Chapter 2

Description of Alternatives

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2.0 Description of the Alternatives

Chapter 2.0 contains the descriptions of the alternatives that are being evaluated. Five alternatives are evaluated in this EIS: No Action Alternative (no pipeline), Boulder Islands North Alternative, Boulder Islands South Alternative, Las Vegas Bay Alternative, and the Process Improvements Alternative (no pipeline). The three pipeline alternatives have a common element, the EI. However, the EI alignment for the Boulder Islands North Alternative is slightly different than the EI alignment for the Boulder Islands South and Las Vegas Bay alternatives. Therefore, the designations of EI-Alignment A and EI-Alignment B are used throughout the EIS to describe the EI portion of the alternatives. The description of impacts resulting from EI-Alignment B is presented once under the Boulder Islands South Alternative then a reference to that section is used in the EI impacts discussions for the Las Vegas Bay Alternative. The series of pipelines and diffusers that would comprise the three pipeline alternatives ensure that the integrity of the combined effluent would be maintained throughout the pipeline. Therefore, the effluent discharged from the pipeline would meet the "end of pipe" requirements stipulated in the treatment facilities' NPDES permits and any water-quality-based effluent limits imposed by NDEP at the point of diffusion. The process used to develop the SCOP alternatives and the alternatives considered but eliminated from further analysis are presented in sections 2.6 and 2.7 of this chapter, respectively.

There are many actions occurring in the vicinity of the Las Vegas Wash and Lake Mead that are not part of the proposed SCOP alternatives. These activities include, but are not limited to, the construction and operation of SNWA's ECSs in the Las Vegas Wash, operation of the Wetlands Park, Water Conservation implemented by SNWA, and Reclamation's operation of the dam systems along the Colorado River System. These activities and other past, present, and reasonably foreseeable actions are addressed in Section 5.0, Cumulative Impacts.

2.1 No Action Alternative

The CWC would not construct pipelines to transport effluent from the treatment facilities. Highly treated effluent would continue to be discharged to the Las Vegas Wash at the existing discharge locations, and effluent flows would continue to enter the Las Vegas Bay for mixing and diffusion in an uncontrolled fashion.

The three agencies currently responsible for municipal wastewater treatment and discharge would expand their facilities to handle the increasing quantities of wastewater through 2050 (Table 2.1-1). Facility expansions and modifications would occur on lands currently owned by the CLV, Clark County, and COH.

The existing facilities and processes at each plant are described in Sections 2.1.1, 2.1.2, and 2.1.3. Even though the three treatment plants are designed and operated differently, the three agencies coordinate treatment and discharges to meet the combined effluent WLAs. Although one plant may be able to achieve lower concentrations of certain constituents,

Table 2.1-1 Wastewater Discharge Projections.[1]

Annual Average Flow (mgd)						
	Flow Increase Rate (%)[2]	2010	2020	2030	2040	2050
CLV WPCF	2.13	75	96	117	139	160
CCWRD CP	1.97	98	117	137	156	176
COH WRF	0.87	25	34	43	51	60
Total		**198**	**247**	**297**	**346**	**396**
Peak Month (mgd)						
	Peaking Factor	2010	2020	2030	20405	2050
CLV WPCF	1.16	87	111	136	161	186
CCWRD CP	1.15	112	135	157	180	202
COH WRF	1.08	27	37	46	55	65
Total		**226**	**283**	**339**	**396**	**453**
Peak Day (mgd)						
	Peaking Factor	2010	2020	2030	2040	2050
CLV WPCF	1.33	99	128	156	184	213
CCWRD CP	1.40	137	164	192	219	247
COH WRF	1.30	33	44	55	66	77
Total		**269**	**336**	**403**	**469**	**537**
Peak Hour (mgd)						
	Peaking Factor	2010	2020	2030	2040	2050
CLV WPCF	1.50	112	144	176	208	240
CCWRD CP	1.60	156	188	219	250	282
COH WRF[3]	1.30	33	44	55	66	77
Total		**301**	**376**	**450**	**524**	**599**

Notes:

[1] The table does not account for reuse because the quantity of effluent used for reuse varies depending on the season. The SCOP system would be designed to handle the largest projected effluent flows.

[2] Projected rate of annual increase.

[3] COH employs flow equalization; therefore, peak hour flow rates are equal to peak day flow rates.

the other plants may not be able to achieve the same performance. At some of the plants, older trains of tertiary equipment are operating in parallel with newer, not necessarily identical trains. Where additional tertiary capacity is required at a given plant, it was assumed that it would be provided by expanding the newer existing tertiary train. In the discussion of existing facilities, the term "existing" is used to describe facilities that meet one of the following criteria:

- The facilities are physically present on the site;
- The facilities are being constructed on the site; or
- The facilities are in the detailed design stage, with construction about to commence in the very near future.

Facilities that will be abandoned within the next few years are not considered "existing", since they will not be part of the treatment scheme in the year 2030 or 2050.

Current, conventional treatment processes and plant optimization would be used to attempt to meet the requirements set by the NDEP through the NPDES permitting program. However, under this alternative the permitted WLA for phosphorus would be exceeded before the end of the planning period. Total phosphorus (TP) from the combined effluent of the treatment facilities is currently treated to 0.2 mg/L. Optimization of the plants would continue to be implemented to treat wastewater to levels needed to attempt to meet water quality objectives. Each of the three treatment plants is unique in their design, processes, facility improvement schedules, and varying capabilities of phosphorus removal. Nonetheless, the three agencies responsible for municipal wastewater treatment would continue to coordinate treatment and discharges to achieve combined TP levels of 0.14 mg/L during plant optimization.

Additions or modifications to treatment facilities would be implemented to accommodate the anticipated increase in effluent quantity. As flows increase in the future, effluent loadings of TP would eventually exceed the TMDL limitations for the Las Vegas Bay, and effluent TIN loadings could cause exceedances of the concentration-based standards for the Las Vegas Wash, Las Vegas Bay, and Lake Mead.

Conventional treatment processes that would continue to be used include secondary and tertiary treatment. Secondary treatment is defined here to include removal of organic loading, and may also include partial removal of phosphorus and nitrogen through biological processes. Tertiary treatment may include nitrification, biological nutrient removal (BNR), chemical addition, and conventional filtration. In all cases, effluent would receive disinfection prior to discharge to the Las Vegas Wash. Processes to optimize the treatment plants' operations would vary based on the existing infrastructure and current processes implemented at each plant (Black & Veatch 2004b). Optimization of treatment facilities may include, but is not limited to:

- Maximizing the volatile fatty acids in biological phosphorus removal (BPR) processes;
- Optimizing aeration basin configuration;
- Optimizing operational criteria – dissolved oxygen concentration, chemical addition;
- Managing overall plant-wide strategies phosphorus in recycle flows;
- Optimizing filtration efficiency through chemical addition and/or media selection; and

- Managing secondary phosphorus release.

Descriptions of the existing facilities at the three WWTPs and the infrastructure and expansions needed to optimize the processes at each plant are provided in the following sections.

2.1.1 City of Las Vegas

2.1.1.1 Existing Facilities and Processes

The CLV WPCF has been located in the vicinity of Vegas Valley Drive and the Las Vegas Wash since the mid 1950s. The CLV WPCF currently occupies 105.5 acres of the 169 acres owned.

The CLV WPCF is designed to treat 91 mgd. Preliminary liquid stream treatment consists of bar screening and vortex grit removal. Following preliminary treatment, the liquid flow is divided into two different treatment streams. About 54 percent of the current flow receives approximately 45 mg/L of ferric chloride and 0.3 mg/L of anionic polymer (for soluble phosphorus removal and odor control) before it is directed to primary clarification. This flow continues to rock-media trickling filters and intermediate clarifiers, followed by activated sludge for nitrification and final clarifiers. The remaining 46 percent of the current flow receives approximately 5 mg/L of ferric chloride (for odor control) before it is directed to primary clarification. This flow continues on to a Bardenpho enhanced BPR activated sludge system for nutrient removal and then to final clarifiers.

Effluent from the final clarifiers of both flow streams is combined and about 25 mg/L of alum is added ahead of the dual media effluent filters with a combined capacity of 78 mgd (121 cfs) (annual average flow). Tri-media type filters (anthracite over sand over gravel) are used. The final effluent is then disinfected with sodium hypochlorite and dechlorinated with sodium bisulfite. Odor control is used at many of the processes throughout the plant.

Primary and trickling filter sludges are gravity thickened. Waste activated sludge from the two activated sludge processes is centrifuge thickened before all sludges are combined in anaerobic digestion. Digested sludge is dewatered by centrifuge, biosolids are taken to a landfill, and solids-processing sidestreams are recycled back to the plant influent. The facility currently produces approximately 170 tons of sludge per day.

The CLV WPCF discharges treated effluent to the Las Vegas Wash from an open channel located at the intersection of Desert Inn Road and the Las Vegas Wash.

Table 2.1-2 summarizes the existing tertiary treatment facilities at the CLV WPCF (Black & Veatch 2004b).

Table 2.1-2 City of Las Vegas Existing Tertiary Treatment Facilities.

Unit Operation	No. Units	Size/Dimensions	Total Annual Average Capacity (mgd)	Notes
Tri-media Filters	30	504 square ft (ft^2) per filter; dimensions: 18 ft wide x 28 ft long	78	4.5 gallons per minute/ ft^2 (gpm/ ft^2) at maximum month flow (all units in service); 6.5 gpm/ ft^2 at peak hour flow (1 unit out of service)

Source: Black & Veatch 2004b

2.1.1.2 Optimization Facilities and Processes

The CLV WPCF could be optimized for phosphorus removal by increasing the alum dose, and implementing polymer dosing at filtration. However, phosphorus removal that is significantly greater than what is currently being achieved would not likely be possible through this method because the solids concentration onto the filters may exceed the reasonable threshold for direct filtration.

It is also possible to remove some additional phosphorus for short periods by increasing ferric chloride at the primary clarifiers. The CLV has used this option successfully in the past. However, the typical ferric dose is already very high, at the point of diminishing returns. Furthermore, the formation of iron scales and sludges precludes the long-term application of higher ferric dosages.

No major addition of infrastructure would be necessary to optimize the CLV WPCF. Equipment to add polymer at filtration is already in place. However, fine-tuning of polymer feeding equipment at filtration would likely be necessary since the system is not in use.

No new waste streams would be generated, but approximately 1,940 pounds per day (lbs/day) of additional alum chemical sludge may be generated at times throughout the year. Disposal of the sludge would continue as described in Section 2.1.1.1.

The estimated costs to optimize the CLV WPCF would be more than $260,000 per year. The costs would occur over time and not all costs would occur simultaneously. These costs would include approximately:

- $150,000 per year for additional alum;
- $38,000 per year for polymer at filtration;
- $10,000 per year for additional sludge disposal; and
- $62,000 per year for increased backwashes.

In addition, there would be unknown costs for increased maintenance resulting from scaling and sludge clogging.

2.1.2 Clark County Water Reclamation District

2.1.2.1 Existing Facilities and Processes

The CCWRD CP and Advanced Wastewater Treatment (AWT) facilities have been located in the vicinity of East Flamingo Road and Hollywood Boulevard since 1956. The CCWRD facilities currently occupy 360 acres of the 640 acres owned.

The existing plant has a capacity of 110 mgd and consists of the following treatment processes: screening, grit removal, primary clarifiers, aeration basins, final clarifiers, dual media conventional filters, ultraviolet disinfection, waste-activated sludge thickening using dissolved air flotation, and dewatering of both the primary sludge and the thickening waste-activated sludge using a plate and frame press with ferric chloride and polymer addition. All solids processing sidestreams are returned to the liquid stream. Historically, the liquid stream has achieved complete nitrification, partial denitrification, and phosphorus removal using a combination of BPR and chemical polishing. The aeration basins combine a pre-anoxic zone, an anaerobic zone, and an aerobic zone to achieve BPR.

The CP is considered the main plant where the majority of the treatment occurs. The AWT provides tertiary treatment and disinfection using ultraviolet light. The CCWRD's CP and AWT have an annual average capacity of 110 mgd (169 cfs). The next CCWRD expansion is planned to increase the total plant capacity to 150 mgd (232 cfs). Facility expansions and modifications would occur on lands currently owned by Clark County. The CCWRD delivered 5.35 mgd (8.2 cfs) of treated reuse water to customers in 2003 (CCWRD 2004).

The CCWRD's CP includes bar screens, grit basins, primary clarifiers, sludge thickeners, and sludge dewatering facilities. The AWT plant includes chemical feed/mixing/flocculation basins, clarifiers, filters, and disinfection (COH et al. 2000).

The total existing secondary treatment capacity at the CCWRD facility is 110 mgd (169 cfs) (annual average basis). Treatment is currently divided between two trains, with the activated sludge process constituting the main treatment for the removal of carbon, ammonia, and phosphorus. Each train also includes provisions for chemical addition for precipitation of phosphorus in the primaries and at the filters (for use during process upsets). The new basins would be divided into aerobic, anoxic, and anaerobic zones and will emphasize BPR (Black & Veatch 2004b).

Tertiary treatment at the CCWRD facilities consists of effluent filters with a combined capacity of 97.5 mgd (151 cfs) (annual average basis). The effluent filters treat the clarified effluent from secondary treatment. The system is designed for direct filtration in which the secondary effluent would be dosed with coagulant and polymer, and applied directly to the filters for enhanced removal of phosphorus and particulates. Table 2.1-3 summarizes the existing tertiary treatment facilities at the CCWRD facility (Black & Veatch 2004b).

Table 2.1-3 Clark County Water Reclamation District Existing Tertiary Treatment Facilities

Unit Operation	No. Units	Size/Dimensions	Total Annual Average Capacity (mgd)	Notes
Filters	24 with an additional 8 under construction	1,200 ft^2/filter; dimensions: 20 ft wide x 60 ft long	97.5 with an additional 32.5 under construction	4.4 gallons per minute per square ft (gpm/ft^2) at peak hour flow (all units in service); 5.0 gpm/ft^2 at peak hour flow (1 unit out of service)

Source: Black & Veatch 2004b

Waste activated sludge at the CCWRD facilities is dewatered by centrifuge, biosolids are taken to a landfill, and solids-processing sidestreams are recycled back to the plant influent. The facility currently produces approximately 540 wet tons of sludge per day.

The CCWRD discharges treated effluent to the Las Vegas Wash in two locations. The AWT facility discharges to the Las Vegas Wash northeast of Telephone Line Road near the intersection of Telephone Line Road and the AWT access road. The CP discharges to the Las Vegas Wash just downstream of the AWT discharge location.

During the past few years, CCWRD has optimized their phosphorus removal operations by implementing both operating changes as well as physical changes. Since the CCWRD is currently optimizing their facilities and processes, their “existing facilities and processes” and their “optimization facilities and processes” are the same. However, for consistency in the Final EIS, the description of the CCWRD facilities and processes are broken into two sections, 2.1.2.1 and 2.1.2.2.

2.1.2.2 Optimization Facilities and Processes

Optimization of phosphorus reduction at the CCWRD is described in this section. The operation of the primary clarifiers, with respect to the sludge wasting practice, was modified to build up solids in the bottom of the clarifier. This practice resulted in the production of volatile fatty acids (VFAs) and allowed the solids to thicken to approximately 5 percent. The increased VFAs enhance the capability of the secondary treatment process to remove phosphorus biologically.

Modifications to the aeration basins and the final clarifiers were implemented to optimize the performance and process control of these facilities. Additional baffling was provided in the aeration basins to optimize the plug flow pattern and minimize the potential for backflow between the various zones. This is especially critical between the aeration zone and the anaerobic zone. In the final clarifiers, the conventional plow scrappers were replaced with rapid sludge removal equipment, which allowed the solids to be removed more efficiently and prevent the buildup of a sludge blanket. The change in the sludge removal system also allowed for a reduction in the return activated sludge flow that minimized nitrate (NO_3) carryover to the anaerobic zone, again optimizing the BPR process.

Several operational changes were implemented that enhanced the BPR process. Within the aeration basins, the aeration system was operated to maximize the oxygen concentration in the first portion of the aerobic zone to optimize phosphorus uptake. A second operating change was to operate at the minimum sludge (or solids) retention time (SRT) that would allow stable nitrification in order to optimize phosphorus uptake and minimize phosphorus release via endogenous respiration. The recycle flows were closely scrutinized to identify changes in operation to reduce the release of phosphorus. Minimizing bottom sludge in the DAFs, minimizing waste-activated sludge holding time, and quickly returning backwash flows to the aeration basins has further enhanced phosphorus removal.

The final optimization step involves the final clarifiers. To reduce secondary release across the filters, the time between backwashes was reduced and chemical addition using alum was provided to the filters.

The combination of the described steps has allowed CCWRD to optimize their treatment facilities with respect to effluent TP at the 110 mgd (169 cfs) capacity. The results of the optimization modifications have resulted in an effluent TP of less than 0.08 mg/L. This is a combination of an ortho-phosphorus concentration of less than 0.02 mg/L and a particulate phosphorus concentration of less than 0.06 mg/L.

No new infrastructure or additional land was necessary to optimize the CCWRD.

No new waste streams would be generated. However, there would be a slight increase in the chemical component of the primary and waste-activated sludge. Based on an increased dosage of approximately 5.0 mg/L of alum, the estimated additional chemical sludge quantities would be approximately 460 lbs/day of additional sludge. The increased disposal cost would be approximately $5,000 per year.

The estimated costs to optimize the CCWRD facilities would be $446,000 per year. The costs would include capital costs in the form of equipment and structural modifications, power costs due to increased aeration, and chemical costs to reduce phosphorus across the primary clarifiers and to trim phosphorus across the filters. Total additional estimated costs would include:

- $126,000 per year for electrical costs;
- $315,000 per year for additional alum; and
- $5,000 per year for additional sludge disposal.

2.1.3 City of Henderson

2.1.3.1 Existing Facilities and Processes

The COH's WWTP has been located on Athens Road just south of the Las Vegas Wash in Henderson, NV since the 1950s. Wastewater Treatment Plants No.1 and No. 3 comprised the original plant. The current COH WRF began operation in 1994. The COH WRF currently occupies 72 acres of the 132 acres owned.

The COH WRF is expanding to increase the annual average capacity to 32 mgd (49 cfs) in order to treat the flows projected through the year 2016. Facility expansions and modifications would occur on lands currently owned by the COH. The treated effluent from the COH WRF is returned to the Las Vegas Wash near the Pabco Road ECS. The COH facility delivered 5.74 mgd (8.8 cfs) of treated reuse water to customers in 2003 (COH 2004).

The existing secondary facilities at the COH WRF are composed of the 24 mgd (37 cfs) WRF train and a new 7.4 mgd (11 cfs) train, based on annual average flow rates. Flow equalization is provided for the entire flow, and the entire facility operates in BNR mode for reduction of nitrogen and phosphorus (Black & Veatch 2004b).

The AWT system treats the clarified secondary effluent for further removal of phosphorus and particulates. The older 22 mgd (34 cfs) (annual average flow) AWT tertiary train includes solids contact clarifiers (SCCs) followed by filters. Each SCC includes a mixing zone, a flocculation center well, and a settling zone, with alum and polymer fed upstream. Deep-bed monomedia sand filters operated in declining rate mode to polish the clarified effluent. The new 7.4 mgd (11 cfs) (annual average flow) supplemental phosphorus removal (SPR) train includes a two-stage rapid mix basin, a three-stage flocculation basin, and a plate settler-aided sedimentation basin, followed by four continuously backwashed filters. Alum and polymer can be fed to either the first or the second stage of the rapid mix basin. The upflow, deep-bed, granular-media filters consist of six 50-square ft (ft^2) modules per cell. Table 2.1-4 summarizes the existing tertiary treatment facilities at the COH WRF (Black & Veatch 2004b).

2.1.3.2 Optimization Facilities and Processes

Optimization of the COH WRF would require reduction of the total solids. This could be accomplished by modifying the existing monomedia filters to dual or multimedia filters and increasing the application of treatment chemicals. This modification would likely require new backwashing equipment to facilitate cleaning of the media. In addition, the existing media, underdrains, and appurtenances within 16 filters would require modifications to optimize the new filters for solids removal.

Additional waste streams would be generated as a result of the additional chemical dosing and higher backwashing rate required. The estimated increase in backwash waste flow is approximately 1 mgd at the design flow of 24 mgd. This is an additional 4 percent of filter throughput. The backwash waste flow would continue to be returned to the system for additional secondary and tertiary treatment.

The annual estimated cost to optimize the COH WRF is unknown. However, it would cost approximately $1.8 million for replacement of underdrains and filter media, and modifications to piping and controls.

Table 2.1-4 City of Henderson Existing Tertiary Treatment Facilities

Unit Operation	No. Units	Size/Dimensions	Total Annual Average Capacity (mgd)	Notes
WRF SCC	4	80-ft diameter, 16-ft Side Water Depth	22	Hydraulic loading rate range = 0.7 to 1.0 gpm/ft^2
WRF Filters	16	225 ft^2 each, 4.6-ft depth	22	Declining rate operation
New two-stage rapid mix basin	1	1,370 cubic ft (cf) per stage	22	Sized for 30 second hydraulic retention time (HRT)/stage at buildout equalized peak day flow of 28.8 mgd
New three-stage floc basin	1	17,780 cf/train	7.4	Sized for 20 minute HRT/train at equalized peak day flow
New plate settler-aided clarifier	1	20,000 ft^2 projected plate area (w/90 percent derating); 1,250 ft^2 basin footprint	7.4	0.37 gpm/ ft^2 projected derated plate area based on maximum month flow
New continuous backwash filters	4	300 ft^2/filter cell; 1,200 ft^2/train	7.4	4.6 gpm/ ft^2 at maximum month flow

Source: Black & Veatch 2004b

2.2 Boulder Islands North Alternative, Preferred Alternative

The Boulder Islands North Alternative includes plant optimization, increased treatment (as needed), and a pipeline that would collect the highly treated effluent discharged from each of the treatment facilities and transport the effluent to an alternate receiving area in the vicinity of the Boulder Islands (Figure 2.2-1). Effluent would be discharged between 120 and 340 ft below the Lake surface, depending on Lake elevation. The discharge would mix rapidly with the surrounding Lake water, and would continue mixing with Lake water as it rises toward the surface and disperses laterally. Additional mixing and dispersion would result from winds blowing on the Lake. Mixing could also be enhanced by controlling the velocity of the discharge, the number and choice of outfall ports, and the division of flow between the pipeline and direct discharge to the Las Vegas Wash. The management of the effluent using these controls would be incorporated into project operations through the Boulder Basin Adaptive Management Plan (AMP), which is described in Section 2.2.2.6. The effluent would be discharged at depth to minimize the loading of phosphorus that reaches the epilimnion and the euphotic zone where there is enough light for algal growth.

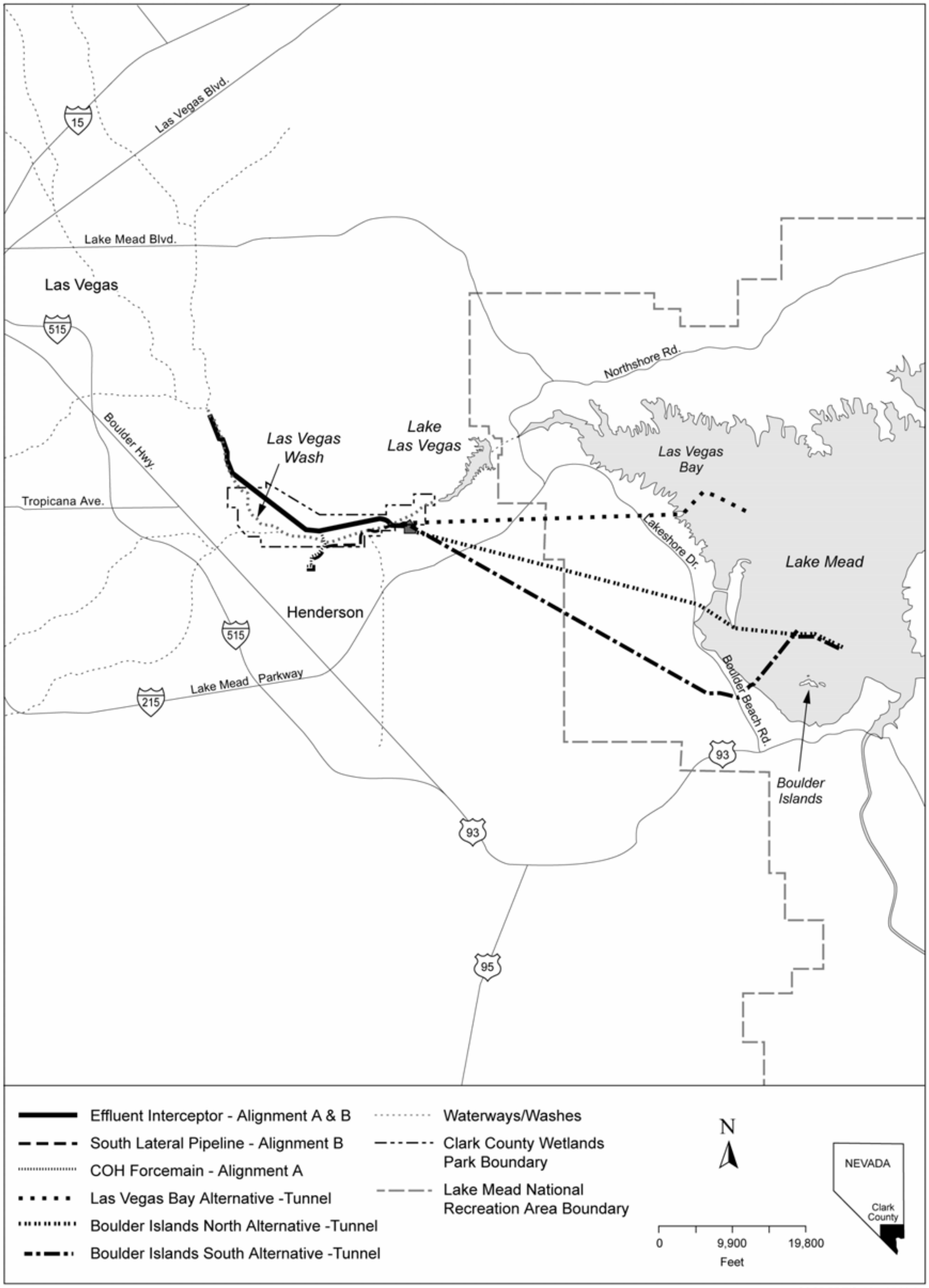

Figure 2.2-1 Alternatives.

Discharge limits for releases near the Boulder Islands would not be subject to the TMDLs, which apply to the flow in the Las Vegas Wash, and in turn protects water quality in the Las Vegas Bay.

The TMDL limits would still apply to Las Vegas Wash discharges. Although the WLAs would not apply to discharges through the Lake Conveyance System (LCS), the TP loading from effluent discharged through the LCS and the Las Vegas Wash into the Boulder Basin would not exceed the current WLA on an average annual basis during ordinary conditions. Although it is difficult to predict if and when extraordinary circumstances may occur, they may arise if regulatory agencies impose requirements that result in increased phosphorus discharges, if an increase results from the achievement of an appropriate environmental benefit, or if reasonable optimization of conventional treatment processes does not consistently achieve the level. In all circumstances, however, the discharge would be regulated by NDEP, who would ensure compliance with all NPDES permit provisions and federal and Nevada water quality requirements.

Current, conventional treatment processes, plant optimization, and increased treatment (as needed) would be used to meet the requirements set by the NDEP through the NPDES permitting program. Current, conventional treatment processes and plant optimization are described in Section 2.1. The Boulder Islands North Alternative is divided into two main pipeline segments, the EI-Alignment A and the Boulder Islands North LCS. In addition, there are ancillary facilities associated with this alternative including connection structures to the treatment plants, a wash return structure at the CCWRD plant, the EI Terminus site, a pressure regulating station (PRS) and hydroelectric power generation facility near the end of the LCS in the vicinity of AMSWTF, Boulder Islands North Diffuser pipeline (BINDP), and a diffuser.

The EI, COH Forcemain, LCS, and related facilities have been designed for year 2050 peak hour flows, which comply with typical design standards. The projected flows are based in part on extrapolations of the flow projections given in the *Needs Assessment Study* (Montgomery Watson 1997b), which covered a 30-year planning period. The flows discharged by the CLV, CCWRD, and COH were projected for an additional 20 years to year 2050 (Table 2.1-1) based on the annual increases indicated in the *Needs Assessment Study*. The projected annual increases in flows were compared with the results of a recently completed population analysis by the Center for Business and Economic Research at UNLV (UNLV 2004) and found to be close in agreement. The flow-rate projections for COH were compared with data from recent plant expansion studies and build-out forecasts. The design capacity of the pipeline includes total flows, reclaimed flows, plus plant discharge flows.

Through collaboration with SNWA, it was determined that the wetlands and riparian vegetation along the upper Las Vegas Wash could be sustained if 30 to 50 mgd (46 to 77 cfs) of effluent flows continue to be discharged to the Las Vegas Wash. Therefore, the EI diversion structures were designed to allow a controlled discharge of 30 to 50 mgd (46 to 77 cfs) to the Las Vegas Wash. The local agencies responsible for water quality management in the Las Vegas Wash have agreed to meet at least once a year and review the need for flow augmentation in the Las Vegas Wash. The SCOP facilities, managed through the Boulder Basin AMP, would be able to accommodate flow adjustments as determined by this management group. The 30 to 50 mgd (46 to 77 cfs) of effluent carried forward in the EIS is for a minimum base flow. Additional

Table 2.2-1 Effluent Interceptor – Alignment A, Total Dimensions of Construction Techniques.

Reach	Length (ft)	Inner Diameter (inches)	Construction Technique	Depth to Invert (ft)
1	7,100	96	Cut-and-Cover	19 – 29
1	420	96	Tunnel	25 – 42
2	13,650	114	Cut-and-Cover	18 – 32
3	11,450	114	Tunnel	128 – 178
COH Forcemain	4,800	54	Cut-and-Cover	11 – 25
COH Forcemain	1,700	54	Tunnel	175

effluent discharged to the Las Vegas Wash considers ecosystem needs and the continuing requirement to meet water quality standards in the Las Vegas Bay and Boulder Basin. The 30 to 50 mgd (46 to 77 cfs) flows would result in a total dissolved solid (TDS) concentration of 2,500 mg/L. One-hundred percent of the effluent flows may be discharged to the Las Vegas Wash during emergencies or maintenance of the pipeline. Regular maintenance at the treatment facilities would be scheduled and coordinated to ensure that all three plants are not discharging 100 percent of their flows to the Las Vegas Wash at the same time.

The Boulder Islands North Alternative would cost approximately $594,363,000 in capital costs and $500,000 per year in O&M costs. The breakdown of capital costs include:

- $23,529,000 for the Reach 1 pipeline and structures;
- $43,170,600 for the Reach 2 pipeline and structures;
- $61,891,500 for the Reach 3 tunnel;
- $10,536,900 for the COH Connection (Las Vegas Wash crossing);
- $26,802,600 for the COH pump station;
- $158,050,800 for the North River Mountains Tunnel No. 3 (NRMT3) including the working shafts;
- $72,852,000 for the hydroelectric/pressure regulating station (HPRS); and
- $197,529,600 for the BINDP.

