Appendix A
Methodologies, Design Criteria and Cost Basis

Appendix A - Design Criteria, Methodology and Cost Basis

The design criteria, methodology and cost basis are described in Appendix A for water, wastewater, and stormwater. The limitations of the TAZ data are also discussed.

LIMITATIONS OF TAZ ANALYSIS

The land use basis for facility planning is Traffic Analysis Zone (TAZ) data provided by the City of Reno and Washoe County, with supplemental information derived from the City's Master Plan and Washoe County planned land uses. Using TAZ data is not ideal for water and wastewater infrastructure planning. The TAZ boundaries were created by the Regional Transportation Commission (RTC) in a manner that made sense for transportation planning. The challenges of using the TAZ data for water and wastewater planning and the assumptions used are listed in the following.

<u>City and County Boundaries</u>. The TAZ boundaries do not take into account jurisdictional boundaries between Reno, Sparks, and Washoe County.

<u>Utility Agency Boundaries</u>. The boundaries do not account for different water purveyors, wastewater treatment areas, and flood control jurisdictions. Water demands and wastewater flows are generated per TAZ. The TAZ generated demands and flows are allocated between different entities by the location of the TAZ centroid. Many of the TAZs in new areas are very large and cross many boundaries. These demands and flows are distributed manually instead of allocating all of the demand and flow in one area.

<u>Target Zones</u>. The TAZ boundaries crossed target area boundaries for the City of Reno Transit Oriented Development and Center areas. To determine the amount of water demand and wastewater flow from the target areas, a TAZ with an area of 10 percent or greater in a target zone is included.

<u>Dwelling Units</u>. The TAZ data lists projected dwelling units by planning year by TAZ. This dwelling unit data does not reflect the most current planned development data. These data are modified with more detailed information provided by the University of Nevada, Reno Small Business Development Center and developer's representatives. In areas with planned unit development designations, the TAZ data were modified to reflect the planned unit development designations. For the next TAZ data update, these new projections should be used as a starting base.

<u>Constrained Areas</u>. The original TAZ data do not take into account constrained areas such as playas, airports, slope constrained areas and floodways. An artificially high number of developable acres causes the dwelling unit projections to be high when multiplied by a dwelling unit per acre factor. The constrained areas were removed.

The water demands are based on lot size, which is calculated by dividing the dwelling units by the available developable acreage to determine the average lot size. For Reno, available residential acreage is determined by subtracting the 2095 commercial industrial acreage from the developable land. The 2095 average lot size is applied for both the 2030 and 2095 projections.

Commercial and Industrial Acreage. The City of Reno commercial and industrial acreage is projected for buildout and not by planning year. Therefore, the same commercial industrial acreage is assumed for 2030 and 2095. The Washoe County TAZ data does not enumerate commercial and industrial acreage. This acreage is estimated using the County planned land use data.

INFRASTRUCTURE ANALYSIS

The design criteria and methodology for water and wastewater are described in this section.

WATER

The water demands and infrastructure design are based on the criteria shown in Table A.1.

Table A.1 - Water Design Criteria

Demand Factors	
Single Family Residential maximum day demand with Potable Water Irrigation (gpm)	$MDD = 0.00904\sqrt{area}$ (area units are square feet)
Per Unit Multi Family Residential maximum day demand without Potable Water Irrigation (gpm)	MDD = 0.15 gpm x # of units
Commercial/Industrial demand factors	1,000 gal/acre/day (Average Day Demand)
Peaking Factor (a)	
ADD to MDD (Commercial Industrial)	Multiply by 1.72 (current TMWA peaking factor)
Pressures	
Minimum Service Pressures During Maximum Day Demands	45 psi
Maximum Service Pressures During Static Conditions	100 psi (b)
Minimum Distribution System Pressure under Maximum Day Demands + Fire	20 psi
Fire Flows	
Residential	2,000 gpm for 2 hours (per International Fire Code)
Commercial	4,000 gpm for 4 hours (per International Fire Code)
Pipe Sizing	
General Pipe sizing	Per NAC criteria for velocity and pressure
Maximum Distribution System Velocities during Max Day Demands	5 fps
Maximum Distribution System Velocities During Max Day Demands + Fire	10 fps

