



SPECIAL MEETING AGENDA

Date: 4/20/2021
Time: 5:00 p.m.
Location: [Zoom.us/join](https://zoom.us/join) – ID# 945 0353 3001

NOVEL CORONAVIRUS, COVID-19, EMERGENCY ADVISORY NOTICE

On March 19, 2020, the Governor ordered a statewide stay-at-home order calling on all individuals living in the State of California to stay at home or at their place of residence to slow the spread of the COVID-19 virus. Additionally, the Governor has temporarily suspended certain requirements of the Brown Act. For the duration of the shelter in place order, the following public meeting protocols will apply.

Teleconference meeting: All members of the City Council, city staff, applicants, and members of the public will be participating by teleconference. To promote social distancing while allowing essential governmental functions to continue, the Governor has temporarily waived portions of the open meetings act and rules pertaining to teleconference meetings. This meeting is conducted in compliance with the Governor Executive Order N-25-20 issued March 12, 2020, and supplemental Executive Order N-29-20 issued March 17, 2020.

- How to participate in the meeting
 - Submit a written comment online up to 1-hour before the meeting start time:
menlopark.org/publiccommentApril20 *
 - Access the meeting real-time online at:
[Zoom.us/join](https://zoom.us/join) – Meeting ID 945 0353 3001
 - Access the meeting real-time via telephone at:
(669) 900-6833
Meeting ID 945 0353 3001
Press *9 to raise hand to speak

*Written public comments are accepted up to 1-hour before the meeting start time. Written messages are provided to the City Council at the appropriate time in their meeting.

- Watch meeting:
 - Cable television subscriber in Menlo Park, East Palo Alto, Atherton, and Palo Alto:
Channel 26
 - Online:
menlopark.org/streaming

Note: City Council closed sessions are not broadcast online or on television and public participation is limited to the beginning of closed session.

Subject to Change: Given the current public health emergency and the rapidly evolving federal, state, county and local orders, the format of this meeting may be altered or the meeting may be canceled. You may check on the status of the meeting by visiting the City's website www.menlopark.org. The instructions for logging on to the webinar and/or the access code is subject to change. If you have difficulty accessing the webinar, please check the latest online edition of the posted agenda for updated information (menlopark.org/agenda).

According to City Council policy, all meetings of the City Council are to end by midnight unless there is a super majority vote taken by 11:00 p.m. to extend the meeting and identify the items to be considered after 11:00 p.m.

Regular Session ([Zoom.us/join](https://zoom.us/join) – ID# 945 0353 3001)

A. Call To Order

B. Roll Call

C. Advisory Body Member Reports

C1. Finance and Audit Committee work plan progress report – continued from March 23, 2021

D. Study Session

D1. Provide direction on the City's paving program and use of rubberized asphalt versus hot mix asphalt for future street resurfacing projects ([Staff Report #21-083-CC](#)) ([Presentation](#))

D2. ConnectMenlo community amenities ([Staff Report #21-084-CC](#)) ([Presentation](#))

[Public comment received on item D2.](#)

Recess

E. Consent Calendar

E1. Authorize the city manager to enter into master professional agreements with M-Group, Arnold Mammarella, Architecture + Consulting, and BAE for professional planning services ([Staff Report #21-085-CC](#))

E2. Adopt Resolution No. 6621 to amend the 2030 climate action plan to include scope of work for 2021 implementation ([Staff Report #21-082-CC](#))

F. Regular Business

F1. Approve City Council 2021 work plan and identify top priorities ([Staff Report #21-081-CC](#))

[Web form public comments received on item F1.](#)

G. City Council Initiated Items

G1. Informal proposal to create a mobile vaccination operation to provide equitable access to vaccination of specific populations at their place of residence ([Staff Report #21-080-CC](#))

H. Adjournment

At every regular meeting of the City Council, in addition to the public comment period where the public shall have the right to address the City Council on any matters of public interest not listed on the agenda, members of the public have the right to directly address the Council on any item listed on the agenda at a time designated by the chair, either before or during the City Council's consideration of the item.

At every special meeting of the City Council, members of the public have the right to directly address the City Council on any item listed on the agenda at a time designated by the chair, either before or during consideration of the item. For appeal hearings, appellant and applicant shall each have 10 minutes for presentations.

If you challenge any of the items listed on this agenda in court, you may be limited to raising only those issues you or someone else raised at the public hearing described in this notice, or in written correspondence delivered to the City of Menlo Park at, or prior to, the public hearing.

Any writing that is distributed to a majority of the City Council by any person in connection with an agenda item is a public record (subject to any exemption under the Public Records Act) and is available by request by emailing the city clerk at jaherren@menlopark.org. Persons with disabilities, who require auxiliary aids or services in attending or participating in City Council meetings, may call the City Clerk's Office at 650-330-6620.

Agendas are posted in accordance with Government Code Section 54954.2(a) or Section 54956. Members of the public can view electronic agendas and staff reports by accessing the City website at menlopark.org/agenda and can receive email notification of agenda and staff report postings by subscribing to the "Notify Me" service at menlopark.org/notifyme. Agendas and staff reports may also be obtained by contacting City Clerk at 650-330-6620. (Posted: 4/15/2021)



STAFF REPORT

City Council

Meeting Date:

4/20/2021

Staff Report Number:

21-083-CC

Study Session:

Provide direction on the City's paving program and use of rubberized asphalt versus hot mix asphalt for future street resurfacing projects

Recommendation

Staff recommends that the City Council provide direction on the use of rubberized asphalt versus hot mix asphalt for street resurfacing projects in the capital improvement plan (CIP.) Staff recommends procuring a bid alternate for rubberized asphalt on resurfacing projects for projects/streets which meet the following criteria:

- Streets with a good to excellent pavement condition rating suitable for a 1.2 to 2.4-inch overlay
- Streets classified as non-local (i.e., collector or arterial)
- Resurfacing projects awarded before mid-May to ensure construction in the summer, when temperature conditions are expected to be most favorable for rubberized asphalt

Policy Issues

Direction would inform planning and proposed projects within the five-year CIP which includes resurfacing projects for maintaining and improving the City's roadway network and for providing safe public infrastructure.

Background

Existing paving management system

The City uses a pavement management system (PMS) for cataloguing its streets and identifying segments in need of repair. The PMS is guided by StreetSaver, a pavement analysis software endorsed by the Metropolitan Transportation Commission (MTC.) Through grants provided by MTC, an inventory of street conditions known as the pavement condition index (PCI) for City streets is performed every two to three years. The PCI evaluates streets based on a scale of zero to 100, ranging from poor to excellent, respectively. As of the latest PCI report from October 2020, Menlo Park's overall PCI is 79 ("good" per Table 1.) In general, streets with higher PCIs are less costly to preserve and may be candidates for surface treatments (e.g., surface overlays or slurry seals) in lieu of full reconstruction. This is generally the desired goal of the PMS since it reflects a more cost effective approach to maintaining streets.

Table 1: PCI Classification	
PCI rating	Street condition
0 to 25	Failed to very poor
25 to 50	Poor
50 to 70	At Risk to fair
70 to 100	Good to excellent

Staff utilizes StreetSaver to evaluate pavement conditions, repair options, and project funding needs based on PCI ratings and other inputs. For example, StreetSaver generates budget scenarios with respect to available funding, price of asphalt and inflation. The program also provides repair recommendations using existing or desired PCI values per Table 2. The City typically alternates repair types, performing overlay one year and slurry seal the next, in order to provide the most cost effective pricing from contractors. StreetSaver produces a five-year list of potential street resurfacing projects. Staff coordinates this list with other City departments and local utilities and performs on-site due diligence before finalizing street resurfacing locations in its upcoming CIP.

Table 2: Recommended asphalt repair options based on PCI	
PCI input	Recommended repair per StreetSaver
Less than 40	Full street section reconstruction
41 to 55	Asphalt grind and overlay (3-inches or more)
56 to 85	Thin overlay (top 1 to 3-inch lift)
86 to 100	Surface coat (slurry seal, etc.)

Rubberized asphalt concrete on future CIP Projects

On April 21, 2020, the City Council requested alternatives to the standard hot mix asphalt (HMA) design to be used in future street resurfacing projects. Rubberized asphalt concrete (RAC) was discussed as a candidate due to its potential environmental benefits and durability. In response, staff reviewed technical publications and conferred with paving contractors to weigh the cost-benefit ratio of utilizing RAC. Staff also assessed impacts that rubberized asphalt may have on its existing StreetSaver methodology for prioritizing projects (which assumes HMA as the basis of design.) The result of these efforts are detailed in the Analysis section.

Analysis

Staff performed a cost-benefit analysis comparing RAC to HMA, as summarized in Table 3 and detailed in the following paragraphs. The analysis highlights the pros and cons of each material for design, construction and maintenance criteria.

Table 3: Comparison of RAC versus HMA

Design criteria	RAC	HMA	Comment
Material composition	Recycled tires	Mostly virgin	
Typical unit cost (> 5,000 Tons)	\$235 per ton	\$187 per ton ¹	Includes construction contingencies
Typical unit cost (≤ 5,000 Tons)	\$264 per ton	\$187 per ton	Includes construction contingencies
Recommended overlay depth	1.2 to 2.4-inches	1 to 12 inches	Depths typically used on projects
Noise reduction benefit	Over 45 mph	-	RAC absorbs noise impact from tires
Cracking and skid resistance	Higher than HMA	-	
Construction criteria	RAC	HMA	Comment
Minimum air temperature	60° F	50° F	For placement and compaction
On-site plant mixer	Required	Not required	On-site more costly
Gas odor	Yes	No	
Maintenance criteria	RAC	HMA	Comment
Expected life span	20 years	15 years	May vary by project
Asphalt spot repairs	HMA backfill	HMA backfill	Interim maintenance during life span
Utility upgrades	HMA backfill	HMA backfill	Utility trenching during life span

1. The unit price of HMA is based on contractor bids for recently awarded CIP projects circa 2020.

Design criteria

Rubberized asphalt is mixed on-site and composed from scraps of recycled tires. HMA is primarily comprised of virgin material mixed in off-site plants. Consequently, RAC is considered a more environmentally friendly alternative to HMA. Rubberized asphalt also has potential noise reduction benefits by absorbing tire friction, however, this is maximized at speeds of 45 miles per hour or greater, otherwise, the car engine typically prevails. RAC also exhibits greater resistance to cracking and skidding which improves performance during rain events and adds to its longevity.

The California Department of Transportation (Caltrans) published a study on rubberized asphalt per Attachment A. The study concluded that RAC is structurally similar to HMA between 1.2 to 2.4-inches thick and is cost-effective when applied as a surface overlay in this range. However, RAC’s performance diminishes versus HMA when paving sections exceed 2.4-inches. Therefore, RAC is generally recommended as a top layer surface treatment, over an existing HMA base, for streets in good to excellent condition. Streets requiring overlays of three inches or more are recommended to be replaced with HMA (which is commonly applied in depths ranging from one to 12 inches.) The report also cautions against using “equivalency ratios” in designing RAC. Equivalency ratios assume that every inch of RAC is structurally equivalent to 2-inches of HMA. This is sometimes employed to justify an offset in the higher unit cost of rubberized asphalt, however, Caltrans determined that this assumption could jeopardize a road’s structural integrity and is not recommended. Instead, Caltrans recommends using a structural base of HMA with a thin overlay of RAC to achieve the benefits of RAC without jeopardizing the structural integrity of the roadway.

The price of rubberized asphalt is most cost effective to procure in larger quantities. Compared to HMA, the unit cost of RAC is approximately 20 percent higher for projects exceeding 5,000 tons of asphalt and 35 percent higher for projects below this threshold. This cost discrepancy is generally due to RAC's higher mobilization fees and construction standards per the following section. For reference, the City's 2020 Santa Cruz and Middle Avenues Street Rehabilitation Project overlaid over four thousand feet of three inch HMA using an estimated 3,330 tons.

Construction criteria

RAC carries a construction premium compared to HMA. For example, rubberized asphalt requires a higher air temperature for compaction (60°F minimum) than HMA (50° F minimum.) Asphalt that is improperly compacted may risk early failure or raveling, thus, the contractor must be well-experienced and install the material with little delay. RAC construction projects also require specialized inspection and are more time intensive to manage. While both RAC and HMA have similar carbon emissions, RAC has been reported to emit an unpleasant gas-like odor during installation. Though this odor is harmless and temporary, it could be a source of concern for the public.

RAC also requires a plant mixer to be in close proximity to the job-site which results in added cost and potential mobilization fees should inclement weather delay paving. This could also extend construction if the mixer cannot be procured in time. Per input from contractors, there are approximately 10 plant mixers available in the State of California at any given time as of this report. Given its higher construction standards, if City Council directs use of RAC on certain or all streets, future construction contracts with RAC should assume a 15 percent construction contingency in lieu of the standard 10 percent. This contingency includes additional geotechnical testing, special inspections and staff oversight required for quality control during construction.

Maintenance criteria

RAC typically holds a 20-year expected life span compared to 15 years for HMA. Although RAC's longevity may offset its higher construction cost, any future overlapping spot repairs or utility upgrades will typically use HMA for backfill. For example, spot repairs are designed to correct settling and requires a deeper section than RAC's recommended depth. Utility main and private lateral upgrades are also typically backfilled with 6-inch HMA over within the trench cut. The City could either choose to continue to allow HMA to be used in these instances, which would reduce the efficacy of RAC over time, or mandate RAC for backfilling these applications. However, mandating RAC would significantly increase construction costs and may be undesirable to permittees such as utilities agencies and homeowners.

Citywide life cycle cost analysis

Staff performed a schematic life cycle cost analysis for RAC and HMA. This analysis provides estimated annual costs for both materials over their respective lifespans applied across the City's roadway network. As a basis of design, the City's roadway network was grouped into three categories based on StreetSaver classifications per Attachment B. These categories are identified as local streets, collectors and arterials. Each category is comprised of additional street classifications per the general plan's circulation element referenced as Attachment C and summarized per Table 4.

Table 4: Street Classifications	
StreetSaver classification	Included general plan street classification (see Attachment C)
Local street	Local access
	Bike boulevard
	Neighborhood connector
Collector	Neighborhood collector
	Mixed-Use collector
Arterial	Minor arterial
	Avenue – neighborhood
	Avenue – mixed used
	Main street
	Primary arterial
	Thoroughfare
	Boulevard

An approximate total surface area was calculated for each street classification. These areas exclude roadways outside the City’s jurisdiction (e.g., Caltrans facilities such as El Camino Real, Willow Road north of Bay Road, Bayfront Expressway, etc..) Staff then assigned a two inch overlay for local streets (given low traffic volumes) and a 2.4-inch overlay at other street classifications based on RAC’s maximum range. An annualized cost of resurfacing projects was derived from this information and multiplied by the unit cost and anticipated life span of RAC and HMA noted in Table 3. The results are highlighted in Table 5 and per the conclusion of this report.

Table 5: Annual life cycle analysis of RAC and HMA				
Street type	Total area (SF ¹)	TONS	Annualized rehabilitation cost (HMA)	Annualize rehabilitation cost (RAC)
Local street	10,235,000	126,300	\$1,575,000	\$1,667,000
Collector	1,896,100	28,100	\$351,000	\$371,000
Arterial	2,310,100	34,200	\$428,000	\$452,000
Total	14,441,200	188,600	\$2,354,000	\$2,490,000
Percent Increase	-	-	-	6%

1. SF is an abbreviation for the unit value square foot.

Conclusion

Rubberized asphalt should be tailored to projects that maximizes its durability, constructability and cost effectiveness. For instance, RAC is most economical for projects overlaying 1.2 to 2.4-inches of asphalt in quantities over 5,000 tons. However, since most CIP resurfacing projects to date are below this threshold, utilizing RAC is expected to carry a 35 percent premium in unit cost compared to HMA for construction. Per Table 3 this is anticipated at \$264 per ton with contingencies (compared to \$187 per ton for HMA.) Streets requiring overlays deeper than 2.4-inches are also not best suited for RAC without multiple mobilizations of

different paving types based on cost and structural issues.

Location should be considered when reviewing RAC as an alternative to HMA. For example, RAC is not recommended in local streets due to odor emissions and limited potential for noise reduction. Local streets also utilize preventative maintenance treatments, such as slurry seals to extend the useful life between overlay projects. Construction schedule should also be assessed in awarding projects with RAC since it is best reserved for higher temperature summer months (May to August) to avoid potential delays and compaction issues.

Although RAC has a higher construction cost than HMA, its longevity and lesser frequency of maintenance should be considered when estimating life cycle costs. Per Table 5, the annual cost of rehabilitation for RAC is approximately 6 percent higher than HMA. Staff recommends procuring a bid alternate for RAC on future resurfacing projects for projects/streets which meet the following criteria:

- Streets with a good to excellent PCI rating (i.e., 70-100) suitable for a 1.2 to 2.4-inch overlay.
- Streets classified as non-local (i.e., collector or arterial)
- Resurfacing projects awarded before mid-May to ensure construction in the summer, when temperature conditions are expected to be most favorable for RAC

Depending on the bid results, additional appropriations of 35 percent or more for currently planned projects may be needed to move forward with RAC. For example, the Willow Road and Ravenswood Avenue resurfacing projects are expected to be constructed this summer and autumn, respectively. Therefore, Willow Road could be a candidate for RAC, but Ravenswood Avenue would not due to temperature requirements. A bid alternate for Willow Road using RAC would be included in the bid requirements following these recommendations. Potential cost implications are discussed further in the impacts on city resources section below.

Staff recommends that the City Council provide direction on the use of RAC for its pavement management system and CIP resurfacing projects.

Other considerations for paving program

In addition to the request for considering RAC, one City Councilmember has requested that staff structure a process for City Council scoping of street resurfacing projects early in the design phase to capture feedback about additional street modifications that could be incorporated into each project. For the upcoming year, staff has received a request for such a session for Middlefield Road. Staff anticipates scheduling a study sessions for this project later in 2021 for this review. For future years, criteria (e.g., street classifications, collision patterns, Tier 1 priority transportation master plan projects) could be set to define which projects or street segments are brought forward for a scoping session.

Impact on City Resources

No additional appropriations or resources are requested at present time, but feedback provided by the City Council during the study session will help staff identify funding needs for future CIP projects. Resurfacing projects tentatively scheduled for construction later this year include Willow Road (from Middlefield Road to Chester Street) and Ravenswood Avenue (from Alma Street to Marcussen Drive.) Willow Road and Ravenswood Avenue and are tentatively scheduled for resurfacing during this summer and autumn seasons respectively and are currently budgeted assuming HMA. As noted above, following the criteria described for the potential use of RAC, the Willow Road bid package would include RAC as a bid alternate. If the bid alternate for RAC is selected, an additional appropriation of 35 percent may be needed from the general or

general capital fund. If bid results for RAC are more than 35 percent higher than the cost of HMA, staff recommends proceeding with HMA.

For future resurfacing projects, other funding sources, including grants, may be available to help offset the additional upfront cost for RAC.

Environmental Review

This action is not a project within the meaning of the California Environmental Quality Act (CEQA) Guidelines §§ 15378 and 15061(b)(3) as it will not result in any direct or indirect physical change in the environment.

Public Notice

Public notification was achieved by posting the agenda, with the agenda items being listed, at least 72 hours prior to the meeting.

Attachments

- A. Rubber asphalt user guide by State of California Department of Transportation, 2006
- B. Street classifications
- C. Hyperlink – Menlo Park general plan circulation element:
menlopark.org/DocumentCenter/View/15015/Circulation-Element_adopted-112916_final_figures?bidId=

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ASPHALT RUBBER USAGE GUIDE



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Revised September 30, 2006

ABSTRACT

This Asphalt Rubber Usage Guide is intended for use by Caltrans design, construction, and maintenance managers and engineers, as well as by field personnel involved in placement of asphalt rubber paving materials including hot mixes and surface treatments. The purpose of this Guide is to provide state-of-the-practice information regarding product selection and use, design, production, construction, and quality control and assurance of the asphalt rubber binder, paving materials and spray applications. The intent is to enable Caltrans to optimize the use of asphalt rubber materials to obtain the advertised benefits. This Guide provides an overview of asphalt rubber (AR) materials, components and binder design, and of the benefits and limitations of these materials. This Guide describes the various types of asphalt rubber products available for use in hot mixes and spray (membrane) applications, and presents criteria for selection and use. It also presents information on:

- Mix design criteria,
- Similarities and differences between asphalt rubber and corresponding conventional bituminous applications,
- Cost and environmental considerations related to asphalt rubber materials, and
- Guidelines for construction and inspection considerations for asphalt rubber pavements and surface treatments.

This Guide does not address maintenance, repair, or rehabilitation of asphalt rubber products. Such information can be found in Chapter 600 of the Caltrans Highway Design Manual and in the Caltrans Maintenance Technical Advisory Guide.

DISCLAIMER

Development of this Guide was sponsored by Caltrans Materials Engineering and Testing Service (METS). The contents of this Guide reflect the views and experience of the authors, who are responsible for the facts and accuracy of the information presented herein. This Guide does not constitute a standard, specification or a regulation.

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GLOSSARY OF TERMS

Asphalt rubber binder (ARB) – is used in various types of flexible pavement construction including surface treatments and hot mixes. According to the ASTM definition (ASTM D 8, Vol. 4.03, “Road and Paving Materials” of the Annual Book of ASTM Standards 2006) asphalt rubber is “a blend of asphalt cement, reclaimed tire rubber, and certain additives in which the rubber component is at least 15 percent by weight of the total blend and has reacted in the hot asphalt cement sufficiently to cause swelling of the rubber particles”. By definition, asphalt rubber binder is prepared using the “wet process”. Caltrans specifications for ARB physical properties fall within the ranges listed in ASTM D 6114, “Standard Specification for Asphalt Rubber Binder,” also located in Vol. 4.03. Recycled tire rubber is used for the reclaimed rubber and is currently referred to as crumb rubber modifier (CRM). The asphalt cement and CRM are mixed and interacted at elevated temperatures and under high agitation to promote the physical interaction of the asphalt cement and CRM constituents. During ARB production and storage, agitation is required to keep the CRM particles suspended in the blend. Various petroleum distillates or extender oil may be added to reduce viscosity, facilitate spray applications, and promote workability. (See **Wet Process**)

Automobile tires – tires with an outside diameter less than 26 inches (660 mm) used on automobiles, pickups, and light trucks.

Crumb rubber modifier (CRM) – general term for scrap tire rubber that is reduced in size for use as modifier in asphalt paving materials. Several types are defined herein. A variety of processes and equipment may be used to accomplish the size reduction as follows:

TYPES OF CRM

Ground crumb rubber modifier – irregularly shaped, torn scrap rubber particles with a large surface area, generally produced by a crackermill.

High natural rubber (Hi Nat) – scrap rubber product that includes 40-48 percent natural rubber or isoprene and a minimum of 50 percent rubber hydrocarbon according to Caltrans requirements. Sources of high natural rubber include scrap tire rubber from some types of heavy truck tires, but are not limited to scrap tires. Other sources of high natural rubber include scrap from tennis balls and mat rubber.

Buffing waste – high quality scrap tire rubber that is a byproduct from the conditioning of tire carcasses in preparation for re-treading. Buffings contain essentially no metal or fiber.

Tread rubber – scrap tire rubber that consists primarily of tread rubber with less than approximately 5 percent sidewall rubber.

Tread peel – pieces of scrap tire tread rubber that are also a by-product of tire re-treading operations that contain little if any tire cord.

Whole tire rubber – scrap tire rubber that includes tread and sidewalls in proportions that approximate the respective weights in an average tire.

CRM PREPARATION METHODS

Ambient grinding - method of processing where scrap tire rubber is ground or processed at or above ordinary room temperature. Ambient processing is typically required to provide irregularly shaped, torn particles with relatively large surface areas to promote interaction with the asphalt cement.

Cryogenic grinding – process that uses liquid nitrogen to freeze the scrap tire rubber until it becomes brittle and then uses a hammer mill to shatter the frozen rubber into smooth particles with relatively small surface area. This method is used to reduce particle size prior to grinding at ambient temperatures.

Granulation – produces cubical, uniformly shaped, cut crumb rubber particles with a low surface area.

Shredding – process that reduces scrap tires to pieces 6 in.² (0.023 m²) and smaller prior to granulation or ambient grinding.

CRM PROCESSING EQUIPMENT

Cracker mill – apparatus typically used for ambient grinding, that tears apart scrap tire rubber by passing the material between rotating corrugated steel drums, reducing the size of the rubber to a crumb particle generally No. 4 to No. 40 (4.75 mm to 425 μm) sieve size.

Granulator – apparatus that shears apart the scrap tire rubber, cutting the rubber with revolving steel plates that pass at close tolerance, reducing the rubber to cubicle particles generally 3/8 in. to No. 10 sieve (9.5 mm to 2.0 mm) in size.

Micro-mill – process that further grinds crumb rubber particles to sizes below the No. 40 (425 μm) sieve size.

Dense-graded – refers to a continuously graded aggregate blend typically used to make hot-mix asphalt concrete (HMA) pavements with conventional or modified binders.

Devulcanized rubber – rubber that has been subjected to treatment by heat, pressure, or the addition of softening agents after grinding to alter physical and chemical properties of the recycled material.

Diluent – a lighter petroleum product (typically kerosene or similar product with solvent-like characteristics) added to asphalt rubber binder just before the binder is sprayed on the pavement surface for chip seal applications. The diluent thins the binder to promote fanning and uniform

spray application, and then evaporates over time without causing major changes to the asphalt rubber properties. Diluent is not used in ARB to make HMA, and is not recommended for use in interlayers that will be overlaid with HMA in less than 90 days due to on-going evaporation of volatile components.

Dry process – any method that includes scrap tire CRM as a substitute for 1 to 3 % of the aggregate in an asphalt concrete paving mixture, not as part of the asphalt binder. The CRM acts as a rubber aggregate in the paving mixture. This method applies only to production of CRM-modified AC mixtures. A variety of CRM gradations have been used, ranging from coarse rubber (1/4 in. to plus No. 8 (6.3 to 2.36 mm) sieve sizes) to “Ultrafine” minus No. 80 (180 μ m) sized CRM. Caltrans has a special provision for RUMAC which includes an intermediate CRM gradation specification. Care must be taken during the mix design to make appropriate adjustments for the low specific gravity of the CRM compared to the aggregate material to assure proper volumetric analysis. Several methods have been established for feeding the CRM dry with the aggregate into hot plant mixing units before the mixture is charged with asphalt cement. Although there may be some limited interaction of the CRM with the asphalt cement during mixing in the AC plant, silo storage, hauling, placement and compaction, the asphalt cement is not considered to be modified in the dry process.

Extender oil – aromatic oil used to promote the reaction of the asphalt cement and the crumb rubber modifier.

Flush coat – application of diluted emulsified asphalt onto a pavement surface to extend pavement life that may also be used to prevent rock loss in chip seals or raveling in HMA.

Gap-graded – aggregate that is not continuously graded for all size fractions, but is typically missing or low on some of the finer size fractions (minus No. 8 (2.36 mm) or finer). Such gradations typically plot below the maximum density line on a 0.45 power gradation chart. Gap grading is used to promote stone-to-stone contact in HMA and is similar to the gradations used in stone matrix asphalt (SMA), but with relatively low percentages passing the No. 200 (75 μ m) sieve size. This type of gradation is most frequently used to make rubberized asphalt concrete-gap graded (RAC-G) paving mixtures.

Interaction – the physical exchange between asphalt cement and CRM when blended together at elevated temperatures which includes swelling of the rubber particles and development of specified physical properties of the asphalt and CRM blend to meet requirements. Although often referred to as reaction, interaction is not a chemical reaction but rather a physical interaction in which the CRM absorbs aromatic oils and light fractions (small volatile or active molecules) from the asphalt cement, and releases some of the similar oils used in rubber compounding into the asphalt cement. The interaction may be more appropriately defined as polymer swell.

Lightweight aggregate – porous aggregate with very low density such as expanded shale, which is typically manufactured. It has been used in chip seals to reduce windshield damage.

Open-graded – aggregate gradation that is intended to be free draining and consists mostly of 2 or 3 nominal sizes of aggregate particles with few fines and 0 to 4 percent by mass passing the No. 200 (0.075 mm) sieve. Open grading is used in hot-mix applications to provide relatively thin surface or wearing courses with good frictional characteristics that quickly drain surface water to reduce hydroplaning, splash and spray.

Reaction – commonly used term for the interaction between asphalt cement and crumb rubber modifier when blended together at elevated temperatures (see **Interaction**).

Recycled tire rubber – rubber obtained by processing used automobile, truck, or bus tires (essentially highway or “over the road” tires). Chemical requirements for scrap tire rubber are intended to eliminate unsuitable sources of scrap tire rubber such as solid tires; tires from forklifts, aircraft, and earthmoving equipment; and other non-automotive tires that do not provide the appropriate components for asphalt rubber interaction. Non-tire rubber sources may be used only to provide High Natural Rubber to supplement the recycled tire rubber.

Rubberized asphalt - asphalt cement modified with CRM that may include less than 15 percent CRM by mass and thus may not comply with the ASTM definition of asphalt rubber (ASTM D 8, Vol. 4.03). In the past, terminal blends (wet process, no agitation CRM-modified asphalt binders including Modified Binder (MB) materials) have typically fallen in this category.

Rubberized asphalt concrete (RAC) – material produced for hot mix applications by mixing asphalt rubber or rubberized asphalt binder with graded aggregate. RAC may be dense-, gap-, or open-graded.

RUMAC – generic type of dry process RAC mixture that has taken the place of proprietary dry process systems such as PlusRide.

Stress-absorbing membrane (SAM) – a chip seal that consists of a hot asphalt rubber binder sprayed on the existing pavement surface followed immediately by an application of a uniform sized cover aggregate which is then rolled and embedded into the binder membrane. Its nominal thickness generally ranges between 3/8 and 1/2-inch (9 and 12 mm) depending on the size of the cover aggregate. A SAM is a surface treatment that is used primarily to restore surface frictional characteristics, seal cracks and provide a waterproof membrane to minimize the intrusion of surface water into the pavement structure. SAMs are used for pavement preservation, maintenance, and limited repairs. Asphalt rubber SAMs minimize reflective cracking from an underlying distressed asphalt or rigid pavement, and can help maintain serviceability of the pavement pending rehabilitation or reconstruction operations.

Stress-absorbing membrane interlayer (SAMI) - originally defined as a spray application of asphalt rubber binder and cover aggregate. However, interlayers now may include asphalt rubber chip seal (SAMI-R), fabric (SAMI-F), or fine unbound aggregate.

Stress-absorbing membrane interlayer-Rubber (SAMI-R) – SAMI-R is an asphalt rubber SAM that is overlaid with an asphalt paving mix that may or may not include CRM. The SAMI-R delays the propagation of the cracks (reflective cracking) through the new overlay.

Terminal blend – See **Wet Process – No Agitation**

Truck tires – tires with an outside diameter greater than 26 inches (660 mm) and less than 60 inches (1520 mm); used on commercial trucks and buses.

Viscosity – is the property of resistance to flow (shearing force) in a fluid or semi-fluid. Thick stiff fluids such as asphalt rubber have high viscosity; water has low viscosity. Viscosity is specified as a measure of field quality control for asphalt rubber production and its use in RAC mixtures.

Vulcanized rubber – crude or synthetic rubber that has been subjected to treatment by chemicals, heat and/or pressure to improve strength, stability, durability, etc. Tire rubber is vulcanized.

Wet Process - the method of modifying asphalt binder with CRM produced from scrap tire rubber and other components as required before incorporating the binder into the asphalt paving materials. Caltrans requires the use of extender oil and addition of high natural CRM. The wet process requires thorough mixing of the crumb CRM in hot asphalt cement (375°F to 435°F, 190°C to 224°C) and holding the resulting blend at elevated temperatures (375°F to 425°F, 190°C to 218°C) for a designated minimum period of time (typically 45 minutes) to permit an interaction between the CRM and asphalt. Caltrans specification requirements include an operating range for rotational viscosity and cone penetration, and minimum values of softening point and resilience,.

The wet process can be used to produce a wide variety of CRM modified binders that have corresponding respective ranges of physical properties. However the most important distinctions among the various blends seem to be related to rotational viscosity of the resulting CRM-asphalt cement blend at high temperature (threshold is 1,500 centipoises (cPs) or 1.5 Pa•sec at 375°F (190°C) depending on governing specification) and whether or not the blend requires constant agitation to maintain a relatively uniform distribution of rubber particles. Viscosity is strongly related to the size of the scrap tire CRM particles and tire rubber content of the CRM-modified blend. CRM gradations used in the wet process are typically minus No. 10 (2 mm) sieve size or finer. CRM-modified binders with viscosities \geq 1,500 cPs at 375°F (190°C) should be assumed to require agitation.

Wet Process-No Agitation - a form of the wet process where CRM is blended with hot asphalt cement at the refinery or at an asphalt storage and distribution terminal and transported to the HMA mixing plant or job site for use. This type of rubberized asphalt (which includes Rubber Modified Binder, RMB) does not require subsequent agitation to keep the CRM particles evenly dispersed in the modified binder. The term “terminal blend” is often used to describe such materials, although they may also be produced in the field. Therefore, calling them terminal blends is unnecessarily restrictive and the preferred description for this type of binder is “**wet process-no agitation**”. Such binders are typically modified with CRM particles finer than the No. 50 (300 μ m) sieve size that can be digested (broken down and melted in) relatively quickly

and/or can be kept dispersed by normal circulation within the storage tank rather than by agitation by special augers or paddles. Polymers and other additives may also be included. In the past, rubber contents for such blends have generally been $\leq 10\%$ by mass of asphalt or total binder (which does not satisfy the ASTM D 8 definition of asphalt rubber), but current reports indicate some California products now include 15% or more CRM. Although such binders may develop a considerable level of rubber modification, rotational viscosity values rarely approach the minimum threshold of 1500 (cPs) or 1.5 Pa•s at 375°F (190°C), that is necessary to significantly increase binder contents above those of conventional HMA mixes without excessive drain-down.

Wet Process-High Viscosity - CRM-modified binders that maintain or exceed the minimum rotational viscosity threshold of 1500 cPs at 375°F (190°C) over the interaction period should be described as “**wet process-high viscosity**” binders to distinguish their physical properties from those of wet process-no agitation materials. These binders require agitation to keep the CRM particles evenly distributed. They may be manufactured in large stationary tanks or in mobile blending units that pump into agitated stationary or mobile storage tanks. Wet process-high viscosity binders include asphalt rubber materials that meet the requirements of ASTM D6114. Wet process-high viscosity binders typically require at least 15% scrap tire rubber to achieve the threshold viscosity. Caltrans requires a minimum total CRM content of 18%.