2.2.1 Effluent Interceptor – Alignment A

The highly treated effluent discharged from the CLV and CCWRD treatment facilities would bypass the Las Vegas Wash via the EI. The COH Forcemain would convey the treated effluent from the COH WRF (Figure 2.2-2). The CLV and CCWRD flows would be combined with the COH flows at the Pabco Connection, and be transported to Lake Mead via the LCS. The

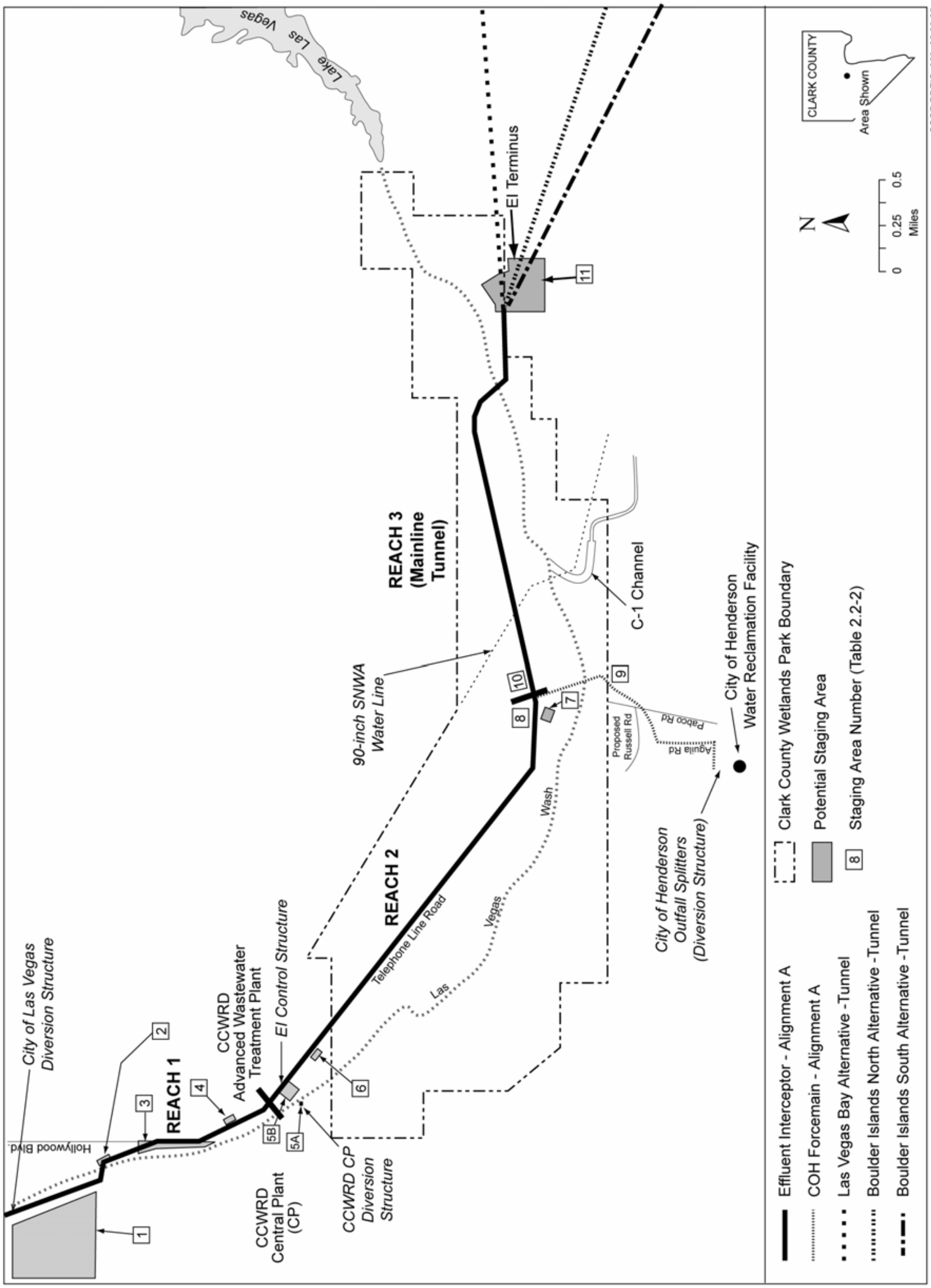

Figure 2.2-2 Effluent Interceptor – Alignment A and Ancillary Facilities.

pipeline, including EI-Alignment A, COH Forcemain, and LCS, would be designed and maintained in a manner that would protect the integrity of the effluent.

The EI-Alignment A portion of this alternative is described in terms of the alignment, ancillary facilities and structures, design flow, construction, and operation. Effluent Interceptor-Alignment A has been divided into three reaches and the COH Forcemain for ease of discussion.

2.2.1.1 Alignment

Information regarding the length, diameter, and construction method to be used for each segment of EI-Alignment A is summarized in Table 2.2-1. Biological and cultural resource surveys were conducted for a 400-ft corridor, 200 ft on either side of the center line, for the linear segments of the EI. The temporary and permanent disturbance would be contained within the surveyed area.

2.2.1.1.1 Reach 1

The CLV effluent would be collected into a 96 inch (244 centimeter [cm]) diameter pipeline that extends in a southeasterly direction to the vicinity of the CCWRD CP and AWT outfall connections (Figure 2.2-2). A combination of cut-and-cover (7,100 ft [2,164 m]) construction and tunneling (420 ft [128 m]) would be used in Reach 1 (Table 2.2-1). Reach 1 of the EI alignment would begin with a connection to the CLV diversion structure. The EI would cross Desert Inn Road then follow the southern boundary of the Desert Inn Road ROW within CLV property continuing to the west bank of the Las Vegas Wash. The EI, using cut-and-cover construction, would follow the west bank of the Las Vegas Wash adjacent to the flood control easement, in a southeasterly direction for approximately 1,500 ft (457 m). A tunnel shaft would be constructed at this location. A 19 to 29 ft (6 to 9 m) deep, 420 ft (128 m) long tunnel would be constructed beginning at this point and would run in an easterly direction under the Las Vegas Wash to the east bank of the Las Vegas Wash. There would be a second tunnel shaft at this location. From this point to Hollywood Boulevard, the pipeline would be installed using cut-and-cover construction, following the east bank of the Las Vegas Wash in a southeasterly direction, adjacent to the flood control easement. The EI would continue in a southerly direction along the western edge of Hollywood Boulevard to the southern edge of Telephone Line Road (Figure 2.2-2). The EI would continue in a southeasterly direction along Telephone Line Road, within CCWRD property, to the EI Control Structure.

The West Working Pit, approximately 40 x 25 ft (12 x 8 m), would be located at staging area 8A on CLV property, which would be used as a temporary construction staging area. The staging area for the 25 x 25 ft (8 x 8 m) East Retrieval Pit would be contained within a 70 ft (21 m) wide pipeline easement and staging area 5B adjacent to the Woodside Homes development. Spoils excavated from the working pit would be hauled by truck to a designated disposal area. The trucks would travel north along the temporary construction easement to Desert Inn Road.

2.2.1.1.2 Reach 2

Reach 2 of EI-Alignment A conveys the combined CLV and CCWRD effluent in a 114 inch (290 cm) diameter pipeline, approximately 13,650 ft (4,161 m) long, beginning 100 ft (30 m)

Table 2.2-2 Staging Areas (EI – Alignment A).

Staging Area	Property	Area
EI-Alignment A Reach 1		
1	CLV property – Directly south of WPCF	37 ac [1]
2	Las Vegas Wash Crossing – East Shaft	0.6 ac
3	CLV Property – Adjacent to Hollywood Boulevard	6.4 ac
4	CCWRD Property	0.7 ac
CCWRD CP & AWT Connection		
5A	CCWRD Property – Near CP Outfall	50 ft x 50 ft
5B	CCWRD Property – Near EI Control Structure and AWT	6.3 ac
EI-Alignment A Reach 2		
6	CCWRD Property – Just North of Wetlands Park Boundary	1.4 ac
7	Clark County Parks and Community Services property – Northwest of Pabco Road ECS [2]	1.1 ac
8	North Side of Pabco Road ECS	3.7 ac
COH Forcemain		
9	Tunnel Shaft South Side of Pabco Road ECS	3.7 ac
10	Located at North Side of Pabco Road ECS	3.7 ac
EI-Alignment A Reach 3 [3]		
11	Reclamation Property – (EI Terminus) East Shaft Staging Area and Terminus	40 ac

Notes:
[1] ac = acre.
[2] Erosion Control Structure.
[3] Reach 3 Tunnel starts at north side of Pabco Road ECS.

northwest of the EI Control Structure located near the entrance to the CCWRD AWT plant (Figure 2.2-2). Effluent Interceptor-Alignment A then follows the south edge of Telephone Line Road in a southeasterly direction to a point north of the Pabco Road ECS. Effluent Interceptor-Alignment A would connect with the Mainline Tunnel shaft for Reach 3 at this point (Figure 2.2-2). The staging areas for Reach 2 are shown on Figure 2.2-2. The staging areas shown correspond to the areas listed in Table 2.2-2. A 175 ft (53 m) wide construction easement would be required for Reach 2. The majority of EI-Alignment A within Reach 2 would be installed using cut-and-cover construction.

The tunneling methods and spoils removal would be the same as described for the tunneling activities in Reach 1.

2.2.1.1.3 Reach 3

Reach 3 of EI-Alignment A begins on the north side of the Las Vegas Wash at the Pabco Road ECS with a tunnel shaft approximately 175 ft (53 m) deep and continues southeasterly for approximately 11,450 ft (3,490 m) terminating on the south side of the Las Vegas Wash at the EI Terminus site (Figure 2.2-2). The working shaft, located at the EI Terminus site, would be 30 ft (9 m) in diameter and approximately 170 ft (52 m) deep. The retrieval shaft would be located at staging area 10 adjacent to the end of Reach 2 and would have a 20 ft (6 m) diameter and 175 ft (53 m) depth.

The staging area at the working shaft/EI Terminus site is approximately 40 acres (17 hectares). The staging area at the retrieval shaft on the north side of the Las Vegas Wash would be approximately 3.7 acres (1.5 hectares) (Table 2.2-2). Spoils would be excavated from the working shaft and hauled by truck to a disposal site using the existing roadway system.

2.2.1.1.4 COH Forcemain

The COH WRF effluent would be conveyed to the EI via the COH Forcemain, which would consist of a 4,800 ft (1,463 m) long, 54 inch (137 cm) diameter pipe that begins at the WRF new effluent pump station and ends at the EI connection (Figure 2.2-2). The majority of the COH Forcemain would be installed using cut-and-cover construction. The COH Forcemain alignment crosses the WRF plant site to Aguila Road, heads north along Aguila Road, and crosses the Las Vegas Wash via a 175 ft (53 m) deep tunnel.

2.2.1.2 Ancillary Facilities and Structures

Ancillary facilities and structures for EI-Alignment A would be required for the operation and maintenance (O&M) of the SCOP pipeline. The descriptions of the EI-Alignment A ancillary facilities and structures follow.

2.2.1.2.1 Connection Facilities

Connection facilities are required to link the effluent flows from the treatment facilities to the EI.

City of Las Vegas Connection

The CLV connection structure would have the capability to send from 0 to 100 percent of the CLV flow to the Las Vegas Wash or the EI. The CLV connection structure would consist of a diversion structure, located within the CLV outfall channel immediately downstream from the existing long-throated Parshall flume, would divert the CLV WPCF discharges into Reach 1 of the EI, or return the flow to the Las Vegas Wash. The diversion structure would be protected by a floodwall.

Clark County Water Reclamation District Connection

The CCWRD connection would consist of a CP diversion structure, AWT connection, EI control structure, and wash return structure (Figure 2.2-2). The existing CP outfall would be modified to include the CP diversion structure, which would be located on CCWRD property on the west side of the Las Vegas Wash. The diversion structure would have the capability to send from 0 to 100 percent of the CP flow to the Las Vegas Wash or the EI.

The pipeline connecting the CP diversion structure to the EI control structure would consist of a 450 ft (137 m) long tunnel (with an inside diameter of 96 inches [244 cm]) under the Las Vegas Wash, and a 220 ft (67 m) long pipeline constructed by the cut-and-cover method. Effluent flows from the AWT would be conveyed to the EI control structure via a 66 inch (167 cm) diameter pipe connection into the existing AWT outfall pipe.

The EI control structure, which serves as the junction structure for the flows from the CLV WPCF and the CCWRD CP and AWT, consists of the inlets from the three treatment plants and two outlets leading to the EI Reach 2 pipeline and the wash return structure. The wash return structure would be used to convey the overflow from the EI control structure to the Las Vegas Wash and prevent the water in the Las Vegas Wash from entering the EI during a flood event.

City of Henderson Connection

The COH Forcemain would begin at a new COH effluent pump station located north of the new final clarifiers (under construction) on the COH WRF site. The effluent pump station would have an overflow diversion weir to allow flow to bypass the pump station to the outfall splitter structure. The outfall splitter structure would allow from 0 to 100 percent of the COH WRF flow to be diverted to the Las Vegas Wash, via the COH's existing Las Vegas Wash outfall (Figure 2.2-2).

One of the COH's existing outfall structures and outfall channel would have to be modified to accommodate COH 2050 peak hour flows. The COH outfall channel would be widened to minimize velocities and reduce scour before entering the Las Vegas Wash. Riprap armoring would be installed along the bottom and sides of the channel for its entire length.

2.2.1.2.2 Effluent Interceptor Terminus

The EI Terminus is the transition point between the EI and the LCS (to Boulder Islands or Las Vegas Bay). The EI Terminus site is located about 1 mile (2 km) southwest of Lake Las Vegas on the south bank of the Las Vegas Wash at Township 21 South, Range 63 East, Section 28 M.D.M. (Figure 1.1-1). All temporary and permanent disturbance associated with the EI Reach 3 tunnel shaft and portal area; the NRMT3 shaft and portal area; and any structures associated with the EI Terminus, including a staging area, would be located within the 40-acre (16 hectares) EI Terminus site, located on land owned by Reclamation. An access portal (manhole) would be the only permanent structure located at the EI Terminus site (Figure 2.2-3).

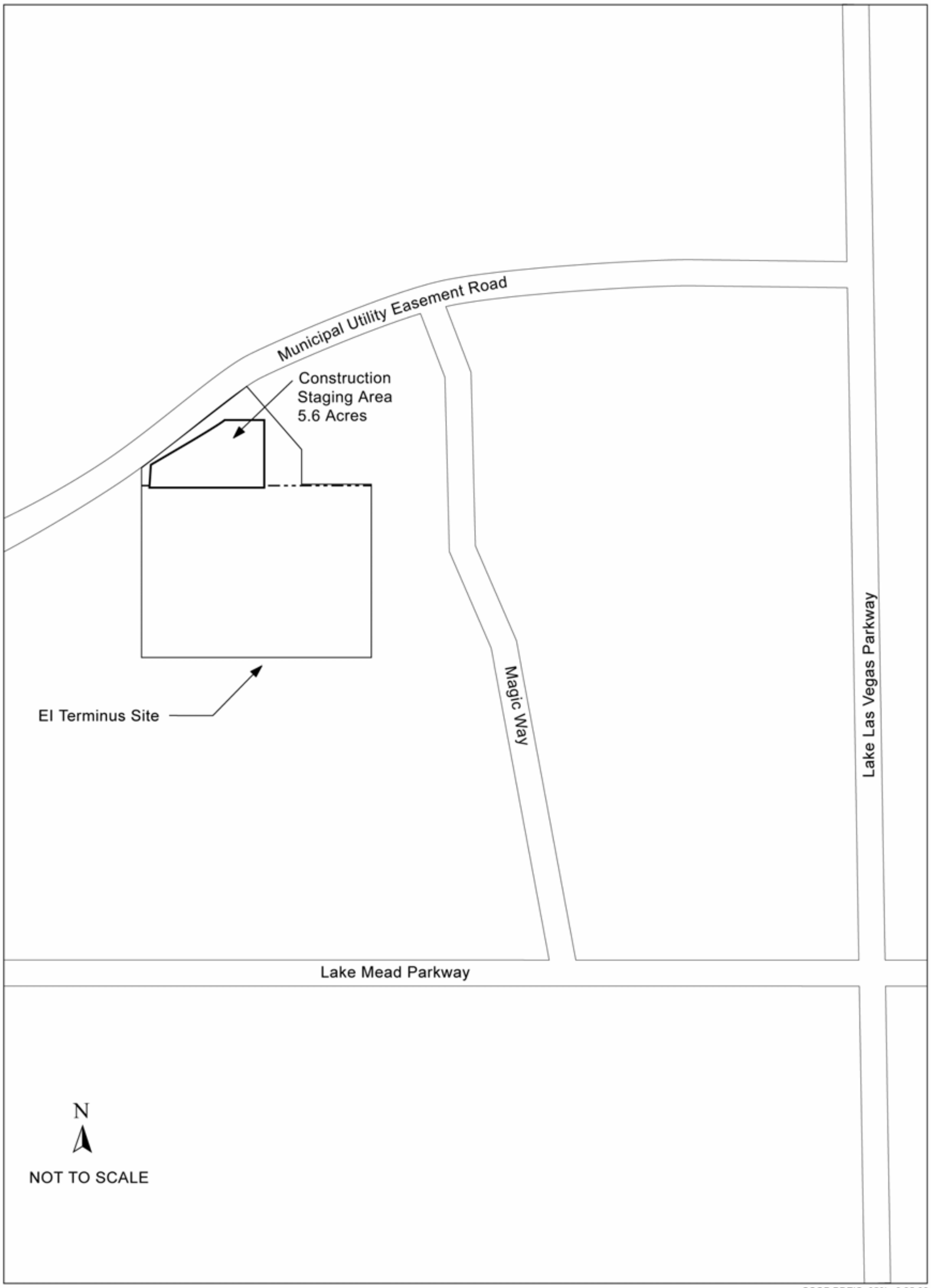

Figure 2.2-3 Effluent Interceptor-Alignment A Terminus Facility.

Access to the EI Terminus site would be provided by an existing municipal road accessible from Magic Way.

2.2.1.2.3 Manholes

Access manholes would be necessary to enter the pipeline for inspection or maintenance. An access manhole includes pipeline access, and a manhole or vault with ground-level access and cover. Along the EI pipeline, access manholes would be located at approximately every 2,000 ft (610 m). The manhole would be 30 inches (76 cm) in diameter and would be located at bends, transitions, and bifurcations along the alignment.

2.2.1.2.4 Maintenance and Access Roads

Access to the EI and ancillary facilities must be available at all times for inspection, maintenance, and emergencies. General construction, operation, and maintenance access to the project area would be via the major highways in the area, which include U.S. highways 95 (US 95), 93 (US 93), and 515 (US 515), Boulder Highway, and Lake Mead Parkway. The EI and COH Forcemain would be accessible by lesser roads such as Desert Inn Road, Hollywood Boulevard, Telephone Line Road, Pabco Road, Olson Street/Sunset Road, Magic Way, and Russell Road (Figure 2.2-4).

2.2.1.3 Land Requirements

A width of 175 ft (53 m) was used to calculate the total land area required for the EI temporary construction easement. A width of 125 ft (38 m) was used to calculate the total land area required for the COH Forcemain temporary construction easement. The permanent easement widths required for the EI reaches and COH Forcemain are:

- 80 ft (24 m) for Reach 1,
- 110 ft (34 m) for Reach 2,
- 40 ft (12 m) for Reach 3 (subsurface easement), and
- 50 ft (15 m) for the COH Forcemain.

Although it is anticipated that the majority of the excavated material and pipe material would be stored within the 175 ft (53 m) temporary construction easement, additional area would be required for material and equipment storage (Table 2.2-2). The sites being considered as construction staging areas would be located adjacent to the EI and COH Forcemain (Figure 2.2-2). The siting of the staging areas on these lands minimizes the amount of new disturbance to federal lands.

Table 2.2-2 lists properties that appear to be suitable for use as staging areas, based on their location and current land use. The staging-area numbers correlate with the identifier numbers presented on Figure 2.2-2.

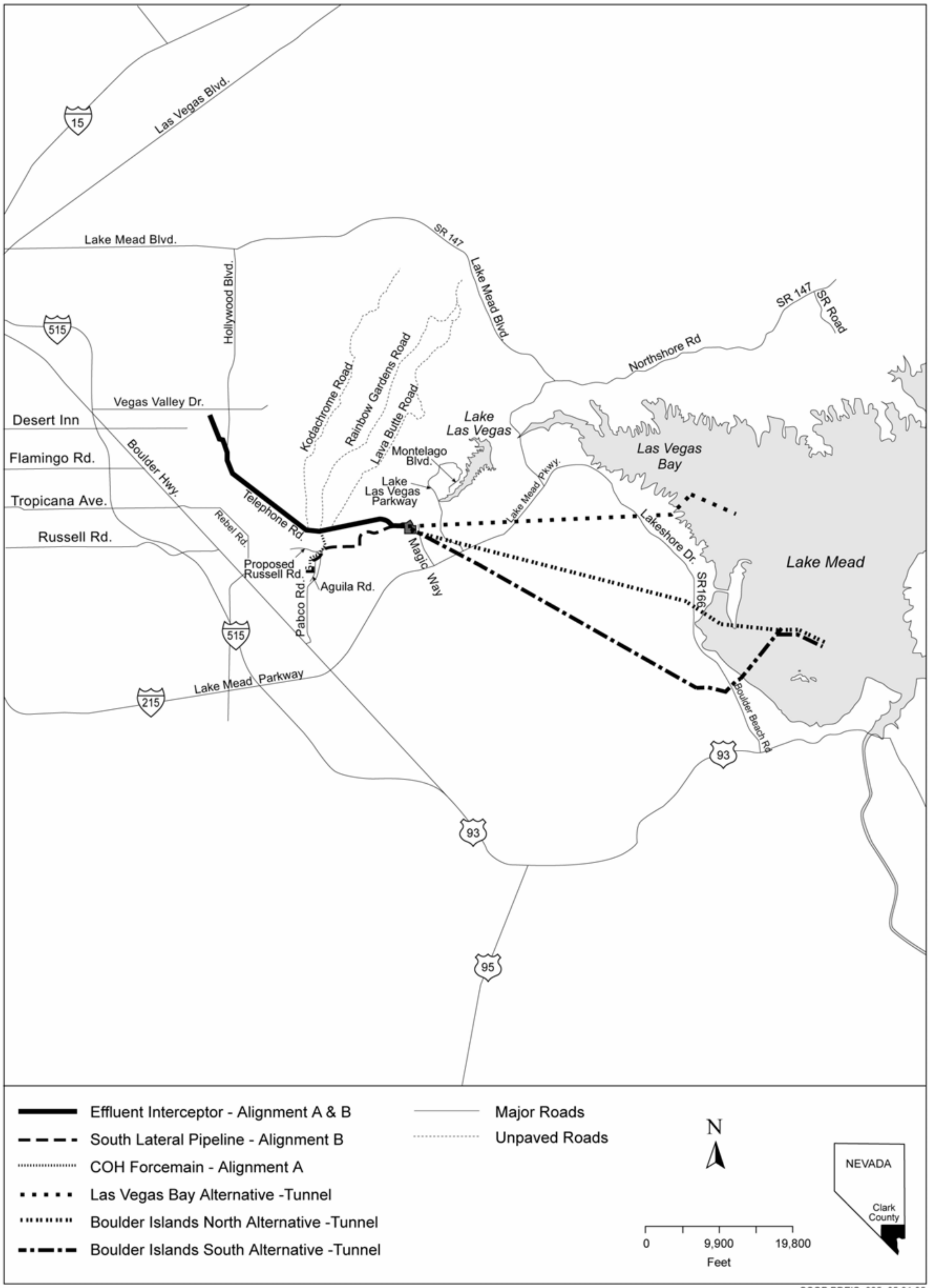

Figure 2.2-4 Maintenance and Access Roads.

2.2.1.4 Construction

Construction of the EI-Alignment A would take approximately 28 months. The only location that would require work in the Las Vegas Wash would be at the CCWRD wash return structure. All other proposed Las Vegas Wash crossings would be via tunnels. The two major construction techniques for the pipeline installation would include cut-and-cover and tunneling. Cut-and-cover construction is comprised of heavy excavation equipment trenching along the alignment and laying pipe to a specified slope.

Project construction activities would include:

- Earthwork including clearing, grading, grubbing, embankment construction, trench excavation, tunneling, fill, and erosion control activities;
- Removal or relocation of existing facilities;
- Structure construction (baffle structures, reservoirs, and control structures);
- Existing traffic maintenance during construction;
- Dust abatement;
- Wildlife fencing, security fencing, and gates;
- Cross-drainage culverts;
- Signing and lighting; and
- Landscaping and seeding.

Equipment to be used during the construction activities includes:

- Scrapers,
- Trenchers,
- Dozers,
- Haul Trucks,
- Dump Trucks,
- Water Trucks,
- Tunnel Boring Machines,
- Graders,
- Front-end Loaders,
- Backhoes,
- Cranes, and
- Flat-bed Trucks.

Techniques: Trench excavation (cut and cover) would be the method of pipe installation for parts of the pipeline alignment. Tunneling would be required on reaches that cross the Las Vegas Wash, typically in the manner of a standard jacking operation for the shorter reaches and shallower depths.

Cut and Cover: Cut-and-Cover construction is comprised of heavy excavators trenching along the alignment and laying pipe to a specified slope. The depth of the trench would vary from 11 to 32 ft (3 to 10 m), depending on the natural topography of the alignment and the reach of pipe. Reach 1 between the CLV facility and the CCWRD facility may require dewatering operations, due to the presence of groundwater, during the construction of the pipeline. Portions along Reach 3 may also require dewatering in areas near the Las Vegas Wash and at the EI Terminus location due to the depth of the structure. Table 2.2-1 summarizes the construction method to be used for each segment of the EI and COH Forcemain.

Tunneling: Tunneling would be required at all Las Vegas Wash crossings and at major utility crossings to limit direct impacts to the Las Vegas Wash and major utilities. The CWC would coordinate with the SNWA and other utility organizations to ensure that the EI does not impact any SNWA waterlines or other utilities. Tunneling would be required at the locations listed in Table 2.2-1.

2.2.1.5 Spoils and Materials

The top 6 inches (15 cm) of surface material would be stockpiled separately from other excavated material at the staging areas, and would be used as seedbed after final grading. It is assumed that the majority of the excavated material would be used as trench backfill or during final grading. The amount of excess material excavated from EI-Alignment A is shown on Table 2.2-3. It would be necessary to import backfill material, which would be stored along the trench. The backfill material would be obtained from a commercially available source. The procurement of this material would be part of the construction activities performed by the construction contractor. The pipe would be strung along the trench on top of the imported trench backfill material. The average volume of imported backfill that would be required for the cut-and-cover portions of EI-Alignment A are shown on Table 2.2-3.

This excess material would be used for other projects or hauled off to the nearest landfill. The number of truckloads required to haul the excess materials and deliver the backfill material is shown on Table 2.2-3.

Table 2.2-3 Spoils Generated and Backfill Material Required for the EI – Alignment A.

Segment	Spoils/Muck (cubic yards)	Backfill (cubic yards)	Truckloads [1]
Cut-and-Cover	355,000	31 – 60	17,750
Tunneling	72,000	--	3,600
Total	427,000	31 – 60	21,350

Note:
[1] Assumes 20 cubic yards per truckload.

2.2.1.6 Operation of the Effluent Interceptor – Alignment A

Effluent Interceptor-Alignment A would be designed to allow maximum flexibility for management of effluent flows. The EI and the associated treatment plant connections would be designed to allow from 0 to 100 percent of the plants' flows to the Las Vegas Wash or the EI. Control points for the system would be located at the three treatment plants. One-hundred percent of the effluent flows may be discharged to the Las Vegas Wash during emergencies or maintenance of the pipeline. Regular maintenance at the treatment facilities would be scheduled and coordinated to ensure that all three plants are not discharging 100 percent of their flows to the Las Vegas Wash at the same time. The CLV and CCWRD flows would be combined with the COH flows by the COH Forcemain and be transported to Lake Mead via the LCS.

The O&M of the EI would be managed by the CWC in coordination with the member agencies and the Management Advisory Committee. A minimum of 30 mgd (46 cfs) of treated effluent would be discharged to the Las Vegas Wash year round. Together with the 20 mgd (31 cfs) of base flow, the total flow in the Las Vegas Wash is expected to be at least 50 mgd (77 cfs).

As part of the pipeline alternatives, a Boulder Basin AMP would be designed and implemented. The Boulder Basin AMP, which is described in Section 2.2.2.6, would include operation of the EI relating to the quantity of effluent delivery to the Las Vegas Wash, EI, and LCS.

2.2.2 Lake Conveyance System, Boulder Islands North

The Boulder Islands North LCS would convey the combined effluent flows from the three treatment facilities to a discharge location near the Boulder Islands in Lake Mead (Figure 2.2-1). The Boulder Islands North LCS is described in terms of the alignment, ancillary facilities and structures, land requirements, construction, and spoils and backfill materials.

2.2.2.1 Alignment

The Boulder Islands North LCS alignment would begin at the EI Terminus, which is the transition point between the EI and LCS, and end northeast of the Boulder Islands as shown on Figure 2.2-5. All temporary and permanent disturbance would be located within the 40-acre (16 hectares) EI Terminus site, located on land owned by Reclamation. The pipeline would be designed to allow extension of the pipe if needed, based on changing lake conditions. The Boulder Islands North LCS alignment is divided into two segments consisting of the NRMT3 and the BINDP.

