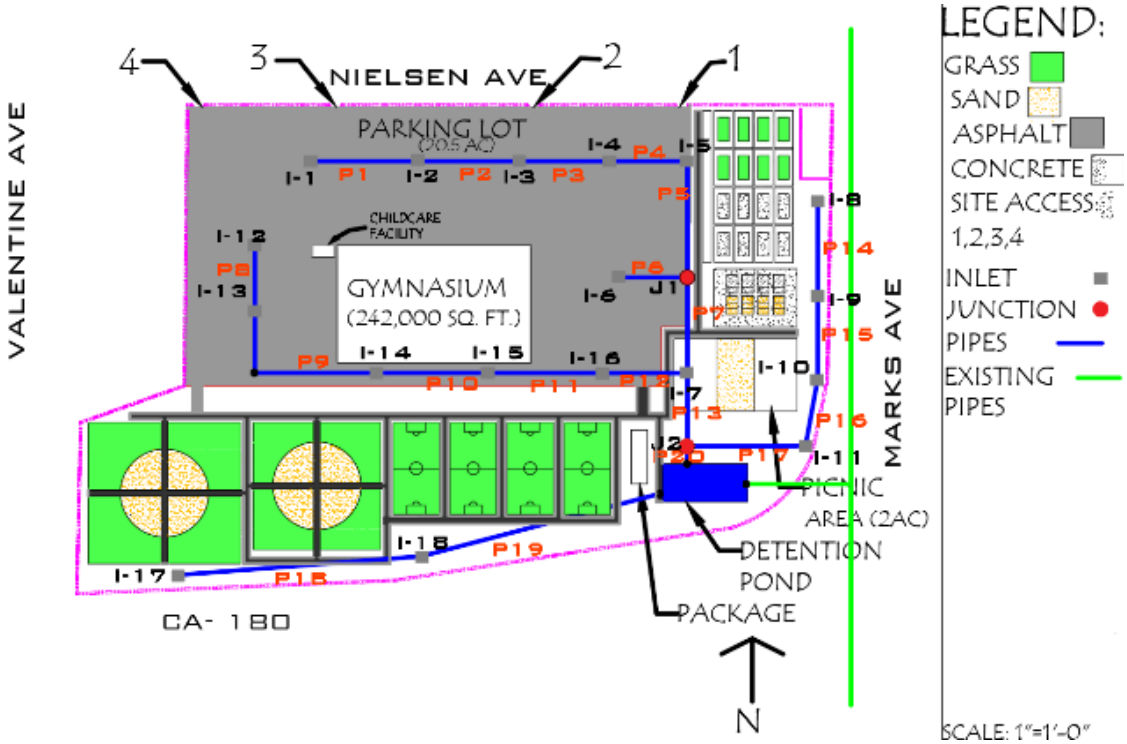


The stormwater design concludes the designing of the collection, conveyance, and the storage facility. Stormwater system design must provide adequate surface drainage while meeting the public safety requirements. The stormwater drainage was designed base on a 10 years storm event.

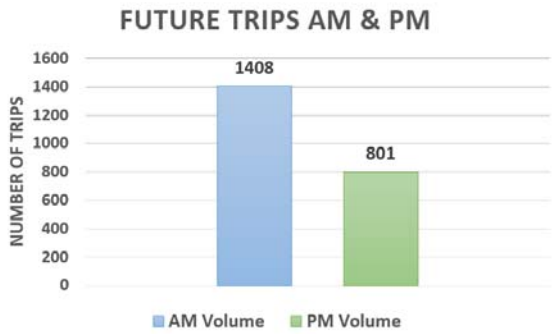
For the 10-year return period storm event, an Intensity Duration Frequency (IDF) curve was developed to determine the flow rate for both the pre-development and post-development conditions. Inlets will be distributed throughout the whole catchment and they should be located to maximize overland flow path. Various methods were used for the stormwater drainage design including Rational Method to determine the sizes. Multiples pipes will be incorporated to connect between inlets to convey the rainfall runoff and discharge to the destination such as on-site basin.

PARKING LOT

The internal transportation system of the Fresno Elite Sports Center is vital to the project. It provides an easy access to the site, enough parking space, has a smooth interior circulation and allows continuous flow of traffic. This transportation design of the Fresno Elite Sports Center's parking lot achieves convenience, sustainability, and design.

The initial step in defining the transportation system impact created by the site is to predict the demand, which is done by estimating the number of future trips entering and exiting

the site. This number was estimated by doing a special study for the traffic flow during the peak hours for both AM and PM. The estimation of peak hours was based on the