1.0 INTRODUCTION AND OVERVIEW

The purpose of this Usage Guide is to provide the California Department of Transportation (Caltrans) with state-of-the-practice information regarding product selection and use, design, production, construction, and quality control and assurance of asphalt rubber binder, paving materials and spray applications. It also contains some generally accepted best practices for asphalt rubber binder preparation and mixture placement. The intent is to enable Caltrans to optimize the use and handling of asphalt rubber materials in order to obtain the many advertised benefits including increased durability and reduced maintenance.

1.1 WHAT IS ASPHALT RUBBER?

According to the ASTM definition, asphalt rubber (AR) is “a blend of asphalt cement, reclaimed tire rubber, and certain additives in which the rubber component is at least 15 percent by weight of the total blend and has reacted in the hot asphalt cement sufficiently to cause swelling of the rubber particles.” By definition, asphalt rubber is prepared using the “wet process.” Physical property requirements are listed in ASTM D 6114, “Standard Specification for Asphalt Rubber Binder,” located in Vol. 4.03 of the Annual Book of ASTM Standards 2006, and in Caltrans Standard Special Provisions for Rubberized Asphalt Concrete (RAC). The asphalt rubber is produced at elevated temperatures ($\geq 350^{\circ}\text{F}$, 177°C) and under high agitation to promote the physical interaction of the asphalt binder and rubber constituents, and to keep the rubber particles suspended in the blend. Various petroleum distillates or extender oil may be added to reduce viscosity, facilitate spray applications, and promote workability.

Recycled tire rubber is used for the reclaimed rubber and is called crumb rubber modifier (CRM). Tire rubber is a blend of synthetic rubber, natural rubber, carbon black, anti-oxidants, fillers, and extender type oils that is soluble in hot paving grade asphalt.

In California, asphalt rubber is specified to include 18 to 22 percent CRM by total mass of the asphalt rubber blend. The CRM must also include 25 ± 2 percent high natural rubber content scrap rubber by mass of the CRM that may come from scrap tires or other sources. Caltrans requires use of extender oil as an asphalt modifier in asphalt rubber. Caltrans specifications for ARB physical properties fall within the ranges listed in ASTM D 6114.

Asphalt rubber should not be confused with other rubberized asphalt products such as the “dry process” in which crumb rubber is substituted for a small proportion of the aggregate and is not reacted with the asphalt binder prior to mixing, or with “terminal blends” (no agitation CRM-modified binders). Terminal blends are made by the wet process, but historically have included no more than 10 percent ground tire rubber along with other additives. Such low CRM content blends do not achieve sufficient viscosity to perform in HMA mixtures in the same manner as high viscosity ARB. However, new terminal blends with up to 15 percent CRM have been developed. Terminal blends must meet the Caltrans requirements for Rubber Modified Binder (RMB).

Rubberized asphalt concrete (RAC) may be produced using a variety of CRM-modified binders, including asphalt rubber, rubberized terminal blends, RMB materials, or by the dry process. Caltrans uses MB and dry process HMA (RUMAC) mixes on a limited basis. Anecdotal reports indicate a wide range of performance, but relatively little conclusive data is available regarding their performance on rehabilitation projects in the California State Highway System. Both types of mixes have been included as test sections in recent Caltrans projects in order to follow their performance over time and compare with performance of typical Caltrans RAC-G mixes. *Consequently, the information presented in this Usage Guide is limited to asphalt rubber paving materials made with high viscosity ARB and may not be appropriate for other rubber modified binder or dry process materials.*

1.2 BRIEF HISTORY OF ASPHALT RUBBER

Development of asphalt rubber materials for use as joint sealers, patches, and membranes began in the late 1930s. In the early 1950s, Lewis and Welborn of the Bureau of Public Roads (BPR) conducted an extensive laboratory study to evaluate “The Effect of Various Rubbers on the Properties of Petroleum Asphalts.” They used 14 types of rubber powders and three asphalts, including “a California asphalt of low-gravity, low-sulfur, low-asphaltenes type.” The results were published in the October 1954 issue of *Public Roads* along with results of a companion “Laboratory Study of Rubber-Asphalt Paving Mixtures,” conducted by Rex and Peck at BPR. The mixtures study looked at a wide range of vulcanized and unvulcanized rubber materials including tread from scrap tires, styrene-butadiene rubber (SBR), natural rubber, polybutadiene, and reclaimed (devulcanized) rubber and at both wet and dry methods of adding them to AC mixtures. Interest and work in this area continued to grow, as did the number of patent applications. In March 1960, the Asphalt Institute held the first Symposium on Rubber in Asphalt in Chicago, IL. It consisted of five paper presentations and discussion.

Charles H. McDonald of the City of Phoenix Arizona worked extensively with asphalt and rubber materials in the 1960s and 1970s and was instrumental in development of the “wet process” (also called the McDonald process) of producing asphalt rubber. He was the first to routinely use asphalt rubber in hot mix patching and surface treatments for repair and maintenance. Asphalt rubber chip seals served effectively as the City’s primary pavement maintenance and preservation strategy for arterial roadways for nearly twenty years, until traffic volumes forced a change to thin AC overlays. Gap-graded asphalt rubber concrete mixtures were developed as a successful substitute.

In 1975, Caltrans began experimenting with asphalt rubber chip seals in the laboratory and small test patches located at 03-Yol-84-PM 16+ and 03-Sac-99-PM 20+, with generally favorable results. In 1978, the first Caltrans dry process rubber-modified AC pavement was constructed on SR 50 at Meyers Flat. It included one percent ground rubber by mass added to the dry aggregate prior to mixing with the paving asphalt. Performance was rated good. The first Caltrans rubberized asphalt concrete (RAC) pavements made with early versions of “wet-process” asphalt rubber binder and dense-graded aggregate were constructed in 1980 at Strawberry (SR 50) and at Donner Summit (I-80). The Strawberry project was an emergency repair to a dramatically failed pavement. The repair included pavement reinforcing fabric (PRF), and a 2.4-inch (0.2 ft, 60 mm) layer of dense-graded HMA to restore structural capacity, under the thin (1.2 inches, 0.1 ft, 30

mm) RAC wearing course. The first three projects are all located in “snow country” at high elevations where tire chains are used in winter. The RAC pavements reportedly performed well in resisting chain abrasion and reflective cracking.

The Ravendale project (02-Las-395) constructed in 1983 significantly changed Caltrans’ approach to the use of asphalt rubber. This project presented a typical dilemma. The cost of rehabilitation by overlaying with dense-graded HMA was prohibitive, so less costly alternatives were considered, including thinner sections of RAC. The project was designed as a series of 13 test sections that included two different thicknesses each of wet process (dense-graded) and dry process (gap-graded) RAC with SAMI (4 sections), wet and dry RAC at 1.8 inches (0.15 ft, 46 mm) thick without SAMI (2 sections), four control sections with different thicknesses of dense-graded HMA from 1.8 to 6 inches (46 to 152 mm), two sections surfaced only by double asphalt rubber chip seals, and one section surfaced with a single asphalt rubber chip. The test sections were monitored over time. The dry process section at this site lasted over 19 years before it was overlaid in 2002, but performance of such pavements elsewhere has varied. By 1987, it was clear that the thin RAC pavements were performing better than thicker conventional dense-graded HMA. Caltrans built more RAC projects and continued to study the performance of RAC constructed at reduced thickness relative to dense-graded HMA structural requirements.

Through 1987, Caltrans constructed one or two RAC projects a year. Dense- or open-graded RAC mixes were placed as surface courses at compacted thicknesses that ranged from 1 inch (25 mm) for open-graded to 3 inches (75 mm) for RAC-D. Some projects included pavement reinforcing fabric (PRF) and/or a leveling course, and some others included asphalt rubber stress absorbing membrane interlayer (SAMI) under the asphalt rubber mixes.

In March 1992 Caltrans published a “Design Guide for Asphalt Rubber Hot Mix-Gap Graded (ARHM-GG)” based on these studies and project reviews. The Guide presented structural and reflection crack retardation equivalencies for gap-graded asphalt rubber mixtures (now designated RAC-G) with respect to dense-graded HMA, and with and without SAMI. These equivalencies were considered to be field validated and were incorporated in Chapter 6 (Tables 3 and 4) of the Caltrans Flexible Pavement Rehabilitation Manual (June 2001). Caltrans considered that RAC-G could generally be substituted for dense-graded HMA at about one-half the thickness.

By 1995, over 100 Caltrans RAC projects had been constructed. Cities and counties in California had by then constructed more than 400 asphalt rubber projects, including asphalt rubber chip seals. However some problems occurred, including some cases of premature distress. Caltrans engineers reviewed RAC performance on the Caltrans projects, selected California city and county projects, and 41 Arizona DOT projects. Some of the problems observed were clearly construction related; many of the contractors involved in those projects had little if any experience working with the RAC mixtures.

The Caltrans review indicated that asphalt rubber materials can perform very well when properly designed and constructed, and that Caltrans should continue using and studying asphalt rubber. A very important finding was that the distresses observed in RAC pavements generally appeared to progress at a much slower rate than would be expected in a structurally equivalent

conventional dense-graded HMA pavement. In many of the cases where premature RAC distress (particularly cracking) had occurred, relatively little maintenance was required to achieve adequate pavement service life because the subsequent distress developed slowly. One-third of the Strawberry RAC was reportedly still exposed and performing after 15 years, with less maintenance resources and time expended than for all pavements in that district with the exception of another RAC section.

Caltrans was also instrumental in developing specifications for modified binders containing crumb rubber. The Modified Binder (MB) specification was developed in the early 1990s as part of a continuing movement towards performance-based specifications from method type or “recipe” specifications. It has been suggested that the specification be renamed as “RMB,” Rubber Modified Binder. Based on analysis of rheological measurements of samples of asphalt rubber binders and limited evaluations of their field performance, Caltrans researchers developed two new parameters for specifying rubberized binders, using residues aged in the Pressure Aging Vessel (PAV).

- Shear susceptibility of the phase angle delta, SSD, which is related to elastic properties, and
- Shear susceptibility of viscosity, SSV, which is related to stiffness.

Ten pilot projects were constructed between December 1997 and November 1999 to evaluate the performance of materials meeting the MB specification. The MB pilots are located mostly in the coastal regions of California and include both dense-graded and gap-graded mixtures placed over a range of structural sections. These projects were reviewed in 2002 by a joint Caltrans-Industry group: eight were rated as “good,” one as fair, and one that exhibited base failure and pumping as poor. Caltrans has prepared a report on these MB pilot projects. However findings to date are limited and use of MB products has been limited to test sections and a warranty project. Heavy vehicle simulator (HVS) trials are being conducted at the University of California Berkeley Richmond Field Station but have not yet been completed.

By mid-2001, over 210 Caltrans RAC projects had been constructed throughout California. Municipalities and counties also continued to use asphalt rubber for hot mixes and surface treatments with generally good performance. However some of the old problems with product selection, design, and construction continued to arise. Districts 7 and 8 reportedly experienced several major RAC failures.

From 2002 through 2004, Caltrans built five pilot RAC overlay projects through its rehabilitation program that include a 5-year warranty on the RAC materials, workmanship, and performance. Warranty conformance is determined by periodic distress surveys of designated performance evaluation sections. The special provisions list specific distress triggers for repairs. The overall objective of these RAC warranty pilot projects was to provide a “level playing field” for wet process (field-produced high viscosity and terminal blend no agitation CRM-modified asphalt binders) and for dry process (CRM as an aggregate substitute) rubber-modified mixes that contain a minimum of 15% CRM (by total mass of binder). No dry process mixes were bid, and only one project used a terminal blend binder in the mix. Performance evaluations to date indicate the overlays are generally in good condition.

Test sections for CRM-modified paving materials were subsequently incorporated by change order into two Caltrans projects constructed in 2004 and 2005. The primary purpose was to assess relative field and laboratory performance of dense-graded HMA control mixes, gap-graded RAC and RUMAC mixes, and dense- and gap-graded MB mixes. Constructability of the respective types of CRM-modified mixes was also evaluated. Both projects are to be monitored over a 5-year period. Field and lab performance will be compared with findings from the HVS study for similar CRM-modified mixtures.

The Firebaugh project was constructed in 2004 on SR 33 in Fresno County just north of the town of Firebaugh. It included a full-thickness (3.5 inches, 90 mm) control section of conventional dense-graded HMA and eight test sections as follows:

- RAC-G (wet process high viscosity field blend, gap-graded) at full (3.5 inches, 90 mm) and half (1.75 inches, 45 mm) thickness
- RUMAC (dry process, gap-graded) at full (3.5 inches, 90 mm) and half (1.75 inches, 45 mm) thickness
- MB-G (wet process terminal blend, no agitation, gap-graded) at full (3.5 inches, 90 mm) and half (1.75 inches, 45 mm) thickness
- MB-D (wet process terminal blend, no agitation, dense-graded) at full (3.5 inches, 90 mm) and half (1.75 inches, 45 mm) thickness

The District 1 RAC experimental project on State Route 20 in Mendocino County consisted of a control and three test sections:

- Dense-graded HMA Control (4.13 inches, 105 mm)
- RAC-G mix (wet process high viscosity field blend, 2.36 inches (60 mm))
- RUMAC-G mix (dry process, 2.36 inches (60 mm))
- MB-D mix (wet process, no agitation terminal blend, 2.36 inches (60 mm))

Emission tests were performed at the District 1 project to determine pollutant emission rates for each mix as requested by the North Coast Mendocino and Lake County Air Quality Management Districts. No problems were reported during mix production or construction.

Research was conducted in 2005 on the structural equivalency of RAC-G to dense-graded HMA. Although reflective cracking was not the subject of the research, the study indicated that the practice of using a reduced RAC-G overlay thickness to retard reflective cracking is still warranted. Limited laboratory test results indicate that the gravel factor (G_f) for RAC-G is similar to but slightly lower than that of dense-graded HMA. Mechanistic-empirical analysis indicates that these two very different types of mixes are structurally similar at thicknesses ranging from 1.2 to 2.4 inches (30 to 60 mm). **Therefore, RAC-G should not be used at half thickness when it is intended to provide a structural equivalent to dense-graded HMA.** The research indicates that as the thickness of RAC-G increases above 2.4 inches (60 mm), the gravel equivalency of RAC-G begins to decrease relative to dense-graded HMA.

These research findings have been adopted by Caltrans. For new construction, Caltrans recommends that RAC-G should not be thicker than 2.4 inches (60 mm) and should be placed on

a layer of conventional HMA rather than directly on an unbound base course. RAC-O should not be thicker than 1.8 inches (45 mm) and should be used only as a surface course. Up to 1.8 inches (45 mm) of RAC-O may be placed on top of 2.4 inches (60 mm) of RAC-G. Also for new construction, the overall pavement thickness may not be reduced when RAC is used (Caltrans, 2006b).

1.3 HOW IS ASPHALT RUBBER USED?

Asphalt rubber is used as a binder in various types of asphalt pavement construction including surface treatments and hot mixes (HMA). It is also used in crack sealants, which are not a subject of this Guide. For hot mixes, asphalt rubber has been found to be most effective and is most commonly used in gap-graded and open-graded mixes, particularly for surface courses and for thin overlays that are 1.2 to 2.4 inches (30 to 60 mm) thick. It may be used in new construction or to rehabilitate an existing pavement. Terminal blends and MB have been used in dense- and gap-graded mixes. The most common spray application is a chip seal, also called a stress absorbing membrane (SAM). Chip seals are primarily used for maintenance and pavement preservation. Asphalt rubber chip seals may also be overlaid with hot mix, making them interlayers, typically called SAMI-R. SAMIs are used primarily for pavement rehabilitation. Chapter 2 provides more detailed information on product selection, usage, and design.

1.4 WHERE SHOULD ASPHALT RUBBER PRODUCTS BE USED?

Asphalt rubber products can be used wherever conventional asphalt concrete or bituminous surface treatments would be used, but provide better resistance to reflective cracking and fatigue than standard dense-graded HMA. Asphalt rubber hot mixes are typically most effective as thin rehabilitative overlays of distressed flexible or rigid pavements. Arizona has had well-documented success with long-term performance of asphalt rubber overlays of rigid pavements (I-17 Durango Curve in Phoenix, I-19 near Tucson, I-40 near Flagstaff), but California's experience with this application has been limited.

Caltrans' reflection crack retardation equivalencies for RAC-G generally allow substitution for dense-graded HMA at about one-half the thickness (as referenced in 1.2). The reduced thickness encourages the use of RAC-G mixtures where there are vertical geometric constraints such as curb-and-gutter alignment or underpass clearance.

Temperature is critical for compaction of RAC mixtures. Because asphalt rubber is stiffer than asphalt cement, higher placement and compaction temperatures are usually required. Temperature guidelines for construction operations are presented in Section 4.0. Because RAC-G is placed in thin layers, ambient temperature, pavement surface temperature and wind have considerable impacts on mat temperature during compaction. Asphalt rubber products should thus be used only where and when weather conditions are favorable for placement. This does not prevent their use at high elevations, but means that paving in such locations requires placement practices and temperature requirements tailored to these more demanding conditions. Asphalt rubber products have been used with success in most of the geographical and climate zones in California and Arizona, from low desert through the mountain/alpine climate zones.

However there are coastal areas in California where favorable conditions for asphalt rubber paving operations may not occur often.

1.5 WHERE SHOULD ASPHALT RUBBER PRODUCTS NOT BE USED?

Problems that have been documented typically have been construction issues related to cold temperature paving or late season construction. This indicates that temperature was a major contributing factor. Temperature also affects placement and compaction of conventional mixtures, but is more critical when working with materials that have been modified to increase high temperature stiffness such as asphalt rubber and are typically being placed in thin lifts. Asphalt rubber paving materials should not be placed in the following conditions:

- During cold or rainy weather with ambient or surface temperatures <55°F (13°C).
- Over pavements with severe cracks more than 0.5 inch (12.5 mm) wide.
- Where traffic and deflection data are not available.
NOTE: Traffic and deflection data are basic requirements for Caltrans structural pavement design and rehabilitation. In some cases it may be necessary to add a layer of dense-graded HMA before overlaying with RAC to provide sufficient pavement structure.
- Areas where considerable handwork is required.
- Where haul distances between AC plant and job site are too long to maintain mixture temperature as required for placement and compaction.

1.6 BENEFITS OF ASPHALT RUBBER

The primary reason for using asphalt rubber is that it provides significantly improved engineering properties over conventional paving grade asphalt. Asphalt rubber binders can be engineered to perform in any type of climate as indicated in ASTM D 6114. Responsible asphalt rubber binder designers usually consider climate conditions and available traffic data in their design to provide a suitable asphalt rubber product. More information on asphalt rubber binder design is presented in Chapter 2.

At intermediate and high temperatures, ARB physical properties are significantly different than those of neat paving grade asphalts such as PG 64-16. The rubber stiffens the binder and increases elasticity (proportion of deformation that is recoverable) over these pavement operating temperature ranges, which decreases pavement temperature susceptibility and improves resistance to permanent deformation (rutting) and fatigue with little effect on cold temperature properties. The benefits of asphalt rubber are summarized in Table 1-1.

Table 1-1 Summary of Benefits of Asphalt Rubber Paving Materials

ARB has:

- Increased viscosity that allows greater film thickness in paving mixes without excessive drain down or bleeding.
- Increased elasticity and resilience at high temperatures.

RAC pavements have:

- Improved durability.
- Improved resistance to surface initiated and fatigue/reflection cracking due to higher binder contents and elasticity.
- Reduced temperature susceptibility.
- Improved aging and oxidation resistance due to higher binder contents, thicker binder films, and anti-oxidants in the tire rubber.
- Improved resistance to rutting (permanent deformation) due to higher viscosity, softening points and resilience (stiffer, more elastic binder at high temperatures).
- Lower pavement maintenance costs due to improved pavement durability and performance.

In addition, RAC and asphalt rubber binders can result in:

- Reduced construction times due to thinner lifts.
- Better chip retention in chip seals due to thick films of highly modified asphalt.
- Improved safety due to better long-term color contrast for pavement markings because carbon black in the rubber acts as a pigment that keeps the pavement blacker longer.
- Savings in energy and natural resources by using waste products.

1.7 LIMITATIONS OF ASPHALT RUBBER

Asphalt rubber materials are useful, but they are not the solution to all pavement problems. The asphalt rubber materials must be properly selected, designed, produced, and constructed to provide the desired improvements to pavement performance. Pavement structure and drainage must also be adequate. Limitations on the use of asphalt rubber include:

- Higher unit costs due to mobilization of asphalt rubber production equipment. For large projects, these unit costs can be spread over enough tonnage so that they can generally be offset by increased service life, lower maintenance costs, and reduced lift thickness. For small projects, mobilization cost is the same, resulting in relatively high unit prices because mobilization costs may not be fully offset.

- Asphalt rubber is not best suited for use in dense-graded HMA. There is not enough void space in the dense-graded aggregate matrix to accommodate sufficient ARB content to enhance performance of dense-graded mixes enough to justify the added cost of the ARB.
- Construction may be more challenging, as temperature requirements are more critical. Asphalt rubber materials must be compacted at higher temperatures than dense-graded HMA because, like polymers, rubber stiffens the binders at high temperatures. Also, coarse gap-graded mixtures may be more resistant to compaction due to the stone-on-stone nature of the aggregate structure.
- Potential odor (see 1.9 for further information).
- If work is delayed more than 48 hours after blending the asphalt rubber, some binders may not be usable. The reason is that the CRM has been digested to such an extent that it is not possible to achieve the minimum specified viscosity even if more CRM is added in accordance with specified limits.
- For chip seals in remote locations, hot and/or pre-coated aggregate may not be available because there may not be a hot-mix plant within reasonable haul distance of the job site.

1.8 COST CONSIDERATIONS

The unit costs of asphalt rubber products are typically higher than those of conventional or polymer modified products. The initial cost is one of the reasons that usage of asphalt rubber hot mixes has been limited to thin lifts, but costs of hot mixes are now converging. Asphalt rubber is generally cost effective when used as thin gap- or open-graded surface courses or overlays of 1.2 to 2.4 inches (30 to 60 mm) compacted thickness, chip seals and interlayer applications.

Asphalt rubber products have been proven to be very useful tools to rehabilitate severely deteriorated pavements with some remaining structural integrity that experience heavy traffic loadings. In many cases, the reduced thickness of RAC overlays (half of dense-graded HMA thickness, with 1.2 inch (30 mm) minimum) offsets much of the increase in initial cost. The added benefits of reduced maintenance demand and longer service life provided by asphalt rubber materials generally offset any remaining cost difference. Using a SAMI-R in place of a layer of HMA or RAC can also save money and speed construction, and provide additional savings.

Cost effectiveness should be evaluated using Life Cycle Cost Analysis (LCCA), for which Caltrans has developed a procedure for implementation in 2006. It includes typical maintenance and rehabilitation (M&R) schedules for California by climate region (coastal, valley, low/high desert, low/high mountain), District, surface type, and M&R treatment design life. It also includes construction unit costs for various rehabilitation strategies.

Costs of construction materials and petroleum products have increased since the year 2000 as illustrated in Table 1-2. The Caltrans Contract Cost Data Summary is the source of the cost data for binders and hot mixes for 2004 and 2005. Caltrans Maintenance provided current costs for chip seals and thin overlays in terms of dollars per lane mile, which have been converted to dollars per square yard.

Table 1-2 Caltrans Cost Data

Item Description	Year		
	2000	2004	2005
CALTRANS CONSTRUCTION ITEMS			
Conventional Type A HMA (dense-graded), \$/ton	30-34	50-64	61-78
Conventional HMA (open-graded), \$/ton		44-61	73-74
Polymer Modified HMA(dense-graded), \$/ton	34-40		
Polymer Modified HMA(open-graded), \$/ton		63	71
RAC-G, \$/ton	44-50	53-65	73-76
RAC-O, \$/ton		64-67	69-78
CALTRANS MAINTENANCE ITEMS			
Chip Seals			
Emulsion Chip Seal, \$/yard ²	1.20-1.50		---
Polymer Modified Emulsion Chip Seal, \$/yard ²	1.50-1.80		2.55-3.40
Asphalt Rubber Chip Seal, \$/yard ²	3.00-3.60		9.25
Thin Overlays			
Conventional HMA (dense-graded), \$/yard ²			6.40
Polymer Modified HMA, \$/yard ²			7.10-9.25
RAC-O, RAC-G, \$/yard ²			8.50
RAC-O-HB, \$/yard ²			9.25

The difference in costs of RAC hot mixes compared to conventional HMA and polymer-modified HMA dropped somewhat in 2004 and 2005 from the customary difference of about \$16/tonne. It is not clear if this is a function of job size, more routine use of RAC, or higher costs of other materials and products.

In 1998 Caltrans conducted an analysis of RAC and dense-graded HMA unit prices versus mix quantity based on data from 1996 and 1997 Caltrans projects. The results were reported in a July 7 memorandum that indicated that unit costs escalate considerably for jobs with less than 2,500 tons (2250 tonnes) of RAC. Mobilization and set up of the asphalt rubber binder production equipment cost as much for small jobs as for big ones, but large projects spread mobilization costs over more RAC tonnage. The memo suggests that smaller RAC projects may not be cost effective with respect to initial cost. Although the break point for project size may have changed since then, unit costs of small projects (three days RAC paving or less) should be evaluated by LCCA during the design phase.

The costs of RAC-O and RAC-O (HB) overlays are higher than conventional OGAC because of the asphalt rubber binder content is 1.2 to 1.6 times higher than for conventional AR-4000 or PG binders. Since open-graded mixtures are not considered as structural elements, there is no reduction in thickness compared to conventional. However, improved durability, particularly resistance to reflective cracking and related reduced maintenance needs, should substantially reduce the overall life cycle costs and help offset the difference in initial cost.

1.9 ENVIRONMENTAL CONSIDERATIONS

1.9.1 Benefits

There are a number of social benefits of using rubber that is ground from recycled scrap tires to build pavements.

1.9.1.1 Not Contributing to Tire Stockpiles. The primary benefit is putting newly generated waste tires into a secondary use instead of contributing to tire stockpiles. The California Integrated Waste Management Board (CIWMB) stated in its 2004 Staff Report that over 40 million reusable and waste tires are generated in California and approximately 2 million more waste tires are imported into the State each year, of which about 75% (30 million) are recycled. This yields a surplus of about 10 million tires per year and does not account for tires that have been stockpiled legally or otherwise in the past, although CIWMB reports that stockpiles have been substantially reduced. CIWMB reported in 2004 that “Over the past few years, California has used nearly ten million waste tires in RAC paving projects, saving them from disposal.”

1.9.1.2 Value-Added Use of Waste Tires. Burning waste tires for fuel is an effective method of disposal that helps to conserve other energy resources, but the value of the rubber is consumed while disposal of incinerator ash and residues remains an issue. Asphalt rubber paving products provide a “value-added” means of reutilizing the waste rubber material. The rubber enhances the physical properties of the resulting paving materials over the life of the pavement, and thus provides a long-term benefit to tax payers and the motoring public. Estimates indicate that RAC-G uses about 1,000 tires per lane mile per 1-inch (\approx 620 tires per lane kilometer per 25 mm) of thickness.

1.9.1.3 Noise Abatement. Reduced traffic noise (primarily tire noise) is another important benefit of using asphalt rubber materials that has been documented in Europe (Belgium, France, Germany, Austria, Netherlands), Canada, Arizona (Quiet Pavements Program), and California (Orange, Los Angeles and Sacramento Counties). Significant reductions in traffic noise, ranging from 40 to 88 percent, have been measured not only for open-graded but also for gap-graded RAC. However there are unanswered questions about how long the noise abatement would continue. The Sacramento County Department of Environmental Review and Assessment and a consultant specializing in acoustics and noise control conducted a six-year study on RAC pavements that was finished in 1999. Their results supported the findings of other similar studies referenced within their report. The Sacramento study showed that the RAC continued to keep the traffic noise level down after six years, while noise measured on the conventional dense-graded HMA was back up to pre-paving levels within four years. California and Arizona are participating in a 10-year FHWA project to study noise levels of a variety of pavements including RAC-G, RAC-O, and RAC-O-HB.

1.9.2 Emissions

The high temperatures and the highly aromatic extender oils involved in asphalt rubber binder and mixture production would be expected to increase the amount of emissions (fumes and smoke) generated by production and construction of asphalt products. This is not necessarily true as evidenced by a number of emissions studies that have been performed during the last 20

years. Study results generally indicate little if any difference from emissions of conventional HMA materials, and no identifiable increase in risk to health or safety of hot plant or paving personnel or the public.

However, the distinctive odor of asphalt rubber continues to trigger concerns about emissions, because people have a natural tendency to think that strong odors indicate a hazard.

1.9.2.1 Hot Plant Tests. Plant “stack tests” were performed during asphalt rubber hot mix production in New Jersey (1994), Michigan (1994), Texas (1995), and California (1994 and Bay Area in 2001). The results generally indicate that emissions measured during asphalt rubber production at HMA plants remain about the same as for conventional hot mix and that amounts of any hazardous components and particulates remain below mandated limits. The Bay Area emissions tests showed that measured emissions rates of particulate and toxic compounds were consistently lower than the EPA’s AP-42 emission factors for conventional HMA plants. Raising HMA plant operating temperatures typically increases emissions. Plant emissions generally appear to be more directly influenced by plant operating temperature, burner fuel and the base asphalt cement than by CRM.

CRM does not include exotic chemicals that present any new health risks when mixed with asphalt cement or asphalt concrete. It consists mostly of various types of rubber and other hydrocarbons, carbon black, oils, and inert fillers. Most of the chemical compounds in CRM are also present in asphalt cement, although the proportions are likely to differ.

The asphalt rubber binder manufacturing plant does require an air quality permit, but emissions levels are low due to the essentially sealed nature of the process. Only some minimal filtered venting is required.

1.9.2.2 Exposure of Paving Personnel. Use of asphalt rubber does not appear to increase health risks to paving personnel, including paver operators, screed person, rakers, roller operators, bootmen on distributor trucks, and other workers. A 2-1/2 year study was performed in Southern California to assess the effects of “Exposure of Paving Workers to Asphalt Emissions (When Using Asphalt Rubber Mixes)”. The study began in 1989 and results were published in 1991, before fume exhaust capture and ventilation devices were implemented on paving equipment. The study monitored a number of individual paving workers in direct contact with fumes during hot mix paving operations as well as spray applications. The researchers found that the results “clearly demonstrated that risks associated with the use of asphalt rubber products were negligible”. “Emission exposures in asphalt rubber operations did not differ from those of conventional asphalt operations”.

The National Institute for Occupational Safety and Health (NIOSH) in cooperation with FHWA has performed evaluations of possible differences in the occupational exposures and potential health effects of crumb rubber modified hot mixes and conventional AC mixes. NIOSH Health Hazard Evaluations were performed at seven paving projects located in Michigan, Indiana, Florida, Arizona, Massachusetts, and at two in California from 1994 through 1997. NIOSH has released some preliminary information on individual projects and a report on the Michigan study was presented at an annual meeting of the Transportation Research Board. These reports

indicated that increasing operating temperatures of AC plants seemed to have a greater effect on emissions quantity and content than did adding CRM. However the December 2000 NIOSH report on Health Effects of Occupational Exposure to Asphalt (No. 2001-110) that references these seven projects does not present any of the findings for asphalt mixtures containing CRM. This latest report does not recommend any changes to the 1977 NIOSH criteria for recommended exposure standards, which can be readily accessed through the NIOSH and OSHA web sites.

Additional information on studies related to asphalt rubber emissions and worker health and safety is compiled in the Caltrans report “Use of Scrap Tire Rubber State of the Technology and Best Practices,” dated February 8, 2005. This report is posted on the Caltrans website for Materials Engineering and Testing Services (METS) and can be downloaded.

2.0 ASPHALT RUBBER PRODUCT DESIGN, SELECTION, AND USE

Asphalt rubber binders can be used in hot mixes and for spray applications as surfaces or interlayers. To aid evaluation of project submittals including asphalt rubber binder designs and quality control plans for binder production, this chapter summarizes the state-of-the-practice of asphalt rubber binder design. It also presents guidance to assist project and pavement designers with selecting the appropriate type of high-viscosity (field blend) asphalt rubber product for the intended use, for maintenance, rehabilitation, or construction.

2.1 ASPHALT RUBBER BINDER (ARB) DESIGN

Asphalt rubber binders must be properly designed and produced to comply with specifications and provide a quality product suitable for the expected climate and traffic conditions. Individual components that comply with specifications may be combined and interacted in proportions that also fully comply, but may yield a binder that is not usable. The interaction between asphalt cement and CRM materials is material-specific and depends on a number of factors, including:

- Asphalt Cement Source and Grade
- Rubber Type
- Rubber Source
- Amount of Rubber
- Gradation of Rubber
- Interaction Time
- Interaction Temperature

Therefore, an appropriate asphalt rubber binder design must be developed using the designated source and grade of asphalt, asphalt modifier (extender oil), and CRM materials (scrap tire and high natural) that will be used for the subject project(s).

Caltrans Standard Special Provisions (SSPs) for asphalt rubber binder require that at least 2 weeks prior to start of construction the Contractor must supply to the Engineer, for approval, an asphalt rubber binder formulation (design or “recipe”) that includes results of specified physical property tests, along with samples of all of the component materials. Samples of the prepared asphalt rubber binder must also be submitted to the Engineer at least 2 weeks before it is scheduled for use on the project.

2.1.1 Caltrans Specification Requirements

Caltrans SSPs for ARB and rubberized asphalt concrete (RAC) mixes are currently being updated to reflect implementation of the performance graded (PG) asphalt binder system and will be incorporated into Section 39 of the Standard Specifications. This section discusses current SSP requirements and recommended changes developed by a Caltrans-Industry working group.

For each project, a detailed review of the special provisions and other contract documents is recommended to assure compliance with the project requirements.

The Aged Residue (AR) system of asphalt binder grading is being replaced by the performance graded (PG) system. AR-4000 will no longer be specified as the base asphalt cement for asphalt rubber binders. Instead, PG 58-22 is specified as the base asphalt cement for use in asphalt rubber binders for the high mountain and high desert climate areas where resistance to cold temperature cracking is critical to long term performance. A stiffer grade, PG 64-16, is specified for use in asphalt rubber in the rest of California (coastal, valley, low or southern mountains, low desert). PG asphalt has been proven capable of making good quality asphalt rubber binders in Arizona, Texas, Florida, and other locations. The change in grading systems should not present any major obstacles to asphalt rubber binder design. However, the base asphalt cement shall not be polymer-modified.