2.2.2.1.1 North River Mountains Tunnel No. 3

The NRMT3 would begin at the NRMT3-West working shaft located at the EI Terminus and would proceed in a southeasterly direction for approximately 39,000 ft (11,887 m) to the NRMT3-East working shaft located on NPS land (Figure 2.2-5). The NRMT3 would be drilled through competent bedrock and would pass beneath property owned by Reclamation, BLM, Lake Las Vegas Golf Course, Three Kids Mine, and NPS. The NRMT3-West working shaft would be approximately 70 ft (21 m) deep. The activities for the western segment of the NRMT3 would be

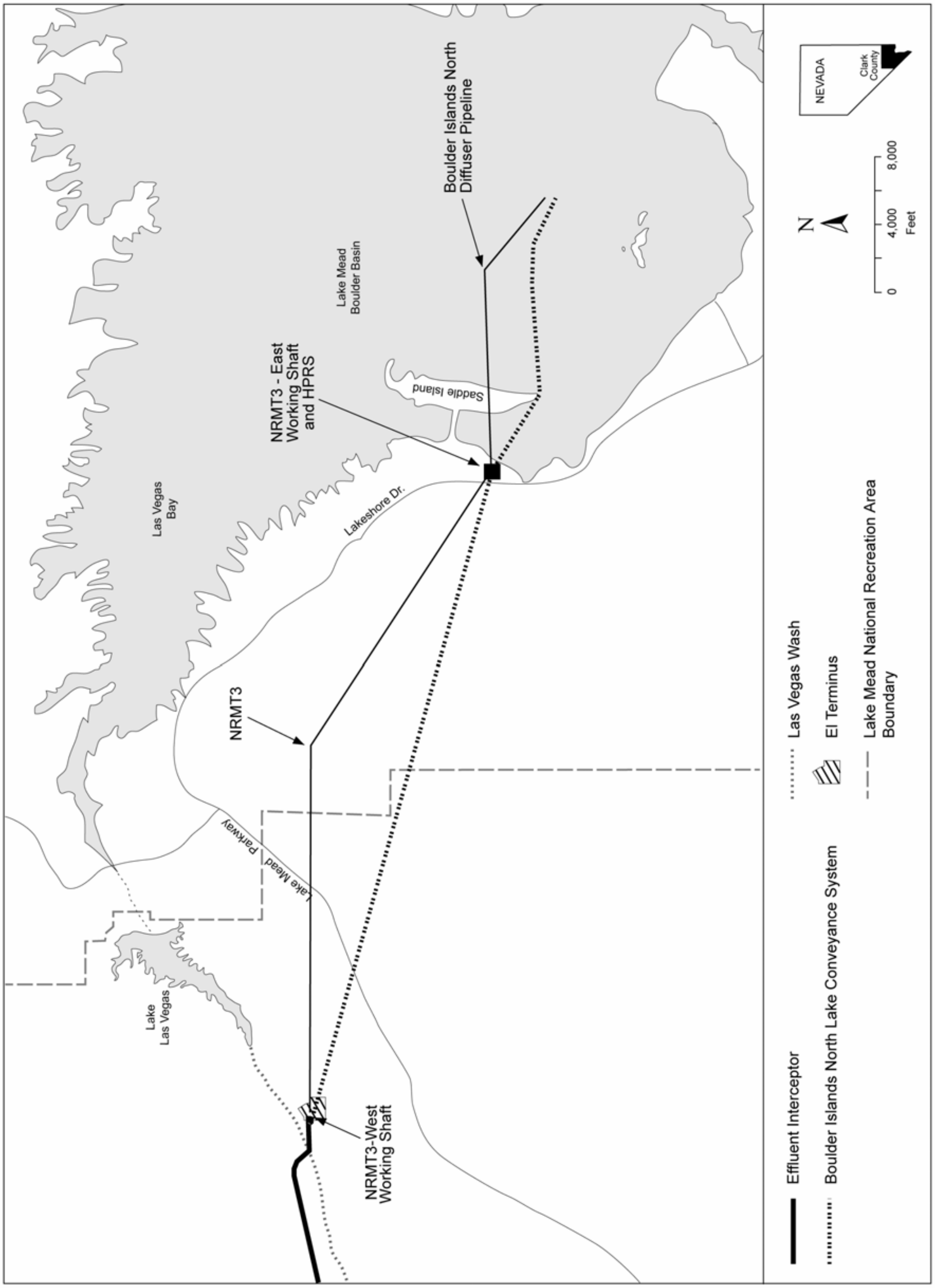

Figure 2.2-5 Boulder Islands North Lake Conveyance System.

staged at the EI Terminus site. The NRMT3-East working shaft would be approximately 60 ft (18 m) deep. The activities for the eastern segment of the NRMT3 would be staged at the NRMT3-East working shaft location. All temporary and permanent disturbance associated with the tunnel shaft, portal area, and HPRS would be located within the 5-acre (2-hectares) site, located on land owned by the NPS. Electrical power and water would be provided to the shafts by using existing roads and utility corridors (Figures 2.2-6 and 2.2-7).

2.2.2.1.2 Boulder Islands North Diffuser Pipeline

The BINDP would be installed using cut-and-cover, dredged, and subaqueous construction techniques. The BINDP would be approximately 28,400 ft (8,656 m) long. The BINDP would start at the HPRS located at the NRMT3-East shaft area and would consist of a series of pipelines installed using a cut-and-cover method to the water line of Lake Mead. At the water line, a dredging construction technique would begin and continue to the lake bottom elevation of 1,000 ft (305 m), at which point subaqueous construction would be used to the diffuser location. The diffuser would be located northeast of the Boulder Islands at an elevation of 880 ft (268 m). The cut-and-cover section is approximately 6,600 ft (2,012 m), the dredged section is approximately 5,300 ft (1,615 m), and the subaqueous section is approximately 16,500 ft (5,029 m) in length.

The cut-and-cover pipeline would be installed in a trench approximately 20 ft (6 m) deep with a minimum cover of 8 ft (3 m). Biological and cultural resource surveys were conducted for a 400-ft corridor, 200 ft on either side of the center line, for the cut-and-cover segment of the BINDP. The temporary and permanent disturbance would be contained within the surveyed area. The dredged pipeline would be installed in an underwater trench 55 ft (17 m) wide with a minimum cover of 6 ft (3 m). The subaqueous pipeline would be installed on pylons anchored to the bottom of Lake Mead. The pipeline would be designed to allow extension of the pipe if needed, based on changing lake conditions.

2.2.2.2 Ancillary Facilities and Structures

Ancillary facilities and structures for the Boulder Islands North LCS would be required for the O&M of the pipeline. The Boulder Islands North LCS ancillary facilities and structures are described in this section.

2.2.2.2.1 Hydroelectric / Pressure Regulating Station

An HPRS would be constructed at the NRMT3-East working shaft location to reduce the internal pressure in the pipeline before discharging to Lake Mead. In addition to reducing the pressure in the pipeline, power would be generated and delivered to the AMSWTF via an underground transmission line. The transmission line alignment is shown on Figure 2.2-7. The HPRS would begin generating power immediately following infrastructure construction. The projected 2050 flows would generate approximately 10 to 15 megawatts (mW) of hydroelectric power. The HPRS would be constructed at an elevation of approximately 1,275 ft (388 m), which is above the historical high water level of Lake Mead. Operation of the HPRS would not be dependent on the Lake level. The location of the HPRS is shown on Figure 2.2-6. The HPRS would be

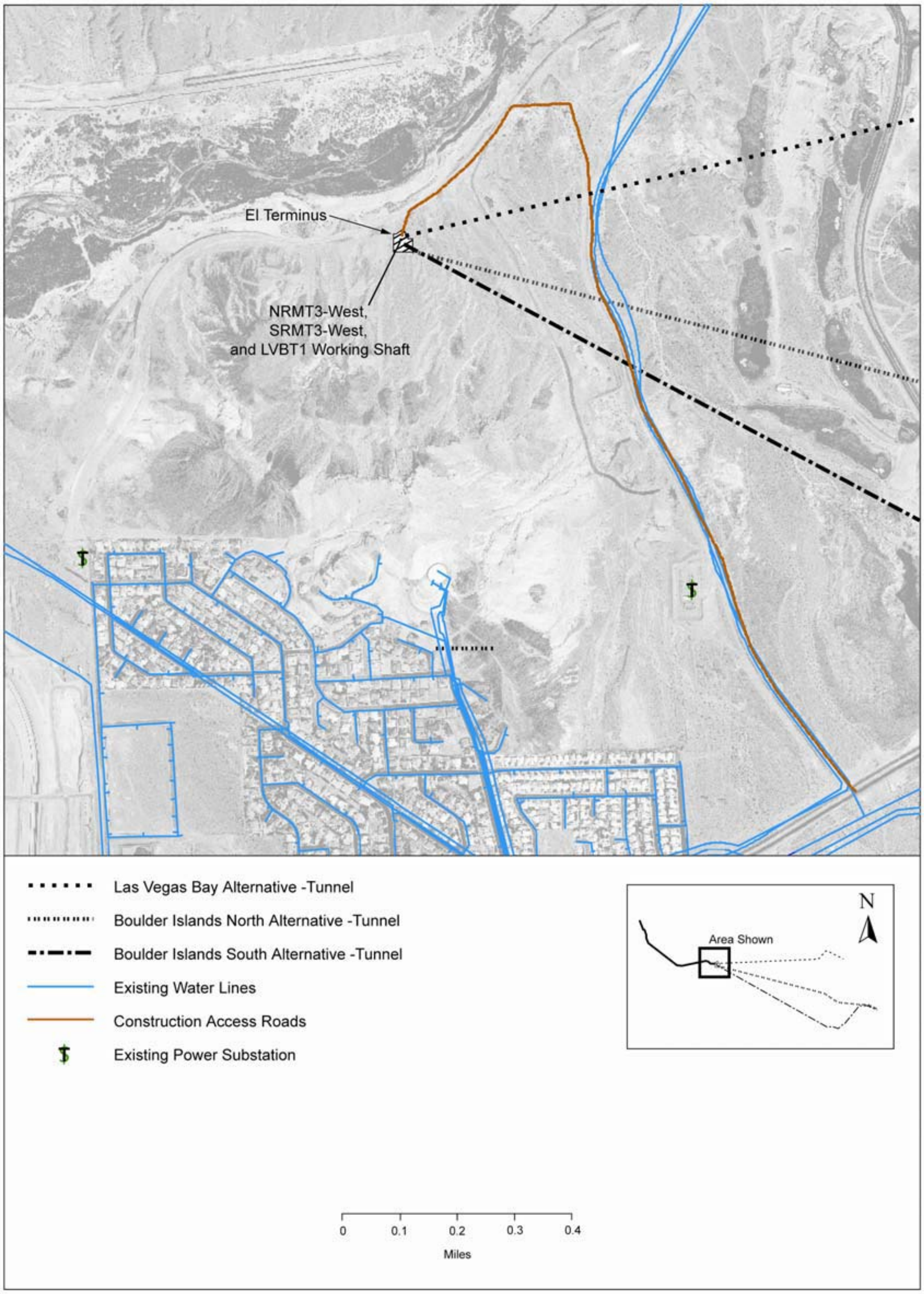

Figure 2.2-6 NRMT3-West, SRMT3-West, and LVBT1 Working Shaft.

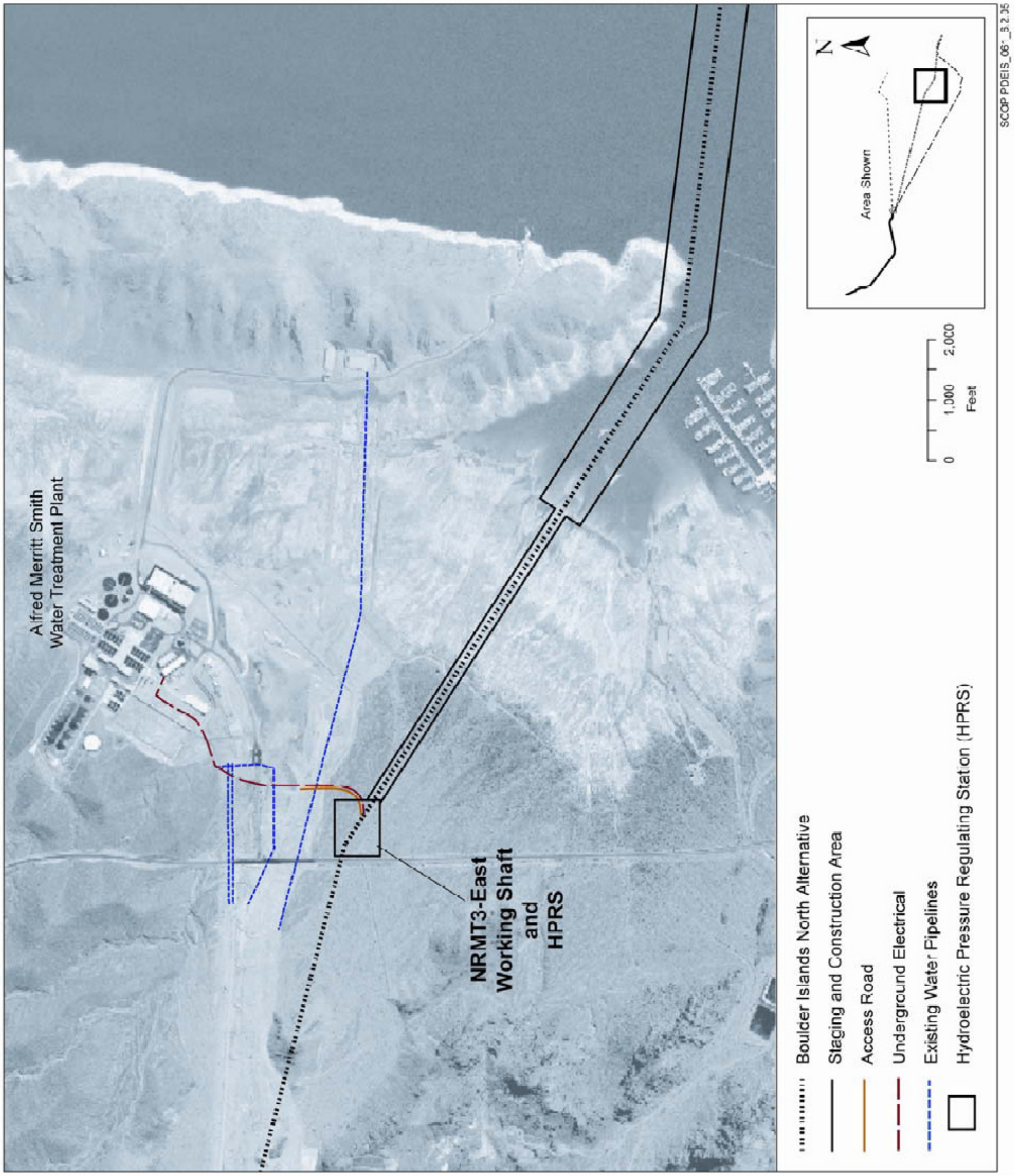

Figure 2.2-7 NRMT3-East Working Shaft and Hydroelectric/Pressure Regulating Station.

constructed in a partially below-grade structure with an earthened cover and surrounding berm to shield the structure from LMNRA visitors. All temporary and permanent disturbance associated with the HPRS would be located within the 5-acre (2-hectares) site, located on land owned by the NPS. The permanent footprint of the below-grade structure would be less than 1 acre (0.4 hectare). Electric power and potable water would be provided via existing power and water lines (Figure 2.2-7).

2.2.2.2.2 Maintenance and Access Roads

General construction, operation, and maintenance access to the Boulder Islands North alignment and shaft locations would be via the major highways in the area, which include US 95, US 93, US 515, Lake Mead Parkway, and Lakeshore Drive (Figure 2.2-5). The working shafts and HPRS would be accessible by existing unpaved roads that provide adequate vehicle access to the shaft locations (Figures 2.2-4, 2.2-6, and 2.2-7). Many of the roads that would be used for access to the various project sites are unnamed, unpaved roads. The unpaved road that would primarily be used for access to the NRMT3-East working shaft is an access road near the entrance to the AMSWTF site.

2.2.2.2.3 Diffuser

The outlet of the LCS would consist of a single port diffuser from each of the pipelines. The subaqueous pipeline would consist of a series of High Density Polyethylene (HDPE) pipes with the diffuser at the end of these pipes. The diffuser ports would be located within Lake Mead and anchored to the Lake bottom at an elevation of approximately 880 ft (268 m). The diffuser would be located approximately 4,200 ft (1,280 m) and 1,500 ft (457 m) from the nearest Boulder Islands shoreline when Lake levels are at 1,178 ft (359 m) and 1,000 ft (305 m), respectively. The velocity and rate of flow through the ports would be controlled from the HPRS. The ports would be oriented to allow a horizontal or slightly downward discharge.

The final configuration of the diffuser would be determined as part of final design. Current modeling indicates that the effluent discharged from the diffuser would have significant thermal buoyancy. This buoyancy would cause the effluent to rise above the elevation of the drinking water intakes. Preliminary and final design would include modeling of the diffuser operations. The modeling would consider changing Lake conditions.

2.2.2.3 Land Requirements

A permanent subsurface utility easement approximately 40 ft (12 m) wide would be needed along the entire tunnel section of the Boulder Islands North LCS. In addition, the NRMT3-East working shaft would require approximately 5 acres (2 hectares) for temporary construction activities. After completion of construction activities, a permanent easement of 300 x 300 ft (91 x 91 m) at the working shafts would be needed.

The BINDP segment of the alignment would require a 1,000 ft (305 m) wide temporary construction easement to provide adequate working area for equipment, pipe, and trench spoils.

A 150 ft (48 m) wide permanent easement would be needed once construction activities are complete.

2.2.2.4 Construction

Construction activities, durations, and types of equipment needed for each segment of the Boulder Islands North LCS are presented in Table 2.2-4. The various segments of the Boulder Islands North LCS would be constructed concurrently.

Employment under the Boulder Islands North Alternative would consist of approximately 8,906 workers each year from 2007 until 2009. Once the EI is constructed, the number of workers needed would be lowered to approximately 7,662 workers. However, in 2012, the total number of workers would increase to approximately 7,813 workers when construction of the hydroelectric power generation facility would be constructed. The number of workers required each year does not reflect an additional 8,906, 7,662, and 7,813 people per year, rather it is expected that this is the total level of employment required per year to sustain the construction, construction support, and other commercial growth rate. Many employees would retain their employment year after year.

Construction equipment and materials for each segment of the alignment would be hauled to the appropriate working shaft site or staging area. The types of materials and equipment that would be delivered are shown on Table 2.2-5. The number of trucks that would deliver the materials and equipment is also shown on Table 2.2-5.

Construction activities and equipment for the BINDP would be similar to those described for the EI. Construction of the BINDP would be limited to the 6-month time frames between October and March of each year. Thus, this segment of the alignment would require 2 or 3 years to complete with construction occurring only during the specified 6-month time frames.

Construction activities and equipment for the BINDP are different than for the other segments of the alignment as shown on Table 2.2-4. The launching of equipment and materials for the diffuser pipeline section of the alignment would occur from two barges. A floating dock would be mobilized to allow trucks to back onto the dock and be loaded with spoils dredged from the floor of Lake Mead. Dredging would be conducted using a clamshell dredge, which consists of a large barge-mounted crane equipped with a clamshell bucket and stabilizing spuds. The project would also require two transfer barges, a small tug or work boat, a second shore-based crane with a smooth-jawed (i.e., no teeth) bucket or large backhoe with a smooth bucket to unload the transfer barges to trucks for transport to the spoil area. The transfer barges would be smaller than the crane barge and consist of a sealed water-tight hull with raised perforated sides to contain dredged spoils as they are deposited onto the barge by the clamshell. Sufficient spoil material would be stockpiled in the designated temporary spoil area for backfilling the trench after the pipeline is laid. Small quantities of fuel would be transported by boat to equipment residing on the barges. Fuel would not be stored on site.

A turbidity curtain would be installed in the areas that require dredging and around the diffuser location. The type of turbidity curtain to be used during dredging activities would be selected in coordination with the CWC, SNWA, NPS, and other agencies to ensure that the curtain performs as needed. It is premature to provide details regarding the turbidity curtain at this time. However, the curtains would be a permeable geotextile fabric that is suspended from buoys floating on the surface of the Lake. Divers would anchor the curtain with weights to secure it to the Lake bottom. The curtain would isolate silt within the curtain perimeter and minimize silt spread outside the dredging areas. An approximate 1,000 ft (305 m) wide section in the Lake would be encompassed by the turbidity curtain at each location to allow room for the dredging support equipment and barges to maneuver. The 1,000 ft (305 m) sections would include paralleling the pipeline (500 ft [152 m] on each side of the centerline) during dredging activities,

Table 2.2-4 Construction Activities, Duration, and Equipment for the Boulder Islands North Lake Conveyance System.

Segment	Construction Activities	Construction Duration (months)	Equipment
North River Mountains Tunnel No. 3 – West (NRMT3-West)	• Mobilization (material and equipment delivery) • Shaft excavation and blasting • Tunnel excavation • Tunnel lining and grouting • Final shaft lining • Connection to EI	35	• Cranes • Muck-loading equipment • Drills • Compressors • Trucks • Dozers • Graders • Backhoes • Construction trailers • Tunnel-boring machine
North River Mountains Tunnel No. 3 – East (NRMT3-East)	• Mobilization (material and equipment delivery) • Shaft excavation and blasting • Tunnel excavation • Tunnel lining and grouting • Final shaft lining	67	Same as NRMT3 – West
Boulder Islands North Diffuser Pipeline (BINDP)	• Mobilization • Dredging • Subaqueous pipeline construction	31[1]	• Barges • Barge-based cranes • Clamshell dredge • Tug or workboat • Turbidity curtain • Shore-based crane • Backhoe • Dozer • Trucks

Note:
[1] Six month time frame from October to March.

Table 2.2-5 Material and Equipment Deliveries for the Boulder Islands North Lake Conveyance System.

Segment	Material & Equipment	Duration	Truckloads
NRMT3-West	• Equipment - Miscellaneous - Construction trailers • Materials - Pipe - Shaft lining and backfill - Grout - Pipe and Pipe embedment materials for connection to EI (at EI Terminus)	• 3 months • Once during mobilization and once during demobilization • 35 months • 3 months • 12 months • 31 months	• 20 per day • 10 (delivered then retrieved) • 20 per day • 50 per day • 50 per day • 50 per day
NRMT3-East	• Equipment - Miscellaneous - Construction trailers • Materials - Pipe - Shaft lining and backfill - Grout - Pipe and Pipe embedment materials for connection to Boulder Islands Outfall Pipeline	• 3 months • Once during mobilization and once during demobilization • 35 months • 3 months • 12 months • 31 months	• 20 per day • 10 (delivered then retrieved) • 20 per day • 50 per day • 50 per day • 50 per day
BINDP	• Equipment - Miscellaneous • Materials - Pipe	• 3 months • 31 months	• 20 per day • 50 per day

and approximately 200 ft (61 m) downstream of where dredging along the pipeline alignment would cease. The curtain would be removed following each construction season.

The subaqueous and dredged pipelines would be constructed of multiple HDPE that are fused onshore, floated into position by barges and slowly filled and allowed to sink to the bottom of Lake Mead. The dredging equipment would be staged off barges and the pipeline lowered into the dredged trench.

2.2.2.5 Spoils and Backfill Materials

The majority of the material that would be excavated from the Boulder Islands North LCS is considered “public minerals” with respect to subsurface rights on federal lands. The excess spoils may be used for public projects such as dust control on federal lands or construction materials for roadways, flood control facilities, or other public projects. The amount of spoils generated from each segment of the Boulder Islands North LCS is shown on Table 2.2-6.

The tunnel spoils would be 2 to 6 inches (5 to 15 cm) or less in size. The spoils would be used for public purposes and spoils would be hauled by truck from the working shafts via the haul routes shown on Figure 2.2-7.

Table 2.2-6. Spoils Removed for the Boulder Islands North Lake Conveyance System.

Segment	**Spoils Removed (cubic yards)**	**Backfill / Grout (cubic yards) [1]**	**Truckloads [2]**
NRMT3-West and Tunnel	154,000	20,400	8,720
NRMT3-East and Tunnel	154,000	20,400	8,720
BINDP	9,500	n/a	475
Total	317,500	40,800	17,915

Notes:
[1] The BINDP requires no hauling from off-site location, backfill processed within construction easements.
[2] Approximate truckloads, depending upon the contractor’s choice of rock hauling trailers, this table assumes 20 cubic yards per truckload. Backfill/Grout was estimated at 20 cubic yards per truck load.

2.2.2.6 Operation of the Boulder Islands North Lake Conveyance System

The Boulder Islands North LCS would be designed to allow maximum flexibility for management of effluent flows. Flows to the LCS would be directed and controlled at the HPRS, which would be located as shown on Figure 2.2-7.

The hydroelectric generation station would likely have two turbines, designed to recover electric power while decreasing the pressure in the LCS. The construction for the hydroelectric units would be staged to match the increased flows over the years of the project. The overall building size and locations of pipe connections for the hydroelectric units would be determined in the initial phase of construction. In the event of a power loss, the gates on the turbines would close and the PRS sleeve valves would open to keep the LCS in operation.

Downstream of the HPRS, the flows would be directed to multiple pipelines that discharge into Lake Mead. Each pipeline would end in a single diffuser port. The diffuser ports would be located within Lake Mead and anchored to the Lake bottom at an elevation of approximately 880 ft (268 m). The velocity and rate of flow through the ports would be controlled from the PRS. The ports would discharge the flow in a horizontal or slightly downward direction. The Lake conditions and flows would determine the operation and orientation of these ports.

Discharges in the vicinity of the Boulder Islands would be subject to NPDES permitting requirements established by NDEP. The NDEP has taken an active role in protecting water quality and regulating wastewater discharges into Lake Mead, and will continue to do so. The NDEP has been particularly interested in phosphorus loading and chlorophyll concentrations in Lake Mead. The NDEP implemented a TMDL program including WLAs for phosphorus (334 lbs/day) and ammonia (970 lbs/day) discharged into the Las Vegas Wash in the 1980s. Although these WLAs would not apply to discharges through the LCS, the TP loading from effluent discharged through the LCS and the Las Vegas Wash into the Boulder Basin would not exceed the current WLA on an average annual basis during ordinary conditions. Although it is difficult to predict if and when extraordinary circumstances may occur, they may arise if regulatory agencies impose requirements that result in increased phosphorus discharges that result in an appropriate environmental benefit. In all circumstances, however, the discharge would be regulated by NDEP, who would ensure compliance with all NPDES permit provisions and federal and Nevada water quality requirements.

In addition, as part of the Boulder Islands North Alternative, a Boulder Basin AMP would be designed and implemented. A summary of the Boulder Basin AMP is provided in the following paragraphs. Preparation of the Boulder Basin AMP is ongoing, but the most up-to-date version is available upon request. However, as indicated by its title, the plan is meant to be "adaptive". A Core Management Team (CMT) consisting of representatives of the NPS, Reclamation, SNWA, and the CWC would manage and revise the AMP as necessary to protect the water quality and recreational and resource values of Lake Mead. The Boulder Basin AMP would be evaluated twice per year (spring and fall) to assess whether the objectives are being met. The Boulder Basin AMP would be modified, if necessary, to address inefficiencies, new contaminants of concern, or changes in Lake conditions. Monitoring data collected as part of the Boulder Basin AMP would be analyzed and reviewed continually to ensure early detection of potential issues.

The initial Boulder Basin AMP is based on the extensive water quality modeling of the Boulder Basin, the current knowledge of Lake Mead and the Las Vegas Wash, and focuses on establishment of baseline conditions and management of the operations of the wastewater treatment and SCOP facilities. It specifically addresses the management of the treatment and release of effluent. It also recognizes the need for identification and management of non-effluent related stressors in the Lake Mead ecosystem.

The initial Boulder Basin AMP would develop processes for the following.

- Establishment of the Boulder Basin AMP Program Structure.
- Establishment of strategic and tactical management objectives and goals for water quality in Boulder Basin. This involves setting goals regarding meeting the various water quality standards as well as determining objectives regarding nutrient management, natural resource

use and disturbance, drinking water quality, downstream water quality, and recreational use including sport fisheries.

- The Boulder Basin AMP is based on two fundamental criteria: (1) operate the SCOP facilities so the effluent is distributed in a manner that would protect drinking water and downstream users, and protect NPS recreational and resource values; and (2) monitor and manage non-effluent related stressors to minimize variances in nutrient loads within Boulder Basin.
- Monitoring water quality. Water quality status and trends would be determined by monitoring at strategic and sensitive areas in Lake Mead. Baseline monitoring would start in 2006 or 2007. Long-term monitoring would also be implemented to provide vital information about the water quality in the Boulder Basin.
- Data analysis and modeling for water quality in the Boulder Basin. This would be an ongoing effort that would involve performing laboratory tests, simple calculations, developing a Boulder Basin Management Indices system (BBMI), and continually updating and utilizing the three-dimensional modeling using the Estuary and Lake Computer Model (ELCOM)-Computational Aquatic Ecosystem Dynamic Model (CAEDYM)-PLUMES suite of models. The BBMI would be reviewed at least annually by a technical committee consisting of appointed experts in the fields of limnology, modeling, permitting, fisheries, and other water quality areas as necessary in an attempt to develop a management indices system that would assist in predicting water quality in Lake Mead and identifying potential water quality areas of concern.
- Develop a Decision Making Process. This process would be used to identify areas of concern and the actions required to resolve the concern. Decision protocols would be developed for protecting water quality at the SNWA intakes and Hoover Dam outlets, and NPS recreational and resource values.
- Development of a SCOP Operational Plan. The components of the SCOP system that are subject to adaptive management changes include: operating the diffuser ports to control the effluent insertion level and horizontal location within the reservoir, adjusting the total nutrient levels released through the wastewater reclamation facilities, and adjusting the flow of effluent released to the Las Vegas Wash. At the outset, an initial SCOP Operational Plan would be developed. This plan would include details for the operation of the system for different seasons, Lake levels, and nutrient loadings. The Operations Plan would be adaptive, especially in the first few operational years of the SCOP. Meetings would be held as needed to change and update the criteria documented in the Plan based on real-world conditions in Lake Mead and the Las Vegas Wash.
- Development of a Management Action Plan (MAP). This process would be designed to respond to water quality changes in areas of concern. When an area of concern is identified through data analysis, modeling, and the decision-making process, a MAP would be designed and implemented as necessary to ensure that existing water quality and recreational and resource values in the areas of concern would be protected. Management action may consist of changing the flow distribution between the Las Vegas Wash and the diffusers, increasing nutrient removal through wastewater treatment processes, best management practices (BMPs) and best available technologies for non-effluent related stressors, and varying the hydraulic operation of the diffusers.

The Boulder Basin AMP process would develop an appropriate mix of indices, goals, milestones, and performance measures to evaluate environmental conditions. The Boulder Basin AMP would also help to identify existing and emerging environmental problems, set environmental priorities, and make program-specific decisions to address the highest priorities.

The Boulder Basin AMP would be administered through the CMT in conjunction with a number of committees and workgroups. It is envisioned that successful progress would be facilitated by a program structure that provides networking opportunities for basin-wide dialogue by providing discussion through evolving interest from active agencies and community involvement. There are many programs and projects that either have been or are in various stages of implementation on Lake Mead. The CMT would work with the other agencies and programs to coordinate the release of effluent through the Las Vegas Wash and the diffuser.

The initial Boulder Basin AMP organization is comprised of the CMT, a Technical Committee, and an Advisory Committee. Figure 2.2-8 presents the Organizational Structure for the initial Boulder Basin AMP. The organizational structure would be reviewed periodically and adjusted if needed and agreed to by all parties in the CMT.

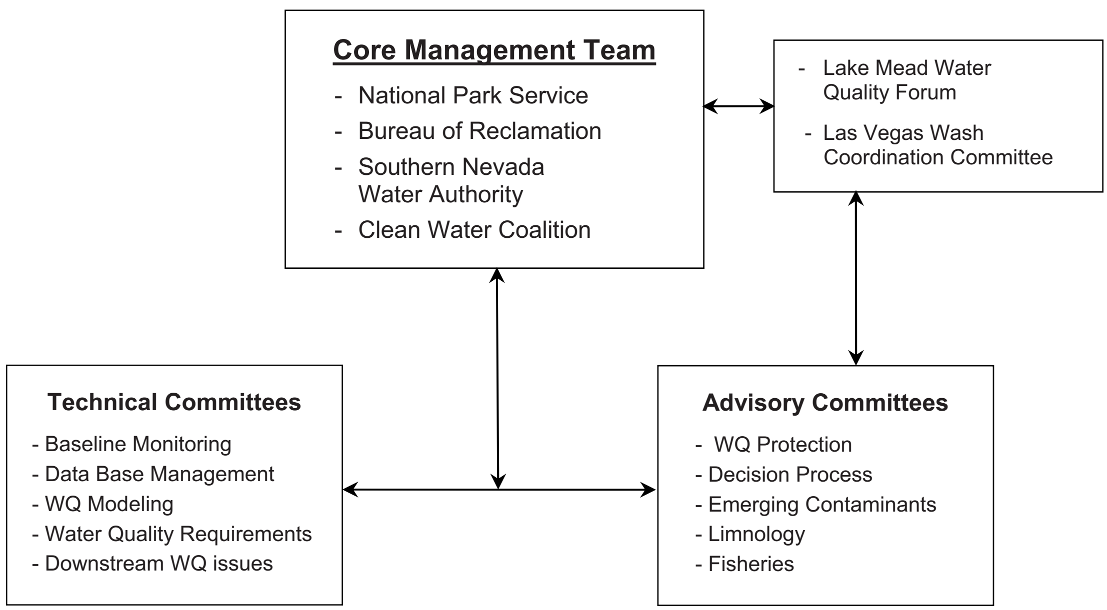

Figure 2.2-8 Organizational Structure for the Initial Boulder Basin AMP.