Hazen Williams “C” Factor for new pipes	130
Storage Tank Sizing (County)	
Total Operational and Emergency Storage (gallons)	= Total ERUs x 850
Total ERUs	= Total average day demand ÷ 700 gal/day
Fire storage	Based on International Fire Code flow and duration
Storage Tank Sizing (TMWA)	
Operational storage	= 15% of total maximum day demand
Emergency storage	= average day demand
Fire storage	Based on International Fire Code flow and duration

(a) Only maximum day demands and maximum day demands + fire flow were considered for facility planning.

(b) It is important to note that transmission main pressures are not limited to 100 psi as are distribution system mains with service taps.

Wastewater

The wastewater flows and facilities are based on the design criteria shown in Table A.2.

Table A.2 - Wastewater Design Criteria

Treatment Plant Flow		
Residential flow rate	per 208 Plan	gpcd
Capita per dwelling unit	2.19	capita/ DU
Commercial/Industrial flow rate	750	gpad
Interceptor Criteria		
Residential flow rate	per 208 Plan, 1.5 PF	gpcd
Commercial flow rate	10,000	gpad
Industrial flow rate	3,000	gpad
Infiltration and Inflow	add 10% of avg gpd	gpd
Depth of Flow	<0.5 pipe diameter	

Wastewater Collection System Analysis

The wastewater collection system was analyzed and designed using the following method.

1. Compile data from existing interceptors and previously planned interceptors if available. Define new interceptors to serve future development areas where necessary.
2. Define sewer collection areas by interceptor location and topography
    a. Create separate collection areas for County areas and City of Reno
3. Define analysis reaches for interceptors based on length and collection area. Define the pipe geometry:
    a. Diameter(s)
    b. Avg. slope (upstream inv. – downstream inv. / length)
4. Determine existing capacity of interceptors

   a. 0.5 d/D
   b. n = 0.014
5. Select TAZs by collection area based on TAZ centroid
   a. Divide large TAZs as necessary
6. Sum 2030 wastewater interceptor flows by collection area
7. Apply flows to interceptors
   a. Apply entire collection area flow if only 1 interceptor is in a collection area
   b. If more than 1 interceptor in collection area, divide flow by number of interceptors
   c. Ignore interceptors that fall on collection boundaries – assume "Conveyors" not "collectors"
   d. Sum flow for each consecutive downstream interceptor
8. For existing interceptors:
   a. Compare 2030 interceptor flow versus existing interceptor capacity, if exceeds:
   b. Determine size of **parallel** interceptor required to carry excess flow at 0.5 d/D (assume same average slope as existing)
9. For new interceptors:
   a. Determine size of new interceptor required to carry flow at 0.5 d/D (assume average slope = slope of existing grade)
10. For new force mains:
   a. Size for full flow such that the velocity is less than 5 fps

Non-Residential Reclaimed Water Demands

Irrigation demands are based on an application rate of 3.5 AFA. The land area assumed to be irrigated is 50% of gross acreage for parks, 50% of gross acreage for open spaces, 20% of gross acreage for schools, and 15% of gross acreage for commercial and industrial.

WATER AND WASTEWATER COST BASIS

The cost estimates for water and wastewater infrastructure are based on the costs shown in Table A.3.

Table A.3 - Water and Wastewater Cost Basis

May 2007 20 Cities ENRCCI	7,942
Pipeline Cost	$12/in/LF
Pump Station Efficiency	70 %
Water Pump Station Cost	30,500*HP^ 0.558 ($400,000 min)
Wastewater Lift Station Cost	250,000+1.0*ADD (gpd)
Reclaimed Water Pump Station Cost	250,000+1.0*ADD (gpd)
Storage Tank Cost	$1/gal
Engineering Cost	20%
Contingency	20%