The current specifications for Asphalt Rubber Binder call for 20 ± 2 percent crumb rubber modifier (CRM) content by total binder mass. The CRM must include 25 ± 2 percent by mass of high natural rubber CRM and 75 ± 2 percent scrap tire CRM. No changes have been recommended to the types of CRM or relative proportions thereof. The scrap tire CRM consists primarily of No. 10 to No. 30 sized particles (2 mm to 600 μ m sieve sizes). The high natural rubber CRM is somewhat finer, mostly No. 16 to No. 50 (1.18 mm to 300 μ m sieve sizes).

The extender oil dosage for chip seals will remain at a range of 2.5 to 6 percent by mass of the asphalt cement. However, the minimum extender oil content for use in RAC mixes may be reduced to one percent to minimize potential for flushing and bleeding for hot climate, high traffic index (TI) locations.

Extender oils and high natural CRM are used to enhance the asphalt rubber interaction. Extender oils act as “compatibilizing” agents for the asphalt rubber interaction by supplying light fractions (aromatics, small molecules) that swell the rubber particles and help disperse them in the asphalt. High natural CRM has also been found to aid chip retention in chip seal applications, even at concentrations as low as 3 percent by asphalt rubber binder mass. Use of high natural CRM appears to improve the bond between cover aggregate and the asphalt rubber membrane.

It is important to understand that just mixing together proportions of arbitrarily selected asphalt, CRM and extender oil components within the specified ranges will not necessarily yield a binder that complies with the physical property requirements in the special provisions. Properties of asphalt rubber binders depend directly on the composition, compatibility and relative proportions of the component materials, as well as on the interaction temperature and duration. There are many combinations of suitable materials within the recipe proportions that simply do not provide an appropriate or even usable asphalt rubber binder. That is why binder design and testing procedures are essential to develop satisfactory asphalt rubber formulations.

2.1.2 Design Considerations

Most high viscosity asphalt rubber binders are produced in the field just prior to use, but may be stored at elevated temperatures for 24 hours or more if construction is delayed. It is important that the ARB properties, particularly the primary field control of viscosity, remain in compliance with specifications when mixed with aggregate or spray-applied. It is desirable for the asphalt rubber binder properties to remain relatively stable over time. Uniformity of binder properties also facilitates RAC production, placement and compaction operations. For this reason, some contractors prefer that the different asphalt rubber binders that they use be formulated to remain within a relatively narrow viscosity range, such as 2,000 to 3,000 cPs, so that other critical construction operations can be performed in a consistent manner from job to job.

Careful consideration should be given to the amount of extender oil included in the asphalt rubber binder. Although it is used for other purposes, extender oil also softens most asphalt cement materials to some extent while the CRM acts to stiffen the binder. The high-temperature stiffening effects of CRM do have limits, and in some low desert regions it is not unusual for exposed AC pavement temperatures to reach 180°F (82°C). In such cases, consideration should be given to limiting the amount of extender oil used. Conversely, extender oil dosage may be increased for locations where cold temperature performance, i.e. resistance to thermal cracking, is the issue. It might also be appropriate to increase extender oil content (within limits) for asphalt rubber binders for low volume roadways, where cracks are not exposed to the kneading action of tires and experience little healing from traffic.

Established asphalt rubber industry best practices for laboratory binder design develop a profile of the asphalt rubber interaction over a period of 24 hours by measuring the physical properties of the asphalt rubber binder sampled at specific time intervals. The current specification allows compliance to be documented with test results of one set of samples taken after 45 minutes of interaction.

Therefore, one of the most important changes to the asphalt rubber binder specifications requires that the binder design includes testing to develop and present a design profile of each specification property value measured at intervals over a 24-hour interaction period. The design profile indicates the compatibility of the components and the quality and stability of the resulting ARB properties over time.

The profile will include, at a minimum, results of specification compliance tests after an initial interaction period of 45 minutes, 4 hours later, and simulated over night cool down and reheat. Viscosity should also be measured and recorded at 2 and 3 hours after addition of the CRM to identify the expected trends for field production. Cool down is simulated by reducing oven temperature to 275°F (135°C) for a period of approximately 16 hours starting at 6 hours after CRM addition and ending 22 hours after CRM addition. After the cool down, the ARB is reheated to the appropriate temperature for viscosity testing (375°F, 190°C) at the end of the 24-hour interaction period.

Table 2-1 presents an example of a state-of-the-practice asphalt rubber binder design profile. Please note that this is one example and other interactions may follow very different patterns.

The asphalt rubber design profile is based on laboratory testing of the specific sources and grades of asphalt, asphalt modifier, and CRM identified for use in asphalt rubber binder production for specific project(s). The design profile must identify the specific component materials (source or supplier and grade) and proportions thereof used in the design and it does not apply to any combinations of different component materials. Due to differences between laboratory and field production, the ARB design profile shall serve only as a guide to indicate expected trends in asphalt rubber viscosity during asphalt rubber binder production and shall not be interpreted as a specification.

Table 2-1 Example Asphalt Rubber Binder Design Profile

Test Performed	Minutes of Reaction					45 minutes Specification Limits***
	45	90	240	360	1,440	
Viscosity, Haake at 190°C, Pa's, (10 ⁻³), or cP (*See Note)	2400	2800	2800	2800	2100	1500 – 4000
Resilience at 25°C, % Rebound (ASTM D5329)**	27	--	33	--	23	18 Minimum
Ring & Ball Softening Point, °C (ASTM D36)	59.0	59.5	59.5	60.0	58.5	52 – 74
Cone Pen. at 25°C, 150g, 5 sec., 1/10 mm (ASTM D217)	39	--	46	--	50	25 – 70

Notes regarding specified test procedures for Asphalt Rubber Binder

- * The viscosity test shall be conducted using a hand-held Haake viscometeror equivalent.
- ** ASTM D 5329 has replaced ASTM D3407
- *** Per Caltrans specifications as of September 2006

2.1.3 Design Procedure and Criteria

Because asphalt rubber interactions are highly material-specific, the first step an asphalt rubber producer must take in the design process is to obtain samples of the base asphalt binder (unmodified PG 58-22 or PG 64-16 depending on project location), CRM, and any other additives that will be used for the subject project(s). Use of extender oil and high natural CRM can help compensate for variability in the other components to some extent, but changes in source or grade of the asphalt cement or CRM can have major impacts on binder properties and would require a new design.

The ARB designer blends trial proportions of the designated components within specification requirements, based on practical experience. The asphalt rubber interaction is then conducted at the specified temperature. Samples of the asphalt rubber binder are taken after various intervals of interaction time as shown in Table 2-1 and tested for specification compliance. This provides a profile of how the asphalt rubber properties behave over time and a reasonable indicator of what to expect during field production, though field data may vary from the lab design. If results of the first trial are not adequate, additional interactions are performed as needed.

Caltrans has specified ranges of particular physical properties for asphalt rubber binders that are indicators of the relative amount of modification achieved by CRM interaction. The properties are rotational viscosity, resilience, ring-and-ball softening point, and cone penetration. The specification limits are shown in Table 2-1.

Viscosity and resilience are the most meaningful indicators of asphalt rubber field performance and are expected to vary as the asphalt rubber interaction proceeds. Viscosity should remain above the minimum 1,500 cPs value throughout the interaction and should not manifest drastic drops. There is no maximum value for resilience. High resilience typically indicates that the binder should perform well in resisting fatigue and reflective cracking. Submittal of the high viscosity binder design profile should be required for both hot mix and spray applications.

Best practice indicates that the asphalt rubber interaction properties (particularly softening point and resilience) should be examined to evaluate whether the extender oil content is appropriate for project environmental and traffic conditions. ASTM D 6114, "Standard Specification for Asphalt Rubber Binder," lists three types of asphalt rubber binder with varying limits on softening point and resilience. The Appendix provides corresponding suggested climate guidelines for type selection that may be used as a reference for such evaluation. Hot, moderate, and cold climate ranges are defined in terms of average monthly minimum and maximum temperatures. Some states have specified asphalt rubber properties based on climate and/or traffic considerations.

2.2 RUBBERIZED ASPHALT CONCRETE (RAC) HOT MIXES

Use of asphalt rubber in hot mixes is typically limited to gap and open gradations because these are most effective with respect to performance and cost. Use of high viscosity (field blend) asphalt rubber binder is not recommended in dense-graded mixtures because there is insufficient void space to accommodate enough of the high viscosity asphalt rubber binder to significantly improve performance of the resulting pavement. However dense gradations are well suited for use with terminal blend (no agitation) binders such as Caltrans MB, and should provide similar structural capacity to conventional dense-graded HMA mixes.

Gap and open-graded RAC mixes are most often used as overlays for maintenance and/or rehabilitation of existing asphalt concrete and portland cement concrete pavements. RAC is also used as surface (wearing) courses for new pavement construction, most often in areas where traffic noise is a consideration. Structural design is performed as for conventional dense-graded HMA pavements. Thickness reductions for resistance to reflective cracking may be applied when gap-graded asphalt rubber surface courses are substituted for dense-graded HMA for use as an overlay of structurally adequate pavement.

According to Section 631.3 of the recently updated Caltrans Highway Design Manual, "When all factors (including cost) are the same, RAC should be used as a preferred material for surface layer instead of HMA."

2.2.1 Gap-Graded Hot Mix

The most commonly used asphalt rubber product in California is gap-graded rubberized asphalt concrete (RAC-G) hot mix. RAC-G acts as a structural layer in the pavement and is most

effective at compacted thicknesses ranging from 1.2 inches (30 mm) to 2.4 inches (60 mm) according to recent structural analysis and modeling. This supports and corresponds to current practice based on empirical experience and economic considerations.

Should an increase in structural capacity greater than 2.4 inches of RAC-G be required, an intermediate layer of dense-graded HMA should be placed first to provide sufficient total pavement thickness. The pavement deflection study determines the structural requirements, which the designer uses to develop alternative structural sections for LCCA.

2.2.1.1 Purpose of RAC-G. RAC-G mixes provide a durable, flexible pavement surface with increased resistance to reflective cracking, rutting and oxidation, good surface friction characteristics due to the texture provided by the gapped aggregate grading, and often reduced traffic noise. RAC-G acts as a structural layer in the pavement.

2.2.1.2 Appropriate Use. RAC-G can be used for overlay or new construction for a wide range of traffic volumes and loadings. RAC-G can also be used in urban areas where there is considerable stop-and-go traffic for which open-graded mixes would not be suitable. Such areas include numerous signalized intersections and driveways. However, RAC-G mixtures are not recommended for parking areas as the surface of these low modulus mixes are likely to scuff when subjected to simultaneous low speed braking and turning movements that are typical in such areas.

2.2.1.3 RAC-G Overlay Thickness Design. Current Caltrans rehabilitation policy is to design an overlay so as to extend the service life of the pavement for ten years, although other design periods can be used. Overlay thickness design is based on the Traffic Index (TI) for the design period and the following three items:

- Structural adequacy upgrade;
- Reflective crack retardation; and
- Ride quality improvement.

Designing a RAC-G overlay involves determining the overlay thickness for a conventional dense-graded HMA overlay based on measured pavement deflection and traffic, then adjusting the thickness according to structural equivalencies between dense-graded HMA and RAC-G. Thickness of dense-graded HMA needed to retard reflective cracking and to restore ride are also evaluated. Reductions to RAC thickness are made when reflective cracking is the primary distress mode in the existing pavement.

Recent research from a limited laboratory test indicates that RAC-G has a gravel factor similar to conventional HMA but slightly lower. For purely structural considerations, RAC-G may be considered equivalent to conventional HMA up to a thickness of about 2.4 inches (60 mm). Mechanistic-empirical (M-E) structural models indicate that RAC-G is most effective when used as a thin surface overlay less than 2.4 inches (60 mm) and use as lower layers in a pavement system provides no added benefit.

2.2.1.4 RAC Overlay Systems. RAC overlays may also be placed as two- and three-layer systems, surfaced with either gap- or open-graded RAC. A two-layer system is typically RAC

placed directly on a SAMI-R which provides additional resistance to reflective cracking. When a leveling course (typically HMA) is placed prior to application of the SAMI-R, a three-layer system is created as shown in Figure 2-1. A finished RAC-G pavement is shown in Figure 2-2.

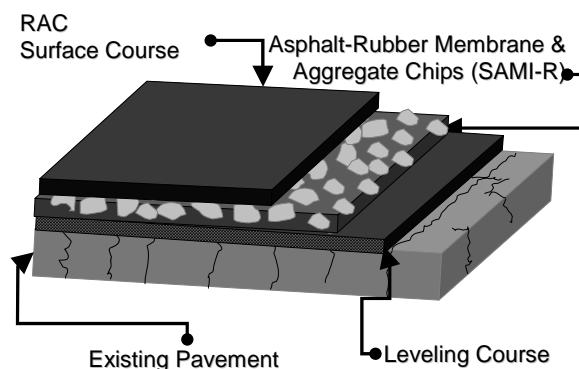


Figure 2-1 Three-Layer System

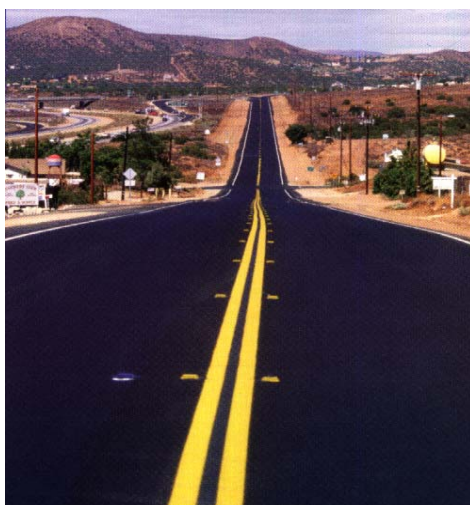


Figure 2-2 Finished RAC-G Pavement

2.2.1.5 RAC-G Mixture Design. Existing California Tests, including CT 367 with Hveem compaction, are used with some modifications as indicated in the updated specifications for RAC-G. These include allowances for lower Hveem stability (minimum 23), requirements for voids in mineral aggregate (VMA) of 18 to 23 percent and a significantly higher binder content than conventional HMA with a minimum requirement of 7.0 percent by mass of dry aggregate. Air voids content requirements are similar to dense graded HMA, and are specified within a range of 3.0 to 5.0 percent based on climate and traffic. Typical mix designs target 4.0 percent air voids. For locations with heavy truck traffic (high TI values) and/or high ambient temperatures, target design air void content should be increased to 5.0 percent to enhance resistance to bleeding and rutting. For rural highways with relatively little traffic, design air void

content may be reduced to between 3.0 and 4.0 percent to enhance durability. Recommended modifications to the RAC-G mix design method include using the average of test results for three briquettes at each binder content, use of Caltrans Laboratory Procedures for volumetric calculations, and reporting voids filled and dust proportion for information.

2.2.2 Open-Graded Hot Mix

Open-graded asphalt concrete (OGAC) pavements provide good surface frictional characteristics. OGAC is also called open-graded friction course (OGFC), and is essentially a hot mix version of a chip seal. OGFC pavements are intended to be free draining so that surface water can quickly travel through the mat to drain out along the edges of the pavement structure. This reduces splash, spray, and hydroplaning during and immediately after rains and thus improves visibility and safety. Conventional OGFC also reduces traffic noise, although reports of long term effectiveness of the reduction vary. Open-graded RAC mixes are designated as RAC-O and RAC-O-HB (High Binder).

Caltrans has used asphalt rubber open graded mixes (RAC-O and RAC-O-HB) primarily as maintenance blankets and as overlays for rehabilitation to restore surface friction. These mixes are highly resistant to reflection of cracks and joints in PCC pavements, and to reflection of severe cracks from underlying AC pavements. RAC-O may be considered one of the “new generation” friction course materials that use highly modified binders to address performance and durability issues of conventional open-graded asphalt concrete, but RAC-O has been in use much longer.

The thicker film coating of the high viscosity ARB increases durability of open-graded pavements. One of the reasons that RAC-O mixtures are durable is that these are relatively low modulus materials, which means that they have lower stress to strain ratios than stiffer materials like dense-graded HMA. They move more in response to the same level of loading, and function by flexing and recovering (relaxing, creeping, rebounding, etc.) rather than by being stiff like HMA. The high asphalt rubber binder contents render these materials very resilient and resistant to fatigue, but they are not stiff layers and are typically placed as thin lifts about 1 to 1.2 inches (24 to 30 mm) thick. Neither RAC-O nor RAC-O (HB) is considered to be a structural element; these materials are considered to be sacrificial and no thickness reduction is applied.

Caltrans continues to evaluate RAC-O-HB which uses higher asphalt rubber binder contents of 8 to 10 percent by mass of dry aggregate. Extensive experience in Arizona has shown that asphalt-rubber binder contents can be increased to 10 percent or more by mass of dry aggregate without excessive drain-off because of the high viscosity of the asphalt rubber binder. Such rich open-graded mixtures have generally provided excellent performance in a variety of climate zones in Arizona, where they are placed at a nominal compacted thickness of ½-inch over asphalt concrete pavements and 1-inch thick over portland cement concrete (PCC) pavements. Although the high binder content mixes are not as free draining as RAC-O, the thicker film coating of the ARB provides improved resistance to fatigue and reflective cracking, as well as to stripping and oxidative aging. These factors increase the durability of open-graded pavements.

2.2.2.1 *Advantages of RAC-O.* These include:

- The thicker asphalt rubber binder film provides improved resistance to stripping and oxidative aging.
- RAC-O mixes are highly resistant to reflection of cracks and joints in PCC pavements, and to reflection of severe cracks from underlying HMA pavements.
- Reduced traffic noise. Noise reduction over time is currently being studied by Caltrans, Arizona DOT, and the Federal Highway Administration (FHWA).

2.2.2.2 *Purpose.* The primary reasons for using RAC-O include:

- Provide a durable, highly flexible pavement surface with enhanced drainage and frictional characteristics
- Reduce splash and spray to improve visibility during wet weather
- Reduce hydroplaning in wet conditions to reduce potential for skidding (see Figure 2-3)
- Provide increased resistance to reflective cracking and oxidation
- Provide a smooth ride
- Use as an alternative to chip sealing because hot mixes are less sensitive to construction operations and essentially eliminate threat of windshield breakage

2.2.2.3 *Appropriate Use.* RAC-O is a surface course (for overlay or new construction) for roadways where traffic flow is essentially uninterrupted by signalization, such as some freeways, rural and secondary highways. It is highly effective as an overlay of PCC and HMA pavements in locations where potential for reflection of joints and/or cracks is severe. RAC-O is also used as a maintenance blanket to restore surface frictional characteristics and to help preserve the underlying pavement. Caltrans does not use RAC-O in snow country due to concerns about possible damage from tire chains and snowplows.

According to the Caltrans April 24, 2006 Memorandum on Use of RAC, RAC-O may also be used as a surface for new HMA pavement construction at a maximum thickness of 1.75 inches (45 mm), and may be placed directly on up to 2.4 inches (60 mm) of RAC-G. According to the Draft Caltrans OGFC Usage Guide, November, 2005, Caltrans has also placed thin overlays of RAC-O and RAC-O-HB directly on portland cement concrete pavement (PCCP) and these pilot projects are reportedly performing well.

Use of RAC-O-HB has been limited to date, but may increase in the future. While the higher binder content of the RAC-O-HB improves durability, it also makes the resulting pavement surface less free draining than RAC-O. Therefore, RAC-O-HB is best used where resistance to reflective cracking is most critical.

Open graded mixes should not be used where there is a significant amount of stop and go traffic or turning vehicles, such as city streets or in parking lots, because the porous low modulus pavement is susceptible to damage from leaking vehicle fluids and to tire scuffs from simultaneous braking and turning motions.



Figure 2-3 Free-Draining RAC-O Next To Dense-Graded HMA

2.2.2.4 RAC-O Mixture Design. Mixture design is performed according to California Test 368, with asphalt rubber binder content set at 1.2 times the optimum PG binder content with a check test for drain off. RAC-O-HB is designed according to the same procedure, but the multiplier for asphalt rubber binder content is increased to 1.6. If long hauls are anticipated, drain off should also be checked for the expected haul time. If excessive, adjustments may be required. For long hauls, reducing mixture temperature for hauling may not be appropriate for complying with minimum requirements for placement temperature.

2.3 ASPHALT RUBBER SPRAY APPLICATIONS

Asphalt rubber spray applications may be used as surface treatments or interlayers. Such applications are typically used for maintenance or rehabilitation of existing pavements, and are very effective at resisting reflective cracking.

2.3.1 Chip Seals (SAMs)

Chip seals are used by Caltrans for preventative and corrective maintenance to:

- Correct surface deficiencies.
- Seal raveled pavement surfaces.
- Seal off and protect the pavement structure against intrusion of surface water.
- Protect the pavement surface from oxidation.

In many jurisdictions, chip seals are called stress-absorbing membranes (SAMs). Chip seals do not add structural strength or correct profile or ride problems. Where traffic volumes allow, they may be used as an alternate to OGAC to restore surface frictional characteristics.

To construct a chip seal, the hot ARB is sprayed on the roadway surface at a rate determined by the Engineer depending on the surface condition. Typical application rates are 0.55 to 0.70 gallons per square yard which provide a relatively thick membrane. The binder is immediately covered with a layer of hot pre-coated chips that must be quickly embedded into the binder by rolling before the membrane cools. Best results are achieved with clean nominal 3/8 to 1/2-inch

(9.5 to 12.5mm) single-sized chips. The standard chip size for Caltrans asphalt rubber seals is 3/8-inch (9.5 mm); 1/2-inch (12.5 mm) chips are used by Caltrans only where ADT is less than 5,000 per lane. Lightweight aggregates may be substituted to minimize windshield breakage by loose chips in areas where traffic is heavy or fast. Pre-coating the aggregate with asphalt cement improves adhesion by removing surface dust and “wetting” the chips. Caltrans requires that the aggregate chips be delivered to the job site precoated and hot. To further aid chip retention after the chips have been embedded and swept, a fog seal of asphalt emulsion (diluted 1:1 with water) is sprayed over the chips at a typical rate of about 0.05 to 0.1 gal/yd² (0.14 to 0.27 l/m²). A light dusting of sand, about 2 to 4 lbs/yd² (1 to 2 kg/m²) is then applied as blotter as directed by the Engineer. Figure 2-4 shows an asphalt rubber chip seal train.



Figure 2-4 Chip Seal Train

Note: All chip seals are very sensitive to construction operations and site environmental conditions. With hot-applied seals, the thin binder membrane cools very quickly regardless of its composition. Embedment and adhesion must be accomplished while the membrane is still hot.

Although some references indicate that asphalt rubber seals can be applied at colder temperatures than emulsion seals due to use of hot precoated chips, placement when the ambient temperature is less than 60°F is not recommended. The potential for problems with embedment and adhesion increases as ambient and surface temperatures decrease.

2.3.1.1 Advantages. Asphalt rubber chip seals provide the same benefits as conventional chip seals, but also provide the following additional advantages:

- Significantly longer service life than conventional chip seals.
- Superior long-term performance in resisting reflective cracking.

2.3.1.2 Purpose. Asphalt rubber chip seals provide a flexible, waterproof, skid resistant and durable surface that resists oxidation and is highly resistant to reflective cracking. A chip seal is not a structural layer and provides no profile adjustment.

2.3.1.3 Appropriate Uses. These include:

- Rehabilitation of structurally sound pavements which are cracked or raveled

- Restoration of surface frictional characteristics (corrective maintenance)
- Routine preventative maintenance to extend the life of AC pavements

Chip seals have been used to restore some serviceability to functionally failed (aged and badly cracked) pavements with relatively sound structural capacity until rehabilitation can be performed. However they are too thin to correct pavement profile, and the aggregate surface may be somewhat noisy and rough to ride on. Appearance may also be an issue, although use of hot precoated chips and flush coat may improve appearance as well as durability. Noise and roughness generated are related to aggregate particle size. Larger cover aggregate is noisier and presents a rougher surface appearance.

Caltrans Maintenance Manual (Volume 1) includes criteria for use of chip seals and cover aggregate size based on speed limits and average daily traffic. The maximum ADT limit for chip seals is 30,000. Use of chip seals is not encouraged in areas with heavy trucks or stop-and-go traffic, at signalized intersections, or in locations where speed limits are ≥ 45 mph (72.4 kph).

2.3.1.4 Asphalt Rubber Binder Design. The specifications for ARB referenced in 2.1 also apply to asphalt rubber binders for chip seals, except that maximum viscosity is 3,000 cPs rather than 4,000. In the future, minimum extender oil content requirements may also differ. The asphalt rubber binder design profile and materials submittals requirements, including test results that verify compliance with ARB physical property specifications over a 24-hour period, are the same for chip seals as for hot mixes.

2.3.1.5 Application Rates. According to Caltrans standard special provisions for asphalt rubber seal coat, SSP37-030, target application rates for asphalt rubber chip seals are:

- Asphalt rubber binder at 0.6-0.7 gal/yd² (2.5-3 l/m²)
- Hot precoated chips (nominal 1/2 or 3/8" size) at 30-44 lbs/yd² (15-22 kg/m²)

However, the exact rate is to be determined by the Engineer. A number of factors should be considered in determining appropriate application rates for asphalt rubber binder and cover aggregate, including:

- Surface texture of the existing pavement: severely aged, oxidized and open-textured surfaces will absorb more binder than newer tighter surfaces.
- Traffic volumes: typically use smaller chips for higher volumes to reduce potential for vehicle damage by loose chips. Binder application rates can be increased for low traffic volume areas.
- Seasonal temperature ranges: thicker membranes may be used in areas with cool climates.
- Aggregate size: large stone requires more asphalt rubber binder (thicker membrane) to achieve 50 to 70 percent embedment. The standard chip size for Caltrans asphalt rubber seals is nominal 3/8-inch, which may be too small for heavy binder applications. However Caltrans policy is to use 1/2-inch chips only where ADT is less than 5,000 per lane.

- Aggregate gradation: single-sized materials require more ARB than do graded aggregates.

There are methods by which the specified aggregate application rate can be evaluated prior to the start of construction. The easiest is to simply lay the aggregate one-stone deep on a measured area, weigh the amount of stone required to cover that area and convert to appropriate units (lbs/yd², kg/m²).

To verify if application rates are appropriate, also check the embedment of the cover stone. The stone should be embedded to a depth of about 50-70 percent after seating in the lab or by rollers and traffic in the field. Excess chip application interferes with embedment and adhesion.

Excess asphalt rubber application can literally submerge or swallow the chips, which results in flushing/bleeding. Loose stones along the roadway edge after sweeping may indicate excessive chip application and wasted stone, that the asphalt rubber application is too light, or that the binder cooled before embedment and adhesion were achieved.

2.3.2 Asphalt Rubber Stress Absorbing Membrane Interlayers (SAMI-R)

A SAMI-R is simply an asphalt rubber chip seal that is overlaid with conventional HMA or RAC. Interlayers are used under corrective maintenance overlays and as a pavement rehabilitation tool, but would not be included in new construction. SAMI-R acts to interrupt crack propagation and has been shown to be highly effective in delaying reflective cracking in overlays of existing distressed asphalt and jointed portland cement concrete (PCC) pavements.

SAMI-R material is very flexible and elastic and has a low modulus; it flexes and creeps to relieve stresses and to heal many of the cracks that do occur. The membrane also provides a seal that minimizes further infiltration of surface water through the pavement structure. In cases where reflective cracking is expected to be the primary distress mode and structural capacity is deemed sufficient, interlayers may be used to reduce the required thickness of the overlay.

Chip retention is not an issue unless the interlayer will be opened to traffic prior to overlay. Otherwise, the aggregate chips are sandwiched in. They are keyed into the overlay during compaction and prevent formation of a slippage plane along the relatively thick asphalt rubber membrane. No fog seal or sand should be applied over an interlayer because it could interfere with bonding of the overlay.

SAMIs may be applied to any type of rigid (PCC) or asphalt pavement, and have proved very effective at minimizing reflection of PCC joints. However the Caltrans Maintenance Manual states that if the surface irregularities (rutting in AC or faulting of PCC) exceed 1/2-inch (12.5 mm) then either a leveling course should be placed or grinding and crack filling are required prior to placing SAMI-R.

2.3.2.1 *Advantages.* These include:

- Highly effective in minimizing reflective cracking in overlays of existing distressed asphalt and jointed portland cement concrete pavements.
- Minimize overlay thickness when reflective cracking is expected to be the primary distress mode and structural capacity is deemed sufficient.
- May contribute to reduced overlay thickness based on reflective cracking equivalency, which fabric does not.

2.3.2.2 *Purpose.* SAMI-R is a low modulus (non-structural) layer that is used to retard and minimize reflective cracking in overlays placed on it, and to minimize further infiltration of surface water through the pavement structure.

2.3.2.3 *Use.* SAMIs are used under thin maintenance overlays and are a pavement rehabilitation tool. A SAMI would not be included as part of new construction. Based on “the cost effectiveness and enhanced performance of sealing the pavement and overlaying” of SAMI-R in the Yolo 16 Esparto Test, the Caltrans Division of Maintenance recommended implementing two-layer pavement strategies as part of the Capital Outlay Preventative Maintenance (CAPM) program (Holland and Brown, 2005).

2.3.2.4 *Design.* Design of the ARB is the same as for chip seal. Determination of appropriate binder and cover aggregate application rates is also the same. SAMIs have been assigned an equivalency factor in rehabilitation projects when reflection cracking is the governing distress mode for overlay design.

3.0 PRODUCTION OF ASPHALT RUBBER BINDERS AND MIXES

This chapter presents information and procedures for production of asphalt rubber binder and how the use of ARB affects HMA mixture production.

3.1 ASPHALT RUBBER BINDER PRODUCTION

Asphalt rubber binder production methods are essentially the same for both hot mix and spray applications. The primary difference is the importance of coordination of asphalt rubber and hot mix production to assure that enough ARB is available to provide the desired RAC mix production rate.

Field production of high viscosity ARB is a relatively straightforward process for which Figure 3-1 shows a schematic. Equipment for feeding and blending may differ among asphalt rubber types and manufacturers, but the processes are similar. The component materials are metered into high shear blending units to incorporate the correct proportions of extender oil and CRM into the paving grade asphalt. The blending units thoroughly mix the CRM into the hot asphalt cement and extender oil, and the blend is pumped into a heated tank where the asphalt rubber interaction proceeds.

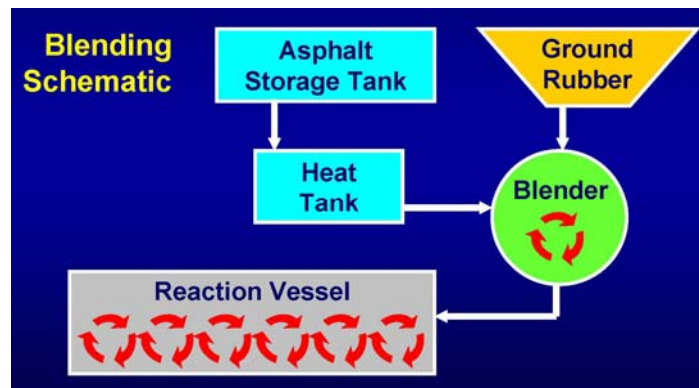


Figure 3-1 Asphalt Rubber Blending Schematic

The quality of the resulting asphalt rubber binder depends on proportioning, temperature, agitation, and time. **Temperature is critical for process control** and temperature gauges or thermometers should be readily visible. Tanks that store the asphalt cement and the asphalt rubber between initial blending and use are heated to temperatures from 375°F to 435° F (190°C to 226°C) and insulated. Asphalt rubber production equipment and storage tanks generally include retort heaters or heat exchangers to heat the asphalt cement and/or asphalt rubber binder. It is reasonable to assume some heat will be lost in any transfers, but this can be reduced by wrapping transfer lines with insulation.

Figure 3-2 shows an example of a typical asphalt rubber production set up at an HMA plant. Binders for spray applications are typically produced close to the job site, not necessarily at an HMA plant, and must also be coordinated with application operations.



Figure 3-2 Asphalt Rubber Production Set Up at HMA Plant

CRM is usually supplied in one ton (0.91 tonne) super sacks (Figure 3-3) that are fed into a weigh hopper for proportioning (Figure 3-4). The containers should be clearly labeled and stored in an acceptable manner. Caltrans' acceptance sampling should be coordinated with asphalt rubber personnel to assure that all CRM lots can be sampled as appropriate.



Figure 3-3 CRM Super Sacks



Figure 3-4 Blending from CRM Weigh Hopper

Augers are needed to agitate the asphalt rubber inside the tanks (Fig. 3.5) to keep the CRM particles well dispersed; otherwise the particles tend either to settle to the bottom or float near the surface. Agitation can be verified by periodic observation through the top hatch or the port where the auger control is inserted

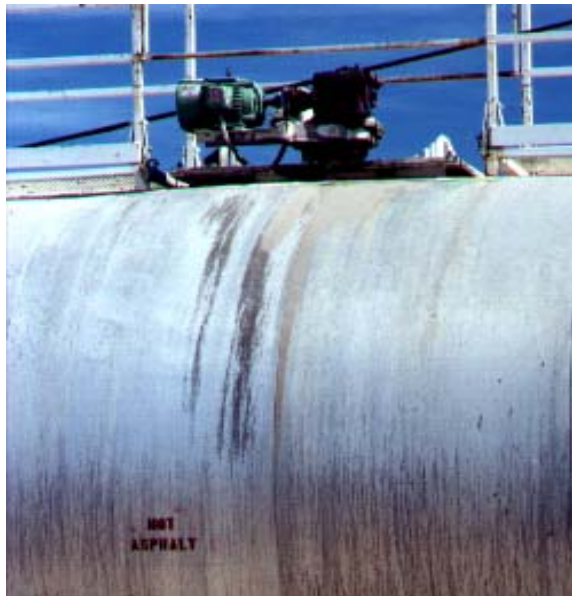


Figure 3-5 Auger for Agitating Asphalt Rubber Storage Tank

The asphalt rubber binder must be interacted with agitation for a minimum of 45 minutes at temperatures from 375 to 425°F (190 to 218°C) to achieve the desired interaction between asphalt and rubber. In order to maintain the reaction temperature within the specified range, the asphalt cement must be hot, 204 to 224°C (400 to 435°F) before the design proportions of scrap tire and high natural CRM are added. This is because the CRM is added at ambient temperature (not heated) and reduces the temperature of the blend.

The component materials are metered into blending units to incorporate the correct proportions of CRM into the asphalt cement, and are thoroughly mixed. The asphalt rubber producer is allowed to add the extender oil while adding the rubber, although in some cases the asphalt cement may be supplied with the extender included. If the asphalt rubber producer adds the extender oil, use of a second meter is recommended to best control the proportioning. The meter for the extender oil should be linked to that for the asphalt cement.