The Lake Mead Water Quality Forum (LMWQF) and the LVWCC would be used as a communication tool with the public and other local, state, and federal agencies. Once SCOP is operational, a summary of the previous year's water quality data and the next year's Operating

Plan would be presented annually to members of the LMWQF and the LVWCC. Attainment of water quality goals would be discussed.

The CMT would oversee the completion of the initial Boulder Basin AMP and the development of a long-term AMP for all SCOP-related operations within Boulder Basin. The CMT would provide oversight on the monitoring of the SCOP facilities and provide interagency coordination on the overall use of Boulder Basin.

The initial Boulder Basin AMP would identify the water quality goals as well as management strategies that would allow a timely identification and reaction if certain action levels for the areas of concern are observed. An example of a management strategy that may be implemented includes development of predictive BBMI between Secchi depth, TP concentrations, and chlorophyll *a* concentrations that can be used to determine when water quality standards may be exceeded.

Currently there is not sufficient data to establish an "action level" of TP through Hoover Dam. Once a minimum of 3 years of baseline data is accumulated, an appropriate "action level" would be selected. The baseline data would be used to develop a methodology for determining management decisions that would maintain TP through Hoover Dam below the State of Nevada RMHQ level. This action would be evaluated and adjusted as necessary.

A water quality monitoring plan would be developed as part of the Boulder Basin AMP. Water quality monitoring in Lake Mead has historically focused on regulatory monitoring for the effluent discharged through the Las Vegas Wash and the water quality for the drinking water supply. The water quality monitoring undertaken to support the Boulder Basin AMP would not be considered a part of the existing NDEP regulatory monitoring. The regulatory monitoring data and information, as well as other water quality data collected by other agencies, would be used to supplement the Boulder Basin AMP data base.

An initial baseline monitoring program including a determination of water quality parameters and the establishment of sampling locations and sampling frequency has been established to assess water quality parameters within Lake Mead and just below Hoover Dam. The parameters that would be monitored as part of the initial baseline monitoring program are shown in Table 2.2-7.

The regulatory and initial operational monitoring locations that have been identified for baseline monitoring are shown in Figure 2.2-9. Samples would be collected from various levels throughout the water column including the hypolimnion. As data is collected, the operational monitoring parameters and locations would be reviewed and, if necessary, adjusted to provide the most valuable information for management of the water quality in Boulder Basin.

In addition to the monitoring parameters presented in Table 2.2-7, a monitoring effort would be undertaken to provide background data for EDCs and PPCP. Monitoring for these compounds would provide useful background data necessary to further define their fate and transport within the lower Colorado River system. Table 2.2-8 presents the compounds that would be monitored through the initial Boulder Basin AMP. This list of analytes may change based on data results, future research, and other conditions such as changing Lake levels.

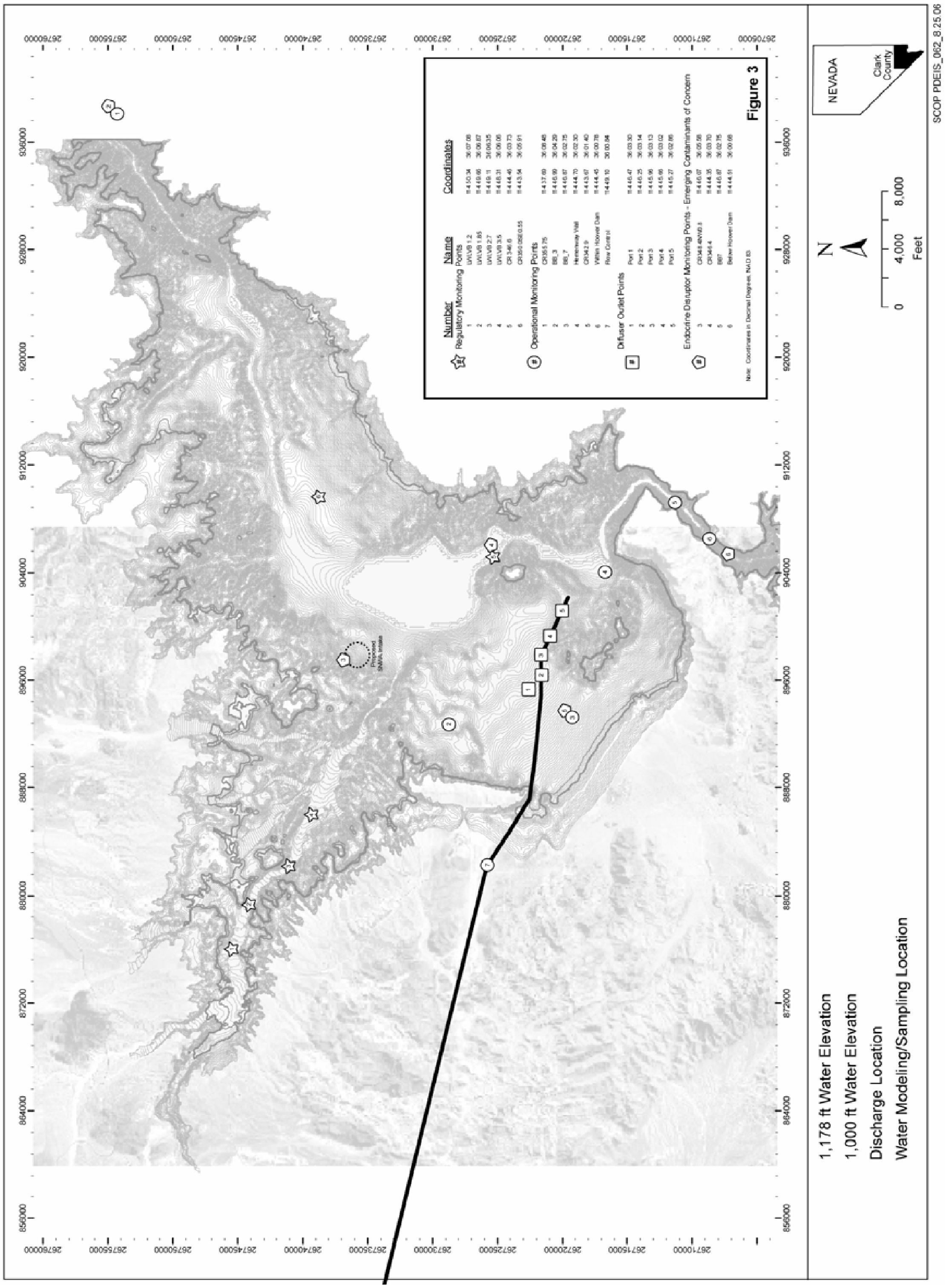

Figure 2.2-9 Water Quality Modeling/Sampling and Discharge Locations.

Table 2.2-7 Initial Baseline Monitoring Parameters.

Parameter	Parameter
Temperature	Fecal Coliform
Dissolved Oxygen	NH_4 (ammonium ion)
Conductivity	NO_2 (nitrite ion)
pH	NO_3 (nitrate ion)
Br (bromide ion)	Total Coliform
Chlorophyll *a*	Total Nitrogen
Chloride	Total Phosphorus
E coli	Total Suspended Solids
Dissolved Ortho Phosphorus	Total Organic Carbon
Total Dissolved Solids	Sulfate
Color	Turbidity

The initial monitoring locations for emerging contaminants of concern within Lake Mead are shown on Figure 2.2-9.

Once the baseline information and data sets are established, a program would be developed for long-term water quality monitoring in the Boulder Basin. The parameters recommended for long-term monitoring would be similar to those chosen for baseline monitoring.

The data collected during monitoring would be routinely analyzed by a technical committee to determine the water quality and hydrodynamics of Lake Mead. The results of this data analysis would be periodically reviewed by the CMT and appropriate actions would be implemented.

2.3 Boulder Islands South Alternative

The Boulder Islands South Alternative includes plant optimization, increased treatment (as needed), and a pipeline that would collect the highly treated effluent discharged from each of the treatment facilities and transport the effluent to an alternate receiving area in the vicinity of the Boulder Islands (Figure 2.2-1). Effluent discharge limits for releases near the Boulder Islands would not be subject to the TMDLs, which apply to the flow of the Las Vegas Wash, and in turn protects water quality in the Las Vegas Bay. The TMDL limits would still apply to Las Vegas Wash discharges. Discharge limits in the Boulder Islands area would be subject to concentration-based Water Quality Based Effluent Limitations. The three treatment agencies would expand their facilities to handle the increasing quantities of wastewater through 2050.

Table 2.2-8 Emerging Compounds of Concern to be Monitored.

Compound	Class	Common Names
a-BHC	Pesticide	Organochlorine
Atorvastatin	Anti-cholesterol	Lipitor
Atrazine	Herbicide	Triazine
b-BHC	Pesticide	Organochlorine
Benzophenone	UV Blocker	Sun Screen
BHT	Antioxidant	Personal care product
Bisphenol A	Plasticizer	
Carbamazepine	Anti-convulsant	
d-BHC	Pesticide	Organochlorine
DEET	Insect Repellant	Personal care product
Diazinon	Pesticide	Organophosphate
Diclofenac	Analgesic	Voltaren
Estradiol	Human Hormone	Estrogen
Estrone	Human Hormone	Estrogen
Ethynylestradiol	Synthetic Hormone	Birth Control
Fluoxetine	Anti-depressant	Prozac
Galaxolide	Fragrance	Synthetic Musk
g-BHC	Pesticide	Organochlorine-Lindane
Gemfibrozil	Anti-lipid	Lopid
Meprobamate	Anti-anxiety	Miltown
Methoxychlor	Pesticide	Organochlorine
Musk Ketone	Fragrance	Synthetic Musk
Naproxen	Analgesic	Aleve
Octylphenol	Alkylphenol	Soap/Detergent-Degradation Product
Phenytoin	Anti-convulsant	Dilantin
Progesterone	Human Hormone	Estrogen
Simvastatin	Anti-lipid	Zocor
Sulfamethoxazole	Antibiotic	
TCEP	Fire Retardant	Phosphate-based
Testosterone	Human Hormone	Androgen
Triclosan	Anti-microbial	
Trimethoprim	Antibiotic	

Current, conventional treatment processes and plant optimization, which are described in Section 2.1, would be used to meet the requirements set by the NDEP through the NPDES permitting program. The Boulder Islands South Alternative is broken up into two main pipeline segments, EI-Alignment B and the Boulder Islands South LCS. In addition, there are ancillary facilities associated with this alternative including connection structures to the treatment plants, wash return structure, the EI Terminus facility, a PRS at the end of the EI and near the end of the Boulder Islands South LCS, and a diffuser.

The design for the EI-Alignment B, South Lateral Pipeline, and related facilities in terms of flows, would be the same as described for EI-Alignment A in Section 2.2.

The Boulder Islands South Alternative would cost approximately $590,000,000 in capital costs and $500,000 per year in O&M costs. The breakdown of capital costs include:

- $30,526,460 for the Reach 1 pipeline and structures, and CLV and CCWRD connections;
- $43,243,366 for the Reach 2 pipeline and structures;
- $48,058,150 for Reach 3 and the EI Terminus;
- $137,263,700 for the South River Mountains Tunnel No. 3 (SRMT3);
- $294,119,024 for the subaqueous pipeline and PRS;
- $15,208,950 for the water tank shaft and Boulder Islands South Outfall Pipeline (BISOP); and
- $21,580,350 for the South Lateral Pipeline and COH Wash Return Structure.

2.3.1 Effluent Interceptor – Alignment B

A large portion of the highly treated effluent discharged from the CLV and CCWRD treatment facilities would bypass the Las Vegas Wash via EI-Alignment B. The South Lateral Pipeline would convey the treated effluent from the COH WRF (Figure 2.3-1). The CLV and CCWRD flows would be combined with the COH flows at the EI Terminus and be either returned to the Las Vegas Wash at a point upstream of Lake Las Vegas, or be transported to Lake Mead via the LCS. The EI-Alignment B, which includes the South Lateral Pipeline, would be designed and maintained in a manner that would protect the integrity of the effluent.

The EI-Alignment B portion of this alternative is described in terms of the alignment, ancillary facilities and structures, design flow, construction, and operation. The EI-Alignment B has been divided into three reaches and the South Lateral Pipeline for ease of discussion.

2.3.1.1 Alignment

Information regarding the length, diameter, and construction method to be used for each segment of EI-Alignment B is summarized in Table 2.3-1.

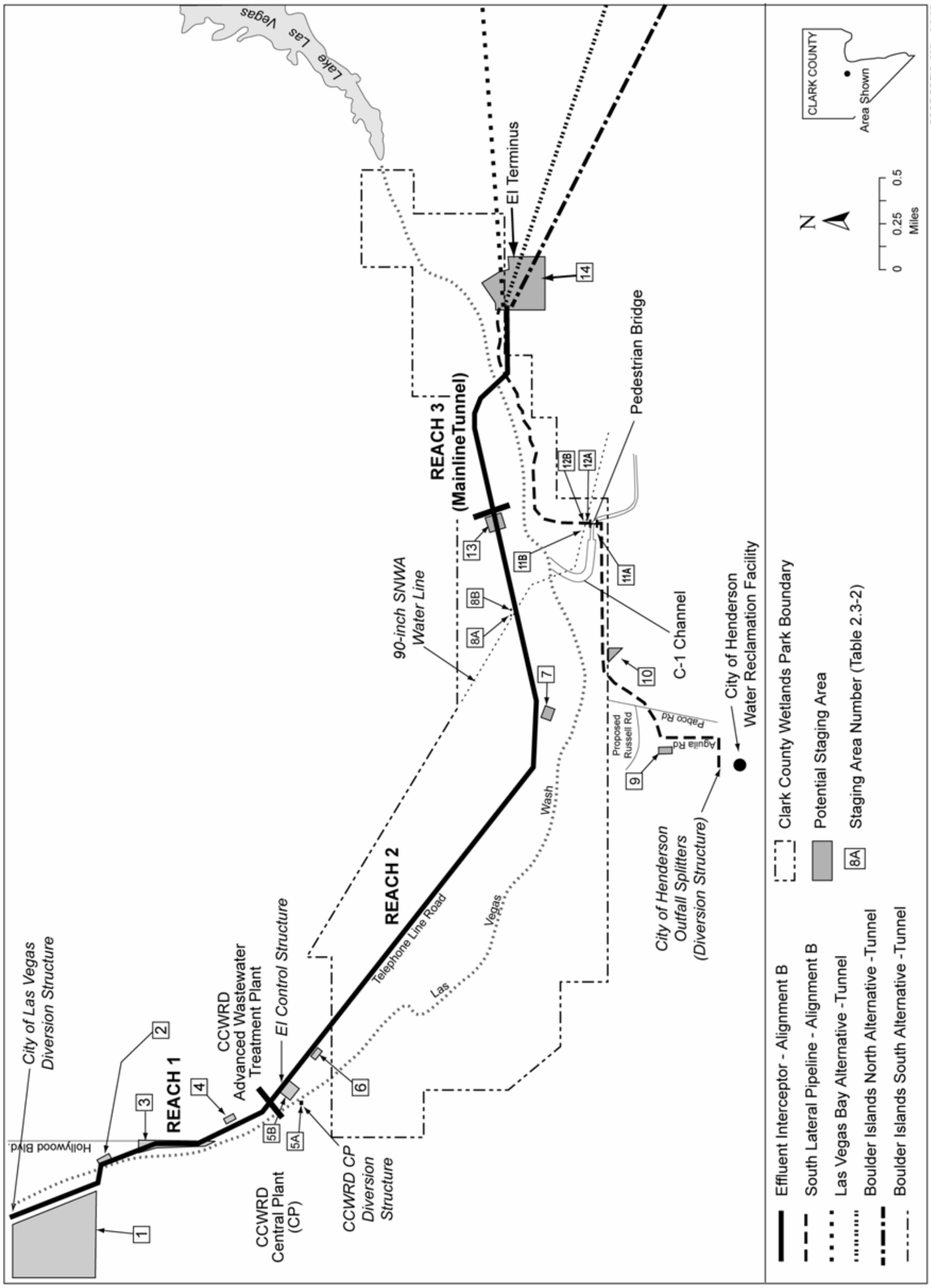

Figure 2.3-1 Effluent Interceptor – Alignment B and Ancillary Facilities.

Table 2.3-1 Effluent Interceptor – Alignment B, Total Dimensions of Construction Techniques.

Reach	Length (ft)	Inner Diameter (inches)	Construction Technique	Depth to Invert (ft)
1	7,100	96	Cut-and-Cover	19 – 29
1	420	96	Tunnel	25 – 42
2	18,600	114	Cut-and-Cover	18 – 32
3	6,500	114	Tunnel	128 – 178
South Lateral Pipeline	17,400	54	Cut-and-Cover	11 – 25

2.3.1.1.1 Reach 1

Reach 1 of EI-Alignment B under the Boulder Islands South Alternative is the same as described for the Boulder Islands North Alternative in Section 2.2.1.1.1.

2.3.1.1.2 Reach 2

Reach 2 of EI-Alignment B conveys the combined CLV and CCWRD effluent in a 114 inch (289 cm) diameter pipeline, approximately 18,600 ft (5,669 m) long, beginning 100 ft (30 m) northwest of the EI control structure located near the entrance to the CCWRD AWT plant (Figure 2.3-1). A 175 ft (53 m) wide construction easement would be required for Reach 2. The majority of EI-Alignment B within Reach 2 would be installed using cut-and-cover construction. Effluent Interceptor–Alignment B then follows the south edge of Telephone Line Road in a southeasterly direction to a point north of the Pabco Road ECS. At this point, EI-Alignment B would continue in a northeasterly direction across open terrain north of the Las Vegas Wash to the Mainline Tunnel shaft for Reach 3 (Figure 2.3-1). The staging areas for EI-Alignment B Reach 2 are shown on Figure 2.3-1. The staging areas shown correspond to the areas listed in Table 2.3-2.

Effluent Interceptor–Alignment B would cross under an existing 90 inch (228 cm) SNWA pipeline. The tunnel would be approximately 55 ft (17 m) long and would be located 1,500 ft (457 m) east of the Pabco Road ECS. The tunneling methods and spoils removal would be the same as described for the tunneling activities in Reach 1.

A meandering 16 ft (5 m) wide chat trail, a trail made of small stones, approximately 6,840 ft (2,085 m) in length, would be constructed within the permanent easement along the portion of the alignment that goes across open terrain to the Mainline Tunnel shaft in Reach 3. The existing grade would be matched to the extent possible with minor grade limitations for maintenance access.

Table 2.3-2 Staging Areas (EI – Alignment B).

Staging Area	Property	Area
EI-Alignment B Reach 1		
1	CLV property – directly south of WPCF	37 ac[1]
2	Las Vegas Wash Crossing – east shaft	0.6 ac
3	CLV property – adjacent to Hollywood Boulevard	6.4 ac
4	CCWRD property	0.7 ac
CCWRD CP & AWT Connection		
5A	CCWRD property – near CP outfall	50 ft x 50 ft
5B	CCWRD property – near EI control structure and AWT	6.3 ac
EI-Alignment B Reach 2		
6	CCWRD property – north of Wetlands Park boundary	1.4 ac
7	Clark County Parks and Community Services property – northwest of Pabco ECS	1.1 ac
8A	Clark County Parks and Community Services property - west working pit for 90-inch SNWA pipeline crossing	40 ft x 25 ft
8B	Clark County Parks and Community Services property - east retrieval pit for 90-inch SNWA pipeline crossing	25 ft x 25 ft
COH South Lateral Pipeline		
9	Private property – east of Aquila Road	1.2 ac
10	COH property – proposed west of Weston Hills and Tuscany Hills developments	1.5 ac
11A	Reclamation property – south bore and jack pit for C-1 Channel crossing	50 ft x 50 ft
11B	Reclamation property – north bore and jack pit for C-1 Channel crossing	50 ft x 50 ft
12A	Reclamation property – south working pit for 90-inch SNWA pipeline crossing	40 ft x 25 ft
12B	Reclamation property – north retrieval pit for 90-inch SNWA pipeline crossing	25 ft x 25 ft
EI-Alignment B Reach 3		
13	Reclamation property – west shaft staging area	3.7 ac
14	Reclamation property – (EI Terminus) east shaft staging area and Terminus	40 ac

Note:
[1] ac = acre

2.3.1.1.3 Reach 3

Reach 3 of EI-Alignment B begins on the north side of the Las Vegas Wash with a tunnel shaft approximately 175 ft (53 m) deep and continues southeasterly for approximately 6,500 ft (1,981 m) terminating on the south side of the Las Vegas Wash at the EI Terminus site (Figure 2.3-1). The working shaft, located at the EI Terminus site, would be 30 ft (9 m) in diameter and approximately 170 ft (52 m) deep. The retrieval shaft would be located at staging area 13 adjacent to the end of Reach 2 and would have a 20 ft (6 m) diameter and 175 ft (53 m) depth.

The staging area at the working shaft/EI Terminus site is approximately 40 acres (16 hectares). The staging area at the retrieval shaft on the north side of the Las Vegas Wash would be approximately 3.7 acres (1.5 hectares) (Table 2.3-2). Spoils would be excavated from the working shaft and hauled by truck to a disposal site using the existing roadway system.

2.3.1.1.4 South Lateral Pipeline

The COH WRF effluent would be conveyed to the EI Terminus via the South Lateral Pipeline, which would consist of a 17,400 ft (5,303 m) long, 54 inch (137 cm) diameter pipe that begins at the WRF outfall splitter structure and ends at the EI Terminus (Figure 2.3-1). The majority of the South Lateral Pipeline would be installed using cut-and-cover construction. The South Lateral Pipeline alignment crosses the WRF plant site to Aguila Road, heads north along Aguila Road, and continues east along Russell Road to the northwest corner of the COH property. It then continues northeasterly toward the Weston Hills development and then easterly in the proposed Russell Road alignment approximately 720 ft (219 m) in the dedicated section of Russell Road, along the northwestern corner of the Tuscany Hills development. The pipeline then turns to the northeast and continues north of the planned 24 ft (7 m) fire/utility access easement for the Tuscany Hills lift station, makes a trenchless crossing under the C-1 Channel, and continues northeasterly along the planned Wetlands Park Scenic Drive (Clark County 1995) to the EI Terminus (Figure 2.3-1). The C-1 Channel crossing would be a trenchless crossing at a depth of between 10 and 22 ft (3 and 7 m).

The South Lateral Pipeline would include the construction of a chat trail, approximately 1,220 ft (371 m) in length, similar to what would be constructed in Reach 2 of EI-Alignment B in Section 2.3.1.1.2. The chat trail would be constructed within the South Lateral Pipeline's permanent easement, within the Wetlands Park to match existing grade to the extent possible with minor grade limitations for maintenance access. The trail would be graded and then surfaced with decomposed granite or some other non-bituminous material. A pedestrian bridge would be built, as part of the trail, across the C-1 Channel to provide connectivity to the Wetlands Park areas north and south of the C-1 Channel (Figure 2.3-1).

2.3.1.2 Ancillary Facilities and Structures

Ancillary facilities and structures for EI-Alignment B would be required for the O&M of the SCOP pipeline. The descriptions of the EI-Alignment B ancillary facilities and structures follow.

2.3.1.2.1 Connection Facilities

Connection facilities are required to link the effluent flows from the treatment facilities to the EI-Alignment B or South Lateral Pipeline. The CLV Connection and CCWRD Connection are the same as described for EI-Alignment A in Section 2.2.1.2.1.

The COH Connection to EI-Alignment B would be via the South Lateral Pipeline, which would tie into an existing outfall splitter structure on the COH WRF site. The outfall splitter structure would allow 0 to 100 percent of the COH WRF flow to be diverted to either the South Lateral Pipeline or the Las Vegas Wash, via the COH's existing Las Vegas Wash outfall (Figure 2.3-1).

One of the COH's existing outfall structures and outfall channel would have to be modified to accommodate COH 2050 peak hour flows. The COH outfall channel would be widened to minimize velocities and reduce scour before entering the Las Vegas Wash. Riprap armoring would be installed along the bottom and sides of the channel for its entire length.

2.3.1.2.2 Effluent Interceptor Terminus

The EI Terminus is the transition point between EI-Alignment B and South Lateral Pipeline, and the LCS (to Boulder Islands or Las Vegas Bay). Combined effluent would either be discharged to the Las Vegas Wash or to the LCS to convey flow to an alternate receiving area in Lake Mead. The EI Terminus site is located about 1 mile southwest of Lake Las Vegas on the south bank of the Las Vegas Wash at Township 21 South, Range 63 East, Section 28 M.D.M. (Figure 1.1-1). The 40-acre EI Terminus site, located on land owned by Reclamation, would include a PRS, distribution box, and wash return structure (Figure 2.3-2). The PRS site would be surrounded by a 6 ft (2 m) high perimeter wall constructed of block, similar to the type of block used in the surrounding areas. The perimeter wall would be set back from the site access road leading to a fabricated wrought iron gate with a keypad entry security system.

The EI Terminus site was selected based on the proximity to the Las Vegas Wash and the ability to hydraulically convey the combined effluents to any one of the alternate receiving areas within Lake Mead. Access to the EI Terminus would be provided by an existing municipal road accessible from Magic Way.

The EI Terminus site would require grading modifications to allow natural drainage channels to flow around the site. The site itself would drain from south to north and exit the site near the entrance gate (Figure 2.3-2). The drainage modifications would incorporate natural drainage channels in the vicinity of the site. All areas disturbed by the drainage improvements would be restored to match existing conditions as closely as possible. The parking area and the access road to the site would be paved with asphalt concrete as shown on Figure 2.3-2.

Electrical power to the EI Terminus would be provided by Nevada Power Company's Lindquist Substation. The transmission lines from the Lindquist Substation would be located along existing roads or within an existing utility corridor.

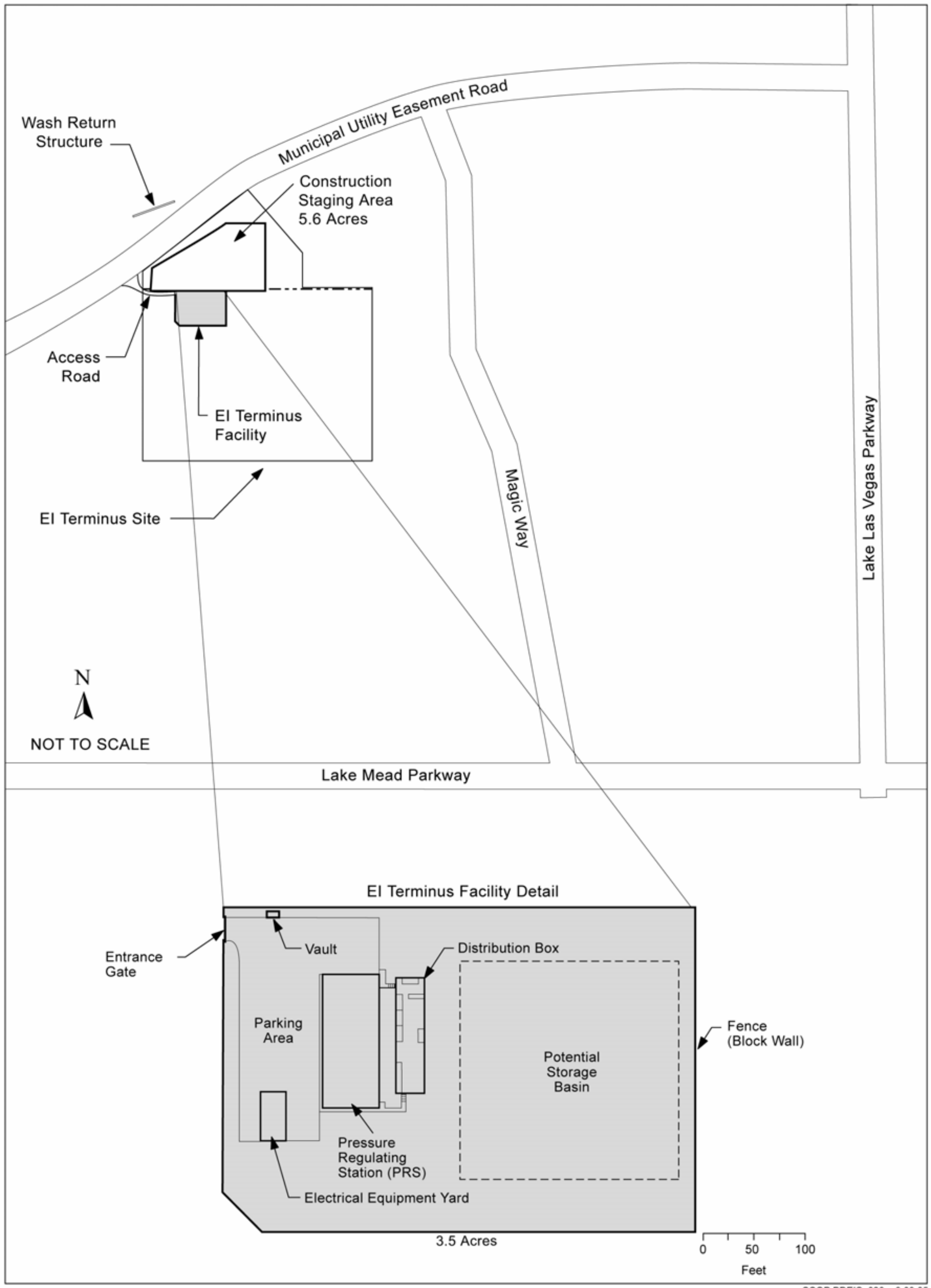

Figure 2.3-2 Effluent Interceptor – Alignment B Terminus Facility.

Pressure Regulating Station

The PRS would be designed to maintain full-flow conditions in Reaches 2 and 3 of EI-Alignment B. In addition, the PRS would allow a free-water surface to be established at this location in the hydraulic profile enabling COH WRF effluent to enter the EI pipeline system.

The PRS building would be designed to house and maintain large water pipe, valves, and electrical equipment. The design of the building exterior and its landscape would be residential in character, and blend in with the desert landscape. The visual appearance of the PRS would follow a "Spanish" style of architecture similar to the Lake Las Vegas Fire Station and nearby golf course buildings. The color of the exterior walls and clay tile roofing would be selected to blend with the desert colors in the area.

Distribution Box

The distribution box would be a concrete structure that combines the flows from EI-Alignment B and the South Lateral pipelines and diverts them to the Las Vegas Wash or the LCS. The distribution box would be equipped with an overflow weir allowing flow to be discharged to the Las Vegas Wash through a 120-inch (305-cm) pipeline to the wash return structure.

Wash Return Structure

The wash return structure used to discharge effluent to the Las Vegas Wash would be located north of the EI Terminus at the top of the Las Vegas Wash bank (Figure 2.3-2). The structure would be a long narrow box with a weir outlet discharging over a riprap embankment, allowing the water to cascade down to the Las Vegas Wash water-surface elevation (Figure 2.3-3). The velocity of the effluent discharged to the Las Vegas Wash would not exceed 4 ft per second (fps) (1 m per second [mps]).

2.3.1.2.3 Manholes

Access manholes would be necessary to enter the pipeline for inspection or maintenance. An access manhole includes pipeline access, and a manhole or vault with ground level access and cover. Along the EI pipeline, access manholes would be located at approximately every 2,000 ft (610 m). The manhole would be 30 inches (76 cm) in diameter and would be located at bends, transitions, and bifurcations along the alignment.

2.3.1.2.4 Maintenance and Access Roads

Access to EI-Alignment B and ancillary facilities must be available at all times for inspection, maintenance, and emergencies. General construction, operation, and maintenance access to the project area would be via the major highways in the area, which include US 95, US 93, and I-515, Boulder Highway, and Lake Mead Parkway. The EI and South Lateral Pipeline would be accessible by lesser roads such as Desert Inn Road, Hollywood Boulevard, Telephone Line Road, Pabco Road, Olson Street/Sunset Road, Magic Way, and Russell Road (Figure 2.2-4).

