APPENDIX E

Drainage and Water Quality Analysis for Barstow Casinos
Draft EIS/TEIR

Drainage and Water Quality Analysis

for

BARSTOW CASINOS

Draft Environmental Impact Statement/TEIR

Prepared for

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March 2007

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ALTERNATIVE 1 - TWO CASINOS ALTERNATIVE

INTRODUCTION

This section addresses site drainage and water quality issues associated with development of a tribal casino gaming facility just southwest of the City of Barstow in San Bernadino County. This development alternative consists of constructing two 49,000-square-foot casino and hotel complexes on the approximately 48 acres of Tribal Land on Lenwood Road. The proposed project is shown in **Figure 1-1**. The analysis includes: (a) a preliminary grading plan incorporating measures to eliminate or mitigate drainage and water quality impacts; (b) an assessment and comparison of pre-construction and post-construction runoff from the site; (c) a determination of appropriate means for collection and safe conveyance of storm runoff from the parking areas, buildings and site landscaping under the proposed project plans; (d) assessment of floodplain impacts; and (e) recommended erosion, sedimentation control, and pollution prevention measures.

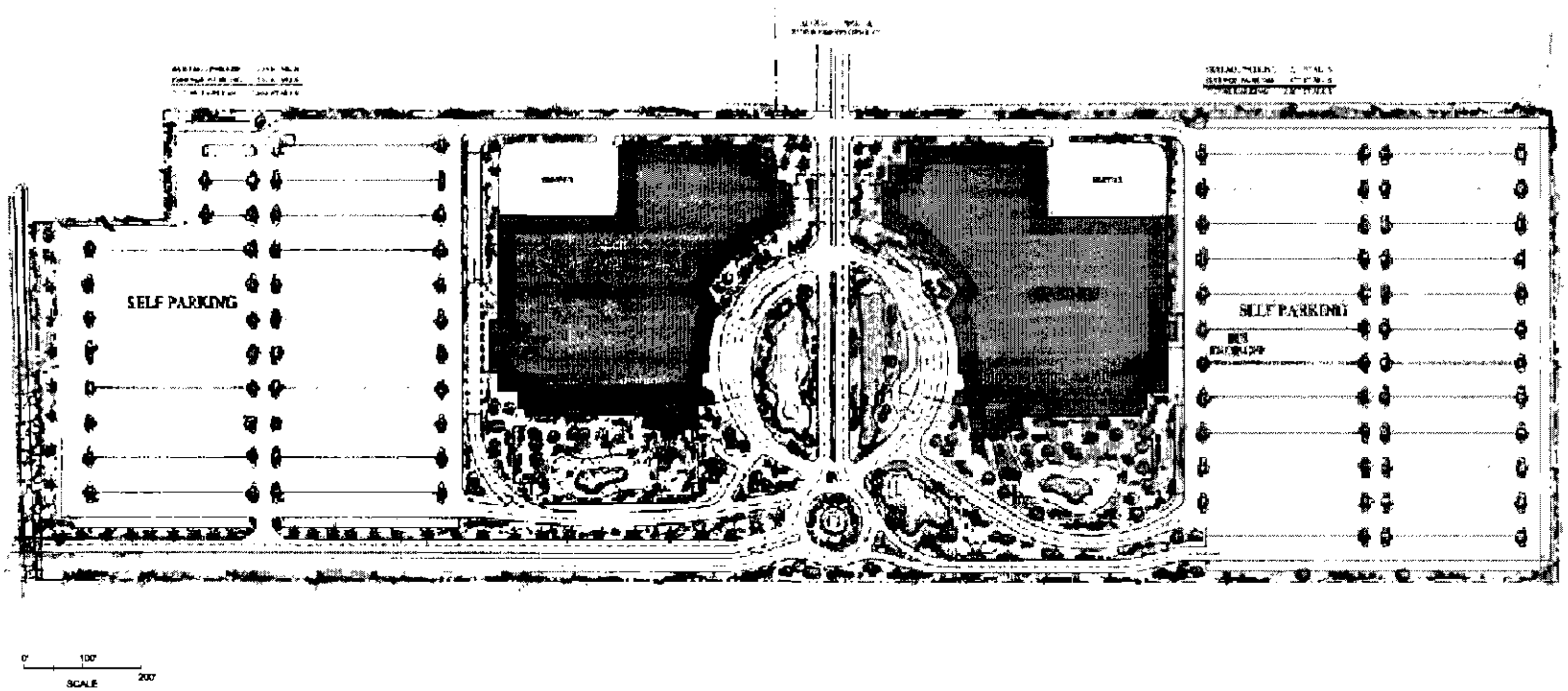
EXISTING CONDITIONS

Regional Hydrological Setting

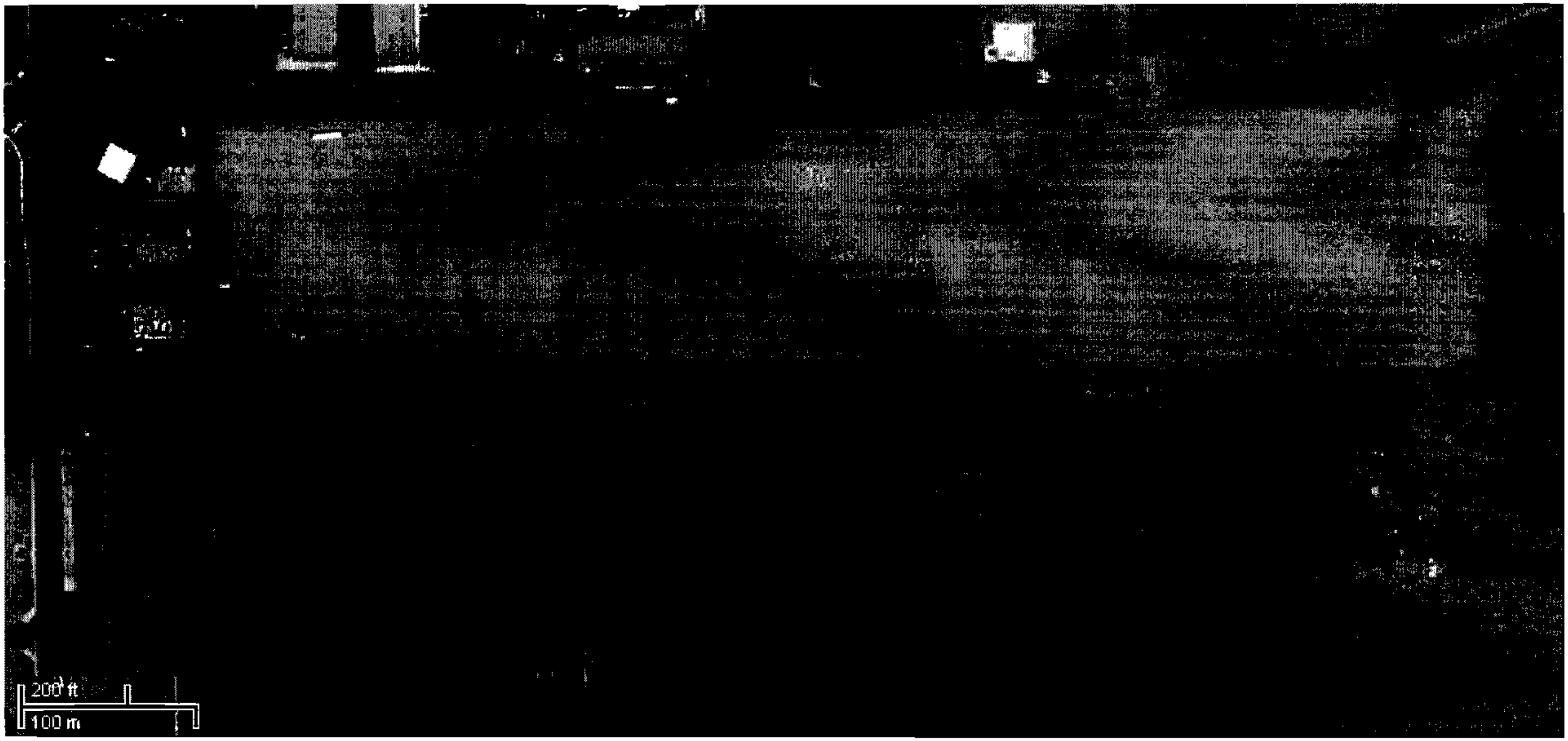
The project site is a 48-acre parcel located within the incorporated boundaries of the City of Barstow, San Bernadino County, California on Lenwood Road. (**Figure 1-2**). The site is bordered by Lenwood Road on the west, commercial/light industrial development on the north, and vacant land to the east and south.

The project site is located within the South Lahontan Watershed Basin, approximately 4 to 5 miles from the Mojave River. The project site is located on gently sloping (3 to 5%) land at elevations ranging from approximately 2,390 feet above mean sea level (msl) to 2,470 feet msl. The topography to the east of the project site rises to elevations nearing 3,000 feet, with average slopes of 10 to 25%. The tributary watershed for the project site has an area of approximately 0.35 square miles (221 acres) extending to the east about 2 miles, with elevations reaching as high as 3,000 feet above sea level.

The predominant vegetation over the project site is desert sage with limited amounts of grasses. Vehicular routes and paths crisscross the site through the sand and a main unpaved road runs from west to east on the property. According to the USGS quadrangle map and the topographic survey, in the past there have been structures at the eastern end of the property along with a well. A site visit in June of 2006 found no evidence of any structures, although the concrete well pad was still present. The property to the north is occupied by commercial and light industrial development including predominantly the Factory Merchants outlet store complex and fast-food restaurants. The vacant land to the south and east is loosely vegetated with desert sagebrush. Across Lenwood Road to the west is the Tanger Outlets complex and associated buildings and parking lots.



BARSTOW CASINOS DRAFT ENVIRONMENTAL IMPACT STATEMENT	QUESTA Civil Environmental & Water Resources P.O. Box 70356 1220 Brickyard Cove Road Point Richmond, CA 94807	Design: CHN Drawn: CHN Checked: NNH Approved: NNH	PROPOSED SITE PLAN BARSTOW, CALIFORNIA	Size: D Project No.: 260044 Rev: 0	Scale: PER PLAN Date: 3/16/2007	Figure: 1-1



SOURCE: Google Aerial Photograph, http://maps.google.com, accessed 3/14/2007, Questa Engineering Corporation

DATE:	3/14/2007
PROJECT:	Barstow Casinos
PROJECT NO.:	260044
DRAWN:	TH
APPROVED:	NH

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ALTERNATIVE 1 & 2
EXISTING SITE

FIGURE
1-2

Rainfall in the area is typical for desert regions with low average annual precipitation occurring between November and April, and occasional summer thunderstorms from July to September. Annual rainfall ranges from 4 to 11 inches, with an annual average of about 6 inches.

Project Site Conditions

The existing site is shown in **Figure 1-3**. The project site slopes gently to the west at a gradient of between 3 and 6 percent and converges toward a drainage channel running westerly. The drainage channel ends approximately 500 feet from the western property line whereupon the flow passes across a rip-rap outfall and then percolates into the soil. Drainage across the property is generally sheet flow with a convergence toward the northwest corner of the property. The site does not appear to have undergone previous grading; however, an abrupt change in elevation at the adjacent vacant parcel to the north implies that the adjacent former property was raised and leveled.

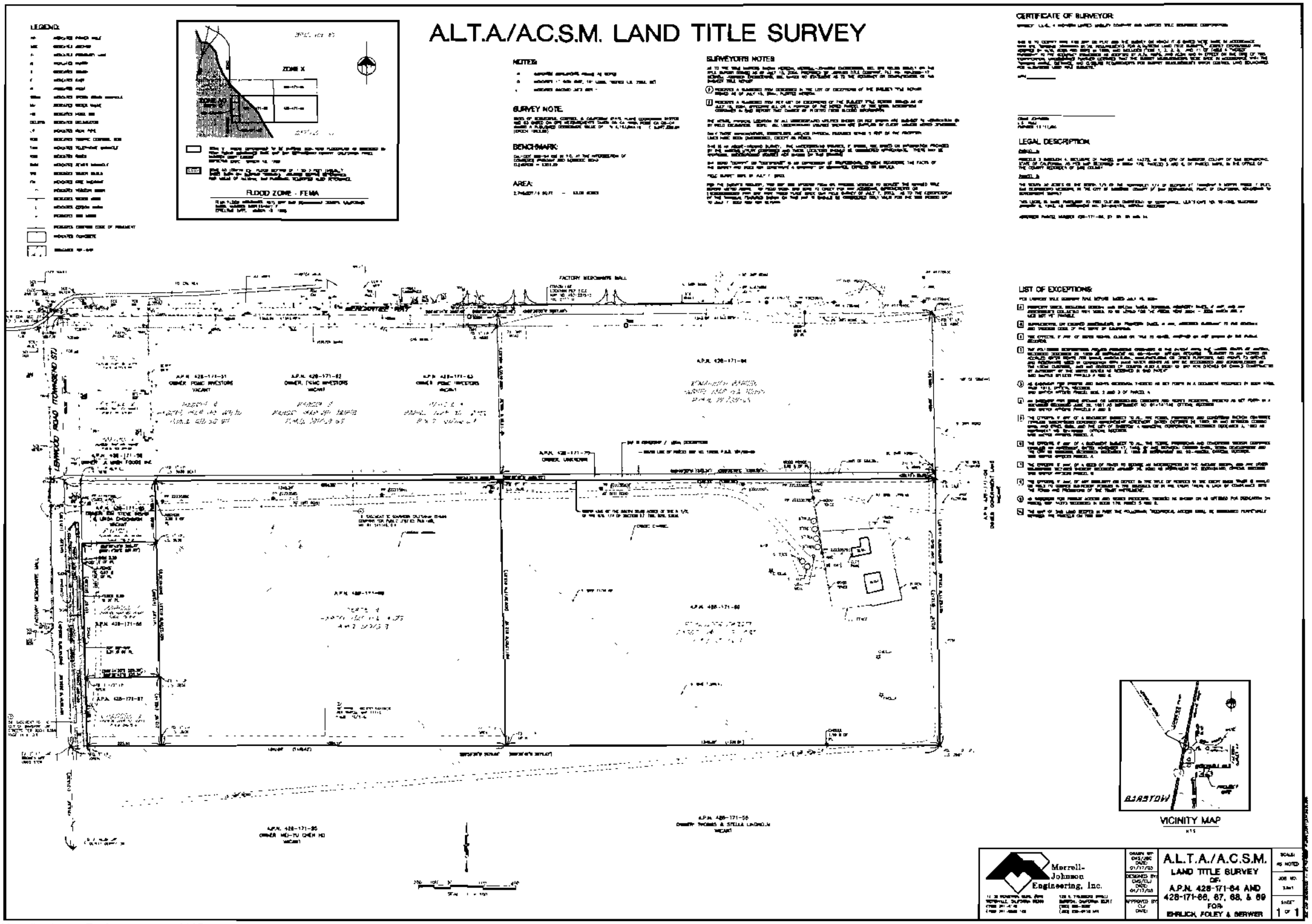
With the exception of the now-gone residential structures on the eastern end of the property the site has remained largely vacant and undeveloped. A well was dug to serve these two buildings and the concrete well pad is still present. A drainage culvert and ditch was constructed to channel water through the site although it ends before reaching the existing off-site concrete drainage ditch along Lenwood Road.

The lands surrounding the project site are of similar vegetation and slope--sparse desert sage and mild slopes of 3 to 6 percent. There is no evidence of grading operations or development to the east or south; the property to the north appears to have been raised and leveled above that of the subject property.

Lenwood Road is four-lane north-south road. Along this road and off-site is a southerly flowing drainage ditch. The ditch is concrete with a trapezoidal section for approximately 200 feet and then passes over a rock-protected section and then onto an earthen drainage ditch. Approximately 150 feet south of the southerly end of the concrete drainage ditch the ditch has a low spot from where it flows west under Lenwood Road through corrugated metal pipe culverts. The concrete section of the drainage ditch is a trapezoidal section approximately twenty feet wide at the top, ten feet wide at the bottom, and five to seven feet deep. Currently, sheet and concentrated flows exit the parcel into the drainage ditch at the northwest corner of the property.