An ARB interacted at lower temperatures will never achieve the same physical properties as the laboratory design, although it may achieve the minimum specification values for use. Hand held rotational viscometers (Haake or equivalent as referenced in Table 2-1) are used to monitor the viscosity of the asphalt rubber interaction over time for quality control and assurance. Before any asphalt rubber binder can be used, compliance with the minimum viscosity requirement must be verified using an approved rotational viscometer. As long as the viscosity is in compliance and the interaction has proceeded for at least 45 minutes, the asphalt rubber may be used.

3.1.1 Hold-Over and Reheating

Caltrans requires that heating be discontinued if ARB material is not used within 4 hours after the 45-minute reaction period. The rate of cooling in an insulated tank varies, but reheating is required if the temperature drops below 375°F (190°C). A reheat cycle is defined as any time an asphalt rubber binder cools below and is reheated to 375 to 425°F (190 to 218°C). Caltrans allows two reheat cycles, but the asphalt rubber binder must continue to meet all requirements, including the minimum viscosity. Sometimes the binder must be held overnight. The asphalt and rubber will continue to interact at least as long as the asphalt rubber remains liquid. The rubber breaks down (is digested) over time, which reduces viscosity. Up to 10 percent more CRM by binder mass can be added to restore the viscosity to specified levels. The resulting asphalt rubber blend must be interacted at 375 to 425°F (190 to 218°C) for 45 minutes and must meet the minimum viscosity requirement before it can be used.

3.1.2 Documentation

3.1.2.1 Certificates of Compliance. According to Caltrans requirements, a certificate of compliance (COC) is required for every binder constituent as well as for the finished asphalt rubber binder. The COCs must include test results that show conformance of all of these materials to the respective special provisions, including chemical composition of the scrap tire and high natural CRM materials and asphalt modifier (extender oil). COCs for each of the component materials delivered to site of the asphalt rubber blending operation should be provided to the Engineer, inspector and/or project staff. It is current policy for Caltrans representatives to sample components and blended asphalt rubber materials at the mixing site for testing and acceptance.

3.1.2.2 Asphalt Rubber Binder Design. A copy of the approved ARB Design Profile that includes results of specified laboratory tests and proportions of each component must be available at the asphalt rubber blending site.

3.1.2.3 Asphalt Rubber Binder Production Log. A Log of ARB Production shall also be maintained for each project. For each batch of asphalt rubber produced, the log should list the weights of each component used, the reaction start time, and results of all viscosity tests performed, including the time and asphalt rubber binder temperature, and the time when the batch was metered into the HMA plant. Figure 3-6 presents an example of an asphalt rubber Binder Viscosity Log. The production log should also include all holdover and reheat cycle information including the time that heating was discontinued, the time that reheating began and corresponding ARB temperature, amount and time of CRM addition if applicable, and subsequent viscosity test results. These data should be recorded on the Asphalt Rubber Binder Viscosity Testing Log shown in Figure 3-6.

Project Name/Number	
Asphalt Rubber (AR) Blender/Supplier	
Location of AR Blending Plant	
RAC Mix Supplier	

ASPHALT RUBBER BINDER FORMULATION

Blend Proportions

Asphalt Cement PG Grade and Supplier		
Asphalt Modifier Type and Supplier		% by AC mass:
Asphalt Cement and Modifier		% by Asphalt Rubber Binder mass:
Scrap Tire CRM Type & Supplier		% by Asphalt Rubber Binder mass:
High Natural CRM Source & Description		% by Asphalt Rubber Binder mass:

Asphalt Rubber Binder (ARB) material must be tested to verify compliance with minimum viscosity requirement of 1,500 Pa•s (x 10⁻³) at 375± 3°F before it can be used.

*Cycle Start Date & Time	AR Batch #	Temperature In ARB Tank (°F)	Temp. During Viscosity Test (°F) (375 ± 3°F)	Measured Viscosity** Pa•s(x10 ⁻³)	Date and Time Sampled	Date and Time Tested	Comments

Viscometer Make, Model and Serial #: _____

Rotor Designation: _____

Test Operator: _____

* The cycle begins when the asphalt rubber tank is fully loaded and temperature in the tank is 375±3 °F.

** Measure viscosity at 375±3 °F according to Caltrans LP-XX. Viscometer may read in units of centipoises (cPs) or dPa•s. Unit conversions are as follows:

$1Pa\bullet s = 1,000 cPs$
 $1dPa\bullet s = 0.1Pa\bullet s = 100 cPs$
 $1mPa\bullet s = 0.001Pa\bullet s = 1 cPs$

Figure 3-6 Example Asphalt Rubber Binder Viscosity Testing Log

3.1.3 Sampling and Testing Requirements

For quality control, sampling and testing frequencies for all components of ARB are listed in Table 3-1. Quality Assurance testing requirements may vary, but sampling requirements typically should not exceed the frequencies shown below.

Tests for CRM gradation and chemical composition may take more time to conduct than for conventional paving materials. Failures to meet these requirements should be evaluated on a case-by-case basis and results of physical property tests of the asphalt rubber binder should also be considered. For RAC-G mixes, volumetric mix properties should also be evaluated.

Table 3-1 QC Sampling and Testing Frequency

Material	QC Sampling and Testing Frequency*
CRM	Chemical composition Each 250 tons (225 tonnes about)
CRM	Gradation and physical properties Each truckload: Each 20 tons (18 tonnes)
Asphalt Rubber Binder	Viscosity: Test every hour during RAC production. Retain 1 gallon (4 liters) /batch
Asphalt Cement	Each 200 tons (180 tonnes) Sample at point of origin or at mixing site.
Asphalt Modifier	Each 25 tons (23 tonnes) Sample at point of origin or at mixing site.

**Minimum frequency is once for each project.*

3.1.3.1 CRM Sampling and Testing. CRM consists of graded particles of ground rubber that tend to agglomerate (clump) in the presence of moisture and may segregate by size. Although CRM manufacturers certify CRM gradation at the plant, segregation may occur during storage and shipping. Segregation is not an issue when the entire container is added to the asphalt rubber blend, but it can affect the small samples (approximately 100 grams) obtained for purposes of gradation testing for acceptance. Caltrans has developed a standard method to obtain representative samples of CRM from shipping containers using tube samplers such as grain probes. It is included in a draft Laboratory Practice (LP-10) for Sampling and Testing CRM which is currently under review by Caltrans and has not yet been implemented.

3.1.3.2 Asphalt Rubber Sampling and Testing. Caltrans requires the Contractor (typically the ARB producer) to sample the asphalt rubber from an appropriate sample valve or the feed line into the AC plant and measure the viscosity at least every hour during AC production. At least 1 gallon of ARB should be wasted to assure that the sampling valve is clear, and the sample to be tested should be poured into a clean, dry container that can be sealed and clearly labeled. At least one viscosity test is required for each asphalt rubber batch, with subsequent hourly measurements during mix production. The Engineer is to be notified when the tests will be performed. Caltrans requires that results of all viscosity tests performed, including the time and ARB temperature, be submitted to the Engineer on a daily basis. Figure 3-6 presents an example Asphalt Rubber Binder Viscosity Testing Log.

Viscosity depends on temperature. It is essential to have a controllable heat source (hot plate, gas stove/burner, etc.) to maintain asphalt rubber sample temperature at $375 \pm 3^{\circ}\text{F}$ ($190 \pm 1^{\circ}\text{C}$) during viscosity measurement.

The Caltrans Laboratory Procedure for testing asphalt rubber binder viscosity (LP-11) with a hand-held rotational viscometer (analog or digital) is still in development and is not yet available. A description is presented below for information, but the actual procedure adopted may differ. The original field test procedure can be obtained from the Transportation Laboratory, Pavement Branch by request.

The open ARB sample container should be set on or over the heat source as appropriate, and the sample should be stirred to prevent scorching or burning. The No. 1 viscometer spindle should be inserted in the hot binder sample near the edge of the can for about one minute to acclimate, without plugging the vent holes. This is longer than the Caltrans test method requires, because 10 seconds is not enough time to raise the spindle temperature by 300°F (167°C). While acclimating, the sample can be thoroughly stirred and the temperature measured. The probe should then be moved to the center of sample to make the viscosity measurement. The analog viscometers have a level bubble for proper orientation (probe shaft perpendicular to binder surface and viscometer level) and an immersion depth mark on the shaft. Bubbles need to be added to the digital models. Once leveled, begin probe rotation. The peak viscosity value is read from scale labeled with the corresponding spindle number (see Figures 3-7 and 3-8 for analog models, and Figure 3-9 for digital model).



Figure 3-7 Hand Held Viscometer Testing
(Analog Model)



Figure 3-8 Analog Viscometer Reading – Scale
No. 1

The peak measurement represents the viscosity of the asphalt rubber binder system and that is typically the value that should be reported and logged. However, for some binders, there is a noticeable pause in the reading immediately after it begins to drop from the peak value before the drop continues. If this occurs, substitute the lower value where the reading paused. As the probe continues to turn, it “drills” into the sample, (i.e., spins rubber particles out of its measurement area) and the apparent viscosity drops to reflect only the liquid phase of the asphalt rubber. Three measurements should be taken and averaged to determine the viscosity. Between

measurements, the viscometer probe should be moved away from the center (without removing it from the asphalt rubber binder sample) and the sample should be thoroughly stirred again.



Figure 3-9 Digital Readout Rotational Viscometer (per manufacturer)

During ARB production, field viscosity measurements may vary from the laboratory design but should follow a similar pattern of increase and/or decrease over the duration of the asphalt rubber interaction. Larger differences than ± 500 centipoises (cPs) or different patterns can indicate that a change may have occurred in component materials since the original design and testing was performed. In such cases, samples of the reacted asphalt rubber binder should be obtained and tested immediately for specification compliance. As long as the asphalt rubber binder viscosity complies with specification limits, the Contractor may elect to use that batch of binder. However in such cases, there is a risk that the test results may show that the sample does not comply with other specified physical property requirements. Complete and well-maintained asphalt rubber production logs can help limit areas of penalty and/or removal and replacement by recording when and/or where the reject material was used.

Upon request or as agreed during the pre-paving conference, asphalt rubber producer personnel should provide to the Engineer or Inspector samples of reacted asphalt rubber binder for quality assurance and acceptance testing for compliance with the specified property limits.

3.1.3.3 Terminal Blend Products. Terminal blend products may be manufactured by different methods and are governed by different specifications and tested with different equipment than the high viscosity asphalt rubber binders described in this Asphalt rubber Usage Guide. **These products are not within the scope of this Guide.**

CAUTION: Remember that the two families of CRM-modified binders, high viscosity asphalt rubber and terminal blend (no agitation) are not interchangeable. Neither type should be directly substituted for the other in a hot mix without laboratory testing to determine appropriate adjustments in binder content and possibly aggregate gradation.

3.2 ASPHALT RUBBER HOT MIXES (RUBBERIZED ASPHALT CONCRETE, RAC)

3.2.1 Mix Production

Using asphalt rubber binder has relatively little effect on hot plant operations, for either batch or continuous HMA plants, except that it may be necessary to increase the plant operating temperature in order to provide the higher mixing and placement temperatures typically required for RAC mixtures.

The asphalt rubber production equipment is independent of the HMA plant, but is usually set up as close to the mixing unit as feasible to minimize the length of the heated and/or jacketed binder feed lines.

The asphalt rubber producer provides special heavy-duty pumps to transfer the asphalt rubber binder, because most HMA plant pumps cannot handle such viscous materials without risk of damage. A two- or three-way valve can be installed in the asphalt feed line that allows the plant to switch between using the ARB or the regular paving asphalt in the HMA plant tanks, according to demand for various HMA products. For drum plants, the asphalt rubber producer is required to use a flow meter that interlocks the ARB feed with the plant aggregate feeds.

RAC production rates may be slightly reduced from dense-graded HMA rates due to higher binder content (increased mixing time) and asphalt rubber binder production rate. Planning and coordination between the asphalt rubber binder producer and the HMA plant operator are important to minimize impacts on RAC production. The binder supplier can in many cases arrange to use more or larger storage and reaction tanks, and schedule materials deliveries and asphalt rubber blending operations to expedite asphalt rubber and mix production. Because of the relatively high mixing temperatures, there is potential for increased emissions of smoke and/or fumes. Reducing the mix production rate usually reduces visible emissions.

3.2.1.1 Inspection and Troubleshooting of the RAC Mixture. Both the plant and field inspectors should visually inspect the RAC in the haul truck bed for signs of any problems with the mix and check mix temperature. Surface readings are not an accurate indicator. Measure the temperature of the RAC mix with a thermometer that has a probe at least 6 inches (152 mm) long, by sticking the full depth of the probe into the mix. If only a heat gun is available, it will be necessary to measure temperature of the RAC as it flows out of the plant discharge chute into the haul truck.

Whenever any type of RAC mixture problem is suspected, the Inspector should obtain samples immediately and have them tested for gradation and ARB content. In some cases, it may be necessary to check voids properties of compacted hot mix specimens. The Inspector should enter a full description of the problem observed and subsequent activities in the project daily log, and immediately report these observations to the Resident Engineer (RE). Test results should be relayed to the RE immediately upon receipt. Some of the potential “trouble” signs to watch for in the mix are as follows.

- Segregation: Particle size segregation may be difficult to identify in some coarse gap-graded mixtures. There are few fines present and that can sometimes make the RAC appear segregated even if it is not. Identify the affected truckloads and corresponding placement areas, take samples and test gradation and binder content to verify. It is also recommended that, if possible, samples of RAC that do not appear segregated should be taken from the same truckload, for comparison. Temperature segregation (hot or cold spots) may be checked with a heat gun or with an infrared camera. The primary concern is differences rather than exact values.
- Blue smoke: Mix is too hot.
- White smoke: Steam – too much moisture. This means that the aggregate was not dried enough prior to mixing with asphalt rubber binder. This may cause the RAC mix to become tender and may contribute to compaction problems.
- Stiff appearance: Mix may be too cool – check temperature.
- Dull, flat appearance: Indicates low asphalt rubber binder content and/or excessive fines (minus No. 200 (0.075 mm) sieve size). Localized areas of dullness may indicate insufficient mixing of the asphalt rubber binder and aggregates, or mix segregation. Take samples and test for gradation and binder content.
- Slumped and shiny: High ARB content. RAC-O, and especially RAC-O (HB) mixtures, may look this way and still meet SSP requirements, so this is not always a problem. An old descriptive term for this is “wormy,” because the mix seems to almost crawl when watched. Look in the truck bed for binder drain down, take and test samples for asphalt rubber binder content and gradation.

The only change to the plant Inspector’s normal duties is the addition of monitoring the asphalt rubber production and viscosity results and sampling the ARB and its components. The Asphalt Rubber Binder Production Log and Testing Log should contain all of the pertinent information, and should be available for inspection. The Inspector should obtain at least one 1-gallon (4 liter) sample from each batch of ARB produced for the project to test for compliance with specification limits.

The normal activities related to plant inspection for conventional HMA production remain the same and include the following items, along with close attention to temperature:

- Observing aggregate storage and handling and plant operations
- Basic sampling and testing procedures for checking aggregate and RAC characteristics;
- Verifying that the correct mixture is being produced according to the design and in compliance with specifications, etc.

3.2.2 Importance of Temperature

The key to quality in producing asphalt rubber materials and constructing asphalt rubber pavements is temperature control in all aspects of the work. Asphalt rubber materials need to be produced and handled at somewhat higher temperatures than conventional bituminous materials and mixtures because they are stiffer than these conventional materials at the typical mixing and compaction temperatures.

Temperature is critical to:

- ARB manufacture
- RAC hot mix production
- RAC delivery
- RAC placement
- RAC compaction

It is therefore important to closely monitor temperature of the materials during all phases of asphalt rubber binder and mixture production and construction. The Inspector should have appropriate equipment for checking temperature of asphalt rubber binder and hot mix, including surface and probe type thermometers that can also measure ambient air temperature, and a heat gun. The asphalt rubber blending and storage tanks should also be equipped with readily visible thermometers.

3.2.3 Safety

Safety is always a consideration when working with hot materials. Conventional HMA mixtures are hot enough to cause burns, and so are asphalt rubber binders and RAC materials. Personnel should wear appropriate protective gear including but not limited to gloves made for handling hot samples and suitable eye protection.

4.0 CONSTRUCTION AND INSPECTION GUIDELINES

This chapter presents information and procedures for construction and inspection of asphalt rubber pavements, chip seals and interlayers, including placement, compaction and finishing.

4.1 HOT MIX (RAC) PAVING EQUIPMENT

Conventional equipment is used to place and compact RAC materials. The field inspector should confirm that the necessary paving equipment is on site before any RAC mix is shipped from the HMA plant. Any equipment-related questions or issues should have been resolved in the pre-paving conference. Availability and paving capability may be affected by unanticipated mechanical problems or logistics.

4.1.1 Haul Trucks

Any type of trucks that are customarily used for transporting HMA may be used, including conventional end or bottom dumps, or horizontal discharge (live bottom). Trucks hauling RAC mix should be tarped to retain heat during transport.

4.1.2 Material Transfer Vehicle (MTV)

Use of this type of equipment is optional and typically limited to large projects. MTVs have been described as “surge bins on wheels” and are most often used when smoothness, segregation, or mixture delivery rate are concerns.

4.1.3 Pavers

Conventional mechanical self-propelled pavers are used to place RAC mixes. Pavers should be equipped with vibratory screed and screed heaters, automatic screed controls with skid, and comply with all of the pertinent Caltrans specification requirements.

4.1.4 Rollers

Rubber tired rollers are not appropriate for compacting RAC mixes because of excessive pick up of the mixture by the tires. Rollers for RAC must be steel-wheeled (drum), and must be equipped with pads and a watering system to prevent excessive pick-up. It may sometimes be necessary to add a little soap to the watering system.

RAC-G mixtures are likely to require more compaction effort than dense-graded HMA. Minimum recommended roller weight is 8 tons (7.3 tonnes); pup rollers cannot provide sufficient compaction. The types of rollers normally include the following:

- **Breakdown roller with vibratory capability.** Two breakdown rollers should be used, especially if paving width exceeds 12 feet (3.65 m).

- **Intermediate roller.** If not of equal or greater width than the breakdown roller(s), two intermediate rollers should be required.
- **Finish roller.** May be vibratory or static, but use the static mode for finishing
- **Standby roller.** One with vibratory capability should be on site and would be required if only one breakdown roller is available.

4.1.5 Sand Spreader

Any Caltrans approved spreader with uniform distribution capabilities to provide a sand blotter for opening the RAC surface to traffic.

4.2 FINAL PREPARATIONS FOR PAVING

Surface preparation must be completed prior to RAC production or spray application. This includes customary items such as removal and replacement of failed pavement, pothole repair (patching), milling or grinding for smoothness and/or to restore or adjust profile, crack filling and/or sealing, etc. Patching should be performed using standard good practice and conventional HMA. Do not overfill cracks, as excess sealer/filler will cause bumps in the overlay, and may migrate up through the RAC mat during compaction and to create “fat spots.” Fill ruts as necessary. If a leveling course is required, use a fine dense-graded HMA material. Immediately prior to mixture delivery, the surface should be swept and tack coat applied.

4.2.1 Tack Coat (Paint Binder)

A tack coat should generally be uniformly applied so as to lightly cover the entire pavement surface to be overlaid. Tack coat may consist of paving grade asphalt or emulsified asphalt. Area of tack application should be limited to what will be paved over on that day. However, tack coat is not required when a SAMI-R will be placed prior to overlaying, and is not recommended when RAC will be placed directly on a new pavement.

4.2.1.1 Emulsified Asphalt. Recommended application rate is 0.05 to 0.1 gal/square yard residual, depending on the condition of the existing surface. Caution should be used when ambient and pavement temperatures are marginally cool and emulsion tack coats are to be used. Emulsion must “break” (i.e. turn from dark brown to black as the suspended asphalt droplets separate from the water) and the water must evaporate prior to paving. Otherwise, the remaining water in the emulsion will turn to steam and rise up through the mat. This prevents the tack from establishing the intended bond with the new pavement and the excess moisture may also cause a tender spot in the mix during compaction. Water trapped between pavement layers may cause stripping. Cold or damp conditions and lack of sun slow evaporation and may delay paving operations.

4.2.1.2 Asphalt Cement. Unmodified PG asphalt cement can also be used as tack for RAC mixes and is preferred for use where site conditions are marginal. Asphalt tack must be hot enough (300 to 350°F, 149 to 176°C) to spray an overlapping fan pattern that provides a uniform application. The distributor truck must have a heater to maintain asphalt temperature and

consistency for spray application. The application rate must be properly controlled to avoid bleeding (too high) or delamination (too low). Any defective or plugged nozzles must be corrected immediately.

4.3 HOT MIX DELIVERY

The same good practices recommended for conventional hot mix delivery should be applied to RAC materials, along with special attention to temperature. Any type of conventional HMA haul truck can be used to transport RAC. However, use of bottom dumps and windrows is not recommended when air and pavement surface temperatures are marginally cool. It is critical that the RAC does not cool below the minimum laydown temperature (290°F, 143°C) during transport. Tarps are needed to maintain acceptable mixture shipment temperatures ranging from 290° to 325°F.

4.3.1 Release Agents

No solvent based release agents or diesel fuel should be used in haul truck beds because of adverse effects on the asphalt rubber binder. Soapy water (dish or laundry soap) is recommended; it is effective and cheap. Dilute silicone emulsions may also be used.

4.3.2 Coordinating Mix Delivery and Placement

Coordination and balance of binder and mix production with mix delivery, placement, and compaction operations is essential to achieving a smooth finished pavement with a pleasing appearance, the two factors that motorists reportedly consider the most important indicators of pavement quality. The paver should never have to stop due to lack of material. If it stops on the new mat, the result is either a bump or depression that is not removable by rolling. If the paver pulls off the mat, it may be necessary to construct a transverse joint. A long line of haul trucks waiting to access the paver usually means that some loads will cool too much to be used. Material transfer vehicles can be used to reduce adverse impacts of irregular mix delivery, but these large heavy machines are generally used only for large projects.

4.3.2.1 Unloading RAC Mix into a Paver Hopper. As for conventional HMA, the haul truck should be centered and backed up to the paver, but should stop just short of contacting the push rollers on the front of the paver (Figure 4-1). After the truck releases its brakes, the paver should move forward to pick up and push the truck forward, instead of the truck bumping the paver. This method helps to minimize screed marks and roughness. End dumps and if used, live bottom trucks, should raise their beds slightly so that the mix slides up against the closed tailgate, then open the gates to discharge the mix in a single mass. This “floods” the paver hopper and helps to minimize potential for mix segregation.

4.3.2.2 Unloading Hot Mix Into A Material Transfer Vehicle. This is easier, because MTVs also have a front hopper to receive the mix, but eliminate the problem of bumping the paver. The same method of discharge should be used to flood the MTV hopper as a paver hopper.

4.3.2.3 Load Tickets. Load tickets should be collected when the mix is discharged from the haul truck. Yield calculations are typically used to verify overall thickness based on total tonnage and

area paved. However in-place thickness of randomly selected cores should also be measured as a check.



Figure 4-1 Unloading RAC-G into Paver Hopper

4.4 HOT MIX PLACEMENT

Placement of asphalt rubber materials or any HMA materials requires good paving practices. Examples of good paving practices are listed in Table 4-1. Temperature is critical for proper placement of all HMA materials and particularly for RAC. Asphalt rubber binders are stiffer than conventional paving asphalt at the customary placement and compaction temperatures, so time available for compaction of modified materials is typically shorter than for conventional dense-graded HMA mixtures. How much shorter depends on a number of variables that are discussed in section 4.5 on Compaction.

Caltrans special provisions for RAC-G specify minimum atmospheric and pavement surface temperatures of 55°F (13°C) for mixture placement. When atmospheric and pavement surface temperatures are between 55°F and 64°F (18°C), spread (lay down) temperature for RAC-G is specified as 290 to 325°F (143 to 163°C). For site temperatures $\geq 64^\circ\text{F}$ (18°C), the lower limit of RAC spread temperature drops to 280°F (138°C).

Placement at minimum ambient temperatures is not recommended, because time available for compaction is very limited and leaves no margin for circumstance or error, which often results in inadequate compaction. When feasible, it is recommended that the minimum ambient temperature requirement for RAC placement be increased to 65°F. Because of the importance of temperature in achieving adequate RAC compaction, operating in the mid to upper end of specified temperature ranges is strongly recommended.

Asphalt rubber paving materials should not be placed during rain or when rain is imminent. If site conditions are wet, windy, or too cold, placement should be delayed until environmental conditions improve. Otherwise, expect significant problems in achieving adequate compaction. Weather conditions may change during the paving operation. If necessary, paving should be stopped until conditions improve.

Table 4-1 Examples of Good Paving Practices

- Use appropriate and properly maintained equipment operated by responsible, well-trained personnel.
- Comply with plans and specifications, and pay attention to details.
- Handle the mix so as to minimize segregation by particle size or temperature.
- Maintain mix temperature by using tarps and, if available, insulated beds on haul trucks.
- Deliver the mixture as a free flowing, homogeneous mass without segregation, crusts, lumps, or significant binder drain-off.
- Coordinate mix production, delivery, placement and paving operations to provide a smooth uninterrupted flow of material to the paver.
- Ideally, the paver should never stop on the new mat.
- Use good workmanship in constructing and compacting cold and hot, longitudinal and transverse joints. Allow appropriate overlap and thickness of hot material for roll-down, and roll from the hot side.
- Do not lute joints.
- Use enough rollers to achieve adequate breakdown and intermediate compaction and to complete finish rolling within the temperature limits for these operations.

4.4.1 Paver Operations

Paver operations for RAC should not differ from those commonly used for conventional HMA, except perhaps for paying closer attention to the temperature of the mix in the hopper. It is important to the quality of the finished product that the paver be operated so as to minimize starting and stopping. The importance of coordinating mix delivery with placement cannot be overemphasized. A consistent paver speed, even if relatively slow, helps maintain a uniform head of material and to control thickness. Care should be taken to dump (fold) the paver wings before mix collected in the corners cools enough to form chunks. However, wings should *never* be dumped into an empty hopper. Slat conveyors should not be allowed to run empty or nearly so.

4.4.2 Raking and Handwork

RAC mixtures are not particularly amenable to raking or handwork, so these activities should be minimized and performed immediately before the mix has time to cool. The relatively coarse RAC-G aggregate gradation and stiffer binder make handwork a problem, and may affect the appearance of joints. The higher asphalt rubber binder content of RAC-O-HB may make raking and handwork a little easier until the binder cools and stiffens.

The lack of fines in the gap and open graded mixes can create a somewhat rough and open-looking texture, even when placed by machine. RAC placed by hand may not provide a pleasing appearance even if the workmanship is excellent and the best practice is applied.

4.4.3 Joints

AC joints are typically defined as longitudinal or transverse, cold or hot. Butt joints are most typical and the practices presented apply to those. Some agencies have adopted wedge joints and/or skewed joints that are not discussed in this Guide; there may be some issues with using wedge joints for thin lifts of RAC, since there are few fines in RAC mixes. Broadcasting of the mix at joints is not good practice and should not be done.

4.4.3.1 Longitudinal Joints are most likely to be cold joints. To provide a good bond with the adjacent pavement, remove any loose material and tack the vertical edge prior to placing hot mix. To minimize need for raking, it is important to set both the screed overlap and height carefully on the adjacent pass. The screed should overlap the cold material by only about 1 to 1.5 inches (25 to 38 mm). The screed should be set above the elevation of the cold side by approximately 1/8 to 1/4 inch for each inch (3 to 6 mm for each 25 mm) of compacted pavement thickness being placed. Compacted thickness of RAC is 1.2 to 2.4 inches (30 to 60 mm) so the differences in height would range from about 0.2 to 0.6 inch (5 to 14.4 mm). This is relatively small compared to maximum stone size in the mix. Since it is difficult to feather RAC mixtures, some raking may be unavoidable. Extra material should be raked onto the hot side, not the cold. Roll from the hot side, not the cold side, to make a tight joint.

If the mix is placed by hand rather than machine, the height difference for compaction should be increased to 1/4 to 3/8 inch for each inch (6.3 to 9.5 mm for each 25 mm). The height difference may vary among mixes, so experience and engineering judgment should be used as appropriate.

4.4.3.2 Transverse Joints. These may be hot or cold. Hot joints should be treated the same as for conventional dense-graded HMA, but the RAC mix will stiffen more quickly. Cold joints should be treated as described for longitudinal joints. Most often, transverse joints are constructed at the end of the paving day or when a lane is finished, using a bulkhead or Kraft paper to provide a vertical butt joint. If the paver runs out the mix, the joint should be constructed where the full compacted thickness is available, and the rest of the mix placed past that point should be removed and wasted. Ideally, transverse joints should be rolled in a transverse direction. This is rarely feasible and they are generally rolled longitudinally.

4.5 HOT MIX COMPACTION

Compaction is essential to the performance of any asphalt pavement. Although asphalt rubber mixtures are very forgiving materials, even they require adequate compaction to achieve the desired performance and durability. The best materials, mix designs, and placement techniques cannot compensate for adverse effects resulting from poor compaction during construction.

The coarse aggregate structure and stiff asphalt rubber binders in RAC-G mixes often require more compaction effort than conventional HMA. Compaction depends primarily on temperature and compactive effort. Breakdown compaction of RAC-G mixtures must be performed in the vibratory mode, and it is advisable to obtain at least 95% of the required density during breakdown rolling. Caltrans plans to implement density requirements for RAC-G mixes, including penalties for inadequate compaction.

However, vibratory compaction is not used for open-graded mixtures. There are no compaction requirements for open-graded mixes. These are typically placed as surface courses in thin lifts about 1 to 1.2 inches thick. Compaction is achieved with a few passes by rollers operating in the static mode.

4.5.1 Temperature Requirements

According to the Special Provisions for RAC-G, when atmospheric and pavement surface temperatures are less than 64°F (18°C), breakdown compaction must be completed before the mat temperature drops below 260°F (127°C). For site temperatures $\geq 18^\circ\text{C}$ (64°F), breakdown compaction must be completed before the mat temperature drops below 250°F (121°C). ***It is strongly recommended that breakdown compaction of RAC-G should be completed before the temperature of the RAC mat drops below 280°F (138°C) in order to achieve adequate compaction.***

Mat temperature should be closely monitored during placement and compaction, and adjustments should be made as needed to speed up the compaction process. It may be necessary to add a second breakdown roller. Inability to perform breakdown rolling within the temperature range specified may be cause to terminate paving operations and reject loads. Also, vibratory rolling below the minimum breakdown rolling temperature should not be allowed, nor should vibratory rolling be permitted after static (finish) rolling.

4.5.2 Factors That Affect RAC and HMA Compaction

Compaction is affected by many factors including:

- Layer thickness,
- Air temperature,
- Pavement/ base temperature,
- Mix temperature,
- Wind velocity, and
- Sunlight or lack thereof.

Thin lifts, cool temperatures and wind reduce the time available for compaction because of temperature loss. Therefore, it is often easier to compact thick lifts (more than 2 inches (50 mm) thick) than thin ones. The rule of thumb is that the compacted thickness should be at least twice the maximum aggregate size, or three times the nominal maximum aggregate size. Otherwise, there may be problems with compaction due to a tendency for stones to stack and to catch under

the screed and be dragged through the mat. When stones stack, they tend to reorient with each paver pass, or to break.

When placing RAC mixtures, it is important for the breakdown roller to follow immediately behind the paver in order to achieve 95 percent of the required compaction during the vibratory breakdown while the mix is still hot. The number of vibratory coverage required may vary depending on the mix and site conditions during placement. The anticipated roller coverages may need to be adjusted based on temperature and wind conditions. Therefore, it is advisable to use two breakdown rollers to keep up with the paver and to obtain sufficient compaction. Intermediate rolling provides relatively little increase in density of RAC mixes.

4.5.3 Test Strips and Rolling Patterns

California Test Method 113 is required for pavements with thickness ≥ 60 mm (2.4 inches) to establish the engineer's approval of equipment and rolling pattern based on achieving a minimum of 95 percent compaction relative to the mix design bulk density. Since 60 mm is the upper limit of RAC thickness, CT 113 may not be required for most RAC pavements. However if CT 113 is used, the temperature ranges for the test must be modified for RAC-G. Test strips for thinner RAC lifts are recommended when feasible to indicate what level of compaction effort is needed to achieve adequate in-place density. During test strip compaction, both Contractor and agency representatives should correlate their respective nuclear gauge(s) on the test strip according to CT 375. Gauge data should then be correlated with core results in order for nuclear density to provide accurate data for quality control during paving.

A Paving Check List is included in Appendix A. This handout should be delivered to the contractor for distribution to all members of the construction staff as well as to the Inspector.

4.5.4 Opening New RAC Pavement to Traffic

4.5.4.1 Sand Blotter: RAC mixes are relatively binder-rich and the surface may be tacky until the new mat has a chance to cure. To prevent tracking and pickup of the newly placed mat upon opening to traffic, a light dusting of clean sand may be spread on the surface of RAC pavement at a rate of about 2 to 4 pounds per square yard to act as a blotter. However applying sand does not cool the pavement. Sand shall be free from clay or organic material. Excess sand shall be removed from the pavement surface by sweeping.

4.5.4.2 Water: In order to open to traffic according to schedule, it may be necessary to cool the new RAC pavement with water. If environmental regulations allow it, application of water shall conform to the provisions in Section 17, "Watering" of the Standard Specifications. If environmental regulations allow, a dilute solution of lime water consisting of a minimum of 50 pounds of hydrated lime per 3,000 gallons of water, may be sprayed on the pavement surface to cool the mat and stiffen the exposed surface of the asphalt rubber binder.

4.6 CHIP SEAL CONSTRUCTION

Chip seals are surface treatments that are extremely sensitive to the effects of construction operations and site conditions, including temperature (ambient air temperature and temperatures

of the cover aggregates, and underlying pavement). There are only minor practical differences in construction of conventional hot chip seals versus asphalt rubber chip seals. The primary difference is that the asphalt rubber membrane is thicker and chips must be large enough so as not to be “swallowed” by the membrane. The other is that the distributor nozzles may have a greater tendency to clog due to the presence of discrete rubber particles. This is addressed by appropriate nozzle sizing.