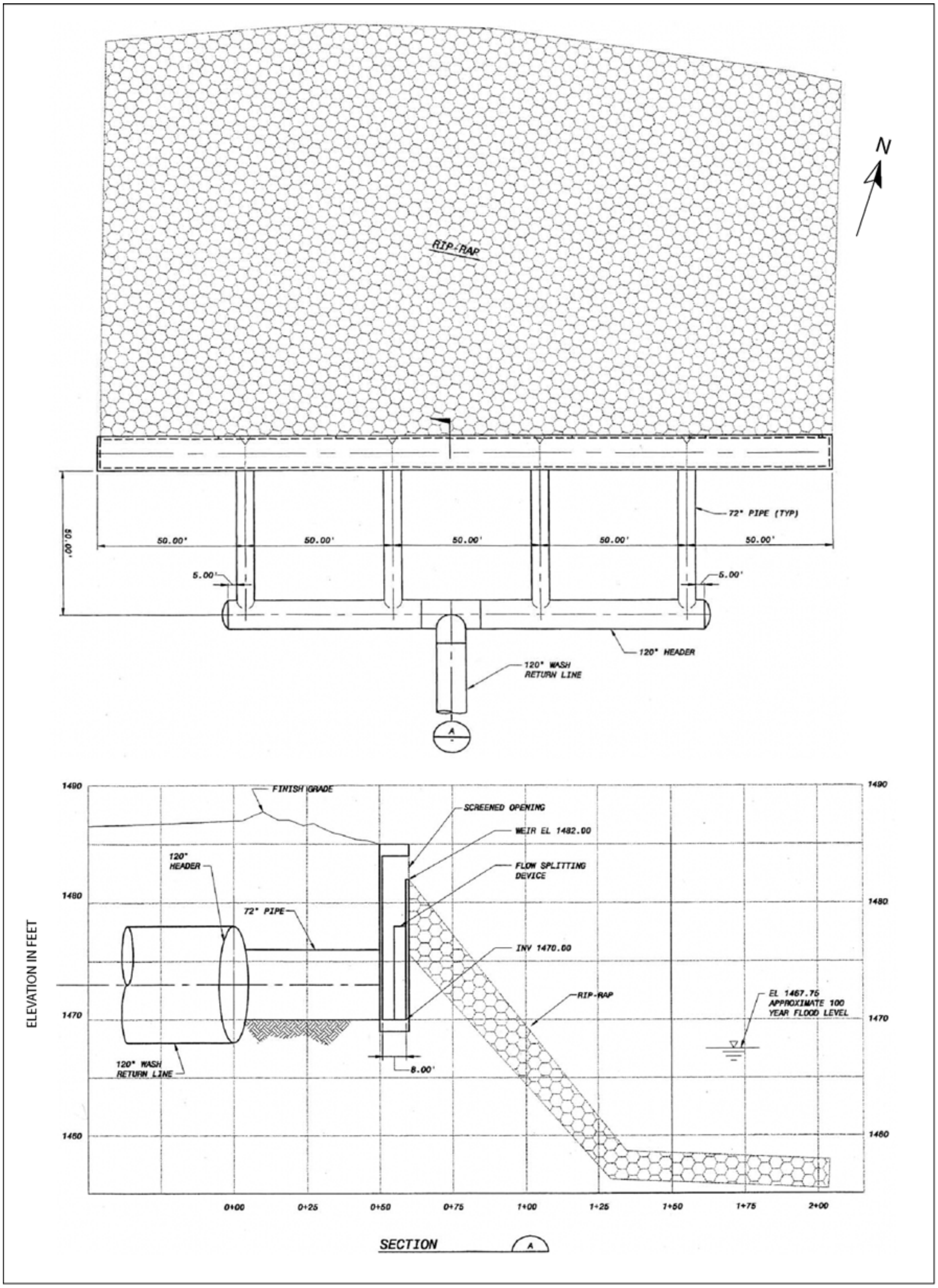

Figure 2.3-3 Wash Return Structure.

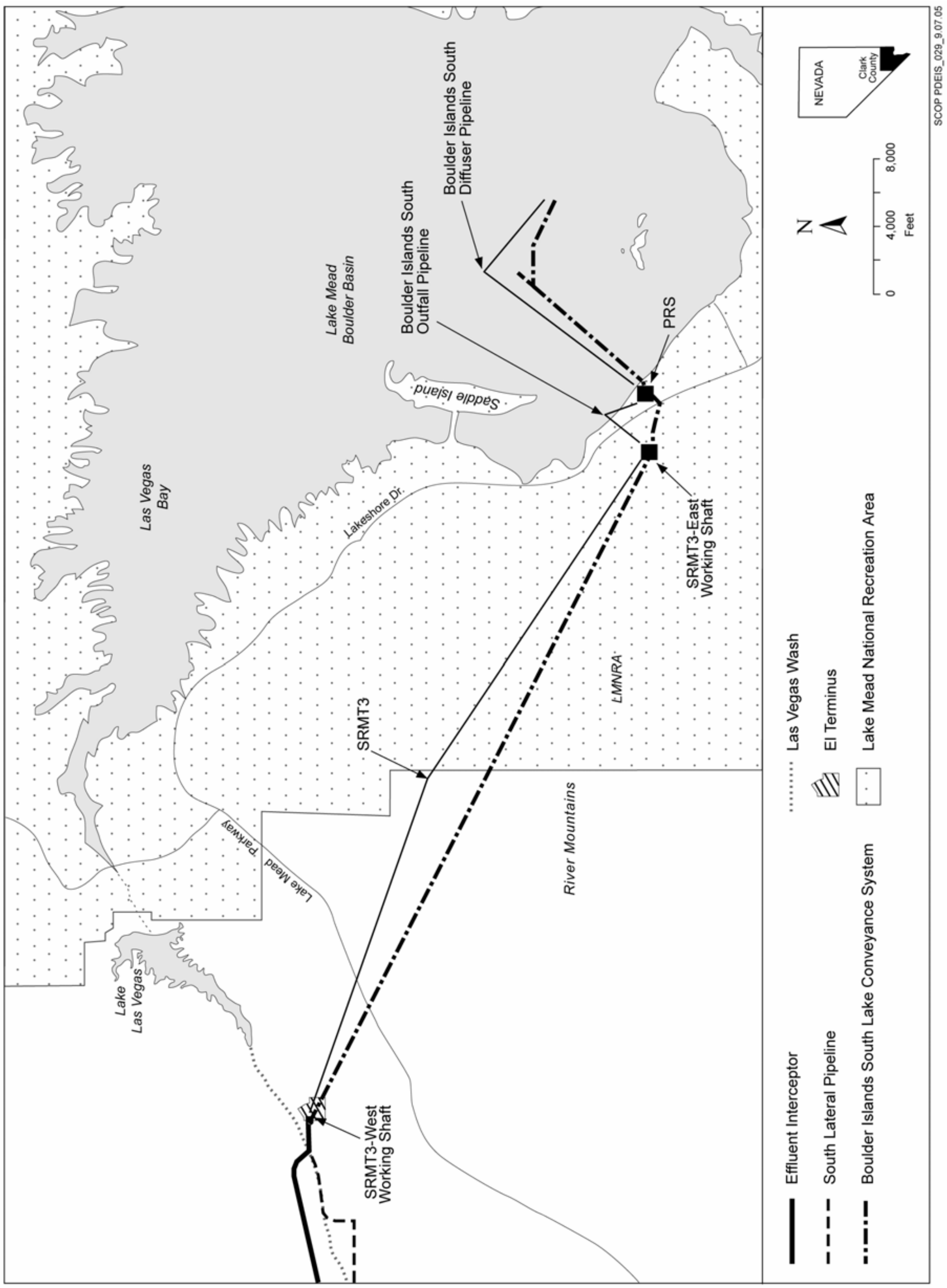

Figure 2.3-4 Boulder Islands South Lake Conveyance System.

2.3.1.3 Land Requirements

A width of 175 ft (53 m) was used to calculate the total land area required for the EI temporary construction easement. A width of 125 ft (38 m) was used to calculate the total land area required for the South Lateral Pipeline temporary construction easement. The permanent easement widths required for EI-Alignment B reaches and South Lateral Pipeline are:

- 80 ft (24 m) for Reach 1,
- 110 ft (33 m) for Reach 2,
- 40 ft (12 m) for Reach 3 (subsurface easement), and
- 50 ft (15 m) for the South Lateral Pipeline.

Although it is anticipated that the majority of the excavated material and pipe material would be stored within the 175 ft (53 m) temporary construction easement, additional area would be required for material and equipment storage (Table 2.3-2). The sites being considered as construction staging areas would be located adjacent to EI-Alignment B and the South Lateral

Pipeline (Figure 2.3-1). The siting of the staging areas on these lands minimizes the amount of new disturbance to federal lands. Table 2.3-2 lists properties that appear to be suitable for use as staging areas, based on their location and current land use. The staging area numbers correlate with the identifier numbers presented in Figure 2.3-1.

2.3.1.4 Construction

Construction of EI-Alignment B would take approximately 28 months. There would be no need to work in the Las Vegas Wash because crossings would be via tunnels. The two major construction techniques for the pipeline installation would include cut-and-cover and tunneling.

Project construction activities would be the same as those described in Section 2.2.1.4. Table 2.3-1 summarizes the construction method to be used for each segment of EI-Alignment B and the South Lateral Pipeline.

Tunneling would be required at all Las Vegas Wash crossings and at major utility crossings to limit direct impacts to the Las Vegas Wash and major utilities. The CWC would coordinate with the SNWA and other utility organizations to ensure that the EI does not impact any SNWA waterlines or other utilities. Tunneling would be required at the locations listed in Table 2.3-1.

2.3.1.5 Spoils and Backfill Materials

The top 6 in (15 cm) of surface material would be stockpiled separately from other excavated material at the staging areas, and would be used as seedbed after final grading. It is assumed that the majority of the excavated material would be used as trench backfill or during final grading. The amount of excess material excavated from EI-Alignment B is shown on Table 2.3-3. It would be necessary to import backfill material, which would be stored along the trench. The pipe would be strung along the trench on top of the imported trench backfill material. The average volume of imported backfill that would be required for the cut-and-cover portions of EI-Alignment B are shown on Table 2.3-3. The backfill material would be obtained from a commercially available source. The procurement of this material would be part of the construction activities performed by the construction contractor**.**

This excess material would be used for other projects or hauled off to the nearest landfill. The number of truckloads required to haul the excess materials and deliver the backfill material is shown on Table 2.3-3.

Table 2.3-3 Spoils Generated and Backfill Material Required for EI-Alignment B.

Segment	Spoils/Muck (cubic yards)	Backfill (cubic yards)	Truckloads [1]
Cut-and-Cover	483,500	31-60	24,175
Tunneling	40,840	0	2,042
Total	524,340	31-60	26,217

Note:
[1] Assumes 20 cubic yards per truckload.

2.3.1.6 Operation of the Effluent Interceptor – Alignment B

Effluent Interceptor-Alignment B would be designed to allow maximum flexibility for management of effluent flows. The EI and the associated treatment plant connections would be designed to allow 0 to 100 percent of the plants' flows to the Las Vegas Wash or the EI. Control points for the system would be located at the three treatment plants. One-hundred percent of the effluent flows may be discharged to the Las Vegas Wash during emergencies or maintenance of the pipeline. Regular maintenance at the treatment facilities would be scheduled and coordinated to ensure that all three plants are not discharging 100 percent of their flows to the Las Vegas Wash at the same time. The CLV and CCWRD flows would be combined with the COH flows at the EI Terminus and be either returned to the Las Vegas Wash at a point upstream of Lake Las Vegas, or be transported to Lake Mead via the LCS.

The O&M of EI-Alignment B would be managed by the CWC in coordination with the member agencies and the Management Advisory Committee. A minimum of 30 mgd (46 cfs) of treated effluent would be discharged to the Las Vegas Wash year round. Together with the 20 mgd (31 cfs) of base flow, the total flow in the Las Vegas Wash is expected to be at least 50 mgd (77 cfs).

A Boulder Basin AMP would be designed and implemented. The Boulder Basin AMP, which is described in Section 2.2.2.6, would include operation of the EI relating to the quantity of effluent delivery to the Las Vegas Wash, EI, and LCS.

The EI Terminus is the transition point between EI-Alignment B and the South Lateral Pipeline, and the LCS (to Boulder Islands or Las Vegas Bay). Combined effluent would either be discharged to the Las Vegas Wash or to the LCS to convey flow to an alternate receiving area in Lake Mead.

The PRS, located at the EI Terminus site, would be designed to maintain full-flow conditions in Reaches 2 and 3 of EI-Alignment B. In addition, the PRS would allow a free-water surface to be established at this location in the hydraulic profile enabling COH WRF effluent to enter the EI pipeline system.

2.3.2 Lake Conveyance System, Boulder Islands South

The Boulder Islands South LCS would convey the combined effluent flows from the three treatment facilities to a discharge location near the Boulder Islands in Lake Mead (Figure 2.2-1). The Boulder Islands South LCS is described in terms of the alignment, ancillary facilities and structures, land requirements, construction, and spoils and backfill materials.

2.3.2.1 Alignment

The Boulder Islands South LCS alignment would begin at the EI Terminus and end northeast of the Boulder Islands as shown on Figure 2.3-4. The pipeline would be designed to allow extension of the pipe if needed, based on changing lake conditions. This alignment is divided into three segments consisting of the SRMT3, BISOP, and the Boulder Islands South Diffuser pipeline (BISDP).

2.3.2.1.1 South River Mountains Tunnel No. 3

The SRMT3 would begin at the SRMT3-West working shaft located at the EI Terminus and would proceed in a southeasterly direction for approximately 23,250 ft (7,087 m) to the SRMT3-East working shaft located on NPS land (Figure 2.3-4). The SRMT3 would be drilled through competent bedrock and would pass beneath property owned by Reclamation, BLM, Lake Las Vegas Golf Course, Three Kids Mine, and NPS. The SRMT3-West working shaft would be approximately 70 ft (21 m) deep. The activities for the western segment of the SRMT3 would be staged at the EI Terminus site. The SRMT3-East working shaft would be 60 ft (18 m) deep. The activities for the eastern segment of the SRMT3 would be staged at the SRMT3-East working shaft location. Electrical power and water would be provided to the shafts by using existing roads and utility corridors (Figures 2.2-6 and 2.3-4).

2.3.2.1.3 Boulder Islands South Diffuser Pipeline

The BISDP would be installed using cut-and-cover, dredged, and subaqueous construction techniques. The BISDP would be approximately 16,800 ft (5,121 m) long. The BISDP would start at the PRS, proceed in a northeasterly direction to the vicinity of the Boulder Islands (Figure 2.3-4), and would consist of a series of pipelines installed using a cut-and-cover construction technique to the water line of Lake Mead. Dredging would be used to install the pipeline to the Lake-bottom elevation of 1,000 ft. Subaqueous construction would be used from the Lake-bottom elevation of 1,000 ft (305 m) to the diffuser location northeast of Boulder Islands at an elevation of 880 ft (268 m). The cut-and-cover section is approximately 2,300 ft (701 m); the dredged section is approximately 3,000 ft (914 m); and the subaqueous section is approximately 11,500 ft (3,505 m) in length.

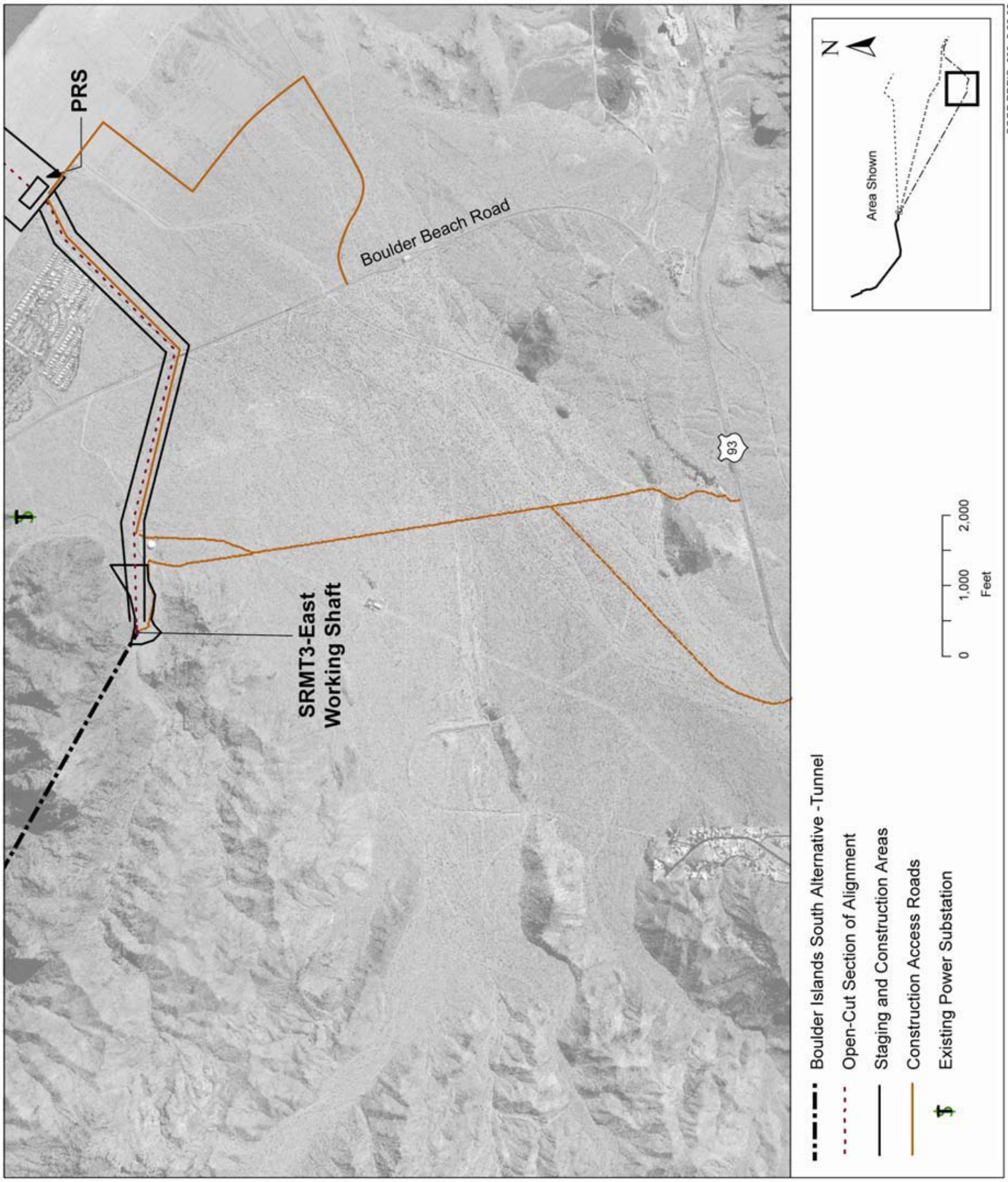

Figure 2.3-5 SRMT3-East Working Shaft.

The cut-and-cover pipeline would be installed in a trench approximately 20 ft (6 m) deep with a minimum cover of 8 ft (2 m). The dredged pipeline would be installed in an underwater trench 55 ft (17 m) wide with a minimum cover of 6 ft (2 m). The subaqueous pipeline would be installed on pylons anchored to the bottom of Lake Mead. The pipeline would be designed to allow extension of the pipe if needed, based on changing lake conditions.

2.3.2.2 Ancillary Facilities and Structures

Ancillary facilities and structures for the Boulder Islands South LCS would be required for the O&M of the pipeline. The Boulder Islands South LCS ancillary facilities and structures are described in this section.

2.3.2.2.1 Pressure Regulating Station

A PRS would be constructed to reduce the internal pressure in the pipeline before discharging to Lake Mead. The PRS would be constructed at a location that is above the historical high water level of Lake Mead. The location of the PRS is shown on Figures 2.3-4 and 2.3-5. The PRS would be constructed in a below-grade structure except for the top slab and a small at-grade structure for access and ventilation equipment. The permanent footprint of the below-grade structure would be approximately 180 x 60 ft (55 x 18 m). Electric power, and potable water would be provided via existing power and water lines (Figure 2.3-4).

2.3.2.2.2 Maintenance and Access Roads

General construction, operation, and maintenance access to the Boulder Islands South alignment and shaft locations would be via the major highways in the area, which include US 95, US 93, US 515, Lake Mead Parkway, and Lakeshore Drive (Figure 2.2-4). The working shafts and PRS would be accessible by existing unpaved roads that provide adequate vehicle access to the shaft locations (Figures 2.2-6 and 2.3-5). Many of the roads that would be used for access to the various project sites are unnamed, unpaved roads. The unpaved road that would primarily be used for access to the SRMT3-East working shaft is approved road 76 (AR 76). Limited closure of AR-76 may be required during construction activities.

2.3.2.2.3 Diffuser

The outlet of the LCS would consist of a subaqueous pipeline and multiport diffuser. The subaqueous pipeline would consist of a series of HDPE pipes with the diffuser at the end of these pipes. The diffuser ports would be located within Lake Mead and anchored to the Lake bottom at an elevation of approximately 880 ft (268 m). The diffuser would be located approximately 4,200 ft (1,280 m) and 1,500 ft (457 m) from the nearest Boulder Islands shoreline when Lake levels are at 1,178 ft (359 m) and 1,000 ft (305 m), respectively. The velocity and rate of flow through the ports would be controlled from the PRS. The ports would be oriented to allow a horizontal or slightly downward discharge. The Lake conditions would determine the operation of the ports.

The final configuration of the diffuser would be determined as part of final design. Current modeling indicates that the effluent discharged from the diffuser would have significant thermal buoyancy. This buoyancy would cause the effluent to rise above the elevation of the drinking water intakes. Preliminary and final design would include modeling of the diffuser operations. The modeling would consider changing Lake conditions.

2.3.2.3 Land Requirements

A permanent subsurface utility easement approximately 40 ft (12 m) wide would be needed along the entire tunnel section of the Boulder Islands South LCS. In addition, the SRMT3-East working shaft would require approximately 9 acres (4 hectares) for temporary construction activities. After completion of construction activities, a permanent easement of 300 x 300 ft (91 x 91 m) at the working shafts would be needed.

The BISOP segment of the alignment would require a 1,000 ft (305 m) wide temporary construction easement to provide adequate working area for equipment, pipe, and trench spoils. A 150 ft (46 m) wide permanent easement would be needed once construction activities are complete.

2.3.2.4 Construction

Construction activities, durations, and types of equipment needed for each segment of the Boulder Islands South LCS are presented in Table 2.3-4. The various segments of the Boulder Islands South LCS would be constructed concurrently.

Employment under the Boulder Islands South Alternative would consist of approximately 9,509 workers each year from 2005 until 2009. Once the EI is constructed, the number of workers needed would be lowered to approximately 8,265 workers. The number of workers required each year does not reflect an additional 9,509 and 8,265 people per year, rather it is expected that this is the total level of employment required per year to sustain the construction, construction support, and other commercial growth rate.

Construction equipment and materials for each segment of the alignment would be hauled to the appropriate working shaft site or staging area. The types of materials and equipment that would be delivered are shown on Table 2.3-5. The number of trucks that would deliver the materials and equipment is also shown on Table 2.3-5.

Construction activities and equipment for the BISOP would be similar to those described for the EI. Construction of the BISOP would be limited to the 6-month time frame between October and March. Thus, this segment of the alignment would require two or three construction seasons to complete.

Table 2.3-4 Construction Activities, Duration, and Equipment for the Boulder Islands South Lake Conveyance System.

Segment	Construction Activities	Construction Duration (months)	Equipment
South River Mountains Tunnel No. 3 – West (SRMT3-West)	• Mobilization (material and equipment delivery) • Shaft excavation and blasting • Tunnel excavation • Tunnel lining and grouting • Final shaft lining • Connection to EI	35	• Cranes • Muck-loading equipment • Drills • Compressors • Trucks • Dozers • Graders • Backhoe • Construction trailers • Tunnel-boring machine
South River Mountains Tunnel No. 3-East (SRMT3-East)	• Mobilization (material and equipment delivery) • Shaft excavation and blasting • Tunnel excavation • Tunnel lining and grouting • Final shaft lining	67	Same as SRMT3 – West
Boulder Islands South Outfall Pipeline (BISOP)	• Mobilization • Pipeline construction • Highway crossing & tunnel construction • PRS construction	16 [1]	Same as SRMT3 – West (without the tunnel-boring machine)
Boulder Islands South Diffuser Pipeline (BISDP)	• Mobilization • Dredging • Subaqueous pipeline construction	31 [1]	• Barges • Barge-based cranes • Clamshell dredge • Tug or workboat • Turbidity curtain • Shore-based crane • Backhoe • Dozer • Trucks

Note:
[1] Six month time frame from October to March.

Table 2.3-5 Material and Equipment Deliveries for the Boulder Islands South Lake Conveyance System.

Segment	Material & Equipment	Duration	Truckloads
SRMT3-West	• Equipment - Miscellaneous - Construction trailers • Materials - Pipe - Shaft lining and backfill - Grout - Pipe and Pipe embedment materials for connection to EI (at EI Terminus)	• 3 months • Once during mobilization and once during demobilization • 35 months • 3 months • 12 months • 31 months	• 20 per day • 10 (delivered then retrieved) • 20 per day • 50 per day • 50 per day • 50 per day
SRMT3-East	• Equipment - Miscellaneous - Construction trailers • Materials - Pipe - Shaft lining and backfill - Grout - Pipe and Pipe embedment materials for connection to BISOP	• 3 months • Once during mobilization and once during demobilization • 35 months • 3 months • 12 months • 31 months	• 20 per day • 10 (delivered then retrieved) • 20 per day • 50 per day • 50 per day • 50 per day
BISOP	• Equipment - Miscellaneous • Materials - Pipe - Backfill	• 3 months • 12 months (during two winter seasons) • 3 months	• 20 per day • 20 per day • 50 per day
BISDP	• Equipment - Miscellaneous • Materials - Pipe	• 3 months • 31 months	• 20 per day • 50 per day

Construction activities and equipment for the BISDP are different than for the other segments of the alignment as shown on Table 2.3-4, and are the same as those described for the BINDP under the Boulder Islands North Alternative in Section 2.2.2.4.

2.3.2.5 Spoils and Backfill Materials

The majority of the material that would be excavated from the Boulder Islands South LCS is considered "public minerals" with respect to subsurface rights on federal lands. The excess spoils may be used for public projects such as dust control on federal lands or construction materials for roadways, flood control facilities, or other public projects. The amount of spoils generated from each segment of the Boulder Islands South LCS is shown on Table 2.3-6.

The tunnel spoils would be 2 to 6 inches (5 to 15 cm) or less in size. The spoils would be used for public purposes and spoils would be hauled by truck from the working shafts via the haul routes shown on Figures 2.2-6 and 2.3-5. The excess trench materials from the BISOP would be hauled to the disposal area using existing unpaved and paved roads. Some of the materials from the diffuser pipeline dredging operation would be deposited over the pipe. Excess materials would be stockpiled in the staging area then hauled via existing unpaved and paved roads to an appropriate disposal location.

Table 2.3-6 Spoils Removed for the Boulder Islands South Lake Conveyance System.

Segment	Spoils Removed (cubic yards)	Backfill / Grout (cubic yards) [1]	Truckloads [2]
SRMT3-West and Tunnel	154,000	20,400	8,720
SRMT3-East and Tunnel	154,000	20,400	8,720
BISOP	100,000	n/a	5,000
BISDP	9,500	n/a	475
Total	417,500	40,800	22,915

Notes:
[1] The BISOP and BISDP require no hauling from off-site location, backfill processed within construction easements.
[2] Approximate truckloads, depending upon the contractor's choice of rock hauling trailers, this table assumes 20 cubic yards per truckload. Backfill / Grout was estimated at 20 cubic yards per truckload.

2.3.2.6 Operation of the Boulder Islands South Lake Conveyance System

The Boulder Islands South LCS would be designed to allow maximum flexibility for management of effluent flows. Flows to the LCS would be directed and controlled at the EI Terminus site. A PRS would be constructed to reduce the internal pressure in the pipeline before discharging to Lake Mead. The PRS would be located as shown on Figure 2.3-5.

At the PRS, the flows would be directed to multiple pipelines that connect to the diffuser. The diffuser ports would be located within Lake Mead and anchored to the Lake bottom at an elevation of approximately 880 ft (268 m). The velocity and rate of flow through the ports would be controlled from the PRS. The ports would discharge the flow in a horizontal, or slightly downward direction. The Lake conditions and flows would determine the operation and orientation of these ports. Operation of the diffuser would be included as part of the Boulder Basin AMP, which is described in Section 2.2.2.6.

2.4 Las Vegas Bay Alternative

The Las Vegas Bay Alternative includes a pipeline that would collect the highly treated effluent discharged from each of the CWC's treatment facilities and transport the effluent to an alternate receiving area in Las Vegas Bay (Figure 2.2-1). Effluent discharge limits would no longer be subject to the TMDLs, but instead would be subject to concentration-based Water Quality Based Effluent Limitations. The three treatment agencies would expand their facilities to handle the increasing quantities of wastewater. Current, conventional treatment processes and plant optimization, which are described in Section 2.1, would be used to attempt to meet the requirements set by the NDEP through the NPDES permitting program. The EI and Las Vegas Bay LCS are described in the following sections.

The design for the EI-Alignment B, South Lateral Pipeline, and related facilities, in terms of flows, would be the same as described for EI-Alignment A in Section 2.2.

The Las Vegas Bay Alternative would cost approximately $540,000,000 in capital costs and $300,000 per year in O&M costs. The breakdown of capital costs include:

- $31,577,000 for the Reach 1 pipeline and structures, and CLV and CCWRD connections;
- $44,775,000 for the Reach 2 pipeline and structures;
- $59,658,000 for Reach 3 and the EI Terminus;
- $50,685,000 for the Las Vegas Bay Tunnel Phase 1 and Phase 2 (LVBT1 and LVBT2);
- $333,313,000 for the subaqueous pipeline, diffuser, and PRS;
- $19,992,000 for the South Lateral Pipeline and COH Wash Return Structure.

2.4.1 Effluent Interceptor – Alignment B

The EI-Alignment B segment of the Las Vegas Bay Alternative is the same as described for the Boulder Islands South Alternative. The description of EI-Alignment B is presented in Section 2.3.1, EI – Alignment B.

2.4.2 Lake Conveyance System, Las Vegas Bay

The Las Vegas Bay LCS would convey the combined effluent from the EI Terminus to a discharge location in Las Vegas Bay (Figure 2.2-1). The Las Vegas Bay LCS is described in terms of the alignment, ancillary facilities and structures, land requirements, construction, and spoils and backfill materials.

2.4.2.1 Alignment

The Las Vegas Bay Alternative begins at the EI Terminus and ends in the Las Vegas Bay as shown on Figure 2.4-1. This alignment has been divided into three segments consisting of the LVBT1, LVBT2, and the Las Vegas Bay Diffuser.

2.4.2.1.1 Las Vegas Bay Tunnel - Phase1

The LVBT1 would begin at the LVBT1 working shaft located at the EI terminus and would proceed in an easterly direction for 14,500 ft (4,420 m) to the LVBT2 working shaft located on Reclamation land (Figure 2.3-1). The LVBT1 would have a 14 ft (4 m) diameter. The LVBT1 would be drilled through competent bedrock and would pass beneath property owned or managed by Reclamation, BLM, and Lake Las Vegas Golf Course.