PROPOSED DRAINAGE PLAN

The proposed project involves the construction of a gaming facility and associated infrastructure, including on-site water supply and wastewater treatment/disposal facilities, driveway and parking areas, building, landscaping and drainage facilities. The development of the project will alter the drainage characteristics of the site through the construction of impervious surfaces (e.g., buildings and paved road/parking area). Shown in **Figure 1-4** and described below is the proposed drainage plan for the project. The drainage plan was developed to ensure proper integration of stormwater runoff and water quality control measures into the overall site development plan for the project.



SOURCE: Merrell-Johnson Engineering, Inc., 2005

DATE:	3/15/2007
PROJECT:	Barstow Casinos
PROJECT NO.:	260044
DRAWN:	TH
APPROVED:	NH

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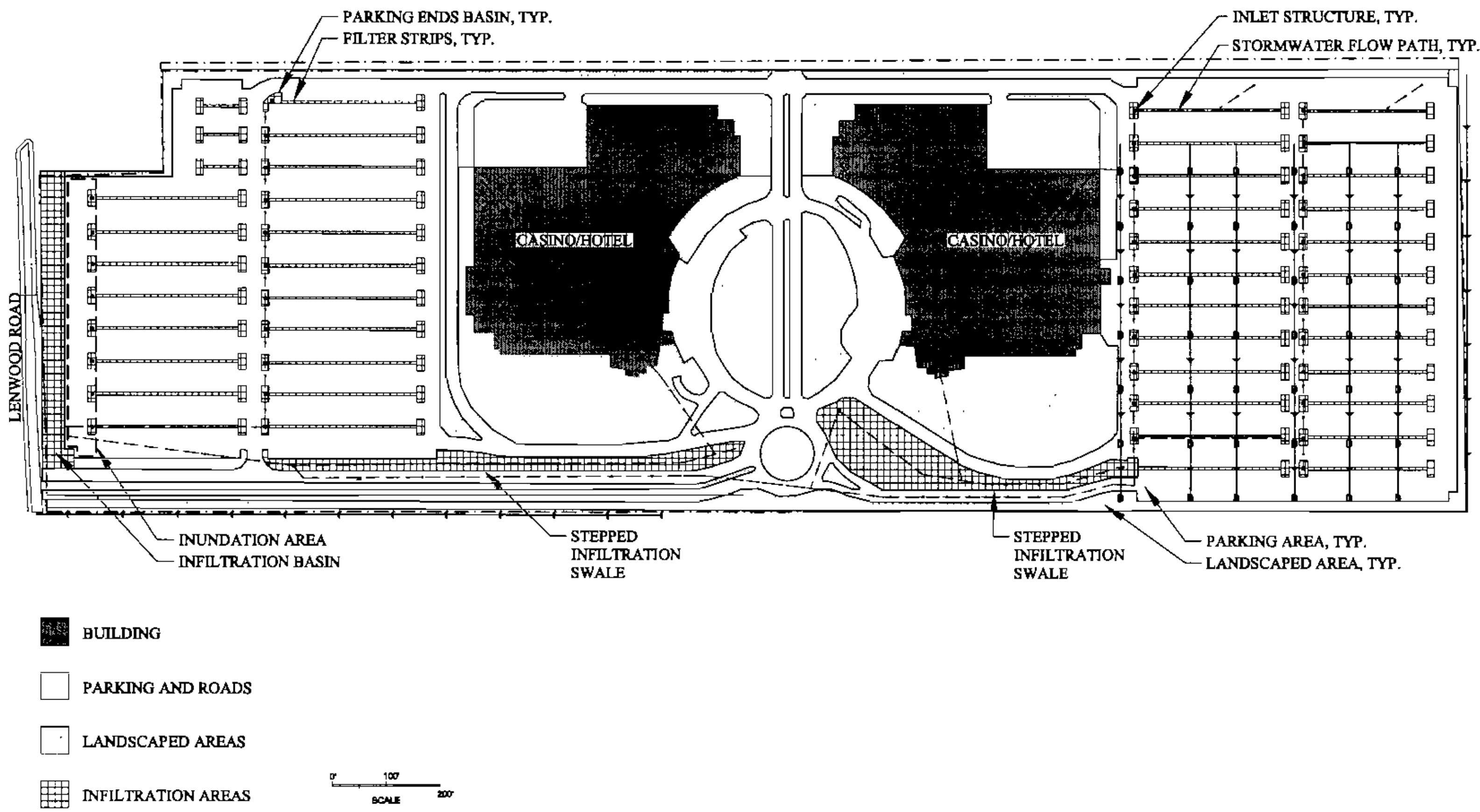
ALTA SURVEY

FIGURE

1-3



BARSTOW CASINOS
DRAFT ENVIRONMENTAL IMPACT STATEMENT

QUESTA Civil Environmental & Water Resources
P.O. Box 70356 1220 Brickyard Cove Road
Point Richmond, CA 94807

Design: CHN	Drawn: CHN	Checked: NNH	Apprd: NNH

FULL ALTERNATIVE
GRADING AND DRAINAGE PLAN
BARSTOW, CALIFORNIA

Size	Project No.	Rev.
D	260044	0
Scale: PER PLAN		
Date: 3/16/2007		
Figure: 1-4		

With respect to stormwater and runoff, the proposed site plan is comprised of four areas: buildings, parking and roads, landscaped areas, and infiltration areas. Buildings and parking and roads constitute impervious surfaces and, under the parameters of the model, completely shed stormwater. Landscaped areas allow for short-term storage of stormwater and infiltration. Infiltration areas consist of gravel or landscaped basins that allow for storage of stormwater, and infiltration of stormwater into the ground below via surface percolation and deep-well infiltration.

Stormwater on the site is generally routed according to the following:

- Stormwater runoff from parking lots sheet flows into gutters and thence into Gravel Parking Strips and Parking Ends Basins.
- Overflow from the Gravel Parking Strips and Parking Ends Basins is conveyed via underground pipes to Infiltration Basins.
- Roof rainwater will flow through downspouts into landscaped areas.
- Excess stormwater in infiltration areas and landscaped areas overflows into subsequent infiltration areas including the retention basin along the western property line.
- The water level in retention basin along the western property line will first overflow onto the parking area Inundation Area. An additional overflow for the retention basin allows water to flow into the Lenwood Wash.

A description of these features is:

Parking Filter Strips. Five-foot wide gravel strips between parking aisles will collect stormwater runoff from the parking lots and convey stormwater to the parking ends while providing both filtration of stormwater, surface area for infiltration, and decreased runoff velocity. The strips are filled with loose gravel or cobble with a subsurface pipe to ensure positive flow to the Parking Ends Basins.

Parking Ends Basins. At the end of each parking row, gravel basins will be used to infiltrate stormwater into the ground. These basins collect stormwater from the parking areas via sheet flow and from the Parking Filter Strips. An outlet pipe conveys excess stormwater from these basins to the Infiltration Basins. One method of increasing concentration time, and thereby reducing peak runoff rates and total storage requirements is to hydraulically restrict the grates and conveyance piping from the parking lot stormwater collection system. This results in localized storage/flooding in the parking lots, which may present an aesthetic concern. Stormwater storage over parking areas need to take into account increased pollutant concentrations and supplemental filtration may be required.

Landscape Areas. The mitigated site plan and stormwater mitigation measures rely on the ability of landscaped areas to accept stormwater for infiltration and detention. The infiltration capacity of these areas is not as high as that of the infiltration areas, but still allows for sufficient permeability based on desert landscaping without impermeable weed barriers. The hydrological model assumes surface conditions and permeability rates consistent with desert landscaping but two specific areas, as shown in the plan, are specifically designed to increase infiltration and slow runoff. These areas would be designed as stepped swales with local slopes not exceeding 3%.

Infiltration Basins. As shown on the plan, some areas will be landscaped with drought tolerant plants and be covered with high permeability cover such as rock or gravel so as to provide infiltration and storage capacity for stormwater. Plantings in these areas will be limited to species that are tolerant of periodic inundation and aesthetic features should be chosen giving consideration to a variable water level. The main infiltration basin used in the current hydrologic model is the area along the western property line as shown in the figure. The area is approximately 500 feet long and 30 feet wide and makes up the majority of the frontage along Lenwood Road. This area does not necessarily need to be contiguous and could be broken up into multiple areas. Installing percolation wells in the basin could be used to increase the overall rate of percolation, and placement of rock riprap with sufficient voids spaces could be used to reduce the apparent depth of the basin.

Inundation Area. An additional storage area is the western and most-downhill portion of the parking lot. If the water level in the infiltration basin rises sufficiently, the water may be allowed to flood the western edge of the parking lot. Assuming an average slope of 5% and a maximum rise of water to 0 inches at the first parking stall, this could accommodate an additional 0.9 acre-feet of storage. If the water level reached the first parking stall an overflow could be provided that allows outfall to the Lenwood Wash. Stormwater storage over parking areas need to take into account increased pollutant concentrations and supplemental filtration may be required.

STORMWATER QUALITY MANAGEMENT

The proposed development will increase the pollutant loading of stormwater runoff primarily through contribution of silts, soils and grease from the proposed parking lots. **Appendix A** identifies several Best Management Practices (BMPs) that should be implemented to mitigate potential impacts from the proposed development. Additionally, the proposed site plan includes specific measures intended to reduce pollutant loading and mitigate this potential impact, including:

Stormwater Interceptors. Several buried stormwater interceptors will be installed at selected locations in the storm drainage system for trapping and collection of silt, oils/greases and other floating debris. Stormwater interceptors (also referred to as oil/water separators) are an identified Best Management Practice for stormwater management, used in situations where high concentrations of oils and grease are expected (e.g., parking lots) or in environmentally sensitive areas. They are included in the proposed stormwater system plan for this project to provide additional protection from accidental spillage or debris build-up in the parking lot. Three or four interceptors will be included in the storm drain system, the sizing and design of which will be determined at the time of final drainage system design.

Parking Filter Strips/Parking Ends Basins/Landscape Areas/Infiltration Basins. In addition to their effect on peak stormwater runoff volumes and detention, these areas provide stormwater quality benefits. The reduction in stormwater velocity results in deposition of silts and larger debris, which can be removed through regular maintenance. The infiltration of stormwater through the gravel and permeable soil will provide onsite filtration and retention of silts and pollutants.

PROJECT RUNOFF ANALYSIS

The proposed project will increase the runoff characteristics of the site by increasing the amount of impervious surfaces (i.e., paved roadways, parking areas, buildings). All of the improvements will contribute to a higher rate of runoff as compared with pre-development conditions. The project runoff analysis presented here addresses the effect mitigation of the impact on stormwater runoff from the developed site due to development. Stormwater from offsite will be routed around the developed site directly to the existing drainage channel along Lenwood Road.

The design approach for mitigating the stormwater impacts is to limit the stormwater peak flow to the pre-development condition and provide filtration methods that remove pollutants and sediment. The 10-year and 100-year, 1-hour storms are the design scenarios used for this analysis. The following tables show the design stormwater runoffs for the existing condition and proposed mitigated condition for the 10-year and 100-year 1-hour storms. The analysis was conducted according to the San Bernadino County Hydrology Manual Rational Method.

The San Bernadino County Hydrology Manual gives the rainfall intensities shown in **Table 1-1** for the design storms at the subject property.

Table 1-1: Rainfall Intensity

Duration	10 Year	100 Year
1 Hour	0.75"	1.2"

Existing Site Analysis

The existing approximately 48-acre site is comprised entirely of natural desert. Stormwater runoff from the existing site will generally flow by sheet and in local channels. For the purposes of the preliminary analysis the existing site is broken up into three distinct flow path segments. **Table 1-2** shows the resulting time of concentration for the existing site using Manning's formula for channelized flow and assuming "poor cover" for overland flow segments L1 and L3. Segment L2 assumes a trapezoidal section with the time of concentration based on Manning's equation with a velocity of 6.3 feet per second.

Rainfall intensity is dependent on Tc and determined from the Hydrology Manual Table 6-3 using a log-log slope of 0.7 for desert areas.

Table 1-2: Time of Concentration

Segment	Length (ft)	Height (ft)	Tc (min)	I (in/hr) 10 year	I (in/hr) 100 year	Comments
L1	510	25	11.75			Using nomograph
L2	1665	45	4.4			Using manning's equation
L3	340	5	13			Using nomograph
		Total	29.1	1.25	2	

Runoff Coefficient
The proportion of stormwater, described by the runoff coefficient, that flows as runoff is determined by the soil type and the Antecedent Moisture Condition (AMC). The AMC takes into account soil saturation from prior rainfall events. The Hydrology Manual assigns AMC I to the 10-year storm, and AMC III to the 100-year storm. The CN value given in the manual are based on an AMC II. Infiltration rate, $\mathbf{F_p}$, is a measure of the infiltration capacity of the soil.

Based on Figure C-6 from the Hydrology Manual, the infiltration rates adjusted for AMC are shown in **Table 1-3**.

Table 1-3: Infiltration Rate, F_p

	F_p	
AMC I	0.88"	For 10 year storm
AMC II	0.66"	
AMC III	0.34"	For 100 year storm

The runoff coefficient, C, is determined according to the following:

$C = 0.9(a_i + \frac{(I - F_p) * a_p}{I})$, for I greater than F_p.

$C = 0.9a_i$, for I less than or equal to F_p.

$a_i = 0$ (no impervious area)

$a_p = 1$

Design Flows
Determine the design runoff, Q = CIA for the design storms.

Table 1-4: Design Flows for Existing Site

Storm	A (acres)	I (in/hr)	Fp (in)	C	Q (cfs)
10 year	49	1.2	0.88	0.27	16.3
100 year	49	2.0	0.34	0.75	98.0

Proposed Site Analysis

The proposed surface conditions for the developed site are described in the drainage plan and shown below in **Table 1-5**.

Table 1-5: Land Use for Proposed Site

Area Description	Area	
	Acres	Percentage
Buildings	7.62	16%
Parking and Roads	26.37	55%
Landscape*	7.54	16%
Infiltration**	6.42	13%

* Assumes natural desert style landscaping without impermeable membranes.

** Assumes gravel swales with drought-tolerant ground cover ("good desert shrub").

Runoff Coefficient

For Subarea 1 and 3 no infiltration is assumed through the paving and roads. Therefore,
C = 0.9

For Subarea 2 (buildings and landscaping) some amount of rainfall will infiltrate. The 10-year storm uses antecedent moisture condition I (AMC I), while the 100-year storm uses AMC III. The CN value is based on an AMC II. The AMC takes into account soil saturation from prior rainfall events.

The average Fp value for the pervious areas is:

10-year storm

Fp-ave = (7.54 acres * 0.58" + 6.42 acres * 0.75")/(7.54 acres + 6.42 acres)
= 0.66"

100-year storm

Fp-ave = (7.54 acres * 0.145" + 6.42 acres * 0.265")/(7.54 acres + 6.42 acres)
= 0.20"

Table 1-6: Subarea 2 Use Distribution

Land Use	A (acres)	A (%)
Buildings	7.62	35.3
Landscaped	7.54	34.9
Infiltration	6.42	29.7

$C = 0.9(a_i + \frac{(I - F_p) * a_p}{I})$, for I greater than F_p.

$a_i = 0.353$ (Buildings)

$a_p = 34.9\% + 29.7\% = 0.647$ (Landscaped and Infiltration areas)

Design Flows

The design runoff, Q = CIA for the design storms are shown in **Table 1-7**.

Table 1-7: Proposed Site Design Flows

Storm	Segment	A (acres)	Tc	I (in)	Fp (in)	C	Q (cfs)
10 year	1	13.2	6.9	3.5	0	0.9	41.6
	2	21.6	5.0	4.4	0.66"	0.81	77.2
	3	13.2	6.9	3.5	0	0.9	41.6
							160
100 year	1	13.2	6.9	5.5	0	0.9	65.3
	2	21.6	5.0	7.0	0.2"	0.88	133.1
	3	13.2	6.9	5.5	0	0.9	65.3
							264

Storage Requirements

Based on the design intent of limiting peak post-development flows to the existing flow conditions, onsite storage will be required to detain stormwater runoff. **Table 1-8** shows the design storage volumes required for the design storms. This volume assumes that the rising and falling legs of the triangular hydrograph have the same time interval.