Temperature is critical to successful chip seal construction whether the binder is conventional paving grade asphalt or high viscosity asphalt rubber. Clean or precoated chips are also critical and, for use with ARB, are required to be hot (260 to 325°F). Embedment and adhesion of the chips must be accomplished by rolling while the asphalt rubber membrane is still hot. Caltrans guidance indicates that the higher temperatures of the asphalt rubber binder and use of hot precoated chips allow placement of asphalt rubber chip seal at cooler temperatures than emulsion binders and at night. However is not advisable to place chip seals when ambient or pavement temperature is less than 60°. Such cool conditions leave little margin for variability in materials, application or site temperature conditions. A reasonable production rate is about 5 to 7 lane miles per day.

4.6.1 Chip Seal Equipment

The equipment required to place a chip seal includes:

- Distributor truck with fume catcher to spray apply asphalt rubber membrane.
- Chip Spreader.
- Haul trucks for chips.
- Roller(s): Because the surface of the chip seal is the cover aggregate, rubber tired rollers may be used to embed the aggregate and are recommended for their kneading action. Steel wheeled rollers may also be used, but may not be as effective for embedding the aggregate.
- Hand tools (broom, shovels, etc.)
- Power broom.
- Distributor truck to apply a flush coat (typically diluted emulsion) -not required for SAMI-R.

4.6.2 Asphalt Rubber Spray Application

The distributor must be properly adjusted and operated to apply the proper amount of asphalt rubber binder uniformly over the surface. As for the tack coat, fanning and overlap is necessary to apply the membrane. The nozzle (snivy) size, spacing, and angle in relation to the spray bar help determine the height of the bar. Streaking may occur if the asphalt rubber binder is too cold, when its viscosity is too high, or the spray bar too low. The person who monitors the application for uniformity and nozzle problems is protected from fumes by a pollution hood over the spray bar. Application rate according to Caltrans special provisions is 0.6 to 0.7 gallons per square yard (2.5 to 3.0 l/m²) and the Resident Engineer determines the exact rate.

Each spray application should start and end on paper (tar paper or roofing felt if possible) to ensure uniformity for the entire application. The application width should be adjusted so that the longitudinal joint (meet-line) is not in the wheel path, but on the centerline or in the center or edge of the driving lanes. After each application, the distance, the width, and the amount of asphalt rubber should be determined to verify the application rate.

4.6.3 Chip Application

The hot pre-coated chips should be applied immediately behind the asphalt rubber binder spray; the chip spreader should follow at a maximum distance of about 65 to 100 feet (20 to 30 meters). The asphalt rubber binder must be fluid so the rock will be embedded by the displacement of the asphalt, preferably to 50 to 70 percent embedment. Embedment should be checked after start up and application rates adjusted as necessary. A chip seal train consisting of binder distributor truck, chip spreader, and roller is shown in Figure 4-2.



Figure 4-2 Chip Seal Train

The standard chip application rate is about 28 to 44 pounds per square yard (15 to 22 kg/m²) with the exact rate to be determined by the Engineer. Trucks should back into the spreader box and should not cross over any exposed asphalt rubber membrane. This is illustrated in Figure 4-3; the chip spreader is in the foreground of the photo, and the raised bed of the haul truck can be seen behind the spreader. The speeds and loads of the trucks hauling the chips should be regulated to prevent damage to the new seal. They should turn as little as possible on the new seal.

The chip spreader should be operated at a speed that will prevent the cover aggregate from being rolled as it is being applied. The aggregate supply should be controlled to assure a uniform distribution across the entire box. If an excess of aggregate is spread in some areas, it should be distributed on the adjacent roadway surface or picked up. Excess application usually interferes with embedment and adhesion and may lead to future problems with chip loss. Areas that do not get enough aggregate cover (about 85 percent of the total membrane area is a reasonable target) should be covered with additional aggregate (normally by hand), but problems with adhesion may occur, because by then the asphalt rubber has cooled.



Figure 4-3 Spreading Precoated Aggregates

Loose stones along the roadway edge after sweeping may indicate excessive chip application and wasted stone, that the asphalt rubber application is too light, or that the binder cooled before embedment and adhesion were achieved. Excess asphalt rubber application can literally submerge or swallow the chips, and results in flushing/bleeding.

4.6.4 Rolling Asphalt Rubber Chip Seals

Pneumatic rollers are normally used for rolling chip seals because the kneading action of the rubber tires promotes embedment. The tires do not bridge across surface irregularities and depressions, as do steel drums.

Skirts around the tires can help maintain elevated tire temperature to aid compaction and minimize any pickup. Rolling of a chip seal is done to orient and embed the rock (get the flat sides down). Rollers should be operated at slow speeds of 4 to 6 mph (6 to 10 kph) so that the rock is set, not displaced. The number of rollers required depends on the speed of operation, as it takes 2 to 4 passes of the roller to set the rock (Figure 4-4).



Figure 4-4 Rubber-Tired Rollers with Skirts on Chip Seal

4.6.5 Sweeping

Sweeping (brooming) is done at the completion of chip sealing to remove surplus aggregate from the surface of the new chip seal to minimize flying rocks. Sweeping can be done shortly after chip application, usually within 30 minutes. It is desirable to sweep during the cool period of the day using a rotary power broom (Figure 4-5).



Figure 4-5 Sweeping Chip Seal to Remove Loose Cover Aggregate

Figure 4-6 shows the surface of a finished asphalt rubber chip seal after sweeping, before application of flush coat and sand. For interlayers, no flush coat or sand is applied.

4.6.6 Flush Coat

The flush coat consists of an application of fog seal over the new asphalt rubber chip seal followed by a sand cover.



Figure 4-6 Finished Chip Seal Before Applying Fog Seal and Sand

4.6.6.1 Fog seals are applied over chip seals to help retain the cover aggregate and provide a more uniform appearance. Fog seals are not applied over SAMI-R because it will be covered with an overlay. Fog seals typically consist of grade CSS-1, CSS-1h, or CQS-1 asphalt emulsion diluted with 50 percent added water. The standard application rate over asphalt rubber chip seals is 0.14 to 0.27 l/m² or as determined by the Engineer.

4.6.6.2 Sand cover is applied immediately after application of the fog seal to prevent pick up and tracking of the chip seal material by vehicle tires. The sand must be clean (free of clay fines or organic material). It is spread in a single application of 1 to 2 kg/m², or at a rate determined by the Engineer.

4.6.7 Traffic Control

Some form of traffic control is required to keep the initial traffic speed below about 25 mph (40 kph). Flag persons or signs help, but the most positive means is a pilot car. The primary purpose of the pilot car is to control the speed of the traffic through the project. This traffic will also supply some additional pneumatic tire rolling and kneading action.

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USEFUL ASPHALT RUBBER WEBSITES:

Caltrans home page < <http://www.dot.ca.gov/>>

Caltrans RAC Reports

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American Chemical Society Rubber Division <<http://www.rubber.org/index.htm>>

Asphalt Emulsion Manufacturers Association (AEMA) <<http://www.aema.org/>>

Asphalt Institute <<http://www.asphaltinstitute.org/>>

Asphalt Recycling & Reclaiming Association <<http://www.ara.org/>>

Asphalt Rubber Technology Service <<http://www.ces.clemson.edu/arts/index.html>>

California Integrated Waste Management Board <<http://www.ciwmb.ca.gov/>>

Federal Highway Administration <<http://www.tfhrc.gov/pubrds/spring97/crum.htm>>

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Federal Highway Administration <<http://www.fhwa.dot.gov/pavement/topics.cfm>>

National Asphalt Pavement Association (NAPA) <<http://www.hotmix.org/>>

National Center for Asphalt Technology (NCAT) <<http://www.eng.auburn.edu/center/ncat/>>

Rubberized Asphalt Concrete Technology Center <<http://www.rubberizedasphalt.org/>>

The Rubber Pavement Association <<http://www.rubberpavements.org/>>

APPENDIX A

Checklists

CHECKLIST OF MATERIALS SUBMITTALS

I. BINDER

A. Binder Formulation

- 1) Paving Asphalt and Modifiers - % of Total Binder
 - a) % Asphalt of Paving Asphalt
 - b) % Extender Oil of Paving Asphalt
- 2) Crumb Rubber Modifier (CRM) - % of Total Binder
 - a) % Scrap tire rubber of total rubber
 - b) % Natural rubber of total rubber, based on
 - i) Specification, and
 - ii) Chemical Analysis of natural rubber

B. Rubber Test Documentation

- 1) Chemical analysis of natural rubber
- 2) Chemical analysis of scrap tire rubber
- 3) Fiber content for both types
- 4) Gradations of tire rubber
- 5) Gradations of natural rubber

C. Certification of Compliance/Specific Product and Project

- 1) Asphalt Cement incl. Source and Grade
- 2) Extender Oil incl. Source and Type ID
- 3) Scrap Tire Rubber including Source and Type ID
- 4) Natural Rubber including Source and Type ID

D. Rubber Samples (Needed for matching with materials at plant)

- 1) Scrap Tire rubber
- 2) Natural rubber

E. Asphalt Rubber Binder 24-Hour Design Profile & Test Results

- 1) Penetration
- 2) Resilience
- 3) Softening Point
- 4) Viscosity

F. Two binder samples

II. AGGREGATE

- A. LA Rattler
- B. Crushed Faces
- C. Sand Equivalent*
- D. K_c and K_f *

III. MIX DESIGN

- A. Target gradations within specification
- B. Binder content vs. air voids plot (Form TL-306)*
- D. Selected binder content (corresponding to specified air voids)
- E. Show recommended range (+0%/-0.3%)*
- G. Stabilometer value*
- H. VMA*
- I. Target Gradations for specified sieves
- J. Bin percentages and sieve analyses for each

* Not applicable to chip seals.

CHECKLIST FOR PAVING AND CHIP SEALS

I. HOT MIX

A. Pre-Spread

1. Functional heater element for hot asphalt tack.
2. Uniform application of tack, at agreed rate of _____.
- C. Joints at proper locations (traffic lane lines or clear of wheel paths in center of lane).
- D. Proper thickness at 0" grind point (screed break at grade break).

B. Compaction Equipment (Steel drum)

1. Vibratory roller for (breakdown) and another vibratory for backup
2. Intermediate roller of the same or greater width than the breakdown roller
3. Finish roller

C. Compaction Process

4. No vibratory mode when mat temperature is below 121°C (250° F)
5. Intermediate roller operating at all times during paving?

D. Post Compaction

1. Sand cover is required, but cannot be applied until compaction is complete except as authorized by Caltrans in special circumstances.

II. CHIP SEALS

A. Pre-Spread

1. Pavement is clean and dry.
2. Pavement temperature in shade above 13° C (55°)
3. Air temperature above 16°C (60°).
4. Hot asphalt coated rocks on site
5. Nominal size chip size 9.5 mm (3/8") or 12.5 mm (1/2")
6. Trucks lock onto hitch of aggregate spreader
7. 3 rubber tire rollers (two if equivalent coverage), all functional
8. One functional 8-10 ton steel wheel roller
9. Sweeper functional
10. Joints are positioned to avoid wheel paths

B. Spread

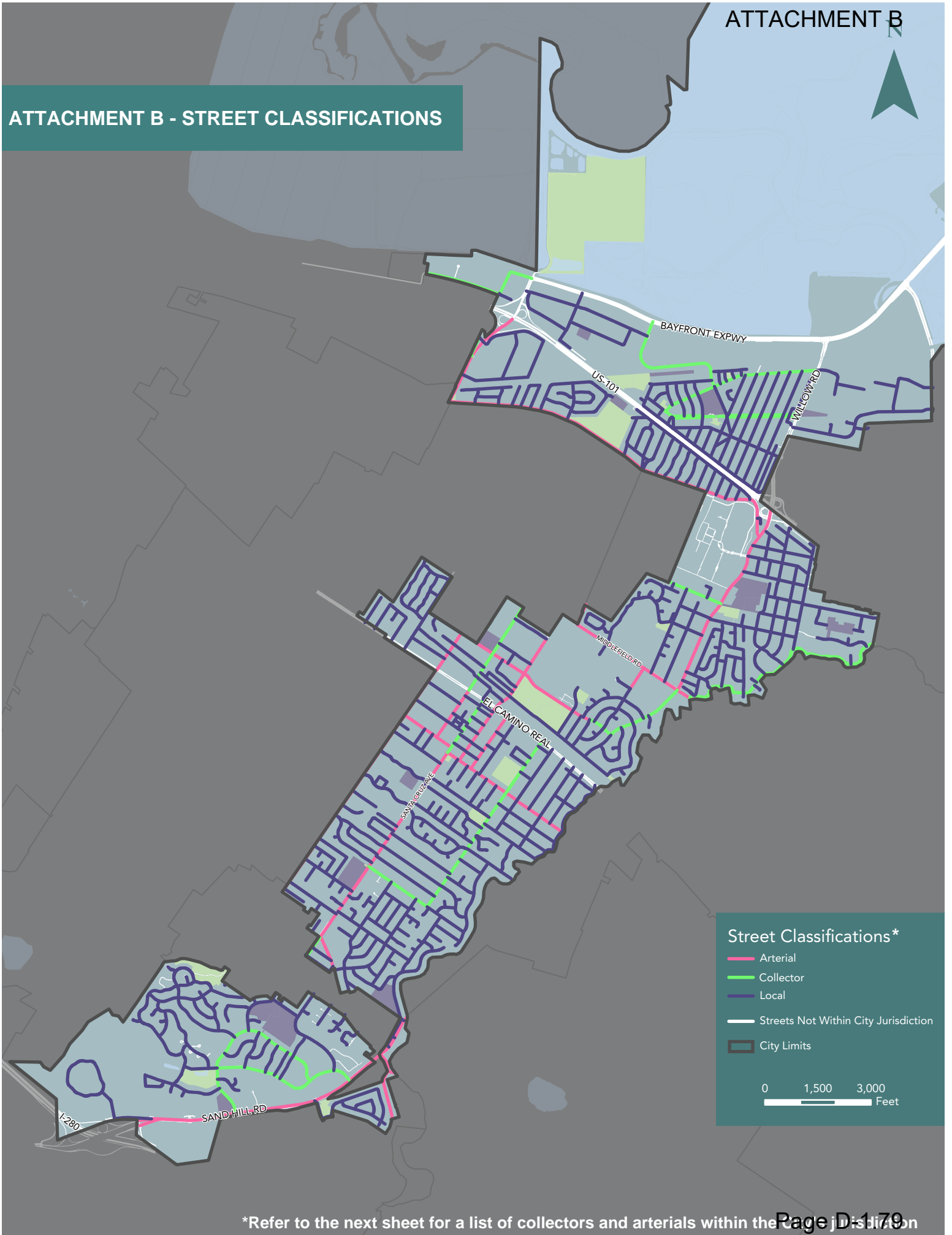
1. Binder application temperature
2. Binder application rate
3. Chip spreader following immediately behind (20-30 m) distributor truck
4. Chip application rate
5. Lead roller follows immediately behind (20-30 m) chip spreader
6. Number of coverage's by rubber tire rollers
7. Joints thoroughly swept 150 mm (6") from edge prior to overlapping application
8. Overlapping nozzle angled to cut back application rate at joints
9. Overlap at longitudinal joints, 102 mm (4") maximum

C. Post-Spread

1. Sweep loose aggregate

**Falling out of compliance with these parameters will be cause to halt paving operations until reconciled.*

ATTACHMENT B - STREET CLASSIFICATIONS



SUMMARY OF CITY STREET CLASSIFICATIONS

STREETSAYER CLASSIFICATION	STREET NAME
COLLECTORS	AVY AVENUE
	CHILCO STREET
	COLEMAN AVENUE
	HAMILTON AVENUE
	HAVEN AVENUE
	IVY DRIVE
	LAUREL STREET
	MARSH ROAD (PARTIAL)
	MARKET PLACE
	MIDDLE AVENUE
	MONTE ROSA DRIVE
	OAK GROVE AVENUE (PARTIAL)
	OLIVE STREET
	SANTA CRUZ AVENUE (PARTIAL)
	SHARON PARK DRIVE
	WILLOW ROAD (PARTIAL)
WOODLAND AVENUE	

ARTERIALS	ALPINE ROAD
	BAY ROAD
	GLENWOOD AVENUE
	JUNIPERO SERRA BOULEVARD (PARTIAL)
	LAUREL STREET
	LINFIELD DRIVE
	LIVE OAK AVENUE
	MARSH ROAD (PARTIAL)
	MENLO AVENUE
	MIDDLEFIELD ROAD
	OAK GROVE AVENUE (PARTIAL)
	RAVENSWOOD AVENUE
	RINGWOOD AVENUE
	SAND HILL ROAD
	SANTA CRUZ AVENUE (PARTIAL)
	UNIVERSITY DRIVE
VALPARAISO AVENUE	
WILLOW ROAD (PARTIAL)	

NOTE: THIS LIST EXCLUDES STREET SEGMENTS NOT WITHIN THE CITY'S JURISDICTION.



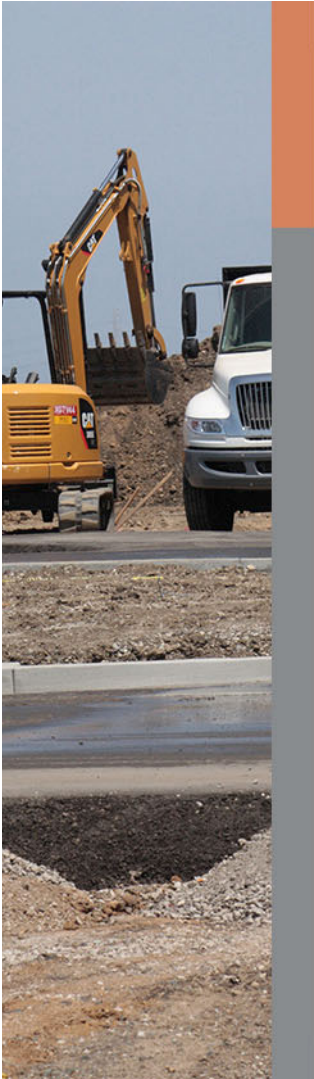
**CITY PAVING PROGRAM AND USE OF
RUBBERIZED VERSUS HOT MIX ASPHALT**



PRESENTATION OUTLINE

- Recommendation
- City paving program outline
- Rubberized versus Hot Mix Asphalt
- Conclusion and Action
- Questions

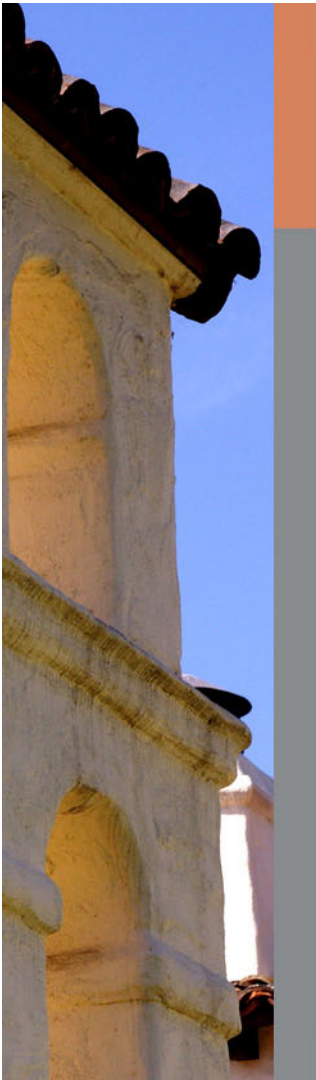




RECOMMENDATION

- Provide direction on use of Rubberized Asphalt Concrete (RAC) versus Hot Mix Asphalt (HMA) for future street resurfacing projects in the Capital Improvement Plan (CIP).

- Future CIP projects meeting the following criteria are recommended to procure a bid alternate for RAC:
 - Streets employing a 1.2 to 2.4 inch overlay
 - Collector or arterial streets
 - Resurfacing projects awarded in a timeframe to ensure peak of summer construction (May to August)

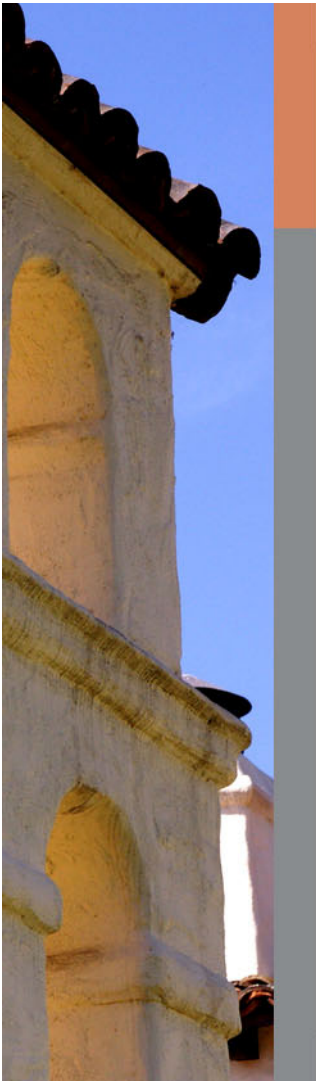


CITY PAVING PROGRAM

- 96.3 centerline miles (over 15M square feet of paving surface)
- Pavement asset valued at ~\$353M (replacement cost)
- Asset management software StreetSaver used to catalogue pavement network. Endorsed by Metropolitan Transportation Commission (MTC).
- Public Works utilizes StreetSaver to evaluate and propose CIP projects based on cost and pavement condition index (PCI). The PCI ranges street conditions from 0 (failed) to 100 (excellent) and an inventory of pavement conditions is updated every two years.

PCI Classification

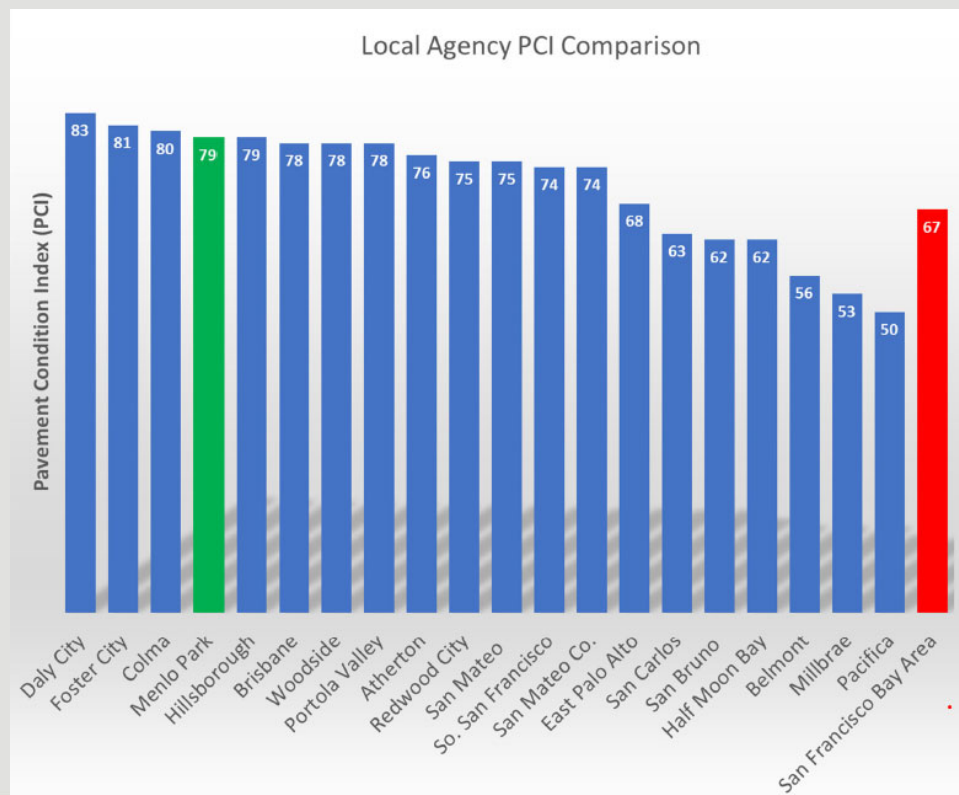
PCI Rating	Street Condition
70-100	Good to Excellent
50-70	At Risk to Fair
25-50	Poor
50-100	Failed to Very Poor

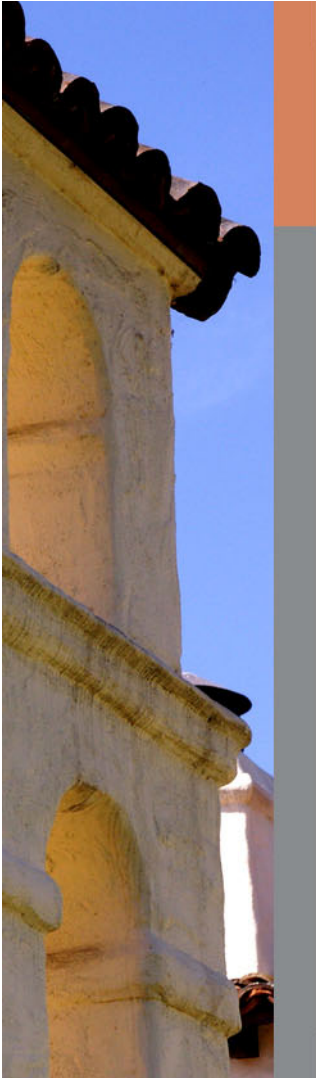


CITY PAVING PROGRAM OUTLINE



- Menlo Park's latest PCI is 79 (Good) and ranks fourth out of twenty local agencies referenced in the 2020 - 2021 Pavement Management Report.



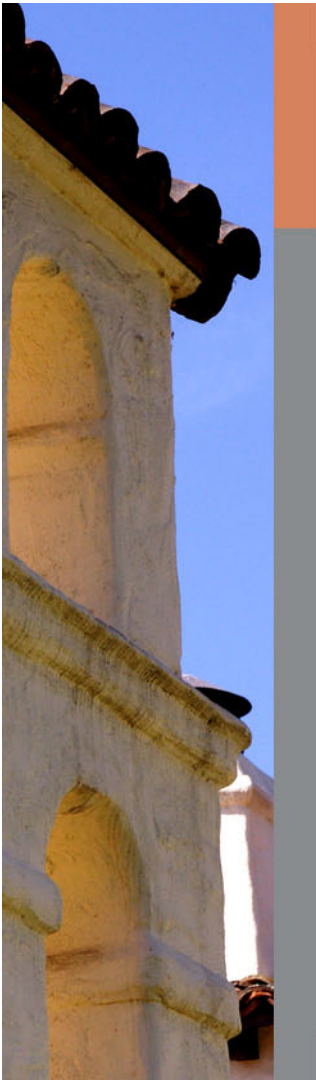


CITY PAVING PROGRAM

- Higher PCI streets utilize **preventative maintenance** (e.g. thin overlay or slurry seals).
- Lower PCI streets require **rehabilitation** (e.g. deep overlays or full reconstruction). Costs increase exponentially as PCI decreases.
- Investing in preventative maintenance maximizes cost efficiency and street lifespan. Public Works manages and maintains the City's PCI and alternates between overlay and slurry seal projects each year.

PCI Repair Scenarios

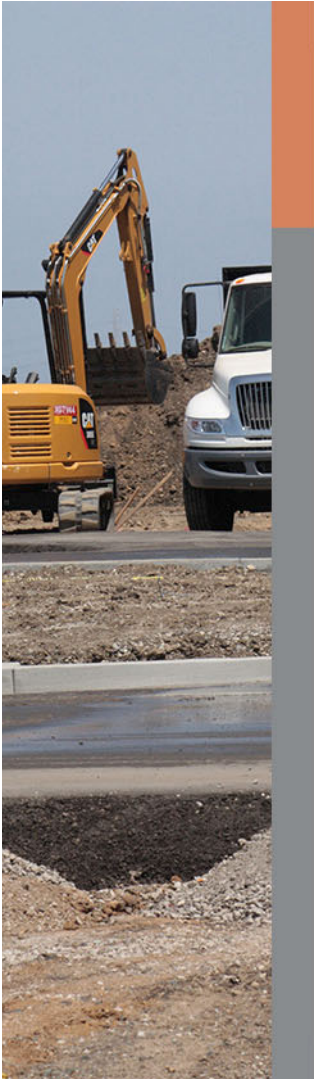
PCI Rating	Repair Type	Anticipated Unit Cost (Square Yard)
86 to 100	Preventative Maintenance (Slurry Seal)	\$5
56 to 85	Thin Overlay (1"-3" depth)	\$30
40 to 55	Thick Overlay (3" or greater)	\$50
0 to 25	Heavy rehabilitation (Reconstruction)	\$200



RUBBERIZED VERSUS HOT MIX ASPHALT

- On April 21, 2020, the City Council requested a feasibility study for RAC on future CIP projects in lieu of HMA. A comparison of both materials is described below:

Design criteria	RAC	HMA
Material Composition	Recycled tires	Mostly virgin
Typical Unit Cost (≤ 5,000 Tons)	\$264 per ton	\$187 per ton
Recommended Overlay Depth	1.2 to 2.4 inches	1 to 12 inches
Noise Reduction Benefit	Over 45 mph	-
Cracking and Skid Resistance	Higher than HMA	-
Construction criteria	RAC	HMA
Minimum Air Temperature	60° F	50° F
On-site Plant Mixer	Required	Not required
Gas (Rubber) Odor	Yes	No
Maintenance criteria	RAC	HMA
Expected Lifespan	20 years	15 years
Spot Repairs or Utility Upgrades	HMA backfill	HMA backfill



RUBBERIZED VERSUS HOT MIX ASPHALT



- Benefits of RAC to HMA:
 - Is comprised of recycled tires and more environmentally friendly
 - Longer estimated lifespan (20 years compared to 15 years for HMA)
 - Retains color and offers greater skid resistance during rain events
 - Provides noise abatement (most notable at speeds 45 mph or greater)

- Limitations of RAC to HMA:
 - Higher construction costs (up to 40% higher with contingencies)
 - Higher construction standards and limited summer schedule
 - Most cost effective as a thin overlay between 1.2 to 2.4 inches
 - Potential odor during construction
 - Longer lifespan offset by maintenance better suited for HMA backfill



RUBBERIZED VERSUS HOT MIX ASPHALT



- RAC and HMA Life Cycle Cost Study
 - Performed City-wide using StreetSaver roadway classifications (local, collector, and arterial).
 - Construction cost averaged over lifespan of each material to estimate annual costs. Includes contingencies.
- Life Cycle Cost summary:
 - Total construction costs:
 - RAC is approximately 40% higher
 - RAC: \$49,800,000
 - HMA: \$35,310,000
 - Total annual costs:
 - RAC is approximately 6% higher
 - RAC: \$2,490,000 per year
 - HMA: \$2,354,000 per year

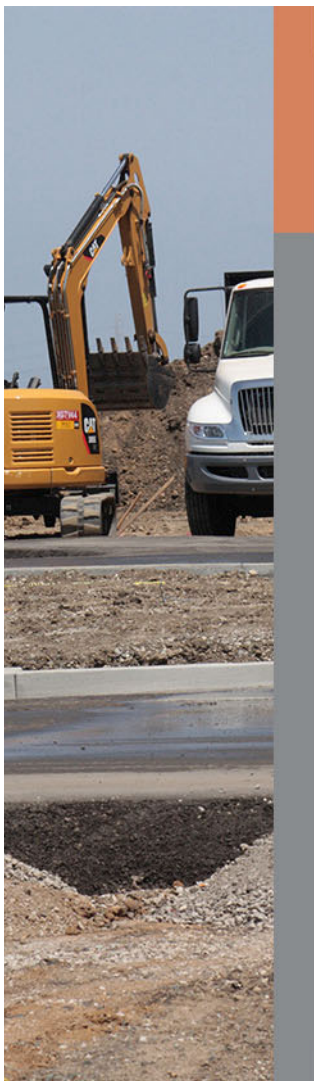




CONCLUSION AND ACTION

- RAC is not best suited for:
 - Streets requiring repairs over 2.4 inches deep
 - Projects with restricted funding or budgeting resources
 - Projects with anticipated construction beyond summer months (May to August)
 - Local streets (due to odor, limited noise reduction, and slurry maintenance)

- RAC best suited for:
 - Projects employing thin overlays (1.2 to 2.4 inches)
 - Projects with summer construction schedule (May to August)
 - Streets under collectors or arterials classification

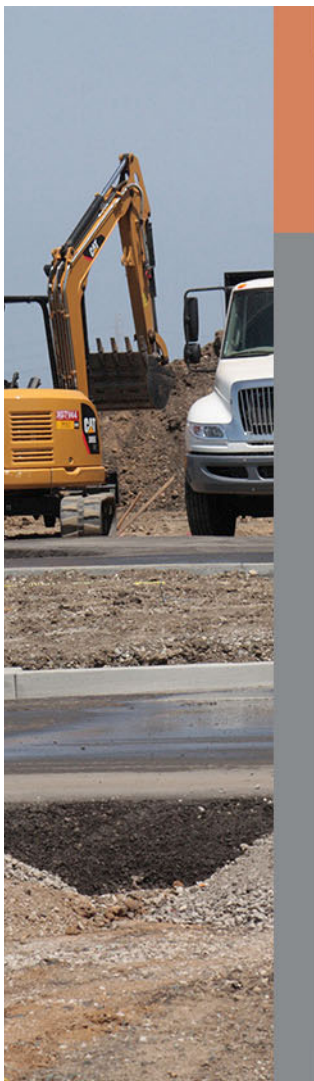




CONCLUSION AND ACTION

- Staff Recommendation:
 - Provide direction on use of RAC versus HMA on future CIP resurfacing projects.

 - Future projects meeting the following criteria are recommendation to procure a bid alternate for RAC:
 - Streets incorporating a 1.2 to 2.4 inch overlay
 - Collector or arterial streets
 - Resurfacing projects awarded in a timeframe to ensure peak of summer construction (May to August)





QUESTIONS?

- We appreciate your consideration





THANK YOU

ARRIENGA FAMILY
GYMNASIUM



STAFF REPORT

City Council

Meeting Date:

4/20/2021

Staff Report Number:

21-084-CC

Study Session:

ConnectMenlo community amenities

Recommendation

City staff recommends the City Council receive recommendations from the City Council's ad hoc subcommittee on ConnectMenlo community amenities (Subcommittee) along with a preliminary analysis from the city attorney's office. Upon receipt of the reports and following public comment, City staff recommends that City Council identify which, if any, of the Subcommittee recommendations City Council desires to explore further and direct City staff to return with the following:

1. Draft ordinances, resolutions, and administrative policies required to implement any or all of the options discussed in Attachment B.
2. Recommendations on a public engagement plan including input from the Planning Commission and/or other advisory bodies.

Additionally, City staff recommends City Council direct the priority of work relative to other City Council work plan items.

Policy Issues

City Council adopted Resolution No. 6360 establishes the community amenities list developed through the ConnectMenlo process. Revising Resolution No. 6360 requires City Council action.