2.4.2.1.2 Las Vegas Bay Tunnel – Phase 2

The LVBT2 would begin at the LVBT2 working shaft and would proceed in an easterly direction for approximately 25,000 ft (7,620 m) to the PRS shaft (Figure 2.3-1). The LVBT2 would have a diameter of 14 ft (4 m). The LVBT2 would be drilled through competent bedrock and would be approximately 515 ft (157 m) deep at the LVBT2 working shaft and 250 ft (76 m) deep at the PRS shaft. The LVBT2 would pass beneath property owned or managed by Reclamation and NPS.

2.4.2.1.3 Las Vegas Bay Diffuser Section

The Las Vegas Bay Diffuser Section would begin at the PRS shaft and would proceed in a northeasterly direction to the shoreline (Figure 2.3-1). The Diffuser Section would exit the PRS shaft as a single 11 ft (3 m) diameter pipeline that would be installed using a cut-and-cover construction technique for approximately 400 ft (122 m) to the high-water line of Lake Mead. The multiple pipeline segments, which begin at the high-water line, would be constructed (using dredging techniques) from the high-water line elevation, to an elevation of 1,000 ft (305 m). The remainder of the subaqueous pipeline would be laid on the Lake floor. The length of the pipeline from the PRS to the diffuser would be 10,700 ft (3,261 m).

2.4.2.2 Ancillary Facilities and Structures

Ancillary facilities and structures for the Las Vegas Bay LCS would be required for the O&M of the pipeline. The Las Vegas Bay LCS ancillary facilities and structures are described in this section.

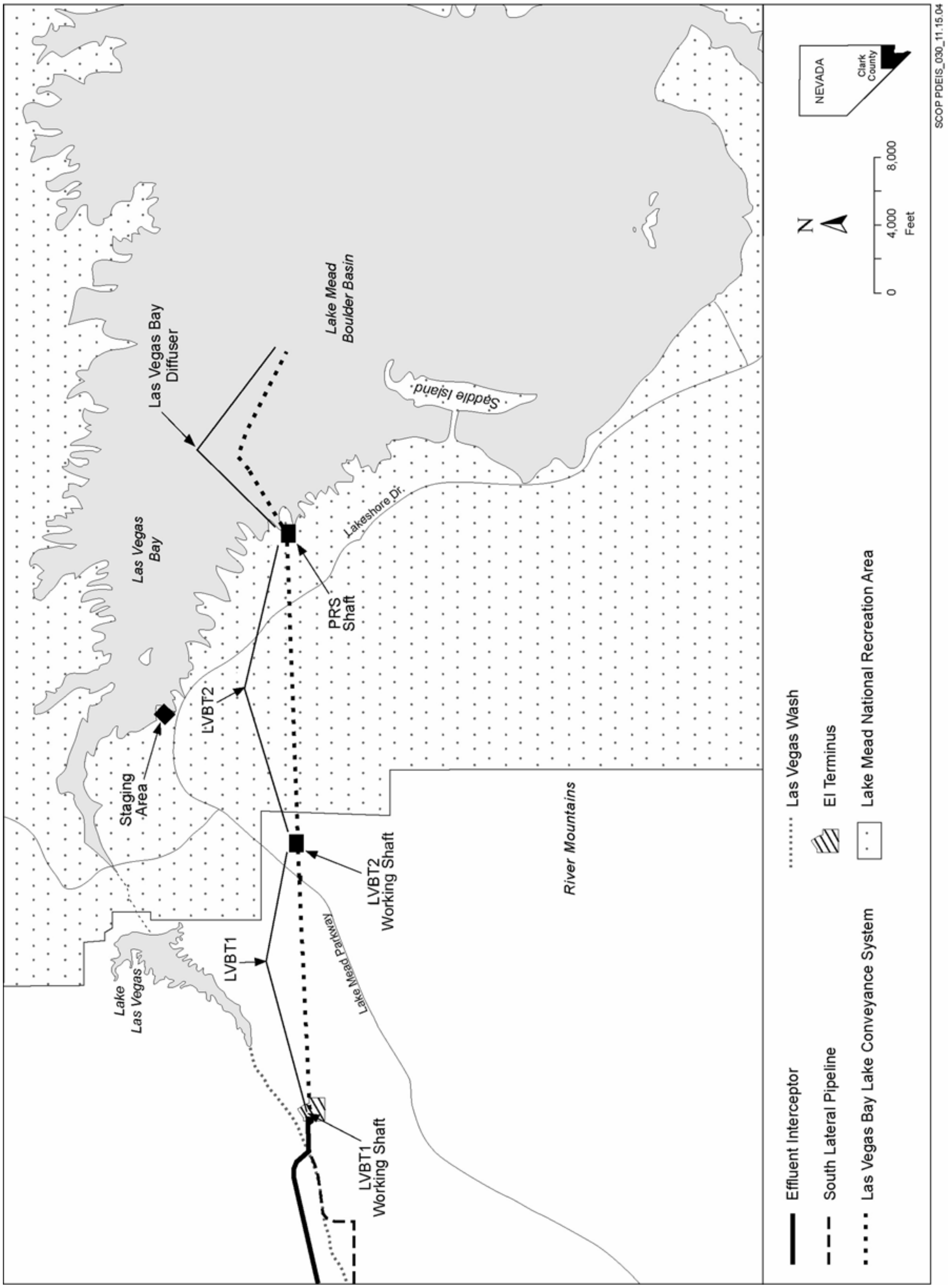

Figure 2.4-1 Las Vegas Bay Lake Conveyance System.

2.4.2.2.1 Working and Retrieval Shafts

The LVBT1 working shaft would be approximately 70 ft (21 m) deep and located on the EI Terminus site. Electrical power and water would be provided from the EI Terminus facility.

The LVBT2 working shaft would be approximately 515 ft (157 m) deep and located on Reclamation land. Electric power and water would be provided to this site using existing power and water lines.

The Las Vegas Bay PRS shaft would be approximately 250 ft (76 m) deep and located on NPS land. Electric power and water would be provided to this site using existing power and water lines.

2.4.2.2.2 Maintenance and Access Roads

General construction, operation, and maintenance access to the Las Vegas Bay alignment and shaft locations would be via the major highways in the area, which include US 95, US 93, US 515, Lake Mead Parkway, and Lakeshore Drive. The working and PRS shafts would be accessible by existing unpaved roads (Figure 2.4-2 and 2.4-3).

2.4.2.2.3 Diffuser

The diffuser for the Las Vegas Bay Alternative would be the same as described for the Boulder Islands North and South alternatives in Sections 2.2.2.2.3 and 2.3.2.2.3. The diffuser ports would be located within Lake Mead on pylons anchored to the Lake bottom at an elevation of approximately 880 ft (268 m). The diffuser would be located approximately 4,000 ft (1,219 m) and 2,500 ft (762 m) from the nearest shoreline in the vicinity of Las Vegas Bay when Lake levels are at 1,178 ft (359 m) and 1,000 ft (305 m), respectively.

2.4.2.3 Land Requirements

A permanent subsurface utility easement approximately 40 ft (12 m) wide would be needed along the entire Las Vegas Bay LCS alignment. In addition, construction activities would require 8.3 acres (3 hectares) at the LVBT2 working shaft and 2.5 acres (1 hectare) at the PRS shaft. After completion of construction activities, a permanent easement of 300 x 300 ft (91 x 91 m) at the working shaft and 180 x 75 ft (55 x 23 m) at the PRS shaft would be needed.

The Las Vegas Bay Diffuser Section of the alignment would require a 200 ft (61 m) wide temporary construction easement for approximately 400 ft (122 m) from the PRS to the high-water line of Lake Mead. Then a 1,000 ft (305 m) wide temporary construction easement would be needed to provide adequate working area for equipment, pipe, and trench spoils for the dredged segment of the pipeline. A 150 ft (46 m) wide permanent easement from the PRS to the shoreline would be needed once construction activities are complete.

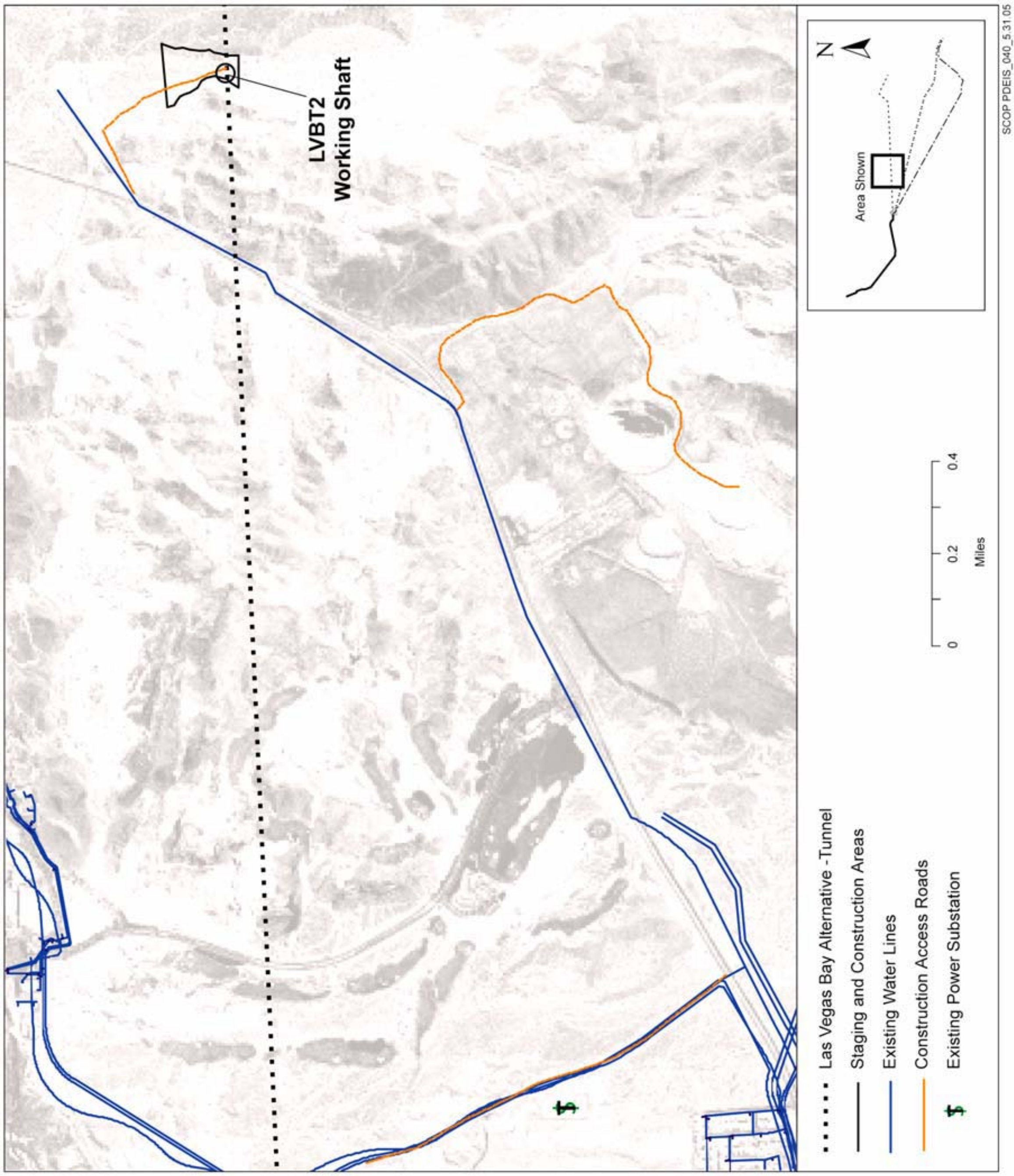

Figure 2.4-2 LVBT2 Working Shaft.

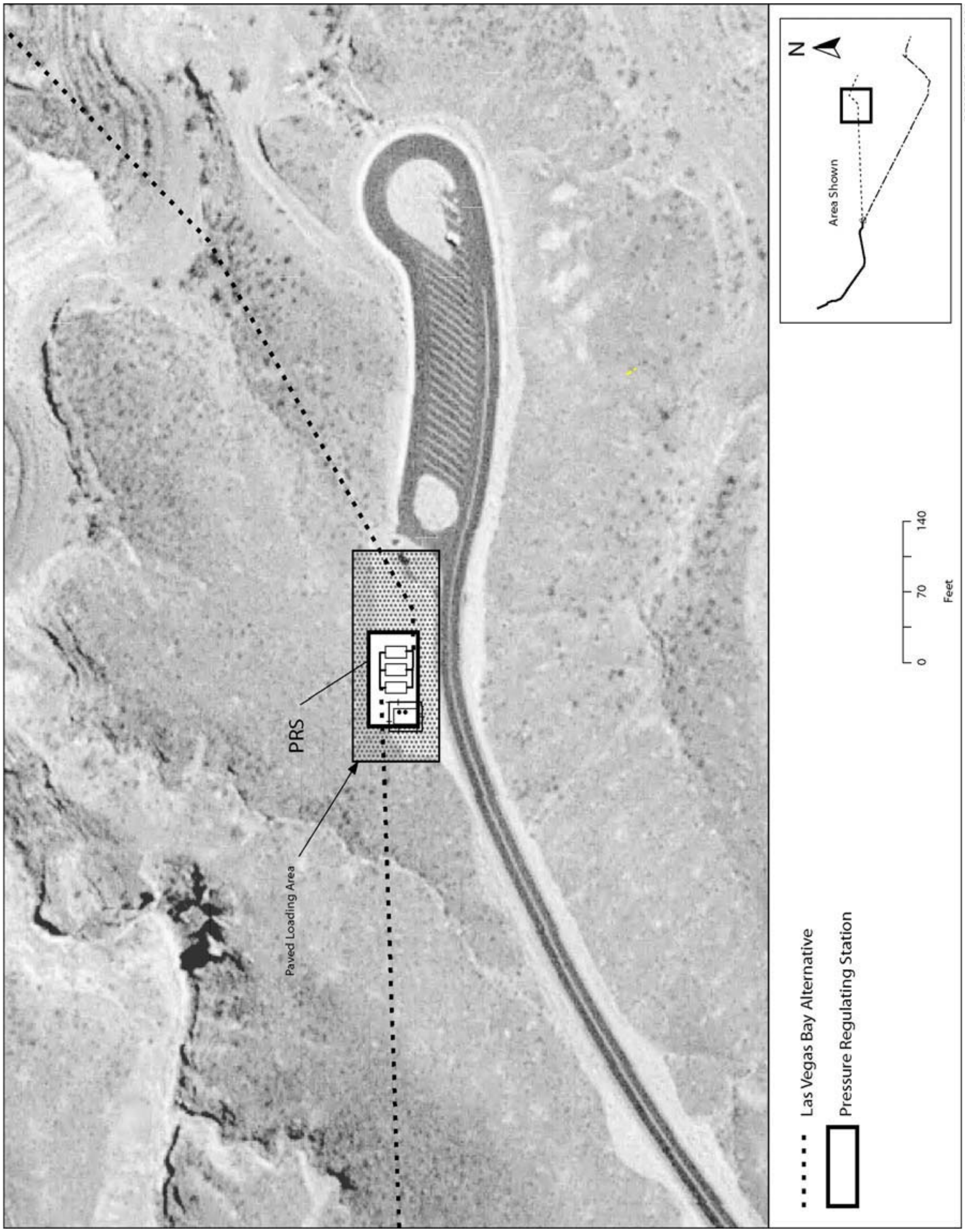

Figure 2.4-3 Las Vegas Bay Pressure Regulating Station.

2.4.2.4 Construction

Construction activities, durations, and types of equipment needed for each segment of the Las Vegas Bay LCS are presented in Table 2.4-1. Construction equipment, materials, and delivery durations for each segment of the alignment are shown on Table 2.4-2. The number of trucks that would deliver the materials is also shown on Table 2.4-2.

Table 2.4-1 Construction Activities, Duration, and Equipment for the Las Vegas Bay Lake Conveyance System.

Segment	Construction Activities	Construction Duration (months)	Equipment
Las Vegas Bay Tunnel – Phase 1 (LVBT1)	• Mobilization (material and equipment delivery) • Shaft excavation and blasting • Tunnel excavation • Tunnel lining and grouting • Final shaft lining • Connection to EI	39	• Cranes • Muck-loading equipment • Drills • Compressors • Trucks • Dozers • Graders • Backhoe • Construction trailers • Tunnel-boring machine
Las Vegas Bay Tunnel – Phase 2 (LVBT2)	• Mobilization (material and equipment delivery) • Shaft excavation and blasting • Tunnel excavation • Tunnel lining and grouting • Final shaft lining • PRS construction	64	Same as LVBT1
Las Vegas Bay Diffuser Section	• Mobilization • Pipeline Construction • Dredging • Subaqueous pipeline construction	12 [1]	• Barges • Barge-based cranes • Clamshell dredge • Tug or workboat • Turbidity curtain • Shore-based crane • Backhoe • Dozer • Trucks

Note:
[1] Six month time frame from October to March.

Table 2.4-2 Material and Equipment Deliveries for the Las Vegas Bay Lake Conveyance System

Segment	Material & Equipment	Duration	Truckloads
LVBT1	• Equipment - Miscellaneous	• 3 months	• 20 per day
	- Construction trailers	• Once during mobilization and once during demobilization	• 10 (delivered then retrieved)
	• Materials - Pipe - Shaft lining and backfill - Grout - Pipe and pipe embedment materials for connection to EI (at EI Terminus)	• 35 months • 3 months • 12 months • 31 months	• 20 per day • 50 per day • 50 per day • 50 per day
LVBT2	• Equipment - Miscellaneous - Construction trailers	• 3 months • Once during mobilization and once during demobilization	• 20 per day • 10 (delivered then retrieved)
	• Materials - Pipe - Shaft lining and backfill - Grout	• 35 months • 3 months • 12 months	• 20 per day • 50 per day • 50 per day
	- Pipe and pipe embedment materials for connection to Las Vegas Bay Diffuser Section	• 31 months	• 50 per day
Las Vegas Bay Diffuser Section	• Equipment - Miscellaneous	• 6 months	• 20 per day
	• Materials - Pipe	• 12 months	• 20 per day
	- Backfill	• 6 months	• 50 per day

Employment for project construction under the Las Vegas Bay Alternative would consist of approximately 8,808 workers for each year of construction from 2005 until 2009. Once the EI is constructed, the number of workers needed would be lowered to approximately 7,564 workers. The number of workers required each year does not reflect an additional 8,808 and 7,564 people per year, rather it is expected that this is the total level of employment required per year to sustain the construction, construction support, and other commercial growth rate.

Construction activities and equipment for the Las Vegas Bay Diffuser segment are different than for the other segments of the alignment as shown on Table 2.4-2. Multiple pipes would exit the PRS shaft and later connect with the diffuser. The segment of the pipeline between the PRS and the shoreline would be installed using cut-and-cover techniques and dredging techniques. The remainder of the diffuser section would be fused onshore, floated into position by barges and slowly filled and allowed to sink to the bottom of Lake Mead. The dredging equipment would be staged from barges and the pipeline lowered into the dredged trench. A turbidity curtain would be installed in the areas that require dredging. The turbidity curtain would be the same as described for the Boulder Islands North LCS in Section 2.2.2.4.

The type of equipment, method of launching equipment, and construction materials for the Las Vegas Bay Diffuser segment of the alignment would be the same as those described for the Boulder Islands North Alternative in Section 2.2.2.4. The configuration of the diffuser is described in Section 2.2.2.2.3. A staging area with a floating dock would be located at the old marina as shown on Figure 2.4-4. Small quantities of fuel would be transported by boat to equipment located on the barges. A fueling facility would be provided at the old marina.

2.4.2.5 Spoils and Backfill Materials

The amount of spoils generated from each segment of the Las Vegas Bay LCS is presented in Table 2.4-3. The tunnel spoils/cuttings would be 2 to 6 inches (5 to 15 cm) or less in size. The spoils would be hauled from the working shaft via existing paved and unpaved roads.

2.4.2.6 Operation of the Las Vegas Bay Lake Conveyance System

The Las Vegas Bay LCS would be operated in a manner similar to that of the Boulder Islands North Alternative. The descriptions of operations and the Boulder Basin AMP are provided in Section 2.2.2.6.

2.5 Process Improvements Alternative

The Process Improvements Alternative has been added to the analyses presented in this EIS based on comments received from the public. Although the Process Improvements Alternative meets the definition of 'No Action' described in CEQ's Forty Questions, and is considered an extension of the No Action Alternative, it is analyzed and presented in this EIS as a separate alternative at the request of the public.

Under the Process Improvements Alternative, the CWC would not construct pipelines to transport effluent from the treatment facilities. Highly treated effluent would continue to be discharged to the Las Vegas Wash at the existing discharge locations, and effluent flows would continue to enter the Las Vegas Bay for mixing and diffusion in an uncontrolled fashion.

The three agencies responsible for municipal wastewater treatment and discharge would expand their facilities to handle the increasing quantities of wastewater through 2050 (Table 2.1-1) as described in Section 2.1.

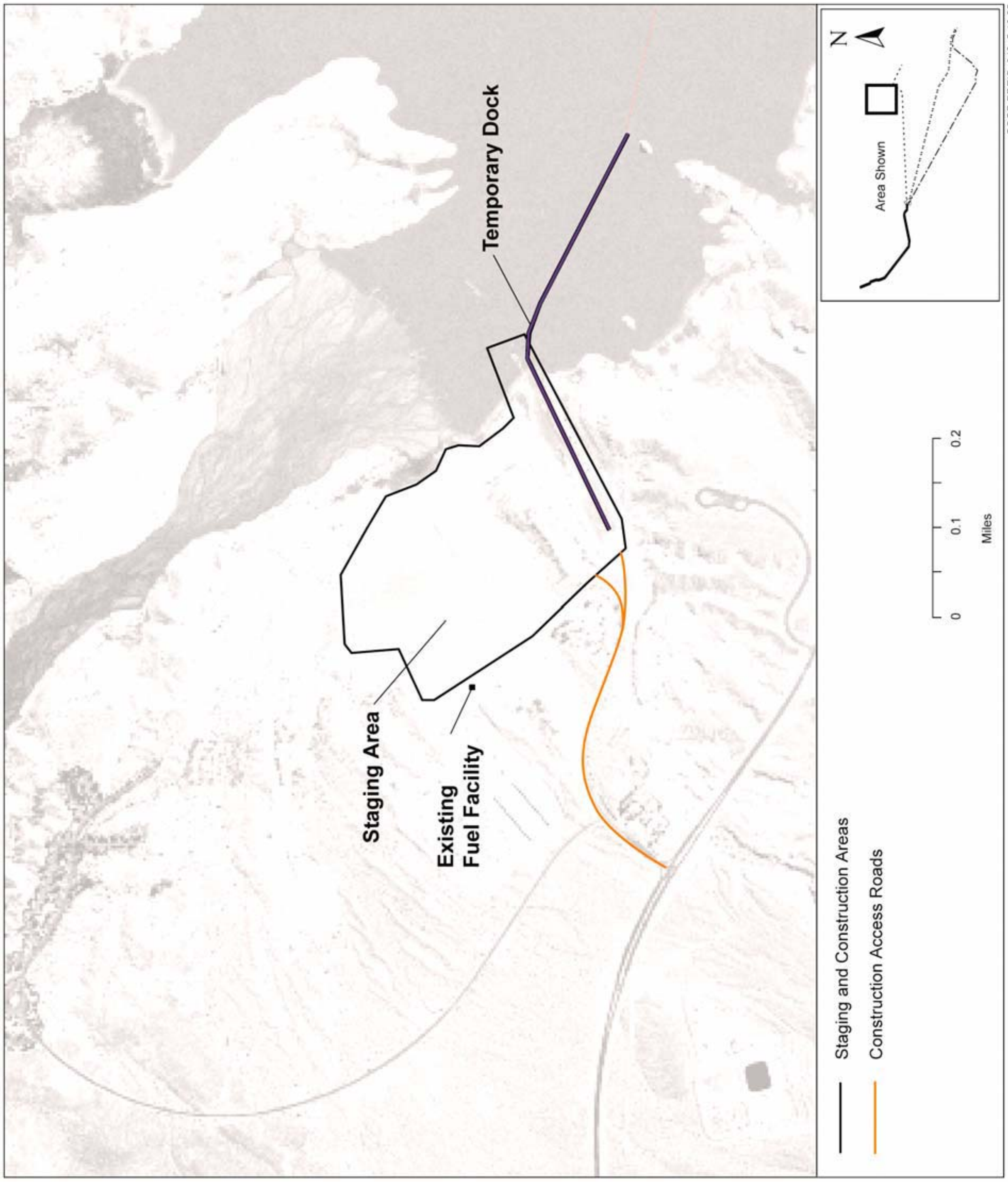

Figure 2.4-4 Old Marina Staging Area.

Table 2.4-3 Spoils Removed for the Las Vegas Bay Lake Conveyance System.

Segment	Spoils Removed (cubic yards)	Backfill / Grout (cubic yards)	Truckloads [1]
LVBT1 Working Shaft	1,300	900	110
LVBT1	95,000	12,300	5,365
LVBT1 Retrieval Shaft	3,000	2,000	250
LVBT2 Working shaft	9,400	150	478
LVBT2 and Diffuser Section	151,000	19,500	8,525
Las Vegas Bay PRS shaft	7,000	4,800	590
Total	**266,700**	**39,650**	**15,318**

Note:
[1] Approximate truckloads, depending upon the contractors choice of rock-hauling trailers, this table assumes 20 cubic yards per truckload. Backfill/grout was estimated at 20 cubic yards per truckload.

In addition to current, conventional treatment processes and plant optimization that are described in Section 2.1, best available technologies would be implemented to attempt to maintain an effluent TP loading of 334 lbs/day or lower loading as the Lake levels decrease. Microfiltration (MF) or ultrafiltration (UF) membranes are described in the following sections as examples of the types of technology that may be implemented to achieve the target effluent TP levels. However, as technologies change and improve, other technologies may be implemented.

Predictive water quality modeling indicates a TP loading of 434 lbs/day, including an effluent TP loading of 334 lbs/day and a non-point source phosphorus loading of 100 lbs/day entering the Las Vegas Bay would have a 16 percent probability of exceeding the water quality standard for chlorophyll at the flow rate predicted to occur in 2050 if the level of Lake Mead remains above 1,100 ft. However, the modeling indicates that when Lake Mead levels decrease to 1,000 ft, the effluent TP loading would need to be approximately 100 lbs/day to not result in water quality standard exceedances in the Las Vegas Bay. A TP concentration of 0.035 mg/L and 0.027 mg/L would need to be achieved by the treatment plants in 2030 and 2050, respectively, to avoid water quality standard exceedances. There may be differing professional opinions, but based on the knowledge and expertise of the Wastewater Treatment Specialists and Engineers consulted, in

2006 it was determined that RO may be the only technology that can reliably achieve combined effluent TP levels of between 0.02 and 0.05 mg/L on an annual average basis. Therefore, if Lake Mead levels decrease to 1,000 ft, RO would need to be implemented to achieve a combined effluent TP concentration between 0.02 and 0.05 mg/L on an annual average basis. However, RO results in a significant loss of return flow credits for southern Nevada and creates a large waste stream that makes the implementation of RO infeasible. Further discussion of the elimination of RO as an alternative is presented in Section 2.7.12.

The Process Improvements Alternative would cost approximately $205,483,592 in capital costs and $29,751,688 per year in O&M costs. The breakdown of capital costs include:

- $80,138,601 for implementation of MF/UF at the CLV treatment facility,
- $106,851,468 for implementation of MF/UF at the CCWRD treatment facility, and
- $18,493,523 for implementation of MF/UF at the COH treatment facility.

2.5.1 City of Las Vegas

Section 2.1.1.2 describes the optimization of the CLV WPCF. The CLV WPCF can reliably achieve 0.14 mg/L on an annual average basis as the lowest possible reliable effluent TP concentration through optimization of the plant. In addition to plant optimization, the WPCF would need to add chemicals and implement the use of MF or UF membranes to reliably achieve TP concentrations of 0.05 mg/L on an annual average basis. The MF/UF membranes would be used to treat the effluent from the sand filters.

Implementation of MF/UF membranes at the CLV WPCF would require modification of existing infrastructure and implementation of new infrastructure. Modification to existing infrastructure would include insertion of piping to insert the MF/UF membrane step following the existing sand filters and before disinfection. New infrastructure to implement MF/UF membranes would include:

- An influent structure,
- MF/UF equipment,
- Concrete tanks for housing the membranes, and
- Containment for the chemicals and cleaning system.

In addition to the MF/UF membranes, additional alum must be added to remove TP (down to a concentration of 0.05 mg/L on an annual average basis). This would generate additional chemical sludge. At a flow of 91 mgd, the additional alum sludge generated to further remove soluble phosphorus would be 170 tons (wet) of sludge per day. The increased chemical sludge would continue to be disposed of in the same manner that it is now. Chemical is added ahead of the filters, and the solids are recycled back into the liquid stream with the remaining filter backwash water. Disposal of the sludge would continue as described in Section 2.1.1.1.

Should it become necessary for the CLV WPCF to achieve between 0.02 and 0.05 mg/L TP on an annual average basis, additional treatment processes would be needed. Other technologies, not currently known or available, would be needed to reliably achieve TP levels of between 0.02 and 0.05 mg/L (annual average).

2.5.2 Clark County Water Reclamation District

Section 2.1.2.2 describes the optimization of the CCWRD facilities. The CCWRD can reliably achieve 0.08 mg/L as the lowest possible reliable effluent TP concentration on an annual average basis through optimization of the plant. In addition to plant optimization, new pressure MF/UF membranes or submerged MF/UF membranes would be required to reliably achieve TP concentrations of 0.04 mg/L (annual average). The CCWRD would evaluate the use of MF/UF membranes, instead of filters, in its next 40 mgd plant expansion (about 30 mgd of new MF/UF membranes). The new MF/UF membranes would be installed in the existing flocculation basins and tertiary filters.

The implementation of MF/UF membranes at the CCWRD facilities would not require additional land. The use of MF/UF membranes would generate a waste stream that would contain solids. Approximately 830 lbs/day of sludge would be produced assuming a flow of 110 mgd. The waste stream would be recycled back into the liquid stream with the remaining filter backwash water. Digested sludge is dewatered by centrifuge, biosolids are taken to a landfill, and solids-processing sidestreams are recycled back to the plant influent. The facility currently produces approximately 540 tons (wet) of additional sludge per day.

As previously described, it would appear that the existing facilities with the recent optimization steps taken by CCWRD can achieve an effluent ortho-phosphorus concentration of 0.02 mg/L on a yearly average. However, the monthly variation during the 2005 and 2006 period ranged between 0.005 and 0.048 mg/L. With the addition of a microfiltration process, the effluent TP would typically be below 0.05 mg/L; consequently no additional process technology is required beyond the microfiltration units.

2.5.3 City of Henderson

Section 2.1.3.2 describes the optimization of the COH WRF. The COH WRF can reliably achieve 0.10 mg/L as the lowest possible reliable effluent TP concentration on an average annual basis through optimization of the plant. In addition to plant optimization, the WRF would need to implement additional technologies, not currently known or available, to reliably achieve TP concentrations of between 0.02 and 0.10 mg/L (annual average).

2.6 Alternatives Development

The alternatives that are analyzed in this EIS were developed over several years through the preparation of technical studies, water quality modeling, and interaction with numerous agencies and members of the public. A brief history of the project is presented in Section 1.3. This section describes the process and activities that have lead to the selection of the alternatives that are analyzed in this EIS.