Table 1-8: Proposed Site Design Flows and Storage

Storm	Peak Runoff (cfs)		Storage (acre-feet)
	Pre-Development	Post-Development	
10 year	16	160	1.2
100 year	98	264	1.0

Review of the results shown in **Table 1-8** shows that without the incorporation of detention measures, the proposed project would cause significant increases in runoff rates and total runoff volume compared with that under pre-development conditions. Consequently, runoff detention mitigation measures are essential if the peak runoff is to be limited.

These storage volumes can be accommodated onsite using the current site plan configuration. The infiltration basin on the western property line is of sufficient area to accommodate storage of peak flows. One possible configuration of the infiltration basin would be for the approximately 500 feet of frontage to be 30 feet wide and form a triangular channel 7 feet deep at the center. Rip-rap or cobbles in the bottom of the basin could reduce the apparent depth of the infiltration basin by using the voids space as storage. Percolation wells installed at regular intervals along the length of the basin would provide additional storage and increase percolation.

OFFSITE STORMWATER RUNON ANALYSIS

Stormwater from offsite will be collected at the eastern and northern property lines in either intercept ditches or subsurface piping. The land that contributes to offsite flow consists primarily of approximately 100 acres of natural desert but also includes the developed commercial areas to the north. The length of the drainage is approximately 7000 feet to the eastern property line with slopes along this drainage ranging from 5% to 10%. Flows from this watershed could be diverted to Lenwood Wash through a series of 36-inch pipes, or the hydraulic equivalent, around the perimeter of the site. According to Mike Stewart of the City of Barstow Public Works Department, such diversion is within standard practice for the Barstow Area.

ASSESSMENT OF FLOOD PLAIN IMPACTS

FEMA Flood Zone Map

The project site is located within two flood zone types: Zone A0, and Zone X. The FEMA description of these areas is:

> ZONE X: Areas determined to be outside 500-year floodplain as indicated by FEMA flood Insurance Rate Map San Bernadino County, California Panel Number 06071c3938F
>
> ZONE A0 (Depth 2): Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined for areas of alluvial fan flooding, velocities also determined.

The western property line and a total of about 10.5 acres of the site are within Zone A0 with flooding depths of one to three feet. Those areas that are within the area of potential flooding are comprised entirely of parking areas, roads, and stormwater detention and retention facilities. Although a flooding of this area would make access to the site restricted due to potential ponding at the entrance to the site, there would be no impedance of the floodway and minimal flooding risk to the proposed buildings.

The remaining 37.5 acres is within Zone X, which is outside of the 500-year floodplain and thus does not pose a significant flooding risk.

SUMMARY AND CONCLUSIONS

The conversion of the site from native desert scrubland to a casino and hotel development with associated paved parking areas, roads, and landscaping will reduce the available area for infiltration of rainfall and increase the total runoff into Lenwood Wash and downstream into the Mojave River. To mitigate these runoff effects, the drainage plan developed for the project to incorporate stormwater detention measures that include a series of gravel parking filter strips and infiltration-detention swales integrated into the parking area. Hydrologic analysis of the project shows that the proposed stormwater detention measures, totaling approximately 1.2 acre-feet of detention volume, will reduce the peak runoff from the site to levels equal to or less than those under pre-development conditions for flows up to the 100-year, 24-hour storm event.

Stormwater quality impacts, which include increase pollutant and silt loading in runoff, should be mitigated by onsite mitigation measures. Available mitigation measures include velocity reduction features, such as swales and basins, and physical filtration through soil or in stormdrain filters.

ALTERNATIVE 2 - REDUCED INTENSITY ALTERNATIVE

INTRODUCTION

This section addresses site drainage and water quality issues associated with development of a reduced intensity version of the Alternative 1 casino project. The project site consists of the western half of the project site described in Alternative 1 and consists of a single 49,000-square-foot gaming casino and hotel complex on about 24.6 acres of Tribal Land on Lenwood Road. The proposed project is shown in **Figure 2-1**. The analysis includes: (a) a preliminary grading plan incorporating measures to eliminate or mitigate drainage and water quality impacts; (b) an assessment and comparison of pre-construction and post-construction runoff from the site; (c) a determination of appropriate means for collection and safe conveyance of storm runoff from the parking areas, buildings and site landscaping under the proposed project plans; (d) assessment of floodplain impacts, and (e) recommended erosion, sedimentation control, and pollution prevention measures.

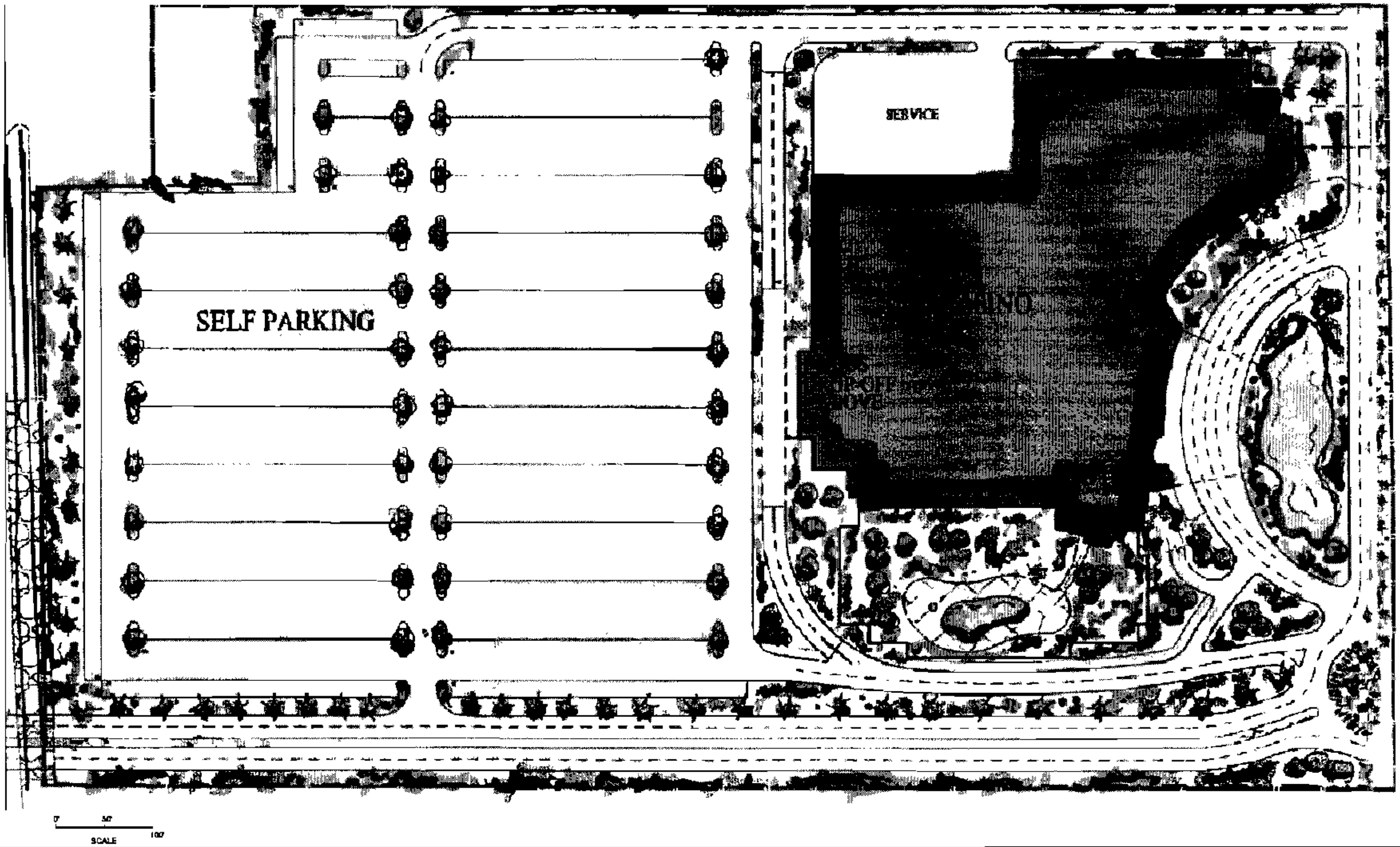
PROPOSED DRAINAGE PLAN

The proposed project involves the construction of a gaming facility and associated infrastructure, including on-site water supply and wastewater treatment/disposal facilities, driveway and parking areas, building, landscaping and drainage facilities. The development of the project will alter the drainage characteristics of the site through the construction of impervious surfaces (e.g., buildings and paved road/parking area). Shown in **Figure 2-2** and described below is the proposed drainage plan for the project. The drainage plan was developed to ensure proper integration of stormwater runoff and water quality control measures into the overall site development plan for the project.

With respect to stormwater and runoff, the proposed site plan is comprised of four areas: buildings, parking and roads, landscaped areas, and infiltration areas. Buildings and parking and roads constitute impervious surfaces and, under the parameters of the model, completely shed stormwater. Landscaped areas allow for short-term storage of stormwater and infiltration. Infiltration areas consist of gravel or landscaped basins that allow for storage of stormwater, and infiltration of stormwater into the ground below via surface percolation and deep-well infiltration.

Stormwater on the site is generally routed according to the following:

- Stormwater runoff from parking lots sheet flows into gutters and thence into Gravel Parking Strips and Parking Ends Basins.
- Overflow from the Gravel Parking Strips and Parking Ends Basins is conveyed via underground pipes to Infiltration Basins.
- Roof rainwater will flow through downspouts into landscaped areas.
- Excess stormwater in infiltration areas and landscaped areas overflows into subsequent infiltration areas including the retention basin along the western property line.
- The water level in retention basin along the western property line will first overflow onto the parking area Inundation Area. An additional overflow for the retention basin allows



BARSTOW CASINOS

DRAFT ENVIRONMENTAL IMPACT STATEMENT

QUESTA
Civil
Environmental
& Water Resources
P.O. Box 70356 1220 Brickyard Cove Road
Point Richmond, CA 94807

Std.	Rev.	Date:	By:	Description:	App'd:

Design: CHN
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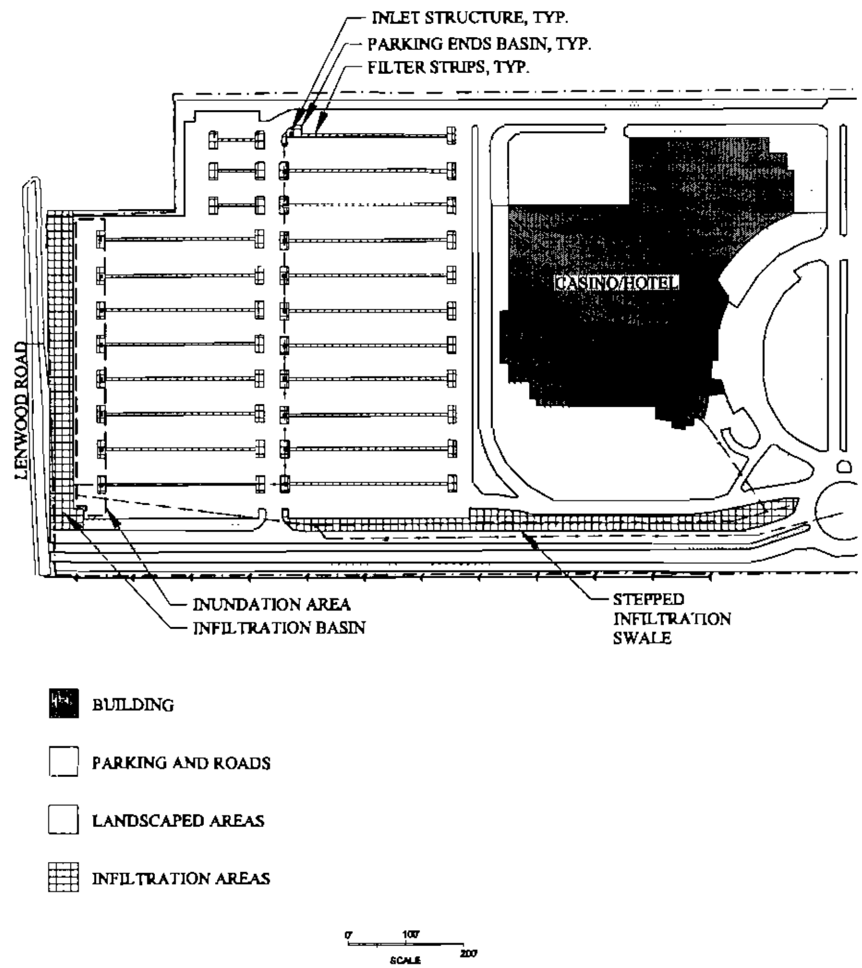
Checked: NNH
App'd: NNH

PROPOSED SITE PLAN

BARSTOW, CALIFORNIA

Size: D
Project No. 260044
Rev. 0
Scale: PER PLAN
Date: 3.16.2007
Figure: 2-1



BARSTOW CASINOS

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Civil Environmental & Water Resources
P.O. Box 70356 1220 Brickyard Cove Road
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Rev.	Date:	By:	Description:	App'd:

Design: CHN
Drawn: CHN
Checked: NNH
App'd: NNH

REDUCED ALTERNATIVE GRADING AND DRAINAGE PLAN

BARSTOW, CALIFORNIA

Size: D
Project No.: 250044
Rev.: 0
Scale: PER PLAN
Date: 3/16/2007
Figure: 2-2

water to flow into the Lenwood Wash.

A description of these features is:

Parking Filter Strips. Five-foot wide gravel strips between parking aisles will collect stormwater runoff from the parking lots and convey stormwater to the parking ends while providing both filtration of stormwater, surface area for infiltration, and decreased runoff velocity. The strips are filled with loose gravel or cobble with a subsurface pipe to ensure positive flow to the Parking Ends Basins.

Parking Ends Basins. At the end of each parking row, gravel basins will be used to infiltrate stormwater into the ground. These basins collect stormwater from the parking areas via sheet flow and from the Parking Filter Strips. An outlet pipe conveys excess stormwater from these basins to the Infiltration Basins. One method of increasing concentration time, and thereby reducing peak runoff rates and total storage requirements is to hydraulically restrict the grates and conveyance piping from the parking lot stormwater collection system. This results in localized storage/flooding in the parking lots, which may present an aesthetic concern. Stormwater storage over parking areas need to take into account increased pollutant concentrations and supplemental filtration may be required.

Landscape Areas. The mitigated site plan and stormwater mitigation measures rely on the ability of landscaped areas to accept stormwater for infiltration and detention. The infiltration capacity of these areas is not as high as that of the infiltration areas, but still allows for sufficient permeability based on desert landscaping without impermeable weed barriers. The hydrological model assumes surface conditions and permeability rates consistent with desert landscaping but two specific areas, as shown in the plan, are specifically designed to increase infiltration and slow runoff. These areas would be designed as stepped swales with local slopes not exceeding 3%.

Infiltration Basins. As shown on the plan, some areas will be landscaped with drought tolerant plants and be covered with high permeability cover such as rock or gravel so as to provide infiltration and storage capacity for stormwater. Plantings in these areas will be limited to species that are tolerant of periodic inundation and aesthetic features should be chosen giving consideration to a variable water level. The main infiltration basin used in the current hydrologic model is the area along the western property line as shown in the figure. The area is approximately 500 feet long and 30 feet wide and makes up the majority of the frontage along Lenwood Road. This area does not necessarily need to be contiguous and could be broken up into multiple areas. Installing percolation wells in the basin could be used to increase the overall rate of percolation, and placement of rock riprap with sufficient voids spaces could be used to reduce the apparent depth of the basin.

Inundation Area. An additional storage area is the western and most-downhill portion of the parking lot. If the water level in the infiltration basin rises sufficiently, the water may be allowed to flood the western edge of the parking lot. Assuming an average slope of 5% and a maximum rise of water to 0 inches at the first parking stall, this could accommodate an additional 0.9 acre-feet of storage. If the water level reached the first parking stall an overflow could be provided that allows outfall to the Lenwood Wash. Stormwater storage over parking areas need to take into account increased pollutant concentrations and supplemental filtration may be required.