Background

On October 6, 2020, City Council received a recommendation from City Councilmember Taylor (Mayor at the time) and Vice Mayor Nash (City Councilmember at the time) to form a City Council ad hoc subcommittee on Subcommittee to review the community amenities list and to suggest revisions to the list for consideration by the City Council at a future date. That same evening, City Council formed the Subcommittee with the following charge: 1) to update the adopted community amenities list to more appropriately serve existing and future residents, 2) to inventory existing, proposed and potential citywide development (amount and type) and 3) to maintain the amenities list data. Staff in the city manager's office was assigned to work with the subcommittee.

Analysis

The City currently is reviewing 10 bonus level development projects in the Bayfront Area, and each requires the contribution of community amenities. The proposed developments could add approximately 3,200 residential units, 1.2 million square feet of office, life science and commercial uses, and 350 hotel rooms. The proposed projects are currently selecting community amenities from the 2016 adopted list, and the proposals include a range of items, including additional affordable housing, office space and funding for a community land trust for the development and preservation of affordable housing, a child care center,

restaurant, and job training and scholarships.

Attachment A transmits the Subcommittee's recommendations to revise the ConnectMenlo community amenities list, implement the in lieu fee envisioned in ConnectMenlo, and establish greater clarity over the community amenities process. The Subcommittee is not recommending a revision to the valuation methodology for community amenities. Attachment B transmits a memorandum from the city attorney's office outlining considerations pertaining to ConnectMenlo community amenities.

Impact on City Resources

City staff have not quantified the impacts of the recommendations pending City Council direction on scope and prioritization.

Environmental Review

This action is not a project within the meaning of the California Environmental Quality Act (CEQA) Guidelines §§ 15378 and 15061(b)(3) as it will not result in any direct or indirect physical change in the environment.

Public Notice

Public notification was achieved by posting the agenda, with the agenda items being listed, at least 72 hours prior to the meeting.

Attachments

- A. Subcommittee recommendation
- B. Memo from city attorney's office: "Community amenities options"

Report prepared by:
Nick Pegueros, Assistant City Manager

Council Community Amenities Subcommittee report #1

The Community Amenities list is outdated and includes amenities no longer desired by the community for a variety of reasons, which are detailed below. Currently eleven Bayfront development projects are under review by the Community Development department. Projects requesting bonus level development are required to provide a community amenity from the adopted community amenities list. Accordingly, it is critical that the list be updated. An in-lieu fee (originally called an impact fee) was envisioned but never implemented, so it is important to adopt an in-lieu fee now to provide another way for developers proposing bonus level projects in the Bayfront area to fulfill their obligation under Resolution 6360 (attachment A).

Recommendations

1. Adopt a **revised community amenities list** for all projects other than currently submitted SB 330 projects. This list will be further updated after broader community outreach to determine additional specific community amenities are desired by the community.
2. Adopt an **in-lieu fee** for all bonus level development projects.
 - Funds will be held in an independent special fund specifically to benefit the local impacted Belle Haven community, which has been most directly impacted by Bayfront development.
 - Guidelines for uses of in-lieu fund to be determined.
3. For non-residential projects and residential projects not subject to SB 330, adopt a **'gatekeeper' application process** that requires Council approval of amenities before an applicant may submit proceed with a development application proposing bonus development levels.
4. Establish a **Community Amenities Working Group** to provide Council with early input for the 'gatekeeper' process.
 - Composition: 5 - 7 community members residing in the Bayfront District 1 area, primarily from the Belle Haven neighborhood. Additional attributes to be determined.
 - Appointed by to be determined.
 - Length of term to be determined.

BackgroundSubcommittee creation and charge

The City Council established the Community Amenities Subcommittee (Councilmember Cecilia Taylor and Vice Mayor Betsy Nash) on October 6, 2020 and charged it with: "1) updating the adopted amenities list to more appropriately serve existing and future residents; 2) inventorying existing, proposed and potential citywide development (amount and type); and 3) maintain the amenities list data."

Council Community Amenities Subcommittee report #1

Subcommittee work

The subcommittee reviewed the current community amenities list (resolution 6360) to determine which of the approved amenities:

- (1) primarily benefit the impacted Menlo Park neighborhood of Belle Haven in District 1,
- (2) have not been provided in the Menlo Park Community Campus project or in an existing development agreement,
- (3) are typically not provided by the city, county, school district, a nonprofit, or other group, or
- (4) are desired to be expedited faster than the typically schedule provided by the city, county, school district, a nonprofit, or other group.

Six amenities on the resolution 6360 list meet the criteria above and were retained in the revised community amenity list (attachment B):

- Grocery store
- Restaurant
- Pharmacy
- Urgent Care Center
- Underground power lines
- Soundwalls adjacent to Highway 101.

In an outreach meeting with a group of community members, the consensus was that qualifying amenities be physically located in Belle Haven, to directly benefit the impacted community. Community members had suggestions on other amenities, most notably improving the neighborhood appearance.

The subcommittee determined that a new process is needed to provide earlier Council input in selecting community amenities for bonus level development projects. The subcommittee chose from alternative processes proposed by City Attorney Nira Doherty and Deputy City Manager Justin Murphy.

To avoid further delay, given the number of development projects currently under review, the subcommittee recommends promptly approving the revised community amenities. Once this list is adopted, outreach should be made to the Belle Haven community and the list further revised if needed.

The in-lieu fee is recommended as a supplement for the amenities list, to provide another way for developers proposing bonus level development to fulfill their obligation under Resolution 6360.

Council Community Amenities Subcommittee report #1

Attachments

A. Hyperlink - Resolution No. 6360 - Resolution of the City Council of the City of Menlo Park approving the community amenities list developed through the ConnectMenlo process.

<https://www.menlopark.org/DocumentCenter/View/15009/6360---Community-Amenities?bidId=>

B. 2021 Proposed Community Amenities List Revisions

2021 PROPOSED Community Amenity List REVISIONS

Amenities are to be located in the impacted community, unless otherwise approved in writing.



REVIEW THE PROPOSED COMMUNITY AMENITIES in resolution 6360, adopted 11-29-2016

The amenities described below were identified during the Belle Haven Vision Plan and during the first year of the ConnectMenlo process. They were ranked in this order in a survey in March/April, 2015. Approximate cost estimates have been added for each amenity.

Transit and Transportation Improvements	Jobs and Training at M-2 Area Companies	Social Service Improvements
<p>A. Sidewalks, lighting, and landscaping – \$100 per linear foot Enhance landscaping and lighting and fill gaps in sidewalk to improve the overall walkability</p>	<p>A. Job opportunities for residents – \$10,000 in specialized training per employee Local employers have a hiring preference for qualified residents</p>	<p>A. Education improvements in Belle Haven – \$10,000 per student Improvements to the quality of student education and experience in Belle Haven</p>
<p>B. Traffic-calming on neighborhood streets – \$100,000 per block/intersection Address cut-through traffic with design features</p>	<p>B. Education and enrichment programs for young adults – \$10,000 per participant Provide programs that target students and young adults to be competitive in the job market, including existing tech jobs</p>	<p>B. Medical center – \$6 million to construct (\$300 per square foot) Medical center providing health care services and outpatient care revised to URGENT CARE CENTER</p>
<p>C. Bike trails, paths or lanes – \$100,000/mile Install new bike lanes and pedestrian paths and connect them to existing facilities and BayTrail</p>	<p>C. Job training programs and education center – \$10,000 per participant Provide residents with job training programs that prepare them with job skills</p>	<p>C. Library improvements at Belle Haven – \$300,000 Expand library programs and activities, especially for children</p>
<p>D. Dumbarton Rail – \$17.5 million to construct and open trolley Utilize the right-of-way for new transit line between Redwood City and Menlo Park in the near term with stations and a new bike/pedestrian path</p>	<p>D. Paid internships and scholarships for young adults – \$10,000 per participant Provide internships at local companies and scholarships to local youth to become trained for tech jobs</p>	<p>D. High-Quality Affordable Housing – \$440,000/unit less land. \$82,000 typical per-unit local gap financing needed for a tax-credit project Integrate quality affordable housing units into new development</p>
<p>E. Innovative transportation solutions (i.e. personal rapid transit) – Price varies Invest in new technology like pod cars and transit that uses separate tracks</p>	<p>E. Senior service improvements – \$100,000 per year Increase the senior services at the Senior Center to include more aides and programs</p>	<p>E. Add restroom at Onetta Harris Community Center – \$100,000 Additional restroom at the community center</p>
<p>F. Bus service and amenities – \$5,000 per rider-seat Increase the number of bus stops, bus frequency and shuttles, and bus shelters</p>	<p>F. Incentives for private home energy upgrades, renewable energy, and water conservation – \$5,000 per home Offer financial assistance or other incentives to help area residents pay for energy-efficient and water conserving home improvements</p>	<p>F. Pool House remodel in Belle Haven – \$300,000 Remodel pool for year-round use with new heating and changing areas</p>
<p>Community-serving Retail</p> <p>A. Grocery store – \$15 million to construct (\$200 per sq ft) plus 25% soft costs, financing, etc. \$3.7 million for 2 years of subsidized rent A full-service grocery store providing a range of goods, including fresh fruits, vegetables and meat and dairy products</p>	<p>G. Telecommunications investment – \$250 per linear foot Improve the area's access to wifi, broadband, and other new technologies</p>	<p>G. Community garden(s) – \$26,000 to construct – 0.3 acres, 25 beds, 2 picnic tables Expand space for community to plant their own produce and flower gardens</p>
<p>B. Restaurants – \$1.5 million (3,000 sq ft. at \$400 per sq ft. plus 25% for soft costs, financing, etc.) A range of dining options, from cafes to sit-down restaurants, serving residents and local employees</p>	<p>D. Soundwalls adjacent to Highway 101 – \$300,000 (\$600/foot) Construct soundwalls between Highway 101 and Kelly Park to reduce sound</p>	<p>D. Dog park – \$200,000 for 0.5 acre (no land cost included) Provide a dedicated, enclosed place where dogs can run</p>
<p>C. Pharmacy – \$3.75 million (15,000 sq ft. at \$200 per sq ft. plus 25% for soft costs, financing, etc.) A full-service pharmacy that fills prescriptions and offers convenience goods</p>	<p>A. Underground power lines – \$200/foot, min., \$50,000/project Remove overhead power lines and install them underground along certain roads</p>	<p>A. Tree planting – \$10,000 per acre Plant trees along streets and parks to increase tree canopy</p>
<p>D. Bank/ATM – \$1.88 million (3,000 sq ft. at \$500 per sq ft. plus 25% for soft costs, financing, etc.) A bank or credit union branch with an ATM</p>	<p>B. Paid internships and scholarships for young adults – \$10,000 per participant Provide internships at local companies and scholarships to local youth to become trained for tech jobs</p>	<p>B. Bedwell Bayfront Park improvements – \$300,000 Improve access to the park and trails within it</p>
<p>These amenities will REMAIN on the approved Community Amenities list.</p> <p>These amenities will be REMOVED from the Community Amenities list unless the community decides to expedite it (and approved in writing).</p>	<p>B. Incentives for private home energy upgrades, renewable energy, and water conservation – \$5,000 per home Offer financial assistance or other incentives to help area residents pay for energy-efficient and water conserving home improvements</p>	<p>C. Community garden(s) – \$26,000 to construct – 0.3 acres, 25 beds, 2 picnic tables Expand space for community to plant their own produce and flower gardens</p>



MEMORANDUM

Date: 4/15/2021
To: Mayor Combs and Members of the City Council
From: Nira Doherty, City Attorney
Re: Community amenities options

The following summary details various options regarding the community amenities policies and procedures including revisions to the community amenities list, providing developers the option to pay a fee instead of developing a community amenity, memorializing a community amenity approval process and clarifying the City's discretion in approving community amenities. As explained further below, some options may only be applicable to certain types of projects due to limitations imposed by State law, namely SB 330, the Housing Crisis Act (2019).

SB 330 allows a housing developer to submit a "preliminary application" to a local agency for a housing development project.¹ The preliminary application process is voluntary, but if a housing developer submits a preliminary application the City must "freeze" the applicable fees and development standards that apply to the subject project.² Going forward, unless an exception occurs, the project is only subject to the "ordinances, policies, and standards" in place at the time the preliminary application was submitted.³ "Ordinances, policies, and standards" are defined broadly, and include all of the City's general plan, precise plan, zoning, design review standards and criteria, subdivision standards and criteria, and "any other rules, regulations, requirements, and policies."⁴ "Ordinances, policies and standards" would include the community amenities list itself as well as any procedures and policies regarding the review and approval of community amenities. Therefore, once an applicant has submitted a preliminary application under SB 330, the applicant vests the then current version of the community amenities list and/or any procedures for review and approval of community amenities.

The community amenities policies reviewed and considered in providing the foregoing analysis are limited to those in Bayfront Zoning Districts (O (Office), L-S (Life Sciences), and R-MU (Residential, Mixed Use)) and codified at Menlo Park Municipal Code 16.43, 16.44, and 16.45. The Land Use Element references the community amenities contemplated in these sections of the Municipal Code in the Corporate Contribution Guiding Principle, Policies LU-4.4 (Community Amenities) and Program LU-4.C (Community Amenity Requirement).

¹ Gov. Code § 65941.1.
² § 65589.5(o).
³ § 65589.5(o)(1).
⁴ § 65589.5(o)(4).

1. Option 1: Revise Community Amenities List

The community amenities provisions of Title 16 provide the City Council the discretion to revise the community amenities list.⁵ Thus, the Council may add or eliminate certain amenities from the list at any time by adopting a resolution establishing a revised community amenities list. Additionally, the Council could add geographic limitations to the community amenities list including specifying that certain amenities must be built offsite, instead of onsite. The only current geographic specification is that all community amenities, except for affordable housing, shall be provided within the area between U.S. Highway 101 and the San Francisco Bay in the city of Menlo Park. Affordable housing may be located anywhere housing is allowed in the city of Menlo Park.

As explained in greater detail above, a revised community amenities list would not apply to applicants for housing development projects that have already submitted preliminary applications.

2. Option 2: Adopt an Ordinance Establishing an In-Lieu Fee

The Community Amenities provisions in Title 16 permit applicants to comply with community amenities requirement by paying a fee. Specifically, the various community amenities provisions state,

“Payment of a fee. If the city adopts an impact fee that identifies a square foot fee for community amenities, an applicant for the bonus development shall pay one hundred twenty percent (120%) of the fee; provided, that the fee adopted by the city council is less than full cost recovery and not less than the total bonus value less the affordable housing amenity value as calculated pursuant to subsection (3) of this section.”

Currently, the City has not adopted a square foot fee for community amenities, so this option is not available to applicants. Should the City adopt a square foot fee for community amenities, such a fee would be an in-lieu fee and could be approved through adoption of an ordinance revising the above referenced sections to clearly state the amount of the in-lieu fee that applicants may elect to pay. To ensure that the fee requirement is clear and to reduce the need to continually revise or increase the fee in the future, the amount of the fee would be tied directly to the value of the amenity (pursuant to the existing valuation formula). This can be accomplished by setting the fee at some percentage of the value of the amenity. Since payment of the in-lieu fee is entirely voluntary, the City may set the fee at an amount that is more or less than 100% of the value of the amenity (such as the 120% amount currently referenced in Title 16.)

⁵ The MPMC provides “the identified community amenities may be updated from time to time by city council resolution.”

3. Option 3: Adopt Regulations Regarding Approval Process for Development Projects

The community amenities provisions in Title 16 allow for broad discretion in approving community amenities.⁶ Currently, community amenities are reviewed along with entitlement of the proposed development. An option that would provide developers earlier assurances and the City earlier discretion in community amenities would be to adopt a “gatekeeper” approval process. This process would require approval of a community amenity prior to a developer proceeding with a development application. The community amenity proposal would be reviewed and approved or denied by the Planning Commission and/or the City Council before the applicant is permitted to submit a development application that intends to use bonus level development.

Once a community amenity is approved, the applicant would be entitled to proceed with a bonus level development application. The gatekeeper process would likely incorporate a study session and/or hearing limit to ensure a timely decision by the City. The development application would follow the existing approval process for development projects. If ultimately approved, the development project would be conditioned upon construction/implementation of the approved community amenity or the payment of a community amenity fee.

The gatekeeper approval process would not apply to housing development projects for the reasons discussed in more detail above.

4. Option 4: Do Nothing

The Council may elect to make no changes to the community amenities list, zoning code provisions or review processes. If the Council does not make any changes, the current community amenities regulations and practices would continue.

⁶ The community amenities provisions of MPMC 16.43, 16.44, and 16.45 provide that the “applicant’s proposal for community amenities shall be subject to review by the planning commission in conjunction with a use permit or conditional development permit.” These provisions do not specify how or to what extent the Commission may review the community amenities, but suggest that the review might occur separately from the underlying project review because a separate use permit and/or CDP may be required.



April 16, 2021

The Honorable Betsy Nash
Vice Mayor
City of Menlo Park
701 Laurel St.
Menlo Park, CA 94025

Re: ConnectMenlo Community Amenities List

Dear Vice-Mayor Nash and Council Members:

The Willow Village team is proud to have engaged in an extensive and unprecedented community outreach effort over the past four years, with special focus, attention, and feedback from our Belle Haven neighbors to help create, shape and refine Willow Village. The community amenities integrated into Willow Village were a direct result of our outreach and have been very well received. We have relied in good faith on the City's 2016 Connect Menlo Amenities List to plan key elements of Willow Village in addition to the significant amount of direct conversations we've had with the community over the years.

Through close coordination with our Belle Haven neighbors we have refined and improved the Willow Village proposal in several ways including:

- Improved the connections to the Belle Haven neighborhood
- Addressed the need for grocery, restaurants, entertainment, and shopping services and reversed the phasing to deliver them in Phase 1 instead of Phase 3
- Added housing to improve the job/housing balance
- Provided more on-site affordable housing
- Reduced office space and employment capacity
- Reduced traffic impacts
- Created exciting new open spaces, parks and trails

ConnectMenlo established that changes in the Community Amenity List should reflect community priorities. Based on our extensive and well-received community outreach, we are confident that our proposed community amenities package reflects community priorities. We respectfully request that the elements that we have proposed in good faith and integrated into our plan, in coordination with our neighbors, be retained and not be removed from the list at this late stage in the development process. The project has been designed with amenities thoughtfully included in direct response to community

input and feedback, and we request that the following amenities be retained on the ConnectMenlo Community Amenities List:

Transit and Transportation Improvements

1. Bike trails, paths or lanes: Install new bike lanes and pedestrian paths and connect them to existing facilities a Bay Trail

Community Serving Retail

2. Bank/ATM: a bank or credit union branch with an ATM

Job Training at M-2 Companies

3. Job training programs: Provide residents with job training programs that prepare them with job skills

Park Planning and Improvements

4. Bedwell Bayfront Park Improvements: Improve access to parks and trails within Bedwell Bayfront Park
5. Dog Park: Provide a dedicated, enclosed place where dogs can run

Additionally, some of the amenities we have integrated into Willow Village were not initially contemplated in the original Community Amenities List and have been requested by many community stakeholders due to the unique nature and opportunities within our plan. These elements have led to a great amount of excitement and we request that the City add the following amenities as options to the Community Amenities List:

6. Community Entertainment Offerings: Cinema, Live Theatre, Bowling, etc.
7. Recreational Open Space: Parks, Town Square / Plaza, Elevated Park (land and improvements)

We also request that the Council add to a “catch all” that would allow additional items to be added to the list as part of a Council-approved Development Agreement for a particular project.

These amenities identified already in the project and the ones above would be over and above what would be required by city code, impact fees or project mitigation measures and would meet our requirements under the Community Amenities resolution for bonus level development. Because Willow Village has included these community amenities into the project based on the existing list and extensive community feedback versus the payment of an in-lieu fee, the project is not feasible if the City Council does not include the items above on the Community Amenities list. The project cannot support the amenities proposed and an in-lieu fee for the difference if the above items are not included in the Community Amenities list.

If the Council chooses to proceed with the update of the Community Amenities List and addition of a gatekeeper process, we request that the Council grant pipeline status to pending projects that have relied in good faith on the current Community Amenities List and process. We suggest such protection for projects with applications on file (whether or not deemed complete) as of March of 2019, when staff encouraged the Council to update the Community Amenities List so that then-pending projects (including Willow Village) would not be delayed by uncertainty as to what amenities would be on the list when the City considers the projects for approval.

It is imperative that we have both certainty and predictability in the process and rules, specifically the retention of items 1-5 above and addition of items 6 and 7 above, for Willow Village to proceed and deliver the services and amenities long requested by our Belle Haven neighbors. Thank you for your consideration of these amenity list items as we work together as partners to make Willow Village a special place for Belle Haven and Menlo Park for generations to come.

Best Regards,

A handwritten signature in black ink, appearing to read "Mike Ghielmetti". The signature is fluid and cursive, with a long, sweeping underline that extends to the right.

Mike Ghielmetti, President
Signature Development Group



April 19, 2021

City Council for the City of Menlo Park
City of Menlo Park
701 Laurel Street
Menlo Park, CA 94025

RE: April 20, 2021 Agenda Item D.2.: Update to the ConnectMenlo Community Amenities

Mayor Combs and Members of the City Council:

We are writing on behalf of Tarlton Properties regarding the City Council's study session for possible updates to the ConnectMenlo Community Amenities ("CMCA") which is on the April 20, 2021 Agenda as Item D.2. Contribution of community amenities is required of project applicants proposing "bonus" level projects in the Life Science, Office, and Residential Mixed-Use Districts in the Bayfront Area; Tarlton, with its capital partners, owns and develops multiple life science facilities in the City's Life Science district, and has proposed several bonus-level projects that are currently undergoing review with the City. These projects are poised to provide substantial contributions in the form of CMCA. Tarlton has a long history of partnership with the City, and was an original advocate for the provision of community amenities as a way to directly benefit the Belle Haven community of which it is a part. Tarlton wishes to offer the City Council the following considerations regarding the recommendations by the Council Community Amenities Subcommittee shown on Page D-2-3 of the staff report:

Recommendation 2: Adopt an Ordinance Establishing an In-Lieu Fee

Tarlton strongly supports the establishment of an in-lieu fee for project applicants to provide community amenities. An in-lieu fee that bears a reasonable relationship to proposed developments and the need for community benefit is authorized by the current community amenities ordinance and consistent with its purpose.¹ An in-lieu fee will give the Council the flexibility to combine amenity funds for meaningful projects, and direct community amenities to where they will have the most impact and/or benefit for the Belle Haven community.

In tandem with its support for an in-lieu fee option, Tarlton notes that the Subcommittee also recommends removing nearly all of the potential community amenities approved with Resolution No. 6360. As noted in the Staff Report, there are 10 bonus level projects currently under review with the City. The projected value of the remaining community amenities would not be sufficient to allow entitlement of those projects that are currently under review, much less any additional project applications that may be submitted. An in-lieu fee is therefore paramount to enable these projects to meet their obligation to provide community amenities until the Council determines and adopts new amenities.

¹ See, e.g., Menlo Park Municipal Code § 16.44.070 (4)(b).

Also, many of the existing bonus project applications have already experienced delays that have lasted for multiple years. We underscore the importance of the City's action to minimize further delay of those projects and others. Tarlton therefore agrees with staff that it "is important to adopt an in-lieu fee now to provide another way for developers proposing bonus level projects in the Bayfront Area to fulfill their obligation."² Therefore, the in-lieu fee must be adopted immediately and independently of the Council's action related to the remainder of the CMCA list to ensure that project entitlement schedules are not further compromised. This will also allow the time needed to conduct community outreach to determine new amenities. Considering the Council's full control over the use of those in-lieu fee funds for current and future amenities, we trust there will not be any reasonable objection to such immediate and independent approval.

Recommendation 3: Establish a Gatekeeper Process for Approval of Community Amenities Proposals

As noted in City Attorney Doherty's Memorandum regarding Community Amenity Options, community amenity proposals are currently reviewed with entitlement for the development project, and a "gatekeeper" process would provide the City with earlier input on the proposed community amenity, as well as provide earlier assurance to the applicant regarding their proposed amenities.³ Such a "gatekeeper" process would be valuable. Its implementation would best be created in a way to mitigate any further project delay.

We highlight our concern about delays because the format of this gatekeeper process is not yet defined, and there is suggestion in the memorandum that it could take place before the applicant can "submit" a development application.⁴ To the extent that suggestion exists, it must be rejected. Such timing would be impracticable as the value of a community amenity is tied to the project itself, and therefore the application. Any format that adds additional delay to the entitlement process may also raise potential issues under the Permit Streamlining Act, and no authority exists to allow the City to prevent submittal of a development application. Therefore, if the Council accepts the Subcommittee's recommendation for a gatekeeper process, then the Council would be best served to consider that such process take place concurrently with a development application's permit and environmental review.

For example, the Planning Commission or City Council, as appropriate, could consider community amenities proposals and make a recommendation at a project study or scoping session. Another possibility would be to employ a procedure similar to that which the City established to review Below Market Rate (BMR) proposals, whereby BMR proposals are submitted with a development application, reviewed by the Housing Commission during project review, and a recommendation is forwarded to the ultimate decisionmaker on the project.⁵ Either of these paths would allow the Commission or Council to

² Council Community Amenities Subcommittee Report, at D-2.3.

³ City Attorney Memorandum re Community Amenities Options, at D-2.9.

⁴ *Id.*

⁵ See, e.g., Menlo Park Municipal Code § 16.96.030 (d).

City Council for The City of Menlo Park

April 19, 2021

- 3 -

consider proposed community amenities early in the application process, allowing time for the applicant to adjust for the City's needs, without compromising entitlement and statutory timelines.

We appreciate the opportunity to address the Council on these important issues.

Best regards,

Monchamp Meldrum LLP



Rob Taboada

Via email: Mayor Drew Combs (DCombs@menlopark.org)
Vice Mayor Betsy Nash (BNash@menlopark.org)
Councilmember Cecilia Taylor (CTTaylor@menlopark.org)
Councilmember Ray Mueller (RDMueller@menlopark.org)
Councilmember Jen Wolosin (jwolosin@menlopark.org)

CC: John Tarlton, Tarlton Properties Inc. (jtarlton@tarlton.com)
Elizabeth Krietemeyer, Tarlton Properties, Inc. (ekrietemeyer@tarlton.com)
Nira Doherty, City Attorney (ndoherty@bwslaw.com)
Starla Jerome Robinson, City Manager (slrobinson@menlopark.org)
Nick Pegueros, Assistant City Manager (nmpegueros@menlopark.org)



Agenda item D2
Lynne Bramlett, Resident

I appreciate the efforts of Vice Mayor Nash and Council Member Taylor to work on this project. I agree with the recommendations in the Subcommittee's report. My only question has to do with the discrepancy between the "eleven" Bayfront projects under development listed in this report and the "10" listed in the staff report. Which is correct? My recommendation is for Council to adopt options 1, 2 and 3.



CONNECTMENLO COMMUNITY AMENITIES

Study Session – April 20, 2021



BACKGROUND

- City Council ad hoc subcommittee
 - Revise ConnectMenlo community amenities list
 - Inventory citywide development
 - Maintain amenities list data
- Additional areas requiring attention
 - In-lieu fee
 - Proposed amenities review process
 - Housing Crisis Act of 2019 (SB 330)



CURRENT ORDINANCE

- Written proposal from applicant on bonus level development sought including:
 - Appraised value of additional gross floor area at bonus level
 - Applicant values the bonus level floor area; independently peer reviewed by City/consultant
 - Community amenities requirement set at 50% of appraised value
 - Value of proposed community amenities proposed
 - Applicant selects a community amenities from City Council approved list
 - Applicant values the amenities; independently peer reviewed by City/consultant
 - In-lieu fee allowed by Ordinance, requires City Council adoption
- Review by planning commission in conjunction with a use permit or by city council with a conditional development permit



REQUESTED DIRECTION

- Subcommittee recommendations
 - Revise community amenities list
 - Adopt an in-lieu fee
 - Establish an application process for proposed amenities
 - Establish a Community Amenities Working Group on the gatekeeper process
- Public engagement plan
 - Stakeholder engagement
 - Planning Commission and advisory bodies
- Priority relative to other City Council work plan items



PROPOSED STUDY SESSION FORMAT

- Public comment
- Subcommittee verbal report
- Questions and discussion
- City Council direction



THANK YOU



STAFF REPORT

City Council

Meeting Date:

4/20/2021

Staff Report Number:

21-085-CC

Consent Calendar:

Authorize the city manager to enter into master professional agreements with M-Group, Arnold Mammarella, Architecture + Consulting, and BAE for professional planning services

Recommendation

Staff recommends that the City Council authorize the city manager to enter into multiyear master professional agreements up to the annual budgeted amounts for the purpose of continuing the following contract services related to development review:

- M-Group for development review;
- Arnold Mammarella, Architecture + Consulting for design review; and
- BAE for the preparation of fiscal impact analysis (FIA) and community amenities evaluation.

Policy Issues

The use of master professional agreements has been established to streamline the request for proposal and purchase requisition process on a per project basis. The community development department is currently using multiple professional firms to supplement the work of existing staff either due to the volume of work, the need for specific technical expertise, temporary leave of absences, and/or the elimination of positions during the fiscal year 2020-21 budget process. Consultant services are needed to continue processing and permitting development projects in a timely manner.

Background

The City has utilized contract services through the master professional agreement process to augment City staff on an as-needed basis over the past two decades. The use of master professional agreements establishes continuity with contract personnel that are familiar with the regulations and policies of the City of Menlo Park and helps to streamline the work of the community development department. City Council authorization is required for the city manager to execute master professional agreements in excess of her financial authority.

The City has experienced a high volume of complex development projects since the adoption of the El Camino Real/Downtown specific plan in 2012 and the ConnectMenlo general plan update in 2016. Since 2013, the City has contracted with the M-Group, who was selected through a request for proposal (RFP) process, to provide planning services. In April 2014, as interest in development continued to grow, the City contracted with a second firm, Arnold Mammarella, Architecture + Consulting, to assist with small-scale environmental review documents and design review services. While the respective 2013 and 2014 City Council approvals can no longer be used to continue annual contracts in excess of the city manager's signing authority, the need for contract planners remain. Most recently, in August 2020, the City Council appropriated \$150,000 and authorized the city manager to enter into an amended contract with the M-

Group totaling \$200,000.

The high volume of projects also impacts building permitting and plan checking services. The City Council approved the most recent master agreement for professional building-related services, including plan checking, inspection services, geotechnical review, arborist review and administrative support, in June 2019. The current master agreements are in effect for a period of five years.

The need for contract services has varied over the years and is dependent upon a variety of factors, including the volume of work, the scope of the work, and level of staffing resources. Contract services have provided essential baseline services such as building permit plan checking, augmented staff to perform baseline work such as management of more complex development review projects and provided technical and/or specialized expertise not performed by current staff such as geotechnical review or the preparation of fiscal impact analyses.

Analysis

Planning Services

Under the City's award authority and bid requirements policy (City Council Procedure #CC 19-001), the City Council can enter into a professional services agreement up to \$200,000 with an informal bid. Staff did not solicit proposals from three providers given the past performance of the M-Group, Arnold Mammarella and BAE, and the timeliness of the work to be done. Staff believes that continued work with these three firms to augment current planning staffing levels will provide the continuity in development review that is needed for the large Bayfront and El Camino Real/Downtown specific plan projects as well as provide consistency in review between projects. Work on these projects require the skills of experienced planners from the M-Group who are able to assist with a range of projects from single-family review to more complex projects, as well as more specialized skills that Arnold Mammarella and BAE perform such as architecture and design review and economic analyses, respectively.

Given the continuing need for contract services to ensure that projects in the pipeline can be processed in a timely manner, staff is requesting that the City Council authorize the city manager to enter into master agreements with each of the three firms through June 30, 2024, to coincide with the term of the other master agreements. The City currently has contracts with each of these firms, but the master agreements would provide flexibility to augment and modify services on an as-needed basis.

M-Group

The City is currently using two principal planners from the M-Group on a part time schedule, approximately 20-25 hours per week for one principal planner who is focused on development review for several projects in the Bayfront Area and a second principal planner on an as-needed basis, for a total contract amount of \$200,000. No additional modifications to the budget or scope or work are needed for the remainder of the current fiscal year. Time spent by contract planners reviewing projects is billable to the project at a high cost recovery rate per the City's cost recovery policy.

Arnold Mammarella

The City currently has a contract with Arnold Mammarella for \$35,000 and staff anticipates an additional \$20,000 will be needed through the end of the fiscal year given the anticipated work, primarily on projects in the Bayfront and El Camino Real/Downtown specific plan areas. Although the combined total does not exceed the city manager's signing authority in this fiscal year, staff would like to continue to work with Arnold Mammarella for the foreseeable future and over the years, the combined contract amount over multiple fiscal years would exceed the city manager's limit. No budget appropriation is required for the

additional services for the remainder of the fiscal year. Time spent by contract planners reviewing projects is billable to the project at a high cost recovery rate per the City’s cost recovery policy.

BAE

BAE provides specialty services, primarily for projects in the Bayfront and El Camino Real/Downtown specific plan areas. The City contracts with BAE for the work on a project-by-project for discrete tasks, and contracts with the applicant as well, who is responsible to pay the fee associated with these tasks. The City collects the fee up-front from the applicant and deposits the funds into a holding account, and the City pays the invoices from these funds. While each contract is within the city manager’s signing authority, collectively, they exceed \$75,000. No general fund money is encumbered for these services; however, staff is still seeking a master agreement so these services can be provided in a timely manner when needed for development review.

Table 1 summarizes the current contract planning services.

Table 1: Planning contract services				
	Services	Current contract amount (FY 2020-21)	Not to exceed amount (FY 2020-21)	Cost recovery
M-Group	Development review, building permit review,	\$200,000	No change	Billed hourly to projects, similar to planners
Arnold Mammarella	Architecture and design review, environmental review	\$35,000	\$55,000	Billed hourly to projects, similar to planners
BAE	Fiscal impact analysis, community amenities evaluation	\$123,655	\$170,000	Pass through; direct costs paid for by applicants

Building services

On June 23, 2020, the City Council adopted a balanced budget for fiscal year 2020-21. The budget significantly reduced available funding for contract services in community development as well as eliminated the plan check engineer and building inspector positions during a time of heavy development review activity in the specific plan and Bayfront areas. Even with these positions, the City has historically used contract services for the past 20 years as part of its overall resource management strategy.

Master agreements are used with multiple firms in order to ensure prompt plan review turnaround and to take advantage of specialized expertise. In June 2019, the City Council authorized a master agreement for a period of five years with the following firms:

- Kutzman and Associates;
- Shums Coda Associates;
- West Coast Consulting;
- 4LEAF, Inc.;
- Municipal Plan Check Services;
- Carlson Management Inc.;
- HortScience | Bartlett Consulting; and
- John J. Heneghan consulting geotechnical and civil engineer.