STORMWATER

The goals and desired outcomes for this update have been explained in other sections of this report. However briefly, the Washoe County Regional Water Management Master Plan, 2004 – 2025, Policy 3.1.a includes a recommendation for the development of a Regional Floodplain Management Plan and a Regional Flood Control Master Plan, and furthermore adoption of this plan by each of the three entity members of the Water Planning Commission. The Management Plan is conceived as a guidance document for the promulgation of non-structural types of flood reduction controls, i.e. the identification of potential flood hazards, strategies to mitigate flood damage in existing areas and strategies to manage future development. The Flood Control Master Plan is a plan that receives guidance from the Management Plan and identifies specific projects within a watershed for the protection of life and property.

The Water Management Plan also stipulates the need for consistent and regionally recognized flood control/drainage engineering design criteria therefore, the Draft Hydrologic Criteria and Drainage Design Manual was developed and utilized for additional specific engineering criteria to provide guidance for this planning update. In addition, Chapter 18.12, Articles 17 through 19 of the City of Reno General Development and Design Standards as well as Chapter II – Storm Drainage was also used. Finally, not all of the necessary engineering criteria are defined in the above cited references and engineering judgment will be discussed and applied in those cases.

FLOODPLAIN DELINEATION

Hydrology

Initial watershed delineation was performed with ArcHydro, using USGS 10m DEM coverage. The minimum contributing area was specified as one square mile. Final basin outlines were delineated by hand in ArcMap using USGS 1:24,000 DRGs.

In order to meet the original timeline for work completion of this update, it was the intention to utilize HEC1/HEC-HMS to estimate flows for floodplain delineation and project size requirements. This program would be adept at predicting future flows based on project land use information. Midway through the plan update it was realized that the land use information would not be made available with adequate time to provide consistent recommendations for all of the study areas. Therefore a more expedient method was selected.

To calibrate the methodology, a representative test watershed was modeled using HMS. The modeled parameters included an assumed 5% impervious surface coverage and a composite curve number of 68. This number was compared to results obtained from the USGS flood-frequency regression equations for Region 2 and 6 and found that an average of the two equations yielded a reasonable number for our test case. Precipitation values for the HMS model were derived from the NOAA Atlas 14 website.

Hydraulics

Manning's n values were assumed to be 0.06 for overbank areas, and 0.045 for in-channel areas. The value for channel areas represents a normal condition channel which is clean, winding, with some pools and shoals with some weeds and stones. The value for overbank areas represents floodplains with light brush and trees in summer. These values are taken from the Manning's n information table contained in HEC-RAS.

Geomorphological Interpretation

Meander belt width was estimated using geomorphic empirical relationships. Three equations were used, two from Inglis (1949), and one from Leopold & Wolman (1957). All three equations related meander amplitude to channel width. Channel widths were measured on USGS Digital Orthophoto Quarter Quads (DOQQs) where the channel was visible. When a defined channel was not visible, no belt width was calculated. Channel width polylines were drawn using the DOQQs. The lengths of the channel line segments were calculated in ArcMap and exported to an Excel spreadsheet, which was used to calculate meander belt width using each empirical relationship mentioned above. The relationship which gave the most conservative result was used to develop the meander belt polygons. This equation (from Inglis 1949) is $A = 18.6w^{0.99}$, where A is amplitude in feet and w is channel width at bankfull stage, also in feet. Using the amplitude lengths calculated in Excel, polylines were created at the location of the channel width measurements. Meander belt polygons were created by joining the ends of the amplitude polyline segments.

Channel widths were difficult to distinguish along the Cold Springs and Red Rock Valley streams, making it impossible to calculate meander belt widths for those basins.

Playas

The following reference provided guidance for development of the FEMA base flood elevation in White Lake; *Hydrologic Analysis of Silver Land and Lemmon Valley Playas*, as revised December 1987. The model assumed impervious surface coverages of 3% to represent existing development and 10% to represent full development within the watershed. The 10% value should be considered as conservative for future conditions.

Although approximate methods were used in this update, the detail will be sufficient to provide a commensurate level of project costs and good planning guidance for the undeveloped areas.