STORMWATER QUALITY MANAGEMENT

The proposed development will increase the pollutant loading of stormwater runoff primarily through contribution of silts, soils and grease from the proposed parking lots. **Appendix A** identifies several Best Management Practices (BMPs) that should be implemented to mitigate potential impacts from the proposed development. Additionally, the proposed site plan includes specific measures intended to reduce pollutant loading and mitigate this potential impact, including:

Stormwater Interceptors. Several buried stormwater interceptors will be installed at selected locations in the storm drainage system for trapping and collection of silt, oils/greases and other floating debris. Stormwater interceptors (also referred to as oil/water separators) are an identified Best Management Practice for stormwater management, used in situations where high concentrations of oils and grease are expected (e.g., parking lots) or in environmentally sensitive areas. They are included in the proposed stormwater system plan for this project to provide additional protection from accidental spillage or debris build-up in the parking lot. Three or four interceptors will be included in the storm drain system, the sizing and design of which will be determined at the time of final drainage system design.

Parking Filter Strips/Parking Ends Basins/Landscape Areas/Infiltration Basins. In addition to their effect on peak stormwater runoff volumes and detention, these areas provide stormwater quality benefits. The reduction in stormwater velocity results in deposition of silts and larger debris, which can be removed through regular maintenance. The infiltration of stormwater through the gravel and permeable soil will provide onsite filtration and retention of silts and pollutants.

PROJECT RUNOFF ANALYSIS

The proposed project will increase the runoff characteristics of the site by increasing the amount of impervious surfaces (i.e., paved roadways, parking areas, buildings). All of the improvements will contribute to a higher rate of runoff as compared with pre-development conditions. The project runoff analysis presented here addresses the effect mitigation of the impact on stormwater runoff from the developed site due to development. Stormwater from offsite will be routed around the developed site directly to the existing drainage channel along Lenwood Road.

The design approach for mitigating the stormwater impacts is to limit the stormwater peak flow to the pre-development condition and provide filtration methods that remove pollutants and sediment. The 10-year and 100-year, 1-hour storms are the design scenarios used for this analysis. The following tables show the design stormwater runoffs for the existing condition and proposed mitigated condition for the 10-year and 100-year 1-hour storms. The analysis was conducted according to the San Bernadino County Hydrology Manual Rational Method.

The San Bernadino County Hydrology Manual gives the rainfall intensities shown in **Table 2-1** for the design storms at the subject property.

Table 2-1: Rainfall Intensity

Duration	10 Year	100 Year
1 Hour	0.75"	1.2"

Existing Site Analysis

The existing approximately 24.6-acre site is comprised entirely of natural desert. Stormwater runoff from the existing site will generally flow by sheet and in local channels. For the purposes of the preliminary analysis the existing site is broken up into two flow path segments. **Table 2-2** shows the resulting time of concentration for the existing site using Manning's formula for channelized flow and assuming "poor cover" for overland flow in segment L2. Segment L1 assumes a trapezoidal section with the time of concentration based on Manning's equation with a velocity of 5.6 feet per second.

Rainfall intensity is dependent on Tc and determined from the Hydrology Manual Table 6-3 using a log-log slope of 0.7 for desert areas.

Table 2-2: Time of Concentration

Segment	Length (ft)	Height (ft)	Tc (min)	I (in/hr) 10 year	I (in/hr) 100 year	Comments
L1	907	17	2.7			Using manning's equation
L2	355	5	13			Using nomograph
		Total	15.7	1.85	3.0	

Runoff Coefficient

The proportion of stormwater, described by the runoff coefficient, that flows as runoff is determined by the soil type and the Antecedent Moisture Condition (AMC). The AMC takes into account soil saturation from prior rainfall events. The Hydrology Manual assigns AMC I to the 10-year storm, and AMC III to the 100-year storm. The CN value given in the manual are based on an AMC II. Infiltration rate, $\mathbf{F_p}$, is a measure of the infiltration capacity of the soil.

Based on Figure C-6 from the Hydrology Manual, the infiltration rates adjusted for AMC are shown in **Table 2-3**.

Table 2-3: Infiltration Rate F_p

	F_p	
AMC I	0.88"	For 10 year storm
AMC II	0.66"	
AMC III	0.34"	For 100 year storm

The runoff coefficient, C, is determined according to the following:

$$C = 0.9(a_i + \frac{(I - F_p) * a_p}{I})$$, for I greater than F_p.

$C = 0.9a_i$, for I less than or equal to F_p.

$a_i = 0$ (no impervious area)

$a_p = 1$

Design Flows

Determine the design runoff, Q = CIA for the design storms.

Table 2-4: Design Flows for Existing Site

Storm	A (acres)	I (in/hr)	Fp (in)	C	Q (cfs)
10 year	25	1.85	0.88	0.27	12.5
100 year	25	3.0	0.34	0.75	56.25

Proposed Site Analysis

The proposed surface conditions for the developed site are described in the drainage plan and shown below in **Table 2-5**.

Table 2-5: Land Use for Proposed Site

Area Description	Area	
	Acres	Percentage
Buildings	3.82	15%
Parking and Roads	14.4	59%
Landscape* and Infiltration**	6.36	26%

* Assumes natural desert style landscaping without impermeable membranes.

** Assumes gravel swales with drought-tolerant ground cover ("good desert shrub").

Runoff Coefficient

The proposed site can be hydraulically modeled as having two areas: area 1 being comprised of the buildings and landscaping, and area 2 being comprised of the lower parking lot. The buildings and parking are assumed to be impermeable with a C = 0.9. The analysis assumes that landscape and infiltration areas are distributed evenly between areas 1 and 2.

The 10-year storm uses antecedent moisture condition I (AMC I), while the 100-year storm uses AMC III. The CN value is based on an AMC II. The AMC takes into account soil saturation from prior rainfall events. Using the average infiltration coefficients from the full-scale alternative, the Fp is 0.66" for the 10-year storm, and 0.20" for the 100-year storm.

The runoff coefficient for the areas is therefore:

$$C = 0.9(a_i + \frac{(I - F_p) * a_p}{I})$$, for I greater than F_p.

$a_i = 0.74$ (Buildings, Parking and Roads)
$a_p = 0.26$ (Landscaped and Infiltration areas)

Design Flows
The design runoff, Q = CIA for the design storms are shown in **Table 2-6**.

Table 2-6: Proposed Site Design Flows

Storm	Segment	A (acres)	Tc	I (in)	Fp (in)	C	Q (cfs)
10 year	1	12.3	6.9	3.5	0.66"	0.86	37.0
	2	12.3	5.0	4.4	0.66"	0.86	46.5
							83.5
100 year	1	12.3	6.9	5.5	0.2"	0.89	60.2
	2	12.3	5.0	7.0	0.2"	0.89	76.6
							136.8

Storage Requirements

Based on the design intent of limiting peak post-development flows to the existing flow conditions, onsite storage will be required to detain stormwater runoff. **Table 2-7** shows the design storage volumes required for the design storms. This volume assumes that the rising and falling legs of the triangular hydrograph have the same time interval.

Table 2-7: Proposed Site Design Flows and Storage

Storm	Peak Runoff (cfs)		Storage (acre-feet)
	Pre-Development	Post-Development	
10 year	12.5	83.5	1.0
100 year	56.25	136.8	0.8

Review of the results shown in **Table 2-7** shows that without the incorporation of detention measures, the proposed project would cause significant increases in runoff rates and total runoff volume compared with that under pre-development conditions. Consequently, runoff detention mitigation measures are essential if the peak runoff is to be limited.

These storage volumes can be accommodated onsite using the current site plan configuration. The infiltration basin on the western property line is of sufficient area to accommodate storage of peak flows. One possible configuration of the infiltration basin would be for the approximately 500 feet of frontage to be 30 feet wide and form a triangular channel 7 feet deep at the center. Rip-rap or cobbles in the bottom of the basin could reduce the apparent depth of the infiltration basin by using the voids space as storage. Percolation wells installed at regular intervals along the length of the basin would provide additional storage and increase percolation.

ASSESSMENT OF FLOOD PLAIN IMPACTS

FEMA Flood Zone Map

The project site is located within two flood zone types: Zone A0, and Zone X. The FEMA description of these areas is:

> ZONE X: Areas determined to be outside 500-year floodplain as indicated by FEMA flood Insurance Rate Map San Bernadino County, California Panel Number 06071c3938F
>
> ZONE A0 (Depth 2): Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined for areas of alluvial fan flooding, velocities also determined.

The western property line and a total of about 10.5 acres of the site are within Zone A0 with flooding depths of one to three feet. Those areas that are within the area of potential flooding are comprised of entirely parking areas, roads, and stormwater detention and retention facilities. Although a flooding of this area would make access to the site restricted due to the flooding at the entrance to the site, there would be no impedance of the floodway and minimal flooding risk to the proposed buildings.

The remaining 14 acres is within Zone X, which is outside of the 500-year floodplain and thus does not pose a significant flooding risk.

SUMMARY AND CONCLUSIONS

The conversion of the site from native desert scrubland to a casino and hotel development with associated paved parking areas, roads, and landscaping will reduce the available area for infiltration of rainfall and increase the total runoff into Lenwood Wash and downstream into the Mojave River. To mitigate these runoff effects, the drainage plan developed for the project to incorporate stormwater detention measures that include a series of gravel parking filter strips and infiltration-detention swales integrated into the parking area. Hydrologic analysis of the project shows that the proposed stormwater detention measures, totaling approximately 1.0 acre-feet of detention volume, will reduce the peak runoff from the site to levels equal to or less than those under pre-development conditions for flows up to the 100-year, 24-hour storm event.

Stormwater quality impacts, which include increase pollutant and silt loading in runoff, should be mitigated by onsite mitigation measures. Available mitigation measures include velocity reduction features, such as swales and basins, and physical filtration through soil or in stormdrain filters.

SECTION B – BIG LAGOON RANCHERIA LOCATION

ALTERNATIVE 3 - CASINO ALTERNATIVE

INTRODUCTION

This section addresses site drainage and water quality issues associated with development of a tribal casino gaming facility for the Big Lagoon Rancheria in Humboldt County. This alternative consists of constructing a single 61,500-square-foot gaming casino and hotel complex on the 11-acre project site within the approximately 20 acres of Tribal Land on the south shore of Big Lagoon. This analysis is an update of the analysis presented in the 2001 Environmental Assessment and includes: (a) a preliminary grading plan incorporating measures to eliminate or mitigate drainage and water quality impacts; (b) an assessment and comparison of pre-construction and post-construction runoff from the site; (c) a determination of appropriate means for collection and safe conveyance of storm runoff from the parking areas, buildings and site landscaping under the proposed project plans; development of floodplain impacts; and (e) recommended erosion, sedimentation control, and pollution prevention measures.

EXISTING CONDITIONS

Regional Hydrological Setting

The project site is an 11-acre parcel located adjacent to Big Lagoon in Humboldt County, California (**Figure 3-1**). Big Lagoon is a predominantly freshwater coastal lagoon located mid-way between the towns of Trinidad and Orick. It has a tributary watershed area of approximately 55 square miles that extends inland about 10 miles, with elevations reaching as high as 2,000 feet above sea level. Big Lagoon itself occupies approximately 90 acres. The main tributary stream in the watershed is Maple Creek, which flows generally in a southeast-to-northwest direction, entering at the southeastern corner of Big Lagoon. Other smaller streams that drain to Big Lagoon include, from north to south, Tom Creek, Diamond Creek, Pitcher Creek and Gray Creek.

The Big Lagoon watershed is largely forested, with relatively sparse development. The most significant features in the watershed include: (1) Highway 101, which crosses the southeastern corner of the lagoon and parallels the east side of the lagoon for a distance of about 3.5 miles; (2) a former lumber mill site located on Maple Creek, just east of Highway 101; (3) a small marina located on the east side of the lagoon; (4) Big Lagoon County Park (with tent camping) along the south shore of the Lagoon; (5) a cluster of seasonal and permanent residences and an elementary school (Big Lagoon Union Elementary School) located immediately south of the County Park; (6) the Big Lagoon Rancheria, consisting of 6 residences, located east of the County Park along the south shore of the lagoon; and (7) Dry Lagoon State Park, encompassing the sand dunes along the west side of the lagoon.

Rainfall in the area is associated primarily with storms from the Pacific Ocean, with about 90 percent of the precipitation occurring during the months of October through April. The annual rainfall in the project area averages about 50 inches per year, with lower amounts along the immediate coast, and increasingly greater amounts inland at the higher elevations in the

SOURCE. Google Aerial Photograph, http://maps.google.com, accessed 3/14/2007, Questa Engineering Corporation

DATE:	3/14/2007
PROJECT:	Barstow Casinos
PROJECT NO.:	260044
DRAWN:	TH
APPROVED:	NH

QUESTA ENGINEERING CORP

ALTERNATIVE 3
EXISTING SITE

FIGURE
3-2

watershed. Based upon stream gauge records for the Little River watershed immediately to the south, the annual runoff into Big Lagoon is estimated to be approximately 123,000 acre-feet.

The water level in Big Lagoon fluctuates seasonally, based upon runoff conditions and whether or not the mouth of the lagoon is open to the ocean. In the summer months when runoff is low, the sand builds up at the mouth and closes off the lagoon outflow. The water level in the lagoon at this time is approximately 6 feet above mean sea level (msl). In the fall, until the sand spit is breached, water level in the lagoon rises in response to increasing runoff from the watershed. The high water level in the lagoon occurs at this time of the year and is estimated to reach a maximum elevation of approximately 18 feet (msl). Once the mouth is open, the lagoon drains and the water level drops back down to its normal level (i.e., 6 feet, msl). Winter storm runoff causes small fluctuations in the lagoon water level that normalize between storms.

Big Lagoon provides numerous beneficial uses, including water contact and non-contact water recreation uses, and a variety of fishery and wildlife habitat uses. It does not serve presently as a source of surface water supply for any domestic, agricultural or industrial uses. No published water quality data for Big Lagoon were found to be available; however, the lagoon is believed to be of exceptionally high quality and suitable for its existing and potential beneficial uses.

Project Site Conditions

The project site occupies an area of approximately 11 acres along the south shore of Big Lagoon. The site slopes toward the lagoon at a slope of approximately 8 to 10 percent. Currently the project site is comprised of 40% wooded and 60% open areas with vehicular access routes, buildings, brush, and grasses. The foundation and preliminary site work for the proposed casino is in the northwest corner of the site.

Previous grading operations created a detention area on the northeast side of the parcel and a berm separating the site from the Lagoon. The berm is approximately 10 feet in elevation and consists, apparently, of un-compacted sands. The detention area has been stripped of topsoil, leaving the underlying densified beach sands exposed.

The lands surrounding the project site immediately to the south and east consist of a dense, mature conifer forest, primarily spruce trees. Roughly 10 acres of the adjoining forest land drain overland through the southern side of the project site (south of the entrance road) and then through the existing Rancheria toward Big Lagoon. The nearest defined watercourse is a small east-to-west drainage within the forested area south of the project site that drains into Big Lagoon on the east side of the Rancheria. The Big Lagoon Rancheria borders the project site on the east and drains overland directly into Big Lagoon; there is no formal drainage system for the Rancheria site.

PROPOSED DRAINAGE PLAN

The proposed project involves the construction of a gaming facility and associated infrastructure, including on-site water supply and wastewater treatment/disposal facilities, driveway and parking areas, building, landscaping and drainage facilities. The development of the project will alter the drainage characteristics of the site through the construction of impervious surfaces (e.g., buildings and paved road/parking area). Shown in **Figure 3-2** and described below is the proposed drainage plan for the project. The drainage plan was developed to ensure proper integration of stormwater runoff and water quality control measures into the overall site development plan for the project.

Stormwater runoff from the site, including the roof, paved roads, landscaping and parking area will be collected, treated and routed through a series of gravel "infiltration-detention swales," underground storm drains, and an extended "wet detention pond," prior to being discharged.