Most of the service providers are for contract plan checkers, which are used to review plans for large projects that would be time consuming for staff to review without impacting service levels and for their

added expertise in reviewing complex mechanical, electrical and plumbing plans, and currently, for smaller projects such as single-family home additions and remodeling, which would have typically been reviewed by the City's in-house plan check engineer. As part of the City Council's upcoming discussion on service level enhancements, the community development department will be requesting to reinstate the plan check engineer position for the upcoming fiscal year to enhance customer service and reduce reliance on contract services.

The approved budget for building contract services was \$512,500 for the fiscal year 2020-21. Recognizing that budgets were significantly reduced, but the expectation for service levels would be maintained, the City Council understood that mid-year augmentations could be requested. During the pandemic, the demand for services has remained high for both large and small development projects. The building division has contracted for services, including administrative support, specialized technical review and plan check review to maintain service levels, and expects the need for such work to continue through the fiscal year and beyond, which will require a budget augmentation through a reallocation of resources for the remainder of the fiscal year.

Impact on City Resources

The existing contract amount of \$479,000 is covered by community development's contract building services budget, but additional funding of \$450,000 is needed to cover the anticipated contract amounts for the remainder of fiscal year 2020-21. City staff anticipates sufficient budgetary savings and offsetting cost recovery in fiscal year 2020-21 to provide for the increased expenditure of \$450,000; therefore, no budget amendment is required at this time.

Environmental Review

This action is not a project within the meaning of the California Environmental Quality Act (CEQA) Guidelines §§ 15378 and 15061(b)(3) as it will not result in any direct or indirect physical change in the environment.

Public Notice

Public notification was achieved by posting the agenda, with the agenda items being listed, at least 72 hours prior to the meeting.

Attachments

None.

Report prepared by:

Deanna Chow, Assistant Community Development Director

Report reviewed by:

Justin Murphy, Deputy City Manager



STAFF REPORT

City Council

Meeting Date:

4/20/2021

Staff Report Number:

21-082-CC

Consent Calendar:

Adopt Resolution No. 6621 to amend the 2030 climate action plan to include scope of work for 2021 implementation

Recommendation

Staff recommends the City Council adopt Resolution No. 6621 to amend the 2030 climate action plan (CAP) to include scope of work for 2021 implementation (Attachment A.)

Policy Issues

In 2019, the City Council declared a climate emergency (Resolution No. 6535) committing to catalyze accelerated climate action implementation. In July 2020, the City adopted a new CAP with the bold goal to reach carbon neutrality (zero emissions) by 2030.

Background

The City Council adopted a 2030 CAP with a bold goal to reach carbon neutrality (zero emissions) by 2030. On April 6, the City Council provided direction and clarification on the CAP's scope of work for 2021 implementation (Attachment B.) The next step included amending the CAP to reflect the direction of City Council for 2021 implementation. Attachment A includes a resolution and the amendments to the CAP. Changes are highlighted in blue text.

Analysis

The amended CAP in Exhibit A of Attachment A provides the scope of work for 2021 implementation and is achievable with current staff capacity and budget. The CAP continues to be a living document that is evolving based on community willingness and ability to change behaviors/preferences, technology advancements and alignment with county, state, and federal policies and programs that result in reduced greenhouse gas (GHG) emissions. These areas can change rapidly, stressing the importance of quickly adapting the implementation of the CAP to utilize city resources and budget efficiently and effectively.

As a result, the CAP is typically revisited every summer to update the City Council and the community on progress and changing external opportunities or limitations that may require further amendments to the scope of work in the CAP. This provides further opportunity to quickly adapt and provide additional direction for activities or projects beyond 2021.

Impact on City Resources

Completing this work is within the CAP budget, and no additional budget requests are necessary at this time.

Environmental Review

The environmental impacts of CAP strategies and any California Environmental Quality Act (CEQA) compliance needs will be identified as they are approved for work by the City Council and analyzed further.

Public Notice

Public notification was achieved by posting the agenda, with the agenda items being listed, at least 72 hours prior to the meeting.

Attachments

- A. Resolution No. 6621 to amend the 2030 climate action plan to include scope of work for 2021 implementation
- B. Hyperlink – April 6 City Council Staff Report # 21-064-CC:
[menlopark.org/DocumentCenter/View/27835/H1-20210406-CC-CAP-Nos-1---6](https://www.menlopark.org/DocumentCenter/View/27835/H1-20210406-CC-CAP-Nos-1---6)

Report prepared by:
Rebecca Lucky, Sustainability Manager

Reviewed by:
Nikki Nagaya, Public Works Director
Deanna Chow, Assistant Community Development Director
Nick Pegueros, Assistant City Manager

RESOLUTION NO. 6621

**RESOLUTION OF CITY COUNCIL OF THE CITY OF MENLO PARK AMENDING
THE CITY OF MENLO PARK'S 2030 CLIMATE ACTION PLAN**

WHEREAS, in July 2020, the City of Menlo Park adopted a 2030 Climate Action Plan that includes a bold goal to achieve zero carbon emissions, or 90 percent reduction in carbon dioxide equivalent (CO₂e), from 2005 levels by 2030 in advance of the State of California's 2045 goal.

WHEREAS, in December 2019, the threat of climate change and the urgent need to combat it, the City of Menlo Park adopted Resolution No. 6525, which resolved to:

1. Declare a climate emergency that threatens the economic and social well-being, health and safety, and security of the City of Menlo Park.
2. Commit to educating the City's residents about the climate emergency and working to catalyze accelerated climate action at the local, state, national, and global levels to provide maximum protection for Menlo Park residents as well as all the people and species of the world.
3. Include health, socio-economic, and racial equity in policymaking and climate solutions at all levels and across all sectors as the consequences of climate change have significant impacts on all Menlo Park residents, but especially the young, the elderly, low income or communities of color, and other vulnerable populations and age groups.
4. Join the nation-wide call for regional accelerated climate collaborative action focused on transforming the region, enacting policies that dramatically reduce heat-trapping emissions, and rapidly catalyzing climate action at all levels of government to restore a safe climate.
5. Commit to the completion of the City's Climate Action Plan 2.0 that will include measurable climate-related goals and actions to attain carbon neutrality in advance of the State of California's 2045 goal, and

WHEREAS, the City Council provided additional direction and clarification on the scope of work for the 2030 Climate Action Plan's 2021 implementation on April 6, 2021, and

WHEREAS, the City Council's direction on the 2021 scope of work is reflected through amendments in 2030 Climate Action Plan in Exhibit A.

NOW, THEREFORE, BE IT RESOLVED, by the Menlo Park City Council to accept and adopt the amendments to the 2030 Climate Action Plan in Exhibit A.

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I, Judi A. Herren, City Clerk of Menlo Park, do hereby certify that the above and foregoing City Council Resolution was duly and regularly passed and adopted at a meeting by said City Council on the twentieth day of April, 2021, by the following votes:

AYES:

NOES:

ABSENT:

ABSTAIN:

IN WITNESS WHEREOF, I have hereunto set my hand and affixed the Official Seal of said City on this twentieth day of April, 2021.

Judi A. Herren, City Clerk

2030 CLIMATE ACTION PLAN

Prepared by the Environmental Quality Commission
Adopted by City Council July 2020 (Resolution No.6575)
Amended April 20, 2021 (Resolution No. 6621)



A 2030 PLAN TO ELIMINATE CARBON EMISSIONS & PROTECT
OUR COMMUNITY FROM CLIMATE CHANGE

Contacts

Rebecca Lucky, Sustainability Manager, City of Menlo Park

Tom Kabat, Environmental Quality Commissioner, City of Menlo Park

James Payne, Environmental Quality Commissioner, City of Menlo Park

Josie Gaillard, Environmental Quality Commissioner, City of Menlo Park

INTRODUCTION

Menlo Park is uniquely threatened by climate change and uniquely positioned to tackle it.

Menlo Park's location on the shore of San Francisco Bay places approximately \$1.3 billion¹ of property in our Belle Haven neighborhood at risk of flooding from climate change by as early as 2070.² While it is impossible for Menlo Park alone to halt the global sea level rise that threatens our city, bold climate leadership on our part is perhaps our only hope of keeping sea level below the height of an "affordable" sea wall. The San Francisco Creek Joint Powers Authority estimated in a 2016 feasibility study that a combination of levees and sea walls built along the shoreline of Menlo Park and East Palo Alto to address just three feet of sea level rise would cost approximately \$100 million.³

If we do not provide visible and inspiring leadership on climate and global greenhouse gas emissions continue rising at their current rate, no sea wall or levee will save the portion of our city between Route 101 and the Bay. That land, which includes a disproportionate percentage of our city's low income residents and residents of color, will be inundated and residents and businesses will have to permanently relocate. On the other hand, if we take a leadership position and our bold climate action inspires rapid and far reaching climate action by other cities, we may be able to save our Belle Haven neighborhood with a combination of sea walls and levees.

The good news is that if there is any city well positioned to lead on climate action, it is Menlo Park. Located in Silicon Valley, our residents and leaders embrace innovation. Our county (San Mateo) is one of the wealthiest in the country,⁴

¹ According to [County of San Mateo Sea Level Rise Vulnerability Assessment](#) p. 139, sea level rise of 3.3 feet will inundate Menlo Park real estate valued at \$1.288 billion and a rise of 6.6 feet will inundate \$1.621 billion in real estate.

² Griggs, G, Árvai, J, Cayan, D, DeConto, R, Fox, J, Fricker, HA, Kopp, RE, Tebaldi, C, Whiteman, EA (California Ocean Protection Council Science Advisory Team Working Group), [Rising Seas in California: An Update on Sea-Level Rise Science, California Ocean Science Trust, April 2017](#). Ranges shown are from the median (50th percentile) to the extreme (99.9th percentile) range of the projections.



YEAR: 2070-2100

the Bay is projected to rise 3.3 feet

which means we have the financial resources to tackle the issue of climate change head on. Analysis conducted by members of the Environmental Quality Commission's Climate Action Plan subcommittee shows that every dollar spent now by the City on bold climate action can be expected to save City residents \$100 in future adaptation costs⁵ addressing sea level rise alone, not to mention the healthcare costs associated with treating ailments caused by air pollution (see "Natural Gas Phase Out" section below).

Finally, our City Council and staff have already demonstrated a capacity for leadership by passing an innovative all-electric Reach Code that virtually eliminates natural gas from new buildings. At last count, 15 other California cities had adopted a "Menlo Park style" all electric Reach Code for new buildings, proving that courageous action on climate does in fact inspire others to follow.

³ [Public Draft Feasibility Report, SAFER Bay Project, Strategy to Advance Flood protection, Ecosystems and Recreation along San Francisco Bay, East Palo Alto and Menlo Park](#), October 2016, p. 37.

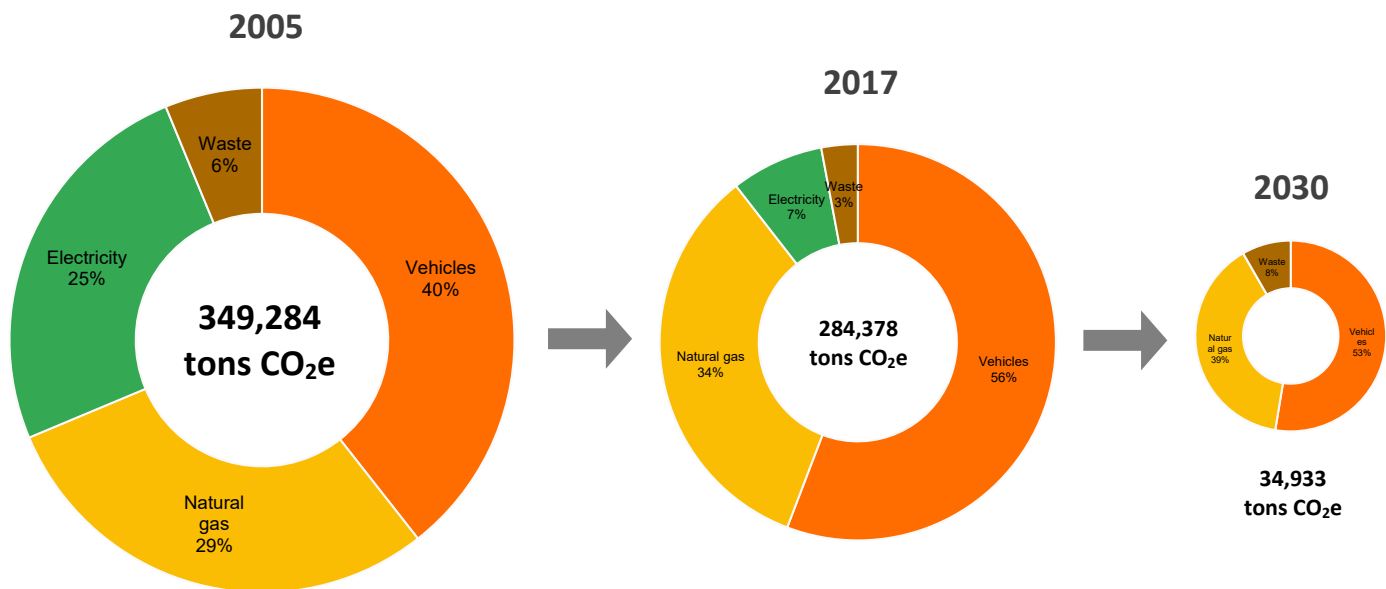
⁴ https://en.m.wikipedia.org/wiki/List_of_highest-income_counties_in_the_United_States

⁵ Supporting analysis available in PDF format in Appendix C and in Excel format upon request

ZERO CARBON BY 2030

In order to address the significant threat to Menlo Park posed by climate change, the City Council adopted a bold climate goal of zero carbon by 2030. This will be achieved through a 90% reduction in carbon dioxide equivalent emissions (CO₂e) from 2005 levels, and elimination of the remaining 10% of CO₂e through direct carbon removal measures.

An inventory of greenhouse gas emissions conducted in December 2019 revealed that emissions in Menlo Park fell from 349,284 tons in 2005 to 284,378 tons of CO₂e in 2017, a reduction of 19%. The aim of this plan will be to reduce community-wide emissions by another 71% for a total reduction of 90% from 2005 emissions, leaving just 34,933 tons of CO₂e per year by 2030.



Menlo Park Community Greenhouse Gas Emissions (metric tons of CO ₂ e)			
	2005	2017	2030
Vehicles	137,628	158,686	18,373
Natural gas	102,295	95,742	13,656
Electricity	87,617	21,528	-
Waste	21,745	8,424	2,903
Total Emissions	349,285	284,380	34,933

OPTIONS FOR ACTION

In order to achieve a goal of “Zero emissions by 2030,” Menlo Park must begin taking bold action immediately. Fortunately, the City has already decarbonized its electricity supply by joining with other cities in the County to create a joint powers authority (Peninsula Clean Energy) that sources power mainly from renewables and hydropower. This creates a clean energy stepping stone from which to decarbonize the rest of the City’s economy.

Our next step is to decarbonize all of our buildings and transportation. In an ideal world with more time, the City’s climate goals could be achieved simply by unleashing the power of free enterprise and relying on markets and educated consumers to transform our fossil-fuel dependent economy to one that stops emitting greenhouse gases in time to avert catastrophic climate change. Members of the Climate Action Plan (CAP) subcommittee of the Environmental Quality Commission (EQC), who prepared this plan, certainly would prefer this type of approach, as it limits the role of government and would reduce the likely opposition from some interest groups. However, no matter how carefully the subcommittee considered various incentive- and education-based laissez-faire approaches, none of them appears able to solve the climate problem in time to avert catastrophic change to our daily lives. In fact, the less action the City takes now, the costlier the government intervention will be later to deal with the resulting climate disasters.

The key reasons that market approaches alone cannot solve climate change are three-fold:

- 1) markets are currently distorted by the absence of accurate pricing for key externalities, such as the right to dump harmful greenhouse gas emissions into the atmosphere, which today is virtually free to any person or business who wishes to do it, leaving the rest of us bear the ever increasing cost,
- 2) powerful political interest groups such as the fossil fuel industry have successfully spread enough disinformation about climate change that Americans significantly underestimate the problem and therefore

underestimate the actions that must be taken to address it, and

- 3) polluting devices last far too long once installed and we simply do not have enough time for the typical market signals to trickle down to those who determine product offerings and today offer environmentally obsolete products to customers.

Just as the US government stepped in forcefully after the bombing of Pearl Harbor to require that much of America’s free market economy be transformed to support the war effort, so too must the government now step in forcefully and confidently to lead the American public away from the brink of climate disaster.

Thankfully, the actions required of every American citizen to forcefully combat climate change are much less onerous than the food rations or military conscription imposed on World War II-era Americans. We are fortunate that a robust private sector has already provided every technological solution and innovation necessary to almost completely retire fossil fuels as an energy source in America today.

PERSONAL ACTION

Below is a list of the personal actions that, if every citizen took them, would halt global warming in its tracks:

- Retire all gas vehicles immediately and replace them with electric vehicles, bikes, transit or another form of non-fossil transport
- Replace every gas appliance in a home (including furnace, water heater and stove) with an efficient electric version
- Power every home and car with 100% renewable electricity, either by installing solar panels or purchasing renewable energy from one’s utility
- Consider the greenhouse gas emissions associated with every purchase decision and choose “low-carbon” products and services whenever possible

- Reduce weekly consumption of meat and animal products, a move which has significant ancillary health benefits.

GOVERNMENT ACTION

At the local government level, climate action must focus on eliminating the use of two categories of fossil fuels: 1) gasoline and diesel fuel in vehicles, and 2) natural gas in home appliances. Given the 25-year expected life of a typical gas furnace, it is critical for the City to begin prohibiting the installation of new replacement gas furnaces and water heaters as soon as possible.

In considering the wide-reaching actions and change required to meet the City's proposed climate goals, researchers reviewed dozens of approaches employed by cities all over the world, including:

- A "5-minute city" approach to zoning implemented in Copenhagen, Denmark that drastically reduced vehicle miles traveled (VMT) and made the city more walkable
- A carbon fee on buildings recently implemented in New York City
- An announced plan to end the flow of natural gas in the City of Arcata, California and now being considered by Palo Alto.

After months of weighing each of the dozens of approaches, the CAP subcommittee identified three basic options for action: 1) a Bold Plan with 22 actions to be implemented over one year, 2) a Moderate Plan with 76 actions to be implemented over three years and 3) a Go Slow Plan with no specific actions other than to follow evolving state rules.

PLAN CHANGES DUE TO COVID-19 PANDEMIC

Shortly after the CAP subcommittee fleshed out the three different approaches to climate action described above, the world was gripped by the global pandemic of COVID-19. The pandemic has

significantly affected the context in which this plan is presented, namely:

- The time and attention of City Council and staff has understandably shifted almost entirely to managing the health risks and economic consequences of the pandemic
- Almost overnight, the country has gone from enjoying robust economic growth to experiencing one of the starkest economic recessions in US history
- Due to the economic recession, the City's budget has shrunk dramatically, with a 2020-21 shortfall of \$12.7 million
- Layoffs of dozens of City staff as a result of the City's budget shortfall
- City commissions, including the Environmental Quality Commission (EQC), unable to meet for 4 months, which means the CAP subcommittee has been delayed in vetting the CAP with the EQC

Despite disrupted City operations, the CAP subcommittee continued refining the Climate Action Plan and vetting it with the City Council's CAP subcommittee (distinct from the EQC's CAP subcommittee) to receive their input on what might be politically viable in Menlo Park. The result of that continued work is a significantly pared down plan, presented below. While the CAP subcommittee still believes that the original Bold or Moderate Plans (presented in Appendix B), with their 22 and 76 actions respectively, are in fact what the Climate Crisis requires, we have decided to propose a significantly pared down plan, with the thought that some action is better than no action. This plan includes only the highest impact actions. This does not mean it is the best plan. It means it is only a good subset of the best plan and future efforts should be made to expand it as our ability and the wisdom of doing so becomes ever more apparent.

THE PLAN

Action	#	Description	2030 GHG Reduction (tons/yr)	Estimated Initial Investment for FY 2020-2021
Explore policy/program options to convert 95% of existing buildings to all-electric by 2030	1	Two basic options: 1) Announce the “end of flow” of natural gas in the City by 2030 OR 2) Enact a “burn-out ordinance” requiring that when gas appliances expire, they must be replaced by electric (preferably high efficiency heat pump) alternatives; phase in for large commercial, small commercial, residential; may require follow-on compliance ordinance as current permit compliance for residential gas appliances is low; will require follow-up “cash-for-clunkers” program to achieve 2030 goal; relies on PCE subsidies to reduce or eliminate cost differential; may require use of UUT funds to cover additional cost differential for low-income residents. Extend burnout ordinance to expiring air conditioners, to be replaced with heat pumps, eliminating need for separate gas heating.	1) 86,465* OR 2) 51,636*	\$195,000 to \$275,000 *Initial investment to hire contract staff (building official, legal aid, energy analyst) and provide policy options that would lead to adoption of a policy, ordinance, and/or program
Set citywide goal for increasing EVs and decreasing gasoline sales	2	Announce and promote goals of 1) increasing the purchase of all new vehicles to be electric by 2025 and 2) reducing gasoline sales each year by 10%, based on the total reported in 2018. Track progress on both goals publicly on an annual basis.	<7,120*	\$0-\$20,000 to influence regional agency or organization to lead on behalf of the city
Expand access to EV charging for multifamily and commercial properties	3	Install or assist building owners in installing EV chargers throughout the City, siting them preferably where they will be used during daylight hours (when solar electricity is abundant on our grid) and also where residents of multi-family housing can access them. Current project to explore and evaluate policy options for existing multifamily properties.	7,370* <13,000* for multifamily	\$140,000 *Initial investment for contract analyst to evaluate multifamily properties
Reduce vehicle miles traveled (VMT) by 25% or an amount recommended by the Complete Streets Commission	4	Reduce VMT, especially by gasoline vehicles, through a two-pronged approach: 1) Change zoning to encourage higher density (esp. for housing) near transit 2) Make the City easier to navigate without a car by accelerating implementation of the Transportation Master Plan with an emphasis on developing a clear network of protected pedestrian/bike paths throughout town Current projects underway that help achieve this goal: SB2 Housing grant, Transportation Management Plan, Transportation Management Association, and implementation of new VMT guidelines for new development	31,743*	Explore in 2021 or 2022 after current and complimentary projects are completed
Eliminate the use of fossil fuels from municipal operations	5	Replace 100% of the following municipal assets with efficient electric substitutes for: 1) Gas pool heating equipment 2) Gas and diesel municipal fleet vehicles 3) Gas furnaces 4) Gas hot water heaters 5) Gas-powered gardening equipment	879*	Currently budgeted for end of life assets/appliances, and new community center/library
Develop a climate adaptation plan to protect the community from sea level rise and flooding	6	Develop a climate adaptation plan focused on protecting areas of the community vulnerable to sea level rise and flooding, as forecasted by the National Oceanic and Atmospheric Administration (NOAA) and California State agencies. Consider requiring developers to fund efforts to protect the community.	0	Flood and Sea Level Rise Resiliency District to Lead
TOTAL (assumes option 2 is chosen in action #1)			98,748+	\$355,000 - \$435,000
*GHG emission reductions have been estimated and have not been verified				

2020 & 2021 Implementation

When the CAP was approved in July 2020, the City Council authorized budget and resources to work on three of the six CAP goals above. This included No.1 (existing building electrification), No.3 (electric vehicle charging infrastructure), and No.5 (eliminating fossil fuel use from city operations).⁶ On April 6 2021, the City Council further refined the scope of work for implementation in 2021.⁷ It is important to note that CAP implementation for 2022 and beyond will be discussed during the annual CAP updates provided to the City Council every summer. Progress on each CAP goal will also be discussed during the annual CAP update and additionally through quarterly reports regarding the City Council’s work plan. See table below for 2021 scope of work implementation.

#	Action	Scope of Work for 2021 Implementation
1	Explore policy/program options to convert 95% of existing buildings to all-electric by 2030	Achieve the following milestones to project completion: <ol style="list-style-type: none"> May 2021: Complete cost effectiveness analysis and staff recommendation on various policy/program pathways toward achieving 95% electrification by 2030. June 2021: Environmental Quality Commission provides advice to City Council on staff recommendation. July/August 2021: City Council reviews policy/program options and EQC recommendations and considers directing staff to draft ordinance(s) and/or implement incentive programs. This will provide the foundation for evaluating the strategy to kick-off the public engagement process. Fall 2021: Public engagement to educate community on costs and how to achieve potential policy requirements and identify any further appropriate exemptions or complementary programs that may be needed to implement proposed ordinance(s). Begin to develop an implementation and administration plan that includes review of improving the building permit process to projects involving building electrification. June 2022: City Council considers adopting ordinances/programs based on public engagement and final EQC recommendations. Finalize implementation and administration plan that may include building permit process changes.
2	Set citywide goal for increasing EVs and decreasing gasoline sales	Defer implementation to the Beyond Gas Initiative (BGI) ⁸ under Joint Venture Silicon Valley. Staff will continue to work with BGI within current staff capacity using existing communication mediums to promote and market information from BGI.
3	Expand access to EV charging for multifamily and commercial properties	Resources will be used to monitor the effectiveness of state and regional charging infrastructure incentives, and the City will promote/market the incentives to multifamily property owners using existing databases and communication mediums. This also includes providing information to tenants on legislative protections and pathways to accessing electric vehicle charging at home. In addition, \$5,000 to \$10,000 in additional incentives will be allocated to further motivate at least two multifamily property owners with existing units/buildings to install EV charging infrastructure.
4	Reduce vehicle miles traveled (VMT) by 25% or an amount recommended by the Complete Streets Commission	Resources will be used to focus on current work underway that would reduce VMT that includes the SB2 Housing grant, completion of the Transportation Management Association feasibility study, and implementation of VMT guidelines for new development adopted in June 2020. In addition, the Complete the Streets Commission’s ⁹ work plan includes prioritizing projects in the Transportation Master Plan ¹⁰ that would reduce VMT. The Complete Streets Commission two-year work plan will be amended to include a future work effort to set a VMT reduction target in 2022 dependent upon staff resourcing to support this effort, provided it does not impact delivery of capital projects planned for the same timeframe.

⁶ <https://menlopark.org/DocumentCenter/View/25680/F1-20200714-CC-CAP>

⁷ <https://www.menlopark.org/DocumentCenter/View/27835/H1-20210406-CC-CAP-Nos-1---6>

⁸ [https://jointventure.org/initiatives/climate-change/beyond-gasoline#:~:text=Beyond%20Gasoline%20\(BGI\)%20aims%20to,regions%20to%20do%20the%20same.&text=BGI%20will%20build%20on%20that,urgency%20of%20the%20climate%20crisis](https://jointventure.org/initiatives/climate-change/beyond-gasoline#:~:text=Beyond%20Gasoline%20(BGI)%20aims%20to,regions%20to%20do%20the%20same.&text=BGI%20will%20build%20on%20that,urgency%20of%20the%20climate%20crisis)

⁹ <https://www.menlopark.org/1187/Complete-Streets-Commission>

¹⁰ <https://www.menlopark.org/1147/Transportation-Master-Plan>

5	Eliminate the use of fossil fuels from municipal operations	<p>Utilize current resources and available budget toward eliminating fossil fuels in building the new Menlo Park Community Campus. In addition, if there are fossil fuel appliances or assets at the end of its life, an evaluation of a non-fossil fuel option as a replacement will be undertaken. Additional appropriations may be required for non-fossil fuel assets or appliances that have a cost premium. Specifically in 2021-22, the City will focus on expanding a pilot program to transition leaf blowers from gas to electric. In future years, as City contractor agreements are procured, the City will incorporate a request for electric leaf blowers as well. A Sustainable Fleet Policy was adopted in 2020. There will be additional opportunities for comprehensive non-fossil fuel asset or appliance replacement planning through the upcoming Corporation Yard Master Plan and Facilities Maintenance Master Plan, subject to funding in the 2021-22 capital improvement plan.</p>
6	Develop a climate adaptation plan to protect the community from sea level rise and flooding	<p>The Safety Element in Menlo Park’s General Plan, which was updated in 2013, will be updated to bring it into compliance with recent changes in General Plan law, including SB 379 (Climate Adaptation and Resiliency.)</p> <p>Continue progress on the Menlo Park SAFER Bay grant application from the Federal Emergency Management Agency (FEMA) Building Resilient Infrastructure and Communities program. The FEMA BRIC grant is a program offering up to \$50 million of federal funds for projects that reduce risks from disasters and natural hazards. The Menlo Park SAFER Bay grant application proposes to construct approximately 3.7 miles of nature-based flood control and sea level rise barriers along the San Francisco Bay shoreline. This will be a significant advancement toward the ultimate goal of providing full flood protection for the residents and business near the Bay. Funding award announcements are anticipated in summer 2021, and staff anticipates incorporating funds to support this work into the fiscal year 2021-22 capital improvement program.</p> <p>Continue to participate in and monitor One Shoreline, a flood and sea level rise resiliency district, that was formed to support planning and mitigation measures for coastal erosion, sea level rise, and flooding threats up to 2100. Menlo Park is a member of this agency and pays dues annually through funds provided in the capital improvement plan. This work covers Menlo Park’s neighborhoods adjacent to the bay and creeks. In February 2021, One Shoreline’s board of directors authorized the Bayfront Canal and Atherton Channel Flood Protection and Ecosystem Restoration project to go out to bid. Bidding is currently underway for pre-qualified bidders and construction is expected to begin in mid-2021.</p> <p>Resources will be utilized to continue to actively work with neighboring communities and other agencies to close gaps not addressed by the above projects and seek further funding. A City Council study session is anticipated to be held by September 2021 on the City’s local hazard mitigation plan, which is currently under development and being developed along with the San Mateo Countywide plan.</p>

You will notice that the plan, as presented, falls well short of the goal of reducing our greenhouse gas emissions by 249,447 tons/yr by 2030. In fact, the plan only addresses 40% of the sought-after reductions. This simplified 6-action plan is significantly scaled back from the more comprehensive plans envisioned before COVID-19 struck, a compromise the CAP subcommittee felt was warranted, given the City's projected budget short-falls. The CAP subcommittee hopes that market momentum in the EV sector will make a significant contribution to the reduction of Menlo Park's greenhouse gas emissions, an effect not accounted for here. **The Environmental Quality Commission expects the significantly truncated six-action plan presented above to be completed within one year and strongly advises City Council to revisit the original, more comprehensive plan in July 2021, so that as the economy improves, those actions can be reincorporated into the plan.**

NATURAL GAS PHASE OUT

Ending the use of natural gas has multiple benefits, including the avoidance of failures in gas system operations, such as the one that destroyed homes and caused death in Brookline, Massachusetts in 2018 and the one that did even greater harm in San Bruno, California in 2010.

The normal operation of gas appliances in buildings has also been found to cause indoor air pollution that would be illegal outdoors due to its negative health impacts, according to a recent study from UCLA.¹¹ That study links chronic exposure to the NO₂ emitted from gas stoves to a range of health ailments, including: asthma, lung inflammation, increased risk of respiratory infection, lung and breast cancer and low birth weight in babies. Doctors in a January article in the New England Journal of Medicine wrote the following, "As physicians deeply concerned about climate change and pollution and their consequences, we consider expansion of the natural gas infrastructure to be a grave hazard to human health." They continued, "We also recommend that new residential or commercial gas hookups not be permitted, new gas

appliances be removed from the market, further gas exploration on federal lands be banned, and all new or planned construction of gas infrastructure be halted."¹² It is therefore within the City's normal powers, which are aimed at protecting the health and safety of its citizens, to seriously consider announcing the "End of Flow" (EOF) of natural gas.

This is similar to an approach proposed in the City of Arcata, California whereby the City would explore and pass an ordinance that sets an end date, for example 7/4/2030, for the flow of natural gas to all gas customers within the City limits. This sets a date certain by which community members would want to make any needed electrification updates to their homes for water heating, cooking and space heating. The City could then either stand back and let community members educate themselves on choices that would work for them, or the City could be an active partner to interested citizens, perhaps leading a helpful bulk buying program for: water heaters, heat pump HVAC units, EV chargers and installation services, or performing other joint effort transformation activities. There is already a local model for city-led bulk buying called Sunshares, which performs bulk buying for home solar systems and electric vehicles. While the idea of city-led bulk buying may sound new and different at first, we should realize that the City of Menlo Park already performs bulk buying of commodities and services for its citizens and businesses, including water supply, public safety services, street tree maintenance, roads and sidewalks, etc.

SOURCES OF FUNDS

Some of the six proposed actions can most likely be implemented by existing staff with extra support from a contractor/consultants.

Other than the General Fund, there are two other potential sources of funds:

- 1) the \$400,000 presented in the 2020-21 Capital Improvement Plan (CIP) as earmarked for implementation of the Climate Action Plan and

¹¹ UCLA Fielding School of Public Health, "Effects of Residential Gas Appliances on Indoor and Outdoor Air Quality and Public Health in California," April 2020, <https://coeh.ph.ucla.edu/effects-residential-gas-appliances-indoor-and-outdoor-air-quality-and-public-health-california>

¹² New England Journal of Medicine, "The False Promise of Natural Gas," Philip J. Landrigan, M.D., Howard Frumkin, M.D., Dr.P.H., and Brita E. Lundberg, M.D., <https://www.nejm.org/doi/full/10.1056/NEJMp1913663>

2) issuing debt or borrowing money¹³.

Saving our community for future generations seems like one of the most prudent uses of borrowed funds one can imagine. Conversely, if we wait until extra City revenue is available to fund climate action, we will most certainly lose the climate fight.

There will be additional capital expenditures incurred as part of the Climate Action Plan, as well, including:

- Investment in EV charging infrastructure
- Street improvements related to the TMP implementation
- Investment in electric replacements for municipal gas and diesel assets

If funds for these capital expenditures have not already been allocated in the City's Capital Improvement Plan (CIP), an amendment would need to be made to the CIP for that purpose. The EQC's CAP subcommittee recommends **against** using funds currently earmarked in the CIP for climate action to pay for municipal greening projects. Such projects are good candidates for outside financing or borrowing, whereas the CAP funds in the CIP should be focused on high impact activities to reduce community-wide greenhouse gas reductions, such as policy development, programs, incentives, education and marketing.

PLAN METRICS

Climate Action Plans have a poor history of being effectively implemented and one reason for that is that progress is typically only measured every five years and with staff turnover, well intentioned plans can go unexamined for years. In order to avoid such an outcome, the CAP subcommittee recommends that a short list of concrete metrics be adopted and that the City Council request quarterly, if not monthly, updates on those metrics.