The process began in 1994. Table 2.6-1 presents the timeline of events that resulted in the development of 11 alternatives that were studied in the Alternate Discharge Study.

2.6.1 Alternate Discharge Study

Numerous solutions to address the increasing effluent quantities in the Valley have been considered beginning with the 11 alternatives identified in the *Needs Assessment Study* and continuing through the Alternate Discharge Study, and finally the alternatives development for the EIS.

The potential alternatives identified in the *Needs Assessment Study* were evaluated during the Alternate Discharge Study. One goal of the Alternate Discharge Study was to move from a list of 11 alternate discharge options to one, viable, preferred alternative. This was accomplished by meeting with key stakeholders to identify a range of issues, perceptions, and concerns. Informal interviews were conducted during which these stakeholders were invited to provide their own and/or their agency's perspectives.

The stakeholders included local, state, and federal government agency representatives as well as local environmental groups. All 28 members of the LVWCC were included. Additionally, the CWC interviewed key downstream users, the MWD, the State of Arizona, and the BLM.

One objective of the interviews was to identify potential constraints. Constraints are issues or problems that could cause an alternative to be more difficult, costly, time consuming, or completely infeasible. The constraints discussed in Section 2.7 were identified during the stakeholder interviews or were issues developed by the ADST. These constraints were used in the decision process to select alternatives that best meet the objectives of the study. The options remaining from the list were used as a foundation for the alternatives studied further in this document.

2.6.2 Clean Water Coalition Citizens Advisory Committee

As discussed in Section 1.6.2, the governing board of the CWC established the CWCCAC to gather public input on water- and wastewater-related issues impacting the southern Nevada watershed and parts of the lower Colorado River. One of the CWCCAC's objectives was to help determine the best alternative for the long-term wastewater discharge outfall location.

The CWCCAC process was made up of the following elements:

- Identification of CWCCAC Purpose,
- Development of an understanding of the regional wastewater and water resource systems,
- Identification of CWCCAC Areas of Concern,
- Development of the CWCCAC Problem Statement to be solved,

Table 2.6-1 Chronology of Events for Development of the SCOP Alternatives.

Date	Event	Result
September 1994	Identification of need to address increased water supplies and facilities.	Advisory committee of Integrated Resources Planning Advisory Committee (IRPAC) formed.
June 1995	IRPAC completed Phase I recommendations regarding water resources, facilities, conservation, planning and finance.	Recommend maximizing reclaimed water where feasible.
November 1995	IRPAC completed Phase II recommendations regarding drinking water, rates, funding and revenue sources.	Recommend increase in sales tax for new wastewater facilities in the region.
July 1995	Wastewater agencies began planning process to evaluate processes needed to meet future water supplies and facilities.	Six alternatives were developed for future discharge scenarios.
July 1997	*Needs Assessment Study* evaluation of the six alternatives completed.	Recommended continued treatment and discharge to Las Vegas Wash, and a feasibility study of alternate discharge locations at Virgin Basin and Boulder Basin.
July 1997	Water Quality Citizens Advisory Committee (WQCAC) formed.	Recommended that the wastewater agencies reduce flows to the Las Vegas Wash by pursuing alternate discharge locations.
June 1998	WQCAC issued recommendations to study water quality in nine areas including the formation of the LVWCC.	The LVWCC was formed to develop a comprehensive plan for the Las Vegas Wash. One of the study teams was the Alternate Discharge Study Team (ADST).
October 1998	LVWCC formed study teams, including ADST.	LVWCC ADST formed a list of 18 alternate discharge options and selection criteria.
October 1999	Alternate Discharge Study Phases I and II commissioned to narrow choices.	Narrowed choices to 11 alternatives.

- Development of an understanding of the potential solution elements,
- Development of evaluation criteria based on areas of concern,
- Application of weights and rating of alternative discharge locations against evaluation criteria, and
- Development and presentation of CWCCAC recommendations to the CWC.

The CWCCAC commenced by outlining their purpose, which was:

To support the Clean Water Coalition in their efforts to identify and implement long-term solutions for the treatment, discharge and reuse of our community's wastewater by studying the nature of our wastewater needs, examining possible solutions to our challenges, evaluating the effect and impact of the proposed solutions and making recommendations to the CWC Board of Directors for implementation.

The CWCCAC's information-gathering process included:

- Taking a tour of the wastewater treatment facilities and Lake Mead;
- Observing presentations of scientific data and results;
- Participating in discussions regarding numerous technical issues; and
- Coordinating with many agencies including NDEP, SNWA, and the three CWC member agencies (CCWRD, CLV, and COH).

Once the CWCCAC felt comfortable that they understood and had explored all the issues, they developed weighted criteria by which all the SCOP alternatives would be rated. Key criteria, water modeling results, comparison of estimated costs of alternatives, and the alternative rating results are presented in the CWCCAC Recommendations Report, which is available upon request.

In an effort to more thoroughly present information to the CWCCAC and allow adequate opportunity for evaluation, a Financial Workgroup was created whose members are volunteers from the CWCCAC. This group met every month in advance of the CWCCAC meetings and reviewed all information in-depth relating to the purpose of the CWCCAC. The Financial Workgroup performed the initial evaluation and ranking of the project criteria and proposed alternatives, which were then taken to the full CWCCAC for review, modification, and acceptance. The Financial Workgroup also developed the draft overall recommendations, which were then discussed, modified, and finalized by the full CWCCAC. The CWCCAC made six recommendations. Many of these recommendations are in progress or have been completed.

- Systems Integration: Promote and participate in a planning process for identifying and integrating all the water resource elements in the Las Vegas Wash/Lake Mead system. In progress.
- Alternate Discharge Location: Identify the preferred alternate discharge location for the community's effluent that addresses the needs of our stakeholders in the areas of water quality, increasing flow projections, and future regulatory standards. Completed.
- Verification of Results and Approach: Prior to the implementation of the SCOP and its associated programs, an independent review of the approach to date and results should be conducted to verify the findings. Completed.
- Financial Considerations: A funding plan should be developed that considers the ability of the local rate payers and businesses to bear its costs, examines a variety of funding mechanisms, and considers the needs of or impacts to all affected stakeholders. In progress.
- Balance Water Resources: The CWC should support efforts to optimize and balance all water resources in southern Nevada. In progress.

- Public Outreach: In tandem with the development of a final wastewater solution, develop a comprehensive outreach plan to foster partnerships with all stakeholders in the acceptance and implementation of the project (CWCCAC 2004). In progress.

2.7 Alternatives Considered but Eliminated from Further Analysis

A NEPA review specifies the purpose and need for an action, describes the action that the federal agency proposes to meet that purpose and need, and identifies reasonable alternatives.
A potential alternative might be eliminated from detailed consideration for many reasons including, but not limited to, if the alternative does not meet the purpose and need for the project, would take too long to implement, would be prohibitively expensive, or would be highly speculative in nature and thus is considered unreasonable. This section identifies the alternatives that were eliminated from further consideration and provides a brief explanation of the reasons for elimination. These alternatives include the following:

- Alternate Alignments for the EI,
- Off-channel wetlands,
- Floating wetlands,
- Impoundment for creation of wetlands,
- North shore pipeline and wetlands,
- North shore pipeline and outfalls,
- Aeration,
- Discharge downstream of Hoover Dam,
- Discharge upstream of Hoover Dam,
- Discharge in the vicinity of Callville Bay,
- Discharge effluent near the Narrows, and
- Implementation of RO.

2.7.1 Alternate Alignments for the Effluent Interceptor

A variety of alignments and construction methods were considered during development of alternatives for the EI. This section presents a summary of the option(s) considered for each reach of the EI. The potential impacts to environmental resources for the evaluated alignments would be similar to the impacts described for the EI-alignments in Section 4.0. Exceptions or additions to those impacts are identified as they pertain to each segment described.

2.7.1.1 Reach 1 Alternatives

Three alternative alignments for Reach 1 were considered but eliminated from further analysis. The three alignments not carried forward are shown on Figure 2.7-1. As shown, each of the three alignment alternatives begin at the CLV outfall connection structure then follow a different alignment to a common connection point utilizing various combinations of cut-and-cover pipeline construction and tunneling. From the connection point, Reach 1 then continues to the vicinity of the CCWRD connection structure in a manner identical for all three alternatives, which are described in more detail below.

2.7.1.1.1 Alternative R1-1

The alignment for Alternative R1-1 would begin at the CLV treatment plant and go east along Desert Inn Road to a point just west of Hollywood Boulevard, at which point it would continue south parallel to Hollywood Boulevard until it reaches the CCWRD AWT (Figure 2.7-1). The majority of Alternative R1-1 would be constructed by tunneling (6,070 ft [1,850 m]). The remaining 770 ft (235 m) would be constructed using cut-and-cover techniques. The 6,840 ft (2,085 m) alignment would begin with a connection to the existing CLV outfall channel and cross Desert Inn Road to the south ROW line. A tunnel would be constructed beginning at the Desert Inn Road south ROW line and the Las Vegas Wash, following an alignment in the easterly direction to a point about 250 ft (76 m) east of the intersection of Desert Inn Road and Hollywood Boulevard. A second tunnel shaft would be constructed at this location. The alignment then continues in a southerly direction east of Hollywood Boulevard to the common connection point. From this point, the pipeline is constructed using cut-and-cover techniques, following the southern edge of Telephone Line Road in a southeasterly direction within CCWRD-owned land to the vicinity of the CCWRD connection point.

Alternative R1-1 was eliminated because:

- Construction costs resulting from the increased length of tunnel would be higher than other alternatives, and
- Existing SNWA facilities would be impacted.

2.7.1.1.2 Alternative R1-2

A combination of cut-and-cover pipeline construction and tunneling would be required for Alternative R1-2. The alignment would begin with a connection to the existing CLV outfall channel, cross Desert Inn Road following the southern boundary of the Desert Inn Road ROW within CLV property, continuing to the west bank of the Las Vegas Wash. The EI, using cut-and-cover construction, would follow the west bank of the Las Vegas Wash, adjacent to the flood control easement, in a southeasterly direction to approximately 450 ft (137 m) north of the southern property line of the CLV parcel. There would be a tunnel shaft at this location. The tunnel would run in an easterly direction, crossing the Las Vegas Wash and the Woodside Homes Development. The tunnel continues east (aligned along a proposed street within the Woodside Homes Development property) to a point 250 ft (76 m) east of Hollywood Boulevard.

There would be a second tunnel shaft at this location. The alignment then continues in a southerly direction east of Hollywood Boulevard to the common connection point. From this point, the pipeline would be constructed using cut-and-cover techniques, following the southern

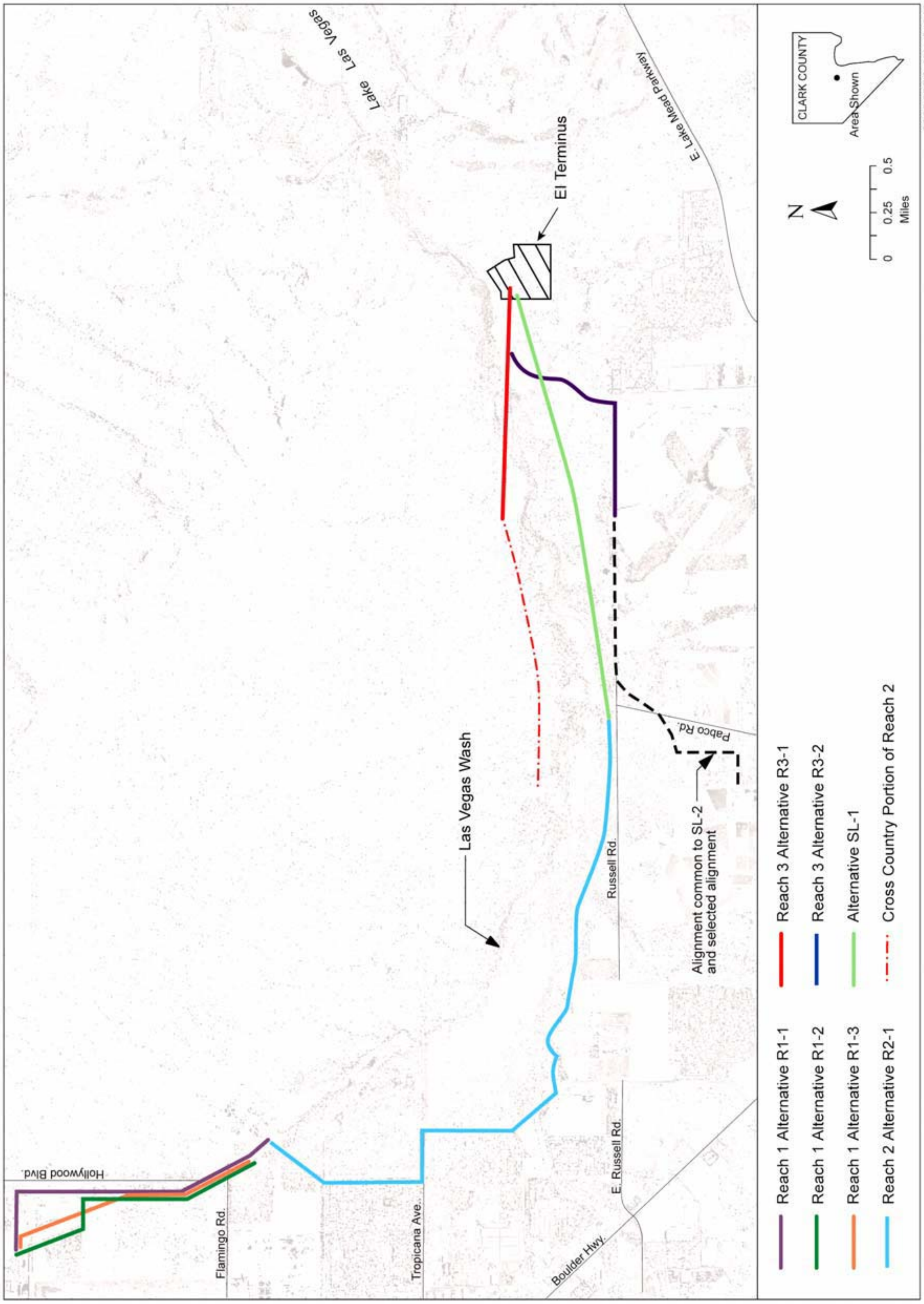

Figure 2.7-1 Effluent Interceptor Alignments Eliminated.

edge of Telephone Line Road in a southeasterly direction within CCWRD-owned land to the CCWRD connection point.

Alternative R1-2 was eliminated because:

- Construction costs resulting from the increased length of tunnel would be higher than other alternatives,
- Private property would need to be purchased or easements would need to be acquired, and
- Existing SNWA facilities would be impacted.

2.7.1.1.3 Alternative R1-3

The East Bank alignment would begin with a connection to the existing CLV outfall channel and would cross Desert Inn Road to the south ROW line. The EI would follow the south ROW of Desert Inn Road easterly, crossing under the Las Vegas Wash to the east bank. The EI would then head in a southeasterly direction following the east bank of the Las Vegas Wash to the vicinity of the SNWA Whitney Lateral, go under the Whitney Lateral, and continue along Hollywood Boulevard to the connection with the CCWRD AWT and CP.

Alternative R1-3 was eliminated because:

- Additional ROWs and easements would be required,
- Crossing the Las Vegas Wash at the location where the proposed Desert Inn Bridge would cross the Las Vegas Wash would expose the EI to future scour from the bridge, and
- Private property would need to be purchased or easements would need to be acquired.

2.7.1.2 Reach 2 Alternatives

Three alternatives for Reach 2 were considered but eliminated from further analysis. One alternative, R2-1, was an alignment located to the south of the Las Vegas Wash. The other two alternatives addressed the restoration of the cross-country portion of the northern Reach 2 alignment.

2.7.1.2.1 Alternative R2-1

The South alignment for Reach 2 would leave the CCWRD plant facilities and proceed south along the westerly boundary of the CCWRD property. The alignment would turn east generally following the southerly boundary of the Wetlands Park to a connection point in the vicinity of the COH WRF.

Alternative R2-1 was eliminated because:

- The south alignment is 3 miles (5 km) longer than the other alignments,
- There would be extensive disruption to city streets and utilities,
- There would be extensive disruption to the Nature Preserve in the Wetlands Park,
- There would be the increased potential to encounter contaminated shallow groundwater, and

- A larger pipe diameter would be needed because of the minimal slope along the southern portion of the Las Vegas Wash.

2.7.1.2.2 Alternative R2-2 and Alternative R2-3

Alternatives R2-2 and R2-3 concern the restoration of the construction area through the cross-country portion of Reach 2 (Figure 2.7-1). This portion of Reach 2 is located within the Wetlands Park. Alternative R2-3 would trench through the cross-country portion of Reach 2, and a maintenance road would be constructed over the pipeline scar. Alternative R2-2 would tunnel the full length of the cross-country portion of Reach 2 resulting in minimal surface disturbance in the area. These two alternatives were eliminated from further analysis because Clark County Parks and Community Services preferred the selected alternative, which includes trenching through the cross-country portion of the alignment, restoring the alignment to its original grade, and constructing a chat trail on the pipeline alignment.

2.7.1.3 Reach 3 Alternatives

Two alternative alignments for Reach 3 were considered but eliminated from further analysis. The two alignments not carried forward are shown on Figure 2.7-1.

2.7.1.3.1 Alternative R3-1

Alternative R3-1 would consist of a tunnel alignment that crosses under the Las Vegas Wash at an oblique angle (Figure 2.7-1). This alternative was not carried forward because engineering and tunneling experts determined that it is preferable to cross the Las Vegas Wash at a perpendicular angle.

2.7.1.3.2 Alternative R3-2

The South alignment (Alternative R3-2) would start at the connection with the COH WRF outfall and Reach 2 of the EI (Figure 2.7-1). Reach 2 of the EI would cross the Las Vegas Wash via a tunnel approximately 0.25 mile (0.4 km) upstream of the Pabco Road ECS to meet the COH connection at the existing COH WRF outfall. The alignment would then head in an easterly direction via open excavation to the vicinity of the C-1 Channel. The EI would cross under the C-1 Channel at a depth of approximately 50 to 60 ft (15 to 18 m) and continue in a tunnel to the EI Terminus. The depth of the tunnel would be determined by reaching competent rock, which could be approximately 130 to 150 ft (40 to 46 m) below the surface.

Alternative R3-2 was eliminated because:

- Contaminated groundwater would be encountered,
- Existing utilities conflict with the alignment,
- A larger diameter pipeline would be needed to cross under the Las Vegas Wash prior to connecting with the COH flows, and

- A longer tunneling segment would be required to cross beneath the C-1 Channel and the Henderson Landfill.

2.7.1.4 South Lateral Pipeline Alternatives

One South Lateral Pipeline alternative, was considered but eliminated from further analysis. The alignment not carried forward is shown on Figure 2.7-1 as “Alternative SL-1”. This alternative was not carried forward in the EIS because of the potential to unearth debris from the Henderson Landfill during construction. Additional reasons for eliminating this alignment include adverse impacts to the proposed COH golf course, longer alignment distance, and hydraulic restrictions.

2.7.2 Off-channel Wetlands

Effluent would be removed from the Las Vegas Wash and channeled through constructed wetlands before returning to Lake Mead. Storm flows and urban runoff would continue to flow in the Las Vegas Wash. There are four options for the points of diversions and returns that could be included in any combination:

- Divert effluent directly from the treatment facilities to the off-channel wetlands,
- Divert effluent indirectly from the Las Vegas Wash to the off-channel wetlands,
- Return flows from the wetlands to the Las Vegas Wash, and
- Return flows from the wetlands to the Las Vegas Bay.

The Off-channel Wetlands Alternative would require a combined effluent delivery system, construction of 5 to 10 miles (8 to 16 km) of pipeline, and construction of pumping stations. Approximately 1,000 to 4,000 acres (405 to 1,619 hectares) of treatment wetlands would be required to accommodate the projected effluent quantities.

This alternative was eliminated because:

- This option would require a large amount of land permanently.
- Wetlands constructed in uplands could affect the threatened and endangered desert tortoise and Las Vegas bear poppy *(Arctomecon californica)*.
- Evaporation and transpiration losses from wetlands vegetation would reduce the amount of return flow credits, as less effluent would be returned to Lake Mead.
- Wetlands would require continuous and, essentially, permanent monitoring to ensure sustained function and value.
- Wetlands would require periodic and continuous maintenance. This could include harvesting and disposal of vegetation if monitoring showed bioaccumulation of toxics such as salts or metals.
- Wetlands have the potential to increase undesirable species such as mosquitoes and midge flies.
- Wetlands would need to be designed to contend with infrequent but severe storm flows.

- Wetlands are reported to potentially increase TDS, Total Organic Carbon (TOC), and coliform bacteria. This could result in decreased water clarity in the Las Vegas Bay. In addition, there is the possibility for accumulation of toxic compounds.
- Humidity would increase in the vicinity of the constructed wetlands.
- Vegetation biomass would increase causing a fire hazard when dried either seasonally or during maintenance.
- This option does not meet the requirement for flexibility in management of effluents that is a primary component of the purpose and need for the proposed action.

2.7.3 Floating Wetlands

Wetlands would be constructed to float in the inner Las Vegas Bay and provide some nutrient removal. Effluent would continue to flow through the Las Vegas Wash. Approximately 2,500 acres (1,012 hectares) of floating wetlands would be required for nitrogen removal from the projected effluent quantities. Seasonal aeration (mixing) would be required for waters greater than 27 ft (8 m) deep.

This alternative was eliminated because:

- Safety would be a concern for persons attempting to climb on the wetlands platforms or boat in the vicinity.
- Wetlands would require continuous and, essentially, permanent monitoring to ensure sustained function and value.
- Wetlands would require periodic and continuous maintenance. This could include harvesting and disposal of vegetation if monitoring showed bioaccumulation of toxics such as salts or metals.
- Floating wetlands of this size, in a fluctuating lake system, and in this climate, are considered technologically experimental.
- Increased recreation in the Las Vegas Bay such as fishing and boating may impact the razorback sucker, a threatened and endangered species found in the Las Vegas Bay.
- The continued discharge of highly treated effluent to the Las Vegas Wash does not meet the requirement for flexibility in management of effluents that is a primary component of the purpose and need for the proposed project.
- Fluctuations in Lake Mead water levels would require the wetlands be moved to the optimal depth and effluent plume location. Sharply decreased water levels could necessitate the wetlands be towed where the Lake depth could exceed the zone of their effective influence.

2.7.4 Impoundment for Creation of Wetlands

A low-level dam would be constructed at the lowest part of the Las Vegas Wash higher than the maximum Lake level. The purpose of the dam would be to impound water, allowing wetlands to form naturally upstream. The number of acres of wetlands and riparian habitat formed would depend upon the placement of the impoundment, but due to topography in the area, it does not appear that they would exceed 100 acres (40 hectares). Effluent would continue to flow through the Las Vegas Wash. A combination concrete and riprap dam would likely be necessary to handle the wide range of flows. The area of wetlands created would be dependent upon the height of the dam.

This alternative was eliminated because:

- Wetlands created would not be sufficient to address the entire effluent stream.
- Wetlands constructed in uplands could affect the threatened and endangered desert tortoise and Las Vegas bear poppy.
- Evaporation and transpiration losses from wetlands vegetation would reduce the amount of return flow credits, as less effluent would be returned to Lake Mead.
- Wetlands would require continuous and essentially permanent monitoring to ensure sustained function and value.
- Wetlands would require periodic and continuous maintenance. This could include harvesting and disposal of vegetation if monitoring showed bioaccumulation of toxics such as salts or metals.
- Silt removal would be required following storm events.
- Wetlands have the potential to increase undesirable species such as mosquitoes and midge flies.
- The impoundment may not survive a 100-year storm event. In smaller storms, the structure would be overtopped and the wetlands would be inundated and possibly submerged. This could serve as a sediment trap that adversely affects the wetlands.
- Wetlands are reported to potentially increase TDS, TOC, and coliform bacteria. This could result in decreased water clarity in the Las Vegas Bay. In addition, there is the possibility for accumulation of toxic compounds.
- The continued discharge of highly treated effluent to the Las Vegas Wash does not meet the requirement for flexibility in management of effluents that is a primary component of the purpose and need for the proposed project.

2.7.5 North Shore Pipeline and Wetlands

Effluent would be removed from the Las Vegas Wash and delivered to Lake Mead via discharge into a series of washes along the northern perimeter of the Las Vegas Bay and Boulder Basin. Flow through these washes would be similar to flow through the Las Vegas Wash except that the flow would be diverted through a currently undetermined number of washes, thereby increasing the flow through each. The anticipated need for ECSs in each wash may result in the creation of wetlands.

This alternative would require construction of 15 to 20 miles (24 to 32 km) of large-diameter pipe, pumping stations, and a combined-effluent delivery system. In addition, ECSs would be needed to prevent erosion in the washes.

This alternative was eliminated because:

- A large amount of land would be needed.
- Wetlands constructed in uplands could affect the threatened and endangered desert tortoise and Las Vegas bear poppy.
- Wetlands would require continuous and, essentially, permanent monitoring to ensure sustained function and value.
- Wetlands would require periodic and continuous maintenance. This could include harvesting and disposal of vegetation if monitoring showed bioaccumulation of toxics such as salts or metals.
- Wetlands have the potential to increase undesirable species such as mosquitoes and midge flies.
- Wetlands would have to be designed to contend with infrequent but severe storm flows.
- Wetlands are reported to potentially increase TDS, TOC, and coliform bacteria. This could result in decreased water clarity in Las Vegas Bay. In addition, there is the possibility for accumulation of toxic compounds.
- Humidity would increase in the vicinity of the constructed wetlands.
- Vegetation biomass would increase causing a fire hazard when dried either seasonally or during maintenance.
- Algal blooms may result from adding nutrient-rich effluent to Lake Mead bays along the north shore that currently have relatively low nutrient loads.
- Grade control and erosion protection would be required on the washes that are conveying surface flow effluent to Lake Mead.

2.7.6 North Shore Pipeline and Outfalls

Effluent would be removed from the Las Vegas Wash and delivered to bays on the north shore of the Las Vegas Bay and Boulder Basin via a pipeline. The effluent would enter Lake Mead through a series of shallow outfalls. This alternative would include the construction of 15 to 20 miles (24 to 32 km) of large-diameter pipe, construction of pumping stations, and a combined-effluent delivery system.

This alternative was eliminated because:

- Installation of the pipeline would disturb large areas and disrupt the recreational experience for LMNRA users.
- Algal blooms may result from adding nutrient-rich effluent to Lake Mead bays along the north shore that currently have relatively low nutrient loads.
- Fluctuations in Lake Mead water levels would require that the outfalls be carefully designed so that mixing would be maximized year-round.

2.7.7 Aeration

An aeration system would be constructed within the inner Las Vegas Bay. The purpose of this alternative is to improve water quality through aeration and mixing. Effluent would continue to flow through the Las Vegas Wash. This alternative would require construction of a submerged diffused aeration system, an on-shore air pumping system, and could require extensive underwater construction.

This alternative was eliminated because:

- Safety would be a concern for persons diving or boating in the vicinity.
- Compressors for aeration would require regular maintenance. In addition, if the system is covered with sediment periodic, dredging may be required.
- Aeration technology is considered experimental for a project this large, in a fluctuating lake system, and in this climate.
- Fluctuations in Lake Mead water levels would require the system be moved to the optimal depth and effluent plume location. Sharply decreased water levels could result in the aeration system being too shallow or not submerged.
- Recreation in the Las Vegas Bay would be adversely affected by noises generated at the on-shore facility containing air compressors. There are also concerns about the visual impacts of air bubbles breaking the surface.
- The continued discharge of highly treated effluent to the Las Vegas Wash does not meet the requirement for flexibility in management of effluents that is a primary component of the purpose and need for the proposed project.
- Boating and fishing opportunities within the Las Vegas Bay may be impacted if the area over the submerged piping needs to be protected from boat anchors for the safety of the equipment and the boaters.

2.7.8 Discharge Downstream of Hoover Dam

Effluent would be conveyed in a common pipeline and tunnel system to an underwater discharge point downstream of Hoover Dam (Figure 2.7-2). It was identified early in the alternatives selection process that the discharge of highly treated effluent below Hoover Dam may impact Lake Mohave. Therefore, Lake Mohave was modeled by J.E. Edinger Associates using the 2-Dimensional CE-QUAL-W2 hydrodynamic and water quality model. Through the modeling and review of historical data, it was determined that Lake Mohave has not historically provided significant uptake for TP delivered through the Hoover Dam. The additional load from an effluent discharge below Hoover Dam is likely to be passed relatively unchanged to the downstream reservoir (Lake Havasu). Modeling also indicate that the dischargers would not be able to meet temperature and other water quality standards.

The Lake Mohave alternative would require a combined effluent delivery system of 20 to 25 miles (32 to 40 km) of large-diameter tunneled pipeline. The tunnel alignment would be near Gold Strike Canyon, a popular hiking and recreational area. Tunnel construction along Gold

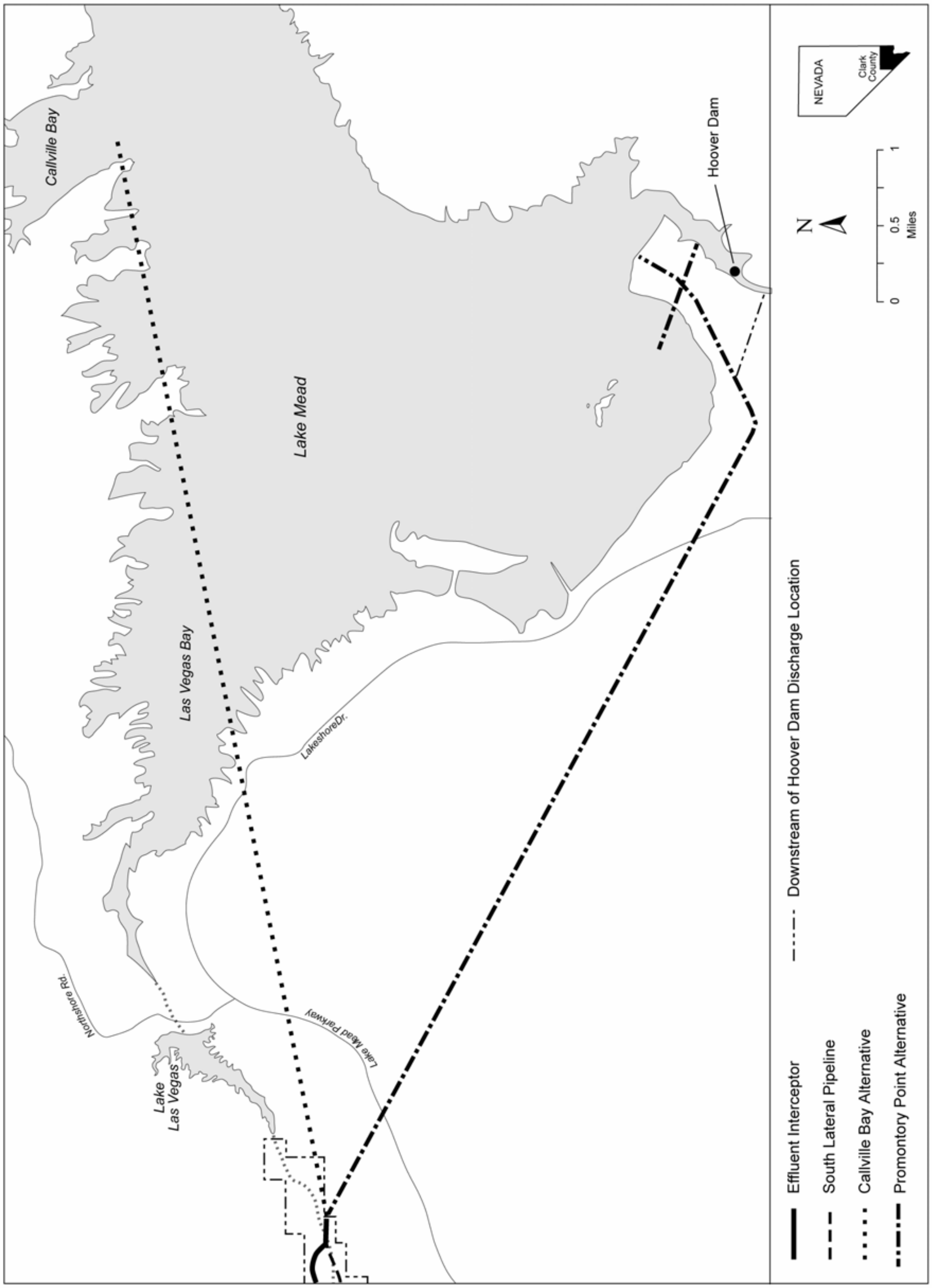

Figure 2.7-2 Lake Conveyance System Alternatives Eliminated.