Roof Runoff

The roof runoff should be relatively clean with very low levels of suspended solids, limited mainly to dust, pollen, and other fallout from the atmosphere. Given the climatic condition of the site, deciduous trees are uncommon and leaf collection on roofs should not pose a problem. Rainfall-runoff from the various sections of roof will be collected in several downspouts and conveyed in underground pipes to be dispersed onsite into gravel detention swales. A gravel-rock dissipater structure, constructed along the property line parallel to the casino building, will be used to absorb and detain the roof runoff. The vegetated-rock dissipater will incorporate a "Reno" mattress or hand-placed rock to create a stable, erosion-resistant area for establishment of vegetation and dispersion of roof runoff.

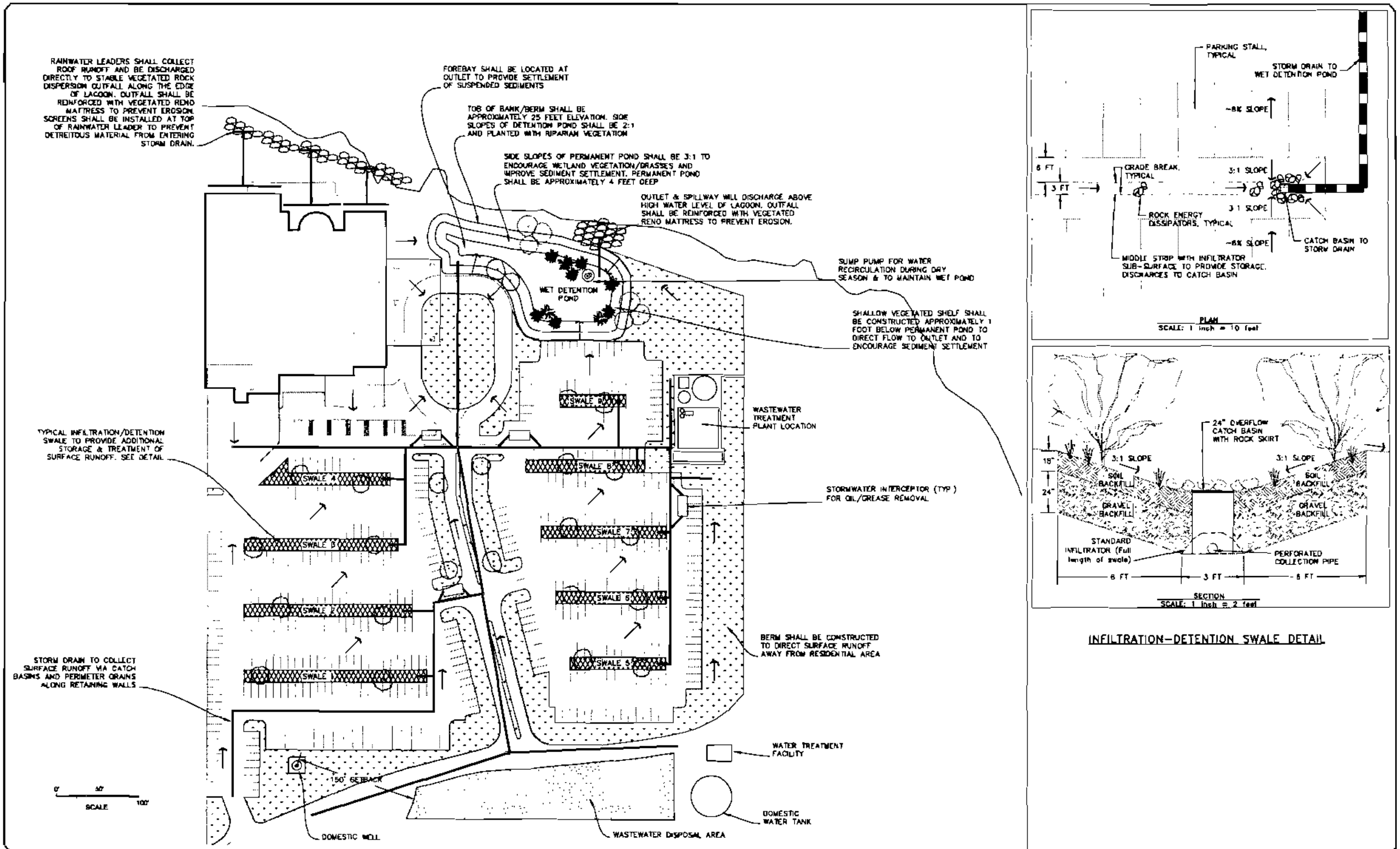
Site Runoff

Gravel Infiltration-Detention Swales. Gravel infiltration-detention swales will be located along the property lines to collect and provide initial treatment and detention of surface runoff flow from the paved parking surface. The treatment functions of the gravel swales will be achieved through physical filtration and settling of particulate matter, absorption by the soil, and uptake by vegetation. Plan and section details of a typical gravel infiltration-detention swale are shown in the inset on **Figure 3-2**, including typical dimensions. The upper 18 inches will consist of a sandy soil substrate to support grasses, small shrubs and some trees. Rock will be placed along bottom of the swale approximately every 20 to 30 feet for energy dissipation.

Below the soils, the swales will be backfilled with gravels and a standard "Infiltrator Chamber," to provide subsurface detention storage of the collected runoff. The runoff will enter and collect in the gravels and chamber either via direct percolation through the soils or through a grated catch basin at the downstream end of the swale. Water will leave the swale at a restricted rate via a storm-drain pipe connected to the catch basin.

The total detention volume provided by the buried chambers and the gravel voids is estimated to be approximately 30 ft^3/l.f. Based on the proposed site plan and parking layout shown in **Figure 3-2**, the total detention capacity provided by all of the gravel infiltration-detention swales amounts to approximately one acre-foot, assuming a full saturated depth of two feet in each swale.

Storm Drains. A storm drain network, consisting of 6-inch to 24-inch diameter buried pipes, will collect runoff from the gravel swales and from other portions of the site and route the flow



BIG LAGOON RANCHERIA

Honorable Virgil Moorehead, Tribal Chairperson
P.O. Box 3060
Trinidad, California 95570

Sht	Rev:	Date:	By:	Description:	App'd

Original scale is inches for reduced plans. Adjust scale 1" = on 11" or this sheet.

Design: M.M.M.
Drawn: M.M.M.
Checked: N.H
Appr'd: N.H

STORM DRAINAGE & DETENTION PLAN

Big Lagoon Rancheria Gaming Facility
Humboldt County
Big Lagoon, California

Size: 0
Dwg. No.: 260044_SD
Rev.: 0
Scale: AS SHOWN
Date: 06-13-01
Figure: 3-3

to the linear detention ponds located along the west and north property lines. The storm drain will be sized to convey peak storm flows, up to the 100-yr event. **Figure 3-2** shows a preliminary storm drainage plan which is adequate for this hydrology analysis, but which will require further refinement based on a final grading plan and other final design details. The arrows indicate the direction of surface flow, which is generally to the northeast in conformance with current site topography. The catch basin and storm drain locations are approximate. Subsurface drainage improvements are not shown. However, these will be required at the toe of any retaining walls incorporated in the final site design, which may be needed at south end of the site, along the adjacent parcel (west side), and at the detention ponds.

Stormwater Interceptors. Several buried stormwater interceptors will be installed at selected locations in the storm drainage system for trapping and collection of silt, oils/greases and other floating debris that passes through or around the grassed swales. Stormwater interceptors (also referred to as oil/water separators) are an identified Best Management Practice for stormwater management, used in situations where high concentrations of oils and grease are expected (e.g. parking lots) or in environmentally sensitive areas. They are included in the proposed stormwater system plan for this project to provide additional protection from accidental spillage or debris build-up in the parking lot. Three or four interceptors will be included in the storm drain system, the sizing and design of which will be determined at the time of final drainage system design.

STORMWATER QUALITY MANAGEMENT

The proposed development will increase the pollutant loading of stormwater runoff primarily through contribution of silts, soils and grease from the proposed parking lots. **Appendix A** identifies several Best Management Practices (BMPs) that should be implemented to mitigate potential impacts from the proposed development. Additionally, the proposed site plan includes specific measures intended to reduce pollutant loading and mitigate this potential impact, including:

Stormwater Interceptors. Several buried stormwater interceptors will be installed at selected locations in the storm drainage system for trapping and collection of silt, oils/greases and other floating debris. Stormwater interceptors (also referred to as oil/water separators) are an identified Best Management Practice for stormwater management, used in situations where high concentrations of oils and grease are expected (e.g. parking lots) or in environmentally sensitive areas. They are included in the proposed stormwater system plan for this project to provide additional protection from accidental spillage or debris build-up in the parking lot. Three or four interceptors will be included in the storm drain system, the sizing and design of which will be determined at the time of final drainage system design.

Parking Filter Strips/Parking Ends Basins/Landscape Areas/Infiltration Basins. In addition to their effect on peak stormwater runoff volumes and detention, these areas provide stormwater quality benefits. The reduction in stormwater velocity results in deposition of silts and larger debris, which can be removed through regular maintenance. The infiltration of stormwater through the gravel and permeable soil will provide onsite filtration and retention of silts and pollutants.

PROJECT RUNOFF ANALYSIS

The proposed project will increase the runoff characteristics of the site by increasing the amount of impervious surfaces (i.e., paved roadways, parking areas, buildings). These improvements will contribute to a higher rate of runoff as compared with pre-development conditions. The project runoff analysis presented here addresses the development areas, excluding the roof runoff from the casino building, which will be segregated and routed directly to the Lagoon as a separate, clean rainwater discharge. The total drainage area of the site, excluding the casino building and the beachfront area, is approximately 8.7 acres.

The runoff from the proposed project site and the required storage volume was estimated using the Soil Conservation Service (SCS) Curve Number (CN) method. The required permanent pond volume for the wet detention pond was determined based on U.S. Environmental Protection Agency (USEPA) criteria for water quality control.

SCS Curve Number Method

The SCS Curve Number method is typically used to estimate the peak runoff and detention storage volume for any duration of rainfall for the frequency of the event chosen. The CN is dependent on the hydrologic soil group (HSG), surface type, hydrologic condition, rainfall distribution type, and antecedent runoff condition (ARC). Technical Release 55 (TR-55) from the SCS presents the CN method and a computer program to estimate peak runoff and detention storage volume.

The depth of rainfall for different frequency events and a 24-hour duration rainfall, were obtained from isohyetals published by National Oceanic and Atmospheric Administration (NOAA) in the Precipitation-Frequency Atlas of the Western United States. The project site has a Type IA rainfall distribution, which represents the Pacific maritime climate, with wet winters and dry summers.

Pre-Development Runoff Analysis

The project site was graded extensively during the mid-1990s; therefore, it was not possible to conduct a field inspection of the site to verify the "pre-development" conditions. The best estimate of pre-development conditions was made from a 1995 aerial photo, which indicates 30% (2.6 acres) of the undeveloped site was wooded and 70% (6.08 acres) was brush and grasses in relatively good hydrologic condition, i.e., hydrologic soil group B. Based on these land use conditions, CN values of 55 and 48 were determined, respectively, for the wooded and grass-brush areas portions of the site.

The composite (weighted average) CN was calculated to be approximately 50 and the time of concentration, t_c, for pre-development conditions was estimated to be 0.4 hours. The t_c is the estimated time it takes for water to flow from the farthest point in the drainage area to the discharge or concentration point. In the pre-development condition, the t_c is relatively high because there are no defined drainage channels to speed the runoff across the site. The flow is primarily overland flow and shallow channel flow across wooded and grassy surfaces, which offer more resistance to flow than stream channels, pipes or ditches. The results of the TR-55 runoff analysis for pre-development conditions are presented in **Table 3-1**, for various storm frequencies. Summarized in the table for each storm frequency are the total 24-hour rainfall depth (i.e., inches of rainfall), the runoff depth, peak flow (in cfs), and the total storm runoff volume for the 8.7-acre drainage area. The rainfall that does not appear as runoff is assumed to be absorbed into the soils on the site. The calculated peak flow is rounded to the nearest cfs by the TR-55 program.

Proposed Development Runoff Analysis

The project site, excluding the casino building and beachfront area, is approximately 8.7 acres. The land use, hydrologic condition, surface areas, soil groups, curve number (CN), and the composite "weighted" CN for the proposed developed condition are presented in **Table 3-2**. The curve numbers were estimated from TR-55, based on these assumed conditions and the average ARC.

The landscape areas and grassed detention swales were judged to have a "B" hydrologic soil group rating, based on the fact that a native sandy topsoil will be placed in these areas for establishment of grasses and other vegetative landscaping. The hydrologic condition was differentiated for the detention swales (poor) and landscape areas (good). The pond and perimeter vegetation was also included in the hydrologic analysis because it will receive direct rainfall that must be accounted for in the runoff and detention pond calculations.

Table 3-1.
Estimated Rainfall and Runoff for Pre-Development Conditions

Storm Frequency (years)	24-hour Rainfall Depth (inches)	Storm Runoff (inches)	Peak Flow (cfs)	Total Runoff Volume (acre-feet)
2	4.5	0.5	0	0.37
10	6.5	1.4	1	1.05
25	7.0	1.7	2	1.27
50	8.0	2.3	3	1.72
100	9.0	2.9	4	2.17

Table 3-2.
Runoff Curve Numbers for Proposed Development

Land Use	Condition	Area (acres)	Soil Group	Curve Number
Landscape areas	good	1.62	B	61
Grassed infiltration-detention swales	poor	0.91	B	79
Impervious: WWTP, tanks	---	0.19	---	98
Impervious: sidewalks	---	0.34	---	98
Impervious: road, parking areas	---	5.09	---	98
Pond: brush-weed-grass mixture	fair	0.53	D	77
	TOTAL	**8.68**		**88**

The time of concentration (t_c) for the developed conditions was estimated to be approximately 10 minutes (0.1 hours), which is much shorter than for the pre-development conditions. Under the developed conditions, the amount of overland flow (e.g., through landscape areas and along the grassed detention swales) will be small; surface flow over the paved parking surfaces and channel flow (in the storm drain system) accounts for the majority of the runoff travel distance, and the lower value for t_c.

The initial abstraction was estimated using the curve number and the peak 24-hour rainfall. In the SCS Curve Number Method, the "initial abstraction" is all losses before runoff begins, including water retained in surface depressions, water intercepted by vegetation, evaporation, and infiltration. The ratio of the initial abstraction and rainfall, the rainfall distribution, the time of concentration, and watershed area were used to prepare a hydrograph for the project area. The storm precipitation, runoff, peak flows, and total volume of runoff for a 24-hour duration storm of varying frequencies are presented in **Table 3-3**. The results presented in **Table 3-3** do not account for the effect of detention storage in the grassed infiltration-detention swales or in the wet detention pond; this is addressed in a separate analysis below.

Table 3-3.
Estimated Rainfall and Runoff for Proposed Development
(Without Detention Measures)

Storm Frequency (years)	24-hour Precipitation (inches)	Storm Runoff (inches)	Flow (cfs)	Total Runoff Volume (acre-feet)
2	4.5	3.2	7	2.39
10	6.5	5.1	11	3.81
25	7.0	5.6	12	4.18
50	8.0	6.6	14	4.93
100	9.0	7.5	17	5.60

Detention Analysis

A comparison of the results in **Tables 3-1** and **3-3** shows that, without the incorporation of detention measures, the proposed project would cause significant increases in runoff rates and total runoff volume compared with that under pre-development conditions. Consequently, runoff detention measures are essential. Analysis of the detention measures included in the proposed drainage plan is presented here.

The effect of detention was modeled using the TR-55 runoff analysis program. This method provides an estimate of the outflow discharge from the detention pond, which is adequate for a planning analysis, with a 25-percent margin of error. A more advanced storm routing method should be completed for the drainage-detention basin final design to determine the optimum design.