Key metrics to track include:

1. Number of gas hot water heaters citywide that are replaced with electric versions (data source: Menlo Park Building Department)
2. Number of gas furnaces citywide that are replaced with electric versions (data source: Menlo Park Building Department)
3. Number of utility natural gas accounts terminated (data source: Peninsula Clean Energy or PG&E)
4. Number of new cars registered that are gas vs. EV (data source: DMV)
5. Number of total cars registered that are gas vs. EV (data source: DMV)
6. Gallons of gasoline sold in Menlo Park (data source: City sales tax reports)
7. Percentage of municipal assets converted from gas or diesel to electric (data source: Menlo Park Public Works Department)
8. Vehicle miles traveled, including trips inbound, outbound and within the City (Google Environmental Insights Explorer)
9. Number of other cities that query and/or copy Menlo Park's climate policies and programs (data source: outreach efforts and research by Menlo Park Sustainability staff)

While Sustainability staff and members of the CAP subcommittee question the value of conducting frequent high level greenhouse gas inventories, we do all agree that measurement is important and believe that tracking the specific items listed above will help staff and Council gain insight into the effectiveness of the climate actions that the City decides to undertake. County efforts to measure greenhouse gas emissions are expected to continue and will hopefully reflect progress made by cities within the County.

METHOD FOR EVALUATING ACTIONS

The six actions detailed above were selected from over 76 actions included in the original Bold and Moderate Plans, because they offer the City the most potential for Greenhouse Gas Reductions per dollar spent.

Dozens of potential climate actions were considered. Actions took many forms, including:

their endowments in order to continue disbursements, <https://www.nytimes.com/2020/06/10/business/ford-foundation-bonds-coronavirus.html>.

¹³ An interesting model for borrowing against existing financial assets (such as the City's reserves) has been employed during the COVID recession by leading charitable Foundations who are borrowing at low interest rates against

city ordinances, city directives, programs and collaborations. Each action was evaluated for the following key criteria:

- Potential to reduce greenhouse gas (GHG) emissions
- City staff resources required to implement
- City cost to implement
- Out-of-pocket expenses for community members to implement (lifecycle economics for user)
- Political feasibility
- Potential for replication by other cities

The cost estimates above should be viewed as preliminary, requiring further thorough analysis by City staff prior to policy adoption.

THE TRUE COST OF CARBON

As mentioned above, there is in fact a societal cost to burning fossil fuels, sometimes referred to as the “cost of carbon.” There are debates today over how best to calculate that cost. Some say it should be based on the damages caused by those emissions. Others say it should be based on the cost to remove those carbon emissions from the atmosphere, once that becomes possible. In the absence of a global consensus, the EQC’s CAP subcommittee attempted to estimate the cost of carbon to Menlo Park by taking the projected losses from sea level rise in our city alone, \$1.3 billion, and dividing that by the tons of CO₂e we expect to emit over the next 40 years in a business as usual situation. Using this simple methodology, we arrived at a “cost of carbon” of \$130/ton for Menlo Park.

There are a number of ways the City could use this figure. We could consider levying a tax of \$130/ton on fossil fuels, in order to cover future damages the City will incur, in essence internalizing the externalized “cost of carbon.” Another way to use this figure would be for the City to factor it in to all decisions concerning assets in the City that consume fossil fuels, for example in calculating the true cost to the City of a gasoline-powered police car or the true cost to citizens of a gas furnace.

NOTE ON LEADERSHIP

Saving our City from sea level rise will require collective global action, which Menlo Park can likely

only influence through bold leadership. In evaluating the relative effectiveness of various climate actions, the CAP subcommittee noted the significant impact that replicability and demonstration of feasibility of a policy or program had on its potential to generate emissions reductions. If other cities can easily copy a policy or program, it is likely to **catalyze emissions reductions many times greater** than our City’s emissions reductions alone. Therefore, it is strongly advised that City staff favor simplicity and replicability in its design of climate policies and programs and it is further advised that the City invest resources in proactively sharing its climate policies and programs with other cities, counties and government entities.

We must also be nimble and ready to act on economic stimulus opportunities that may present themselves, as the Country attempts to pull itself out of a recession.

NOTE ON UTILITY PARTNERS

An analysis of community member economics for each action revealed that rebates can make or break the economics behind purchasing decisions for equipment like electric vehicles and electric heat pumps for space and water heating, all of which are essential for progress on climate action. The City can greatly increase the political feasibility of many climate actions included in this plan by calling on its local Community Choice Energy (CCE) provider to rapidly deploy the significant capital currently held on its balance sheet to fund rebates on electric replacements of gas appliances. Such rebates can make climate friendly replacements cost effective and that enables city councils like ours to pass ordinances requiring such replacements. In turn, the new electric devices generate net revenue that rebuilds the CCE’s financial reserves.

To this end, Peninsula Clean Energy’s board recently signaled its support for local cities’ efforts to electrify, voting on May 28, 2020 to invest \$6 million to electrify existing buildings in San Mateo County. This program will reportedly include substantial incentives for: 1) the installation of electric heat pump water heaters, 2) upgrades to electric service panels so they can handle the increased electric demands of all-electric homes, and 3) whole-home electric conversions for low income residents. Such programs are a promising

signal that local CCEs intend to help ease the financial burden of converting homes from natural gas to all-electric, since it is not only essential for fighting climate change but also in their long-term financial interest to do so.

NOTE ON EQUITY

Climate change does not affect all members of society equally. Tragically it disproportionately affects low income people and people of color, as evidenced right here in Menlo Park, where sea level rise is expected to have a devastating impact on residents of our Belle Haven neighborhood. A similar pattern is observed all over the globe, where poor island nations are becoming the first to be wiped off the globe. Climate justice advocate Hop Hopkins illustrates the connection between climate change and racism by explaining how allowing climate change to occur requires that we accept that portions of our local and global communities are “sacrifice zones, and you can’t have sacrifice zones without disposable people, and you can’t have disposable people without racism.”

Meanwhile wealthier segments of society go on emitting greenhouse gases at ten times the rate of poorer segments, unwilling to make even small changes to their purchasing decisions. The COVID crisis has shed a light on the shocking inequity in health outcomes for people of color, some of which can be attributed to well documented racial disparities in exposure to air pollution from fossil fuels. Menlo Park must ask itself whether it wishes to continue contributing to this global and local inequity, or whether it can strongly prioritize leadership in solving these interconnected problems.

Finally, although Menlo Park is situated in one of the wealthiest Counties in the country, that wealth is not equally distributed and some residents may find it difficult to afford at least the capital outlay for the changes recommended in this plan. To address issues of equity, there are a number of options for ensuring that low-income residents have the financial support they need to make the required changes to their homes and vehicles. Both the State and local CCEs have shown a willingness to provide financial subsidies specifically targeted at low income residents. Peninsula Clean Energy recently set aside \$2 million, out of a \$6 million program, just to assist

low-income residents with all-electric retrofits of their homes. If the City wishes to further bolster that support, it could consider allowing the Utility User’s Tax (UUT) on natural gas sales to increase from its current 1% level to the existing voter-approved level of 3.5%. That would provide an estimated \$500,000 in additional funding every year to low-income families converting gas appliances to all-electric. The City must take an active role in ensuring that low-income residents are not unfairly disadvantaged by the requirements of its Climate Action Plan.

ANOTHER NOTE ON COVID-19

Lastly, this Climate Action Plan is being presented to City leaders in the midst of a generation-defining event, namely the global COVID-19 pandemic. It is understandable and appropriate that City leaders would devote their immediate attention to protecting the health and wellbeing of our community, as we fight this deadly virus.

As the health emergency wanes, however, the CAP subcommittee hopes that Council members will view the proposed Climate Action Plan as an opportunity for Menlo Park. COVID-19 has jolted us all out of our routines and everyday existence, highlighting in a graphic way our vulnerability as a species. Climate change has the potential to do the same, only on an even greater scale. If we are able to take in the lessons presented to us by this current crisis, we will be better prepared to address the climate crisis that is coming. For example, we should ask ourselves: Do we want to be like South Korea and flatten the carbon “curve” by proactively investing in mitigating the carbon dioxide “contagion”? Or will we delay, like Italy, and only take decisive action once the problem has ballooned? Is it still acceptable to stand by and watch one window of opportunity after another close before our eyes, leaving us with a much larger problem, the only response to which threatens to destroy our economy? Can we accept that this problem, like COVID, will ravage poor communities and people of color? The choice is ours. How will we act?

This Climate Action Plan presents us with economic opportunities as well. If enacted, this plan will jumpstart a new local market in electric appliance installation, injecting money into the

economy and providing hundreds of new jobs, just when they are needed.

Finally, as medical professionals learn more about the adverse health impacts of burning fossil fuels in our homes, the Climate Action Plan offers Menlo Park an opportunity to set a new standard for health and safety in our homes and places of work by removing fossil fuels from our air completely.

Our future is in our hands. It is time to act.

APPENDIX A

ORIGINAL PLAN OPTIONS – BOLD, MODERATE AND GO SLOW

Dr. John Holdren, scientific advisor to President Obama, advised that humans have three basic choices when it comes to climate change: 1) mitigate the problem by reducing our emissions, 2) adapt to the problem and try to move out of harm's

way, or 3) suffer. What every civic leader must do today is pick the mix of those three options that they are willing to bring to their communities.

A summary of the benefits and drawbacks of each plan, from a City official's perspective, is offered below.

Bold Plan	Moderate Plan	Go Slow Plan
<ul style="list-style-type: none"> • A few bold actions • One-year implementation • Achieves goal of Zero by 2030 • Less \$ now (staff resources) • Less \$ later (lower sea walls) • Subject to opposition • Less human suffering • Regional leadership role 	<ul style="list-style-type: none"> • Many moderate actions • Three-year implementation • Makes progress toward goal of Zero by 2030 • More \$ now (staff resources) • Some \$ later (sea walls) • Subject to some opposition • Some human suffering • Regional leadership role 	<ul style="list-style-type: none"> • No proactive actions • No specific implementation time • Falls well short of Zero by 2030 goal • Less \$ now (staff resources) • More \$ later (high sea walls) • Subject to some opposition • More human suffering • No regional leadership role

THE MODERATE PLAN

The Moderate Plan is a set of 60+ actions (Appendix B), implemented over 3 years, that involve working with the community (residents, businesses and commuters) to assist and compel them to change, while simultaneously working with other cities, the County, the State and utilities to make such change easier. This would be accomplished by changing laws, capabilities and economics in a way that transforms standard practice, similar to the way that our all-electric Reach Codes are transforming standard practice in new construction. Menlo Park is gaining credibility in this area and therefore has a reasonable chance of catalyzing regional change through bold leadership and knowledge sharing.

The Moderate Plan would also seek an expanded vision and commitment from Community Choice Energy providers (CCEs), who will reap considerable benefit in the form of increased net revenue from electrification, just as oil companies will see diminishing revenue. According to this plan, the CCEs would be advised to rapidly deploy

their net revenue, in order to quickly transform the market to support building electrification.

The Moderate Plan is the most time-intensive option of those presented, with significant staff resources deployed in the next three years to pass incremental ordinances that will drive needed behavior change. **Sustainability staff currently estimate that implementing the Moderate Plan would require approximately 6 incremental full time equivalent (FTE) staff for the first year and a similar or smaller number in the remaining two years included in the plan.** These incremental staff resources could be hired as consultants and would not be needed past the 3-year term of the plan.

While the action-intensive approach of the Moderate Plan may seem cumbersome, the CAP subcommittee suspects that the public requires incremental education and a piecemeal approach to rule changes, in order to have time to adjust to change. As such, the Moderate Plan also includes significant public outreach and education efforts to

assist the public and businesses in understanding the benefits of mutual cooperation.

Finally, the Moderate Plan by itself would not guarantee that the City would reach its proposed climate goal of Zero emissions by 2030. Instead, this plan would put us on a path to achieve that goal in a later year or, alternatively, could be seen as laying the groundwork for implementation of additional measures, such as those outlined in the Bold Plan, starting in year 4 of climate action when the public may be more receptive to bolder action.

THE BOLD PLAN

The Bold Plan is much simpler (Appendix B) in that it involves far fewer actions and therefore fewer staff resources to implement. It also has the advantage of nearly guaranteeing achievement of the City's climate goals. It achieves this primarily by announcing to the community that the City will stop the flow of natural gas (a potent greenhouse gas) and restrict the use of gasoline vehicles within City limits by a certain date in the future, possibly by the year 2030. This approach gives community members time to make the needed adjustments to their homes and transportation, all of which are perfectly feasible, within an announced 10-year timeframe.

As for the elimination of gasoline and diesel (GAD) fuels from Menlo Park vehicles, the Bold Plan could include a normal health-and-safety powers type ordinance, requiring the phasing out of underground fuel tanks by 7/4/2030, for example. Any businesses that used underground fuel storage tanks would need to remove them for certain by that date. If climate preservation is being seriously pursued in the next decade and automobile makers follow their plans for electric vehicle production, there will be much lower need for GAD stations left in our area and those that remain will be selling a fraction of the volume of gasoline that they do now. This could mean that, regardless of which climate plan the City pursues, the number of local gasoline stations is likely to drop significantly within the next decade from the current 12 to as few as six. Some locations could be repurposed as EV charging stations with amenities such as a coffee shop, convenience store or car wash.

Another approach to eliminating GAD fuels would be for the City to pass a number of ordinances that

reduce the subsidies currently offered to GAD-powered cars and trucks. Some of the subsidies that could be reduced or eliminated for GAD vehicles include City-provided free parking in downtown lots and free parking on the side of public streets, a subsidy the City already limits overnight in Menlo Park. Both of these measures would encourage reductions in vehicle miles traveled (VMT) in the City, as well as conversions to electric vehicles (EVs). These shifts would also offer residents the ancillary benefits of reduced traffic congestion and/or reduced air pollution.

THE GO SLOW PLAN

The Go Slow Plan (GSP) would entail stepping back from climate leadership and following other entities, if and when they step forward to lead. The City would forgo the opportunity to carve out its own unique approach to problems, as we did with the recent Reach Codes, and would likely end up joining County efforts or copying other Cities' approaches. A Go Slow Plan would likely entail sitting quietly on the sidelines and following plans developed and offered by regional or state entities, as they emerge. The Go Slow Plan is by far the most risky of the plans in that it results in the highest likely damage cost to public and private property from sea level rise and would cause the most human suffering in vulnerable parts of our City. Gut-wrenching decisions will face City officials as they decide how much money to spend delaying the eventual loss of real estate valued at over \$1 billion along our Bay shoreline. One can imagine weighty decisions about what neighborhoods to save resulting in heated disagreement among residents that would tear at the fabric of our community.

Although the Go Slow Plan may look "easy" in the short term, due to the lower staffing requirements and the slower pace of change required now, this approach may in fact prove to be penny wise and pound foolish. In reality, a Go Slow approach simply hands a growing problem to a future City Council, who would have even less time and resources at their disposal to battle climate change and oversee adaptation on multiple fronts.

We understand from the worldwide scientific body, the Intergovernmental Panel on Climate Change (IPCC), that time is of the essence and that in order to have a meaningful impact on climate change,

any mitigation efforts must start immediately. This would render the Go Slow Plan scientifically imprudent, leaving the City Council to choose between: a) implementing the Moderate Plan immediately and simultaneously exploring the Bold Plan for later implementation if needed, b) cutting to the chase and just pursuing the Bold Plan immediately or c) developing a plan they feel would perform better.



STAFF REPORT

City Council

Meeting Date: 4/20/2021
Staff Report Number: 21-081-CC

Regular Business: Approve City Council 2021 work plan and identify top priorities

Recommendation

City staff recommend that City Council adopt Attachment A as the 2021 work plan and further identify top priorities to focus limited resources.

Policy Issues

City Council conducts an annual goal setting process to prioritize resources for the remainder of the current fiscal year and inform the budget development for the upcoming fiscal year, which begins July 1.

Background

City Council narrowed their 2021 work plan projects at their March 9 City Council meeting. A recap of City staff's understanding was transmitted to City Council at their March 23 meeting. In the March 23 transmittal, City staff solicited feedback and input on the recap from City Council.

Analysis

Attachment A consolidates City Council direction from their March 9 meeting and remains substantially unchanged from the recap transmitted at their March 23 meeting, Attachment B. The only modification includes expanding "Gas leaf blower enforcement" to "Gas leaf blower ordinance and enforcement."

City staff grouped the projects identified by City Council in general buckets for ease of consideration. "City Council" projects are those projects requiring City Council policy direction. "Climate change" encompasses both climate change mitigation and adaptation projects. "Land use" and "Public facilities and services" include projects in those respective areas.

City staff recommends adopting or amending Attachment A as City Council's 2021 work plan. City Council may also act to prioritize any items on the work plan.

Next steps

1. May 7 – City manager's proposed fiscal year 2021-22 operating budget released. City staff has incorporated a contingency budget for City Council adopted 2021 priorities and work plan to ensure available funds in fiscal year 2021-22.
2. May 10 – City Council study session on parks projects and potential use of Measure T bonds to inform capital improvement plan.
3. June 8 – Public hearing on city manager's proposed fiscal year 2021-22 operating budget.
4. June 22 – Regular business item to adopt the fiscal year 2021-22 operating budget.

Impact on City Resources

The impact on City resources will be assessed as work plan project mature to an action item by City Council.

Environmental Review

This action is not a project within the meaning of the California Environmental Quality Act (CEQA) Guidelines §§ 15378 and 15061(b)(3) as it will not result in any direct or indirect physical change in the environment.

Public Notice

Public notification was achieved by posting the agenda, with the agenda items being listed, at least 72 hours prior to the meeting.

Attachments

- A. 2021 work plan
- B. Hyperlink – Recap of City Council direction on projects under consideration for 2021 priorities and work plan (Staff Report #21-063-CC): menlopark.org/DocumentCenter/View/27676/J5-20210323-CC-goals-and-priorities

Report prepared by:
Nick Pegueros, Assistant City Manager

City of Menlo Park
2021 work plan
as of April 20

City Council

Redistricting
Racial equity - NLC's REAL program and baseline project
Public safety commission
Emergency preparedness
City Council advisory body policies

Climate change

CAP #1-Explore policy/program options to convert 95% of existing buildings to all-electric by 2030
CAP #2-Set citywide goal for increasing EVs and decreasing gasoline sales
CAP #3-Expand access to electric vehicle charging for multifamily and commercial properties
CAP #4-Reduce vehicle miles traveled (VMT) by 25% or an amount recommended by the Complete Streets Commission
CAP #4a-Transportation management association (TMA) formation
CAP #4b-Middle Avenue rail crossing and complete street
CAP #5-Eliminate the use of fossil fuels from municipal operations
CAP #6-Develop a climate adaptation plan to protect the community from sea level rise and flooding
CAP #6a-Menlo Park SAFER Bay implementation

Land use

2022 housing element and related zoning code updates and documents
ECR/Downtown Specific Plan area housing development initiatives
Accessory dwelling unit ordinance update
Development & environmental review process education series
ConnectMenlo community amenities list update

Public services

Menlo Park Community Campus building
Reimagining downtown
Public health advocacy (COVID-19, mental health)
Menlo Park Community Campus programming
Caltrain grade separation
Caltrain rail corridor quiet zone analysis
Gas leaf blower ordinance and enforcement
Willow Road traffic calming

Agenda item F1 Marcy Abramowitz and Others, Resident

Dear Mayor Combs, Vice Mayor Nash and esteemed Council Members,

We are writing on behalf of more than one thousand Menlo Park residents represented by our HOAs, and others, spanning every block in proximity to the Caltrain line from the Atherton border to the San Francisquito Creek, including the 150+ residents who have submitted comments or spoken at Council meetings, to request that Council designate an independent engineering assessment of the City's four crossings for Quiet Zone status a top priority for calendar year 2021.

Quiet Zones, which eliminate train horn blasts except in limited circumstances, meet Federal safety requirements, and are growing in number throughout the US, especially in residential communities. Recently, QZs have been established in Marin County, San Diego and other areas of Southern California. Atherton Council Member DeGolia refers to the designation of a QZ at Fair Oaks Avenue as the single most positively received decision made by Council during his tenure.

Horn noise in Menlo Park is a major problem for thousands of people who live and work within earshot of the trains, with detrimental impacts on health and safety, and quality of life. Unsafe decibel levels have been verifiably recorded, and medical professionals have referenced numerous scholarly studies on the negative impacts of excessive noise on physical and mental wellness. Residents have shared personal stories of chronically disrupted sleep, children unable to play outdoors without covering their ears, challenges with working and learning at home, inability to hear intruders and vehicular hazards, and difficult choices about moving away from Menlo Park in order to find quiet. We also heard of residents in older rentals with thin windows and walls who cannot afford to move to quieter homes.

As Menlo Park seeks to add housing density in proximity to transit, and Caltrain ramps up its schedule, the already negative impacts of horn noise will worsen significantly.

Establishing a Quiet Zone in Menlo Park would enhance our City in untold ways. It is easy to imagine how much more desirable it would be to live, work, shop and recreate in proximity to the train, but without incessant horn noise.

In 2022, Atherton will extend their QZ to Watkins Avenue. By acting in 2021, Menlo Park can take the first steps to extend Atherton's Quiet Mile south to our city. We fervently request that you designate the study of our four crossings for QZ status a top priority for this calendar year. Thank you for your consideration.

Respectfully,

Marcy Abramowitz, Maria Amundson, Joshua Gossett, Felton Gables HOA
Scott Barnum, Park Forest HOA
Alex Beltramo, Mills Street / San Antonio Avenue
JoAnne Goldberg, Linfield Oaks Neighborhood Association
Amy Mushlin, Mills Court
Matt Normington, Marquis HOA

Agenda item F1
Longtime Resident, Resident

To Menlo Park City Council:

Please be aware of another sad tragedy where a pedestrian was killed near Encinal Ave on the train track on March 25th:

<https://twitter.com/CaltrainAlerts/status/1375181289007898624>

<https://www.nbcbayarea.com/news/local/pedestrian-hit-killed-by-caltrain-in-menlo-park/2502686/>

Caltrain tragedies like this, is a glaring reminder that the train horn is an ineffective, and pointless approach towards ensuring railroad safety. In addition to that, it is only adding harms toward community well-being as voiced by hundreds of residents through council meeting comments/calls throughout the recent years. (Rough estimate shows nearly 10%/thousands of residents are impacted by the train horns)

Let's come to our senses, install quad-gates, establish quiet-zones. So that it 1. provide better safety and 2. remove this harmful stress for the thousands of MP residents.

With the estimate from this article (\$250k-500k per quad-gate install), it should cost less than 1% of our annual budget (2019 \$170million). This should be an easy decision, considering the improved happiness and property value increases that would help the city for years to come:

<https://www.snyder-associates.com/silencing-train-horns-navigating-establishment-railroad-quiet-zone/>

Agenda item F1 Lynne Bramlett, Resident

I will also be attending tonight's Fire Board meeting so I may miss the agenda topic.

First, I am working on a proposal related to a possible Public Safety Commission and one related to Emergency Preparedness. After more input, I plan to next reach out to the new City of MP Police Chief on this topic.

However, I write mainly pertaining to the existing commissions. The roles need modernizing. Many residents are highly educated and have had highly responsible positions. So, they do not want to attend meetings where they mostly listen to informational reports. The residents also want to move progress forward and they don't like what can seem like excessive bureaucracy.

What staff seem to want, and what the residents want, seem very different. I recommend the excellent book by Matt Leighninger: "The Next Form of Democracy: How Expert Rule is Giving Way to Shared Governanceand Why Politics Will Never Be the Same." I re-read the introduction last night and I saw even more ideas that will help us with current challenges, including the residents desire to modernize policing. In short, what the residents serving want (shared governance) is consistent with a broader worldwide trend. I would make a photo copy of the intro and distribute it, but I don't want to violate copyright law. Reading and discussion the introduction together would, I think, be a fruitful next step.

Books on successful volunteer programs also give insight into why volunteers join and why they leave. The volunteer of today wants to be empowered and to make a difference, and they avidly dislike bureaucracy.

I request that Council start the process of evaluating the effectiveness of the MP advisory commissions to:

1. See if these roles are working as originally intended
2. Identify where the roles need evolving and/or the commission might no longer be necessary;
3. Incorporate best practices from other cities; and
4. Ensure that the City is complying with all state statues regarding our commissions.

The roles also need redesigning so that they better "institutionalize" a mechanism that supports your goal of overall strong operational stewardship of the taxpayer's money.

I will separately send you the memo I wrote on the topic in May 2019.



STAFF REPORT

City Council Meeting Date: 4/20/2021
Staff Report Number: 21-080-CC

City Council Initiated Items: Informal proposal to create a mobile vaccination operation to provide equitable access to vaccination of specific populations at their place of residence

Recommendation

City staff seek City Council direction on requests from Mayor Combs and City Councilmember Mueller to create a mobile vaccination operation to provide equitable access to vaccination of specific populations at their place of residence (Attachment A.)

Per City Council Procedure #CC-20-013 – “City Councilmember requests” a majority of the City Council may direct the following:

- Direct the city manager to prioritize staff resources to prepare a formal staff report for further City Council consideration and/or action, or
- Direct the item to an advisory body for preparation of a formal staff report with no additional staff support required, or
- Direct the city manager to prepare a formal staff report for further City Council consideration as resources are available, or
- Defer action to the City Council’s annual goal setting process.

If the request does not receive sufficient City Council support, the item is not considered further.

Policy Issues

At their August 25 meeting, the City Council adopted City Council Procedure #CC-20-013 – “City Councilmember requests,” to assist in determining the City Council’s desire to move forward with work on requests by one or two City Councilmembers.

Background

City Councilmember Mueller emailed city.council@menlopark.org April 11 requesting the addition of Attachment A to the City Council agenda for consideration.

Analysis

Pending City Council direction, City staff will analyze the impact on staff.

Impact on City Resources

Unknown.

Environmental Review

This action is not a project within the meaning of the California Environmental Quality Act (CEQA) Guidelines §§ 15378 and 15061(b)(3) as it will not result in any direct or indirect physical change in the environment.

Public Notice

Public notification was achieved by posting the agenda, with the agenda items being listed, at least 72 hours prior to the meeting.

Attachments

A. Request from Mayor Combs and City Councilmember Mueller dated April 10

Report prepared by:
Nick Pegueros, Assistant City Manager

Informal Proposal to Create a Mobile Vaccination Operation (MVO) to Provide Equitable Access to Vaccination of Specific Populations at their Place of Residence.

4/10/2021

**Informal Proposal Sponsors:
Menlo Park Mayor Drew Combs
Menlo Park City Councilmember Ray Mueller**

SECTION 1: INTRODUCTION & BACKGROUND

It is the intent and vision of the Informal Proposal's sponsors, Mayor Drew Combs and Councilmember Ray Mueller, for the City of Menlo Park in collaboration with the Menlo Park Fire Protection District, to explore the creation of a COVID-19 Mobile Vaccination Operation (hereinafter MVO) for specific priority groups, to deliver vaccination at targeted persons residences. The MVO would plan, implement, and oversee the provision of these mobile services in order to provide equitable access to COVID-19 vaccine through services targeted among the following groups:

- Residents living in long-term care facilities, board and care homes, and other congregate settings; and/or,
- Persons with limited mobility, such as homebound seniors, persons with physical or developmental disabilities, behavioral disorders, serious mental illness, or other similarly restrictive conditions.
- Persons with daytime scheduling difficulty due to work hours.
- Persons whom lack technical expertise or reliable internet connectivity to schedule vaccination appointments.

Increasing the proportion of community members who live or work in Menlo Park and have been vaccinated against COVID-19 is key to slowing the spread of this virus, addressing health and economic disparities resulting from the pandemic, as well as implementing a safe reopening plan. Accelerating the pace of immunization is critical to return to more normal operations of businesses, schools, and social life. The City of Menlo Park and Menlo Park Fire Protection District can collaborate to prioritize equitable access for COVID-19 vaccination and, to that effect, commit to focus vaccination efforts among those who live or work in communities experiencing disproportionate impacts from COVID-19 including both health disparities—transmission, infection, severe disease, and death—as well as disparate economic impacts that are the result of the public health emergency. Those in our community whom are homebound, or whom are unable to travel to vaccination centers due to work obligations, or whom are unable to schedule vaccination appointments due to the digital divide, must not be left behind.

This informal proposal has not yet been approved by the City Council of Menlo Park, nor the County of San Mateo. The idea for the informal proposal was first raised by Councilmember Mueller and discussed at the joint meeting between the City of Menlo Park and Menlo Park Fire Protection District. Thereafter Mayor Combs and Councilmember Mueller were invited to bring the Informal Proposal to the Menlo Park Fire Protection District to obtain information that the Menlo Park City Council will need in consideration of whether to approve and fund the MVO, in terms of costs and logistics. Should the Menlo Park Fire Protection District express a willingness to work collaboratively on this project, and provide the necessary data, the Informal Proposal Sponsors will then submit the Informal Proposal to the Menlo Park City Council for consideration of approval, and then present it to the County of San Mateo for consideration and approval. After both entities have approved the Informal Proposal, it is contemplated the City of Menlo Park would then issue a Formal Proposal under which the contract would operate. The Informal Proposal Sponsors believe the MVO would be beneficial to all Menlo Park residents, but given the City is now split into City Council Districts, the Informal Proposal Sponsors leave open the possibility that other City Councilmembers may express the desire for the District they represent to opt out of the MVO. Additionally, should other jurisdictions wish to join the MVO, it could be expanded to include other

areas within the Menlo Park Fire Protection District boundaries, including unincorporated San Mateo County, Atherton and East Palo Alto.

SECTION 2: SCOPE OF WORK & DELIVERABLES

It is contemplated the following services and deliverables will be necessary under the MVO:

- Plan, implement, and oversee the provision of COVID-19 mobile vaccination services as a vaccination mobile clinic(s) in order to provide equitable access to COVID-19 vaccine through services targeted among the following groups:
 - Residents living in long-term care facilities, board and care homes, and other congregate settings; and/or,
 - Persons with limited mobility, such as homebound seniors, persons with physical or developmental disabilities, behavioral disorders, serious mental illness, or other similarly restrictive conditions.
 - Persons with daytime medical appointment scheduling difficulty due to work hours.
 - Persons whom lack technical expertise or reliable internet connectivity to schedule vaccination appointments.
- Comply with all applicable San Mateo County laws, policies, guidelines, requirements, and criteria for advancing strategic objectives related to COVID-19 vaccination:
 - Applicable laws, regulations, and policies additionally include those of the State of California and the federal government of the United States.
- Provide equitable access to program services for eligible community members at no cost to the individual, regardless of ability to provide proof of insurance.
- Seek reimbursement from the patient's healthcare insurance and/or other Federal reimbursement sources, when possible.
- Provide culturally competent services to City of Menlo Park residents and workers.
- Work with the City of Menlo Park to establish a schedule for mobile services at designated vaccination mobile clinic(s) and/or individual residences.
- Acquire and maintain all equipment, supplies, and infrastructure necessary for mobile service delivery, including, but not limited to:
 - Disinfectants;
 - Personal Protective Equipment (PPE);
 - Syringes;
 - Swabs.
- Implement, administer, and provide oversight to a fully mobile vaccination workflow including dose administration, clinical support, and related client services; staff coordination, supervision, and oversight; and the provision of other relevant logistics and operations.
 - Vaccine administration, clinical and client supports, and related program services to include items such as:
 - Administering vaccine doses to eligible community members at the location of their homes;
 - Providing client aftercare, information, and monitoring for adverse reactions;
 - Utilizing the County's designated digital platform(s) for registration, scheduling, and intake. Should the County approve the use of any contractor-provided system(s), that system(s) must have a user interface that is easy to access, understand, and appropriate for the cultural and literacy needs of targeted populations, e.g. Medi-Cal eligible residents;
 - Managing queues, providing triage services, and preparing clients for vaccine administration;
 - Providing same-day, on-site registration support;

- Ensuring consistent availability of translated materials, providing on-demand translation services for monolingual speakers of threshold languages, and also providing on-demand ASL interpretation;
- Daily and weekly reporting of individual-level and aggregated data to County, State, and federal agencies or systems, including such as HCSA, CalREDIE, and other local, state, or federal agencies as required, including within no more than twenty-four (24) hours of administering a dose of COVID-19 vaccine and adjuvant (if applicable), recording in the vaccine recipient's record, and reporting complete and accurate vaccine administration data required in the MyTurn reporting tool or other technology platforms required by federal, state, or County agencies (such as, for example, VaccineFinder, and CAIR2);
- Daily reporting of individual and aggregate vaccine doses to state reporting systems, such as the California Immunization Registry (CAIR) and federal systems such as the CDC's VaccineFinder.
- Report daily vaccine inventories, transfers, redistributions, and reporting to CAIR2 or the appropriate County Immunization Registry, thereby facilitating visibility and oversight for the State, as directed by the County and/or State.
- Coordination with the City of Menlo Park for all outreach, publicity, and media contacts.
- Staff coordination, supervision, training, and oversight may include items such as:
 - Hiring, orienting, and providing ongoing training to clinical and support staff, including volunteers;
 - Ensuring appropriately licensed drivers;
 - Providing appropriate healthcare workers, e.g. licensed clinicians, as well as clinical supervision;
 - Providing training and supervision to staff and volunteers who support clinical teams; and,
 - Ensuring all staff and volunteers conduct themselves according to the highest level of professional and culturally respectful behavior in all public interactions.
- Other logistics and operations may include:
 - Cold chain transportation and storage;
 - Ongoing inventory monitoring of vaccine supplies and vaccine use;
 - Setup and closing of temporary mobile clinic site(s);
 - Legal and appropriate storage and disposal of biohazard waste;
 - Provision and maintenance of HIPAA-compliant technologies necessary for operating program services, e.g., verifying eligibility, entering registration data, transmitting protected health information (PHI), client correspondence, etc.;
 - Ensuring high-quality data collection and entry;
 - IT and Wi-Fi/internet support;
 - Provision and oversight of safety services for both clients, staff, and volunteers; and,
 - Subcontractor and/or vendor management, as applicable.

Section 3 - Informal Proposal Request

The Informal Proposal's sponsors request the following information at the outset:

1. Would the Menlo Park Fire Protection District be interested in collaborating with the City of Menlo Park on the MVO as described?
2. If so, would the Menlo Park Fire Protection District Board assign liaisons to work with the Informal Proposal's Sponsors to gather information related to which items within the contemplated scope of work the MPFPD would be able to provide the City of Menlo Park and at what cost, as well as to help identify any items missing from the scope of work?