Strike Canyon would be disruptive to recreational users of Gold Strike Canyon and Lake Mohave. In addition, there is a designated wilderness area, which is approximately 1 mile (1.6 km) below Hoover Dam. This wilderness area contains habitat for the desert bighorn sheep.

Tunnel construction would be challenging because of the presence of geothermal hot springs. Hot springs reach the ground surface just downstream of Hoover Dam along the banks of the Colorado River. If hot water is encountered during tunnel operations, specialized equipment and provisions would need to be used.

The construction activities would require an access road through Gold Strike Canyon to the site. In addition, a deep shaft and PRS would need to be constructed in the steep canyon walls. The pipeline and facilities would be located in a relatively pristine environment; impacts to habitat and wildlife would be significant.

In addition to the modeling findings and the constructability issues, the Discharge Downstream of Hoover Dam Alternative was eliminated for the following reasons:

- Temperature and other water quality standards in Lake Mohave would be exceeded.
- Downstream users such as Lake Mohave (and its fish hatchery), the Colorado River Indian tribes, California, Arizona, and Mexico would experience adverse impacts. Because the modeling indicated little to no nutrient assimilation in Lake Mohave, the MWD expressed concerns that a ‘downstream’ alternative would adversely impact the water quality they currently see at their intakes near Parker Dam in Lake Havasu.
- Construction activity and effluent discharge would occur within close proximity of the recreational areas just downstream of the Hoover Dam.
- All construction activities would be within the viewshed of the Hoover Dam tourist area.
- Construction of this alternative would be prohibitively expensive.
- There is a high probability that the tunnel alignment would pass through several geothermal hot springs. These hot springs could be disrupted during construction and with the presence of the pipeline. In addition, there is the possibility that the geothermal hot springs would raise the temperature of the effluent.
- The topography around Gold Strike Canyon is steep and irregular, which presents construction and operation difficulties.
- There is a high probability of encountering traditional cultural properties (TCPs). The area downstream of Hoover Dam is important to the Hualapai and Southern Paiute peoples, and many of the canyons and hot springs have significance to both tribes. The area around Sugarloaf Mountain and Gold Strike Canyon are considered TCPs. This would require extensive consultation with the affected tribes.
- Portions of the alignment and discharge location would be within the Hoover Dam Historic District. In addition, the Hoover Dam and immediate vicinity have been named a National Historic Landmark.

Impacts to sensitive biological resources may be significant. There would be possible disruption to cliff habitat and associated wildlife species during construction. A number of springs may be impacted that are habitat for the relict leopard frog (*Rana onca)*, which is a candidate for listing as threatened or endangered. In addition, the area immediately behind Hoover Dam, and south through Black Canyon into Lake Mohave proper, contains one of the last remnant populations of the razorback sucker and this area is currently designated critical habitat. Being the last, large population in the Lower Colorado River system, the Lake Mohave population of razorback suckers is very important to the recovery of the species.

The NPS *Lake Management Plan* (2002) included the Black Canyon as a "primitive zone", which means among other things that there are no roads, structures, facilities, or commercial services present, plus the area has natural-appearing landscape with pristine views.

2.7.9 Discharge Upstream of Hoover Dam in the Vicinity of Promontory Point

The Promontory Point Alternative would consist of a long tunnel with diffuser ports at three different locations out of Promontory Point (Figure 2.7-2). This alternative was modeled using the 3-Dimensional ELCOM and CAEDYM hydrodynamic and water quality model. In addition, the impacts that this alternative would have on Lake Mohave and the downstream users was evaluated using the 2-Dimensional CE-QUAL-W2 hydrodynamic and water quality model. Modeling results indicated that the Promontory Point epilimnetic or hypolimnetic discharge alternative would have similar water quality impacts to those experienced with the Discharge Downstream of Hoover Dam Alternative (Section 2.7.8). The Hoover Dam influence on Lake Mead is of such magnitude that effluent discharged at Promontory Point would be pulled through the Hoover Dam and into Lake Mohave with little or no nutrient assimilation. The MWD objected due to the adverse impact to the water quality at the MWD intakes. A Promontory Point discharge would alter MWD's formula for mixing Colorado River water with state or federal water from northern California, causing an increase in MWD's water treatment costs.

In addition to the water quality impacts, constructing the Promontory Point Alternative would be difficult. The tunnel alignment passes through the River Mountains in a southeasterly direction towards Hemenway Wash and then in an easterly direction towards Promontory Point. The tunnel would be approximately 16 miles (26 km) long and require two deep shafts: one near the Hacienda Hotel, and one on Promontory Point where the diffusers would be constructed. The PRS shaft at Promontory Point would be extremely deep. The shafts would be located within the National Historic Landmark Boundary, and the shafts would be difficult and expensive to design and construct. In addition, this alignment has the potential to encounter geothermal activity. Hot springs reach the ground surface along the banks of the Colorado River. If hot water were encountered during tunnel operations, specialized equipment and provisions would need to be used.

In addition to the modeling results, engineering considerations, and pipeline costs, the Promontory Point Alternative was eliminated for the following reasons:

- Impacts to downstream users. Because the modeling indicated little to no nutrient assimilation, MWD was concerned that this alternative would adversely impact the water quality they currently see at their intakes near Parker Dam in Lake Havasu.

- The effluent would be discharged within close proximity of the Hoover Dam overlook and visitor area just upstream of the Hoover Dam.
- Portions of the alignment and discharge location would be within the Hoover Dam Historic District. The Hoover Dam and immediate vicinity have been named a National Historic Landmark and any portion of the proposed project that would encroach upon the Hoover Dam Historic District would invoke additional regulations.
- There is a high probability of encountering TCPs.
- Construction could be prohibitively expensive due to deep shaft construction near the Hacienda Hotel; deep shaft and PRS construction near the tip of Promontory Point, a historically sensitive area; and the potential presence of geothermal hot springs.

2.7.10 Discharge in the Vicinity of Callville Bay

Effluent would be conveyed in a common pipeline and tunnel system to an underwater discharge point in the vicinity of Callville Bay (Figure 2.7-2). This alternative would require a combined-effluent delivery system, construction of 20 to 25 miles (32 to 40 km) of large-diameter pipe and tunnels, and construction of pumping stations.

The Callville Bay receiving area was modeled by Flow Science using the 3-Dimensional ELCOM and CAEDYM hydrodynamic and water quality model. Water quality modeling results for the Callville Bay Alternative indicate that the mixing and assimilative capacity of the receiving waters is not optimal and that there is an increased potential for algal production from adding relatively nutrient-rich effluent to the enclosed bays and coves in this area.

In addition to the modeling findings, the alternative was eliminated for the following reasons:

- The Callville Bay discharge is upstream of the SNWA raw-water intake structures.
- The NPS-operated raw-water intake near the Callville Bay marina is located on a floating barge that pulls water from approximately 14 ft (4 m) below the surface. A Callville Bay discharge would impact the water quality at the NPS water intake.
- The effluent would be discharged within close proximity of a high-use recreational area within an enclosed bay.
- Construction costs would be high.

2.7.11 Discharge Effluent near the Narrows

Effluent would be conveyed to a shallow discharge location upstream of the Narrows. This alternative would require a combined-effluent delivery system, construction of 25 to 30 miles (40 to 48 km) of large-diameter pipe, and construction of several pumping stations.

This alternative was eliminated because:

- Algal blooms may result from adding nutrient-rich effluent to Lake Mead bays along the north shore that currently have relatively low nutrient loads,

- Water quality monitoring results for the Narrows indicates that the mixing and assimilative capacity of the receiving waters is not optimal, and
- The construction of one pipeline for discharge through a single point does not leave any room for flexibility.

2.7.12 Implementation of Reverse Osmosis

The implementation of RO was considered because should it become necessary for the CLV WPCF and the COH WRF to achieve between 0.02 and 0.05 mg/L TP on an annual average basis, additional treatment processes would be needed. There may be differing professional opinions, but based on the knowledge and expertise of the Wastewater Treatment Specialists and Engineers consulted, in 2006 it was determined that RO may be the only technology that can reliably achieve combined effluent TP levels of between 0.02 and 0.05 mg/L on an annual average basis. Therefore, if Lake Mead levels decrease to 1,000 ft, RO would need to be implemented at the CLV and COH facilities to achieve a combined effluent TP concentration between 0.02 and 0.05 mg/L on an annual average basis. Implementation of RO at the CLV and COH facilities is described as an example of the type of technology that may be used to reliably achieve TP levels of between 0.02 and 0.05 mg/L (annual average).

An RO system would require the previously described MF/UF membrane system to pre-treat the influent to the RO system. Pretreatment with MF/UF membranes would allow use of polyamide RO membranes, which have lower overall operating costs and improved performance compared to the older-style cellulosic derivatives. Addition of acid and anti-scalant would also be used as a pretreatment for RO to prevent scaling by calcium carbonate and other sparingly soluble salts. Brine or reject-water containment and a means for its treatment/disposal would be required. In addition, post-treatment pH adjustment and/or alkalinity addition is needed for corrosion control. Pre-chloramination of membranes may also be recommended; some field results treating municipal wastewater effluent show that operating MF/UF membranes and RO membranes with a low (2 to 5 mg/L) chloramine residual helps control biological and organic fouling of membranes that can reduce productivity and increase operating costs. Reverse osmosis design requires consideration of flux, recovery, hydraulics, operational flexibility, and capital and O&M costs.

As explained for addition of MF/UF, the piping would need to be modified to accommodate MF/UF and RO units in series following the existing sand filters and before disinfection.

This alternative resulted in two significant impacts, and was therefore eliminated from further consideration. First, implementation of RO would create a brine or reject-water stream. Reverse osmosis membranes concentrate dissolved material. This concentrate, or brine is discharged without recycling to avoid precipitation on the membrane surface. The brine stream would consist of all particles, dissolved materials, and other contaminants removed from the effluent flow. Treatment technologies for disposal of brine or reject water streams are being developed, but currently there are no ideal low-cost methods of brine disposal for inland facilities. Therefore, the disposal of the reject water stream that would be created by the use of RO would be a significant impact because viable disposal options are not currently available, and they could require large land areas and costly processes.

The second significant impact resulting from the implementation of RO is the loss of input water. Approximately 15 to 20 percent of input water would be lost as reject water. Therefore, between 33 and 44 mgd of input water would be lost, reducing the return flow credits by between approximately 12,000 and 16,000 million gallons per year. The loss of return flow credits is a significant adverse impact to southern Nevada because water usage in Nevada cannot be sustained without at least maintaining their current return flow credits.

2.8 Environmentally and Agency-preferred Alternative

The environmentally preferred alternative is the alternative that would meet the requirements of section 101 of NEPA. This alternative would satisfy the following requirements:

- Fulfill the responsibilities of each generation as trustee of the environment for succeeding generations.
- Ensure for all generations safe, healthful, productive, and aesthetically and culturally pleasing surroundings.
- Attain the widest range of beneficial uses of the environment without degradation, risk of health or safety, or other undesirable or unintended consequences.
- Preserve important historic, cultural, and natural aspects of our national heritage, and maintain, wherever possible, an environment that supports diversity and variety of individual choice.
- Achieve a balance between population and resource use that would permit high standards of living and a wide sharing of life's amenities, and
- Enhance the quality of renewable resources, and approach the maximum attainable recycling of depletable resources.

In summary, the environmentally preferred alternative is the alternative that causes the least damage to the biological and physical environment, and best protects, preserves, and enhances historic, cultural, and natural resources.

Identification of the agency-preferred alternative allows the public to understand what actions the agency would like to implement.

The No Action Alternative, while it eliminates the need for construction on federally managed lands, would result in water quality standard exceedances in the Las Vegas Bay. The water quality standard exceedances may result in increased algae production, which may have an adverse effect on recreation in the Las Vegas Bay area of Lake Mead. In addition, the No Action Alternative does not provide the flexibility needed to manage the increasing effluent flows in the Valley. For these reasons, the No Action Alternative is not preferred from an environmental perspective.

The impacts resulting from the Las Vegas Bay, Boulder Islands South, and Boulder Islands North alternatives are similar. The three pipeline alternatives would result in minor, temporary impacts to surface water, biological resources, recreation, noise, air quality, visual resources, and traffic during construction. The Las Vegas Bay Alternative is not preferred from an environmental perspective because although water quality standards would not be exceeded, modeling indicates that effluent discharged in the Las Vegas Bay would not undergo as much dilution as discharge in the vicinity of the Boulder Islands.

Although the Process Improvements Alternative has been analyzed, after reviewing the additional information and analyses, the Final EIS concludes that the Process Improvements Alternative cannot meet key elements of the purpose and need of the project, including the needs to ensure compliance with water quality standards for Lake Mead at a Lake level of 1,000 ft, and to provide the management flexibility to respond to future water quality issues and regulatory requirements.

The Boulder Islands South and Boulder Islands North alternatives result in similar impacts. However, the Boulder Islands South Alternative would generate a larger quantity of spoils that would require disposal. The increased spoil quantity results in an increased number of trucks needed to haul the spoils to designated disposal areas. In addition, the Boulder Islands South Alternative has the potential to affect more archaeologically significant sites than the other alternatives. For these reasons, the Boulder Islands South Alternative is not preferred from an environmental perspective.

The Boulder Islands North Alternative is the environmentally preferable alternative because, overall, it would best meet the requirements of section 101 of NEPA. It would provide the flexibility needed to manage the increasing effluent flows in the Valley, without degradation of Reclamation and NPS resources. In addition, this alternative would use effluent flows through the pipeline to generate electrical power that would be used by the AMSWTF. The generation of hydroelectric power is considered an environmentally responsible action and a beneficial impact of the Boulder Islands North Alternative.

2.9 Comparison of Alternatives by Resource and Potential Impacts

Chapter 4.0 presents an analysis of the impacts resulting from the No Action Alternative, Boulder Islands North Alternative, Boulder Islands South Alternative, Las Vegas Bay Alternative, and Process Improvements Alternative. Table 2.9-1 provides a comparison of alternatives by resource and potential impact.

Table 2.9-2 provides a summary of the mitigation measures that may be implemented to reduce or eliminate the potential impacts to resources. Although mitigation measures are typically implemented to minimize or eliminate significant impacts, Table 2.9-2 also includes actions that would be taken to minimize or eliminate insignificant impacts. Additional mitigation measures and details are provided in the appropriate sections of Chapter 4.

Table 2.9-1 Summary of Environmental Impacts.

Resource	No Action (No Pipeline)	EI-Alignment A	EI-Alignment B	Boulder Islands North LCS	Boulder Islands South LCS	Las Vegas Bay LCS	Process Improvements (No Pipeline)
Water Resources							
Surface Water	No significant impact.	Insignificant increase in erosion potential during construction.	Insignificant increase in erosion potential during construction.	Insignificant increase in erosion potential during construction. Dredged material would be contained, therefore, no significant impact would occur.	Insignificant increase in erosion potential during construction. Dredged material would be contained, therefore, no significant impact would occur.	Insignificant increase in erosion potential during construction. Dredged material would be contained, therefore, no significant impact would occur.	No significant impact.
Groundwater	No impact.	Dewatering during construction may result in lowering water levels in domestic wells, and subsidence. This may result in a significant impact.	Dewatering during construction may result in lowering water levels in domestic wells, and subsidence. This may result in a significant impact.	No impact.	No impact.	No impact.	No impact

Table 2.9-1 Summary of Environmental Impacts (continued).

Resource	No Action (No Pipeline)	EI-Alignment A	EI-Alignment B	Boulder Islands North LCS	Boulder Islands South LCS	Las Vegas Bay LCS	Process Improvements (No Pipeline)
Surface Water Quality	Increases in chlorophyll levels throughout Boulder Basin. This may be a significant adverse impact. Water quality standards would be exceeded at Lake levels of 1,000 ft for 2030 and 2050 effluent flows. This may be a significant adverse impact. Increase in effluent total phosphorus(TP) through Hoover Dam of 1 part per billion (ppb) with 2030 flows and 2 ppb with 2050 flows. This increase would result in an insignificant impact downstream of Hoover Dam.	Dilution of constituents from groundwater and urban runoff would be reduced. This would be a significant adverse impact if concentrations exceed water quality standards.	Dilution of constituents from groundwater and urban runoff would be reduced. This would be a significant adverse impact if concentrations exceed water quality standards.	Water-quality standards would not be exceeded. Increased dilution of effluent-related constituents compared to baseline and No Action Alternative. Reduced quantities of nutrients would enter the inner Las Vegas Bay. Increase in effluent TP through Hoover Dam of 1 ppb with 2030 flows and 2 ppb with 2050 flows. This increase would result in an insignificant impact downstream of Hoover Dam.	Water quality standards would not be exceeded. Increased dilution of effluent-related constituents compared to baseline and No Action Alternative. Reduced quantities of nutrients would enter the inner Las Vegas Bay. Increase in effluent TP through Hoover Dam of 1 ppb with 2030 flows and 2 ppb with 2050 flows. This increase would result in an insignificant impact downstream of Hoover Dam.	Water quality standards would not be exceeded. Increased dilution of effluent-related constituents compared to baseline and No Action Alternative, but not as much dilution as the Boulder Islands Alternative. Increase in effluent TP through Hoover Dam of 1 ppb with 2030 flows and 2 ppb with 2050 flows. This increase would result in an insignificant impact downstream of Hoover Dam.	Dilution of constituents from groundwater and urban runoff would be increased. This is a beneficial impact. Effluent-related constituents entering Lake Mead would be reduced, but this would not significantly change water quality in Boulder Basin or downstream of Hoover Dam.

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Table 2.9-1 Summary of Environmental Impacts (continued).

Resource	No Action (No Pipeline)	EI-Alignment A	EI-Alignment B	Boulder Islands North LCS	Boulder Islands South LCS	Las Vegas Bay LCS	Process Improvements (No Pipeline)
Biological Resources	Increased flows would likely result in an insignificant expansion of riparian plant and wetland communities.	Construction activities would temporarily impact vegetation and wildlife including the desert tortoise. This would be an Insignificant impact. Operation of the EI may result in the transition from wetland communities to drier, more salt tolerant, riparian communities in the Las Vegas Wash. Increased selenium concentrations due to decreased dilution may pose a bioaccumulation hazard to wildlife in the Las Vegas Wash. This may be a significant adverse impact.	Construction activities would temporarily and insignificantly impact vegetation and wildlife including the desert tortoise. Operation of the EI may result in the transition from wetland communities to drier, more salt tolerant, riparian communities in the Las Vegas Wash. Increased selenium concentrations due to decreased dilution may pose a bioaccumulation hazard to wildlife in the Las Vegas Wash. This may be a significant adverse impact.	Construction activities would temporarily and insignificantly impact biological resources. Effluent-related constituents that may adversely impact aquatic resources would be reduced in the Las Vegas Bay, as would the nutrient source. The reduction in nutrients to the Las Vegas Bay may adversely impact the quality of sport fishing in the Las Vegas Bay.	Construction activities would temporarily and insignificantly impact biological resources. Effluent-related constituents that may adversely impact aquatic resources would be reduced in the Las Vegas Bay, as would the nutrient source. The reduction in nutrients to the Las Vegas Bay may adversely impact the quality of sport fishing in the Las Vegas Bay.	Construction activities would temporarily impact biological resources. Effluent-related constituents that may impact aquatic resources would continue to enter the Las Vegas Bay.	Increased flows would likely result in an insignificant expansion of riparian plant and wetland communities.

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Table 2.9-1 Summary of Environmental Impacts (continued).

Resource	No Action (No Pipeline)	EI-Alignment A	EI-Alignment B	Boulder Islands North LCS	Boulder Islands South LCS	Las Vegas Bay LCS	Process Improvements (No Pipeline)
Cultural Resources	No impact to identified National Register of Historic Places (NRHP) sites. The discovery of numerous buried cultural features in areas not far from the proposed cut-and-cover segment of Reach 2 indicate that although surface artifacts were not observed in the vicinity of the EI, subsurface artifacts may be present and may be affected by construction activities.	No significant impacts.	No significant impacts.	No cultural resources would be impacted by the terrestrial portion of the LCS. The submerged sections of the Boulder Islands North Alternative would cross submerged portions of the SCIRR sites 26CK4046B, the service road site 26CK7254, and portions of the aggregate storage piles which are part of site 26CK7285. These sites may also be affected by the installation of the turbidity curtain. These activities would have adverse impacts on the integrity of the sites. If the sites cannot be avoided, the NPS would consult with the Nevada SHPO and the Advisory Council on Historic Preservation to determine appropriate mitigation measures.	Three above-ground elements of Site 26CK7115 are located near the SRMT3-East working shaft. The impacts from the submerged sections of this alternative would be the same as those described for the Boulder Islands North Alternative.	No impact.	No impact to identified NRHP sites.

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Table 2.9-1 Summary of Environmental Impacts (continued).

Resource	No Action (No Pipeline)	EI-Alignment A	EI-Alignment B	Boulder Islands North LCS	Boulder Islands South LCS	Las Vegas Bay LCS	Process Improvements (No Pipeline)
Recreation	Increased levels of chlorophyll in the inner Las Vegas Bay may result in temporary algae blooms that deter recreational use. On the other hand, additional nutrients may have a beneficial impact on sport fishing.	Minor impacts during construction.	Minor impacts during construction. Trails and pedestrian bridge would be beneficial.	Temporary and minor impacts at Lakeshore Drive and Lake Mead Resort areas during construction. No long-term adverse impacts. The reduction of nutrients entering the Las Vegas Bay may adversely impact the quality of sport fishing in the Las Vegas Bay.	Temporary and minor impacts at Boulder Beach area during construction. No long-term adverse impacts. The reduction of nutrients entering the Las Vegas Bay may adversely impact the quality of sport fishing in the Las Vegas Bay.	Temporary and minor impacts at Sunset Scenic Overlook and Las Vegas Bay areas during construction.	Decreased levels of nutrient loadings to the Las Vegas Bay may have an adverse impact on sport fishing.
Hazardous Materials	No impact.	Perchlorate-contaminated groundwater may be encountered during construction.	Perchlorate-contaminated groundwater may be encountered during construction.	No impact.	No impact.	No impact.	Additional sludge from the use of MF/UF membranes would require transport and disposal to a landfill. This is an insignificant impact.
Noise	No significant impact.	Impacts would be temporary and insignificant during construction.	Impacts would be temporary and insignificant during construction.	Impacts would be temporary and insignificant during construction.	Impacts would be temporary and insignificant during construction.	Impacts would be temporary and insignificant during construction.	No significant impact.
Air Quality	No impact.	Impacts would be temporary and insignificant during construction.	Impacts would be temporary and insignificant during construction.	Impacts would be temporary and insignificant during construction.	Impacts would be temporary and insignificant during construction.	Impacts would be temporary and insignificant during construction.	No impact.

Table 2.9-1 Summary of Environmental Impacts (continued).

Resource	No Action (No Pipeline)	EI-Alignment A	EI-Alignment B	Boulder Islands North LCS	Boulder Islands South LCS	Las Vegas Bay LCS	Process Improvements (No Pipeline)
Earth Resources	No impact.	No significant impact.	No significant impact.	No significant impact.	No significant impact.	No significant impact.	No impact.
Land Use	No impact.	No significant impact.	No significant impact.	No significant impact.	No significant impact.	No significant impact.	No impact.
Visual Resources	No impact.	No significant adverse impact.	No significant adverse impact. Chat trail would provide new access to viewing areas within the Wetlands Park.	Impact would be temporary and insignificant at the Lakeshore Drive and Lake Mead Resort areas during construction. Views of construction areas within the LMNRA would be impacted until restoration is complete.	Impact would be temporary and insignificant in the Boulder Beach area during construction. Views of construction areas within the LMNRA would be impacted until restoration is complete.	Impact would be temporary and insignificant at the Sunset Scenic Overlook during construction. Views of construction areas within the LMNRA would be impacted until restoration is complete.	No impact.
Socio-economics [1]	Mitigation would be implementation of the Process Improvements Alternative.	Cost: $87 million.	Cost: $87 million.	Cost: $594 million (includes EI costs).	Cost: $590 million (includes EI costs).	Cost: $540 million (includes EI costs).	Cost: $205 million for capital costs plus $30 million annually for O&M costs.
Environmental Justice	No impact.	No impact.	No impact.	No impact.	No impact.	No impact.	No impact.

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Table 2.9-1 Summary of Environmental Impacts (continued).

Resource	No Action (No Pipeline)	EI-Alignment A	EI-Alignment B	Boulder Islands North LCS	Boulder Islands South LCS	Las Vegas Bay LCS	Process Improvements (No Pipeline)
Transportation and Traffic	No significant impact.	Impact would be temporary and insignificant.	Impact would be temporary and insignificant.	Impact would be temporary and insignificant.	Temporary closure of AR-76 may be required. Impact would be temporary and insignificant.	Impact would be temporary and insignificant.	No impact.
Paleontological Resources	No impact.	No impact.	No impact.	No impact.	No impact.	No impact.	No impact.

Note
[1] Costs do not include $29 million for plant optimization, which is included in all the alternatives.

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Table 2.9-2 Summary of Mitigation Measures.

Resource	Effluent Interceptor (Both Alignments)	Boulder Islands North LCS	Boulder Islands South LCS	Las Vegas Bay LCS	Process Improvements
Water Resources					
Surface Water	Open trench excavation will not cross two major ephemeral washes at any one time.	Open trench excavation will not cross two major ephemeral washes at any one time.	Same as Boulder Islands North LCS.	Same as Boulder Islands North LCS.	None required.
Groundwater	Groundwater will be monitored and if contamination is suspected, analyzed, and disposed of per NDEP guidance. Groundwater levels in the area will be monitored. Backfill with suitable permeability will be used.	None required.	None required.	None required.	None required.
Surface Water Quality	Although the Boulder Basin AMP is not a mitigation measure because it is part of the proposed alternative, flows to the Las Vegas Wash may be adjusted to minimize impacts from increasing non-effluent related concentrations of constituents such as selenium that result from less dilution with effluent flows. NDEP would regulate parameter concentrations if necessary.	Although the Boulder Basin AMP is not a mitigation measure because it is part of the proposed alternative, flows to the Las Vegas Wash may be adjusted to minimize impacts from increasing non-effluent related concentrations of constituents such as selenium that result from less dilution with effluent flows. NDEP would regulate parameter concentrations if necessary.	Same as Boulder Islands North LCS.	Same as Boulder Islands North LCS.	None required.

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Table 2.9-2 Summary of Mitigation Measures (continued).

Resource	Effluent Interceptor (Both Alignments)	Boulder Islands North LCS	Boulder Islands South LCS	Las Vegas Bay LCS	Process Improvements
Biological Resources	Pre-construction surveys for terrestrial species identified in EIS will be conducted. A USACE Mitigation and Monitoring Plan will be implemented.	Pre-construction surveys for terrestrial species identified in EIS will be conducted. A USACE Mitigation and Monitoring Plan will be implemented. Construction activities within 100 yards (91m) of a razorback sucker spawning area will not be allowed from December 1 to May 1. Although the Boulder Basin AMP is not a mitigation measure because it is part of the proposed alternative, flows to the Las Vegas Wash may be adjusted to minimize impacts to biological resources.	Same as Boulder Islands North LCS.	Same as Boulder Islands North LCS.	None required.
Cultural Resources	Pre- and post-construction assessments will be conducted. Avoidance of some sites will be required. A qualified monitor will be present during construction activities to protect resources in the event that subsurface cultural resources are encountered.	A Programmatic Agreement has been initiated that ensures the required mitigation measures are implemented to minimize or eliminate the potential impact to cultural resources.	Avoidance of some sites will be required for the terrestrial segments of the LCS. In addition, a qualified construction monitor will be present during construction at some sites. A Programmatic Agreement has been initiated that ensures the required mitigation measures are implemented to minimize or eliminate the potential impact to cultural resources.	None required.	None required.

Table 2.9-2 Summary of Mitigation Measures (continued).

Resource	Effluent Interceptor (Both Alignments)	Boulder Islands North LCS	Boulder Islands South LCS	Las Vegas Bay LCS	Process Improvements
Recreation	Public will be routed around or away from construction areas.	Public will be routed around or away from construction areas. Coordination with Clark County Parks and Community Services to ensure the activities are conducted within the Clark County Wetlands Park Master Plan guidelines. Some construction activities within the LMNRA will be limited to October through March. Notices to Mariners will be published prior to construction activities, Aids to Navigation for Inland Waterways will be implemented, and at least one-way boat traffic near the Lake Mead Resort Marina will be maintained during construction activities.	Public will be routed around or away from construction areas. Coordination with Clark County Parks and Community Services to ensure the activities are conducted within the Clark County Wetlands Park Master Plan guidelines. Some construction activities within the LMNRA will be limited to October through March.	Same as Boulder Islands South LCS.	None required.
Hazardous Materials	Groundwater suspected of containing perchlorate will be analyzed and disposed of in accordance with NDEP guidelines.	None required.	None required.	None required.	None required.
Noise	None required.	None required.	None required.	None required.	None required.
Air Quality	Applicable permits will be obtained.	Applicable permits will be obtained.	Same as Boulder Islands North LCS.	Same as Boulder Islands North LCS.	None required.
Earth Resources	Restoration plans for disturbed areas will be prepared and implemented.	Restoration plans for disturbed areas will be prepared and implemented.	Same as Boulder Islands North LCS.	Same as Boulder Islands North LCS.	None required.

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Table 2.9-2 Summary of Mitigation Measures (continued).

Resource	Effluent Interceptor (Both Alignments)	Boulder Islands North LCS	Boulder Islands South LCS	Las Vegas Bay LCS	Process Improvements
Land Use	None required.	Notices to Mariners will be published prior to construction activities, Aids to Navigation for Inland Waterways will be implemented, and at least one-way boat traffic near the Lake Mead Resort Marina will be maintained during construction activities.	None required	None required	None required.
Visual Resources	None required.	Restoration plans for disturbed areas will be prepared and implemented.	Same as Boulder Islands North LCS.	Same as Boulder Islands North LCS.	None required.
Socioeconomics	None required.	None required	None required.	None required.	None required.
Environmental Justice	None required.	None required	None required.	None required.	None required.
Transportation and Traffic	Construction traffic management plans will be prepared and implemented.	Construction traffic management plans will be prepared and implemented. Routes through LMNRA would be coordinated with the NPS.	Same as Boulder Islands North LCS.	Same as Boulder Islands North LCS.	None required.
Paleontological Resources	None required.	None required.	None required.	None required.	None required.