Two separate detention scenarios were analyzed: (1) detention storage in the wet detention pond only; and (2) detention storage in the wet detention pond plus the grassed infiltration-detention swales within the parking area. The detention storage volume for the wet detention pond was taken to be 1.24 acre-feet, based on the full detention volume adjusted for the incorporation of a vegetated shelf, which is recommended for water quality treatment functions. The 1.24 acre-foot detention storage volume assumes the permanent wet pond is full (to a depth of 4 feet) and does not include any credit for the additional available detention storage capacity available within the two-foot freeboard depth (i.e., above the spillway elevation).

The collection of runoff water in the grassed infiltration-detention swales within the parking lot will contribute to a runoff time lag that will significantly reduce the peak rate of inflow to the wet detention basin and will also provide detention storage capacity in the gravel voids and "Infiltrator Chambers." To account for this additional runoff reduction, the detention storage capacity in the grassed detention swales (estimated to be 0.99 acre-feet) was added directly to the wet detention pond storage volume for the TR-55 detention analysis. Under this analysis, the adjusted total detention storage volume is 2.23 acre-feet. This is a conservative approach that neglects the runoff lag effect of detention in the grassed swales. A more rigorous analysis that includes the lag effect would have the result in an increased time of concentration, and a corresponding reduction in the peak rainfall intensity and associated runoff rate and detention requirements.

The results of the detention analysis are presented in **Table 3-4** for various storm frequencies (2-yr through 100-yr). Presented for comparison are peak discharge rates for: (a) pre-development conditions; (b) proposed development conditions, without detention measures; (c) proposed development conditions, including the detention effects of solely the wet detention basin (neglecting freeboard capacity); and (d) proposed development conditions, including the combined detention effects of the wet detention pond plus the detention storage capacity within the grassed detention swales within the parking lot. The analysis confirms that implementation of the complete drainage plan, including the wet detention pond and the grassed infiltration-detention swales, will maintain the runoff rates into Big Lagoon from the project site at levels equal to or less than the pre-development conditions, for storm conditions up to the 100-yr event.

The TR-55 detention-routing method is less accurate when the ratio of the storage volume (V_s) to runoff volume (V_r) approaches the limits of 0.12 and 0.50. For this project, the limits of accuracy are reached for the smaller storm events (e.g., 2-yr, 10-yr, 25-yr), which is the reason the results in **Table 3-4** can only be expressed as " < X" for certain rainfall runoff events. The results are adequate for planning analysis; however, a more detailed hydrologic model (e.g., HEC-1, HMS, SWMM) should be completed for the final drainage-detention system design to assure proper sizing and optimum design of the outflow structure. The fact that the V_s/V_r ratio is exceeded for several runoff conditions is a further indication that the amount of detention storage provided in the proposed drainage plan is more than ample, and greater than that normally encountered in analyses using the TR-55 method.

Table 3-4.
Summary of Runoff Analysis Results

Storm Frequency (years)	Pre-Development Peak Discharge (cfs)	Proposed Development - Peak Discharge, Q_o (cfs)		
		No Detention Measures	Wet Detention Pond Only	Detention Pond & Grassed Swales
2	0	7	$Q_o < 0.7$	$Q_o < 0.7$
10	1	11	3	$Q_o < 1.1$
25	2	12	3	$Q_o < 1.2$
50	3	14	5	2
100	4	17	7	3

FLOODING

Most of the project site is elevated well above the high water line of Big Lagoon (which is approximately 18 feet, msl) and has a moderate 8- to 10-percent slope toward the lagoon. The finished ground floor elevation of the gaming facility will be 30 feet, msl. Only a very narrow strip of the site along the shore of the lagoon will be subject to inundation, and none of the proposed improvements will be subject to flooding from the lagoon or from local drainage.

In terms of potential flooding impacts on Big Lagoon from the proposed project, there will be an increase in the total volume of storm runoff into the lagoon from the site, but the effects on lagoon water levels will be negligible. The preceding drainage analysis shows that the peak storm runoff rate from the project will not be increased over pre-development conditions, but the total volume of runoff during most storm events will be increased due to conversion of the site from native woodland and meadow to largely impervious surfaces (parking, roads and building). Under pre-development conditions most of the rainfall from storm events is absorbed in the soils, percolates downward to the groundwater zone and, over time, migrates laterally into the lagoon. The only rainfall that does not reach the lagoon is that which is taken up by vegetation or lost to direct evaporation from the land surface. Under the project conditions a much higher percentage of rainfall will run off directly into the lagoon during and immediately following the storm event. This can be seen in **Tables 3-1** and **3-3**, which show, respectively, the estimated total storm runoff volume for pre-development and post-development conditions for various storm frequencies. In the worst case (i.e., 100-yr event), the additional runoff volume from the project site is estimated to be 3.43 acre-feet of water (5.60 AF - 2.17 AF). Hypothetically, if this added runoff were to be superimposed instantaneously upon the approximately 1,000-acre water surface of Big Lagoon, the water level rise would be less than 0.05 inches. This is insignificant and would not change the flooding or "high water" conditions of Big Lagoon. Moreover, the 100-yr runoff event would most likely not coincide with the annual high water conditions in the lagoon (i.e., late fall). Rather, peak storm runoff would be expected to occur during the winter rainy season, after the annual breaching of the sand spit, when the water level in the lagoon would have already dropped to near its normal winter level (e.g., approximately 6 feet, msl). Under these conditions, the added runoff volume from the project site would have no impact on Big Lagoon flooding or "high water" levels.

SUMMARY AND CONCLUSIONS

The conversion of the site from native woodland and brush to a large paved parking area and gaming facility will reduce the available area for infiltration of rainfall and increase the runoff into Big Lagoon. To mitigate these runoff effects, the drainage plan developed for the project incorporates stormwater detention measures that include a series of gravel infiltration-detention swales integrated into the parking area. Hydrologic analysis of the project shows that the proposed stormwater detention measures, totaling approximately 2.23 acre-feet of detention volume, will reduce the peak runoff from the site to levels equal to or less than those under pre-development conditions for flows up to the 100-yr, 24-hr storm event.

ALTERNATIVE 4 - RV PARK ALTERNATIVE

INTRODUCTION

This section addresses site drainage and water quality issues associated with development of a recreational vehicle (RV) park on the Big Lagoon Rancheria property in Humboldt County. This alternative is a reduced intensity alternative from the previously discussed gaming facility Alternative 3 on the same 11 acres within the 20 acres of Tribal Land on the south shore of Big Lagoon. The park would feature 166 RV parking pads with associated facilities including restrooms and bathhouses, laundry facilities, recreation centers, maintenance facilities, a pump station, and a kayak rental.

PROPOSED DRAINAGE PLAN

The development of the project will alter the drainage characteristics of the site through the construction of impervious surfaces (e.g., buildings and paved road/parking area). The preliminary drainage plan developed for this lower intensity alternative is intended to ensure proper integration of stormwater runoff and water quality control measures into the overall site development plan for the project. The detention components of the plan are the same as for Alternative 3 but the stormwater routing and detention features used in the parking area are not used. Instead, stormwater runoff will be routed through the unpaved recreation and landscaped areas.

The roof runoff should be relatively clean with very low levels of suspended solids, limited mainly to dust, pollen, and other fallout from the atmosphere. Given the climatic condition of the site, deciduous trees are uncommon and leaf collection on roofs should not pose a problem. Rainfall-runoff from the various sections of roof will be collected in downspouts and dispersed to the landscaped areas surrounding the buildings.

STORMWATER QUALITY MANAGEMENT

The proposed development will increase the pollutant loading of stormwater runoff primarily through contribution of silts, soils and grease from the proposed parking lots. **Appendix A** identifies several Best Management Practices (BMPs) that should be implemented to mitigate potential impacts from the proposed development.

PROJECT RUNOFF ANALYSIS

The proposed project will increase the runoff characteristics of the site by increasing the amount of impervious surfaces (i.e., paved roadways, parking areas, buildings). These improvements will contribute to a higher rate of runoff as compared with pre-development conditions. The project runoff analysis presented here addresses the developed area exclusive of the beachfront area. The total drainage area of the site, excluding the beachfront area, is approximately 10.1 acres.

The runoff from the proposed project site and the required storage volume was estimated using the Soil Conservation Service (SCS) Curve Number (CN) method. The required permanent pond volume for the wet detention pond was determined based on U.S. Environmental Protection Agency (USEPA) criteria for water quality control.

SCS Curve Number Method

The SCS Curve Number method is typically used to estimate the peak runoff and detention storage volume for any duration of rainfall for the frequency of the event chosen. The CN is dependent on the hydrologic soil group (HSG), surface type, hydrologic condition, rainfall distribution type, and antecedent runoff condition (ARC). Technical Release 55 (TR-55) from the SCS presents the CN method and a computer program to estimate peak runoff and detention storage volume.

The depth of rainfall for different frequency events and a 24-hour duration rainfall, were obtained from isohyetals published by National Oceanic and Atmospheric Administration (NOAA) in the Precipitation-Frequency Atlas of the Western United States. The project site has a Type IA rainfall distribution, which represents the Pacific maritime climate, with wet winters and dry summers.

Pre-Development Runoff Analysis

The project site was graded extensively during the mid-1990s; therefore, it was not possible to conduct a field inspection of the site to verify the "pre-development" conditions. The best estimate of pre-development conditions was made from a 1995 aerial photo, which indicates 30% (2.6 acres) of the undeveloped site was wooded and 70% (6.08 acres) was brush and grasses in relatively good hydrologic condition, i.e., hydrologic soil group B. Based on these land use conditions, CN values of 55 and 48 were determined, respectively, for the wooded and grass-brush areas portions of the site.

The composite (weighted average) CN was calculated to be approximately 50 and the time of concentration, t_c, for pre-development conditions was estimated to be 0.4 hours. The t_c is the estimated time it takes for water to flow from the farthest point in the drainage area to the discharge or concentration point. In the pre-development condition, the t_c is relatively high because there are no defined drainage channels to speed the runoff across the site. The flow is primarily overland flow and shallow channel flow across wooded and grassy surfaces, which offer more resistance to flow than stream channels, pipes or ditches. The results of the TR-55 runoff analysis for pre-development conditions are presented in **Table 4-1**, for various storm frequencies. Summarized in the table for each storm frequency are the total 24-hour rainfall depth (i.e., inches of rainfall), the runoff depth, peak flow (in cfs), and the total storm runoff volume for the 8.7-acre drainage area. The rainfall that does not appear as runoff is assumed to be absorbed into the soils on the site.

Proposed Development Runoff Analysis

The land use, hydrologic condition, surface areas, soil groups, curve number (CN), and the composite "weighted" CN for the proposed developed condition are presented in **Table 4-2**. The curve numbers were estimated from TR-55.

The landscape areas were judged to have a "B" hydrologic soil group rating, based on the fact that native sandy topsoil will be placed in these areas for establishment of grasses and other vegetative landscaping. The pond and perimeter vegetation was also included in the hydrologic analysis because it will receive direct rainfall that must be accounted for in the runoff and detention pond calculations.

Table 4-1.
Estimated Rainfall and Runoff for Pre-Development Conditions

Storm Frequency (years)	24-hour Rainfall Depth (inches)	Storm Runoff (inches)	Peak Flow (cfs)	Total Runoff Volume (acre-feet)
2	4.5	0.5	0	0.37
10	6.5	1.4	1	1.05
50	8.0	2.3	3	1.72
100	9.0	2.9	4	2.17

Table 4-2.
Runoff Curve Numbers for Proposed Development

Land Use	Condition	Area (acres)	Soil Group	Curve Number
Landscape areas	good	7.36	B	61
Gravel Roads	---	2.33	---	85
Impervious: buildings, WWTP, tanks	---	0.42	---	98
	TOTAL	10.1		**68**

The time of concentration (t_c) for the proposed developed condition was estimated to be less than 0.1 hours; the calculations allow for a computational increase in t_c up to 0.1 hours. This t_c is much shorter than for the pre-development conditions. Under the developed conditions, the amount of overland flow (i.e., through landscape areas) will be small; surface flow over the roads and channel flow accounts for the majority of the runoff travel distance, and the lower value for t_c.

The initial abstraction was estimated using the curve number and the peak 24-hour rainfall. In the SCS Curve Number Method, the "initial abstraction" is all losses before runoff begins, including water retained in surface depressions, water intercepted by vegetation, evaporation, and infiltration. The ratio of the initial abstraction and rainfall, the rainfall distribution, the time of concentration, and watershed area were used to prepare a hydrograph for the project area. The storm precipitation, runoff, peak flows, and total volume of runoff for a 24-hour duration storm of varying frequencies are presented in **Table 4-3**. The results presented in **Table 4-3** do not account for the effect of detention storage in the wet detention pond; this is addressed in a separate analysis below.

Table 4-3.
Estimated Rainfall and Runoff for Proposed Development
(Without Detention Measures)

Storm Frequency (years)	24-hour Precipitation (inches)	Peak Flow (cfs)	Total Runoff Volume (acre-feet)
2	4.5	3.1	1.02
10	6.5	7.0	2.29
50	8.0	10.3	3.39
100	9.0	12.7	4.15

Detention Analysis

A comparison of the results in **Tables 4-1** and **4-3** shows that, without the incorporation of detention measures, the proposed project would cause significant increases in runoff rates and total runoff volume compared with that under pre-development conditions. Consequently, runoff detention measures are essential.

Based on the design intent of limiting peak post-development volume to the existing flow conditions, onsite storage will be required to detain stormwater runoff. **Table 4-4** shows the design storage volumes required for the design storms. This comparison assumes the conservative case of a restriction on stormwater runoff volume.

Table 4-4.
Summary of Runoff Analysis Results

Storm Frequency (years)	Pre-Development Runoff Volume (acre-feet)	Post-Development Runoff Volume (acre-feet	Storage Required (acre-feet)
2	0.37	1.02	0.65
10	1.05	2.29	1.24
50	1.72	3.39	1.67
100	2.17	4.15	1.98

Review of the results shown in **Table 4-4** shows that without the incorporation of detention measures, the proposed project would cause significant increases in runoff rates and total runoff volume compared with that under pre-development conditions. Consequently, runoff detention mitigation measures are essential if the peak runoff is to be limited.

These storage volumes can be accommodated onsite using the existing detention basin provided that the total storage volume is increased to a minimum of 1.98 acre-feet. The current detention storage volume for the wet detention pond is estimated to be 1.24 acre-feet, based on the full detention volume adjusted for the incorporation of a vegetated shelf, which is recommended for water quality treatment functions. The 1.24 acre-foot detention storage volume assumes the permanent wet pond is full (to a depth of 4 feet) and does not include any credit for the additional available detention storage capacity available within the two-foot freeboard depth (i.e., above the spillway elevation). Increasing the depth of the detention pond within its existing footprint to 6.4 feet would provide sufficient storage for the 100-year storm.

FLOODING

Most of the project site is elevated well above the high water line of Big Lagoon (which is approximately 18 feet, msl) and has a moderate 8- to 10-percent slope toward the lagoon. The approximate finished ground elevation of the recreational facilities will be 30 feet, msl, or higher. Only a very narrow strip of the site along the shore of the lagoon will be subject to inundation, and none of the proposed improvements will be subject to flooding from the lagoon or from local drainage.

In terms of potential flooding impacts on Big Lagoon from the proposed project, there will be an increase in the total volume of storm runoff into the lagoon from the site, but the effects on lagoon water levels will be negligible. The preceding drainage analysis shows that the peak storm runoff rate from the project will not be increased over pre-development conditions, but the total volume of runoff during most storm events will be increased due to conversion of the site from native woodland and meadow to largely impervious surfaces (parking, roads and building). Under pre-development conditions most of the rainfall from storm events is absorbed in the soils, percolates downward to the groundwater zone and, over time, migrates laterally into the lagoon. The only rainfall that does not reach the lagoon is that which is taken up by vegetation or lost to direct evaporation from the land surface. Under the project conditions a much higher percentage of rainfall will run off directly into the lagoon during and immediately following the storm event. This can be seen in **Tables 4-1** and 4-**3**, which show, respectively, the estimated total storm runoff volume for pre-development and post-development conditions for various storm frequencies. In the worst case (i.e., 100-yr event), the additional runoff volume from the project site is estimated to be 3.43 acre-feet of water (5.60 AF - 2.17 AF). Hypothetically, if this added runoff were to be superimposed instantaneously upon the approximately 1,000-acre water surface of Big Lagoon, the water level rise would be less than 0.05 inches. This is insignificant and would not change the flooding or "high water" conditions of Big Lagoon. Moreover, the 100-yr runoff event would most likely not coincide with the annual high water conditions in the lagoon (i.e., late fall). Rather, peak storm runoff would be expected to occur during the winter rainy season, after the annual breaching of the sand spit, when the water level in the lagoon would have already dropped to near its normal winter level (e.g., approximately 6 feet, msl). Under these conditions, the added runoff volume from the project site would have no impact on Big Lagoon flooding or "high water" levels.