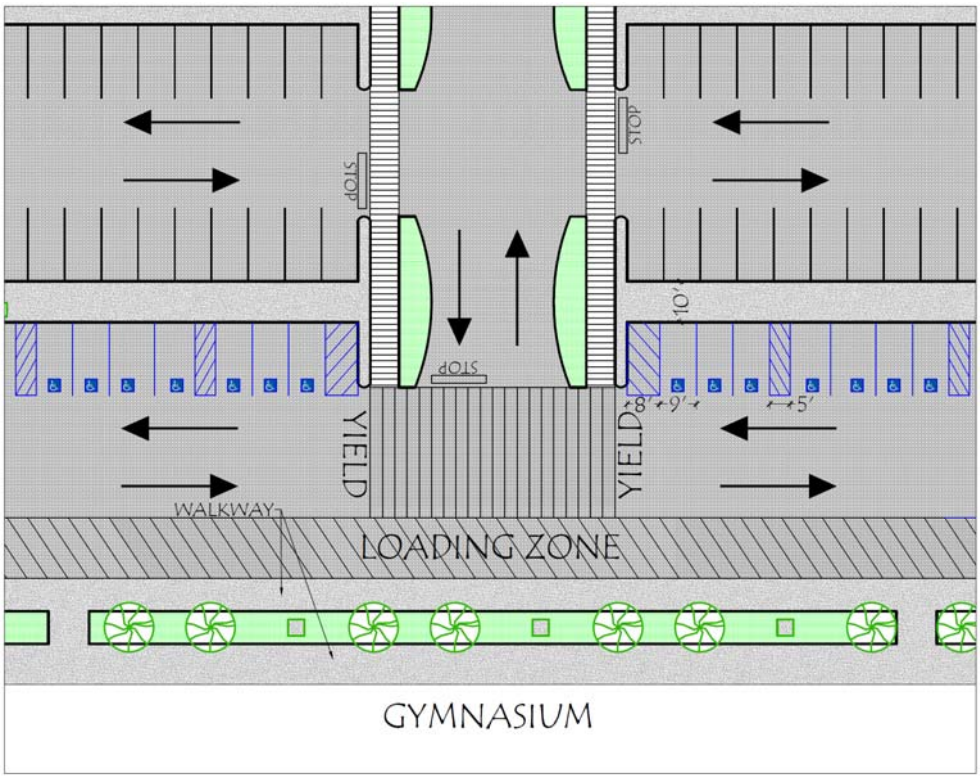
maximum number of events the site will host. As the parking lot of the sports center has two different facilities (indoor and outdoor), the site will have a high number of visits. The recorded number of future trips are 1408 for AM peak hours and 801 trips for PM peak hours during events.

The site also has five different driveways each 30' to regulate the flow of the traffic during the peak hours and for emergency conditions. This design of the driveways is based on the City of Fresno standard drawings. The parking stall design is based on the City of Fresno standards and measurements which is 18' for the length and 9' for the width. The parking lot has the capacity of 1600 parking stalls.

The design is as per the American Disability Act (ADA) requirements, with the standard number and size of parking stalls which is 27, among which 6 are for vans. Each van ADA stalls has an incorporated aisle of 8' to provide the full access. Also, the parking lot will include a separate parking space that is reserved for busses. Multiple spaces of bike parking are also available by the landscape of the site.

OFFSITE ROAD

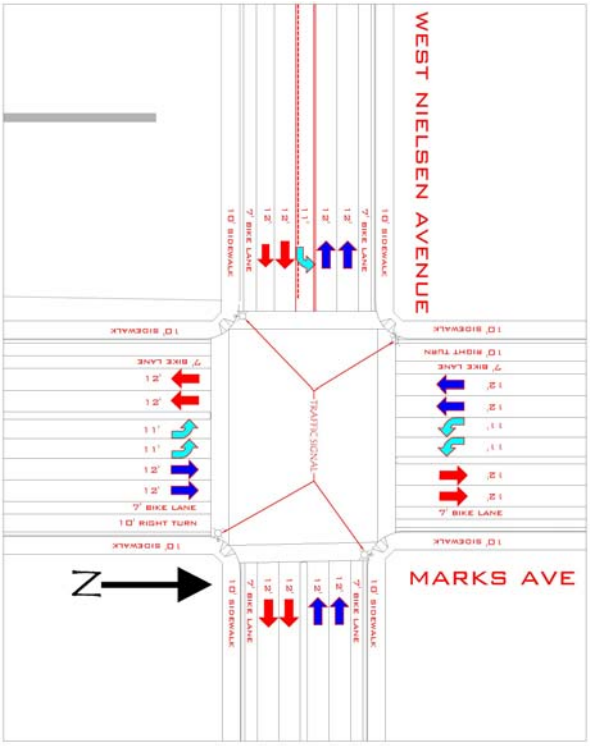
The design engineers are also concerned with the raods surrounding the site. Design of the intersection will assure that users of Fresno



Elite Sport Center will have minimum wait time when traveling through the intersection at Nielsen and Marks Ave. Currently on North Marks Avenue, there is a single left turn lane that leads onto West Nielsen Avenue. The Fresno Elite Sport Center is projected to attract AM Peak hour of 1408. Adding a left turn lane on Marks Avenue will help ease the traffic impact on the intersection. Also, an additional 12' wide lane will be added on West Nielsen Avenue to accommodate North Marks Avenue dual left turn lanes.

Currently the traffic control at the intersection is a four way stop. This traffic control will not be enough to move traffic along without causing vehicle delay. Adding traffic signals will help with movement of traffic and getting drivers to their desired destination.

With the modifications to the intersection complete, the roads around the site will better



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