SUMMARY AND CONCLUSIONS

The conversion of the site from native woodland and brush to a recreational vehicle park will reduce the available area for infiltration of rainfall and increase the runoff into Big Lagoon. To mitigate these runoff effects, the drainage plan developed for the project incorporates stormwater detention measures that include a series of gravel infiltration-detention swales integrated into the parking area. Hydrologic analysis of the project shows that the proposed stormwater detention measures, totaling approximately 2.23 acre-feet of detention volume, will reduce the peak runoff from the site to levels equal to or less than those under pre-development conditions for flows up to the 100-yr, 24-hr storm event.

SECTION C – LOS COYOTES LOCATION

ALTERNATIVE 5 - CASINO ALTERNATIVE

INTRODUCTION

This section addresses site drainage and water quality issues associated with development of a tribal casino gaming facility on the Los Coyotes Reservation in San Diego County. This development alternative consists of constructing one 29,450-square-foot casino and hotel complex on approximately 13 acres of 19 acres of Tribal Land. The remaining acreage is intended for wastewater disposal or will not be developed. The proposed project is shown in **Figure 5-1.** The analysis includes: (a) a preliminary grading plan incorporating measures to eliminate or mitigate drainage and water quality impacts; (b) an assessment and comparison of pre-construction and post-construction runoff from the site; (c) a determination of appropriate means for collection and safe conveyance of storm runoff from the parking areas, buildings and site landscaping under the proposed project plans; (d) assessment of floodplain impacts, and (e) recommended erosion, sedimentation control, and pollution prevention measures.

EXISTING CONDITIONS

Regional Hydrological Setting

The Los Coyotes Reservation site comprises approximately 19 acres within the approximately 25,050 acres of Tribal trust land in San Diego County located between the Cleveland National Forest and the Anza-Borrego Desert State Park approximately 70 miles northeast of the City of San Diego, see **Figure 5-2**.

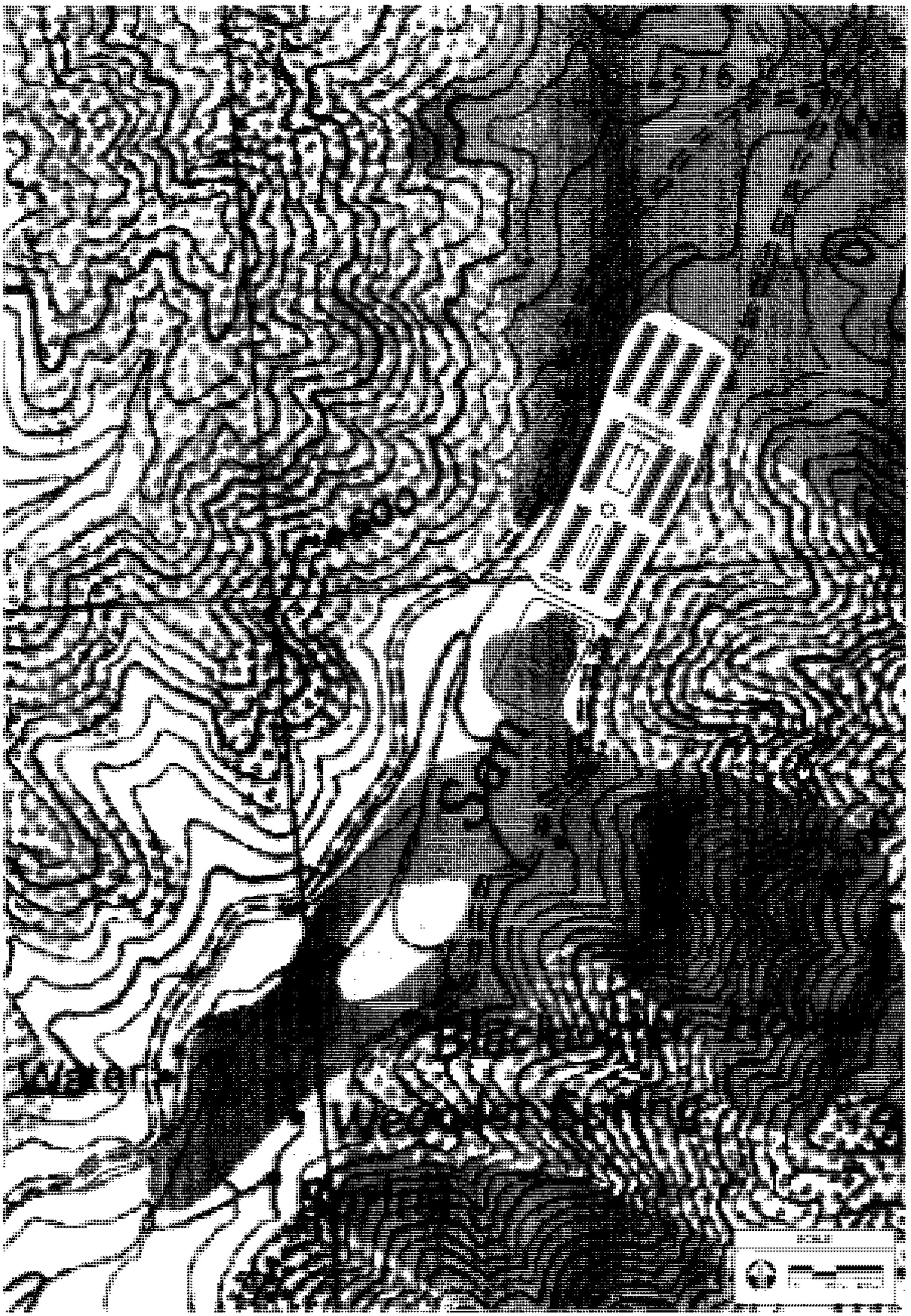
The project site lies within the San Diego River Basin and the San Luis Rey watershed. The project site is located in the San Ysidro Creek Canyon in an area with a general slope of about 4 percent. The watershed encompassing the project site ranges in elevation from 4,400 feet above mean sea level (msl) at the project site to 6,354 feet above msl at the drainage divide. The tributary watershed for the project site has an area of approximately 2.56 square miles (1,640 acres) extending to the north about 2.75 miles.

The San Ysidro Creek canyon in the vicinity of the project site is largely undeveloped. A maintained gravel road provides access to water tanks, emergency vehicle access, and access to a few residences. Culverts are provided where the road crosses San Ysidro Creek. Vegetation in the vicinity is primarily annual grasses with tree species including oaks and bays. With the exception of the access road, the project site is undeveloped.

Rainfall in the area occurs mainly between December and March, with occasional Summer rainfall. Annual average rainfall at the project site is 16 inches.

Project Site Conditions

The project site slopes gently to the southwest between 3 and 6% generally following the course of San Ysidro Creek. A mild cross slope drains the site toward the creek. Drainage across the



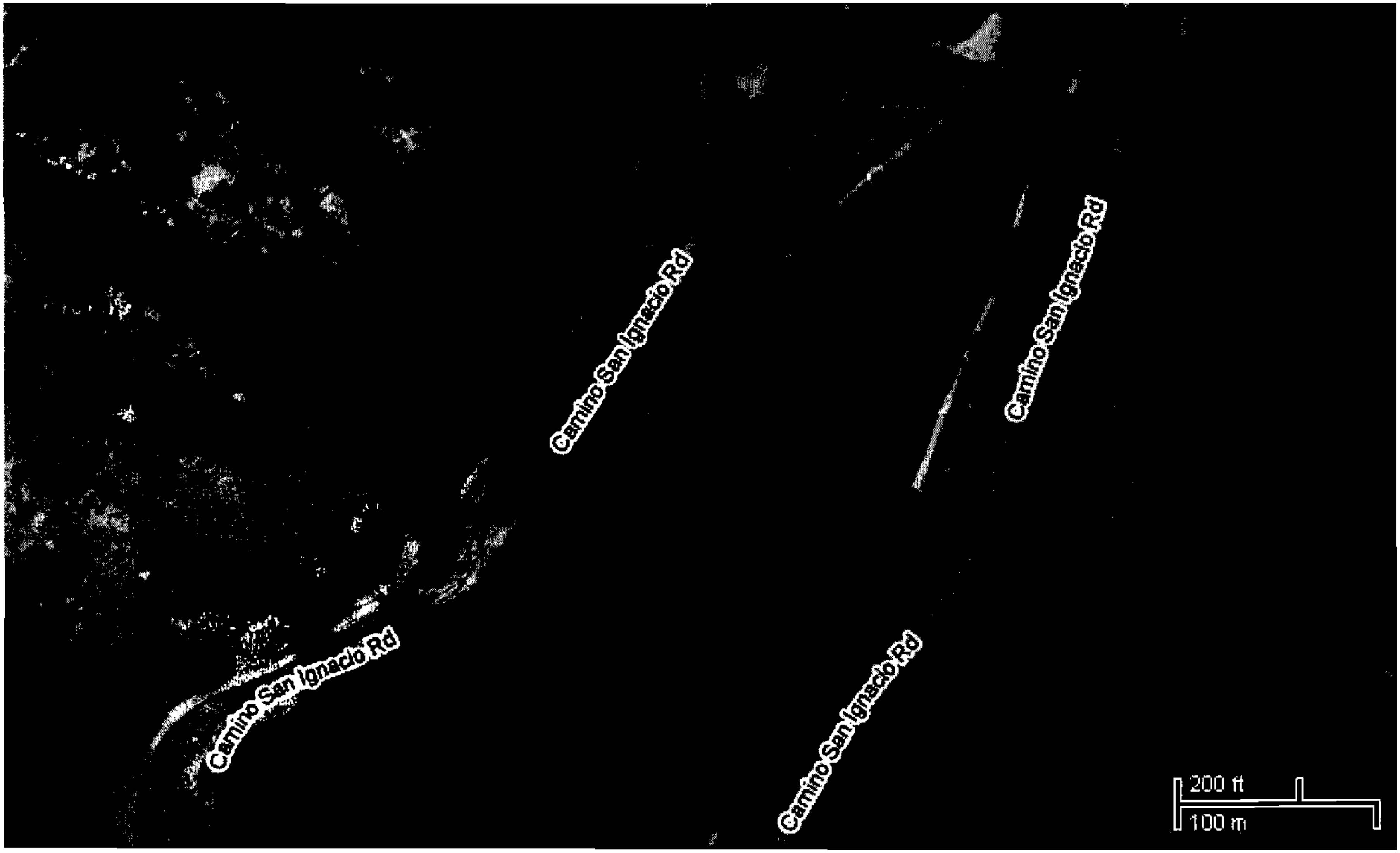
SOURCE: "Hot Springs Mt., CA" USGS 7.5 Minute Topographic Quadrangle, Section 26, T10S R4E,San Bernadino Baseline & Meridian; AES, 2006

DATE:	11/1/2006
PROJECT:	Barstow Casinos
PROJECT NO.:	260044
DRAWN:	TH
APPROVED:	NH

QUESTA ENGINEERING CORP

PROPOSED SITE PLAN

FIGURE 5-1



SOURCE: Google Aerial Photograph, http://maps.google.com, accessed 3/14/2007, Questa Engineering Corporation

DATE:	3/14/2007
PROJECT:	Barstow Casinos
PROJECT NO.:	260044
DRAWN:	TH
APPROVED:	NH

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ALTERNATIVE 5
EXISTING SITE

FIGURE
5-2

property is generally sheet flow. The site has not undergone previous grading and was formed from alluvial and colluvial processes from the creek and surrounding canyon.

PROPOSED DRAINAGE PLAN

The proposed project involves the construction of a gaming facility and associated infrastructure, including on-site water supply and wastewater treatment/disposal facilities, driveway and parking areas, building, landscaping and drainage facilities. The development of the project will alter the drainage path and infiltration characteristics of the site through rerouting of stormwater flows and reduction of pervious surfaces. The orientation of the site is such that the developed site can be graded to generally conform to the existing contours. Due to the relatively small size of the project relative to that of the upstream watershed, the proposed paving does not have a significant impact on the time of concentration. The principle impact of the proposed paving is the decrease in pervious surface and the corresponding increase is peak flows as well as potential water quality effects from pollutants originating from the paved areas. The following describes the general flow routing for stormwater falling on the site.

Roof Runoff

Rainfall runoff from the roof will flow through downspouts and be dispersed to the landscape surrounding the buildings. The landscaped areas are to be graded such that stormwater maintains positive flow away from all structures. The landscaped areas will have drainage inlets to convey excess stormwater to the detention basins. The roof runoff from the casino and hotel building should be relatively clean with very low levels of suspended solids, limited mainly to dust, pollen, leaves and other fallout from the atmosphere

Site Runoff

The site runoff from the parking and paved areas will be routed through vegetated areas to reduce the increase the time of concentration across the site and to provide filtration of stormwater pollutants. Rainfall on parking areas will sheet flow into parking filter strips. From there the stormwater will collect in subsurface pipes and discharge to detention basins that are sized to limit the peak post development runoff rate to the pre-developed runoff rate.

Parking Filter Strips. Five-foot wide gravel strips between parking aisles will collect stormwater runoff from the parking lots and convey stormwater to the drainage inlets at the ends of the parking aisles. These strips provide filtration of stormwater, surface area for infiltration, and decrease runoff velocity. The strips are filled with loose gravel or cobble with a subsurface pipe to ensure positive flow of excess infiltration and prevent excessive ponding in the parking spaces.

Parking End Basins. At the end of each parking row, gravel basins will be used to infiltrate stormwater into the ground. These basins collect stormwater from the parking areas via sheet flow and from the Gravel Parking Strips. An outlet pipe conveys excess stormwater from these basins to the Infiltration Basins. One method of increasing concentration time, and thereby reducing peak runoff rates and total storage requirements is to hydraulically restrict the grates and conveyance piping from the parking lot stormwater collection system. This results in localized storage/flooding in the parking lots, which may present an aesthetic concern. Stormwater storage over parking areas need to take into account increased pollutant concentrations and supplemental filtration may be required.

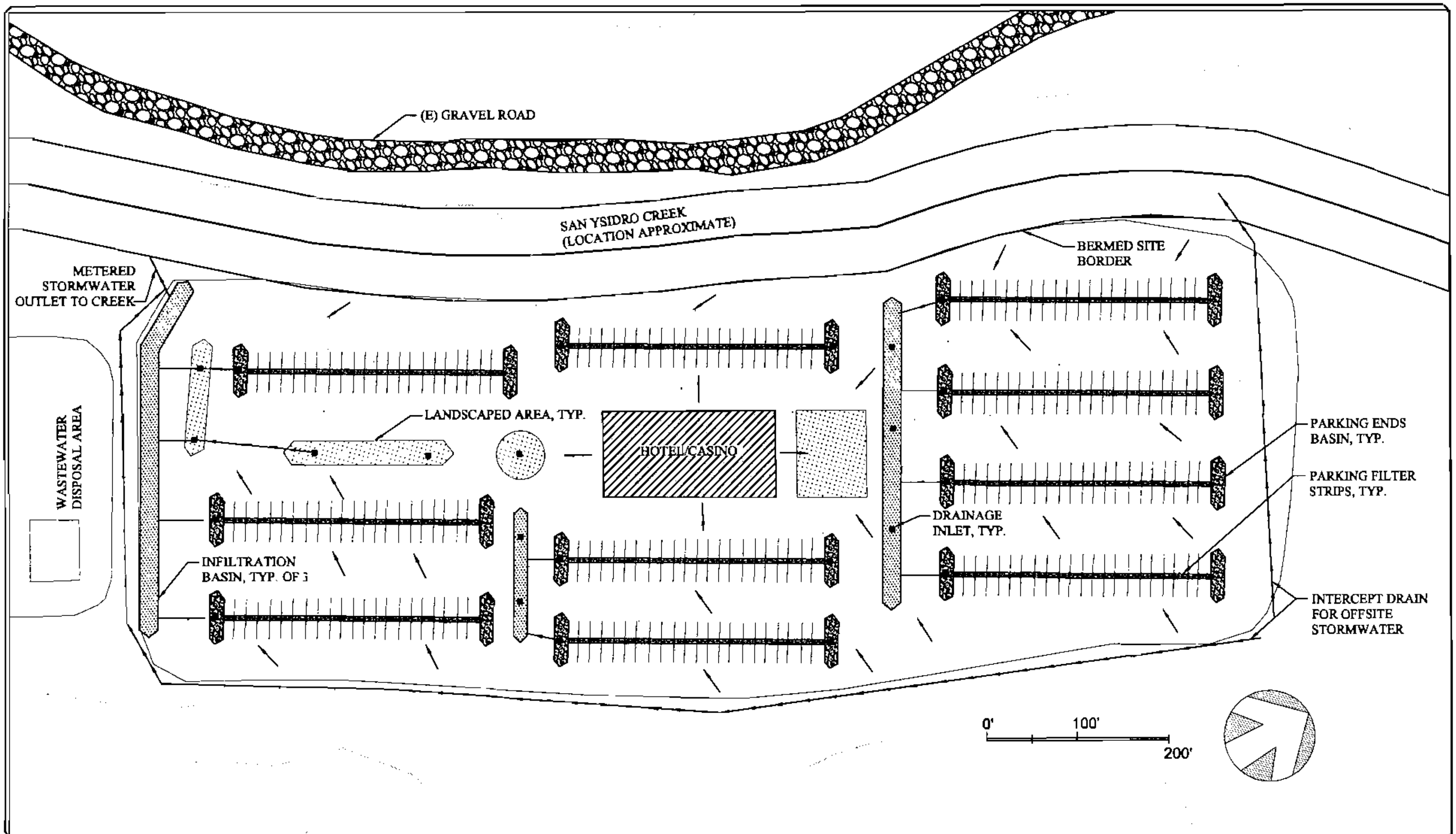
Storm Drains. A storm drain network, consisting of 6-inch to 24-inch diameter buried pipes, will collect stormwater from the basins and other portions of the site and route the flow to the linear detention ponds located along the south and west borders of the parking lots. The storm drain will be sized to convey peak storm flows, up to the 100-yr event. **Figure 5-3** shows a preliminary storm drainage plan that is adequate for this hydrology analysis, but which will require further refinement based on a final grading plan and other final design details. The arrows indicate the direction of surface flow, which is generally to the southwest in conformance with current site topography. The catch basin and storm drain locations are approximate. Subsurface drainage improvements are not shown. However, these will be required at the toe of any retaining walls incorporated in the final site design, which may be needed at the eastern edge of the site and between parking areas if terraced lots are used.

Stormwater Interceptors. Several buried stormwater interceptors will be installed at selected locations in the storm drainage system for trapping and collection of silt, oils/greases and other floating debris that passes through or around the grassed swales. Stormwater interceptors (also referred to as oil/water separators) are an identified Best Management Practice for stormwater management, used in situations where high concentrations of oils and grease are expected (e.g., vehicle maintenance yards) or in environmentally sensitive areas. They are included in the proposed stormwater system plan for this project to provide additional protection from accidental spillage or debris build-up in the parking lot. Two to four interceptors will be included in the storm drain system, the sizing and design of which will be determined at the time of final drainage system design.

STORMWATER QUALITY MANAGEMENT

The proposed development will increase the pollutant loading of stormwater runoff primarily through contribution of silts, soils and grease from the proposed parking lots. **Appendix A** identifies several Best Management Practices (BMPs) that should be implemented to mitigate potential impacts from the proposed development. Additionally, the proposed site plan includes specific measures intended to reduce pollutant loading and mitigate this potential impact, including:

Stormwater Interceptors. Several buried stormwater interceptors will be installed at selected locations in the storm drainage system for trapping and collection of silt, oils/greases and other floating debris. Stormwater interceptors (also referred to as oil/water separators) are an identified Best Management Practice for stormwater management, used in situations where high concentrations of oils and grease are expected (e.g., parking lots) or in environmentally sensitive areas. They are included in the proposed stormwater system plan for this project to provide additional protection from accidental spillage or debris build-up in the parking lot. Three or four interceptors will be included in the storm drain system, the sizing and design of which will be determined at the time of final drainage system design.



BARSTOW CASINOS

SAN DIEGO, CALIFORNIA

QUESTA Engineering Corp. Civil, Environmental & Water Resources

P.O. Box 70356, 1220 Brickyard Cove Road, Point Richmond, CA 94807

Rev.	Date	By:	Description:	App'd

Design: CHN
Drawn: CHN
Checked: CHN
App'd: NNH

MITIGATED SITE PLAN
LOS COYOTES SITE

Size: B | Project No.: 280044 | Rev: 0
Scale: 1"=200'
Date: 2/16/2007
Sheet: 5-3

Parking Filter Strips/Parking Ends Basins/Landscape Areas/Infiltration Basins. In addition to their effect on peak stormwater runoff volumes and detention, these areas provide stormwater quality benefits. The reduction in stormwater velocity results in deposition of silts and larger debris, which can be removed through regular maintenance. The infiltration of stormwater through the gravel and permeable soil will provide onsite filtration and retention of silts and pollutants.

PROJECT RUNOFF ANALYSIS

The stormwater runoff analysis is based on the Rational Method from the San Diego County Hydrology Manual (June 2003). The design basis for this analysis is based on limiting the post development peak runoff to the pre-development value by detaining stormwater onsite. The design storms used were the 50 and 100-year 24-hour storms. The wastewater disposal and undeveloped areas are not slated for modifications to their surface condition and thus are not included in this analysis. Only the 13 acres of gaming facility, related infrastructure and landscaped areas are analyzed.

Pre-Development

The rainfall data shown in **Table 5-1** is taken from the Hydrology Manual with the 6-hour storm value adjusted to be no less than 45% of the 24-hour storm measurement.

Table 5-1: Rainfall Data

Duration	50 year	100 year	Comments
24 hour	10.0"	11.0"	
6 hour	4.0"	4.5"	
6 hour (adj)	4.5"	5.0"	Adjusted to 45% of 24 hour storm

The Hydrology Manual shows that the project site is located in an area of Soil Hydrologic Group 'A', which corresponds to a 'C' value of 0.20. Further soils testing would be needed to confirm this soils analysis but for the purposes of this preliminary analysis, this soil group corresponds to a more conservative comparison of pre- and post-development.

For the purposes of this analysis, only the time of concentration for overland flow is considered, as the flow through San Ysidro Creek is much faster than the overland flow component. Using Figure 3-4 from the Hydrology Manual with E = 30' and L = 580', Tc = 3.3 minutes. A minimum value of 5 minutes is used for Tc. Runoff from the site is assumed to flow to the southwest towards San Ysidro Creek in parallel flow paths.

Table 5-2 shows the peak stormwater runoff rate 'Q' discharging from the project site for the design storms.

Table 5-2: Pre-Development Peak Flows

Storm	Intensity (in/hr)	Q (cfs)
50 year	11.86	30.8
100 year	13.17	34.2

Post-Development

The drainage site plan shows a configuration that provides mitigation of the stormwater impacts yet retains the aesthetic intent and functionality of the original site plan. The surface of the developed site is divided into two categories: buildings and paved surfaces, and vegetated landscaped and infiltration areas. Based on the preliminary site plan, buildings and paved surfaces make up approximately 11.5 acres (90%) and vegetated areas make up the remaining 1.3 acres (10%) of the developed 13 acres of the site. Stormwater runoff from the impermeable buildings and paved areas will sheet flow into landscaped areas and parking filter strips, respectively. These vegetated areas will serve to reduce the velocity of the runoff as well as provide filtration. Stormwater will flow from the vegetated areas to detention basins that will provide storage such that the peak stormwater runoff does not exceed the undeveloped condition.

Due to the orientation of the site relative to the natural gradient, the time of concentration is not heavily influenced by the effect of paved surfaces. Instead the primary factor affecting stormwater runoff from the site is the increase in paved area. The runoff coefficient for the composite site is 0.8, which corresponds to a 400% increase in the peak runoff rate. Based on a triangular hydrograph and a design basis of restricting the post-development peak flow for the design storms to the pre-development flow, the peak run-off rates storage requirements for the proposed site are shown in Table 5-3.

Table 5-3: Post-Development Peak Flow and Storage Requirements

Storm	Intensity (in/hr)	Q (cfs)	Storage (acre-ft)
50 year	11.86	128	0.50
100 year	13.17	142	0.56

The proposed preliminary drainage plan is capable of providing sufficient storage to mitigate the effects of the decrease in permeable surfaces.

SUMMARY AND CONCLUSIONS

The conversion of the site from native woodland and brush to a large paved parking area and gaming facility will reduce the available area for infiltration of rainfall and increase the runoff into San Ysidro Creek. To mitigate these runoff effects, the drainage plan developed for the project incorporates stormwater detention measures that include a series of gravel parking filter strips and infiltration-detention swales integrated into the parking area. Hydrologic analysis of the project shows that the proposed stormwater detention measures, totaling approximately 0.6

acre-feet of detention volume, will reduce the peak runoff from the site to levels equal to or less than those under pre-development conditions for flows up to the 100-year, 24-hour storm event.

ALTERNATIVE 6 - CAMPGROUND ALTERNATIVE

INTRODUCTION

This section addresses site drainage and water quality issues associated with development of a campground facility on the Los Coyotes Reservation in San Diego County. This development alternative consists of constructing a campground with 213 sites and supporting facilities on approximately 13 acres of the approximately 19 acres of Tribal Land as a non-gaming alternative to the Alternative 5 Casino Alternative. Alternative 6 is located at the same site as Alternative 5 and comprises the same development footprint. The analysis includes: (a) a preliminary grading scheme incorporating measures to eliminate or mitigate drainage and water quality impacts; (b) an assessment and comparison of pre-construction and post-construction runoff from the site; (c) a determination of appropriate means for collection and safe conveyance of storm runoff from the parking areas, buildings and site landscaping; (d) an assessment of floodplain impacts, and (e) recommended erosion, sedimentation control, and pollution prevention measures.

PROPOSED DRAINAGE PLAN

The proposed project involves the construction of a campground facility and associated support structures and infrastructure, including on-site water supply and wastewater treatment/disposal facilities, driveway and parking areas, buildings, landscaping and drainage facilities. The development of the project will alter the drainage path and infiltration characteristics of the site through rerouting of stormwater flows and reduction of pervious surfaces. The orientation of the site is such that the developed site can be graded to generally conform to the existing contours. Due to the relatively small size of the project relative to that of the upstream watershed, the proposed paving does not have a significant impact on the time of concentration. The principle impact of the proposed paving is the decrease in pervious surface and the corresponding increase is peak flows as well as potential water quality effects from pollutants originating from the paved areas. The following describes the general flow routing for stormwater falling on the site.

Roof Runoff

Rainfall runoff from the roofs will flow through downspouts and be dispersed to the landscape surrounding the buildings. The landscaped areas are to be graded such that stormwater maintains positive flow away from all structures. The landscaped areas will have drainage inlets to convey excess stormwater to the detention basins. The roof runoff from the buildings should be relatively clean with very low levels of suspended solids, limited mainly to dust, pollen, leaves and other fallout from the atmosphere

Site Runoff

The site runoff from the parking and paved areas will be routed through vegetated areas to reduce the increase the time of concentration across the site and to provide filtration of stormwater pollutants. From there the stormwater will collect in subsurface pipes and discharge to a detention basin that is sized to limit the peak post development runoff rate to the pre-developed runoff rate.

STORMWATER QUALITY MANAGEMENT

The proposed development will increase the pollutant loading of stormwater runoff primarily through contribution of silts, soils and grease from the proposed parking lots. **Appendix A** identifies several Best Management Practices (BMPs) that should be implemented to mitigate potential impacts from the proposed development. Landscape areas are the major BMP for this alternative and in addition to their effect on peak stormwater runoff volumes and detention, these features provide stormwater quality benefits. The reduction in stormwater velocity results in deposition of silts and larger debris, which can be removed through regular maintenance. The infiltration of stormwater through the gravel and permeable soil will provide onsite filtration and retention of silts and pollutants.

PROJECT RUNOFF ANALYSIS

The stormwater runoff analysis is based on the Rational Method from the San Diego County Hydrology Manual (June 2003). The design basis for this analysis is based on limiting the post development peak runoff to the pre-development value by detaining stormwater onsite. The design storms used were the 50 and 100-year 24-hour storms.

Pre-Development

The rainfall data shown in **Table 6-1** is taken from the Hydrology Manual with the 6-hour storm value adjusted to be no less than 45% of the 24-hour storm measurement.

Table 6-1: Rainfall Data

Duration	50 year	100 year	Comments
24 hour	10.0"	11.0"	
6 hour	4.0"	4.5"	
6 hour (adj)	4.5"	5.0"	Adjusted to 45% of 24 hour storm

The Hydrology Manual shows that the project site is located in an area of Soil Hydrologic Group 'A', which corresponds to a 'C' value of 0.20. Further soils testing would be needed to confirm this soils analysis but for the purposes of this preliminary analysis, this soil group corresponds to a more conservative comparison of pre- and post-development. **Table 6-2** shows the peak stormwater runoff rate 'Q' discharging from the project site for the design storms.

For the purposes of this analysis, only the time of concentration for overland flow is considered, as the flow through San Ysidro Creek is much faster than the overland flow component. Using Figure 3-4 from the Hydrology Manual with E = 30' and L = 580', Tc = 3.3 minutes. A minimum value of 5 minutes is used for Tc. Runoff from the site is assumed to flow to the southwest towards San Ysidro Creek in parallel flow paths.

Table 6-2 shows the peak stormwater runoff rate 'Q' discharging from the project site for the design storms.

Table 6-2: Pre-Development Peak Flows

Storm	Intensity (in/hr)	Q (cfs)
50 year	11.86	30.8
100 year	13.17	34.2

Post-Development

The drainage site plan for the campground alternative is comprised primarily of sheet flow across paved areas and into vegetated or landscaped areas. The preliminary site plan for the developed 13 acres is made up approximately 5.1 acres of impermeable surfaces including buildings and paved areas, and 7.9 acres of permeable surfaces including campsites, the playground, and landscaped or undeveloped areas. Stormwater runoff from the impermeable buildings and paved areas will sheet flow into landscaped areas and parking filter strips, respectively. These vegetated areas will serve to reduce the velocity of the runoff as well as provide filtration. Stormwater will flow from the vegetated areas to detention basins that will provide storage such that the peak stormwater runoff does not exceed the undeveloped condition.

Due to the orientation of the site relative to the natural gradient, the time of concentration is not heavily influenced by the effect of paved surfaces. Instead the primary factor affecting stormwater runoff from the site is the increase in paved area. The runoff coefficient for the composite site is 0.47, which results in a 240% increase in peak runoff from the pre-developed condition. Based on a triangular hydrograph and a design basis of restricting the post-development peak flow for the design storms to the pre-development flow, the peak run-off rates storage requirements for the proposed site are shown in **Table 6-3**.

Table 6-3: Post-Development Peak Flow and Storage Requirements

Storm	Intensity (in/hr)	Q (cfs)	Storage (acre-ft)
50 year	11.86	73	0.17
100 year	13.17	81	0.19

SUMMARY AND CONCLUSIONS

The conversion of the site from native woodland and brush to a recreational campground facility will reduce the available area for infiltration of rainfall and increase the runoff into San Ysidro Creek. To mitigate these runoff effects, a drainage plan developed for the project should incorporate stormwater detention measures that provide onsite filtration and detention with a minimum available storage of 0.19 acre-feet to reduce the peak runoff from the site to levels equal to or less than those under pre-development conditions for flows up to the 100-year, 24-hour storm event.